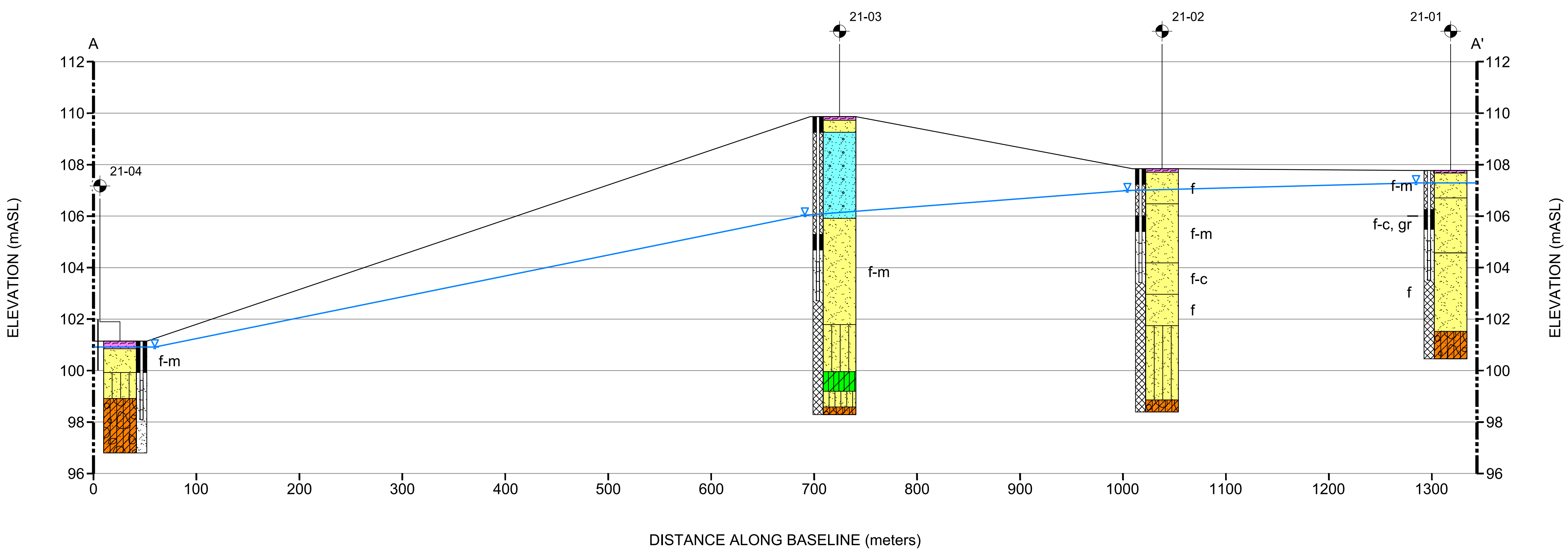
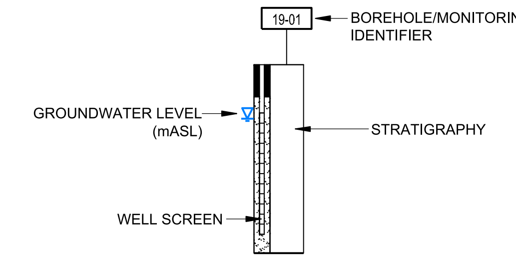


LEGEND

- SITE BOUNDARY
- INTERPRETED POSITION OF GROUNDWATER TABLE, APRIL 12, 2023
- f — FINE
- f-m — FINE TO MEDIUM
- f-c — FINE TO COARSE
- f-c, gr — FINE TO COARSE, SOME GRAVEL
- f-m, gr — FINE TO MEDIUM, SOME GRAVEL
- BOREHOLE



SOIL STRATIGRAPHY

- TOPSOIL
- SAND
- SAND AND SILT
- SAND AND GRAVEL
- SILTY SAND
- CLAYEY SILT
- GLACIAL TILL

0 100 200
1:5,000 HORIZONTAL METERS

0 5 10
1:200 VERTICAL METERS

CLIENT
R.W. TOMLINSON LIMITED

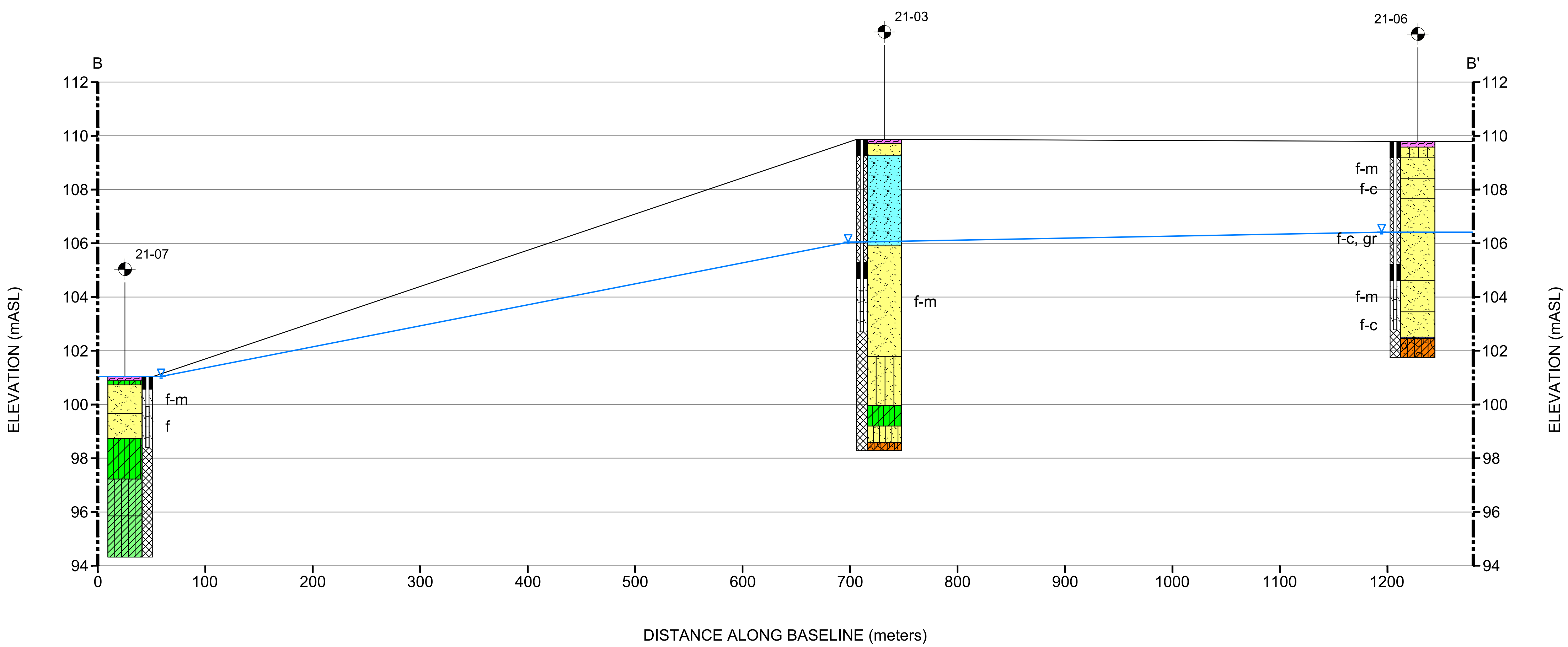
PROJECT
WATER REPORT
EAST OXFORD, ONTARIO

TITLE
GEOLOGICAL CROSS-SECTION A-A'

CONSULTANT
wsp

YYYY-MM-DD	2025-12-02
DESIGNED	----
PREPARED	ZS
REVIEWED	CAMC
APPROVED	BH

PROJECT NO.	CONTROL	REV.	FIGURE
21471757	0003	0	5



LEGEND

SITE BOUNDARY

INTERPRETED POSITION OF GROUNDWATER TABLE, APRIL 12, 2023

f	FINE
f-m	FINE TO MEDIUM
f-c	FINE TO COARSE
f-c, gr	FINE TO COARSE, SOME GRAVEL
f-m, gr	FINE TO MEDIUM, SOME GRAVEL

BOREHOLE

19-01 BOREHOLE/MONITORING IDENTIFIER

GROUNDWATER LEVEL (mASL)

STRATIGRAPHY

WELL SCREEN

SOIL STRATIGRAPHY

TOPSOIL	CLAYEY SILT
SAND	SILTY CLAY
SAND AND SILT	COBBLES
SAND AND GRAVEL	GLACIAL TILL
SILTY SAND	

0 100 200
1:5,000 HORIZONTAL METERS

0 5 10
1:200 VERTICAL METERS

CLIENT
R.W. TOMLINSON LIMITED

PROJECT
WATER REPORT
EAST OXFORD, ONTARIO

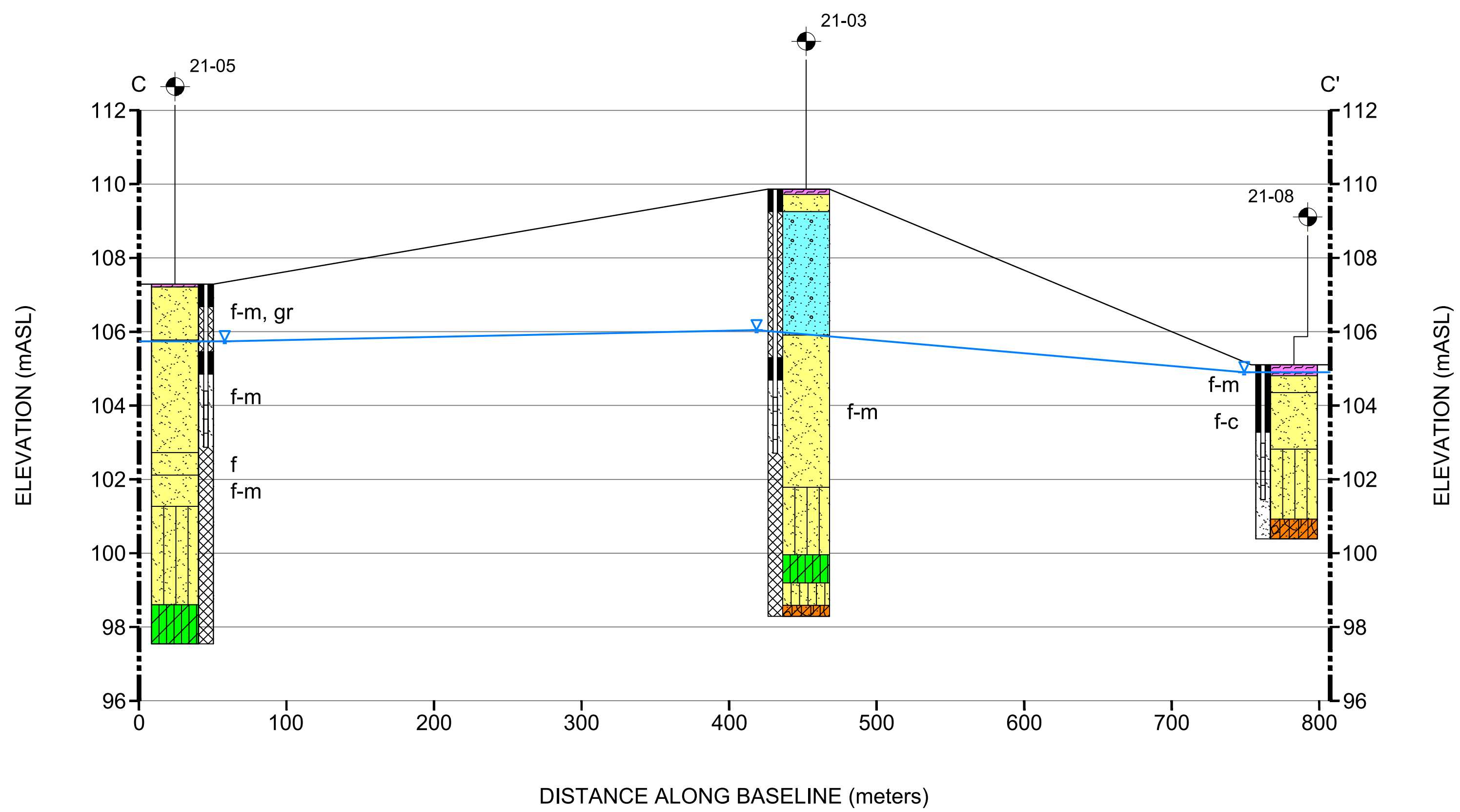
TITLE
GEOLOGICAL CROSS-SECTION B-B'

CONSULTANT

wsp

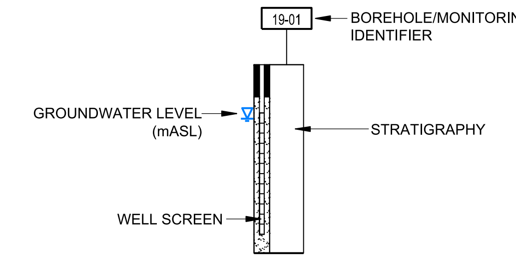
YYYY-MM-DD	2025-12-02
DESIGNED	----
PREPARED	ZS
REVIEWED	CAMC
APPROVED	BH

PROJECT NO.	CONTROL	REV.	FIGURE
21471757	0003	0	6



LEGEND

- SITE BOUNDARY
- INTERPRETED POSITION OF GROUNDWATER TABLE, APRIL 12, 2023
- f — FINE
- f-m — FINE TO MEDIUM
- f-c — FINE TO COARSE
- f-c, gr — FINE TO COARSE, SOME GRAVEL
- f-m, gr — FINE TO MEDIUM, SOME GRAVEL
- BOREHOLE



SOIL STRATIGRAPHY

- TOPSOIL
- SAND
- SAND AND SILT
- SAND AND GRAVEL
- SILTY SAND
- CLAYEY SILT
- GLACIAL TILL

0 100 200
1:5,000 HORIZONTAL METERS

0 5 10
1:200 VERTICAL METERS

CLIENT
R.W. TOMLINSON LIMITED

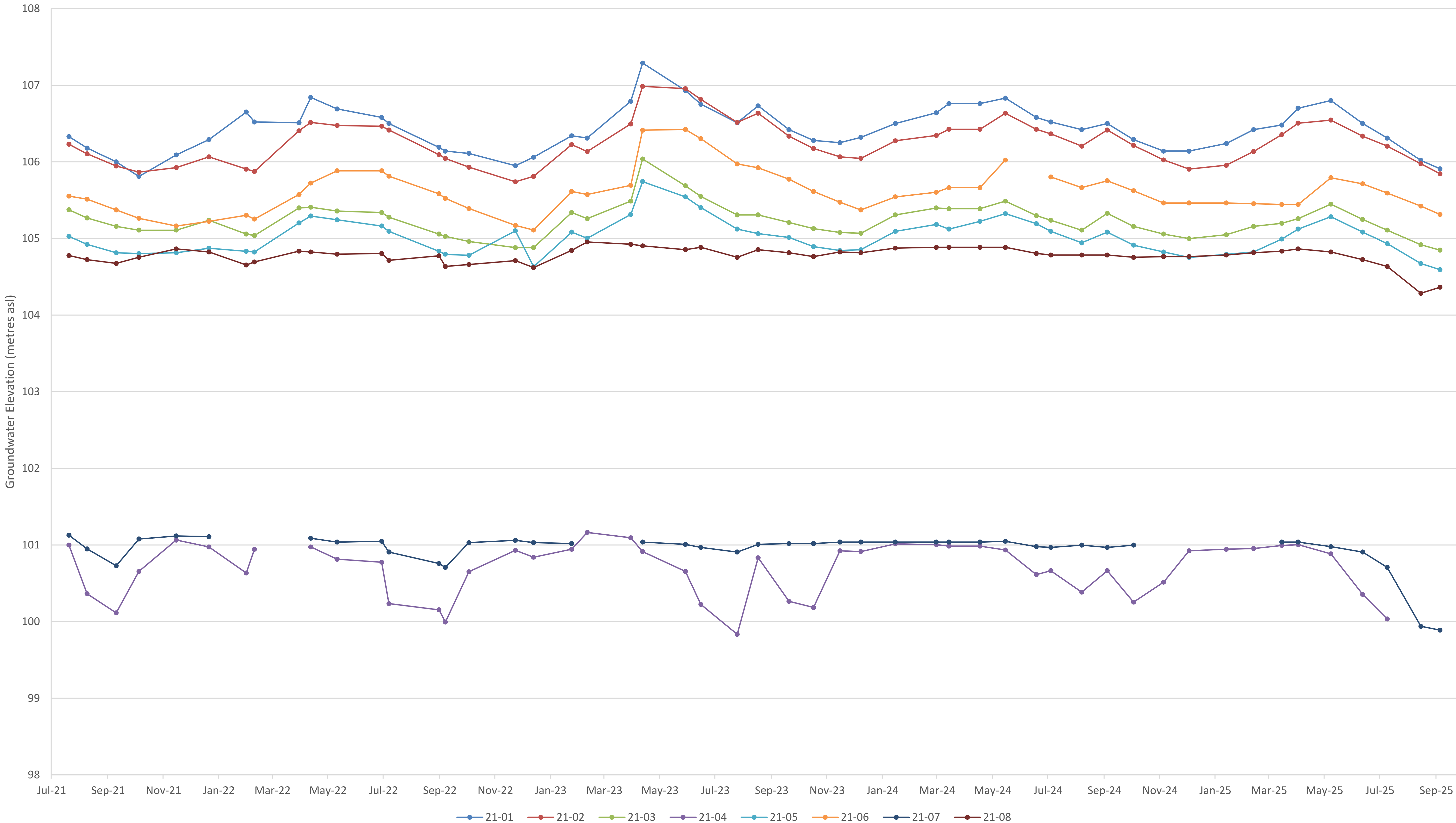
PROJECT
WATER REPORT
EAST OXFORD, ONTARIO

TITLE
GEOLOGICAL CROSS-SECTION C-C'

CONSULTANT
wsp

YYYY-MM-DD	2025-12-02
DESIGNED	----
PREPARED	ZS
REVIEWED	CAMC
APPROVED	BH

PROJECT NO.	CONTROL	REV.	FIGURE
21471757	0003	0	7



CLIENT
R.W. TOMLINSON LIMITED

PROJECT
PROPOSED EAST OXFORD PIT
WATER REPORT

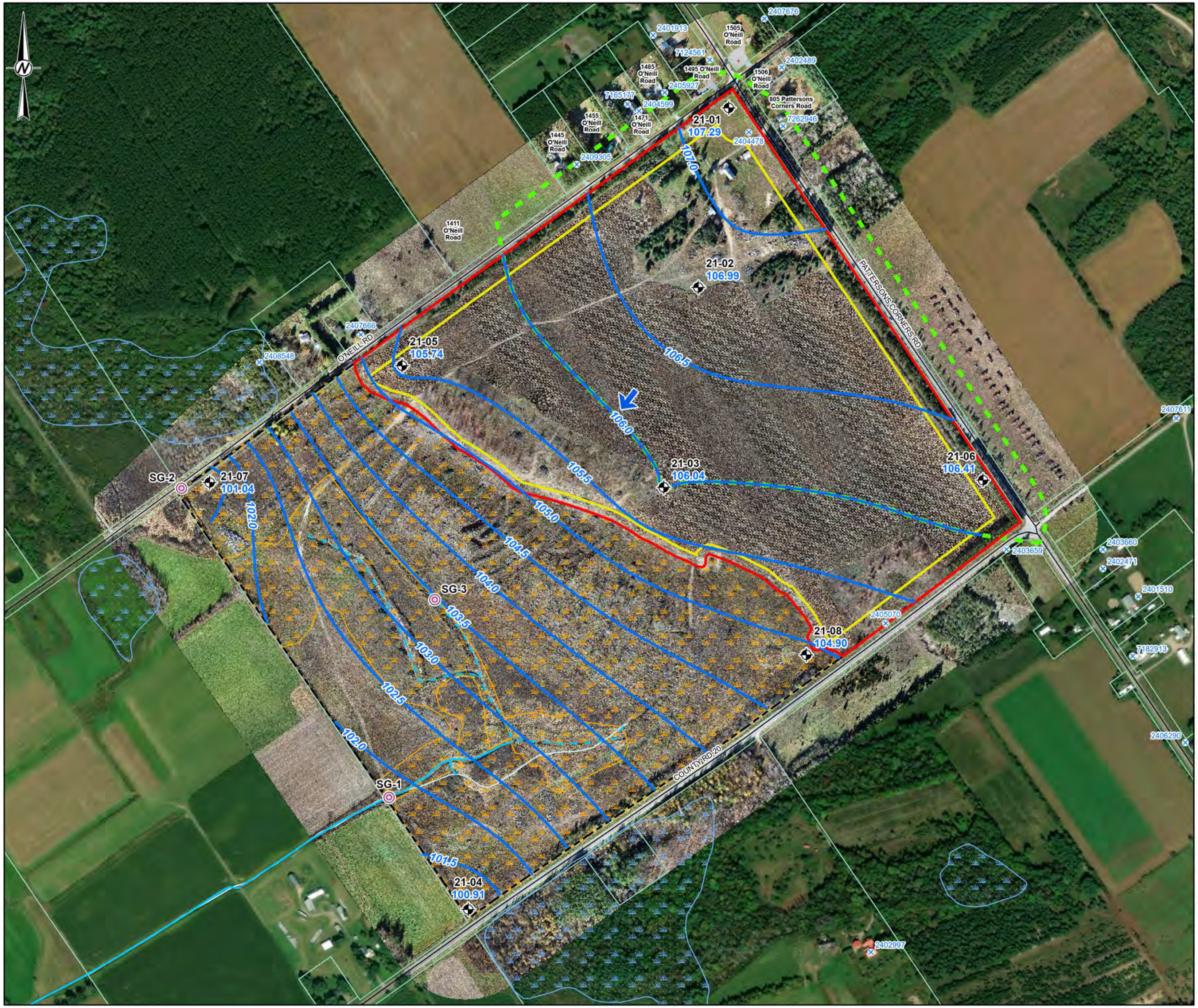
CONSULTANT

wsp

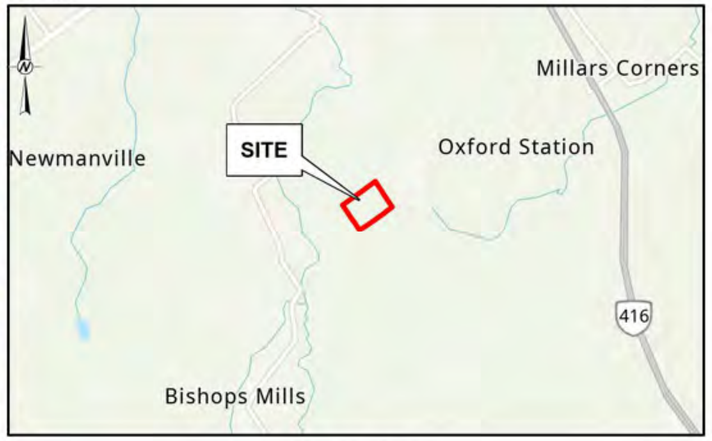
YYYY-MM-DD	2025-11-12
PREPARED	CAMC
DESIGN	--
REVIEW	BH
APPROVED	BH

TITLE
GROUNDWATER ELEVATIONS AT MONITORING WELLS 21-01, 21-02, 21-03, 21-04, 21-05, 21-06, 21-07 AND 21-08

PROJECT No.	PHASE	Rev.	FIGURE
21471757		0	8



KEY MAP



SCALE: 1:200,000

LEGEND

- MECP WWIS WATER WELL LOCATION
- APPROXIMATE BOREHOLE LOCATION
- STAFF GAUGE LOCATION
- INTERPRETED GROUNDWATER FLOW DIRECTION
- GROUNDWATER ELEVATION CONTOUR, MASL
- PROPOSED LICENCED BOUNDARY
- PROPOSED LIMIT OF EXTRACTION
- APPROXIMATE BOUNDARY OF TOMLINSON PROPERTY
- PREDICTED GROUNDWATER LEVEL DRAWDOWN RADIUS OF INFLUENCE
- ROADWAY
- PERMANENT STREAM
- INTERMITTENT STREAM
- WATERCOURSE
- 2025 WSP EVALUATED - NOT SIGNIFICANT WETLANDS
- UNEVALUATED WETLANDS
- PROPERTY PARCEL BOUNDARY

0 50 100 200

1:6,000 METRES

NOTE(S)

1. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: VANTOR, ESRI, NASA, NGA, USGS, SOURCES: ESRI, TOMTOM, GARMIN, FAO, NOAA, USGS, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
3. COORDINATE SYSTEM: NAD 1983 CSRS UTM ZONE 18N

