Appendix 1.0-J Norwest, Runaway Ramp Report

TELKWA COAL
LIMITED

NORWEST
CORPORATION

May 26, 2010

File #: 08-4037

Peace River Coal Inc.
Trend Operations
PO Box 919
Tumbler Ridge, BC
V0C 2W0

Attn: Steve Amor
Mine Manager

Dear Steve:

Re: Technical Review of Existing Runaway Ramp System

At the request of Peace River Coal Inc. (PRC), Norwest Corporation (Norwest) has completed a technical review of the existing runaway ramp system at the Trend Mine (the review). The desktop review was completed in Norwest's Calgary Office; the author did not visit the operation. The scope of the review was twofold. In the first part, Norwest was asked to examine whether the existing runaway ramp system meets the requirements of Part 6.9.2, of the British Columbia Mines Act which states:

"On roadways where the grade exceeds 5% the manager shall have installed and maintained runaway lanes or retardation barriers where condition s/ risks warrant."

In the second part, Norwest was asked to quantify the performance characteristics of the existing system and where warranted make component specific recommendations towards enhancing system performance.

BACKGROUND

Through continuous improvement equipment manufacturers have dramatically improved the reliability and performance of large haulage trucks braking systems to the point where complete loss of braking events are rare where a complete loss of braking event is defined as the loss of dynamic / retarder braking (dynamic brakes) in conjunction with the failure of the mechanical braking system (service brakes). The best defense against such an occurrence is the establishment and reinforcement of procedures that address the inspection, maintenance and operation of the braking systems. Procedures should include but not necessarily be limited to the following:

1. **Preventive Maintenance** – The preventive maintenance program must include the periodic inspection, adjustment and if necessary, component replacement of the critical elements of the braking systems.

2. **Truck Operation** – The equipment operator on the pre-operation check and/or in response to a change in braking system performance should inspect all visible components of the braking systems for completeness, fluid leaks, and wear. If a problem is detected, the unit should be shutdown until it is inspected by maintenance personnel and released back into service.

There is higher risk that a truck will lose its dynamics or primary braking system then there is that the truck would experience a complete and simultaneous failure of both the primary and secondary systems. The mine must have and reinforce operating procedures to be implemented in the event of such an occurrence to ensure that improper action on the part of the operator does not serve to further aggravate the problem. The operating procedure should include training regarding the importance of dynamically applying and maintaining full use of the service brake until the truck is stopped as opposed to feathering the brake which can lead to overheating, loss of friction and, ultimately, failure of the service brake. Proper deployment of the service brakes can prevent a runaway whereas feathering can cause a runaway. The procedure should be reviewed periodically with all equipment operators.

In spite of the foregoing measures the potential for a runaway occurring cannot be ignored. As such, mine operators review the vertical alignment of their haulage ways and install runaway ramps at high exposure locations to serve as a last means of stopping a truck.

METHODOLOGY

To enable the analysis PRC provided Norwest with an AutoCAD copy of the Trend Mine's base drawing complete with 2 m contours. Additionally, PRC supplied long sections through each of the existing runaway ramps that specified both the length and grade of each ramp. Norwest then assigned names to each of the existing runaway ramps, Ramp "#", and to each of the road segments associated therewith, RDSEG "X". See Figure 1.

Norwest examined the following characteristics of each component of the haulage way which on aggregate compose the runaway ramp system.

1. The maximum speed reached at the end of each road segment (V_2), at the entrance of the associated or first available runaway ramp.
2. The stopping distance required on that runaway ramp given (V_2) for each runaway ramp, road segment combination.

Maximum Speed (V_2) was found using the following equation.

$$S = \frac{(V_2)^2 - (V_1)^2}{2g * \sin\theta}$$

Where S = length of road segment (feet)
(V_2) = maximum speed or speed at entrance to runaway ramp (ft/sec)
(V_1) = speed at onset of complete braking loss = 27.3 ft/sec or 30 kph
g = acceleration due to gravity = 32.2 ft/sec^2
Angle θ = Road Grade minus the average net Rolling Resistance (4%) expressed in degrees

Stopping Distance (S) on the runaway ramp or the minimum runaway ramp length was found using the same equation by solving for (S) with (V_2) set to zero and (V_1) being set to the maximum speed calculated for its companion road segment. Rolling resistance on the runaway ramp was increased to 5%.

