

DATE April 17, 2017**PROJECT No.** 1775699 (3000)**TO** Mr. Rodney Fagan
Baffinland Iron Mine Corp.**CC** Adam Gyorffy, Marc Rougier, Ken Bocking**FROM** Michelle Tyldesley**EMAIL** MTyldesley@golder.com**CRUSHER PAD EXPANSION DETAILED DESIGN BRIEF, MARY RIVER PROJECT, NUNAVUT**

1.0 INTRODUCTION

Baffinland Iron Mines Corporation (Baffinland) retained Golder Associates Ltd. (Golder) to prepare a detailed design for an expansion of the existing Crusher Pad. This expansion is required to provide an additional area for stockpiling ore and/or aggregates. The construction is planned to be carried out prior to the spring freshet in 2017 and will involve increasing the size of the Crusher Pad by approximately 10%. This technical memorandum outlines the background, design criteria and details, and impacts on the water management infrastructure for the proposed Crusher Pad expansion.

2.0 BACKGROUND

The Mary River Project is owned and operated by Baffinland. The Crusher Pad is the location where ore is stockpiled, crushed, and loaded into B-trains trucks for haulage to the Milne Port. Two ore crushing set-ups and a single aggregate crushing set-up are located on the existing Crusher Pad. The aggregates produced at the Crusher Pad are used across the site as required.

The Sedimentation Pond, which is adjacent to the west side of the existing Crusher Pad, is used to remove suspended solids from the surface water runoff on the Crusher Pad. A perimeter ditch conveys the flows from the Crusher Pad to the Sedimentation Pond. Water collected in the Sedimentation Pond is released via pumping at a location downstream near Mary River. The existing Sedimentation Pond was designed by Hatch (Hatch, 2015). The design criteria are provided in Hatch (2013).

3.0 CRUSHER PAD EXPANSION DESIGN

Details on the Crusher Pad expansion design including the design criteria and design elements (the expansion, the perimeter ditch, and the vehicle safety berm) are provided in the following section.

3.1 Design Criteria

The following design criteria were considered for the Crusher Pad Expansion:

- The Crusher Pad expansion will be used for stockpiling of ore and aggregates. The size and approximate footprint of the expansion was provided by Baffinland based on a stockpile capacity of 0.134 to 0.2 Mt.



- The granular pavement structure for the expansion is designed to support loaded CAT 777G haul trucks and a CAT 988K loader.
- The subgrade will consist of ultra-fine material.
- A perimeter vehicle safety berm will be provided where a drop off of 3 m or greater exists.
- The expansion pad ditch will be capable of conveying the 1:10 year, 24 hour storm event.
- A single lane of traffic (8 m in width) is to be maintained between the stockpile area and the perimeter of the expansion.

3.2 Crusher Pad Expansion Design Elements

The expansion will include infilling the existing perimeter ditch and removing the existing berm at the tie-in, expanding the pad, constructing a ditch around the perimeter of the expansion, tying the expansion ditch into the existing perimeter ditch, and constructing a vehicle safety berm where required. The details on these design elements are described in the following sections. The attached Drawings 001 to 003 present the site plan, cross-sections and typical details, respectively.

3.2.1 Existing Perimeter Ditch and Existing Berm

Along the tie-in of the expansion and the existing Crusher Pad, the existing perimeter ditch will be infilled and the existing berm will be removed. The existing perimeter ditch will be infilled with Type 4 (75 mm minus) material for approximately 25.0 m from where the existing perimeter ditch will tie into the expansion ditch. The remainder of the existing perimeter ditch east of the tie-in can be infilled with either ultra-fine material, Type 4 (75 mm minus) material, material from the existing berm adjacent to the perimeter ditch, or a mixture. A geotextile will be placed between the interface of the Type 4 material and the ultra-fine material to prevent the potential migration of fines. The limit of the existing perimeter ditch and berm to be infilled and removed is shown on Drawing 001 and a typical detail is shown on Drawing 003.

