October 26, 2023 Project No. 19130670

Craig Bellinger, Environmental and Land Project Manager
R. W. Tomlinson Limited
100 Citigate Drive
Ottawa, Ontario
K2J 6K7

STORMWATER MANAGEMENT BRIEF AND SEDIMENT AND EROSION CONTROL PLAN
PROPOSED STITTSVILLE 2 QUARRY
CITY OF OTTAWA, ONTARIO

Dear Mr. Bellinger,

This letter summarizes the stormwater management (SWM) plan and sediment and erosion control plan for the proposed Stittsville 2 Quarry, as described in the Level 1 and Level 2 Water Report (WSP 2023).

R.W. Tomlinson Limited (Tomlinson) operates a number of pits and limestone quarries in the Ottawa area. The materials are used in the Ottawa area for road construction and in site preparation for commercial and residential developments. As part of the long-term business plan in the Ottawa area, Tomlinson wishes to license, under the *Aggregate Resource Act* (ARA), a property adjacent to the existing licensed Tomlinson Stittsville Quarry in order to supply the western end of Ottawa with aggregate products into the future.

The proposed Stittsville 2 Quarry is located in the Geographic Township of Goulbourn in the City of Ottawa, Ontario. The proposed quarry property is located on Lots 15 and 16, Concession XI (see attached Figure 1). The property is bounded by Jinkinson Road and the existing Tomlinson Stittsville Quarry to the north, the Goulbourn Wetland Complex to the east, the Trans-Canada Trail to the south and the Lafarge Canada Inc. (Lafarge) Bell Quarry property to the west. Access to the site is currently from Jinkinson Road.

The proposed extraction area covers an area of approximately 109.8 hectares (ha). The Stittsville 2 Quarry will be developed in three lifts. The final quarry floor for the proposed Stittsville 2 Quarry will slope from approximately 123 metres above sea level (asl) in the southwest to approximately 101 metres asl in the northeast which generally follows the contact between the Bobcaygeon Formation and Gull River Formation. The base of the quarry excavation is below the average position of the groundwater table.

Local Surface Water Drainage

The study area, as shown in Figure 1, is within the Flowing Creek catchment, which is a part of the Jock River sub-watershed. The Flowing Creek catchment has a drainage area of approximately 50 square kilometres (km^2) and the Jock River sub-watershed has a drainage area of 555 km^2.

The most prominent surface water feature in the local area is the Goulbourn Wetland Complex, a provincially significant wetland (PSW), located on and to the east of the Stittsville 2 Quarry property. Under existing conditions, surface runoff on the property either drains towards the western wetland (non-PSW), the southern wetland (non-PSW) or the eastern wetland that forms part of the Goulbourn Wetland Complex. The western and eastern wetland features are connected by a drainage pathway, as shown in Figure 1. The Goulbourn Wetland Complex drains from northwest to southeast from its headwaters directly northwest of Speedway Road, approximately 1.5 kilometers northwest of the proposed quarry site, to its confluence with a branch of the Flowing Creek southeast of Fallowfield Road, approximately 6 kilometres southeast of the proposed quarry site. Flowing Creek then drains to the Jock River near the Town of Richmond, Ontario.

Quarry Design & Operations

The development of the Stittsville 2 Quarry is anticipated to occur concurrently to the operation of the existing Stittsville Quarry. Extraction activities will proceed east and south from the common boundary with the existing Stittsville Quarry. Once excavation to the southern limit has been reached, any remaining bedrock in the extraction area to the north (along Jinkinson Road) will be removed. During the initial phases of quarry development, a sump will be located in the existing Stittsville Quarry, and this sump would be relocated (as required) within the extraction area during the operational life of the proposed Stittsville 2 Quarry. The proposed quarry will be developed in three lifts, which may operate simultaneously depending on rock quality and market demand. The depth of each lift is dependent on bedrock formation thickness. The anticipated lowest quarry floor elevation will be approximately 101 metres asl.

Following the extraction of material, the property will be rehabilitated by backfilling the excavation. It is anticipated that the excavation will be backfilled to the original grade throughout the limit of extraction allowing for future potential development in the area near Jinkinson Road with a naturalized area throughout the remainder of the site.

Site Drainage

Under existing conditions, the area around the proposed Stittsville 2 Quarry was separated into 13 sub-catchments, including the existing Stittsville Quarry, based on a convergence point selected at a culvert located downstream of the site at Fernbank Road, as detailed in the attached Figure 48. Discharge from the existing quarry (i.e., sub-catchment 3) is pumped directly into the western wetland (i.e., sub-catchment 1C and 4A). Drainage from these sub-catchments as well as 5C then flows east to a small drainage pathway with a culvert crossing, located within the proposed extraction area before, continuing to the Goulbourn Wetland Complex. Ultimately, all the sub-catchments detailed in Figure 48 drain to the Goulbourn Wetland Complex.

As a result of the proposed quarry, the non-PSW western and southern wetlands will be removed to accommodate development of the Stittsville 2 Quarry. Drainage will be captured by the quarry footprint and will ultimately continue to report to the Goulbourn Wetland Complex via a quarry discharge point directed towards Sub-catchment 4B under operational conditions.

Under rehabilitated conditions, the quarry will be backfilled to original grade throughout the limit of extraction, allowing for future potential development in the area near Jinkinson Road and a naturalized area in the southern portion of the property. The proposed naturalized area will include forests, wetlands, meadow and thicket. This area will be planted with mixed native species and will provide a range of habitats. The ultimate drainage directions and sub-catchment areas are expected to closely resemble existing pre-development conditions.

Quarry and Stormwater Management

All precipitation falling within the quarry footprint, stormwater runoff from surrounding disturbed areas and groundwater seepage to the quarry, will be collected on the quarry floor and/or conveyed to the quarry sump. The quarry sump is designed to settle suspended solids from the water before discharging offsite and is subject to an Environmental Compliance Approval (ECA) under Section 53 of the *Ontario Water Resources Act*. The ECA provides a site effluent limit for total suspended solids. The ECA also recognizes the dynamic nature of the quarrying operation and allows the sump to be relocated from time to time to facilitate aggregate extraction operations.

At the present time, water from the existing Stittsville Quarry is pumped from the sump up to the surrounding grade and discharged into the western wetland (see Figure 1), before draining east to the Goulbourn Wetland Complex by gravity as approved by the existing ECA. Any future expansion or modification of the water management works required as part of the license for the proposed Stittsville 2 Quarry, will be completed in compliance with the provisions of the existing ECA, or an amendment application will be submitted to Ministry of Environment, Conservation and Parks for review and approval.

Effects of Quarry Discharge

Any water collecting within the proposed Stittsville 2 Quarry will be directed to the existing Stittsville Quarry sump or a new sump constructed within the proposed Stittsville 2 Quarry. Discharge from the Stittsville Quarry (or, in the future, from the proposed Stittsville 2 Quarry) is, and will continue to be, regulated by the Ministry of the Environment, Conservation and Parks ECA No. 8386-54RR6N (dated July 12, 2002). The ECA specifies a compliance limit on the quarry sump discharge water for total suspended solids of 25 milligrams per Litre (mg/L) or less which is typical for quarries in Ontario. During periods of discharge, the ECA requires monthly sampling of the water being discharged and sampling within the receiving watercourse.

Surface Water Impacts

Ultimately, there will be no change in catchment area contributing to the Goulbourn Wetland Complex as all site runoff from baseline, operational, and rehabilitated conditions will continue to flow east via the existing Stittsville Quarry water management infrastructure. Quarry discharge rates are specified by the existing ECA for the site. During the initial phases of the proposed Stittsville 2 Quarry, the existing water management system is expected to have sufficient capacity to handle the gradually increasing surplus from the proposed Stittsville 2 Quarry. If/when required to manage increased capacity or water quality, the site industrial sewage works capacity will be redesigned and Tomlinson will apply for an amendment to the ECA.

While the existing Stittsville Quarry and the proposed Stittsville 2 Quarry are operational, the combined excavation will act as a large extended detention pond during storms due to the collection of water in the excavation and the limited pump rate from the sump specified on ECA No. 8386-54RR6N (0.09 m^3/sec). Therefore, peak storm flow rates during large events are expected to be lower during operations than under pre-quarry development conditions, and the existing Stittsville Quarry and proposed Stittsville 2 Quarry are not expected to negatively contribute to flooding or water quality issues within the receiving watercourse.

Operation of the existing Stittsville Quarry and proposed Stittsville 2 Quarry are not expected to contribute to erosion problems in the receiving watercourse as the detention of drainage in the quarry excavation offers some degree of attenuation of large erosive peak flows associated with storm events.

Sediment and Erosion Control Plan

Topsoil and/or overburden stripped in the operation of the site will be stored in berms within the setback along the southern, eastern and northern boundaries of the site and will be used in the rehabilitation of the site. The locations of the berms are shown on the Operations Plan provided in Attachment 1. Existing vegetation adjacent to the berms will be retained where feasible and unvegetated areas where vegetation was removed for berm creation will be replanted where feasible. Existing and proposed berms will be kept back at least 3 metres from the licensed boundary and will have an approximate slope of 2:1. The berm slopes will be seeded to ensure that adequate vegetation is established and maintained to control erosion.

During construction and earth-moving operations (including the construction of berms), sediment control measures will be put in place to prevent runoff of suspended solids from leaving the site. These measures will be in place prior to the onset of site preparation and remain in place until rehabilitation is complete. Sediment fencing will be constructed of heavy material and solid posts and be properly installed (trenched in) to maintain its integrity during inclement weather events.

Closure

If you have any questions, please contact the undersigned.
Yours truly,

WSP Canada Inc.

