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DOE/AL/62350-8F

GEOMORPHIC STABILITY FIELD RECONNAISSANCE SITE VISIT CANONSBURG, PENNSYLVANIA (DECEMBER 1992)

FINAL

May 1993

Work Performed Under Contract No. DE-AC04-91AL62350

**Prepared for
U.S. Department of Energy
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EXECUTIVE SUMMARY

To license the Canonsburg site, the U.S. Nuclear Regulatory Commission (NRC) has required that geomorphic stability be demonstrated for the stream banks and slopes around the perimeter of the site for 200 years. Based on a study of the stream channel and slopes, it has been determined that due to recent human intervention, the required geomorphic stability cannot now be achieved without installation of erosion protection works and continued monitoring of the site. The Pittsburgh District Corps of Engineers has plans to channelize Chartiers Creek and install erosion protection rock within the next 5 or 6 years, if local government agencies raise the necessary matching funds. Much of the stream bank and slope adjacent to the "fenced in" western area of the site is anticipated to remain geomorphically stable for more than 20 years, but less than 200 years without human intervention. Therefore in much of this area, the Corps of Engineers will have adequate time to perform its work without jeopardizing the integrity of the controlled area. In contrast, two approximately 200-foot (ft) (60-meter [m]) long portions of the stream channel located north-northwest of the encapsulation area are subject to active stream erosion that threatens the integrity of the controlled area. These areas should be fixed by installation of erosion protection rock within the next 2 years.

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1.0 INTRODUCTION

In a letter dated October 6, 1992, John Surmeier of the NRC stated that the "DOE may be able to demonstrate that the site design and configuration of residual radioactive material (RRM) are adequate to resist erosion from both on-site precipitation and flood events in Chartiers Creek, considering the minimum 200-year stability requirement of the U.S. Environmental Protection Agency (EPA) standards." During the U.S. Department of Energy (DOE)/NRC Canonsburg site meeting on October 7, 1992, Surmeier stated that a geomorphic stability study and report indicating that the controlled-fenced area would be stable for 200 years is required for NRC licensing of the Canonsburg site.

At the request of the DOE site manager for Canonsburg, during the week of December 14, 1992, the lead project engineer of the Uranium Mill Tailings Remedial Action (UMTRA) Technical Assistance Contractor (TAC) staff traveled to the Canonsburg site. During this period, the TAC's lead project engineer performed the required geomorphic study and extensively photographed the Chartiers Creek channel, the stream banks, and the Canonsburg site slopes located adjacent to the stream channel. Results of the findings of this field investigation are included in this report.

2.0 GENERAL SITE DESCRIPTION

Review of the October 1986 Canonsburg remedial action completion report and the Project document files indicate that present day usage of terms Area A, Area B, and Area C do not exactly agree with the original site descriptions. To maintain consistency with the completion report, the following definitions of the different areas included on the Canonsburg site should be used.

Area A—This is the area included in the lined encapsulation area. High-level contaminated material (i.e., more than 100 picocuries per gram [pCi/g]) is included in Area A. This area has a clay liner bottom, a cover barrier system, and a vegetated cover surface. Area A is located west of Strabane Avenue, in the central portion of the fenced-in area.

Area B—This is an area located north of Area A, outside of the lined encapsulation area, and inside of a riprap erosion protection wall. This area covers approximately 1.6 acres (0.6 hectares). MK Ferguson's completion report indicates that a 4-ft (1.2-m) thick layer of highly contaminated material (i.e., an average contamination of 650 pCi/g) was left in this area.

Residential/Technology Area—This area is the remainder of the site located west of Strabane Avenue and outside of Areas A and B. This portion of the site is located inside of the fence and predominately west and northwest of Area A. This area includes vicinity property material and RRM with a contamination of less than or equal to 100 pCi/g.

Area C—This is the unfenced area located east of Strabane Avenue.

For detailed locations of the four site areas described above, refer to the site plan included in Appendix A.

