Water Treatment And Management Overview

Giant Mine Remediation Project Environmental Assessment
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Adrian Paradis (AANDC)
Mike Nahir (AANDC)
Bruce Halbert (Technical Advisor)
Rudy Schmidtke (Technical Advisor)
John Hull (Technical Advisor)

Presentation Outline

- Overall Water Management Strategy
- Approach to Setting Objectives
- Water Treatment Plant
- Outfall Pipeline and Diffuser
- Monitoring Plan
- Benefits

Overall Water Management Strategy

- Current System comprises:
  - Pumping minewater to ponds on the tailings areas for interim storage
  - Seasonal treatment of contaminated site waters and clarification of treated effluent in sedimentation ponds
  - Discharge of treated effluent to Baker Creek in late summer and fall

Overall Water Management Strategy (cont'd)

- Proposed System will:
  - Eliminate surface ponds through storage of minewater underground
  - Eliminate sedimentation ponds through construction of new treatment plant
  - Involve operation of a new water treatment plant year round
  - Discharge treated effluent directly to Yellowknife Bay through a new outfall and diffuser

Positive Effects

- Reduction in arsenic load in minewater:
  - Untreated minewater load = 20,400 kg/year
  - Current WTP treated effluent load = 290 kg/year
  - Proposed WTP effluent load = 150 kg/year
- Reduction in the arsenic loading to Baker Creek greater than 290 kg/year
- Reduction in the arsenic load to Yellowknife Bay greater than 140 kg/year
- Enhancement of treated effluent mixing with lake water, as a result of discharge through an outfall diffuser
- Elimination of surface pond reduces risks to waterfowl/wildlife

APPROACH BASED ON:

- Protection of water quality in Yellowknife Bay to support all beneficial uses including:
  - providing a healthy environment for all forms of aquatic life including fish
  - source of drinking water
  - recreational pursuits (boating, swimming, diving….)
- Selected Canadian water quality guidelines for protection of freshwater aquatic life (CWQG FAL) as appropriate objectives as they are more stringent than objectives/guidelines for other water uses.

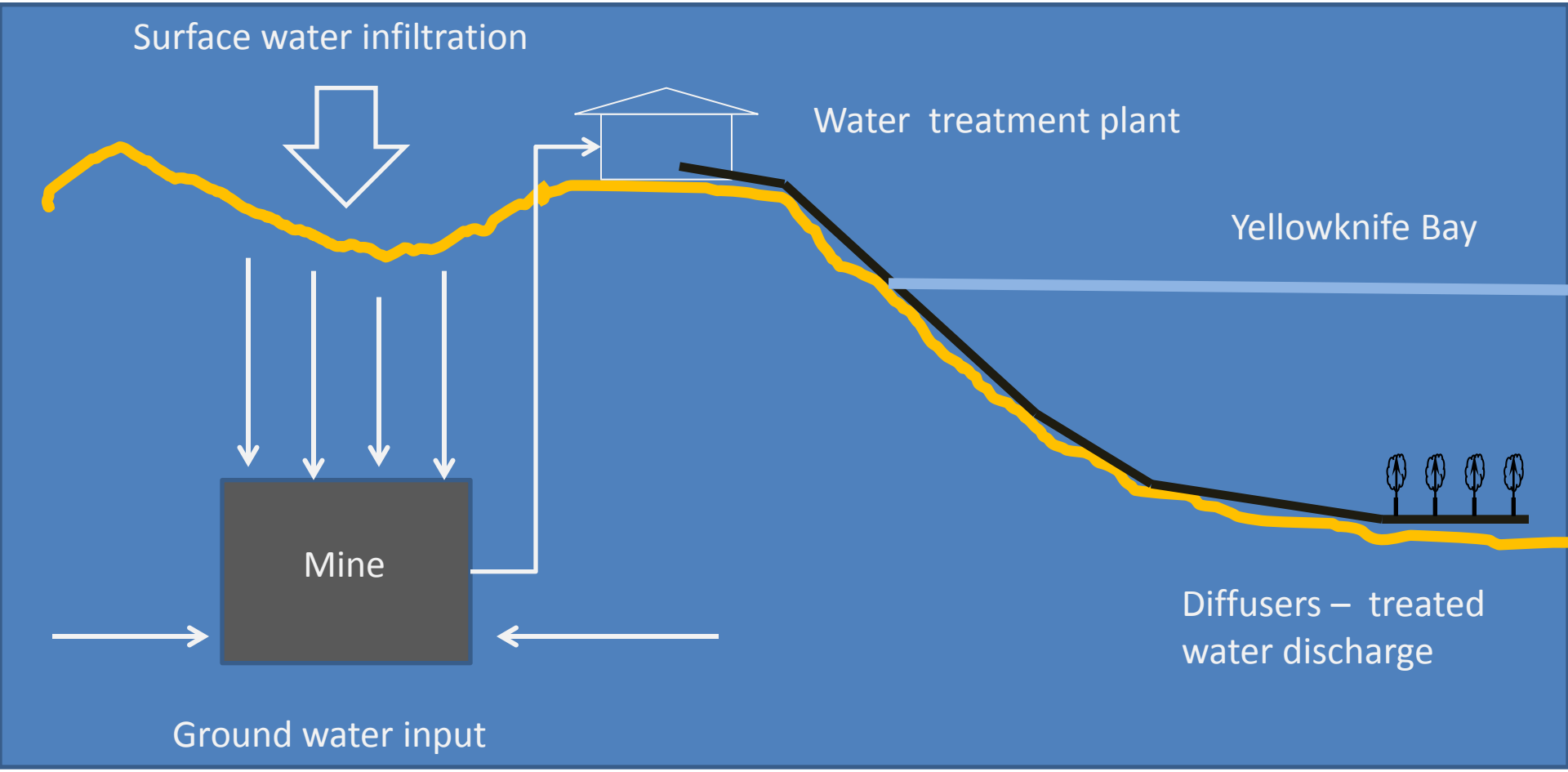
APPROACH ADOPTED (CONT'D):

