Ministry of the Environment, Conservation and Parks

Presentation to the Joint Review Panel for the Marathon Palladium Project

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Topic: Hydrology

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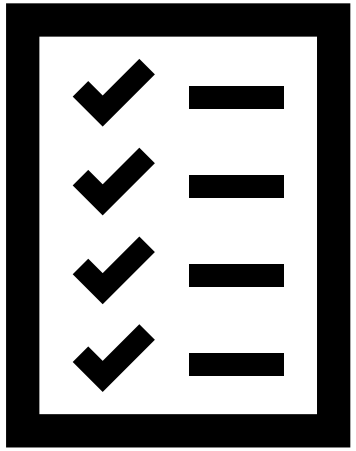
Outline

Discussion Topics:

- Scope and Mandate of Review
- Effluent Discharge to Hare Lake
  - Review and Analysis
  - Recommendations for Further Analysis
- Groundwater Losses to Surface Water Features
  - Review and Analysis
  - Recommendations for Further Analysis
- Potential Impacts to Surface Water Features
  - Review and Analysis
  - Recommendations for Further Analysis
- Monitoring Program Recommendations
- Conclusions and Summary of Recommendations



Scope of Review

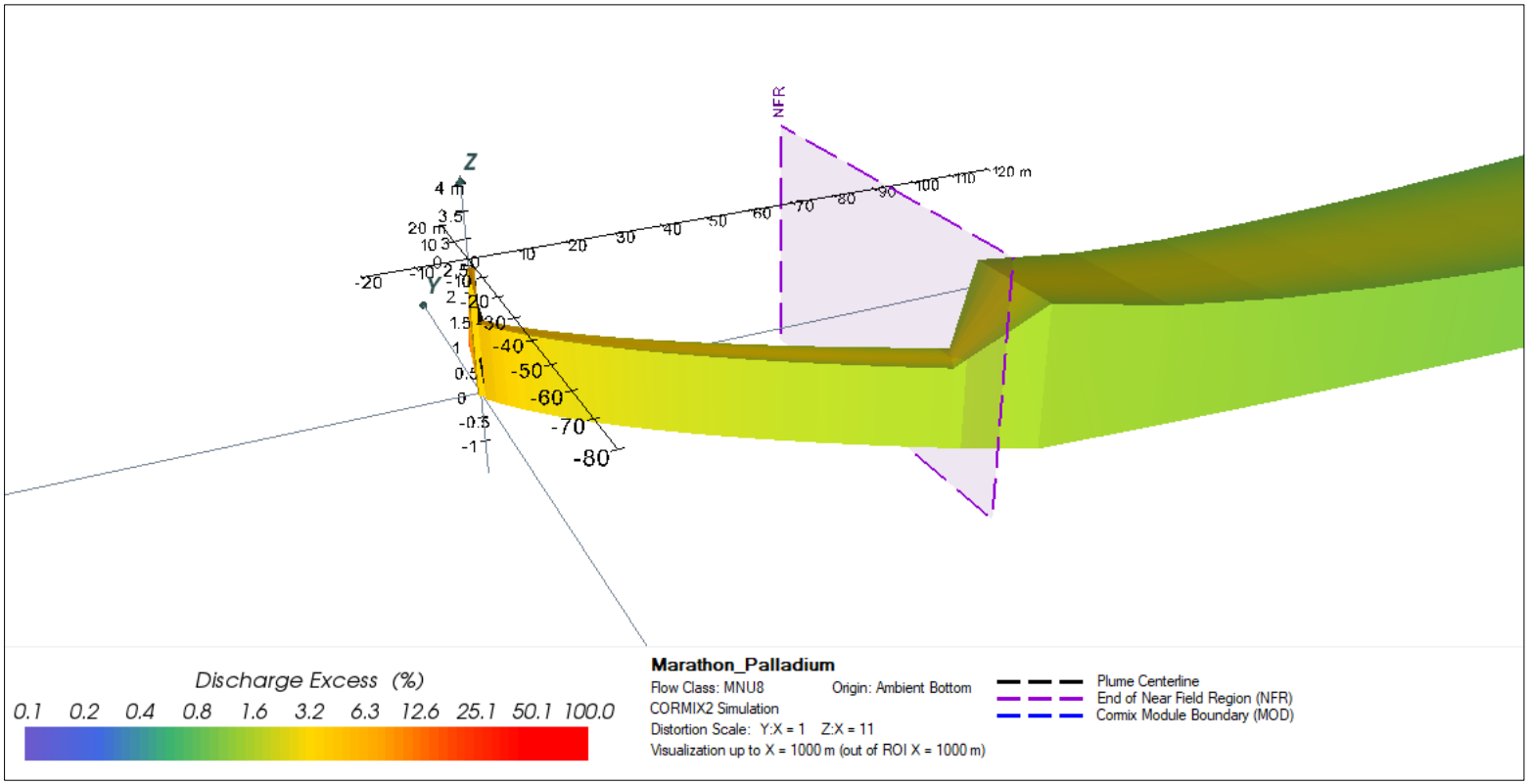
The MECP hydrology review focused on three topics not considered to be resolved by the responses by the proponent to the Information Requests (IR) (as well as a discussion on monitoring) which can be summarized as:

- **Effluent discharge to Hare Lake**
- **Groundwater Losses to Surface Water Features**
- **Potential Impacts to Surface Water Features**
    - Uncertainty Analysis
    - Methodology of Determining Impacts
    - Section 35 (Flow Impacts) Authorizations
- **Monitoring**
    - Additional Stations
    - Trigger Thresholds
    - Mitigation and Contingency Measures

Effluent Discharge to Hare Lake

Review and Analysis

- Mine effluent discharge is proposed to be directed to Hare Lake (i.e., the receiver) during the operations phase
- CORMIX modelling was used to predict the maximum mixing zone extent. A mixing zone based on concentration (i.e., when concentrations return to applicable receiver criteria) will be required when effluent limits are developed.
- Potential for meromixis in Hare Lake was also evaluated using the CORMIX modelling.



CORMIX Modelling Results – Base Case

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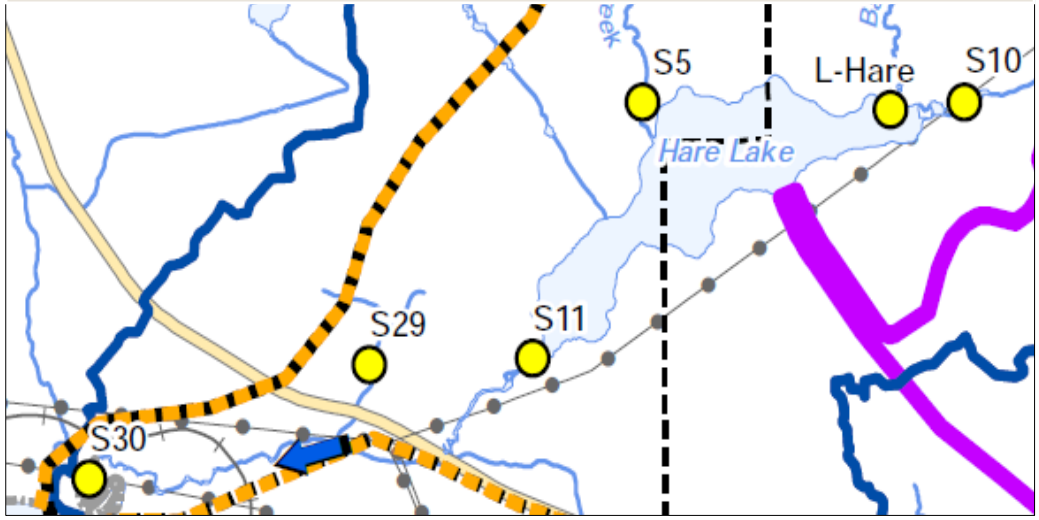
Effluent Discharge to Hare Lake

Recommendations for further analysis

- The proponent should re-evaluate the CORMIX modelling considering the $7Q_{20}$ inflows/outflows (as well as the 1 in 20 dry year lake level) to Hare Lake.
- Worst-case scenario assessment should include the potential for zero flow at the outlet of the lake and potential mitigation measures that will be enacted by the proponent in this scenario.