ANALYSIS

The equation above was used to characterize each existing road segment and associated runaway ramp pair. In addition, the technical merit associated with introducing additional runaway ramps to the road system was examined.

From a probability of failure point of view it is equally likely that a full braking loss event would occur at any point along a segment. To examine truck performance across the road segment maximum speed was calculated from the starting point of the road segment as well as the midpoint.

Road Segment A, Runaway Ramp 1

Road Segment A begins on the 1600 dump and ends at Runaway Ramp 1 (RR1). RDSEG A is 480 m long and has an average downhill grade of 6.7%. RR 1 is 292 m long at a 4.3% grade. The results of the analysis are shown in Table 1.

TABLE 1
RUNAWAY RAMP 1 ANALYSIS

Road Segment	Runaway Ramp	max speed (kph)		stopping distance (m)	
		full segment	half segment	full segment	half segment
A	1	65	51	177	108

The analysis shows that a truck experiencing a full braking loss at the midpoint of RDSEG A at an initial speed of 30 kph would reach RR1 at a speed of 51 kph. Similarly, if the truck experienced full braking loss at the beginning of RDSEG A it would reach RR1 at a speed of 65 kph. As constructed, RR1 is adequate to stop the truck at either arrival speed.

Road Segment B, Runaway Ramp 2

Road Segment B begins at RR1and ends at RR2. RDSEG B is 318 m long and has an average downhill grade of 5.0%. RR 2 is 260 m long at 6.2% grade. The results of the analysis are shown in Table 2.

TABLE 2
RUNAWAY RAMP 2 ANALYSIS

Road Segment	Runaway Ramp	max speed (kph)		stopping distance (m)	
		full segment	half segment	full segment	half segment
B	2	42	37	62	47

The analysis shows that a truck experiencing a full braking loss at the midpoint of RDSEG B at an initial speed of 30 kph would reach RR2 at a speed of 37 kph. Similarly, if the truck experienced full braking loss at the beginning of RDSEG B it would reach RR2 at a speed of 42 kph. As constructed, RR2 is adequate to stop the truck at either arrival speed.

Road Segment C, Runaway Ramp 3

Road Segment C begins at RR2and ends at RR3. RDSEG C is 311 m long and has an average downhill grade of 9.0%. RR 3 is 250 m long at 3.0% grade. The results of the analysis are shown in Table 3.

TABLE 3
RUNAWAY RAMP 3 ANALYSIS

Road Segment	Runaway Ramp	max speed (kph)		stopping distance (m)	
		full segment	half segment	full segment	half segment
C	3	70	54	240	142

The analysis shows that a truck experiencing a full braking loss at the midpoint of RDSEG C at an initial speed of 30 kph would reach RR3 at a speed of 54 kph. Similarly, if the truck experienced full braking loss at the beginning of RDSEG C it would reach RR3 at a speed of 70 kph. As constructed, RR3 is adequate to stop the truck at either arrival speed.

Road Segment D, Run-Out RDSEG D

Road Segment D begins at RR3 and ends at an elevation of 1506 at the 1510 corner between RR 3 and RR4. This segment does not have a runaway ramp rather Norwest examined the merit of developing a run-out area to the west of the 1510 corner; Run-Out RDSEG D. RDSEG D is 422 m long and has an average downhill grade of 4.3%. The results of the analysis are shown in Table 4.

TABLE 4
RUN-OUT RDSEG D ANALYSIS

Road Segment	Runaway Ramp	max speed (kph)		stopping distance (m)	
		full segment	half segment	full segment	half segment
D	Run-Out RDSEG D	35	33	37	32

The analysis shows that a truck experiencing a full braking loss at the midpoint of RDSEG D at an initial speed of 30 kph would reach the 1510 corner at a speed of 33 kph. Similarly, if the truck experienced full braking loss at the beginning of RDSEG D it would reach the 1510 corner at a speed of 35 kph. RDSEG D with a grade of 4.3% is very near the rolling resistance of 4% resulting in very little speed gain over the segment. Run-Out RDSEG D was developed on the west side of the 1510 corner at a grade of 8%. The analysis found that the run-out area would need to be 40 m in length or greater to stop the truck.