- Based assessment on meeting objectives at the edge of the diffuser near-field mixing zone.
  - For arsenic the receiving water quality objective is 0.005 mg/L (5 µg/L) based on CWQG FAL
  - Effluent arsenic level from New Water Treatment Plant expected to be normally less than 0.2 mg/L (200 µg/L) with peak short-term levels of up to 0.4 mg/L (400 µg/L)
  - Ambient arsenic concentration in Yellowknife Bay based on recent monitoring data averaged 0.0009 mg/L (0.9 µg/L)
- Dilution target therefore set at 100-to-1 for the design of the outfall diffuser to meet water quality objective for arsenic.

PREDICTED CONCENTRATIONS BETTER THAN GUIDELINES

Parameter	Units	Measured Ambient Water Quality [a)]	Expected WTP Effluent Quality [b)]	Predicted Water Quality at Edge of Mixing Zone (100:1 Dilution)	Canadian Water Quality Guideline [c)]
Metals and Metalloids					
Arsenic	µg/L	0.9	200 (target)	2.9	5
Copper	µg/L	1	16	1.1	2
Lead	µg/L	0.1	2.5	0.12	1
Nickel	µg/L	6	70	6.6	25
Zinc	µg/L	3	75	3.7	30
General Chemistry					
Ammonia	mg/L	0.0055	5.3	0.06	1.54
Nitrate	mg/L	0.07	5.3	0.12	2.9
Sulphate	mg/L	4.7	925	13.8	-

New Water Treatment Plant – Elimination of Surface Storage



Improved Mine Water Quality

- Quality of untreated minewater variable – up to arsenic at 280 mg/L
- Must be treated prior to discharge into the environment
- Effluent criteria
  - Target arsenic effluent criteria is 0.2 mg/L (200µg/L) before entering diffuser
  - Bench scale testing indicates process can do better