Seven Day Duration Low Flows for 20 year return period (Watershed 105)	
Watershed Location	Return Period (20 years)
S30 station flow (m^3/s)[1]	0.048
S11 station flow (m^3/s)[2]	0.046
S10 station flow (m^3/s)[2]	0.006
[1] ungauged stream; [2]gauged stream	



Surface Water Quantity Monitoring Stations around proposed receiver (Hare Lake) [displayed as yellow circles ; Discharge Pipeline shown in purple].

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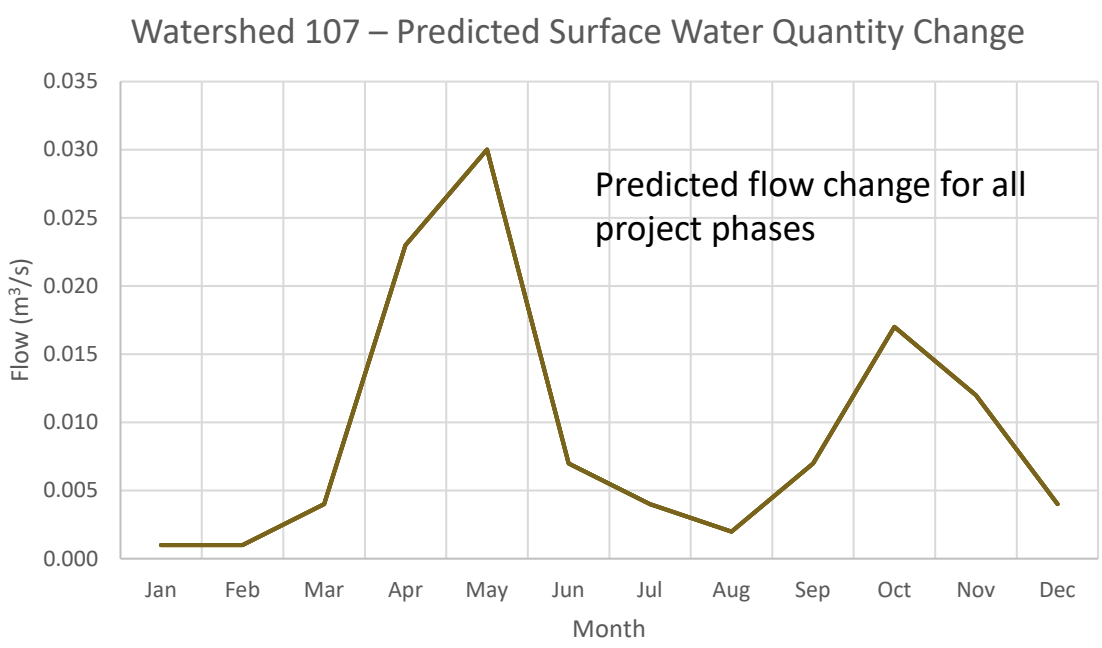
Groundwater Losses to Surface Water

Review and Analysis

It is not clear if or how the groundwater losses to surface water features have been characterized as part of the assessment of potential impacts to valued ecosystem components

- The predicted impacts to the Mean Monthly Flows (MMF) in some watersheds within the project area do not appear to consider the changes in groundwater inputs
  - For example, the change in groundwater discharge to Watershed 107

Watershed 107 – Groundwater Discharge Change	
Baseline Discharge Rate (m^3/d)	114
End of Mining [Year 12] (m^3/d)	105
End of Mining Percent Change (%)	7.3
Post-Closure (m^3/d)	107
Post-Closure Percent Change (%)	5.5



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Groundwater Losses to Surface Water

Recommendations for further analysis

- The proponent should comment on if or how the groundwater losses to surface water features have been characterized.
- Impacts to surface water levels resulting from the predicted reductions in groundwater discharge have not been quantified. The proponent should assess the potential for drawdown in lakes potentially effected by the project:
    - Terru Lake (~8% groundwater losses at end of operations)
    - Unnamed Lake in watershed 104 (~3.9% groundwater losses at end of operations)
- Monitoring, trigger values, and mitigation measures for water features potentially impacted by changes in groundwater inputs will be required for MECP permitting and approvals processes, should the project be given approval to proceed.