CLIENT
R.W. TOMLINSON LIMITED

PROJECT
WATER REPORT
EAST OXFORD, ONTARIO

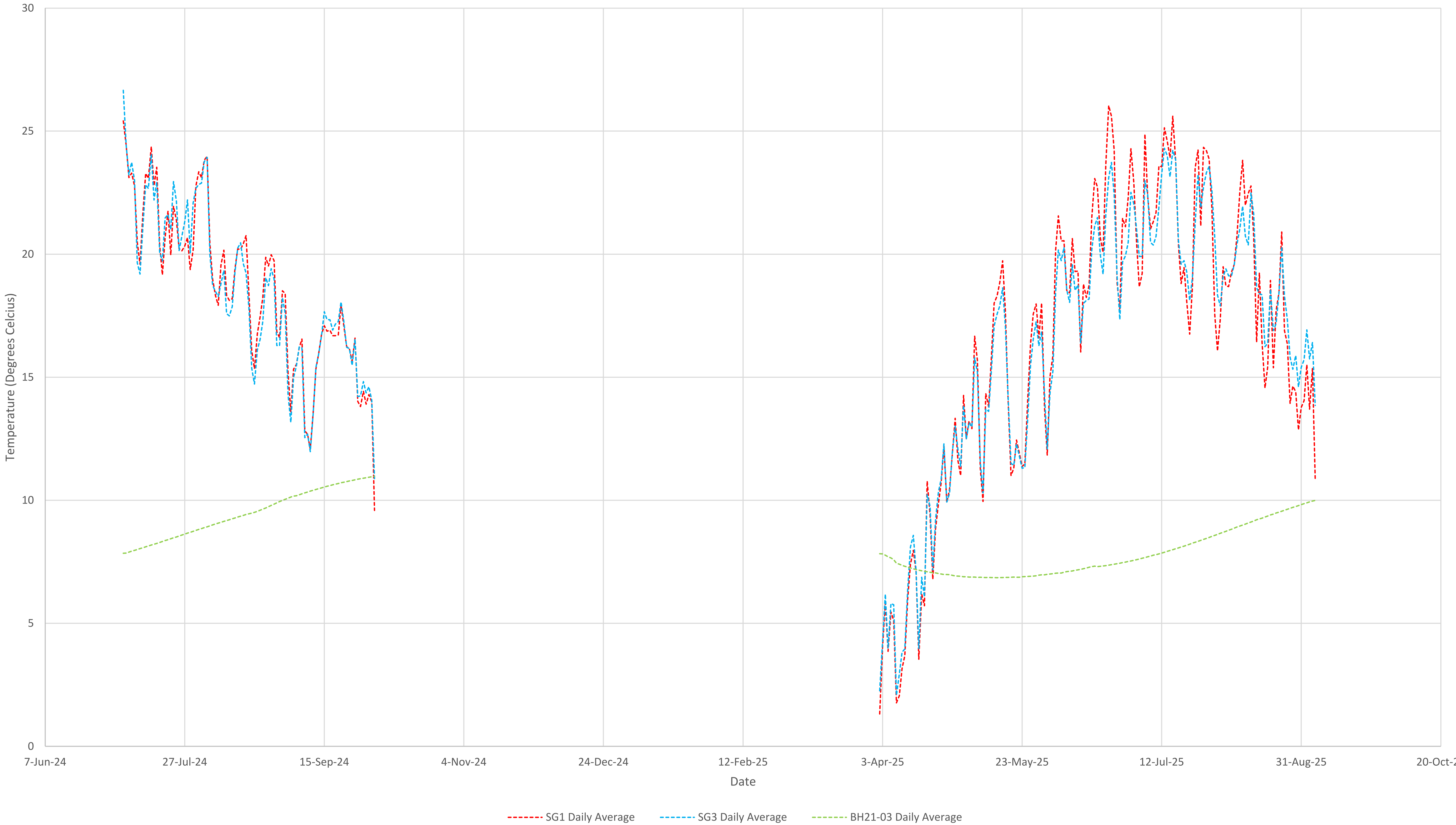
TITLE
INTERPRETED GROUNDWATER FLOW DIRECTION AND RADIUS OF INFLUENCE

CONSULTANT

wsp

YYYY-MM-DD	2025-12-02
DESIGNED	SG
PREPARED	BR
REVIEWED	CAMC
APPROVED	BH

PROJECT NO.	CONTROL	REV.	FIGURE
21471757	0003	0	9



CLIENT
R.W. TOMLINSON LIMITED

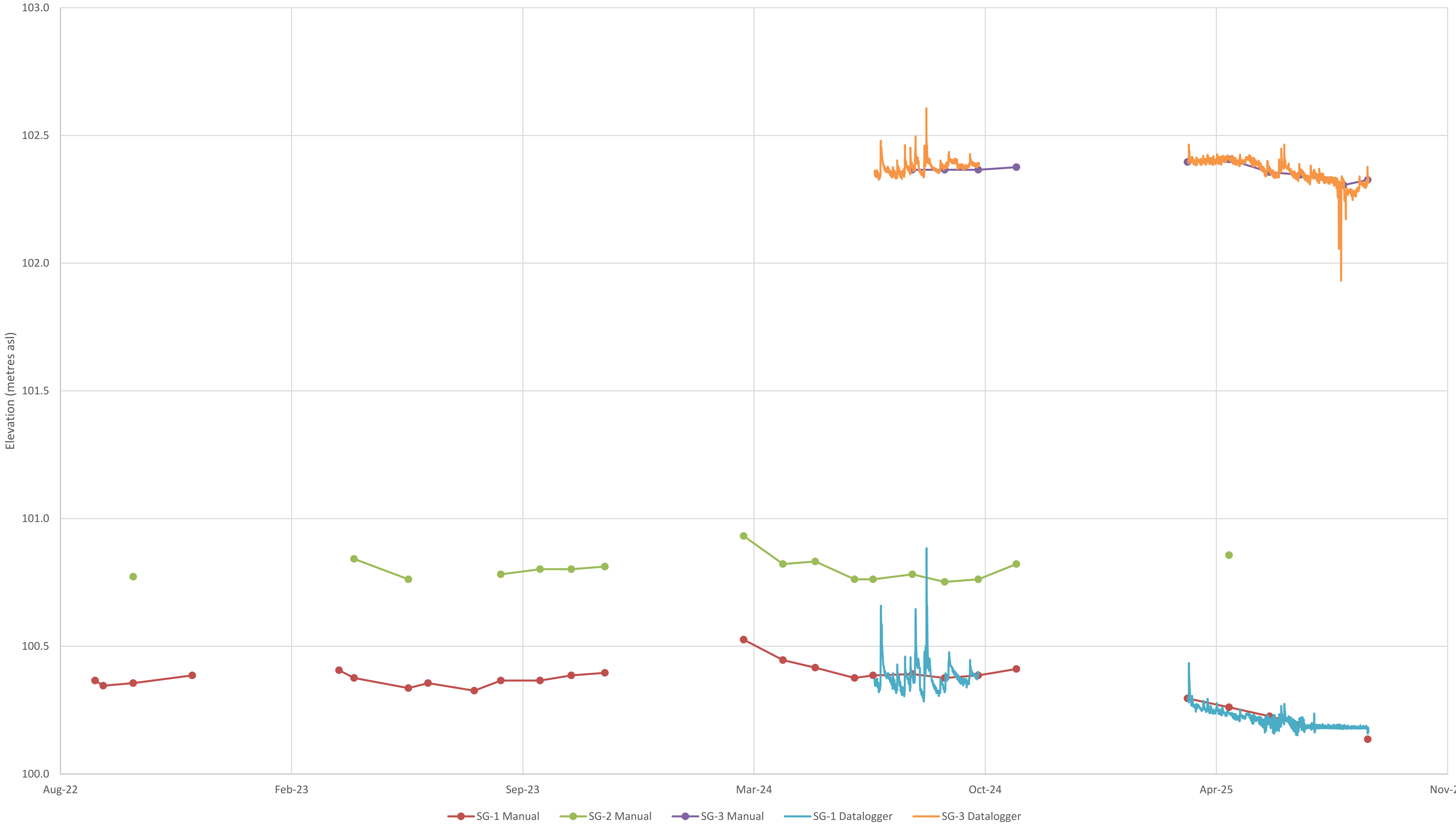
PROJECT
PROPOSED EAST OXFORD PIT
WATER REPORT

CONSULTANT

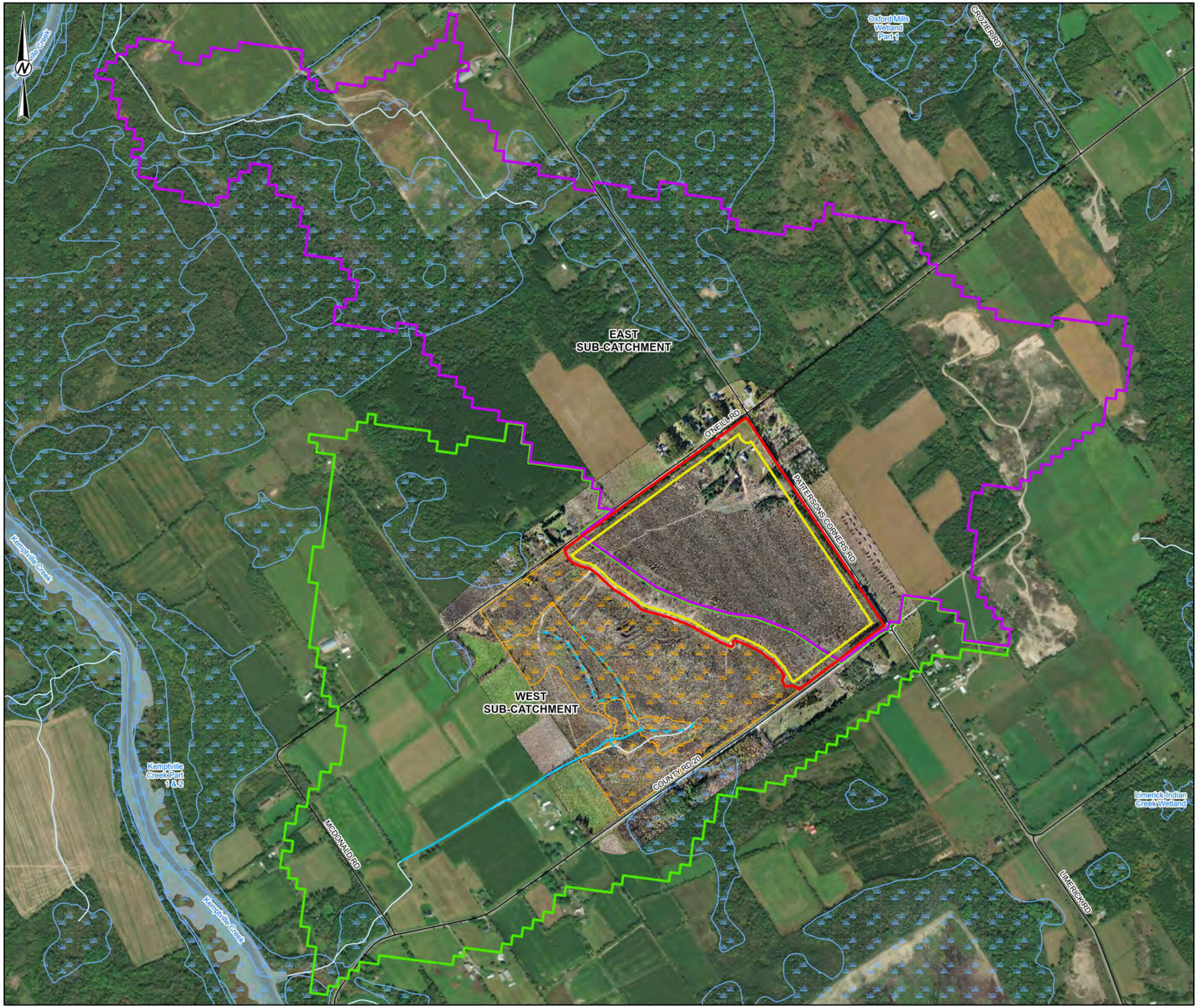
YYYY-MM-DD	2025-11-12
PREPARED	CAMC
DESIGN	--
REVIEW	BH
APPROVED	BH

TITLE
WATER TEMPERATURES AT SURFACE WATER LOCATIONS SG-1, SG-3 AND MONITORING WELL 21-03

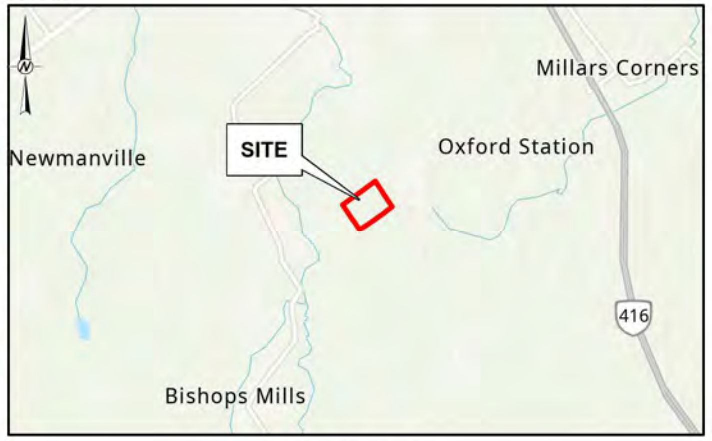
PROJECT No.	PHASE	Rev.	FIGURE
21471757		0	10



CLIENT R.W. TOMLINSON LIMITED	PROJECT PROPOSED EAST OXFORD PIT WATER REPORT
CONSULTANT: WSP YYYY-MM-DD: 2025-11-12 PREPARED: CAMC DESIGN: -- REVIEW: BH APPROVED: BH	TITLE SURFACE WATER ELEVATIONS AT SG-1, SG-2 AND SG-3
	PROJECT No. 21471757 · PHASE · Rev. 0 · FIGURE 11



KEY MAP



SCALE: 1:200,000

LEGEND

- PROPOSED LICENCED BOUNDARY
- PROPOSED LIMIT OF EXTRACTION
- EAST SUB-CATCHMENT
- WEST SUB-CATCHMENT
- ROADWAY
- PERMANENT STREAM
- INTERMITTENT STREAM
- WATERCOURSE
- WATERBODY
- 2025 WSP EVALUATED - NOT SIGNIFICANT WETLANDS
- UNEVALUATED WETLANDS

0 125 250 500

1:12,500 METRES

NOTE(S)

1. SITE CATCHMENTS WERE DELINEATED BASED ON SURVEYED TOPOGRAPHY; CATCHMENTS OUTSIDE THE SITE WERE DELINEATED USING THE MINISTRY OF NATURAL RESOURCES (MNRF) ONTARIO WATERSHED INFORMATION TOOL (OWIT) AND WERE NOT GROUND-TRUTHED.
2. ALL LOCATIONS ARE APPROXIMATE

REFERENCE(S)

1. CONTAINS INFORMATION LICENSED UNDER THE OPEN GOVERNMENT LICENCE - ONTARIO
2. BASE MAP: VANTOR, ESRI, NASA, NGA, USGS, SOURCES: ESRI, TOMTOM, GARMIN, FAO, NOAA, USGS, © OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
3. COORDINATE SYSTEM: NAD 1983 CSRS UTM ZONE 18N

CLIENT
R.W. TOMLINSON LIMITED

PROJECT
WATER REPORT
EAST OXFORD, ONTARIO

TITLE
WATERSHED SUB-CATCHMENT AREAS

CONSULTANT

wsp

YYYY-MM-DD	2025-12-02
DESIGNED	---
PREPARED	BR
REVIEWED	CD
APPROVED	BH

PROJECT NO.	CONTROL	REV.	FIGURE
21471757	0003	0	12

APPENDIX A

Important Information and Limitations of Report

Important Information and Limitations of Report

WSP Canada Inc. ("WSP") prepared this report solely for the use of the intended recipient, R.W. Tomlinson Limited, in accordance with the professional services agreement between the parties. In the event a contract has not been executed, the parties agree that the WSP General Terms for Consultant shall govern their business relationship which was provided to you prior to the preparation of this report.

The report is intended to be used in its entirety. No excerpts may be taken to be representative of the findings in the assessment.

The conclusions presented in this report are based on work performed by trained, professional and technical staff, in accordance with their reasonable interpretation of current and accepted engineering and scientific practices at the time the work was performed.

The content and opinions contained in the present report are based on the observations and/or information available to WSP at the time of preparation, using investigation techniques and engineering analysis methods consistent with those ordinarily exercised by WSP and other engineering/scientific practitioners working under similar conditions, and subject to the same time, financial and physical constraints applicable to this project.

WSP disclaims any obligation to update this report if, after the date of this report, any conditions appear to differ significantly from those presented in this report; however, WSP reserves the right to amend or supplement this report based on additional information, documentation or evidence.

WSP makes no other representations whatsoever concerning the legal significance of its findings.

The intended recipient is solely responsible for the disclosure of any information contained in this report. If a third party makes use of, relies on, or makes decisions in accordance with this report, said third party is solely responsible for such use, reliance or decisions. WSP does not accept responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken by said third party based on this report.

WSP has provided services to the intended recipient in accordance with the professional services agreement between the parties and in a manner consistent with that degree of care, skill and diligence normally provided by members of the same profession performing the same or comparable services in respect of projects of a similar nature in similar circumstances. It is understood and agreed by WSP and the recipient of this report that WSP provides no warranty, express or implied, of any kind. Without limiting the generality of the foregoing, it is agreed and understood by WSP and the recipient of this report that WSP makes no representation or warranty whatsoever as to the sufficiency of its scope of work for the purpose sought by the recipient of this report.

In preparing this report, WSP has relied in good faith on information provided by others, as noted in the report. WSP has reasonably assumed that the information provided is correct and WSP is not responsible for the accuracy or completeness of such information.

Benchmark and elevations used in this report are primarily to establish relative elevation differences between the specific testing and/or sampling locations and should not be used for other purposes, such as grading, excavating, construction, planning, development, etc.

Overall conditions can only be extrapolated to an undefined limited area around these testing and sampling locations. The conditions that WSP interprets to exist between testing and sampling points may differ from those that actually exist. The accuracy of any extrapolation and interpretation beyond the sampling locations will depend on natural conditions, the history of Site development and changes through construction and other activities. In addition, analysis has been carried out for the identified chemical and physical parameters only, and it should not be inferred that other chemical species or physical conditions are not present. WSP cannot warrant against undiscovered environmental liabilities or adverse impacts off-Site.

The original of this digital file will be kept by WSP for a period of not less than 10 years. As the digital file transmitted to the intended recipient is no longer under the control of WSP, its integrity cannot be assured. As such, WSP does not guarantee any modifications made to this digital file subsequent to its transmission to the intended recipient.

This limitations statement is considered an integral part of this report.

APPENDIX B

Qualifications and Experience

CAITLIN COOKE, M.Sc., P.Geo.

Lead Hydrogeologist, Earth and Environment

Areas of practice

Hydrogeology

PROFILE

Caitlin is a hydrogeologist with over 20 years of consulting experience with WSP and Golder in Ottawa. Her expertise includes hydrogeological investigations in support of Permit to Take Water applications and construction dewatering registrations under the Environmental Activity and Sector Registry. She is responsible for planning, project management, technical analysis and reporting for a variety of hydrogeological and environmental investigations, including monitoring of groundwater and surface water quality at landfills and quarries, borehole drilling and groundwater monitoring well installation, groundwater supply assessments for residential and commercial developments, and groundwater modelling in support of construction dewatering projects and permit to take water applications. Caitlin has a strong awareness of and commitment to health and safety, and has prepared comprehensive plans for worker health and safety for numerous work sites, including landfills, residential development sites, quarries and wetlands.

EDUCATION

M.Sc. Earth Sciences, University of Waterloo, Waterloo, Ontario	2004
B.Sc. Earth Sciences, University of Waterloo, Waterloo, Ontario	2002

PROFESSIONAL DEVELOPMENT

Critical Thinking in Aquifer Test Interpretation	2011
WHMIS	2004, 2009, 2015

PROFESSIONAL ASSOCIATIONS

Association of Professional Geoscientists of Ontario	P.Geo.
International Association of Hydrogeologists	Member

CAREER

Lead Hydrogeologist, WSP	2022 – Present
Hydrogeologist, Golder Associates Ltd., Ottawa, Ontario (WSP Acquisition)	2004 – 2022

PROFESSIONAL EXPERIENCE

Infrastructure

- Nation Municipality Water Transmission Line, Limoges, Ontario, Canada (2021): Hydrogeologist. Conducted background review, technical hydrogeological analysis and reporting related to the installation of a 10km pipeline by open-cut and HDD techniques. Analysis included predictions of the rate of groundwater inflow, water quality testing and the identification of hydrogeological risks. Coordinated a pre-construction private well testing program.
- City Centre Avenue and Elm Street West IRSW, Ottawa, Ontario, Canada (2021-2022): Hydrogeologist. Conducted background review, technical hydrogeological analysis and reporting related to the road, sewer and watermain reconstruction of

City Centre Avenue and Elm Street West in downtown Ottawa. Analysis included predictions of the rate of groundwater inflow, water quality testing and the identification of hydrogeological risks.

— Albert Street, Queen Street, Slater Street and Bronson Avenue IRSW, Ottawa, Ontario, Canada (2020). Hydrogeologist. Conducted background review, technical hydrogeological analysis and reporting related to the road, sewer and watermain reconstruction of Albert Street, Queen Street, Slater Street and Bronson Avenue in downtown Ottawa. Analysis included predictions of the rate of groundwater inflow, water quality testing and the identification of hydrogeological risks.

— Strandherd Drive and Kennedy Burnett Stormwater Management Pond Construction, Ottawa, Ontario, Canada (2019-2021). Hydrogeologist. Conducted background review, technical hydrogeological analysis and reporting related to the road, sewer and watermain reconstruction of Strandherd Drive and the rehabilitation and deepening of the Kennedy Burnett Stormwater Pond. Analysis included predictions of the rate of groundwater inflow, water quality testing and the identification of hydrogeological risks.

— Bronson Avenue Overpass, Ottawa, Ontario, Canada (2018-2019). Hydrogeologist. Conducted background review, technical hydrogeological analysis and reporting related to the road, sewer and watermain reconstruction of Bronson Avenue at the Highway 417 Overpass. Analysis included predictions of the rate of groundwater inflow, water quality testing and the identification of hydrogeological risks.

— Airport Parkway Culvert Renewal, Ottawa, Ontario, Canada (2018-2019). Hydrogeologist. Conducted background review, technical hydrogeological analysis and reporting related to the renewal of culverts at the Airport Parkway northbound Walkley Road off-ramp. Analysis included predictions of the rate of groundwater inflow and the identification of hydrogeological risks.

— Borthwick, Quebec and Gardenvale IRSW, Ottawa, Ontario, Canada (2017-2019). Hydrogeologist. Conducted background review, technical hydrogeological analysis and reporting related to infrastructure installation/replacement for segments of Borthwick Avenue, Quebec Street and Gardenvale Avenue. Analysis included predictions of the rate of groundwater inflow, water quality testing and the identification of hydrogeological risks.

— Rideau Valley Drive Storm Sewer, Ottawa, Ontario, Canada (2014-2015). Hydrogeologist. Conducted background review, technical hydrogeological analysis and reporting related to the road and storm sewer reconstruction of Rideau Valley Drive in the village of Kars. Analysis included predictions of the rate of groundwater inflow, water quality testing at private residences and the identification of hydrogeological risks.

Land Development

— Ottawa Hospital new campus, Ottawa, Ontario (2021-2024). Lead hydrogeologist. Developed and managed hydrogeological testing program to evaluate hydrogeological conditions across the development site. Estimated groundwater inflow to excavations during construction of advanced works and prepared documentation to support registration on the EASR, including identification of hydrogeological risks.

— Findlay Creek Village Development and Pathways Development, Ottawa, Ontario, Canada (2004-present). Hydrogeologist. Managed annual groundwater and natural environment monitoring programs associated with the PTTWs for the sites.

Maintained a network of more than twenty pressure transducers at groundwater monitoring locations. Evaluated groundwater elevation trends in the adjacent Provincially Significant Wetland (PSW). Reviewed groundwater elevation data, performed data analysis and interpretation and prepared comprehensive annual reports.

— Village of Limoges Drinking Water and Wastewater Expansion, Limoges, Ontario, Canada (2013-2016). Hydrogeologist. Managed hydrogeological investigations for the proposed expansion of the Village of Limoges drinking water supply. Prepared a Category 3 Permit to Take Water application for two new wells and demonstrated potential impacts to the local environment. Liaised with geotechnical, archaeological and biological disciplines during these investigations.

CHRISTOPHER DAVIDSON, B.Sc. (Eng.), P.Eng.

Senior Water Resources Engineer
Ontario – Environment Planning

Areas of practice

Water Resources Management

Stormwater Design

Hydrologic Modelling

Hydraulic Modelling

Languages

English

French

PROFILE

Christopher Davidson is a licensed engineer in the province of Ontario with more than 20 years of experience in the field of water resources, including stormwater design, hydrology and hydraulic modelling, water balances, water management, and climate interactions with surface water.

Project experience includes design of stormwater collection and detention systems, design of hydraulic structures, flood delineation and management, and climate change impacts and mitigation. Water resources work has been completed for clients in the Municipalities, Land Developers, Power Generation, Aggregate and Mining Sectors.

EDUCATION

B.Sc. (Eng.) Environmental (Civil) Engineering, University of Waterloo, Ontario, Canada	2003

AWARDS

Professional Engineers Ontario Mississauga Chapter "Young Member Award"	2015

PROFESSIONAL ASSOCIATIONS

Professional Engineers Ontario	PEO
Engineers in Residence	EIR

CAREER

Senior Water Resources Engineer, Surface Water, Ontario – Environment Planning, WSP, Mississauga, Ontario, Canada	2021 – Present
Water Resources Engineer, Golder Associates Ltd. (WSP Acquisition), Mississauga, Ontario, Canada	2007 – 2021
Water Resources EIT, R.J. Burnside & Associates Limited, Brampton, Ontario, Canada	2003 – 2007
Engineering Co-op Student, City of London, Ontario, Canada	2002

RELEVANT PROFESSIONAL EXPERIENCE

Stormwater Design

— Biggars Lane Landfill Stormwater Design, Mount Pleasant, Ontario, Canada (2022): Provided designs for stormwater management for the expansion of the Biggars Lane Landfill. Design included detailed design for a proposed runoff capture and conveyance, assessment of an existing stormwater management pond, hydrologic/hydraulic modelling, and assessment of changes for a nearby municipal drain. Client: Client: County of Brant.

— Vineland Research Station Tree Culture Research Park, Vineland Station, Ontario, Canada (2021): Detailed design, construction support, and permitting for a proposed urban tree research park. The goal of the design was to isolate trees in HDPE cells in a variety of growing media over multiple growing seasons and measure the effects of urban runoff in order to develop best-practices for urban trees and use in low impact development features. Design included tree cells, drainage in the cells, a collection system to allow measurement of infiltration, and permitting for discharges. Client: Vineland Research and Innovation Centre.

