Rainy River Project

APPENDIX P

ASSESSMENT OF ALTERNATIVES FOR TAILINGS AND MINE ROCK STORAGE

newgold Rainy River Project

ASSESSMENT OF ALTERNATIVES
FOR STORAGE OF MINE WASTE

RAINY RIVER PROJECT

Pursuant to the:
Guidelines for the Assessment of Alternatives
for Mine Waste Disposal

Prepared by:

AMEC Environment & Infrastructure
a Division of AMEC Americas Limited
160 Traders Blvd. E., Suite 110
Mississauga, Ontario
L4Z 3K7

On behalf of:

New Gold Inc.
1111 Victoria Avenue East
Thunder Bay, Ontario
P7C 1B7

October 2013
TC111504

amec

October 17, 2013
TC111504

Mr. Kyle Stanfield, P.Eng
Director, Environment & Sustainability
New Gold Inc.
1111 Victoria Avenue East
Thunder Bay, ON
P7C 1B7

Dear Mr. Stanfield,

AMEC Environment & Infrastructure is pleased to submit the attached Assessment of Alternatives for Storage of Mine Waste for the Rainy River Project.

This report outlines the alternatives considered for the storage of mine waste (tailings, mine rock and overburden) for the Rainy River Project, using the multiple accounts assessment methodology required by Environment Canada per the *Guidelines for the Assessment of Alternatives for Mine Waste Disposal*. Several technologies and m ultiple locations were considered from the outset prior to arriving at the conclusions herein. Conventional tailings slurry stored in an area to the northwest of the open pit was determined to be the optimal alternative for tailings storage. Two surface stockpiles to the west and east of the open pit were determined to be the preferred alternatives for storage and management of mine rock and overburden.

We greatly appreciate the opportunity to provide support for your Rainy River Project. Should you have any questions regarding the study, please do not hesitate to contact us.

Yours Sincerely,

AMEC Environment & Infrastructure,
a division of AMEC Americas Limited

Dan Russell, P.Geo.
Senior Environmental Geoscientist

Sheila Daniel, M.Sc. P.Geo.
Senior Associate Geoscientist
Head, Environmental Management

AMEC Environment & Infrastructure
a Division of AMEC Americas Limited
160 Traders Blvd. East, Suite 110
Mississauga, Ontario, Canada L4Z 3K7
Tel (905) 568-2929
Fax (905) 568-1686
www.amec.com

EXECUTIVE SUMMARY

Rainy River Resources Ltd. (RRR) has been exploring the Rainy River Project (RRP) property since 2005, with the objective of developing a gold mine and milling complex on the site. RRR proposes to construct, operate and eventually reclaim a new open pit and underground gold mine. The RRP is located in the Township of Chapple, District of Rainy River, in northwestern Ontario, and has several unique characteristics:

- The RRP is located primarily on private land;
- Extensive rural residential properties purchased by RRR proposed for development have been logged and used for some limited rangeland for decades;
- Several of the local streams frequently stop flowing during the summer and fall dry periods; and
- Several of the local streams are municipal drains.

RRR has conducted an extensive Aboriginal and public consultation program since 2010, and continues to do so. Several agreements with Aboriginal groups have been signed as a result of the relationships which have been fostered. RRR has also worked diligently to negotiate agreements with various landowners through the exploration phase and Feasibility Study preparation in anticipation of the proposed development of the RRP.

Other important information arising from the consultation process includes:

- While limited bait fishing does occur with certain project area streams, the area does not support a significant commercial or recreational fishery; and
- Aboriginal groups have not identified any active traditional uses of the lands within or immediately adjacent to the project site.

RRR has completed over 1,800 diamond drill holes to date totalling almost 780,000 metres (m), and has undertaken or commissioned extensive environmental baseline (4 years), geotechnical, mineralogical, engineering, logistics and economic studies related to potential property development.

The *Fisheries Act* prohibits the harmful alteration, disruption, or destruction of fish habitat and the deposition of a deleterious substance into waters frequented by fish. However, the associated Metal Mining Effluent Regulations (MMER; SOR/2002-222) include provisions to designate natural, fish-bearing waterbodies for storage of mine waste on Schedule 2 of these Regulations. These provisions include cases when the storage of mine waste in such waterbodies (including waterbodies which will be overprinted by a portion of an otherwise on-land mine waste stockpile) makes the most environmental sense when all factors, including long-term risk, are taken into account (Environment Canada 2011).

As part of the regulatory amendment process to list a waterbody on Schedule 2 of the Metal Mining Effluent Regulations, an alternatives assessment considering well-established and feasible mine waste storage methods is required. This report provides an assessment of alternatives for the storage of tailings and mine rock which has been undertaken to examine each feasible alternative on merit.

A total of five alternate tailings storage methods (in-pit storage, underground disposal, dry-stack tailings, filtered tailings, and conventional slurry) and eight tailings impoundment sites were selected for consideration at the outset. Four methods and four sites were screened out from further consideration due to fatal flaws.

Three alternate mine rock storage methods (in-pit disposal during operations, in-pit disposal at closure and conventional surface mine rock stockpiles) and five mine rock stockpile sites were selected for consideration at the outset. Two alternate methods and one stockpile site were screened out from further consideration due to fatal flaws.

The remaining tailings and mine rock alternatives were analyzed using a multiple accounts analysis factoring in environmental, technical, socio-economic and cost considerations. Each category (account) was broken down into evaluation criteria (sub-accounts). Each sub-account was broken down into measurement criteria (indicators). Each indicator was rated based on a six-point scale. Sub-accounts and indicators were weighted based on impacts relative to other sub-accounts or indicators, and ratings were assigned. Results for each alternative were calculated which allowed for comparison. Sensitivity analyses were conducted to consider how different views and biases affected the results of the analysis.

Conventional slurry tailings were established as the most suitable method for this project. Of the four alternative sites which remained after the pre-screening process, the results of the multiple accounts analysis indicate that Alternative B is the preferred choice of location for a tailings management facility. A sensitivity analysis was carried out, which varies the relative weighting of the four primary considerations. The results of this sensitivity analysis confirm the robustness of the process indicating Alternative B as the preferred site.

Conventional surface storage of mine rock was established as the most suitable method for this project. As the project requires disposal and management of overburden, potentially acid-generating mine rock and non-potentially acid-generating mine rock, two locations for the storage of mine waste are preferred. The results of the multiple accounts analysis indicate that Alternative C and Alternative E are the preferred choice of location for the mine rock stockpiles. The selection of these alternatives is confirmed through the sensitivity analysis.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1.0 INTRODUCTION

1.1 Background

Rainy River Resources Ltd. (RRR) has been exploring the Rainy River Project (RRP) property since 2005, with the objective of developing a gold mine and process plant complex on the site. RRR intends to construct, operate and eventually reclaim a new open pit and underground gold mine at the RRP site. The development of tailings and mine rock storage areas could require approval under the Metal Mining Effluent Regulations (MMER; SOR/2002-222) requirements. AMEC Environment & Infrastructure, a division of AMEC Americas Limited (AMEC), was retained by RRR to provide an assessment of alternatives for storage of tailings and mine rock (waste rock) in support of mine development pursuant to the requirements of the MMER.

This document outlines the potential storage locations, selection criteria and methodology used to identify preferred alternatives for mine waste storage (tailings and mine rock). A multiple accounts analysis (MAA) following the methodology outlined in Environment Canada (2011; as modified 2013) has been used to examine and compare different components and effects from mine waste storage, and to provide a decision-making tool which is transparent and defensible. Sensitivity analyses are provided to allow for different weightings of key MAA components and to evaluate differing values on potential environmental, technical, economic and social impacts.

1.2 Location and Physical Environment

The RRP is located in the Township of Chapple, District of Rainy River, in northwestern Ontario, approximately 65 kilometres (km) northwest of Fort Frances and 420 km west of Thunder Bay (Figure 1-1). The Universal Transverse Mercator coordinates for the centroid of the proposed open pit are at 425660E, 5409700N (NAD 83 Zone 15). The RRP site has several unique characteristics:

- The RRP is located primarily on private land;
- Extensive rural residential properties purchased by RRR proposed for development have been logged and used for some limited rangeland for decades;
- Several of the local streams frequently stop flowing during the summer and fall dry periods; and
- Several of the local streams are municipal drains.

Lands in the immediate RRP site vicinity are typically gently rolling to flat. The Pinewood River system which drains most of the RRP site area, occupies a broad lacustrine plain. The project site is located in a low density rural area within which some limited agricultural (mainly cattle and fodder cropping) and logging activities occurs. Adjacent areas show mostly second growth poplar forests and wetlands. The area is intersected by a well-developed network of both Provincial and Municipal access roads as well as private roads crossing privately-held lands.

Overburden in the area is clay-rich, with thicknesses in the order of 20 to 30 metres (m) in areas closer to the RRP site, where not disrupted by bedrock exposures. There are three main overburden units: Lake Agassiz lacustrine sediments; Whitemouth Lake (Keewatin) till, a stiff, highly plastic clay-rich till with occasional varving; and Whiteshell (Labradorean) till, a dense sandy till (KCB 2011). The stratigraphy generally consists of a thin layer of organics overlying 20 to 30 m of Whitemouth Lake till and about 2 m of Whiteshell till. Groundwater is generally present near surface with artesian conditions noted by KCB (2011) in the Whitemouth Lake till.

1.3 Stakeholder and Aboriginal Consultation, Discussions and Meetings

Stakeholder and Aboriginal consultation is recognized by RRR, stakeholders (including government agencies) and Aboriginal people as an important part of the Environmental Assessment (EA) and mine planning process.

RRR has actively engaged local and regional stakeholders and Aboriginal people so that:

- Local and traditional knowledge and land use is better understood about the project area and region and improves baseline reporting, effects assessment and management decisions;
- Concerns and interests are considered in the selection of natural environment valued ecosystem components and human environment valued ecosystem components addressed in the EA;
- Mitigation or enhancement measures used to manage effects are relevant, achievable and appropriate in the local / regional context;
- Local environmental and social values are better understood and incorporated into the determination of significance of effects; and
- An Aboriginal consultation record is established and will assist the Provincial and Federal Crown in determining the significance of and appropriate accommodation for any effects on Aboriginal people.

RRR has conducted an extensive Aboriginal and public consultation program since 2010, and continues to do so following the Stakeholder Consultation and Engagement Plan and Aboriginal Consultation and Engagement Plan which were included in the approved Amended Proposed ToR. These plans and the Aboriginal and public consultation program activities have supported the development of this report on MMER Alternatives Assessment. A detailed record of consultation, discussions and meetings with Aboriginal groups and the general public related to the RRP is included as Appendix D in the final EA Report.

Several agreements with Aboriginal groups have been signed as a result of the relationships which have been fostered. RRR has also worked diligently to negotiate agreements with various landowners through the exploration phase and Feasibility Study preparation in anticipation of the proposed development of the RRP.

Consultation activities which informed the preparation of the final EA Report and the MMER Alternatives Assessment Report included:

- Distribution of environmental baseline studies for government review;
- Distribution of Draft EA Report (Version 1) for Aboriginal review;
- Distribution of Draft EA Report (Version 2) for stakeholder and Aboriginal review;
- Community open houses;
- Stakeholder interviews and meetings;
- Aboriginal group meetings and discussions;
- Site tours;
- Distribution of required Provincial notices;
- Newsletters and updates;
- Updates to the RRP website;
- Ceremonies; and
- Workshops.

In response to concerns expressed by Aboriginal communities indicating that they did not have the time, financial, and human resource capacity to adequately review the RRP EA Report, RRR committed financial resources to the Aboriginal groups for an independent technical review of the draft RRP EA Report (Version 1). The draft EA Report (Version 1) was issued to Aboriginal groups in May 2013, eight weeks in advance of the general public and government agencies, in order to allow sufficient time for comment. While a copy of the Assessment of Alternatives for Mine Waste Disposal was not available at that time, the draft EA Report (Version 1) included a comprehensive discussion of mineral waste alternatives in Section 4 and Appendix O of the report.

The following Aboriginal groups were provided access to a digital version of the draft EA Report (Version 1) on May 17, 2013:

- Anishinaabeg of Naongashiing First Nation;
- Buffalo Point First Nation;
- Couchiching First Nation;
- Lac La Croix First Nation; Mishkosiminiziibiing (Big Grassy River) First Nation;
- Mitaanjigamiing First Nation;

- Naotkamegwanning First Nation;
- Naicatchewenin First Nation;
- Nigigoonsiminikaaning First Nation;
- Ojibways of Onigaming First Nation;
- Rainy River First Nations;
- Region 1 Consultation Committee / Sunset Country Métis / Métis Nation of Ontario;
- Seine River First Nation; and
- Fort Frances Chiefs Secretariat.

RRR received comments resulting from the independent technical review on August 14, 2013. At the request of the Aboriginal groups, the comments and responses are considered confidential and are therefore not documented herein. The comments were however, fully considered and incorporated into the final EA Report. RRR also made a number of commitments to the Aboriginal groups as a result of the comments received as provided in Appendix A. RRR shared their commitments and responses to the Aboriginal review comments with the Aboriginal groups and appropriate regulatory authorities on September 18, 2013.

Big Grassy River First Nation undertook a second independent review that was provided to the company on October 18, 2013. The review concluded that additional work with the community was required and the Company has committed to continuing the close engagement with the community in support of project development.

The draft EA Report (Version 2) was released for stakeholder review on July 12, 2013 and included a comprehensive discussion of mineral waste alternatives in Section 4 of the report. A listing of the direct recipients of the draft EA Report (Version 2) is located in Appendix D-5 of the final EA Report. The public comment period for the draft EA Report (Version 2) commenced July 19, 2013 and remained open until August 19, 2013, with government agencies afforded an additional 15 days for review. All written submissions containing comments on the draft EA Report and corresponding responses from RRR are provided in Appendix D of the final EA Report. The comment / response tables also describe the current status of the response and where appropriate, indicate where response to the comment is incorporated in the final EA Report. For ease of reference a copy of all comments received on the draft EA Report (Version 2) which specifically relate to mineral waste management are appended to this document (Appendix B).

Eight community open houses have been held to date, specific to the environmental approvals process for development of the RRP. These open houses provided opportunities for individuals to receive information regarding the RRP, project alternatives and provide feedback on appropriate management of environmental effects. Mineral waste management was a key topic during each open house. The open houses were held as follows:

- Rainy River, May 30, 2012

- Barwick, May 31, 2012
- Township of Sioux Narrows-Nestor Falls, November 7, 2012
- Emo, November 8, 2012
- Seine River First Nation, November 13, 2012;
- Mitaanjigamiing First Nation, November 20, 2012;
- Barwick, July 30, 2013; and
- Fort Frances, August 8, 2013.

Comments and concerns regarding mine waste management captured through meetings and discussions during Aboriginal and public stakeholder consultations as well as those captured during the public comment period on the draft EA Report are detailed in Appendix D of the final EA Report and are outlined in the tables below.

Topic	Aboriginal Concerns
Mine rock stockpiles	• Management of mine rock • Potential acid rock drainage and metal leaching • Management at closure
Tailings management area	• Tailings management and prevention of and effects on local waters Impacts to health of wildlife, particularly small mammals, and birds • Post-closure use of tailings management area
Water quality	• Effect of tailings management area discharges on water quality • Potential adverse effects on natural environment and human health
Air quality	• Fugitive dust emissions from tailings management area

Topic	Stakeholder Concerns
Mine rock stockpiles	• Proposed management and assessment of alternatives • Potential for acid generating rock • Siting and alternatives • Management at closure
Tailings management area	• Tailings management • Prevention of acid rock drainage • Post-closure use of tailings management area • Habitat compensation
Water quality	• Effect of tailings management area discharges on water quality

Other related important information arising from the consultation process includes:

- While limited bait fishing does occur with certain project area streams, the area does not support a significant commercial or recreational fishery; and

- Aboriginal groups have not identified any active traditional uses of the lands within or immediately adjacent to the project site.

A draft version of this report was provided to the Canadian Environmental Assessment Agency, Environment Canada and the Ministry of the Environment for their review on September 3, 2013. A copy was subsequently provided to Ministry of Northern Development and Mines at their request, on September 11, 2013. Comments were provided by Environment Canada on the draft report on October 7, 2013. RRR sent responses to Environment Canada on their comments on the draft report on October 11, 2013 which have been incorporated into this final report as appropriate. A copy of the summary comment and response table is appended for completeness (Appendix C).

As outlined in the RRP EA Stakeholder Consultation and Engagement Plan and Aboriginal Consultation and Engagement Plan, RRR will continue to maintain a record of its consultation activities for the RRP. RRR will also continue Aboriginal engagement sessions throughout the project. Appendix D contains a summary listing of all the comments received by RRR to date related to mine waste alternatives assessment.

1.4 Planned Operations

The project is planned to extract gold bearing ore through a combination of open pit and underground mining operations. Gold recovery will occur via gravity concentration followed by cyanide leaching and carbon-in-pulp recovery. In-plant cyanide destruction will reduce cyanide to low levels in the tailings slurry prior to discharge into the tailings management area (TMA).

Two primary mineral wastes will arise from the RRP:

- Tailings from processing of ore: approximately 110 to 120 million tonnes (Mt) of tailings will be generated; and

- Mine rock from extraction of ore from the open pit or underground mine: a total of 350 to 400 Mt of mine rock will be produced.

A primary driver of the project design is the geochemistry of the tailings and mine rock. An extensive investigation has been conducted and provided to the regulatory agencies for review (AMEC 2013a). An encapsulation mitigation design has been developed to ensure that any potentially acid generating (PAG) mine rock remains in a geochemically stable condition. A significant portion of the mine rock is expected to be PAG based on current information and understanding. Work is underway to further the understanding of the geochemistry of the site, and will be used to help determine if management of mine wastes can be optimized as part of the mine scheduling. In order to provide for maximum flexibility in the scheduling and management of overburden, PAG mine rock and non-potentially acid generating (NPAG) mine rock will be stored during operations and at closure primarily in two separate stockpiles.

A critical aspect of amenability to reclamation for the TMA is the long term management of tailings acid rock drainage (ARD) potentials, as the tailings are PAG. The preferred strategy for managing tailings ARD potential where possible is to provide a per manent water cover at closure to limit oxygen contact with the tailings solids. If a complete water cover cannot be reasonably provided, then the proposed approach is to provide a combined water cover / low permeability (clay-rich till) cover, or low permeability clay-rich till cover alone. Covers are more expensive and ar e generally less effective for controlling oxygen exposure unless saturated conditions can be maintained. The low permeability of the clay-rich till proposed for use as the cover material suggests that there is a good probability of saturated conditions being present.

A summary of the geochemistry work completed to date as provided in the final EA Report for the RRP (AMEC 2013b) is provided in Appendix E for ease of reference.

Storage will also be required for overburden material stripped from the pit area.

1.5 Assessment of Alternatives Overview

As per the Guideline (Environment Canada 2011):

> *The MMER stipulates that for mine waste to be deposited in a natural, fish-bearing waterbody, the waterbody must be listed in Schedule 2 of the Regulations, designating it as a tailings impoundment area (TIA). In the context of these guidelines, a TIA is a natural waterbody frequented by fish into which tailings, waste rock, low-grade ore, overburden and any effluent that contains any concentration of the deleterious substances specified in the MMER, and of any pH, are disposed.*

Further, the Guideline (Environment Canada 2011) states:

> *[It is] strongly recommended that this assessment be undertaken during the EA to streamline the overall regulatory review process and minimize the time required to proceed with the MMER amendment process.*

For this reason, RRR has submitted this draft alternatives assessment in parallel with the Federal environmental assessment process, pursuant to the *Canadian Environmental Assessment Act, 2012*.

The purpose of this assessment of alternatives is to objectively and rigorously assess all feasible options for mine waste disposal. The assessment of alternatives is broken into the following seven steps in the guidelines:

Step 1. Identify candidate alternatives;
Step 2. Pre-screening assessment;
Step 3. Alternative characterization;
Step 4. Multiple-accounts ledger;

Step 5. Value-based decision process;
Step 6. Sensitivity analysis; and
Step 7. Document results.

- Step 1 involves determining which technologies and sites could be used for the storage of tailings and mine rock.

- Step 2 screens out any alternatives which have a fatal flaw, ensuring at least one alternative does not overprint natural waters frequented by fish.

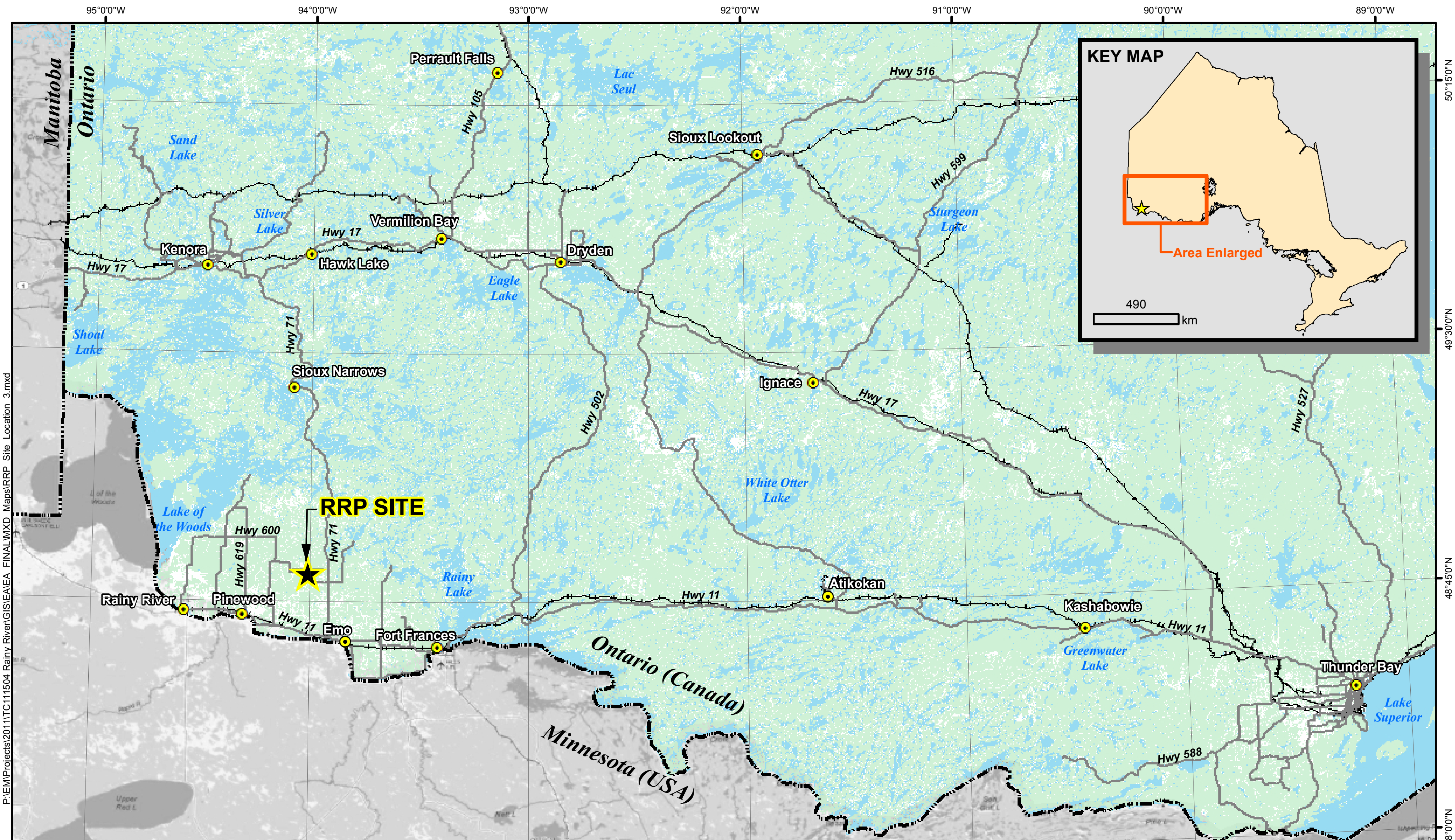
- Step 3 involves characterizing the alternatives from environmental, technical, cost and socio-economic perspectives.

- Step 4 is the beginning of the MAA and includes setting up evaluation criteria and measurement criteria (sub-accounts and indicators, respectively).

- Step 5 is the value based process where each sub-account and indicator is weighted in importance, and assigned a value (scoring, weighting and quantitative analysis).

- Step 6 is a sensitively analysis that recognises that all stakeholders will not place the same importance on each impact.

- The results are documented in Step 7.



LEGEND

- RRP Site
- Regional Communities
- Provincial / National Border
- Regional Road / Highway
- Railway

NOTES:
- Ontario base data extracted from Land Information Ontario (MNR) data warehouse, Queen's Printer for Ontario, 2011-2012
- Base data outside of Ontario extracted from ESRI DeLorme World Basemap

newgold™ Rainy River Project amec

RAINY RIVER PROJECT

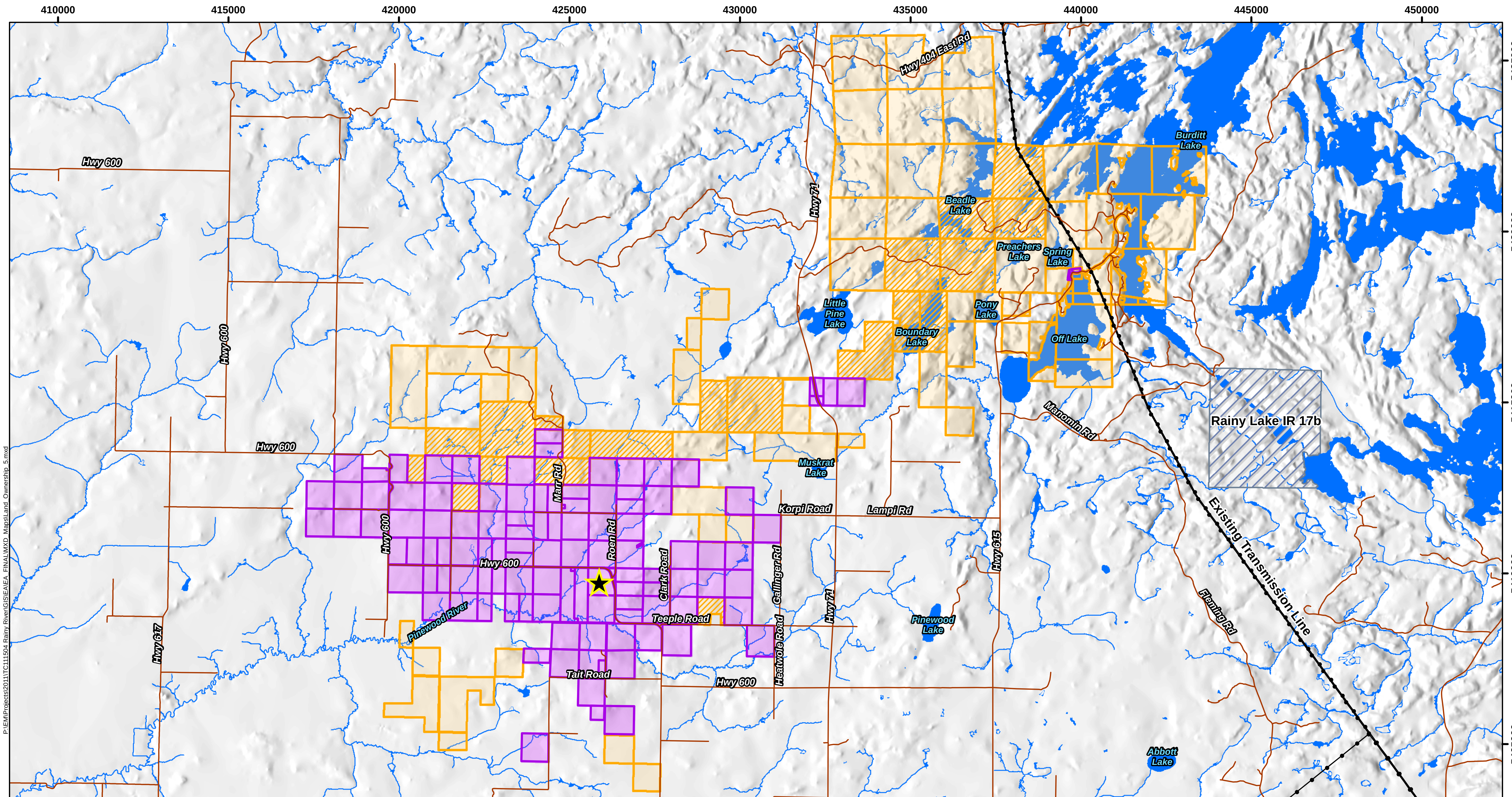
Site Location

Datum: NAD83
Projection: UTM Zone 15N

N W E S

0 25 50 100 150 200 250 Kilometres

PROJECT N^{o}: TC111504	**FIGURE: 1-1**
SCALE: 1:1,800,000	DATE: October 2013



P:\EM\Projects\2011\TC111504 Rainy River\GIS\EA\EA_FINAL\MXD_Maps\Land_Ownership_5.mxd

LEGEND

- RRP Site
- Roads
- Existing Transmission Line
- First Nation Land

Rainy River Resources Land Tenure

- Rainy River Resources Active Dispositions (Patented and Leasehold)
- Rainy River Resources Active Unpatented Claim
- Rainy River Resources Active Unpatented Claim - to be brought to lease

NOTES:
- Road and Utility data and topographic data extracted from Land Information Ontario, Ontario Road Network, MNR Queen's Printer for Ontario, 2011-2012
- Land tenure information derived from MNDM Claimap service, data extracted on Sept. 25, 2013 and RRP Land Ownership property maps

Datum: NAD83
Projection: UTM Zone 15N

N W E S

0 5 10 20 30 Kilometres

newgold Rainy River Project amec

RAINY RIVER PROJECT

Land Ownership

PROJECT N^{o}: TC111504	**FIGURE: 1-2**
SCALE: 1:107,000	DATE: October 2013

2.0 MULTIPLE ACCOUNTS ANALYSIS METHODOLOGY

The methodology utilized to assess mineral waste alternatives and provided herein follows from and is intended to be compliant with Environment Canada (2011).