PROFESSIONAL GEOSCIENTIST
KRIS A. MARENTETTE
PRACTISING MEMBER
0287
26/10/2023
ONTARIO

Kris Marentette, M.Sc., P.Geo.
Senior Hydrogeologist

Brian Henderson, M.A.Sc., P.Eng.
Environmental Engineer

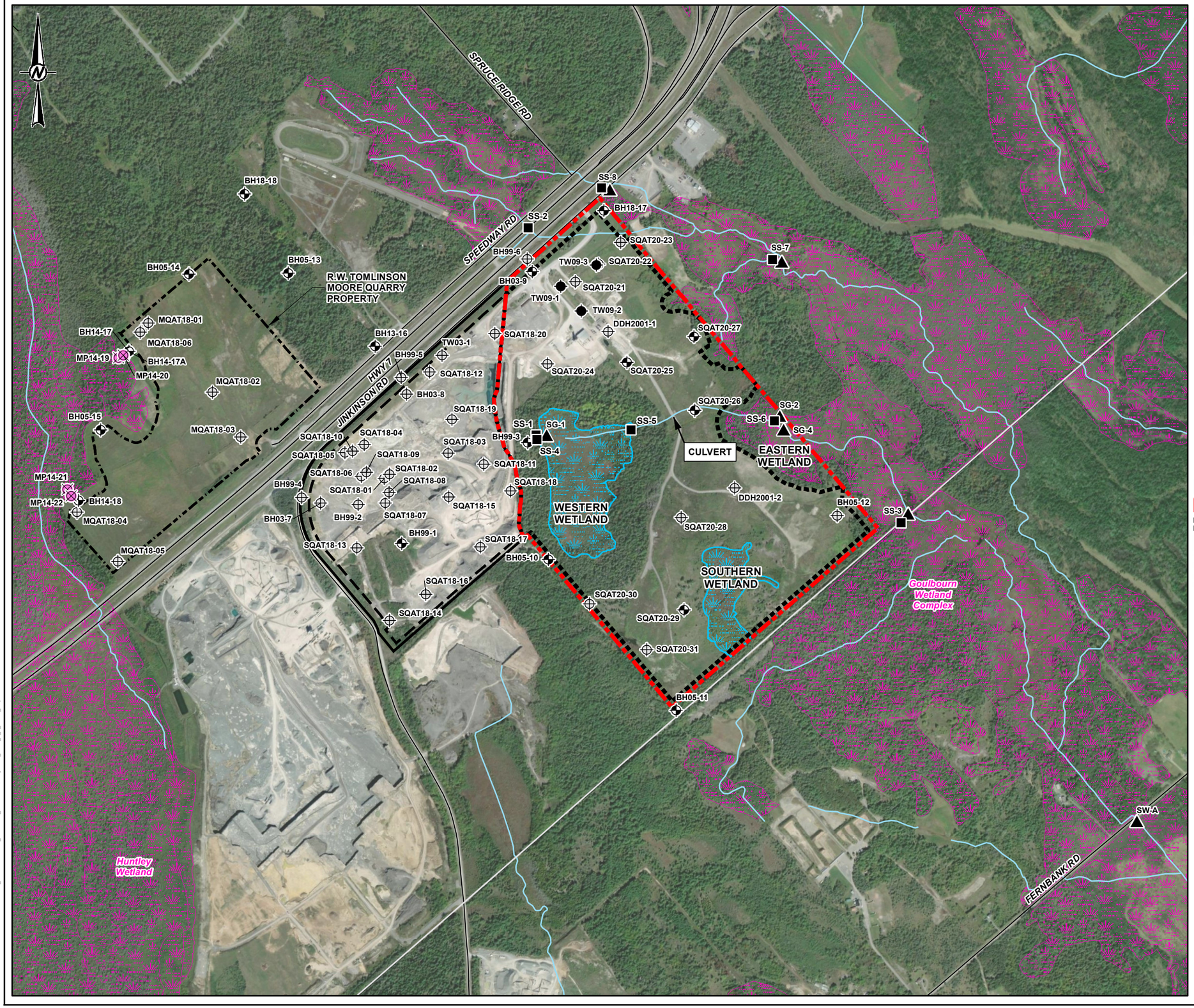
KAM/BJH/rk

Attachments: Figure 1 – Key Plan
Figure 48 – Site Plan
Attachment 1 – Draft Operations Site Plan 2 of 5 and 3 of 5 (October 2023)
Attachment 2 – Author Qualifications and Experience

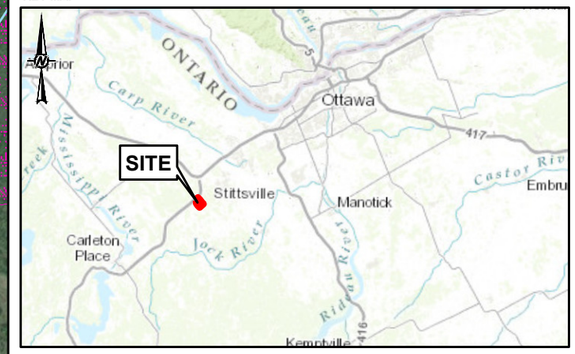
https://golderassociates.sharepoint.com/sites/115663/project files/6 deliverables/swm brief & sediment & ecp/final/19130670-l-rev0-sq2 stormwater management brief_28aug2023.docx

References

WSP Canada Inc. 2023. Level 1 and Level 2 Water Report, Site Plan Licence Application for a Class “A” Quarry Below Water, Proposed Stittsville 2 Quarry, Ottawa, Ontario, November 2023.



KEY MAP



SCALE 1:1,000,000

LEGEND

- EXISTING BOREHOLE LOCATION
- MONITORING WELL LOCATION
- DECOMISSIONED BOREHOLE/MONITORING WELL LOCATION
- MINI-PIEZOMETER LOCATION
- STAFF GAUGE
- SURFACE WATER OR EFFLUENT MONITORING LOCATION
- ROADWAY
- RAIL TRAIL
- WATERCOURSE
- PROVINCIALLY SIGNIFICANT WETLAND (PSW)
- WETLAND (NOT PROVINCIALLY SIGNIFICANT)
- PROPOSED STITTSVILLE 2 QUARRY LICENSED AREA
- PROPOSED STITTSVILLE 2 QUARRY EXTRACTION AREA
- STITTSVILLE QUARRY LICENSED AREA
- STITTSVILLE QUARRY EXTRACTION AREA
- MOORE QUARRY LICENSED PROPERTY

0 130 260 520

1:13,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
   SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 18N

CLIENT
R.W. TOMLINSON LIMITED

PROJECT
PROPOSED STITTSVILLE 2 QUARRY
LEVEL 1 AND 2 WATER REPORT

TITLE
SITE PLAN

CONSULTANT
wsp

YYYY-MM-DD	2023-07-31
DESIGNED	BH
PREPARED	BR/MG
REVIEWED	BH
APPROVED	KAM

PROJECT NO.	CONTROL	REV.	FIGURE
19130670	0008	0	1

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25mm

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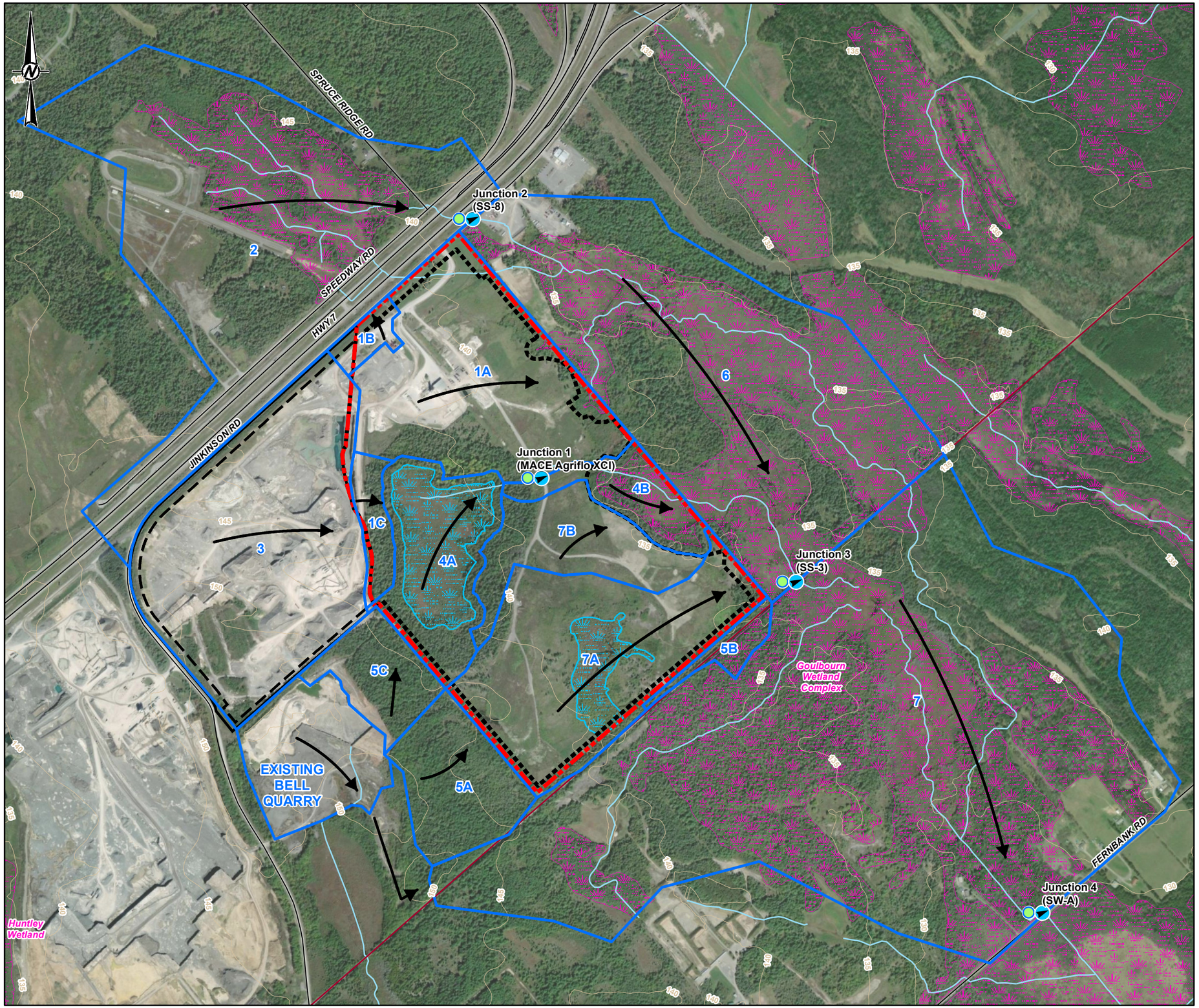
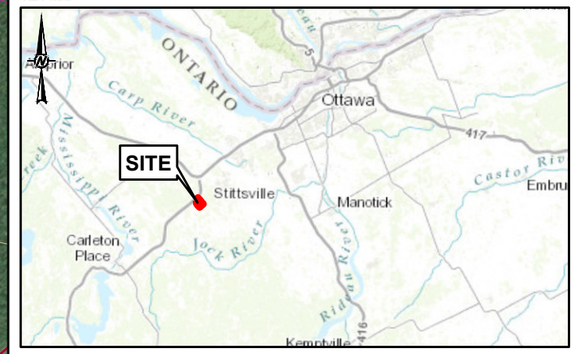


KEY MAP



SCALE 1:1,000,000

LEGEND

- JUNCTION
- FLOW MEASUREMENT LOCATION
- ROADWAY
- OTN SEGMENT DERIVED
- TOPOGRAPHIC CONTOUR, metres
- WATERCOURSE
- FLOW DIRECTION
- SUB-CATCHMENT AREA
- PROVINCIALLY SIGNIFICANT WETLAND (PSW)
- WETLAND (NOT PROVINCIALLY SIGNIFICANT)
- PROPOSED STITTSVILLE 2 QUARRY LICENSED AREA
- PROPOSED STITTSVILLE 2 QUARRY EXTRACTION AREA
- STITTSVILLE QUARRY LICENSED AREA
- STITTSVILLE QUARRY EXTRACTION AREA

0 120 240 480

1:12,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
   SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY
3. COORDINATE SYSTEM: NAD 1983 UTM ZONE 18N

CLIENT
R.W. TOMLINSON LIMITED

PROJECT
PROPOSED STITTSVILLE 2 QUARRY
LEVEL 1 AND 2 WATER REPORT

TITLE
HYDROLOGIC MODEL CATCHMENT BOUNDARIES - SCENARIO 2 (EXISTING CONDITIONS)