3.0 FINDINGS

3.1 CHANNEL DOWNSTREAM FROM THE SITE

The stream flows on a bedrock channel bottom just east of the site at the Conrail bridge crossing, to beyond the Phillip Murray Bridge on State Route 980 east of downtown Canonsburg. The channel sides are eroded into bedrock or they have been graded and covered with riprap erosion protection as part of the U.S. Army Corps of Engineers (USACE) flood control work. Flood control work on Chartiers Creek was initiated by the USACE near U.S. Route 79 east of Canonsburg in 1970 and was finished with the Canonsburg-Houston flood protection project completed in approximately 1982 (see Appendix B, sign in photograph 5). As can be seen in the attached photographs 1 through 7 taken on December 15, 1992, the sides of the Chartiers Creek channel in the reach located below the Canonsburg site are stable and well maintained.

3.2 CHANNEL AT THE SITE

Stability findings along the Chartiers Creek channel adjacent to the UMTRA Canonsburg site will be reviewed going upstream from the Conrail railroad bridge, passing along Area C, going under the Strabane Avenue bridge, and then going around Areas A and B. For a detailed description of the Canonsburg site, refer to the site plan in Appendix A.

3.2.1 Area C

Area C is an unfenced portion of the site located east of the main cell, east of Strabane Avenue, and north of the Conrail tracks. The Canonsburg completion report, dated October 1986, indicates that Area C was filled during remedial action work at the site.

A map of Chartiers Township, page 113 in Caldwell's Illustrated Historical Centennial Atlas of 1876, in the Canonsburg municipal library, indicates that Chartiers Creek's alignment has not significantly changed in the past 100+ years, except where the USACE realigned it (i.e., east of downtown Canonsburg). The Caldwell Atlas and the Federal Emergency Management Administration (FEMA) "Flood Insurance Study, Borough of Canonsburg, Pennsylvania," dated October 1979, indicate that Area C was originally a low-lying floodplain area.

Active stream bank erosion was observed along the side slopes of Area C. Steep side slopes, stream flood flows, and mass wasting (i.e., landsliding) were observed in an active erosional mechanism on December 15 and 16, 1992. For details of this erosion occurring along the banks of Area C, refer to photographs 8 through 13 included in the Appendix B.

Area C is not presently geomorphically stable.

Photographs 14 through 28, illustrating the findings listed above, are included in Appendix B.

Observations of the stream channel and banks adjacent to the Residential/Technology Area and Area B indicate that these areas have been affected by human intervention. They will not remain geomorphically stable for 200 years without maintenance consisting of construction of erosion control works and monitoring of bank stability during the long-term surveillance works and process.

3.3 CHANNEL UPSTREAM FROM THE SITE

Directly upstream from the UMTRA Canonsburg site is the village of Houston, Pennsylvania, and Chartiers Township. Due to increased development in these upstream areas, added runoff flows and increased flooding have been reported in those communities. Township officials have contacted the Pittsburgh District USACE to reactivate the Houston portion of the Canonsburg-Houston flood prevention project. The Houston portion of this work was originally designed with the entire project; however, it was not constructed with the Canonsburg portion of the project due to lack of funds.

Increased storm water flow in Chartiers Creek, caused by increased development upstream from the UMTRA Canonsburg site, is a factor that tends to aggravate recent active erosional mechanisms observed along the banks of the UMTRA site.

3.4 STREAM MORPHOLOGY

Chartiers Creek is a temperate climate, meandering stream that has become entrenched into sedimentary bedrock downstream from the UMTRA Canonsburg site, and is flowing on alluvial soil deposits in the channel adjacent to the site. This downstream entrenchment in bedrock greatly reduces the potential for vertical erosion of the stream channel adjacent to the UMTRA site. Increases in stream flow or localized increases in stream flow velocities should cause lateral erosion of alluvial (i.e., soil) deposits along the existing stream banks.

Groundwater flow in the alluvial aquifer and in the sedimentary bedrock at the site is reported to be toward the northeast and east, which approximates the direction of surface water stream channel flow.

Bedrock at the Canonsburg UMTRA site dips toward the east. Dip of bedrock at this site has no visible effect on the lateral erosion migration of the stream channel or on the active sloughing areas located north-northwest of Area A.