2.1 Preliminary Screening

The process of preliminary screening (called the pre-screening assessment in the Guidelines), allows those alternatives that do not meet unique minimum specifications to be removed from the assessment process. By not meeting these minimum requirements, the alternative contains a fatal flaw that is so unfavourable or severe that eliminates the site as a candidate mine waste disposal alternative. Pre-screening criteria are formulated such that a "yes" or "no" response is possible. There must be no reasonable mitigation strategy that would convert a "yes" into a "no" response.

2.2 Alternatives Characterization

The reduced number of alternatives remaining is characterized to:

- Ensures that all aspects of the alternative are properly considered; and

- The description allows direct comparison between alternatives, ensuring complete transparency of the alternatives assessment process.

Per the Guidelines, there is no ideal number of alternatives that should be carried through, but there should be at least three or more alternatives remaining and determined to be worthy of detailed assessment. At least one of these alternatives should not impact a natural waterbody that is frequented by fish, unless it can be demonstrated that this possibility does not reasonably exist based on site-specific circumstances.

2.3 Ledger Format

Preliminary screening of alternatives can be used to eliminate alternatives with any fatal flaws, which can occur with minimal judgement. However, evaluation criteria used in the multiple accounts analysis considers the material impact, such as a benefit or loss, associated with each alternative.

A multiple accounts ledger includes a three level hierarchy comprised of accounts, sub-accounts and indicators. Accounts identify the general area of consideration and include:

- Environmental;
- Technical;
- Project economics; and

- Socio-economic.

Each account is split into evaluation criteria (sub-accounts) that are used to determine the level of impact to the account. For example, an environmental account could contain sub-accounts that include terrestrial ecosystem impacts, aquatic ecosystem impacts, impacts to groundwater and impacts to air quality. Sub-accounts should conform to the following criteria detailed by Environment Canada (2011):

- Sub-accounts need to be impact driven;
- The sub-account must differentiate one alternative from another;
- The sub-account must be relevant to the account;
- The sub-account must be understandable, and unambiguously defined for clarity;
- Sub-accounts must not be redundant; and
- Sub-accounts should be judgementally independent (one sub-account cannot depend on the value of another sub-account).

While sub-accounts measure impacts between the alternatives, they are often not easy to quantify and rank in a transparent manner. Measurement criteria (indicators) allow qualitative or quantitative measurement of the impact associated with each sub-account. For the purposes of this MAA, each indicator will have a six point scale established that details how an alternative will be valued.

Environment Canada (2011) provides a sampling of characterization criteria against which the alternatives may be evaluated.

Subaccounts, indicators and scoring criteria assigned to each of the four primary accounts are described in Section 5.0 (Tailings Management Area) and Section 9.0 (Mine Rock Stockpile).

2.4 Value-Based Decision Process

2.4.1 Scoring

Each alternative is assigned a score for every indicator ranging from one to six. A six is assigned when the alternative meets the best criteria on the qualitative value scales for the indicator, and likewise a one is assigned when the alternative meets the worst criteria.

2.4.2 Weighting

An experienced team consisting of geotechnical engineers, environmental scientists and geoscientists participated along with RRR, in determining the appropriate weighting of the mineral waste alternatives.

Weight was applied to each sub-account and indicator on a scale of one to six based on the relative importance each sub-account and indicator. A weight of two is considered twice as important as a weight of one, likewise, a weight of four is twice as important as a weight of two. By design of the scale, no sub-account or indicator can be valued more than six times more important than another sub-account or indicator.

Indicators and sub-accounts

The weight of indicators is comparable within each individual sub account and cannot influence separate sub-accounts. In the event of only one indicator in a given sub-account, a weight of one was applied. Sub-account weights are only applicable within a given account and are not comparable across accounts.

Account

The Base Case account weights as suggested in Environment Canada (2011; Section 2.6.2 therein) are as follows:

- Environment – 6;
- Technical – 3;
- Project economics – 1.5; and
- Socio-economic – 3.

As per the guidelines, the base case includes weighting the environment account twice as important as the technical and socio-economic accounts, which in turn are weighted twice as important as the project cost (economics) account.

In addition to the base case, additional scenarios are considered in order to evaluate the robustness of the analytical process and determine the degree to which various options are influenced by the choice of weightings. Case 2 weights all accounts equally (i.e. no preference for one over another). Case 3 weights the Environment account twice as high as the Technical and Socio-Economic factors, but completely discounts cost factors (i.e. it asks "how would the decision look if cost was not a factor?"). Case 4 weights the Environmental and Technical accounts twice as high as the Economic and Socio-economic accounts, while Case 5 puts twice as much weight on the Environmental and Socio-Economic accounts. The sensitivity analyses in Section 6.0 and Section 10 evaluate the results of these additional four scenarios against the base case.

2.4.3 Quantitative Analysis

The MAA follows the methodology provided in Environment Canada (2011):

For each indicator, the indicator value (S) of each alternative is listed in one column. The weighting factor (W) is listed in another column and the combined indicator merit score ($S \times W$) is calculated as the product of these values.

Indicator merit scores can be directly compared across alternatives, and likewise sub-account merit scores ($\Sigma\{S \times W\}$) can be directly compared across alternatives. However, to allow comparison of these values against values for other sub-accounts, the scores must be normalized to the same six-point scale used to score each indicator value. This is achieved by dividing the sub-account merit score by the sum of the weightings (ΣW) to yield a sub-account merit rating ($R_s = (\Sigma\{S \times W\} / \Sigma W)$. This will again be a value between 1 and 6. This normalization is necessary to balance out different numbers of indicators and sub-accounts for each account. Without this normalization, the number of indicators associated with each sub-account, and the number of sub-accounts associated with each account, would have to be identical, otherwise the analysis will be skewed by accounts with more sub-accounts or indicators.

The results of these analyses are presented in Section 5.2 for the tailings management alternatives and Section 9.2 for the mine rock storage alternatives.

3.0 TAILINGS MANAGEMENT ALTERNATIVES ASSESSMENT – PRE-SCREENING ASSESSMENT

3.1 RRP Pre-screening Criteria

Prior to completing a comprehensive MAA, a pre-screening assessment is applied to determine whether any alternatives have an inherent fatal flaw. If an alternative (technology or location) has a fatal flaw then it will not be carried forward to the MAA.

Pre-screening criteria developed for the RRP tailings pre-screening assessment of alternative disposal methods and locations (as applicable) were:

- Does the mine waste disposal system rely on proven technology? (yes/no);
- Does the alternative have capacity for a significant percentage of total tailings? (yes/no);
- Is the alternative feasible with respect to project scheduling? (yes/no);
- Does the alternative technology provide a benefit over conventional technologies? (yes/no);
- Is the location reasonably close to the open pit / process plant? (yes/no);
- Will all mine waste disposal impacts be limited to the Pinewood River watershed? (yes/no); and
- Is this the most suitable alternative in the vicinity of the impoundment location? (yes/no).

A summary of the advantages and disadvantages for each tailings deposition alternative is provided in Table 3-1. The results of the pre-screening assessment for both deposition alternatives and alternative locations are provided Table 3-2.

3.2 Possible Tailings Deposition Methods

Five preliminary alternate methods were identified for tailings deposition / storage (AMEC 2011):

- In-pit storage;
- Underground backfill;
- Dry stack tailings production;
- Filtered tailings; and
- Conventional slurry / containment area.

In addition to the above storage methods, co-disposal of tailings and PAG mine rock was discussed as a potential storage solution at the outset of the project design, but was not considered a viable alternative and is not considered further herein.

Co-disposal of approximately 175 to 200 Mt of mine rock (the PAG portion of the total mine rock volume) with an anticipated 110 to 120 Mt of tailings would require a single, very large facility (or multiple large facilities). Of primary concern is the ability to mitigate sulphide oxidation and prevent the onset of ARD during operation and to maintain conditions on closure. The topography in the area around the RRP site and on the site itself is flat to gently rolling. This local condition leads to a requirement to construct a complete ring dam. The requirement for a ring dam and the necessary height of the stockpile to contain the volume of materials would not allow the facility to passively maintain a flooded condition on closure. It would require an ongoing water taking from local water course(s) in perpetuity to keep the materials flooded, which would not be a viable option.

As a result, an engineered cover would be required at closure for ARD management for a co-disposal facility. As indicated in Section 1.4, engineered covers are both costly to implement and are most successful at inhibiting sulphide oxidation when saturated conditions are maintained. Achieving saturated conditions in a stockpile of an estimated height in excess of 40 m is expected to be difficult to achieve and maintain.

Due to the ground foundation conditions across most of the RRP site, dam slopes in the order of 5:1 to 6.5:1 are required for safety and stability. An incremental increase of, for example, 20 m in excess of the dam height of the preferred TMA option would result in an outward increase of the storage facility footprint by 100 m or more around most, if not all of the perimeter. This increases the volume of material required for construction by approximately 3 to 5 times that of the preferred option. For a larger co-disposal facility, these quantities may not be available from pit development overburden stripping alone due to mine scheduling, nor be available from the overburden and NPAG mine rock stockpiles. When taken into consideration with the volume of clay-rich overburden required to construct an engineered cover at closure for a co-disposal option, development of a co-disposal facility could require an additional dedicated aggregate facility.

3.2.1.1 In-Pit Storage

Open pit disposal involves pumping tailings to an existing open pit capable of storing tailings generated by a process plant. Tailings can be pumped (slurry or thickened) or conveyed (filtered) to a mined out open pit. Water management can be relatively straightforward compared to surface impoundments, with no discharge to the environment if the open pit is not already flooded. If the open pit is already flooded as part of a planned closure scenario, tailings can be pumped (slurry) and discharged at depth in the open pit to reduce the effect on surface water in the open pit.

3.2.1.2 Underground Storage (Backfill)

Underground disposal as mine backfill was under consideration for disposal of some of the tailings at the RRP. Tailings moisture content is generally reduced to about 20% water by weight (filtered) prior to underground deposition. Underground disposal of tailings in paste backfill is helpful if such backfill is needed for underground structural support, and binding materials can also be added to increase strength.

3.2.1.3 Dry Stack Tailings

The concept of dry stack (filtered) tailings was also considered. Dry stack tailings production involves using a variety of filtration systems within the process plant to produce a relatively dry tailings (typically about 20% moisture) which can be trucked or conveyed to a dry tailings stockpile. This method of tailings management is primarily utilized in drier climates where water conservation is a critical issue, as well as at some northern settings where the dry stack tailings remain in an inert frozen state within permafrost. With dry stack tailings, conventional dam containment is not required, as the tailings essentially become a pile of fine sand- and silt-sized material.

3.2.1.4 Thickened Tailings

Thickened (filtered) tailings production involves using a variety of filtration systems within the process plant to produce a partially dewatered tailings (upwards of 70% moisture) which can be pumped to a storage area by pipeline. Unlike dry stack tailings, conventional tailings dams are required to contain the filtered tailings. Thickened tailings deposition is used where there is an advantage to developing a steeper tailings beach, such as against a natural slope draining towards a downstream tailings dam. In such an instance, more tailings can be stored with less dam volume, as opposed to developing a flatter deposited tailings profile.

3.2.1.5 Conventional Slurry Containment

The standard method of tailings disposal for northern Ontario mining operations is a permanent surface impoundment (tailings management area; TMA) surrounded as necessary with dams to ensure containment. Tailings discharged to a TMA can be discharged at conventional densities in the range of 40 to 55% solids by weight. The optimal strategy for PAG tailings is to deposit the tailings at a low gradient such that they can be more easily flooded at closure. Flooding restricts oxygen exposure to the tailings preventing the oxidation of sulphides.

3.3 Initial Site Selection Factors

There are no currently existing mine waste disposal sites, as the RRP site has not been previously developed by the minerals industry, apart from exploration-related activities. Initial factors taken into account for the selection of new tailings storage location are as follows:

- **Topographic containment:** Good topography reduces the requirement for dams and minimizes the length and height of containment structures. Natural containment is generally preferred for long term stability. The storage capacity-to-dam volume ratio (also called dam fill ratio) is an important consideration where containment structures are required. Dams are typically the largest proportion of the total cost related to tailings storage when surface impoundments for slurry are used.

- **Expandability:** The volume of tailings and storage requirement described for which the assessment is being completed is based on anticipated minable reserves. As a general preference, the tailings storage facility should have the potential for expansion.

- **Existing land use:** Considerations related to property ownership and rights, population and housing, recreation, transportation corridors, transmission line and other service corridors, easements and right-of-ways should be taken into account.

- **Aboriginal traditional land use:** Aboriginal traditional land use including information about how recent and current traditional practices are carried out on the land potentially affected should be considered as part of the process. This information is collected through discussions and Traditional Knowledge / Traditional Land Use studies with Aboriginal community Elders and other knowledge holders.

- **Proximity to the process plant:** Shorter pipeline lengths are preferred from the perspective of maintenance and potential for damage / spills. Pumping costs and risk increase with distance from the process plant. The site should be easily accessible and preferably of lower or at the same elevation as the process plant.

- **Watersheds and drainage:** Keeping site activities in as few watersheds as possible is generally preferred. Locating tailings storage areas in the upper reaches of watershed(s) minimizes water management and the need for diversions. Depending on the means of storage, middle watershed areas may be preferred unless a permanent water cover is desired.

- **Facility footprint:** A smaller physical footprint is generally favoured as having less direct environmental impacts. A small footprint also commonly equates to less runoff to manage and therefore lower operational costs and environmental risk.

- **Provide downstream buffering capacity:** It is attractive to have surface area available downstream for effluent collection (polishing pond if needed) and a water treatment plant if needed or available as a contingency.

3.4 Pre-Screening of Deposition Method

Open Pit Storage

As only one pit is proposed for the RRP, utilizing in-pit disposal was screened out. The configuration and proposed development strategy (progressing deeper and enlarging the surface area over time), is not amenable to in-pit disposal. Should an additional pit be developed as part of the future mine, this alternative would be reconsidered at a future date.

Underground Backfill

This method was also screened out as only a small proportion of the total tailings volume (approximately 3.3 Mt versus a requirement of approximately 116 Mt) can be stored within the proposed underground workings. In addition, there are currently no underground workings at the RRP and none are planned until several years into the project. As a result this alternative is only available later in the mine life. This alternative may be examined further in the future for supplemental storage.

Dry Stack Tailings

The use of dry stack tailings at the RRP would have a number of disadvantages. In the climate of northern Ontario, the use of dry stack for tailings deposition is an unproven technology. Other disadvantages for dry stack tailings include:

- Aerially exposed tailings would yield problematic drainage over time due to sulphide oxidation. Dry stack tailings are not a suitable tailings disposal alternative for PAG tailings due to the preference to eliminate tailings oxidation through submergence.
- The dry stacked tailings would be prone to both wind and water erosion / dispersion;
- Without dam containment, the tailings slope angles would be considerably flattened, resulting in a much larger surface area and land impact compared with conventional dam containment. The prevalence of watercourses at the RRP site would require the associated dry stack footprint to expand into creek valleys with such impacts subject to the *Fisheries Act* and MMER Schedule 2 considerations, as well as the increased likelihood of impacting areas identified as habitat for Species at Risk;
- Large water holding ponds would still be required for mine water ammonia management for periods of higher mine water production, such as during spring runoff and other wet periods;
- There would be an increased requirement for mine rock storage that could otherwise have been used in construction of dams;

- The necessary in-plant filtration systems would require considerable energy usage during operation (discharging additional greenhouse gases to the environment and increasing operating costs);

- Constructing and maintaining the systems would have considerably greater cost than the use of conventional tailings dams; and

Given that the same geographic locations would likely be considered for dry stack disposal as for conventional slurry containment, the use of dry stack tailings technology is not considered further as it poses no advantages for the RRP.

Thickened Tailings

Thickened tailings have higher operating costs arising from the processing required to remove water. Thickened tailings can allow greater flexibility when depositing tailings on steeper areas, however they do still require containment dams which will require aggregate material as well as incur construction as well as operating (maintenance) costs. As the RRP tailings are PAG, they will need to be submerged to prevent oxidation for long term ARD management. Conventional slurry discharge is more amenable to a pe rmanent water cover to prevent oxidation and thickened tailings provide no benefits over conventional slurry. This alternative is not considered further.

Conventional Slurry Containment

Conventional slurry containment has many of the same disadvantages as thickened tailings, with the exception of the processing required to remove water. This method also presents the most reliable method for eliminating oxidation of sulphides through submergence. All of these disadvantages are considered acceptable, and a conventional slurry containment TMA has been identified as the only technology without a fatal flaw for the RRP. As such, it is carried forward as the technology used at each of the locations carried forward in to the MAA.

3.5 Pre-Screening of Alternative Locations

Alternative locations were initially selected to lie within a 10 km radius of the open pit in order to assist in maintaining a compact overall project footprint, and reduce the length of pipelines for pumping (and the risks associated with longer pipelines). An additional criteria was applied of maintaining the alternative locations within the Pinewood River watershed in order to constrain any potential environmental impacts.

Eight alternative tailings storage locations were identified at the preliminary stage as potential tailings storage options on the basis of capacity to hold the design tonnage, ability to mitigate potential environmental concerns, land ownership considerations, and proximity to the process plant (Figure 3-1).

Per Table 3-2, Alternatives E, F, G, and H were screened out from further consideration.

Alternative H cannot contain a significant percentage of the entire volume of tailings requiring storage without unacceptable high dam heights. Higher dams will result in a decreased level of safety. In addition, foundation conditions across the RRP site are such that dam slopes of approximately 5:1 to 6.5:1 are required for stability, which would require a disproportionate amount of fill material to construct relative to the volume of tailings to be contained, and require a much larger footprint than that indicated on Figure 3-1.

Alternatives F and G unnecessarily extended effects beyond the Pinewood River watershed. One of the primary drivers for the RRP has been to maintain as compact a footprint as possible as requested during consultation in order to minimize effects to the environment, and these alternatives do not meet that philosophy as they cross the watershed boundary.

Alternative E is not the most suitable alternative in the vicinity of the impoundment location (that is, another alternative in the same general vicinity was a better alternative). Alternative E overlaps with the area preferred for the explosives facility, which has specific location criteria prescribed by the Quantity Distance Principles User's Manual (NRCan 1995). This location is well removed from the principal RRP work site areas and from private residences for safety purposes, but sufficiently close to the open pit and underground workings so as not to involve the undue transport of manufactured product. The proposed location also avoids interference with known whip-poor-will territories (a Species at Risk). The only available alternative for siting the explosives manufacturing facilities is a location west of the overburden stockpile. This location is almost twice as far from the open pit, is located within approximately 2 km of Dearlock, and is considered unacceptable which presents a flaw for Alternative E.

Alternatives A, B, C and D meet all the preliminary criteria and were screened to be considered for more detailed evaluation.

Table 3-1: Disposal Method Advantages and Disadvantages

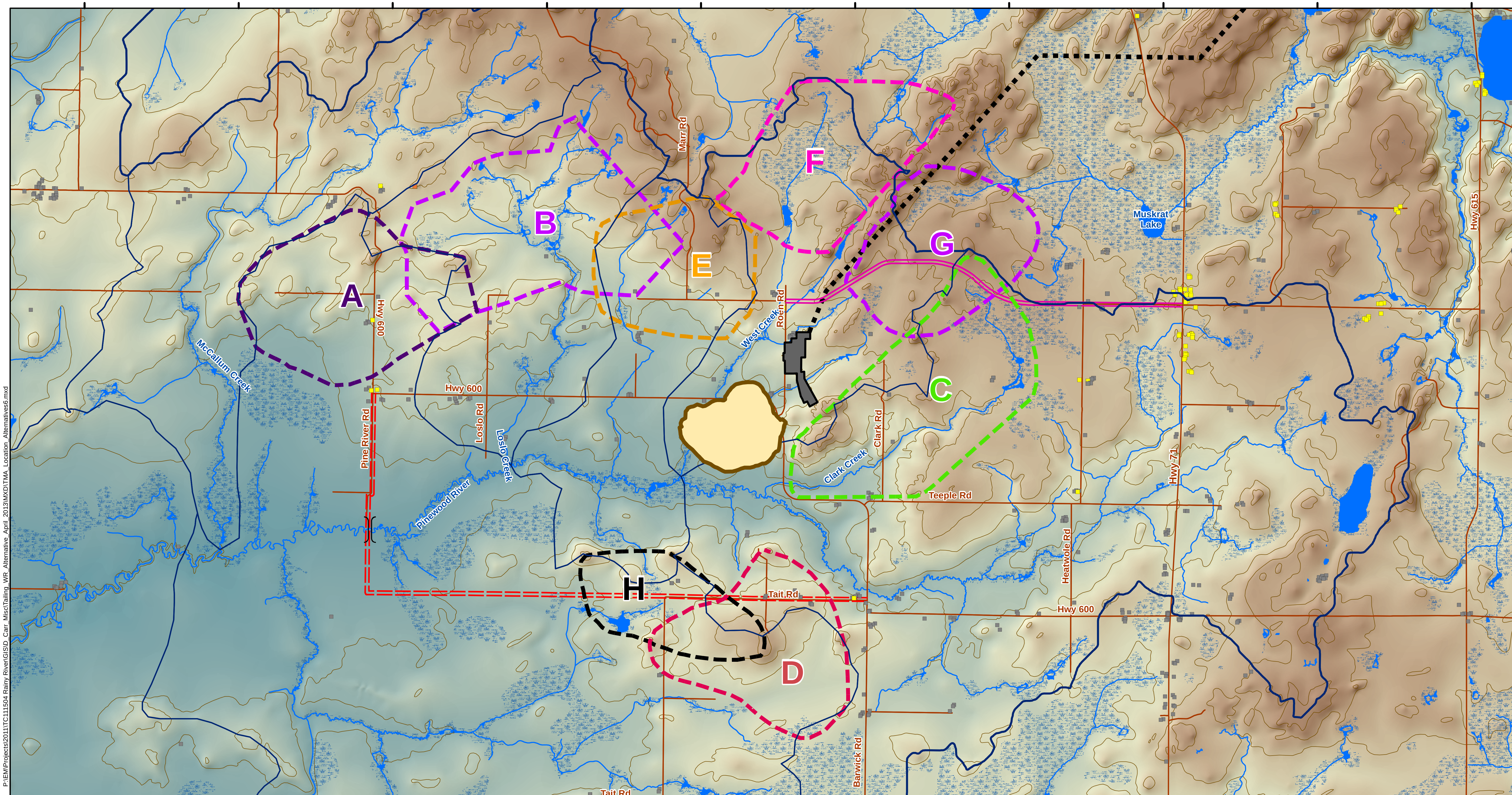
Disposal Method	Advantages	Disadvantages
In-pit Storage	• Smaller project footprint using pre-existing facilities reduces or eliminates the need to overprint potentially unaffected terrestrial or aquatic habitat • No dams required as tailings volume is contained by the pit • Can control sulphide oxidation	• Method is not feasible as the RRP design has a single open pit • Insufficient capacity for total tailings containment due to conflicts arising from attempting to store tailings in an operating open pit
Underground Backfill	• Using pre-existing facilities reduces or eliminates the need to overprint potentially unaffected terrestrial or aquatic habitat • Paste backfill technology can be used to improve structural stability of underground workings • No dams required; tailings volume contained by underground workings • Can control sulphide oxidation	• Method is not feasible as underground mining does not start for several years • Insufficient capacity at RRP for storage of a significant portion of total tailings • Underground mining does not start at beginning of tailings production
Dry Stack Storage	• No dams required to contain dry materials • Removal of water during processing results in a greater opportunity to recycle water within the plant rather than pump it into TMA as a slurry • No dam construction costs, resulting in lower project capital costs	• Unsuitable for water cover for control of sulphide oxidation • Larger land footprint resulting from flatter side slopes • Increased footprint will result in the potential encroachment on watercourses in the RRP area (unless dams utilized) • Increased potential for dust management issues • Higher operating costs than conventional slurry containment, primarily related to power requirements • Tailings must be conveyed / trucked potentially resulting in increased air quality impacts and increased costs
Thickened Tailings	• Able to deposit with steeper slopes, resulting in greater storage efficiency over conventional slurry • Lower operating costs compared to dry stack storage • Tailings can be pumped via pipeline • Smaller footprint than uncontained dry stack storage and conventional slurry • Potential for water cover for ARD control	• Difficult to control sulphide oxidation • Greater need for water management requirements (precipitation, seepage, tailings fluids) within TMA • Higher operating costs for dewatering of tailings, primarily related to power requirements • Ongoing management of containment structures • Considerable requirement for aggregate material, that may or may not be sourced from mine wastes • Higher initial capital costs due to dam construction
Conventional Slurry Containment	• Sufficient capacity for total containment at RRP • Decreased footprint compared to uncontained dry stack storage • Easily deposited at a low gradient to allow for establishment of water cover control of sulphide oxidation	• Greater need for water management requirements (precipitation, seepage, tailings fluids) within TMA • Ongoing management of containment structures • Considerable requirement for aggregate material, that may or may not be sourced from mine waste • Higher initial capital costs due to dam construction

Table 3-2 Tailings Management Alternatives Pre-Screening Analysis

Pre-Screening Criteria	Rationale	Disposal Method Alternative					TMA Location Alternative							
		Open Pit Storage	Underground Backfill	Dry Stack Storage	Thickened Tailings Impoundment	Conventional Slurry Impoundment	A	B	C	D	E	F	G	H
Does the alternative provide the best means of mitigating sulphide oxidation?	PAG tailings require a cover to limit the interactionof oxygen with sulphides and prevent the onset of ARD.	Yes[1]	Yes	No	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Does the mine waste disposal system rely on proven technology?	If a specific deposition method relies on unproven technology at the project site, then it could justifiably be argued that the alternative should be excluded from further consideration.	Yes	Yes	No[2]	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Does the alternative have capacity for a significant percentage of total tailings?	If a specific deposition method or location cannot contain a significant portion of the tailings, it would not be the primary tailings impoundment method or location and other methods or locations would be required.	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Is the alternative feasible with respect to project scheduling?	If the alternative cannot accept tailings as required by the mining and processing schedule, other tailings impoundment methods will be required and the alternative should be removed from further consideration.	No[3]	No[3]	Yes	Yes	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Does the alternative technology provide a benefit over conventional technologies?	If the technology does not provide any significant technical, environment, or socio-economic benefits relative to other technologies, as pertinent to the RRGP, then it should be excluded from further consideration.	N/A	N/A	No[4]	No[4]	Yes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Is the location reasonably close to the open pit / process plant?	If the tailings deposition location is a significant distance from the open pit, it would unnecessarily increase the environmental and social footprint of the project while driving up project costs.	N/A	N/A	N/A	N/A	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Will all mine waste disposal impacts be limited to the Pinewood River watershed?	Environmental footprint should be limited to the extent possible without significantly impacting a second watershed.	Yes	Yes	Depends on Location	Depends on Location	Depends on Location	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Is this the most suitable alternative in the vicinity of the impoundment location?	If two disposal locations significantly overlap, with one alternative clearing being preferable (from an environmental or social perspective), then the less preferable location can be excluded from further consideration.	N/A	N/A	N/A	N/A	N/A	Yes	Yes	Yes	Yes	No	No	No	No
	Carried forward to alternatives assessment?	**No**	**No**	**No**	**No**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**No**	**No**	**No**	**No**

[1] Open pit storage is suitable if the pit has been previously flooded
[2] Dry Stack (filtered) methods are typically employed in arid or arctic environments
[3] Open pit will not have significant storage capacity until completion of mining activities at end of mine life, and underground will only have minimal capacity mid to late project
[4] These methods do not provide any significant benefits over conventional slurry deposition at the RRGP

N/A Not Applicable



LEGEND

- Residence-House
- Lodging Cabin-Occasional Use
- Building - Unknown Use
- Local Roads
- Contours, 10 m interval (LIO-MNR)
- Watercourses
- Low-lying Area

Elevation Colour Ramp

High ground

Low ground

TMA Options

- TMA Alternative A
- TMA Alternative B (Proposed)
- TMA Alternative C
- TMA Alternative D
- TMA Alternative E
- TMA Alternative F
- TMA Alternative G
- TMA Alternative H

Proposed Site Feature

- Open Pit
- Plant Site / Ancillary Facilities
- Transmission Line
- Highway Re-alignment
- East Access Road

- Pinewood River Watershed
- Pinewood River Subwatershed Areas

Notes:
- Road data extracted from Land Information Ontario, Ontario Road Network, MNR Queen's Printer for Ontario, 2011-2012
- Background topographic and elevation data extracted from MNR Land Information Ontario, Queen's Printer for Ontario, 2011-2012

Datum: NAD83
Projection: UTM Zone 15N

0 2 4 8 12 16 Kilometres

newgold Rainy River Project amec

RAINY RIVER PROJECT

Tailing Management Area Location Alternatives

PROJECT N°: TC111504	FIGURE: 3-1
SCALE: 1:60,000	DATE: October 2013

P:\EM\Projects\2011\TC111504 Rainy River\GIS\D_Carr_Misc\Tailing_WR_Alternative_April_2013\MXD\TMA_Location_Alternatives6.mxd

4.0 TAILINGS MANAGEMENT ALTERNATIVES ASSESSMENT – ALTERNATIVES CHARACTERIZATION

4.1 Alternative A

Alternative A was selected as one of two TMA alternatives to be considered that does not overprint waters frequented by fish. The alternative is centred immediately north of several residential receptors (Figure 3-1). In order to meet capacity requirements it must overprint a north-south portion of Highway 600, west of the RRP mine site. Alternative A has a surface area of 803 ha, and will require an approximate total dam volume of 18.7 Mm^3 to contain 116 Mt of tailings plus provision for adequate freeboard[1]. A total of 3 dams are required, containing 96% of the perimeter. These dams have lengths of 910 m, 545 m and 8,360 m, and respective average heights of 8 m, 9 m and 15 m. The maximum dam height associated with this alternative would be approximately 28 m.