3.2.2 Crusher Pad Expansion

The expansion will involve expanding the footprint of the existing Crusher Pad towards the south-east by approximately 8,350 m². The expansion will be sloped toward the south-west with an approximate grade of 1.2%. The single lane of traffic (8 m in width) will be provided around the perimeter with a 3% grade toward the ditch.

The subgrade will consist of ultra-fine material and the granular pavement structure will consist of a crushed granular material. At the perimeter of the expansion pad, the ultra-fine material will be constructed with a 3H:1V slope and then covered with geotextile (Layfield LP7 or approved equivalent) and granular material (Type 4 (75 mm minus) or Type 5 (32 mm minus)) to prevent migration and erosion of the ultra-fine material.

The subgrade for the expansion will be formed by placing the ultra-fine material in lifts and compacting. The compacted thickness of each lift should be 300 mm or less and each lift should be compacted by a minimum of 3 passes over all areas of a dozer, a loaded haul truck or the loader. At the perimeter of the expansion pad, the subgrade will be constructed with a 3H:1V sideslope.

A 1.0 m thick pavement structure will be constructed on top of the finished subgrade. The pavement structure for the expansion may consist of 1.0 m of Type 4 (75 mm minus) material. Alternatively, the pavement structure may have two layers, comprising 0.8 m of Type 4 (75 mm minus) material with a 0.2 m cap of Type 5 (32 mm minus) or comprising 0.8 m of Type 6 (300 mm minus material) with a 0.2 m cap Type 4 (75 mm minus) material in an

effort to improve trafficability, reduce tire wear, and maintain grade and surface condition. These options are detailed on Drawing 003. The 1.0 m thick pavement structure will be carried through the ditch.

The toe of the proposed stockpile to be placed on the Crusher Pad expansion is required to be offset a minimum of 8.0 m from the upstream edge of the perimeter ditch.

3.2.3 Expansion Ditch

A ditch will be constructed along the edge of the expansion as shown in Drawing 001. Construction details for the expansion ditch are shown on Drawing 003. The perimeter ditch will consist of a trapezoidal-shaped channel with a 0.5 m base width, a minimum depth of 0.6 m, and side slopes of 2H:1V. The expansion ditch has the same cross-section as the existing perimeter ditch. The expansion ditch is approximately 270 m in length with an average grade of approximately 0.6 %. The granular pavement structure will be extended across the ditch; thus this granular material will act as erosion protection. No additional rip rap or liner is required in the ditch.

3.2.4 Vehicle Safety Berm Expansion

A vehicle safety berm will be constructed along the southern edge of the expansion area where a drop off of 3 m or greater exists, as shown in Drawing 001. The vehicle safety berm is only required along approximately half the length of the perimeter ditch. Construction details for the vehicle safety berm are shown on Drawing 003. The height of the berm is 2 m (from the base of the ditch to the crest) as determined by $\frac{3}{4}$ of the maximum wheel height (taken as the CAT 777G haul truck). The berm will be constructed with granular material (Type 4 (75 mm minus) material, Type 5 (32 mm minus) material, Type 6 (300 mm minus) material or oversized material).

4.0 WATER MANAGEMENT INFRASTRUCTURE CAPACITY ASSESSMENT

An assessment was completed to determine the impact of the increased runoff area from the Crusher Pad expansion on the existing water management infrastructure. The Sedimentation Pond storage and pumping capacity, and the perimeter ditch discharge capacity were reviewed.

4.1 Pond Storage Capacity

Based on the available information, the current pond capacity (approximately 3,490 m³) was sized to contain the 1:10 year storm 24 hour event below the design high water level (HWL) of 191.88 m. The required pond capacity to contain the 1:10 year storm 24 hour event including the expansion would be approximately 3,972 m³.

Based on the existing pond storage capacity below the HWL and the proposed increase in catchment area, the pond can contain a 24 hour event with a rainfall intensity of approximately 1.6 mm/hr which is between the 1:5 year storm 24 hour event (1.4 mm/hr) and 1:10 year storm 24 hour event (1.7 mm/hr).