Potential Impacts to Surface Water Features – Uncertainty Analysis

Review and Analysis

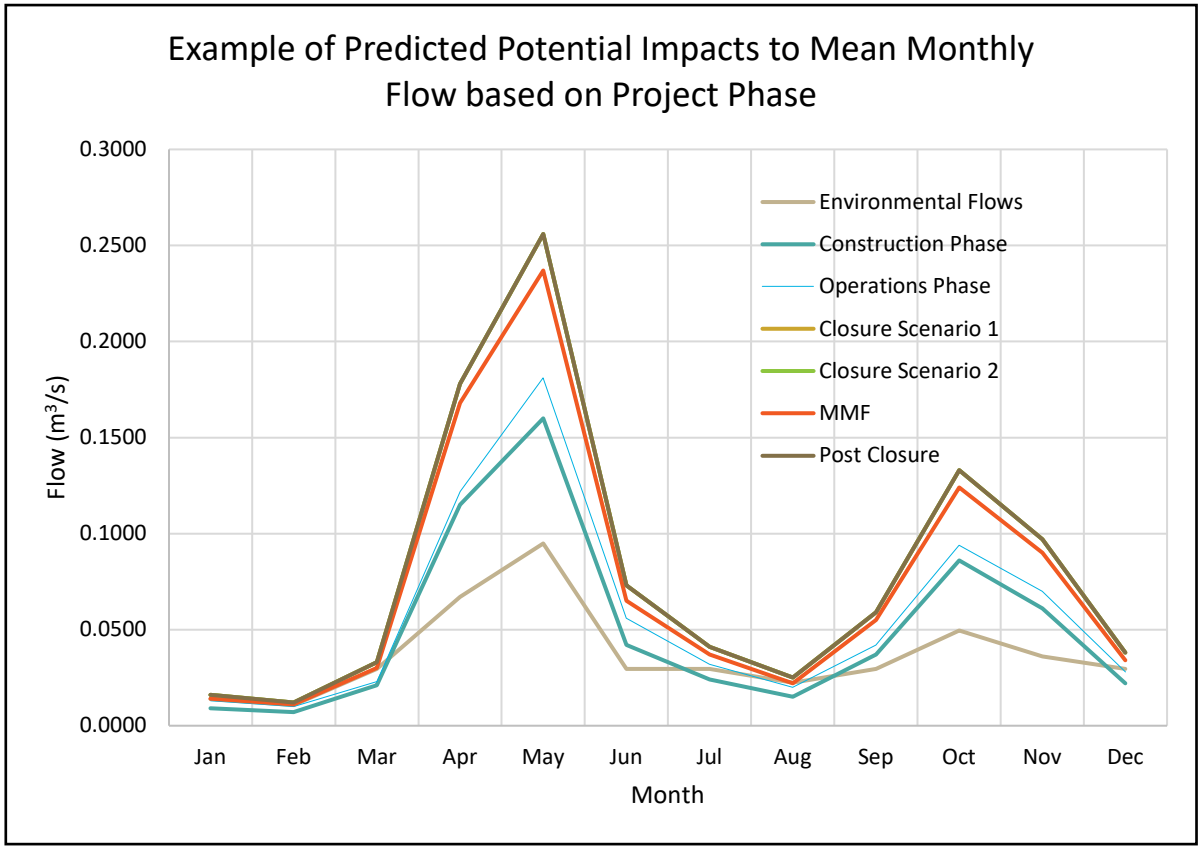
In order to determine baseline and potential impacts to surface water features, data from local Water Survey of Canada (WSC) stations was used to determine baseline and impacted flows using area-ratio relationships (i.e., pro-ration)

- Pro-rating data between watersheds is often used to estimate baseline streamflow since there is commonly a lack of adequate baseline data collected onsite.
- Baseline Mean Monthly Flow (MMF) and predicted MMF during project phases were developed using these relationships.