CONSULTANT

wsp

YYYY-MM-DD	2023-07-31
DESIGNED	BH
PREPARED	BR/MG
REVIEWED	MR
APPROVED	KAM

PROJECT NO.	CONTROL	REV.	FIGURE
19130670	0008	0	48

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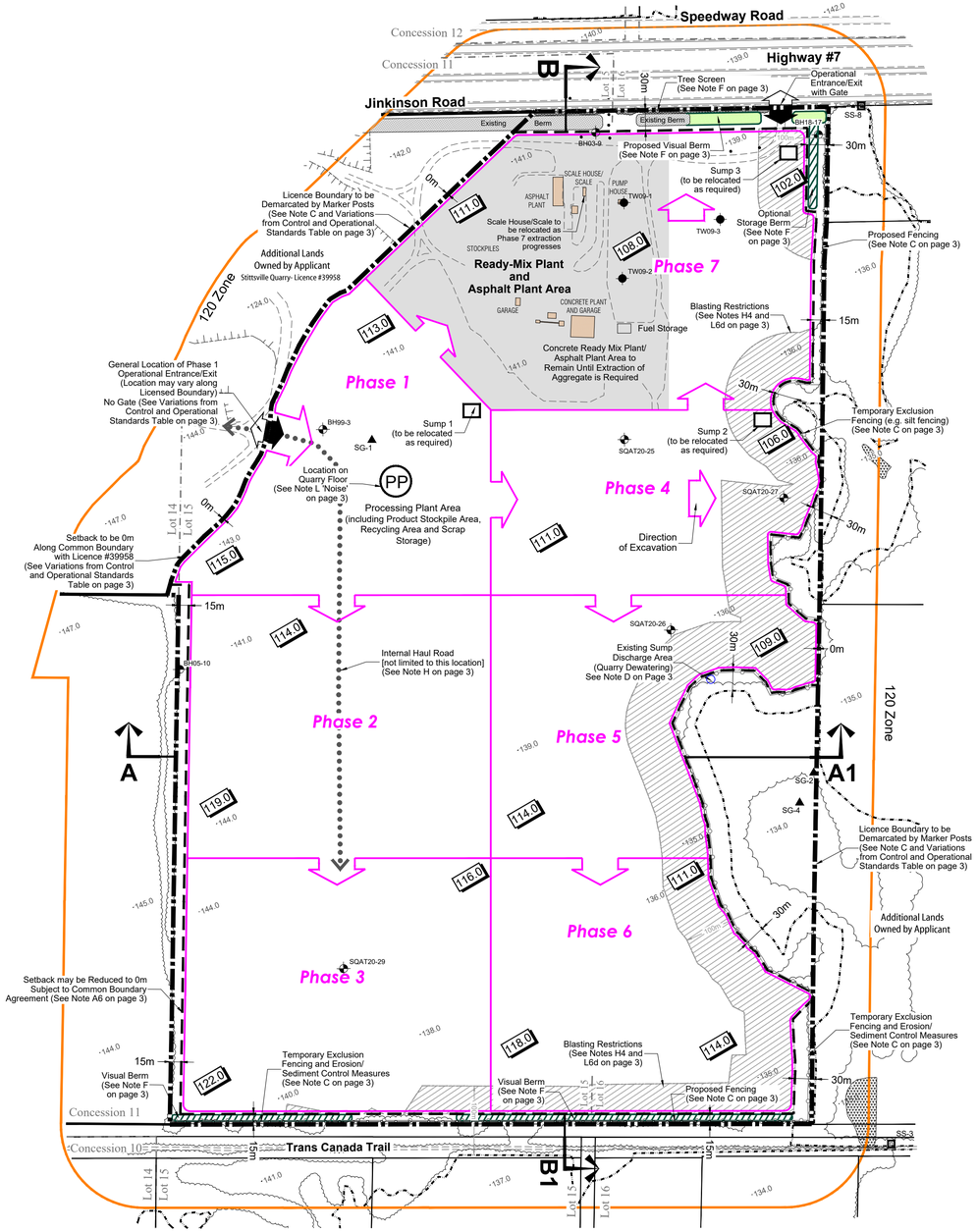
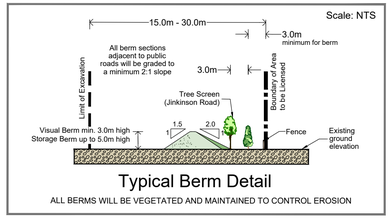
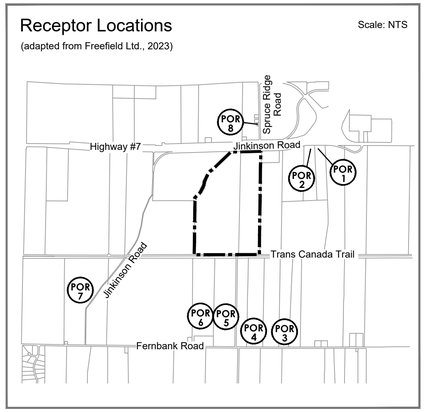
ATTACHMENT 1

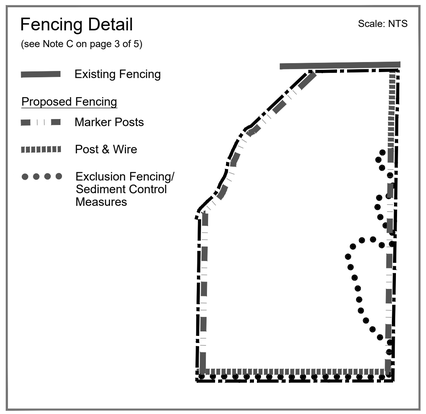
Draft Operations Site Plan 2 of 5 and 3 of 5 (October 2023)

SEQUENCE OF OPERATIONS









Phase Notes:

A. Phase 1
1. Site preparation in Phase 1 to include: establishing fencing/marker posts around the licensed boundary prior to extraction (subject to overrides); temporary turtle exclusion fencing (e.g. silt fencing) shall be installed along the western, eastern and southern portions of the limit of extraction where it abuts natural areas prior to site clearing; removal of vegetation within 5m of limit of extraction where applicable; initial stripping of overburden/topsoil and construct visual berms along Jinkinson Road as shown on Sequence of Operations drawing.
2. Continue with stripping of overburden as shown. Store any excess material in berms.
3. Locate quarry sump and sump outlet to capture and redistribute accumulated water.
4. Construct tree screen in the locations shown on Sequence of Operations.
5. Begin Phase 1 extraction in an easterly direction and to the elevations (maximum depth of extraction) as shown (see Note F on page 3).
6. Phase 1 may be extracted to a maximum depth of 115.0 masl (west portion of Phase) to 107.0 masl (east portion of Phase).
7. Processing for Phase 1 will initially occur in the existing Licence #39958 or when sufficient room is available in this site.
8. Progressive rehabilitation along the east limit of this Phase (1st Lift) may be initiated once the extent of extraction has occurred in this area. Rehabilitation will consist of backfilling of the quarry face to the bench of the next lift.
9. Prepare Phase 2 for extraction

B. Phase 2
1. Strip overburden/topsoil. Store any excess material in berms in areas within the limit of extraction.
2. Commence extraction in a southerly direction and to the elevations (maximum depth of extraction) as shown.
3. Phase 2 may be extracted to a maximum depth of 119.0 masl (southwest portion of Phase) to 113.0 masl (northeast portion of Phase).
4. Progressive rehabilitation along the west limit and a portion of the east limit of this Phase (1st Lift) may be initiated once the extent of extraction has occurred in this area. Rehabilitation will consist of backfilling of the quarry face to the bench of the next lift.
5. Prepare Phase 3 for extraction.

C. Phase 3
1. Continue with stripping of overburden/topsoil following the direction of excavation. Store any excess material in berms.
2. Construct visual berm along south boundary of property with strippings.
3. Begin Phase 3 extraction in an southerly direction and to the elevations (maximum depth of extraction) as shown.
4. Phase 3 may be extracted to a maximum depth of 122.0 masl (southwest portion of Phase) to 116.0 masl (northeast portion of Phase).
5. Initiate progressive rehabilitation along the west and east limit of this Phase (1st Lift) once the extent of extraction has progressed to allow for side slope rehabilitation. Progressive rehabilitation will consist of backfilling of the quarry face to the bench of the next lift.
6. Continue with progressive rehabilitation in Phase 2.
7. Prepare Phase 4 for extraction.

D. Phase 4
1. Strip overburden/topsoil. Store any excess material in berms or use in progressive rehabilitation of previous Phase(s).
2. Commence extraction in an easterly direction and to the elevations (maximum depth of extraction) as shown.
3. Phase 4 may be extracted to a maximum depth of 111.0 masl (west portion of Phase) to 106.0 masl (east portion of Phase).
4. Progressive rehabilitation along the east limit of this Phase (1st Lift) may be initiated once the extent of extraction has occurred in this area. Rehabilitation will consist of backfilling of the quarry face to the bench of the next lift.
5. Continue with progressive rehabilitation in Phase 3.
6. Sump may be relocated from Phase 1 to this Phase once sufficient room is available.
7. Prepare Phase 5 for extraction.

E. Phase 5
1. Strip overburden/topsoil. Store any excess material in berms or use in progressive rehabilitation of previous Phase(s).
2. The direction of extraction will be southerly.
3. Extraction may occur to a maximum depth of 114.0 masl in the southwest portion of the Phase to 109.0 masl in the northeast portion of the Phase.
4. Progressive rehabilitation along the east limit of this Phase (1st Lift) may be initiated once the extent of extraction has occurred in this area. Rehabilitation will consist of backfilling of the quarry face to the bench of the next lift.
5. Continue with progressive rehabilitation in Phase 4.
6. Prepare Phase 6 for extraction.

F. Phase 6
1. Strip overburden/topsoil. Store any excess material in berms or use in progressive rehabilitation of previous Phase(s).
2. The direction of extraction will be southerly.
3. Extraction may occur to a maximum depth of 118.0 masl in the southwest portion of the Phase to 111.0 masl in the northeast portion of the Phase.
4. Progressive rehabilitation along the east limit of this Phase (1st Lift) may be initiated once the extent of extraction has occurred in this area. Rehabilitation will consist of backfilling of the quarry face to the bench of the next lift.
5. Continue with progressive rehabilitation in Phase 5.
6. Prepare Phase 7 for extraction.

G. Phase 7
1. Initiate stripping of overburden/topsoil. Store any excess material in berms or use in progressive rehabilitation of previous Phase(s).
2. Buildings/Plants and associated infrastructure to be relocated as extraction progresses within Phase 7.
3. Sump may be relocated from Phase 4 to this Phase once sufficient room is available.
4. Continue with progressive rehabilitation in Phase 6.

H. Not Shown on Sequence of Operations
1. The concrete ready mix plant, asphalt plant and associated structures will remain on site until the encroachment of extraction in Phase 7 requires the removal of the plants.
2. Remove any equipment, scrap, haul roads and buildings on site.
3. Finalize rehabilitation of site (see Rehabilitation Plan on page 4 for details).

Legal Description

PART OF LOTS 14, 15 and 16
CONCESSION 11
(geographic township of Goulbourn)
CITY OF OTTAWA

Legend

- Boundary of Area to be Licensed
- Limit of Excavation — ALL SETBACKS ARE DRAWN TO SCALE AND SHOW LABELLED DISTANCES
- Existing Fence — PAGE WIRE FENCE UNLESS OTHERWISE NOTED
- Existing Licensed Boundary
- Building/Structure — LOCATION AND USE FOR BUILDINGS ON-SITE AND WITHIN 120m ARE SHOWN ON THIS PAGE
- Drainage Feature — AS LABELLED
- Existing Spot Elevation — METRES ABOVE SEA LEVEL
- General Direction of Excavation — (SEE NOTES ON THIS PAGE)
- Operational Access — MAINTAINED BY A GATE WHICH WILL BE CLOSED WHEN PIT IS NOT IN OPERATION
- Visual Berm — SEE "TYPICAL BERM DETAIL" AND NOTES ON THIS PAGE/PAGE 3 OF 5
- Existing Vegetation
- Optional Storage Berm — SEE "TYPICAL BERM DETAIL" AND NOTES ON THIS PAGE/PAGE 3 OF 5
- Provincially Significant Wetland — (WSP/ONTARIO GEOHUB)
- Proposed Fence — 1.2m HIGH POST & WIRE FENCE UNLESS OTHERWISE NOTED
- Monitoring Well Locations / Borehole Locations — BH18-17, TW09-2, SS-3
- Surface Water or Effluent Monitor Locations — SG-4
- Staff Gauge — (WSP)
- Sediment/Erosion Control Measures
- Existing Berm
- Tree Screen
- Potential Fish Spawning Habitat — (WSP)
- Proposed Spot Elevation — QUARRY FLOOR (METRES ABOVE SEA LEVEL) BOTTOM OF BOBCAYGEON FORMATION
- Blasting Restrictions — SEE NOTES ON PAGE 3 OF 5 (EXPLOTECH)
- Internal Haul Road — LOCATION TO VARY AS OPERATIONS PROGRESS
- Cross Sections — SEE PAGE 5 OF 5 FOR EXISTING AND REHABILITATED CROSS SECTIONS

Site Plan Amendments

No.	Date	Description	By

MHBC PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE
200 - 540 BINGEMANS CENTRE DR. KITCHENER, ON. N2B 3X9 | P: 519.576.3650 F: 519.576.0121 | WWW.MHBCPLAN.COM

MNRF Approval Stamp

Stamp

DRAFT
Neil DeRuyter

north

Applicant

TOMLINSON

R. W. Tomlinson Limited
100 CitiGate Drive, Ottawa Ontario, K2J 6K7
Tel: (613) 822-1867 Fax: (613) 822-6844

DRAFT
Rob Pierce
R.W. Tomlinson Limited
Vice President Planning and Development

Project

Stittsville 2 Quarry

ARA Licence Reference No.