Road Segment E, Runaway Ramp 4

Road Segment E begins at the end of RDSEG D and ends at RR4. RDSEG E is 220 m long and has an average downhill grade of 10.9%. RR 4 is 306 m long at 4.6% grade. The results of the analysis are shown in Table 5.

TABLE 5
RUNAWAY RAMP 4 ANALYSIS

Road Segment	Runaway Ramp	max speed (kph)		stopping distance (m)	
		full segment	half segment	full segment	half segment
E	4	69	54	196	117

The analysis shows that a truck experiencing a full braking loss at the midpoint of RDSEG E at an initial speed of 30 kph would reach RR4 at a speed of 54 kph. Similarly, if the truck experienced full braking loss at the beginning of RDSEG E it would reach RR4 at a speed of 69 kph. As constructed, RR4 is adequate to stop the truck at either arrival speed.

Road Segment F, Runaway Ramp 5

Road Segment F begins at RR4 and ends at RR5. RDSEG F is 205 m long and has an average downhill grade of 9.8%. RR 5 is 220 m long at 4.7% grade. The results of the analysis are shown in Table 6.

TABLE 6
RUNAWAY RAMP 5 ANALYSIS

Road Segment	Runaway Ramp	max speed (kph)		stopping distance (m)	
		full segment	half segment	full segment	half segment
F	5	63	49	159	98

The analysis shows that a truck experiencing a full braking loss at the midpoint of RDSEG F at an initial speed of 30 kph would reach RR5 at a speed of 49 kph. Similarly, if the truck experienced full braking

loss at the beginning of RDSEG F it would reach RR5 at a speed of 63 kph. As constructed, RR5 is adequate to stop the truck at either arrival speed.

Road Segment G, Proposed Runaway Ramp 6, Potential Runaway Ramp 6

Road Segment G begins at RR5 and ends at the 1440 corner which is the proposed location for RR6. RDSEG G is 201 m long and has an average downhill grade of 6.0%. The stopping distance was calculated using 8% grade on the runaway ramp. The results of the analysis are shown in Table 7.

TABLE 7
PROPOSED RUNAWAY RAMP 6 ANALYSIS

Road Segment	Runaway Ramp	max speed (kph)		stopping distance (m)	
		full segment	half segment	full segment	half segment
G	6 (Proposed)	44	38	59	43

The analysis shows that a truck experiencing a full braking loss at the midpoint of RDSEG G at an initial speed of 30 kph would reach RR6 at a speed of 38 kph. Similarly, if the truck experienced full braking loss at the beginning of RDSEG G it would reach RR6 at a speed of 44 kph. A minimum length for RR6 of 60 m would be required to service RDSEG G.

Norwest examined the merit of installing the runaway ramp at a second location; Potential Runaway Ramp 6. There is limited free space, approximately 60 m in total length, available at this location to install a runaway ramp. The analysis found that if a runaway ramp featuring a 15% grade were installed, the required stopping distance would match the available space of 60 m. If PRC wishes to pursue this alternate location for RR6 then a detailed design would be required to confirm that the design requirements can be met given the spatial limitation of the site.

Road Segment H, Proposed Runaway Ramp 7

At present, there are no runaway ramps servicing the 1540 waste dump access road on the NE end of the property. Norwest has examined the need for runaway ramps along these haulage ways.

Road Segment H begins at an elevation of 1608 at the eastern end of the pit and is used to haul material to the north. RDSEG H is 157 m long and has an average downhill grade of 8.9%. The stopping distance was calculated using 8% grade on the runaway ramp. The results of the analysis are shown in Table 8.

