REPORT
TO
DEPARTMENT OF SUPPLY AND SERVICES
CONTRACT NO. 23440-0-9198/01-X8G

RE
RUNOUT CHARACTERISTICS OF DEBRIS FROM DUMP FAILURES IN MOUNTAINOUS TERRAIN

STAGE 1
DATA COLLECTION

VOLUME II
DRAWINGS AND PHOTOGRAPHS

September, 1991

Golder Associates Ltd.
CONSULTING ENGINEERS
Mine waste rock and overburden dumps are massive structures. Mountain top coal mines in British Columbia are constructing the largest man-made structures on the face of the earth. These immense waste dumps are often up to 400 meters high, contain in excess of one billion cubic meters of material, and often form mid-valley fills or rock drains. Instability of the structures has caused increased concern by mine operators and government regulators because of risk to the safety of personnel, equipment and infrastructure, and their impact on the environment.

In mid-1990 representatives of industry, CANMET, and the Ministries of Environment, and Energy, Mines and Petroleum Resources formed the Mine Waste Rock Pile Research Committee to foster research work and ensure a common understanding of these waste dumps.

The Interim Guidelines, published in May 1991, were the first two documents in a series undertaken by the committee. Three Interim Reports (Methods of Monitoring, Failure Runout Characteristics, Volumes I and II, and Review and Evaluation of Failures) continue the series of studies directed at improving our understanding of behaviour and developing a consistent database for waste dumps. Prominent geotechnical consultants and industry representatives have contributed their expertise to the studies.

The interim studies are being widely distributed by the Ministry of Energy, Mines and Petroleum Resources in the hope that all concerned with mine dumps will find them useful in establishing dumps that are stable, safe, and economically feasible. I anticipate that the studies will be distilled in the next year to develop a standard for investigation, design, operation, and monitoring of mine dumps.

In April 1992 the committee is sponsoring a series of workshops to introduce all of the studies to key industry personnel.

Tim Eaton, P.Eng.
Geotechnical Manager
Resource Management Branch
March 6, 1992
RESEARCH PROJECTS COMPLETED BY THE COMMITTEE

Investigation and Design Manual (1991)
Operating and Monitoring Manual (1991)
Methods of Monitoring (1992)
Failure Runout Characteristics - Volumes I and II (1992)
Review and Evaluation of Failures (1992)
PROFILE FOR DATA FILE # 1
FCL BROWNIE SPOIL - F GULLY
FAILURE DATE : JUN. 11, 1983
Figure 1

DISTAL PORTION OF DEBRIS IN GULLEY E

TEST PIT THROUGH DISTAL PORTION OF GULLEY E DEBRIS

GULLEY F  GULLEY E  GULLEY D

DISTAL PORTION OF DEBRIS IN GULLEY E
PROFILE FOR DATA FILE # 3
FCL BROWNIE GULLY D-E
FAILURE DATE: SEP. 12, 1984
CREST POSITION NOT KNOWN
AND NOT SHOWN - SEE SECTION
PROFILE FOR DATA FILE # 5
FCL BROWNIE SPOIL - F' GULLY
FAILURE DATE: JUL. 24, 1984
PROFILE FOR DATA FILE # 6
FCL BROWNIE SPOIL
FAILURE DATE : AUG. 16, 1985
PROFILE FOR DATA FILE # 7
FCL BROWNIE G SPOIL
FAILURE DATE: JUN. 29, 1985
PROFILE FOR DATA FILE # 11
FCL BROWNIE, GULLY G&H
FAILURE DATE: SEP. 16, 1985
Note: Profile estimated based on written description (FCL report).
PROFILE FOR DATA FILE # 12
FCL 13 SEAM ALTERNATE SPOIL
FAILURE DATE : AUG. 14, 1986
PROFILE FOR DATA FILE # 14
FCL BLACKSTONE EMERGENCY DUMP
FAILURE DATE: OCT. 05, 1986
Figure 16 S

PROFILE FOR DATA FILE # 16
FCL BLACKRILL SPOIL
FAILURE DATE: JUN. 17, 1985
PROFILE FOR DATA FILE # 19
FCL CLODE SPOIL PILE
FAILURE DATE: MAY. 05, 1972
PROFILE FOR DATA FILE # 20
FCL 2 MSPOIL
FAILURE DATE: MAY, 27, 1972

Elevation (m)

Horizontal Distance (m)
Figure 27 S

PROFILE FOR DATA FILE # 27
FCL CLODE WASTE PILE
FAILURE DATE: NOV. 12, 1974
Scale in Feet
APPROX. METRIC SCALE 1:2000

Figure 27 T
PCL 2-SPOIL 11/12/74

DUMP TOE POSITION

Approx. Metric Scale 1:2000
PROFILE FOR DATA FILE # 35
BLMR HARMER II BRIDGE
FAILURE DATE : NOV. 18, 1980

