FILE
2.2.2

WESTERN NUCLEAR, INC.

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December 16, 1996

F:4 03-317

Mr. Gary Robertson, Head
Waste Management Section
Washington Department of Health
Division of Radiation Control
Airdustrial Park, Building 5
P. O. Box 47827
Olympia, Washington 98504-7827

RE: Radon-222 Flux Measurements on the Sherwood Tailing Impoundment Surface After Final Cover Placement.

Dear Mr. Robertson:

In accordance with the requirements of 10 CFR 40, Appendix A, Criterion 6, Western Nuclear, Inc. (WNI) performed radon-222 flux sampling on the Sherwood Uranium Mill Tailing Impoundment after the reclamation cover placement was completed as described in the WNI Sherwood Project Tailing Reclamation Plan (12/94 TRP), as revised. This letter transmits results of flux measurements made on October 2-3, 1996.

The flux verification procedure is referenced within 10 CFR 40, Appendix A, Criterion 6 (2) and is the field sampling guidance described in 40 CFR 61, Appendix B, Method 115 (Copies of the requirements were provided in Appendices F and G, respectively, of the February 28, 1996 WNI "Sherwood Project Tailing Impoundment Monitoring and Stabilization Plan").

Sampling was performed with the Large Area Activated Charcoal Canister (LAACC) method as described in Method 115, § 1.0. A single set of samples was collected over the reclaimed surface of the Sherwood Tailing Impoundment (Method 115, § 2.1.1). The surface at completion of cover placement and at the time of sampling was dry, ie.; there were no saturated areas (Method 115, § 2.1.2). A total of 105 measurements were made on the impoundment surface (Method 115, § 2.1.3). Sample sites were selected from a 100 x 100 foot grid layout over the impoundment. All sample locations, except for off-surface control sites, were located over the lined portion of the tailing impoundment (Attachment 1).

Weather conditions (Method 115, § 2.1.4) were favorable during the sampling period. Rainfall had occurred neither within 24 hours prior to nor during sample collection. Ambient temperature did not fall below 40 °F during the sample period.

The footprint of the lined impoundment was determined to be 80 acres or 323,749 meters^2 (Method 115, § 2.1.5). Mean radon flux is calculated over this single unit or region.

Energy Laboratories, Inc. (ELI) (Casper, Wyoming branch) provided the field sampling equipment which included the LAACC units, written field procedures, data sheets and chain-of-custody forms. These documents are included as Attachment 2. WNI provided the personnel to place and collect samplers, record field data, package samples and fill out chain-of-custody forms. All samplers were positioned at sample sites as described in Method 115, § 2.1.6.

Attachment 3 contains the data reported by ELI. Per Method 115, § 2.1.7, the mean flux for the Sherwood impoundment was 0.51 $\pm$ 0.03 pCi/m^2-s. The regulatory limit for radon flux from uranium mill tailing piles is 20 pCi/m^2-s. There were no unusual events or conditions observed which would have affected the reported results. Attachment 3 contains all 115 measurements and includes 10 off-impoundment controls and 5 replicate samples. The mean flux value reported above is calculated from 100 samples excluding controls and replicates.

Attachment 4 contains field replicate (Table 1) and control (Table 2) sample data. Laboratory duplicates are presented within the analytical report (Attachment 3). All comparisons are acceptable. It should be noted that samples 96-55102, 96-55122 and 96-55182 were also field replicate samples; and sample 96-55202 was an offsite control.

Field replicate samples (Attachment 4, Table 1) were collected by placing two sample collectors directly adjacent to each other at the same site. Though not technically true replicates, significant differences in results would have flagged internal analytical QA/QC. No differences were observed between results of any paired samples.

Ten control samplers were placed around the impoundment. The location of these samples is identified by station location on the diversion channel embankment with the following exceptions: a) a field replicate was placed at the site of well MW-4 (96-55127 & 96-55131); and b) a sampler was placed at MW-10 (96-55106) and MW-2 (96-55202). Control data does not differ from observations on the impoundment surface.

In summary, the results of radon-222 flux measurements demonstrate that the Sherwood uranium mill tailing impoundment complies with the NRC performance standard for radon-222 emissions. The 0.51$\pm$ 0.03 pCi/m^2-s mean flux rate is well below the NRC (and WDOH) regulatory 20 pCi/m^2-s limit. Laboratory QA/QC information verifies the reported values. Field QA/QC data and observations further support the data set. Weather conditions invalidating sample results were not observed during the sampling period.

Should you have any questions regarding these data or require additional information, please contact us at your earliest convenience.

Sincerely,

Brad K. DeWaard, Radiation Safety Officer

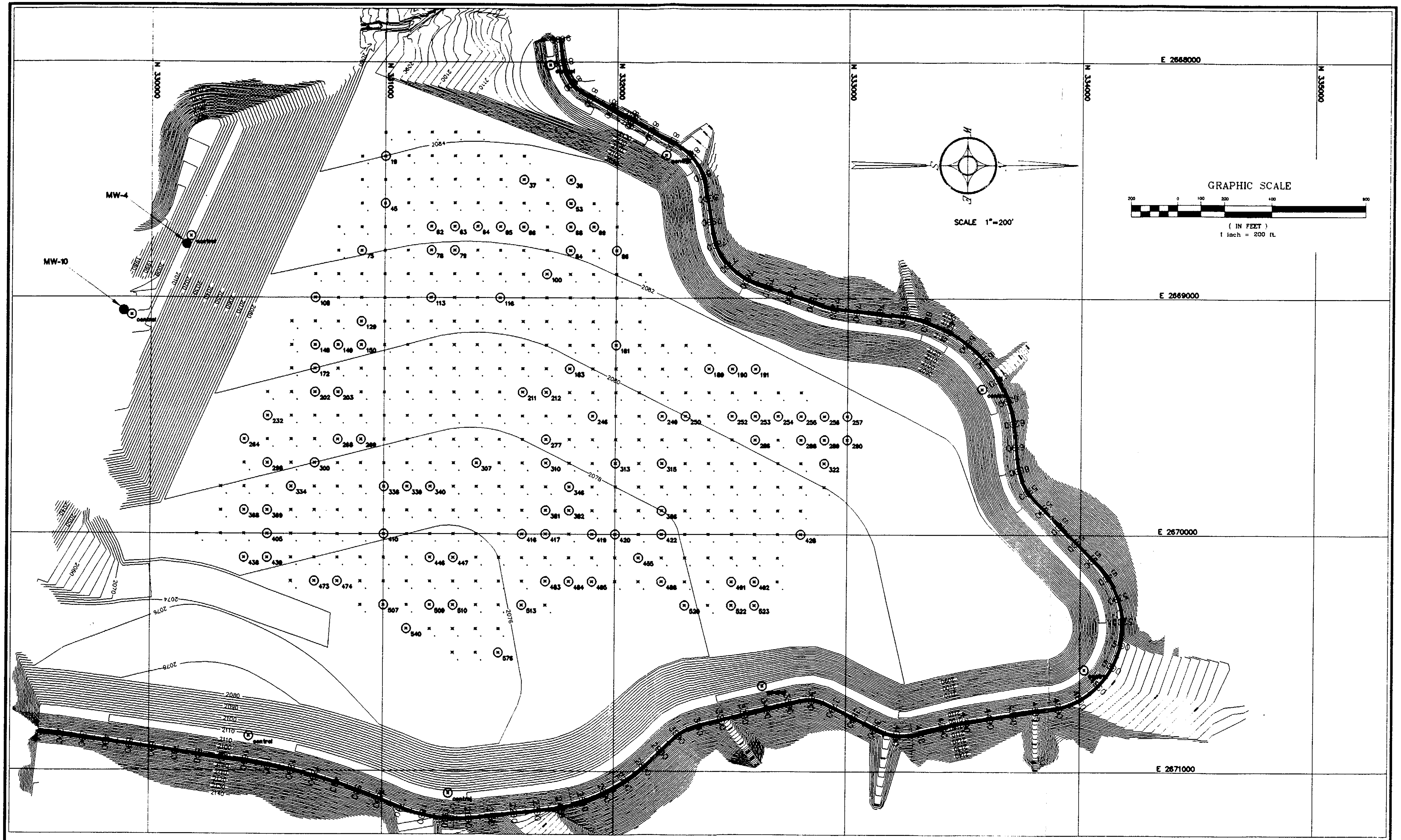
/bkd

ATTACHMENTS - (4)

cc: C. Abeyta (w/o attachments)
S. J. Baker
K. C. Bennett (w/o attachments)
L. L. Miller (SMI)
J. R. Blacklaw (WDOH)
D. B. Stoffel (WDOH)

ATTACHMENT 1.

SAMPLE LOCATIONS FOR
RADON-222 FLUX MEASUREMENTS



LEGEND

⊗ 540	RADON FLUX SAMPLE POINT No.
×	GRID POINT OVER LINER
⊗ control	RADON FLUX CONTROL SAMPLE POINT

REVISIONS		
DATE	BY	

ASCII FILE: [illegible]
PROJECT FILE: RADON2
ACAD FILE: RADONSAM.DWG

PROJECT AREA: SHERWOOD URANIUM MILLSITE
STATE WASHINGTON COUNTY STEVENS
SECTION [illegible] TWP. [illegible] RGE. [illegible]

TITLE: RADON FLUX SAMPLING SITES MAP

Design By KWB | Scale 1" = 200' | Date 12/06/94
Drawn By KWB | Checked By | Sheet 1 of 1

DWG. NO.

WESTERN NUCLEAR INC

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

THAT CAN BE VIEWED AT THE RECORD TITLED: RADON FLUX SAMPLING SITES MAP WITHIN THIS PACKAGE...OR, BY SEARCHING USING THE DOCUMENT/REPORT NUMBER: NONE

NOTE: Because of this page's large file size, it may be more convenient to copy the file to a local drive and use the Imaging (Wang) viewer, which can be accessed from the Programs/Accessories menu.

ATTACHMENT 2.

FIELD PROCEDURES, DATA SHEETS AND

CHAIN-OF-CUSTODY FORMS

ENERGY LABORATORIES, INC. - CASPER, WYOMING

STANDARD OPERATING PROCEDURES

LARGE AREA ACTIVATED CHARCOAL COLLECTORS (LAACC)

Approved By:

Originator	8/16/96 *Date*
Technical Reviewer (if applicable)	8/16/96 *Date*
ELI Quality Assurance Officer	8-16-96 *Date*
R. A. Harling *ELI Laboratory Manager*	8-16-96 *Date*

Distribution of Official Copies:

ELI Laboratory Manager
All ELI Staff

1.0 MEASURING RADON FLUX USING LARGE AREA ACTIVATED CHARCOAL COLLECTORS (LAACC)

The method used to measure radon flux involves absorption of radon on activated charcoal in a large area collector. The collector is placed onto the surface of the material to be measured and is allowed to collect radon for a time period of 24 hours. The radon collected on the charcoal is then measured by gamma spectroscopy.

Per 40 Code of Federal Regulations (CFR), *Part 61, Environmental Protection Agency, National Emission Standards for Hazardous Air Pollutants; Radionuclides; Final Rule and Notice of Reconsideration*, December 15, 1989, it is imperative that the temperature and moisture conditions are met for the measurement activity. Notification to the appropriate agencies should be made accordingly.

The collector consists of a PVC end cap with handle, screened spacer pads, charcoal distribution grid, screened retainer pad, and a steel retaining rod. Approximately 180 grams of activated charcoal is spread in the distribution grid. The retainer pad is placed over the charcoal and held in place by the retaining rod.

The collector is loaded with the charcoal by removing the retaining rod and pad, and placing the preweighed charcoal into the collector. The charcoal is then transported to the field in a sealed prenumbered can. The LAACC and charcoal canister numbers are recorded. The loading process should be done in an enclosed area so adverse wind conditions do not disturb the charcoal (blow it away). To allow for a quick transfer of charcoal into the LAACCs prior to deployment, LAACC units should be loaded by two or more personnel. Another team of two or more personnel should begin deployment immediately upon the charcoal transfer of a group of 10 to 20 LAACCs. Minimize the time a loaded LAACC is allowed to sit in ambient atmosphere. Care must be taken to minimize confusion and order of LAACCs and charcoal cans. An organized method of transfer and a large working area assist in minimizing any errors in LAACC/canister mismatching. A large vehicle could provide for the necessary enclosed area (such as a Suburban or equivalent).

The prenumbered collectors are deployed by carefully positioning the end cap on a flat surface of the material to be measured with soils or tailings used to seal the edge, at the predetermined location. It is imperative that a complete seal is obtained between the collector and the material to be measured. A shovel or a hand trowel may be used to scoop the material around the edge of the collector, being careful not to scoop material into the vent hole. The location identification, LAACC number, and the set time should be recorded.

After approximately 24 hours (minor time overruns are acceptable) of exposure, the collectors are picked up and the time retrieved is recorded. If any other conditions are observed (such as a broken seal, wind blown conditions, etc.), they should also be recorded. The transfer of the charcoal should begin immediately upon retrieval. The LAACCs are transported to the enclosed work area where a team of two or more personnel are responsible for transferring the charcoal carefully back into the appropriate prenumbered cans. The time between retrieval and transferring the exposed charcoal should be held to a minimum, however, site and field conditions contribute to the timeliness of the transfer.

The activated charcoal is removed from the collector by removing the retaining rod and pad from the collector and dumping the charcoal into a large funnel which leads into the prenumbered steel alloy can. The can's lid is placed and a wrap of electrical tape is applied to the can seam to eliminate any leakage or introduction of air into the can. The tape also assists in creating a closed (sealed) system to allow for the radon collected to equilibrate for four (4) hours before counting to allow the ingrowth of the radon daughters.

The sealed cans are transported to the laboratory where they are counted and recorded. The following information pertains to the calculation that will be made to ascertain the radon flux for each specific LAACC location.

2.0 *U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA) REQUIREMENTS FOR FIELD MEASUREMENT OF RADON FLUX*

Radon-222 Emissions from Uranium Mill Tailings Piles - Per 40 CFR, *Part 61, Environmental Protection Agency, National Emission Standards for Hazardous Air Pollutants; Radionuclides; Final Rule and Notice of Reconsideration*, December 15, 1989, the following has been reprinted:

Method 115 - Monitoring for Radon-222 (^{222}Rn) Emissions

> This Appendix describes the monitoring methods which must be used in determining the ^{222}Rn emissions from underground uranium mines, uranium mill tailings piles, phosphogypsum stacks, and other piles of waste material emitting radon.

2.1 *Measurement and Calculation of Radon Flux from Uranium Mill Tailings Piles*

2.1.1 *Frequency of flux measurement*

A single set of radon flux measurements may be made, or if the owner or operator chooses, more frequent measurements may be made over a one year period. These measurements may involve quarterly, monthly, or weekly intervals. All radon measurements shall be made as described in paragraphs 2.1.2 through 2.1.6 except that for measurements made over a one year period, the requirement of paragraph 2.1.4(c) shall not apply. The mean radon flux from the pile shall be the arithmetic mean of the mean radon flux for each measurement period. The weather conditions, moisture content of the tailings and area of the pile covered by water existing at the time of the measurement shall be chosen so as to provide measurements representative of the long term radon flux from the pile and shall be subject to EPA review and approval.

2.1.2 *Distribution of flux measurements*

The distribution and number of radon flux measurements required on a pile will depend on the clearly defined areas of the pile (called regions) that can have significantly different radon fluxes due to surface conditions. The mean radon flux shall be determined for each individual region of the pile. Regions that shall be considered for operating mill tailings piles are:

- water covered areas,
- water saturated areas (beaches),
- dry top surface areas, and
- sides, except where earthen material is used in dam construction.

For mill tailings after disposal the pile shall be considered to consist of only one region.

2.1.3 Number of radon flux measurements

Radon flux measurements shall be made within each region of the pile, except for those areas covered with water. Measurements shall be made at regularly spaced locations across the surface of the region, realizing that surface roughness will prohibit measurements in some areas of a region. The minimum number of flux measurements considered necessary to determine a representative mean radon flux value for each type of region on an operating pile is:

- water saturated area - no measurements required as radon flux is assumed to be zero,
- water saturated beaches - 100 radon flux measurements,
- loose and dry top surface - 100 radon flux measurements, and
- sides - 100 radon flux measurements, except where earthen materials is used in dam construction.

For mill tailings pile after disposal which consists of only one regional minimum of 100 measurements are required.

2.1.4 Restrictions to radon flux

Measurements - the following restrictions are placed on making radon flux measurements:

- measurements shall not be initiated within 24 hours of a rainfall;
- if a rainfall occurs during the 24 hour measurements period, the measurement is invalid if the seal around the lip of the collector is surrounded by water; and
- measurements shall not be performed if the ambient temperature is below 35°F or if the ground is frozen.

2.1.5 Areas of pile regions

The approximate area of each region of the pile shall be determined in units of square meters.

2.1.6 Radon Flux Measurements

Measuring radon flux involves the absorption of radon on activated charcoal in a large-area collector. The radon collector is placed on the surface of the pile area to be measured and allowed to collect for a period of 24 hours. The radon collected on the charcoal is measured by gamma-ray spectroscopy. The detailed measurement procedure provided in Appendix A of EPA 520/5-85-0029(1) shall be used to measure the radon flux on uranium mill tailings, except the surface of the tailings shall not be penetrated by the lip of the radon collector as directed in the procedure, rather the collector shall be carefully positioned on a flat surface with soil or tailings used to seal the edge.

2.1.7 *Calculations*

The mean radon flux for reach region on the pile and for the total pile shall be calculated and reported as follows:

a. The individual radon flux calculations shall be made as provided in Appendix A EPA 86 (1). The mean radon flux for each region of the pile shall be calculated by summing all individual flux measurements for the region and dividing by the total number of flux measurements for the region.

b. The mean radon flux for the total uranium mill tailings pile shall be calculated as follows:

$$J_s = \frac{J_1A_1 + \ldots J_2A_2 \ldots J_iA_i}{A_t}$$

Where:

J_S	=	mean flux for the total pile (pCi/m²-s)
J_1	=	mean flux measured in region i (pCi/m²-s)
A_1	=	area of region i (m²)
A_t	=	total area of pile (m²)

2.1.8 *Reporting*

The results of the individual flux measurements, the approximate locations on the pile, and the mean radon flux foe each region and the mean radon flux for the total stack shall be included in the emission test report. Any conditions or unusual event that occurred during the measurements that could significantly affect the results should be reported.

3.0 *SAMPLING AND LABORATORY PROCEDURES FOR ATTAINING RADON FLUX MEASUREMENTS*

Quality Assurance Procedures for Measuring ^{222}Rn Flux - Per 40 CFR, Part 61, *Environmental Protection Agency, National Emission Standards for Hazardous Air Pollutants; Radionuclides; Final Rule and Notice of Reconsideration*, December 15, 1989, the following has been reprinted:

Method 115 - Monitoring for ^{222}Rn Emissions

This Appendix describes the monitoring methods which must be used in determining the ^{222}Rn emissions from underground uranium mines, uranium mill tailings piles, phosphogypsum stacks, and other piles of waste material emitting radon.

a. *Sampling Procedures*

Records of field activities and laboratory measurements shall be maintained. The following information shall be recorded for each charcoal canister measurement:

- site,
- name of pile,
- sample location,
- sample ID number,
- date and time on,
- date and time off, and
- observations of meteorological conditions and comments.

Records shall include all applicable information associated with determining the sample measurement, calculations, observations, and comments.

b. *Sample Custody*

Custodial control of all charcoal samples exposed in the field shall be maintained in accordance with EPA chain of custody field procedures. A control record shall document all custody changes that occur between the field and laboratory personnel.

c. *Calibration Procedures and Frequency*

The radioactivity of two standard charcoal sources, each containing a carefully determined quantity of Radium-226 (^{226}Ra) uniformly distributed through 180 grams of activated charcoal, shall be measured. An efficiency factor is computed by dividing the average measured radioactivity of the two standard charcoal sources, minus the background, in cpm by the known radioactivity of the sources in dpm. The same two standard charcoal sources shall be at the beginning and at the end of each day's counting as a check of the radioactivity counting equipment. A background count using unexposed charcoal should be made at the beginning and at the end of each counting day to check for inadvertent contamination of the detector or other changes affecting the background. The unexposed charcoal comprising the blank is changed with each new batch of charcoal used.

d. *Internal Quality Control Checks and Frequency*

The charcoal from every tenth exposed canister shall be recounted. Five percent of the samples analyzed shall be either blanks (charcoal having no radioactivity added) or samples spiked with known quantities of ^{226}Ra.

e. *Data Precision, Accuracy, and Completeness*

The precision, accuracy, and completeness of measurements and analyses shall be within the following limits for samples measuring greater than 1.0 pCi/m^2-s.

- Precision: 10%
- Accuracy: 10%
- Completeness: At least 85% of the measurements must yield usable results

Energy Laboratories, Inc. (ELI) has two multi-channel gamma spectrometers available at its Casper facility.

ELI is an EPA certified and listed laboratory. Certification has been maintained in the areas for determination of radiochemical, inorganics, and organics in drinking waters. ELI has been actively participating in EPA's Radon Proficiency Program since its inception for determination of radon concentrations in homes and structures. ELI has two staff members presently accepted by the U. S. Nuclear Regulatory Commission (NRC) as Radiation Safety Officers and have performed radiation surveys for uranium operations since 1980. These surveys include alpha, beta, and gamma emitting radionuclides in air, soil/surface, and water for determination of employee occupational exposure awhile working at mine sites.

Copies of ELI's Quality Assurance and certifications are available upon request.

The professional personnel will be available for consultation prior to and during the sampling duration. The following areas should be addressed before sampling:

- timing of collection (24 hours sampling or annual),
- regions within the tailings impoundment (quantity and area),
- personnel responsible for placement of collectors,
- EPA notification of intent to proceed with collection,
- current topographical map of tailings impoundments to be sampled,
- sample point locations to be marked prior to collector placement, and
- location of any background samples such as up wind of the impoundment (undisturbed areas) as a point of comparison.

ELI will provide the company with a report that will include a minimum of the following:

- number and laboratory ID of collectors placed;
- date and time of collectors placed, retrieved, and charcoal counted;
- map of location of collectors (provided by company);
- radon flux calculations for each detector, region, and total tailings impoundment;
- spectrum print out for each detector, if requested; and
- quality assurance data will be provided upon request. This data will consists of duplicates, blanks, standards, and geometry verification.

LARGE AREA ACTIVATED CHARCOAL CANISTER (LAACC) FIELD NOTES

Client: Western Nuclear, Inc. **Location:** Wellpinit, WA Sherwood Project

Weather Condition: Slightly Overcast 60°F **Precip:** — **Min Temp:** 44°F

Inst.: ____ **Eff:** ____ **Tech:** ____

Inst. Back: ____

Charcoal Back: ____ **Lot:** ____

Standard: ____ **Count:** ____

LAACC Unit #	Charcoal Can #	Location I.D. / Station	Mo/Day/Yr 24 hr time set	Mo/Day/Yr 24 hr time removed	Site Personnel Initials	Lab Sample Number	Date/Time Start	Count Min	Gross Counts	Comments
1	1	3400	10/02/96 17:27	10/03/96 17:29	BKD, LSM, IFW, JWH, CA					
2	2	1900	" 17:30	" 17:30						
3	3	428	" 16:40	" 15:57						
4	4	86	" 16:08	" 15:47						
5	5	890	" 17:20	" 17:20						
6	6	1000	" 17:32	" 17:33						
7	7	183	" 16:04	" 16:17						
8	8	250	" 15:42	" 16:19						
9	9	269	" 15:58	" 16:05						
10	10	322	" 15:32	" 16:07						
11	11	381	" 15:51	" 16:04						
12	12	382	" 15:50	" 16:04						
13	13	830	" 17:22	" 17:22						
14	14	10	" 17:37	" 17:37						
15	15	417	" 15:51	" 16:01						LAACC Unit Cracked

LARGE AREA ACTIVATED CHARCOAL CANISTER (LAACC) FIELD NOTES

Client: Western Nuclear, Inc. **Location:** Wellpinit, WA Sherwood Project

Weather Condition: Slightly Overcast 60°F **Precip:** — **Min Temp:** 44°F

Inst.: ______ **Eff:** ______ **Tech:** ______
Inst. Back: ______
Charcoal Back: ______ **Lot:** ______
Standard: ______ **Count:** ______

LAACC Unit #	Charcoal Can #	Location I.D. / Station	Mo/Day/Yr 24 hr time set	Mo/Day/Yr 24 hr time removed	Site Personnel Initials	Lab Sample Number	Date/Time Start	Count Min	Gross Counts	Comments
16	16	254	10/02/96 15:36	10/03/96 16:13	[initials]					
17	17	640	" 17:24	" 17:25						
18	18	422	" 16:37	" 15:58						
19	19	447	" 15:55	" 15:53						
20	20	338	" 16:56	" 16:07						
21	21	313	" 15:45	" 16:21						
22	22	250	" 15:42	" 16:19						
23	23	161	" 16:07	" 16:16						
24	24	446	" 15:55	" 15:52						
25	25	211	" 16:00	" 16:15						
26	26	68	" 15:08	" 15:45						
27	27	322	" 15:32	" 16:07						
28	28	277	" 16:02	" 16:14						
29	29	286	" 15:38	" 16:17						
30	30	386	" 15:46	" 16:05						

LARGE AREA ACTIVATED CHARCOAL CANISTER (LAACC) FIELD NOTES

Client: Western Nuclear, Inc. Location: Wellpinit, WA Sherwood Project

Weather Condition: Slightly overcast 60°F Precip: — Min Temp: 44°F

Inst.: ______ Eff: ______ Tech: ______
Inst. Back: ______
Charcoal Back: ______ Lot: ______
Standard: ______ Count: ______

LAACC Unit #	Charcoal Can #	Location I.D. / Station	Mo/Day/Yr 24 hr time set	Mo/Day/Yr 24 hr time removed	Site Personnel Initials	Lab Sample Number	Date/Time Start	Count Min	Gross Counts	Comments
46	46	310	10/02/96 16:02	10/03/96 16:12	[signature]					
47	47	473	" 15:18	" 15:33						
48	48	507	" 15:20	" 15:35						
49	49	491	" 15:29	" 15:43						
50	50	69	" 15:08	" 15:46						
51	51	39	" 15:07	" 15:49						
52	52	439	" 14:52	" 15:31						
53	53	252	" 15:39	" 16:17						
54	54	339	" 16:55	" 16:07						
55	55	509	" 15:22	" 15:36						
56	56	483	" 15:25	" 15:47						
57	57	513	" 15:25	" 15:39						
58	58	100	" 15:10	" 15:51						
59	59	416	" 15:51	" 16:02						
60	60	63	" 15:04	" 15:43						

LARGE AREA ACTIVATED CHARCOAL CANISTER (LAACC) FIELD NOTES

Client: Western Nuclear, Inc. Location: Wellpinit, WA Sherwood Project

Weather Condition: Slightly Overcast Precip: — Min Temp: 44°F

Inst.: ______ Eff: ______ Tech: ______

Inst. Back: ______

Charcoal Back: ______ Lot: ______

Standard: ______ Count: ______

LAACC Unit #	Charcoal Can #	Location I.D. / Station	Mo/Day/Yr 24 hr time set	Mo/Day/Yr 24 hr time removed	Site Personnel Initials	Lab Sample Number	Date/Time Start	Count Min	Gross Counts	Comments
61	61	268	10/02/96 15:16	10/03/96 16:05	[illegible]					
62	62	148	" 14:53	" 15:58						
63	63	172	" 14:51	" 15:59						
64	64	256	" 15:35	" 16:10						
65	65	474	" 15:18	" 15:34						LAACC Unit cracked
66	66	212	" 16:01	" 16:15						
67	67	66	" 15:06	" 15:45						
68	68	84	" 15:10	" 15:50						
69	69	232	" 14:48	" 16:00						LAACC Unit # [illegible] Broken Side
70	70	113	" 15:13	" 15:54						
71	71	53	" 15:07	" 15:49						
72	72	75	" 14:45	" 15:39						
73	73	257	" 15:35	" 16:09						
74	74	253	" 15:37	" 16:16						
75	75	288	" 15:35	" 16:11						

LARGE AREA ACTIVATED CHARCOAL CANISTER (LAACC) FIELD NOTES

Client: Western Nuclear, Inc. **Location:** Wellpinit, WA Sherwood Project

Weather Condition: Slightly Overcast 60°F **Precip:** — **Min Temp:** 44°F

Inst.: ____ **Eff:** ____ **Tech:** ____
Inst. Back: ____
Charcoal Back: ____ **Lot:** ____
Standard: ____ **Count:** ____

LAACC Unit #	Charcoal Can #	Location I.D. / Station	Mo/Day/Yr 24 hr time set	Mo/Day/Yr 24 hr time removed	Site Personnel Initials	Lab Sample Number	Date/Time Start	Count Min	Gross Counts	Comments
76	76	485	10/02/96 15:26	10/03/96 15:45	[initials]					
77	77	438	" 14:52	" 15:30						
78	78	62	" 15:02	" 15:41						
79	79	150	" 14:59	" 15:56						
80	80	455	" 15:48	" 15:55						
81	81	386	" 15:46	" 16:05						
82	82	108	" 14:48	" 15:55						
83	83	346	" 17:04	" 16:22						
84	84	522	" 15:29	" 15:42						
85	85	405	" 14:54	" 15:32						
86	86	37	" 15:06	" 15:50						
87	87	246	" 16:05	" 16:25						
88	88	79	" 15:01	" 15:40						
89	89	203	" 15:15	" 16:00						
90	90	211	" 16:00	" 16:15						

LARGE AREA ACTIVATED CHARCOAL CANISTER (LAACC) FIELD NOTES

Client: Western Nuclear, Inc. Location: Wellpinit, WA Sherwood Project

Weather Condition: Slightly Overcast 60°F Precip: — Min Temp: 44°F

Inst.: Eff: Tech:

Inst. Back:

Charcoal Back: Lot:

Standard: Count:

LAACC Unit #	Charcoal Can #	Location I.D. / Station	Mo/Day/Yr 24 hr time set	Mo/Day/Yr 24 hr time removed	Site Personnel Initials	Lab Sample Number	Date/Time Start	Count Min	Gross Counts	Comments
91	91	410	10/02/96 15:56	10/03/96 15:51	BKD					
92	92	520	" 15:28	" 15:41						Unit Cracked
93	93	129	" 15:00	" 15:55						
94	94	540	" 15:21	" 15:36						
95	95	300	" 15:16	" 16:04						
96	96	368	" 14:51	" 15:30						
97	97	307	" 16:00	" 16:11						
98	98	64	" 15:05	" 15:44						
99	99	45	" 14:45	" 15:37						
100	100	116	" 15:11	" 15:54						
101	101	290	" 15:33	" 16:08						
102	102	369	" 14:54	" 15:49						
103	103	189	" 15:41	" 16:15						
104	104	576	" 15:24	" 15:38						
105	605	149	" 14:57	" 15:57						

LARGE AREA ACTIVATED CHARCOAL CANISTER (LAACC) FIELD NOTES

Client: Western Nuclear, Inc. **Location:** Wellpinit, WA Sherwood Project

Weather Condition: Slightly Overcast 60°F **Precip:** — **Min Temp:** 44°F

Inst.: ______ **Eff:** ______ **Tech:** ______

Inst. Back: ______

Charcoal Back: ______ **Lot:** ______

Standard: ______ **Count:** ______

LAACC Unit #	Charcoal Can #	Location I.D. / Station	Mo/Day/Yr 24 hr time set	Mo/Day/Yr 24 hr time removed	Site Personnel Initials	Lab Sample Number	Date/Time Start	Count Min	Gross Counts	Comments
106	106	202	10/02/96 14:56	10/03/96 15:59	BxD					
107	107	492	" 15:30	" 15:43						
108	108	419	" 16:35	" 16:00						
109	109	19	" 14:43	" 15:36						Unit cracked
110	110	2	" 17:26	" 17:27						Unit cracked
111	111	510	" 15:22	" 15:37						
112	112	488	" 16:45	" 15:44						
113	113	447	" 15:55	" 15:53						
114	114	264	" 14:50	" 16:03						
115	115	340	" 16:54	" 16:10						
116	116	Unused, unopened								
117	117	"								
118	118	"								
119	119	"								
120	120	"								

MEMORANDUM

To: *LAACC Users*

From: *Sheryl Garling with Energy Laboratories, Inc.*

Subject: *Chain-of-Custody For Large Area Activated Charcoal Canister (LAACC) Units*

ELI has designed this memorandum to serve as (1) *Chain-of-Custody* for shipping and receiving the LAACC Units and supplies that accompany the equipment, (2) directions on transfer of activated carbon to and from LAACC Units, and (3) placement information.