4.2 Pond Pumping Capacity

An increase in run-off volume reporting to the Sedimentation Pond will increase the pumping requirements; however, it is understood that Baffinland already has sufficient capacity to pump water from the pond. It is understood that the current pumping capacity is 423 gpm (approx. 2,300 m³/day) and additional pumps are available if required. In 2016, Baffinland pumped only 85 m³ from the Sedimentation Pond.

4.3 Perimeter Ditch Capacity

The pad expansion will increase the peak flow in the perimeter ditch by approximately 0.03 m³/s during the 1:10 year storm. This is considered to be negligible and no perimeter ditch upgrade is recommended.

5.0 CONSTRUCTION CONSIDERATIONS

The construction considerations related to the Crusher Pad expansion are provided below:

- Snow shall be removed from the footprint of the expansion prior to construction.
- Sedimentation and erosion mitigation measures shall be in place before commencing construction.
- All materials shall be placed in horizontal lifts with a nominal compacted thickness of 300 mm or less.
- Each lift shall be compacted by a minimum of 3 passes over all areas of a dozer, a loaded haul truck or the loader.
- Field fitting the tie-in of the expansion into the existing Crusher Pad will be required. Additional fill may be required past the limits of the tie-in to ensure adequate drainage.
- An as-built survey should be collected to properly document the construction.

6.0 CONCLUSIONS

Golder completed a Crusher Pad expansion detailed design and reviewed the capacity of the existing Crusher Pad water management infrastructure based on the proposed expansion. Construction drawings for the Crusher Pad expansion site plan, sections, and typical details are presented in Drawings 001, 002 and 003, respectively.

The expansion increases the Crusher Pad footprint by approximately 10% (8,350 m²). The sub-grade of the expansion is to be constructed with ultra-fine material and the pavement structure is to consist of 1.0 m thick crushed granular material. A ditch will be constructed around the perimeter of the expansion area tying into the existing perimeter ditch upstream of the entry into the Sedimentation Pond. A vehicle safety berm will be constructed along the southern edge of the expansion. Along the expansion tie-in with the existing pad, the existing perimeter ditch will be infilled and the existing berm will be removed.

The existing Crusher Pad Sedimentation Pond will no longer contain the design storm (1:10 year, 24 hour storm event). The added catchment area decreases the pond capacity design storm to between the 1:5 year, 24 hour storm event and the 1: 10 year, 24 hour event. The existing perimeter ditch west of the Crusher Pad expansion can still convey the design storm (1:10 year 24 hour storm event).

7.0 CLOSING REMARKS

We trust that this technical memorandum satisfies your current requirements. Please contact the undersigned should you have any questions.

GOLDER ASSOCIATES LTD.



Michelle Tyldesley, P.Eng.(ON)
Geotechnical Engineer

JWS/MJT/jl

Attachments: Drawing 001 - Site Plan
Drawing 002 - Cross Sections
Drawing 003 - Typical Details