PRE-FAILURE DUMP SURFACE

ORIGINAL GROUND SURFACE

Elevation (m)

Horizontal Distance (m)
PROFILE FOR DATA FILE # 36
WESTAR, ADIT 40 C1 DUMP
FAILURE DATE : JUN. 29, 1982
Figure 38 S

PROFILE FOR DATA FILE # 38
KAISER ERICKSON CREEK, ADIT 29 SOUTH
FAILURE DATE: FEB. 08, 1976

BALMER 5975 02/08/76
PROFILE FOR DATA FILE # 40
KAISER BALMER PIT, No. 2 SPOIL
FAILURE DATE : NOV. 24, 1968

PRE-FAILURE DUMP SURFACE

ORIGIN GROUND SURFACE

SLIDE TERMINUS

Elevation (m)

Horizontal Distance (m)
POST-FAILURE CONTOURS

Approx. Scale: 1 in. to 200 ft.
SEVERAL DAYS POST FAILURE DURING RE-OPENING OF HIGHWAY
PROFILE FOR DATA FILE # 42
WESTAR BALMER ADIT 29 N
FAILURE DATE: MAY 05, 1971

ORIGINAL GROUND SURFACE

Elevation (m)

Horizontal Distance (m)
Photograph looking south showing slide debris from Adit 29 North and Harmer No. 2 waste dumps in Harmer Creek.
Figure 43 S

PROFILE FOR DATA FILE # 43
KAISER HARMER KNOB
FAILURE DATE : MAY 13, 1971

PRE-FAILURE DUMP SURFACE
RUN OUT DEBRIS IN SIX MILE CREEK

TERMINUS ON OPEN FAN AREA

TIGHTLY INCISED CREEK
Figure 44

PROFILE FOR DATA FILE # 44
ADIT 29 S, 6380 FT DUMP
FAILURE DATE: MAY 25, 1973

PRE-FAILURE DUMP SURFACE

ORIGINAL GROUND SURFACE
Figure 48

DEBRIS OUTLINE FROM QCL 86-100-27-001 "PLAN SHOWING 1640 MM DUMP FAILURE JUNE 21, '86"

1640 MM DUMP DEBRIS TERMINATED AGAINST EXISTING DEBRIS OF SEPT 9, '85 1660N DUMP FAILURE (EVENT 54)

GROUND CONTOURS REVISED BENEATH 1640 DEBRIS TO SHOW CONTOURS OF PRECEDING FAILURE DEBRIS

BASE DRAWING OF ORIGINAL GROUND CONTOURS FROM QCL SHEET X-32

APPROX. CREST PRE-Failure
APPROX. TOE PRE-Failure
APPROX. TOE OF 1875 MM DUMP

OUTLINE OF 1660N DUMP FAILURE SEPT 9, 1985

OUTLINE OF 1640 MM DUMP DEBRIS TO SHOW CONTOURS OF PRECEDING FAILURE DEBRIS
PROFILE FOR DATA FILE # 49
QUINTETTE COAL 1705 WN
FAILURE DATE : JUN 30, 1986

Slide Debris
SECTION LINE AND DUMP OUTLINE FROM QCL DWG 86-200-27-001 Rev 0
"PLAN SHOWING 17Q5WN DUMP FAILURE JUNE 30 1986"

BASE DWG IS QCL MAP Y-31
PROFILE FOR DATA FILE # 54
QUINTETTE 1660 N
FAILURE DATE: SEP. 07, 1985

Horizontal Distance (m)

Elevation (m)

0 250 500 750 1000 1250 1500 1750 2000 2250 2500 2750 3000

2000 1900 1800 1700 1600 1500 1400 1300 1200 1100 1000

PRE-FAILURE DUMP SURFACE

ORIGINAL GROUND SURFACE

SLIDE TERMINUS
PROFILE FOR DATA FILE # 62
LINE CREEK 1996 DUMP
FAILURE DATE: JUL. 01, 1982

PRE-FAILURe DUMP SURFACE

ORIGINAL GROUND SURFACE

SLIDE TERMINUS

Elevation (m)

Horizontal Distance (m)
Figure 62

Deposit of debris in area of slide impact.

REFERENCE: Geographic Air Survey Ltd.,
Photo number G8209039-1-7.
PROFILE FOR DATA FILE # 75
WESTAR GREENHILLS, HAWK PIT DUMP
FAILURE DATE: MAR. 20, 1983
PROFILE FOR DATA FILE # 76
WESTAR GREENHILLS 2200 EAST DUMP
FAILURE DATE: MAY 11, 1983
PROFILE FOR DATA FILE # 79
GREENHILLS EAST 2140
FAILURE DATE: JUL. 12, 1986
GREENHILLS EAST 2140
FAILURE DATE: FEB. 12, 1987

PROFILE FOR DATA FILE # 80
GREENHILLS EAST 2140
FAILURE DATE: FEB. 12, 1987
Figure 81 S

PROFILE FOR DATA FILE # 81
GREENHILLS EAST 2140
FAILURE DATE: MAR. 07, 1987

PRE-FAILURE DUMP SURFACE

ORIGINAL GROUND SURFACE
PROFILE FOR DATA FILE # 89
GREENHILLS NORTH 21000
FAILURE DATE : JUL. 01, 1985?