- Nassau Airport Stormwater Management, Nassau, Bahamas (2019): Designed stormwater management system for the airplane parking aprons at the Lynden Pindling International Airport in Nassau, Bahamas. Included reviewing existing information and background reports for the airport, setting out survey and monitoring requirements, hydrologic and hydraulic modelling of existing conditions, development and costing of a range of proposed drainage options, and engineering design for the preferred option. Client: Nassau Airport Development Company (NAD).
- Middlesex Landfill Stormwater Management, Middlesex, Ontario, Canada (2019): Prepared and evaluated conceptual designs for stormwater management at two existing landfill sites in Middlesex County. Work with local conservation authorities to prepare stormwater briefs for Design and Operation and Closure plans for the landfills. Client: The Municipality of Southwest Middlesex.
- Milton Derry Green Stormwater Peer Review, Milton, Ontario, Canada (2017): Peer review of a proposed stormwater management plan, including channel widening and naturalization, proposed stormwater ponds, and culvert capacity reviews for the adjacent railway easement. Client: Town of Milton.
- Barrie Landfill Stormwater Design, Barrie, Ontario, Canada (2014): Completed detail design and modelling for a proposed stormwater management system for the Barrie Landfill. A stormwater management system was designed for the site, including capture swales, conveyance swales, roadway spill points, flow spreaders, and six stormwater management infiltration ponds laid out in series. The proposed system was modelled using EPA SWMM 5. The ultimate system design included infiltration ponds, with added constraints relating to landfill gas collection systems and public impact with respect to maintaining green spaces and pathways. Client: City of Barrie.
- Etobicoke Stormwater Management, Toronto, Ontario, Canada (2014): Designed a stormwater management system for a ready-mix site. The system included collection from buildings, proposed grading changes, major flow pathways, and a stormwater management pond. The proposed system was modelled using Visual Otthymo. Challenges included limited space for stormwater management and required enhancement of peak flow mitigation to increase capacity in historic storm conveyance systems downstream of the site. Client: Holcim.
- Nuclear Deep Geological Repository Stormwater Management, Kincardine, Ontario, Canada (2013): Designed a stormwater management for surface water at the proposed Deep Geological Repository for nuclear waste near the Bruce Nuclear site. Design included a proposed pipe system and a collection system for large stockpiles of excavated material, as well as a stormwater management pond design to remove suspended solids (from the runoff and from dewatering flow during construction). The proposed system was modelled using EPA SWMM 5. Challenges included low grades, high water levels in nearby Lake Huron, and adjacent wetland features. Client: CNWO.
- McMasterville Stream Channel Relocation, Masterville, Quebec, Canada (2011): Lead modeller for the design of a proposed new channel to divert a creek around an area of potential groundwater contamination. The project included hydrologic modelling to estimate return period flows in the new creek and HECRAS hydraulic modelling of the proposed channel. A geomorphic assessment was also prepared, and a plan for fisheries rehabilitation was included in construction design and tender documents. Client: ICI Explosives Inc.

Water Resources Management

- Gold Mine Water Taking Permits and Cumulative Effects Assessment, Goudreau, Ontario, Canada (2023): Surface water technical lead for the permitting a gold mine in Ontario. Developed hydrologic/hydraulic model for a lake to assess the cumulative effects of several mine takings and diversion. Prepared supporting studies and applications for water taking permit as well as construction permits for Transport Canada Navigation Protection and Natural Resources Land Access. Client: Alamos Gold Inc.
- Mine Closure Planning, Cadillac, Quebec, Canada (2023): Surface water technical lead for closure of a tailings storage facility in Quebec. Oversaw development of hydrologic/hydraulics models of the existing tailings storage facilities and conceptual design of additional storage for closure conditions and meeting Directive 019. Client: Agnico-Eagle Mines Ltd.
- Darlington New Nuclear Project Wetland Water Balance, Clarington, Ontario, Canada (2022): Created a water balance for significant features at the site of the proposed New Nuclear Project. Assess the flow to the features and any changes in hydroperiod for existing, construction, and post-construction scenarios associated with the development of new nuclear facilities. Client: Ontario Power Generation (OPG).
- Colborne WWTP Discharge Assimilative Capacity, Colborne, Ontario, Canada (2021): Cumulative impact assessment in support of ECA approvals for expansion of a WWTP system. Included background data review, support for CORMIX modelling, and discussions with regulators. Client: Northumberland County.
- Havelock WWTP Discharge Assimilative Capacity, Havelock, Ontario, Canada (2021): Cumulative impact assessment in support of ECA approvals for expansion of a WWTP system. Included background data review, field studies, and discussions with regulators. Client: Township of Havelock-Belmont-Methuen.
- Walker Landfill EA, Ingersoll, Ontario, Canada (2019): Review and assist with preparation of EA documents for proposed landfill. Included modelling, conceptual design for stormwater system, evaluation of potential impacts, and climate change projections to evaluate future conditions. Client: Walker Industries.

Hydrologic Modelling

- Glenridge Quarry Naturalization, St. Catharines, Ontario, Canada (2022): Senior review for hydrologic and hydraulic modelling of the drainage system at the Glenridge Quarry. Modelling included runoff an piped connections between various on-site ponds. Client: Regional Municipality of Niagara.
- Markham Airport Site Remediation, Markham, Ontario, Canada (2014): Provided modelling assistance for rehabilitation of an airport site development. Created Visual Otthymo and MIDUSS models to estimate the flows in a tributary to the Rouge River crossing the site and used HECRAS to delineate floodlines. Worked with the TRCA to establish setbacks and limits for development around the creek (including fill removal) and developed a plan for rehabilitation of the floodplain and removal of a temporary haul road and culvert crossing the tributary stream. Created HECRAS models for site drainage features including surface swales to control runoff and promote infiltration. Client: Markham Airport Inc.
- Pickering Nuclear Flooding, Pickering, ON, Canada (2013): Modelled intense rainfall and peak wave overtopping at Area 3 at Pickering Nuclear in EPA SWMM5 to evaluate potential flood levels across the site. The model included both minor

storm drainage system (pipes) and major storm drainage (overland flow and ponding) as well as links between the two systems. Used updated wave and lake level information to estimates of wave heights and breakwater overtopping during extreme storm events. Reported on the potential flood level effects of proposed changes at the site and flood protection requirements for key equipment. Client: OPG.

Hydraulic Modelling

— Stream Erosion and Reconstruction, Region of Peel, Ontario, Canada (2025): Conceptual and detailed design for interim erosion protection at a culvert in Brampton. Scope included fluvial geomorphology assessment of the stream, assessment of ongoing erosion risks at the structure, and design and permitting of interim erosion protection measures. Client: Region of Peel.

— Stream Natural Channel Design, Port Hope, Ontario, Canada (2023): Conceptual design of a stream naturalization project to provide habitat for brook trout. Scope included hydrologic modelling for catchment flows, hydraulic modelling for channel design, and work with bioscience team to develop offline pond habitat. Client: Canadian Nuclear Laboratories (CNL).

— Cameco Port Hope Floodline and Mitigation, Port Hope, Ontario, Canada (2021): Combined hydrologic/hydraulic modelling for a Cameco property. Included floodline modelling for a creek adjacent to the site as well as stormwater design for conveyance from the site and downstream municipal storm sewers. Client: Cameco.

— Mariposa Brook Drainage Study, Lindsay, Ontario, Canada (2005): Performed a hydraulic analysis using HEC-RAS software on a 17-km section of municipal drain and evaluated cleanout options for increasing capacity in the of drain as well as reducing downstream flooding. Client: Government of Ontario*

Stream Erosion and Scour Analysis

— Etobicoke Creek Sewer Twinning Hazard Assessment, Region of Peel, Ontario, Canada (2025): Fluvial geomorphology and erosion hazard delineation along a section of urban creek for a proposed sanitary sewer project. Client: Region of Peel .

— Malaga Road Creek Hazard Setback Assessment, Oshawa, Ontario, Canada (2024): Fluvial geomorphology and hydraulic modelling to support the hazard assessment setback for a proposed residential development along Oshawa Creek. Client: Durham Region.

— Pottersburg Creek Scout Assessment, London, Ontario, Canada (2024): Vertical scour assessment and assessment of scour protection measures for a proposed sewer crossing under Pottersburg Creek in London, Ontario. Client: GM Blue Plan.

— CN Rail Erosion Analysis, Algonquin Park, Ontario, Canada (2014): Created a HEC-RAS model for a river section in northern Ontario, then used the model to evaluate the water level and geomorphology implications of a series of proposed remediation options along a historic CN right of way. The modelling included some discussion of mitigation options, including weir construction, stream bank armouring, and vegetative covering. Client: CN Rail.

— Trans Canada Pipelines Scour Assessment, Toronto, Ontario, Canada (2014): Directed field work and analysis to estimate scour depths at water crossings for proposed natural gas pipelines in Ontario. Used a variety of scour models to estimate conservative burial depths required so that pipes are not exposed during major flow events. Work included preparation of EA baseline reports burial depth recommendations for detailed design. Client: TransCanada PipeLines Limited.

Waste and Water Quality

- Lambton Coal Station Pond Closure, Lambton, Ontario, Canada (2014): Created an EPA SWMM5 model to evaluate the closure of a water treatment system at the Lambton Generating Station. The model included a series of ponds collecting landfill runoff and was used to evaluate timing of closure (with respect to single storm events and continuous modelling of seasonal runoff) in order to allow rehabilitation of a series of ponds. Client: Ontario Power Generation.
- Sustainable Approaches to Soil, Sediment, and Materials Management from SWM Ponds, Waterloo, Ontario, Canada (2013): Assessed the incoming sediment load to a number of stormwater management facilities in the Waterloo area as part of the program examining sustainable use of materials in Waterloo. Estimates were compared against measured sediment accumulation rates (where available) and used to extrapolate actual accumulation rates in other ponds. The goal of the work was to look at various options for the use of the pond sediment material after cleanout. Client: City of Waterloo.
- Bruce A Nuclear Generation Station Restart, Ontario, Canada (2007): Investigate the water qualities issues associated with the proposed cleanout of pipes at the Bruce A nuclear site. Client: Canadian Nuclear Safety Commission.

PUBLICATIONS AND PRESENTATIONS

Publications

- Davidson, Christopher. August/September 2020. Water Resilience: The Missing Piece in Dealing with Climate Change. Environmental Science and Engineering Magazine.
- Davidson, Christopher. November 2020. How Water Resilience Helps Communities Deal with Climate Change. Municipal World Magazine.

Presentations

- Christopher Davidson. 2023. An Estimate of Climate Costs for Mississauga Storm Sewers. 2023 Credit Valley Conservation Research Symposium, December. Mississauga, Canada.
- Davidson, Christopher and Kevin MacKenzie. 2017. Mapping Climate Risks in an Interconnected System. 37th Annual Conference of the International Association for Impact Assessment, April. Montreal, Canada.
- Christopher Davidson and Steve Auger. 2016. Development of a Low Impact Development and Urban Water Balance Modelling Tool. International Low Impact Development Conference - American Society of Civil Engineers, August. Portland, United States.
- Christopher Davidson and Kevin MacKenzie. 2011. Golder Daily Climate Record Generator. 20th Canadian Hydrotechnical Conference, CSCE, June. Ottawa, Canada.

BRIAN HENDERSON, M.A.Sc., P.Eng.

Principal Environmental Engineer

Areas of practice

Hydrogeology

PROFILE

Brian Henderson, P.Eng., is a Principal Environmental Engineer with WSP Canada Inc. in Ottawa with almost 20 years of experience in hydrogeology. 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 construction dewatering, hydrogeological impact studies and municipal water supply studies. 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. Brian provides senior/peer review on a wide variety of projects and support during project design and construction.

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

PROFESSIONAL ASSOCIATIONS

Professional Engineers Ontario, 2009	PEO

CAREER

Principal Environmental Engineer, WSP Canada Inc. (acquisition of Golder Associates Ltd.)	2022 – Present
Environmental Engineer, Golder Associates Ltd., Ottawa, Ontario	2006 – 2022

PROFESSIONAL EXPERIENCE

Hydrogeology

Infrastructure

- **Combined Sewage Storage Tunnel, Ottawa, Ontario (2013-2019):** Hydrogeological lead to carry out 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. Tasks included design and implementation of the hydrogeological field program, carrying out packer test data analysis, compiling and interpreting data and completing 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. Technical review and guidance was provided to the design team along with guidance and supervision of contractors.
- **South Nepean Collector Sewer Phase Two, Ottawa, Ontario (2015-2017):** Hydrogeological lead undertaking the 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 (2010-2012):** Intermediate Hydrogeologist carrying out 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. 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. 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 (2010-2016):** Intermediate Hydrogeologist undertaking 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 (2019-2021):** Hydrogeological lead undertaking 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 (2015):** Hydrogeologist undertaking 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 (2015-2016):** Intermediate hydrogeologist undertaking 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 (2018-2020):** Lead Hydrogeologist undertaking 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*. 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 (2012):** Hydrogeologist conducting the hydrogeological subsurface investigations in support of design and tender of watermain replacement, completing a Permit to Take Water application for the City of Ottawa, and assisting in developing construction specifications for soil and groundwater management.
- **Jockvale Road Jock River Bridge Replacement, Ottawa, Ontario (2012-2013):** Hydrogeologist undertaking 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. A Permit to Take Water was obtained 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. A monitoring program was developed to support the water taking activities.

General Hydrogeology

- **Permit to Take Water Applications/ Environmental Activity and Sector Registry Documentation, Ontario (2006-Present):** Conducted background review, technical hydrogeological analysis and reporting related to Category 1, 2 and 3 Permit to Take Water applications as well as dewatering and discharge plans to support Environmental Activity and Sector Registry registrations for construction dewatering projects, quarry dewatering and pumping tests.
- **Groundwater Numerical Modelling, Ontario (2006-Present):** 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 (2006-Present):** 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 (2011-2014):** Lead hydrogeologist to completed the necessary studies to inform a Master Plan for the potable water and wastewater 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.
- **Hydrogeological Assessment for Quarry Licensing, Henderson Quarry, Ottawa, Ontario (2008-2018):** 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 was the lead hydrogeologist on the project developing detailed conceptual and numerical models of groundwater flow, and demonstrating potential impacts to local environment and proposing mitigative measures.
- **Hydrogeological Assessment for Quarry Licensing, Brickyards Quarry, Ottawa, Ontario (2015-2019):** Lead hydrogeologist carrying out the required

hydrogeological studies to support an application under the Aggregate Resource Act and the Planning Act for a site plan license for a new quarry. Tasks included developing detailed conceptual and numerical models of groundwater flow, demonstrating potential impacts to local environment and proposing mitigative measures. On-site hydraulic conductivity testing and groundwater/surface water interaction studies were completed.

- **Hydrogeological Assessment for Quarry Licensing, Bank Street Quarry, Ottawa, Ontario (2018-2023):** Lead hydrogeologist carrying out the required hydrogeological studies to support an application under the Aggregate Resource Act for a site plan license for a new quarry. Tasks included developing detailed conceptual and numerical models of groundwater flow, demonstrating potential impacts to local environment and proposing mitigative measures. On-site hydraulic conductivity testing and groundwater/surface water interaction studies were completed.
- **Hydrogeological Assessment for Quarry Licensing, Canaan Quarry, Ottawa, Ontario (2006-2007):** Hydrogeologist carrying out the required hydrogeological studies to support an application under the Aggregate Resource Act and the Planning Act for a site plan license for a quarry expansion. Tasks included developing detailed conceptual and numerical models of groundwater flow, demonstrating potential impacts to local environment and proposing mitigative measures. On-site hydraulic conductivity testing and groundwater/surface water interaction studies were completed.
- **Conceptual Design for the Remediation of a Closed Landfill, County of Northumberland, Ontario (2009-2016):** Lead hydrogeologist on a project where Golder presented a number of remediation alternatives to the County of Northumberland to address surface water compliance issues arising from leachate derived impacts identified in a nearby creek caused by a closed landfill. Hydrogeological tasks included a review and analysis of existing data, developing the conceptual groundwater flow model, carrying out numerical modelling of the remediation options, and preparing reports.
- **Options Evaluation and Preliminary Design for Tailings Management Option, Nunavut (2011):** Hydrogeologist on a project where Golder completed a tailings and waste rock management options evaluation and preliminary design of selected tailings management options at a mine site in Nunavut. Hydrogeological tasks included 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 (2009):** Hydrogeologist on a project where 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. Tasks included field program design, compilation, interpretation and analysis of data, conceptual model development, numerical modelling, report preparation and QA/QC of deliverables.
- **Wellhead Protection Study, Deloro, Ontario (2007-2008):** Hydrogeologist on a project where Golder completed a Groundwater Vulnerability Study, a threats inventory and a water quality risk assessment for the municipal water supply well in Deloro, 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. Tasks included field program design, compilation, interpretation and analysis of data, conceptual model development, numerical modelling, groundwater vulnerability mapping, report preparation and QA/QC of deliverables.

- **Phase III ESA at the Ottawa International Airport, Ottawa, Ontario (2009-2010):** 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.

APPENDIX C

Record of Borehole Sheets

RECORD OF BOREHOLE: 21-01

PROJECT: 21471757

SHEET 1 OF 1

LOCATION: N 4976584.9 ;E 371193.2

BORING DATE: July 9, 2021

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Boring method: Power Auger, 200 mm Diam. (Hollow Stem)

Elev. / Depth (m)	Soil Profile Description
107.77	GROUND SURFACE
0.00	TOPSOIL - (SP) SAND, fine, some silt; dark brown, contains organic matter (rootlets); non-cohesive, moist, loose
0.10	(SP) SAND, fine to medium; orange to brown, mottled; non-cohesive, moist, loose
106.70 / 1.07	(SW) gravelly SAND to SAND, some gravel, fine to coarse, trace silt; light brown, contains cobbles; non-cohesive, moist to wet, compact
104.57 / 3.20	(SP) SAND, fine, some medium, trace silt; light brown; non-cohesive, wet, dense
101.52 / 6.25	(SM) SILTY SAND, some clay, some gravel; grey (GLACIAL TILL); non-cohesive, wet, very dense
100.45 / 7.32	End of Borehole

Sample Number	Type	Blows/0.30m	Additional Lab. Testing
1	SS	9	
2	SS	5	
3	SS	68	M
4	SS	28	M
5	SS	45	
6	SS	37	
7	SS	15	M
8	SS	20	
9	SS	74	
10	SS	>60	

Piezometer or Standpipe Installation: Flushmount Casing; Backfill; Bentonite Seal; Silica Sand; 50 mm Diam. PVC #10 Slot Screen; Cave

Dynamic Penetration Resistance, Blows/0.3m: 20, 40, 60, 80
Shear Strength Cu, kPa: nat V. + Q - ●; rem V. ⊕ U - ○; 20, 40, 60, 80
Hydraulic Conductivity, k, cm/s: 10^{-5}, 10^{-4}, 10^{-3}, 10^{-2}
Water Content Percent: Wp, W, Wl; 20, 40, 60, 80

Note(s):

1. Water level measured at a depth of 1.37 m (Elev. 106.4 m) upon completion of drilling.

2. Water level measured in screen at a depth of 1.44 m (Elev. 106.33 m) on July 20, 2021.

DEPTH SCALE 1 : 50

WSP GOLDER

LOGGED: JS

CHECKED: LEB

MIS-BHS 001 21471757.GPJ GAL-MIS.GDT 3/15/22 ZS

PROJECT: 21471757

RECORD OF BOREHOLE: 21-02

SHEET 1 OF 2

LOCATION: N 4976305.0 ;E 371150.9

BORING DATE: July 14, 2021

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80

SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ : 20 40 60 80

HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-5} 10^{-4} 10^{-3} 10^{-2}

WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl : 20 40 60 80

SOIL PROFILE

DESCRIPTION	ELEV. DEPTH (m)
GROUND SURFACE	107.84
TOPSOIL	0.00
(SP) SAND, fine, some silt; brown, mottled; non-cohesive, moist, loose	0.15
(SP) SAND, fine to medium, some silt; brown; non-cohesive, wet, compact	106.47 / 1.37
(SW) SAND, fine to coarse, trace gravel, trace silt; brown; non-cohesive, wet, dense	104.18 / 3.66
(SP) SAND, fine, some silt; brown; non-cohesive, wet, dense	102.96 / 4.88
(SM/ML) SILTY SAND to sandy SILT, fine, trace gravel, trace clay; grey; non-cohesive, wet, compact to very dense	101.74 / 6.10
(SM) SILTY SAND, some gravel; grey (GLACIAL TILL); non-cohesive, wet, very dense	98.85 / 8.99
End of Borehole	98.39 / 9.45

SAMPLES

NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING
1	SS	5	
2	SS	4	
3	SS	14	
4	SS	19	M
5	SS	15	
6	SS	44	M
7	SS	33	
8	SS	44	
9	SS	15	
10	SS	21	
11	SS	61	
12	SS	>126	
13	SS	>51	

PIEZOMETER OR STANDPIPE INSTALLATION

- Bentonite Seal
- Backfill
- Bentonite Seal
- Silica Sand
- 50 mm Diam. PVC #10 Slot Screen
- Cave

CONTINUED NEXT PAGE

DEPTH SCALE 1 : 50

WSP GOLDER

LOGGED: JS/KG

CHECKED: LEB

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-5} 10^{-4} 10^{-3} 10^{-2}); WATER CONTENT PERCENT Wp ⊢—○W—⊣ Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Note(s): 1. Water level measured at a depth of 2.13 m (Elev. 105.71) upon completion of drilling. 2. Water level measured in screen at a depth of 1.61 m (Elev. 106.23 m) on July 21, 2021.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

RECORD OF BOREHOLE: 21-03

PROJECT: 21471757

LOCATION: N 4975992.3 ;E 371102.9

BORING DATE: July 12, 2021

SHEET 1 OF 2

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

GROUND SURFACE: 109.87

Soil Profile Description	Elev. / Depth (m)	Sample Number	Type	Blows/0.30m	Additional Lab. Testing	Piezometer or Standpipe Installation
TOPSOIL - (SW) SAND, some gravel and silt; dark brown, contains organic matter; non-cohesive, moist, loose	0.00					Bentonite Seal
(SW) gravelly SAND, some silt; brown, mottled; non-cohesive, moist, loose	0.15	1	SS	8		
(SW) gravelly SAND to SAND and GRAVEL, trace to some silt, contains cobbles; brown; non-cohesive, moist, very dense	109.26 / 0.61	2	SS	111		
		3	SS	114		
		4	SS	83	M	Backfill
		5	SS	>130		
(SP) SAND, fine to medium, trace to some gravel, trace to some silt; brown; non-cohesive, moist to wet, dense to very dense	105.91 / 3.96	6	SS	61		
		7	SS	37	M	Bentonite Seal
		8	SS	33		Silica Sand
		9	SS	65	M	50 mm Diam. PVC #10 Slot Screen
		10	SS	26		
		11	SS	62		
(SM) SILTY SAND, fine; grey brown to brown; non-cohesive, wet, very dense to dense	101.79 / 8.08	12	SS	46	M	Cave
		13	SS	23		
	99.96 / 9.91	14	SS	10		

Dynamic Penetration Resistance, Blows/0.3m: 20, 40, 60, 80

Shear Strength Cu, kPa: nat V. + Q - ● ; rem V. ⊕ U - ○ ; 20, 40, 60, 80

Hydraulic Conductivity, k, cm/s: 10^{-5}, 10^{-4}, 10^{-3}, 10^{-2}

Water Content Percent: Wp —○W— Wl ; 20, 40, 60, 80

CONTINUED NEXT PAGE

DEPTH SCALE 1 : 50

WSP GOLDER

LOGGED: JS

CHECKED: LEB

PROJECT: 21471757

RECORD OF BOREHOLE: 21-03

SHEET 2 OF 2

LOCATION: N 4975992.3 ;E 371102.9

BORING DATE: July 12, 2021

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

--- CONTINUED FROM PREVIOUS PAGE ---

DEPTH SCALE METRES	BORING METHOD	DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.30m	PIEZOMETER OR STANDPIPE INSTALLATION
10	Power Auger 200 mm Diam. (Hollow Stem)	(ML) CLAYEY SILT; grey, contains shells; non-cohesive, wet, compact		14	SS	10	
11		(SM/ML) SILT and fine SAND, trace clay; grey; non-cohesive, wet, very dense	99.20 / 10.67	15	SS	88	Cave
		(SM) SILTY SAND, some clay, some gravel; grey, contains cobbles and boulders (GLACIAL TILL); non-cohesive, wet, very dense	98.59 / 11.28	16	SS	>50	
		End of Borehole	98.29 / 11.58				

Column headings also include: STRATA PLOT; DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○; 20, 40, 60, 80); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-5}, 10^{-4}, 10^{-3}, 10^{-2}); WATER CONTENT PERCENT (Wp —O^W— Wl; 20, 40, 60, 80); ADDITIONAL LAB. TESTING.

Note(s):

1. Water level measured at a depth of 5.54 m (Elev. 104.33 m) upon completion of drilling.

2. Water level measured in screen at a depth of 4.49 m (Elev. 105.38 m) on July 21, 2021.

Depth scale: 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

DEPTH SCALE

1 : 50

WSP GOLDER

LOGGED: JS

CHECKED: LEB

RECORD OF BOREHOLE: 21-04

PROJECT: 21471757

SHEET 1 OF 1

LOCATION: N 4975329.9 ;E 370810.8

BORING DATE: July 16, 2021

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Boring method: Power Auger, 200 mm Diam. (Hollow Stem)

DEPTH SCALE METRES	DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.30m	PIEZOMETER OR STANDPIPE INSTALLATION
	GROUND SURFACE	101.14				
0	TOPSOIL - (SW) SAND, some gravel and silt; dark brown, contains organic matter; non-cohesive, moist, very loose	0.00				Bentonite Seal
	(SP) SAND, fine to medium; grey brown; non-cohesive, moist, loose	100.84 / 0.30	1	SS	2	
1			2	SS	13	
	(SM) SILTY SAND, fine; grey; non-cohesive, wet, compact	99.92 / 1.22	3	SS	11	Silica Sand
2	(SM) SILTY SAND, some angular gravel, trace clay; grey (GLACIAL TILL); non-cohesive, wet, dense to very dense	98.91 / 2.23	4	SS	23	50 mm Diam. PVC #10 Slot Screen
3			5	SS	62	Silica Sand
4			6	SS	36	
	End of Borehole	96.80 / 4.34				

Other column headings (no values entered): DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●, rem V. ⊕ U - ○; 20, 40, 60, 80); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-5}, 10^{-4}, 10^{-3}, 10^{-2}); WATER CONTENT PERCENT (Wp, W, Wl; 20, 40, 60, 80); ADDITIONAL LAB. TESTING.

