Native Council of Nova Scotia

The Self-Governing Authority for Mi'kmaq/Aboriginal Peoples residing Off-Reserve in Nova Scotia throughout traditional Mi'kmaq Territory

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Reaching Home Indigenous Program

Parenting Journey Program

Youth Outreach Program

Mi'Kma'ki Environments Resource Developments Secretariat (MERDS)

Aboriginal Connections in Trades & Apprenticeship (ACITA)

April 29, 2020

Mr. James Millard
Manager, Environment and Community
Atlantic Mining NS Inc
409 Billybell Way, Mooseland
Middle Musquodoboit, Nova Scotia
B0N 1X0

RE: Environmental Impact Statement, Fifteen Mile Stream Gold Project, Highway 374, Trafalgar, Nova Scotia

Dear Mr. Millard,

The Native Council of Nova Scotia was organized in 1974 and represents the interests, needs, and rights of Off-Reserve Status and Non-Status Section 91(24) Indians/Mi'kmaq/Aboriginal Peoples continuing on our Traditional Ancestral Homelands throughout Nova Scotia as Heirs to Treaty Rights, Beneficiaries of Aboriginal Rights, with Interests to Other Rights, including Land Claim Rights.

The Native Council of Nova Scotia (NCNS) Community of Off-Reserve Status and Non-Status Indians/Mi'kmaq/Aboriginal Peoples supports projects, works, activities and undertakings which do not significantly alter, destroy, impact, or affect the sustainable natural life ecosystems or natural eco-scapes formed as hills, mountains, wetlands, meadows, woodlands, shores, beaches, coasts, brooks, streams, rivers, lakes, bays, inland waters, and the near-shore, mid-shore and off-shore waters, to list a few, with their multitude of in-situ biodiversity.

Our NCNS Community has continued to access and use natural life within those ecosystems and eco-scapes where the equitable sharing of benefits arising from projects and undertakings serve a beneficial purpose towards progress in general and demonstrate the sustainable use of the natural wealth of Mother Earth, with respect for the Constitutional Treaty Rights, Aboriginal Rights, and Other Rights of the Native Council of Nova Scotia Community continuing throughout our Traditional Ancestral Homeland in the part of the Mi'kma'ki now known as Nova Scotia

Physical environment considerations

The Fifteen Mile Stream (FMS) Gold Project Environmental Impact Statement (EIS) document is an extensive and generally well-prepared document. However, the EIS and its appendices appear to have not properly or fully addressed certain groundwater/surface-water interactions in four regards. Specifically:

1. The EIS addresses changes in stream baseflow during operations and post-closure using a regional (whole watershed) water balance approach for the six surface sub-watersheds (or parts thereof) studied. The forecasts were that watershed-wide changes in groundwater flux to surface water (i.e. watershed-wide baseflow) would not be significant. That may be so regionally, but a regional water balance approach cannot address localized effects.

   The EIS has not clearly shown what vertical separations might be expected between certain surface water features and decreasing groundwater table elevations during operation and post-closure – no map is provided to show those relationships. Instead, this type of assessment appears to have been limited to giving a generalized description of possible groundwater drawdown effects, and biology-based hypothesis made without direct groundwater model evidence about wetlands. No such analysis appears for streams. Only summary information is presented on the changes in groundwater flux to surface water; thus, it is not possible for EIS reviewers to determine or evaluate how the surface water and groundwater models were "linked".

2. The EIS does not appear to have adequately addressed some of the FMS EIS Guideline items in the Conformity Review Concordance Table (Table CS-1, November 4, 2019 and November 5, 2020). Consequently, the EIS could not adequately show groundwater elevation changes (re. Bullet 4 below) and, thus, certain groundwater/surface-water interactions and localized changes to stream baseflow during operation and post-closure.

3. The EIS appears to have not recognized, included, or adequately characterized several, potentially very important nearby geologic structures (faults or shear zones) that could affect aquifer hydraulic conductivity and distribution and thus, local and nearby off-site groundwater flow patterns (subject also of bullet 2 above). Had these been included, then the hydrogeologic model used for the EIS could/should have been conceptualized and constructed much differently, thus likely producing much different outcomes regarding potential on-site and nearby off-site groundwater and surface-water interactions.

4. The hydrological model used for the EIS employed constant head boundaries along Seloam Brook from Seloam Lake to Fifteen Mile Stream (including the Seloam Brook diversion), and along Fifteen Mile Stream from the north boundary of the model to the Anti Dam Flowage. This effectively removed all ability for the model to properly predict groundwater elevation changes along these very critical sections of stream, which potential is to decrease or outright remove baseflow from some sections of the streams, and thus summer-time cold-water refuge habitat for trout that are known to be present in these watercourses. This also biases model output and relevant groundwater elevation

change predictions relative to possibly groundwater-fed wetlands also present along or near these streams.

The sections of the Conformity Review Concordance Table relevant to the above, with a column added to include our comments, are presented on the next page. Details on our comments in the table and relevant to the comments above are also presented below.