Packed by: LAACC UNITS UNC M&M CHARCOAL CANS DAVE GLASSER/ELI, ELI-Casper Branch, Casper, Wyoming.

The LAACC Units have been shipped or delivered to:

Company Name: WESTERN NUCLEAR, INC

Street Address: ELIJAH ROAD - PLANT

City, State, Zip: WELLPINIT WA

Phone & Fax: 509/747-2081 fax -2063

Contact Person: BRAD DEWAARD

LAACC Units Shipped & No's: from UNC's 115 UNITS LAACC Units Rec'd & No's: Rec'd 115 Units from UNC. 10/02/96

Charcoal Cans Shipped & No's: 126 Charcoal Cans Rec'd & No's: Rec'd 125 units from UNC 10/02/96

TRIP BLANKS 15 B " 15 Trip Blanks from ELI 10/02/96

The attached *Large Area Activated Charcoal Canister (LAACC) Field Notes* table should be used when placing the LAACC Unit onto the tailings impoundments or stacks. The data necessary to generate proper radon flux is transcribed from your notes. Please write clearly. Field notes should be copied and one set returned to the laboratory along with LAACC Units, canisters, and any other equipment.

The following materials would be helpful for LAACC Unit set up and transfer of charcoal:

- funnel and holder,
- silicon grease,
- pliers,
- extra electrical tape, and
- a table within a building.

When transferring activated carbon (charcoal) into the LAACC Unit (preferably inside a building), care should be taken that:

- charcoal is leveled into the units,
- charcoal canister number has been identified to the corresponding LAACC unit number on the field notes, and
- the retaining rod is securely placed back into position.

LOT No. 96-30

SHERWO[illegible] PROJECT
CHAIN OF CUSTODY RECORD

Page 1 of 1 for [illegible]
Shipping Container No. 7435056812

RESULTS TO ☐ BILL TO ☑
Western Nuclear Inc.
Sherwood Project
Attn: Brad K. DeWaard
P.O. Box 392
Wellpinit, WA 99040
Tel: (509) 747-2081 Fax: (509) 747-2063

☐ ☐ Consultant

SAMPLER: (Print Name/Signature) Brad K. DeWaard [signature]

ANALYSES REQUIRED

SAMPLE IDENTIFICATION	DATE	TIME	SAMPLE MATRIX	NO. OF CONTAINERS	Ra-226										CHECK BY
Selected Debris	10/04/96	1200	Act. Charcoal	140	X										
Sampling Equipment	10/04/96	1200	NA	115	NA										

RELINQUISHED BY: (Signature/Company)	DATE	TIME	METHOD OF SHIPMENT	RECEIVED BY: (Signature/Company)	DATE	TIME
1. [signature]	10/04/96	1200	Samples FEDEX			
2. [signature]	10/04/96	1200	LAAcc. Units UPS-3-day			
3.						
4.						

ATTACHMENT 3.

LARGE AREA ACTIVATED CHARCOAL CANISTER

RADON FLUX REPORT

ENERGY LABORATORIES, INC.
P.O. BOX 3258 • CASPER, WY 82602 • PHONE (307) 235-0515
2393 SALT CREEK HIGHWAY • CASPER, WY 82601 • FAX (307) 234-1639

Large Area Activated Charcoal Canister (LAACC) Radon Flux Report

Project: WESTERN NUCLEAR, INC. **Date Set:** 10-02-96
Location: Wellpint, WA - Sherwood Project **Date Remove:** 10-03-96
Report Date: October 21, 1996 **Date Counted:** 10-07-96
Weather: Slightly overcast, 60° F.

Method: WNI's employees placed and retrieved LAACC units. EPA Method 115 per 40 CFR 61 (NESHAPs). Radon Flux results have been corrected for instrument & charcoal background counts.

Lab I.D.	LAACC #	Canister #	Location	10-02-96 Time Set	10-03-96 Time Remove	Radon Flux pCi/m2s
96- 55093	1	1	3400	17:27	17:29	<0.5
96- 55094	2	2	1900	17:30	17:30	<0.5
96- 55095	3	3	428	16:40	15:57	<0.5
96- 55096	4	4	86	16:08	15:47	<0.5
96- 55097	5	5	890	17:20	17:20	<0.5
96- 55098	6	6	1000	17:32	17:33	0.5
96- 55099	7	7	183	16:04	16:17	<0.5
96- 55100	8	8	250	15:42	16:19	<0.5
96- 55101	9	9	269	15:58	16:05	0.5
96- 55102	10	10	322	15:32	16:07	<0.5
Duplicate	-	-	-	-	-	<0.5
96- 55103	11	11	381	15:51	16:04	<0.5
96- 55104	12	12	382	15:50	16:04	<0.5
96- 55105	13	13	830	17:22	17:22	<0.5
96- 55106	14	14	10	17:37	17:37	<0.5
96- 55107	15	15	417	15:51	16:01	<0.5
96- 55108	16	16	254	15:36	16:13	<0.5
96- 55109	17	17	640	17:24	17:25	<0.5
96- 55110	18	18	422	16:37	15:58	<0.5
96- 55111	19	19	447	15:55	15:53	<0.5
96- 55112	20	20	338	16:56	16:07	<0.5
Duplicate	-	-	-	-	-	0.5
96- 55113	21	21	313	15:45	16:21	<0.5
96- 55114	22	22	250	15:42	16:19	<0.5
96- 55115	23	23	161	16:07	16:16	<0.5
96- 55116	24	24	446	15:55	15:52	<0.5
96- 55117	25	25	211	16:00	16:15	<0.5
96- 55118	26	26	68	15:08	15:45	<0.5
96- 55119	27	27	322	15:32	16:07	<0.5

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ELI

Large Area Activated Charcoal Canister (LAACC) Radon Flux Report

Project:	WESTERN NUCLEAR, INC.	Date Set:	10-02-96
Location:	Wellpint, WA - Sherwood Project	Date Remove:	10-03-96
Report Date:	October 21, 1996	Date Counted:	10-07-96
Weather:	Slightly overcast, 60° F		

Lab I.D.	LAACC #	Canister #	Location	10-02-96 Time Set	10-03-96 Time Remove	Radon Flux pCi/m2s
96- 55120	28	28	277	16:02	16:14	<0.5
96- 55121	29	29	286	15:38	16:17	<0.5
96- 55122	30	30	386	15:46	16:05	<0.5
Duplicate	-	-	-	-	-	<0.5
96- 55123	31	31	289	15:34	16:11	<0.5
96- 55124	32	32	334	16:58	16:04	<0.5
96- 55125	33	33	65	15:05	15:44	<0.5
96- 55126	34	34	420	16:35	16:00	<0.5
96- 55127	35	35	MW4	17:39	17:39	<0.5
96- 55128	36	36	315	15:45	16:20	<0.5
96- 55129	37	37	190	15:40	16:15	<0.5
96- 55130	38	38	255	15:36	16:12	<0.5
96- 55131	39	39	MW4	17:39	17:39	<0.5
96- 55132	40	40	523	15:30	15:42	<0.5
Duplicate	-	-	-	-	-	<0.5
96- 55133	41	41	484	15:26	15:46	0.5
96- 55134	42	42	249	15:42	16:19	0.5
96- 55135	43	43	191	15:40	16:14	<0.5
96- 55136	44	44	298	14:55	16:02	0.5
96- 55137	45	45	78	15:01	15:40	<0.5
96- 55138	46	46	310	16:02	16:12	<0.5
96- 55139	47	47	473	15:18	15:33	<0.5
96- 55140	48	48	507	15:20	15:35	<0.5
96- 55141	49	49	491	15:29	15:43	<0.5
96- 55142	50	50	69	15:08	15:46	<0.5
Duplicate	-	-	-	-	-	<0.5
96- 55143	51	51	39	15:07	15:49	<0.5
96- 55144	52	52	439	14:52	15:31	<0.5
96- 55145	53	53	252	15:39	16:17	<0.5
96- 55146	54	54	339	16:55	16:07	<0.5
96- 55147	55	55	509	15:22	15:36	<0.5

ELI

Large Area Activated Charcoal Canister (LAACC) Radon Flux Report

Project:	WESTERN NUCLEAR, INC.	Date Set:	10-02-96
Location:	Wellpint, WA - Sherwood Project	Date Remove:	10-03-96
Report Date:	October 21, 1996	Date Counted:	10-07-96
Weather:	Slightly overcast, 60° F.		

Lab I.D.		LAACC #	Canister #	Location	10-02-96 Time Set	10-03-96 Time Remove	Radon Flux pCi/m2s
96-	55148	56	56	483	15:25	15:47	<0.5
96-	55149	57	57	513	15:25	15:39	<0.5
96-	55150	58	58	100	15:10	15:51	0.6
96-	55151	59	59	416	15:51	16:02	<0.5
96-	55152	60	60	63	15:04	15:43	<0.5
Duplicate		-	-	-	-	-	<0.5
96-	55153	61	61	268	15:16	16:05	0.6
96-	55154	62	62	148	14:53	15:58	<0.5
96-	55155	63	63	172	14:51	15:59	<0.5
96-	55156	64	64	256	15:35	16:10	<0.5
96-	55157	65	65	474	15:18	15:34	<0.5
96-	55158	66	66	212	16:01	16:15	<0.5
96-	55159	67	67	66	15:06	15:45	<0.5
96-	55160	68	68	84	15:10	15:50	0.5
96-	55161	69	69	232	14:48	16:00	<0.5
96-	55162	70	70	113	15:13	15:54	<0.5
Duplicate		-	-	-	-	-	<0.5
96-	55163	71	71	53	15:07	15:49	<0.5
96-	55164	72	72	75	14:45	15:39	<0.5
96-	55165	73	73	257	15:35	16:09	<0.5
96-	55166	74	74	253	15:37	16:16	<0.5
96-	55167	75	75	288	15:35	16:11	<0.5
96-	55168	76	76	485	15:26	15:45	<0.5
96-	55169	77	77	438	14:52	15:30	<0.5
96-	55170	78	78	62	15:02	15:41	0.6
96-	55171	79	79	150	14:59	15:56	<0.5
96-	55172	80	80	455	15:48	15:55	<0.5
Duplicate		-	-	-	-	-	<0.5
96-	55173	81	81	386	15:46	16:05	<0.5
96-	55174	82	82	108	14:48	15:55	0.7
96-	55175	83	83	346	17:04	16:22	0.5

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Large Area Activated Charcoal Canister (LAACC) Radon Flux Report

Project: WESTERN NUCLEAR, INC. Date Set: 10-02-96
Location: Wellpint, WA - Sherwood Project Date Remove: 10-03-96
Report Date: October 21, 1996 Date Counted: 10-07-96
Weather: Slightly overcast, 60° F.

Lab I.D.	LAACC #	Canister #	Location	10-02-96 Time Set	10-03-96 Time Remove	Radon Flux pCi/m2s
96- 55176	84	84	522	15:29	15:42	0.5
96- 55177	85	85	405	14:54	15:32	<0.5
96- 55178	86	86	37	15:06	15:50	0.6
96- 55179	87	87	246	16:05	16:25	<0.5
96- 55180	88	88	79	15:01	15:40	<0.5
96- 55181	89	89	203	15:15	16:00	0.6
96- 55182	90	90	211	16:00	16:15	<0.5
Duplicate	-	-	-	-	-	<0.5
96- 55183	91	91	410	15:56	15:51	<0.5
96- 55184	92	92	520	15:28	15:41	<0.5
96- 55185	93	93	129	15:00	15:55	<0.5
96- 55186	94	94	540	15:21	15:36	0.5
96- 55187	95	95	300	15:16	16:04	<0.5
96- 55188	96	96	368	14:51	15:30	<0.5
96- 55189	97	97	307	16:00	16:11	<0.5
96- 55190	98	98	64	15:05	15:44	0.6
96- 55191	99	99	45	14:45	15:37	<0.5
96- 55192	100	100	116	15:11	15:54	<0.5
Duplicate	-	-	-	-	-	<0.5
96- 55193	101	101	290	15:33	16:08	<0.5
96- 55194	102	102	369	14:54	15:49	0.5
96- 55195	103	103	189	15:41	16:15	<0.5
96- 55196	104	104	576	15:24	15:38	<0.5
96- 55197	105	105	149	14:57	15:57	0.6
96- 55198	106	106	202	14:56	15:59	<0.5
96- 55199	107	107	492	15:30	15:43	0.5
96- 55200	108	108	419	16:35	16:00	0.5
96- 55201	109	109	19	14:43	15:36	<0.5

ELI

Large Area Activated Charcoal Canister (LAACC) Radon Flux Report

Project:	WESTERN NUCLEAR, INC.	Date Set:	10-02-96
Location:	Wellpint, WA - Sherwood Project	Date Remove:	10-03-96
Report Date:	October 21, 1996	Date Counted:	10-07-96
Weather:	Slightly overcast, 60° F.		

Lab I.D.	LAACC #	Canister #	Location	10-02-96 Time Set	10-03-96 Time Remove	Radon Flux pCi/m2s
96- 55202	110	110	2	17:26	17:27	<0.5
Duplicate	-	-	-	-	-	<0.5
96- 55203	111	111	510	15:22	15:37	<0.5
96- 55204	112	112	488	16:45	15:44	<0.5
96- 55205	113	113	447	15:55	15:53	<0.5
96- 55206	114	114	264	14:50	16:03	<0.5
96- 55207	115	115	340	16:54	16:10	<0.5

ELI

Large Area Activated Charcoal Canister (LAACC) Radon Flux Quality Assurance Report

Project:	WESTERN NUCLEAR, INC.	**Date Set:**	10-02-96
Location:	Wellpint, WA - Sherwood Project	**Date Remove:**	10-03-96
Report Date:	October 23, 1996	**Date Counted:**	10-07-96
Weather:	Slightly overcast, 60° F.		

Trip Blank - Lab I.D.	Cannister #	Radon Flux - pCi/m2s*
96- 55208	1	<0.5
96- 55209	2	<0.5
96- 55210	3	<0.5
96- 55211	4	<0.5
96- 55212	5	<0.5
96- 55213	6	<0.5
96- 55214	7	<0.5
96- 55215	8	<0.5
96- 55216	9	<0.5
96- 55217	10	<0.5
96- 55218	11	<0.5
96- 55219	12	<0.5
96- 55220	13	<0.5
96- 55221	14	<0.5
96- 55222	15	<0.5

Blank Charcoal cpm	Standard Number 1 cpm	Standard Number 2 cpm
82	1669	3300

Total Number of Laboratory Duplicates:	11
Total Number of Field Duplicates:	NA
Total Number of Trip Blank Cannisters:	15
Total Number of Measurements On Sherwood Project:	115
Average Radon Flux for Sherwood Project:	0.5 pCi/m2s
Minimum Radon Flux for Sherwood Project:	<0.5 pCi/m2s
Maximum Radon Flux for Sherwood Project:	0.7 pCi/m2s

* Note: ELI's Radon Flux Practical Quantitative Limit (PQL) is 0.5 pCi/m2s.

Report Approved By: [signature] **Reviewed By:** [signature]

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ATTACHMENT 4

Table 1. Results of field replicates.

Lab ID No.	Location No.	LAACC* No.	Flux value (pCi/m²-s)	Comments (units are pCi/m²-s)
96-55117	211	25	< 0.5	
96-55182		90	< 0.5	Lab duplicate: flux < 0.5
96-55100	250	8	< 0.5	
96-55114		22	< 0.5	
96-55102	322	10	< 0.5	Lab duplicate: flux < 0.5
96-55119		27	< 0.5	
96-55122	386	30	< 0.5	Lab duplicate: flux < 0.5
96-55173		81	< 0.5	
96-55111	447	19	< 0.5	
96-55205		113	< 0.5	
96-55127	MW-4	35	< 0.5	Control Sample
96-55131		39	< 0.5	Control Sample

*Large Area Activated Charcoal Canister.

Table 2. Control samples.

Lab ID No.	Location No./ID	LAACC* No.	Flux value (pCi/m²-s)	Comments (units are pCi/m²-s)
96-55127	MW-4	35	< 0.5	Field Replicate Samples
96-55131		39	< 0.5	
96-55106	MW-10	14	< 0.5	
96-55098	Sta 1000	6	< 0.5	
96-55094	Sta 1900	2	< 0.5	
96-55093	Sta 3400	1	< 0.5	
96-55202	Sta 4900	110	< 0.5	Lab duplicate: flux < 0.5
96-55109	Sta 6400	17	< 0.5	
96-55105	Sta 8300	13	< 0.5	
96-55097	Sta 8900	5	< 0.5	

*Large Area Activated Charcoal Canister.

WDOH SURFACE STABILITY INSPECTION ISSUES

In a letter dated August 20, 1999, from WDOH, a total of 12 issues were raised relative to soil erosional stability and riprap placement. A site meeting was held on September 7 with WDOH and WNI representatives. This meeting resulted in a plan to address the 12 issues raised in the August 20 letter. A letter was transmitted from WNI to WDOH on September 16, 1999, that described the actions to be taken to address each issue. A September 21, 1999, letter from the WDOH acknowledged receipt of the September 16 letter and presented WDOH's position on each of the issues.

The following presents each of the 12 issues raised by the WDOH and WNI's response to each of the issues.

ISSUE 1

Area west of the impoundment near the dam outslope and the site access road where some surface flow and soil erosion is occurring away from the constructed channel and culvert due to local ditching from construction effect.

RESPONSE

Remedial construction was performed in the area to address the WDOH concerns. The design of the remedial construction was included in a letter to WDOH dated October 11, 1999 (Attachment A). Construction was completed on October 20, 1999, and the as-built conditions are included in the final structural stability inspection report dated November 15, 1999, which is included in Section 3 of this submittal.

ISSUE 2

Northwest section of the diversion channel where silty soil has been deposited in the channel.

RESPONSE

As indicated in the September 16, 1999, letter and as agreed to in the WDOH letter of September 21, 1999, the sediment deposited in this area was redistributed up- and down-stream of the area. This regrading was completed on September 31, 1999, and was observed and approved by WDOH personnel.

ISSUE 3

Area of gully soil erosion up-gradient of the silt collection point in the diversion channel.

RESPONSE

Remedial construction was performed in the area to address the WDOH concerns. The design of the remedial construction was included in a letter to WDOH dated October 11, 1999 (attached). Construction was completed on October 25, 1999, and the as-built conditions are included in the final structural stability inspection report dated November 15, 1999, which is included in Section 3 of this submittal.

ISSUE 4

Areas of rill erosion in the diversion channel (both sides) up-gradient from the rock-covered slopes.

RESPONSE

Some minor rilling has occurred on the diversion channel side slopes above the riprap lined portion of the diversion channel. This rill erosion is most prominent on the long (approximately 100 feet) slopes on the outside slope of the channel along the east side of the reclaimed impoundment. These long slopes exist between confluences where quartz monzonite bedrock is at the surface of the cut slopes. An analysis was performed to determine if this rilling would adversely impact the long-term performance of the diversion channels. This analysis is included in Attachment B to this submittal.

As demonstrated in the analysis (Attachment B) the minor amount of rilling that is expected along these slopes will not impact the performance of the channel. The only potential impact would occur if excess sediment were to occur that would reduce the capacity of the diversion channel so that the channel could not convey the runoff from the design storm event (the possible maximum precipitation (PMP) event). As the evaluation shows, the channel was designed and constructed to accommodate approximately 30 times the amount of sediment predicted from the slope above the riprap.

ISSUE 5

Areas of rill soil erosion on margin slopes between the diversion channel and the impoundment surface.

RESPONSE

Erosional stability of the margins is provided by vegetation and/or the inherent stability of the underlying quartz monzonite. A complete discussion of the erosional stability of the margins, including the results of the vegetation monitoring and the quartz monzonite mapping is included in the Monitoring and Stabilization Plan (MSP) completion report which is included in this submittal as Section 3. The monitoring, evaluation and discussion included in the MSP completion report concludes that the margin stability meets the performance objectives of WAC 246-252.

ISSUE 6

Area west (actually east as discussed during the September 7, 1999, site visit) (about 200 feet) of the impoundment outfall where gully soil erosion and deposition is occurring from southerly stormwater flow.

RESPONSE

There is a small area (approximately 3 acres) between the swale outlet and the margin, as shown on Figure 1, that drains to the south. This drainage configuration is consistent with the original design. As the regraded gentle slope transitions into the steeper natural topography, a small amount of gullying and general erosion is apparent. This erosion will not, however, impact the reclaimed tailing impoundment. Any head-cutting would be limited to the small drainage basin, which is at least 700 feet from the edge of the reclaimed tailing surface. Additionally, quartz monzonite bedrock is at or near the surface for much if not all of this small drainage basin and therefore any gullying would be limited to a depth of only a few inches.

ISSUE 7

Area immediately south and southwest of the impoundment outfall swale showing gully soil erosion and deposition from stormwater flow across the swale.

ISSUE 8

Gullies have developed at the toe of the outlet swale. In these areas, silty topsoil has eroded away and underlying quartz monzonite bedrock is exposed. Some of the quartz monzonite bedrock in the tailing impoundment area weathers quire readily when exposed, and other areas are quite resistant to weathering. The distinction between the two types of quartz monzonite was apparent during construction of the diversion channel because some quartz monzonite was readily ripped and some areas of quartz monzonite required blasting. Has the nature of the quartz monzonite underlying the toe of the outlet swale been characterized and documented? What construction features of the outlet swale would prevent shifting of the riprap (raveling), if the exposed quartz monzonite significantly weathers over time?

RESPONSE

Issues seven and eight are both in regards to the swale outlet and are therefore addressed together.

During the design of the surface reclamation it was determined that erosion could occur at the transition from the swale outlet and the steeper natural ground. It was recognized that this erosion could undercut the riprap at the swale outlet unless this area was designed and constructed to address undercutting. A rock filled toe trench at the end of the swale outlet was added to address this concern. The design of this toe trench was included in Appendix G of the Tailing Reclamation Plan, December 1994, WNI submittal and was included in the approved construction specifications and drawings. Documentation of the construction of the swale outlet including the toe trench was included in the Tailing Reclamation Plan (TRP) completion Report (WNI, 1997). A copy of the design documentation, the relevant portions of the construction specifications and drawings and the relevant portions of the TRP completion report are attached as Attachment C to this submittal.

As can be seen from the design report, erosion at the toe of the swale outlet was not only expected but the outlet toe trench was designed and constructed to address the concern of preventing this erosion from head-cutting into the swale outlet. Further, as presented in the design documentation, the toe trench was designed assuming the underlying material was loose sand. As discussed by WDOH, the toe trench is in quartz monzonite. Visual observations and pocket penetrometer test results indicate that the underlying quartz monzonite material is much more resistant to erosion than loose sand, which was assumed in the design. The pocket penetrometer results indicated an unconfined strength of less than 0.5 tons/ft^2 for the loose sand and greater than 4.5 tons/ft^2 for the quartz monzonite. However, regardless of the extra stability afforded by the underlying quartz monzonite, the swale outlet toe will be stable since it was designed assuming only loose sand.

ISSUE 9

There is a 150 ft^2 area at the southern transition from Confluence G, which lacks placement of large riprap. A geological evaluation appears to indicate that visible filter material overlies quartz monzonite. Has the underlying quartz monzonite been characterized and is it adequate to provide long-term stability to the riprap in this confluence?

ISSUE 10

There is an area approximately 10 feet by 15 feet at the downstream transition zone of Confluence G that is missing larger riprap (ie., 10"D_{50}) and only underlying filer material is visible.

RESPONSE

Issues nine and ten relate to the same area and are addressed together.

Additional riprap was placed in this area to cover the 10 x 15 foot area as agreed upon during the September 7 site visit. The riprap was placed on September 30, 1999 under WDOH staff direction and was then inspected and approved by WDOH.

ISSUE 11

In all confluences, except Confluence A, there are several random areas in which the large riprap is thin and segregated (not well graded) (i.e., not touching adjacent riprap, thus resulting in voids in the riprap layer, and less than 100% coverage) with the filter layer visible. While most of these random areas are 1 to 2 ft^2, some were noted as large as 5 to 6 ft^2.

RESPONSE

As decided upon during the September 7 site visit, these areas were remediated by adding additional rock. This work was done from September 27 through September 30 and in areas determined by WDOH. All work was under WDOH staff direction and was then inspected and approved by WDOH.

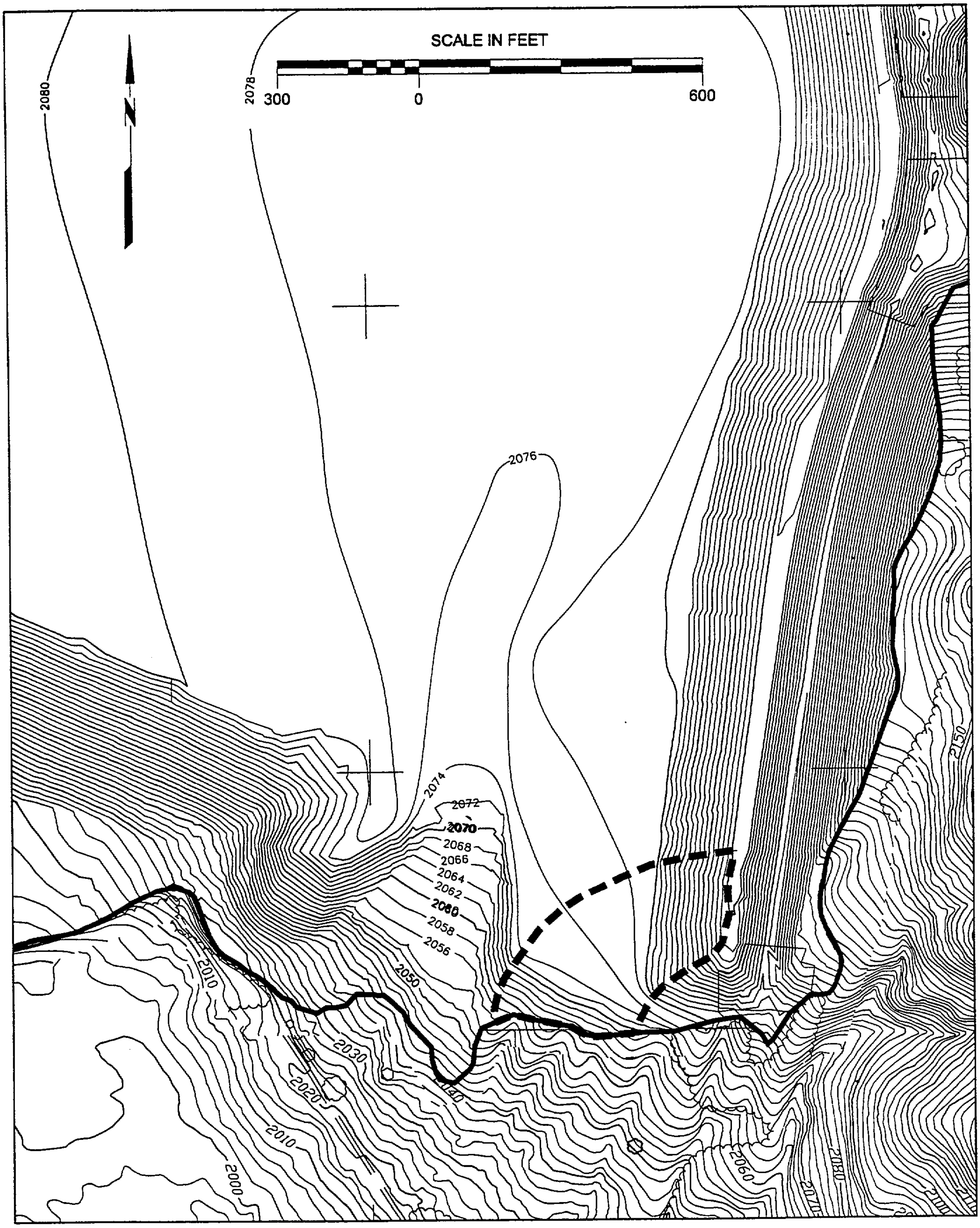
ISSUE 12

There is scarring (from equipment gouging) and compaction (rock imbedded into the filter) in small rock (i.e., 3" D_{50}) placement areas, predominantly in the smaller portion of the diversion channel on the west side of the impoundment.

RESPONSE

As with issue 11, all areas where additional rock was determined to be necessary was decided in the field with WDOH. The additional rock was placed from September 27 through September 30. All work was under WDOH staff direction and was then approved by WDOH.

Areas where construction traffic has imbedded the overlying riprap into the underlying filter were not modified. The erosional stability of these areas are not diminished as a result of the riprap being imbedded in the filter and in fact, the stability of the rock should be enhanced since the imbeddment will tend to stabilize the rock from any motion that might be induced by flowing water.



SHEPHERD MILLER
INCORPORATED

FIGURE 1

Date:	NOVEMBER 1999
Project:	03-317/1999
File:	FIG-1199-01.DWG

ATTACHMENT A.1

OCTOBER 11, 1999 LETTER FROM SMI TO WNI

SHEPHERD MILLER
INCORPORATED

October 11, 1999

SMI # 03317

Mr. Brad DeWaard
Western Nuclear, Inc.
P.O. Box 392
Wellpinit, Washington 99049

This letter is in response to your letter dated September 21, 1999 regarding surface stability inspection issues at the Sherwood project site. Specifically this letter presents the required design to address the regrading activities for Issue 1, the area immediately west of the reclaimed embankment and Issue 3, the reclaimed northwest borrow area.

