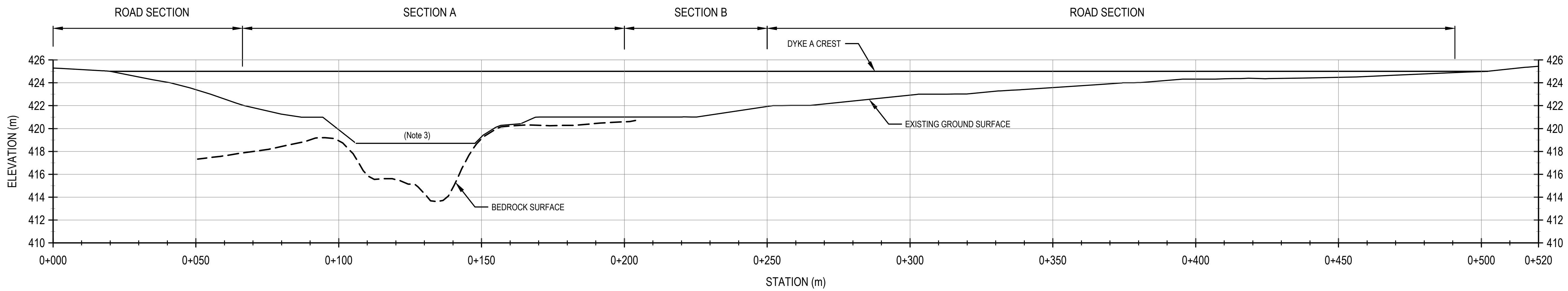
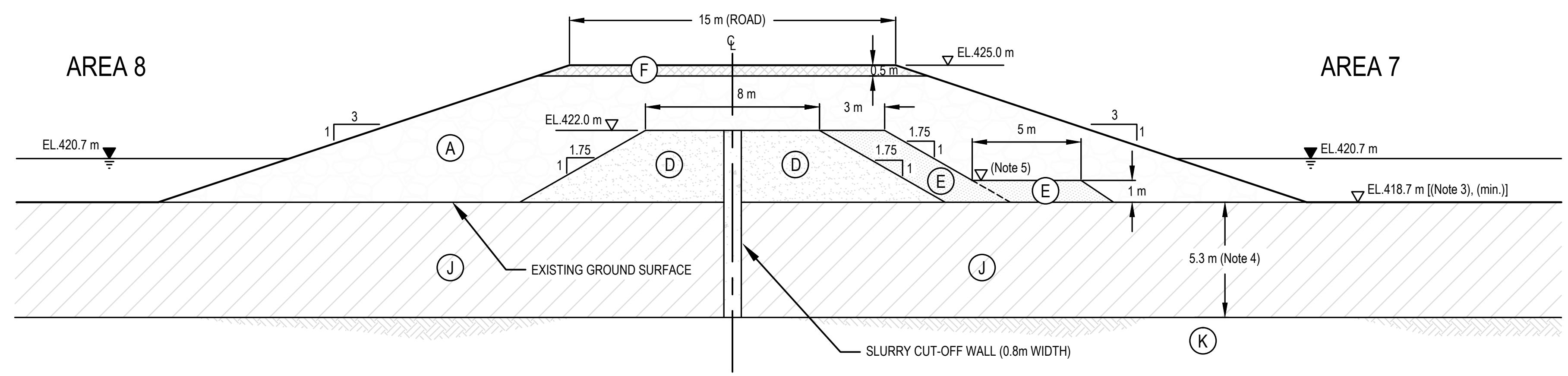