Conformity Review Concordance Table

Requirement of the FMS EIS Guidelines (Please refer to the August 31, 2018 EIS Guidelines for the complete text. Text in this column for reference only.	Section of the EIS	Information Requirement	Location of Information Requirement in Updated EIS Submission 2020	Intervener notes
7.1.5 Groundwater and surface water	Section 6.5 Section 6.6 Appendix B.2 Appendices F.1 and F.2	The EIS requires an appropriate hydrogeologic model for the project area, which discusses the hydrostratigraphy and groundwater flow systems; a sensitivity analysis will be performed to test model sensitivity to climatic variations (e.g. recharge) and hydrogeologic parameters (e.g. hydraulic conductivity). Provide information or a sufficient rationale for the omission of the following from the hydrogeological model: • addressing the zones of "enhanced hydraulic conductivity" • regional (deep) groundwater flow regime • the use of large uniform beds to represent fractured rock • calibration of the model using baseflow (and not just heads) from streams • the irregular model extent shape • representative ranges of input parameters that represent the hydrogeological conditions that are then assessed in the sensitivity analysis.	Appendix B.2	Appendix B.2 (or other Appendices providing data), and thus the relevant text in Sections 6.5 and 6.6 of the EIS, do not appear to provide adequate information on and/or sufficient rationale for the omission of the following from the hydrogeological model: • addressing the zones of "enhanced hydraulic conductivity" • regional (deep) groundwater flow regime • the use of large uniform beds to represent fractured rock • the irregular model extent shape • representative ranges of input parameters that represent the hydrogeological conditions that are then assessed in the sensitivity analysis Please see text for explanations of the concerns.

		Provide a sensitivity analysis to assess the effects in the event that some potentially acid generating waste rock is classified, incorrectly, as non-acid generating wasterock and be then either used for construction purposes or stored in the incorrect waste rock stockpile.		
	Section 6.6.3	Provide baseline information pertaining to the bathymetry, maximum and mean depths, and water level fluctuations for all watercourses described in the EIS. As the reference document "McCallum (2019") is not publicly available, a description of the baseline data collection methodology is not available. Provide a characterization of groundwater – surface water interactions. Describe the temperature changes in surface water as a result of groundwater-surface water interactions.	Appendix G.1 Appendix G.11 Section 6.6.8.1.2.5 Appendix B.2	Appendix G.1 provides water depths for only Anti Dam Flowage and Seloam Lake. Appendix G.11 provides water depth and level fluctuation data at some (where hydrometric stations were installed), but not all watercourses. Thus, watercourse sensitivity to decreased groundwater elevations beneath them where streams and groundwater are in direct hydraulic communication (i.e. direct baseflow) has not been defined. The data presented in Section 6.6.8.1.2.5 are regional (whole watershed) water balance values that are based on a groundwater model flux output data; it does not describe the possible changes in groundwater elevations that may interact with and directly affect wetland water feeding or stream baseflow where these surface water features may be in direct hydraulic communication with groundwater. Further, groundwater model output can be extremely sensitive to model construction (boundary locations and type (inactive or no-flow, Dirichlet), lateral and vertical hydraulic conductivity variability, leakance between hydrostratigraphic units, etc.), and streams within the study area were not modelled as river boundaries – many were in fact modelled as Dirichlet boundaries – which is fine for determining flux, but not status as recharge (feeding groundwater) or discharge (receiving baseflow) zones. Besides that data presented in Section 6.6.8.1.2.5, besides generic mention of baseflow influencing streams and wetlands, and besides acknowledging that water temperature is a critical factor influencing brook trout distribution and production in Section 6.12.3.1.1.1, but not defining how baseflow might affect that, keyword

				searches of Appendix B.2 for 'temperature' and of the main EA document for 'temperature change' failed to provide any descriptions any temperature changes in surface water as a result of groundwater-surface water interactions within the study area.
7.2.2 Changes to Groundwater and Surface Water	Section 6.6.6 Section 6.6.8	Describe how project activities may impact pH, turbidity, or temperature in the surrounding waterbodies. If no changes to pH, turbidity, dissolved oxygen, or temperature are anticipated, substantiate conclusions with scientific knowledge. Clearly state assumptions and describe how each assumption was tested.	Section 6.8.6.1.2.3 Appendix B.6	Section 6.8.6.1.2.3 states: "The GoldSim water quality models did not predict changes in temperature associated with the Project; temperature is not a conservative constituent and can vary on a very small timestep. Complex hydrodynamic temperature modelling is typically reserved for cases where there is cold water refugia, which is not the case at the Site." However, Section 6.12.3.1.1.1 states "Within the FMS Study Area, fifteen individual brook trout were observed within Watercourses 1, 6, 12, 20 and 24 with suitable habitat types which support rearing, overwintering, foraging, refuge and passage. All of these watercourses where brook trout were observed are contiguous with WL2 and fish habitat (i.e., open water) is present within the wetland." This would generally imply that cold water refugia are indeed present within the study area. These, or the potential for impacts to them resulting from changes in baseflow, have not been assessed as such. Appendix B.6 covered operations effluent effects, but did not assess stream effects related to baseflow, or water temperature, which can increase with decreases in baseflow, thus increasing the potential for cold-water species habitat destruction.