Area west of the reclaimed embankment

The WDOH raised concern that the regrading in this area directs flow from an area immediately west of the southern portion of the reclaimed impoundment to the south and close to the rock lined groin along the west edge of the reclaimed embankment. Concern was raised that if this flow were deep enough it could flow into the groin area.

As discussed during our site inspection on September 7, 1999 this concern will be addressed by enlarging the existing drainage to the south to keep drainage water away from the groin area. This will be done by removing the existing rock in the drainage, excavating the subsoil material and replacing the existing rock. Figure 1 depicts a typical cross section of the reconfigured drainage.

Your letter suggested that regrading be done in the small drainage basin to direct flow towards the west and the roadway culvert. I disagree with performing any regrading in the drainage basin for two reasons. First, enlarging the existing drainage to the south will address the concern and thus regrading the drainage basin is not necessary. Additionally, this area has become revegetated and any regrading in the area will destroy the successful revegetation effort. Since enlarging the existing drainage addresses the concern and regrading the drainage basin will destroy the revegetation effort, regrading will not be done in this area. This is consistent with conversations I had with John Blacklaw of your office during our site visit of September 7.

Environmental & Engineering Consultants

3801 Automation Way, Suite 100
Fort Collins, CO 80525
Phone: (970) 223-9600
Fax: (970) 223-7171
www.shepmill.com

Reclaimed northwest borrow area

The WDOH raised concern that the existing bench on the reclaimed northwest borrow area would continue to contribute sediment to the diversion channel. To address this concern, the bench will be removed and the area will be regraded to a uniform slope. All disturbed areas will be reseeded with the same seed mixture that was used for all other disturbed areas outside of the tailing area. Erosion control netting (jute matting) will be installed over the disturbed area. This netting will insure erosional stability until the vegetation becomes established and will eliminate any need for any type of vegetation success criteria for this area. The netting will be installed in accordance with manufacturer's recommendations.

Both of these areas will be inspected and documented as part of the semi-annual surface stability inspection. If the inspector concludes that the areas have been constructed as designed, these issues will be considered successfully completed and closed.

Because of the short remaining construction season, we request that you give prompt concurrence to this design letter so that construction activities can be completed as soon as possible.

If you have any questions, please let me know as soon as possible.

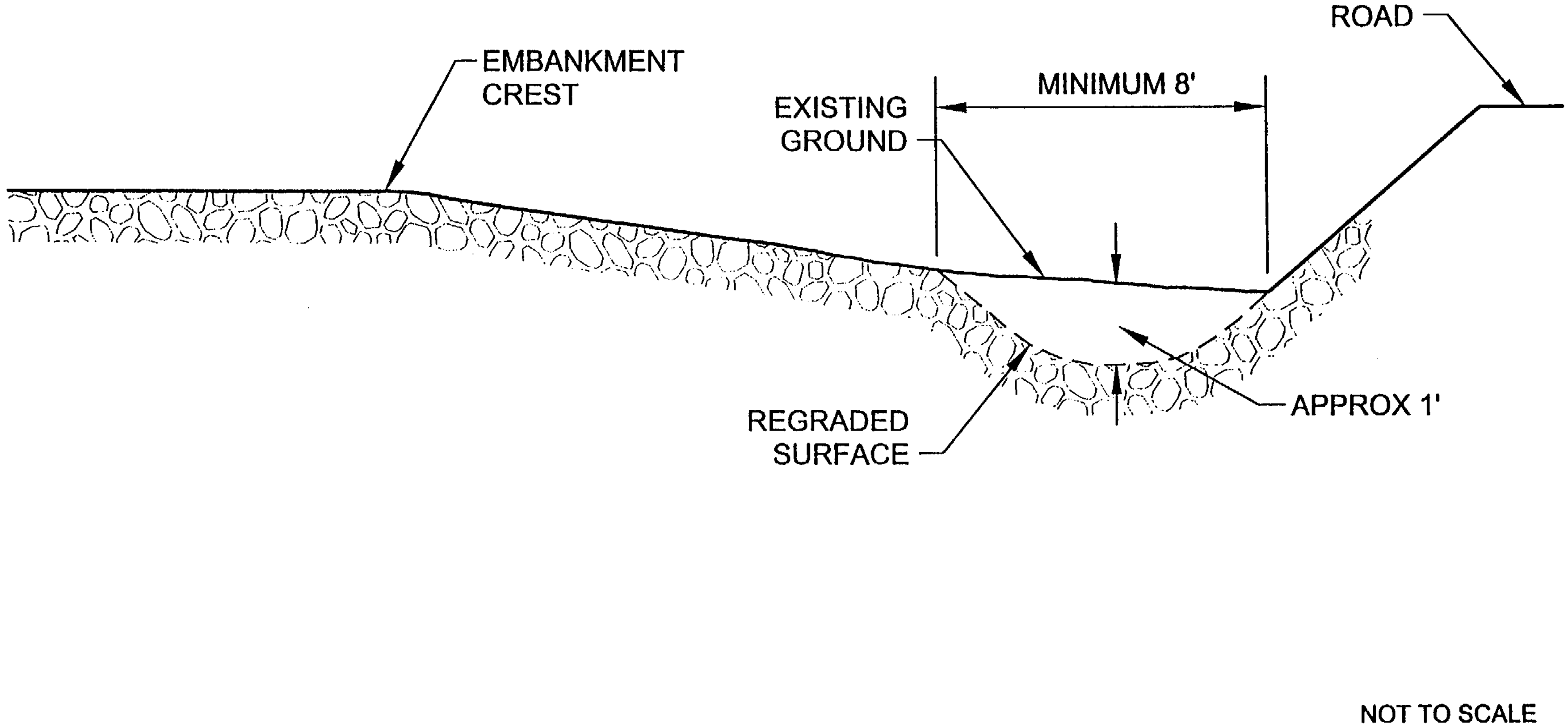
Sincerely,
SHEPHERD MILLER, INC.

Louis Miller

Louis Miller, PE
Vice President

Attachments

LOUIS L. MILLER
STATE OF WASHINGTON
27992
REGISTERED PROFESSIONAL ENGINEER
EXPIRES 5/1/00
10-11-99



SHEPHERD MILLER
INCORPORATED

FIGURE 1
TYPICAL CROSS SECTION

Date:	OCTOBER 1999
Project:	03-317
File:	XS-10-99.dwg

ATTACHMENT B

B.1 EVALUATION OF IMPACT OF RILLING ON DIVERSION CHANNEL

B.2 1995 SEDIMENT TRANSPORT ANALYSIS

B.3 DIVERSION CHANNEL CROSS SECTIONAL AREA VERIFICATION, TABLE 9 FROM: SHERWOOD TAILING RECLAMATION CONSTRUCTION COMPLETION REPORT

ATTACHMENT B.1

EVALUATION OF IMPACT OF RILLING ON DIVERSION CHANNEL

Introduction

Rilling has been observed on the slopes of the diversion channel above the riprap lined portion of the channel. The rilling is most evident on the long (approximately 100 ft) slopes above the riprap on the east side of the diversion channel east of the impoundment. These slopes exist between confluences and are in areas with shallow quartz monzonite bedrock. Inspection of the rills indicates that the depth of the rills is a maximum of approximately 2 inches and covers approximately 10% of the total area of the slope. The underlying quartz monzonite bedrock appears to be a stable base that limits deeper rilling.

Concern has been raised by WDOH regarding the impact of this rilling on the long-term performance of the diversion channel. Specifically, the WDOH has expressed concern that excess sediment could reduce the capacity of the channel to the point that the channel might overflow during the design storm event.

The following presents an estimate of the amount of sediment that might be expected from the worse case slope, and compares that to the capacity of the channel to accommodate sediment. The analysis concludes that the channel was designed and built to accommodate much more (approximately 30 times more) sediment than is expected from the slopes above the riprap.

Sediment Estimate

The longest slope was used to estimate the amount of sediment that might be generated from the channel slope above the riprap. This worse case slope is shown on Figure 1 and occurs at Station 13+00.

This slope has approximately 100 feet of slope above the ripraped portion of the channel. An estimate of the maximum amount of sediment that might be expected was made by assuming a total depth of rilling of 2 inches and assuming the rilling occurred over 50% of the slope. This yields a total of approximately 8 cubic feet of sediment per linear foot of channel. It is expected that native vegetation will become established over time and further limit future erosion. Therefore, assuming one-half of the slope will be eroded to a depth of 2 inches is a fairly conservative assumption.

Sediment Capacity in Channel

The design and construction of the diversion channel included provisions for sediment. Additionally, other inherent conservative assumptions led to oversizing the channel, which further enhances the ability of the channel to accommodate sediment. The following quantifies the extra capacity designed and built into the diversion channel.

A sediment transport analysis was performed (WNI, 1995). Applicable portions of this submittal are included as Attachment B. The results of that evaluation indicated that a maximum of approximately 1.6 feet of sediment would accumulate in the northern most confluence. Areas between the confluences, where the rilling has been observed, were predicted to have essentially no accumulated sediment. However, all portions of the diversion channel were designed assuming 2 feet of sediment in the bottom of the channel. Therefore, there is approximately 44 cubic feet per linear foot of channel of capacity that was designed for sediment. This volume is calculated using the 16 feet bottom width, a two foot depth and 3:1 side slopes.

The diversion channel was also designed to have one foot of freeboard. This yields approximately 140 cubic feet per linear foot of channel capacity to accommodate additional sediment. This volume is calculated using a bottom width of 16 feet, 3:1 side slopes and a total depth of flow of 20 feet with the freeboard from 20 to 21 feet.

As documented in the reclamation plan completion report (Table 9 from the Completion Report, which is attached as Attachment B.3), most of the diversion channel cross sections were built bigger than designed. The channel cross sections along the east side of the impoundment have cross sectional areas ranging from 50 to 100 square feet larger than designed. This indicates that at least 50 cubic feet per linear foot of channel capacity is available for sediment due to over-building the diversion channel.

The total extra capacity from these three design and construction features are approximately 235 cubic feet per linear foot of channel.

Results and Conclusions

As evaluated above, the amount of sediment that can be expected from the slopes above the ripraped portion of the diversion channel is approximately 8 cubic feet per linear foot of channel. The extra capacity of the channel to accommodate this sediment has been calculated to 235 cubic feet per linear foot of channel. It is clear that the amount of sediment that could be generated is only a small fraction of the total extra capacity of the channel. Therefore, the minor rilling observed on the slopes above the riprap will not impact the long-term performance of the diversion channel.

ATTACHMENT B.2

1995 SEDIMENT TRANSPORT ANALYSIS

03 317

SHERWOOD PROJECT
RESPONSES TO WDOH COMMENTS ON THE DECEMBER 1994 TAILING RECLAMATION PLAN

Prepared for

Western Nuclear, Inc.
Sherwood Mine
Wellpinit, Washington

Prepared by

Shepherd Miller Inc.
1600 Specht Point Drive, Suite F
Fort Collins, CO 80525

August 1995

SMI
Shepherd Miller, Inc.

1.4 Sediment Transport and Deposition Prediction

The Corps of Engineers' HEC-6 model (1993) is a sediment transport model which considers sediment inflow from tributaries, bed material conditions, and hydraulic conditions to predict on a cross section by cross section basis the change in bed elevation due to either scour or deposition. HEC-6 models changes on a cross section basis and therefore accounts for localized impacts such as sediment deltas. HEC-6 was used to model sediment transport in the diversion channel for the 10-year, 20-year, 50-year, 100-year, 200-year, 500-year and PMP storm events.

Basin sediment yield predicted by SEDCAD+ was input to the diversion channel for each storm event modeled. The grain size distribution of the watershed sands presented in Appendix D, Attachment E of the 12/94 TRP. was also input to the model. Resistance to flow of the diversion channel bed was selected assuming that trees would be present (Manning's n = 0.1). If a Manning's n value of 0.03, corresponding to the riprap condition, were to be used, flow velocities would increase and predicted sediment transport through the diversion channel would be greater. Therefore, the use of Manning's n of 0.1 is conservative.

HEC-6 is a steady state flow model which means that it analyzes a single discharge over a period of time. Since the diversion channel is designed for the peak PMF discharge, which is an instantaneous value, it is necessary to estimate a discharge that will be sustained for a reasonable period of time. The majority of the flood runoff during a PMF occurs during a three hour period. Therefore, the flood discharge used in the model was selected to occur for a three hour period spanning the time of the flood peak, such that the total volume of water is the same as that of the flood hydrograph. This is conservative, because use of a higher discharge would result in greater sediment transport and less deposition through the diversion channel.

HEC-6 allows the user to employ several different sediment transport functions. Seven functions were selected for evaluation under low and high sediment transport conditions. These seven, referred to in the HEC-6 manual and described in Vanoni (1975), were the Toffaleti (1966) function, Yang (1973) function, DuBoys (Brown, 1950) function, Colby (1964) function, Toffaleti (1966) and Schoklitsch (1930) combination function, Meyer-Peter and Müller (1948) function, and Madden's (1985, unpublished) modification of the Laursen (1958) function.

To determine which function to use in this report, analyses for the PMF were performed using all seven functions. The seven functions yielded comparable results with the highest value being only about 4 percent higher than the average of the seven functions. The Colby function yielded a value that was approximately equal to the average of the seven functions; therefore, the Colby function was used in the analysis of all storm events modeled. The function yielding the highest value (Toffaleti) could have been used; however, since it was only 4 percent higher than the the Colby function, the difference in the amount of sediment deposited would have been negligible.

Table 1.4 summarizes the increase in bed elevation for the three stations where the maximum amount of sediment deposition is predicted by HEC-6. Table 1.5 presents the accumulated sediment from all the storms selected to occur in 1000 years, and also includes the PMP sediment. The PMP sediment is included with that from the other storms because it is not known whether the PMP sediment will occur prior to, during, or after the peak water discharge. Inclusion of the PMP sediment conservatively assumes that the sediment accumulates before the peak water discharge occurs. Further conservatism exists because the analysis assumes that the PMP occurs at the end of the 1000-year period, after all the other storms have already occurred.

The results summarized in Table 1.5 indicate that an accumulation of sediment from 50 10-year, 30 20-year, 10 50-year, 5 100-year, 3 200-year and 2 500-year storms would result in no more than 0.12 feet of sediment in the diversion channel. This relatively minor amount of sediment deposition results from the difference between sediment inflows and sediment transported by diversion channel flows. This maximum sediment depth would occur at Cross Section 5000 at the north portion of the diversion channel. Combined with 1.40 feet of sediment deposited at this location during the PMF, a total of 1.52 feet of sediment is predicted by HEC-6 to accumulate at Cross Section 5000. HEC-6 results are included as Attachment 1.

TABLE 1.4 CHANNEL BED ELEVATION INCREASE (ft) AT SIGNIFICANT TRIBUTARY JUNCTIONS

Storm Event	Bed Elevation Increase (ft)		
	Cross Section 2000	Cross Section 4000	Cross Section 5000
10-year	0	0	0
20-year	0	0	0
50-year	0	0	0
100-year	0	0	0.01
200-year	0	0	0.01
500-year	0.01	0	0.02
PMP	0.49	0.27	1.40

TABLE 1.5 ACCUMULATED BED ELEVATION INCREASE AT CROSS SECTION 5000

Storm Event	Number of Events Occurring in 1000 years	Total Sediment Depth at Cross Section 5000 (ft)
10-year	50	0
20-year	30	0
50-year	10	0
100-year	5	0.05
200-year	3	0.03
500-year	2	0.04
PMP		1.40
	Total	1.52

The principal reason sediment settles onto the channel bed is the change in slope from the relatively steep tributaries (approximately 4 to 10 percent) to the relatively flat diversion channel (0.25 to 0.75 percent). All of the tributary water flow is carried within the diversion channel but the flatter slope in the diversion channel results in less sediment transport capacity than exists in the tributaries. HEC-6, like HEC-2, does not model infiltration through the channel bed because this is an insignificant proportion of the total flow amount, especially in large flood analyses.

The following section evaluates the impact on diversion channel capacity of sediment accumulation combined with the impact of vegetation growing in the channel. Modifications to the diversion channel design are presented in Section 5.

adjacent drainage area and possibly over the entire tailing surface area in order to prevent erosion of the radon attenuation barrier.

The adjacent drainage area that would contribute runoff to the tailing surface is about 694 acres. This area plus an additional 145 acres on the tailing impoundment would result in a PMF volume of about 608 acre-feet. This volume of runoff would pond to a maximum elevation of about 2076 feet assuming the impoundment top configuration shown on Figure 10 on Page R.2-41 of the 12/94 TRP. Since the lowest contour shown on Figure 10 on Page R.2-41 of the 12/94 TRP is 2057 feet, ponded water would be a maximum of 19 feet deep on the reclaimed tailing surface.

The duration of this ponding would be a concern as would sedimentation, settlement and groundwater impacts. The mean lake evaporation rate at the site is about 3 feet/year. This means that after the occurrence of a PMF, it would take a maximum of over 6 years to evaporate all of the water assuming no infiltration and no additional runoff from the 694 acre drainage area. Infiltration would reduce this duration but would possibly result in contaminants entering the groundwater in unacceptable amounts especially if the design of the radon cover is revised to an all sand cover to address WDOH's biointrusion and freeze/thaw impacts on the currently proposed clay cover. Another concern would be sediment deposition. Additional storage capacity would have to be provided on the tailing surface to allow for the sediment that would be deposited from the contributing 694 acre drainage area. This would require that the tailing embankment be maintained at a higher elevation than currently proposed in the 12/94 TRP. A higher embankment would result in larger riprap requirements for both the face of the embankment and groin areas at the toe. This alternative would not meet the requirements of Criterion 4 of WAC 246-252-030 which requires that the upstream rainfall catchment areas be minimized to decrease erosion potential and the size of floods which could erode or wash out sections of the tailings disposal area. Considering all of these potential problem areas, it is concluded that the proposed reclamation plan to allow flood waters to pond on the surface is not justified.

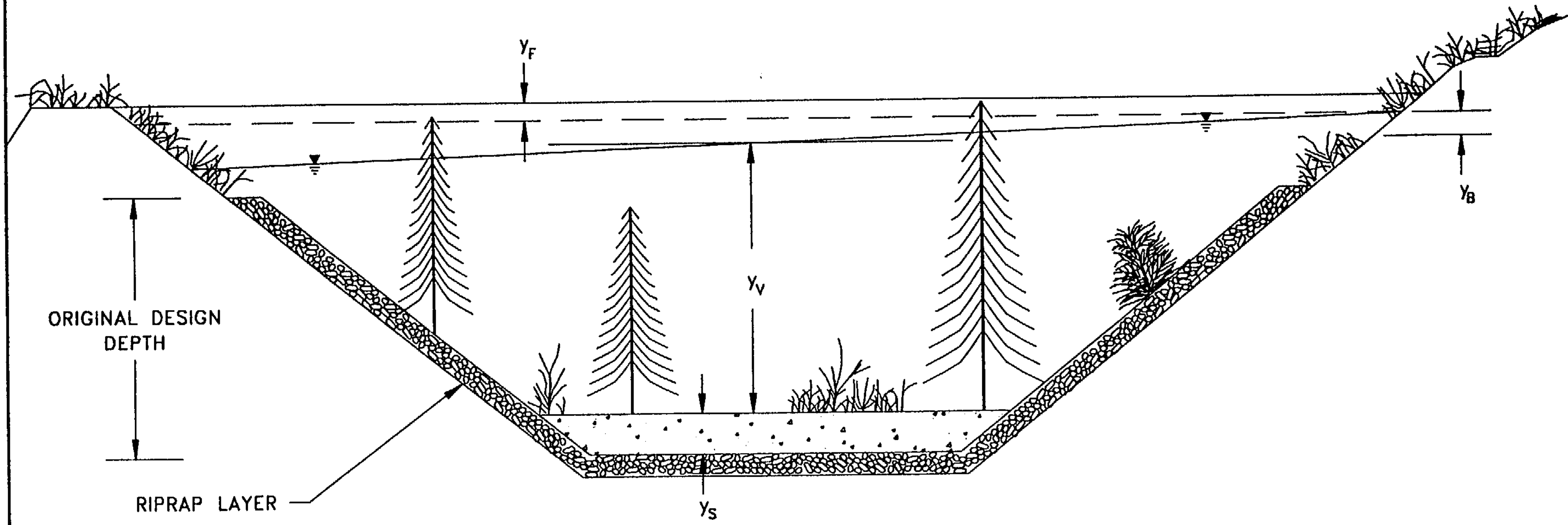
The potential costs of this WDOH proposal for an engineered percolation pond appear, then, to offset any benefits afforded by such a design. Further, other design options including the preferred option proposed in the 12/94 TRP, offer significantly enhanced benefits relative to those of the percolation pond.

5.0 DIVERSION CHANNEL DESIGN MODIFICATION

Since relocation or deletion of the diversion channel are not beneficial alternatives, modification to the diversion channel design in the 12/94 TRP, is proposed to ensure that the channel will contain 1) 2.0 feet of sediment deposited on the bed, 2) PMF flows through a vegetated channel as modeled by HEC-2 with Manning's n equal to

0.10, 3) superelevation, and 4) 1.0 foot of freeboard. The 1.0 foot of freeboard in addition to considerations for sediment, vegetation, and superelevation, is a final degree of conservatism and provides significant cross sectional area to the channel should it be needed. For example, at the downstream end of the channel, the depth is 22 feet and the top width is 140 feet wide. The cross sectional area in the upper 1-foot of channel is about 137 square feet. This area corresponds to a depth of over 5.8 feet at the bottom of the channel. Therefore, there could be as much as 5.8 feet of sediment in the channel and the PMF would still be contained within the channel freeboard.

Figure 5.1 shows the modified channel design schematically. The design of the diversion channel is proposed to be modified by increasing the amount of compacted fill on the berm between the channel and the tailings impoundment. Table 5.1 summarizes the changes in design depth for the channel, comparing channel depth as presented in the 12/94 TRP to the modified channel depth designed for sediment, vegetation and superelevation. Table 5.2 is a more detailed summary of the issues investigated in this response report.



y_S = SEDIMENT DEPTH
y_V = PMF DEPTH WITH VEGETATION IN CHANNEL
y_B = AMOUNT OT SUPERELEVATION AT BENDS
y_F = FREEBOARD = 1.0 FOOT

NOT TO SCALE

SHEPHERD MILLER INCORPORATED

FIGURE 5.1
DIVERSION CHANNEL
SCHEMATIC

Date:	MAY 1995
Project:	317/31
File:	DETAIL

TABLE 5.1
MODIFIED CHANNEL DEPTHS AND ELEVATIONS

COLUMN NO.	2	3	4	5	6	7	8
		TRP RESULTS, n=0.031 (NO SEDIMENT OR VEGETATION) 1)			MODIFIED RESULTS, n=0.1 (2 FT OF SEDIMENT AND VEGETATION)		
STATION	CHANNEL BOTTOM ELEV. (ft)	REQUIRED CHANNEL DEPTH (ft)	MINIMUM CHANNEL DEPTH PROPOSED (ft)	ELEVATION OF TOP OF RIPRAP (ft)	REQUIRED CHANNEL DEPTH 2) (ft)	MINIMUM CHANNEL DEPTH PROPOSED (ft)	PROPOSED ELEVATION OF TOP OF RIPRAP (ft)
0	2087.00	14.42	15.00	2102.00	21.43	22.00	2109.00
200	2087.50	14.42	15.00	2102.50	21.33	22.00	2109.50
400	2088.00	14.42	15.00	2103.00	21.42	22.00	2110.00
600	2088.50	14.42	15.00	2103.50	21.42	22.00	2110.50
800	2089.00	14.42	15.00	2104.00	21.44	22.00	2111.00
1000	2089.50	14.42	15.00	2104.50	21.44	22.00	2111.50
1200	2090.00	14.42	15.00	2105.00	21.53	22.00	2112.00
1400	2090.50	14.43	15.00	2105.50	21.52	22.00	2112.50
1600	2091.00	14.43	15.00	2106.00	21.52	22.00	2113.00
1800	2091.50	14.43	15.00	2106.50	21.44	22.00	2113.50
2000	2092.00	14.44	15.00	2107.00	21.41	22.00	2114.00
2200	2092.50	14.43	15.00	2107.50	21.38	22.00	2114.50
2400	2093.00	14.80	15.00	2108.00	21.31	22.00	2115.00
2600	2093.50	14.57	15.00	2108.50	21.16	22.00	2115.50
2800	2094.00	14.36	15.00	2109.00	21.08	22.00	2116.00
3000	2094.50	14.19	15.00	2109.50	20.95	21.00	2115.50
3200	2095.00	14.03	15.00	2110.00	20.77	21.00	2116.00
3400	2095.50	13.91	15.00	2110.50	20.67	21.00	2116.50
3600	2096.00	13.80	15.00	2111.00	20.58	21.00	2117.00
3800	2096.50	13.71	15.00	2111.50	20.59	21.00	2117.50
4000	2097.00	13.64	15.00	2112.00	20.52	21.00	2118.00
4200	2097.50	13.58	15.00	2112.50	20.33	21.00	2118.50
4400	2098.00	13.78	15.00	2113.00	20.27	21.00	2119.00
4600	2098.50	13.58	15.00	2113.50	20.11	21.00	2119.50
4800	2099.00	13.40	15.00	2114.00	19.97	20.00	2119.00
5000	2099.50	13.26	15.00	2114.50	19.83	20.00	2119.50
5200	2100.00	13.30	15.00	2115.00	19.68	20.00	2120.00
5400	2101.50	12.13	15.00	2116.50	18.51	19.00	2120.50
5600	2103.00	10.95	11.00	2114.00	17.42	18.00	2121.00
5800	2104.50	10.37	11.00	2115.50	16.59	17.00	2121.50
6000	2106.00	10.19	11.00	2117.00	16.08	16.00	2122.00
6200	2107.50	10.16	11.00	2118.50	15.65	16.00	2123.50
6400	2109.00	10.16	11.00	2120.00	15.22	16.00	2125.00
6600	2110.50	10.87	11.00	2121.50	14.71	15.00	2125.50
6800	2112.00	9.51	9.50	2121.50	13.61	14.00	2126.00
7000	2113.50	8.98	9.50	2123.00	12.71	13.00	2126.50
7200	2115.00	7.51	9.50	2124.50	11.30	12.00	2127.00
7400	2116.50	6.13	9.50	2126.00	9.98	10.00	2126.50
7600	2118.00	5.14	9.50	2127.50	8.87	10.00	2128.00
7800	2119.50	4.93	5.00	2124.50	8.15	9.00	2128.50
8000	2121.00	4.99	5.00	2126.00	7.83	8.00	2129.00
8200	2122.50	4.98	5.00	2127.50	7.72	8.00	2130.50
8400	2124.00	4.97	5.00	2129.00	7.56	8.00	2132.00
8600	2125.50	4.65	5.00	2130.50	7.34	8.00	2133.50
8800	2127.00	4.74	5.00	2132.00	6.59	8.00	2135.00

1) REFER TO ATTACHMENT B, APPENDIX D IN THE DECEMBER 1994 TRP.

2) INCLUDES SEDIMENT, VEGETATION, SUPERELEVATION AND 1.0 FOOT OF FREEBOARD. SEE TABLE 5.2.

TABLE 5.2

REQUIRED CHANNEL DEPTH FOR PMF ALLOWING FOR TREES GROWING IN CHANNEL, SEDIMENT DEPOSITION, AND SUPERELEVATION

STATION	CHANNEL BOTTOM ELEVATION	PMF ELEVATION[1] CHANNEL WITHOUT VEGETATION OR SEDIMENT (ft)	PMF ELEVATION[2] CHANNEL WITH TREES AND 2.0 FT. OF SEDIMENT (ft)	SUPER-ELEVATION (ft)	REQUIRED TOP OF CHANNEL ELEVATION[3] (ft)	MINIMUM CHANNEL DEPTH REQUIRED (ft)	RIGHT OVERBANK VELOCITY (ft/s)	CHANNEL DEPTH PROPOSED IN TRP (ft)	ADDITIONAL CHANNEL DEPTH REQUIRED (ft)	ADDITIONAL CHANNEL DEPTH PROPOSED (ft)
0 +00	2087.00	2100.42	2107.43	0.00	2108.43	21.43		15.0	6.4	7.0
1 +00	2087.25	2100.67	2107.63	0.00	2108.63	21.38		15.0	6.4	7.0
2 +00	2087.50	2100.92	2107.83	0.00	2108.83	21.33	1.5	15.0	6.3	7.0
3 +00	2087.75	2101.17	2108.13	0.00	2109.13	21.38		15.0	6.4	7.0
4 +00	2088.00	2101.42	2108.42	0.00	2109.42	21.42	1.5	15.0	6.4	7.0
5 +00	2088.25	2101.67	2108.67	0.00	2109.67	21.42		15.0	6.4	7.0
6 +00	2088.50	2101.92	2108.92	0.00	2109.92	21.42	1.5	15.0	6.4	7.0
7 +00	2088.75	2102.17	2109.17	0.00	2110.17	21.42	1.5	15.0	6.4	7.0
8 +00	2089.00	2102.42	2109.44	0.00	2110.44	21.44		15.0	6.4	7.0
9 +00	2089.25	2102.67	2109.69	0.00	2110.69	21.44		15.0	6.4	7.0
10 +00	2089.50	2102.92	2109.94	0.00	2110.94	21.44	1.5	15.0	6.4	7.0
11 +00	2089.75	2103.17	2110.19	0.09	2111.28	21.53		15.0	6.5	7.0
12 +00	2090.00	2103.42	2110.44	0.09	2111.53	21.53	1.5	15.0	6.5	7.0
13 +00	2090.25	2103.68	2110.69	0.09	2111.78	21.53		15.0	6.5	7.0
14 +00	2090.50	2103.93	2110.93	0.09	2112.02	21.52	1.5	15.0	6.5	7.0
15 +00	2090.75	2104.18	2111.18	0.09	2112.27	21.52		15.0	6.5	7.0
16 +00	2091.00	2104.43	2111.43	0.09	2112.52	21.52	1.5	15.0	6.5	7.0
17 +00	2091.25	2104.68	2111.69	0.00	2112.69	21.43		15.0	6.4	7.0
18 +00	2091.50	2104.93	2111.94	0.00	2112.94	21.44	1.5	15.0	6.4	7.0
19 +00	2091.75	2105.19	2112.18	0.00	2113.18	21.43		15.0	6.4	7.0
20 +00	2092.00	2105.44	2112.41	0.00	2113.41	21.41	1.0	15.0	6.4	7.0
21 +00	2092.25	2104.69	2112.65	0.00	2113.65	21.40		15.0	6.4	7.0
22 +00	2092.50	2103.93	2112.88	0.00	2113.88	21.38		15.0	6.4	7.0
23 +00	2092.75	2105.37	2113.12	0.00	2114.12	21.37	1.4	15.0	6.4	7.0
24 +00	2093.00	2106.80	2113.31	0.00	2114.31	21.31		15.0	6.3	7.0
25 +00	2093.25	2106.94	2113.50	0.00	2114.50	21.25	1.2	15.0	6.3	7.0
26 +00	2093.50	2107.07	2113.66	0.00	2114.66	21.16		15.0	6.2	7.0
27 +00	2093.75	2107.22	2113.84	0.06	2114.90	21.15		15.0	6.2	7.0
28 +00	2094.00	2107.36	2114.02	0.06	2115.08	21.08	1.3	15.0	6.1	7.0
29 +00	2094.25	2107.53	2114.21	0.06	2115.27	21.01		15.0	6.0	6.0
30 +00	2094.50	2107.69	2114.39	0.06	2115.45	20.95	1.3	15.0	5.9	6.0
31 +00	2094.75	2107.86	2114.58	0.00	2115.58	20.83		15.0	5.8	6.0
32 +00	2095.00	2108.03	2114.77	0.00	2115.77	20.77	1.3	15.0	5.8	6.0
33 +00	2095.25	2108.22	2114.97	0.00	2115.97	20.72		15.0	5.7	6.0
34 +00	2095.50	2108.41	2115.17	0.00	2116.17	20.67	1.3	15.0	5.7	6.0
35 +00	2095.75	2108.36	2115.38	0.00	2116.38	20.63		15.0	5.6	6.0
36 +00	2096.00	2108.30	2115.58	0.00	2116.58	20.58	1.3	15.0	5.6	6.0
37 +00	2096.25	2108.76	2115.79	0.00	2116.79	20.54		15.0	5.5	6.0
38 +00	2096.50	2109.21	2116.00	0.09	2117.09	20.59	1.3	15.0	5.6	6.0
39 +00	2096.75	2109.43	2116.22	0.09	2117.31	20.56		15.0	5.6	6.0
40 +00	2097.00	2109.64	2116.43	0.09	2117.52	20.52	1.2	15.0	5.5	6.0
41 +00	2097.25	2112.08	2116.63	0.09	2117.72	20.47		15.0	5.5	6.0
42 +00	2097.50	2110.08	2116.83	0.00	2117.83	20.33		15.0	5.3	6.0
43 +00	2097.75	2116.95	2117.03	0.00	2118.03	20.28	1.3	15.0	5.3	6.0
44 +00	2098.00	2110.78	2117.27	0.00	2118.27	20.27	1.1	15.0	5.3	6.0

1 PMF ELEVATIONS FROM PAGES D.B-27 TO D.B-29 OF ATTACHMENT B TO APPENDIX D OF THE DECEMBER 1994, TRP.

2 PMF ELEVATIONS FROM HEC-2 ANALYSIS IN ATTACHMENT 1 OF THESE RESPONSES.

3 TOP OF CHANNEL ELEVATION IS EQUAL TO THE SUM OF THE PMF ELEVATION WITH TREE GROWTH, 2.0 FEET OF SEDIMENT, 1 FOOT OF FREEBOARD, AND SUPERELEVATION.