This alternative is suited to the development of internal dams for separate water ponding and management of excess water as could be required. This alternative would overprint a portion of the existing Highway 600 not currently planned for realignment, which would then require re-routing.

RRR has acquired surface rights or has options to acquire surface rights, to a substantive portion of the Alternative A footprint.

4.2 Alternative B

Alternative B is located in the headwaters of the Loslo Creek watershed, positioned northwest of the open pit, and is closer to the process plant than Alternative A. Alternative B avoids existing access roads and residences, but must overprint the headwaters of Loslo Creek and Marr Creek. The alternative has a footprint of 912 ha and will require an approximate dam volume of 14.1 Mm^3 to contain 116 Mt of tailings. Two dams are required, containing 75% of the perimeter. These dams have lengths of approximately 900 m and 8,805 m, and respective average heights of 7 m and 15 m. The maximum dam height associated with this alternative will be approximately 24 m.

This alternative takes advantage of high ground along its northern border, and is also suited to the development of internal dams for separate water ponding. This higher ground, which would not require dam containment, is also advantageous for directing runoff into the TMA at closure to develop a water cover to inhibit the onset of ARD. The lower portion of Loslo Creek (Cowser Municipal Drain) is also well suited to the development of a constructed wetland that would be used to improve overall final effluent quality.

[1] Freeboard is the elevation difference between the water surface elevation and the elevation at which water will flow out of the impoundment, typically through a designed spillway.

RRR has acquired surface rights or has options to acquire surface rights to the entire Alternative B footprint.

4.3 Alternative C

Alternative C situated within the Clark Creek watershed is positioned east of the open pit in very close proximity to the process plant. The alternative overprints Clark Creek (Teeple Municipal Drain), a local road (Clark Road), and a couple of residences which have already been acquired by RRR. Alternative C has a footprint of 858 ha, and will require an approximate dam volume of 25.9 Mm^3 to contain 116 Mt of tailings. A total of four dams are required for this alternative, containing 95% of the perimeter. These dams have lengths of approximately 2,590 m, 640 m, 2,340 m and 6,065 m, and respective average heights of 7 m, 3 m, 9 m and 20 m. The maximum dam height associated with this alternative will be approximately 41 m.

Alternative C takes partial advantage of the shallow valley topography provided by the Clark Creek watershed. The site does not lend itself particularly well to the development of more than one internal pond for water management.

RRR has acquired surface rights or has options to acquire surface rights, to portions of the Alternative C footprint.

4.4 Alternative D

Alternative D was selected as a second site that does not overprint waters frequented by fish. The alternative is centred on the area immediately west of Black Hawk and overprints portions of Tait Road. This alternative is located on the south side of the Pinewood River. Use of this tailings alternative will therefore require a tailings pipeline river crossing. Alternative D covers an area of 594 ha, and will require an approximate dam volume of 32.7 Mm^3 to contain 116 Mt of tailings. Alternative D requires a complete ring dam as the topography is not advantageous. The topography of this alternative is also elevated in the central region, which constrains overall tailings holding capacity, and would require a 9,660 m dam with an average height of 25 m. The maximum dam height associated with this alternative will be approximately 28 m.

It would also overprint a portion of the proposed Highway 600 re-alignment.

RRR has acquired surface rights or has options to acquire surface rights, to a small portion of the Alternative D footprint.

4.5 Alternative E

Alternative E is situated in the upper portion of the Marr Creek watershed. It is located north of the open pit, within very close proximity to the process plant. It overprints the headwaters of Marr Creek, a local access road (Marr Road), as well as several buildings which have been acquired by RRR. Alternative E has an area of 492 ha with an approximate dam volume of 33.7 Mm^3 to contain 116 Mt of tailings, and a maximum dam height of 39 m. Average height of the dam is 21 m.

This alternative takes advantage of limited high ground along its northern border for directing runoff into the TMA at closure, resulting in a single dam around 85% of the site's perimeter.

RRR has acquired surface rights or has options to acquire surface rights to the entire Alternative E footprint.

4.6 Alternative F

Alternative F is located north of the process plant and covers the headwaters of West Creek as well as an area outside the Pinewood River watershed. It has a footprint of 636 ha and will require an approximate dam volume of 18.2 Mm^3 to contain 116 Mt of tailings. A total of four dams are required for this alternative, containing 88% of the perimeter. These dams have lengths of approximately 170 m, 440 m, 125 m and 8,220 m, and respective average heights of 2 m, 3 m, 0.5 m and 17 m, with a maximum dam height of 25 m.

This alternative has an area of high ground along its eastern edge as well as higher ground to the west of the site which forms a V-shaped valley. These elevated areas would help to direct seepage and runoff for collection and management.

RRR has acquired surface rights or has options to acquire surface rights, to portions of the Alternative F footprint.

4.7 Alternative G

Alternative G is located to the northeast of the open pit and process plant. It is divided between two watersheds, with approximately 50% within the Pinewood River watershed and 50% in the neighbouring watershed. This alternative has a footprint of 573 ha and will require an approximate dam volume of 26.1 Mm^3 to contain 116 Mt of tailings. Three dams are required for this alternative, containing 97% of the perimeter. These dams have lengths of 7,250 m, 805 m and 585 m, and respective average heights of 21 m, 12 m and 12 m with a maximum dam height of 28 m.

Alternative G takes advantage of the same ridge of high ground along its western side (approximately 25% of the perimeter) as that on the eastern side of Alternative F which would help direct runoff. This alternative would overprint a portion of the preferred alignment for the East Access Road, which provides public access from the east side of the project site to Marr Road, as well as main access to the site.

RRR has acquired surface rights or has options to acquire surface rights, to portions of the Alternative G footprint.

4.8 Alternative H

Alternative H is located on the south side of the Pinewood River and partially overlaps Alternative D. As with Alternative D, topography is not advantageous and it would require a complete ring dam with an approximate volume of 48.5 Mm^3 to contain 116 Mt of tailings, with a maximum dam height of 44 m. The average height of the dam around the perimeter is 29 m.

This alternative has a footprint of approximately 357 ha. It requires that treated tailings be piped over the Pinewood River, and would overprint a portion of the proposed Highway 600 re-alignment.

RRR has acquired surface rights or has options to acquire surface rights, to a small portion of the Alternative H footprint.

Table 4-1 summarizes the characterization criteria for the tailings management alternatives with respect to the applicable subaccounts and indicators (described further in Section 4.0). As Alternatives E, F, G and H are not considered for further analysis due to fatal flaws, they are excluded from this table and additional consideration.

Table 4-1: TMA Alternatives Characterization

Account	Sub-Account	Indicator	Unit	Alternative A	Alternative B	Alternative C	Alternative D
Environmental	Aquatic Resources	Aquatic habitat losses	Metres	0	12,600	6,900	0
		Number of fish bearing waterbodies impacted	Quantity	0	1	1	0
	Water Quality	Availability of downgradient land for additional treatment	—	Surplus	Surplus	Adequate	None
		Effluent storage capacity and flexibility to protect downstream aquatic resources	—	Moderate storage surplus	Surplus storage	Storage seasonally adequate	Minimal storage capacity
	Terrestrial Resources - General	Area of TMA	Hectares	717	912	858	594
		Area of RRGP footprint	Hectares	4,050	3,860	2,330	2,150
	Terrestrial Resources - Air Quality / Noise	Distance to property boundary	Metres	>500	>500	>500	>500
	Terrestrial Resources - Effects to Species	Area of forest	Hectares	508	592	567	459
		Area of wetland	Hectares	1.1	75.7	104.3	13.3
	Terrestrial Resources - Avian Species	ESA avian species observations within alternative	Quantity	5	8	17	2
	Hydrology / Hydrogeology	Number of subwatersheds affected	Quantity	2	3	2	2
		Stream crossings by tailings and reclaim pipelines	Quantity	1	1	0	1
		Distance to nearest off property well	Kilometres	0	0	0.16	0
	Geochemistry	Amenability to develop water cover for control of ARD	—	Passive water cover with some pumping	Passive water cover	Passive water cover with some pumping	Passive water cover with some pumping
Technical	Design Factors	Material scheduling and ability to accommodate changes in material availability	—	Overburden quantity and scheduling adequate	Overburden quantity and scheduling adequate	Overburden quantity adequate; scheduling may need to change	Overburden quantity adequate; scheduling may need to change
		Length of perimeter ditching	Percent of perimeter	100%	75%	100%	100%
		Use of natural topography for containment	Percent perimeter dam	100%	75%	100%	100%
		Potential expansion capacity - dam fill required for 20% increase	Cubic metres	4.3M	3.9M	4.9M	9.6M
		Storage to dam fill ratio	Ratio	4.4	5.8	3.2	2.5
		Water storage capacity and flexibility	—	1-2 years	1-2 years	< 1 year	Short-term with little flexibility
		Starter dam volume required to store 10 Mm^3 of tailings	Cubic metres	1.3M	0.9M	2.3M	2.3M
	Dam Safety Factors	Pond position	—	Partially away from dam	Away from dam	Mainly adjacent to dam	Mainly adjacent to dam; limited by topography
		Maximum height of dams	Metres	28	24	41	28

Account	Sub-Account	Indicator	Unit	Alternative A	Alternative B	Alternative C	Alternative D
		Percentage of alternative contained by dams	Percentage	95%	75%	95%	100%
	Operational Complexity	TMA/water management operation complexity	—	Very low complexity	Very low complexity	Difficult	Difficult
		Distance from mill	Metres	5,275	2,690	850	3,050
		Access to reclaim water	—	Multiple ponds	Multiple ponds	Single pond	Seasonally limited
Project Economics	Capital Costs	Construction costs	CAD	$187M	$141M	$259M	$327M
		Pipeline costs	CAD	$0.61M	$0.31M	$0.10M	$0.35M
		Costs to realign local roadways	CAD	$7M	$0	< $1M	< $1M
	Operational Costs	Pumping costs	Metres of head	1.1	16.3	23.5	6.2
	Closure Costs	Cover	—	Overburden cover ± passive water	Passive water cover	Overburden cover ± passive water	Overburden cover ± passive water
		Inspections / maintenance at closure	—	Infrequent	Infrequent	Annual	Annual
		Water management	—	Passive water management	Passive water management	Passive water management	Initial pumping with subsequent passive water management
	Ancillary Costs	Habitat offsetting costs	CAD	$0	up to $500k	$750k to 1M	$0
		Land acquisition	CAD	Possibly unable to acquire	$0	Up to $5M	$5M to 10M
	Opportunity Costs	Risk arising from schedule delays	—	None	Very minor	Moderate	None
Socio-Economic	Aboriginal Land Use and Heritage Value	Traditional land use	—	No recent traditional land use activities identified during Traditional Knowledge study	No recent traditional land use activities identified during Traditional Knowledge study	No recent traditional land use activities identified during Traditional Knowledge study	No recent traditional land use activities identified during Traditional Knowledge study
	Ecological / Cultural Values	Loss of biodiversity, including ESA avian species habitat	—	Permanent, irreversible displacement of a small number of species	Permanent, irreversible displacement of a small number of species	Permanent, irreversible displacement of a small number of species	Permanent, irreversible displacement of a small number of species
		Loss of hunting opportunity	—	Permanent, irreversible loss of hunting opportunities within a localized area	Permanent, irreversible loss of hunting opportunities within a localized area	Permanent, irreversible loss of hunting opportunities within a localized area	Permanent, irreversible loss of hunting opportunities within a localized area
		Loss of agricultural use	Hectares	172	0	64	35
		Affected baitfish resources	—	None	Permanent, irreversible impacts to small scale fishery; mitigation possible	Permanent, irreversible impacts to small scale fishery; mitigation possible	None
	Land Access	Required changes to local access	—	Major change to provincial highway	No impact	Minor local routing changes	Major local routing changes

Account	Sub-Account	Indicator	Unit	Alternative A	Alternative B	Alternative C	Alternative D
		Potential difficulty of land acquisition	—	Possibly unable to acquire	None	Moderate	High
	Economic Risks and Benefits	Risk to project viability and loss of regional socio-economic benefits	—	None	Moderate	Moderate	None
	Operational Impacts and Aesthetics	Potential impact on residences	Kilometres	0.19	0.57	0.65	0.34
		Height of dams	Metres	28	24	41	28
	Closure, Post-closure Risks	Potential impact on residences	—	Small number of residences within 1 km	Small number of residences within 1 km	Small number of residences within 1 km	Several residences within 1 km
	Archaeological / Cultural Sites	Areas of archaeological potential	—	Pioneer farmstead	Minor sites requiring cataloguing only	Minor sites requiring cataloguing only	Minor sites requiring cataloguing only

M = Million
K = Thousand

5.0 TAILINGS MANAGEMENT ALTERNATIVES ASSESSMENT – MULTIPLE ACCOUNTS LEDGER

5.1 Determination of Site Specific Indicators

Measurement criteria or indicators are required to be developed in order to allow for a qualitative or quantitative measurement of the impact associated with each sub-account. Indicators are expected to represent the most important aspects of the project and the surrounding environment and which can be used to differentiate among the alternatives.

Environment Canada (2011) provides examples of criteria against which the alternatives may be evaluated; while clearly indicating that not all criteria may be applicable to all projects. These criteria were taken as a starting point for a discussion among a multidisciplinary team of engineers, environmental scientists and geoscientists, as to what the most appropriate criteria were for the RRP tailings management. This discussion also incorporated the following site-specific factors which are of particular relevance to the RRP:

- **Geochemistry of mine wastes:** a significant portion of the mine wastes are expected to be PAG and will require specific handling and containment to prevent / mitigate against the onset of ARD;

- **Species at Risk:** early and ongoing discussions with the Ministry of Natural Resources emphasized the need to carefully survey the area for Species at Risk and to take this information under careful consideration when designing the project;

- **Discussions and meetings with Aboriginal Groups:** based on discussions and negotiated agreements to date, economic opportunities brought forward by the RRP are expected to be welcomed by local Aboriginal Groups, while at the same time a desire to protect the local and regional environments was expressed;

- **Water management:** the RRP site has a surplus of water which must be carefully managed to balance the most efficient use of it and the protection of surface water. An integrated water management plan has been proposed for the site which incorporates the mill, and the TMA and MRS to maximize water recycling and minimize taking of fresh water from local waterbodies;

- **Local socio-economic conditions:** the RRP is located in an area of the Province which has seen a general decline in the economy over the last several years, partly as a result of a decrease in activity in the forestry sector. The RRP is expected to bring a net economic benefit to the area; and

- **Macro-economic conditions:** while it is always desirable to keep project costs down, mineral project developers are more sensitive to the impacts of higher costs under the current conditions in the mining sector, which may increase the difficulty of raising funds for development and construction.

With these factors taken into account, the list of sub-accounts and indicators presented in Table 4-1 were developed to evaluate each of the four TMA alternatives.

5.2 TMA Alternatives Assessment – Value Based Decision Process

A multiple accounts ledger was developed for the four TMA alternatives identified after pre-screening. The scoring criteria for the indicators shown in Table 4-1 are given in Table 5-1.

The initial analysis used the base case weightings for the four primary accounts (environment, technical, project economics and socio-economic) recommended by Environment Canada (2011):

- Environment – 6;
- Technical – 3;
- Project economics – 1.5; and
- Socio-economic – 3.

Table 5-2 presents the weightings given to the various sub-accounts and indicators, as determined in consultation with an experienced team of geotechnical engineers, environmental scientists and geoscientists who are familiar with the project.

Table 5-3 through Table 5-10 presents the results of the multiple accounts analysis for the individual indicators and sub-accounts, while the overall results of this analysis are shown in Table 5-11. The final analysis indicates that Alternative B is the most suitable choice of location for development of the TMA.

Table 5-12 provides a listing of the rationale for the selected sub-accounts and indicators used in the TMA alternatives analysis.

5.2.1 Environment

Alternative A ranked higher than the other options, with favourable scores arising from the lack of impact to waters frequented by fish and a relatively low level of impact to both wetlands and *Endangered Species Act* listed wildlife species.

5.2.2 Technical

Alternative B was the highest-ranked alternative for technical considerations, receiving the highest scores for design factors and dam safety factors. These scores were influenced most by a favourable storage-to-dam fill ratio, the lowest requirement of material for construction of a starter dam, the greatest amount of natural containment, ease of maintaining the pond away from the dam, and the lowest overall dams.

5.2.3 Project Economics

This account is heavily influenced by capital (dam construction) costs. Other costs are typically an order of magnitude less, and do not have as much influence on the outcome. Alternative B was the highest-ranked alternative in this account, benefitting largely from the greater amount of natural containment, and therefore lower direct costs for dam construction. In addition, land acquisition costs are not a contributing factor as the site is located on land wholly-owned by RRR.

5.2.4 Socio-Economic

Alternative B is the highest ranked alternative for the socio-economic account. This account was influenced most by access considerations (Alternative B has no impact on access to local residences or transportation routes) and by operational aesthetic considerations (very limited potential for air quality or noise impacts on nearby receptors and low dam heights with a reduced visual impact).

Table 5-1 TMA Accounts, Sub-Accounts, Indicators and Scoring Criteria

Account	Sub-Account	Indicator	Unit	Score					
				6 (best)	5	4	3	2	1 (worst)
Environmental	Aquatic Resources	Aquatic habitat losses	Metres	0	<500	500 to 1,000	1,000 to 5,000	5,000 to 10,000	>10,000
		Number of fishbearing waterbodies impacted	Quantity	0	1	2	3	4	5 or more
	Water Quality	Availability of downgradient land for additional treatment	—	Capacity for multiple downstream polishing ponds/wetland treatment	Capacity for single downstream polishing pond/wetland treatment (3.5)				No capacity for downstream polishing ponds/wetland treatment
		Effluent storage capacity and flexibility to protect downstream aquatic resources	—	Able to store excess effluent under any but the most extreme scenario	Able to store excess effluent for extended polishing with discharge in subsequent 1 to 2 years	Able to store excess effluent; must be discharged following spring	Able to store a moderate quantity of effluent; must be discharged prior to winter	Able to store a small quantity of excess effluent for a short period of time	Unable to store any excess effluent under any scenario
	Terrestrial Resources - General	Area of TMA	Hectares	<250	250 to 500	500 to 750	750 to 1,000	1,000 to 1,500	>1,500
		Area of RRGP footprint	Hectares	<1,000	1,000 to 2,000	2,000 to 3,000	3,000 to 4,000	4,000 to 5,000	>5,000
	Terrestrial Resources - Air Quality / Noise	Distance to property boundary	Metres	>500	300 to 500	200 to 300	150 to 200	100 to 150	<100
	Terrestrial Resources - Effects to Species	Area of forest	Hectares	<150	150 to 300	300 to 450	450 to 600	600 to 750	>750
		Area of wetland	Hectares	0	<25	25 to 50	50 to 75	75 to 100	>100
	Terrestrial Resources - Avian Species	ESA avian species observations within alternative	Quantity	0	1 to 2	3 to 4	5 to 6	7 to 10	>10
	Hydrology / Hydrogeology	Number of subwatersheds affected	Quantity	1	2, all within Pinewood	3, all within Pinewood	2-3, in/out of Pinewood	1, outside Pinewood	>1, outside Pinewood
		Stream crossings by tailings and reclaim pipelines	Quantity	0	1	2	3	4	5+
		Distance to nearest off property well	Kilometres	>3	2 to 3	1.5 to 2	1 to 1.5	0.5 to 1	<0.5
	Geochemistry	Amenability to develop water cover for control of ARD	—	Passive water cover to be established	Passive water cover supplemented with low permeability soil cover	Passive water cover, supplemented by periodic pumping	Frequent, ongoing pumping required for complete water cover	Low permeability soil cover supplemented with water cover	Water cover not feasible; soil cover required
Technical	Design Factors	Material scheduling and ability to accommodate changes in material availability	—	All material requirements can be met by operations schedule	All material requirements can be met by operations; adjustments to operations schedule may be required	Starter dam material available from stripping; some crushing of aggregate sources required	Starter dam material available from stripping; extensive crushing of aggregate sources required	Insufficient material available on site for ultimate dam; offsite sources required	Requirements for starter dam material cannot be met by overburden stripping schedule
		Length of perimeter ditching	Percent of perimeter	<20%	20 to 40%	40 to 60%	60 to 80%	80 to 90%	90 to 100%
		Use of natural topography for containment	Percent perimeter dam	<20%	20 to 40%	40 to 60%	60 to 80%	80 to 90%	90 to 100%
		Potential expansion capacity - dam fill required for 20% increase	Cubic metres	0	0 to 2M	2M to 4M	4M to 6M	6M to 8M	>8M
		Storage to dam fill ratio	Ratio	>5	4 to 5	3 to 4	2 to 3	1 to 2	<1
		Water storage capacity and flexibility	—	Able to store excess water under any but the most extreme runoff scenario	Excess storage with discharge/use in subsequent 1 to 2 years	Some excess storage; must be discharged/used within ~1 year	Moderate storage; must be discharged/used prior to spring melt	Limited storage for a short period of time	Unable to store any excess water under any scenario
		Starter dam volume required to store 10 Mm^3 of tailings	Cubic metres	<1M	1M to 1.25M	1.25M to 1.5M	1.5M to 2M	2M to 2.5M	>2.5M
	Dam Safety Factors	Pond position	—	Pond can be maintained away from dam throughout operation and closure	Pond can be maintained away from the dam under most circumstances	Pond can be maintained away from the dam approximately half the time	Small portion of the pond is in contact with the dam	Pond is generally in contact with the dam	Dam required for containment of pond
		Maximum height of dams	Metres	<20	20 to 24	25 to 29	30 to 34	35 to 39	>40
		Percentage of alternative contained by dams	Percentage	<20%	20 to 40%	40 to 60%	60 to 80%	80 to 90%	90 to 100%
	Operational Complexity	TMA/water management operation complexity	—	Very easy	Easy	Moderately easy	Moderately difficult	Difficult	Very difficult
		Distance from mill	Metres	<500	500 to 1,000	1,000 to 2,000	2,000 to 3,000	3,000 to 4,000	> 4,000
		Access to reclaim water	—	Multiple ponds with surplus storage	Single pond with surplus storage	Potential for seasonal limitations to reclaim water	Seasonally limited access to sufficient reclaim water	Difficult to maintain pond with sufficient water for reclaim	None
Project Economics	Capital Costs	Construction costs	CAD	< $150M	$150 to 165M	$165 to 180M	$180 to 200M	$200 to 250M	> $250M
		Pipeline costs	CAD	<$200k	$200 to 400k	$400k to 600k	$600k to 800k	$800k to 1M	>$1M
		Costs to realign local roadways	CAD	$0M	$0 to 1M	$1M to 2M	$2M to 5M	$5M to 10M	>$10M
	Operational Costs	Pumping costs	Metres of head	<5	5 to 10	10 to 15	15 to 20	20 to 25	>25
	Closure Costs	Cover	—	Passive water cover to be established	Passive water cover supplemented with low permeability soil cover	Low permeability soil cover supplemented with passive water cover	Perpetual pumping required for complete water cover	Low permeability soil cover supplemented with active water cover	Low permeability soil cover required; no water cover available
		Inspections / maintenance at closure	—	None required	Infrequent inspections and/or maintenance required	Annual inspections and/or maintenance required	Semi-annual inspections and/or maintenance required	Quarterly inspections and/or maintenance required	Permanent active management required at closure
		Water management	—	Minimal water management due to passive flooding; passive or no treatment	Short term pumping followed by passive flooding; passive or no treatment	Passive flooding with treatment prior to discharge	Short term pumping followed by passive flooding; treatment prior to discharge	Long term/intermittent pumping with some passive flooding; treatment may be required	Perpetual pumping and treatment of water
	Ancillary Costs	Habitat offsetting costs	CAD	$0M	$0 to 500k	$500 to 750k	$750k to 1M	$1M to 1.5M	>$1.5M
		Land acquisition	CAD	$0M	$0 to 2M	$2M to 5M	$5M to 10M	>$10M	Possibly unable to acquire
	Opportunity Costs	Risk arising from schedule delays	—	None	Possible minor schedule delays with no material risk to project	Potential delays up to 3 months	Potential delays up to 6 months	Proposed option poses potential for delays in excess of 1 year; significant risk to project	Loss of investor confidence in project resulting in inability to raise funds for development

Account	Sub-Account	Indicator	Unit	Score					
				6 (best)	5	4	3	2	1 (worst)
Socio-Economic	Aboriginal Land Use and Heritage Value	Traditional land use	—	No recent traditional land use activities identified for the project area as part of Traditional Knowledge studies; all options given score of 1					
	Ecological / Cultural Values	Loss of biodiversity, including ESA avian species habitat	—	No loss of biodiversity	Short term (construction phase), displacement of a small number of species	Medium term (life of Project), displacement of a small or large number of species	Long term, reversible displacement of a small or large number of species	Permanent, irreversible displacement of a small number of species	Permanent, irreversible displacement of a large number of species
		Loss of hunting opportunity	—	No impact to recreational hunting opportunities	Short term (construction phase), reversible impacts to hunting opportunities	Medium term (life of Project), reversible impacts to hunting opportunities	Long term, reversible impacts to hunting opportunities	Permanent, irreversible loss of hunting opportunities within a localized area	Permanent, irreversible loss of hunting opportunities across a large area
		Loss of agricultural use	Hectares	0	<50	50 to 100	100 to 200	200 to 400	>400
		Affected baitfish resources	—	No fisheries resources affected	Short term (construction phase), reversible impacts to small scale fisheries	Medium term (life of Project), reversible impacts to fisheries	Long term, reversible impacts to fisheries	Permanent, irreversible impacts to small scale fishery; mitigation possible	Permanent, irreversible impacts to small scale fishery; mitigation not possible
	Land Access	Required changes to local access	—	No impacts to local access	Minor changes to secondary access routes	Major changes to secondary access routes	Minor changes to primary access routes	Major changes to primary access routes	Large areas completely cut off; significant access improvements required
		Potential difficulty of land acquisition	—	None required	Small portion of TMA not on RRR property; high likelihood of acquisition	Small portion of TMA not on RRR property; acquisition difficult and changes to design may be needed	Large portion of TMA not on RRR property; high likelihood of acquisition	Large portion of TMA not on RRR property; acquisition difficult	Possibly unable to acquire
	Economic Risks and Benefits	Risk to project viability and loss of regional socio-economic benefits	—	None	Low risk of minor project delays and delayed regional benefits	Moderate risk of minor project delays and delayed regional benefits	High risk of minor to moderate project delays and delayed regional benefits	Risk of significant project delays and delayed regional benefits	Imposition of option would result in cancellation of project
	Operational Impacts and Aesthetics	Potential impact on residences	Kilometres	Few residences within 2 to 5 km	Multiple residences within 2 to 5 km	Few residences within 1 to 2 km	Multiple residences within 1 to 2 km	Few residences within 1 km	Multiple residences within 1 km
		Height of dams	Metres	<20	20 to 24	25 to 29	30 to 34	35 to 39	>40
	Closure, Post-closure Risks	Potential impact on residences	—	Few residences within 2 to 5 km	Multiple residences within 2 to 5 km	Few residences within 1 to 2 km	Multiple residences within 1 to 2 km	Few residences within 1 km	Multiple residences within 1 km
	Archaeological / Cultural Sites	Areas of archaeological potential	—	None identified	Few minor sites; cataloguing required	Several minor sites; cataloguing required	Few important sites; cataloguing and relocation required	Several important sites; cataloguing and relocation required	High value site(s) not amenable to relocation or disturbance

Table 5-2: TMA Analysis Component Weightings

Account	Weight	Sub-Account	Weight	Indicator	Weight
Environmental	6	Aquatic Resources	5	Aquatic habitat losses	5
				Number of fishbearing waterbodies impacted	3
		Water Quality	4	Availability of downgradient land for additional treatment	2
				Effluent storage capacity and flexibility to protect downstream aquatic resources	5
		Terrestrial Resources - General	4	Area of TMA	1
				Area of RRGP footprint	1
		Terrestrial Resources - Air Quality / Noise	3	Distance to property boundary	1
		Terrestrial Resources - Effects to Species	3	Area of forest	3
				Area of wetland	2
		Terrestrial Resources - Avian Species	4	ESA avian species observations within alternative	4
		Hydrology / Hydrogeology	3	Number of subwatersheds affected	3
				Stream crossings by tailings and reclaim pipelines	1
				Distance to nearest off property well	1
		Geochemistry	4	Amenability to develop water cover for control of ARD	4
Technical	3	Design Factors	5	Material scheduling and ability to accommodate changes in material availability	2
				Length of perimeter ditching	1
				Use of natural topography for containment	1
				Potential expansion capacity - dam fill required for 20% increase	1
				Storage to dam fill ratio	4
				Water storage capacity and flexibility	4
				Starter dam volume required to store 10 Mm^3 of tailings	2
		Dam Safety Factors	6	Pond position	3
				Maximum height of dams	2
				Percentage of alternative contained by dams	3
		Operational Complexity	3	TMA/water management operation complexity	2
				Distance from mill	1
				Access to reclaim water	3
Project Economics	1.5	Capital Costs	6	Construction costs	6
				Pipeline costs	1
				Costs to realign local roadways	3
		Operational Costs	2	Pumping costs	2
		Closure Costs	2	Cover	1
				Inspections / maintenance at closure	1
				Water management	3
		Ancillary Costs	2	Habitat offsetting costs	2
				Land acquisition	4
		Opportunity Costs	4	Risk arising from schedule delays	4
Socio-Economic	3	Aboriginal Land Use and Heritage Value	3	Traditional land use	3
		Ecological / Cultural Values	4	Loss of biodiversity, including ESA avian species habitat	2
				Loss of hunting opportunity	2
				Loss of agricultural use	3
				Affected baitfish resources	1
		Land Access	3	Required changes to local access	3
				Potential difficulty of land acquisition	5
		Economic Risks and Benefits	4	Risk to project viability and loss of regional socio-economic benefits	4
		Operational Impacts and Aesthetics	4	Potential impact on residences	4
				Height of dams	2
		Closure, Post-closure Risks	2	Potential impact on residences	2
		Archaeological / Cultural Sites	2	Areas of archaeological potential	2