Bullet 1 – the use of a water balance approach to assess baseflow

We believe that the statement above is self-explanatory and does not need to be expanded upon.

Bullet 2 – Conformity Review Concordance Table omissions

The following are more detailed explanations of the omissions and concerns regarding each bullet in column 5 (Intervener notes) for Guidelines Section 7.1.5 (Groundwater and surface water, first row of the Conformity Review Concordance Table). We note that attempts were made on behalf of the proponent to address and respond to these items in the table in the 17 April 2020 letter included at the start of Appendix B.2 of the EIS. There is some overlap between what directly follows with the concerns expressed in Bullets 1, 3 and 4 of this response.

- ***addressing the zones of "enhanced hydraulic conductivity"***

The lateral and vertical extent of the (fracture) zones of "enhanced hydraulic conductivity" or their characteristics as defined and considered in the EIS or Appendix B.2 does not appear to have been sufficient to properly model groundwater and the effects of pumping at or near the pit on surface waters in the area. The following paragraphs describe why.

Only about 200 m of the of Seigel Fault Zone was considered for sensitivity analysis SR3 outside of the proposed pit; however, the Seigel Fault Zone is believed to extend much farther west and east than that (see Bullet 3 details below).

The cross-section in Figure 6.4-7 shows low to very low RQD (rock quality designation) values within the anticline and at the Seigel Fault Zone, which is likely due to both the fault and fold dilation. Numerous drillholes were advanced through these broken rock zones, but hydraulic conductivity data was presented from only two drillholes.

The drillhole logs presented in Appendix B.8 are not legible, and the descriptions found in Section 6.4 of the EIS and in Appendix B.2 are very generic. Fault gauge, "shale smearing", and/or cataclasis should be expected within the argillite zones at the Seigel Fault Zone or Serpent Fault to possibly block groundwater flow, and more transmissive brecciation is expected to be present in the more competent greywacke – but descriptions of these features were not found in the EIS or its appendices. So, these faulted zones should be expected to be quite heterogeneous, perhaps much more transmissive in zones, than is suggested, or which can be provided, by the very limited hydraulic conductivity (K) test data presented within the fault zones.

It is unclear also from the methods described in Appendix B.2 whether any consideration was given to groundwater up-flow via the shallower parts of the faults (greater pumping volumes) during operation, but based on the model boundary configuration (no-flow boundary for the lower horizontal model layer) up-flow at the fault was not considered just before post-operation.

The Serpent Fault, which may or may not be transmissive (no data was presented in this regard), was not included during regular modelling or in any of the sensitivity analysis. There are also other nearby zones of enhanced hydraulic conductivity (faults and shear zones) that are known or thought to be present in the area (see details for Bullet 3 below), some of which may directly intercept the proposed pit, or which may be in indirect hydraulic communication with the pit, that have not been identified at all in Sections 6.4 or 6.5 of the EIS or in Appendix B.2 (see further details are provided in Bullet 3 of this submission). Atlantic Gold is a very competent resource exploration company that, during its exploration activities and most certainly as a part doing their due diligence on the mine property, would have no doubt identified these features, so the reason for their omission in the EIS is unclear.

The shallow depth (3-18 m) packer testing done at vertical monitoring wells (2018 work) and on angled exploration drillholes (2017 work) suggest K values that range by over 3 orders of magnitude across the site, and by at least 1 order of magnitude (much more limited data) in deeper bedrock. The methods used or the rationale for selecting specific boreholes or depths to test is not given in the EIS or its appendices, nor is the packer data or its interpretations (however, detailed borehole logs of the vertical boreholes and data and interpretations for the less significant single-well response tests are provided). Had this variability in K values been integrated into the hydrological model instead of the geometric mean, then perhaps the lateral heterogeneity of the site could have been better defined, and some of the effects of the potentially more transmissive geologic structures that were not mapped or included in the model could have been identified and characterized also for Sensitivity Analysis SR1 and SR2?

- ***regional (deep) groundwater flow regime***

The groundwater model did consider varying hydraulic conductivity for assumed hydrostratigraphic units based on depth. However, the approach appears to have been limited entirely on addressing hydraulic conductivity in relation to isostatic pressure; Appendix B.2 and the EIS do not at all discuss the flow regimes in terms of those described by Tóth (1963).

The greater area contains many major northwest-southeast trending faults (2 to 4 km frequency regionally and locally) along with numerous related synthetic faults. Those faults can traverse many lithological sequences, forming large-scale structures that span several kilometres laterally and over depth. Their sheer physical extent implies that their hydraulic properties can have a major influence on deep groundwater flow systems – which within the Meguma Terrane may transcend even major primary surface watersheds and geologic boundaries (ewC, 2006). As such, the EIS may not have fully or correctly considered the context by which to evaluate the effects of deep groundwater flow dewatering at the pit within the intermediate or regional flow regimes (i.e. effects off-site or outside the study area).