TABLE 8
PROPOSED RUNAWAY RAMP 7 ANALYSIS

Road Segment	Runaway Ramp	max speed (kph)		stopping distance (m)	
		full segment	half segment	full segment	half segment
H	7	54	44	88	58

The analysis shows that a truck experiencing a full braking loss at the midpoint of RDSEG H at an initial speed of 30 kph would reach RR7 at a speed of 44 kph. Similarly, if the truck experienced full braking loss at the beginning of RDSEG H it would reach RR7 at a speed of 54 kph. A minimum length for RR7 of 90 m would be required to service RDSEG H.

Road Segments I-1 & I-2, Proposed Runaway Ramp 8

RDSEG I-1 and RDSEG I-2 merge at an elevation of 1547 becoming the access road to the 1540 dump. Road Segment I-1 begins at an elevation of 1602 at the northern pit edge. RDSEG I-1 is 380 m long and has an average downhill grade of 7.4%. RDSEG I-2 is east of RDSEG I-1 and begins at an elevation of 1594 at the end of RDSEG H. RDSEG I-2 is 529 m long and has an average downhill grade of 3.8%. Both road segments end at the proposed location for RR8. Each road segment leading to RR8 was analyzed to ensure that RR8 could be used by trucks hauling on either route. The stopping distance was calculated using 8% grade on the runaway ramp. The results of the analysis are shown in Table 9.

TABLE 9
PROPOSED RUNAWAY RAMP 8 ANALYSIS

Road Segment	Runaway Ramp	max speed (kph)		stopping distance (m)	
		full segment	half segment	full segment	half segment
I-1	8	65	51	127	78
I-2	8	25	28	19	23

The analysis shows that a truck experiencing a full braking loss at the midpoint of RDSEG I-1 at an initial speed of 30 kph would reach RR8 at a speed of 51 kph. Similarly, if the truck experienced full braking loss at the beginning of RDSEG I-1 it would reach RR8 at a speed of 65 kph. A truck experiencing a full braking loss at the midpoint of RDSEG I-2 at an initial speed of 30 kph would reach RR8 at a speed of 28 kph. Similarly, if the truck experienced full braking loss at the beginning of RDSEG I-2 it would reach RR8 at a speed of 25 kph. A minimum length for RR8 of 130m would be required to service both RDSEG I-1 & I-2.

The analysis found that a truck experiencing full loss of breaking on RDSEG I-2 would lose speed as it approaches RR8. This means that no runaway ramp would be required if RDSEG I-1 was not in service.

Road Segment J, Proposed Runaway Ramp 9

Road Segment J begins at RR8 and ends at an elevation of 1552 on the access road to the 1540 dump at the proposed location of RR9. RDSEG J is 321 m long and has an average downhill grade of 6.9%. The stopping distance was calculated using 8% grade on the runaway ramp. The results of the analysis are shown in Table 10.

TABLE 10
PROPOSED RUNAWAY RAMP 9 ANALYSIS

Road Segment	Runaway Ramp	max speed (kph)		stopping distance (m)	
		full segment	half segment	full segment	half segment
J	9	57	46	99	64

The analysis shows that a truck experiencing a full braking loss at the midpoint of RDSEG J at an initial speed of 30 kph would reach RR9 at a speed of 46 kph. Similarly, if the truck experienced full braking loss at the beginning of RDSEG J it would reach RR9 at a speed of 57 kph. A minimum length for RR9 of 100 m would be required to service RDSEG J.

Road Segment K, Run-Out RDSEG K

Road Segment K begins at RR9 and ends at the entrance to the1540 Dump. No runaway ramp is proposed for this segment rather Norwest examined the merit of using the 1540 Dump as a run-out area to stop the truck. RDSEG K is 198 m long and has an average downhill grade of 6.1%. The stopping distance was calculated using 0% grade on the dump. The results of the analysis are shown in Table 11.

TABLE 11
RUN-OUT RDSEG K ANALYSIS

Road Segment	Runaway Ramp	max speed (kph)		stopping distance (m)	
		full segment	half segment	full segment	half segment
K	Run-Out RDSEG K	45	38	153	112

The analysis shows that a truck experiencing a full braking loss at the midpoint of RDSEG K at an initial speed of 30 kph would reach the entrance to the 1540 Dump at a speed of 38 kph. Similarly, if the truck experienced full braking loss at the beginning of RDSEG K it would reach the 1540 Dump at a speed of 45 kph. The analysis showed that there is sufficient room on the 1540 Dump for the truck to stop.

