
MEMORANDUM

To: Alexey Klyashtorin and Chris Reid – Saskatchewan Research Council, Project CLEANS
Gunnar Uranium Mine
Mark Liskowich and Trevor Podiama – SRK Consulting

From: Kristie Bonstrom, P.Geo.

cc: Ian Wilson – Saskatchewan Research Council
Denise Chapman and Brian Ayres – O’Kane Consultants Inc.

Date: July 15, 2015

Re: **SRC Gunnar Tailings Remediation Plan – Borrow Material Balance and Suitability (963-1-MEM-0003)**

The Saskatchewan Research Council (SRC) was contracted by the Government of Saskatchewan to act as Project Manager, licence applicant and designated agent to undertake remedial activities at the Gunnar uranium deposit (the Site). SRC has retained O’Kane Consultants Inc. (OKC) to develop a remediation plan for the Gunnar tailings deposits. As part the Gunnar Tailings Remediation project OKC completed a background review and gap assessment. It was determined that the availability of sufficient suitable borrow material volumes for the tailings remediation cover system was a key risk to the design. As such, OKC completed a field investigation in June 2015 to characterize material properties and estimate borrow materials volumes at the Site.

This memorandum provides summaries of borrow material volumes and material properties resulting from the field investigation and subsequent laboratory testing program. In addition, material suitability for use in a cover system is discussed. The objective of this memorandum is to clarify the implications of the field investigation on remediation designs for the Site tailings deposits and waste rock piles. A report detailing the field investigation including borrow area descriptions, test pit and sample descriptions etc. will be delivered to SRC in the coming week. Preliminary key findings of the borrow investigation are provided below to avoid unnecessary delays in the optimization of remediation plans for the Site tailings deposits and other site aspects.

Material Properties:

Previous studies included detailed test pit and laboratory testing programs that targeted Investigation Areas 6 and 13¹ as well as the airstrip². The current field investigation targeted Investigation Areas 1, 2, 5, 11, and 12. Several bulk samples were collected from each target borrow area and submitted for particle size distribution (PSD) analysis. Figure 1 provides a summary of PSDs for the current and previous studies.

¹ Golder Associates Ltd. 2011. Former Gunnar Mine Site 2011 Borrow Investigation. Report submitted to Saskatchewan Research Council, October 2013

² AECOM. 2010. Gunnar Mine Site Remediation Project 2009 Field Report: Groundwater and Borrow Source Investigation. Report Submitted to Saskatchewan Research Council, September 2010.

The majority of materials encountered in Areas 1, 2, 11, 12, and 13 were clay- and silt-size particles. Areas 5 and 6 have varying quantities of clay and silt to sand and gravel size particles. Based on PSD analyses, materials were partitioned into three texturally based categories: finer-textured (clay and silt), medium-textured (fine sand to coarse sand) and coarser-textured (sand and gravel or coarser).