TABLE 5.2 (continued)

REQUIRED CHANNEL DEPTH FOR PMF ALLOWING FOR TREES GROWING IN CHANNEL, SEDIMENT DEPOSITION, AND SUPERELEVATION

STATION	CHANNEL BOTTOM ELEVATION	[1] PMF ELEVATION CHANNEL WITHOUT VEGETATION OR SEDIMENT (ft)	[2] PMF ELEVATION CHANNEL WITH TREES AND 2.0 FT. OF SEDIMENT (ft)	SUPER-ELEVATION (ft)	[3] REQUIRED TOP OF CHANNEL ELEVATION (ft)	MINIMUM CHANNEL DEPTH REQUIRED (ft)	RIGHT OVERBANK VELOCITY (ft/s)	CHANNEL DEPTH PROPOSED IN TRP (ft)	ADDITIONAL CHANNEL DEPTH REQUIRED (ft)	ADDITIONAL CHANNEL DEPTH PROPOSED (ft)
45 +00	2098.25	2110.93	2117.44	0.00	2118.44	20.19		15.0	5.2	6.0
46 +00	2098.50	2111.08	2117.61	0.00	2118.61	20.11	1.1	15.0	5.1	6.0
47 +00	2098.75	2111.24	2117.78	0.00	2118.78	20.03	1.1	15.0	5.0	5.0
48 +00	2099.00	2111.40	2117.97	0.00	2118.97	19.97		15.0	5.0	5.0
49 +00	2099.25	2111.58	2118.15	0.00	2119.15	19.90	1.1	15.0	4.9	5.0
50 +00	2099.50	2111.76	2118.33	0.00	2119.33	19.83		15.0	4.8	5.0
51 +00	2099.75	2112.03	2118.50	0.00	2119.50	19.75		15.0	4.8	5.0
52 +00	2100.00	2112.30	2118.68	0.00	2119.68	19.68	1.0	15.0	4.7	5.0
53 +00	2100.75	2112.47	2118.85	0.00	2119.85	19.10		15.0	4.1	5.0
54 +00	2101.50	2112.63	2119.01	0.00	2120.01	18.51	1.2	15.0	3.5	4.0
55 +00	2102.25	2112.79	2119.22	0.00	2120.22	17.97		15.0	*3.0	4.0
56 +00	2103.00	2112.95	2119.42	0.00	2120.42	17.42	1.1	11.0	6.4	7.0
57 +00	2103.75	2113.41	2119.76	0.00	2120.76	17.01		11.0	6.0	6.0
58 +00	2104.50	2113.87	2120.09	0.00	2121.09	16.59	1.0	11.0	5.6	6.0
59 +00	2105.25	2114.53	2120.53	0.00	2121.53	16.28		11.0	5.3	6.0
60 +00	2106.00	2115.19	2120.97	0.09	2122.06	16.06	1.0	11.0	5.1	6.0
61 +00	2106.75	2115.93	2121.52	0.09	2122.61	15.86		11.0	4.9	5.0
62 +00	2107.50	2116.66	2122.06	0.09	2123.15	15.65	0.9	11.0	4.7	5.0
63 +00	2108.25	2117.41	2122.64	0.09	2123.73	15.48		11.0	4.5	5.0
64 +00	2109.00	2118.16	2123.22	0.00	2124.22	15.22	1.7	11.0	4.2	5.0
65 +00	2109.75	2119.27	2123.72	0.00	2124.72	14.97		11.0	4.0	4.0
66 +00	2110.50	2120.37	2124.21	0.00	2125.21	14.71	0.8	11.0	3.7	4.0
67 +00	2111.25	2120.42	2124.38	0.00	2125.38	14.13	0.9	11.0	3.1	4.0
68 +00	2112.00	2120.51	2124.61	0.00	2125.61	13.61	0.9	9.5	4.1	4.0
69 +00	2112.75	2120.64	2124.90	0.00	2125.90	13.15	0.8	9.5	3.7	4.0
70 +00	2113.50	2121.48	2125.21	0.00	2126.21	12.71	0.2	9.5	3.2	4.0
71 +00	2114.25	2121.49	2125.25	0.00	2126.25	12.00	0.2	9.5	2.5	3.0
72 +00	2115.00	2121.51	2125.30	0.00	2126.30	11.30	N/A	9.5	1.8	2.0
73 +00	2115.75	2121.55	2125.38	0.00	2126.38	10.63	0.3	9.5	1.1	1.0
74 +00	2116.50	2121.63	2125.48	0.00	2126.48	9.98	0.3	9.5	0.5	1.0
75 +00	2117.25	2121.79	2125.63	0.00	2126.63	9.38	N/A	9.5	0.0	0.0
76 +00	2118.00	2122.14	2125.87	0.00	2126.87	8.87	N/A	9.5	0.0	0.0
77 +00	2118.75	2122.79	2126.25	0.00	2127.25	8.50		9.5	0.0	0.0
78 +00	2119.50	2123.43	2126.63	0.02	2127.65	8.15	N/A	5.0	3.2	3.0
79 +00	2120.25	2124.21	2127.22	0.02	2128.24	7.99		5.0	3.0	3.0
80 +00	2121.00	2124.99	2127.81	0.02	2128.83	7.83	N/A	5.0	2.8	3.0
81 +00	2121.75	2125.74	2128.52	0.02	2129.54	7.78		5.0	2.8	3.0
82 +00	2122.50	2126.48	2129.22	0.00	2130.22	7.72	N/A	5.0	2.7	3.0
83 +00	2123.25	2127.23	2129.89	0.00	2130.89	7.64	N/A	5.0	2.6	3.0
84 +00	2124.00	2127.97	2130.56	0.00	2131.56	7.56		5.0	2.6	3.0
85 +00	2124.75	2128.56	2131.20	0.00	2132.20	7.45		5.0	2.4	3.0
86 +00	2125.50	2129.15	2131.84	0.00	2132.84	7.34		5.0	2.3	3.0
87 +00	2126.25	2129.95	2132.22	0.00	2133.22	6.97		5.0	2.0	2.0
88 +00	2127.00	2130.74	2132.59	0.00	2133.59	6.59	1.5	5.0	1.6	2.0

1 PMF ELEVATIONS FROM PAGES D.B-27 TO D.B-29 OF ATTACHMENT B TO APPENDIX D OF THE DECEMBER 1994, TRP.

2 PMF ELEVATIONS FROM HEC-2 ANALYSIS IN ATTACHMENT 1 OF THESE RESPONSES.

3 TOP OF CHANNEL ELEVATION IS EQUAL TO THE SUM OF THE PMF ELEVATION WITH TREE GROWTH, 1.5 FEET OF SEDIMENT, 1 FOOT OF FREEBOARD, AND SUPERELEVATION.

ATTACHMENT B.3

DIVERGENT CHANNEL CROSS SECTION AREA VERIFICATION,

TABLE 9 FROM: SHERWOOD TAILING RECLAMATION CONSTRUCTION COMPLETION REPORT.

Prepared For:

WESTERN NUCLEAR, INC.
SHERWOOD PROJECT
Wellpinit, Washington

SHERWOOD TAILING RECLAMATION

CONSTRUCTION COMPLETION REPORT

VOLUME 1 of 3

Prepared By:

SHEPHERD MILLER, INC.
Fort Collins, Colorado

JUNE 1997

Table 9 - DIVERSION CHANNEL CROSS SECTIONAL AREA VERIFICATION

Diversion Channel Station Number	Riprapped Cross-Sectional Area			Total Channel Cross-Sectional Area		
	As-Built (ft^2)	Design (ft^2)	Difference (ft^2)	As-Built (ft^2)	Design (ft^2)	Difference (ft^2)
1+04	Unlimited area due to field fit. Note: riprap installed to required level.					
2+00	791.1	783.0	8.1	1779.6	1615	164.6
3+00	789.6	783.0	6.6	1668.4	1615	53.4
4+00	813.0	783.0	30.0	1692.6	1615	77.6
5+00	813.0	783.0	30.0	1691.4	1615	76.4
6+00	799.4	783.0	16.4	1679.7	1615	64.7
7+00	792.2	783.0	9.2	1667.7	1615	52.7
8+00	784.9	783.0	1.9	1695.4	1615	80.4
9+00	806.8	783.0	23.8	1709.4	1615	94.4
10+00	792.7	783.0	9.7	1680.2	1615	65.2
11+00	807.9	783.0	24.9	1693.4	1615	78.4
12+00	807.5	783.0	24.5	1700.7	1615	85.7
13+00	789.1	783.0	6.1	1685.8	1615	70.8
14+00	792.1	783.0	9.1	1674.5	1615	59.5
15+00	793.0	783.0	10.0	1678.1	1615	63.1
16+00	CONFLUENCE "G", VARIABLE AREAS *					
17+00	CONFLUENCE "G", VARIABLE AREAS *					
18+00	CONFLUENCE "G", VARIABLE AREAS *					
19+00	CONFLUENCE "G", VARIABLE AREAS *					
20+00	800.0	783.0	17.0	1736.2	1615	121.2
21+00	CONFLUENCE "F", VARIABLE AREAS *					
22+00	CONFLUENCE "F", VARIABLE AREAS *					
23+00	CONFLUENCE "F", VARIABLE AREAS *					
24+00	CONFLUENCE "F", VARIABLE AREAS *					
25+00	793.1	783.0	10.1	1696.1	1615	81.1
26+00	820.0	783.0	37.0	1736.3	1615	121.3
27+00	824.1	783.0	41.1	1707.8	1615	92.8
28+00	815.4	783.0	32.4	1701.4	1615	86.4
29+00	808.2	783.0	25.2	1562.8	1478	84.8
30+00	794.4	783.0	11.4	1539.2	1478	61.2
31+00	CONFLUENCE "F2", VARIABLE AREAS *					
32+00	CONFLUENCE "F2", VARIABLE AREAS *					
33+00	CONFLUENCE "F2", VARIABLE AREAS *					
34+00	804.8	783.0	21.8	1543.4	1478	65.4
35+00	787.2	783.0	4.2	1530.4	1478	52.4
36+00	863.2	783.0	80.2	1643.0	1478	165.0
37+00	790.7	783.0	7.7	1524.2	1478	46.2
38+00	842.1	783.0	59.1	1585.1	1478	107.1
39+00		CONFLUENCE "E", VARIABLE AREAS *				
40+00		CONFLUENCE "E", VARIABLE AREAS *				
41+00	806.9	783.0	23.9	1544.2	1478	66.2
42+00	812.6	783.0	29.6	1549.5	1478	71.5

* See section 2.3.2.3 and Figure 4.

Table 9 - DIVERSION CHANNEL CROSS SECTIONAL AREA VERIFICATION

Diversion Channel Station Number	Riprapped Cross-Sectional Area			Total Channel Cross-Sectional Area		
	As-Built (ft^2)	Design (ft^2)	Difference (ft^2)	As-Built (ft^2)	Design (ft^2)	Difference (ft^2)
43+00	802.8	783.0	19.8	1535.2	1478	57.2
44+00	804.0	783.0	21.0	1538.6	1478	60.6
45+00	CONFLUENCE "E1", VARIABLE AREAS *					
46+00	CONFLUENCE "E1", VARIABLE AREAS *					
47+00	CONFLUENCE "E1", VARIABLE AREAS *					
48+00	CONFLUENCE "D", VARIABLE AREAS *					
49+00	CONFLUENCE "D", VARIABLE AREAS *					
50+00	CONFLUENCE "D", VARIABLE AREAS *					
51+00	CONFLUENCE "D", VARIABLE AREAS *					
52+00	CONFLUENCE "D", VARIABLE AREAS *					
53+00	804.5	783.0	21.5	1422.7	1347	75.7
54+00	796.4	783.0	13.4	1272.9	1223	49.9
55+00	821.9	783.0	38.9	1317.9	1223	94.9
56+00	468.7	439.0	29.7	1241.4	1104	137.4
57+00	447.2	439.0	8.2	1202.6	1104	98.6
58+00	454.5	439.0	15.5	1075.8	991	84.8
59+00	442.0	439.0	3.0	1050.1	991	59.1
60+00	448.3	439.0	9.3	939.1	884	55.1
61+00	449.6	439.0	10.6	941.8	884	57.8
62+00	447.8	439.0	8.8	957.3	884	73.3
63+00	481.0	439.0	42.0	996.2	884	112.2
64+00	CONFLUENCE "C", VARIABLE AREAS *					
65+00	CONFLUENCE "C", VARIABLE AREAS *					
66+00	539.6	439.0	100.6	910.3	783	127.3
67+00	488.4	439.0	49.4	882.8	783	99.8
68+00	CONFLUENCE "B", VARIABLE AREAS *					
69+00	CONFLUENCE "B", VARIABLE AREAS *					
70+00	344.2	335.0	9.2	631.6	599	32.6
71+00	338.3	335.0	3.3	628.0	599	29.0
72+00	346.2	335.0	11.2	544.2	516	28.2
73+00	342.9	335.0	7.9	540.6	516	24.6
74+00	340.7	335.0	5.7	377.0	368	9.0
75+00	352.0	335.0	17.0	388.5	368	20.5
76+00	338.6	335.0	3.6	375.8	368	7.8
77+00	373.3	335.0	38.3	411.2	368	43.2
78+00	127.8	104.0	23.8	381.0	304	77.0
79+00	135.8	104.0	31.8	407.0	304	103.0
80+00	122.8	104.0	18.8	304.1	245	59.1
81+00	CONFLUENCE "A", VARIABLE AREAS *					
82+00	CONFLUENCE "A", VARIABLE AREAS *					
83+00	CONFLUENCE "A", VARIABLE AREAS *					
84+00	115.6	104.0	11.6	315.5	245	70.5

* See section 2.3.2.3 and Figure 4.

Table 9 - DIVERSION CHANNEL CROSS SECTIONAL AREA VERIFICATION

Diversion Channel Station Number	Riprapped Cross-Sectional Area			Total Channel Cross-Sectional Area		
	As-Built (ft^2)	Design (ft^2)	Difference (ft^2)	As-Built (ft^2)	Design (ft^2)	Difference (ft^2)
85+00	121.3	104.0	17.3	286.9	245	41.9
86+00	117.9	104.0	13.9	339.6	245	94.6
87+00	197.6	104.0	93.6	509.6	245	264.6
88+00	256.4	104.0	152.4	658.5	245	413.5
89+00	253.7	104.0	149.7	**		
90+00	208.9	104.0	104.9	**		

* See section 2.3.2.3 and Figure 4.
*Area above the riprap is very large due to flat terrain.

ATTACHMENT C

DRAINAGE SWALE OUTLET DESIGN: CONSTRUCTION DOCUMENTATION

C.1 DIVERSION CHANNEL AND SWALE APRON DETAIL (DESIGN DRAWING)

C.2 TAILING COVER SWALE OUTLET DESIGN (APPENDIX G, ATTACHMENT C TO 12/94 TAILINGS RECLAMATION PLAN)

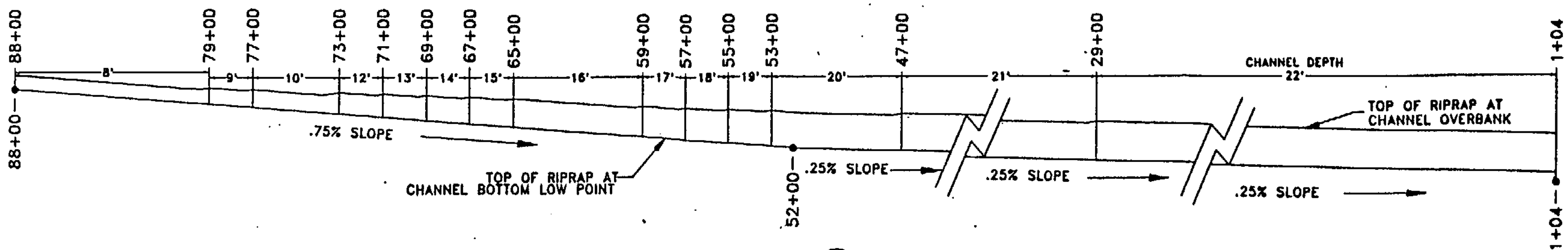
C.3 FIGURES C.1, C.2, C.3 FROM APPENDIX G, ATTACHMENT C TO 12/94 TAILING RECLAMATION PLAN

C.4 SECTION 2.3.5.1 SWALE OUTLET DESIGN REQUIREMENTS FROM SHERWOOD TAILING RECLAMATION CONSTRUCTION COMPLETION REPORT.

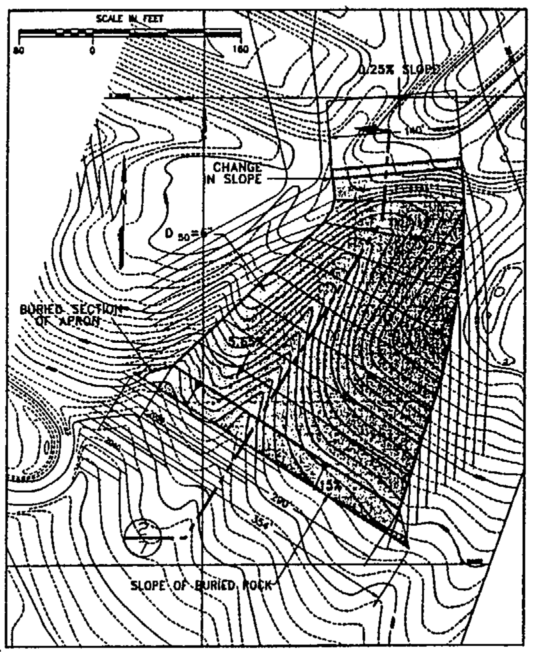
C.5 APPENDIX O, EROSIONAL STABILITY OF TAILING IMPOUNDMENT SWALE FOR THE AS-BUILT CONDITIONS FROM SHERWOOD TAILING RECLAMATION CONSTRUCTION COMPLETION REPORT.

ATTACHMENT C.1

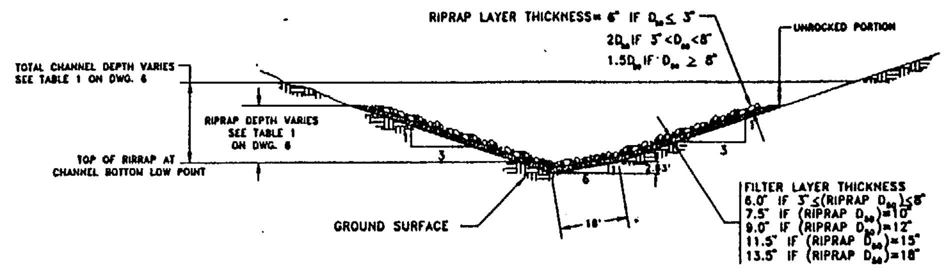
DIVERSION CHANNEL AND SWALE APRON DETAIL (DESIGN DRAWING)



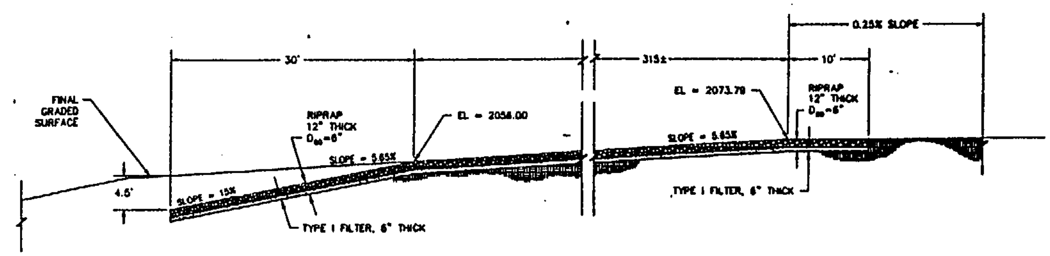
3/7 DIVERSION CHANNEL PROFILE
NOT TO SCALE



1/7 PLAN VIEW OF TAILING COVER SWALE OUTLET
NOT TO SCALE



4/7 DIVERSION CHANNEL TYPICAL CROSS SECTION
NOT TO SCALE



2/7 CROSS-SECTION OF TAILING COVER SWALE OUTLET
NOT TO SCALE

SWA-DET.DWG
11-13-93

NO	DESCRIPTION	BY	CHKD	APPROVED		DATE
1	REVISED TO REFLECT REALIGNED CHANNEL	SLS	ROG	LLM		11/95
2	UPDATED CHANNEL ALIGNMENT PROFILE	MLG	ROG	LLM		4/96
3	MODIFY SWALE ELEVATION	BRJ	ROG	LLM		8/96

REVISIONS

DRAWING NO.	DRAWING TITLE

DESIGNERS

ENGINEERING RECORD	BY	DATE

PREPARED BY
SMI
SHEPHERD MILLER, INC.

PREPARED FOR
WNI
WESTERN NUCLEAR, INC.

TITLE
DIVERSION CHANNEL
AND
SWALE APRON DETAILS

317 | DEC, 1994 | 7 | 3
1" = 20' | SWA-DET.DWG

Rev 4

ATTACHMENT C.2

TAILING COVER SWALE OUTLET DESIGN (APPENDIX G, ATTACHMENT C TO 12/94 TAILINGS RECLAMATION PLAN)

ATTACHMENT C
TAILING COVER SWALE OUTLET DESIGN

The tailing cover swale outlet was analyzed as a non-circular culvert, using the Department of Transportation Method (DOT, 1983) for calculating scour as recommended by the NRC STP (1990). The design was a three step process. This process is outlined below.

1. Determine depth and width of scour that could occur at the swale outlet as a result of the PMF.

2. Determine the dimensions of the apron necessary to prevent scour from impacting the erosional stability of the swale.

3. Determine the necessary rock size for the apron.

STEP 1:
This method required the determination of several parameters. The duration of the peak discharge (t) was conservatively estimated to be 15 minutes. This was derived from the hydrograph for the channel outlet using the HEC-1 model. This hydrograph is presented on Figure C.1 of this Attachment.

The swale outlet apron has two regions of different slope. The upper region has a slope of approximately four percent and an initial width of approximately 140 feet. The lower region has an initial width of 290 feet and a slope of 9.7 percent. Both regions were evaluated for scour and appropriate rock size.

The natural soil in the area is assumed to consist of soil represented by the SC-2 soil composite (presented in Appendix A). Based on the grain size curve, SC-2 soil is classified for purposes of determining the maximum gully depth as graded sand. Values (α_e, β, θ) for depth and width of scour are provided in Table V-1 of the DOT (1983) Method for graded sand (see Appendix D, Attachment E). The values used are listed below.

Material Identification: Graded Sand	Depth β	θ	α_e
Depth	0.85	0.07	0.75
Width	0.76	0.06	4.78
Length	0.41	0.04	12.62

Because the outlet of the swale is classified as a noncircular culvert, the diameter D is replaced by an equivalent depth y_e, where y_e is defined as:

$$y_e = \left[\frac{A}{2}\right]^{1/2}$$

where A is the cross-sectional area of flow.

Substituting equivalent depth and the values obtained in Table V-1 (DOT, 1983 pg. V-11) into the dimensionless equations listed below, the depth (h_s), width (W_s), and length (L_s) of scour were determined.

$$\frac{h_s}{y_e} = \alpha_e \left[\frac{Q}{\sqrt{g}\ y_e^{5/2}}\right]^{\beta} \left[\frac{t}{t_o}\right]^{\theta}$$ **Depth of Scour**

$$\frac{W_s}{y_e} = \alpha_e \left[\frac{Q}{\sqrt{g}\ y_e^{5/2}}\right]^{\beta} \left[\frac{t}{t_o}\right]^{\theta}$$ **Width of Scour**

$$\frac{L_s}{y_e} = \alpha_e \left[\frac{Q}{\sqrt{g}\ y_e^{5/2}}\right]^{\beta} \left[\frac{t}{t_o}\right]^{\theta}$$ **Length of Scour**

where:

Q = Discharge (627 cfs obtained in HEC-1 output)
g = acceleration of gravity (32.2 ft/s^2)
y_e = equivalent depth for noncircular culverts (upper apron: 5.84 ft; lower apron: 5.91 ft)
t = time in minutes of duration of peak discharge (15 min.)
t_o = experimental time base = 316 min. (DOT, 1983 pg. V-2)
α, β, θ are obtained in Table V-1 (DOT, 1983 pg. V-11)

The results of these analyses have determined that the maximum depth, width, and length of scour for the upper apron are 4.5 ft, 29.0 ft, and 73.6 feet, respectively. The maximum depth, width, and length of scour for the lower apron were determined to be 4.5 ft., 28.7 ft., and 73.6 ft, respectively. The location of the maximum depth of scour is 0.4(L_s) which is equal to approximately 30 feet from the initiation of the 9.7 percent slope.

STEP 2:

After the depth, width, and length of the largest possible scour hole have been determined, the dimensions of the apron are derived. These dimensions include the width and the angle of flare for the apron. These dimensions were determined as suggested by the Department of Transportation (DOT, 1983 pg. V-6) using the following equations:

$$\theta = \tan^{-1}\left[\frac{1}{3Fr}\right]$$ **Angle of Flare**

$$W = Wo + 2L\tan\theta$$ **Downstream width**

Where W_o is the initial width of the channel, L is the length of the apron, and Fr is the Froude Number at the outlet of the channel.

The length the lower apron was determined to be approximately 30 feet based on the estimated location of maximum scour depth. As shown in Figure C.3, the apron will extend from the initiation of the four percent slope to approximately 30 feet below the initiation of the 9.7 percent slope. The riprap will be installed at a 4H:1V slope and backfilled with native materials to the pre-existing 9.7 percent surface slope. This length will prevent erosion from "headcutting" and impacting the erosional stability of the swale under PMF conditions.

The maximum scour into the sand material is calculated to be 4.5 feet under PMF conditions. The depth to top of the riprap apron will be at least 4.5 feet at a distance of 30 feet from the initiation of the 9.7 percent slope or to bedrock, whichever is less.

A plan view and a cross section of the apron are shown on Figures C.2 and C.3.

STEP 3

After the dimensions of the apron were established, the necessary rock size for the apron was determined. The rock was sized using the CSU method (Abt et. al, 1988). This is a procedure developed to determine rock sizes for large flows over slopes ranging up to 20%. The slope of the upper apron is approximately 4 % and the slope of the lower apron is approximately 25 % (4H:1V). A median rock size (D_{50}) of 3.6 inches was calculated for the upper apron and a D_{50} of 5.2 inches was calculated for the lower apron. A D_{50} of 6 inches will be used for both apron regions due to lower cost of producing this rock size. The 6 inch rock will be used downstream of the slope change and a distance of 10 feet upstream from the initiation of the upper apron. Details of the apron are shown on Figures C.2 and C.3. Filter type I, described in Appendix H, will be installed below the riprap at a thickness of one-half the size of the riprap.