There is an existing 130m long +10% grade ramp near the end and west of RDSEG K. Although this ramp is on the opposite side of the road for the loaded truck, it could be adapted to serve as a replacement for Run-Out RDSEG K.

DISCUSSION

The analysis found that all existing ramps are of sufficient length and grade to stop a truck experiencing full braking loss at the beginning of the applicable road segment. If a truck were to experience full braking loss at the midpoint of the road segment it would reach a speed in the range of 28 kph and 54 kph at the entrance to the runaway ramp; depending on the road / ramp pair under consideration. Therefore if full braking loss occurred at any point on the road segment below the midpoint then the arrival speed would be less.

If a truck were to experience full braking loss at the beginning of the road segment it would reach a speed in the range of 25 kph and 70 kph at the entrance to the associated runaway ramp; depending on the road / ramp pair under consideration. If full braking loss was experienced between the start and midpoint of a road segment then the arrival speed would be between that for the full segment and that for the midpoint.

The effect of a truck that has experienced full braking loss bypassing the first available runaway ramp was examined. For example, if a truck were to experience full braking loss at the beginning of RDSEG 4 and the operator elected to bypass Ramp 4 then the truck would arrive at Ramp 5 at a speed of 89 kph. The example shows the importance of taking the first available runaway ramp; this cannot be overstressed.

RECOMMENDATIONS AND CONCLUSIONS

1. The analysis found that the system could be enhanced through the introduction of four (4) additional runaway ramps, the first is Proposed Runaway Ramp 6 located near the thermal coal stockpile and just above the 1440 Corner. The remaining three (3) are located along the course of the 1540 Dump Road at the east end of current mining activity. The author is unaware as to how the mine plan will evolve and as such, PRC must consider the value of the proposed runaway ramps to the mine plan on a go forward basis. The locations of the proposed ramps are shown on Figure 1 while the design criteria were presented in the ANALYSIS section of this report.
2. Norwest personnel did not visit the Trend Mine to inspect the as-built runaway ramps. Norwest recommends that PRC operations personnel inspect each ramp to confirm or otherwise enhance its viability.
3. Norwest referenced two internet based publications over the course of the study. PRC is cautioned that some of the formulae presented therein may not be expressed correctly. Nonetheless, these publications were found to be very useful. They can be found at the following locations:

   www.techtransfer.osmre.gov/NTTMainSite/Library/.../section5.pdf
   www.msha.gov/READROOM/HANDBOOK/PH99-I-4.pdf

4. Norwest developed a spreadsheet for calculating maximum speed and minimum stopping distances. We have included a working copy of that spreadsheet with this report for PRC's use.

