LIFE IN THE WAKE OF A 200 YEAR FLOOD EVENT
AT THE FORDING RIVER OPERATIONS, JUNE 1995

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ABSTRACT

On June 6, 1995, a major flood event estimated to be greater than a Q200 flow, devastated the Elk Valley area of Southeastern British Columbia. Major highways, bridges and rail lines were impacted with damage estimates in the tens of millions.

Fording Coal Limited sustained nearly 7 million dollars in damages to rail lines, roads, bridges, settling ponds and other infrastructure. This paper summarizes the events leading up to the flood, describes the damages caused and remedial actions, and discusses what can be learned for the future.

INTRODUCTION

Fording Coal Limited's, Fording River Operations is located in the Southeastern corner of British Columbia in the East Kootenay region. At an elevation of 1646m, the mine's climate can be described as continental temperature with seasonal temperature extremes of +35°C in summer and -40°C in winter. Annual precipitation averages 882mm, with 30 percent usually falling as snow.

Mining operations at Fording River began in 1970 with annual clean coal production of 3 million tonnes, and has increased to today's production level of over 7 million tonnes of clean coal.

The coal mining operation is primarily a large truck/shovel fleet, with one dragline accounting for approximately 20 percent of production. The operation employs 800 employees that work the mine on a continuous 24 hour, year-round, basis.
FLOOD PROTECTION DESIGN CRITERIA

As the mine, processing and support facilities are built in and around many permanent drainage systems, each with its own individual requirements and associated risks, design criteria for significant infrastructure have evolved with the following major groupings:

<table>
<thead>
<tr>
<th>Structure</th>
<th>Design Criteria</th>
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<tbody>
<tr>
<td>Settling Ponds / Ditches</td>
<td>Q10, 24 hrs. max. rainfall, overflow protection.</td>
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<tr>
<td>Temporary Fish Enhancement Structures or Roads</td>
<td>Q10</td>
</tr>
<tr>
<td>Large Short Term Dams/Small Culverts</td>
<td>Q20, overflow protection</td>
</tr>
<tr>
<td>Large Long Term Culverts, Bridges on Fish Movement Streams</td>
<td>Q50</td>
</tr>
<tr>
<td>Permanent Culverts, Bridges</td>
<td>Q200</td>
</tr>
<tr>
<td>Permanent Floodplain Protection (Riprap, Armour)</td>
<td>Q200</td>
</tr>
</tbody>
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These design criteria used are a combination of government regulations, guidelines, company risk analysis (probability of occurrence and exposure to risk) and 25 years of experience to site specific conditions. To date, they have proven to be reliable and reasonable criteria.

CONDITIONS LEADING UP TO THE FLOOD

The winter of 1994/95 was by most accounts normal in terms of total precipitation. Total snowfall was 243 cm, however, by mid May, it became clear that the snowpack for the time of year was well above normal, caused by cool weather in April and May with continual accumulation of snow at higher elevations and little increase in streamflow as is expected in this period.

In the weeks leading up to the flood, diligent preparations to ensure ditches, ponds and culverts were well maintained, were conducted. All was in readiness for a significant, later than normal, spring peak flow. Or so we thought.

On June 6, 1995 with streams still running at near base flow, a major storm event which dropped 65mm of rain in less than 24 hours, coupled with warm weather melting of the late snowfall, swelled streams to record flows.
In Henretta Creek, flows increased from approximately 6m$^3$/sec on June 5th to over 45m$^3$/sec at 12:45 p.m on June 6th. Q200 flow predictions for Henretta Creek were 32.8m$^3$/sec.

**FLOOD DESCRIPTION AND DAMAGE**

Although all flow measuring devices at Fording River and in the general area were damaged or destroyed by the flood, estimates of flows in Henretta Creek and the Fording River system were assumed to be in the Q200 or greater range. Flow return calculations do vary with the data set used, but it is clear that future return flow calculations will be higher based on inclusion of flows estimated for the 1995 year.