Note(s):

1. Water level measured in screen at a depth of 0.14 m (Elev. 101.00 m) on July 20, 2021.

DEPTH SCALE 1 : 50

WSP GOLDER

LOGGED: JD

CHECKED: LEB

RECORD OF BOREHOLE: 21-05

PROJECT: 21471757

LOCATION: N 4976174.3 ;E 370692.1

BORING DATE: July 13, 2021

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

Soil Profile

Description	Elev. / Depth (m)
GROUND SURFACE	107.29 / 0.00
TOPSOIL - (SP) SAND, fine, some silt; dark brown, contains organic matter; non-cohesive, moist, loose	0.08
(SP) SAND, fine to medium, some gravel, some to trace silt; brown to light brown; non-cohesive, moist, loose to compact	105.77 / 1.52
(SP) SAND, fine to to medium, trace gravel, trace silt; brown; non-cohesive, wet, dense	102.72 / 4.57
(SP) SAND, fine, some silt; brown; non-cohesive, wet, dense	102.11 / 5.18
(SP) SAND, fine to medium; brown, rust mottling; non-cohesive, wet, compact	101.27 / 6.02
(SM/ML) SILTY SAND to sandy SILT, fine; grey; non-cohesive, wet, compact to dense - Some to trace clay below 7.01 m depth.	98.60 / 8.69
(ML) CLAYEY SILT, some to trace fine sand; grey; cohesive to non-cohesive, w>PL to wet, firm to compact	97.54 / 9.75
End of Borehole	

Note(s):
1. Water level measured at a depth of 2.29 m upon completion of drilling

Samples

Number	Type	Blows/0.30m	Additional Lab. Testing
1	SS	9	
2	SS	15	
3	SS	54	
4	SS	39	
5	SS	37	M
6	SS	38	
7	SS	46	M
8	SS	30	
9	SS	19	
10	SS	3	M
11	SS	38	
12	SS	20	
13	SS	65	

Dynamic Penetration Resistance, Blows/0.3m: 20, 40, 60, 80

Shear Strength Cu, kPa: nat V. +, Q - ●, rem V. ⊕, U - ○: 20, 40, 60, 80

Hydraulic Conductivity, k, cm/s: 10^{-5}, 10^{-4}, 10^{-3}, 10^{-2}

Water Content Percent: Wp, W, Wl: 20, 40, 60, 80

Piezometer or Standpipe Installation

- Bentonite Seal
- Backfill
- Bentonite Seal
- Silica Sand
- 50 mm Diam. PVC # 10 Slot Screen
- Cave

CONTINUED NEXT PAGE

DEPTH SCALE 1 : 50

WSP GOLDER

LOGGED: JS

CHECKED: LEB

MIS-BHS 001 21471757.GPJ GAL-MIS.GDT 3/15/22 ZS

PROJECT: 21471757

RECORD OF BOREHOLE: 21-05

LOCATION: N 4976174.3 ;E 370692.1

BORING DATE: July 13, 2021

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

DEPTH SCALE METRES	BORING METHOD	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (m)	SAMPLES: NUMBER	TYPE	BLOWS/0.30m	DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20 40 60 80); SHEAR STRENGTH Cu, kPa nat V. + Q - ● rem V. ⊕ U - ○ (20 40 60 80)	HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-5} 10^{-4} 10^{-3} 10^{-2}); WATER CONTENT PERCENT Wp —○W— Wl (20 40 60 80)	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
		--- CONTINUED FROM PREVIOUS PAGE ---									
10		Note(s): 1. Water level measured in screen at a depth of 2.26 m (Elev. 105.03 m) on July 20, 2021.									
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

MIS-BHS 001 21471757.GPJ GAL-MIS.GDT 3/15/22 ZS

DEPTH SCALE
1 : 50

WSP GOLDER

LOGGED: JS
CHECKED: LEB

RECORD OF BOREHOLE: 21-06

PROJECT: 21471757

SHEET 1 OF 1

LOCATION: N 4976012.7 ;E 371599.6

BORING DATE: July 14-15, 2021

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

BORING METHOD: Power Auger, 200 mm Diam. (Hollow Stem)

DESCRIPTION	ELEV. / DEPTH (m)	NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE	109.79					
TOPSOIL	0.00					
(SM) SILTY SAND, fine; dark brown; non-cohesive, moist, very loose	109.58 / 0.21	1	SS	2		Bentonite Seal
(SP) SAND, fine to medium; brown; non-cohesive, moist, loose	109.18 / 0.61	2	SS	7		
(SW) SAND, fine to coarse, trace gravel; brown; non-cohesive, moist, compact	108.42 / 1.37	3	SS	25		
(SW) gravelly SAND, fine to coarse, trace silt; brown, non-cohesive, moist to wet, dense	107.66 / 2.13	4	SS	32		Backfill
		5	SS	85	M	
		6	SS	40		
		7	SS	35		Bentonite Seal
(SP) SAND, fine to medium, some silt; brown; non-cohesive, wet, dense	104.61 / 5.18	8	SS	42	M	Silica Sand
(SW) SAND, fine to coarse; brown; non-cohesive, wet, compact to very dense	103.45 / 6.34	9	SS	25		50 mm Diam. PVC #10 Slot Screen
		10	SS	69		
Broken rock/cobbles	102.51 / 7.33					
(SM) gravelly SILTY SAND, very fine; grey brown (GLACIAL TILL); non-cohesive, wet, very dense		11	SS	146		Cave
End of Borehole	101.76 / 8.03					

Note(s):

1. Water level measured at a depth of 4.57 m (Elev. 105.22 m) upon completion of drilling.

2. Water level measured in screen at a depth of 4.23 m (Elev. 105.55 m) on July 21, 2021.

DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m: 20 40 60 80
SHEAR STRENGTH Cu, kPa: nat V. + Q - ● rem V. ⊕ U - ○ 20 40 60 80
HYDRAULIC CONDUCTIVITY, k, cm/s: 10^{-5} 10^{-4} 10^{-3} 10^{-2}
WATER CONTENT PERCENT: Wp ⊢—○W—⊣ Wl 20 40 60 80

DEPTH SCALE METRES: 0–10

DEPTH SCALE 1 : 50

WSP GOLDER

LOGGED: JS/KG/KM

CHECKED: LEB

RECORD OF BOREHOLE: 21-07

PROJECT: 21471757
LOCATION: N 4975986.8 ;E 370396.2
BORING DATE: July 13, 2021
SHEET 1 OF 1
DATUM: Geodetic
SAMPLER HAMMER, 64kg; DROP, 760mm
PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Boring method: Power Auger, 200 mm Diam. (Hollow Stem)

Description	Elev. (m)	Depth (m)	Sample Number	Type	Blows/0.30m
GROUND SURFACE	101.03	0.00			
(PT) Fibrous PEAT		0.15			
(ML) CLAYEY SILT, trace sand; light brown, mottled; cohesive, w>PL, firm		0.30	1	SS	3
(SP) SAND, medium to fine, some silt, trace clay; light brown, mottled; non-cohesive, wet, loose to compact			2	SS	13
(SP/SM) SAND, fine, some silt to SILTY SAND, fine, trace to some clay; grey; non-cohesive, wet, compact	99.66	1.37	3	SS	11
(ML/CL) CLAYEY SILT to SILTY CLAY, some fine sand; grey; cohesive, w>PL, soft to firm	98.74	2.29	4	SS	2
			5	SS	1
(CI/CH) SILTY CLAY to CLAY; grey; cohesive	97.22	3.81	6	SS	5
			7	SS	8
(CI/CH SILTY CLAY to CLAY; grey; cohesive, w>PL, very stiff	95.85	5.18	8	SS	11
			9	SS	9
End of Borehole	94.32	6.71			

Note(s):

1. Water level measured at a depth of 0.77 m (Elev. 100.26 m) upon completion of drilling.

2. Water level measured in screen at a depth of -0.10 m (Elev. 101.13 m) on July 21, 2021.

Chart columns: DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●; rem V. ⊕ U - ○) (20, 40, 60, 80); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-5}, 10^{-4}, 10^{-3}, 10^{-2}); WATER CONTENT PERCENT (Wp —○W— Wl) (20, 40, 60, 80); ADDITIONAL LAB. TESTING

PIEZOMETER OR STANDPIPE INSTALLATION: Bentonite Seal; Silica SAND; 50 mm Diam. PVC #10 Slot Screen; Clay Cuttings

DEPTH SCALE 1 : 50

WSP GOLDER

LOGGED: JS
CHECKED: LEB

RECORD OF BOREHOLE: 21-08

PROJECT: 21471757

SHEET 1 OF 1

LOCATION: N 4975735.9 ;E 371329.6

BORING DATE: July 16, 2021

DATUM: Geodetic

SAMPLER HAMMER, 64kg; DROP, 760mm

PENETRATION TEST HAMMER, 64kg; DROP, 760mm

Boring method: Power Auger, 200 mm Diam. (Hollow Stem)

DESCRIPTION	ELEV. / DEPTH (m)	SAMPLE NUMBER	TYPE	BLOWS/0.30m	ADDITIONAL LAB. TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
GROUND SURFACE	105.11					
(PT) Fibrous PEAT	0.00					
(SP) SAND, fine to medium; grey brown; non-cohesive, moist, very loose	104.81 / 0.30	1	SS	4		
(SW) SAND, fine to coarse; light brown; non-cohesive, moist to wet, compact	104.35 / 0.76	2	SS	16		Bentonite Seal
		3	SS	13		Silica Sand
(SM) SILTY SAND, fine; brown; non-cohesive, wet, compact	102.82 / 2.29	4	SS	27		50 mm Diam. PVC #10 Slot Screen
		5	SS	38	M	
		6	SS	37		Silica Sand
(SM) SILTY SAND, some angular gravel, trace clay; grey (GLACIAL TILL); non-cohesive, wet, dense to very dense	100.92 / 4.19	7	SS	>50		
End of Borehole	100.39 / 4.72					

Note(s):

1. Water level measured in screen at a depth of 0.33 m (Elev. 104.78 m) on July 20, 2021.

Chart columns: DYNAMIC PENETRATION RESISTANCE, BLOWS/0.3m (20, 40, 60, 80); SHEAR STRENGTH Cu, kPa (nat V. + Q - ●; rem V. ⊕ U - ○) (20, 40, 60, 80); HYDRAULIC CONDUCTIVITY, k, cm/s (10^{-5}, 10^{-4}, 10^{-3}, 10^{-2}); WATER CONTENT PERCENT (Wp —○W— Wl) (20, 40, 60, 80). Hydraulic conductivity test interval shaded from approx. 2.2 m to 3.7 m depth.

DEPTH SCALE 1 : 50

WSP GOLDER

LOGGED: JD

CHECKED: LEB

APPENDIX D

Well Response Test Analyses

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST BH21-01

INTERVAL (metres below ground surface)

Top of Interval =	**2.74**
Bottom of Interval =	**4.27**

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

where K = (m/sec)

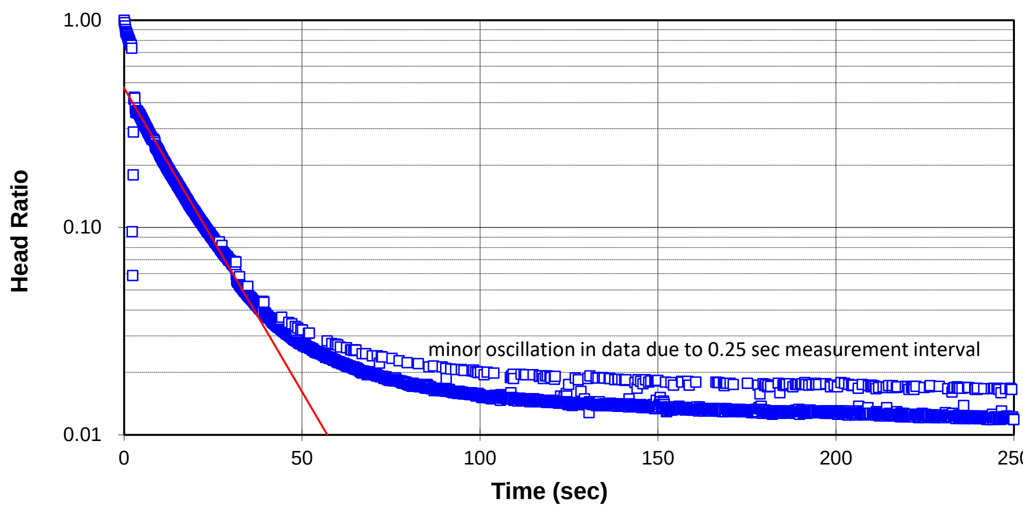
where:
- r_c = casing radius (metres)
- R_e = filter pack radius (metres)
- L_e = length of screened interval (metres)
- t = time (seconds)
- h_t = head at time t (metres)

INPUT PARAMETERS

r_c =	**2.5E-02**
R_e =	**1.0E-01**
L_e =	**1.5**
t_1 =	**3.8**
t_2 =	**31.8**
h_1/h_0 =	**0.36**
h_2/h_0 =	**0.06**

RESULTS

K=	**4E-05**	**m/sec**
K=	**4E-03**	**cm/sec**



Project Name:	Tomlinson AR East Oxford	Analysis By:	SPS
Project No.:	21471757	Checked By:	LEB
Test Date:	2021-07-20	Analysis Date:	2021-06-24

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST BH21-01

INTERVAL (metres below ground surface)

Top of Interval =	**2.74**
Bottom of Interval =	**4.27**

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

where K = (m/sec)

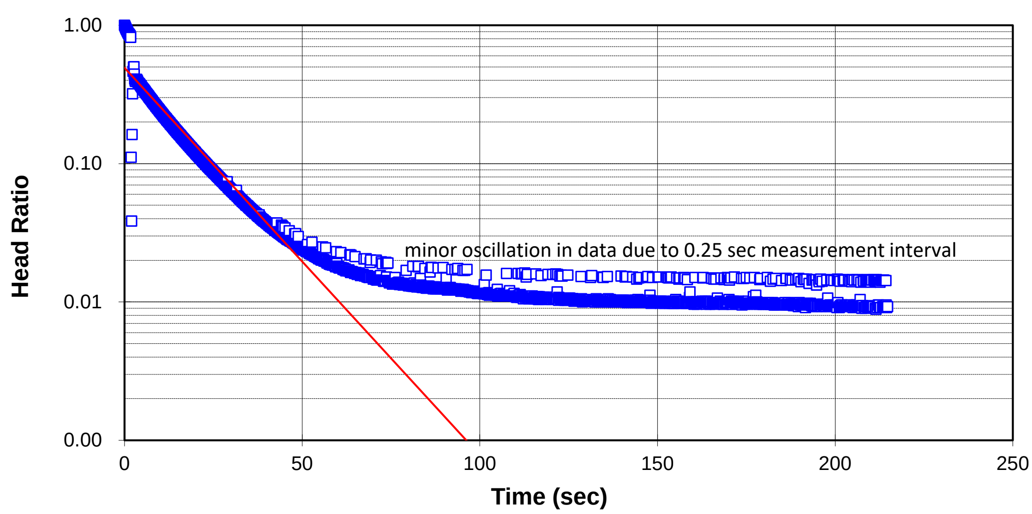
where:
- r_c = casing radius (metres)
- R_e = filter pack radius (metres)
- L_e = length of screened interval (metres)
- t = time (seconds)
- h_t = head at time t (metres)

INPUT PARAMETERS

r_c =	2.5E-02
R_e =	1.0E-01
L_e =	1.5
t_1 =	4.25
t_2 =	39.75
h_1/h_0 =	0.38
h_2/h_0 =	0.04

RESULTS

K=	4E-05	m/sec
K=	4E-03	cm/sec



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-20

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-06-24

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST BH21-01

INTERVAL (metres below ground surface)

Top of Interval = 2.74
Bottom of Interval = 4.27

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

where K = (m/sec)

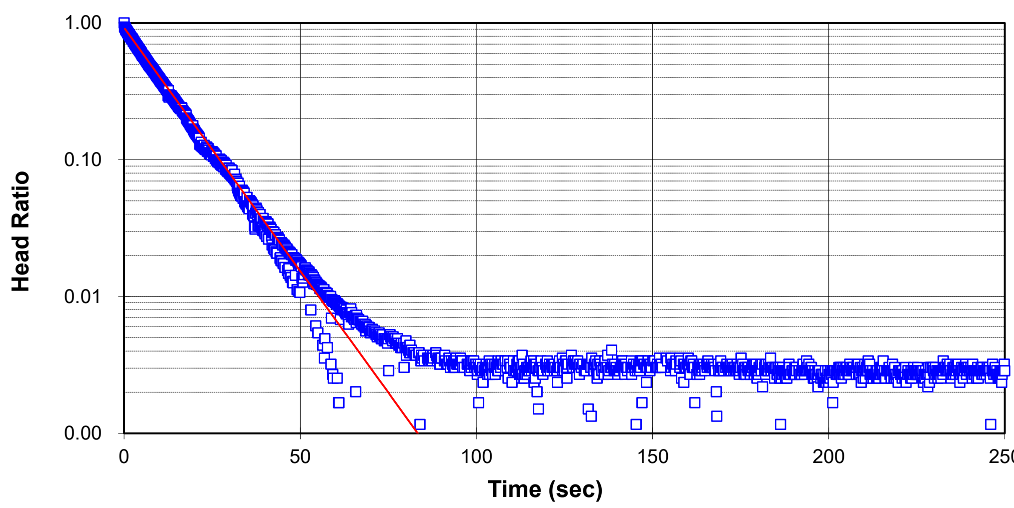
where:
- r_c = casing radius (metres)
- R_e = filter pack radius (metres)
- L_e = length of screened interval (metres)
- t = time (seconds)
- h_t = head at time t (metres)

INPUT PARAMETERS

r_c =	2.5E-02
R_e =	1.0E-01
L_e =	1.5
t_1 =	1.25
t_2 =	36.625
h_1/h_0 =	0.83
h_2/h_0 =	0.05

RESULTS

K=	5E-05	m/sec
K=	5E-03	cm/sec



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-20

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-06-24

Golder Associates Ltd.

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST BH21-01

INTERVAL (metres below ground surface)

Top of Interval = 2.74
Bottom of Interval = 4.27

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

where K = (m/sec)

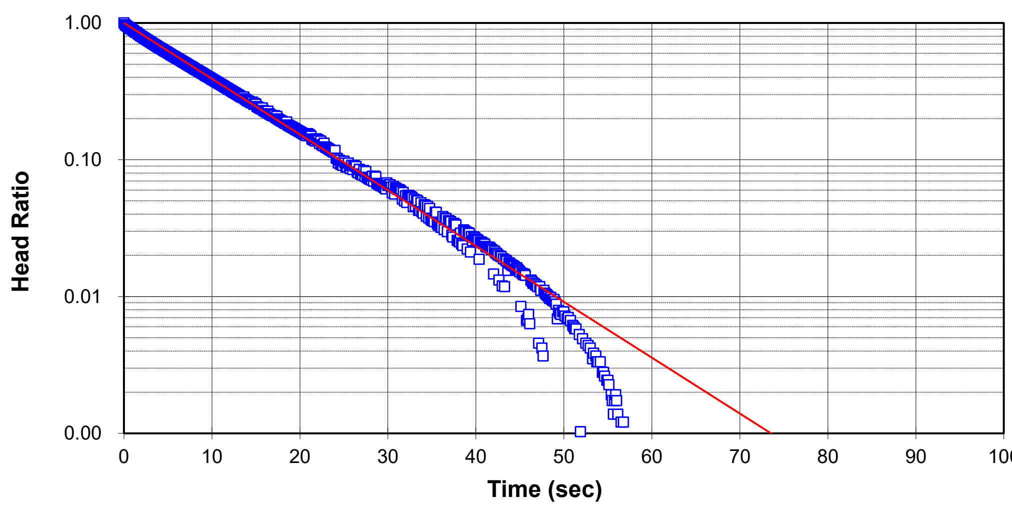
where:
r_c = casing radius (metres)
R_e = filter pack radius (metres)
L_e = length of screened interval (metres)
t = time (seconds)
h_t = head at time t (metres)

INPUT PARAMETERS

r_c =	2.5E-02
R_e =	1.0E-01
L_e =	1.5
t_1 =	0
t_2 =	33.5
h_1/h_0 =	1.00
h_2/h_0 =	0.04

RESULTS

K=	5E-05	m/sec
K=	5E-03	cm/sec



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-20

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-06-24

Golder Associates Ltd.

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST BH21-02

INTERVAL (metres below ground surface)

Top of Interval = 2.90
Bottom of Interval = 4.42

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

where K = (m/sec)

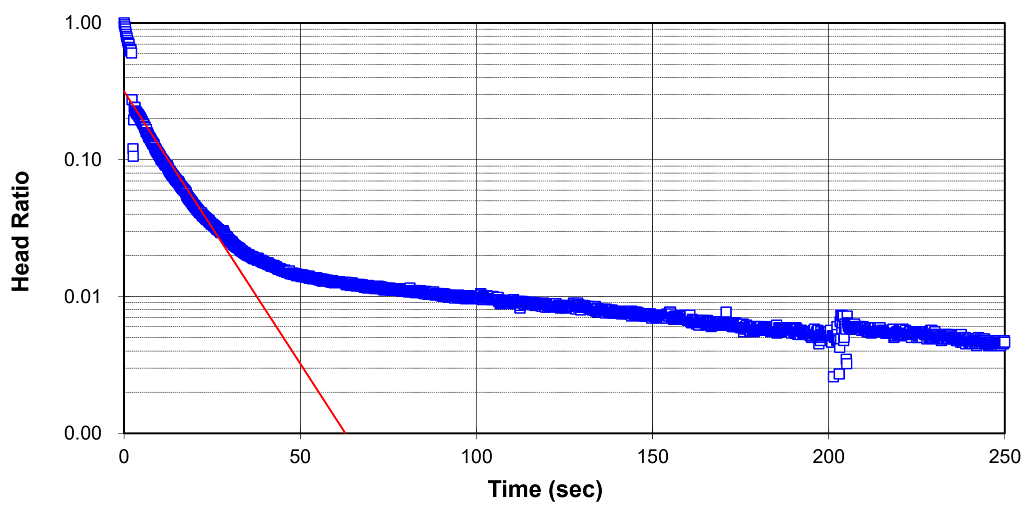
where:
- r_c = casing radius (metres)
- R_e = filter pack radius (metres)
- L_e = length of screened interval (metres)
- t = time (seconds)
- h_t = head at time t (metres)

INPUT PARAMETERS

r_c =	2.5E-02
R_e =	1.0E-01
L_e =	1.5
t_1 =	2.875
t_2 =	24
h_1/h_0 =	0.24
h_2/h_0 =	0.04

RESULTS

K=	5E-05	m/sec
K=	5E-03	cm/sec



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-20

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-07-28

Golder Associates Ltd.

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST BH21-02

INTERVAL (metres below ground surface)

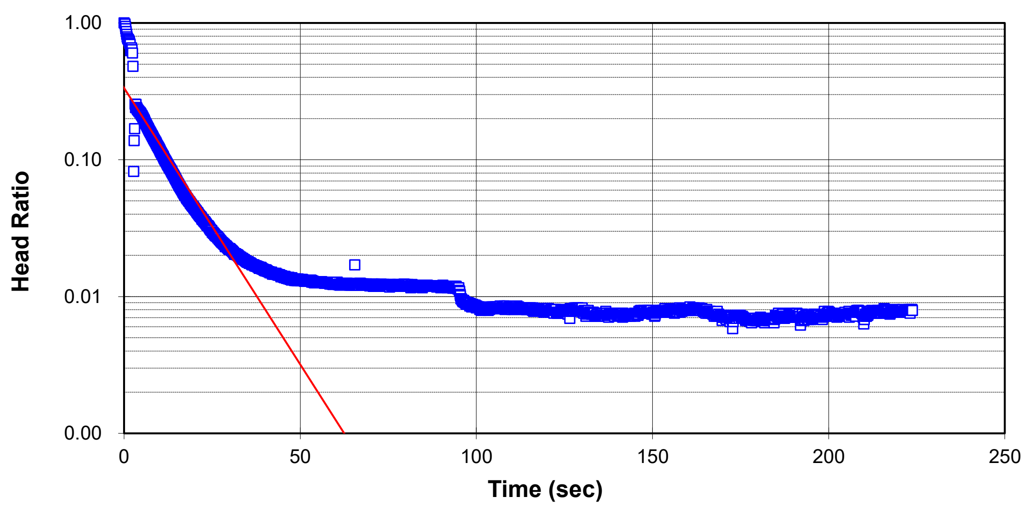
Top of Interval = 2.90
Bottom of Interval = 4.42

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

where K = (m/sec)

where:
r_c = casing radius (metres)
R_e = filter pack radius (metres)
L_e = length of screened interval (metres)
t = time (seconds)
h_t = head at time t (metres)

INPUT PARAMETERS		RESULTS		
r_c =	2.5E-02			
R_e =	1.0E-01			
L_e =	1.5	K=	5E-05	m/sec
t_1 =	3.625	K=	5E-03	cm/sec
t_2 =	28.75			
h_1/h_0 =	0.24			
h_2/h_0 =	0.02			



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-20

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-07-28

Golder Associates Ltd.

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST BH21-02

INTERVAL (metres below ground surface)

Top of Interval = 2.90
Bottom of Interval = 4.42

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

where K = (m/sec)

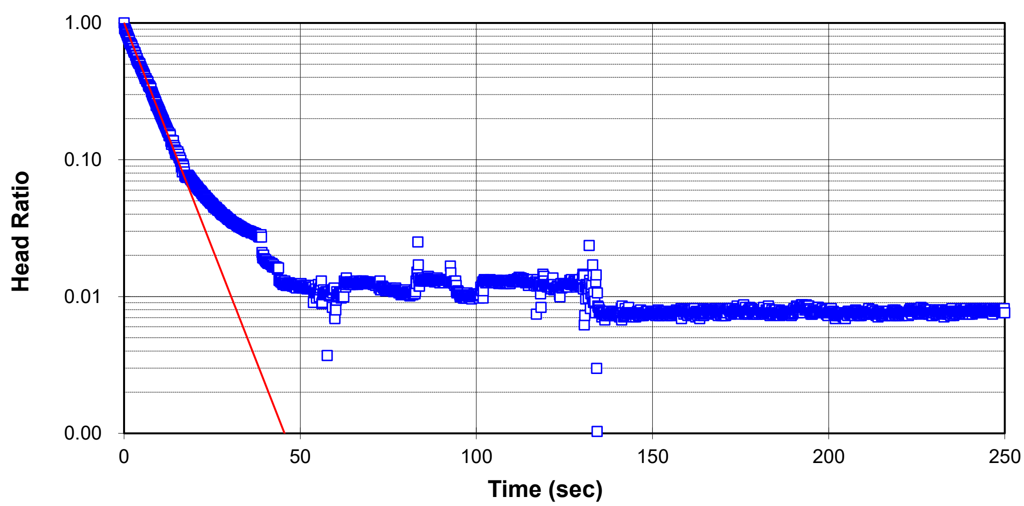
where:
- r_c = casing radius (metres)
- R_e = filter pack radius (metres)
- L_e = length of screened interval (metres)
- t = time (seconds)
- h_t = head at time t (metres)

INPUT PARAMETERS

r_c =	2.5E-02
R_e =	1.0E-01
L_e =	1.5
t_1 =	0
t_2 =	16.5
h_1/h_0 =	1.00
h_2/h_0 =	0.08

RESULTS

K=	9E-05	m/sec
K=	9E-03	cm/sec



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-20

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-07-28

Golder Associates Ltd.