REFERENCES:

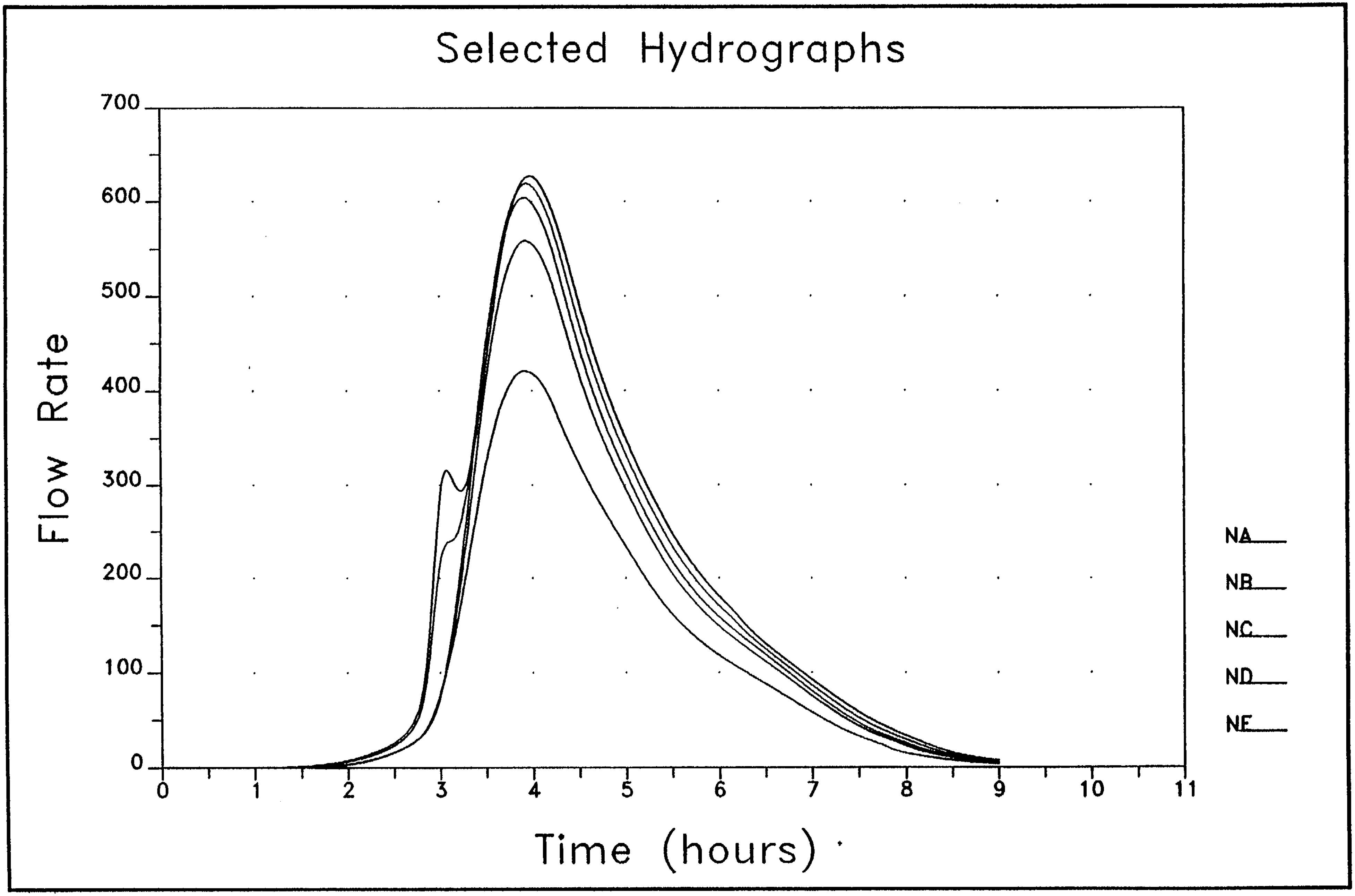
Abt, S.R., et al. "Development of Riprap Design Criteria by Riprap Testing in Flumes: Phase II," NUREG/CR-4651. Vol 2, 1988.

U.S. Department of Transportation (DOT), "Hydraulic Design of Energy Dissipators for Culverts and Channels", Hydraulic Engineering Circular No.14, September 1983.

U.S. Nuclear Regulatory Commission (NRC), "Final Staff Technical Position Design of Erosion Protection Covers for Stabilization of Uranium Mill Tailing Sites," 1990.

ATTACHMENT C.3

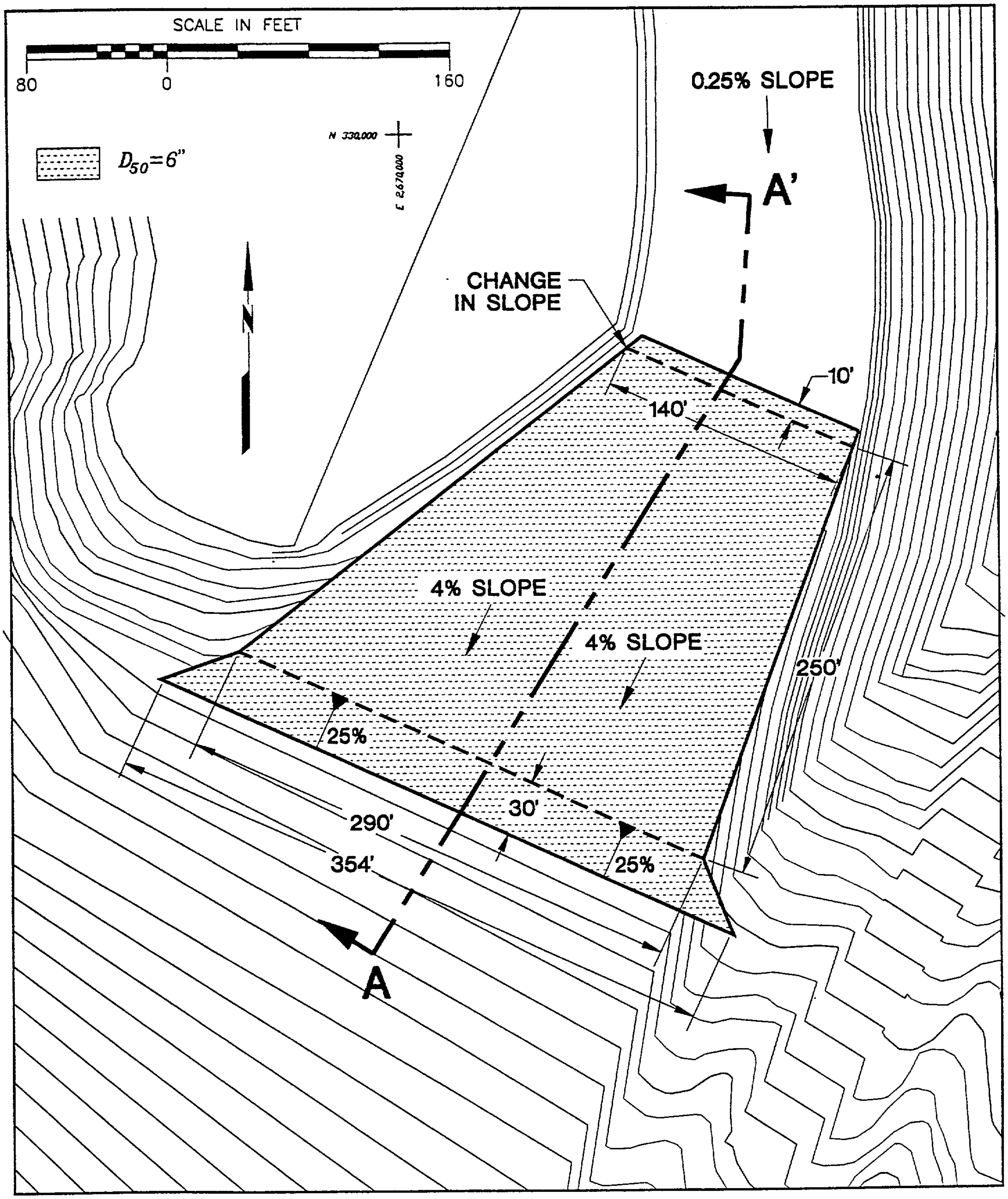
FIGURES C.1, C.2, C.3 FROM APPENDIX G, ATTACHMENT C TO 12/94 TAILINGS RECLAMATION PLAN



SMI
SHEPHERD MILLER, INC.

FIGURE C.1
ROUTED HYDROGRAPHS FOR
TAILING COVER SWALE

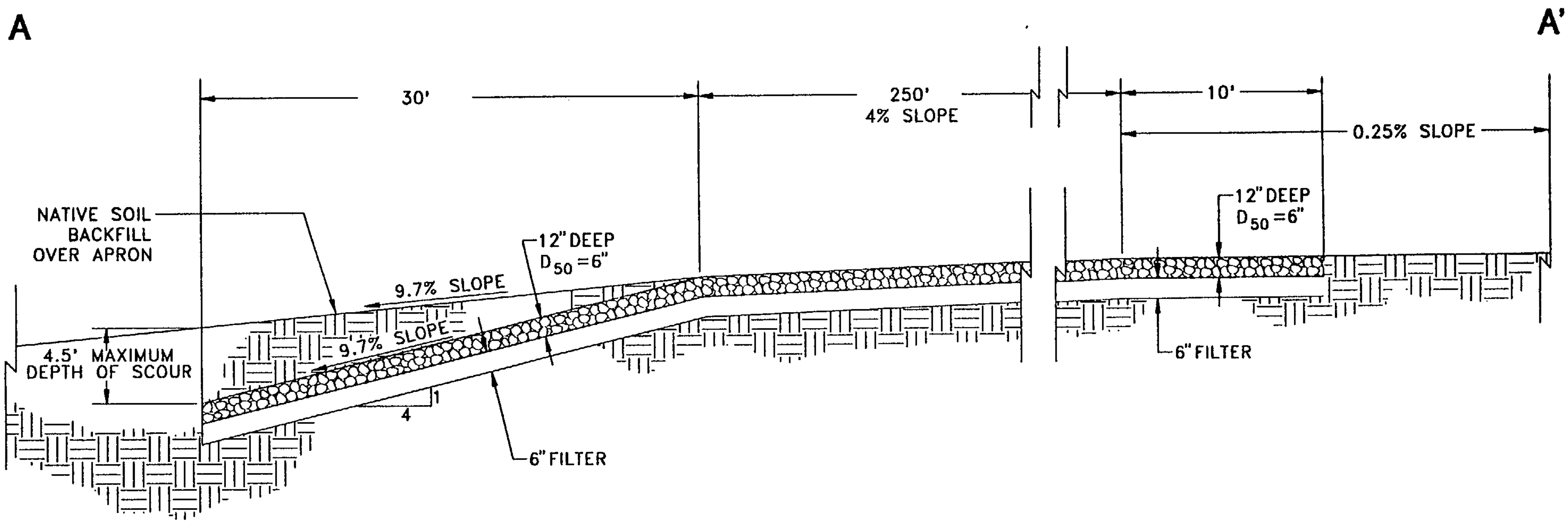
Date:	DEC., 1994
Project:	317
File:	SURF-1



SMI
SHEPHERD MILLER, INC.

FIGURE C.2
TAILING COVER SWALE
PLAN VIEW OF OUTLET

Date:	DEC., 1994
Project:	317\T31
File:	APRONXS1



SMI
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FIGURE C.3
TAILING COVER SWALE OUTLET
CROSS SECTION A–A'

Date:	DEC., 1994
Project:	317\T31
File:	APRONXS2

ATTACHMENT C.4

SECTION 2.3.5.1 SWALE OUTLET DESIGN REQUIREMENTS FROM SHERWOOD TAILING RECLAMATION CONSTRUCTION COMPLETION REPORT.

Section 5.2.1 of the Technical Specifications. Gradation test results also indicated compliance with the Technical Specifications.

2.3.4.4 Embankment Outslope Groin Filter and Riprap

Riprap and filter material was placed along the contact between the west side of the embankment toe and natural ground (groin). The placed riprap size, the filter type, and the thickness of the riprap and filter are presented in Table 17. Table 17 also presents the design requirements for the riprap and filter. As can be seen, the riprap sizes placed are equal to or larger than required. The filter material placed is consistent with the size of overlying riprap, and the thickness of riprap and filter are equal to or greater than required. Rock durability and gradation testing results are presented in Section 2.1.7. All durability tests performed in riprap used in the groin areas indicated a rating of 80 or higher as required in Section 5.2.1 of the Technical Specifications. The gradation test results also indicated compliance with the Technical Specifications.

2.3.5 Swale Outlet

2.3.5.1 Design Requirements

The outlet of the swale shall be protected with riprap and filter material to control erosion. The design requirements for the swale outlet are presented in Section 5, Tables 2A and 2B, and Drawing 7 of the Technical Specifications. Specifically, the design requirements are as follows:

1. The swale outlet shall have the dimensions and slopes as detailed on Drawing 7 of the Technical Specifications.
2. The riprap and filter gradations, thickness, and durability requirements are specified in Section 5.0, Table 2A, Table 2B, and Drawing 7 of the Technical Specifications.

2.3.5.2 Swale Outlet Dimensions and Slopes

The slopes, length, width, and depth of the buried apron portion of the swale outlet were determined by surveying and measuring the swale outlet. The as-built and design dimensions and slopes are presented in Table 18. As can be seen, the swale outlet dimensions and slopes are essentially the same as the design, with the exception of the length and slope of the swale outlet apron.

Analysis shows that the as-built conditions provide the level of erosional protection assumed in the design. Evaluation of the as-built conditions is provided in Appendix O.

2.3.5.3 Swale Outlet Filter and Riprap

Filter and riprap material were placed in accordance with the requirements of the technical specifications. Riprap with a minimum (D_{50}) size of 6 inches and type I Filter were used throughout. Durability test results for these materials are presented in Section 2.1.7. The durability test results indicated that all riprap placed in the swale apron had a rating of 80 or greater. The gradation test results indicated compliance with the Technical Specifications.

The thicknesses of the filter and riprap were measured at four locations. The results of the measurements, along with the required thicknesses, are presented in Table 19. As can be seen, all thickness measurements are equal to or greater than design requirements.

ATTACHMENT C.5

APPENDIX O, EROSIONAL STABILITY OF TAILING IMPOUNDMENT SWALE FOR THE AS-BUILT CONDITIONS FROM SHERWOOD TAILING RECLAMATION CONSTRUCTION COMPLETION REPORT.

APPENDIX O

EROSIONAL STABILITY OF TAILING IMPOUNDMENT SWALE FOR AS-BUILT CONDITIONS

EROSIONAL STABILITY OF AS-BUILT TAILING IMPOUNDMENT SWALE OUTLET

1.0 PURPOSE

Drawing 7 of the WDOH approved Technical Specifications presents plan and profile views of the Tailing Cover Impoundment Swale Outlet. That drawing indicates that the buried apron of the outlet requires a slope of 15%, a scour depth of 4.5 ft and a length of 30 ft. A survey of the finished swale outlet structure has indicated dimensions that vary somewhat from the Drawing 7 dimensions.

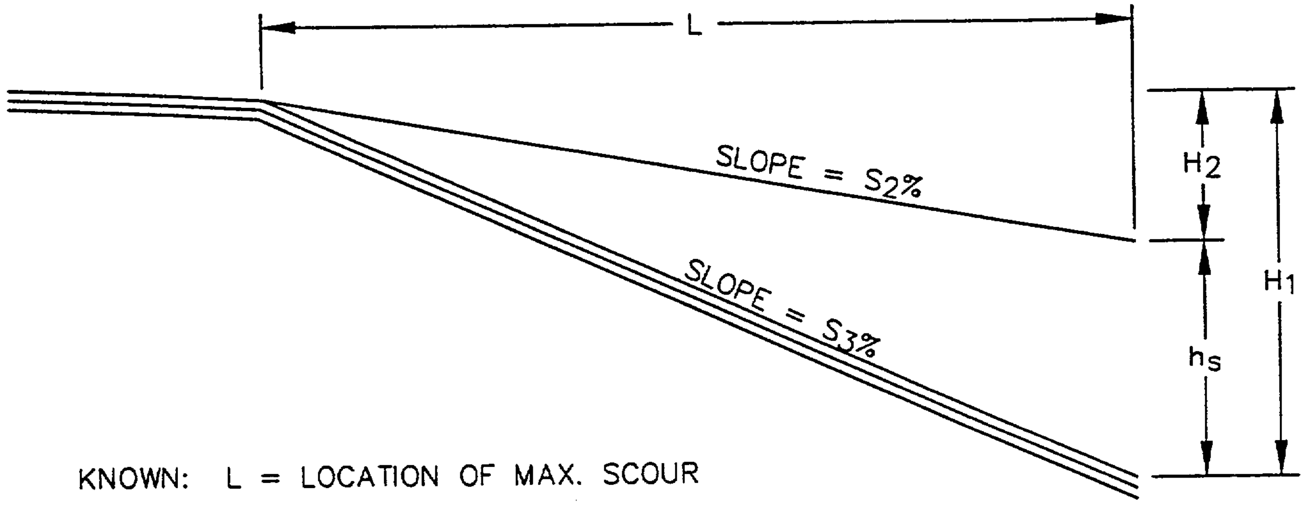
The purpose of this Appendix is to discuss how the design of the swale outlet evolved from the 12/94 TRP to the construction level design and to evaluate the erosional stability of the As-Built tailing swale outlet apron. Table O-1 provides a comparison of the design and the As-Built dimensions for the outlet apron.

Table O-1 Comparison of Design and As-Built Tailing Swale Apron Dimensions

Feature	Design in April 1996 Technical Specifications	Design in WDOH Approved November 1996 Technical Specifications	As-Built
Length (ft)	30	30	23.3
Scour Depth (ft)	4.5	4.5	4.5
Width (ft)	290	290	290.1
Slope of native ground (%)	9.7	5.65	5.65
Slope of buried riprap (%)	25	21[a]	24.8

(a) The design slope in Drawing 7 of the WDOH approved November, 1996 Technical Specifications is shown as 15%. This slope was calculated by dividing the scour depth h_s (4.5 ft) by the length (L)(30 ft). This value is incorrect because as shown in Figure O-1, the slope is equal to the depth H_1 divided by L. As discussed below the correct slope is 21%.

As illustrated in Figure O-1, the slope of the tailing swale apron (S_3) is equal to the depth H_1 divided by the length L. However, since the value of H_1 is not known, it is necessary to derive an equation for S_3 in terms of the ground slope S_2 and the scour depth h_s which are known values. The equation as derived on Figure O-1 is as follows:



KNOWN: L = LOCATION OF MAX. SCOUR

h_s = DEPTH OF MAX. SCOUR = 4.5 FT.

S_2 in% = GROUND SURFACE

$$S_3 \text{ in\%} = \frac{H_1}{L}(100)$$

SOLVE FOR S_3 IN TERMS OF S_2 AND h_s WHICH ARE KNOWN VALUES

$$\frac{H_1}{L}(100) = \frac{S_3 \text{ in\%}}{100}, \quad \text{so } H_1 = \frac{(S_3 \text{ in\%})(L)}{100},$$

$$\frac{H_2}{L}(100) = \frac{S_2 \text{ in\%}}{100}, \quad \text{so } H_2 = \frac{(S_2 \text{ in\%})(L)}{100},$$

$$h_s = H_1 - H_2$$

$$h_s = \frac{(S_3 \text{ in\%})(L)}{100} - \frac{(S_2 \text{ in\%})(L)}{100}$$

$$\frac{100hs}{L} = (S_3 \text{ in\%}) - (S_2 \text{ in\%})$$

$$\therefore S_3 \text{ in\%} = \frac{100hs}{L} + S_2 \text{ in\%}$$

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FIGURE O-1
SHERWOOD PROJECT
TAILINGS SWALE OUTLET APRON SLOPE

Date:	JUNE 1997
Project:	03-319
File:	SWALE-1

$$S_3(\%) = \left[\frac{100h_s}{L}\right] + S_2(\%) \qquad \text{Equation 1}$$

The swale apron slope is shown in Drawing 7 of the November 1996 Technical Specifications as 15%. This value is in error because as stated in the footnote in Table O-1, an incorrect depth was used in the slope calculation. Using the equation above results in a correct slope of 21%.

$$S_3(\%) = \left[\frac{(100)(4.5)}{30}\right] + 5.65$$

$$S_3 = 21\%$$

In preparing the Construction Drawings, all three swale apron designs summarized above were reviewed. The decision was made at that time that the apron slope should be as was initially in the April 1996 Technical Specifications (25%). This required a change in the length (L) of the apron. This revised L was calculated by rearranging Equation 1 above to solve for L. The resultant equation was as follows:

$$L = \left[\frac{100h_s}{S_3(\%)-S_2(\%)}\right] \qquad \text{Equation 2}$$

$$L = \left[\frac{(100)(4.5)}{25-5.65}\right]$$

$$L = 23\ feet$$

Based on a comparison of several tailing swale apron designs it is concluded that there are no significant differences between the November 1996 Technical Specification design and the As-Built since the differences in dimensions are within acceptable construction practices. The greatest differences are the apron slope (Technical Specifications [24%] verses As-Built [21%]) and the length (Technical Specifications [30 ft] verses As-Built [23.3]). Based on this comparison, it is further concluded that the As-Built tailing impoundment swale apron is erosionally stable.

ATTACHMENT B

FALL 1999

STABILITY REPORT

Sheila Pachernegg, P.E.
Post Office Box 128
Spokane, WA 99210
phone/fax: 509-624-1160

November 15, 1999

Western Nuclear, Inc.
Attn: Mr. Brad DeWaard
P. O. Box 358
Elijah Road
Wellpinit, WA 99040

RE: FALL 1999 INSPECTION REPORT
SHERWOOD PROJECT
RECLAIMED TAILING IMPOUNDMENT AREA

This letter report documents the results of the Fall 1999 structural stability inspection of the Western Nuclear, Inc. (WNI) Sherwood Tailing Impoundment Area Reclamation Project.

Scope of Inspection

The Fall 1999 inspection was conducted on November 3 and 12, 1999 in accordance with guidance summarized in **Section 2.3**, *Structural Stability Monitoring of the Monitoring and Stabilization Plan, Sherwood TRP* (March 1997); and revisions to the inspection transects, which were approved via license amendment number #32. The revised inspection transects allow for visual observation of all reclamation components and potential areas of instability. This report addresses only the structural stability portion of the *Monitoring and Stabilization Plan* (MSP). The other components of the MSP, groundwater and vegetation monitoring, are addressed by WNI in separate reports.

In accordance with the *WNI Monitoring and Stabilization Plan* and revised transects, the areas of inspection included:

- Tailing impoundment surface cover, swale, and outlet;
- Drainage diversion channel (including west drainage area), confluences, and outlet;
- Tailing impoundment margins;

- Tailing embankment and groin;
- Additional areas of previous disturbance;

Although the watershed drainage basin surrounding the reclaimed tailing impoundment was not directly inspected in Fall 1999 (in accordance with the revised transects), it is presumed that any significant impacts within the watershed drainage basin would be detected in the side drainages, diversion channel confluences, and/or the reclaimed tailing impoundment margins.

Where applicable, elements of the reclamation design were visually inspected for new occurrences or changes in: rill development, settlement, gullying, head-cutting, slumping, erosion and deposition, loss of erosion protection material, and man-made or animal impacts which may adversely affect erosion protection performance or compromise the stability and integrity of the reclamation design elements. Although evaluation and monitoring of the vegetative cover is outside the scope and intent of these inspections, information collected from the structural stability inspections is shared with the vegetation stability inspector.

A site map and photographic documentation are provided as Attachment A to this inspection report. Observations and conclusions were verbally transmitted to Brad DeWaard prior to leaving the site at the end of the inspection to serve as 24-hour notification to the owner.

The inspection resulted in **no corrective action requirements** to maintain overall stability and integrity of the reclamation design elements. The following summarizes the scope of the Fall 1999 inspection and field observations.

Field Observations

Prior to conducting the Fall 1999 inspection, correspondence and documentation related to surface regrading issues and proposed plans of action for the area west of the reclaimed embankment and reclaimed northwest borrow area were reviewed. These specific areas were inspected on November 3, 1999, accompanied by Brad DeWaard; and the remaining structural stability inspection was completed on November 12, 1999.

Inspection of the site on November 12, 1999 was conducted during overcast and rainy weather conditions, with unseasonably warm temperatures. Field observations are summarized in the following and resulted in **no corrective action requirements** to maintain reclamation design element stability. Refer to Attachment A of this inspection report for the transect locations and photographic documentation (note that the date on the photographs is incorrectly recorded as November 13, 1999):

- **Tailing impoundment surface cover, swale and outlet:**

  No changes from previous inspections were observed in the tailing impoundment surface cover other than continued improvements in re-vegetation. The previously observed settlement area is drier (contains less impounded water than noted during the Spring 1999 inspection). **This area does not pose a structural stability problem** (refer to photo documentation numbers 1, 2, 3, and 4).

  As noted in all previous inspection reports, rills and gullies (exposing bedrock) are still observed near the outlet, which is over 2,000 feet from the reclaimed tailings area (refer to the site map and photo documentation numbers 5 through 10 in Attachment A). With the exceptions of continuing stabilization by vegetation, minor occurrences of ponding and spring seepage along the margins (photo documentation numbers 8 and 9), and drier conditions no changes were observed in the area since the Spring 1999 inspection. **No corrective action** is required to maintain reclamation design element stability.

- **Drainage diversion channel (including west drainage area), confluences, and outlet:**

  As observed during previous inspections in the northwestern portion of the impoundment area, accumulation of sediment in the drainage diversion channel resulting from concentrated stormwater flow (gully) has to date resulted in **no corrective actions** to maintain reclamation design element stability. However, this area has recently undergone regrading and erosion control measures as documented in:

  > *WN-I0133-1: License Condition 37: Sherwood Monitoring and Stabilization Plan Inspection Results and Resolution of 2 Surface Regrading Issues, Submission of Regrading Designs for Approval*, October 11, 1999; and
  >
  > *WN-I0133-1: License Condition 37; Sherwood Monitoring and Stabilization Plan Inspection; Regrading As-built Report for Two Surface Regrading Issues*, (Attachment B).

Based upon all previous inspections, there has been no demonstrated need for completing this corrective action. There continues to be no indications that the drainage and conveyance functions of the system have changed or degraded since the Spring 1999 inspection (or previous inspections). The repair work was completed in accordance with the October 11, 1999 design and as documented in the November 1, 1999 report (refer to photo documentation numbers 11, 12, and 13 in Attachment A). **No corrective action** is required to maintain reclamation design element stability.

The drainage diversion channel outlet (refer to photo documentation numbers 14 and 15) has downcut an established gully that has been observed during previous inspections. Steady improvement continues to be observed, with increased density of vegetation dispersing the flow and subsequently reducing downcutting effects. This area is outside the reclamation boundaries, but it is noted that no adverse impacts require corrective action to maintain reclamation design element stability.

The rock armoring throughout the site has exhibited no visually observable degradation (due to weathering) that would adversely impact the function of the various reclamation components, including the conveyance and erosional protection capabilities of the drainage diversion channel. Additionally, any observed irregularities in the armor related to thickness, rock size, void spaces, and infiltration of sediment are considered to be insignificant and require **no corrective action** to maintain conveyance function of the drainage diversion channel and reclamation design element stability (refer to photo documentation numbers 16 through 22 in Attachment A).

The west drainage area has also undergone some regrading (refer to photo documentation numbers 23 and 24 in Attachment A), in accordance with:

> *WN-I0133-1: License Condition 37: Sherwood Monitoring and Stabilization Plan Inspection Results and Resolution of 2 Surface Regrading Issues, Submission of Regrading Designs for Approval,* October 11, 1999; and
>
> *WN-I0133-1: License Condition 37; Sherwood Monitoring and Stabilization Plan Inspection; Regrading As-built Report for Two Surface Regrading Issues* (Attachment B).

Although previous inspections have not indicated the need to complete this corrective action, the repair work is in accordance with the October 11, 1999 design and as documented in the November 1, 1999 report. **No corrective action** is required to maintain reclamation design element stability.

- **Tailing impoundment margins**

  As discussed in previous inspection reports, some rills and gullies are still observed on tailing impoundment margins and in many of the disturbed area slopes above the drainage diversion channel and confluences. Soils transported during the rilling process are invading the rock armoring on the slope toes. This is considered to be beneficial by allowing vegetation to reclaim the slope from both the crown and toe. The magnitude and frequency of occurrences are becoming less apparent as vegetative cover continues to increase in density. Slopes with exposed bedrock and/or poor soil development are still relatively barren of vegetation. However, they exhibit no evidence of structural instability (refer to photo documentation numbers 25 through 30 in Attachment A). A monitoring well abandonment area is shown in photo documentation number 31.

  During the Fall 1999 inspection, there were no observable changes in the frequency, magnitude, and locations of rills and gullies from observations during previous inspections. **No corrective action** is required to maintain reclamation design element stability.

- **Tailing embankment and groin:**

  There is no evidence of slumping, erosion of the rock armoring, or gullying. This is consistent with all previous inspections (refer to photo documentation numbers 32, 33, and 34). **No corrective action** is required to maintain reclamation design element stability.

- **Watershed drainage basin surrounding the reclaimed tailing impoundment:**

  During the Fall 1999 inspection, there was no evidence of significant impacts or changes within the watershed drainage basin exhibited along the reclaimed tailing impoundment margins, side drainages, and confluences within the drainage diversion channel. **No corrective action** is required to maintain reclamation design element stability.

Conclusions

- No corrective actions are required, based upon field observations during the Fall 1999 inspection.

- No significant changes in erosional features were observed at the site between the Spring and Fall 1999 inspections.

- As required by WDOH, the area west of the impoundment near the tailing embankment and site access road and the area of gully erosion upgradient of the silt collection point in the diversion channel have undergone corrective actions since the Spring 1999 inspection. These areas have been repaired in accordance with the October 11, 1999 design and as documented in the as-built reports. To date (and based upon all previous inspections at the site), no corrective actions have been recommended to maintain reclamation design element stability.

- The rock armoring throughout the site has exhibited no visually observable degradation (due to weathering) that would adversely impact the function of the various reclamation components, including the conveyance and erosional protection capabilities of the drainage diversion channel. Additionally, any observed irregularities in the armor related to thickness, rock size, void spaces, and infiltration of sediment are considered to be insignificant and do not compromise the conveyance function of the drainage diversion channel and reclamation design element stability.

- Although rill and gully erosional features are still observed along the margins and in previously disturbed areas, there were no observable changes in the frequency, magnitude, and locations of rilling and gullies from observations during previous inspections. These erosional features continue to show improvement, especially in areas having increased density of vegetative cover.

- Slopes with exposed bedrock and/or poor soil development are still relatively barren of vegetation. However, there are no observable changes from previous inspections; and these slopes exhibit no evidence of structural instability.

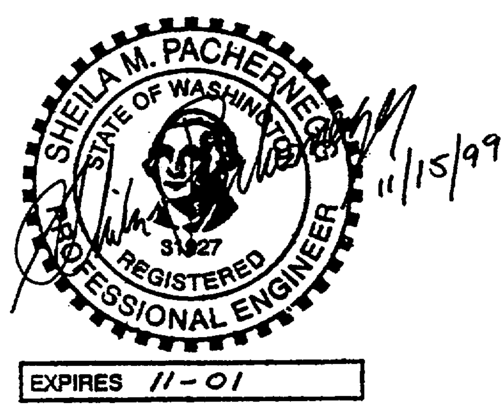
- Based on the results of this inspection and the four previous inspections (Fall 1997, Spring 1998, Fall 1998, and Spring 1999), the post-construction structural stability aspects of the reclamation indicate the site is performing as designed. As such, no future structural stability monitoring as part of the MSP is necessary.

Please contact me at 509-624-1160 if you have any questions or require clarifications related to this inspection report.

Sincerely,

Sheila Pachernegg, P.E.