VOLUMES REDUCED AFTER REMEDIATION

	Average Year	Wet Year
Pre-Freezing	630,000	822,200
Post Freezing	404,300	517,500

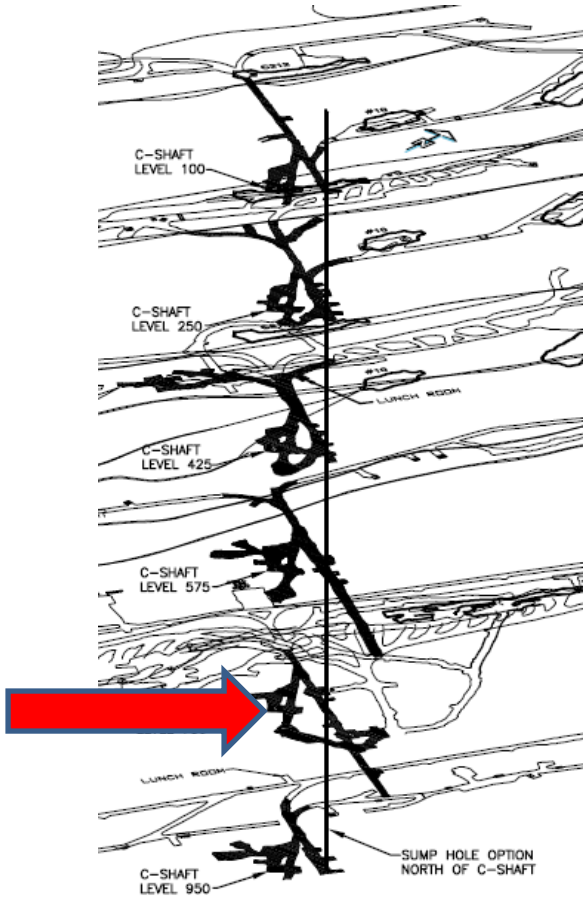
Design Criteria

Flows & Storage			
Short-Term			
	Average Treatment Flow Rate	26.0	L/s
	Peak Wet Year Flow Rate	33.9	L/s
Long-Term			
	Average Treatment Flow Rate	16.7	L/s
	Peak Wet Year Flow Rate	21.3	L/s

Flexible Pump Placement in Well

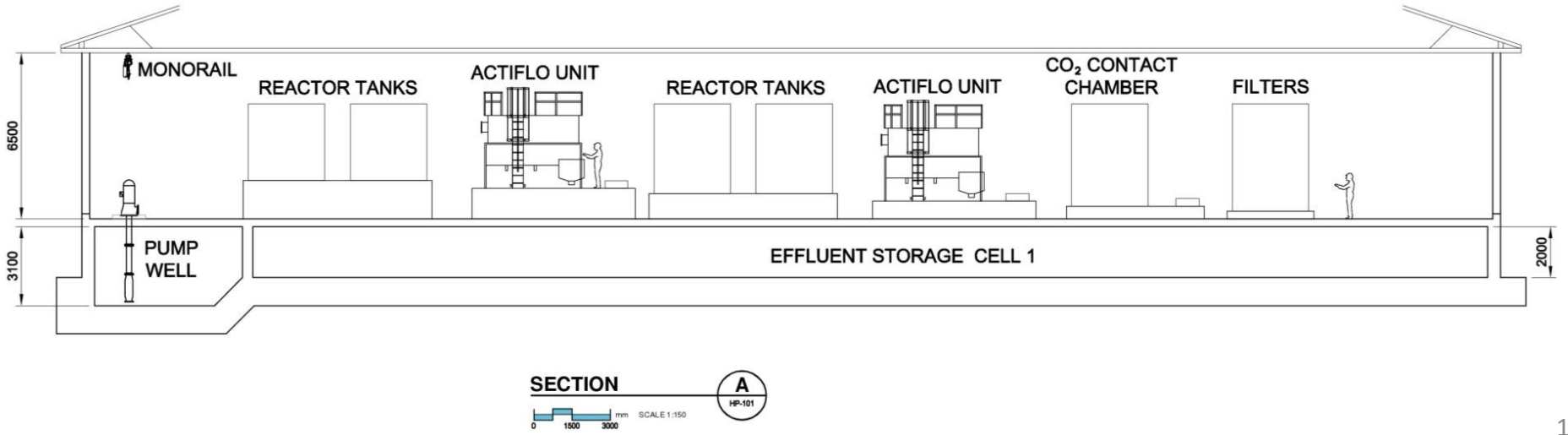
Below 750 foot level near C Shaft

- Designed for intake level flexibility to manage future water level



WATER TREATMENT PLANT – CONVENTIONAL DESIGN

- Proven technology (similar to current process)
- Room for expansion
- Provides office space and control room for Freeze program