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST BH21-02

INTERVAL (metres below ground surface)

Top of Interval = **2.90**
Bottom of Interval = **4.42**

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

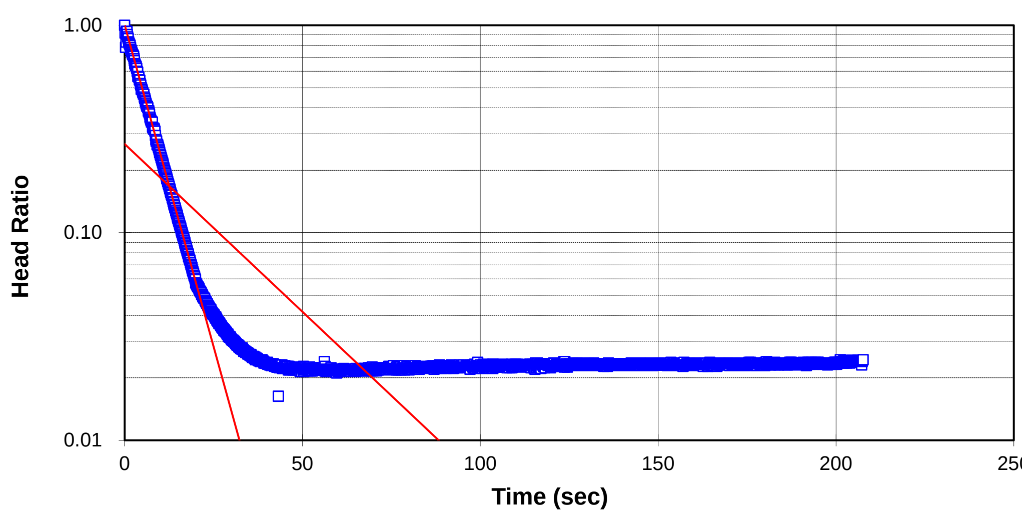
where K = (m/sec)

where:
r_c = casing radius (metres)
R_e = filter pack radius (metres)
L_e = length of screened interval (metres)
t = time (seconds)
h_t = head at time t (metres)

INPUT PARAMETERS	
r_c =	0.025
R_e =	0.10
L_e =	1.5
t_1 =	0
t_2 =	19.5
h_1/h_0 =	1.00
h_2/h_0 =	0.06

RESULTS

K=	8E-05	m/sec
K=	8E-03	cm/sec



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-20

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-07-28

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST BH21-03

INTERVAL (metres below ground surface)

Top of Interval = 5.64
Bottom of Interval = 7.16

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

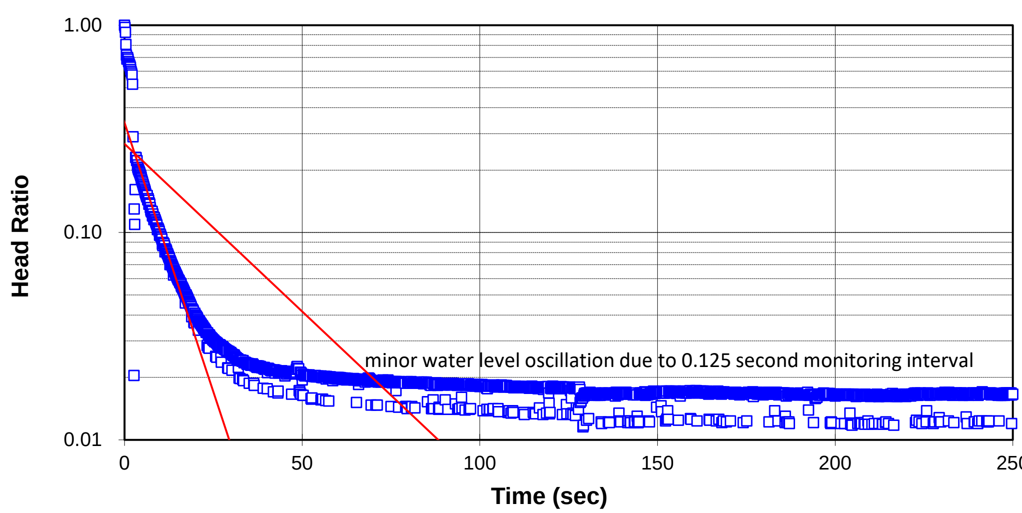
where K = (m/sec)

where:
r_c = casing radius (metres)
R_e = filter pack radius (metres)
L_e = length of screened interval (metres)
t = time (seconds)
h_t = head at time t (metres)

INPUT PARAMETERS	
r_c =	0.025
R_e =	0.10
L_e =	1.5
t_1 =	3.25
t_2 =	12.625
h_1/h_0 =	0.23
h_2/h_0 =	0.08

RESULTS

K=	7E-05	m/sec
K=	7E-03	cm/sec



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-21

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-07-28

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST BH21-03

INTERVAL (metres below ground surface)

Top of Interval = 5.64
Bottom of Interval = 7.16

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

where K = (m/sec)

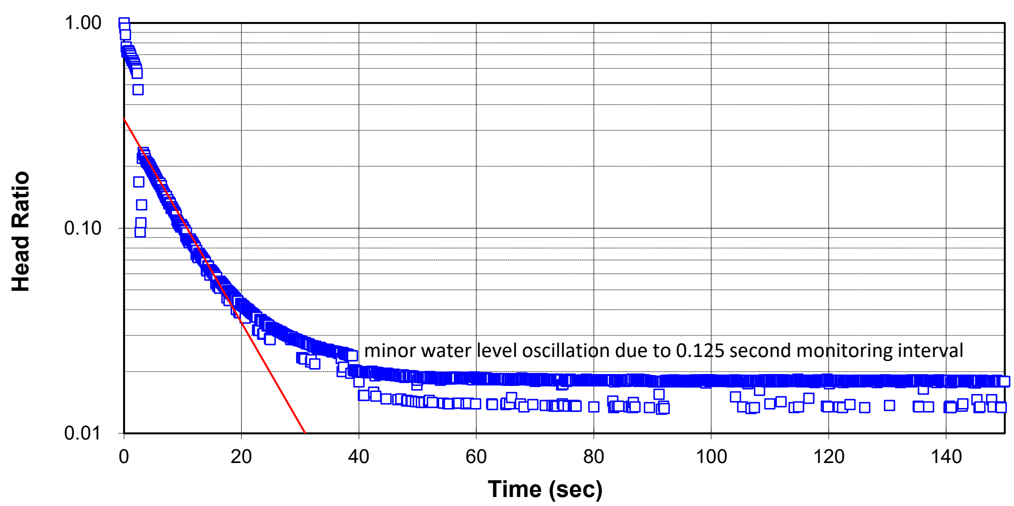
where:
r_c = casing radius (metres)
R_e = filter pack radius (metres)
L_e = length of screened interval (metres)
t = time (seconds)
h_t = head at time t (metres)

INPUT PARAMETERS

r_c =	0.025
R_e =	0.10
L_e =	1.5
t_1 =	3.25
t_2 =	17.5
h_1/h_0 =	0.23
h_2/h_0 =	0.05

RESULTS

K=	6E-05	m/sec
K=	6E-03	cm/sec



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-21

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-07-28

Golder Associates Ltd.

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST BH21-03

INTERVAL (metres below ground surface)

Top of Interval =	**5.64**
Bottom of Interval =	**7.16**

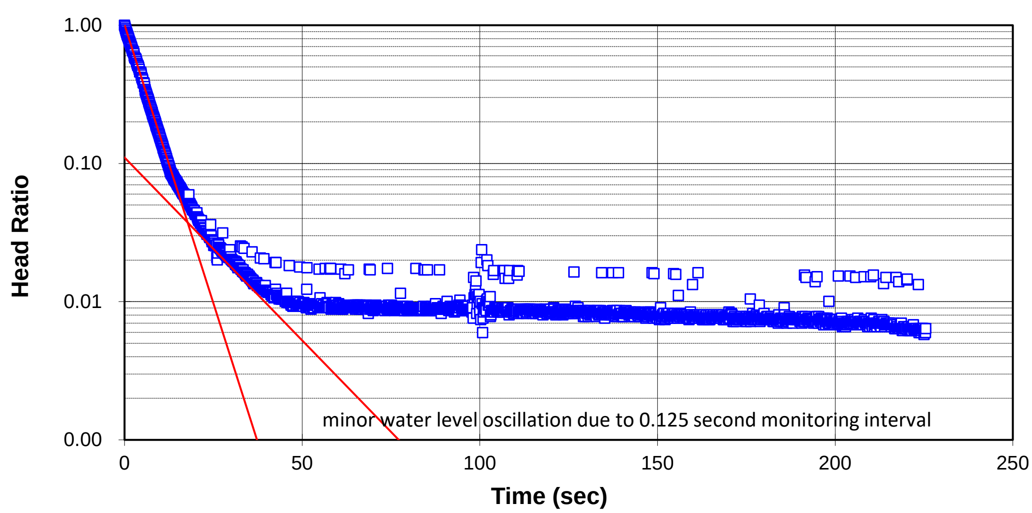
$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

where K = (m/sec)

where:

r_c = casing radius (metres)
R_e = filter pack radius (metres)
L_e = length of screened interval (metres)
t = time (seconds)
h_t = head at time t (metres)

INPUT PARAMETERS		RESULTS		
r_c =	0.025			
R_e =	0.10	K=	1E-04	m/sec
L_e =	1.5	K=	1E-02	cm/sec
t_1 =	0			
t_2 =	13.5			
h_1/h_0 =	1.00			
h_2/h_0 =	0.08			



Project Name:	Tomlinson AR East Oxford	Analysis By:	SPS
Project No.:	21471757	Checked By:	LEB
Test Date:	2021-07-21	Analysis Date:	2021-07-28

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST BH21-03

INTERVAL (metres below ground surface)

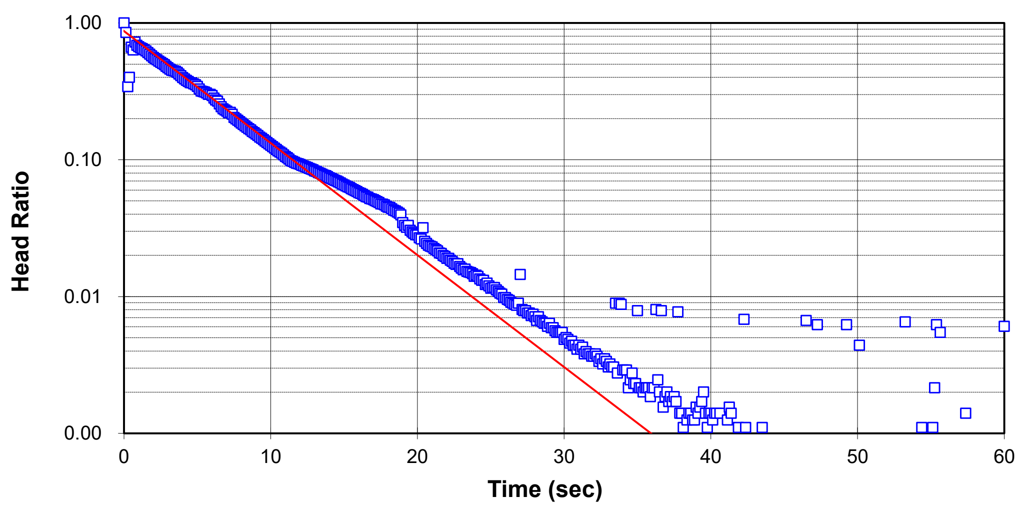
Top of Interval = 5.64
Bottom of Interval = 7.16

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

where K = (m/sec)

where:
- r_c = casing radius (metres)
- R_e = filter pack radius (metres)
- L_e = length of screened interval (metres)
- t = time (seconds)
- h_t = head at time t (metres)

INPUT PARAMETERS		RESULTS		
r_c =	0.025			
R_e =	0.10			
L_e =	1.5	K=	1E-04	m/sec
t_1 =	0.125	K=	1E-02	cm/sec
t_2 =	11.875			
h_1/h_0 =	0.85			
h_2/h_0 =	0.09			



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-21

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-07-28

Golder Associates Ltd.

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST BH21-04

INTERVAL (metres below ground surface)

Top of Interval = **1.52**
Bottom of Interval = **3.05**

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

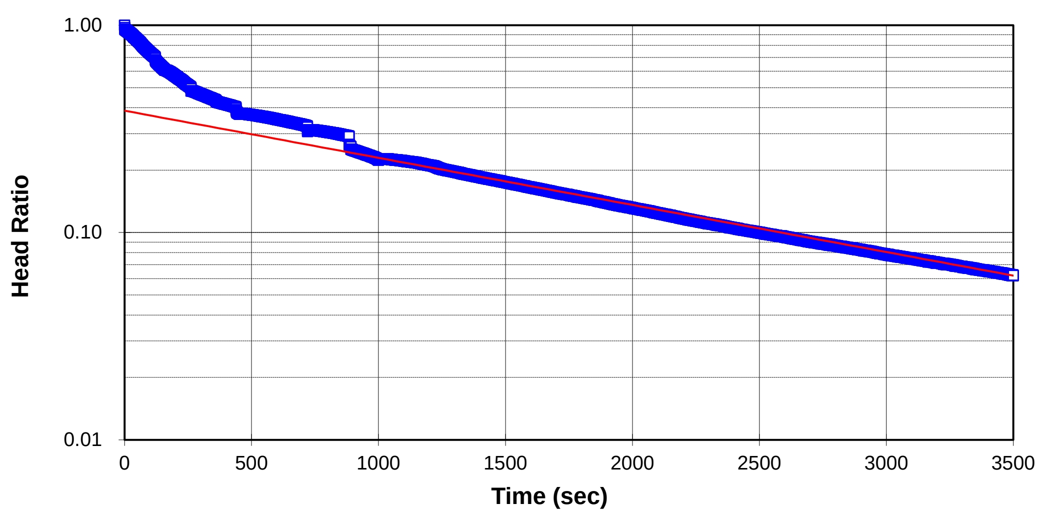
where K = (m/sec)

where:
r_c = casing radius (metres)
R_e = filter pack radius (metres)
L_e = length of screened interval (metres)
t = time (seconds)
h_t = head at time t (metres)

INPUT PARAMETERS	
r_c =	0.025
R_e =	0.10
L_e =	1.5
t_1 =	1310
t_2 =	3500
h_1/h_0 =	0.20
h_2/h_0 =	0.06

RESULTS

K=	3E-07	m/sec
K=	3E-05	cm/sec



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-21

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-07-28

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST BH21-04

INTERVAL (metres below ground surface)

Top of Interval = **1.52**
Bottom of Interval = **3.05**

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

where K = (m/sec)

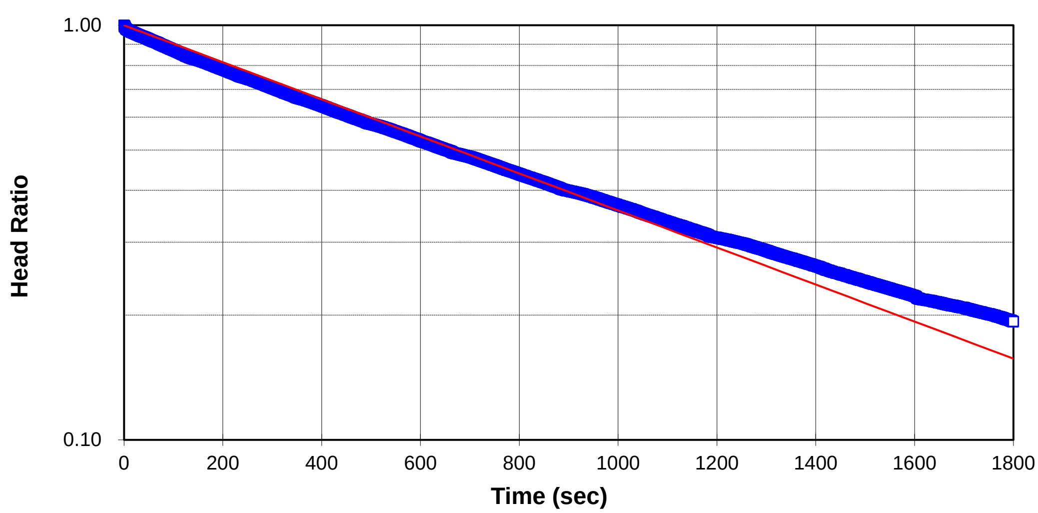
where:
r_c = casing radius (metres)
R_e = filter pack radius (metres)
L_e = length of screened interval (metres)
t = time (seconds)
h_t = head at time t (metres)

INPUT PARAMETERS

r_c =	0.025
R_e =	0.10
L_e =	1.5
t_1 =	0
t_2 =	886
h_1/h_0 =	1.00
h_2/h_0 =	0.40

RESULTS

K=	6E-07	m/sec
K=	6E-05	cm/sec



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-21

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-08-03

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST BH21-05

INTERVAL (metres below ground surface)

Top of Interval = 3.01
Bottom of Interval = 4.53

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

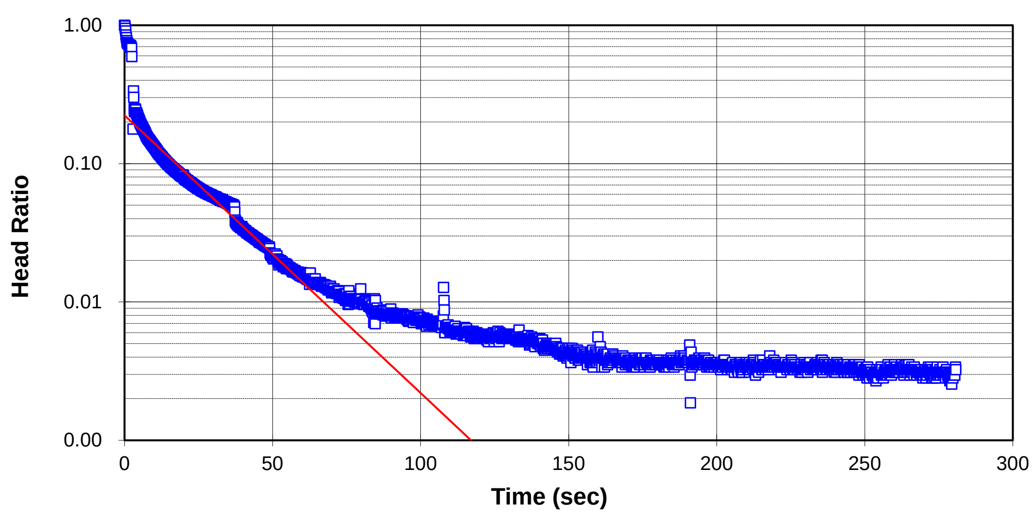
where K = (m/sec)

where:
- r_c = casing radius (metres)
- R_e = filter pack radius (metres)
- L_e = length of screened interval (metres)
- t = time (seconds)
- h_t = head at time t (metres)

INPUT PARAMETERS	
r_c =	0.025
R_e =	0.10
L_e =	1.5
t_1 =	7.375
t_2 =	54.5
h_1/h_0 =	0.16
h_2/h_0 =	0.02

RESULTS

K=	3E-05	m/sec
K=	3E-03	cm/sec



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-21

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-08-03

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST BH21-05

INTERVAL (metres below ground surface)

Top of Interval = 3.01
Bottom of Interval = 4.53

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1+\left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

where K = (m/sec)

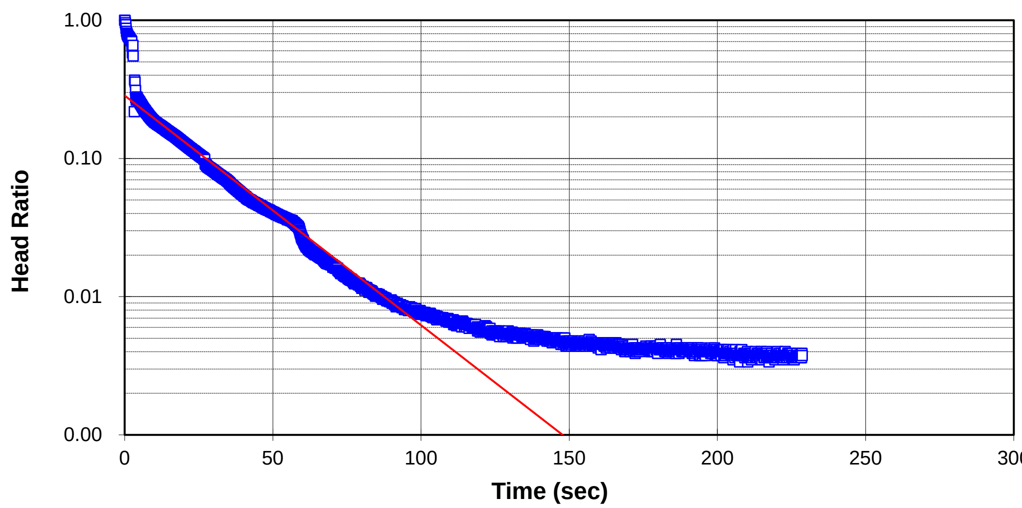
where:

r_c = casing radius (metres)
R_e = filter pack radius (metres)
L_e = length of screened interval (metres)
t = time (seconds)
h_t = head at time t (metres)

INPUT PARAMETERS	
r_c =	2.5E-02
R_e =	1.0E-01
L_e =	1.5
t_1 =	7.375
t_2 =	58
h_1/h_0 =	0.22
h_2/h_0 =	0.03

RESULTS

K=	2E-05	m/sec
K=	2E-03	cm/sec



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-21

Analysis By: SPS
Checked By: 0
Analysis Date: 2021-08-03

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST BH21-05

INTERVAL (metres below ground surface)

Top of Interval =	**3.01**
Bottom of Interval =	**4.53**

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

where K = (m/sec)

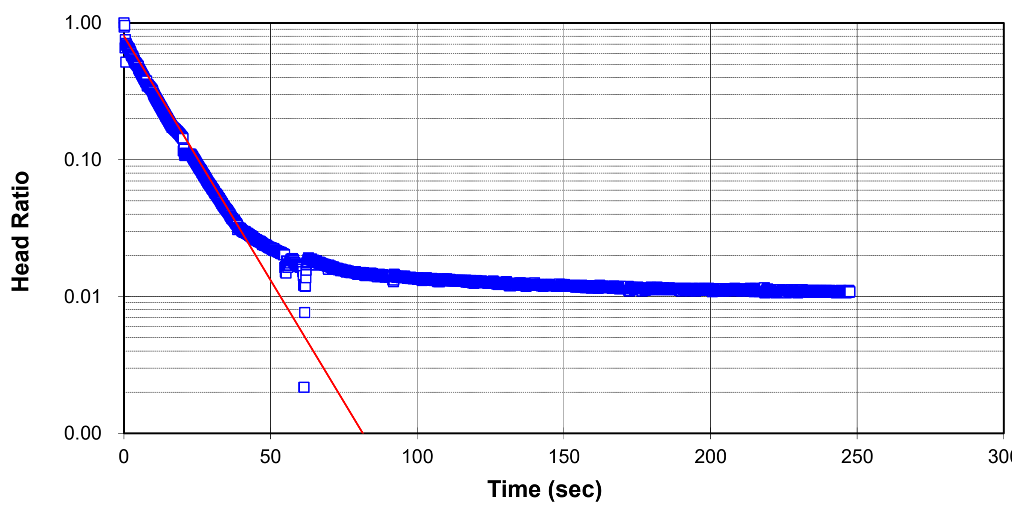
where:
r_c = casing radius (metres)
R_e = filter pack radius (metres)
L_e = length of screened interval (metres)
t = time (seconds)
h_t = head at time t (metres)

INPUT PARAMETERS

r_c =	0.025
R_e =	0.10
L_e =	1.5
t_1 =	0
t_2 =	40
h_1/h_0 =	0.80
h_2/h_0 =	0.03

RESULTS

K=	5E-05	m/sec
K=	5E-03	cm/sec



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-21

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-08-03

Golder Associates Ltd.

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST BH21-05

INTERVAL (metres below ground surface)

Top of Interval = 3.01
Bottom of Interval = 4.53

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

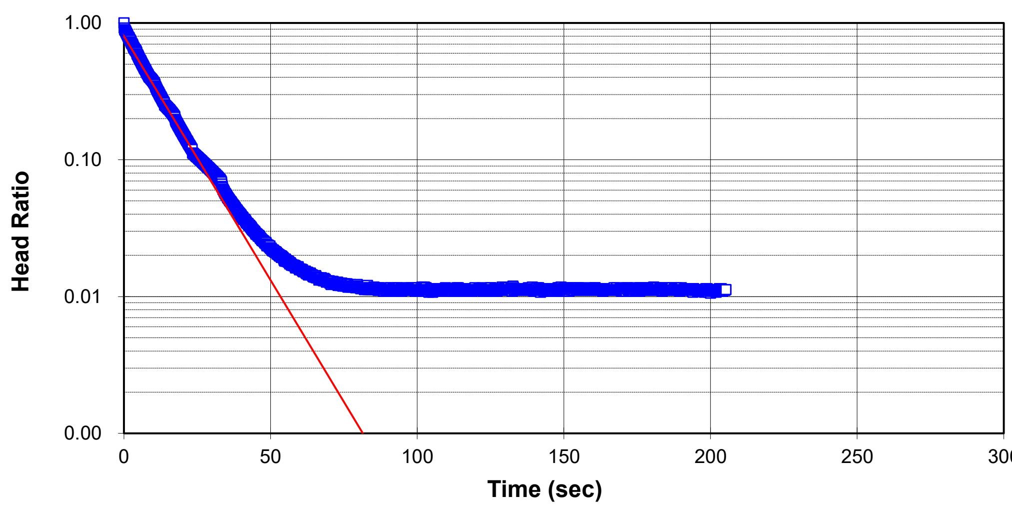
where K = (m/sec)

where:
r_c = casing radius (metres)
R_e = filter pack radius (metres)
L_e = length of screened interval (metres)
t = time (seconds)
h_t = head at time t (metres)

INPUT PARAMETERS	
r_c =	0.025
R_e =	0.10
L_e =	1.5
t_1 =	0
t_2 =	40
h_1/h_0 =	0.80
h_2/h_0 =	0.03

RESULTS

K=	5E-05	m/sec
K=	5E-03	cm/sec



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-21

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-08-03

Golder Associates Ltd.