- ***the use of large uniform beds to represent fractured rock***

The model used for the EIS assumed a porous-equivalent approach for bedrock with secondary permeability (fracture flow). Use of this approach is perfectly fine, and at times the only viable way to construct a model where secondary permeability is predominant and the nature and distribution of the fractures is thought to be relatively consistent throughout the model domain. However, this approach cannot account for the structurally-based heterogeneity of the site in terms of recharge flux and/or the aquifer anisotropy expected in the areas of enhanced hydraulic conductivity along major discrete fault zones, such as the Seigel Fault Zone, the Serpent Fault, and other local major faults that have not been mapped for this EIS and their associated faults (see Bullet 3 below). Therefore, it is suggested that those structural features, and the large variance in K values obtained across the site that may be directly or indirectly associated with them, should have been incorporated into the hydrogeological model for it to properly represent the groundwater and related surface water conditions at and around the study area.

Although not bedrock, except for the odd drumlin, the mineral soil horizon within and around the study area and model domain are consistent enough to warrant the use of a single value for K for that hydrostratigraphic unit. However, organic materials are also present at wetlands at the 1:250,000 mapping scale, and possibly also in lake bottoms, which may have very different K values and which could have a direct effect on recharge and seepage into or out of the bedrock model layers beneath. The variable K values to represent these different soil hydrostratigraphic unit could have been easily applied to the model to account for this and thus, to better characterize possible groundwater and surface-water interactions.

- ***the irregular model extent shape***

The explanations given in the table at the front of and in Section 3.3.1 of Appendix B.2 describe where the domain boundaries are, but the report does not provide any rationale for the selection of those groundwater model boundary locations.

While MODFLOW, which is the perhaps most broadly used groundwater model, employs a rectangular form for model cell determination, hydrogeological model domains do not need to be rectangular. Thus, MODFLOW (and other groundwater models based on rectilinear cells) allow for defining inactive cells (no flow boundaries) within the greater cell rectangle. FEFLOW's triangular mesh allows doing the same, but in a smoother (i.e. less "cubic") manner that may better follow natural features, without the need to include outside inactive cells.

But what is critical to correctly doing any groundwater modelling is to properly conceptualize a possible groundwater model domain in terms of Tóth's (1963) regional, intermediary and local flow regimes, and recognizing how those groundwater flow regimes might fit within the overlying regional topography and the intermediate and local-scale surface watershed boundary and stream patterns. Only then can one proceed to possibly represent those natural features and flow constraints and criterion numerically. This requires using a reiterative process to model design/construction, which does not appear to have been used, or at least is not described in Appendix B.2. Additionally, truncating potential groundwater flow contribution and recharge areas and their associated surface watersheds, such as was done for the northern and eastern domain boundaries of the EIS model, may be done – but not where doing so may cause conditions (head or flow, depending on the purpose of the model) at those artificial boundaries to change when applying stresses within the model area(s) of interest. Appendix B.2 gives no clear rationale for the selection of those artificial boundaries or viable descriptions of real nature in this regard. It is suggested based on our own modelling experiences that these boundaries are not appropriate to what should be the goals of the model used and of the EIS.

The same criteria must apply to boundaries inside models – not only are the location of boundaries important, but also their numerical or mathematical representation in the model. This is because many physical features that are hydrologic boundaries can be mathematically represented in more than one way.

As stated in Reilly and Harbaugh (2004):
"The determination of an appropriate mathematical representation of a boundary condition is dependent upon the objectives of the study. For example, if the objective of a model study is to understand only the present and no estimate of future conditions is planned, then local surface-water bodies may be simulated as known constant-head boundaries; however, if the model is intended to forecast the response of the system to additional withdrawals that may affect the stage of the surface-water bodies, then a constant head is not appropriate and a more complex boundary is required."

In this regard, the model used for the EIS is clearly not appropriate to meeting what should be its intended goal of forecasting future conditions; namely, the effects of mine pit dewatering on surface water features and changes in groundwater-contact with wetlands or baseflow to streams.

Additionally, the amounts of vertical leakance between horizontal model layers are not defined in the EIS or in Appendix B.2, nor does there appear to be any mention in the EIS or in any appendices of any confining layers present within the model. As such, the groundwater heads simulated by the model for "deep bedrock" and shown in Figure 9B of Appendix B.2 should and must be assumed to also be those groundwater heads likely to have a direct effect on surface water features and on the availability of localized baseflow for streams.

Page 16 of Reilly and Harbaugh (2004) does a great job of describing the basic steps and process to represent and test boundary conditions; none of those appear to have been done for the EIS.

- ***representative ranges of input parameters that represent the hydrogeological conditions that are then assessed in the sensitivity analysis***

Single well response testing methods generally measure hydraulic conductivity only immediately at and over a very short distance radially around the borehole being tested; they typically are not representative of possible greater aquifer-wide conditions. Nevertheless, that testing did report K values from 13 wells ranging by nearly two orders of magnitude. The results from packer testing (which can represent greater distances within aquifers) ranged by 3 orders of magnitude from 35 shallow (3-18 m) bedrock intervals tested across the study area, and by 1 order of magnitude in 12 tested intervals 18-100 m deep. So, it is clear that a huge spatial variability in K exists at the site. Soil values for K are also expected to vary across the study area depending on the presence of till, drumlins, or wetland organics. Since the K values are known to vary so greatly across the site, the question arises: why was this variability not integrated into the groundwater model?