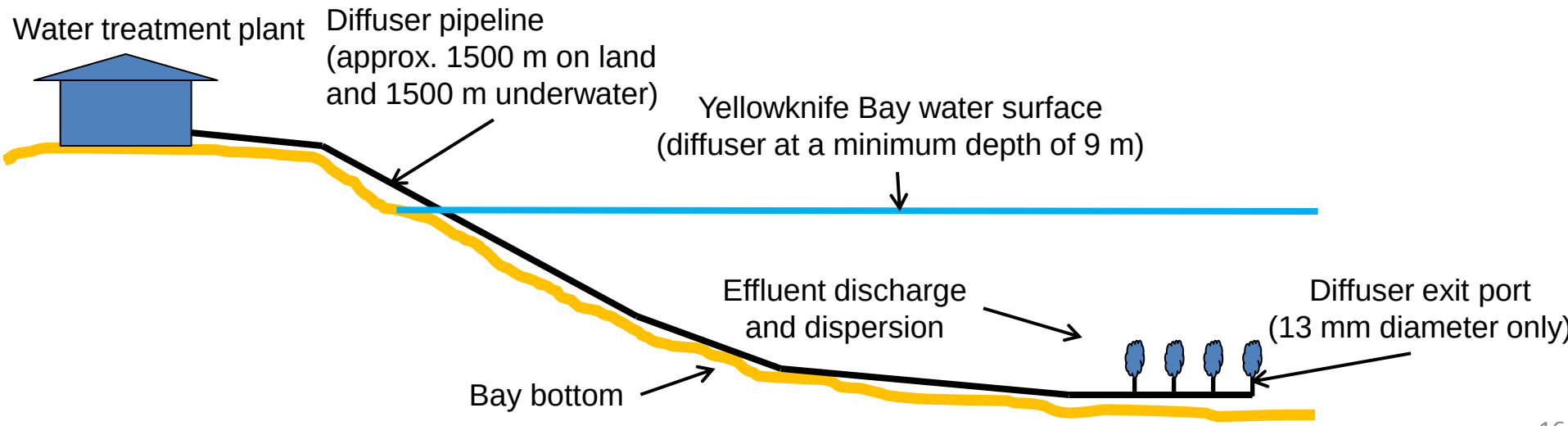


LOCATION IN PREVIOUSLY DISTURBED AREA

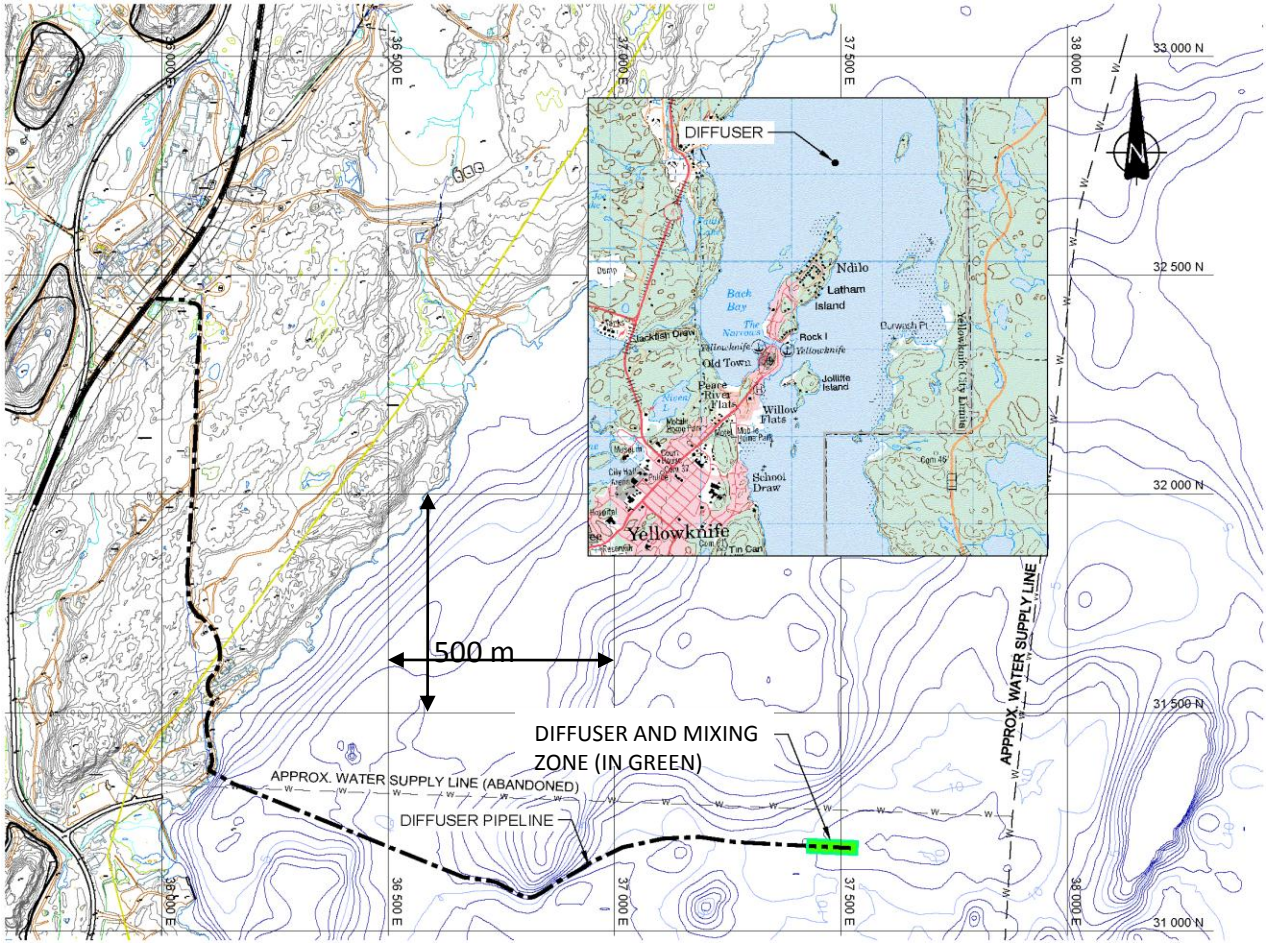
Proposed Water Treatment Plant Location

Why Use a Diffuser?

- Manages mixing, consistent with industry practice
- Meets CCME and NWT Diffuser Design guidelines
- No impact beyond the near-field mixing zone
- Large improvement on existing Baker Creek discharge: lower flow rate, lower concentration, greater mixing