The rising flows on June 6th and 7th were well beyond design criteria used to protect infrastructure along the Henretta Creek and Fording River, as well as in the Elk/Flathead area and the Foothills area of Southwestern Alberta impacted by the storm. Tens of millions of dollars were incurred in damages to rail lines, rail bridges, powerlines, roads, bridges, gas lines, culverts, businesses and homes.

Road and rail traffic, gas and power distribution was disturbed for *weeks* while repairs were made.

Many lives were endangered during the flood, and one fatality was attributed to the extreme flows.

At Fording River Operations flood and storm related damages exceeded 3 million dollars and our neighbouring mine, Coal Mountain Operations experienced similar financial impacts.

At Fording River the major impacts were:

- Displacement of large culverts and flooding of the pit in Henretta Creek.
- Damage to powerlines across the property.
- Damage to newly topsoiled and seeded areas.
- Damage to fish enhancement projects in the Fording, Henretta and Fish Pond Creek.
- Dyke and inlet damage to Clode, Eagle, Lake Mountain and Kilnamock Settling Ponds.
- Partial removal of North and South Tailings Ponds and dykes.
- Removal of culverts and damage to highways and sewage lines.
- Displacement and damage to every bridge and major culvert on the Fording River.
- Loss of 4 water metering stations.
- Loss of power and gas services.
- Loss of road and rail services.
MITIGATION AND REPAIRS

In the brief hours leading up to the peak of the flood, mitigation measures were undertaken to prevent more serious damage. A major diversion or overflow channel was constructed adjacent to the culverts conducting Henretta Creek through Henretta Pit, the dragline was moved to higher ground and rock was placed along the Fording River to prevent erosion of the powerline and tailings pond dykes. At one point, 6 – D10 and D11 crawler dozers, loaders, 6-170 and 240 ton trucks, and numerous support equipment such as backhoes were involved in the protection effort.

Mitigative efforts succeeded in minimizing capital losses, loss of services, and disruption to operations.

Over the next 6 months, work continued on repair and replacement of damaged infrastructure in order of priority. Immediate attention to flood repairs in critical areas minimized impact on the environment and reduced longer term effects. Examples included repairs to settling ponds and tailings pond dykes, where the potential for major amounts of sediments to enter the Fording River were prevented with protection action and immediate rebuilding. Work in and about the streams was minimized and supported by local ministries.

The following before and after photographs of flood damage and repairs give examples of the nature and extent of the impact of the 1995 flood.
North Tailings Pond Dyke and Tailings Line Damage June 8, 1995

PHOTOGRAPH 2

North Tailings Pond Dyke following repairs September, 1995
PHOTOGRAPH 3

Damage to Clode Settling Pond Dyke June 8, 1995

PHOTOGRAPH 4

Repaired Clode Pond Dyke September, 1995
RECOMMENDATIONS AND CONCLUSIONS

Given such a rare opportunity to reflect on the adequacy of flood protection design at the Fording River Operations with the reconcilable experience of the 1995 flood, it is clear that with minor exceptions, flood protection was within acceptable risk criteria.

One recommended change to future flood protection is the provision for overflow protection above the design flows for major culverts and bridges.

It is usually relatively simple and inexpensive to construct an overflow channel or low point around a bridge or culvert installation such that flows above the design will bypass the structures avoiding major damage. Overflow channels may, however, damage roads or other less critical and less costly structures. An example of this approach is illustrated in photographs 5 and 6.

PHOTOGRAPH 5

Swift Creek Bridge Showing Flood Damage Due to No Overflow Protection June 6, 1995
Another recommendation is to establish an emergency plan for floods including contingency drainage plans, resource contacts, and location of required equipment and materials.

Flood protection design must take into account legislative requirements of licencing agencies, probability for exceeding design criteria, exposure to the risk, and site specific conditions. Accordingly, final design acceptance should include approving agencies, experienced hydologists, engineers, environmental specialists, insuring agencies and operators.

Design criteria should then be periodically reviewed with changes in data, technology and local knowledge.