Ken Bocking, P.Eng.
Principal, Senior Geotechnical Engineer

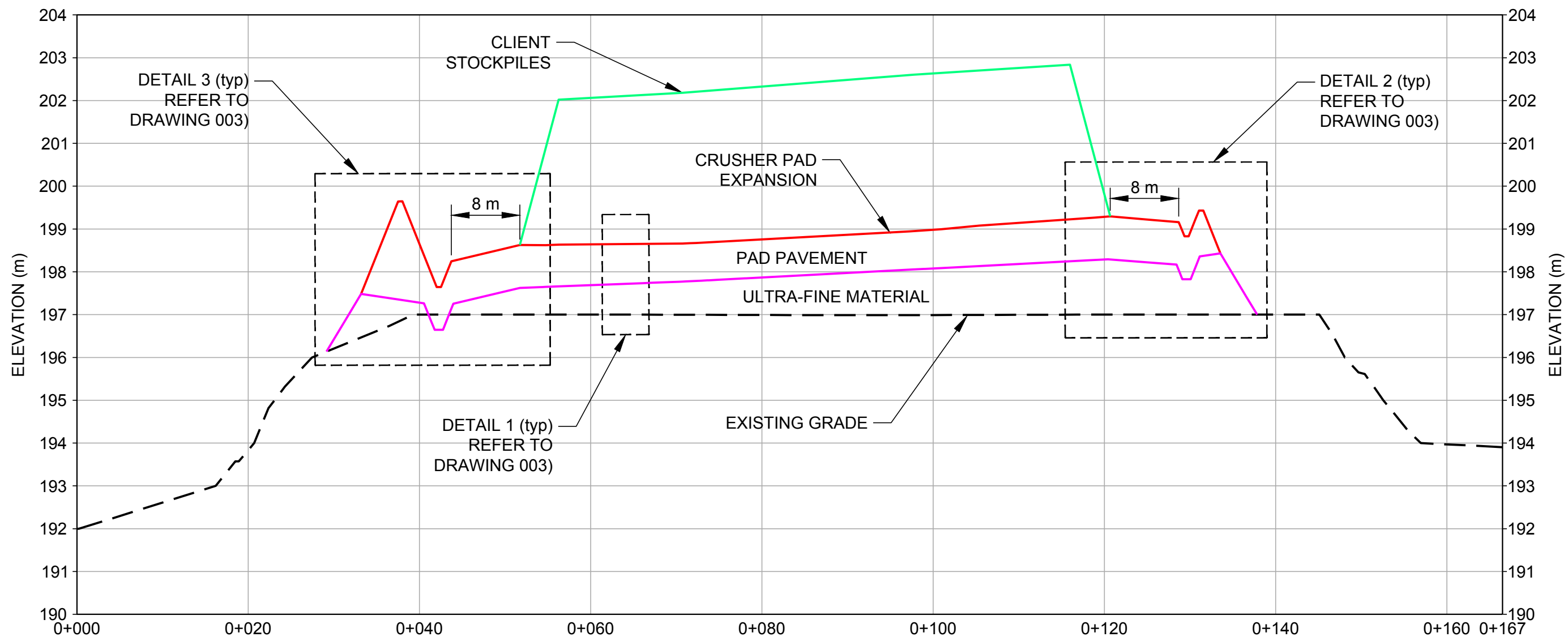
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References

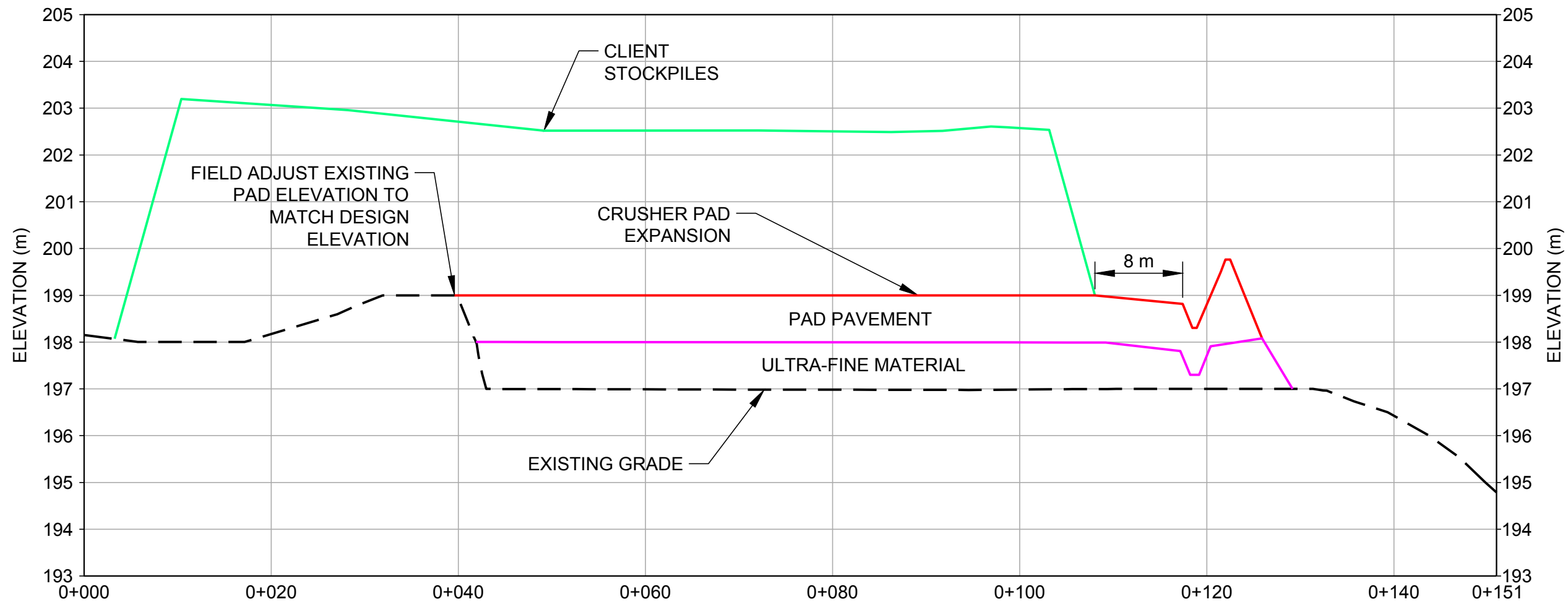
Hatch (Hatch Ltd.) 2013. Civil Design Criteria. Hatch Project No. H349000. Issued to Baffinland. 28 August 2013.