Table 5-3 TMA Environment Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Aquatic Resources	Aquatic habitat Losses	5	6	30	1	5	2	10	6	30
	Number of fishbearing waterbodies impacted	3	6	18	5	15	5	15	6	18
	Sub Account Merit Score		48		20		25		48	
	Sub Account Merit Rating		**6.0**		**2.5**		**3.1**		**6.0**	
Water Quality	Availability of downgradient land for additional treatment	2	6	12	6	12	1	2	3.5	7
	Effluent storage capacity and flexibility to protect downstream aquatic resources	5	5	25	6	30	3	15	2	10
	Sub Account Merit Score		37		42		17		17	
	Sub Account Merit Rating		**5.3**		**6.0**		**2.4**		**2.4**	
Terrestrial Resources - General	Area of TMA	1	3	3	3	3	3	3	4	4
	Area of RRGP footprint	1	2	2	3	3	4	4	4	4
	Sub Account Merit Score		5		6		7		8	
	Sub Account Merit Rating		**2.5**		**3.0**		**3.5**		**4.0**	
Terrestrial Resources - Air Quality / Noise	Distance to property boundary	1	6	6	6	6	6	6	6	6
	Sub Account Merit Score		6		6		6		6	
	Sub Account Merit Rating		**6.0**		**6.0**		**6.0**		**6.0**	
Terrestrial Resources - Effects to Species	Area of forest	3	3	9	3	9	3	9	3	9
	Area of wetland	2	5	10	2	4	1	2	5	10
	Sub Account Merit Score		19		13		11		19	
	Sub Account Merit Rating		**3.8**		**2.6**		**2.2**		**3.8**	
Terrestrial Resources - Avian Species	ESA avian species observations within alternative	4	3	12	2	8	1	4	5	20
	Sub Account Merit Score		12		8		4		20	
	Sub Account Merit Rating		**3.0**		**2.0**		**1.0**		**5.0**	
Hydrology / Hydrogeology	Number of subwatersheds affected	3	5	15	4	12	5	15	5	15
	Stream crossings by tailings and reclaim pipelines	1	5	5	5	5	6	6	5	5
	Distance to nearest off property well	1	1	1	1	1	1	1	1	1
	Sub Account Merit Score		21		18		22		21	
	Sub Account Merit Rating		**4.2**		**3.6**		**4.4**		**4.2**	
Geochemistry	Amenability to develop water cover for control of ARD	4	4	16	5	20	4	16	4	16
	Sub Account Merit Score		16		20		16		16	
	Sub Account Merit Rating		**4.0**		**5.0**		**4.0**		**4.0**	

Table 5-4 TMA Technical Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Design Factors	Material scheduling and ability to accommodate changes in material availability	2	6	12	6	12	5	10	5	10
	Length of perimeter ditching	1	1	1	3	3	1	1	1	1
	Use of natural topography for containment	1	3	3	4	4	3	3	1	1
	Potential expansion capacity - dam fill required for 20% increase	1	5	5	6	6	4	4	3	3
	Storage to dam fill ratio	4	5	20	5	20	3	12	2	8
	Water storage capacity and flexibility	4	4	16	6	24	2	8	2	8
	Starter dam volume required to store 10 Mm^3 of tailings	2	6	12	5	10	5	10	6	12
	Sub Account Merit Score		69		79		48		43	
	Sub Account Merit Rating		**4.6**		**5.3**		**3.2**		**2.9**	
Dam Safety Factors	Pond position	3	4	12	6	18	2	6	2	6
	Maximum height of dams	2	4	8	5	10	1	2	4	8
	Percentage of alternative contained by dams	3	1	3	3	9	1	3	1	3
	Sub Account Merit Score		23		37		11		17	
	Sub Account Merit Rating		**2.9**		**4.6**		**1.4**		**2.1**	
Operational Complexity	TMA / water management operation complexity	2	6	12	6	12	4	8	2	4
	Distance from mill	1	1	1	3	3	5	5	2	2
	Access to reclaim water	3	6	18	6	18	5	15	4	12
	Sub Account Merit Score		31		33		28		18	
	Sub Account Merit Rating		**5.2**		**5.5**		**4.7**		**3.0**	

Table 5-5 TMA Project Economic Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Capital Costs	Construction costs	6	3	18	6	36	1	6	1	6
	Pipeline costs	1	3	3	5	5	6	6	5	5
	Costs to realign local roadways	3	2	6	6	18	5	15	5	15
	Sub Account Merit Score		27		59		27		26	
	Sub Account Merit Rating		**2.7**		**5.9**		**2.7**		**2.6**	
Operational Costs	Pumping costs	2	6	12	3	6	4	8	5	10
	Sub Account Merit Score		12		6		8		10	
	Sub Account Merit Rating		**6.0**		**3.0**		**4.0**		**5.0**	
Closure Costs	Cover	1	4	4	6	6	4	4	4	4
	Inspections / maintenance at closure	1	5	5	5	5	4	4	4	4
	Water management	3	6	18	6	18	6	18	5	15
	Sub Account Merit Score		27		29		26		23	
	Sub Account Merit Rating		**5.4**		**5.8**		**5.2**		**4.6**	
Ancillary Costs	Habitat offsetting costs	2	6	12	5	10	3	6	6	12
	Land acquisition	4	1	4	6	24	4	16	3	12
	Sub Account Merit Score		16		34		22		24	
	Sub Account Merit Rating		**2.7**		**5.7**		**3.7**		**4.0**	
Opportunity Costs	Risk arising from schedule delays	4	6	24	5	20	3	12	6	24
	Sub Account Merit Score		24		20		12		24	
	Sub Account Merit Rating		**6.0**		**5.0**		**3.0**		**6.0**	

Table 5-6 TMA Socio-Economic Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Aboriginal Land Use and Heritage Value	Traditional land use	3	1	3	1	3	1	3	1	3
	Sub Account Merit Score		3		3		3		3	
	Sub Account Merit Rating		**1.0**		**1.0**		**1.0**		**1.0**	
Ecological and Cultural Values	Loss of biodiversity, including ESA wildlife species	2	2	4	2	4	2	4	2	4
	Loss of hunting opportunity	2	2	4	2	4	2	4	2	4
	Loss of agricultural use	3	3	9	6	18	4	12	5	15
	Affected baitfish resources	1	6	6	2	2	2	2	6	6
	Sub Account Merit Score		23		28		22		29	
	Sub Account Merit Rating		**2.9**		**3.5**		**2.8**		**3.6**	
Land Access	Required changes to local access	3	2	6	6	18	5	15	4	12
	Potential difficulty of land acquisition	5	1	5	6	30	4	20	2	10
	Sub Account Merit Score		11		48		35		22	
	Sub Account Merit Rating		**1.4**		**6.0**		**4.4**		**2.8**	
Economic Risks and Benefits	Risk to project viability and loss of regional socio-economic benefits	4	6	24	5	20	4	16	6	24
	Sub Account Merit Score		24		20		16		24	
	Sub Account Merit Rating		**6.0**		**5.0**		**4.0**		**6.0**	
Operational Impacts and Aesthetics	Potential impact on residences	4	1	4	4	16	4	16	2	8
	Height of dams	2	4	8	5	10	1	2	4	8
	Sub Account Merit Score		12		26		18		16	
	Sub Account Merit Rating		**2.0**		**4.3**		**3.0**		**2.7**	
Closure and Post-closure Risks	Potential impact on residences	2	2	4	2	4	2	4	1	2
	Sub Account Merit Score		4		4		4		2	
	Sub Account Merit Rating		**2.0**		**2.0**		**2.0**		**1.0**	
Preservation of Archaeological and Cultural Sites	Areas of archaeological potential	2	3	6	5	10	4	8	4	8
	Sub Account Merit Score		6		10		8		8	
	Sub Account Merit Rating		**3.0**		**5.0**		**4.0**		**4.0**	

Table 5-7 TMA Environment Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Environment	Aquatic Resources	5	6.0	30.0	2.5	12.5	3.1	15.6	6.0	30.0
	Water Quality	4	5.3	21.1	6.0	24.0	2.4	9.7	2.4	9.7
	Terrestrial Resources - General	4	2.5	10.0	3.0	12.0	3.5	14.0	4.0	16.0
	Terrestrial Resources - Air Quality / Noise	3	6.0	18.0	6.0	18.0	6.0	18.0	6.0	18.0
	Terrestrial Resources - Effects to Species	3	3.8	11.4	2.6	7.8	2.2	6.6	3.8	11.4
	Terrestrial Resources - Avian Species	4	3.0	12.0	2.0	8.0	1.0	4.0	5.0	20.0
	Hydrology / Hydrogeology	3	4.2	12.6	3.6	10.8	4.4	13.2	4.2	12.6
	Geochemistry	4	4.0	16.0	5.0	20.0	4.0	16.0	4.0	16.0
	Account Merit Score		131.1		113.1		97.1		133.7	
	Account Merit Rating		**4.4**		**3.8**		**3.2**		**4.5**	

Table 5-8 TMA Technical Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Technical	Design Factors	5	4.6	23.0	5.3	26.3	3.2	16.0	2.9	14.3
	Dam Safety Factors	6	2.9	17.3	4.6	27.8	1.4	8.3	2.1	12.8
	Operational Complexity	3	5.2	15.5	5.5	16.5	4.7	14.0	3.0	9.0
	Account Merit Score		55.8		70.6		38.3		36.1	
	Account Merit Rating		**4.0**		**5.0**		**2.7**		**2.6**	

Table 5-9 TMA Economic Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Economic	Capital Costs	6	2.7	16.2	5.9	35.4	2.7	16.2	2.6	15.6
	Operational Costs	2	6.0	12.0	3.0	6.0	4.0	8.0	5.0	10.0
	Closure Costs	2	5.4	10.8	5.8	11.6	5.2	10.4	4.6	9.2
	Ancillary Costs	2	2.7	5.3	5.7	11.3	3.7	7.3	4.0	8.0
	Opportunity Costs	4	6.0	24.0	5.0	20.0	3.0	12.0	6.0	24.0
	Account Merit Score		68.3		84.3		53.9		66.8	
	Account Merit Rating		**4.3**		**5.3**		**3.4**		**4.2**	

Table 5-10 TMA Socio-Economic Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative B		Alternative C		Alternative D	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Socio-Economic	Aboriginal Land Use and Heritage Value	3	1.0	3.0	1.0	3.0	1.0	3.0	1.0	3.0
	Ecological and Cultural Values	4	2.9	11.5	3.5	14.0	2.8	11.0	3.6	14.5
	Land Access	3	1.4	4.1	6.0	18.0	4.4	13.1	2.8	8.3
	Economic Risks and Benefits	4	6.0	24.0	5.0	20.0	4.0	16.0	6.0	24.0
	Operational Impacts and Aesthetics	4	2.0	8.0	4.3	17.3	3.0	12.0	2.7	10.7
	Closure and Post-closure Risks	2	2.0	4.0	2.0	4.0	2.0	4.0	1.0	2.0
	Preservation of Archaeological and Cultural Sites	2	3.0	6.0	5.0	10.0	4.0	8.0	4.0	8.0
	Account Merit Score		60.6		86.3		67.1		70.4	
	Account Merit Rating		**2.8**		**3.9**		**3.1**		**3.2**	

Table 5-11 TMA Account Analysis

Account	Weight*	Alternative A		Alternative B		Alternative C		Alternative D	
		Rating	Score	Rating	Score	Rating	Score	Rating	Score
Environment	6	4.4	26.2	3.8	22.6	3.2	19.4	4.5	26.7
Technical	3	4.0	11.9	5.0	15.1	2.7	8.2	2.6	7.7
Economic	1.5	4.3	6.4	5.3	7.9	3.4	5.1	4.2	6.3
Socio Economic	3	2.8	8.3	3.9	11.8	3.1	9.2	3.2	9.6
Alternative Merit Score		52.8		57.4		41.8		50.3	
Alternative Merit Rating		**3.9**		**4.3**		**3.1**		**3.7**	

Table 5-12: Rationale for TMA Analysis Sub-accounts and Indicators

Account	Sub-Account	Rationale	Indicator	Rationale
Environmental	Aquatic Resources	Minimizing or avoiding impacts to aquatic resources is a key environmental criteria due to the sensitivity of species and habitats to disruption.	Aquatic habitat losses	Minimizing the overall impact to aquatic habitat is preferred.
			Number of fish bearing waterbodies impacted	Fewer impacted waterbodies reduces the potential impacts to quantity and diversity of aquatic species.
	Water Quality	Avoiding impacts to water quality is important for both the protection of aquatic species as well as for providing flexibility with various water management scenarios.	Availability of downgradient land for additional treatment	The availability of land downstream is advantageous for the use and/or construction of wetland polishing ponds for final effluent treatment.
			Effluent storage capacity and flexibility to protect downstream aquatic resources	Alternatives with greater storage capacity are better able to manage water flows and extend retention time during extreme (high or low) flow years.
	Terrestrial Resources - General	A primary aim of the holistic design of the RRP has been to maintain a compact project footprint to minimize overall environmental impacts.	Area of TMA	Smaller TMA areas have an overall lower environmental impact.
			Area of RRGP footprint	A smaller project footprint is preferable, resulting in a lower overall impact to the environment.
	Terrestrial Resources - Air Quality / Noise	Air quality and noise impacts are directly related to the ability to get regulatory approval for the alternative.	Distance to property boundary	The potential for noise and air quality effects is greatly reduced with distance to the property boundaries.
	Terrestrial Resources - Effects to Species	Terrestrial species may be affected by impacts to their habitats.	Area of forest	A smaller area is preferred; used as a proxy to quantify potential impacts to terrestrial species.
			Area of wetland	A smaller area is preferred; used as a proxy to quantify potential impacts to amphibian species.
	Terrestrial Resources - Avian Species	Avian species at risk are a particular focus of project environmental investigations.	ESA avian species observations within alternative	Minimizing impacts to ESA listed species is a key environmental criteria.
	Hydrology / Hydrogeology	Surface and groundwater resources may be affected by larger or more complex alternatives.	Number of subwatersheds affected	Restricting the alternative to the fewest number of subwatersheds is preferred, to minimize the area overprinted as well as reducing unnecessary capture of flows to otherwise unimpacted subwatersheds.
			Stream crossings by tailings and reclaim pipelines	In the event of a pipeline rupture or spill, impacts to water bodies are potentially greater and more difficult to remediate. Fewer stream crossings are preferred.
			Distance to nearest off property well	As distance increases, the potential for effects related to groundwater seepage is greatly reduced.
	Geochemistry	All tailings at the RRP are assumed to potentially acid-generating	Amenability to develop water cover for control of ARD	Passive water cover is the most effective method of excluding oxygen from tailings and inhibiting onset of sulphide oxidation.

Account	Sub-Account	Rationale	Indicator	Rationale
Technical	Design Factors	Several factors contribute the design and operational complexity of a TMA facility; a simpler, more flexible facility is preferred.	Material scheduling and ability to accommodate changes in material availability	Greater flexibility in material scheduling is favourable from a dam construction perspective.
			Length of perimeter ditching	Less ditching for management of runoff and seepage is preferred.
			Use of natural topography for containment	Natural topography is more stable than dam containment.
			Potential expansion capacity - dam fill required for 20% increase	Should additional mineral resources be identified as the project progresses, it is advantageous to use an existing mine waste storage facility, and preferable to undertake minimal additional construction.
			Storage to dam fill ratio	The higher the ratio is, the less dam construction required to contain the volume of tailings required. The result is greater safety and lower costs.
			Water storage capacity and flexibility	The ability of the TMA to store excess water is of benefit to the desire to increase recycling in the process plant, as well as to manage water flows in extreme flow years (wet or dry).
			Starter dam volume required to store 10 Mm^3 of tailings	Lower material quantities required for a starter dam reduces the risk of impacts related to mine development / stripping scheduling.
	Dam Safety Factors	Dam safety is considered to be of very high importance for both safety of personnel, neighbouring residents and protection of the environment.	Pond position	Safety is increased as the pond is kept away from the dam, avoiding the potential for erosion and overtopping.
			Maximum height of dams	Lower dams have a much lower risk of failure.
			Percentage of alternative contained by dams	Minimizing the length of dams required for containment (i.e. maximizing natural containment) results in lower risk of failure.
	Operational Complexity	The more complicated a system is, the more difficult it is to operate and maintain, resulting in higher costs and greater risk of operational upset.	TMA/water management operation complexity	Ease of water management is preferred.
			Distance from mill	Greater distances require longer pipelines which increases the risk of a spill somewhere along the length, and increases the need for inspections and maintenance.
			Access to reclaim water	The ability to use reclaim water for processing is advantageous as it reduces the demand for fresh water from the environment.

Account	Sub-Account	Rationale	Indicator	Rationale
Project Economics	Capital Costs	Capital costs to construct the TMA and other infrastructure are a significant portion of the overall project budget. Minimizing these expenditures is preferred.	Construction costs	Overwhelmingly related to dam construction and dam volume.
			Pipeline costs	Costs to install pipeline from process plant to TMA; dictated by length of pipeline.
			Costs to realign local roadways	Costs incurred to maintain local access if preferred alternative overprints a portion of current access routes.
	Operational Costs	Ongoing costs to operate the TMA and pump tailings will impact overall project financial performance.	Pumping costs	Energy costs to pump tailings to TMA, as a function of elevation differential between process plant and TMA.
	Closure Costs	Intensive closure costs will directly impact overall project financial performance, as well as increase the requirement for closure bonding.	Cover	Engineered sediment or other synthetic covers are more costly to design and implement. Passive water cover is preferred.
			Inspections / maintenance at closure	Alternatives which have lower requirements for ongoing inspections and maintenance will result in lower closure costs and are preferred.
			Water management	Long term water treatment results in increased closure costs.
	Ancillary Costs	Additional costs related to individual alternatives, which contribute to the overall cost of the alternative and impact project financial performance.	Habitat offsetting costs	Alternatives with no or lower offsetting costs (e.g. habitat recreation) are preferred.
			Land acquisition	If RRR does not hold surface rights or the option to acquire surface rights to the alternative footprint, additional costs will need to be incurred to acquire them, if possible.
	Opportunity Costs	Potential schedule delays related to approvals and permittability of an alternative may impact the ability to raise project financing	Risk arising from schedule delays	Alternatives which are more likely to receive timely regulatory approval are preferred.
Socio-Economic	Aboriginal Land Use and Heritage Value	Aboriginal consultation is recognized by RRR as an important part of the Environmental Assessment (EA) and mine planning process, and traditional uses of area lands are given strong consideration in project decisions.	Traditional land use	Alternatives which do not impact areas described as having traditional Aboriginal uses are preferred. To date, no recent traditional land use activities have been identified during TK studies.
	Ecological / Cultural Values	Minimizing or avoiding potential impacts to people's way of life, culture and community are important to balance with the need for regional economic development.	Loss of biodiversity, including ESA avian species habitat	Alternatives with lower Impacts to overall species quantity and diversity are preferable.
			Loss of hunting opportunity	Hunting is considered a culturally significant activity within the region.
			Loss of agricultural use	Agriculture (dominantly cattle and forage crops) represents a significant land use in the region.
			Affected baitfish resources	A small baitfish resource exists within some project area streams.
	Land Access	It is important that RRR balance the ability to access land for construction of a TMA and other project components while maintaining local public access to residences and recreational areas.	Required changes to local access	Alternatives with fewer disruptions to existing local access routes are preferred
			Potential difficulty of land acquisition	If RRR does not hold surface rights or the option to acquire surface rights to the alternative footprint, the choice of alternative will be influenced the ability to

Account	Sub-Account	Rationale	Indicator	Rationale
				acquire them.
	Economic Risks and Benefits	The RRP will bring welcome and needed economic benefits to the region.	Risk to project viability and loss of regional socio-economic benefits	Alternatives which may result in a delay of the project or put the project at risk of being carried out would have a direct effect on the positive economic benefits brought to the region by the RRP.
	Operational Impacts and Aesthetics	The operations phase of the project will produce a certain level of unavoidable industrial activity and associated effects.	Potential impact on residences	Fewer residences which are further away are less likely to be affected by potential noise and air quality effects during operations.
			Height of dams	Higher dams have a greater visual impact on the local landscape.
	Closure, Post-closure Risks	During closure and post-closure the facilities will begin to be reclaimed, but there will less active management.	Potential impact on residences	Fewer residences which are further away are less likely to be affected by potential air quality effects during closure.
	Archaeological / Cultural Sites	Archaeological or cultural heritage sites are an important component of the history of the people of the region.	Areas of archaeological potential	Alternatives in areas of lower archaeological potential are preferred.

6.0 TAILINGS MANAGEMENT ALTERNATIVES ASSESSMENT – SENSITIVITY ANALYSIS

A sensitivity analysis was carried out using the Scenario Manager feature of Microsoft Excel 2007, with summary results for all scenarios output as a pivot table for ease of comparison.

Four sensitivity analysis scenarios were given consideration, in addition to the base case:

- **TMA1:** Base case;
- **TMA2:** All accounts weighted equally;
- **TMA3:** Environment account weighted twice as important as technical and s ocio-economic accounts, cost account has no weight;
- **TMA4:** Environment and technical accounts weighted twice as important as socio-economic and cost accounts; and
- **TMA5:** Environment and socio-economic accounts weighted twice as important as technical and cost accounts.

RRR believes that the scenarios presented offer a r easonable diversity of considerations for those factors which should most heavily influence the selection of a TMA alternative. A nearly unlimited number of additional scenarios for sensitivity analysis could be proposed by adjusting weightings for individual indicators and subaccounts.

The results of the sensitivity analysis are documented in Table 6-1, and indicate that under any reasonable scenario considered, Alternative B is the best-rated choice for placement of the TMA.

RRR therefore concludes that based on the results of the sensitivity analysis, the weightings and ratings chosen and the site selection process as a whole can be considered robust.

Table 6-1: TMA Assessment Sensitivity Analysis

Scenario	Scenario Description	Alternative Merit Rating			
		Alternative A	Alternative B	Alternative C	Alternative D
TMA1	Base case	3.9	4.3	3.1	3.7
TMA2	All accounts weighted equally	3.8	4.5	3.1	3.6
TMA3	Environment account weighted twice as important as technical and socio-economic accounts, cost account has no weight	3.9	4.1	3.1	3.7
TMA4	Environment and technical accounts weighted twice as important as socio-economic and cost accounts	4.0	4.5	3.1	3.6
TMA5	Environment and socio-economic accounts weighted twice as important as technical and cost accounts	3.8	4.3	3.1	3.7

7.0 MINE ROCK / OVERBURDEN STORAGE ALTERNATIVES ASSESSMENT – PRE-SCREENING ASSESSMENT

7.1 RRP Pre-Screening Criteria

As with the TMA alternatives assessment analysis, a pre-screening assessment is applied to determine whether any alternatives have an inherent fatal flaw. If an alternative (technology or location) has a fatal flaw then it will not be carried forward to the MAA.

Pre-screening criteria developed for the RRP mine rock and overburden pre-screening assessment of alternative disposal methods and locations (as applicable) were:

- Does the alternative have capacity for a significant percentage of mine rock or overburden?
- Is the alternative feasible with respect to project scheduling?
- Is the location reasonably close to the open pit?
- Is this the most suitable alternative in the vicinity of the impoundment location?
- Will all mine waste disposal impacts be limited to the Pinewood River Basin?

The results of this pre-screening assessment are provided in Table 7-1, with a discussion of the alternatives below.

7.2 Possible Mine Waste Storage Methods

There are three primary means of mine rock / overburden storage available to consider:

- Storage within mine workings during operation;
- Transfer of mine waste to mine workings for storage at closure; and
- Storage in surface stockpiles.

These are in addition to the preferential re-use of NPAG materials as appropriate during the construction, operation and closure phases of the RRP.

Storage within Mine Workings

Storage within mine workings during operation involves hauling mine rock to mined out stopes in the underground and completed portions of the open pit. This method works best when there is a relatively small amount of PAG rock in comparison to NPAG rock, and at redeveloped /

expansion mine sites where there are existing workings to deposit mine rock in. Depositing PAG rock in mine workings may assist with ARD prevention.

Transfer to Mine Workings at Closure

Transfer of mine rock to mine workings at closure is similar to the above alternative, and grants more flexibility for new mines where there are no existing workings to deposit material in at closure. This alternative requires a temporary stockpile during the operations phase. The primary disadvantage is that all mine waste would need to be double handled which dramatically increases closure costs. Depositing PAG rock in mine workings may assist with ARD prevention.

Surface Stockpiles

Surface stockpiles are common at mine sites in Ontario. They allow for one time handling of mine rock, and simple segregation and management of overburden, PAG rock and NPAG rock.

7.3 Initial Site Selection Factors

The RRP site has not been previously developed by the minerals industry, apart from exploration-related activities and disturbance. As such, there are currently no existing mine workings available for re-use. A sand and gravel pit previously developed by the Ontario Ministry of Transportation exists on the RRP site immediately north of the proposed open pit, to which RRR now holds title.

An estimated 350 to 400 Mt of mine rock will be generated as a result of open pit mining, of which 44% is expected to be PAG. Hence, PAG rock will be encapsulated progressively during operations to prevent ARD generation. Runoff from any mine rock storage site will need to be managed, possibly during mine operations, as well as upon closure. An additional 70 to 80 Mt of overburden will also need to be stored on site. A portion of these volumes will be used in TMA construction, PAG rock encapsulation, progressive reclamation and closure activities. The focus of this report is on mine rock storage due to the greater volume and also as a result that any location acceptable for mine rock storage would be similarly acceptable for overburden storage.

Initial factors taken into account for the preliminary site selection (AMEC 2011) are as follows:

- **Expandability:** The volume of mine waste and storage requirements described herein, are based on anticipated mine rock storage of 350 to 400 Mt. It is preferred that the stockpile areas should have the potential for expansion.

- **Existing land use:** Considerations related to property ownership and rights, population and housing, recreation, transportation corridors, transmission line and other service corridors, easements and right-of-ways should be taken into account.

- **Aboriginal traditional land use:** Aboriginal traditional land use including information about how recent and current traditional practices are carried out on the land potentially affected should be considered as part of the process. This information is collected through discussions and Traditional Knowledge / Traditional Land Use studies with Aboriginal community Elders and other knowledge holders.

- **Proximity to the pit:** Shorter transportation distances are preferred as the operating costs for mine waste storage are directly proportional to the distance material has to be trucked. Increased travel distances generally increases air emissions. In addition, the ability to direct runoff to the pit upon closure is also an advantage, particularly for PAG mine rock storage stockpile(s).

- **Watersheds and drainage:** Concentrating site activities in as few watersheds as possible is attractive. Two of the site alternatives considered avoid overprinting surficial waterbodies and potential waters frequented by fish.

- **Facility footprint:** A smaller physical footprint is generally favoured as having fewer direct environmental impacts. A smaller footprint also commonly equates to less runoff to manage, and therefore lower operational costs and environmental risk.

- **Provide downstream buffering capacity:** It is necessary to have space available downstream of the stockpile(s) for runoff collection, management and monitoring (and attractive to have space for a water treatment plant if needed).

7.4 Pre-Screening of Disposal Method

Storage within Mine Workings

Storage of mine rock and overburden within mine workings during operations is not viable for storage of a significant portion of the mine rock to be generated from RRP operations. Underground operations are not expected to commence until several years into the project, and in any case would only be able to store a very small portion of the total mine rock, requiring another alternative to be considered as well. In addition, the proposed mine plan and development strategy of a single open pit is not amenable to using it as a storage solution during operations.

Transfer to Mine Workings at Closure

While technically feasible, transfer of mine rock to the mine workings on closure would be prohibitively expensive and is not supported by the project economics. In addition, including a bulking factor into the volume of mine rock to be stored would mean that not all of the rock could be moved into the pit, therefore still requiring additional storage. Finally, this alternative would still require the use of an interim storage strategy throughout the mine life, with associated potential environmental effects. For these reasons, this alternative is not considered further in this preliminary assessment.

Surface Stockpiles

Stockpiles on surface remain as the most viable alternative for management of mine rock / overburden.

7.5 Pre-Screening of Alternative Locations

Alternative locations were initially selected within a 10 km radius of the open pit in order to reduce potential air emissions and ai r quality impacts, and to reduce haulage costs. An additional criteria was applied of preferentially maintaining the stockpile locations within the Pinewood River watershed in order to constrain potential environmental impacts to one watershed as practical.

Five alternative mine rock storage locations (Figure 7-1) were identified at the pre-screening stage as potential mine rock storage options, and w ere screened in accordance with criteria listed in Section 7.1.

Per Table 7-1, Alternative B was screened out from further consideration.

Alternative B is located near the houses at Black Hawk. Sound modelling indicates that under any usage scenario, sound levels from regular ongoing operations will exceed Ministry of the Environment sound quality guidelines. As a result, this alternative would be unable to receive Provincial approval for operation, considered to be a fatal flaw regardless of its performance in a multiple accounts analysis.