Stream channel flow is dependent on runoff volumes, since no stream control structures (such as dams) are located upstream from the UMTRA site.

4.0 ANALYSIS OF FINDINGS

Visual observations of the stream channel bank and active sloughing indicate that one of the most active mass wasting areas is located north and northwest of the western end of Area B. Field measurements indicate that the UMTRA fence in this area was approximately 20 ft (6 m) from the stream bank on December 16, 1992. Aerial photographs of this site taken on May 31, 1986, indicate that the fence-to-bank distance in this same area was 35 ft (11 m).

The average erosion rate (E_{rate}) for the 1986 to 1992 period is as follows:

$$E_{rate} = (35 \text{ ft} - 20 \text{ ft}) / (78.5 \text{ months}) = 0.2 \text{ ft/month}$$

If a similar erosion rate occurs in the future due to continued flooding and channel blockage, the laterally moving stream bank will reach the UMTRA security fence in approximately 8 years.

$$\text{Time to Fence} = (20 \text{ ft}) / (0.2 \text{ ft/month}) = 100 \text{ months or approximately 8 years}$$

Using the May 31, 1986, topographic map, at 12 approximately equally spaced locations, the distance from the stream edge to the UMTRA fence was measured and the results are as follows: 55 ft (17 m), 60 ft (18 m), 60 ft (18 m), 90 ft (27 m), 78 ft (24 m), 55 ft (17 m), 75 ft (23 m), 80 ft (24 m), 65 ft (20 m), 45 ft (14 m), 45 ft (14 m), and 40 ft (12 m).

Using the erosion rate calculated above and slope stability analysis based on an estimated undrained shear strength friction angle of the slope soil of $\phi' = 30$ degrees, erosion time to the fence and the slope factor of safety for the minimum, maximum, and average conditions were calculated as follows:

<u>Distance to Fence</u>	<u>Erosion Time</u>	<u>Slope (H:V)[*]</u>	<u>Factor of Safety^{**}</u>
40 ft (12 m) (Min)	17 years	1.9 to 1	1.1
90 ft (27 m) (Max)	38 years	4.3 to 1	2.5
62 ft (19 m) (Avg)	26 years	3.0 to 1	1.7

^{*} Horizontal:Vertical

^{**} Calculated factors of safety, for gravity static loadings, of less than 1.5 are considered unstable. A slope with a safety factor of 1.0 is in the process of failing.

Results of these calculations presently indicate that the slopes along the western side of the site are generally stable, except for the localized sloughing areas at the stream bank identified northwest of Area A (see site plan).

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 HISTORICAL EVIDENCE

Active erosion and sloughing activity currently observed northwest of Area A are apparently recently occurring phenomena caused by human intervention. Photographs of the banks of the stream channel taken during a site visit in August 1982 show that the stream banks are highly vegetated, relatively flat, and stable (see photographs 1 through 4, August 1982, in Appendix C). The May 12, 1983, *Geomorphic Stability Report for the Canonsburg Site*, prepared by Sergeant, Hauskins & Beckwith, Consulting Geotechnical Engineers, page 15, first paragraph states: "Large-scale bank erosion is not occurring along the portion of Chartiers Creek upstream from the Street Railway grade for a distance of about 4000 ft (1220 m). The stream channel in this area appears to be quite stable." Review of this historical material indicates that the Chartiers Creek bank west and northwest of Area A was stable during the site characterization and construction phases of the project.

5.2 FUTURE REPAIR EFFORTS

Flooding in the Borough of Houston and Chartiers Township has renewed public interest in the USACE Project to channelize and stabilize Chartiers Creek from Houston past the UMTRA site and to the end of the USACE-completed Canonsburg project. The Chartiers Township trustees have recently contacted the USACE Pittsburgh Office about doing the channel improvement work.

According to Jack Goga of the Pittsburgh USACE Office, the USACE has been contacted by local officials to restart channel improvement work on Chartiers Creek. The USACE has a complete set of plans for this work, prepared in the early 1980s, which will have to be reviewed and modified, as necessary. The USACE does not have funding for this work in their FY93 budget, so the earliest start-up date would be FY94. If everything goes well, the channel improvement work on Chartiers Creek past the UMTRA site could be completed by 1997 or 1998.