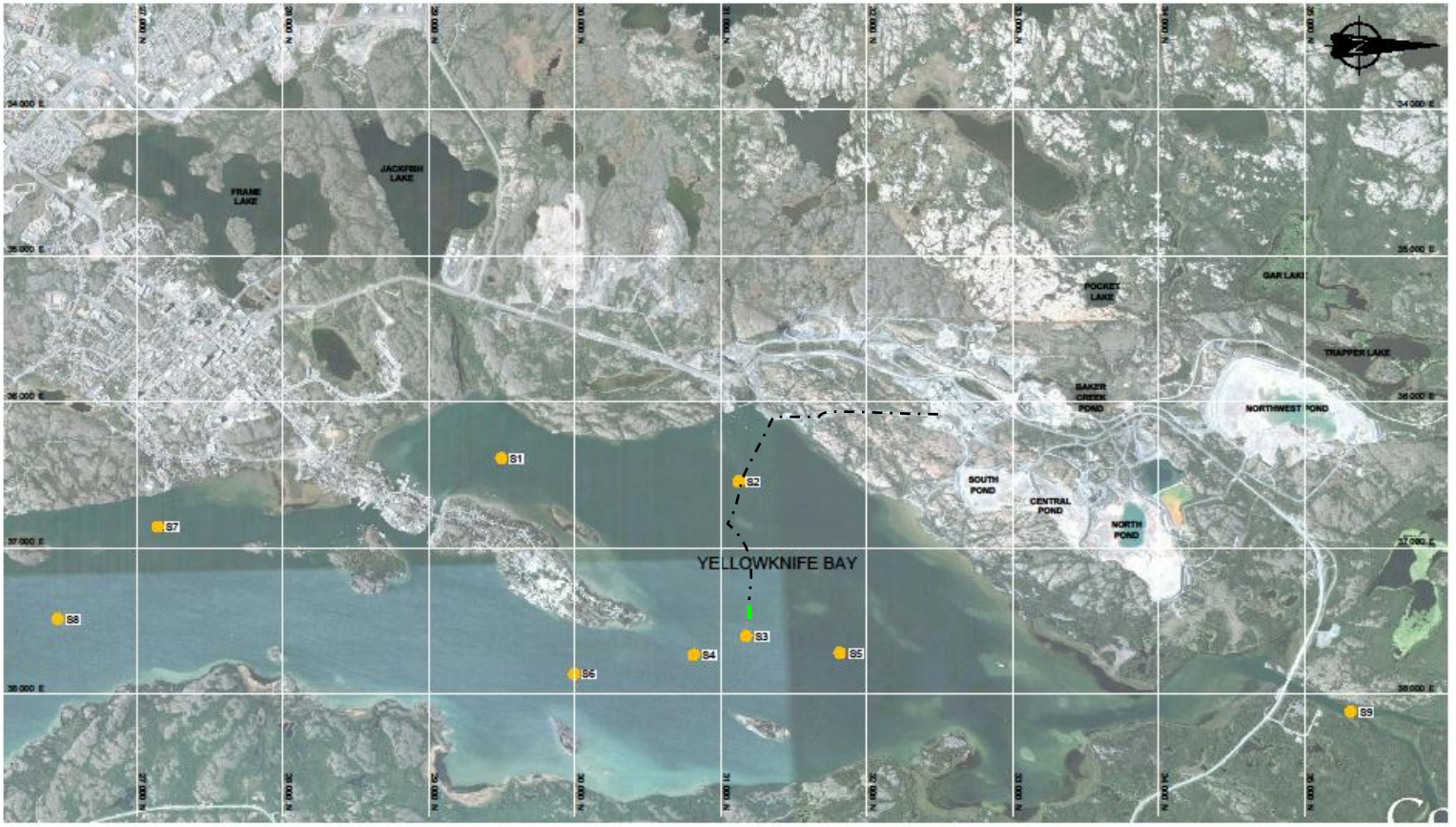
DIFFUSER IN NORTH YELLOWKNIFE BAY



Diffuser Design

- Designed to diffuse the effluent as efficiently as possible, and that should also diffuse the heat. So we expect no impact on the ice. But we will of course carry out additional analyses in detailed design and then monitor the full scale.
- Safe for recreation
- Ice cover:
  - Discharge temperature between 2°C and 10°C
  - Water temperature in Bay at proposed site of diffuser in March 2012 at depth was +0.5°C
  - Monitoring of the ice cover in area of diffuser will be part of project monitoring in the winter to confirm design is protective of safety for winter activities.