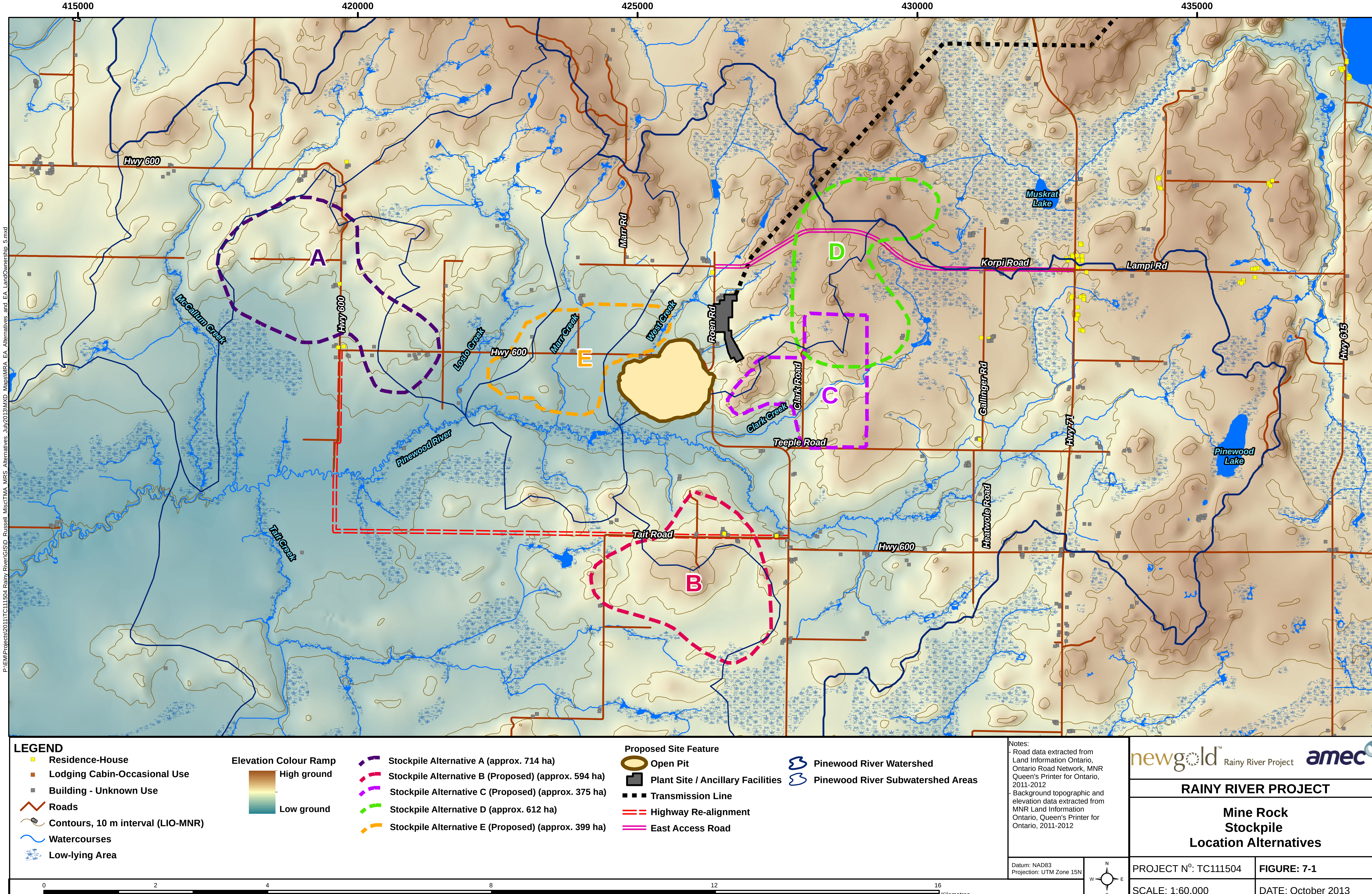
Alternatives A, C, D and E meet all the preliminary criteria and were pre-screened to be considered for more detailed evaluation.

Table 7-1 Mine Rock / Overburden Storage Alternatives Pre-Screening Analysis

Pre-Screening Criteria	Rationale	Disposal Method Alternative			MRS Location Alternative				
		Mine Working Disposal During Operations	Mine Working Disposal At Closure	Surface Stockpile	A	B	C	D	E
Does the alternative have capacity for a significant percentage of mine rock or overburden?	If a specific deposition method or location cannot contain a significant portion of the mine rock, it would not be the primary tailings impoundment method or location and other methods or locations would be required.	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Is the alternative feasible with respect to project scheduling?	If the alternative cannot accept mine rock as required by the mining schedule, other mine rock storage locations will be required and the alternative should be removed for further consideration.	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Is the location reasonably close to the open pit?	If the mine rock storage location is a significant distance from the open pit, it would unnecessarily increase the environmental and social footprint of the project while driving up project costs.	Yes	No[1]	Depends on Location	Yes	Yes	Yes	Yes	Yes
Is this the most suitable alternative in the vicinity of the impoundment location?	If two disposal locations significantly overlap, with one alternative clearly preferable (from an environmental or social perspective), then the less preferable location can be excluded from further consideration. Alternately, if there are additional fatal flaws with the proposed location, it may be excluded from further consideration.	N/A	N/A	Depends on Location	Yes	No[2]	Yes	Yes	Yes
Will all mine waste disposal impacts be limited to the Pinewood River Watershed	Environmental footprint should be limited to the extent possible without significantly impacting a second watershed. Extensive additional baseline studies would be required if tailings are deposited in a separate watershed.	Yes	Yes	Depends on Location	Yes	Yes	Yes	Yes	Yes
	Carried forward to alternatives assessment?	**No**	**No**	**Yes**	**Yes**	**No**	**Yes**	**Yes**	**Yes**

[1] By establishing a temporary (life of mine) stockpile, haulage distances are effectively doubled.
[2] Alternative B cannot meet Ministry of the Environment sound quality guidelines, and therefore cannot be approved under any possible scenario.

N/A Not Applicable



415000
420000
425000
430000
435000
5415000
5410000
5405000
Hwy 600
Marr Rd
Korpi Road
Lampi Rd
Muskrat Lake
McCallum Creek
Hwy 600
Losio Creek
Marr Creek
West Creek
Roen Rd
Clark Road
Clark Creek
Teeple Road
Gallinger Rd
Hwy 71
Hwy 615
Pinewood River
Pinewood Lake
Tait Creek
Tait Road
Heatwole Road
A
B
C
D
E
P:\EM\Projects\2011\TC111504 Rainy River\GIS\0_Russell_Misc\TMA_MRS_Alternatives_July2013\MXD_Maps\MRA_EA_Alternatives_and_EA_LandOwnership_5.mxd
LEGEND
Residence-House
Lodging Cabin-Occasional Use
Building - Unknown Use
Roads
Contours, 10 m interval (LIO-MNR)
Watercourses
Low-lying Area
Elevation Colour Ramp
High ground
Low ground
Stockpile Alternative A (approx. 714 ha)
Stockpile Alternative B (Proposed) (approx. 594 ha)
Stockpile Alternative C (Proposed) (approx. 375 ha)
Stockpile Alternative D (approx. 612 ha)
Stockpile Alternative E (Proposed) (approx. 399 ha)
Proposed Site Feature
Open Pit
Plant Site / Ancillary Facilities
Transmission Line
Highway Re-alignment
East Access Road
Pinewood River Watershed
Pinewood River Subwatershed Areas
Notes:
- Road data extracted from Land Information Ontario, Ontario Road Network, MNR Queen's Printer for Ontario, 2011-2012
- Background topographic and elevation data extracted from MNR Land Information Ontario, Queen's Printer for Ontario, 2011-2012
Datum: NAD83
Projection: UTM Zone 15N
N
E
S
W
0
2
4
8
12
16
Kilometres
newgold Rainy River Project
amec
RAINY RIVER PROJECT
Mine Rock Stockpile Location Alternatives
PROJECT N°: TC111504
FIGURE: 7-1
SCALE: 1:60,000
DATE: October 2013

8.0 MINE ROCK / OVERBURDEN STORAGE ALTERNATIVES ASSESSMENT – ALTERNATIVES CHARACTERIZATION

8.1 Alternative A

Alternative A was selected as a site that does not overprint waters frequented by fish. The alternative is centred on the area immediately north of Dearlock and overprints the north-south portion of Highway 600, west of the RRP mine site. Alternative A has a footprint of 717 ha. RRR has acquired surface rights or has options to acquire surface rights, to a substantive portion, but not all of the Alternative A footprint.

8.2 Alternative B

Alternative B was selected as another site that does not overprint waters frequented by fish. The alternative is centred on the area immediately west of Black Hawk and overprints portions of Tait Road. This alternative is located on the south side of the Pinewood River. Alternative B covers an area of 594 ha,

Alternative B would require complete perimeter ditching for management of runoff and seepage as the topography is not favourable for directing flows. It would also overprint a portion of the proposed Highway 600 re-alignment. RRR has acquired surface rights or has options to acquire surface rights to a small portion of the Alternative B footprint.

8.3 Alternative C

Alternative C in the Lower Clark Creek watershed is positioned immediately east of the open pit. The alternative overprints a portion of lower Clark Creek and a local road (Clark Road). The lower portion of Clark Creek is a Municipal drain (Teeple Drain) and is partially overprinted by this alternative. Diversion of the upper portion of Clark Creek away from the stockpile and connecting south to a small Pinewood River tributary is required with this alternative. Alternative C covers an area of 375 ha and is generally able to take advantage of valley topography, which facilitates efficient runoff and seepage collection. RRR has acquired surface rights or has options to acquire surface rights, to all of the Alternative C footprint.

8.4 Alternative D

Alternative D is located immediately north of Alternative C and does not overprint any waters frequented by fish. This alternative is located further away from the open pit compared with Alternative C, and is located on a topographic high which constrains its capacity (as with all upland sites). This alternative is in conflict with the proposed East Access Road which is intended to provide alternative access to local traffic using the Marr Road, as the current access to Marr Road will be severed by the open pit and process plant site development. Alternative D has a footprint of 612 ha. Its position at the top of the watershed divide will make runoff and seepage collection more difficult, as runoff will naturally flow into four separate creek systems, one of which is outside of the Pinewood River watershed. RRR has acquired surface rights or has options to acquire surface rights to only portions of the Alternative D footprint.

8.5 Alternative E

This western alternative is positioned immediately west of the open pit. Alternative E has a surface area of 399 ha and i s entirely located on lands to which RRR has acquired surface rights or has options to acquire surface rights. The terrain associated with this alternative is relatively flat and it overlays the lower reach of the Marr Creek / Cowser Drain.

Table 8-1 summarizes the characterization criteria for the mine rock management alternatives with respect to the applicable subaccounts and indicators (described further in Section 9.0). Alternative B is not considered for further analysis due to fatal flaws and is excluded from this table.

Table 8-1: MRS Alternatives Characterization

Account	Sub-Account	Indicator	Unit	Alternative A	Alternative C	Alternative D	Alternative E
Environmental	Aquatic Resources	Aquatic habitat losses	Metres	0	1780	0	3202
		Number of fish bearing waterbodies affected	Quantity	0	1	0	1
	Water Quality	Favourable topography to direct seepage for protection of surface water quality	–	Partially constrained; requires pumping	Good topographic containment	Partially constrained; requires pumping	Partially constrained; requires pumping
	Terrestrial Resources - General	Area of MRS	Hectares	717	375	612	399
	Terrestrial Resources - Air Quality / Noise	Air quality / noise; distance to nearest receptors	Kilometres	0.2	1.8	0.9	2.8
		Air quality / emissions; distance from pit	Kilometres	9.0	2.5	3.8	2.5
	Terrestrial Resources - Effects to Species	Area of forest	Hectares	461	270	524	256
		Area of wetland	Hectares	0	6	28	5
	Terrestrial Resources - Avian Species	ESA avian species observations within alternative	–	17	7	4	7
	Hydrology / Hydrogeology	Number of subwatersheds affected	Quantity	2; within Pinewood watershed	2; within Pinewood watershed	3; one outside Pinewood watershed	3; within Pinewood watershed
	Geochemistry	Amenability to direct runoff to open pit at closure for management of potential ARD	–	Alternate required	Short; passive	Moderate; pumping	Short; passive
Technical	Design Factors	Ease of site preparation	–	Easy	Easy	Moderately easy	Easy
		Risk due to geotechnical conditions	–	Moderate	Low	Low	Moderate
		Use of natural topography for containment of seepage / runoff	Percent perimeter ditching	65%	30%	65%	70%
		Expansion capacity (additional height for an additional 20% storage)	Metres	4	9	3	6
	Safety Factors	Maximum height of MRS	Metres	12	26	14	24
	Operational Complexity	TMA / water management operation complexity	–	Moderately difficult	Easy	Difficult	Easy
		Distance from pit	Kilometres	9	2.5	3.8	2.5
Project Economics	Capital Costs	Construction costs (ditching)	CAD	$231k	$83k	$215k	$183k
		Costs to realign local roadways	CAD	$7M	$0	$1M to 2M	$0
	Operational Costs	Haulage costs	CAD	$108M	$30M	$46M	$30M
	Closure Costs	Area of MRS for reclamation	Hectares	717	375	612	399
		Inspections / maintenance at closure	–	Infrequent	Annual	Annual	Annual
	Ancillary Costs	Habitat offsetting costs	CAD	$0	$500 to 750k	$0	$500 to 750k
		Land acquisition costs	CAD	Possibly unable to acquire	0	$5M to 10M	0
	Opportunity Costs	Risk arising from schedule delays	–	Minor	Moderate	Minor	Moderate

Account	Sub-Account	Indicator	Unit	Alternative A	Alternative C	Alternative D	Alternative E
Socio-Economic	Aboriginal Land Use and Heritage Value	Traditional land use	–	No recent traditional land use activities identified during Traditional Knowledge study	No recent traditional land use activities identified during Traditional Knowledge study	No recent traditional land use activities identified during Traditional Knowledge study	No recent traditional land use activities identified during Traditional Knowledge study
	Ecological / Cultural Values	Loss of biodiversity, including ESA avian species habitat	–	Long term, reversible displacement of a small or large number of species	Long term, reversible displacement of a small or large number of species	Long term, reversible displacement of a small or large number of species	Long term, reversible displacement of a small or large number of species
		Loss of hunting opportunity	–	Long term, reversible impacts to hunting opportunities	Long term, reversible impacts to hunting opportunities	Long term, reversible impacts to hunting opportunities	Long term, reversible impacts to hunting opportunities
		Loss of agricultural use	Hectares	219	0	0	93
		Affected baitfish resources	–	None	Permanent, irreversible impacts to small scale fishery; mitigation possible	None	Permanent, irreversible impacts to small scale fishery; mitigation possible
	Land Access	Required changes to local access	–	Major change to provincial highway	No impacts	Major local changes	No impacts
		Potential difficulty of land acquisition	–	Possibly unable to acquire	None required	High	None required
	Economic Risks and Benefits	Risk to project viability and loss of regional socio-economic benefits	–	None	Low	None	Low
	Operational Impacts and Aesthetics	Air quality / noise; distance to nearest receptors	Kilometres	0.2	1.8	0.9	2.8
		Height of MRS	Metres	12	26	14	24
	Archaeological / Cultural Sites	Areas of archaeological potential	–	Pioneer farmstead	Minor sites requiring cataloguing only	Minor sites requiring cataloguing only	Minor sites requiring cataloguing only

9.0 MINE ROCK / OVERBURDEN STORAGE ALTERNATIVES ASSESSMENT – MULTIPLE ACCOUNTS LEDGER

9.1 Determination of Site Specific Indicators

The process and factors for determining site-specific criteria described in Section 5.1 were also applied to development of a set of sub-accounts and indicators for the evaluation of mine rock storage alternatives for the RRP.

Mine rock will be classified according to its geochemical characteristics to ensure effective management. Geochemistry studies have been extensive and are well advanced to understand the extent of potential for acid generation and metal leaching from the mine rock (Appendix A).

As the rock has a relatively low readily dissolvable metal content, management of the rock had been dictated primarily by its acid generation potential. Depending on the acid generation potential, the mine rock will be permanently stockpiled in one of two different locations and classified as PAG or non-potentially acid generating (NPAG). A lesser quantity of NPAG will be re-used in site construction.

The mine rock segregation program as currently planned will consist of:

- Developing a detailed mine rock management strategy around the distribution of NPAG and PAG materials, including the selection of materials to be used for mine site construction; and

- Developing a program of ongoing testing (Leco furnace testing of blast hole drill cuttings) to be carried out during mining operations to assess the acid generating potential of the mine rock being removed, so that it can be directed to the appropriate mine stockpile location.

Mine rock segregation programs of the above type are standard industry practice where there are potential concerns over ARD.

An added consideration for identification of mine rock storage area(s), is that storage will also be required for overburden material stripped from the pit area (and some other limited areas). This material will be of a similar nature to that of the surrounding overburden.

9.2 MRS Alternatives Assessment – Value Based Decision Process

A multiple accounts ledger was developed for the four remaining MRS alternatives in order to account for those indicators which are expected to represent the most important aspects of the project and the surrounding environment, and which can be used to differentiate among the alternatives.

The scoring criteria for the indicators shown in Table 8-1 are given in Table 9-1.

The initial analysis used the base case weightings for the four primary accounts (environment, technical, project economics and socio-economic) recommended by Environment Canada (2011):

- Environment – 6;
- Technical – 3;
- Project economics – 1.5; and
- Socio-economic – 3.

Table 9-2 presents the weightings given to the various sub-accounts and indicators, as determined in consultation with an experienced team of geotechnical engineers, environmental scientists and geoscientists who are familiar with the project.

Table 9-3 through Table 9-10 presents the results of the multiple accounts analysis for the individual indicators and sub-accounts, while the overall results of this analysis are shown in Table 9-11. The final analysis indicates that Alternatives C and E are the most suitable alternative locations for development of the two (encapsulated PAG and NPAG) mine rock stockpiles.

Alternative C is preferred for storage of PAG mine rock due to the natural topography in this area, which will allow capture of runoff by gravity from the stockpile in ditches during construction and operation, to be directed to a mine rock pond for further management. It also has the advantage of being able to readily direct runoff and seepage on closure to the open pit for additional treatment if necessary.

Alternative E is therefore proposed for storage of NPAG mine rock and overburden. It will also be designed with ditching to capture runoff for monitoring and further treatment, if necessary.

Table 9-12 provides a listing of the rationale for the selected sub-accounts and indicators used in the TMA alternatives analysis.

9.2.1 Environment

Alternative C received the highest score for the environmental account, with Alternative E only slightly lower. As a r esult, these two alternatives could be considered approximately interchangeable. These alternatives were influenced most by their ability to meet noise and air quality criteria for the project, as well as the ease with which runoff can be managed at closure by directing flows to the adjacent open pit.

9.2.2 Technical

All alternatives scored very similarly for technical considerations, with Alternative C receiving the highest score, closely followed by Alternative A. Alternative C (and Alternative E) both scored highly for their ability to readily integrate into the site-wide water management plan and their proximity to the open pit which allows for greater ease of truck fleet scheduling. The score for Alternative A was influenced by its relatively low stockpile height which contributes to a higher overall degree of safety for this alternative (all alternatives include a stable design).

9.2.3 Economic

Operational expenditures are the driving factor for this account, and the scores for Alternative C and Alternative E both reflect their proximity to the open pit, resulting in considerably lower haulage costs. The scores for both of these alternatives are further enhanced as they are both situated on lands currently held by RRR (or with options to acquire), requiring no material additional land acquisition costs.

9.2.4 Socio-Economic

Alternative E received the highest score for this account, influenced the most by operational aesthetic considerations (air quality and noise). Both Alternative C and Alternative E also received a greater score for not having an additional impact on local traffic patterns and access routes for the public.

Table 9-1 MRS Accounts, Sub-Accounts, Indicators and Scoring Criteria

Account	Sub-Account	Indicator	Unit	Score					
				6 (best)	5	4	3	2	1 (worst)
Environmental	Aquatic Resources	Aquatic habitat losses	Metres	0	<500	500 to 1,000	1,000 to 5,000	5,000 to 10,000	>10,000
		Number of fishbearing waterbodies affected	Quantity	0	1	2	3	4	5 or more
	Water Quality	Favourable topography to direct seepage for protection of surface water quality	–	Topography favourable for seepage collection (6)		Topography partially constrains seepage; some ditching and pumping needed (3.5)		Seepage management very difficult due to topography (1)	
	Terrestrial Resources - General	Area of MRS	Hectares	<250	250 to 500	500 to 750	750 to 1,000	1,000 to 1,500	>1,500
	Terrestrial Resources - Air Quality / Noise	Air quality / noise; distance to nearest receptors	Kilometres	> 5.0	2.5 to 5.0	2.0 to 2.5	1.5 to 2.0	1.0 to 1.5	< 1.0
		Air quality / emissions; distance from pit	Kilometres	< 1	1 to 2	2 to 3	3 to 4	4 to 5	> 5
	Terrestrial Resources - Effects to Species	Area of forest	Hectares	<150	150 to 300	300 to 450	450 to 600	600 to 750	>750
		Area of wetland	Hectares	0	<25	25 to 50	50 to 75	75 to 100	>100
	Terrestrial Resources - Avian Species	ESA avian species observations within alternative	–	0	1 to 2	3 to 4	5 to 6	7 to 10	>10
	Hydrology / Hydrogeology	Number of subwatersheds affected	Quantity	1	2, all within Pinewood watershed	3, all within Pinewood watershed	2-3, in / out of Pinewood watershed	1, outside Pinewood watershed	>1, outside Pinewood watershed
	Geochemistry	Amenability to direct runoff to open pit at closure for management of potential ARD	–	Short distance, passive drainage direct to open pit	Moderate distance, passive drainage direct to open pit	Short distance, pumping required to reach pit	Moderate distance, pumping required to reach pit	Long distance, pumping required to reach pit	Runoff not easily directed to open pit; requires alternate management
Technical	Design Factors	Ease of site preparation	–	Very easy	Easy	Moderately easy	Moderately difficult	Difficult	Very difficult
		Risk due to geotechnical conditions	–	No geotechnical risk	Low geotechnical risk; easily mitigated through design	Moderate geotechnical risk; easily mitigated through design	Significant geotechnical risk; design mitigation possible	High geotechnical risk; design mitigation possible	High geotechnical risk; design mitigation difficult or not possible
		Use of natural topography for containment of seepage / runoff	Percent perimeter ditching	<20%	20 to 40%	41 to 60%	61 to 80%	81 to 90%	91 to 100%
		Expansion capacity (additional height for an additional 20% storage)	Metres	<5	5 to 10	11 to 15	16 to 20	> 20	Cannot accommodate additional capacity
	Safety Factors	Maximum height of MRS	Metres	< 10	10 to 15	16 to 20	21 to 25	26 to 30	> 30
	Operational Complexity	TMA / water management operation complexity	–	Very easy	Easy	Moderately easy	Moderately difficult	Difficult	Very difficult
		Distance from pit	Kilometres	< 1	1 to 2	2 to 3	3 to 4	4 to 5	> 5
Project Economics	Capital Costs	Construction costs (ditching)	CAD	< $100k	$100 to 125k	$126 to 150k	$151 to 175k	$176 to 200k	> $200k
		Costs to realign local roadways	CAD	$0	$0 to 1M	$1M to 2M	$2M to 5M	$5M to 10M	>$10M
	Operational Costs	Haulage costs	CAD	< $25M	$25 to 30M	$31 to 35M	$36 to 40 M	$41 to 45M	> $45M
	Closure Costs	Area of MRS for reclamation	Hectares	<250	250 to 500	500 to 750	750 to 1000	1000 to 1500	>1500
		Inspections / maintenance at closure	–	None required	Infrequent inspections and / or maintenance required	Annual inspections and / or maintenance required	Semi-annual inspections and / or maintenance required	Quarterly inspections and / or maintenance required	Permanent active management required at closure
	Ancillary Costs	Habitat offsetting costs	CAD	$0M	$0 to 500k	$500 to 750k	$750k to 1M	$1M to 1.5M	>$1.5M
		Land acquisition costs	CAD	$0M	$0 to 2M	$2M to 5M	$5M to 10M	>$10M	Possibly unable to acquire
	Opportunity Costs	Risk arising from schedule delays	–	None	Possible minor schedule delays with no material risk to project	Potential delays up to 3 months	Potential delays up to 6 months	Proposed option poses potential for delays in excess of 1 year; significant risk to project	Loss of investor confidence in project resulting in inability to raise funds for development
Socio-Economic	Aboriginal Land Use and Heritage Value	Traditional land use	–	No recent traditional land use activities identified for the project area as part of Traditional Knowledge studies; all options given score of 1					
	Ecological / Cultural Values	Loss of biodiversity, including ESA avian species habitat	–	No loss of biodiversity	Short term (construction phase), displacement of a small number of species	Medium term (life of Project), displacement of a small or large number of species	Long term, reversible displacement of a small or large number of species	Permanent, irreversible displacement of a small number of species	Permanent, irreversible displacement of a large number of species
		Loss of hunting opportunity	–	No impact to recreational hunting opportunities	Short term (construction phase), reversible impacts to hunting opportunities	Medium term (life of Project), reversible impacts to hunting opportunities	Long term, reversible impacts to hunting opportunities	Permanent, irreversible loss of hunting opportunities within a localized area	Permanent, irreversible loss of hunting opportunities across a large area
		Loss of agricultural use	Hectares	0	<50	50 to 100	100 to 200	200 to 400	>400
		Affected baitfish resources	–	No fisheries resources affected	Short term (construction phase), reversible impacts to small scale fisheries	Medium term (life of Project), reversible impacts to fisheries	Long term, reversible impacts to fisheries	Permanent, irreversible impacts to small scale fishery; mitigation possible	Permanent, irreversible impacts to small scale fishery; mitigation not possible
	Land Access	Required changes to local access	–	No impacts to local access	Minor changes to secondary access routes	Major changes to secondary access routes	Minor changes to primary access routes	Major changes to primary access routes	Large areas completely cut off; significant access improvements required
		Potential difficulty of land acquisition	–	None required	Small portion of MRS not on RRR property; high likelihood of acquisition	Small portion of MRS not on RRR property; acquisition difficult and changes to design may be needed	Large portion of MRS not on RRR property; high likelihood of acquisition	Large portion of MRS not on RRR property; acquisition difficult	Possibly unable to acquire
	Economic Risks and Benefits	Risk to project viability and loss of regional socio-economic benefits	–	None	Low risk of minor project delays and delayed regional benefits	Moderate risk of minor project delays and delayed regional benefits	High risk of minor to moderate project delays and delayed regional benefits	Risk of significant project delays and delayed regional benefits	Imposition of option would result in cancellation of project
	Operational Impacts and Aesthetics	Air quality / noise; distance to nearest receptors	Kilometres	> 5.0	2.5 to 5.0	2.0 to 2.5	1.5 to 2.0	1.0 to 1.5	< 1.0
		Height of MRS	Metres	< 10	10 to 15	16 to 20	21 to 25	26 to 30	> 30
	Archaeological / Cultural Sites	Areas of archaeological potential	–	None identified	Few minor sites; cataloguing required	Several minor sites; cataloguing required	Few important sites; cataloguing and relocation required	Several important sites; cataloguing and relocation required	High value site(s) not amenable to relocation or disturbance

Table 9-2: MRS Analysis Component Weightings

Account	Weight	Sub-Account	Weight	Indicator	Weight
Environmental	6	Aquatic Resources	5	Aquatic habitat losses	5
				Number of fish bearing waterbodies affected	3
		Water Quality	4	Favourable topography to direct seepage for protection of surface water quality	4
		Terrestrial Resources - General	2	Area of MRS	2
		Terrestrial Resources - Air Quality / Noise	3	Air quality / noise; distance to nearest receptors	6
				Air quality / emissions; distance from pit	3
		Terrestrial Resources - Effects to Species	3	Area of forest	3
				Area of wetland	2
		Terrestrial Resources - Avian Species	4	ESA avian species observations within alternative	4
		Hydrology / Hydrogeology	2	Number of subwatersheds affected	2
		Geochemistry	5	Amenability to direct runoff to open pit at closure for management of potential ARD	5
Technical	3	Design Factors	4	Ease of site preparation	3
				Risk due to geotechnical conditions	4
				Use of natural topography for containment of seepage / runoff	3
				Expansion capacity (additional height for an additional 20% storage)	1
		Safety Factors	3	Maximum height of MRS	3
		Operational complexity	3	TMA / water management operation complexity	2
				Distance from pit	1
Project Economics	1.5	Capital costs	3	Construction costs (ditching)	3
				Costs to realign local roadways	3
		Operational costs	6	Haulage costs	6
		Closure costs	2	Area of MRS for reclamation	2
				Inspections / maintenance at closure	1
		Ancillary costs	3	Habitat offsetting costs	2
				Land acquisition costs	4
		Opportunity Costs	4	Risk arising from schedule delays	4
Socio-Economic	3	Aboriginal land use and heritage value	3	Traditional land use	3
		Ecological / cultural values	4	Loss of biodiversity, including ESA avian species habitat	2
				Loss of hunting opportunity	2
				Loss of agricultural use	4
				Affected baitfish resources	1
		Land access	3	Required changes to local access	3
				Potential difficulty of land acquisition	5
		Economic risks and benefits	4	Risk to project viability and loss of regional socio-economic benefits	4
		Operational impacts and aesthetics	6	Air quality / noise; distance to nearest receptors	6
				Height of MRS	2
		Archaeological / cultural sites	2	Areas of archaeological potential	2

Table 9-3 MRS Environment Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A		Alternative C		Alternative D		Alternative E	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Aquatic Resources	Aquatic habitat losses	5	6	30	3	15	6	30	3	15
	Number of fishbearing waterbodies affected	4	6	24	5	20	6	24	5	20
	Sub Account Merit Score		54		35		54		35	
	Sub Account Merit Rating		**6.0**		**3.9**		**6.0**		**3.9**	
Water Quality	Favourable topography to direct seepage for protection of surface water quality	4	3.5	14	6	24	3.5	14	3.5	14
	Sub Account Merit Score		14		24		14		14	
	Sub Account Merit Rating		**3.5**		**6.0**		**3.5**		**3.5**	
Terrestrial Resources - General	Area of MRS	2	4	8	5	10	4	8	5	10
	Sub Account Merit Score		8		10		8		10	
	Sub Account Merit Rating		**2.0**		**2.5**		**2.0**		**2.5**	
Terrestrial Resources - Air Quality / Noise	Air quality / noise impact on nearest receptors	6	1	6	3	18	1	6	5	30
	Air quality / emissions impacts (distance from pit)	3	1	3	4	12	3	9	4	12
	Sub Account Merit Score		9		30		15		42	
	Sub Account Merit Rating		**2.3**		**7.5**		**3.8**		**10.5**	
Terrestrial Resources - Effects to Species	Area of forest	3	3	9	5	15	3	9	5	15
	Area of wetland	2	6	12	5	10	4	8	5	10
	Sub Account Merit Score		21		25		17		25	
	Sub Account Merit Rating		**5.3**		**6.3**		**4.3**		**6.3**	
Terrestrial Resources - Avian Species	ESA avian species observations within alternative	4	1	4	2	8	4	16	2	8
	Sub Account Merit Score		4		8		16		8	
	Sub Account Merit Rating		**1.0**		**2.0**		**4.0**		**2.0**	
Hydrology/ Hydrogeology	Number of subwatersheds affected	2	5	10	5	10	3	6	4	8
	Sub Account Merit Score		10		10		6		8	
	Sub Account Merit Rating		**5.0**		**5.0**		**3.0**		**4.0**	
Geochemistry	Amenability to direct runoff to open pit at closure for management of potential ARD	5	1	5	6	30	3	15	6	30
	Sub Account Merit Score		5		30		15		30	
	Sub Account Merit Rating		**1.0**		**6.0**		**3.0**		**6.0**	