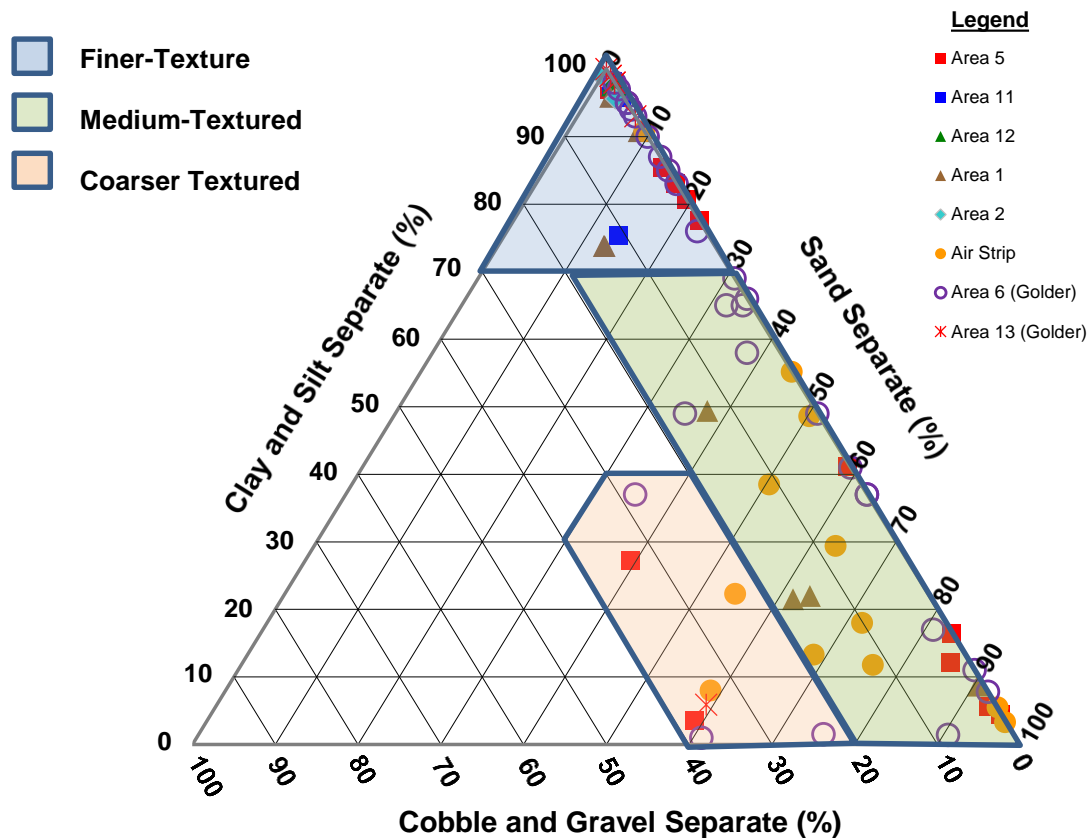


Figure 1. Textural triangle showing PSDs measured for borrow materials from previous and current investigations.

Areas 5 and 6 coupled with airstrip material are the most promising in terms of cover system material. The following are high-level recommended borrow material uses for cover system construction based on the textural categories:

- Finer-Textured:
 - Not recommended for cover system use due to propensity for frost heaving and erosion.
 - Recommended for possible use as fill for part of the Langley Bay Landform however further analyses are required.
- Medium-Textured:
 - Recommended for use at the base of a cover system as much of the medium textured material encountered is comprised of fine sand that may be highly susceptible to erosion.
- Coarser Textured:
 - Recommended for use at the surface of cover systems placed on surfaces with a slope gradient >1%.

Material Volumes:

Available Borrow Material:

Table 1 provides estimated volumes for available borrow materials at the Site based on previous and current studies. Estimated volumes include borrow area reclamation design criteria, which will be outlined in the pending field investigation report. However, volumes reported for Areas 6 and 13 do not include these and will be revised upon receipt of further information. It is not anticipated volumes for Areas 6 and 13 will be substantially reduced when borrow area reclamation design criteria are incorporated.

During Golder Associates Ltd.'s (Golder's) investigation of Area 6, the water table was encountered at several locations proximate to the lake east of the airstrip. As such, they reported borrow volumes above and below the water table. Much of these materials were medium and coarser-textured, which are the most promising for use in the cover systems. During the current investigation the water table was encountered primarily in the finer-textured borrow areas and these saturated materials were not included in the total volumes.

Table 1
 Estimated borrow material volumes.

Investigation Area	Total Area (m ²)	Assumed Organic Material (m ³)	Finer Textured (m ³)	Medium Textured (m ³)	Coarser Textured (m ³)
1	59,150	5,920	125,210	-	-
2	97,930	9,790	310,950	-	-
5	277,120	27,710	587,850	194,190	47,940
11	118,610	11,860	278,430	-	-
12	152,540	15,250	383,100	-	-
West Airstrip	54,450	-	-	-	80,930
<i>Subtotal</i>	<i>759,800</i>	<i>70,530</i>	<i>1,685,540</i>	<i>194,190</i>	<i>128,870</i>
6	1,040,000	154,430	789,130	109,420	251,890
13	290,000	134,100	646,100		
<i>totals above water table</i>		<i>359,060</i>	<i>3,120,770</i>	<i>303,610</i>	<i>380,760</i>
6		13,470	875,210	230,440	44,650
<i>totals below water table</i>		<i>372,530</i>	<i>3,995,980</i>	<i>534,050</i>	<i>425,410</i>

There is approximately **684,000 m³** of medium and coarser-textured material combined available above the water table based on field investigative work completed to date. If material below the water table is considered, then approximately **960,000 m³** of borrow material is available.