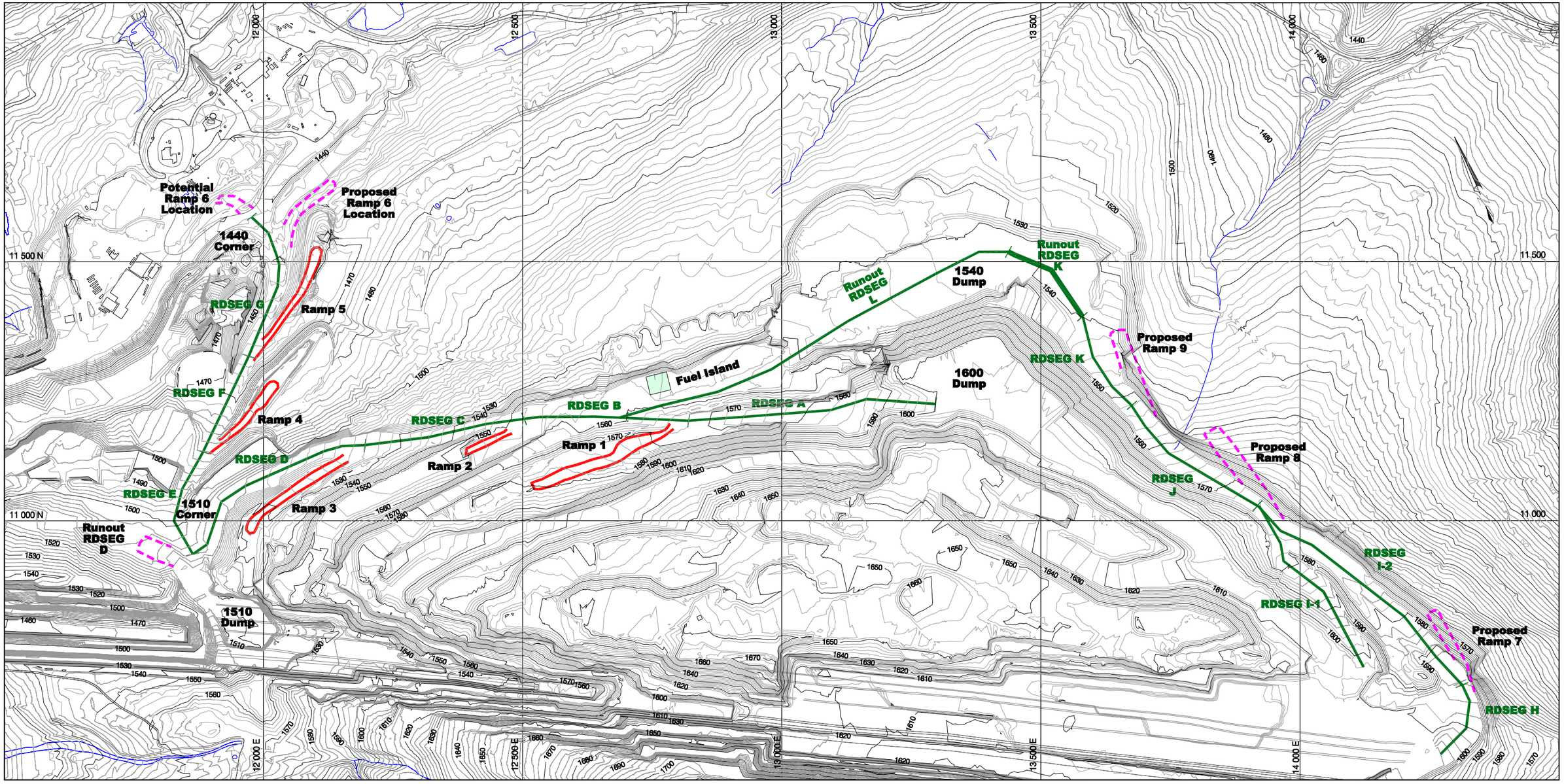
Norwest trusts that this report meets PRC's requirements. Should you have any questions or require further clarification, please feel free to contact me at (403) 237-7763.

Sincerely yours,

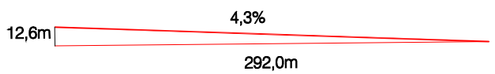
NORWEST CORPORATION

Greg MacMaster, P.Eng.
Manager, Surface Mining

GJM/tn



Ramp 1



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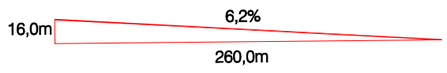

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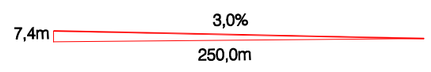

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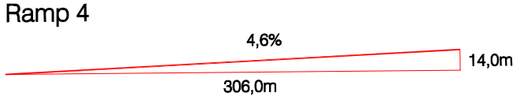
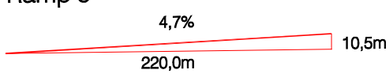
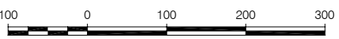


Ramp 5





"Original signed and sealed by Author"

Peace River Coal Inc.

TREND COAL PROJECT

RUN AWAY RAMPS

FIGURE 1

DRAWN BY: M.L.E. CHK'D BY: G.Mac DATE: 05 26 10	FILE: Fig1_Run Away Ramp Status Map 08-4037\MiningEng\Trend Runaway Ramps\	NORWEST APEGGA Permit P05015