Sensitivity Run 1 (SR1) looked at the seasonal availability of potential groundwater recharge based on seasonal variability of precipitation. But it did not address the potential spatial variability of soil infiltration (actual recharge as opposed to surface runoff) because it did not incorporate the variability for soil K into the model due to the different types of soil present within the model domain (nor in bedrock). Therefore, it was not possible to define possible changes to groundwater flowpaths due to changes in recharge (or within bedrock, for that matter), so how could the model possibly represent changes in flow at the mine pit? What were the transient run conditions used for this assessment?

For SR2, no rationale was given for the specific storage values used or the changes applied, nor could any reference be found about values for specific storage, storativity, or porosity (except one assumed change in value in Section 4.2 of Appendix B.2, and one in Section 6.5.6.2 re. the Touquoy Mine site) within the EIS or any of its appendices. The questions, then, are: Where did the values mentioned in Appendix B.2 re. SR2 come from? And what aquifer values for storativity or porosity were actually used to construct the model? How were those determined?

For SR3, no rationale was given for using only one value for K for the entire fault (which is perhaps a mean from only two data points, but appears more likely to be a mean from testing points that are not even near the fault zone – that detail appears to be missing in Appendix B.2). Nor is any rationale given for what appears to be a random increase "by a factor of 10" of the "globally used" model value for K for SR3. A "factor of 10" is only a 1 order of magnitude change above what appears to be an already depreciated mean value for a fault zone; single fault zones are known to frequently contain values for K that range by more than 3 orders of magnitude across the fault and relative to neighbouring rock. It is suggested here that the values used for SR3 are not adequate to represent the Seigel Fault Zone.

Sensitivity run SR4 assumes only an increase in water storage within vertical mine shafts. There is no reference in Appendix B.2 about any information having been sought, except for the on-line mine opening database, which gives only mine shaft location and depth. However, there is wealth of detailed underground mine drawing information available for many of Nova Scotia's former gold mining districts, including at Fifteen Mile Stream.

As part of this EIS review, a search was done of Nova Scotia Energy and Mines assessment report files using NovaScan. With only about 15 minutes of effort, a sampling of at least half a dozen detailed underground mine working plans was easily found, downloaded, and quickly reviewed. Those plans showed the locations and depths of many mine shafts at Fifteen Mile Stream, along with detailed information on working levels, underground drifts, cross-tunnels, and stopes, as well as where those underground workings intercepted both Serpent Fault and the Seigel Fault Zone.

The underground workings would not only significantly increase the amount of water storage above that estimated in Appendix B.2 for SR4, but those underground workings would also create channels and infinitely conductive groundwater flow paths capable of significantly changing the outcome of the SR4 analysis. SR4 should have been carried out as two separate runs; one to address wider-reaching conditions while excavating/dewatering the shallower parts of the mine pit, and another to assess conditions below the old workings. So besides having covered way too small an area (the Seigel Fault Zone extends far past 200 m beyond the mine pit), it appears that insufficient data may have been used in completing Sensitivity run SR4. Consequently, as presented, it is inadequate to represent real on-site conditions, now, and in the future.

Bullet 3 – failure to recognize, include, or adequately characterize important geologic structures

Faults play an important role in flow and transport in regional groundwater systems. For this reason, the inclusion of faults in regional and local groundwater models can be important when considering the impacts of large/deep groundwater extractions on surface water features.

Faulting modifies groundwater systems in two ways. Firstly, faulting causes discontinuities in layers at faults (juxtaposition). Depending on the permeability of the layers on adjacent sides of the fault, the juxtaposition effects (which is only related to layer geometry) can either keep fluxes the same, change their direction, or decrease them. Secondly, a number of processes that modify rocks both during and after faulting may act to enhance or reduce permeability in the region of the fault itself. The modifications to permeability represent a range of behaviours at and around fault planes that can broadly be described as: a barrier – where faults act to reduce the flux, a conduit – where faults act to allow across or up fault fluxes, or a conduit/barrier – where the flux is enhanced parallel to the fault and reduced perpendicular to the fault (McCallum et al, 2018). It is therefore important for groundwater modelling to represent modifications to layering and the conduit and/or barrier behaviour of faults.

The EIS appears to have not recognized, included, or adequately characterized several perhaps very important nearby geologic structures (faults or shear zones) that could seriously affect aquifer hydraulic conductivity and distribution and thus, local and nearby off-site groundwater flow patterns. Had these been included, then the manner in which the hydrogeologic model used for the EIS should have been conceptualized and constructed would be different, thus potentially substantially changing its outcomes regarding some of the on-site and nearby off-site groundwater and surface-water interactions.