Potential Impacts to Surface Water Features

Review and Analysis (continued)

- Potential Impacts to Surface Water Features have been predicted using updated methodology (i.e., based on MMF changes).
- No mitigation measures are proposed for waterbodies not covered by the *Fisheries Act*
  - This includes potential impacts during construction for watersheds 110, 111, 112, 113



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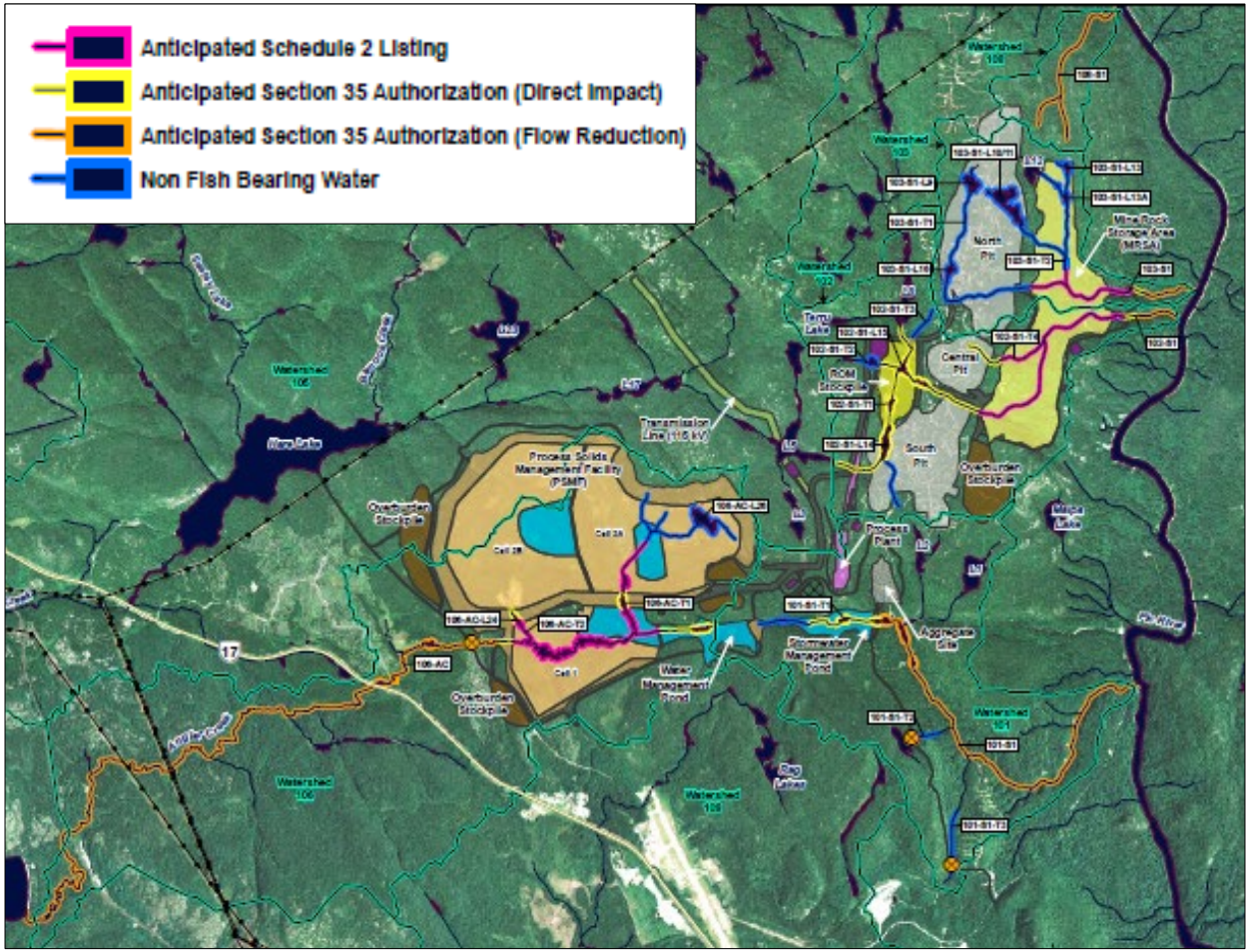
Potential Impacts to Surface Water Features – Section 35 (Flow Impacts) Authorizations

Review and Analysis (continued)



- The draft Fish and Fish Habitat Compensation and Offset Plan assumed complete fish habitat loss in *Fisheries Act* Section 35 streams (flow reduction); however, DFO approval has not been issued.
- Should the DFO approval not be issued (with the same assumptions), there may not be adequate monitoring and mitigation in these impacted systems.