Table 9-4 MRS Technical Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A		Alternative C		Alternative D		Alternative E	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Design Factors	Ease of site preparation	3	5	15	5	15	4	12	5	15
	Risk due to geotechnical conditions	4	4	16	5	20	5	20	4	16
	Use of natural topography for containment	3	4	12	5	15	3	9	3	9
	Expansion capacity (additional height of stockpile for an additional 20% storage capacity)	1	6	6	5	5	6	6	5	5
	Sub Account Merit Score		49		55		47		45	
	Sub Account Merit Rating		**4.5**		**5.0**		**4.3**		**4.1**	
Safety Factors	Maximum height of MRS	3	5	15	2	6	5	15	3	9
	Sub Account Merit Score		15		6		15		9	
	Sub Account Merit Rating		**5.0**		**2.0**		**5.0**		**3.0**	
Operational Complexity	TMA/water management operation complexity	2	3	6	5	10	2	4	5	10
	Distance from pit	1	1	1	4	4	3	3	4	4
	Sub Account Merit Score		7		14		7		14	
	Sub Account Merit Rating		**2.3**		**4.7**		**2.3**		**4.7**	

Table 9-5 MRS Project Economic Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A		Alternative C		Alternative D		Alternative E	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Capital Costs	Construction costs (ditching)	3	1	3	6	18	1	3	2	6
	Costs to realign local roadways	3	2	6	6	18	4	12	6	18
	Sub Account Merit Score		9		36		15		24	
	Sub Account Merit Rating		**1.5**		**6.0**		**2.5**		**4.0**	
Operational Costs	Haulage costs	6	1	6	5	30	1	6	5	30
	Sub Account Merit Score		6		30		6		30	
	Sub Account Merit Rating		**1.0**		**5.0**		**1.0**		**5.0**	
Closure Costs	Area of MRS for reclamation	2	4	8	5	10	4	8	5	10
	Inspections / maintenance at closure	1	5	5	5	5	5	5	5	5
	Sub Account Merit Score		13		15		13		15	
	Sub Account Merit Rating		**4.3**		**5.0**		**4.3**		**5.0**	
Ancillary Costs	Habitat offsetting costs	2	6	12	4	8	6	12	4	8
	Land acquisition	4	1	4	6	24	3	12	6	24
	Sub Account Merit Score		16		32		24		32	
	Sub Account Merit Rating		**2.7**		**5.3**		**4.0**		**5.3**	
Opportunity Costs	Risk arising from schedule delays	4	5	20	3	12	5	20	3	12
	Sub Account Merit Score		20		12		20		12	
	Sub Account Merit Rating		**5.0**		**3.0**		**5.0**		**3.0**	

Table 9-6 MRS Socio-Economic Indicator Analysis

Sub-Account	Indicator	Weight	Alternative A		Alternative C		Alternative D		Alternative E	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Aboriginal Land Use and Heritage Value	Traditional land use	3	1	3	1	3	1	3	1	3
	Sub Account Merit Score		3		3		3		3	
	Sub Account Merit Rating		**1.0**		**1.0**		**1.0**		**1.0**	
Ecological and Cultural Values	Loss of biodiversity, including ESA avian species habitat	2	3	6	3	6	3	6	3	6
	Loss of hunting opportunity	2	3	6	3	6	3	6	3	6
	Loss of agricultural use	4	2	8	6	24	6	24	4	16
	Affected baitfish resources	1	6	6	2	2	6	6	2	2
	Sub Account Merit Score		26		38		42		30	
	Sub Account Merit Rating		**2.9**		**4.2**		**4.7**		**3.3**	
Land Access	Required changes to local access	3	2	6	6	18	4	12	6	18
	Potential difficulty of land acquisition	5	1	5	6	30	2	10	6	30
	Sub Account Merit Score		11		48		22		48	
	Sub Account Merit Rating		**1.4**		**6.0**		**2.8**		**6.0**	
Economic Risks and Benefits	Risk to project viability and loss of regional socio-economic benefits	4	6	24	5	20	6	24	5	20
	Sub Account Merit Score		24		20		24		20	
	Sub Account Merit Rating		**6.0**		**5.0**		**6.0**		**5.0**	
Operational Impacts and Aesthetics	Air quality / noise; distance to nearest receptors	6	1	6	3	18	1	6	5	30
	Height of MRS	2	5	10	2	4	5	10	3	6
	Sub Account Merit Score		16		22		16		36	
	Sub Account Merit Rating		**2.0**		**2.8**		**2.0**		**4.5**	
Preservation of Archaeological and Cultural Sites	Areas of archaeological potential	2	3	6	5	10	5	10	5	10
	Sub Account Merit Score		6		10		10		10	
	Sub Account Merit Rating		**3.0**		**5.0**		**5.0**		**5.0**	

Table 9-7 MRS Environment Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative C		Alternative D		Alternative E	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Environment	Aquatic Resources	5	6.0	30.0	3.9	19.4	6.0	30.0	3.9	19.4
	Water Quality	4	3.5	14.0	6.0	24.0	3.5	14.0	3.5	14.0
	Terrestrial Resources - General	2	2.0	4.0	2.5	5.0	2.0	4.0	2.5	5.0
	Terrestrial Resources - Air Quality / Noise	3	2.3	6.8	7.5	22.5	3.8	11.3	10.5	31.5
	Terrestrial Resources - Effects to Species	3	5.3	15.8	6.3	18.8	4.3	12.8	6.3	18.8
	Terrestrial Resources - Avian Species	4	1.0	4.0	2.0	8.0	4.0	16.0	2.0	8.0
	Hydrology/ Hydrogeology	2	5.0	10.0	5.0	10.0	3.0	6.0	4.0	8.0
	Geochemistry	5	1.0	5.0	6.0	30.0	3.0	15.0	6.0	30.0
	Account Merit Score		89.5		137.7		109.0		134.7	
	Account Merit Rating		**3.2**		**4.9**		**3.9**		**4.8**	

Table 9-8 MRS Technical Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative C		Alternative D		Alternative E	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Technical	Design Factors	4	4.5	17.8	5.0	20.0	4.3	17.1	4.1	16.4
	Safety Factors	3	5.0	15.0	2.0	6.0	5.0	15.0	3.0	9.0
	Operational Complexity	3	2.3	7.0	4.7	14.0	2.3	7.0	4.7	14.0
	Account Merit Score		39.8		40.0		39.1		39.4	
	Account Merit Rating		**4.0**		**4.0**		**3.9**		**3.9**	

Table 9-9 MRS Economic Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative C		Alternative D		Alternative E	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Economic	Capital Costs	3	1.5	4.5	6.0	18.0	2.5	7.5	4.0	12.0
	Operational Costs	6	1.0	6.0	5.0	30.0	1.0	6.0	5.0	30.0
	Closure Costs	2	4.3	8.7	5.0	10.0	4.3	8.7	5.0	10.0
	Ancillary Costs	3	2.7	8.0	5.3	16.0	4.0	12.0	5.3	16.0
	Opportunity Costs	4	5.0	20.0	3.0	12.0	5.0	20.0	3.0	12.0
	Account Merit Score		47.2		86.0		54.2		80.0	
	Account Merit Rating		**2.6**		**4.8**		**3.0**		**4.4**	

Table 9-10 MRS Socio-Economic Sub-Account Analysis

Account	Sub-Account	Weight	Alternative A		Alternative C		Alternative D		Alternative E	
			Rating	Score	Rating	Score	Rating	Score	Rating	Score
Socio-Economic	Aboriginal Land Use and Heritage Value	3	1.0	3.0	1.0	3.0	1.0	3.0	1.0	3.0
	Ecological and Cultural Values	4	2.9	11.6	4.2	16.9	4.7	18.7	3.3	13.3
	Land Access	3	1.4	4.1	6.0	18.0	2.8	8.3	6.0	18.0
	Economic Risks and Benefits	4	6.0	24.0	5.0	20.0	6.0	24.0	5.0	20.0
	Operational Impacts and Aesthetics	6	2.0	12.0	2.8	16.5	2.0	12.0	4.5	27.0
	Preservation of Archaeological and Cultural Sites	2	3.0	6.0	5.0	10.0	5.0	10.0	5.0	10.0
	Account Merit Score		60.7		84.4		75.9		91.3	
	Account Merit Rating		**2.8**		**3.8**		**3.5**		**4.2**	

Table 9-11 MRS Account Analysis

Account	Weight*	Alternative A		Alternative C		Alternative D		Alternative E	
		Rating	Score	Rating	Score	Rating	Score	Rating	Score
Environment	6	3.2	19.2	4.9	29.5	3.9	23.4	4.8	28.9
Technical	3	4.0	11.9	4.0	12.0	3.9	11.7	3.9	11.8
Economic	1.5	2.6	3.9	4.8	7.2	3.0	4.5	4.4	6.7
Socio Economic	3	2.8	8.3	3.8	11.5	3.5	10.4	4.2	12.5
Alternative Merit Score		43.3		60.2		50.0		59.8	
Alternative Merit Rating		**3.2**		**4.5**		**3.7**		**4.4**	

Table 9-12: Rationale for MRS Analysis Sub-accounts and Indicators

Account	Sub-Account	Rationale	Indicator	Rationale
Environmental	Aquatic Resources	Minimizing or avoiding impacts to aquatic resources is a key environmental criteria due to the sensitivity of species and habitats to disruption.	Aquatic habitat losses	Minimizing the overall impact to aquatic habitat is preferred
			Number of fish bearing waterbodies impacted	Fewer impacted waterbodies reduces the potential impacts to quantity and diversity of aquatic species
	Water Quality	Avoiding impacts to water quality is important for both the protection of aquatic species as well as for providing flexibility with various water management scenarios.	Favourable topography to direct seepage for protection of surface water quality	The availability of land downstream is advantageous for the use and/or construction of wetland polishing ponds for final effluent treatment
	Terrestrial Resources - General	A primary aim of the holistic design of the RRP has been to maintain a compact project footprint to minimize overall environmental impacts.	Area of MRS	Smaller MRS areas have an overall lower environmental impact
	Terrestrial Resources - Air Quality / Noise	Air quality and noise impacts are directly related to the ability to get regulatory approval for the alternative.	Air quality / noise; distance to nearest receptors	The potential for noise and air quality effects is greatly reduced with distance to the property boundaries
			Air quality / emissions; distance from pit	Exhaust emissions from haul trucks will increase in direct proportion to the distance of the MRS from the open pit
	Terrestrial Resources - Effects to Species	Terrestrial species may be affected by impacts to their habitats.	Area of forest	A smaller area is preferred; used as a proxy to quantify potential impacts to terrestrial species
			Area of wetland	A smaller area is preferred; used as a proxy to quantify potential impacts to amphibian species
	Terrestrial Resources - Avian Species	Avian species at risk are a particular focus of project environmental investigations.	ESA avian species observations within alternative	Minimizing impacts to ESA listed species is a key environmental criteria
	Hydrology / Hydrogeology	Surface and groundwater resources may be affected by larger or more complex alternatives.	Number of subwatersheds affected	Restricting the alternative to the fewest number of subwatersheds is preferred, to minimize the area overprinted as well as reducing unnecessary capture of flows to otherwise unimpacted subwatersheds
	Geochemistry	Approximately 50% of the mine rock at the RRP is expected to be potentially acid-generating	Amenability to direct runoff to open pit at closure for management of potential ARD	Seepage and runoff are to be directed to the open pit at closure to aid in the flooding of the pit, as well as to manage any deleterious water quality; alternatives which can be easily direct to the open pit (e.g. Gravity and/or proximity) are preferred

Account	Sub-Account	Rationale	Indicator	Rationale
Technical	Design Factors	Several factors contribute the design and complexity of a MRS facility; a simpler, more flexible facility is preferred	Ease of site preparation	Sites which require less work (e.g. tree clearing, blasting) prior to use are preferred
			Risk due to geotechnical conditions	Alternatives on bedrock foundations are inherently more stable and are preferred; other materials or saturated ground may contribute to instability
			Use of natural topography for containment of seepage / runoff	Natural topography can help to contain and direct seepage and runoff for treatment
			Expansion capacity (additional height for an additional 20% storage)	Should additional mineral resources be identified as the project progresses, it is advantageous to use an existing mine waste storage facility
	Safety Factors	Stockpile safety is considered to be of very high importance for both safety of personnel, neighbouring residents and protection of the environment	Maximum height of stockpiles	Lower stockpiles have a much lower risk of failure
	Operational Complexity	The more complicated a system is, the more difficult it is to operate and maintain, resulting in higher costs and greater risk of operational upset	TMA/water management operation complexity	Ease of water management is preferred
			Distance from pit	A stockpile which is a greater distance from the open pit may require more complex fleet scheduling and material handling.
Project Economics	Capital Costs	Capital costs related to the MRS are smaller than the operating costs, but will still impact the project development budget and financial performance. Minimizing these expenditures is preferred.	Construction costs	Costs are primarily related to the amount of ditching required to be constructed for the management of runoff and seepage
			Costs to realign local roadways	Costs incurred to maintain local access if preferred alternative overprints a portion of current access routes
	Operational Costs	Ongoing costs to transport mine rock greater distances will have a significant impact on overall project financial performance	Haulage costs	Haulage costs are directly proportional to the distance from the open pit to the MRS; shorter distances are strongly preferred
	Closure Costs	Intensive closure costs will directly impact overall project financial performance, as well as increase the requirement for closure bonding	Area of MRS for reclamation	Larger areas have greater requirements for a cover to inhibit the onset of sulphide oxidation, which result in greater costs
			Inspections / maintenance at closure	Alternatives which have lower requirements for ongoing inspections and maintenance will result in lower closure costs and are preferred
			Water management	Long term water treatment results in increased closure costs

Account	Sub-Account	Rationale	Indicator	Rationale
	Ancillary Costs	Additional costs related to individual alternatives, which contribute to the overall cost of the alternative and impact project financial performance	Habitat offsetting costs	Alternatives with no or lower offsetting costs (e.g. habitat recreation) are preferred
			Land acquisition	If RRR does not hold surface rights or the option to acquire surface rights to the alternative footprint, additional costs will need to be incurred to acquire them, if possible
	Opportunity Costs	Potential schedule delays related to approvals and permittability of an alternative may impact the ability to raise project financing	Risk arising from schedule delays	Alternatives which are more likely to receive timely regulatory approval are preferred
Socio-Economic	Aboriginal Land Use and Heritage Value	Aboriginal consultation is recognized by RRR as an important part of the Environmental Assessment (EA) and mine planning process, and traditional uses of area lands are given strong consideration in project decisions	Traditional land use	Alternatives which do not impact areas described as having traditional Aboriginal uses are preferred. To date, no recent traditional land use activities have been identified during TK studies.
	Ecological / Cultural Values	Minimizing or avoiding potential impacts to people's way of life, culture and community are important to balance with the need for regional economic development	Loss of biodiversity, including ESA avian species habitat	Alternatives with lower Impacts to overall species quantity and diversity are preferable
			Loss of hunting opportunity	Hunting is considered a culturally significant activity within the region
			Loss of agricultural use	Agriculture (dominantly cattle and forage crops) represents a significant land use in the region
			Affected baitfish resources	A small baitfish resource exists within some project area streams
	Land Access	It is important that RRR balance the ability to access land for construction of a MRS and other project components while maintaining local public access to residences and recreational areas	Required changes to local access	Alternatives with fewer disruptions to existing local access routes are preferred
			Potential difficulty of land acquisition	If RRR does not hold surface rights or the option to acquire surface rights to the alternative footprint, the choice of alternative will be influenced the ability to acquire them
	Economic Risks and Benefits	The RRP will bring welcome and needed economic benefits to the region	Risk to project viability and loss of regional socio-economic benefits	Alternatives which may result in a delay of the project or put the project at risk of being carried out would have a direct effect on the positive economic benefits brought to the region by the RRP
	Operational Impacts and Aesthetics	The operations phase of the project will produce a certain level of unavoidable industrial activity and associated effects	Potential impact on residences	Fewer residences which are further away are less likely to be affected by potential noise and air quality effects during operations
			Height of dams	Higher dams have a greater visual impact on the local landscape
	Archaeological / Cultural Sites	Archaeological or cultural heritage sites are an important component of the history of the people of the region	Areas of archaeological potential	Alternatives in areas of lower archaeological potential are preferred

10.0 MINE ROCK / OVERBURDEN STORAGE ALTERNATIVES ASSESSMENT – SENSITIVITY ANALYSIS

A sensitivity analysis was carried out using the Scenario Manager feature of Microsoft Excel 2007, with summary results for all scenarios output as a pivot table for ease of comparison.

Four scenarios were given consideration, in addition to the base case:

- **MRS1:** Base case;
- **MRS2:** All accounts weighted equally;
- **MRS3:** Environment account weighted twice as important as technical and s ocio-economic accounts, cost account has no weight;
- **MRS4:** Environment and technical accounts weighted twice as important as socio-economic and cost accounts; and
- **MRS5:** Environment and socio-economic accounts weighted twice as important as technical and cost accounts.

A nearly unlimited number of additional scenarios for sensitivity analysis could be proposed by adjusting weightings for individual indicators and subaccounts. RRR believes that the scenarios presented offer a reasonable diversity of considerations for those factors which should most heavily influence the selection of a MRS alternative.

The results of the sensitivity analysis are documented in Table 10-1, and indicate that under any reasonable scenario considered, Alternatives C and E are the best-rated choices for surface storage of mine rock.

RRR therefore concludes that based on the results of the sensitivity analysis the weightings and ratings chosen and the site selection process as a whole can be considered robust.

Table 10-1: MRS Assessment Sensitivity Analysis

Scenario	Scenario Description	Alternative Merit Rating			
		Alternative A	Alternative C	Alternative D	Alternative E
MRS1	Base case	3.2	4.5	3.7	4.4
MRS2	All accounts weighted equally	3.1	4.4	3.6	4.3
MRS3	Environment account weighted twice as important as technical and socio-economic accounts, cost account has no weight	3.3	4.4	3.8	4.4
MRS4	Environment and technical accounts weighted twice as important as socio-economic and cost accounts	3.3	4.4	3.7	4.3
MRS5	Environment and socio-economic accounts weighted twice as important as technical and cost accounts	3.1	4.4	3.6	4.4

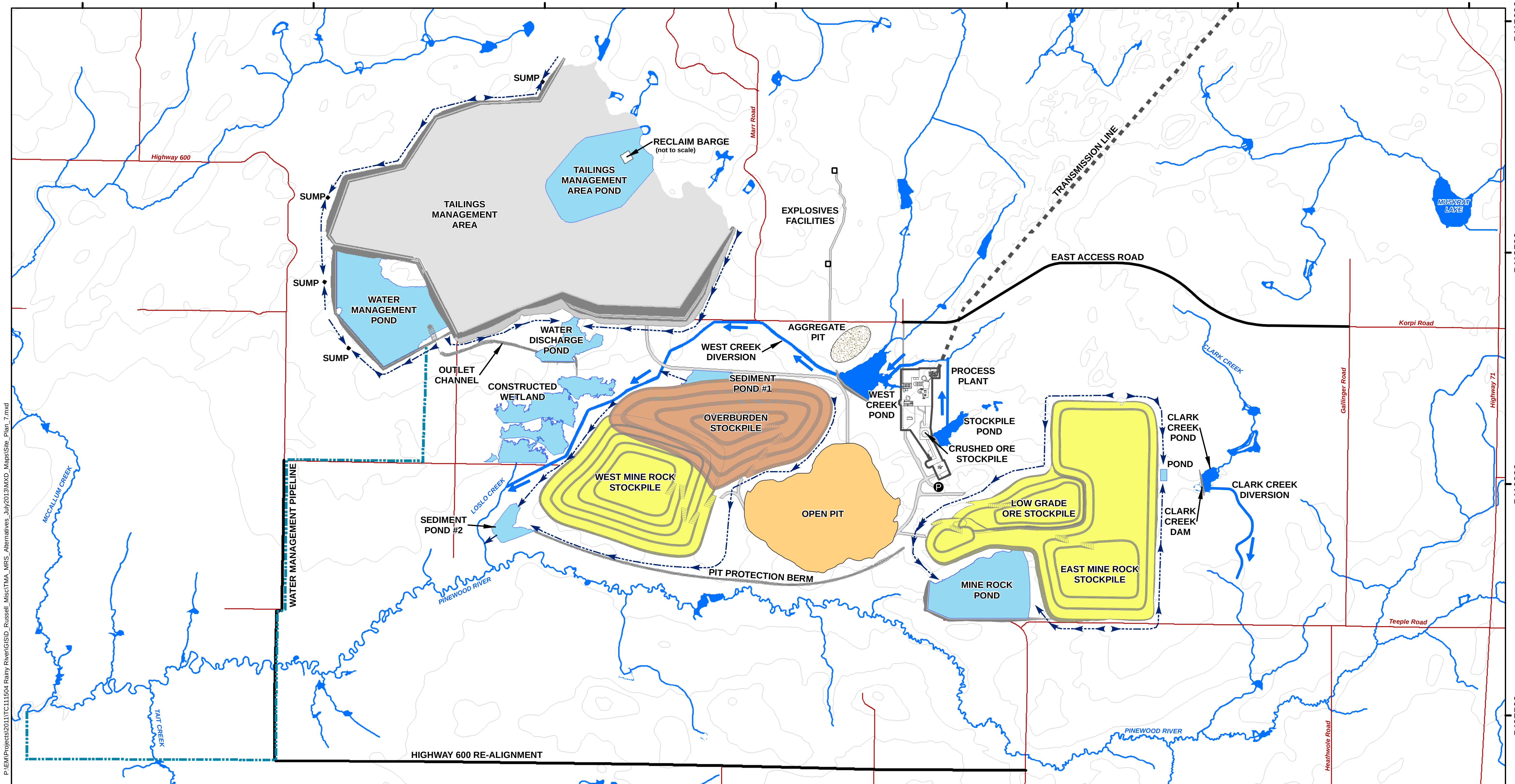
11.0 CONCLUSIONS

Using the MAA methodology and the account weights prescribed by Environment Canada, the preferred alternative for tailings management is the use of conventional slurry technology, with storage in a surface impoundment located in the upper portion of the Loslo Creek watershed, to the northwest of the open pit and plant site. This site allows for ease of integration into the overall site-wide water management plan, provides an optimal location for development of a water cover at closure, as well as having favourable safety and design factors.

The preferred method for storage of mine rock and overburden is the use of conventional surface stockpiles, with two sites preferred in order to optimize scheduling of materials and prevention of potential ARD both during operations and at closure of the site. The two preferred sites are located directly west and east of the open pit.

Figure 11-1 shows the proposed site plan for the RRP, including the preferred options for tailings, mine rock and overburden storage; as well as their interaction with other key components of the site such as watercourses, water management features and infrastructure.

This analysis has been completed using the best knowledge available at the time, including known technical factors, environmental considerations and the experience of personnel at other similar projects. This process is most effective when input from all stakeholders has been taken into consideration, including the proponent, consultants, the local and broader communities and populations as well as government. The current analysis includes direct input from the first two groups with information collected during extensive Aboriginal, community and regulatory consultation and discussions strongly influencing the choices and the overall project design.



LEGEND

Proposed Site Features

- Underground Portal
- Open Pit
- Process Plant
- Water Management Pipelines
- Site Roads
- Pond
- Aggregate Pit
- 230 kV Transmission Line
- Deposited Tailings
- Overburden Stockpile
- Rock Stockpile
- Ditch
- Watercourse Diversion
- Flow Direction

0 1.25 2.5 5 7.5 10 Kilometres

NOTES:
- Site Plan from AMEC CAD drawing May 3, 2013, derived from BBA drawing 3098003-003000-41-D20-0001, April 29, 2013
- Stockpile modification provided by BBA, Sept 30, 2013

Datum: NAD83
Projection: UTM Zone 15N

newgold Rainy River Project amec

RAINY RIVER PROJECT

Site Plan
Ultimate Footprint

PROJECT N°: TC111504	FIGURE: 11-1
SCALE: 1:39,500	DATE: October 2013

12.0 REFERENCES

AMEC. 2011. Scoping Study: Tailings, Mine Waste and Water Management, Rainy River Project. September 2011.

AMEC. 2013a. Rainy River Gold Project, Report on Metal Leaching and Acid Rock Drainage Characterization of Mine Rock and Tailings.

AMEC. 2013b. Volume 2: Final Environmental Assessment Report (Environmental Impact Statement), Rainy River Project, Township of Chapple, Ontario. October 2013.

Environment Canada. 2011. Guidelines for the Assessment of Alternatives for Mine Waste Disposal.

Klohn Crippen Berger (KCB). 2011. Rainy River Gold Project, Baseline Report 2008-2010.

Natural Resources Canada (NRCan). 1995. Quantity Distance Principles User's Manual.

APPENDIX A

RRR COMMITMENTS RESULTING FROM THE INDEPENDENT FIRST NATIONS REVIEW OF THE DRAFT EA REPORT (VERSION 1)

#	COMMITMENT
1	Traditional Knowledge/Traditional Land Use (TK/TLU) data has been widely collected for the RRP, including from the closest communities of Big Grassy River First Nation, Rainy River First Nations and Naicatchewenin First Nation. All TK/TLU sessions were community driven, meaning that the method of data collection was community specific. No TK/TLU data has been identified for the Project area specifically. The majority of the data has been broad and overreaching, which Rainy River Resources (RRR) will continue to respect as it serves as the basis for First Nations' unique relationship to the land. TK/TLU collection will continue; information collected will be appropriately considered for construction, operation and closure phases. For example, RRR will further investigate the historical travel corridor and incorporate appropriately any new information that may become available.
2	RRR will share results of the TK/TLU data sessions in a non-public First Nations forum(s).
3	RRR will commit to a joint water quality monitoring and reporting program with the area First Nations as part of the existing monthly water quality monitoring program which is currently carried out by RRR. The program will be funded by RRR and form an integral part of the overall environmental management program as it relates to First Nations traditional knowledge and assurances of maintaining water quality and by extension, aquatic biota protection. The program will be developed jointly with the First Nations in lead-up to the initiation of mine construction.
4	RRR will continue to communicate closely with First Nations regarding the Project.
5	RRR has an open invitation for First Nations to participate in all baseline and environmental monitoring programs, including Whip-poor-will, where appropriate and to share monitoring results. RRR will continue to advise of the opportunity at public forums in order to encourage anyone who's interested to participate.
6	All RRR staff will undergo cultural awareness training. Temporary contractors will undergo an awareness program as part of the regular induction program when working at the mine.
7	Additional information related to Lake Sturgeon and the Rainy River First Nations management program will be added to the Final EA Report. RRR has committed to a program of close coordination with Rainy River First Nations in support of the pre-existing First Nation Watershed Program and water quality protection. Company funding will be provided as part of the fisheries compensation program to further water quality enhancement programs for the Pinewood and similar agriculturally-impacted waterways.
8	RRR will reach out to the Seven Generations Education Institute and/or the MNR to obtain any additional information on baseline health of animals and fish.
9	First Nations will play an active role in the development of the mine Closure Plan, including development of the monitoring and mitigation programs. While the Closure Plan will be completed prior to construction, RRR will consult on significant revisions periodically during operations to ensure incorporation of TK and best management practices.
10	Monitoring programs targeted at ungulates (moose, deer) will be coordinated with First Nations.
11	RRR would be pleased to assemble a map showing the locations of the closest First Nation community water supply intakes on receipt of the locations/coordinates.
12	While the Draft EA has shown no impacts to First Nations or non-Aboriginal people's health, any new information that has a potential to impact health will be provided to First Nations.
13	RRR will work with First Nations to ensure employee overall well-being. Programs to highlight the dangers of drug use combined with drug testing will be implemented.

APPENDIX B

SUMMARY OF THE MINE WASTE-RELATED COMMENTS AND RRR RESPONSES FROM THE STAKEHOLDER AND ABORIGINAL REVIEW OF THE DRAFT EA REPORT (VERSION 2)

Stakeholder: **Ontario Federation of Anglers (OFAH)**
Point of Contact: **Shari Sokay, Land Use Specialist**
Comments received: **August 19, 2013**
Comments regarding: **Rainy River Project, Draft Environmental Assessment Report (Ver. 2)**

#	COMMENT (abbreviated)	RESPONSE	STATUS*
4	In conclusion, the OFAH has concerns regarding the potential for impacts to local fish and fish habitat. The OFAH acknowledges that the existing models do not predict a significant accumulation of heavy metal; however, we would strongly recommend that a Ministry of Environment (MOE) Environmental Effects Monitoring Program be implemented to ensure that any discharges, or other environmental effects, remain below model predictions and safe consumption guidelines.	The RRP will be subject to the Federally-regulated Metal Mining Effluent Regulations and will be required to conduct intensive Environmental Effects Monitoring, in addition to other types of environmental monitoring required by the Provincial and Federal government by various environmental approvals and authorizations. Regular weekly water quality sampling will be augmented with monthly and quarterly sampling both near the mine as well as in downstream and reference locations as part of an intensive monitoring program.	Complete

*As of submission of the Final Environmental Assessment Report.