Since the USACE's work will not be completed for 4 or 5 years at the earliest, it is recommended that channel erosion protection work at the problem points located north-northwest of the west end of Area B be designed and constructed within 2 years. Erosion progress along the channel should be monitored during the yearly surveillance and maintenance (S&M) site visits. Monitoring of stream channel erosion should be added to the S&M plan and checklist.

Erosion monitoring of these new sloughing areas may be accomplished by installing additional erosion marker stakes and by comparing yearly aerial photographs. The proposed aerial photography work could be contracted to be done at the aerial photography subcontractor's convenience to reduce costs. As an alternative, a local surveyor could be contracted to establish control points at stable locations, and

6.0 LIST OF CONTRIBUTORS

The following individuals contributed to the preparation of this report.

Name	Contribution
J. Lommler (TAC)	Task management, field geomorphology work, data analysis, technical report document preparation.
G. Lindsey	Technical content review.
R. Saar	Technical review.
C. Silva	Technical editing, document coordination.
Creative Computer Services	Word processing support.

APPENDIX A

GEOMORPHIC STABILITY STUDY SITE PLAN

CANONSBURG GEOMORPHIC STABILITY STUDY DECEMBER 1992

- LEGEND**
- BANK SLOUGHING
 - PREVIOUS PROPERTY BOUNDARY
 - PROPERTY BOUNDARY
 - EXISTING SITE FEATURES & CONTOURS
 - FINAL SITE FEATURES
 - SLIDE GATE
 - SWING GATE
 - CONSTRUCTION GRID COORDINATE
 - REFERENCE GRID POINT
 - DRAINAGE SWALE
 - PERMANENT FENCING
 - OUTSIDE LIMIT (TIE) OF STRABING

U. S. DEPARTMENT OF ENERGY ALBUQUERQUE, NEW MEXICO		CANONSBURG SITE PHASE II CONSTRUCTION SITE PLAN	
DOCUMENT NO. 3083 CAN B 0181278-05, COPY		DATE: 12/1/92 BY: [Signature] CHECKED: [Signature] APPROVED: [Signature]	
DE-AC04-82AL14086		CAN-PS-10-0011	
REVISIONS		REVISIONS	
NO.	DATE	DESCRIPTION	BY
1	12/1/92	ISSUED FOR CONSTRUCTION	[Signature]
2	12/1/92	CLAMPED FENCE DETAILS AND NOTE 3	[Signature]
3	12/1/92	ADDED SECTION 1 & 2, CELL FOUNDATION LIMITS	[Signature]
4	12/1/92	REVISED LIMIT OF DISCONTINUATION AREA 3 DRAINAGE SWALE	[Signature]
5	12/1/92	REVISED LOCATION OF BUILT UP WALL AND DETAIL	[Signature]
6	12/1/92	ADDED NOTE 3	[Signature]