ICE THICKNESS SAMPLE LOCATIONS



LEGEND

S2 SAMPLING STATION

REFERENCES

1. IMAGE FROM GOOGLE EARTH. DATE: 16/05/2012

0 300 600 900 1200 1500

SCALE IN METRES

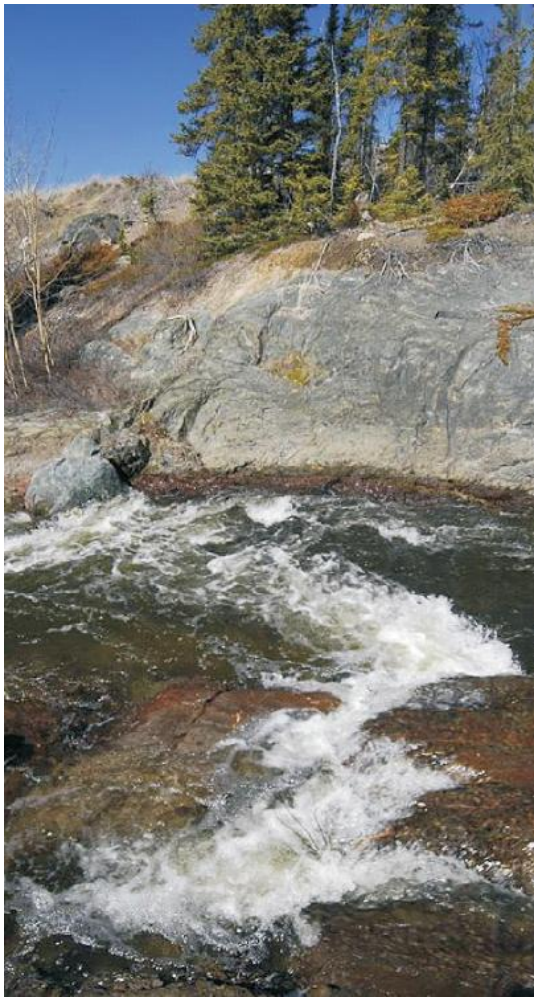
19

Bottom Sediment

- To minimize risk of sediment entrainment, diffuser ports will be:
  - A minimum of 1 m above the sediment
  - Angled upwards