The geologic structures that were not included in the EIS regional and local hydrogeological conceptualization and groundwater model construction include:

- the Serpent Fault within the site (which appears to control the section of Seloam Brook form Seloam Lake to the proposed mine pit),
- the easterly and westerly extensions of the Seigel Fault Zone outside of the site,
- the Mosher River Fault immediately to the east of the site, as mapped by Campbell (1988) and White and Scallion (2011),

- the Bear Brook Anti Dam Flowage Fault immediately to the west of the site, as mapped by Campbell (1988),

- other nearby regional faults, such as the Liscomb River Fault (Campbell, 1988) to the east, and the Reynolds Lake – Union Dam Fault (White and Scallion, 2011) to the west, which are parallel to the Mosher River and Bear Brook – Anti Dam Flowage Faults,

- a possible fault that, based on shaded relief images, appears to extend from Twin Lakes over 4 km southeast of the proposed mine pit, through the mine pit and along an unnamed brook, to at least 4 km north-northwest of the mine pit area, which is parallel to the Mosher River and Bear Brook Anti Dam Flowage Faults, and

- a number of smaller, possible parallel faults that control many surface water features east and west of the above-noted lineament, a part of Fifteen Mile Stream north-northwest of the pit location, and which may suggest a level of structural complexity at the site that possibly approaches that of the 1 to 2 km spaces en-echelon sinistral fault system shown by White and Scallion (2011) west of the Reynolds Lake – Union Dam Fault.

Further, the north-south section of Fifteen Mile Stream from near where the Seigel Fault Zone would be expected to intercept it (at the northwest to north bend in Route 374) northward about 4 km to the syncline and Beaverbank Formation mapped by White and Scallion (2011) appears to be controlled by a fault that may be synthetic (an adjustment) to the Bear Brook Anti Dam Flowage Fault. There are also a number of east-west brooks immediately to the north of the mine pit area and a few km south of it that parallel the Seigel Fault Zone.

Evidence for the faults and suspected fault zones noted above based on lineaments is apparent in all of maps in the EIS that show topographic and surface water features, in Campbell (1988), in White and Scallion (2011), and in the shaded relief image in Figure 1. The easterly extension of the Seigel Fault Zone is suggested by the faulting noted in drillholes by Campbell (1988), and the westerly extension of it is suggested by the severe faulting noted in drillholes by Richardson and Terry (1988) and their cross section in Figure 2.