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST BH21-06

INTERVAL (metres below ground surface)

Top of Interval =	**5.49**
Bottom of Interval =	**7.01**

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

where K = (m/sec)

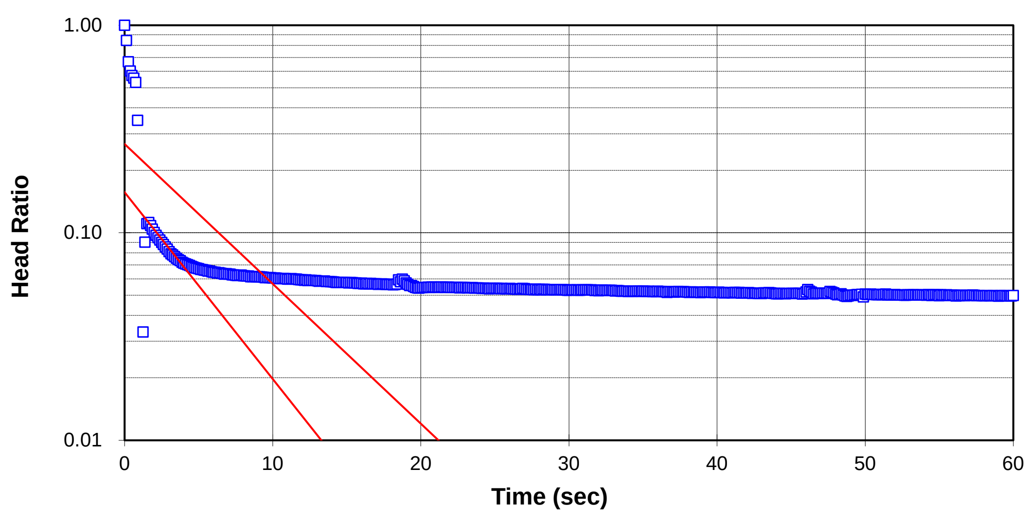
where:
r_c = casing radius (metres)
R_e = filter pack radius (metres)
L_e = length of screened interval (metres)
t = time (seconds)
h_t = head at time t (metres)

INPUT PARAMETERS

r_c =	0.025
R_e =	0.10
L_e =	1.5
t_1 =	1.625
t_2 =	3.625
h_1/h_0 =	0.11
h_2/h_0 =	0.07

RESULTS

K=	1E-04	m/sec
K=	1E-02	cm/sec



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-21

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-08-03

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST BH21-06

INTERVAL (metres below ground surface)

Top of Interval = 5.49
Bottom of Interval = 7.01

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

where K = (m/sec)

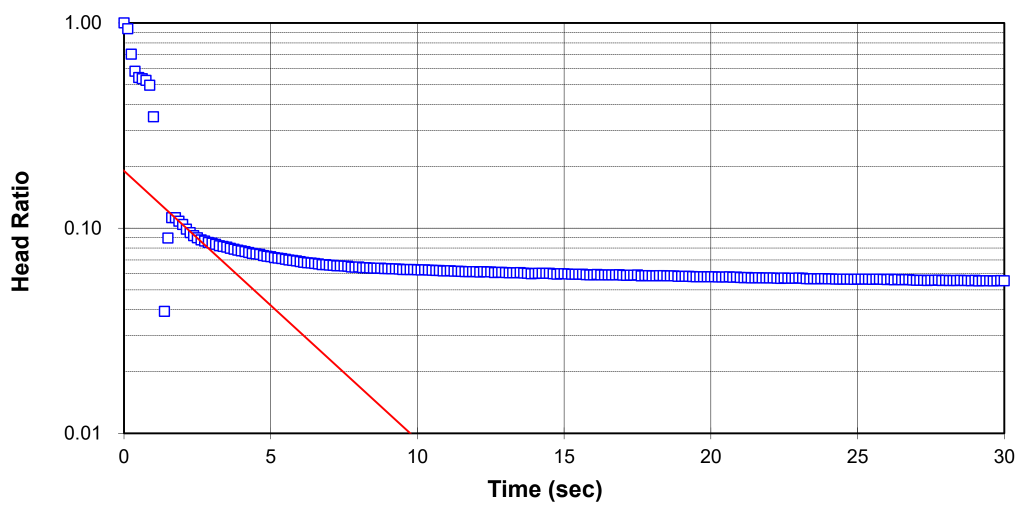
where:
r_c = casing radius (metres)
R_e = filter pack radius (metres)
L_e = length of screened interval (metres)
t = time (seconds)
h_t = head at time t (metres)

INPUT PARAMETERS

r_c =	0.025
R_e =	0.10
L_e =	1.5
t_1 =	1.875
t_2 =	2
h_1/h_0 =	0.11
h_2/h_0 =	0.10

RESULTS

K=	2E-04	m/sec
K=	2E-02	cm/sec



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-21

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-08-03

Golder Associates Ltd.

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST BH21-06

INTERVAL (metres below ground surface)

Top of Interval =	**5.49**
Bottom of Interval =	**7.01**

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

where K = (m/sec)

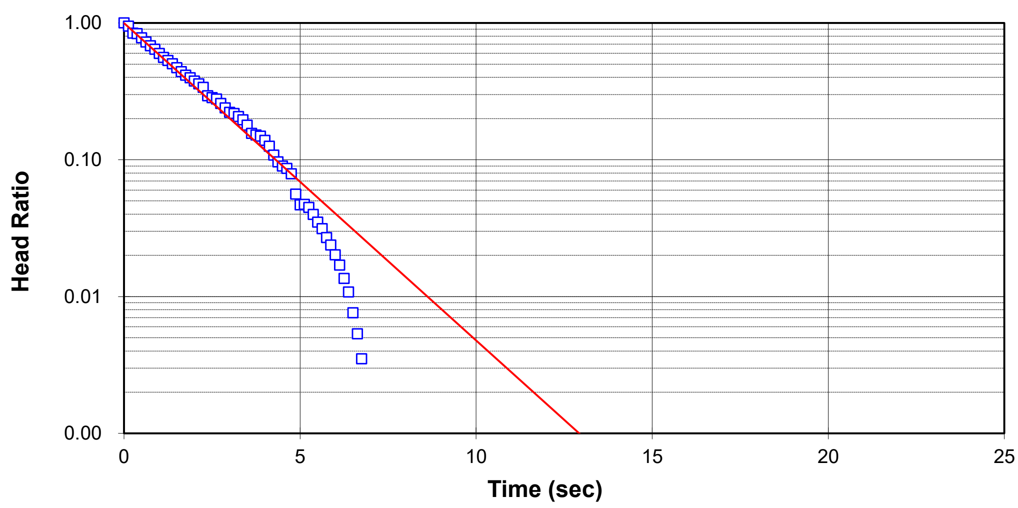
where:
r_c = casing radius (metres)
R_e = filter pack radius (metres)
L_e = length of screened interval (metres)
t = time (seconds)
h_t = head at time t (metres)

INPUT PARAMETERS

r_c =	0.025
R_e =	0.10
L_e =	1.5
t_1 =	0
t_2 =	4.75
h_1/h_0 =	1.00
h_2/h_0 =	0.08

RESULTS

K=	3E-04	m/sec
K=	3E-02	cm/sec



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-21

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-08-03

Golder Associates Ltd.

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST BH21-06

INTERVAL (metres below ground surface)

Top of Interval = 5.49
Bottom of Interval = 7.01

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1+\left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

where K = (m/sec)

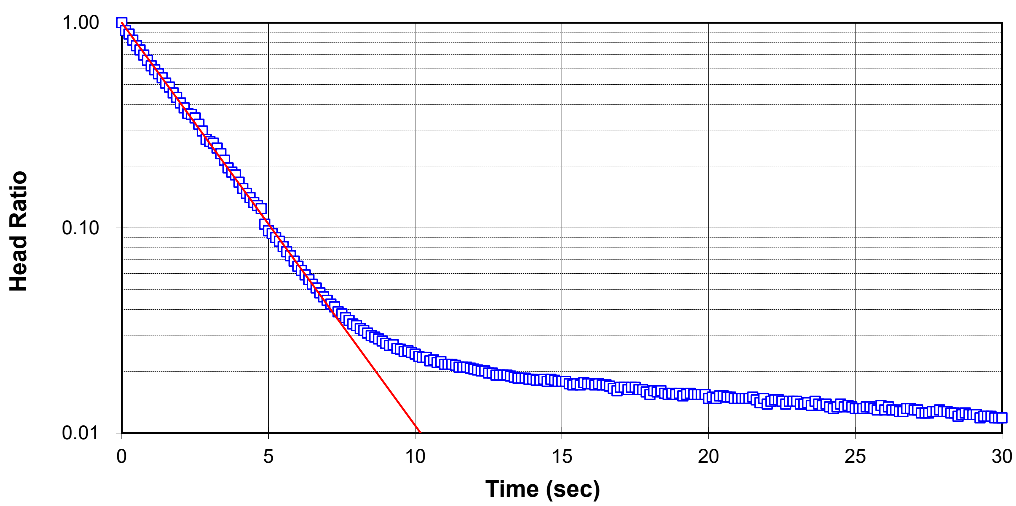
where:
- r_c = casing radius (metres)
- R_e = filter pack radius (metres)
- L_e = length of screened interval (metres)
- t = time (seconds)
- h_t = head at time t (metres)

INPUT PARAMETERS

r_c =	0.025
R_e =	0.10
L_e =	1.5
t_1 =	0
t_2 =	6.375
h_1/h_0 =	1.00
h_2/h_0 =	0.06

RESULTS

K=	3E-04	m/sec
K=	3E-02	cm/sec



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-21

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-08-03

Golder Associates Ltd.

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST BH21-07

INTERVAL (metres below ground surface)

Top of Interval = 1.11
Bottom of Interval = 2.63

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

where K = (m/sec)

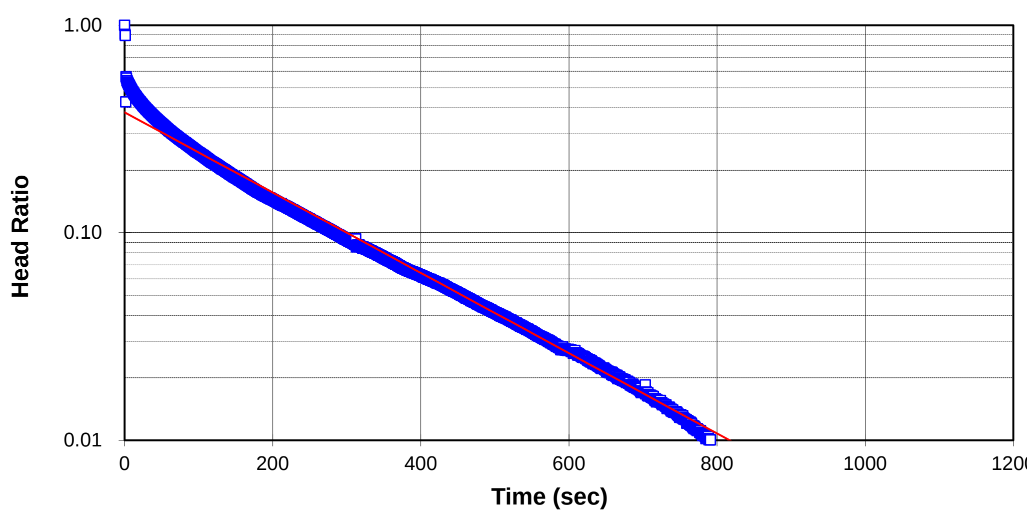
where:
r_c = casing radius (metres)
R_e = filter pack radius (metres)
L_e = length of screened interval (metres)
t = time (seconds)
h_t = head at time t (metres)

INPUT PARAMETERS

r_c =	0.025
R_e =	0.10
L_e =	1.5
t_1 =	98
t_2 =	549
h_1/h_0 =	0.25
h_2/h_0 =	0.03

RESULTS

K=	3E-06	m/sec
K=	3E-04	cm/sec



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-21

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-08-03

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST BH21-07

INTERVAL (metres below ground surface)

Top of Interval = 1.11
Bottom of Interval = 2.63

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

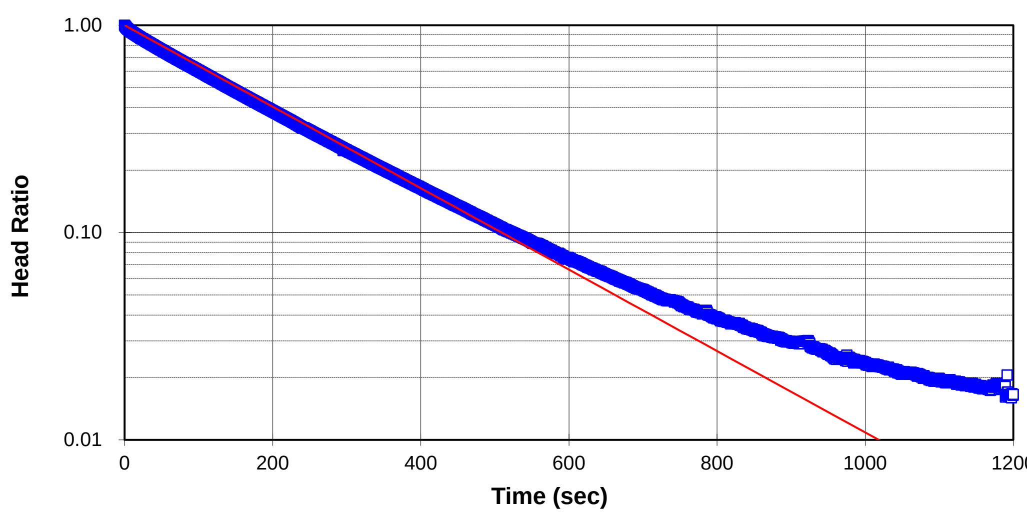
where K = (m/sec)

where:
r_c = casing radius (metres)
R_e = filter pack radius (metres)
L_e = length of screened interval (metres)
t = time (seconds)
h_t = head at time t (metres)

INPUT PARAMETERS	
r_c =	0.025
R_e =	0.10
L_e =	1.5
t_1 =	0
t_2 =	408
h_1/h_0 =	1.00
h_2/h_0 =	0.16

RESULTS

K=	3E-06	m/sec
K=	3E-04	cm/sec



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-21

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-08-03

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST BH21-08

INTERVAL (metres below ground surface)

Top of Interval =	**2.13**
Bottom of Interval =	**3.66**

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

where K = (m/sec)

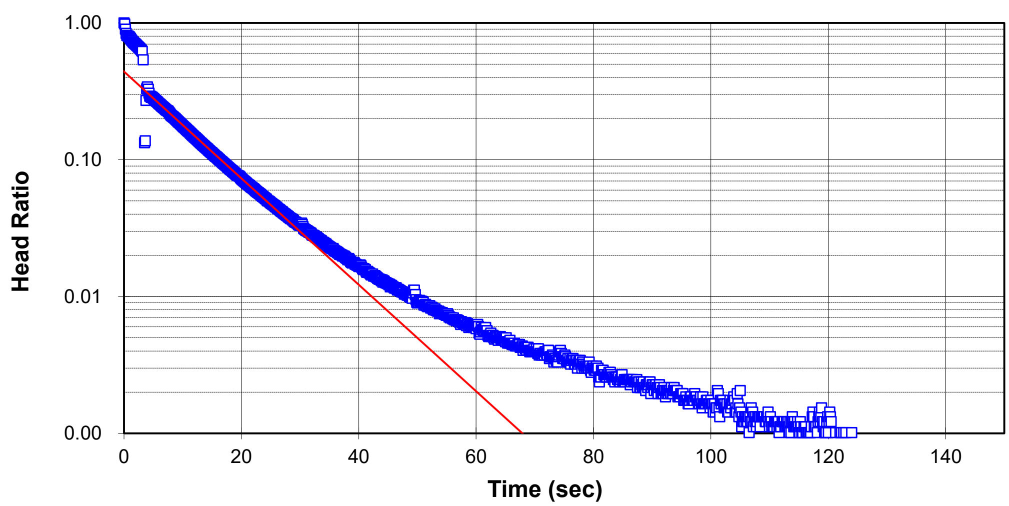
where:
- r_c = casing radius (metres)
- R_e = filter pack radius (metres)
- L_e = length of screened interval (metres)
- t = time (seconds)
- h_t = head at time t (metres)

INPUT PARAMETERS

r_c =	0.025
R_e =	0.10
L_e =	1.5
t_1 =	5.375
t_2 =	21
h_1/h_0 =	0.27
h_2/h_0 =	0.07

RESULTS

K=	5E-05	m/sec
K=	5E-03	cm/sec



Project Name:	Tomlinson AR East Oxford	Analysis By:	SPS
Project No.:	21471757	Checked By:	LEB
Test Date:	2021-07-20	Analysis Date:	2021-08-09

Golder Associates Ltd.

HVORSLEV SLUG TEST ANALYSIS
FALLING HEAD TEST BH21-08

INTERVAL (metres below ground surface)

Top of Interval = 2.13
Bottom of Interval = 3.66

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

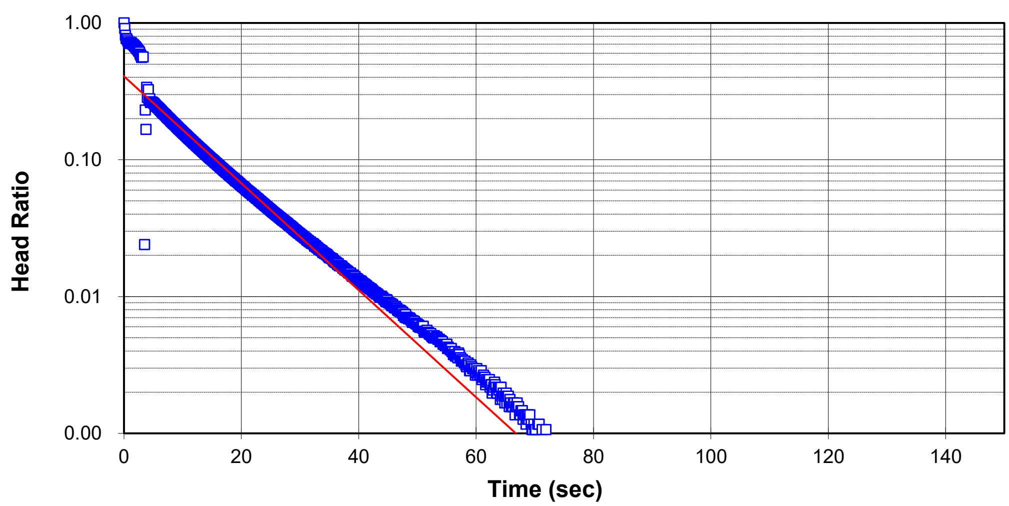
where K = (m/sec)

where:
r_c = casing radius (metres)
R_e = filter pack radius (metres)
L_e = length of screened interval (metres)
t = time (seconds)
h_t = head at time t (metres)

INPUT PARAMETERS	
r_c =	0.025
R_e =	0.10
L_e =	1.5
t_1 =	5.25
t_2 =	26.625
h_1/h_0 =	0.25
h_2/h_0 =	0.04

RESULTS

K=	5E-05	m/sec
K=	5E-03	cm/sec



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-20

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-08-09

Golder Associates Ltd.

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST BH21-08

INTERVAL (metres below ground surface)

Top of Interval =	**2.13**
Bottom of Interval =	**3.66**

$$K = \frac{r_c^2}{2L_e} \ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{\ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

where K = (m/sec)

where:

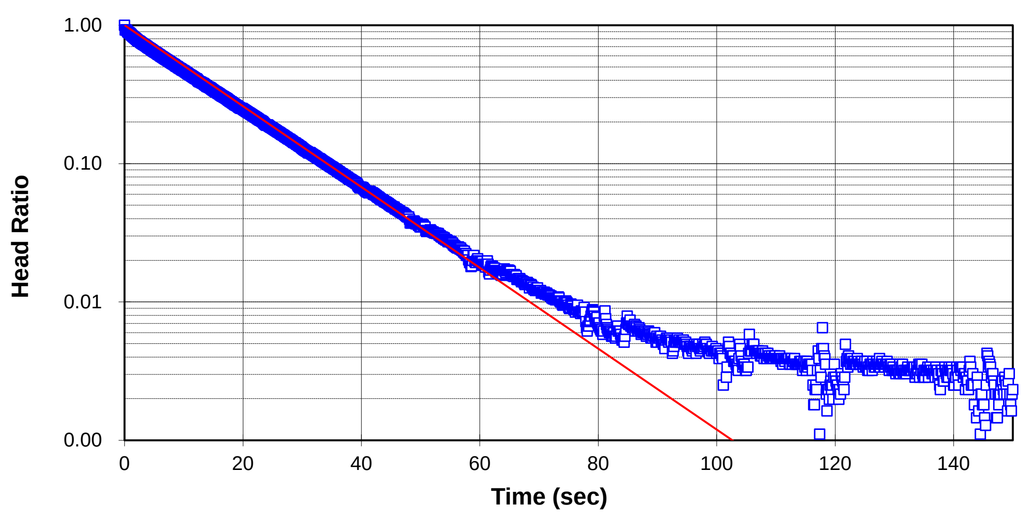
r_c = casing radius (metres)
R_e = filter pack radius (metres)
L_e = length of screened interval (metres)
t = time (seconds)
h_t = head at time t (metres)

INPUT PARAMETERS

r_c =	**0.025**
R_e =	**0.10**
L_e =	**1.5**
t_1 =	**0**
t_2 =	**58.125**
h_1/h_0 =	**1.00**
h_2/h_0 =	**0.02**

RESULTS

K=	**4E-05**	**m/sec**
K=	**4E-03**	**cm/sec**



Project Name:	Tomlinson AR East Oxford	Analysis By:	SPS
Project No.:	21471757	Checked By:	LEB
Test Date:	2021-07-20	Analysis Date:	2021-08-09

HVORSLEV SLUG TEST ANALYSIS
RISING HEAD TEST BH21-08

INTERVAL (metres below ground surface)

Top of Interval =	**2.13**
Bottom of Interval =	**3.66**

$$K = \frac{r_c^2}{2L_e} ln\left[\frac{L_e}{2R_e} + \sqrt{1 + \left(\frac{L_e}{2R_e}\right)^2}\right]\left[\frac{ln\left(\frac{h_1}{h_2}\right)}{(t_2 - t_1)}\right]$$

where K = (m/sec)

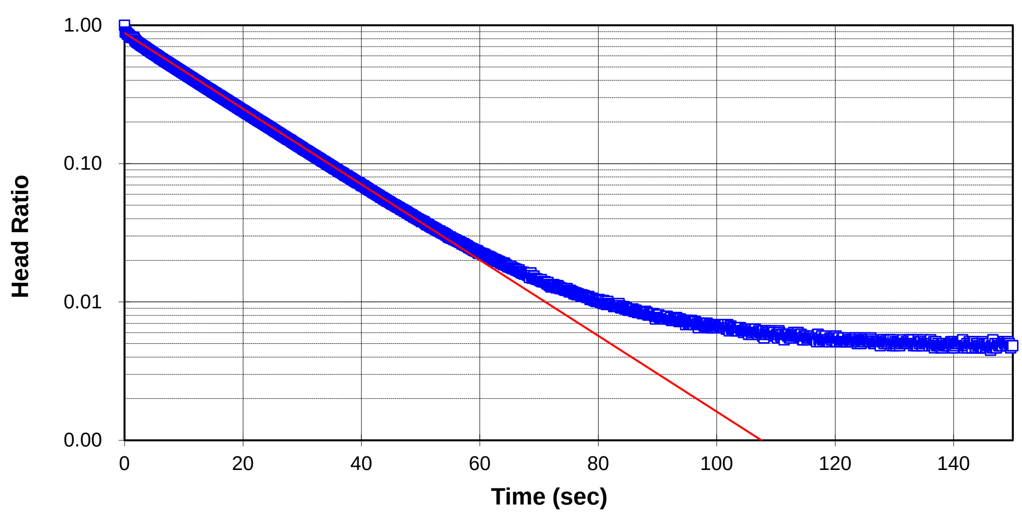
where:
- r_c = casing radius (metres)
- R_e = filter pack radius (metres)
- L_e = length of screened interval (metres)
- t = time (seconds)
- h_t = head at time t (metres)

INPUT PARAMETERS

r_c =	0.025
R_e =	0.10
L_e =	1.5
t_1 =	0.875
t_2 =	40.625
h_1/h_0 =	0.83
h_2/h_0 =	0.07

RESULTS

K=	4E-05	m/sec
K=	4E-03	cm/sec



Project Name: Tomlinson AR East Oxford
Project No.: 21471757
Test Date: 2021-07-20

Analysis By: SPS
Checked By: LEB
Analysis Date: 2021-08-09

APPENDIX E

Groundwater and Surface Water Elevations

Table E-1: Summary of Groundwater Elevations in Monitoring Wells

Date	Groundwater Elevations (metres above sea level)							
	21-01	21-02	21-03	21-04	21-05	21-06	21-07	21-08
20-Jul-21	106.33	106.23	105.38	101.00	105.03	105.55	101.13	104.78
09-Aug-21	106.18	106.11	105.27	100.36	104.92	105.51	100.95	104.72
10-Sep-21	106.00	105.95	105.16	100.11	104.81	105.37	100.73	104.67
5-Oct-21	105.81	105.87	105.11	100.65	104.80	105.26	101.08	104.75
15-Nov-21	106.09	105.93	105.11	101.06	104.81	105.16	101.12	104.86
21-Dec-21	106.29	106.07	105.24	100.97	104.87	105.22	101.11	104.82
31-Jan-22	106.65	105.91	105.06	100.63	104.83	105.30	Frozen	104.65
09-Feb-22	106.52	105.88	105.04	100.94	104.82	105.25	Frozen	104.69
30-Mar-22	106.51	106.41	105.40	Dry	105.20	105.57	Frozen	104.83
12-Apr-22	106.84	106.52	105.41	100.97	105.29	105.72	101.09	104.82
11-May-22	106.69	106.48	105.36	100.81	105.24	105.88	101.04	104.79
29-Jun-22	106.58	106.47	105.34	100.77	105.16	105.88	101.05	104.80
07-Jul-22	106.50	106.42	105.28	100.23	105.09	105.81	100.91	104.71
31-Aug-22	106.19	106.10	105.06	100.15	104.83	105.58	100.76	104.77
07-Sep-22	106.14	106.05	105.03	99.99	104.79	105.52	100.71	104.63
03-Oct-22	106.11	105.93	104.96	100.65	104.78	105.39	101.03	104.66
23-Nov-22	105.95	105.74	104.88	100.93	105.10	105.17	101.06	104.71
13-Dec-22	106.06	105.81	104.88	100.84	104.63	105.11	101.03	104.62
24-Jan-23	106.34	106.23	105.34	100.94	105.08	105.61	101.02	104.84
10-Feb-23	106.31	106.14	105.26	101.16	105.00	105.27	Frozen	104.95
30-Mar-23	106.79	106.50	105.49	101.09	105.31	105.69	Frozen	104.92
12-Apr-23	107.29	106.99	106.04	100.91	105.74	105.41	101.04	104.90
29-May-23	106.93	106.96	105.69	100.65	105.54	106.42	101.01	104.85
15-Jun-23	106.75	106.82	105.55	100.22	105.40	106.30	100.97	104.88
25-Jul-23	106.51	106.52	105.31	99.83	105.12	105.97	100.91	104.75