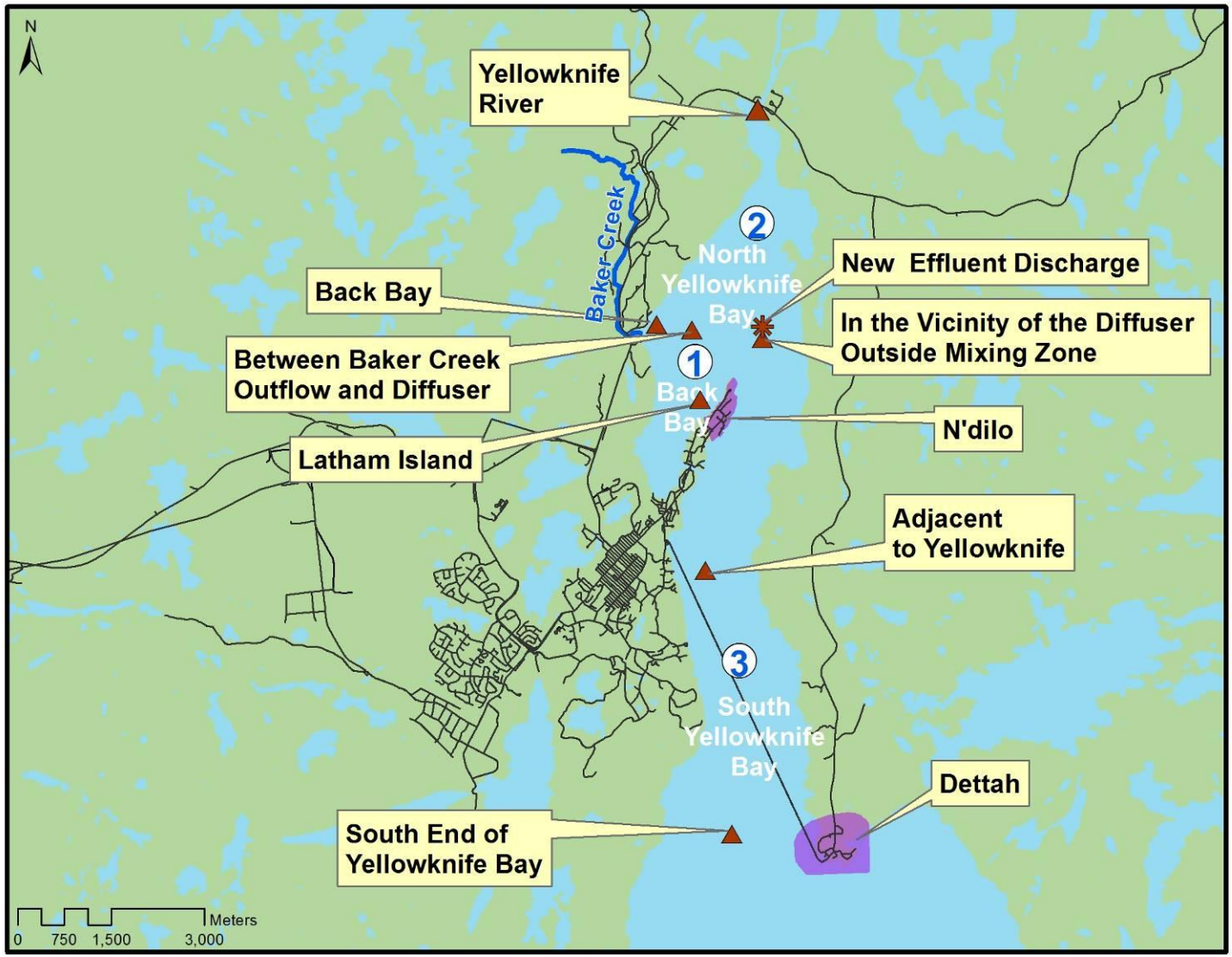
MONITORING FOR SURFACE WATER QUALITY

- Extensive monitoring program is proposed
- Continued operation of the existing surface water Surveillance Network Program (SNP):
  - Trapper Creek (2 locations)
  - Baker Creek (6 locations)
- New sampling stations to be established in Great Slave Lake:
  - Back Bay (3 locations)
  - Yellowknife Bay (4 locations)
- Ongoing sampling of surface water “seeps”.



Surface Water Monitoring

Yellowknife Bay (Proposed)



MONITORING

AQUATIC ENVIRONMENT

- Fish monitoring in Baker Creek and Yellowknife Bay (every 3 years):
  - to assess fish health and fish tissue chemistry.
- Aquatic effects monitoring (every 3 years):
  - to evaluate effects of the treated minewater discharge to Yellowknife Bay.
- Benthic invertebrate, aquatic vegetation and sediment monitoring in Baker Creek (every 3 years):
  - to determine how recovery is progressing.

MONITORING

ICE THICKNESS

- A monitoring program will be put in place to measure discharge on ice formation.
- The monitoring program will be coordinated with the program administered by the Yellowknife Fire Department (YKFD).
- The area of the outfall diffuser will be marked each winter until such time that it is proven that the discharge is not adversely affecting ice thickness.
- In the event that the discharge is shown to have a negative effect on ice formation, mitigative measures (such as cooling of the discharge water temperature, modification of the nozzle angle) will be implemented.

BENEFITS OF REMEDIATION

- The proposed water treatment system will:
  - Significantly reduce arsenic loadings to both Baker Creek and North Yellowknife Bay
  - Eliminate surface storage of contaminated water and associated risks to waterfowl and wildlife
  - Apply well proven and robust treatment methods to reduce arsenic below current treatment levels
  - Use well understood diffuser technology to minimize the mixing zone
  - Eliminate seasonal fluctuations and provide year-round employment
  - Be monitorable and adaptable over the long term

BENEFITS OF REMEDIATION

- New water treatment plant will:
  - use conventional technology familiar to Yellowknife
  - operate year-round; continuous employment opportunities
- The proposed outfall diffuser to North Yellowknife Bay will:
  - achieve rapid mixing of treated effluent with lake water
  - not adversely impact the arsenic level in the Bay beyond a very small initial mixing zone, and
  - have minimal impact on ice thickness and be protective of public safety
- Elimination of surface ponds and above ground storage of untreated minewater will:
  - reduce risks to waterfowl and other wildlife

BENEFITS OF REMEDIATION

- Consistent with its overall objective the Remediation Project will:
  - result in an overall improvement in the quality of the Surface Water Environment
  - protect all beneficial water uses in Yellowknife Bay (swimming, boating, fresh water aquatic life, drinking water)
- To confirm these conclusions and identify any adaptations that may be required, a comprehensive environmental monitoring program will be put in place

The water management system will not result in significant adverse impacts on the aquatic environment.

Photo Credit: Golder Associates