Stakeholder: **Ministry of Northern Development and Mines**
Point of Contact: **Rob Purdon, Mine Rehabilitation Specialist**
Comments received: **September 3, 2013**
Comments regarding: **Rainy River Project, Draft Environmental Assessment Report (Ver. 2)**

#	COMMENT	RESPONSE	STATUS*
1	I am concerned that the proponent is not going to finalize Appendix P (Assessment of Alternatives for Tailings and Mine Rock Storage) as part of the EIS. This is an important component form a mine closure perspective and I am reluctant to provide detailed comments on the EIS as I will likely have to re-visit these comments...	Appendix P is only related to the Federal process for approval of placement of mineral waste over waters frequented by fish and accordingly is in their Regulatory-prescribed format (a Multiple Accounts Analysis). The alternatives assessment for tailings and mine rock from the Provincial perspective is complete in our opinion within the draft Environmental Assessment (EA) Report. A copy has been provided to MNDM separately.	Complete
3	**Section 13.4.1 – Geochemistry FMP – Context and Objectives:** “At closure the major portion of the tailings will be flooded to limit exposure to oxygen or covered with clay/clay till overburden” – which will it be? The proponent should present a clearer concept for long term management of the tailings in support of the EA, especially when it appears that a large portion of the tailings has the potential to be acid generating and/or have a significant potential for metal leaching.	The intent to cover the tailings surface at closure with a combined water and overburden cover is outlined in the project description (Section 4.19.3): "The tailings management area development plan currently provides for a water and overburden cover at closure to restrict oxygen contact with the tailings surface."; as well as within the evaluation of alternatives (Section 6.19.4), as stated in Section 6.19.4.3, ",...The combined alternative consisting of an enlarged central ponded area, surrounded by a perimeter zone of tailings covered with overburden, provides the best balance of environmental protection, cost and risk, and is therefore the preferred alternative." Please let us know if any further clarification is required.	Complete

#	COMMENT	RESPONSE	STATUS*
5	**Appendix E, Section 3.3 Stockpiles:** The draft conceptual closure plan calls for a multi-layered cover for the east mine rock pile to inhibit water infiltration and the influx of oxygen. Conceptually this could be a valid approach but more details and costs will need to be provided when the proponent submits a certified closure plan to MNDM for filing.	RRR and our consultant appreciates the support the Ministry of Northern Development and Mines (MNDM) provided during the early planning stage for this approach discussed initially during the January 2013 Federal / Provincial closure planning session, described more fully in the conceptual closure plan. The draft Closure Plan to be submitted in December 2013 for MNDM for review and in 2014 as a final Closure Plan for MNDM filing, will include more detail as required by the Provincial requirements.	On-going
6	**Appendix E, Section 4.4 Tailings Management Area:** The draft conceptual closure plan indicates that "for dam safety reasons, it is preferred that the permanent water cover should not come into contact with the TMA dams" and that there will be "a perimeter zone of exposed tailings beach of approximately 200m width" which will be covered with a low permeability layer of overburden to prevent infiltration and oxygenation of the tailings. It is not clear what dam safety concerns drive this, but there could be problems with erosion of the cover on the tailings beaches due to wave action and/or precipitation over the long term. More detail regarding the drivers for this aspect of tailings management is needed.	The intent to cover the tailings management area at closure with a combined water and overburden cover and the rationale for this approach is provided in the evaluation of alternatives (Section 6.19.4). The closure water balance will be described in the draft Closure Plan to be submitted in December 2013 for MNDM for review and in 2014 within the final Closure Plan for MNDM filing.	Complete

#	COMMENT	RESPONSE	STATUS*
11	**Appendix G, Section 8.2.1 Surrogate Development:** While I am supportive of the “surrogate approach” used to construct the block model to determine PAG and NPAG mine rock distributions and support the adjustment of the trendline to ensure that no PAG material is classified as NPAG, the proponent should provide more details regarding how they intend to audit or monitor their work as the mine develops to ensure that PAG material is segregated and handled appropriately. Perhaps this will be presented in the missing Appendix P […]	Your comments are appreciated. The proposed segregation approach is described briefly in Section 4.6.2 of the Draft EA Report, and will be detailed in the Closure Plan to be filed with MNDM. A draft is intended to be provided to MNDM in December 2013. Appendix P is only related to the Federal process for approval of placement of mineral waste over waters frequented by fish and accordingly is in their Regulatory-prescribed format (a Multiple Accounts Analysis). A copy has been provided to MNDM separately.	On-going
12	It is my recommendation that periodic static and kinetic testing is performed during operations to confirm that the surrogate characterization method remains valid with respect to changes and/or variability in the ore and waste rock. The proponent should develop an auditing program for consideration.	Your comments are appreciated. The proposed segregation approach is described briefly in Section 4.6.2 of the Draft EA Report, and will described in the draft Closure Plan to be submitted in December 2013 for MNDM for review and in 2014 within the final Closure Plan for MNDM filing. A quality assurance / quality control program will be described in the Closure Plan and implemented.	On-going
13	**Appendix G, Section 8.3 ARD Onset Times:** This section indicates that “without appropriate mitigation measures such as the planned encapsulation of PAG mine rock, hot spots could be sufficiently developed to have noticeable acid on-set after 5 years and more pronounced acid onset from unprotected PAG rock could be evident within 10 years post exposure.” I am at a loss to find details regarding the “planned encapsulation” in the documents submitted other than those provided with the draft conceptual closure plan (as noted above) and cannot provide further comments.	Per your comments, the encapsulation plan has been provided in the conceptual closure plan in order to obtain comments prior to finalization of the design. Further detail will be provided in the draft Closure Plan to be submitted in December 2013 for MNDM for review and in 2014 within the final Closure Plan for MNDM filing.	On-going
16	I hope to re-visit these comments and the EIS in more detail once the proponent provides Appendix P.	A copy of the Assessment of Alternatives for Tailings and Mine Rock Storage has been provided to Mr. Purdon.	Complete

*As of submission of the Final Environmental Assessment Report.

Stakeholder: **Department of Fisheries and Ocean**
Point of Contact: **Sara Eddy, Senior Fisheries Protection Biologist**
Comments received: **September 4, 2013**
Comments regarding: **Rainy River Project, Draft Environmental Assessment Report (Ver. 2)**

#	COMMENT	RESPONSE	STATUS*
12	**Section 6.5.1, p.6-26:** Delete wording "might be more attractive to DFO and EC". This alternative would not require overprinting waters frequented by fish.	This text will be modified in the Final EA Report accordingly.	Complete
13	**Section 6.8.1, p.6-44:** May need to reword portions of this section based on discussion with DFO	Comment noted, and the text will be revised in the Final EA Report as appropriate.	Complete No changes

*As of submission of the Final Environmental Assessment Report.

Stakeholder: **Environment Canada**
Point of Contact: **N/A**
Comments received: **September 5, 2013**
Comments regarding: **Rainy River Project, Draft Environmental Assessment Report (Ver. 2)**

#	COMMENT	RESPONSE	STATUS*
56	**Section 6.5 – Mine Rock and Overburden Management; Pg. 6-27 and Section 6.8.1 – Alternative C; Pg. 6-47:** The EIS states in the evaluation of Alternative C and E "As long as Schedule 2 can be obtained within approximately 10 months following the completion of the Environmental Assessment". The details and timing for MMER and Schedule 2 Amendments are outlined in the "MPMO Agreement for the Rainy River Gold Project" and "Short Companion Document" (to be posted on the MPMO's webpage www.mpmobggp.gc.ca). EC recommends that this understanding of the details and timing be indicated by the proponent.	The text of the Final EA Report will be revised to reflect this information.	Complete
57	**Section 6.8.1 – Alternative C; Pg. 6-45:** The first paragraph of Alt. C states "….the title to which has already been acquired by RRR. Alternative **B** has a footprint…Typo – it should read Alternative "C". EC requests that the proponent correct the typo.	This typographic error occurred inadvertently and will be corrected in the Final EA Report.	Complete

#	COMMENT	RESPONSE	STATUS*
59	**Section 6.19.4.3 – Summary Evaluation; Pg. 6-115:** It is not clear how the proposed option of partial cover and flooding will completely prevent the formation of ARD. Complete flooding will prevent ARD by limiting the diffusion of oxygen to the tailings. Complete cover of the tailings with low permeability overburden will limit ARD by limiting the amount of water that reaches the tailings. A combination of the two could leave potential for significant ARD due to gaps and edges as it is unclear how the two mitigations will work in combination. With rise and fall of water levels in the proposed pond this could result in wetting and drying of at least a 100 m to 200 m perimeter of tailings around the pond with potential for ARD. EC recommends that the proponent reconsider full flooding or full coverage, or provide more rationale on how this combination of techniques will work. Also, consideration needs to be made as to whether the fluctuating water levels in the tailings will create unacceptable amounts of ARD. This comment should also be considered with the comment above.	The cover of low permeability overburden will be constructed to extend below the low water mark of the tailings pond, so that no tailings will be directly exposed to the atmosphere as the pond fluctuates in size in response to normal climatic variations. Protection of this cover will be put in place as needed to address any wave action / erosion potential. Further, the low permeability overburden cover will ensure that the underlying tailings generally remain water saturated with little ability for oxygen to infiltrate.	Complete
86	EC has noted that the Assessment of Alternatives for Mine Waste Disposal has not been completed. The Proponent should provide an assessment of alternatives for mine waste disposal in accordance with EC guidelines. The Proponent has indicated that a draft will be provided to EC as soon as possible.	A draft Assessment of Alternatives for Mine Waste Disposal was provided to Environment Canada on September 3, in advance of the Final EA Report as initially proposed.	Complete

*As of submission of the Final Environmental Assessment Report.

Stakeholder: **Ministry of Natural Resources**
Point of Contact: **Rachel Hill, District Planner; John Van den Broeck SAR Biologist; Christopher Martin, Biologist; Melissa Mosley Management Biologist; Marney Brown; Kevin Brown; P. Cooze, Forester;**
Comments received: **September 6, 2013**
Comments regarding: **Rainy River Project, Draft Environmental Assessment Report (Ver. 2)**

#	COMMENT	RESPONSE	STATUS*
75	**Vol 2 section 6.8.2 Pg 6-46:** Alternative B has been selected as the preferred alternative, based on human environment/socio economic perspective. But has the highest significance to the environment. It would appear the alternative was selected largely on cost. There needs to be a better description of how the performance objectives and evaluations were assessed. There is more clarification needed on: 1) why Alternative A would not be feasible (ie pg 6-47 why there would be more difficulty obtaining environmental approvals, 2) why there is an unfavorable tailings storage to dam fill ratio when it appears to be comparable to B 3) why the land tenure would be an issue when there is a very small portion of area that is not RRG that could not be purchased or avoided). 4) why the cost estimate for alternative A is stated to be 60M on pg 6-49 but only 46M for the dam cost differential, 5) why there is not a breakdown of the 60M estimated on Pg 6-49. 6) And why there is no cost estimate for option B. From the analysis in the report, it does not seem to justify environmental impacts.	Alternative B was selected primarily on the basis of costs and socio-economic factors, much of which are also related to cost and the ability of the Project to move forward to create economic opportunities for the local area and the region. Alternative A was rated as "preferred" from an environmental perspective, but Alternative B was rated as "acceptable" for environmental effects. Alternatives A, C and D all achieved "unacceptable" ratings for one of more performance objectives, and were therefore rejected. The potential difficulty in obtaining environmental approvals for Alternative A relates to possible noise (and perceived dust) issues for adjacent residents in Dearlock which could complicate obtaining an Environmental Compliance Approval (ECA) for air. Air ECA approvals are very time consuming, and AMEC has faced extensive delays on another Ontario mining project over related air issues. Approval complications may also arise over a further re-routing of Highway 600, when other reasonable alternatives are available. This situation is unlike that of re-routing Highway 600 around the open pit, because the highway currently passes through the open pit and there is no alternative except to re-route the highway. In public meetings local citizens have stressed the importance of maintaining local access.	On-going

#	COMMENT	RESPONSE	STATUS*
		Dam construction volumes are sensitive to the natural terrain and to overall dam height, because of the low slope angles required for working with clay fill materials to construct the dams. Section 6.8.1 shows that the dam fill differential between Alternatives A and B is 4.6 Mm^3, which with an estimated $\$10/m^3$ placement cost (all-in), results in a base cost differential of $46 M. The $60M cost differential between Alternatives A and B estimated includes the $46 M dam costs; $8 M to re-align Highway 600; costs for longer tailings pipelines; additional land acquisition costs; and an allowance for increased haul distance for dam fill. Most of the material for dam construction will derive from the open pit. The cost differential of $60M is sufficient to give Alternative A an unacceptable rating for costs. Further information on the environmental approval and cost differentials will be provided in the Final EA Report. Additional information will also be provided in Appendix P of the Final EA Report, which will contain the Assessment of Alternatives for Tailings and Mine Rock Storage, prepared pursuant to the Federal Metal Mining Effluent Regulation (MMER).	

*As of submission of the table to the regulatory agencies.

APPENDIX C

SUMMARY OF COMMENTS AND RRR RESPONSES FROM THE ENVIRONMENT CANADA REVIEW OF THE DRAFT ASSESSMENT OF ALTERNATIVES FOR STORAGE OF MINE WASTE PURSUANT TO THE METAL MINING EFFLUENT REGULATIONS (SEPTEMBER 2013)

newgold Rainy River Project

Stakeholder: **Environment Canada**
Point of Contact: **Dan McDonell**
Comments received: **October 7, 2013**
Comments regarding: **Rainy River Project, Draft Assessment of Alternatives for Mine Waste Disposal**

#	COMMENT	RESPONSE	STATUS
1	The Proponent has provided two figures showing the locations of the tailings management area location alternatives (Fig. 3-1; pg. 20) and mine rock stockpile location alternatives (Fig. 7-1; pg. 44). However, a figure(s) with a greater level of detail for the preferred alternative choice(s) is/are also requested. A figure(s) is needed which shows the locations of the Proponent's preferred alternatives for tailings and mine rock disposal. This figure(s) should also provide more detail on the features/components of the TMA and mine rock stockpiles so that EC has a better understanding of the proposed water management for the site(s). The Proponent is requested to provide two separate (or a combined figure) showing the location and layout of the preferred choice of location of tailings management area (TMA) and the mine rock stockpiles. This figure(s) should clearly show the different features/ components of the TMA and the mine rock stockpiles (these include any dams/embankments, seepage collection and management systems, upstream and downstream watercourses and other water treatment and management features).	The requested figures will be provided in the final document.	Complete Figure 11-1
2	The Proponent has characterized about 50% of mine rock and most of the tailings as potentially acid generating (PAG). The Proponent has not indicated if co-disposal of all PAG tailings and waste rock at one location was also considered as an alternative. Co-disposal of all PAG tailings and waste rock should be considered as an alternative as it may result in a smaller environmental impact than separate disposal locations. EC requests clarification from the Proponent on whether co-disposal of all PAG tailings and waste rock at one location was considered as an alternative. If co-disposal was not considered as an alternative, please provide the rationale.	A discussion of co-disposal of mine rock and tailings will be included in the final document.	Complete Section 3.2

amec

#	COMMENT	RESPONSE	STATUS
3	The Proponent has considered relevant sub-accounts and indicators in the alternatives characterization for tailings management area (Table 4-1; pg. 23) and mine rock storage area (Table 8-1; pg. 47). However, there is no description of the sub-accounts and indicators provided in the text. The rationale for the selection of the sub-accounts and indicators is an important component in demonstrating that the Proponent has assessed the proposed options by considering the environmental, socio-economic, technical and economic factors relevant to each option. Without this information it is difficult for reviewers to assess the work completed by the Proponent in developing the multiple accounts analysis (MAA). The Proponent is requested to provide in the main text a description of the sub-accounts and indicators for used for the Tailings and Mine Rock/ Overburden multiple accounts analyses.	A description of the sub-accounts and indicators used in the multiple accounts analyses will be included in the final document.	Complete Section 5.2 Section 9.2
4	The MAA undertaken by the Proponent for the mine rock storage alternatives assessment has resulted in two locations (Alternative C and E) being selected as the preferred locations for the mine rock stockpiles. There is little detail provided on the two mine rock storage piles. The two preferred locations for mine rock storage piles and their intended uses should be fully described so that the rationale for their selection may be understood by third party reviewers. EC requests that the Proponent provide more detailed description of the preferred alternatives, indicating that : 1) Alternative C is being proposed for the storage/disposal of PAG mine rock and ore; and 2) Alternative E is proposed for storage/disposal of Non-PAG mine rock and overburden.	The discussion of the two preferred locations for mine rock disposal will be amended in the final document to provide additional information, such as that presented in the draft Environmental Assessment (EA) Report.	Complete Section 9.1 Section 9.2

#	COMMENT	RESPONSE	STATUS
5	EC understands that the Proponent has undertaken consultations with Aboriginal groups and that they have not identified any traditional land uses within or adjacent to the project site. There is very little discussion provided on the consultations undertaken by the Proponent. Consideration of Aboriginal concerns with respect to the proposed mine waste disposal options, including the identification of relevant Traditional Knowledge should be incorporated into the alternatives assessment. Details on the Proponent's consultations with affected stakeholders and Aboriginal groups are necessary to demonstrate that the Proponent has undertaken a thorough assessment of mine waste disposal options. EC requests that the Proponent provide more discussion on Aboriginal consultation activities, including any comments or perceptions on the project and in particular, any comments related to the alternatives for mine waste disposal.	A detailed record of consultation, discussions and meetings with Aboriginal groups and the general public related to the Rainy River Project (RRP) is included as Appendix D in the Final EA Report. The Draft EA Report (Ver. 1) was issued to Aboriginal groups in May 2013 in order to allow sufficient time for comment. While a copy of the Assessment of Alternatives for Mine Waste Disposal was not available at that time, the Draft EA Report did include a comprehensive discussion of mineral waste alternatives in Section 4 of the report. RRR and our consultant will provide a copy of the extracted comments received related to mineral waste management and alternatives on behalf of the Aboriginal groups on the draft EA Report along with the Rainy River Resources (RRR) response. A summary will also be provided of all comments received prior to the Draft EA Report issuance from Aboriginal groups on these aspects. The intent is that the final document will be appended to the Final Environmental Assessment Report and consulted on in a holistic manner with the rest of the Rainy River Project. Further detail will be provided in the Final Report.	Complete Section 1.3
6	EC requests that the environmental sub-accounts be expanded to enhance the MAA and improve the Alternatives Assessment document. Enhancing the MAA and the Alternatives Assessment document through the expansion of environmental sub-accounts will help fulfill the purpose of this assessment of alternatives, which is to objectively and rigorously assess all feasible options for mine waste disposal. EC requests that the environmental sub-accounts be expanded to enhance the MAA and improve the Alternatives Assessment document. The Proponent should consider proposing additional indicators such as impacts to water quality, impacts to terrestrial species, and number of fish bearing water bodies impacted.	Thank you for your comment. The tables will be reviewed and expanded / amended as appropriate.	Complete Table 4-1 Table 5-1 to Table 5-11 Table 8-1 Table 9-1 to Table 9-11

#	COMMENT	RESPONSE	STATUS
7	The Proponent has stated that "Covers are more expensive and are less effective for controlling oxygen exposure". The rationale for this statement is unclear. The Proponent is requested to identify which type of covers (water cover or soil/dry cover) they are referring to and the rationale for the statement in Section 1.3.	The statement refers to engineered low permeability covers, and will be corrected in the final text.	Complete Section 1.4
8	1. EC requests the Proponent to explain in more detail how the four screened out alternatives met the elimination criteria described in Section 3.1 (i.e., based on overlap of two disposal locations, with one alternative being preferable over the other). 2. Alternative E appears to be smaller in area than alternative H (Figure 3-1, pg. 20). Yet, the alternative H has been screened out due to lack of sufficient space to contain a significant percentage of the entire volume of tailings requiring storage, whereas alternative E has not been screened out by applying the same rationale. EC asks the Proponent to clarify this ambiguity. 3. The Proponent is requested to clarify if they consider the combination of in-pit and underground tailings disposal with the disposal of tailings in the TMA, when they screened out alternative H based on lack of adequate storage capacity to hold the tailings	1. Additional detail will be provided in the final document. 2. Alternative E is larger than Alternative H, having areas of 492 ha and 357 ha, respectively. Alternative E was screened out on the basis that there is a more suitable alternative in the immediate area (Alternative B) that has greater capacity, and does not overlap with the preferred area for the explosives facilities. 3. In-pit and/or underground tailings disposal were not considered as viable standalone options for tailings disposal as these alternatives are not available for storage until late in the mine life. For the same reason, they are not considered as a significant source of supplementary storage to conventional tailings deposition during the operations phase, as deposition into an active pit is not practical, and the underground storage capacity is less than 3% of the total (Section 3.4). Should there be available storage capacity at a later, as yet undefined, point in the operations phase, consideration will be given to the viability of either in-pit or underground storage of tailings.	Complete Section 3.5 Complete Complete

#	COMMENT	RESPONSE	STATUS
9	Eight alternative tailings storage locations were identified for initial screening, with four options being screened out and four carried forward for MAA. While the locations of all the alternatives are provided in Figure 3-1 (pg. 20), no description has been given for the four alternatives that were screened out. It is important to fully characterize all alternatives equally so that the reader can clearly understand the assessments of all feasible options for the mine waste disposal. It is also important to include detailed rationale to support any decisions which result in the elimination of alternatives. EC requests that the Proponent provide details on the key characteristics and features of these four eliminated alternatives, similar to the level of information provided for the screened in alternatives (Alternatives A, B, C and D). EC also requests a detailed rationale supporting the decision to eliminate four alternatives from further consideration.	A discussion of the four eliminated alternatives will be provided in the final document.	Complete Section 4.5 to Section 4.8
10	A greater level of detail is needed for the proposed alternatives for consideration for tailings storage. It is important to fully characterize all alternatives equally with sufficient detail so that the reader can clearly understand the assessments of all feasible options for the mine waste disposal. The Proponent is requested to provide more details for each of the proposed alternatives for consideration for tailings storage (such as the number of dams required to contain tailings in the alternatives, total length of the dams, individual dam heights, number of seepage collection and water management ponds associated with the alternatives etc.).	Additional information on the proposed alternatives will be included in the final document.	Complete Section 4.1 to Section 4.8

#	COMMENT	RESPONSE	STATUS
11	The Proponent states that Aboriginal groups have expressed "a desire to protect the local and regional environments". Concerns raised by Aboriginal groups do not appear to be reflected in the MAA. Consultation with Aboriginal groups is an important part of the alternatives assessment process. Any concerns raised by Aboriginal groups should be reflected in the sub-accounts and indicators for the MAA. EC suggests that the Proponent add 'Aboriginal and Public Perception/ Opinion' as a sub-account under the 'Socio-economic Account', with additional indicators to rank the opinions of the Aboriginal groups and the public.	Further detail will be provided regarding consultation activities to date related to mineral waste management in the final document. No specific comments on mine waste alternatives have been received to date which would justify inclusion of a subaccount of 'Aboriginal and Public Perception/ Opinion'; i.e. there is nothing to differentiate the various alternatives, as per section 2.5.1 of the EC *Guidelines for the Assessment of Alternatives for Mine Waste Disposal*, and the inclusion of this sub-account would have no impact on the final assessment.	Complete Section 1.3 Complete
12	Five alternative mine rock storage locations were identified for initial screening with one option, Alternative B, eliminated from further consideration due to regulatory criteria. No detailed description of Alternative B is provided. It is important to fully characterize all alternatives equally so that the reader can clearly understand the assessments of all feasible options for the mine rock storage locations. It is also important to include detailed rationale to support any decisions which result in the elimination of alternatives. EC requests that the Proponent provide a description of Alternative B similar to the level of information provided for the screened in alternatives (Alternatives A, C, D, and E) in Section 8.0. Editorial correction: The last sentence of this section incorrectly identifies the Alternatives that were carried forward for MAA – A, B, C and D rather than A, C, D and E.	A description of Alternative B will be included in the final document. RRR appreciates the editorial correction; this oversight will be corrected in the final document.	Complete Section 8.2

#	COMMENT	RESPONSE	STATUS
13	The Proponent has eliminated Alternative B, located south of the open pit, from further consideration using pre-screening criterion “is this the most suitable alternative in the vicinity of the impoundment location?” A brief explanation is provided as a footnote to Table 7-1, which states that ”Alternative B cannot meet Ministry of the Environment sound quality guidelines, and therefore cannot be approved under any possible scenario.” The pre-screening criterion that was applied to Alternative B and the explanation provided for its elimination from further consideration is not clear. The Proponent is requested to clarify the supporting rationale for the elimination of Alternative B.	Alternative B is located adjacent to the community of Black Hawk. Sound modelling indicates that under any usage scenario, sound levels from regular ongoing operations will exceed Ministry of the Environment Sound Quality Guidelines. As a result, this alternative would be unable to receive provincial approval for operation, considered to be a fatal flaw, regardless of its performance in a multiple accounts analysis. For this reason, it was eliminated from any further consideration.	Complete Section 7.5

newgold Rainy River Project

APPENDIX D

SUMMARY OF COMMENTS RECEIVED BY RRR TO DATE REGARDING MINE WASTE ALTERNATIVES ASSESSMENT

Comments from the General Public and Stakeholders

ROC #	Event Type	Date	Event Summary	Participating Organizations	Stakeholder Commenting	Comments	Official Response
58	Open House	05/31/2012	RRR hosted an open house in Barwick to give an update on the Project and discuss the Draft Terms of Reference (ToR).	Ainsworth Lumber, Bending Lake Iron, Crozier Warehouse, Eberly Trucking, Fort Frances Sportsmans Club, Individual - GP, Island Gold, Ontario Federation of Anglers and Hunters, Ontario Ministry of Northern Development and Mines, The Sharp Group, Thunder Bay - Rainy River, Township of Chapple, Township of La Vallee, Township of Morley, AMEC Environment & Infrastructure, Pwi-Di-Goo-Zing Ne-Yaa-Zhing Advisory Services / Rainy River Resources, Rainy River Resources	1) Chris Bonner-Vickers (Fort Frances Sportsmans Club); 2) Chris Bonner-Vickers (Fort Frances Sportsmans Club); 2) Unknown Unknown (Individual - GP)	1) Elk have been moving into the area from the north (Cameron Lake area) where they were transplanted. They do not hunt elk, but have heard them. Also, there is no open season on moose in WMU 10 (west of Flemming Road and south of 404/Strachan Road). A cougar was sighted on the Off Lake/Flemming Road area two years ago in the evening. There are many Ruffed Grouse in the area, and Whitetail Deer and bear populations are 'exploding'. Hunting is very popular in the area. 2) The area where the mine waste rock pile is proposed as well as along Roen Road over to Fleming Road are very popular areas for hunting. Concerned about loss of access to hunting areas as well as the effects on moose or other wildlife species that are 'aquatic' from the TMA – what would happen if a moose wandered into the TMA? How would that affect the quality of the meat? What would happen if the animals negatively affected by the mine activities/TMA infrastructure were displaced into WMU 9a and 9b where there is open season for moose – quality of the meat?	Noted.
59	Letter	06/14/2012	The Ontario Federation of Anglers and Hunters (OFAH) gave a written response to the Draft Terms of Reference (ToR). OFAH has not had a meeting since the release of the Draft ToR, so the comments are those of the individual member, not necessarily the group. Response from RRR was sent 12-07-05.	Ontario Federation of Anglers and Hunters, Rainy River Resources	1) Bruce Hamilton (Ontario Federation of Anglers and Hunters)	1) At the open house in Barwick, I was informed that creeks on the North side of the Tailings Management Area (TMA) will be dammed and left to find a new watercourse from the area on their own. This is unacceptable. These must be diverted to other existing waterways. This should make it easier to detect any seepage from the TMA. I also have a concern that the vast size of the TMA will be very susceptible to wave action which could cause berm deterioration or spilling.	The TMA is being designed to ensure that downstream drainages are mimicked in as many circumstances as feasible both during mine operations as well as after future mine closure. The objective of the TMA design basis is to utilize both existing topography as well as the naturally occurring low-permeability clay resources of the area to ensure tailings solids and related excess water are fully contained at all times according to legislated requirements. The TMA design will also include the need to ensure freeboard considers wave action and the need for extra containment during extreme storm events. Geotechnical and groundwater monitoring systems will also be a requirement of the TMA construction. The Environmental Assessment report and associated Closure Plan will detail these plans and mitigation strategies to ensure legislated requirements are met.