Attachments (2)



Attachment A

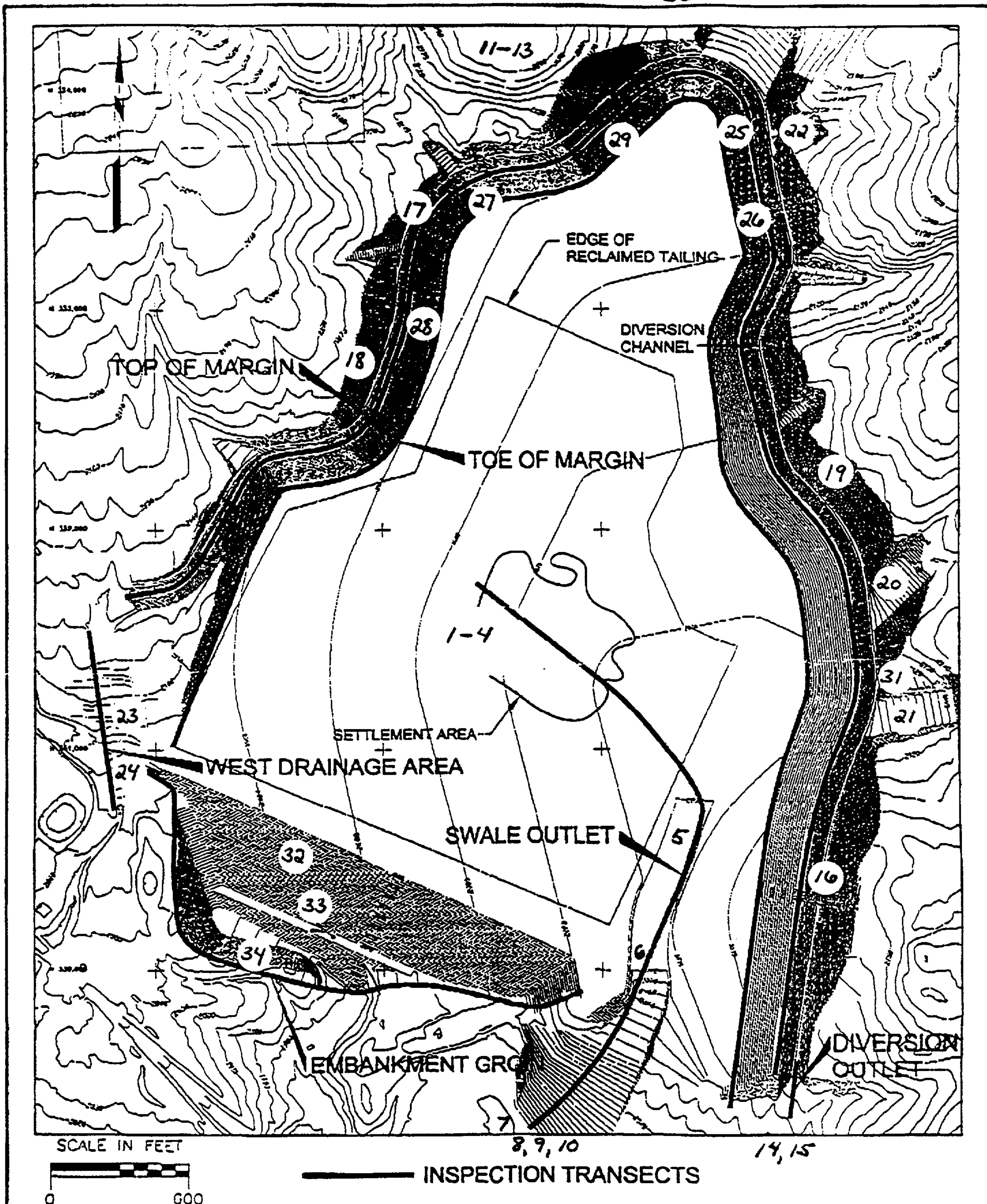


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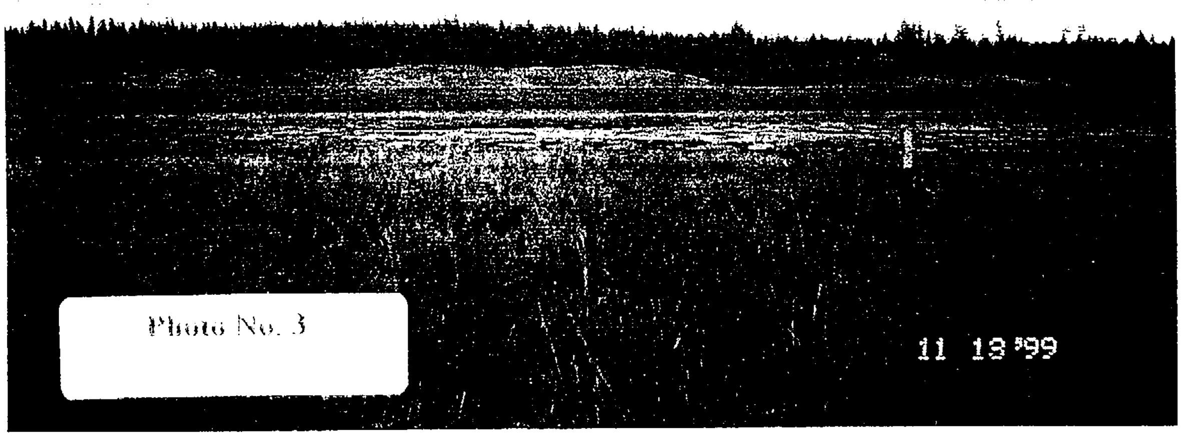
FIGURE 1
SRUCTURAL STABILITY MONITORING PLAN

Date:	SEPTEMBER 1998
Project:	03-317
File:	STR-STAB.DWG


Photo No. 1
11 13 '99


Photo No. 2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11 13 '99

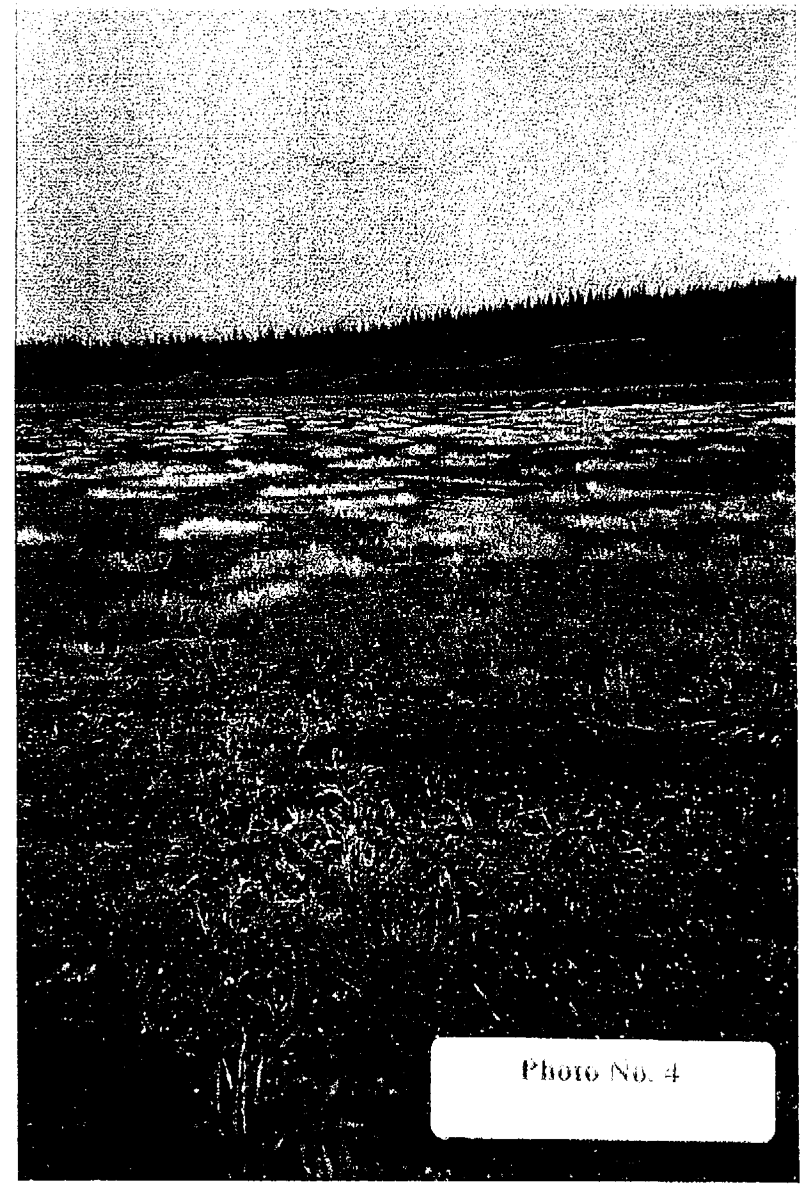


Photo No. 4

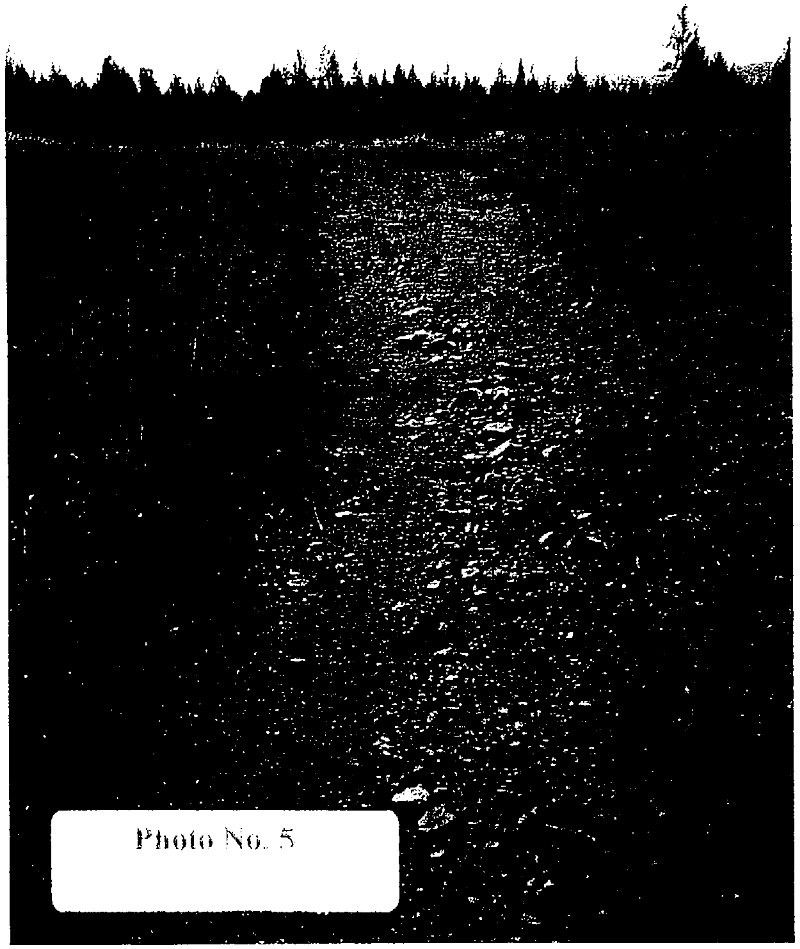


Photo No. 5

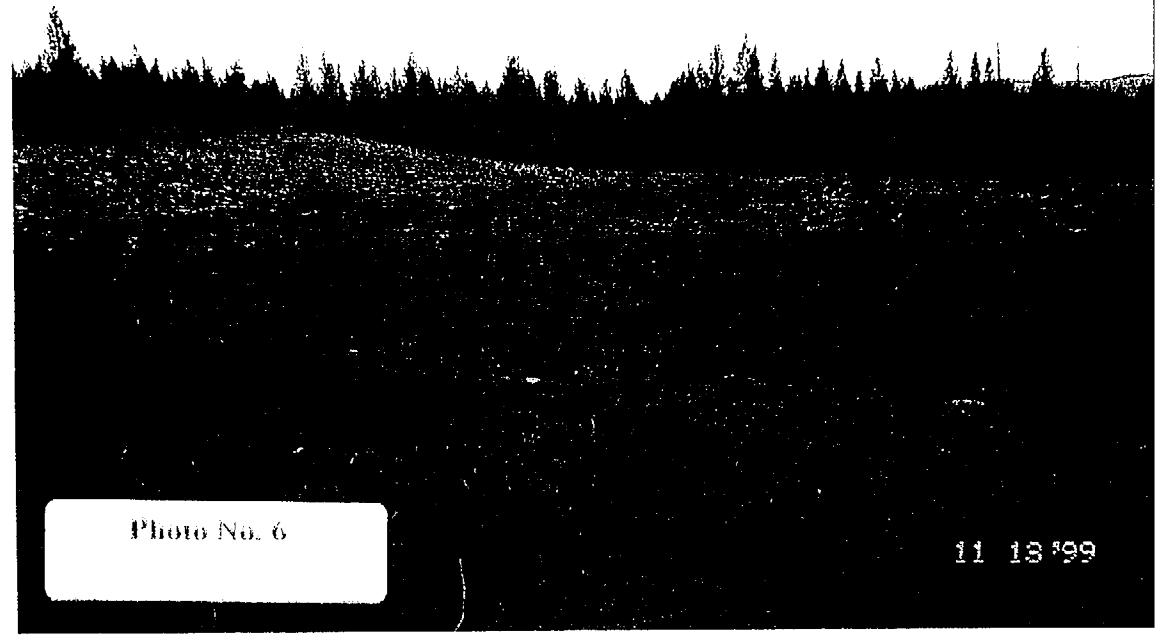


Photo No. 6

Photo No. 7

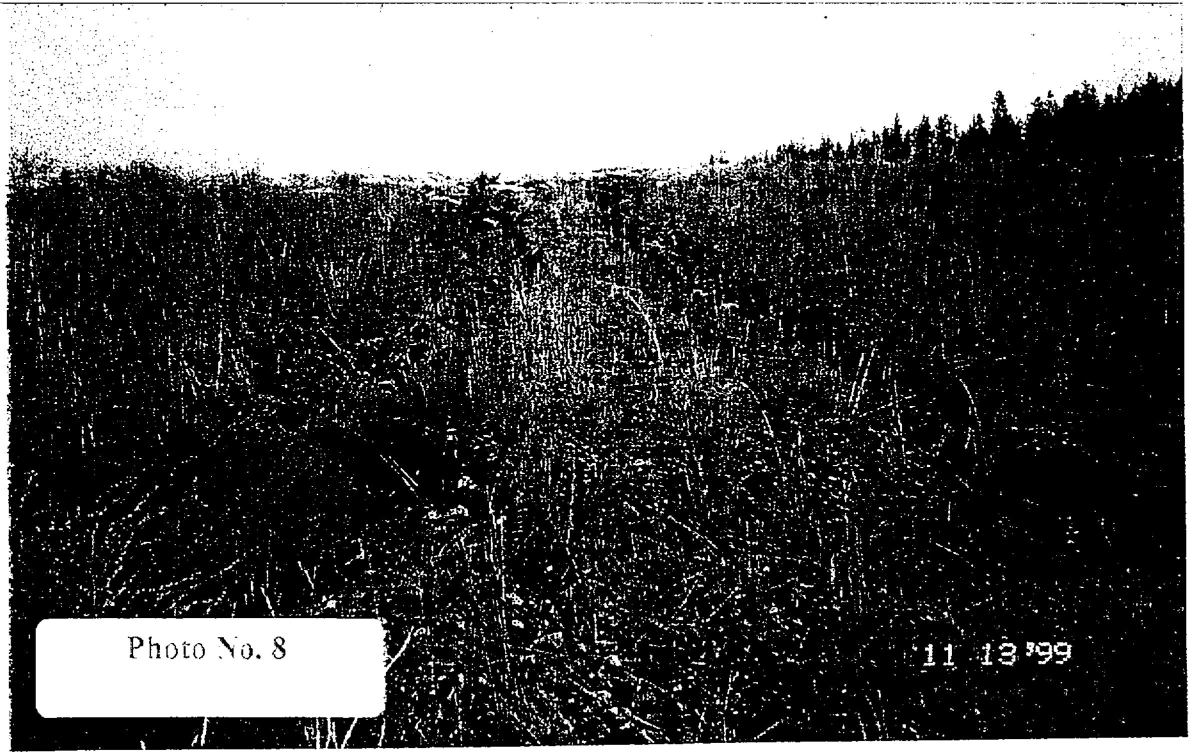
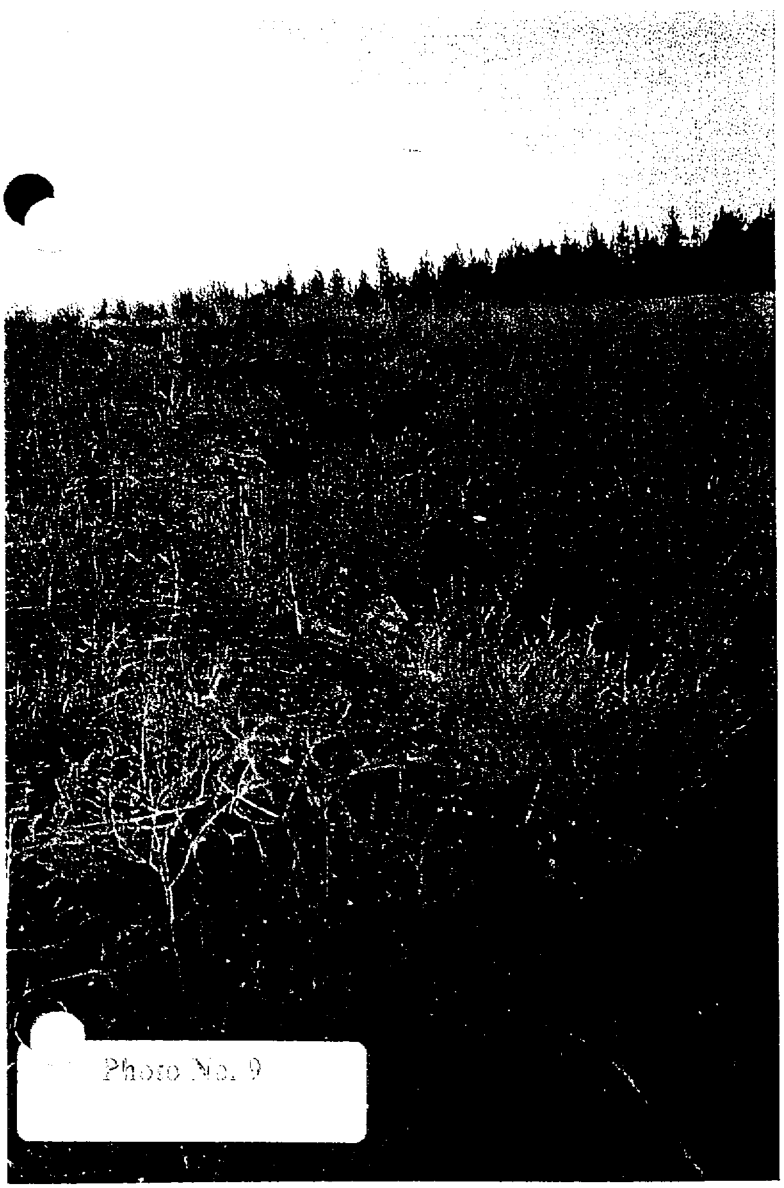


Photo No. 8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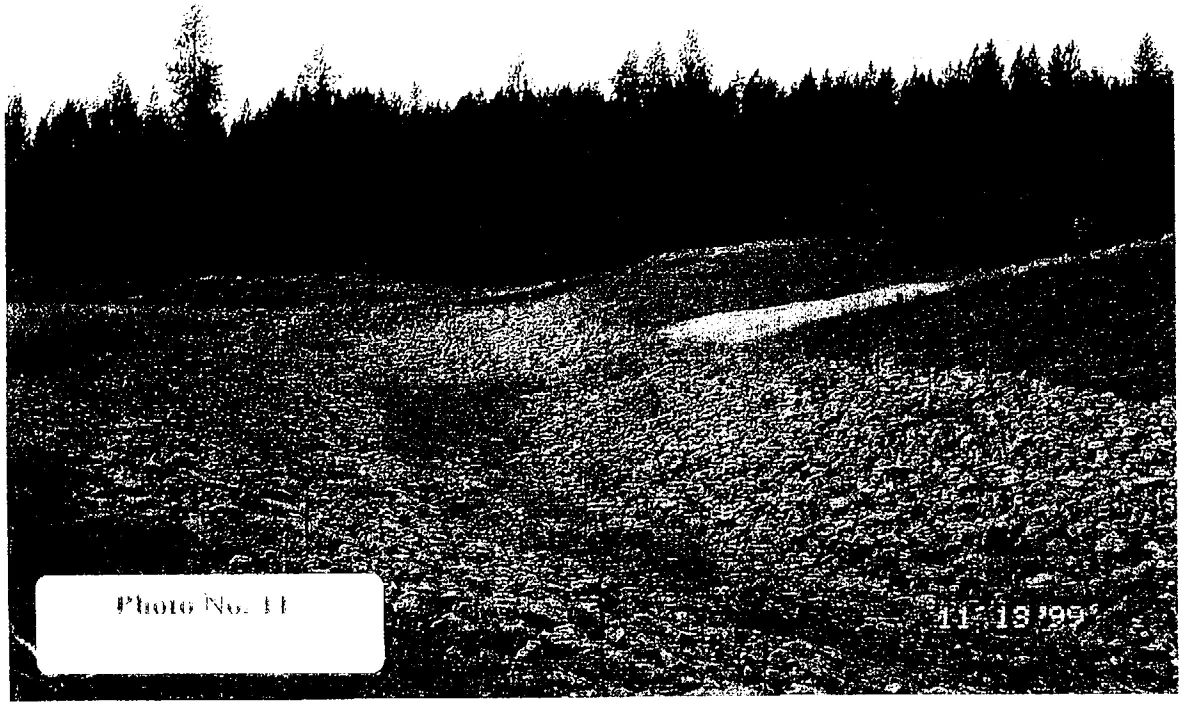

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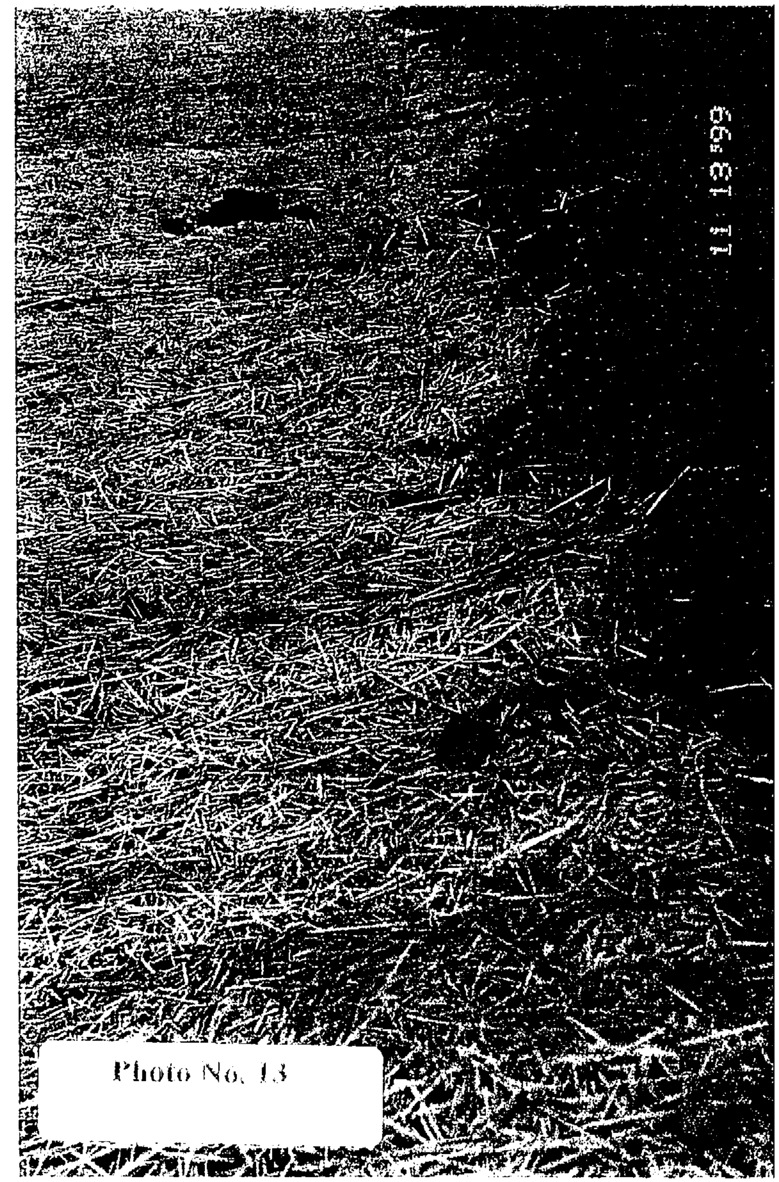

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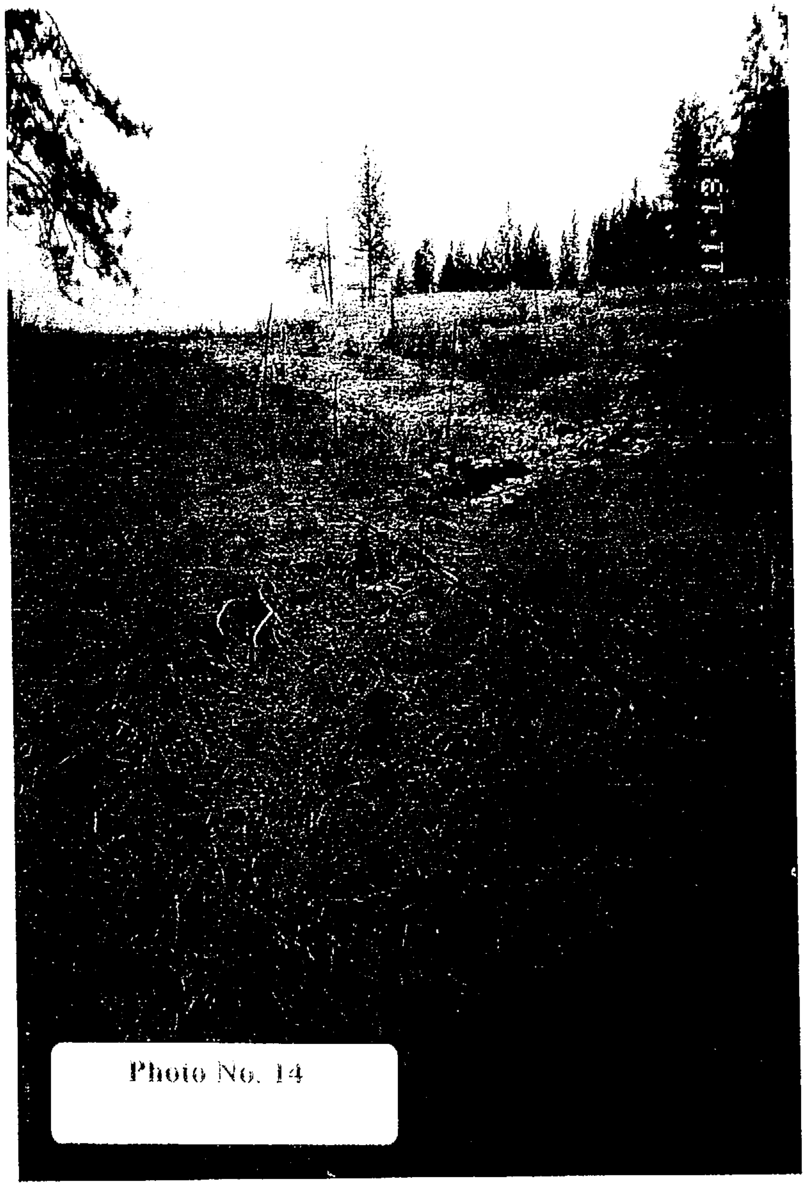

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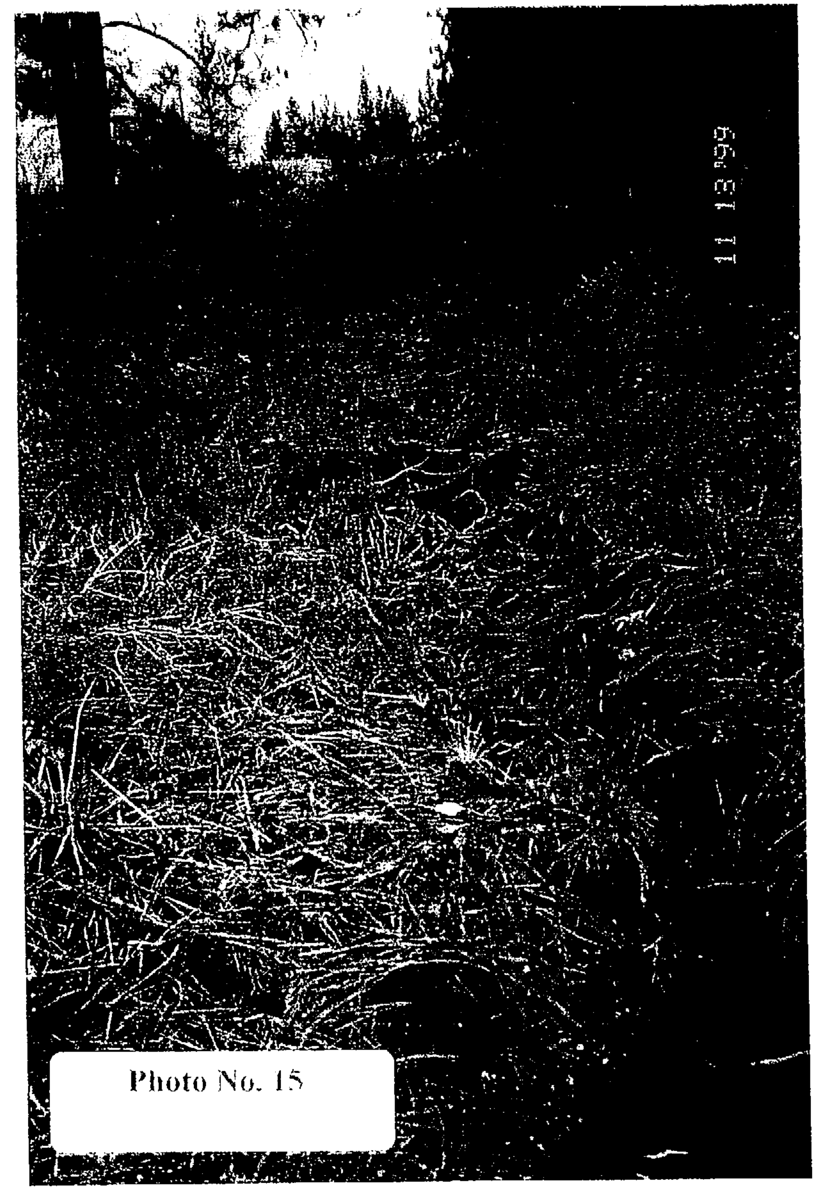