0 50 m

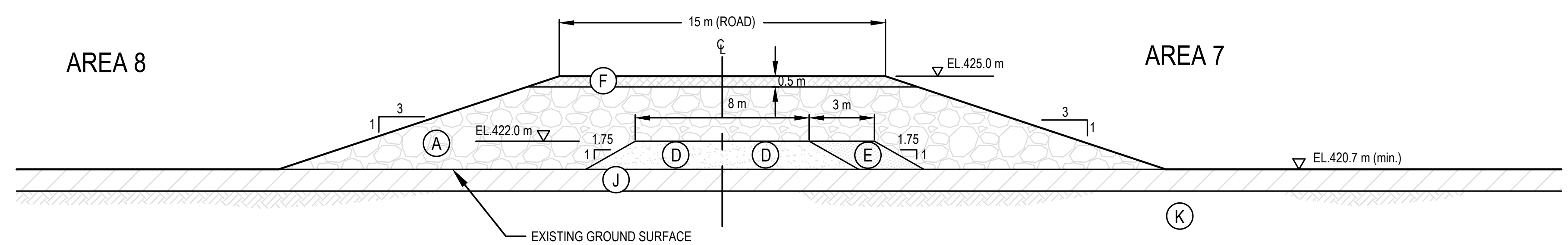
Scale: 1: 1 500

VERTICAL EXAGGERATION = 4x

PROFILE - DYKE A



TYPICAL SECTION A - DYKE A (WATER RETENTION/DIVERSION DYKE)



TYPICAL SECTION B - DYKE A

0 10 m

Scale: 1: 300

A	MINE ROCK FILL	G	RIP RAP
B	TRANSITION	H	FINE PK FILTER
C	LINER BEDDING	I	COARSE PK
D	TILL FILL	J	OVERBURDEN
E	TILL FILTER	K	BEDROCK
F	ROAD SURFACE FILL		

NOTES
- DIMENSIONS ARE IN METERS UNLESS SPECIFIED OTHERWISE
- PROFILE OF BEDROCK SURFACE ELEVATION ESTIMATED FROM AMEC 2004 GEOTECHNICAL SITE INVESTIGATION
- BATHYMETRY INFORMATION TO BE VERIFIED
- TOP OF BEDROCK DEPTH TO BE VERIFIED
- BLANKET FILTER TO BE PLACED WHERE GROUND SURFACE IS EQUAL TO OR BELOW THE ELEVATION OF 420.0 m

STATUS
ISSUED FOR USE

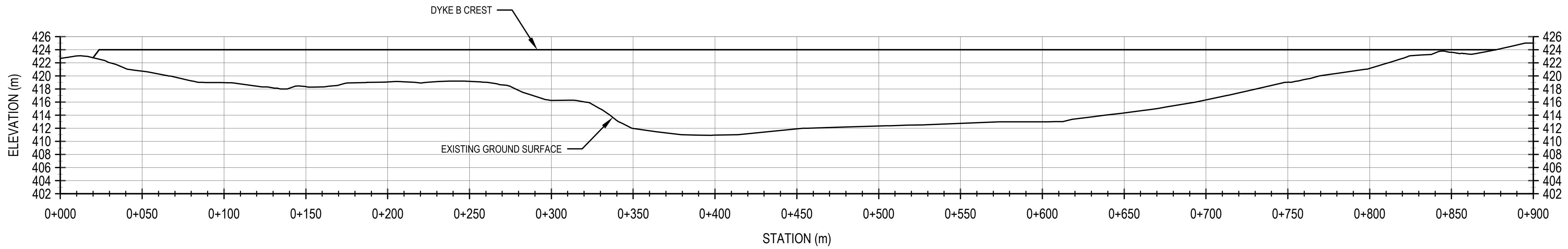
CLIENT
DE BEERS CANADA
MOUNTAIN PROVINCE DIAMONDS INC.
A TETRA TECH COMPANY

2012 GAHCHO KUÉ EIS SUPPLEMENT
NWT, CANADA

PROFILE AND TYPICAL SECTION
DYKE A

PROJECT NO.	DWN	CKD	REV	
E14101143	DRG	GZ	0	**Figure 2**
OFFICE	DATE			
EDM	March 23, 2012			

Q:\Edmonton\Drafting\CIVIL3D\E141\E14101143\Production Drawing\Updated Dyke Design Memo March 2012\E14101143_FIG 2-16_R1.dwg [FIGURE 2] March 27, 2012 - 4:01:42 pm (BY: GAMMIE, DON)