Pre-approval review:

For submission to MNRF October 2023

Plan Scale **1:4,000 (Arch D)**

SCALE
50 0 100 200
METRES

Plot Scale 1:4 [1mm = 4 units] MODEL

Drawn By D.G.S./GC

Checked By N.D.

File No. **9137AI**

File Name

OPERATIONAL PLAN

Drawing No.

2 OF 5

K:\9137AI-Tomlinson-Stittsville Quarry 2\A\Operplan 2of5 October2023.dwg

A. General

1. This site plan is prepared under the Aggregate Resources Act for a Class A Licence, Quarry Below Water. The notes and drawing on this page reflect the *Aggregate resources of Ontario: Site plan standards (August 2020)*, specifically Operations for all sites (Numbers 33-56 in the standards).
2. Area Calculations:
   Licence Area: 121.7 hectares (300 acres) Limit of Excavation: 108.7 hectares (268 acres)
3. The maximum number of tonnes of aggregate to be removed from this site, in combination with existing Licence #39958, in any calendar year, is 3,000,000.
4. An office/scale house and scale may be located on the site as shown on the Sequence of Operations drawing on page 2 of 5.
5. The elevation of the on-site groundwater table ranges from 140.5 masl in the western portion of the site to 134.5 masl in the eastern portion of the site The existing water table elevations are shown on each cross section on page 5 of 5.
6. Setbacks will be as shown and labelled on the Sequence of Operations Diagram (page 2 of 5) and on the Existing Features Plan (page 1 of 5). The 15m setback adjacent to Licence #4189 may be reduced to 0m subject to a common boundary agreement with the adjacent licensee. Prior to reducing the setback, the common boundary agreement and amended site plan shall be provided to MNRF. This change will not be considered a major amendment.
7. Source Water Protection: The site is located in the Rideau Valley Source Water Protection Area. The site is not mapped as being located in a Wellhead Protection Area (WHPA), Significant Groundwater Recharge Area but is located within a Highly Vulnerable Aquifer Area. Mitigation measures are outlined in the Hydrogeology notes under Section L Report Recommendations.

B. Hours of Operation

1. The ready-mix concrete plant and asphalt plant operations may occur on a 24-hour basis (24 hours) with limited operations permitted during the evening and nighttime period (7 am to 7 pm). Quarry operations are as follows: rock drill (7am-7pm); portable crusher and screening plant (24 hours); loaders (24 hours); loading and shipping of product for off site delivery (24 hours). See also Section L 'Noise' for further details.

C. Site Access and Fencing

1. The site shall be accessed through the existing operational entrance/exit which is located along the north boundary of the property off Jinkinson Road. This entrance/exit is gated. Other points of access along the common boundary with adjacent Licence #39958 will be utilized. Internal haul routes and access points to Licence #39958 may be relocated as needed.
2. The north boundary of the site along Jinkinson Road is fenced. The south boundary of the site will be fenced. Portions of the east licence boundary within the existing wetland/woodlot and the common boundary with adjacent Licence #39958 will not be fenced (see Note M 'Variations from Control and Operation Standards'). Where there is no fencing, 1.2m marker posts will be installed that are visible from one to the other.
3. Temporary turtle exclusion fencing and soil and erosion control measures are described in Note L 'Natural Environment'.

D. Drainage

1. Drainage of undisturbed areas will continue and be in the directions shown on the Existing Features drawing on page 1 of 5. Dewatering will occur via discharge from sump to the location(s) along the eastern portion of the site as shown on the Sequence of Operations drawing.

E. Site Preparation

1. Prior to site preparation, a Spills Contingency Plan shall be developed to address any potential spills from equipment on-site [O.Reg 244/ 97 Section 0.12 (3) 2].
2. Timber resources will be salvaged for use as saw logs, fence posts and fuel wood where appropriate. Non-merchantable timber, stumps and brush may be mulched for use in progressive rehabilitation. Excess material not required for uses mentioned above will be burned (with applicable permits).
3. Topsoil and overburden shall be stripped and stored separately in accordance with the Sequence of Operations diagram and associated notes on page 3 of 5.
4. Excess topsoil and overburden not required for immediate use in the construction of visual berms or rehabilitation, may be temporarily stockpiled inside the extraction area. Topsoil and overburden stockpiles shall be located within the limit of excavation and remain a minimum of 30 metres from the licence boundary (subject to O.Reg 244/ 97 Section 0.13 (1) 13i). Stockpiles will not exceed 20m in height above the original ground level.
5. Temporary topsoil and overburden stockpiles which remain for more than one year shall have their slopes vegetated to control erosion. Seeding shall not be required if these stockpiles have vegetated naturally in the first year.
7. Silt fences will be properly installed and maintained as required. (see also 'Fencing Detail' on page 2 of 5 for further details).

F. Berms and Screening

1. Visual berms shall be constructed at the the frontage of the site along Jinkinson Road as a continuation of the berms already in place and along the Trans Canada Trail (see Phase Notes on page 2 of 5 for details).
2. Optional storage berms may be located on site. Locations may be on the quarry floor or within the setbacks as shown on the Sequence of Operations diagram on page 2 of 5.
3. See 'Typical Visual Berm/ Tree Screen Detail' on page 2 of 5 for details relating to berm construction and will be vegetated and maintained to control erosion using a low maintenance grass/legume seed mixture (e.g. MTO Seed Mix) composed of Creeping red Fescue, Perennial Ryegrass, Kentucky Bluegrass and White Clover. Temporary erosion control will be implemented as required.
4. Existing vegetation within the setbacks shall be maintained to the extent possible where any visual berms are to be located.
5. A tree screen shall be located along the Jinkinson Road frontage to augment the existing and proposed visual berms.

G. Extraction Sequence

1. The operational plan depicts a schematic operations sequence for this property. Phases do not represent any specific or equal time period. The direction of extraction will be in accordance with the Sequence of Operations diagram shown on page 2 of 5. All extraction, processing and transportation equipment operating within these Phases shall comply with the restrictions identified in Note L 'Noise'.
2. Rehabilitation will be progressive and proceed as limits of extraction (area and depth) are reached. Any deviations from the operations sequence shown (extraction, stripping and rehabilitation areas) will require the approval of MNRF.
3. See Phase Notes on page 2 of 5 for details.

H. Extraction Details

1. The maximum depth of extraction is as shown as spot elevations and extraction will occur in up to 3 lifts through the four phases as shown on the Sequence of Operations Diagram on page 2 of 5 and in accordance with the Ministry of Labour requirements. The maximum lift height shall be 12m. The proposed quarry floor will range in elevation from 102 to 122 masl (18 m to 37 m below the existing ground surface).
2. Aggregate stockpiles will be located on the active quarry floor and will move throughout the life of the operations of the quarry. Stockpiles will be a maximum of 20m high and will not be located within 30m of the Licensed boundary, except where adjacent to Licences #39958 and #4149.
3. Internal haul road locations will vary as extraction progresses.

I. Equipment and Processing

1. The equipment used on site for extraction and aggregate processing may include:
   - Extraction and Aggregate Processing - Rock Drill, Stationary Crushing Plant, Loaders or Excavators, Haulage Trucks, Highway Trucks.
   - Asphalt Plant - Mixer, Screen, Conveyors, Loader, Highway Trucks
   - Ready-Mix Plant - Loader, Haulage Trucks, Highway Trucks, Conveyors

   (there is an existing Asphalt Plant and Ready-Mix Plant on-site and will continue to be used).
2. Processing equipment shall remain a minimum of 30 metres from the licence boundary (except where the licence boundary abuts adjacent licences - see Section M 'Variations from Control and Operation Standards').
3. All processing equipment is subject to applicable permitting under MECP Environmental Compliance Approvals.

J. Fuel Storage

1. Fuel or associated products may be stored on site. See Sequence of Operations drawing on page 2 of 5 for location. The licensee or permittee shall ensure that fuel storage tanks are installed and maintained in accordance with the *Technical Standards and Safety Act, 2000* [O.Reg 244/ 97 Section 0.12 (3) 1].

K. Scrap and Recycling

1. Temporary scrap storage will be located within the processing plant area. Initially this storage area will be in the existing Licence #39958, but will be located on site once the processing plant has been relocated into Phase 1. Scrap will only include materials derived from the operation of the pit such as scrap metal or lumber, discarded machinery and equipment. Scrap will not be located within 30m of any body of water or within 30m of the boundary of the site, subject to where there is a common boundary with the adjacent Licence #39958 [O.Reg 244/ 97 Section 0.13 (1) 24/25]. All scrap will be removed on an ongoing basis. The property will be kept in an orderly condition.
2. Recycling activities:
   - may occur on site and will be in close proximity to the processing plant .
   - recycling activities shall remain accessory to the quarry operation and once extraction ceases, recycling activities will be no longer permitted
   - shall not interfere with the operational phases of the site or rehabilitation of the site [O.Reg 244/ 97 Section 0.13 (1) 32]

L. Report Recommendations

1. Noise: **"Acoustic Assessment Report for the Proposed Stittsville II Quarry" April 2023 (Source: Freefield Ltd.)**

a. Quarry Operations

i. The operation of a standard hydraulic rock drill may take place only during the daytime period (07:00 - 19:00), anywhere in the extraction, area above or below grade.

ii. The operation of the portable crushing and screening plant (crusher) may take place on a twenty-four-hour basis (24-hour) and shall comply with the following: The crusher is to be located on the quarry floor, one or more lifts down, a minimum 10 m below grade.

iii. The operation of the loaders may take place on a twenty-four-hour basis (24-hour), anywhere in the extraction, area above or below grade, and shall comply with the following: When operating during the daytime period (07:00 - 19:00): A maximum of three (3) loaders may be in operation concurrently carrying out extraction, loading and stockpiling operations.

iv. When operating during the evening or nighttime period (19:00 - 07:00): i. A maximum of two (2) loaders may be in operation concurrently carrying out extraction, loading and stockpiling operations. v. The loading and shipping of product using trucks may take place on a twenty-four-hour basis (24-hour) and shall comply with the following: When operating on-site, trucks shall not exceed 20 km/h and shall not use compression braking (Jake Brakes).

b. Asphalt Plant

i. The operation of the asphalt plant and associated equipment, may take place on a twenty-four-hour basis (24-hour) and shall comply with the following: 7.2.1.1 The asphalt plant is to remain in its existing location shown on Figure 2 and 14 or relocated to the alternative location shown on Figure 9.

ii. The dust silo blower (source: AP_Baghouse_Fan) is to be fitted with air intake silencer, spec: Stoddard F64-5 or similar, constructed of minimum 16-gauge weather resistant metal and shall have a high transmission loss casing. The minimum dynamic insertion loss of the silencer is to meet minimum attenuation requirements noted in Table 7. The maximum outdoor sound power of the dust silo blower, at the point of emissions into the atmosphere, after installation of the silencer, is not to exceed the level listed in Table 2.