Hatch (Hatch Ltd.) 2015. Crusher Pad Sedimentation Pond Earthworks & Drainage Plan. Drawing No. H34900-4385-10-035-0001. Issued for Construction. Issued to Baffinland. 27 Mar 2015

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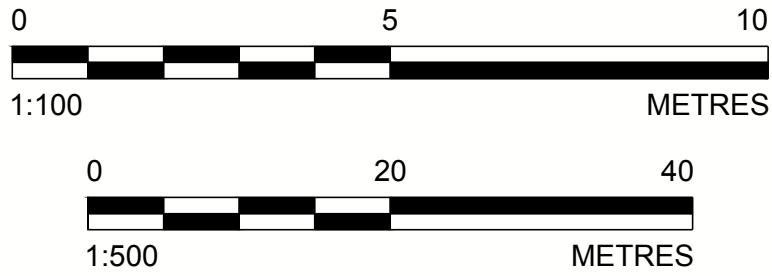


HORIZ. SCALE 1:500 m
VERT. SCALE 1:100 m
A-A' CROSS-SECTION
001

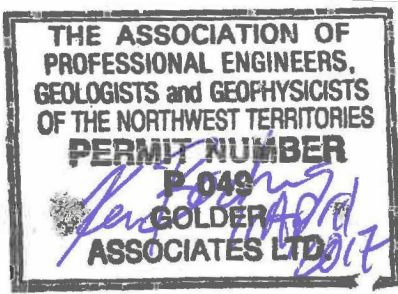


HORIZ. SCALE 1:500 m
VERT. SCALE 1:100 m
B-B' CROSS-SECTION
001

- NOTES**
1. REFER TO DRAWING 003 FOR DETAILS.
 2. REFER TO DRAWING 001 FOR ADDITIONAL NOTES.



0	2017-04-11	ISSUED FOR CONSTRUCTION	MLF	MJT	MJT	KAB	
A	2017-04-07	ISSUED FOR CLIENT REVIEW	MLF	MJT	MJT	KAB	
REV.	YYYY-MM-DD	DESCRIPTION	DESIGNED	PREPARED	REVIEWED	APPROVED	