ROC #	Event Type	Date	Event Summary	Participating Organizations	Stakeholder Commenting	Comments	Official Response
60	E-mail	06/16/2012	Individual provided written comments to the Draft Terms of Reference. RRR responded on 12-08-08.	Individual - GP, Rainy River Resources	1) Trish & Colin Neilson (Individual - GP)	1) Concerned that the northwest corner of the TMA is too close to the McCallum Creek watershed. With the planned low level berm at this location, high water levels from an excess melt or a flood an could take leachate from plant tailings into a non manageable environment. With an ever-increasing probability of extreme weather events predicted, the berm height should be adjusted.	The TMA is designed to ensure that downstream drainages are mimicked in as many circumstances as feasible both during mine operations as well as after future mine closure. The objective of the TMA design basis is to utilise both existing topography as well as the naturally occurring low-permeability clay resources of the area to ensure tailings solids and related excess water are fully contained at all times according to legislated requirements. The TMA design will also include the need for extra containment during extreme storm events. Geotechnical and groundwater monitoring systems will also be a requirement of the TMA construction. The EA report and associated Closure Plan will detail these plans and mitigation strategies to ensure legislated requirements are met.
71	Letter	06/08/2012	Rainy Lake Conservancy (RLC) provided comments on the Draft Terms of Reference (ToR) regarding related to mine rock and tailings management, open pit geochemistry, water quality and monitoring, design alternatives/risk analysis, power supply, best practices as well as potential impacts to the Clearwater-Pipestone and Rainy Lake systems. RRR responded 12-06-28.	Rainy Lake Conservancy, Rainy River Resources	1) Paul Anderson (Rainy Lake Conservancy)	1) The waste rock piles must not be allowed to degrade the environment or threaten human health. Potential contaminants and the potential for AMD underscore the need to fully assess and evaluate the potential for contaminated leachate from the waste rock piles. Unless the Proponent demonstrates (using widely accepted industry procedures and standards) that AMD will not occur, then a full underliner, underdrain, and monitoring system may be needed.	The comments from your organization are related to mine rock and tailings management, open pit geochemistry, water quality and monitoring, design alternatives/risk analysis, best practices as well as potential impacts to the Clearwater-Pipestone and Rainy Lake systems. RRR has hired world-class consultants to assess each of these and other aspects to ensure that the Environmental Assessment demonstrates that the mine operation will be compatible with the surrounding rural and natural environments.
88	E-mail	06/16/2012	Individual gave written comments on the Draft Terms of Reference (ToR) including concerns about vegetation, effects to their honey farm, the tailings management area, and size of the mine footprint. Indicated that project would provide economic benefits and leave a positive legacy if post closure landscaping is done well. RRR responded 12-06-28.	Individual - GP, Rainy River Resources	1) Rick and Linda Neilson (Individual - GP)	1) Concerned the Tailing Management Area is too close to the Jones Creek watershed.	The EA process is designed to ensure that the mine operates in a manner that will ensure the long-term environmental viability of the surrounding landscape. We are confident that as we proceed through the Environmental Assessment process that you will see the efforts that have been made to ensure this end is reached.

Comments from Government Agencies

ROC #	Event Type	Date	Event Summary	Participating Organizations	Stakeholder Commenting	Comments	Official Response
67	Letter	06/15/2012	Ministry of Natural Resources (MNR) Fort Frances District provided comments on the Draft Terms of Reference (ToR).	Ministry of Natural Resources, Rainy River Resources	1) Greg Chapman (Ministry of Natural Resources)	1) Tailings Management – there is only one tailings management option presented (Figure 2). The other alternative needs to be defined on a map and better described with more detail. Tailings management areas are important components of mine development.	The Proposed ToR will indicate that a comprehensive assessment of mineral waste management alternatives will be provided in the EA, consistent with the alternatives assessment requirements associated with the Federal Metal Mining Effluent Regulations and in accordance with the Guidelines for the Assessment of Alternatives for Mine Waste Disposal (Environment Canada 2011). The EA (and associated technical documents if applicable) will include drawings showing other tailings management options.
67	Letter	06/15/2012	Ministry of Natural Resources (MNR) Fort Frances District provided comments on the Draft Terms of Reference (ToR).	Ministry of Natural Resources, Rainy River Resources	1) Greg Chapman (Ministry of Natural Resources)	1) More details of the Alternative Mine Rock Storage Plan needs to be identified.	The Proposed ToR will indicate that a comprehensive assessment of mineral waste management alternatives will be provided in the EA, consistent with the alternatives assessment requirements associated with the Federal Metal Mining Effluent Regulations and in accordance with the Guidelines for the Assessment of Alternatives for Mine Waste Disposal (Environment Canada 2011). The EA (and associated technical documents if applicable) will include drawings showing other mine rock storage options.
67	Letter	06/15/2012	Ministry of Natural Resources (MNR) Fort Frances District provided comments on the Draft Terms of Reference (ToR).	Ministry of Natural Resources, Rainy River Resources	1) Greg Chapman (Ministry of Natural Resources)	1) More details of the Alternative Overburden Storage Plan needs to be identified.	The Proposed ToR will indicate that a comprehensive assessment of mineral waste management alternatives will be provided in the EA, inclusive of overburden storage, re-use during reclamation and other alternatives as appropriate.
104	Letter	06/15/2012	Canadian Environmental Assessment Agency (CEA Agency) sent comments on the Draft Terms of Reference (ToR).	Canadian Environmental Assessment Agency, Rainy River Resources	1) Stephanie Davis (Canadian Environmental Assessment Agency)	1) The draft ToR states that "A number of other possible areas for tailings storage are potentially available in the general Project area, subject to land acquisition." (pg. 23) For further clarity on the proposed Project, please specifically outline all of the potential TMAs that will be addressed in the EA.	The Proposed ToR will indicate that a comprehensive assessment of mineral waste management alternatives will be provided in the EA, consistent with the alternatives assessment requirements associated with the Federal Metal Mining Effluent Regulations and in accordance with the Guidelines for the Assessment of Alternatives for Mine Waste Disposal (Environment Canada 2011). The EA (and associated technical documents if applicable) will include drawings showing other tailings management options. Noted and will be clarified in the Proposed ToR.

newgold Rainy River Project

APPENDIX E

RRP GEOCHEMISTRY SUMMARY
(EXCERPT FROM FINAL EA REPORT)

[Excerpt from Final Environmental Assessment Report]

5.0 DESCRIPTION OF THE ENVIRONMENT

5.5 Geochemistry

5.5.1 Mineralogy and Lithology

The geology of the RRP site is complex, with mineralization divided into four separate styles among a number of different rock types with varying styles of alteration (BBA 2012). In general, gold mineralization is dominantly vein-hosted and primarily associated with sulphide minerals including pyrite, chalcopyrite, sphalerite and galena.

Mine rock represents the greatest quantity of material and highest risk for possible future acid drainage at the site. The complexity of the geology and the varying mineralization styles are key factors to consider as different units may contribute more or less to ML / ARD potential. Within the RRP area, felsic metavolcanics, mafic metavolcanics and clastic metasediments have been identified as the main lithological units associated with mine waste, with preliminary volume estimates from drill core of 60%, 17% and 11%, respectively (AMEC 2013h). Additional lithologies make up an estimated 12% of the volume of mine rock.

5.5.2 Static Test Results

5.5.2.1 Overburden

Previous geochemical baseline studies (KCB 2011b) included analysis of 28 overburden samples, with 19 samples (14 Whiteshell Till and 5 Whitemouth Lake Till / Lake Agassiz sediment) submitted for acid base accounting testing and 28 samples submitted for total element and leachable metals (shake flask extraction) analyses. Subsequently, an additional three overburden samples were collected and submitted for acid base accounting testing, elemental content and leachable metals (AMEC 2013h). Two of the samples were collected from Whiteshell Till with the third consisting of Whitemouth Lake Till.

In the case of both the original 28 samples and the three additional samples, the Whiteshell Till samples exhibited sulphur values above the specified screening criteria, with values for sulphur ranging from <0.1 to 3%. In addition, anomalous levels of silver and arsenic were present in many of the samples. In an additional Whiteshell sample, cadmium and zinc were both above the 10 times crustal abundance screening threshold.

In general, the Whiteshell Till exhibits a lower neutralization potential than the Whitemouth Lake Till, with AMEC (2013h) reporting NPR values of <2 and 70.3, respectively. Previous results indicated that 4 of the 14 Whiteshell Till samples had an NPR of <2. Values <2 are considered to be potentially acid generating (PAG), which suggests that the Whiteshell Till may be PAG, or of uncertain acid generating character. The general trend of the results from both till units are reflective of their provenance, with the Whiteshell Till derived in part, from local mineralized bedrock.

Short term leach tests on samples from both till units suggested generally low potential for metal leaching. Shake flask extraction results for both the Whitemouth Lake and Whiteshell Till samples are all below Provincial effluent discharge criteria and below PWQO, with the exception of copper and aluminium concentrations from the Whitemouth Lake Till, which marginally exceeded PWQO.

5.5.2.2 Mine Rock

All mine rock samples (n = 386) had paste pH values between 4.7 and 9.9, with a median value of 9.0. Concentrations of total sulphur ranged from below detection limit (<0.01%) to 13.8% with most samples in the range of 0.1 to 5%. Most samples in excess of 5% total sulphur were from relatively minor sub-lithologies of pyritic metasediments or chemical metasediments. The relationship of total sulphur and calculated sulphide sulphur confirms that sulphide is the main source of sulphur for the majority of the rock types.

The calculated NPR values ranged from 0.08 to 630 with mean and median values of 9.8 and 2.3, respectively. Based on the total dataset, 29% of mine rock samples had an NPR <1 and 53% had an NPR >2. Based on guidelines in Mine Environmental Neutral Drainage (2009), approximately 47% of the samples would be classified as PAG (NPR <2).

In general, samples with NPR <1 had net acid generation pH (NAGpH) values near or less than 4.5. The only exception was one pyritic sediment sample with NAGpH value of 4.9. Samples with NPR >2 recorded NAGpH values greater than 4.5 indicating that those samples had little potential to produce net acidity in the future. The majority of samples with NPR between 1 and 2 had NAGpH values above 4.5 and were classified as uncertain in terms of future acid generation. Close inspection of the data indicates that no samples with an NPR above 1.65 generated a NAGpH <4.5. This suggests that materials with a NPR >1.65 may potentially be considered non-potentially acid generating (NPAG). Additional data from the ongoing humidity cell testing would be required to further assess this possibility.

A total of 165 felsic metavolcanic samples were analyzed, with NPR values ranging from 0.12 to 78, with mean and median values of 4 and 1.5, respectively. Approximately 59% of the samples (97 of 165 samples) had NPR <2 and 33% of the samples (55 of 165 samples) had NPR <1.

A total of 59 mafic metavolcanic samples were analyzed. The NPR of these samples ranged from 0.44 to 630 with mean and median values of 23 and 4.8, respectively. Approximately 34% of the samples (20 of 59 samples) had NPR <2 and 14% of the samples (8 of 59 samples) had NPR <1.

A total of 18 intermediate metavolcanic samples were analyzed with resultant NPR values between 0.27 and 28 with mean and median values of 6 and 1.8, respectively. Nine of 18 of the intermediate metavolcanic samples had NPR <2 and seven of these had NPR <1.

A total of 81 metasediment samples were analyzed from various sublithologies; 41 of these samples represented clastic metasediments, 25 were pyritic metasediments and 15 were chemical metasediments. The NPR of clastic metasediment samples ranged from 0.3 to 22.4 with mean and median values of 3.3 and 1.0, respectively. Approximately 66% of clastic metasediment samples (27 of 41 samples) had NPR <2 and 49% of samples (20 of 41 samples) had NPR <1.

The NPR of chemical metasediment samples ranged from 0.2 to 125. Five of 15 chemical metasediment samples had NPR <2 and three of these had NPR <1.

Pyritic metasediments NPR ranged from 0.1 to 7. Fifteen of 25 pyritic metasediment samples had NPR <2 and 13 of these samples had NPR <1.

A total of 51 intrusive samples (excluding diabase) were analyzed from various sublithologies and of these 7 were early mafic to ultramafic intrusive, 20 were early felsic to intermediate intrusive, 14 were later mafic to ultramafic intrusives and 10 were later felsic to intermediate intrusives. All intrusive samples except the early felsic to intermediate intrusive samples had an NPR >2. Five of 20 early felsic to intermediate intrusive samples had NPR <2 and two of these samples had NPR <1.

A total of six late structural zone samples and six diabase samples were analyzed with results summarized below. The NPR values for the late structural samples ranged from 0.2 to 4.9, with a median NPR of 1.3. The NPR values for the diabase samples ranged from 2 to 15 with a median NPR of 6.6. Three of six late structural samples had an NPR value <2, with two of these having an NPR <1. One of six diabase samples had an NPR approximately equal to 2 and the remainder with NPR >4.

5.5.2.3 Tailings

Three simulated tailings samples were produced during metallurgical testing of ore composite materials developed jointly by RRR and SGS Lakefield. The ore composites produced and resulting tailings represent three different types of ore. The tailings types tested include materials produced from early stage ore (Starter Pit sample), ore from late in mine life (ROM sample) and the main ore zone (ODM sample).
All of the tailings samples had consistent slightly alkaline paste pH values (8.2 to 8.8) with the ROM samples having higher paste pH values than the ODM and Starter Pit samples. Concentrations of total sulphur were also consistent throughout all of the samples with values ranging from 2.1 to 2.3% (Table 7-13 in Appendix G). The ODM samples had the highest overall sulphur content. The relationship between total sulphur and sulphide sulphur shows that

sulphide and sulphate are both contributing to the total sulphur content (Figure 7-21 in Appendix G).

The siderite corrected Sobek NP values ranged from 107 to 186 kg $CaCO_3$/t, while the modified Sobek NP values ranged from 41 to 46 kg $CaCO_3$/t. Carbonate NP values ranged from 33 to 41 kg $CaCO_3$/t (Table 7-13 in Appendix G). Siderite corrected values seem high in comparison, but were verified by retest by the laboratory. Higher siderite corrected values are probably related to fine grain size of the tailings and in part due to higher fizz test classification than the waste rock. For tailings the modified Sobek NP is inferred to represent the most reasonable overall assessment of NP.

The calculated NPR values (based on the modified Sobek NP) ranged from 0.74 to 0.91 (Table 7-13 in Appendix G). Based on these values all of the tailings samples would be classified as PAG (NPR <2) based on the Mine Environmental Neutral Drainage guidelines (Figure 7-22 in Appendix G).

All of the tailings samples had NAGpH values less than 4.5.

5.5.3 Elemental Content

5.5.3.1 Overburden

For comparative purposes, elemental content of the AMEC (2013h) overburden samples were compared to 10 times average continental crust values (Price 1997). Overall, bismuth was detected in excess of 10 times the average crustal abundance for all samples. Sulphur was detected in excess of the 10 times screening criteria for both Whiteshell Till samples, but not the Whitemouth Lake Till sample. Arsenic and silver were above the 10 times screening criteria in Whiteshell Till samples, and cadmium and zinc were above the 10 times screening criteria in the other one.

5.5.3.2 Mine Rock

For comparative purposes, elemental content of the mine rock samples were compared to 10 times average continental crust values (Price 1997). Overall, sulphur, bismuth and selenium stand out as anomalous with respect to 10 times average crustal abundance. The mean and median concentration for sulphur for the entire acid base accounting sample set was 1.4% and 1.0%, respectively in comparison to 0.35% for 10 times the average crustal abundance. The mean and median concentration for bismuth for all samples was 0.6 and 0.2 ppm, respectively in comparison to 0.085 ppm for the 10 times average crustal abundance. The mean and median concentration for selenium for all samples was 0.8 ppm and 1.0 ppm, respectively in comparison to 0.5 ppm for 10 times average crustal abundance. It should be noted that the detection limit for selenium in the current work is at the reported 10 times crustal abundance concentration of 0.5 ppm.

Several other elements including silver, arsenic, cadmium and zinc sometimes had concentrations in excess of 10 times the crustal abundance. Copper, chromium, mercury, molybdenum, antimony thorium and tungsten had isolated occurrences where an elemental concentration was in excess of the 10 times crustal abundance screening criteria.

As previously identified, sulphur, bismuth and selenium were elevated in all rock units sampled. The other elements that are sometimes or infrequently elevated tend to vary among the rock types. The variations in distribution of these elements among samples (by lithology) are identified in Appendix F (Table 7-7 in Appendix G).

5.5.3.3 Tailings

For comparative purposes, the elemental content of the tailings were compared to 10 times the average continental crust values (Price 1997). Overall, arsenic, bismuth, cadmium, selenium and silver stand out as anomalous with respect to 10 times average crustal abundance (Table 7-14 in Appendix G). The mean and median concentrations for arsenic of entire dataset were 70 ppm and 65 ppm, respectively, in comparison to 18 ppm for 10 times the crustal abundance. The mean and median concentrations for bismuth in the dataset were 1.2 ppm and 0.89 ppm, respectively, in comparison to 0.085 ppm for 10 times the crustal abundance. The mean and median concentrations for cadmium in the dataset were 4.3 ppm and 4.6 ppm, respectively, in comparison to 1.5 ppm for 10 times the crustal abundance. The mean and median concentrations for selenium were 0.7 ppm in comparison to 0.5 ppm for 10 times the crustal abundance. It should be noted that the detection limit for selenium in the tailings is reported to be higher than 10 times the crustal abundance at 0.7 ppm. The mean and median concentrations for silver were 0.86 ppm and 0.87 ppm, respectively, in comparison to 0.75 ppm for 10 times the crustal abundance.

Antimony and zinc were also identified as elements that had concentrations in excess of 10 times the crustal abundance and were elevated in all but the ROM samples.

5.5.4 Leachable Metals

A total of 64 rock samples representing different lithologies and metal contents were analyzed by the shake flask extraction test to assess the presence of potentially leachable metals. These test methods are not intended to simulate site-specific leaching conditions, but to provide a screening assessment of the potential for metal leachability. The shake flask extraction testing results were compared to regulated mining effluent discharge values (O.Reg. 560/94) as well as the more stringent PWQO for reference purposes only. These guidelines are useful in identifying parameters of interest when evaluating final discharge to receiving waters.

All samples exhibited neutral to slightly alkaline pH in the range of pH 7 to a maximum of pH 8.8. Dissolved metal concentrations in the shake flask extraction tests were generally low with no results reported at concentrations above O.Reg 560/94. Aluminum concentrations were consistently elevated in comparison to PWQO. Six samples that included felsic metavolcanic, chemical metasediment, felsic intrusive and mafic to ultramafic rocks exhibited dissolved chromium at very low concentrations in the range of 0.001 to 0.002 mg/L. Three samples that included chemical metasediment and felsic metavolcanic rocks exhibited dissolved cobalt at low concentrations of 0.001 to 0.008 mg/L. A single sample logged as a late felsic to intermediate intrusive exhibited dissolved arsenic at 0.22 mg/L. A single sample logged as felsic volcanic exhibited dissolved cadmium at a concentration of 0.004 mg/L.

Elevated concentrations of zinc and cadmium were noted in a number of samples possibly due to the presence of sphalerite occurring sporadically throughout the deposit. The possible significance of this in mine rock is being assessed in ongoing work.

Based on short term leach tests there is little evidence of metal leaching from rock under neutral pH conditions. Aluminum was somewhat elevated in the short term leach tests completed (and often elevated in these test due to the presence of colloidal aluminium and are not considered an indicator of a readily soluble phase in the sample). It should be noted that short term leach results are not directly applicable to actual leaching conditions as these tests only measure a particular moment in time and do not account for longer term (kinetic) changes in the weathering, oxidation and/or metal solubility in the sample that would be expected under field conditions.

All of the tailings samples were analyzed by the shake flask extraction test to assess the presence of potentially leachable metals. The results are presented in Table 7-15 in Appendix G, along with comparison to regulated effluent discharge values (O.Reg. 560/94). The more stringent PWQO are also provided for reference purposes only. All of the tailings samples exhibited neutral to slightly alkaline pH in the range of pH 7.3 to 8.5. Dissolved metal concentrations in the shake flask extraction tests were generally low with no results reported at concentrations above O.Reg 560/94. Aluminum concentrations were consistently elevated in comparison to PWQO. The ROM samples exhibited silver concentrations elevated in comparison to PWQO and the Starter Pit samples exhibited antimony concentrations elevated in comparison to PWQO.

5.5.5 Block Model

5.5.5.1 Surrogate Development

The approach to block modelling utilizes the large exploration database to interpolate the potential PAG and NPAG mine rock volume distributions within the future open pit. The large exploration database provides near continuous sampling data over 1 to 2 m sample intervals from borehole spacings within the pit at generally between 10 to 30 m. In order to utilize this large data set however, a relationship was required to estimate the NP and AP of rock samples on the basis of rock chemistry rather than traditional acid base accounting data. This approach essentially produces surrogate relationships for NP and AP from the existing ICP-MS exploration geochemistry data set. Three-dimensional modelling of the NP and AP within the pit based on the existing borehole sample data and analyses can then proceed; in this case supporting the development of a 5 x 5 x 5 m block model of NP and AP. When combined this data describes a three dimensional distribution of NPR on the basis of the 5 x 5 x 5 blocks.

The following sections describe how the surrogate relationships for NP and AP were developed, and checked. The surrogate relationships and block model results presented are considered interim and additional checks and evolution of this approach is continuing.
The AP is determined by the following relation (MEND 2009):

$$AP\ (kg\ CaCO_3/t) = Sulphide\ Sulphur\ (wt\%) \times 31.25$$

AMEC has determined that the ICP-MS sulphur analysis used for the exploration samples is a reasonable fit to sulphide sulphur and thus AP. Therefore the relation below can be used to determine surrogate AP from the exploration database using ICP-MS sulphur (Figure 8-7 in Appendix G). This relationship applies across all lithologies:

$$Surrogate\ AP\ (kg\ CaCO_3/t) = ICP\text{-}MS\ Sulphur\ (wt\%) \times 31.25$$

The relationship between NP and the exploration ICP-MS data is less clear due to a more complex relationship between NP and mine rock mineralogy. Calcium carbonate (calcite) and calcium-magnesium carbonate (dolomite) have been confirmed to be the dominant neutralizing minerals in the RRP waste rock and there is a good correlation between ICP-MS calcium and acid base accounting NP for all waste lithologies with the exception of diabase (Figure 8-8 in Appendix G). The following best-fit relation can be used as a predictor of NP from ICP-MS calcium for all lithologies except diabase:

$$Surrogate\ NP\ (kg\ CaCO_3/t) = (37.14 \times Calcium\ [\%]) - 4.21$$

A conservative estimate of NP for diabase can be based on the minimum NP determined in the current acid base accounting data set (approximately 20 kg $CaCO_3$/t).

5.5.5.2 Evaluation of Error and Implications of Surrogate Calculations

The excellent relationship between ICP-MS sulphur and acid base accounting sulphur indicates that the surrogate AP determined in this manner will result in little error in AP prediction on this basis. Although the correlation between ICP-MS calcium and acid base accounting NP is very good, there is some scatter in the data that could result in incorrect coding of some waste rock samples as NPAG when acid base accounting NP would determine a PAG condition (Figure 8-9 in Appendix G). The alternate relationship is also possible (surrogate NP would determine a PAG condition when acid base accounting NP would determine a NPAG condition).

An option for minimizing the potential problem of mapping PAG as NPAG material on the basis of the surrogate relationship is to shift the best-fit line to a point where such miscoding no longer occurs in the acid base accounting database. Adjustment of the trend line in such a manner results in the following more conservative surrogate relationship (Figure 8-8 in Appendix G):

$$NP\ (kg\ CaCO_3/t) = (37.14 \times Calcium\ [\%]) - 19.0$$

By using this trend, in total 8% of the acid base accounting samples were misclassified, but none of these resulted in PAG rock being misclassified as NPAG rock (Figure 8-10 in Appendix G). All misclassifications resulted in NPAG rock being classified as PAG rock. From a waste management perspective, this could result in some NPAG rock being placed in the PAG waste rock pile, but the likelihood of the opposite condition occurring is considered minor.

5.5.5.3 Acid Rock Drainage Block Model Results

Results of the block model are presented in several plan views and sections cut through the proposed pit (Figures 8-11 through 8-17 in Appendix G). Individual blocks are identified as PAG (NPR <1), uncertain (NPR between 1 and 2) and NPAG (NPR >2). Ore blocks on the basis of gold equivalent cut-off grade (with allowance for silver) are also identified. These initial block model results are generally consistent with the low resolution spatial distribution indicated by plotting acid base accounting data (Figures 8-4 through 8-6 in Appendix G). NPAG materials predominate in the south and PAG materials predominate in the northern regions of the pit.

Materials quantities derived from the current mine plan and block model are provided in Table 8-2 in Appendix G. The estimate indicates that approximately 44% of the waste material within the future pit will be PAG. As the project moves forward additional block model runs are planned to optimize the management and handling of mine rock.

5.5.6 Kinetic Test work

5.5.6.1 Mine Rock

Twenty samples of mine rock were chosen to undergo testing in humidity cells. The first set of 10 selected from initial KCB sampling, was initiated by KCB in February, 2010. A second set was selected from the 2011 AMEC sample set was initiated by AMEC in May, 2012. These samples were selected to cover the range of NP and AP for PAG material with NPR <2 for major lithologies comprising mine rock from the proposed pit (Table 5-4 and Figure 5-1 in Appendix G). Several selected samples approaching median NPR for the major lithologies were also included as well as a few samples containing elevated zinc.

The pH of 18 of the 20 mine rock humidity cells has remained relatively constant over the duration of testing. The median pH value for these circumneutral cells was 7.4. Two of the humidity cells exhibited significant declines in pH over the course of testing becoming more acidic. Consistent with these results, low acidity loading rates were observed in all pH neutral cells (average 1.5 mg/kg/wk). In the two acidic cells, maximum acidity loading rates were recorded at 43 and 23 mg/kg/wk, respectively.

Sulphate loads for all neutral pH mine rock humidity cells have exhibited a generally steady state throughout the duration of testing with the exception of an initial drop within the first 20 weeks of operation. Median steady state loading rates ranged from 1.4 to 22.6 mg/kg/wk in all cells The highest sulphate loading rate for the non-acid cells was for a low NPR (0.7) mafic volcanic sample with 8.1% sulphide. The two acidic cells exhibited increasing sulphate release rates, beginning at approximately 20 weeks and 60 weeks, respectively. Both cells reached a maximum steady sulphate release rate of approximately 23 mg/kg/week after acid onset.

For circumneutral humidity cells, Ag, Be, Bi, Cr, Fe, Hg, P, Tl, Ti and Zr were found in concentrations in the leachate at or near detection limits. For six elements (Cd, Cu, Li, Ni, Se and Zn), two to four cells exhibited somewhat elevated leachate concentrations (maximum 50 times detection limit values), but were more typically at or near detection limit values. Eight elements (B, Ca, K, Mg, Na, S, Si and Sr) had loadings that consistently decreased throughout the duration of testing. The remaining 10 elements (Al, As, Ba, Co, Mn, Mo, Pb, Sn, V and U) all had loadings consistently above detection limit and generally remained steady throughout the testing period. For the acidic humidity cells, notable increases in loading rates were observed after the cells went acid for 14 elements (Al, Be, Cd, Co, Cr, Cu, Fe, Li, Ni, Pb, Si, Sr, U and Zn).

5.5.6.2 Tailings

Six tailings humidity cells are currently in operation representing three tailings types (each in duplicate). As of November 19, 2012 the ODM cells were in operation for 30 weeks, Starter Pit cells were in operation for 21 weeks and the ROM cells were in operation for 25 weeks. Detailed results for the tailings humidity cells can be found in Appendix G.

The pH of the tailings cells remained relatively constant with a slightly downward trend. Values for pH range between 6.6 and 8.1, with a median pH value of 7.2. The pH for all cells remained relatively constant around pH 7.0 after week 10. Acidity loading rates have remained constant around 2.0 mg/kg/wk throughout the entirety of the testing period. Alkalinity loading rates were initially high (up to 80 mg/kg/wk), but declined to around 2 mg/kg/wk as testing progressed. Sulphate loading rates follow a similar trend as alkalinity with high initial loadings (up to 280 mg/kg/wk), declining by week five to fairly steady rates between 10 and 20 mg/kg/wk.

Eighteen elements (Ag, As, Be, Bi, Ca, Cr, Cu, Hg, Li, Ni, P, Se, Tl, Th, Ti, V, W, Y, Zn) had loading rates near or at detection limit for the all cells. The following observations are provided for early stage (21 to 30 weeks of operation) metal loadings from the tailings humidity cells:

- Major elements (Al, Ca, Fe, K, Mg, Na and Si) all exhibited loading under 10 mg/kg/wk with the exception of Ca which had loading rates as high as 100 mg/kg/wk;

- Most trace elements exhibited loading rates below 0.01 mg /kg/ wk (As, Ba, Mo, Ni, Sb and Sn) and with some consistently lower than 0.001 mg/kg/wk (Cd, Co, Pb, Th, U and Y); and

- A few metals exhibited elevated loading rates in comparison to others (B, Mn, Sr and Zn).

5.5.7 Field Test Cells

Field cells are kinetic tests constructed to provide site-specific drainage quality information under field, rather than laboratory, conditions. The objective of a field cell is to expose selected drill core material to weathering conditions at the site and collect drainage water over time for laboratory analysis. Seven field cells were constructed on the RRP site in October 2011. A maximum of 14 sampling events were captured between October 2011 and November 2012 (Appendix G).

Core from various lithologies were preselected from the major lithologies expected from the future pit mine rock at the site. Sample selection was made from long sections of generally consistent lithology and further guided by calcium and sulphur contents from exploration data. Lithologies targeted for this work included felsic and intermediate volcanics, mafic volcanics, metasediments along with a single cell for pyritic metasediment.

The pH values of the field cell leachate ranged from 7.4 to 8 for all field cells exhibiting a generally declining trend for most of 2012. The field cell leachate pH values were generally above the average steady state pH range observed in the humidity cell leachate (7.0 to 7.6).

Acidity loading rates are similar for all field cells, and range from 0.08 to 1.6 mg/m^2/wk, and increased to some extent over the course of the experiments. The field cell loading rates were similar to the average steady state loading rates of the humidity cells (0.08 to 0.7 mg/m^2/wk), particularly during the initial 35 weeks of field cell operation. Alkalinity loadings varied over time and were similar for all field cells. Loading rates ranged from 1.4 to 2.2 mg/m^2/wk, and generally decreased over the course of sampling. Rates were generally elevated relative to the average steady state loading rates observed in the humidity cell leachate (0.06 to 3.4 mg/m^2/wk). Sulphate loading for all field cells were elevated for the initial sampling event and ranged from

5.5 to 10 mg/m^2/wk. Sulphate loading rates declined over time in all field cell leachates, and ranged from 0.2 to 6.0 mg/m^2/wk for the remainder of samples collected.

Metals analyses on leachates from the field cells had concentrations near or at the detection limit for Ba, Be, Bi, B, Cd, Cr, Co, Fe, Pb, Li, Mn, Hg, Ni, Se, Ag, Te, Tl, Si, Sn, Ti, W, U, V, Zn and Zr. All detectable field cell loading rates were elevated for the initial three weeks of flushing and increased again in the early spring (weeks 32 to 35). Generally the field cell loading rates were variable, although a general decreasing trend over time was observed for most constituents.