iii. The operation of the loader may take place on a twenty-four-hour basis (24-hour) and shall comply with the following: During the daytime, evening and nighttime period (24-hour) a maximum of one loader may be in operation at the asphalt plant.

iv. The predicted noise impacts shown in Tables A2.8.1 to A2.8.8 are based on the implementation of the following mitigation measures:

The loading and shipping of product using trucks may take place on a twenty-four-hour basis (24-hour) and shall comply with the following: When operating on-site, trucks shall not exceed 20 km/h and shall not use compression braking (Jake Brakes).

c. Ready Mix Concrete Plant Operations:

i. The ready-mix concrete plant may operate on a twenty-four-hour basis (24-hour) and shall comply with the following: The ready-mix concrete plant is to remain in its existing location shown on Figure 2 and 15 or relocated to the alternative location shown on Figure 9.

ii. The operation of the loader may take place on a twenty-four-hour basis (24-hour) and shall comply with the following: During the daytime, evening and nighttime period (24-hour) a maximum of one loader may be in operation at the ready-mix concrete plant.

iii. The loading and shipping of product using trucks may take place on a twenty-four-hour basis (24-hour) and shall comply with the following: When operating on-site, trucks shall not exceed 20 kph and shall not use compression braking (Jake Brakes).

iv. Testing and routine maintenance operations of the emergency generator shall take place only during the daytime period (07:00 - 19:00). The existing silencer installed on the standby generator exhaust is to be maintained.

d. Portable Construction Equipment

Portable construction equipment used for site preparation (e.g. land clearing and construction of berms) and rehabilitation shall comply with MECP Publication NPC-115, Construction Equipment, August 1978. (This publication gives noise standards to be met by construction equipment in Ontario.) Site preparation and rehabilitation activities shall take place only during daytime hours (07:00 - 19:00).

e. New Process

If a new process is introduced to the site, or the layout of the existing asphalt plant or existing ready-mix concrete plant is altered, then this new or modified process shall be assessed by a qualified acoustical consultant prior to commissioning. Noise mitigation measures shall be reviewed, and altered, if necessary, to ensure that MECP sound level limits are met at all points of reception.

2. Natural Environment: **"Natural Environment Report and Environmental Impact Study, Proposed Stittsville 2 Quarry" October 2, 2023 (Source: WSP)**

a. Establish a 15 m setback along the south boundary of the Site, a 0-15 m setback along the eastern boundary of the Site except where a 30 m setback has been applied to the Goulbourn Wetland Complex PSW, and a 30m setback along Jinkinson Road. These setbacks are to be clearly demarcated and respected. Existing natural vegetation communities will be retained within the 30 m wetland setbacks and all other portions of the eastern and southern setbacks where forests occur.

b. Prairie dropseed plants on the Site shall be moved to the Goulbourn Wetland Complex PSW buffer prior to site preparation.

c. Implement sediment and erosion control measures along the limit of disturbance prior to Site clearing.

d. No clearing of vegetation shall occur within the core breeding bird season (April 1 – August 31) unless a nesting survey has been completed by a qualified biologist within 24 hours of the clearing, and no active nests were observed.

e. No tree clearing shall occur within the active season for bats (April 1 - September 30).

f. To mitigate any potential impacts from blasting, blasting shall be completed in accordance with DFO standards as outlined in Explotech (2023).

g. Prepare an Information Gathering Form for eastern whip-poor-will and Blanding's turtle for submission to the MECP to initiate authorizations under the ESA.

f. To mitigate the potential for turtles, especially Blanding's turtle, to be harmed on the Site during extraction, the following mitigation shall be undertaken:
   - Encounter Protocol: The protocol shall include information on how to identify Blanding's turtle, how to protect a nest, how to report sightings to the NHIC, and instructions on what to do in the event that a turtle or nest is found on-Site.
   - All on-Site staff shall be familiar with and trained on the components of the Encounter Protocol described above.
   - If Blanding's turtle is identified on the Site, all work shall stop and the species shall be protected from harm. MECP shall be notified immediately to seek guidance on ways to avoid impacts under the ESA prior to resuming work.
   - Fencing shall be installed along the eastern and southern boundaries of the extraction limit, and along the western boundary of extraction where adjacent to natural areas to deter turtles from entering the Site. Exclusion fencing should be designed and installed according to MNRF recommendations (MNRF 2013b). Fencing along the western boundary will be temporary until such time as the adjacent lands approved for aggregate extraction are developed.

g. An Awareness Package, SAR Encounter Protocol and SAR Training Program shall be prepared that lists the SAR that may be present on the Site or in the local landscape, and identify what to do if one is observed on the Site. The Awareness Package shall include:
   - Information / training on identifying SAR.
   - What to do if a SAR is observed (moving, injured, dead or nesting).
   - How to protect a turtle or bird nest.
   - Information on how to report a SAR sighting to the NHIC.
   - Instructions that if a SAR is found on the Site, all work must stop and the species shall be protected from harm. MECP shall be notified immediately to seek guidance on ways to avoid impacts under the ESA prior to resuming work.

h. Undertake rehabilitation as outlined in the rehabilitation plan

3. Archaeology: **"Stage 1 Archaeological Assessment of Proposed Quarry Site on Lots 14 and 15, Concession XI Goulbourn Township, Regional Municipality of Ottawa, Carleton" November 29, 1999 (Heritage Quest Inc.) and "Stage 1 Archaeological Assessment: Stittsville Quarry 2 Part Lots 15 and 16, Concession 11, Geographic Township of Goulbourn, Carleton County, City of Ottawa, Ontario" January 2023 (Source: Matrix Heritage Inc.)**

a. Based on the results of this investigation it is recommended that: No further archaeological study is required for the subject property as delineated in Map 1 of report.

4. Hydrogeology: **"Level 1 and Level 2 Water Report " March 2023 (Source: WSP)**

A comprehensive complaints response program has been developed for the purpose of responding to well interference complaints from local water supply well users. Each complaint will be dealt with on a case-by-case basis in accordance with the response program outlined in Section 9 of the Report.

The groundwater and surface water monitoring programs defined on the existing PTTW and the ECA for the Stittsville Quarry (Licence #39958) shall be continued during the development of the Stittsville 2 Quarry. The following additional components shall be added to the existing monitoring programs:

a. Monthly Groundwater Level monitoring (during Operational periods) in monitoring wells BH05-10A, BH05- 10B, BH05-10C, BH05-11, BH05-12A*, BH05-12B*, BH05-12C*, SQAT20-25, SQAT20-26, SQAT20-27 and SQAT20-29. Monitoring frequency reverts to quarterly during non-operational periods at the Stittsville and Stittsville 2 Quarries. Monitoring wells installed in BH05-12 should either be repaired or replaced prior to operations commencing at the Stittsville 2 Quarry.

b. Monthly staff gauge and continuous surface water level measurements (during ice-free conditions) at a background station upstream of the proposed quarry discharge for Stittsville 2 Quarry (i.e., SS-7), at the convergence of the proposed quarry discharge and the NGWC (e.g. SS-6 but subject to changes during operational conditions), at the rail trail (i.e., SS-3), and at Fernbank Road (i.e., SW-A).

c. Water quality sampling at the above locations, as required by the ECA.

5. Maximum Predicted Water Table Report: **"Proposed Stittsville 2 Quarry" March 2023 (Source: WSP)**

a. Based on the available groundwater elevation data, the maximum predicted water table was estimated using the data collected from 2020 to 2022 at the shallow monitoring wells (99-1, BH99-3D, BH03-9C, BH05-10C, BH05-11, BH05-13C, BH13-16D, BH18-17D, SQAT20-25, SQAT20-26, SQAT20-27 and SQAT20-29). The data from December 13, 2021 was used to estimate the maximum predicted groundwater table since water levels in the shallow monitoring wells was generally higher during this session as compared to the other sessions. The water table generally slopes down from the western side of the site at BH99-3D (140.5 metres asl) to the eastern side of the site at SQAT20-27 (134.5 metres asl).

6. Blasting: **"Blast impact Analysis" August 2023 (Explotech Engineering Ltd.)**

a. All blasts shall be monitored for both ground vibration and overpressure at the closest privately owned sensitive receptors adjacent the site, or closer, with a minimum of two (2) instruments – one installed in front of the blast and one installed behind the blast.

b. Blasts shall be designed to maintain vibrations at the TC Energy pipeline below 50mm/s or any such document, regulation or corporate policy in effect at the time. When vibration calculations suggest vibrations at the pipeline may exceed 35mm/s, the pipeline shall be monitored for ground vibration.

c. Blasts shall be designed to maintain vibrations at the Enbridge pipeline below 50mm/s or any such document, regulation or corporate policy in effect at the time. When vibration calculations suggest vibrations at the pipeline may exceed 35mm/s, the pipeline shall be monitored for ground vibration.

d. Blasts shall be designed to maintain water overpressure below 100kPa at the location of the closest fish habitat as per DFO guidelines. While blasting encroaches within 100m of the fish habitat, water overpressure monitoring will be conducted. The results will be reviewed by a qualified engineering firm and confirm compliance with the 100kPa guideline limit, and determine whether additional hydrophone monitoring is required.

e. Blasts shall be designed to maintain vibrations below 13mm/s at the location of the closest identified active spawning bed as per DFO guidelines. When blasting during active spawning season, a minimum of one supplemental vibration monitor shall be installed on the shoreline closest to the spawning bed to confirm the vibration levels.

f. The guideline limits for vibration and water overpressure shall adhere to standards as outlined in the Guidelines For the Use of Explosives In or Near Canadian Fisheries Waters (1998) or any such document, regulation or guideline which supersedes this standard.

g. Blasts shall be designed to maintain vibrations at the closest non-sensitive receptors below 50mm/s. When vibration calculations suggest vibrations may exceed 35mm/s, the buildings shall be monitored for ground vibration.

h. The guideline limits for vibration and overpressure shall adhere to standards as outlined in the MECP Model Municipal Noise Control By-law publication NPC 119 (1978) or any such document, regulation or guideline which supersedes this standard.

i. In the event of an exceedance of NPC 119 limits or any such document, regulation or guideline which supersedes this standard, blast designs and protocols shall be reviewed prior to any subsequent blasts and revised accordingly in order to return the operations to compliant levels.

j. Orientation of the aggregate extraction operation and will be designed and maintained so that the direction of the overpressure propagation will be away from structures as much as possible.

k. Blast designs shall be continually reviewed with respect to fragmentation, ground vibration and overpressure. Blast designs shall be modified as required to ensure compliance with current applicable guidelines and regulations.

l. Blasting procedures such as drilling and loading shall be reviewed on a yearly basis and modified as required to ensure compliance with industry standards.

m. Detailed blast records shall be maintained in accordance with current industry best practices.

Legal Description

PART OF LOTS 14, 15 and 16
CONCESSION 11
(geographic township of Goulbourn)
CITY OF OTTAWA

M. Variations from Control and Operation Standards

No.	O.Reg 244/97 Section 0.13	Variation	Rationale
1	(1)10.i	0m excavation setback along common boundary with existing quarry (Licence #39958).	Adjacent property to the northwest is owned and operated by Tomlinson.
2	(1)13.i	Overburden materials may be stored within 30m of licence boundary, next to adjacent Licences #39958 and #4149. Stockpiling of aggregate, topsoil, and operation of portable plant may occur within 30m of common boundary with existing Licence #39958	Adjacent properties to the west are licensed quarries.
3	(1)16	Berms may be located within 3m of the boundary of adjacent Licence #39958.	Adjacent property to the west is a licensed quarry owned and operated by Tomlinson.
4	(1)18	Overburden material may be used to rehabilitate areas in the existing Licence #39958.	Adjacent property to the west is a licensed quarry owned and operated by Tomlinson.
5	(3)(a)	Fencing is not required along a portion of the eastern boundary that runs through Provincially Significant Wetlands. Fencing along the northwest boundary adjacent to Licence #39958 is not required.	These boundaries will be demarcated by 1.2m high marker posts that are visible from one to the other. Adjacent property to the northwest is a licensed quarry owned and operated by Tomlinson. If conditions in or around the licensed property change or if licensed site is surrendered, a 1.2m high fence will be installed.