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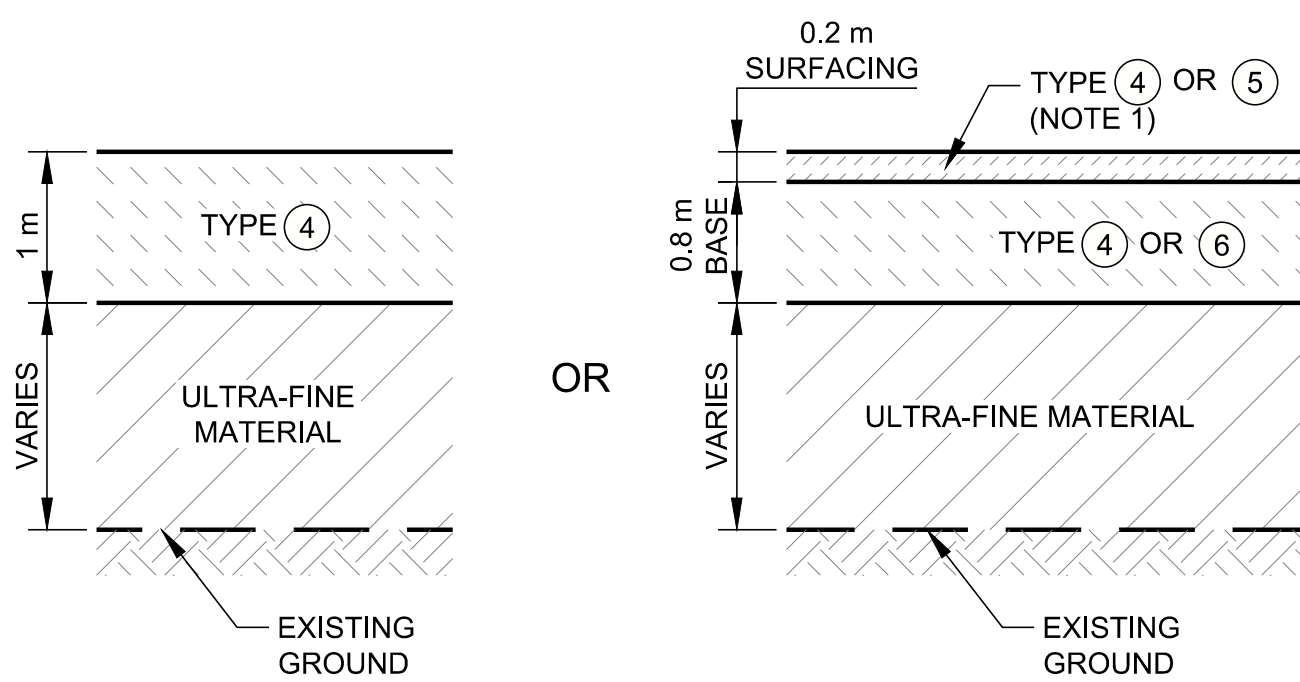
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PROJECT
MARY RIVER PROJECT
CRUSHER PAD EXPANSION

TITLE
CROSS-SECTIONS

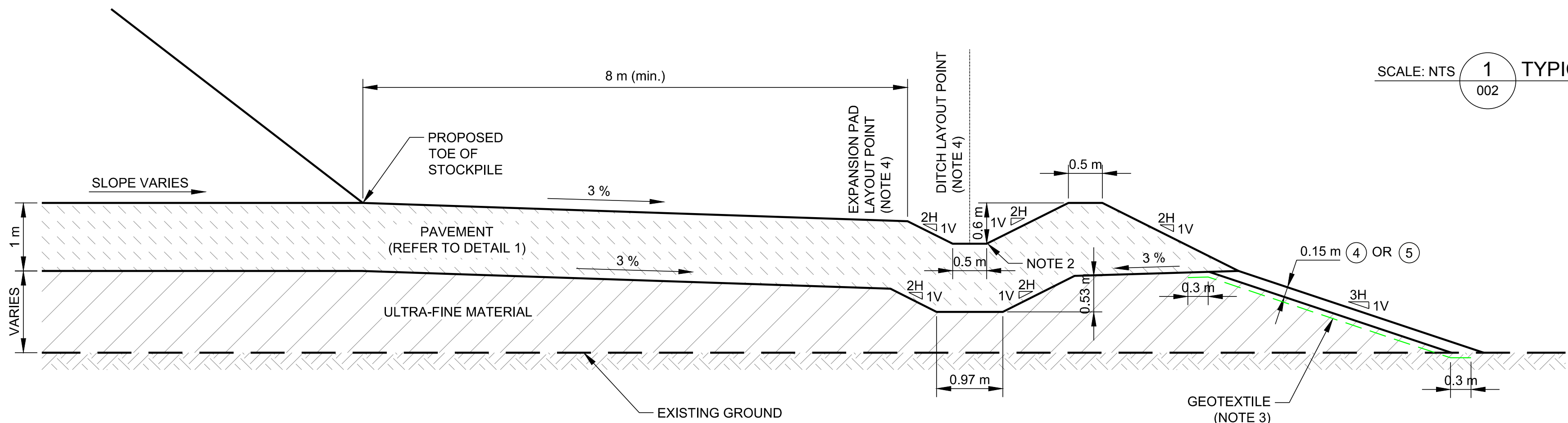
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25 mm IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