APPENDIX B
PHOTOGRAPHS-DECEMBER 1992

**STREAM BANK CONDITION - CHARTIERS CREEK
PHOTOS TAKEN ON DECEMBER 15-17, 1992**

**Photo 1: Channelized Chartiers Creek Looking West
from SR 980 "Phillip Murray" Bridge**

Photo 2: Detail of Riprap Channel, northwest of 980 Bridge

**STREAM BANK CONDITION - CHARTIERS CREEK
PHOTOS TAKEN ON DECEMBER 15-17, 1992**

**Photo 3: Central Avenue Bridge - Bedrock Channel
just Downstream from Northeast Abutment**

**Photo 4: Looking Southwest (upstream) from Central Avenue
to South Jefferson Street Bridge**

**STREAM BANK CONDITION - CHARTIERS CREEK
PHOTOS TAKEN ON DECEMBER 15-17, 1992**

**Photo 5: Corps of Engineers, Canonsburg-Houston
Project Sign by S. Jefferson Bridge**

**Photo 6: Channel Bedrock Bottom, South of Youngstown St.
Approx. 0.2 mile downstream from UMTRA site**

**STREAM BANK CONDITION - CHARTIERS CREEK
PHOTOS TAKEN ON DECEMBER 15-17, 1992**

**Photo 7: Bedrock Channel Beneath Conrail Bridge
just Downstream from Area C**

**Photo 8: Channel Adjacent to Area C, Upstream from Conrail
Bridge, Landslides Visible along Bank**

**STREAM BANK CONDITION - CHARTIERS CREEK
PHOTOS TAKEN ON DECEMBER 15-17, 1992**

Photo 9: Area C, Landslide Closeup View

**Photo 10: Area C, Landslides
North End of Area**

**STREAM BANK CONDITION - CHARTIERS CREEK
PHOTOS TAKEN ON DECEMBER 15-17, 1992**

**Photo 11: Area C, Landslide Closeup View, Soil on
Snow Indicates Active Erosion**

**Photo 12: Area C, Erosion Beneath Large Willow Tree,
Just Downstream from Strabane Av. Bridge**

**STREAM BANK CONDITION - CHARTIERS CREEK
PHOTOS TAKEN ON DECEMBER 15-17, 1992**

**Photo 13: Overall View of Stream Bank From
Strabane Avenue Bridge**

**Photo 14: Stream Bank Erosion Located North of Area
B, Viewed from Strabane Av. Bridge**

**STREAM BANK CONDITION - CHARTIERS CREEK
PHOTOS TAKEN ON DECEMBER 15-17, 1992**

**Photo 15: North Bank of Stream, North of Area A-B,
Residual Soil Exposed on "Cutting Face"**

**Photo 16: Bank Erosion NE
of Area B**

**STREAM BANK CONDITION - CHARTIERS CREEK
PHOTOS TAKEN ON DECEMBER 15-17, 1992**

Photo 17: Landslide Located North of Area A, Slide Movement Bending 4.5" Pipeline"

Photo 18: Slide Located North of "Residential" Area, Enclosure Fence Visible Nearby

Photo 19: Bank Erosion NW
of Residential
Area

Photo 20: Bank Erosion NW
of Residential
Area

**STREAM BANK CONDITION - CHARTIERS CREEK
PHOTOS TAKEN ON DECEMBER 15-17, 1992**

**Photo 21: Landslide North of "Residential" Area
View from Across Chartiers Creek**

**Photo 22: Slide Located Northwest of "Residential" Area,
Enclosure Fence Visible Nearby**

**STREAM BANK CONDITION - CHARTIERS CREEK
PHOTOS TAKEN ON DECEMBER 15-17, 1992**

**Photo 23: Landslide Northwest Side of "Residential" Area
View from Across Chartiers Creek**

**Photo 24: Slide Northwest Side of "Residential" Area,
View from Across Stream**

**STREAM BANK CONDITION - CHARTIERS CREEK
PHOTOS TAKEN ON DECEMBER 15-17, 1992**

Photo 25: Stream Bank Along West Side of "Technical" Area,
Note Flood Stage of Chartiers Creek

Photo 26: Stream Bank Along West Side of Technical Area,
Note Debris on Slope Surface

**STREAM BANK CONDITION - CHARTIERS CREEK
PHOTOS TAKEN ON DECEMBER 15-17, 1992**

**Photo 27: Stream Bank Along West Side of "Technical" Area,
Note Ceramic Debris on Slope Surface**

**Photo 28: Stream Bank Along West Side of Technical Area,
Note Ceramic Debris on Slope Surface**

APPENDIX C
PHOTOGRAPHS-AUGUST 1982

STREAM BANK CONDITION - CHARTIERS CREEK
PHOTOS TAKEN ON AUGUST 30, 1982

Photo 1: South Bank just North of Containment Cell
Bank Appears Relatively Stable

Photo 2: Close View of Bank, North of Future Cell Area

**STREAM BANK CONDITION - CHARTIERS CREEK
PHOTOS TAKEN ON AUGUST 30, 1982**

Photo 3: View of Northerly Bank, North of Site

Photo 4: View of Northerly Bank, North of Site