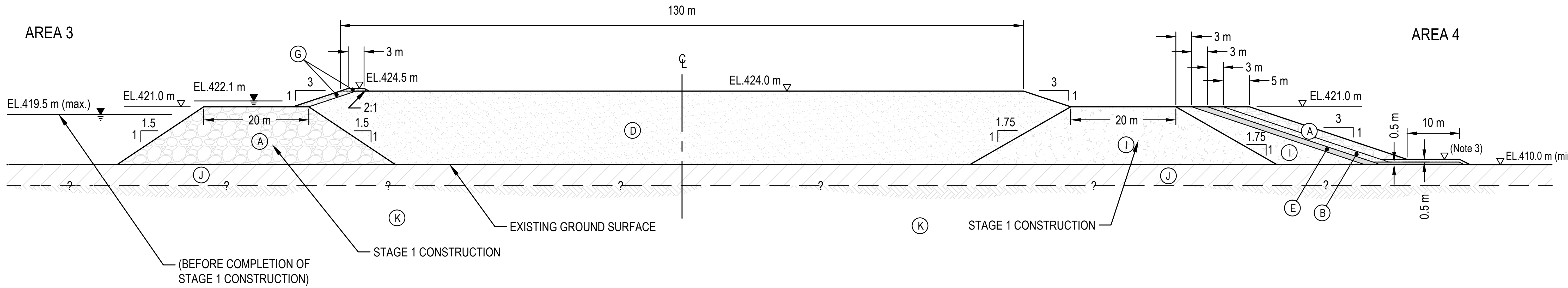


0 100 m

Scale: 1: 3 000

VERTICAL EXAGGERATION = 4x

PROFILE - DYKE B



0 25 m

Scale: 1: 750

TYPICAL SECTION - DYKE B (INTERNAL WATER RETENTION DYKE)

(A)	MINE ROCK FILL	(G)	RIP RAP
(B)	TRANSITION	(H)	FINE PK FILTER
(C)	LINER BEDDING	(I)	COARSE PK
(D)	TILL FILL	(J)	OVERBURDEN
(E)	TILL FILTER	(K)	BEDROCK
(F)	ROAD SURFACE FILL		

NOTES
- DIMENSIONS ARE IN METERS UNLESS SPECIFIED OTHERWISE
- OVERBURDEN THICKNESS TO BE DETERMINED IN FUTURE SITE INVESTIGATION
- BLANKET FILTER TO BE PLACED WHERE GROUND SURFACE IS EQUAL TO OR BELOW THE ELEVATION OF 414.0 m

STATUS
ISSUED FOR USE

CLIENT

DE BEERS CANADA

MOUNTAIN PROVINCE DIAMONDS INC.

JDS Energy & Mining Inc.

eba A TETRA TECH COMPANY

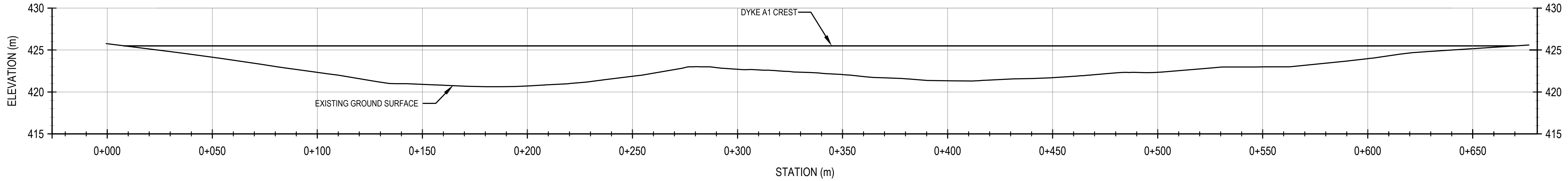
2012 GAHCHO KUÉ EIS SUPPLEMENT NWT, CANADA