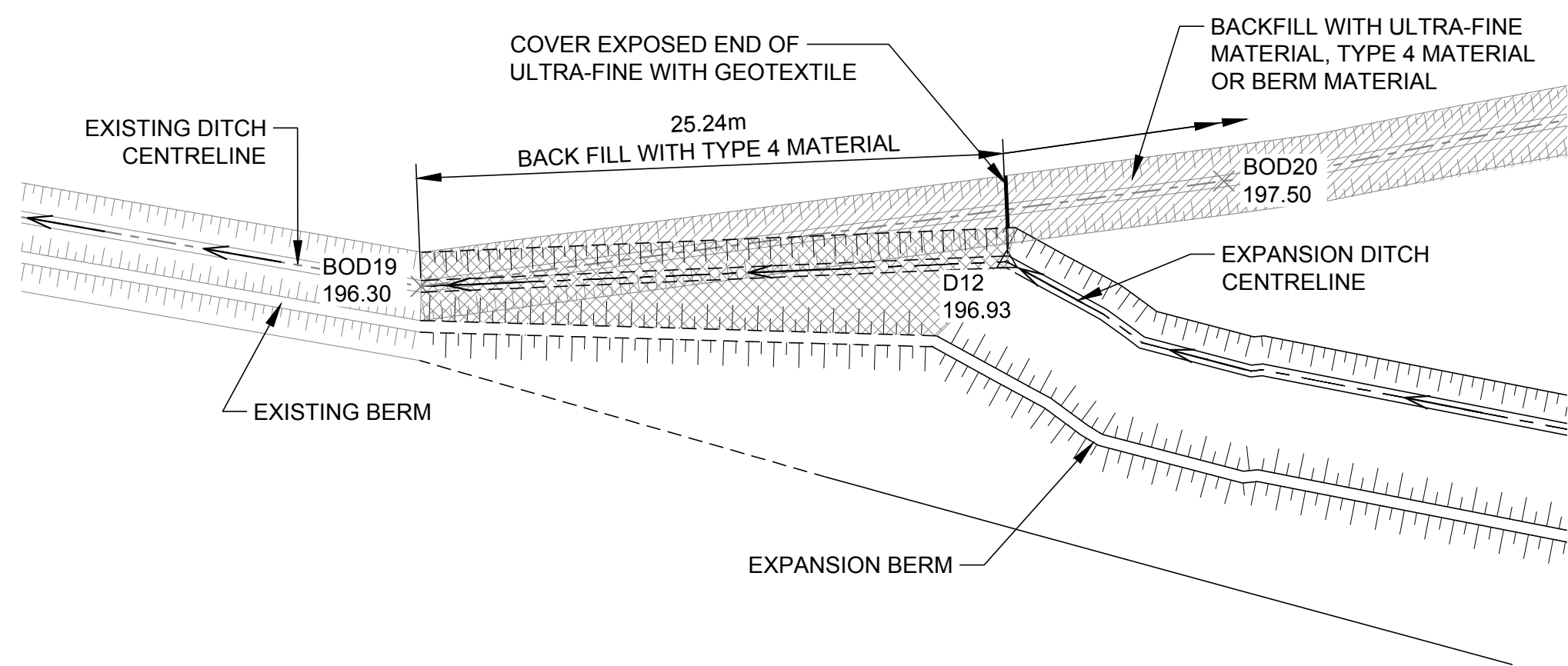


- LEGEND**
- — — — — EXISTING GROUND
- ④ TYPE 4 (75 mm MINUS) MATERIAL
- ⑤ TYPE 5 (32 mm MINUS) MATERIAL
- ⑥ TYPE 6 SELECTED (0.3 m MINUS) RUN OF QUARRY MATERIAL
- - - - - GEOTEXTILE
- ← — — — — FLOW DIRECTION