Site Plan Amendments

No.	Date	Description	By

MHBC PLANNING URBAN DESIGN & LANDSCAPE ARCHITECTURE
200 - 540 BINGEMANS CENTRE DR. KITCHENER, ON. N2B 3X9 | P: 519.576.3650 F: 519.576.0121 | WWW.MHBCPLAN.COM

MNRF Approval Stamp

Stamp

DRAFT

Applicant

TOMLINSON

R. W. Tomlinson Limited
100 CitiGate Drive, Ottawa Ontario, K2J 6K7
Tel: (613) 822-1867 Fax: (613) 822-6844

DRAFT

Rob Pierce
R.W. Tomlinson Limited
Vice President Planning and Development

Project

Stittsville 2 Quarry

ARA Licence Reference No.

Pre-approval review:

For submission to MNRF - October 2023

Plan Scale: **NTS**

Plot Scale 1:4 [1mm = 4 units] MODEL

Drawn By D.G.S.

Checked By N.D.

File No. **9137W**

File Name

OPERATIONAL NOTES PLAN

Drawing No.

3 OF 5

K:\9137AI-Tomlinson-Stittsville Quarry 2\AI\Notesplan 3of5 October2023.dwg

ATTACHMENT 2

Author Qualifications and Experience

Education

M.Sc. Geology, University of Windsor, Windsor, Ontario, 1988

B.Sc. Geology, Honours, University of Windsor, Windsor, Ontario, 1986

Certifications

Registered Professional Geoscientist, 2002

Languages

English – Fluent

WSP Canada Inc. – Ottawa, Ontario

Employment History

Career Summary

Principal/Senior Hydrogeologist (1997 to Present)

Mr. Kris A. Marentette, M.Sc., P.Geo., is a Principal and Senior Hydrogeologist in the Ottawa office of WSP Canada Inc. (previously Golder Associates), and has 20 years of broad experience in the fields of water supply development, physical hydrogeological characterization studies, regional scale groundwater studies, waste management, contaminated sites assessment /remediation, aggregate resource evaluations and the licensing and permitting of quarry development and expansion projects. Kris is responsible for business development, project management, and senior technical review of hydrogeology, quarry and sand and gravel pit development and expansion, golf course irrigation, site assessment and remediation projects, and waste facility siting, design, operation and environmental compliance monitoring assignments from the Ottawa office.

From 1997 to 2001, Mr. Marentette was Project Manager for Golder Associates' component of one of the largest Environmental Site Assessment (ESA) contracts in Canada which involved the assessment of over 780 sites which were being transferred from Transport Canada to NAV CANADA. Golder Associates completed Phase I ESA of approximately 400 sites of which about 130 sites required Phase II ESA activities. The sites ranged from small antennas towers to large, complex international airports. Project involved considerable logistic planning to mobilize personnel across the country, familiarity with federal and provincial soil and groundwater remediation criteria, development of site-specific remediation options (including permafrost sites), and ongoing interaction with consultant team and Transport Canada/NAV CANADA.

Kris has also been involved as principal consultant or senior reviewer for over 100 Phase I ESAs and over 50 Phase II ESAs completed by the Ottawa office. These projects included industrial, commercial, and residential properties ranging from former coal gasification plants to microcircuit manufacturers. Projects have included an evaluation of permitting requirements related to waste water discharges and air emissions as well as designated substances surveys. Kris has also conducted subsurface investigations at numerous bulk storage, fuel dispensing and pipeline sites; development of groundwater and soil vapour monitoring programs; design and permitting of remedial measures including product recovery and excavation of contaminated soil; supervision and verification of site remediation.

Kris has provided environmental consultation services to many wood product manufacturers in Renfrew County and Lanark County in the context of assessing environmental impacts of wood waste storage and lumber yard and sawmill operations on the natural environment. While working for the wood product manufacturers, Kris established a consistent approach to site investigations and set a focused list of leachate indicator parameters for groundwater and surface water assessments which has met with Ontario Ministry of Environment (MOE) approval.

Kris has been the Golder Associates Project Manager on a number of Ministry of Natural Resources quarry and pit licensing projects for both new operations and expansions to existing operations and has extensive experience in managing these complex, multi-disciplinary projects. Participated in comprehensive aggregate resource evaluations of Paleozoic sedimentary sequences (limestone) and Precambrian marble deposits at quarries in eastern Ottawa for the purpose of developing preferred site development plans to maximize the production of high quality aggregate products. The aggregate resource evaluations have typically included borehole coring, geological core logging, geophysical evaluations and comprehensive laboratory testing programs. Participated in other quarry-related projects associated with the Ministry of Environment Permit to Take Water Program and the issuance of Certificates of Approval (Industrial Sewage Works) under Section 53 of the Ontario Water Resources Act as well as studies undertaken for the purpose of complying with requirements under the Aggregate Resources Act. In the case of the Permit to Take Water approvals and industrial sewage works applications under Sections 34 and 53 of the Ontario Water Resources Act, Kris has consulted with, and interacted extensively, with MOE personnel in both the local District and Regional offices and with key personnel within the Environmental Assessment and Approvals Branch of the MOE in Toronto. Kris was the Project Manager assigned to assist the City of Ottawa in a comprehensive project focused on assisting City staff in understanding the intricate details of the MOE's Permit to Take Water Program. Kris is also well known to the local conservation authorities (Rideau Valley Conservation Authority, Mississippi Valley Conservation Authority and South Nation Conservation) as a result of involvement in water supply and quarry-related projects in the Ottawa area and has interacted with the Ontario Stone, Sand & Gravel Association on various issues related to the aggregate industry (e.g., addressing the MOE concern associated with the potential presence of dinitrotoluene in quarry discharge water, source water protection, etc.). Kris has appeared as an expert witness before the Ontario Municipal Board on quarry-related applications.

Golder Associates Ltd. – Ottawa, Ontario
Hydrogeologist/Senior Hydrogeologist (1988 to 1997)

Responsible for business development and the initiation, implementation and direction of hydrogeological investigations from the Ottawa office. Projects have included test well drilling programs for private services developments; subsurface investigations as related to the installation of subsurface sewage disposal systems; communal water supply investigations; and, regional hydrogeological studies to assist in establishing planning policies for future private services developments and to develop standards for water well construction.

Project manager for numerous hydrogeological studies of existing/proposed landfill sites including the assessment of impacts on water resources and developing and implementing monitoring programs and contingency and remedial action plans. Participated in hydrogeological aspects of waste management studies, preparation and submission of documentation to obtain Emergency Certificates of Approval and Site Interim Expansions of landfill sites under both the Environmental Assessment Act and Environmental Protection Act. Projects have included preparation of landfill site development and

operations plans including evaluations of landfill final cover design options. Expert testimony at hearings before the Environmental Assessment Board.

Also responsible for investigation, design and implementation of soil and groundwater remediation programs at hydrocarbons, metals, solvents, and PAH contaminated sites including the risk assessment approach to site management. Projects have included third party peer review of site remediation programs.

Conducted hydrogeological assessments of quarry developments/expansions and pre-acquisition environmental site audits.

PROJECT EXPERIENCE – WATER RESOURCES MANAGEMENT

Village of Winchester Water Supply Project
Ontario, Canada

Project Hydrogeologist for the Village of Winchester Water Supply Expansion Project. This project included the preliminary evaluation of potential target aquifers followed by a comprehensive test well investigation and aquifer characterization program. Participated in the development of a comprehensive Water Resources Protection Strategy.

Rural Subdivision Development
Ontario, Canada

Supervised test well drilling programs for numerous residential, industrial and commercial private services subdivision developments including evaluation and selection of target aquifers, development of site specific well construction requirements, analysis and interpretation of physical hydrogeological data and groundwater chemical data and preparation and submission of detailed hydrogeological reports. Responsible for conducting many subsurface investigations as related to the installation of small and large subsurface septic sewage disposal systems for private services developments including projects subject to the Ontario Ministry of the Environment Reasonable Use Guideline B-7.

Communal / Commercial Water Supply Evaluation
Ontario, Canada

Project Manager for communal water supply investigations for non-profit housing developments in Elgin and Clayton, Ontario and time share condominium development in Cobden, Ontario; responsible for groundwater resource evaluation with respect to project specific water supply requirements. Conducted hydrogeological assessment of the Evergreen Spring Water Site in the Township of Sebastopol, Ontario for Cott Beverages Ltd.; assessment included characterization of geological setting, quantity, quality and age of spring water and evaluation of potential sources of contamination in the vicinity of the spring.

Township of Kingston Planning Study
Ontario

Conducted hydrogeological study and general terrain analysis of rural Kingston Township to characterize the present status of the Township's groundwater resources to assist in establishing planning policies for locating new developments on private services and to provide standards for water well construction within the Municipality.

Land Development Evaluation
Ontario

Conducted a preliminary hydrogeological and terrain evaluation of a 400 acre parcel of land south of the Ottawa International Airport with respect to the feasibility of developing the site as a rural residential subdivision on private services.

PROJECT EXPERIENCE – WASTE MANAGEMENT

Township of Clarence Landfill Buchanan Landfill Bourget, Ontario/Chalk River, Ontario, Canada	Preparation and submission of documentation to the Ontario Ministry of the Environment to obtain an exemption from the Environmental Assessment Act and approval under the Environmental Protection Act for interim expansions of the Township of Clarence Landfill and Buchanan Landfill. Project involved detailed hydrogeological and geophysical site characterization studies, development of mitigation measures to address existing off-site impacts on groundwater and surface water resources and participation in the preparation of the site development and operations reports, trigger mechanisms, and contingency measures, site closure plans, public participation/presentations, document preparation and representation to regulatory agencies. Expert testimony at the Environmental Assessment Board hearings resulting in successful applications.
Dodge Landfill Espanola, Ontario, Canada	Project Hydrogeologist responsible for hydrogeological studies of existing landfill in support of an application to the Ontario Ministry of Environment for a long-term site expansion.
Lanark County Waste Management Master Plan City/Township of Kingston Waste Management Master Plan Ontario, Canada	Hydrogeological consultant on the master plan study teams involving technical aspects and document preparation, Environmental Assessment process, EA level field investigations and evaluation of site-specific engineered containment system requirements at the preferred sites and presentations to the steering committees and the public.
Armbro Mine Landfill Development Marmora, Ontario, Canada	Project Hydrogeologist as part of the Metro Toronto area landfill site search, for hydrogeological assessment, conceptual design and technical feasibility evaluation of constructing a municipal landfill in the 250 metre deep former open pit iron ore mine.
Township of Clarence Waste Management Planning Study Ontario, Canada	As part of a multi-disciplinary team, responsible for the hydrogeological aspects of a long term waste management planning study under the Environmental Assessment Act and Environmental Protection Act, including development and evaluation of alternative waste management components and systems, a systematic landfill site selection process and interaction with the Public Liaison Committee, municipal council and the public.
Municipal Waste Management Planning Studies Ontario, Canada	Participated in hydrogeological aspects of waste management planning studies to identify potentially suitable areas for landfill development to satisfy the long term waste disposal requirements for the Township of Grattan, Township of Pittsburgh and the Townships of Palmerston, North and South Canonto.