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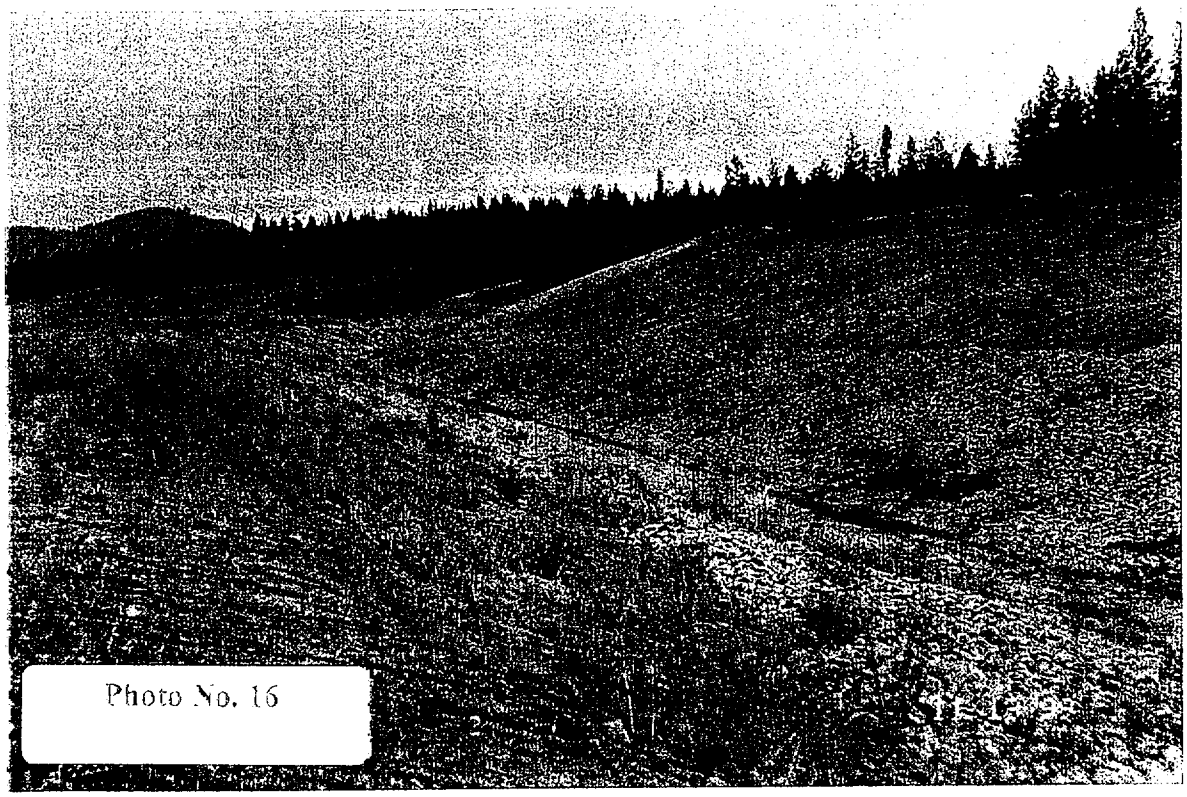

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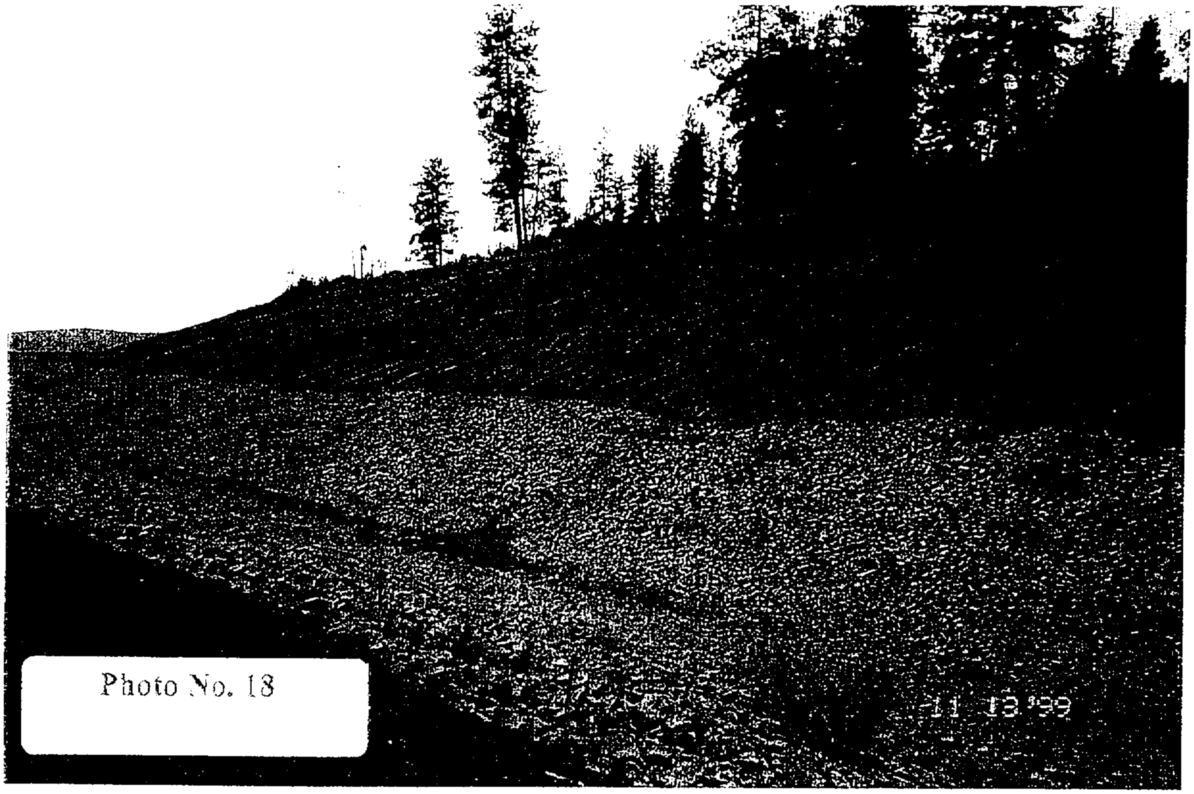

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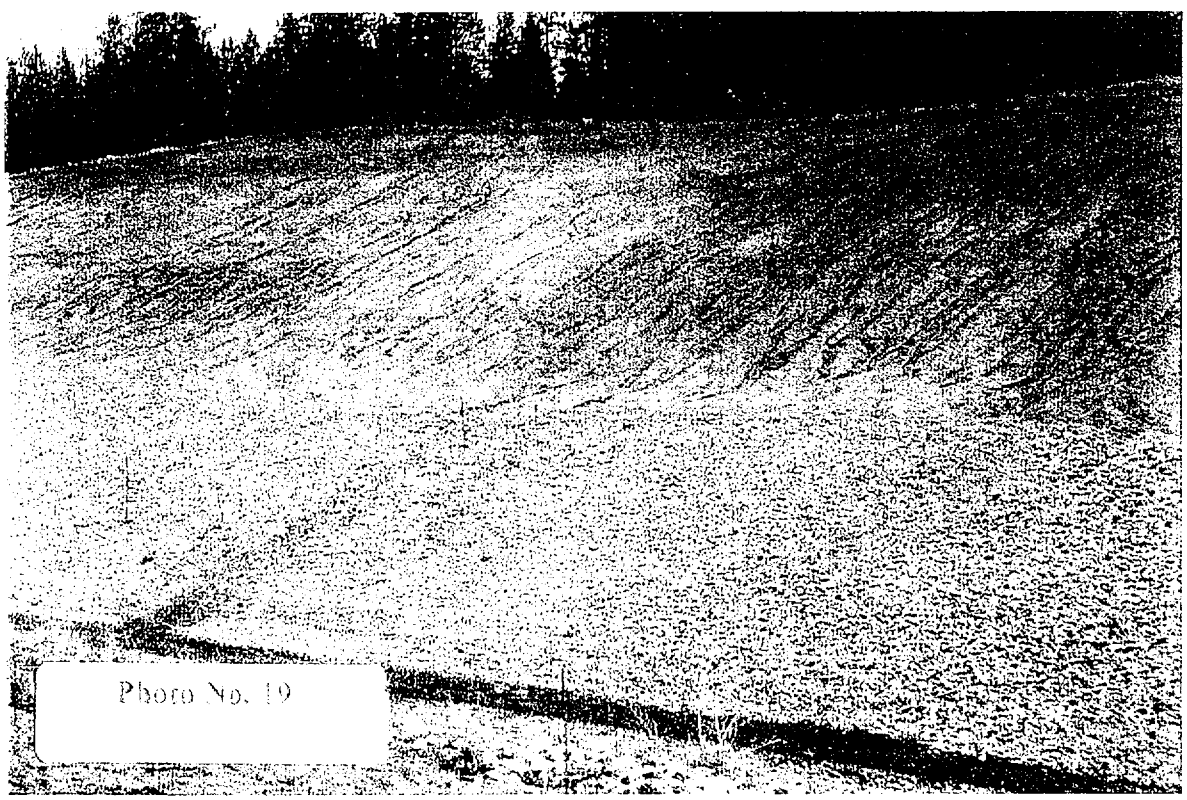
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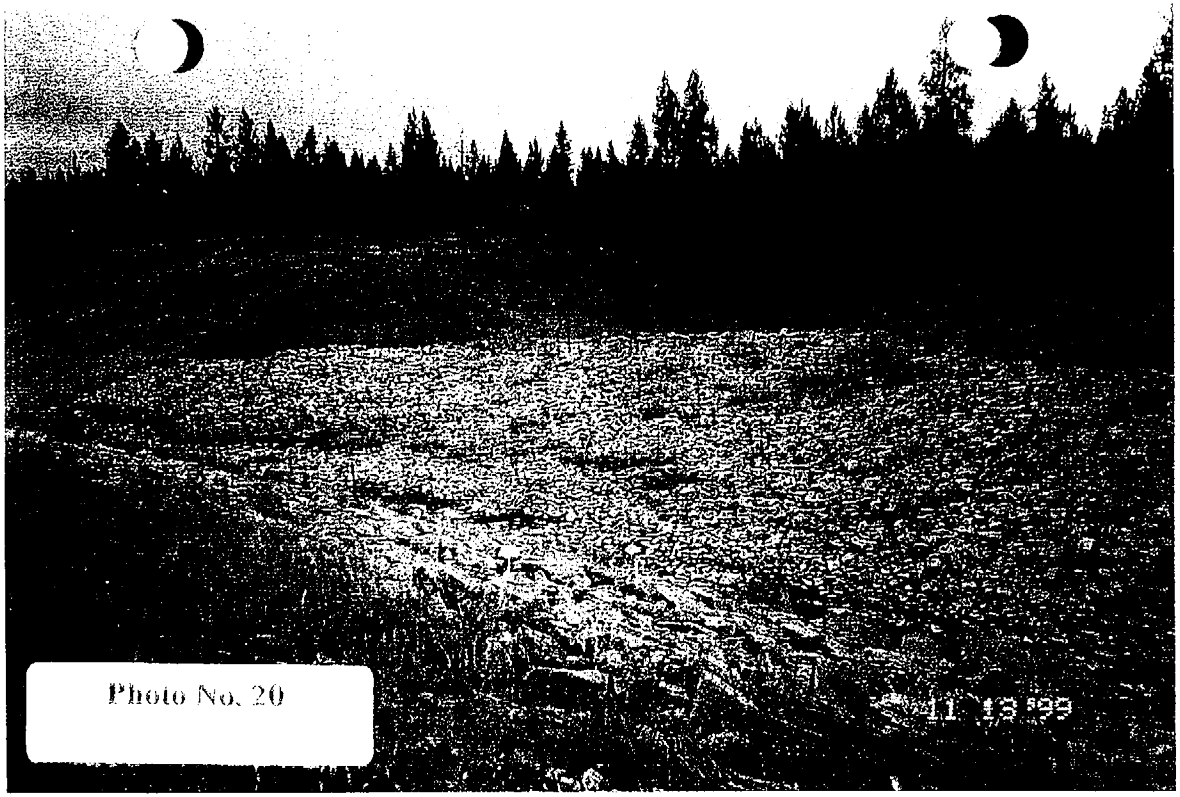

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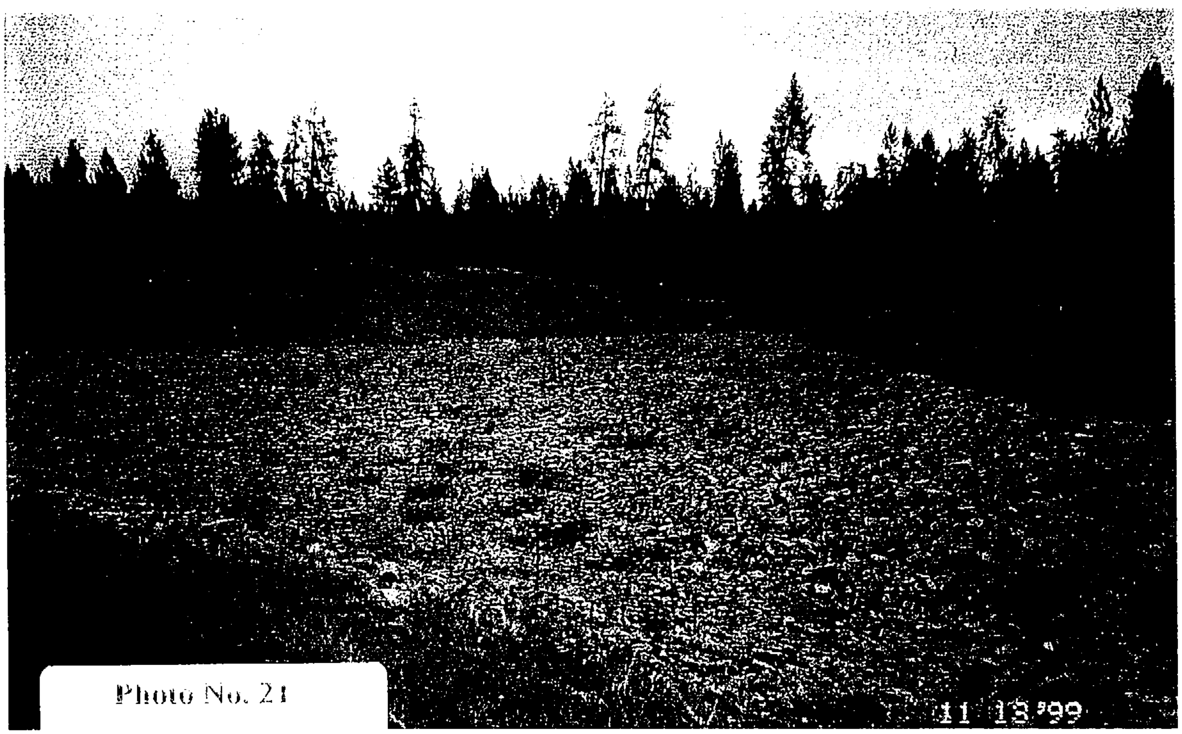

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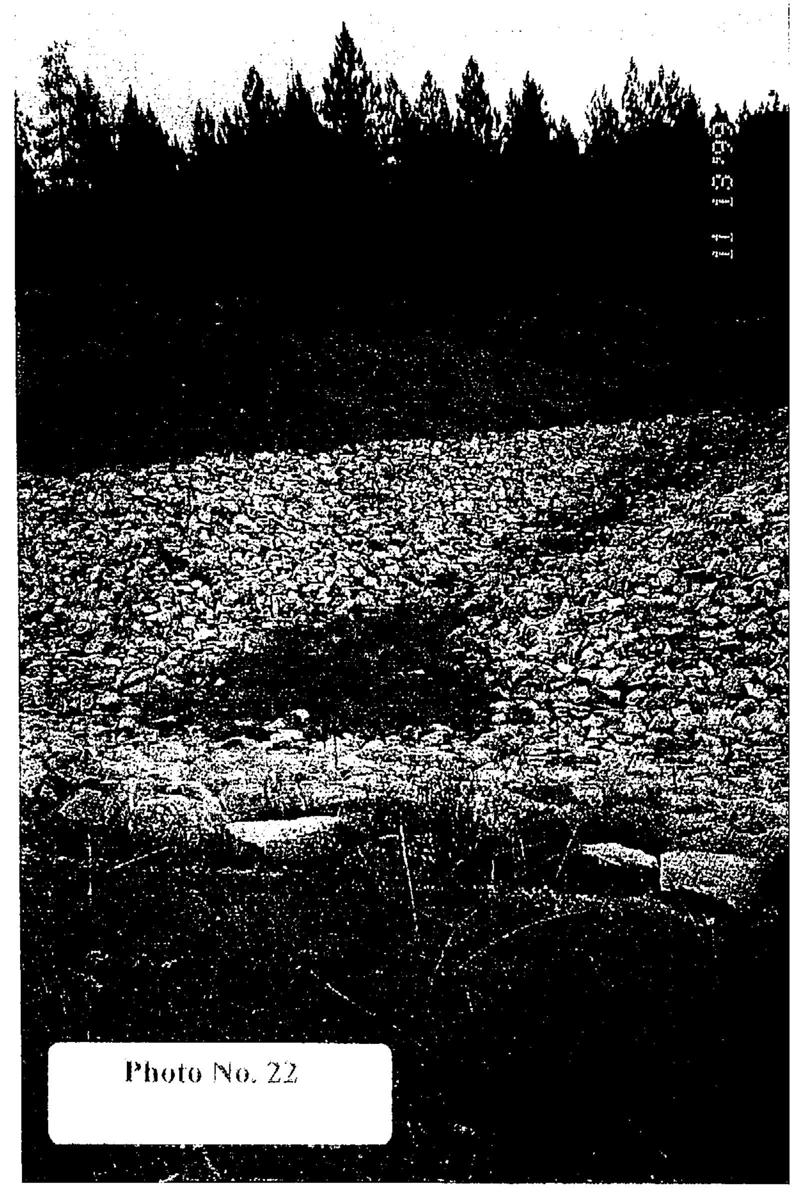

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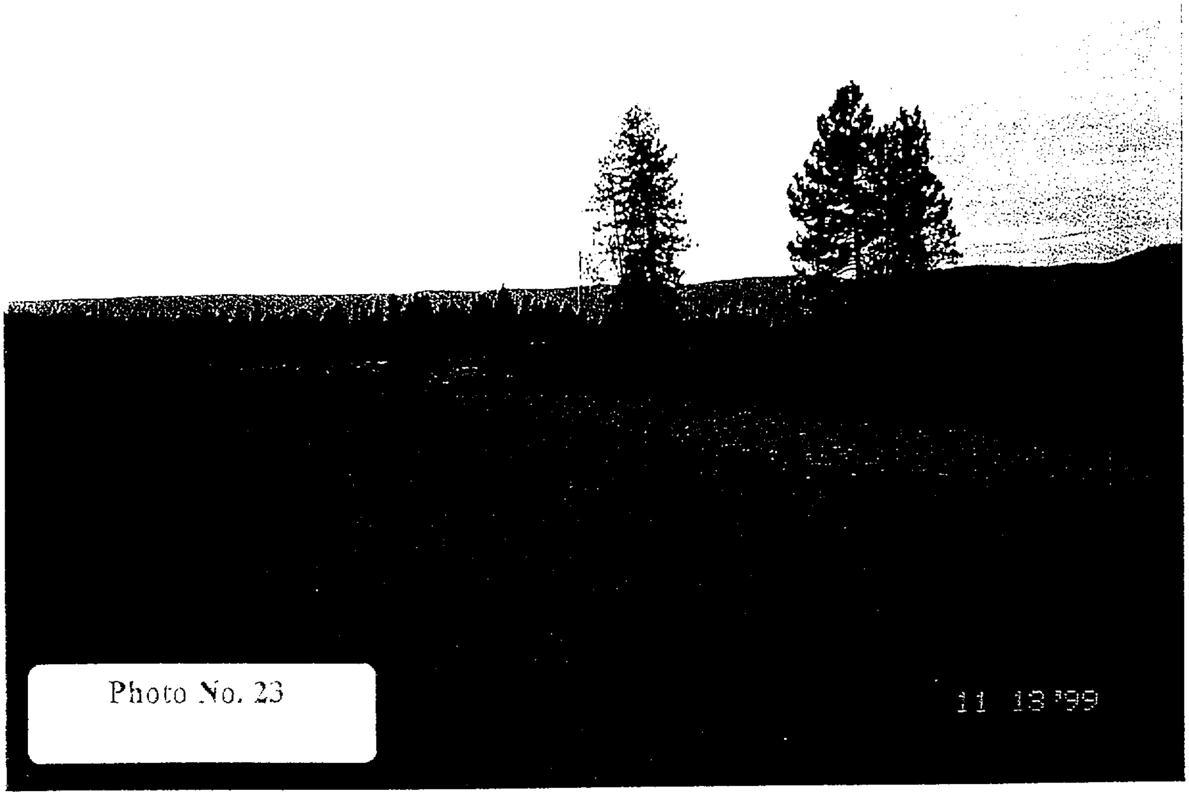

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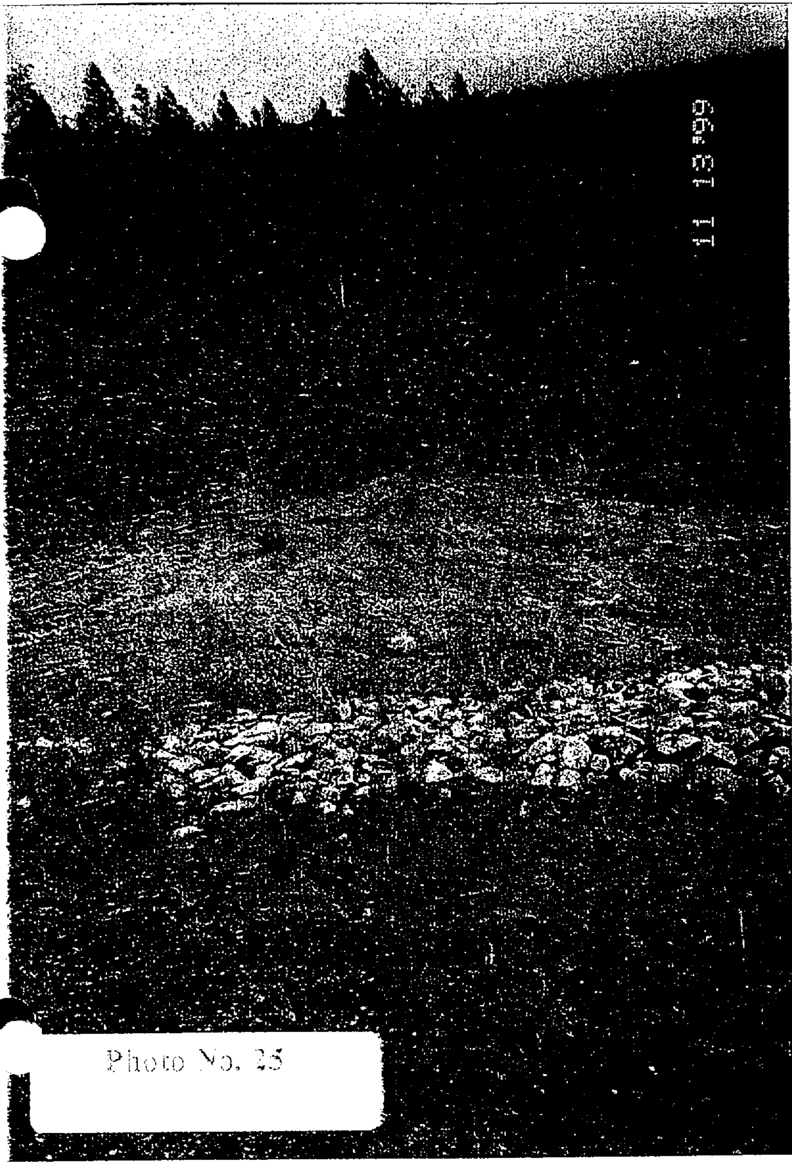

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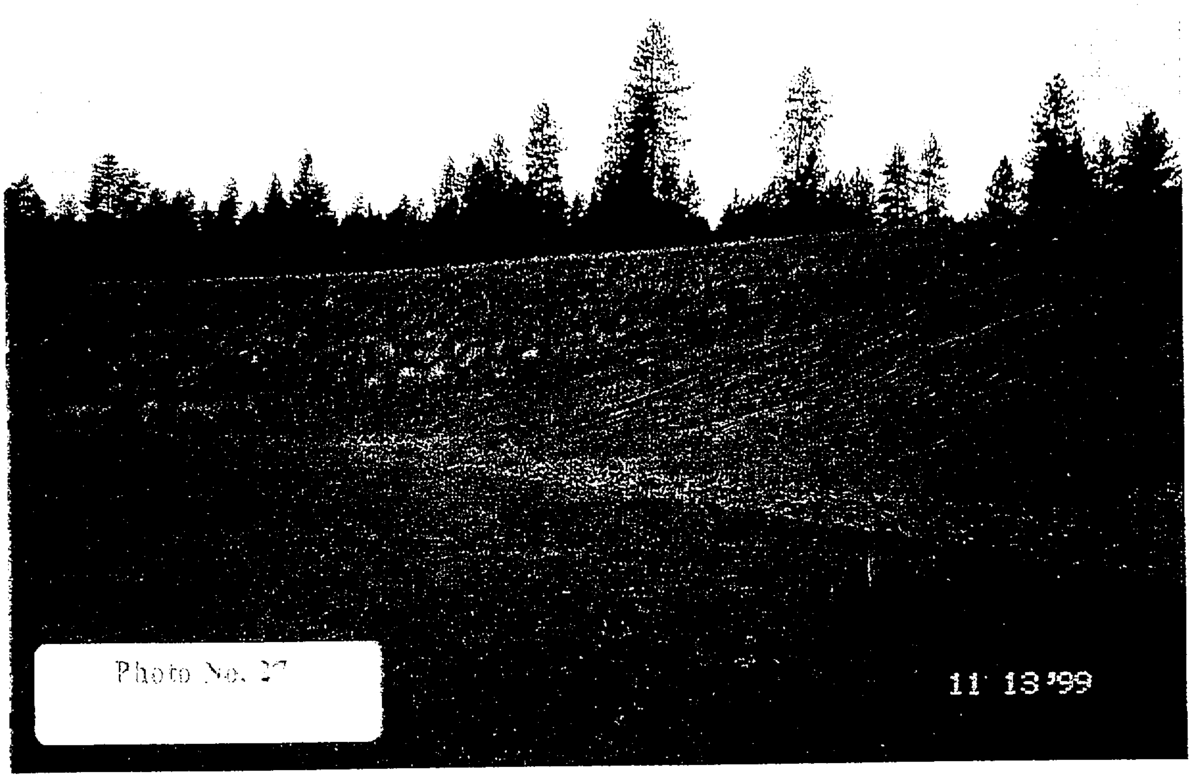

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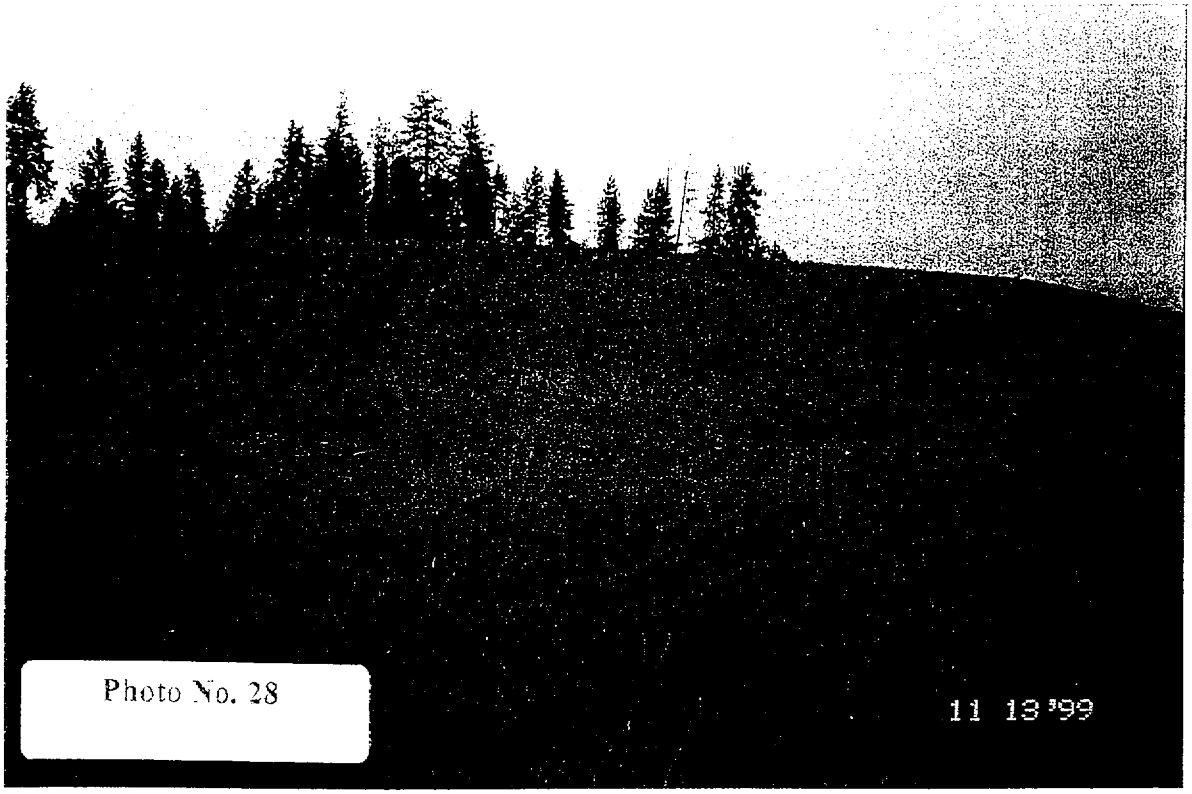

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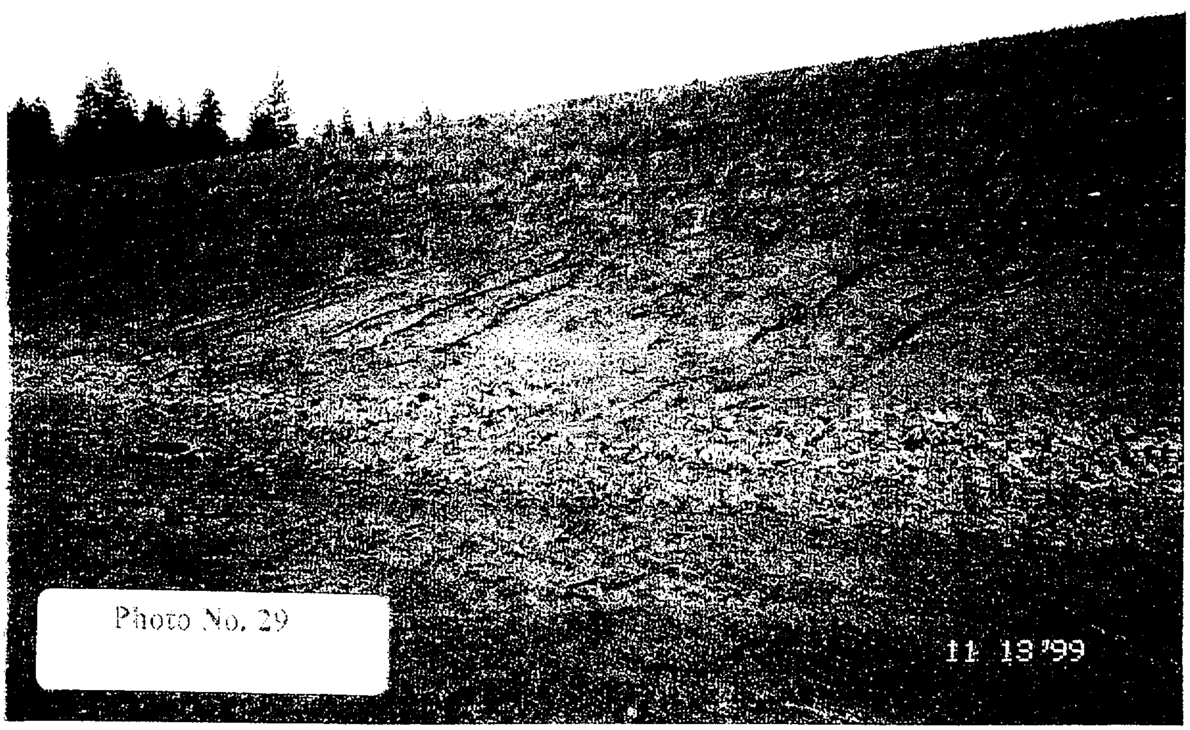