PROFILE AND TYPICAL SECTION DYKE B

PROJECT NO.	DWN	CKD	REV
E14101143	DRG	GZ	0
OFFICE	DATE		
EDM	March 23, 2012		

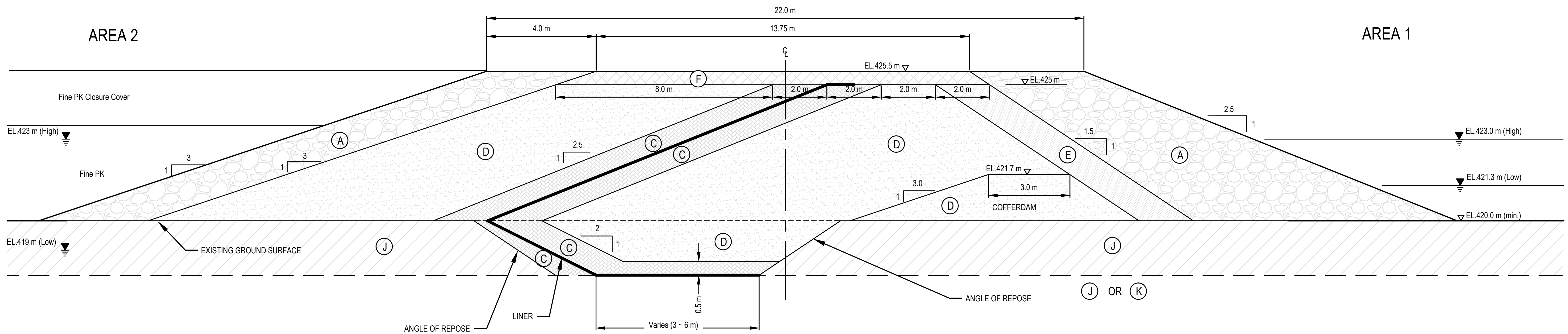
Figure 3

Q:\Edmonton\Drafting\CIVIL3D\E141\E14101143\Production Drawing\Updated Dyke Design Memo March 2012\E14101143_FIG 2-16_R1.dwg [FIGURE 3] March 27, 2012 - 12:25:45 pm (BY: GAMMIE, DON)



0 100 m
Scale: 1: 2 000
VERTICAL EXAGGERATION = 4x

PROFILE - DYKE A1



0 5 m
Scale: 1: 150

TYPICAL SECTION - DYKE A1

A	MINE ROCK FILL	G	RIP RAP
B	TRANSITION	H	FINE PK FILTER
C	LINER BEDDING	I	COARSE PK
D	TILL FILL	J	OVERBURDEN
E	TILL FILTER	K	BEDROCK
F	ROAD SURFACE FILL		

NOTES
- DIMENSIONS ARE IN METERS UNLESS SPECIFIED OTHERWISE
- OVERBURDEN THICKNESS TO BE DETERMINED IN FUTURE SITE INVESTIGATION
- KEY TRENCH EXCAVATED TO COMPETENT OVERBURDEN (SATURATED INORGANIC PERMAFROST WHEN AVAILABLE) OR TOP OF BEDROCK

STATUS
ISSUED FOR USE

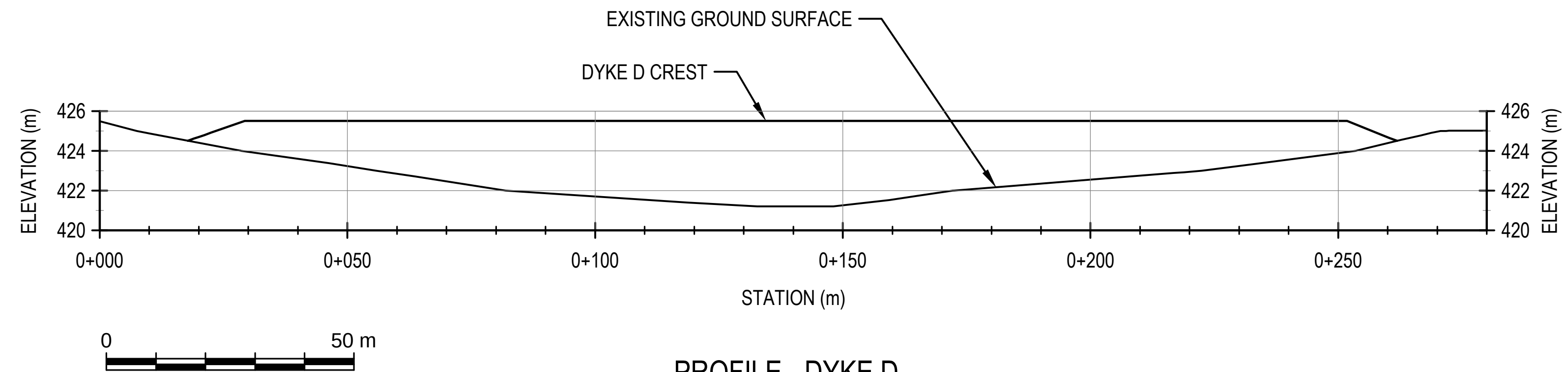
CLIENT
DE BEERS CANADA
MOUNTAIN PROVINCE DIAMONDS INC.
JDS Energy & Mining Inc.
eba A TETRA TECH COMPANY