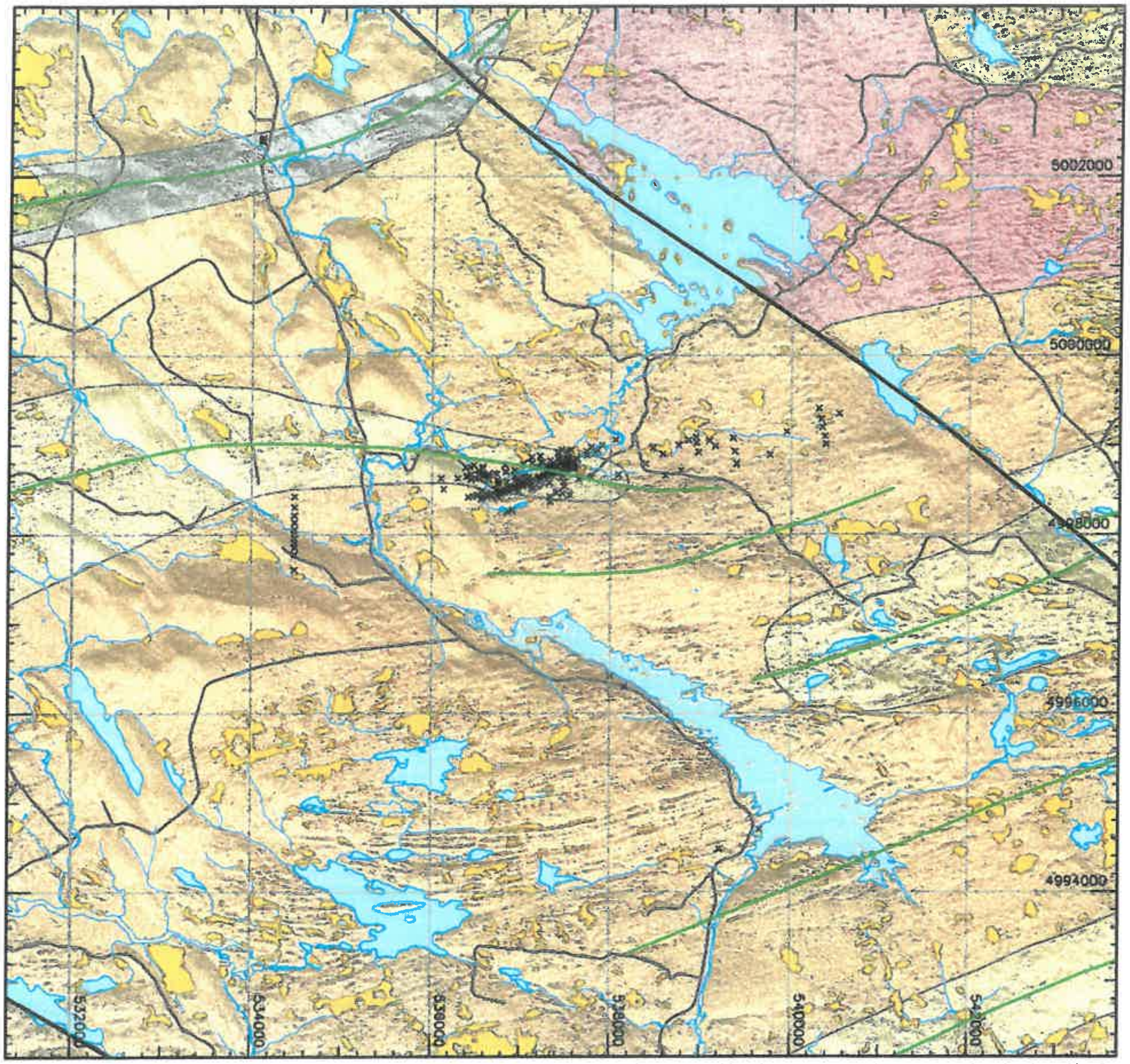

Figure 1. Bedrock geology over shaded relief of the Fifteen Mile Stream EIS area. Shaded relief generated from 1 m horizontal resolution LiDAR DEM with the sun 30° above the horizon at 180° azimuth, with 15x vertical exaggeration applied. Lakes are blue, wetlands are khaki. Bedrock geology: light beige = Governor Lake Fm., dark beige = Taylor Head Fm., grey = Beaverbank Fm., olive = Cunard Fm., pink = Seloam Lake Monzogranite, dark black line = fault (published), green line = anticline/syncline, x = drillhole location. Scale: UTM grid = 2 km.

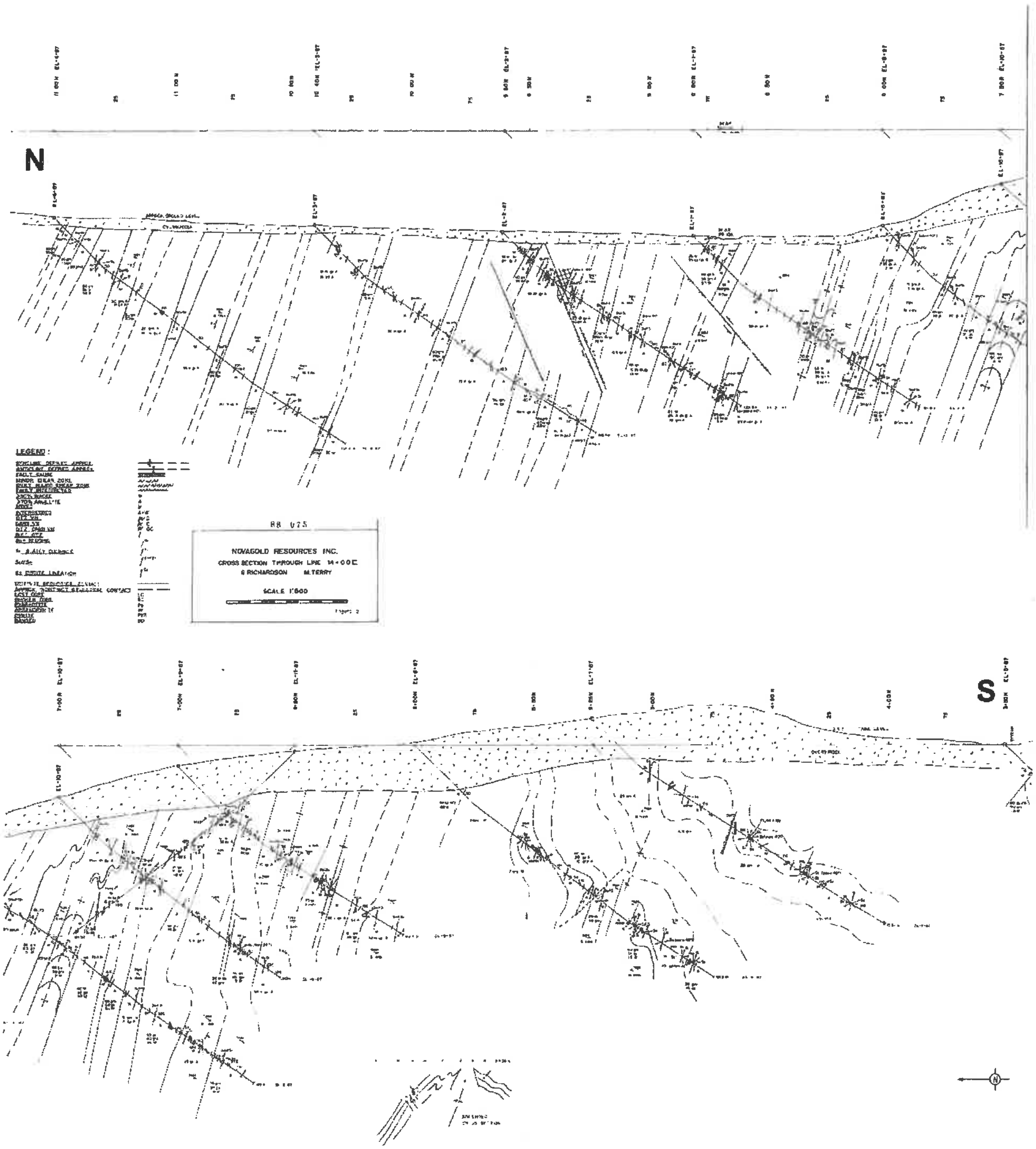

Figure 2. Drillhole fence cross-section showing extension of the Seigel Fault Zone intersecting with the Bear Brook Anti Dam Flowage Fault (Richardson and Terry, 1988).