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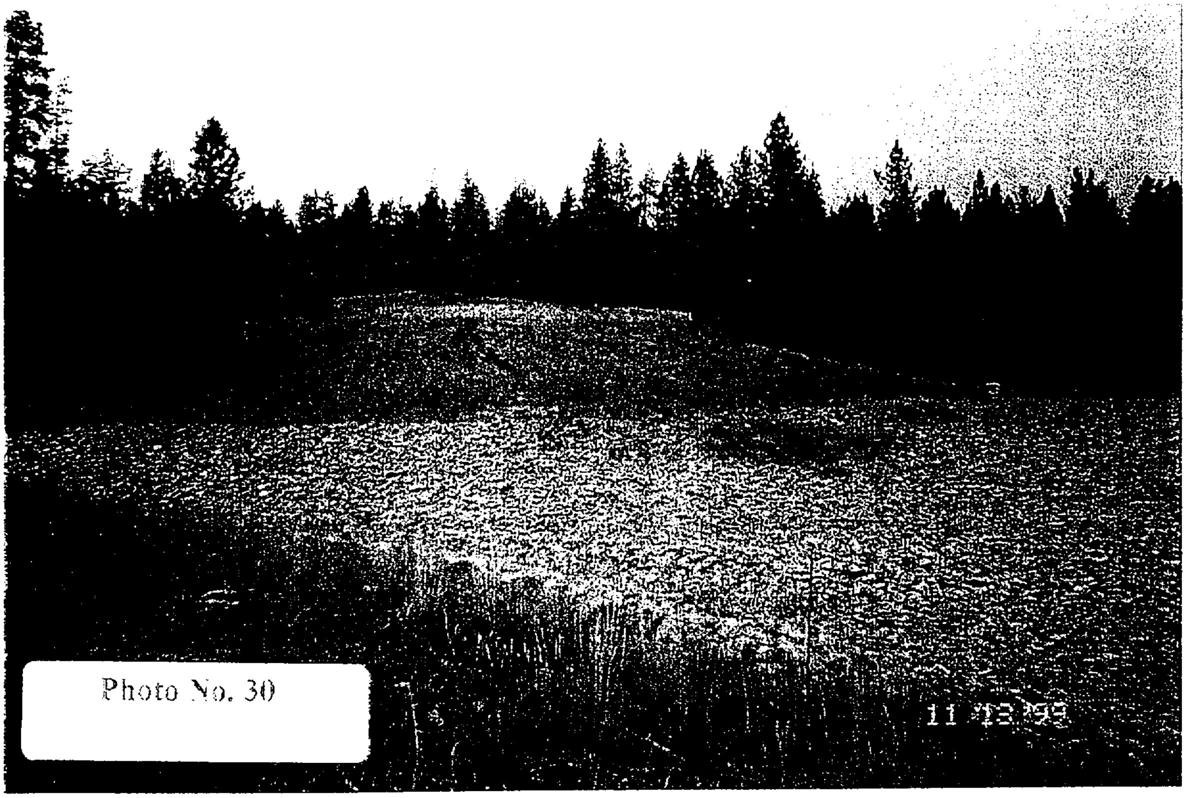

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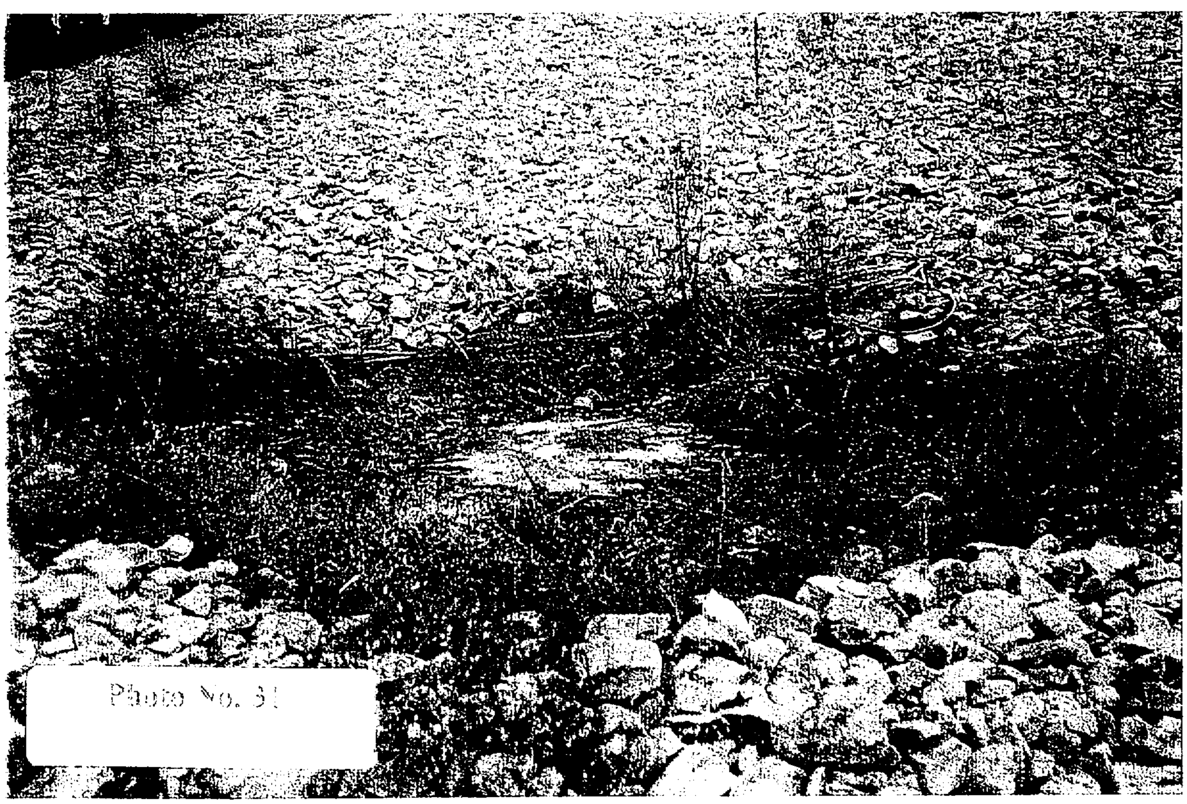

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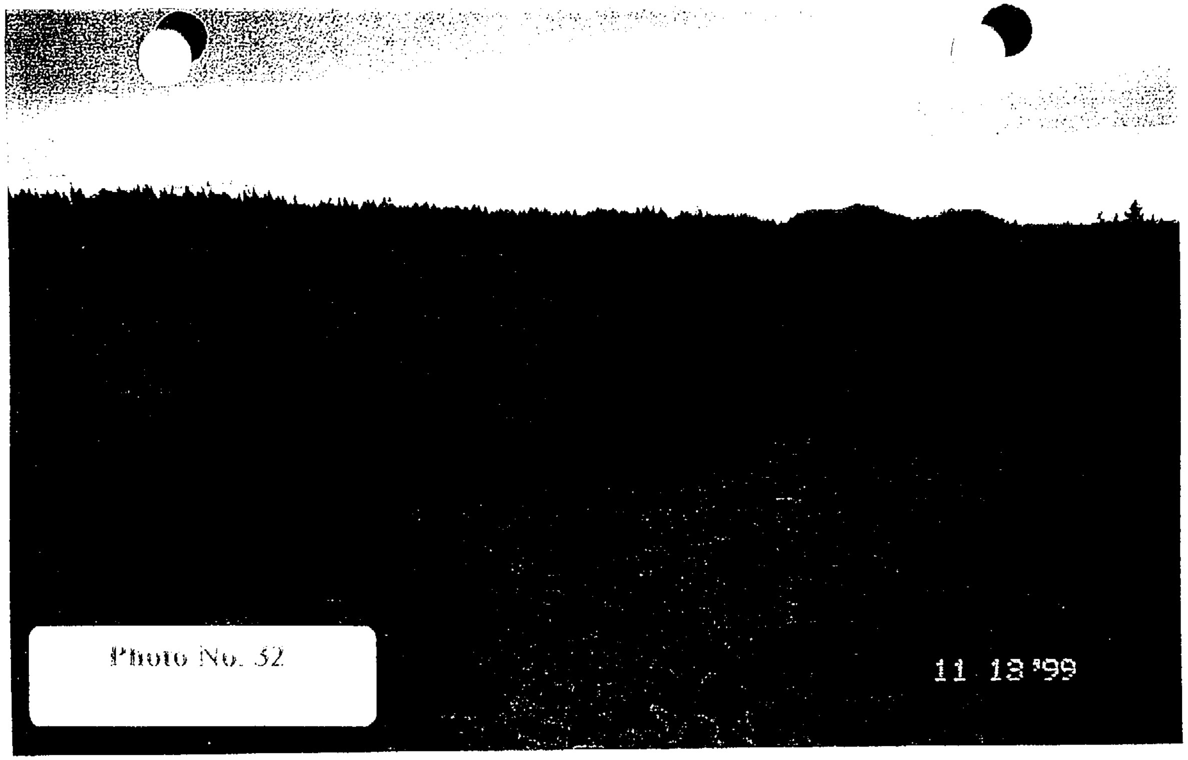

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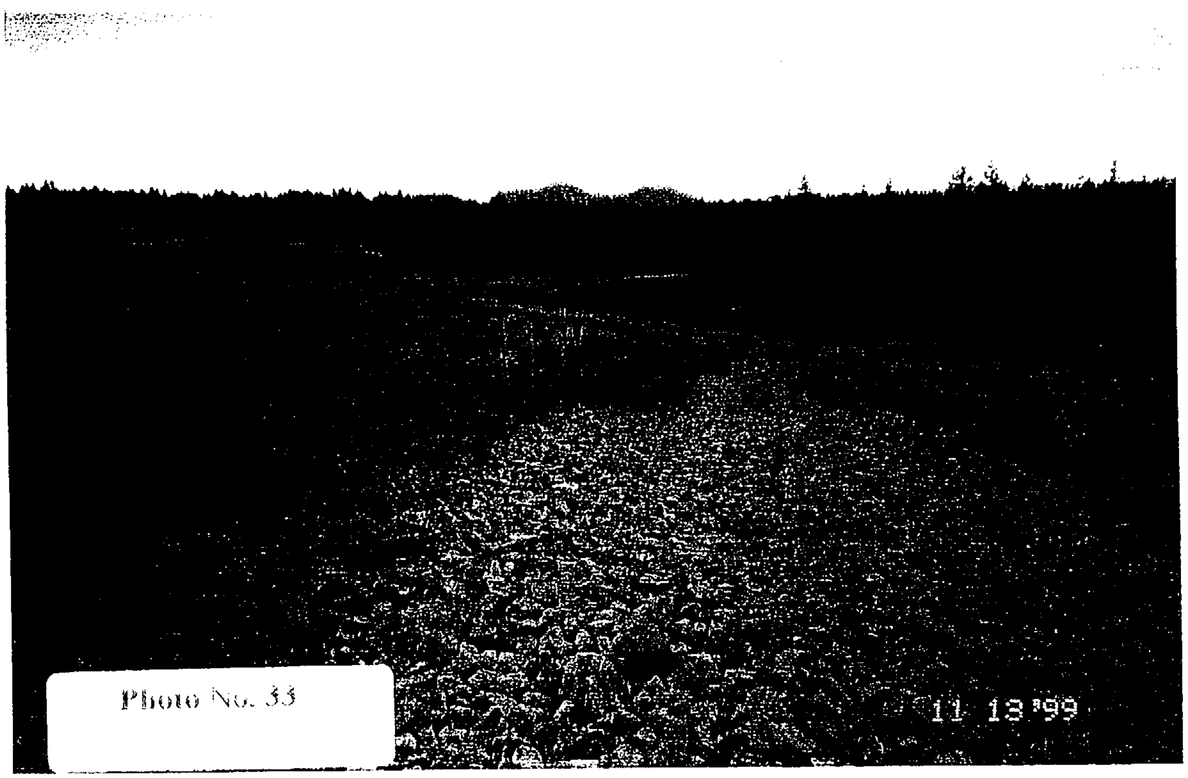

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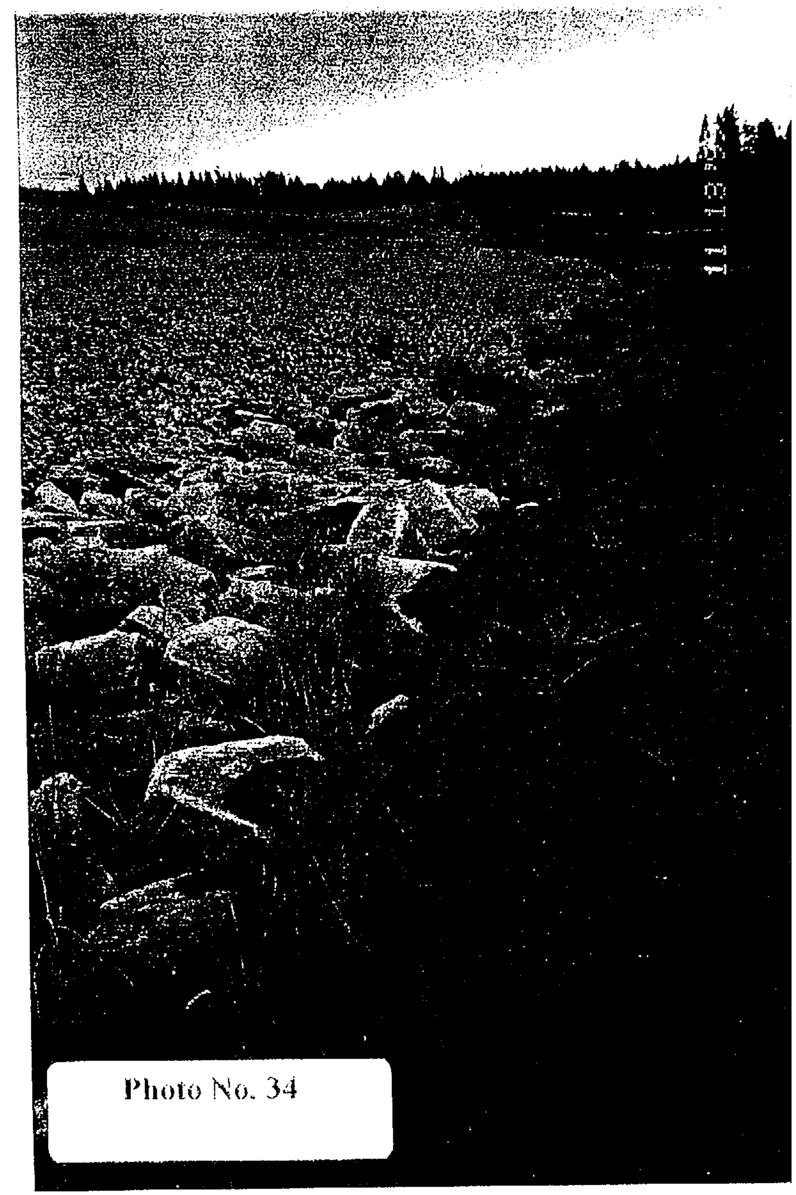


Photo No. 34

Attachment B

WESTERN NUCLEAR, INC.

SHERWOOD PROJECT
P. O. BOX 392 • WELLPINIT, WASHINGTON 99040 • (509) XXXXXXXX 258-4521

November 1, 1999

Mr. Gary Robertson, Head
Waste Management Section
Washington Department of Health, Division of Radiation Protection
7171 Cleanwater Lane, Building 5
P. O. Box 47827
Olympia, WA 98504-7827

Re: WN-I0133-1: License Condition 37; Sherwood Monitoring and Stabilization Plan Inspection; Regrading As-built Report for Two Surface Regrading Issues.

Dear Mr. Robertson:

This letter represents the as-built report for the two final surface stability regrading issues identified in your letter dated August 20, 1999 and further discussed in your letter dated September 21, 1999:

1.) The area west of the impoundment near the dam outslope and site access road; and
2.) Area of gully erosion up-gradient of the silt collection point in the diversion channel.

In accordance with License Condition 37, design criteria (Attachment 1) were submitted for Regrading Item #1, above, in my letter dated October 11, 1999. Regrading was performed by grading surface riprap and subsurface soils to enhance existing drainage to protect the main embankment groin area. Attachment 2 contains a set of photographs which demonstrate before and after appearance of the area. During field inspection on October 22, 1999, Mr. John Blacklaw of your staff voiced verbal concurrence that the regrading performed fulfilled the design specifications. In addition, the fall engineering stability inspection to be performed by Ms. Sheila Pachernegg, P.E. will include critical review of this regrading design and as-built.

Formal engineering design criteria for Regrading Item #2, above, were included in my letter dated October 11, 1999. In addition, field review and approval of the regrading design was provided by Mr. John Blacklaw of your staff on October 13, 1999. Briefly, an existing berm at the base of a slope had failed resulting in flow concentration of runoff. The regrading design would remove the berm completely to eliminate flow concentration. The regrading disturbance would then be seeded with native species and covered with an erosion protection blanket. The seed mix utilized was that used for tailing reclamation.

On October 22, 1999, Mr. Blacklaw reviewed and verbally approved the as-built regrading, seeding and in-progress installment of the erosion blanketing. The erosion protection blanketing was completed on October 25, 1999. Attachment 3 is the manufacturers brochure for the erosion blanketing. Temporary, photo-degradable, straw blanketing as shown on pages 4 and 5 were used. The heavier S150 product was used on the bottom 1/5 of the slope. Page 23 depicts installation for slopes. Blankets were installed horizontally to the slope. Page 20 depicts stapling patterns. Six inch wire staples were used. Pattern 'B' was utilized throughout with staggered 3 foot centers using 1.2 staples per square yard . Three thousand square yards of blanketing was installed and secured with 4000 staples. Attachment 4 contains pictures of the regraded slope with the completed erosion blanket installation. It was noted during installation of the erosion blanketing that approximately 1/3 of the area had quartz monzonite bedrock within six inches of the regraded surface. The fall engineering stability inspection to be performed by Ms. Sheila Pachernegg, P.E. will include critical review of this regrading design and as-built.

This additional remedial construction was performed at Sherwood to facilitate timely license termination. We anticipate that the completion of regrading and WDOH approval of this regrading as-built document, as well as the evaluations to address the other structural stability issues (submitted under separate cover) will resolve <u>all</u> structural concerns regarding the tailing reclamation plan and construction.

This letter also reaffirms the position of Western Nuclear, Inc. (WNI) that we sincerely believe no additional reclamation is warranted or necessary. The Washington Department of Health (WDOH) has previously approved the tailing reclamation plan and also previously approved the construction completion report that documents that construction was performed in accordance with the approved reclamation plan. Our decision to accommodate the WDOH in these issues does not indicate nor should it be construed in any way that WNI believes or concedes that the approved reclamation plan and the approved reclamation construction are insufficient to meet all performance objectives for the reclamation of uranium mill tailing impoundments as set forth in WAC 246-252.

Should you have any questions regarding this as-built document and the attachments, please contact me at your earliest convenience.

Sincerely,

Brad K. DeWaard
Resident Agent

/bd
Attachments - 4

cc: L. J. Corte, Esq.
L. L. Miller, SMI
E. M. Schern
H. W. Shaver, Esq., S & L
WNI - Central File (Sherwood, WN-I0133-1, L.C. 37.)

ATTACHMENT 1.

SHEPHERD MILLER
INCORPORATED

October 11, 1999 SMI # 03317

Mr. Brad DeWaard
Western Nuclear, Inc.
P.O. Box 392
Wellpinit, Washington 99049

This letter is in response to your letter dated September 21, 1999 regarding surface stability inspection issues at the Sherwood project site. Specifically this letter presents the required design to address the regrading activities for Issue 1, the area immediately west of the reclaimed embankment and Issue 3, the reclaimed northwest borrow area.

Area west of the reclaimed embankment

The WDOH raised concern that the regrading in this area directs flow from an area immediately west of the southern portion of the reclaimed impoundment to the south and close to the rock lined groin along the west edge of the reclaimed embankment. Concern was raised that if this flow were deep enough it could flow into the groin area.

As discussed during our site inspection on September 7, 1999 this concern will be addressed by enlarging the existing drainage to the south to keep drainage water away from the groin area. This will be done by removing the existing rock in the drainage, excavating the subsoil material and replacing the existing rock. Figure 1 depicts a typical cross section of the reconfigured drainage.

Your letter suggested that regrading be done in the small drainage basin to direct flow towards the west and the roadway culvert. I disagree with performing any regrading in the drainage basin for two reasons. First, enlarging the existing drainage to the south will address the concern and thus regrading the drainage basin is not necessary. Additionally, this area has become revegetated and any regrading in the area will destroy the successful revegetation effort. Since enlarging the existing drainage addresses the concern and regrading the drainage basin will destroy the revegetation effort, regrading will not be done in this area. This is consistent with conversations I had with John Blacklaw of your office during our site visit of September 7.

Environmental & Engineering Consultants

3801 Automation Way, Suite 100
Fort Collins, CO 80525
Phone: (970) 223-9600
Fax: (970) 223-7171
www.shepmill.com

Reclaimed northwest borrow area

The WDOH raised concern that the existing bench on the reclaimed northwest borrow area would continue to contribute sediment to the diversion channel. To address this concern, the bench will be removed and the area will be regraded to a uniform slope. All disturbed areas will be reseeded with the same seed mixture that was used for all other disturbed areas outside of the tailing area. Erosion control netting (jute matting) will be installed over the disturbed area. This netting will insure erosional stability until the vegetation becomes established and will eliminate any need for any type of vegetation success criteria for this area. The netting will be installed in accordance with manufacturer's recommendations.

Both of these areas will be inspected and documented as part of the semi-annual surface stability inspection. If the inspector concludes that the areas have been constructed as designed, these issues will be considered successfully completed and closed.

Because of the short remaining construction season, we request that you give prompt concurrence to this design letter so that construction activities can be completed as soon as possible.

If you have any questions, please let me know as soon as possible.

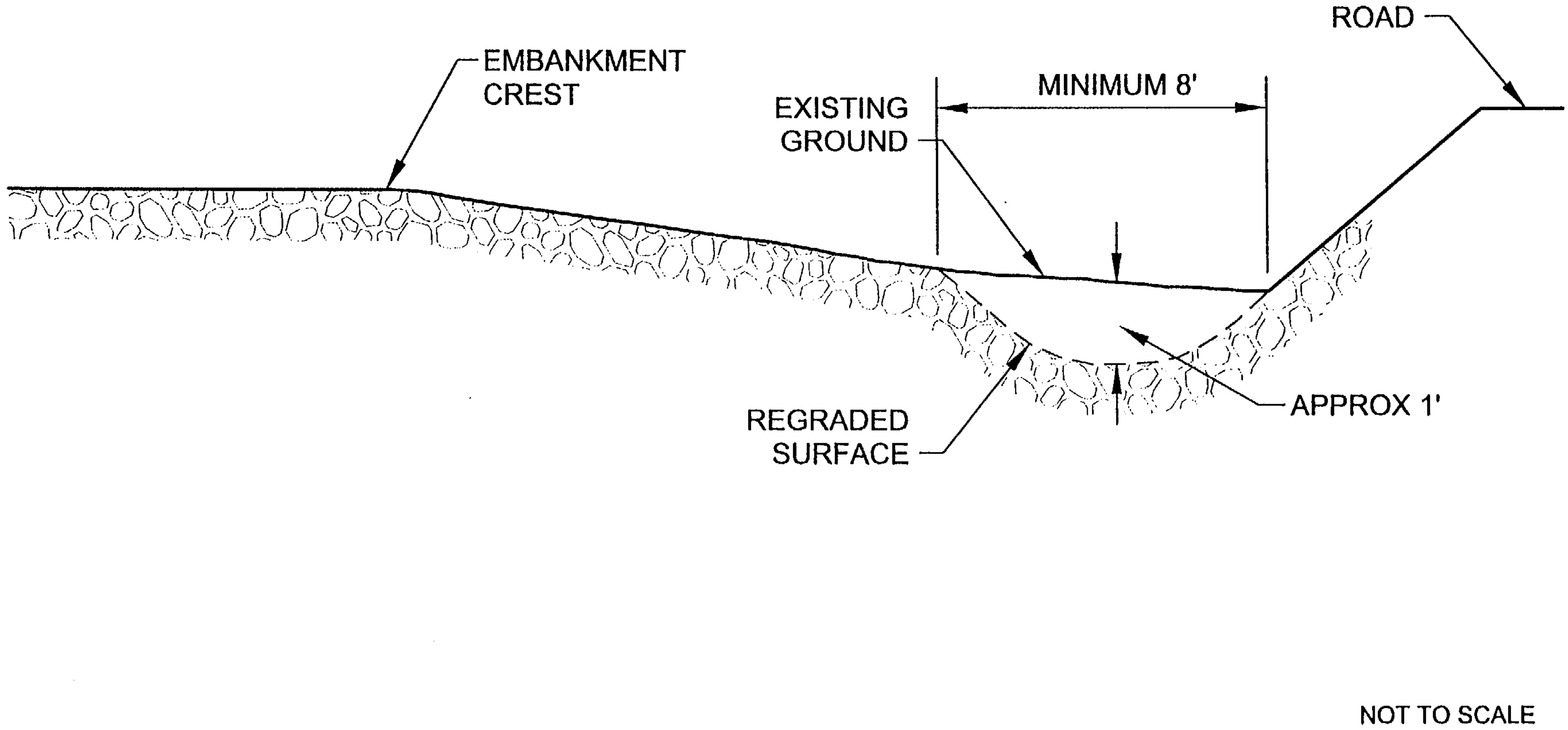
Sincerely,
SHEPHERD MILLER, INC.

Louis Miller

Louis Miller, PE
Vice President

Attachments

LOUIS L. MILLER
STATE OF WASHINGTON
27992
REGISTERED PROFESSIONAL ENGINEER
EXPIRES 5/1/00
10-12-99

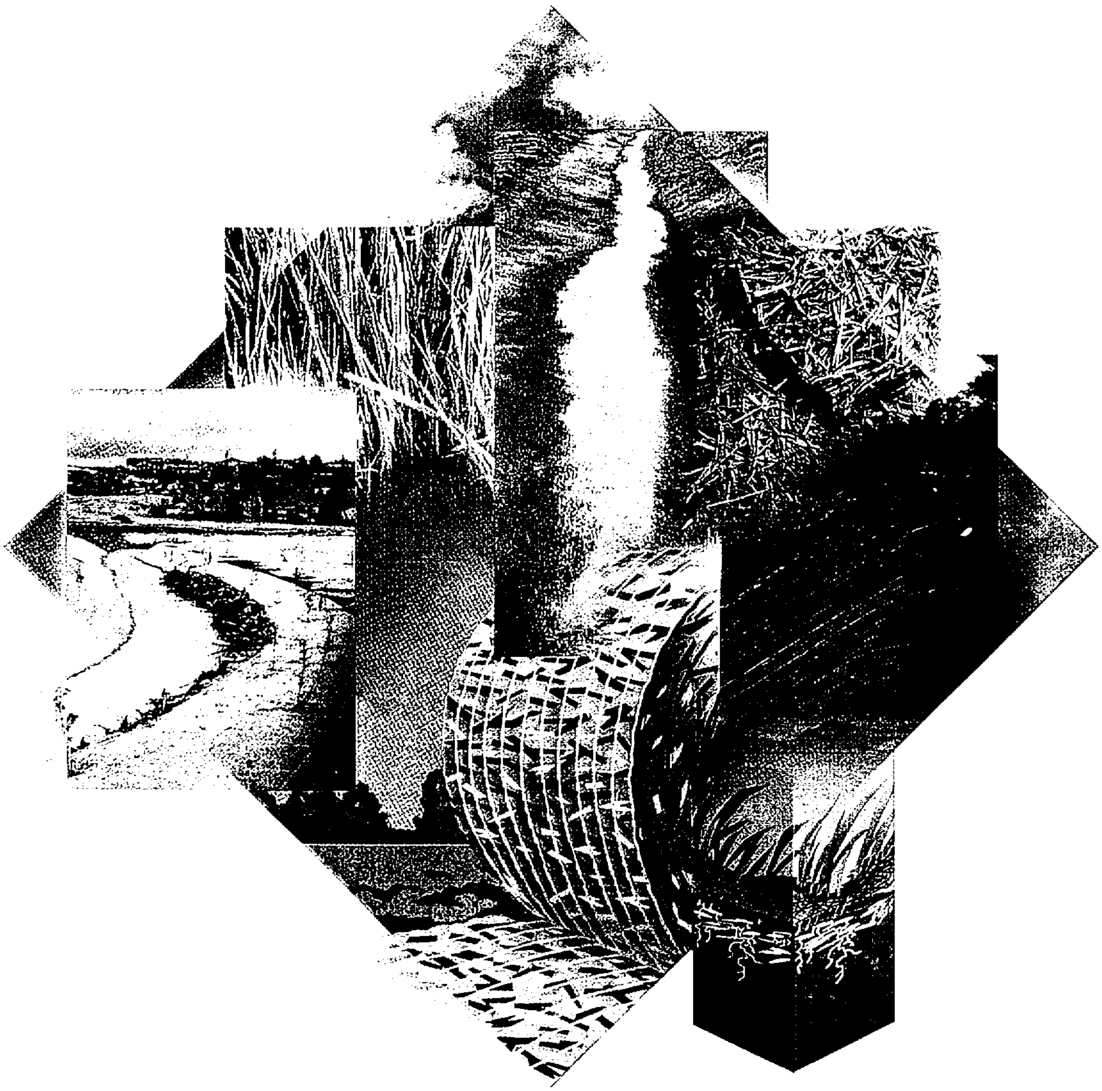


SHEPHERD MILLER
INCORPORATED

FIGURE 1
TYPICAL CROSS SECTION

Date:	OCTOBER 1999
Project:	03-317
File:	XS-10-99.dwg

NORTH
AMERICAN
GREEN®



EROSION CONTROL
HAS NEVER BEEN MORE ADVANCED

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