Date	Groundwater Elevations (metres above sea level)							
	21-01	21-02	21-03	21-04	21-05	21-06	21-07	21-08
17-Aug-23	106.73	106.64	105.31	100.83	105.06	105.92	101.01	104.85
20-Sep-23	106.42	106.34	105.21	100.26	105.01	105.77	101.02	104.81
17-Oct-23	106.28	106.18	105.13	100.18	104.89	105.61	101.02	104.76
15-Nov-23	106.25	106.07	105.08	100.92	104.84	105.47	101.04	104.82
08-Dec-23	106.32	106.05	105.07	100.91	104.85	105.37	101.04	104.81
15-Jan-24	106.50	106.28	105.31	101.01	105.09	105.54	101.04	104.87
29-Feb-24	106.64	106.35	105.40	101.00	105.18	105.60	101.04	104.88
14-Mar-24	106.76	106.43	105.39	100.98	105.12	105.66	101.04	104.88
17-Apr-24	106.76	106.43	105.39	100.98	105.22	105.66	101.04	104.88
15-May-24	106.83	106.84	105.49	100.93	105.32	106.02	101.05	104.88
18-Jun-24	106.58	106.43	105.30	100.61	105.19	Not measured	100.98	104.80
04-Jul-24	106.52	106.37	105.24	100.66	105.09	105.80	100.97	104.78
7-Aug-24	106.42	106.21	105.11	100.38	104.94	105.66	101.00	104.78
4-Sep-24	106.50	106.42	105.33	100.66	105.08	105.75	100.97	104.78
3-Oct-24	106.29	106.22	105.16	100.25	104.91	105.62	101.00	104.75
5-Nov-24	106.14	106.03	105.06	100.51	104.82	105.46	Frozen	104.76
3-Dec-24	106.14	105.91	105.00	100.92	104.75	105.46	Frozen	104.76
13-Jan-25	106.24	105.96	105.05	100.94	104.79	105.46	Frozen	104.78
12-Feb-25	106.42	106.14	105.16	100.95	104.82	105.45	Frozen	104.81
15-Mar-25	106.48	106.36	105.20	100.99	104.99	105.44	101.04	104.83
2-Apr-25	106.70	106.51	105.26	101.00	105.12	105.44	101.04	104.86
8-May-25	106.80	106.55	105.45	100.88	105.28	105.79	100.98	104.82
12-Jun-25	106.50	106.34	105.25	100.35	105.08	105.71	100.91	104.72
9-Jul-25	106.31	106.21	105.11	100.03	104.93	105.59	100.71	104.63
15-Aug-25	106.02	105.98	104.92	Dry	104.67	105.42	99.94	104.28

Date	Groundwater Elevations (metres above sea level)							
	21-01	21-02	21-03	21-04	21-05	21-06	21-07	21-08
5-Sep-25	105.91	105.85	104.85	Dry	104.59	105.31	99.89	104.36

Table E-2: Summary of Surface Water Elevations at Staff Gauges

Date Measured	Surface Water Elevation		
	SG-1	SG-2	SG-3
Aug 31, 2022	100.34	Dry	Not established
Sep 07, 2022	100.35	Dry	Not established
Oct 03, 2022	100.36	100.77	Not established
Nov 23, 2022	100.39	Frozen	Not established
Dec 13, 2022	Frozen	Frozen	Not established
Jan 24, 2023	Frozen	Frozen	Not established
Feb 10, 2023	Frozen	Frozen	Not established
Mar 30, 2023	100.41	Frozen	Not established
Apr 12, 2023	100.38	100.84	Not established
May 29, 2023	100.34	100.76	Not established
Jun 15, 2023	100.36	Dry	Not established
Jul 25, 2023	100.33	Dry	Not established
Aug 17, 2023	100.37	100.78	Not established
Sep 20, 2023	100.37	100.80	Not established
Oct 17, 2023	100.39	100.80	Not established
Nov 15, 2023	100.40	100.81	Not established
Dec 08, 2023	Frozen	Frozen	Not established
Jan 15, 2024	Frozen	Frozen	Not established
Feb 29, 2024	Frozen	Frozen	Not established
Mar 14, 2024	100.53	100.93	Not established
April 17, 2024	100.45	100.82	Not established
May 15, 2024	100.42	100.83	Not established
Jun 18, 2024	100.38	100.76	Not established
Jul 04, 2024	100.39	100.76	Not established
Aug 07, 2024	100.39	100.78	102.37
Sep 04, 2024	100.38	100.75	102.37
Oct 03, 2024	100.39	100.76	102.37
Nov 05, 2024	100.41	100.82	102.38
Dec 03, 2024	Frozen	Frozen	Frozen
Jan 13, 2025	Frozen	Frozen	Frozen

Date Measured	Surface Water Elevation		
	SG-1	SG-2	SG-3
Feb 12, 2025	Frozen	Frozen	Frozen
Mar 15, 2025	Frozen	Frozen	Frozen
Apr 02, 2025	100.30	Frozen	102.40
May 08, 2025	100.26	100.86	102.41
Jun 12, 2025	100.23	Dry	102.36
Jul 09, 2025	100.20	Dry	102.35
Aug 15, 2025	Dry	Dry	102.31
Sep 05, 2025	100.14	Dry	102.33

Note: Top of staff gauge elevation relative to geodetic datum surveyed at SG-1 and SG-3 by Tomlinson in October 2024, and at SG-2 by WSP in October 2025

APPENDIX F

Analytical Modelling Results

Inflow to the Open Pit (1)
Based on Equations by Marinelli and Niccoli (2000)

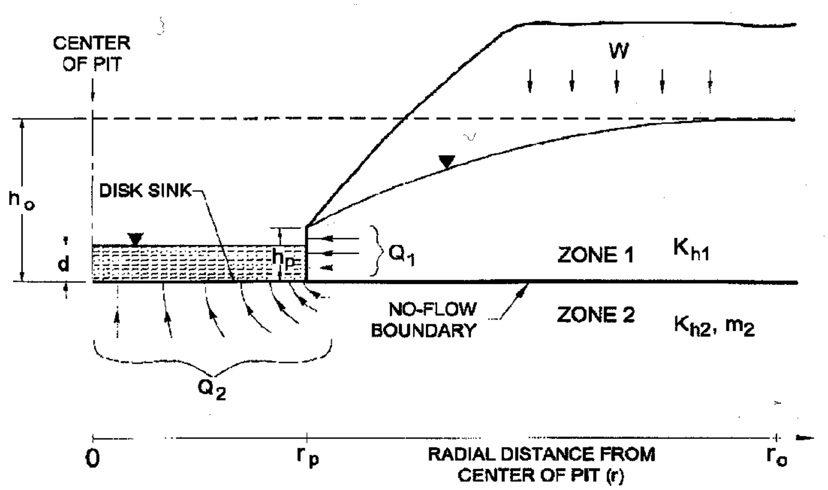


Figure 2. Pit inflow analytical model.

Marinelli, F., and W. L. Niccoli. 2000. Simple analytical equations for estimating ground water inflow to a mine pit. Ground Water 38, no. 2: 311-314.

(A) $$h_o = \sqrt{{h_p}^2 + \frac{W}{K_{h1}}\left[r_o^2 \ln\left(\frac{r_o}{r_p}\right) - \frac{(r_o^2 - r_p^2)}{2}\right]}$$

(A1) $$h = \sqrt{{h_p}^2 + \frac{W}{K_{h1}}\left[r_o^2 \ln\left(\frac{r}{r_p}\right) - \frac{(r^2 - r_p^2)}{2}\right]},$$

(B) $$Q_1 = W\pi(r_o^2 - r_p^2),$$

(C) $$Q_2 = 4r_p\left(\frac{K_{h2}}{m_2}\right)(h_0 - d)$$

(D) $$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

Input Parameters

W (m/s)	9.3E-09	recharge flux
Kh1 (m/s)	6.5E-05	horizontal hydraulic conductivity in Zone 1
Kh2 (m/s)	1.1E-06	horizontal hydraulic conductivity in Zone 2
Kv2 (m/s)	1.1E-07	vertical hydraulic conductivity in Zone 2
ho (m)	5.8	initial saturated thickness above the base of Zone 1
hp (m)	4.5	saturated thickness at the pit wall
rp (m)	344.1	effective pit radius
d (m)	4.5	depth of the pit lake

Inflow to the Open Pit (2)
Based on Equations by Marinelli and Niccoli (2000)

Inflow from Zone 1

ro (m)	623.1	radius of influence calculated by iterating equation A

(known ho)		(ho calculated using eq. A)
5.8	=	5.8

Q1 (m3/s)	7.9E-03	pit inflow from Zone 1 calculated using equation B
Q1 (m3/day)	680.5	
Q1 (USgpm)	124.9	

Inflow from Zone 2

m2	3.16227766	anisotropy parameter calculated using equation D

Q2 (m3/s)	6.5E-04	pit inflow from Zone 2 calculated using equation C
Q2 (m3/day)	56.0	
Q2 (USgpm)	10.3	

Total Pit Inflow

Q (m3/s)	8.5E-03
Q (m3/day)	736.5
Q (USgpm)	135.1

One Metre Radius of Influence

r (m)	372.9	radius of influence calculated by iterating equation A1

(known h)		(h calculated using eq. A1)
4.8	=	4.8

Pit Area

	Area (ha)	Area (m2)	R (m)	Radius of Ilius of Influence (m)	
Operations	38.1	381000	344	372.9	29

Inflow to the Open Pit (1)
Based on Equations by Marinelli and Niccoli (2000)

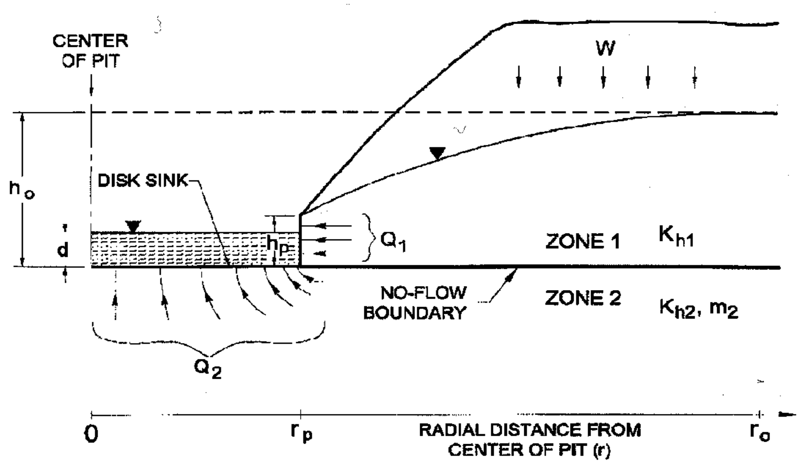


Figure 2. Pit inflow analytical model.

Marinelli, F., and W. L. Niccoli. 2000. Simple analytical equations for estimating ground water inflow to a mine pit. Ground Water 38, no. 2: 311-314.

(A) $$h_o = \sqrt{{h_p}^2 + \frac{W}{K_{h1}}\left[r_o^2 \ln\left(\frac{r_o}{r_p}\right) - \frac{\left(r_o^2 - r_p^2\right)}{2}\right]}$$

(A1) $$h = \sqrt{{h_p}^2 + \frac{W}{K_{h1}}\left[r_o^2 \ln\left(\frac{r}{r_p}\right) - \frac{\left(r^2 - r_p^2\right)}{2}\right]},$$

(B) $$Q_1 = W\pi\left(r_o^2 - r_p^2\right),$$

(C) $$Q_2 = 4r_p\left(\frac{K_{h2}}{m_2}\right)(h_0 - d)$$

(D)

Input Parameters

W (m/s)	9.3E-09	recharge flux
Kh1 (m/s)	2.1E-04	horizontal hydraulic conductivity in Zone 1
Kh2 (m/s)	1.1E-06	horizontal hydraulic conductivity in Zone 2
Kv2 (m/s)	1.1E-07	vertical hydraulic conductivity in Zone 2
ho (m)	5.8	initial saturated thickness above the base of Zone 1
hp (m)	4.5	saturated thickness at the pit wall
rp (m)	344.1	effective pit radius
d (m)	4.5	depth of the pit lake

Inflow to the Open Pit (2)
Based on Equations by Marinelli and Niccoli (2000)

Inflow from Zone 1

ro (m)	815.7	radius of influence calculated by iterating equation A
(known ho)		(ho calculated using eq. A)
5.8	=	5.8
Q1 (m3/s)	1.6E-02	pit inflow from Zone 1 calculated using equation B
Q1 (m3/day)	1379.4	
Q1 (USgpm)	253.1	

Inflow from Zone 2

m2	3.16227766	anisotropy parameter calculated using equation D
Q2 (m3/s)	6.3E-04	pit inflow from Zone 2 calculated using equation C
Q2 (m3/day)	54.6	
Q2 (USgpm)	10.0	

Total Pit Inflow

Q (m3/s)	1.7E-02
Q (m3/day)	1434.0
Q (USgpm)	263.1

One Metre Radius of Influence

r (m)	389.5	radius of influence calculated by iterating equation A1
(known h)		(h calculated using eq. A1)
4.8	=	4.8

Pit Area

	Area (ha)	Area (m2)	R (m)	Radius of Ilius of Influence (m)	
Operations	38.1	381000	344	389.5	45

Parameter	Geomean K	Highest Site K
Drawdown (s), metres	1.3	1.3
Hydraulic Conductivity (K), metres per second	7E-05	2E-04
Aquifer Saturated Thickness (B), metres	5.8	5.8
Length of Pit Lake(L), metres	700	700

Author	Formula	R (m)	R (m)
Sichardt (1930)	$R = 3000s\sqrt{K}$	32	56
Kusakin (in Bear, 1979)	$R = 575s\sqrt{BK}$	15	26
Wrobel (1980)	$R = 1500s\sqrt{K}logL$	45	80

APPENDIX G

Laboratory Certificate of Analysis

Your Project #: 21471757A
Site Location: EAST OXFORD
Your C.O.C. #: 886220-01-01

Attention: Kris Marentette

Golder Associates Ltd
1931 Robertson Rd
Ottawa, ON
CANADA K2H 5B7

Report Date: 2022/07/29
Report #: R7232586
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C2K5441
Received: 2022/07/21, 12:55

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Dissolved Aluminum (0.2 u, clay free) (1)	1	N/A	2022/07/25	CAM SOP-00447	EPA 6020B m
Alkalinity (1)	1	N/A	2022/07/26	CAM SOP-00448	SM 23 2320 B m
Chloride by Automated Colourimetry (1)	1	N/A	2022/07/25	CAM SOP-00463	SM 23 4500-Cl E m
Dissolved Organic Carbon (DOC) (1, 2)	1	N/A	2022/07/26	CAM SOP-00446	SM 23 5310 B m
Total Metals Analysis by ICPMS (1)	1	N/A	2022/07/27	CAM SOP-00447	EPA 6020B m
Total Ammonia-N (1)	1	N/A	2022/07/27	CAM SOP-00441	USGS I-2522-90 m
Nitrate & Nitrite as Nitrogen in Water (1, 3)	1	N/A	2022/07/27	CAM SOP-00440	SM 23 4500-NO3I/NO2B
Animal and Vegetable Oil and Grease (1)	1	N/A	2022/07/28	CAM SOP-00326	EPA1664B m,SM5520B m
Total Oil and Grease (1)	1	2022/07/27	2022/07/28	CAM SOP-00326	EPA1664B m,SM5520B m
OC Pesticides (Selected) & PCB (1, 4)	1	2022/07/25	2022/07/28	CAM SOP-00307	EPA 8081A/8082B m
OC Pesticides Summed Parameters (1)	1	N/A	2022/07/23	CAM SOP-00307	EPA 8081A/8082B m
Sulphate by Automated Colourimetry (1)	1	N/A	2022/07/25	CAM SOP-00464	EPA 375.4 m
Total Dissolved Solids (1)	1	2022/07/26	2022/07/27	CAM SOP-00428	SM 23 2540C m
Total Kjeldahl Nitrogen in Water (1)	1	2022/07/25	2022/07/26	CAM SOP-00938	OMOE E3516 m
Total Phosphorus (Colourimetric) (1)	1	2022/07/26	2022/07/29	CAM SOP-00407	SM 23 4500-P I
Mineral/Synthetic O & G (TPH Heavy Oil) (1, 5)	1	2022/07/27	2022/07/28	CAM SOP-00326	EPA1664B m,SM5520F m
Total Suspended Solids (1)	1	2022/07/26	2022/07/27	CAM SOP-00428	SM 23 2540D m
Turbidity (1)	1	N/A	2022/07/22	CAM SOP-00417	SM 23 2130 B m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Your Project #: 21471757A
Site Location: EAST OXFORD
Your C.O.C. #: 886220-01-01

Attention: Kris Marentette

Golder Associates Ltd
1931 Robertson Rd
Ottawa, ON
CANADA K2H 5B7

Report Date: 2022/07/29
Report #: R7232586
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C2K5441
Received: 2022/07/21, 12:55

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by Bureau Veritas Mississauga, 6740 Campobello Rd , Mississauga, ON, L5N 2L8
(2) Dissolved Organic Carbon (DOC) present in the sample should be considered as non-purgeable DOC.
(3) Values for calculated parameters may not appear to add up due to rounding of raw data and significant figures.
(4) Chlordane (Total) = Alpha Chlordane + Gamma Chlordane
(5) Note: TPH (Heavy Oil) is equivalent to Mineral / Synthetic Oil & Grease

Encryption Key Katherine Szozda
Katherine Szozda
Project Manager
29 Jul 2022 17:29:35

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Katherine Szozda, Project Manager
Email: Katherine.Szozda@bureauveritas.com
Phone# (613)274-0573 Ext:7063633
==
Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Job #: C2K5441
Report Date: 2022/07/29

Golder Associates Ltd
Client Project #: 21471757A
Site Location: EAST OXFORD
Sampler Initials: C.A

OIL & GREASE - A/V/M/T (WATER)

Bureau Veritas ID		TFZ312		
Sampling Date		2022/07/21 11:00		
COC Number		886220-01-01		
	UNITS	**SW-1**	**RDL**	**QC Batch**
Calculated Parameters				
Total Animal/Vegetable Oil and Grease	mg/L	<0.50	0.50	8125399
Petroleum Hydrocarbons				
Total Oil & Grease	mg/L	0.50	0.50	8134257
Total Oil & Grease Mineral/Synthetic	mg/L	0.50	0.50	8134267

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Bureau Veritas 100 – 36 Antares Dr. Nepean, ON, K2E 7W5 Phone: 613-274-0573 Website: www.bvna.com

Bureau Veritas Job #: C2K5441
Report Date: 2022/07/29

Golder Associates Ltd
Client Project #: 21471757A
Site Location: EAST OXFORD
Sampler Initials: C.A

RESULTS OF ANALYSES OF WATER

Bureau Veritas ID		TFZ312			TFZ312		
Sampling Date		2022/07/21 11:00			2022/07/21 11:00		
COC Number		886220-01-01			886220-01-01		
	UNITS	SW-1	RDL	QC Batch	SW-1 Lab-Dup	RDL	QC Batch
Inorganics							
Total Ammonia-N	mg/L	<0.050	0.050	8130668			
Total Dissolved Solids	mg/L	225	10	8131896			
Total Kjeldahl Nitrogen (TKN)	mg/L	0.41	0.10	8129014			
Dissolved Organic Carbon	mg/L	7.2	0.40	8126035			
Total Phosphorus	mg/L	0.005	0.004	8130705			
Total Suspended Solids	mg/L	<10	10	8131891	<10	10	8131891
Dissolved Sulphate (SO4)	mg/L	2.3	1.0	8126437			
Turbidity	NTU	3.9	0.1	8126077	4.3	0.1	8126077
Alkalinity (Total as CaCO3)	mg/L	200	1.0	8127345			
Dissolved Chloride (Cl-)	mg/L	3.9	1.0	8126423			
Nitrite (N)	mg/L	<0.010	0.010	8126494			
Nitrate (N)	mg/L	<0.10	0.10	8126494			
Nitrate + Nitrite (N)	mg/L	<0.10	0.10	8126494			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

Bureau Veritas 100 – 36 Antares Dr. Nepean, ON, K2E 7W5 Phone: 613-274-0573 Website: www.bvna.com

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Bureau Veritas ID		TFZ312			TFZ312		
Sampling Date		2022/07/21 11:00			2022/07/21 11:00		
COC Number		886220-01-01			886220-01-01		
	UNITS	SW-1	RDL	QC Batch	SW-1 Lab-Dup	RDL	QC Batch
Metals							
Dissolved (0.2u) Aluminum (Al)	ug/L	25	5	8126377	25	5	8126377
Total Aluminum (Al)	ug/L	140	4.9	8132847			
Total Antimony (Sb)	ug/L	<0.50	0.50	8132847			
Total Arsenic (As)	ug/L	<1.0	1.0	8132847			
Total Barium (Ba)	ug/L	30	2.0	8132847			
Total Beryllium (Be)	ug/L	<0.40	0.40	8132847			
Total Bismuth (Bi)	ug/L	<1.0	1.0	8132847			
Total Boron (B)	ug/L	<10	10	8132847			
Total Cadmium (Cd)	ug/L	<0.090	0.090	8132847			
Total Calcium (Ca)	ug/L	51000	200	8132847			
Total Chromium (Cr)	ug/L	<5.0	5.0	8132847			
Total Cobalt (Co)	ug/L	<0.50	0.50	8132847			
Total Copper (Cu)	ug/L	1.1	0.90	8132847			
Total Iron (Fe)	ug/L	230	100	8132847			
Total Lead (Pb)	ug/L	<0.50	0.50	8132847			
Total Lithium (Li)	ug/L	<5.0	5.0	8132847			
Total Magnesium (Mg)	ug/L	20000	50	8132847			
Total Manganese (Mn)	ug/L	15	2.0	8132847			
Total Molybdenum (Mo)	ug/L	1.0	0.50	8132847			
Total Nickel (Ni)	ug/L	<1.0	1.0	8132847			
Total Potassium (K)	ug/L	420	200	8132847			
Total Selenium (Se)	ug/L	<2.0	2.0	8132847			
Total Silicon (Si)	ug/L	3000	50	8132847			
Total Silver (Ag)	ug/L	<0.090	0.090	8132847			
Total Sodium (Na)	ug/L	2400	100	8132847			
Total Strontium (Sr)	ug/L	52	1.0	8132847			
Total Tellurium (Te)	ug/L	<1.0	1.0	8132847			
Total Thallium (Tl)	ug/L	<0.050	0.050	8132847			
Total Tin (Sn)	ug/L	<1.0	1.0	8132847			
Total Titanium (Ti)	ug/L	14	5.0	8132847			
Total Tungsten (W)	ug/L	<1.0	1.0	8132847			
Total Uranium (U)	ug/L	1.1	0.10	8132847			
Total Vanadium (V)	ug/L	2.5	0.50	8132847			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Bureau Veritas ID		TFZ312			TFZ312		
Sampling Date		2022/07/21 11:00			2022/07/21 11:00		
COC Number		886220-01-01			886220-01-01		
	UNITS	**SW-1**	**RDL**	**QC Batch**	**SW-1 Lab-Dup**	**RDL**	**QC Batch**
Total Zinc (Zn)	ug/L	<5.0	5.0	8132847			
Total Zirconium (Zr)	ug/L	<1.0	1.0	8132847			

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

Bureau Veritas Job #: C2K5441
Report Date: 2022/07/29

Golder Associates Ltd
Client Project #: 21471757A
Site Location: EAST OXFORD
Sampler Initials: C.A

ORGANOCHLORINATED PESTICIDES BY GC-ECD (WATER)

Bureau Veritas ID		TFZ312		
Sampling Date		2022/07/21 11:00		
COC Number		886220-01-01		
	UNITS	**SW-1**	**RDL**	**QC Batch**
Calculated Parameters				
Aldrin + Dieldrin	ug/L	<0.005	0.005	8125352
Chlordane (Total)	ug/L	<0.005	0.005	8125352
DDT+ Metabolites	ug/L	<0.005	0.005	8125352
Heptachlor + Heptachlor epoxide	ug/L	<0.005	0.005	8125352
o,p-DDD + p,p-DDD	ug/L	<0.005	0.005	8125352
o,p-DDE + p,p-DDE	ug/L	<0.005	0.005	8125352
o,p-DDT + p,p-DDT	ug/L	<0.005	0.005	8125352
Total Endosulfan	ug/L	<0.005	0.005	8125352
Total PCB	ug/L	<0.05	0.05	8125352
Pesticides & Herbicides				
Aldrin	ug/L	<0.005	0.005	8128089
Dieldrin	ug/L	<0.005	0.005	8128089
a-Chlordane	ug/L	<0.005	0.005	8128089
g-Chlordane	ug/L	<0.005	0.005	8128089
o,p-DDD	ug/L	<0.005	0.005	8128089
p,p-DDD	ug/L	<0.005	0.005	8128089
o,p-DDE	ug/L	<0.005	0.005	8128089
p,p-DDE	ug/L	<0.005	0.005	8128089
o,p-DDT	ug/L	<0.005	0.005	8128089
p,p-DDT	ug/L	<0.005	0.005	8128089
Lindane	ug/L	<0.003	0.003	8128089
Endosulfan I (alpha)	ug/L	<0.005	0.005	8128089
Endosulfan II (beta)	ug/L	<0.005	0.005	8128089
Endrin	ug/L	<0.005	0.005	8128089
Heptachlor	ug/L	<0.005	0.005	8128089
Heptachlor epoxide	ug/L	<0.005	0.005	8128089
Hexachlorobenzene	ug/L	<0.005	0.005	8128089
Methoxychlor	ug/L	<0.01	0.01	8128089
Aroclor 1016	ug/L	<0.05	0.05	8128089
Aroclor 1221	ug/L	<0.05	0.05	8128089
Aroclor 1232	ug/L	<0.05	0.05	8128089
Aroclor 1242	ug/L	<0.05	0.05	8128089
Aroclor 1248	ug/L	<0.05	0.05	8128089