Bullet 4 – use of constant boundary conditions along critical streams

We believe that the statement above was explained sufficiently in the discussion on "Bullet 2 – the irregular model extent shape" and does not need to be elaborated or expanded upon.

Conclusions on physical environment considerations

The use of a regional water balance approach is simply not suited to properly describing the effects that groundwater pumping at the proposed mine pit can have on localized wetlands and on the delivery of baseflow to streams; it would be a shame to see aquatic habitat suffer and disappear during operation and/or post-closure for "apparently unknown reasons" as a result of this very basic oversight. The hydrogeologic model also does not adequately represent the structural complexity that is likely present of the site; it is suggested that the model itself and the sensitivity analysis that are based on it fail to properly address the goals of the EIS, which should be to understand as best as can be done the impacts that lowering groundwater elevations may have on surface water features, without which it is impossible to define proper mitigation, or proper levels of compensation if mitigation is not possible.

Redoing the hydrologic model is not expected to be a daunting or very costly task; most of it is desktop type work, and much of the data needed to improve the model to better represent the site appears to already be available – by virtue of the environmental assessment work that has already been completed, or by better sharing information that no doubt has been gathered during the mine exploration and due diligence work that should already be done. Any new data that may be required and/or follow-up field work should be being able to be completed in a very well focused, cost-effective and time-effective manner.

As noted in the first paragraph of this discussion section, the Fifteen Mile Stream (FMS) Gold Project Environmental Impact Statement (EIS) document is an extensive and generally well-done document, with the exception of the issues describe above. We look forward to seeing these deficiencies addressed so that this mining endeavour may proceed successfully following a truly and completely well executed environmental assessment.

The Potential Loss of Habitat, Fauna, Flora, and Access to Natural Life

As the project stands, regarding the oversights outlined in the previous sections, there is a mounting potential for groundwater elevation change that will directly affect ground-water fed wetlands within and outside of the project study boundaries. The cumulative effects anticipated from the influence of the mine pit dewatering include: a permanent loss of some wetlands, an increase in temperature in surface water in streams, and reduced accessibility to natural life utilized by Section 91(24) Indians/Mi'kmaq/Aboriginal Peoples.

With regard to loss of wetlands, if a corrected model is produced and predicts a greater decrease in groundwater elevation, then it follows that the model will more accurately represent the potential for permanent dewatering of ground-fed wetlands. A corrected model that accounts for faults, currently absent in the existing model, will more accurately represent where drawdown may occur. The greatest concern at present is that a permanent decrease in wetland acreage will ultimately lead to loss of wetland function and net loss of flora and fauna that inhabit these locations.

A major concern regarding the drawdown of the water table caused by the mine pit dewatering is a potential increase in the surface water temperature. Traditionally, surface water temperature is influenced by cool water introduced as baseflow, which is an important groundwater-surface water interaction. If that process is interrupted by a decrease in groundwater elevation, then the surface water temperature will increase, which can jeopardize the optimal habitat conditions for temperature dependent species. It is our belief that the streams mentioned in sections 7.2.2 of the Conformity Review Concordance Table, that are known to possess brook trout, a highly temperature dependent species, are likely to be influenced by this process; the optimal temperature range for growing and survival of brook trout, as depicted by Mullen (1958), lies between the narrow range of 11-16 ° C. Thus, the dewatering of the mine pit threatens to restrict this important groundwater-surface water interaction, resulting in an increase in surface water temperature outside of this narrow temperature range, and thus irreversibly altering the habit, making it unsuitable for brook trout.

These cumulative effects to habitat, fauna, and flora will result in the depreciation of access to natural life utilized by section 91(24) Indians/Mi'kmaq/Aboriginal Peoples. As it currently stands, the model used to represent the effects of the mine pit dewatering appears to be inaccurate, and does not represent the damage that may occur to the environment. Eschewing a corrected model in favour of the current one increases unacceptably the risk of losing of natural life. It derogates not only Aboriginal Rights, but the protections of Treaty Rights and Other Rights of the Rights-Bearing Aboriginal People living Off-Reserve as Represented by the Native Council of Nova Scotia.

Going Forward To
A Better Future

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The Honourable Bernadette Jordan, Minister of Fisheries, Oceans and the Canadian Coast Guard
The Honourable Iain Rankin, Minister of Intergovernmental Affairs
The Honourable Keith Irving, Minister of Environment
The Honourable Chuck Porter, Minister of Lands and Forestry
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