Required Borrow Material:

Table 2 presents the cover system and fill volume requirements for the current Tailings Remediation Plan. Total borrow material required for the tailings deposits cover system and fill, as presented in the Gunnar Tailings Remediation Plan Report, is **675,000 m³**. These volumes include a minimum 0.5 m thick cover system for all tailings deposits (except Catchment 3 Back Release which includes a 1.0 m thick cover system) and borrow fill material for construction of the Langley Bay landform. When coupled with Other Site Aspect requirements outlined by SRK⁴, total borrow material requirements are approximately **990,000m³**. Based on the high-level recommendations for material use in the cover system, there is a risk that not enough suitable medium and coarser-textured borrow material is available to fulfill preliminary cover system designs for the tailings areas as well as other site aspects. As such, the cover system and landform designs should be optimized to reduce the risk of inadequate suitable borrow material volumes.

Table 2
 Cover system and fill volume requirements based on July 7, 2015 design.

Gunnar Tailings Deposit	Waste Rock Fill for Landform (m³)	Till or Soil Fill for Landform (m³)	Till or Soil Cover System Fill (m³)
Gunnar Main	620,000		240,000
Gunnar Central	110,000		60,000
Langley Bay	0	230,000	80,000
Back release – Catchment 3	0		50,000
Beaver Pond	90,000		15,000
Subtotal	820,000	230,000	445,000
Other Site Aspects			
WRPs	-		108,000
Landfill and Acid Plant			207,000
Total	820,000	230,000	760,000

Gunnar Tailings Remediation Plan Implications:

Based on the above findings the following are a set of refinements for consideration during the detailed design phase of the project:

1. Optimize Cover System and Landform Fill Borrow Material Requirement for the Current Tailings Remediation Plan. To achieve construction of these designs the following must be included:
 - a. Include saturated material from Area 6;
 - b. Use clay and silt borrow material for fill as a basal layer in some or one landform;

³ O’Kane Consultants Inc. 2015. Gunnar Site Remediation Project – Tailings Remediation Plan. Report submitted to Saskatchewan Research Council, July 2015.

⁴ SRK Consulting. 2015. Gunnar – Other Site Aspects. Presentation submitted to Saskatchewan Research Council, July 2015.

- c. Optimize the Tailings Deposit Cover Systems as per Table 3 using the following assumptions for cover system profiles:
 - i. Gunnar Main: 0.3 m coarser-textured material over 0.3 m medium-textured material over waste rock fill or tailings;
 - ii. Gunnar Central: 0.3 m coarser-textured material over 0.3 m medium-textured material over waste rock fill;
 - iii. Langley Bay: 0.5 m coarser-textured material over finer-textured fill;
 - iv. Catchment 3 Back Release: 0.3 m coarser-textured material over 0.3 m medium-textured material over 0.5 m waste rock; and
 - v. Beaver Pond: 0.3 m coarser-textured material over 0.3 m medium-textured material over waste rock fill.

Table 3

Medium and coarser-textured borrow materials required for tailings remediation.

Tailings Deposit	Medium-Textured Material (m³)	Coarser-Textured Material (m³)
Gunnar Main	144,000	144,000
Gunnar Central	36,000	36,000
Langley Bay	-	80,000
Catchment 3	15,000	15,000
Beaver Pond	9,000	9,000
Totals	204,000	284,000
Material Remaining – Above WT	99,610	96,760
Material Remaining – Below WT	330,050	141,410

- 2. Include Larger Volume of Waste Rock fill into Tailings Landform and Cover System Design:
 - a. Cover system material requirements for the Tailings Remediation Plan as per Table 3;
 - b. Potentially reduce cover system requirements for the WRPs as discussed during the Failure Modes and Effects Analysis completed July 8th, 2015.
- 3. Relocation of Gunnar Main and/or Gunnar Central Tailings to Gunnar Main:
 - a. OKC is conducting further examination of the technical and economic feasibility of this option;
 - b. Tailings volume estimates are being revised by OKC based on recent borehole information.

OKC will work with SRK over the next weeks to ensure borrow materials will be optimized to the full extent. We recommend that OKC and SRK meet to discuss the findings presented in this memorandum.

Closure:

We trust the information provided in this memorandum is of value to SRC and SRK regarding finalization of remediation plans of the various aspects at the Site. We look forward to your feedback on information presented herein. Please do not hesitate to contact me at 306-955-3249 or kbonstrom@okc-sk.com should you have any questions or comments.