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Bureau Veritas 100 – 36 Antares Dr. Nepean, ON, K2E 7W5 Phone: 613-274-0573 Website: www.bvna.com

Bureau Veritas Job #: C2K5441
Report Date: 2022/07/29

Golder Associates Ltd
Client Project #: 21471757A
Site Location: EAST OXFORD
Sampler Initials: C.A

ORGANOCHLORINATED PESTICIDES BY GC-ECD (WATER)

Bureau Veritas ID		TFZ312		
Sampling Date		2022/07/21 11:00		
COC Number		886220-01-01		
	UNITS	SW-1	RDL	QC Batch
Aroclor 1254	ug/L	<0.05	0.05	8128089
Aroclor 1260	ug/L	<0.05	0.05	8128089
alpha-BHC	ug/L	<0.005	0.005	8128089
beta-BHC	ug/L	<0.005	0.005	8128089
delta-BHC	ug/L	<0.005	0.005	8128089
Endosulfan sulfate	ug/L	<0.005	0.005	8128089
Endrin aldehyde	ug/L	<0.005	0.005	8128089
Endrin ketone	ug/L	<0.005	0.005	8128089
Mirex	ug/L	<0.005	0.005	8128089
Octachlorostyrene	ug/L	<0.005	0.005	8128089
Oxychlordane	ug/L	<0.005	0.005	8128089
Toxaphene	ug/L	<0.2	0.2	8128089
Surrogate Recovery (%)				
2,4,5,6-Tetrachloro-m-xylene	%	68		8128089
Decachlorobiphenyl	%	96		8128089

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Bureau Veritas Job #: C2K5441
Report Date: 2022/07/29

Golder Associates Ltd
Client Project #: 21471757A
Site Location: EAST OXFORD
Sampler Initials: C.A

TEST SUMMARY

Bureau Veritas ID: TFZ312
Sample ID: SW-1
Matrix: Water

Collected: 2022/07/21
Shipped:
Received: 2022/07/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	8126377	N/A	2022/07/25	Azita Fazaeli
Alkalinity	AT	8127345	N/A	2022/07/26	Surinder Rai
Chloride by Automated Colourimetry	KONE	8126423	N/A	2022/07/25	Alina Dobreanu
Dissolved Organic Carbon (DOC)	TOCV/NDIR	8126035	N/A	2022/07/26	Nimarta Singh
Total Metals Analysis by ICPMS	ICP/MS	8132847	N/A	2022/07/27	Rupinder Gill
Total Ammonia-N	LACH/NH4	8130668	N/A	2022/07/27	Raiq Kashif
Nitrate & Nitrite as Nitrogen in Water	LACH	8126494	N/A	2022/07/27	Amanpreet Sappal
Animal and Vegetable Oil and Grease	BAL	8125399	N/A	2022/07/28	Automated Statchk
Total Oil and Grease	BAL	8134257	2022/07/27	2022/07/28	Maulik Jashubhai Patel
OC Pesticides (Selected) & PCB	GC/ECD	8128089	2022/07/25	2022/07/28	Li Peng
OC Pesticides Summed Parameters	CALC	8125352	N/A	2022/07/23	Automated Statchk
Sulphate by Automated Colourimetry	KONE	8126437	N/A	2022/07/25	Alina Dobreanu
Total Dissolved Solids	BAL	8131896	2022/07/26	2022/07/27	Masood Siddiqui
Total Kjeldahl Nitrogen in Water	SKAL	8129014	2022/07/25	2022/07/26	Rajni Tyagi
Total Phosphorus (Colourimetric)	SKAL/P	8130705	2022/07/26	2022/07/29	Shivani Shivani
Mineral/Synthetic O & G (TPH Heavy Oil)	BAL	8134267	2022/07/27	2022/07/28	Maulik Jashubhai Patel
Total Suspended Solids	BAL	8131891	2022/07/26	2022/07/27	Shaneil Hall
Turbidity	AT	8126077	N/A	2022/07/22	Neil Dassanayake

Bureau Veritas ID: TFZ312 Dup
Sample ID: SW-1
Matrix: Water

Collected: 2022/07/21
Shipped:
Received: 2022/07/21

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Dissolved Aluminum (0.2 u, clay free)	ICP/MS	8126377	N/A	2022/07/25	Azita Fazaeli
Total Suspended Solids	BAL	8131891	2022/07/26	2022/07/27	Shaneil Hall
Turbidity	AT	8126077	N/A	2022/07/22	Neil Dassanayake

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	5.3°C

Results relate only to the items tested.

Bureau Veritas Job #: C2K5441
Report Date: 2022/07/29

QUALITY ASSURANCE REPORT

Golder Associates Ltd
Client Project #: 21471757A
Site Location: EAST OXFORD
Sampler Initials: C.A

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8128089	2,4,5,6-Tetrachloro-m-xylene	2022/07/28	67	50 - 130	64	50 - 130	50	%				
8128089	Decachlorobiphenyl	2022/07/28	93	50 - 130	101	50 - 130	85	%				
8126035	Dissolved Organic Carbon	2022/07/26	95	80 - 120	100	80 - 120	<0.40	mg/L	3.7	20		
8126077	Turbidity	2022/07/22			101	85 - 115	<0.1	NTU	9.9	20		
8126377	Dissolved (0.2u) Aluminum (Al)	2022/07/25	100	80 - 120	103	80 - 120	<5	ug/L	2.4	20		
8126423	Dissolved Chloride (Cl-)	2022/07/25	NC	80 - 120	104	80 - 120	<1.0	mg/L	0.28	20		
8126437	Dissolved Sulphate (SO4)	2022/07/25	NC	75 - 125	101	80 - 120	<1.0	mg/L	0.48	20		
8126494	Nitrate (N)	2022/07/27	91	80 - 120	94	80 - 120	<0.10	mg/L	0.54	20		
8126494	Nitrite (N)	2022/07/27	104	80 - 120	109	80 - 120	<0.010	mg/L	NC	20		
8127345	Alkalinity (Total as CaCO3)	2022/07/26			96	85 - 115	<1.0	mg/L	1.0	20		
8128089	a-Chlordane	2022/07/28	91	50 - 130	103	50 - 130	<0.005	ug/L	NC	30		
8128089	Aldrin	2022/07/28	93	50 - 130	95	50 - 130	<0.005	ug/L	NC	30		
8128089	alpha-BHC	2022/07/28	82	30 - 130	99	30 - 130	<0.005	ug/L	5.3	40		
8128089	Aroclor 1016	2022/07/28					<0.05	ug/L				
8128089	Aroclor 1221	2022/07/28					<0.05	ug/L				
8128089	Aroclor 1232	2022/07/28					<0.05	ug/L				
8128089	Aroclor 1242	2022/07/28					<0.05	ug/L	NC	30		
8128089	Aroclor 1248	2022/07/28					<0.05	ug/L	NC	30		
8128089	Aroclor 1254	2022/07/28					<0.05	ug/L	NC	30		
8128089	Aroclor 1260	2022/07/28					<0.05	ug/L	NC	30		
8128089	beta-BHC	2022/07/28	85	30 - 130	91	30 - 130	<0.005	ug/L	15	40		
8128089	delta-BHC	2022/07/28	84	30 - 130	95	30 - 130	<0.005	ug/L	4.9	40		
8128089	Dieldrin	2022/07/28	103	50 - 130	121	50 - 130	<0.005	ug/L	NC	30		
8128089	Endosulfan I (alpha)	2022/07/28	86	50 - 130	88	50 - 130	<0.005	ug/L	NC	30		
8128089	Endosulfan II (beta)	2022/07/28	90	50 - 130	104	50 - 130	<0.005	ug/L	NC	30		
8128089	Endosulfan sulfate	2022/07/28	102	30 - 130	119	30 - 130	<0.005	ug/L	2.9	40		
8128089	Endrin aldehyde	2022/07/28	88	30 - 130	83	30 - 130	<0.005	ug/L	3.6	40		
8128089	Endrin ketone	2022/07/28	85	30 - 130	91	30 - 130	<0.005	ug/L	0.70	40		
8128089	Endrin	2022/07/28	100	50 - 130	112	50 - 130	<0.005	ug/L	NC	30		
8128089	g-Chlordane	2022/07/28	87	50 - 130	98	50 - 130	<0.005	ug/L	NC	30		
8128089	Heptachlor epoxide	2022/07/28	94	50 - 130	107	50 - 130	<0.005	ug/L	NC	30		
8128089	Heptachlor	2022/07/28	101	50 - 130	112	50 - 130	<0.005	ug/L	NC	30		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8128089	Hexachlorobenzene	2022/07/28	80	50 - 130	93	50 - 130	<0.005	ug/L	NC	30		
8128089	Lindane	2022/07/28	84	50 - 130	100	50 - 130	<0.003	ug/L	NC	30		
8128089	Methoxychlor	2022/07/28	94	50 - 130	99	50 - 130	<0.01	ug/L	NC	30		
8128089	Mirex	2022/07/28	86	30 - 130	102	30 - 130	<0.005	ug/L	3.3	40		
8128089	o,p-DDD	2022/07/28	104	50 - 130	113	50 - 130	<0.005	ug/L	NC	30		
8128089	o,p-DDE	2022/07/28	83	50 - 130	89	50 - 130	<0.005	ug/L	NC	30		
8128089	o,p-DDT	2022/07/28	110	50 - 130	121	50 - 130	<0.005	ug/L	NC	30		
8128089	Octachlorostyrene	2022/07/28	90	30 - 130	92	30 - 130	<0.005	ug/L	5.7	40		
8128089	Oxychlordane	2022/07/28	90	30 - 130	99	30 - 130	<0.005	ug/L	4.5	30		
8128089	p,p-DDD	2022/07/28	109	50 - 130	121	50 - 130	<0.005	ug/L	NC	30		
8128089	p,p-DDE	2022/07/28	88	50 - 130	91	50 - 130	<0.005	ug/L	NC	30		
8128089	p,p-DDT	2022/07/28	95	50 - 130	93	50 - 130	<0.005	ug/L	NC	30		
8128089	Toxaphene	2022/07/28					<0.2	ug/L				
8129014	Total Kjeldahl Nitrogen (TKN)	2022/07/26	96	80 - 120	103	80 - 120	<0.10	mg/L	NC	20	99	80 - 120
8130668	Total Ammonia-N	2022/07/27	99	75 - 125	101	80 - 120	<0.050	mg/L	NC	20		
8130705	Total Phosphorus	2022/07/28	92	80 - 120	93	80 - 120	<0.004	mg/L	7.6	20	91	80 - 120
8131891	Total Suspended Solids	2022/07/27					<10	mg/L	NC	25	98	85 - 115
8131896	Total Dissolved Solids	2022/07/27					<10	mg/L	0.057	25	97	90 - 110
8132847	Total Aluminum (Al)	2022/07/27	98	80 - 120	102	80 - 120	<4.9	ug/L	0.38	20		
8132847	Total Antimony (Sb)	2022/07/27	102	80 - 120	102	80 - 120	<0.50	ug/L				
8132847	Total Arsenic (As)	2022/07/27	99	80 - 120	100	80 - 120	<1.0	ug/L				
8132847	Total Barium (Ba)	2022/07/27	94	80 - 120	96	80 - 120	<2.0	ug/L				
8132847	Total Beryllium (Be)	2022/07/27	97	80 - 120	100	80 - 120	<0.40	ug/L				
8132847	Total Bismuth (Bi)	2022/07/27	92	80 - 120	95	80 - 120	<1.0	ug/L				
8132847	Total Boron (B)	2022/07/27	93	80 - 120	92	80 - 120	<10	ug/L				
8132847	Total Cadmium (Cd)	2022/07/27	99	80 - 120	98	80 - 120	<0.090	ug/L				
8132847	Total Calcium (Ca)	2022/07/27	96	80 - 120	102	80 - 120	<200	ug/L				
8132847	Total Chromium (Cr)	2022/07/27	99	80 - 120	102	80 - 120	<5.0	ug/L	NC	20		
8132847	Total Cobalt (Co)	2022/07/27	98	80 - 120	99	80 - 120	<0.50	ug/L				
8132847	Total Copper (Cu)	2022/07/27	96	80 - 120	98	80 - 120	<0.90	ug/L	5.7	20		
8132847	Total Iron (Fe)	2022/07/27	101	80 - 120	101	80 - 120	<100	ug/L				
8132847	Total Lead (Pb)	2022/07/27	95	80 - 120	97	80 - 120	<0.50	ug/L	0.73	20		

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		SPIKED BLANK		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8132847	Total Lithium (Li)	2022/07/27	95	80 - 120	99	80 - 120	<5.0	ug/L				
8132847	Total Magnesium (Mg)	2022/07/27	100	80 - 120	100	80 - 120	<50	ug/L				
8132847	Total Manganese (Mn)	2022/07/27	101	80 - 120	102	80 - 120	<2.0	ug/L				
8132847	Total Molybdenum (Mo)	2022/07/27	100	80 - 120	100	80 - 120	<0.50	ug/L				
8132847	Total Nickel (Ni)	2022/07/27	98	80 - 120	101	80 - 120	<1.0	ug/L				
8132847	Total Potassium (K)	2022/07/27	98	80 - 120	101	80 - 120	<200	ug/L				
8132847	Total Selenium (Se)	2022/07/27	100	80 - 120	103	80 - 120	<2.0	ug/L				
8132847	Total Silicon (Si)	2022/07/27	99	80 - 120	102	80 - 120	<50	ug/L				
8132847	Total Silver (Ag)	2022/07/27	100	80 - 120	101	80 - 120	<0.090	ug/L				
8132847	Total Sodium (Na)	2022/07/27	100	80 - 120	102	80 - 120	<100	ug/L				
8132847	Total Strontium (Sr)	2022/07/27	98	80 - 120	99	80 - 120	<1.0	ug/L				
8132847	Total Tellurium (Te)	2022/07/27	100	80 - 120	99	80 - 120	<1.0	ug/L				
8132847	Total Thallium (Tl)	2022/07/27	95	80 - 120	97	80 - 120	<0.050	ug/L				
8132847	Total Tin (Sn)	2022/07/27	99	80 - 120	97	80 - 120	<1.0	ug/L				
8132847	Total Titanium (Ti)	2022/07/27	96	80 - 120	99	80 - 120	<5.0	ug/L				
8132847	Total Tungsten (W)	2022/07/27	99	80 - 120	102	80 - 120	<1.0	ug/L				
8132847	Total Uranium (U)	2022/07/27	94	80 - 120	96	80 - 120	<0.10	ug/L				
8132847	Total Vanadium (V)	2022/07/27	100	80 - 120	102	80 - 120	<0.50	ug/L				
8132847	Total Zinc (Zn)	2022/07/27	98	80 - 120	102	80 - 120	<5.0	ug/L	1.8	20		
8132847	Total Zirconium (Zr)	2022/07/27	99	80 - 120	100	80 - 120	<1.0	ug/L				
8134257	Total Oil & Grease	2022/07/28			99	85 - 115	<0.50	mg/L	0.76	25		
8134267	Total Oil & Grease Mineral/Synthetic	2022/07/28			96	85 - 115	<0.50	mg/L	0.52	25		

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

Bureau Veritas Job #: C2K5441
Report Date: 2022/07/29

Golder Associates Ltd
Client Project #: 21471757A
Site Location: EAST OXFORD
Sampler Initials: C.A

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Anastassia Hamanov, Scientific Specialist

Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas
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CHAIN OF CUSTODY RECORD Page 1 of 1

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:		Laboratory Use Only:	
Company Name	#14090 Golder Associates Ltd	Company Name:		Quotation #:	C22487	Bureau Veritas Job #:	Bottle Order #: 886220
Attention:	Central Accounting	Attention:	Kris Marcelle	P.O. #:		COC #: C#886220-01-01	Project Manager: Katherine Szozda
Address:	1931 Robertson Rd, Ottawa ON K2H 5B7	Address:		Project:	~~20448878A~~ 21471757A		
Tel:	(613) 592-9600 Fax: (613) 592-9601	Tel:	Fax:	Project Name:	East Oxford		
Email:	gld.CanadaAccountsPayableInvoices@wsp.com	Email:		Site #:			
				Sampled By:	C. Albert		

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BUREAU VERITAS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): Table 1, Res/Park, Medium/Fine, Table 2, Ind/Comm, Coarse, Table 3, Agri/Other, For RSC, Table ___

Other Regulations: CCME, Sanitary Sewer Bylaw, Reg 558, Storm Sewer Bylaw, MISA, Municipality ___, [X] PWQO, Reg 406 Table ___, Other ___

Special Instructions:

Include Criteria on Certificate of Analysis (Y/N)? ___

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	Standard S/W Sample Analysis	# of Bottles	Comments
1		SW-1	July 21/22	11AM	SW	—	X	9	
2									
3									
4									
5									
6									
7									
8									
9									
10									

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT: [X]
(will be applied if Rush TAT is not specified)
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ___ Time Required: ___
Rush Confirmation Number: ___ (call lab for #)

RECEIVED IN OTTAWA

21-Jul-22 12:55
Katherine Szozda
C2K5441
JDK ENV-1674
ON Ice

RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
C. Albert	July 21/22	2pm	Ken Jerry	2022/07/21	12:55	
C. Albert	July 21/22	2pm	[illegible]	2022/07/22	0850	

Time Sensitive

Laboratory Use Only			
Temperature (°C) on Recei	Custody Seal	Yes	No
5, 5, 6	Present		
	Intact		

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BUREAU VERITAS'S STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVNA.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVNA.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS.

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS

White: Bureau Veritas Yellow: Client

APPENDIX H

Water Balance

Appendix H: Water Balance for Level 1 and Level 2 Water Report, Proposed East Oxford Pit, Ontario

Table H-1: EAST OXFORD PIT WATER HOLDING CAPACITY FOR THE PERIOD 1939-2019 - 10mm WHC

Water Holding Capasity	10	mm
Heat Index	36.68	
Lower Zone	6	mm
A	1.079	
Date Range	1939	2019
Latitude	45.32	
Longitude	75.67	

Date	Temperature	Precipitation	Rain	Melt	Potential Evaporation	Actual Evapotranspration	Deficit	Surplus	Snow	Soil	Accumulated Precipitation
	(oC)	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
January	-10.7	62	11	14	0	0	0	25	84	10	295
February	-9	56	11	16	1	1	0	26	113	10	350
March	-2.9	65	31	77	5	5	0	103	70	10	416
April	5.7	73	68	75	31	31	0	112	0	10	490
May	13.1	76	76	0	80	67	-13	15	0	5	566
June	18.3	85	85	0	116	83	-34	5	0	2	651
July	20.9	88	88	0	136	84	-52	5	0	1	739
August	19.6	84	84	0	118	80	-38	3	0	2	823
September	14.8	82	82	0	75	64	-12	16	0	5	905
October	8.3	77	77	0	37	35	-2	38	0	8	77
November	1.2	76	59	8	10	10	0	56	9	10	154
December	-6.9	79	26	14	1	1	0	40	48	10	233
AVE	6.0										
TTL		904	698	204	610	461	-151	444			

Table H-2: EAST OXFORD PIT WATER HOLDING CAPACITY FOR THE PERIOD 1939-2019 - 100mm WHC

\ Water Holding Capasity	100	mm
Heat Index	36.68	
Lower Zone	6	mm
A	1.079	
Date Range	1939	2019
Latitude	45.32	
Longitude	75.67	

Date	Temperature	Precipitation	Rain	Melt	Potential Evaporation	Actual Evapotranspration	Deficit	Surplus	Snow	Soil	Accumulated Precipitation
	(oC)	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
January	-10.7	62	11	14	0	0	0	24	84	98	295
February	-9	56	11	16	1	1	0	26	113	98	350
March	-2.9	65	31	77	5	5	0	101	70	100	416
April	5.7	73	68	75	31	31	0	112	0	100	490
May	13.1	76	76	0	80	80	0	14	0	81	566
June	18.3	85	85	0	116	112	-4	5	0	49	651
July	20.9	88	88	0	136	114	-22	3	0	20	739
August	19.6	84	84	0	118	87	-31	1	0	16	823
September	14.8	82	82	0	75	65	-10	3	0	30	905
October	8.3	77	77	0	37	36	-1	9	0	63	77
November	1.2	76	59	8	10	10	0	31	9	89	154
December	-6.9	79	26	14	1	1	0	32	48	97	233
AVE	6.0										
TTL		904	698	204	610	542	-68	361			

Table H-3: EAST OXFORD PIT WATER HOLDING CAPACITY FOR THE PERIOD 1939-2019 - 250mm WHC

Water Holding Capasity	250	mm
Heat Index	36.68	
Lower Zone	6	mm
A	1.079	
Date Range	1939	2019
Latitude	45.32	
Longitude	75.67	

Date	Temperature	Precipitation	Rain	Melt	Potential Evaporation	Actual Evapotranspration	Deficit	Surplus	Snow	Soil	Accumulated Precipitation
	(oC)	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
January	-10.7	62	11	14	0	0	0	17	84	230	295
February	-9	56	11	16	1	1	0	21	113	235	350
March	-2.9	65	31	77	5	5	0	91	70	247	416
April	5.7	73	68	75	31	31	0	109	0	250	490
May	13.1	76	76	0	80	80	0	14	0	231	566
June	18.3	85	85	0	116	116	0	5	0	196	651
July	20.9	88	88	0	136	135	-1	3	0	146	739
August	19.6	84	84	0	118	111	-7	1	0	118	823
September	14.8	82	82	0	75	72	-4	2	0	127	905
October	8.3	77	77	0	37	37	0	6	0	161	77
November	1.2	76	59	8	10	10	0	16	9	202	154
December	-6.9	79	26	14	1	1	0	18	48	224	233
AVE	6.0										
TTL		904	698	204	610	599	-12	303			

Table H-4: EAST OXFORD PIT ANNUAL VALUES

Land Use	Water Holding Capacity	Precipitation	Actual Evapotranspration	Surplus	Infiltration Factor				Infiltration	Runoff
					Topography	Soil	Cover	Total		
	mm	mm/yr	mm/yr	mm/yr					mm/yr	mm/yr
Forest	250	904	599	303	0.3	0.4	0.2	0.9	273	30
Rehabilitation Wetland Area	*(Precip-PET)* [1]	904	610	294				1.0	294	0
Agricultural, Pasture and Shrubs	100	904	542	361	0.3	0.4	0.1	0.8	289	72
Pasture Area to Rehabilitation Pit Lake	100	904	542	361				1.0	361	0
Gravel	10	904	461	444				0.5	222	222
Flooded Pit	*(Precip-PET)* [1]	904	610	294				1.0	294	0
Pit Lake	*(Precip-PET)* [1]	904	610	294				1.0	294	0

[1] - Average Annual Surplus for Open Water areas assumed as Average Annual Precipitation minus Average Annual Evapotranspiration losses

Table H-5: EAST OXFORD PIT ESTIMATED AVERAGE ANNUAL WATER BALANCE - EXISTING SCENARIO

Land Use	Water Holding Capacity	Area	Precipitation		Actual Evapotranspration		Surplus		Infiltration Factor	Infiltration		Runoff	
	mm	m^2	mm/yr	m^3/yr	mm/yr	m^3/yr	mm/yr	m^3/yr		mm/yr	m^3/yr	mm/yr	m^3/yr
Forest	250	53,697	904	48,500	599	32,200	303	16,300	0.9	273	14,600	30	1,600
Agricultural, Pasture and Shrubs	100	383,420	904	346,600	542	207,800	361	138,800	0.8	289	111,000	72	27,800
Gravel	10	3,883	904	3,500	461	1,800	444	1,700	0.5	222	900	222	900
Total		**441,000**	**904**	**398,600**	**548**	**241,800**	**356**	**156,800**		**287**	**126,500**	**69**	**30,300**

[1] - Average Annual Surplus for Open Water areas assumed as Average Annual Precipitation minus Average Annual Evapotranspiration losses

Table H-6: EAST OXFORD PIT ESTIMATED AVERAGE ANNUAL WATER BALANCE - OPERATIONAL SCENARIO

Land Use	Water Holding Capacity	Area	Precipitation		Actual Evapotranspration		Surplus		Infiltration Factor	Infiltration		Runoff	
	mm	m^2	mm/yr	m^3/yr	mm/yr	m^3/yr	mm/yr	m^3/yr		mm/yr	m^3/yr	mm/yr	m^3/yr
Forest	250	25,750	904	23,300	599	15,400	303	7,800	0.9	273	7,000	30	800
Agricultural, Pasture and Shrubs	*100*	43,250	904	39,100	542	23,400	361	15,600	0.8	289	12,500	72	3,100
Flooded Pit	*(Precip-PET)* [1]	372,000	904	336,300	610	226,900	294	109,500	1.0	294	109,500	0	0
Total		**441,000**	**904**	**398,600**	**602**	**265,700**	**301**	**132,900**		**293**	**129,000**	**9**	**3,900**

[1] - Average Annual Surplus for Open Water areas assumed as Average Annual Precipitation minus Average Annual Evapotranspiration losses

Table H-7: EAST OXFORD PIT ESTIMATED AVERAGE ANNUAL WATER BALANCE - REHABILITATED SCENARIO

Land Use	Water Holding Capacity	Area	Precipitation		Actual Evapotranspration		Surplus		Infiltration Factor	Infiltration		Runoff	
	mm	m^2	mm/yr	m^3/yr	mm/yr	m^3/yr	mm/yr	m^3/yr		mm/yr	m^3/yr	mm/yr	m^3/yr
Forest	250	25,750	904	23,300	599	15,400	303	7,800	0.9	273	7,000	30	800
Rehabilitation Wetland Area	(Precip-PET)	1,200	904	1,100	610	700	294	400	1.0	294	400	0	0
Agricultural, Pasture and Shrubs	100	43,250	904	39,100	542	23,400	361	15,600	0.8	289	12,500	72	3,100
Pasture areas to Rehabilitation Pit Lake	100	190,800	904	172,500	542	103,500	361	68,900	1.0	361	68,900	0	0
Rehabilitation Pit Lake	*(Precip-PET)*	180,000	904	162,700	610	109,900	294	53,000	1.0	294	53,000	0	0
Total		**441,000**	**904**	**398,600**	**573**	**252,900**	**330**	**145,700**		**322**	**141,800**	**9**	**3,900**

[1] - Average Annual Surplus for Open Water areas assumed as Average Annual Precipitation minus Average Annual Evapotranspiration losses

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