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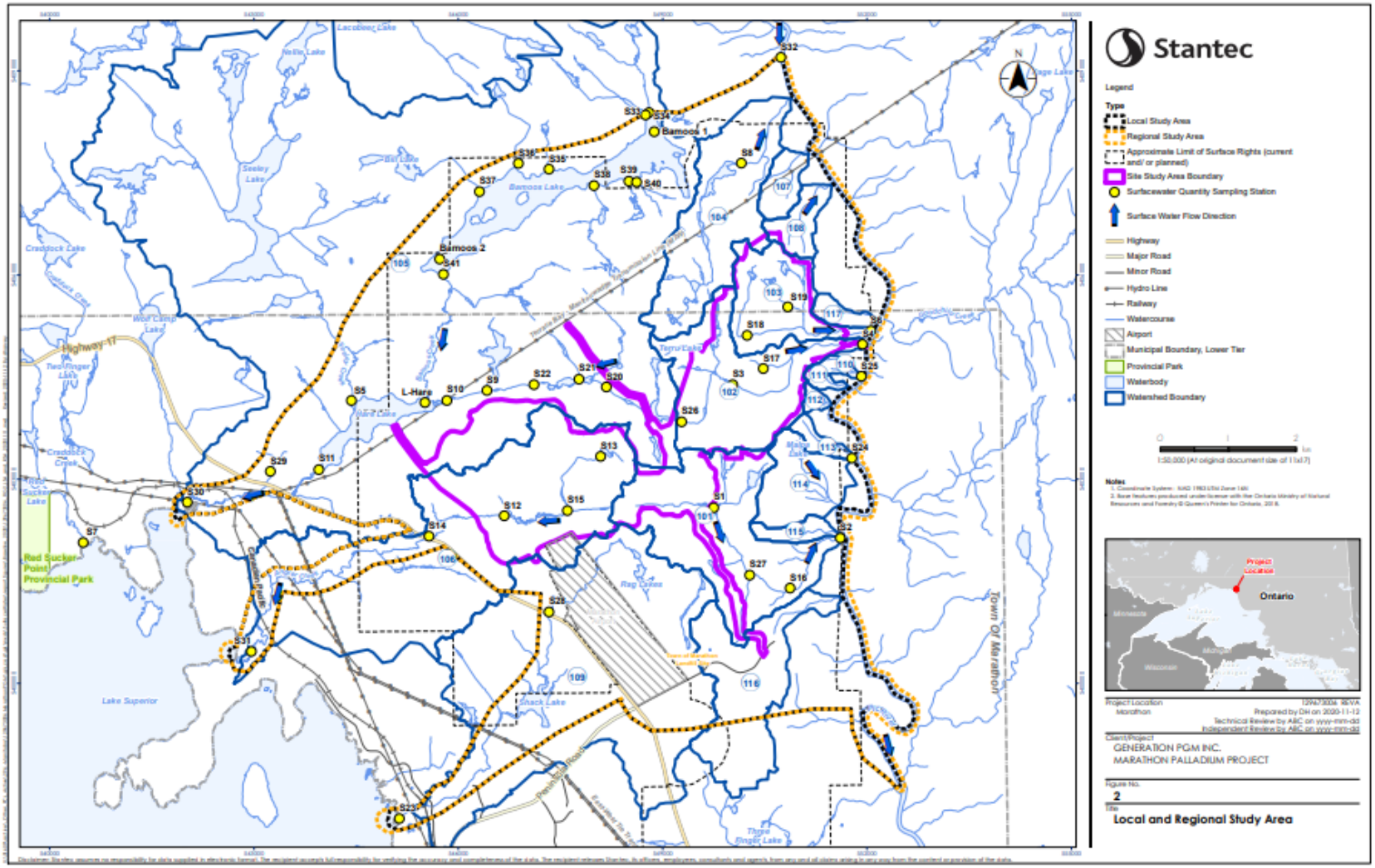
Potential Impacts to Surface Water Features

Recommendations for further analysis

- Uncertainty in the assessment with regard to the reduction in MMF should be reduced over time through collection of site-specific data.
- Once the Draft Fisheries Offset and Compensation Plan is finalized, the proponent should confirm that the design of monitoring programs and mitigation measures is sufficient.
- Mitigation measures should be proposed for those watersheds that are not covered under the *Fisheries Act* (i.e., Watersheds 110, 111, 112 and 113).
- The monitoring program should be updated based on the review and analysis, to be discussed in the following slides.