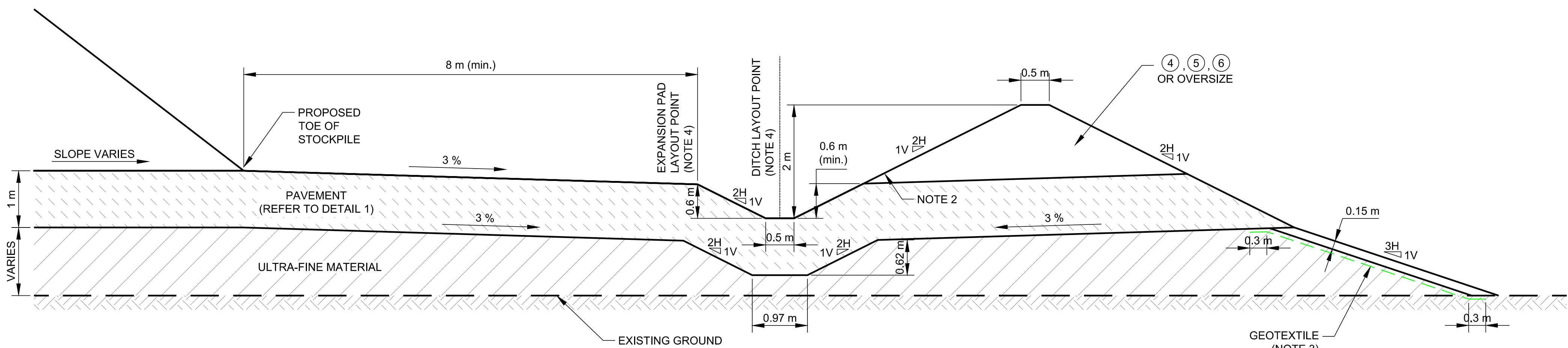
- ## NOTES
1. TYPE 4 OR 5 MATERIAL PROVIDED FOR TRAFFICABILITY.
 2. NO RIP RAP OR LINER IS REQUIRED FOR THE DITCH. IN THE EVENT THE NEED FOR RIP-RAP OR LINER ARISES, IT CAN BE INSTALLED AT A LATER DATE.
 3. GEOTEXTILE TO BE LAYFIELD LP7 OR APPROVED EQUIVALENT.
 4. LAYOUT POINTS FOR THE PAD AND DITCH ARE PROVIDED ON DRAWING 001.
 5. REFER TO DRAWING 001 FOR ADDITIONAL NOTES.



SCALE: NTS 2
002 TYPICAL DITCH SECTION DETAIL



SCALE: NTS **4** DITCH CONNECTION AND INFILLING DETAIL
001

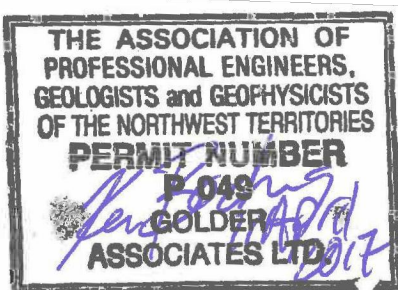


TYPICAL DITCH SECTION DETAIL
(WITH SAFETY BERM)

SCALE: NTS

3
002

0	2017-04-11	ISSUED FOR CONSTRUCTION			MLF	MJT	MJT	KAB
A	2017-04-07	ISSUED FOR CLIENT REVIEW			MJT	MLF	MJT	KAB
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TYPICAL DETAILS

PROJECT NO.	PHASE	REV.	of	DRAWING
1775699	3000	0		003