Various Landfill Sites
Eastern and Northern Ontario, Canada

Responsible for undertaking and/or managing hydrogeological and waste management studies at in excess of 50 municipal landfill sites. The typical objectives of these studies have been to define the physical and contaminant hydrogeology including use of geophysical methods; undertake site-specific impact assessments on groundwater and surface water resources and gas migration; complete site performance evaluations in terms of current regulatory requirements; develop site-specific remedial action plans; design and implement annual hydrogeological monitoring programs; assist in the preparation of site development, operations and contingency and remedial action plans; and, to assemble the necessary documentation required to apply to the Ontario Ministry of Environment for Certificate of Approval revisions to permit continued disposal. Conducted evaluations of final cover design options using the Hydrologic Evaluation of Landfill Performance (HELP) computer model for the purpose of selecting the most appropriate final cover design for numerous landfills based on hydrogeological considerations, economics and availability of construction materials in the vicinity of the sites.

PROJECT EXPERIENCE – CONTAMINATED SITES INVESTIGATION AND REMEDIATION

Nation-Wide Environmental Site Assessments
Canada

Project Manager for Golder Associates' component of one of the largest environmental site assessment contracts in Canada which involved the assessment of over 780 sites which were being transferred from Transport Canada to NAV CANADA. Golder Associates completed Phase I ESAs of approximately 400 sites of which about 130 sites required Phase II ESA activities. The sites ranged from small antenna towers to large, complex international airports. Project involved considerable logistic planning to mobilize personnel across the country, familiarity with federal and provincial soil and groundwater remediation criteria, development of site-specific remediation options (including permafrost sites), and ongoing interaction with consultant team and Transport Canada/NAV CANADA.

Assessment of Rockcliffe Airbase Lands
Ottawa, Ontario, Canada

Project Manager to participate as part of a multi-disciplinary team assembled to conduct an existing conditions assessment related to potential redevelopment of the Rockcliffe site for residential land use. Completed a review of subsurface environmental investigation reports in terms of identifying potential development constraints associated with soil and groundwater conditions at the site. Presented recommended actions for evaluating issues of potential environmental concern including development of cost estimates to address these concerns.

Environmental Site Assessments
Eastern Ontario, Canada

Senior Reviewer for over 100 Phase I ESAs and over 50 Phase II ESAs completed by the Ottawa office. These projects included industrial, commercial and residential properties ranging from former coal gasification plants to microcircuit manufacturers. Projects have included an evaluation of permitting requirements related to waste-water discharges and air emissions as well as designated substances surveys.

Assessment of Diesel Fuel Release
Smiths Falls, Ontario, Canada

Project Manager for an environmental impact study which focused on a diesel fuel leak at a large industrial site and included the delineation of the areal extent of contamination, assessment with respect to current soil and groundwater remediation criteria and participation in the development and implementation of a site specific monitoring program and evaluation of remedial options.

Petroleum Hydrocarbon Releases
Eastern Ontario, Canada

Conducted subsurface investigations at numerous bulk storage, fuel dispensing and pipeline sites; development of groundwater and soil vapour monitoring programs; design and permitting of remedial measures including product recovery and excavation of contaminated soil; supervision and verification of site remediation.

Investigation of Salt Storage Facilities
Eastern Ontario, Canada

Project Manager for hydrogeological investigation relating to an assessment of poor groundwater quality adjacent to a salt dome near Almonte, Ontario. Project involved an evaluation of existing water quality data, development and implementation of a replacement well drilling program and long term groundwater quality monitoring program; project involved extensive consultation with municipal officials, affected homeowners and representatives from the Ontario Ministry of the Environment. Responsible for hydrogeological impact assessments relating to salt storage facilities near Eganville and Deep River, Ontario. Investigations included reconnaissance level geophysical surveys to characterize general dimension of the contaminant plumes followed by confirmation drilling, monitoring well installation and groundwater sampling programs to delineate the nature and extent of the contaminant plumes originating from the salt storage facilities and to differentiate between groundwater impacts from the salt storage facilities and that from nearby landfill sites.

PROJECT EXPERIENCE – AGGREGATE INDUSTRY

Stittsville Quarry
Township of Goulbourn (Ottawa), Ontario, Canada

Project Manager and Project Hydrogeologist retained by R.W. Tomlinson Limited to provide geoscience and engineering services and to co-ordinate a multi-disciplinary study team in the preparation of the supporting documents, for a submission to the Ontario Ministry of Natural Resources, in support of an application for a Category 2, Class “A” license for a 44 million tonne quarry which intends to extract limestone from below the established groundwater table. Assignment also included preparation and submission of applications to the Ontario Ministry of Environment for approval under Section 34 (Permit to Take Water) and Section 53 (Industrial Sewage Works) of the Ontario Water Resources Act. All required approvals were obtained and the quarry became operational in September 2002. Kris continues to be involved as Project Director on all environmental compliance monitoring requirements associated with the Ministry of Natural Resources aggregate license and the Ministry of Environment approvals under Section 34 and 53 on the Ontario Water Resources Act.

Rideau Road Quarries
City of Gloucester (Ottawa), Ontario, Canada

In 2003, Golder Associates was retained by R.W. Tomlinson Limited to provide geoscience and engineering services and to co-ordinate a multi-disciplinary study team in the preparation of the supporting documents, for a submission to the Ontario Ministry of Natural Resources, in support of an application for a Category 2, Class "A" license for a 40 hectare parcel of land adjacent to Tomlinson's existing quarry operations. The quarry was designed to extract limestone from below the established groundwater table for the production of high quality aggregate suitable for all types of asphalt pavements. Kris was Project Director and Project Hydrogeologist for this assignment and Golder Associates' primary responsibilities included preparation of Level 1 and Level 2 Hydrogeological studies and Natural Environment evaluations of the property. Of particular significant for this project was the innovative approach develop by Golder Associates (in consultation with the Ministry of Natural Resources) for the purpose of addressing the presence of the American ginseng plant species and butternut trees on the property. The aggregate license was issued by the Ministry of Natural Resources in 2006.

Tatlock Quarry
Township of Lanark Highlands, Ontario, Canada

Project Director and Project Hydrogeologist retained in 2002 by Omya Canada Inc. to conduct Level 1 and Level 2 hydrogeological studies in support of an application to the Ministry of Natural Resources for a Category 2, Class "A" license for the extraction of calcitic marble (crystalline limestone) at the Omya Tatlock Quarry located northwest of Perth, Ontario. Golder Associates was also responsible for the preparation of an application for an industrial sewage works approval under Section 53 of the Ontario Water Resources Act. The quarry license application was issued by the Ministry of Natural Resources in April 2006 and the industrial sewage works approval was issued by the Ministry of Environment in March 2006. Kris continues to advise Omya Canada Inc. on matters related to environmental compliance monitoring and other issues pertaining to Ministry of Natural Resources aggregate license and the Ministry of Environment approvals under Section 34 and 53 on the Ontario Water Resources Act.

Dunvegan Quarry
Township of North Glengarry, Ontario, Canada

Project Hydrogeologist retained by the Township of North Glengarry to conducted a peer review of the hydrogeological aspects of the Cornwall Gravel Company Ltd. Dunvegan Quarry license application. The peer review focused on developing an opinion as to whether the Hydrogeological Assessment Report addressed the various components specified as part of a Hydrogeological Level 1 study and Hydrogeological Level 2 study in the context of a Category 2, Class "A" Quarry Below Water.

Klock Quarry
Aylmer, Quebec, Canada

Golder Associates was retained by Lafarge Canada Inc. to conduct the hydrogeological and natural environment assessments associated with obtaining approval for the extraction of limestone from a property situated adjacent to the existing Klock Quarry. Kris is responsible for overall project co-ordination and direction of a multi-disciplinary team.

Brechin Quarry
City of Kawartha Lakes, Ontario, Canada

Project Manager and Project Hydrogeologist retained by R.W. Tomlinson Limited to complete the necessary hydrogeological, hydrological and ecological studies to support an application under the Aggregate Resources Act. The proposed Brechin Quarry is located in the former Township of Carden within the City of Kawartha Lakes, Ontario. The property covers an area of approximately 206 hectares and involves an aggregate resource of 70 million tonnes with an expected operational timeframe of over 70 years. The assignment involves a comprehensive assessment of the potential effects of quarry development on private water supply wells and an adjacent Provincially Significant Wetland and other natural environment (biological) features as well as consideration of the potential cumulative impacts associated with multiple quarry developments in the area of the proposed Tomlinson Brechin Quarry. This project involves extensive municipal and public consultation as well as interaction with representatives of the Ontario Ministry of Natural Resources and Ontario Ministry of Environment. The aggregate license was issued by the Ministry of Natural Resources in 2009.

TRAINING

Ministry of Environment Approvals Reform and Air Emission Summary and Dispersion Modelling Report Workshop
Ministry of the Environment, 1998

Site Specific Risk Assessment Seminar
Ottawa, 1998

Contaminated and Hazardous Waste Site Management
1997

Occupational Health and Safety Course
1989, 1995

Groundwater Protection in Ontario Conference
Toronto, 1991

Short Course in Dense, Immiscible Phase Liquid Contaminants (DNAPLs) in Porous and Fractured Media
Waterloo Centre for Groundwater Research, 1990

PROFESSIONAL AFFILIATIONS

Associate Member, Ontario Stone Sand and Gravel Association (OSSGA)

Member, Association of Groundwater Scientists and Engineers (N.G.W.A.)

Member, International Association of Hydrogeologists

Member, Ottawa Geotechnical Group, The Canadian Geotechnical Society

Member, Ontario Water Well Association

WSP Canada Inc. – Ottawa, Ontario

Education

Master's of Applied Science Environmental Engineering, Carleton University, Ottawa, Ontario, 2006

Bachelor Environmental Engineering, Carleton University, Ottawa, Ontario, 2003

Bachelor of Arts Psychology, University of Guelph, Guelph, Ontario, 1996

Certifications

Registered Professional Engineer, Professional Engineers of Ontario, March 2009

Career Summary

Brian Henderson, P.Eng., is an Environmental Engineer with WSP Canada Inc. (previously Golder Associates), in Ottawa. He holds B.Eng. and M.A.Sc. degrees, both from the department of Civil and Environmental Engineering at Carleton University. He manages a wide variety of hydrogeological and environmental projects including borehole drilling, groundwater and surface water analysis and groundwater monitoring well installation. He has experience with the construction of numerical groundwater flow models used to assess the potential hydrogeological impacts of quarry and construction de-watering and larger scale models for regional studies.

Employment History

WSP Canada Inc.(previously Golder Associates Ltd.) – Ottawa, Ontario
Environmental Engineer (2006 to Present)

Brian is responsible for project management, technical analysis, data management and reporting for a variety of hydrogeological and environmental projects. In this role he leads the planning, management and execution of permitting applications, groundwater resource protection studies and other environmental/hydrogeological projects. Brian carries out groundwater sampling, field investigations (including soil and groundwater investigations and monitoring); residential groundwater sampling; data management, analysis and interpretation. In addition, he monitors and reports on the compliance of quarry sites and landfills in accordance with their Certificates of Approval and Permits to Take Water. Brian performs groundwater modelling for wellhead protection studies, construction-related groundwater control and quarry hydrogeological studies.

Carleton University – Ottawa, Ontario
Teaching Assistant (2003 to 2005)

Conducted problem analysis sessions for several environmental engineering courses; prepared and coordinated seminars; and helped students one on one. Courses included third year contaminant transport, third year water resources engineering and a fourth year risk assessment course.

City of Ottawa – Ottawa, Ontario
Engineering Assistant (2003)

Working under supervision of City of Ottawa standards engineer, helped to write the City of Ottawa's Sewer Use Guidelines, attended meetings from other departments about the guidelines, researched current acceptable products to determine if they would meet future standards and reviewed new products to establish if they meet with the City's standards.

Carleton University – Ottawa, Ontario
Research Assistant – NSERC Undergraduate Research Award (2002)

Conducted research on the separation of cellulose from sugarcane bagasse plant residue; applied laboratory procedures and analytical techniques to investigate the effectiveness of the separation for a series of individual experimental trials; and designed a bench-scale model for the continuous separation of cellulose based on the experimental trials.