Monitoring Program - Baseline Hydrology Stations

Review and Analysis



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Monitoring Program – Flow Stations

Recommendations

- Several on-site rating curves should be improved for some flow monitoring stations
- Temporal range of manual measurements should be included in baseline documentation

Station ID	Recommendations
S1, S2, S3, S4, S6	Monitor depending on finalization of DFO Approvals.
S8	Continue monitoring for baseline
S9	Continue monitoring for baseline
S10	Continue monitoring for baseline
S11	Continue monitoring for baseline
S24 (Outlet of watershed 113)	Add flow monitoring and develop rating curve
S25 (Outlet of watershed 110)[1]	Add flow monitoring and develop rating curve
Outlet of Watershed 108	Establish new stations depending on finalization of DFO Approvals.
Reference station(s)	Establish new stations or rely on existing stations that will not be impacted by the project. Add flow and water level monitoring for baseline.

[1] Station 25 could be used as a surrogate station for determining potential impacts to watershed 111 and 112

Monitoring Program – Water Level Stations

Recommendations (cont.)

- On-site infrastructure should be monitored regularly, and this data should be incorporated into the water balance model to validate water balance predictions.

Station ID	Recommendations
Terru Lake	Add water level monitoring for baseline
Lake 8	Add water level monitoring for baseline
Lake 5	Add water level monitoring for baseline
Lake 12	Add water level monitoring for baseline
Hare Lake	Continue (restart) water level monitoring for baseline
Unnamed Lake in subwatershed 104	Add water level monitoring for baseline
Reference Lake(s)	Add water level monitoring for baseline. Create new stations or rely on existing stations that will not be impacted by the project.

Monitoring Program

Recommendations (cont.)

Flow Trigger Threshold

- For watersheds not covered under *Fisheries Act* authorizations, MECP proposes that a difference (i.e., decrease) in daily flows of greater than 20% between the reference stations and the impacted stations for 2 consecutive months be the trigger threshold for the implementation of mitigation measures.
- Impacted stations (both flow and level) should be compared to reference stations (or un-impacted stations) as well as to baseline data, if available.

Mitigation Measures

- Plans should be developed for additional mitigative measures, including but not limited to the following (these plans should be developed prior to MECP permitting):
    - Flow supplementation,
    - Reduce/cease takings from waterbodies, and/or
    - Engineering controls to limit groundwater losses.

EA Phase Recommendations

Conclusions and Summary of Recommendations

- The proponent should re-evaluate the CORMIX modelling considering the $7Q_{20}$ inflows/outflows (as well as the 1 in 20 dry year lake level) to Hare Lake and the maximum predicted effluent discharge rate (i.e., rated capacity of the effluent treatment plant), consistent with the Ministry's Guideline B-1-5: *Deriving Receiving Water Based Point Source Effluent Requirements for Ontario Waters*. The assessment of the worst-case scenario should include the potential for zero flow at the outlet of the lake and potential mitigation measures that will be enacted by the proponent in this scenario.
- The proponent should explain if and how the predicted groundwater discharge losses to surface water features have been accounted for within the potential streamflow reduction calculations.
- The potential impacts to Lake 8 should be assessed by the proponent with respect to the proposed water taking from this waterbody.

EA Phase Recommendations (continued)

Conclusions and Summary of Recommendations

- The monitoring program (discussed previously) should be implemented to collect adequate baseline data for potentially impacted surface water features. This program should include water level stations in Terru Lake, Lake 8, Lake 12, Lake 5, Unnamed Lakes in subwatershed 104, Hare Lake, and reference lake stations.
- Flow monitoring at the following stations should be restarted as part of baseline monitoring: S8, S9, S10, and S11. As well, the following monitoring stations should be equipped with flow monitoring capabilities with data collection as part of baseline monitoring: S24 (Outlet of watershed 113), and S25 (Outlet of watershed 110) and reference flow stations.
- Should the project be given approval to proceed, recommendations for MECP permitting and approvals are discussed in the MECP written submission.

Thank you!

Questions?