PRE-FAILURE DUMP SURFACE

ORIGINAL GROUND SURFACE
PROFILE FOR DATA FILE # 112
QUINTETTE 1690 MT
FAILURE DATE: AUG. 17, 1984
PROFILE FOR DATA FILE # 113
QUINTETTE 1690 MARMOT
FAILURE DATE : OCT. 04, 1985
PROFILE FOR DATA FILE # 149
FCL SOUTH SPOIL
FAILURE DATE: JUL. 16, 1986

PRE-FAILURE DUMP SURFACE

SLIDE TERMINUS

ORIGINAL GROUND SURFACE
GRADUAL FAILURE ARRESTED BY TOE BERM
PROFILE FOR DATA FILE # 153
FCL S.S STG. 2, ACCESS ROAD
FAILURE DATE : MAY 29,1990
PROFILE FOR DATA FILE # 154
FCL S.S STG. 2, ACCESS ROAD
FAILURE DATE : JUL.07, 1990
Figure 154 T

ORIGINAL GROUND CONTOURS

Approx. Scale: 1:2000

EXTENT OF SLIDE DEBRIS FOR EVENT 153

APPROX. CREST PRIOR TO FAILURE
PROFILE FOR DATA FILE # 155
FCL SOUTH SPOIL
FAILURE DATE : OCT.26, 1989
Photo 1 - Side view of spoil pile movement. Note (1) Steep upper scarp. (2) Uniform upper parallel sloped to top of Blackwood Pit. (3) Runout area in the valley bottom. The material developed high velocity and scoured the terrace top and valley bottom. The present conditions provide better spoil pile foundations than previously.

From report by C. Brawner to Fording Coal Ltd. November 14, 1989.

Photo 6 - Toe runout zone looking from above. The toe ran up the far mountain as a result of the velocity. The spoil appears to have ski jumped off the creek terrace and possibly liquified when it encountered the valley bottom softer and wetter sediments. The toe acted much like the toe of the Hope-Princeton rock slide when it hit the valley bottom. The valley bottom is now obviously more stable.
PROFILE FOR DATA FILE # 156
WESTAR GREENHILLS, NORTH DUMP 2031m
FAILURE DATE: NOV. 22, 1989
Figure 156 T11/22/89

GREENHILLS NORTH

DUMP FAILURE OUTLINE FROM WESTAR DWG NO 541 NOV 23 1989.

TERMINUS OF RUNOUT FOR FAILURE

CREST POSITION POST-FAILURE

CREST POSITION PRE-FAILURE

RUNOUT DEBRIS JULY 1985

TOE OF NORTH DUMP PRE-FAILURE

OVERBURDEN DEBRIS FROM SEPT 7 1986 FAILURE

ORIGINAL GROUND CONTOURS

BASE CONTOUR MAP IS WESTAR SHEET F5

DUMP FAILURE OUTLINE FROM WESTAR DWG NO 541 NOV 23 1989.

Approx. Scale: 1:5000

0 100 200 300 400 500 m
PROFILE FOR DATA FILE # 157
QUINTETTE 1660 DUMP
FAILURE DATE : NOV. 07, 1987

Horizontal Distance (m)

Elevation (m)

PRE-FAILURE DUMP SURFACE

ORIGINAL GROUND SURFACE
PROFILE FOR DATA FILE # 158
QUINTETTE WOLVERINE WEST
FAILURE DATE: MAY 13, 1988

PRE-FAILURE DUMP SURFACE

ORIGINAL GROUND SURFACE

Elevation (m)

0 125 250 375 500 625 750 875 1000 1125 1250 1375 1500

Horizontal Distance (m)
The inclination of the slope on the right valley wall is controlled by the inclination of a major set of cross joints. The strike of the sedimentary units is approximately parallel to the axis of the valley. The stratigraphic dip is toward the right hand side of the photo.

A view looking in the down-valley direction, showing the debris run that resulted from the 17 May '88 failure on the face of the Wolverine West Dump, and the right valley wall. The surficial colluvial soil mantle on the right valley wall is thin, and is only quasi-stable on the slope.

PROFILE FOR DATA FILE # 162
FCL BROWNIE SPOIL – F GULLY
FAILURE DATE : JUN. 1983
DUMP CREST LOCATION NOT KNOWN REFER TO SECTION 162S FOR ESTIMATED POSITION

CONTOURS ARE ORIGINAL GROUND