City of Ottawa – Ottawa, Ontario
Laboratory Assistant (2001 to 2002)

Laboratory tested asphalt, aggregates and concrete used in road construction. Laboratory tests included particle size distribution and proctor values for aggregates, the compressive strength of concrete, and particle distribution, volume of voids, percent asphalt cement, and marshal properties for asphalt. In the field, core samples were taken and densities of asphalt were measured using a nuclear density gauge.

PROJECT EXPERIENCE – HYDROGEOLOGY

Rehabilitation of the West Block
Ottawa, Ontario

Undertook the hydrogeological components associated with the rehabilitation of the West Block prior to occupation by the House of Commons. Brian prepared a Category 3 Permit to Take Water (PTTW) application and supporting documentation for water taking for construction dewatering from the proposed excavations inside and outside of the building.

Retrofit, Historical Restoration and Seismic Upgrade of the Wellington Building
Ottawa, Ontario

Undertook the hydrogeological components associated with the assessment, and development of a treatment system for contaminated groundwater which was encountered under the floor slab. Brian undertook the modelling required to estimate potential groundwater inflow to the treatment system.

Major Rehabilitation of the Government Conference Centre
Ottawa, Ontario

Undertook the hydrogeological components associated with the rehabilitation of the Government Conference Center prior to occupation by the Senate of Canada. Brian designed the field testing components of the hydrogeological program and prepared a Category 3 Permit to Take Water (PTTW) application and supporting documentation for water taking for construction dewatering from the proposed excavations inside and outside of the building.

Integrated Road, Sewer and Watermain Replacement/ Rehabilitation
Ontario

Conducted background review, technical hydrogeological analysis and reporting related to infrastructure installation/replacement throughout the City of Ottawa. Analysis included predictions of the rate of groundwater inflow, water quality testing and the identification of hydrogeological risks.

Permit to Take Water Applications/ Environmental Activity and Sector Registry Documentation
Ontario

Conducted background review, technical hydrogeological analysis and reporting related to Category 1, 2 and 3 Permit to Take Water (PTTW) applications as well as dewatering and discharge plans to support Environmental Activity and Sector Registry (EASR) registrations for construction dewatering projects, quarry dewatering and pumping tests.

Groundwater Numerical Modelling
Ontario

Conducted hydrogeological investigations for proposed and existing quarry sites and construction dewatering projects. Developed detailed conceptual and numerical models for groundwater flow, and demonstrated impacts to local environment.

Groundwater and Surface Water Monitoring Programs
Ontario

Managed groundwater and surface water monitoring programs; conducted data checks, technical review and analysis; and, prepared a comprehensive annual report for various landfill and quarry sites.

Potable Water and Wastewater Expansion
Village of Limoges, Ontario

In response to a hydraulic review of the potable water and wastewater systems for the Village of Limoges, Golder completed the necessary studies to inform a Master Plan for the two systems in accordance with the requirements of a Municipal Class Environmental Assessment. The Master Plan addressed the growth potential and the capacity constraints to develop a long-term outlook for the community. Brian served as Project Manager and Hydrogeologist for this project. As Project Manager he was responsible for budget/schedule maintenance and control, QA/QC of deliverables, development of a health & safety plan, communication with client and stakeholders, contractor guidance and supervision as well as team organization and communication. Brian also carried out data analysis, report preparation, field program design and water level/sample collection to complete a hydrogeological study to evaluate possible well locations.

Hydrogeological and Hydrological Assessments for Quarry Licensing
Ottawa (Goulbourn Twp.), Ontario

Golder carried out the necessary hydrogeological, hydrological and ecological studies to support applications under the Aggregate Resource Act and the Planning Act for a site plan license for a new quarry. Brian developed detailed conceptual and numerical models of groundwater flow, demonstrated potential impacts to local environment and proposed mitigative measures.

Hydrogeological Assessment for Quarry Licensing
Ottawa (Gloucester Twp.), Ontario

Golder carried out a hydrogeological studies to support an application under the Aggregate Resource Act and the Planning Act for a site plan license for a new quarry. Brian developed detailed conceptual and numerical models of groundwater flow, demonstrated potential impacts to local environment and proposed mitigative measures. He carried out on-site hydraulic conductivity testing and groundwater/surface water interaction studies. He was responsible for designing the field program and health & safety plan and preparing the report.

Hydrogeological Assessment for Quarry Licensing
Canaan Quarry Expansion, Ottawa, Ontario

Golder carried out a hydrogeological study to support an application under the Aggregate Resource Act and the Planning Act for a site plan license for a quarry expansion. Brian developed detailed conceptual and numerical models of groundwater flow, demonstrated potential impacts to local environment and proposed mitigative measures. He carried analysis of on-site hydraulic conductivity testing data. He was responsible for designing the field program and health & safety plan and preparing the report.

Conceptual Design for the Remediation of a Closed Landfill
County of Northumberland, Ontario

Golder presented a number of remediation alternatives to the County to address surface water compliance issues arising from leachate derived impacts identified in a nearby creek caused by a closed landfill. After a review and analysis of existing data, Brian developed the conceptual groundwater flow model, carried out numerical modelling of the remediation options, and prepared reports.

Options Evaluation and Preliminary Design for Tailings Management Option
Nunavut

Golder completed a tailings and waste rock management options evaluation and preliminary design of selected tailings management options at a mine site in Nunavut. Brian completed monitoring well development and sampling for groundwater quality of a deep monitoring well below permafrost using the WestbayTM monitoring well system.

Groundwater Vulnerability Study
Kingston, Ontario

Golder completed a Groundwater Vulnerability Study for the municipal water supply well servicing a subdivision in the northeast part of Kingston, Ontario. The groundwater vulnerability study included the delineation of the wellhead protection area (WHPA) around the well and the determination of vulnerability scores for the different zones within the WHPA. Brian was responsible for field program design, compilation, interpretation and analysis of data and report preparation. He also carried out the QA/QC of deliverables, conceptual model development and numerical modelling.

Phase III ESA at the Ottawa International Airport
Ottawa, Ontario

Golder completed a Phase III Environmental Site Assessment at the MacDonald-Cartier Ottawa International Airport which attempted to define the extent of groundwater and soil impacts based on the data gap analysis and the water quality results from the available monitoring wells installed during previous investigations. Brian was responsible for the collection of soil and groundwater samples, field program development, data analysis and report preparation. He also carried out compilation and interpretation of data, conceptual model development and contractor guidance and supervision.

Wellhead Protection Study
Deloro, Ontario

Golder carried out a Wellhead Protection Study for the Village of Deloro municipal well. The study included a groundwater vulnerability analysis, a threats inventory and a water quality risk assessment. Brian carried out groundwater flow modelling for the delineation of wellhead protection areas for the municipal well in Deloro. He conducted groundwater vulnerability mapping using ISI methods within the delineated areas.

PROJECT EXPERIENCE – HYDROGEOLOGY - INFRASTRUCTURE

Combined Sewage Storage Tunnel
Ottawa, Ontario

Golder carried out geotechnical and hydrogeological investigations for a new 6 km combined sewer storage tunnel system in Ottawa. A field investigation and reporting program was completed through the downtown core to support the preliminary and detail design team. Brian assisted with the design and implementation of the hydrogeological field program, carried out the packer test data analysis, compiled and interpreted data and completed pumping tests which were challenging due to the location on the streets of downtown Ottawa. Results of the hydrogeological assessment were included in a report used as a supporting document for a Permit to Take Water application for construction dewatering for the project. Brian also provided technical review and guidance to the team and the guidance and supervision of contractors.

South Nepean Collector Sewer Phase Two
Ottawa, Ontario

Undertook hydrogeological investigation for 2.5 kilometers of new deep trunk sewer in Barrhaven just north of the Jock River through sensitive clays, bouldery glacial till with permeable sand seams, and limestone bedrock. Providing hydrogeological input to design, tender documents and construction, including a PTTW application with supporting documentation. Key issues included assessment of the potential for basal heave, basal instability and general excavation conditions for the 6 to 10 metre deep excavations.

Ottawa Light Rail Transit Preliminary Design
Ottawa, Ontario

From 2010 to 2012, Golder carried out geotechnical, environmental and hydrogeological investigations for a new 12.5 km light rail transit system in Ottawa. A field investigation and reporting program was completed through the downtown core to support the preliminary design team. Brian assisted with the design and implementation of the hydrogeological field program, carried out the packer test data analysis, compiled and interpreted data and completed pumping tests which were challenging due to the location on the streets of downtown Ottawa. Brian also provided technical review and guidance to the team and the guidance and supervision of contractors.

West Transitway Extension (Bayshore Station to Moodie Drive)
Ottawa, Ontario

Undertook the hydrogeological components of the functional and detailed design for the West Transitway extension from Bayshore Station to Moodie drive. Subsurface conditions were determined using pre-existing information and a limited number of new test pits and boreholes/monitoring wells. A pumping test was carried out in the vicinity of Moodie Drive, due to the high hydraulic conductivity of the shallow bedrock, and numerical modelling analyses were undertaken to evaluate the issues related to construction dewatering. Golder obtained draft PTTW's for construction dewatering associated with construction of Phases 1 and 2.

Manotick Watermain Link
Ottawa, Ontario

Undertook hydrogeological investigations for detailed design of a watermain through the Village of Manotick, including two crossings under the Rideau River. Completed a Permit to Take Water application with supporting documentation.

Spencer Avenue Integrated Road, Sewer and Watermain Construction
Ottawa, Ontario

Undertook the, hydrogeological investigation for the integrated replacement of the roadway, watermain and sewer along Spencer Avenue from Western Avenue to Holland Avenue. Providing hydrogeological input to design and construction, and a Permit to Take Water application with supporting documentation.

Gilmour Trunk Sewer Reconstruction
Ottawa, Ontario

Undertook the hydrogeological investigation for the integrated replacement of the roadway, watermain and a deep trunk sewer along Gilmour Street, Waverley Street, Cartier Street and Elgin Street, with deep shaft connection to the Rideau Canal Interceptor trunk sewer. Providing hydrogeological input to design, tender documents and construction, including a Permit to Take Water application with supporting documentation.

Lavergne Street Integrated Road Sewer and Watermain Reconstruction
Ottawa, Ontario

undertook the hydrogeological component of the design and construction for the integrated replacement of the roadway, watermain and sewer along Lavergne Street, Jolliet Avenue, Ste Monique Street, et al. in Vanier. Project included deep excavations in peats, highly permeability sands below the water table, and shallow shale bedrock. Non-standard construction measures were considered and assessed as a means of limiting the potential for impacts to adjacent structures resulting from compression of the underlying peat soils due to groundwater level lowering. A Permit to Take Water application with supporting documentation was prepared.

Holland Avenue Watermain Replacement
Ottawa, Ontario

Geotechnical, hydrogeological and environmental subsurface investigations in support of design and tender of watermain replacement. Mr. Henderson undertook the hydrogeological components of the project, completed a Permit to Take Water application for the City of Ottawa, and assisted in developing construction specifications for soil and groundwater management.

Jockvale Road Jock River Bridge Replacement
Ottawa, Ontario

Undertook the hydrogeological components associated with the detailed design of the Jock River bridge replacement and the widening and reconstruction of Jockvale Road and associated subsurface utilities in Barrhaven. Golder obtained a Category 3 Permit to Take Water (PTTW) for water taking from the excavation for the Jockvale roadway/sewer service trenches, the bridge caissons and the North and South shafts for the construction of the horizontal utility bore below the Jock River. Analytical and numerical modelling was carried out to evaluate rates of water taking and impacts to the sensitive clay deposit and two dozen private water supply wells located within 500 metres of the site. Golder developed a monitoring program to support the water taking activities.

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