2012 GAHCHO KUÉ EIS SUPPLEMENT
NWT, CANADA

PROFILE AND TYPICAL SECTION
DYKE A1

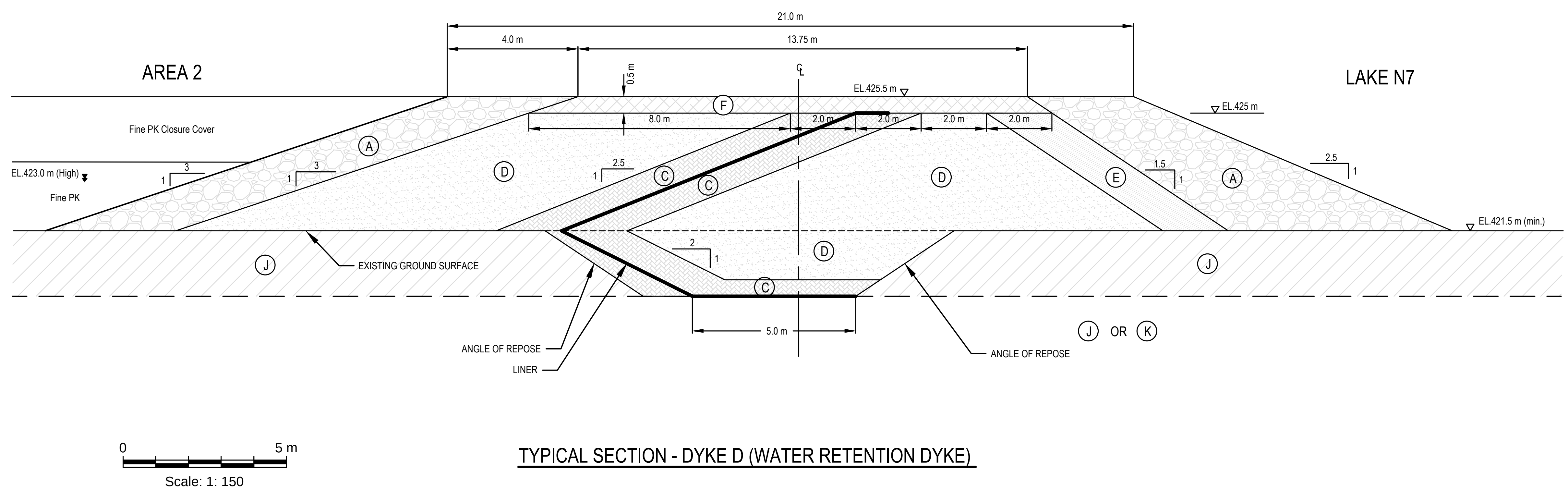
PROJECT NO.	DWN	CKD	REV
E14101143	DRG	GZ	0
OFFICE	DATE		
EDM	March 23, 2012		

Figure 4



VERTICAL EXAGGERATION = 4x

PROFILE - DYKE D



TYPICAL SECTION - DYKE D (WATER RETENTION DYKE)

(A)	MINE ROCK FILL	(G)	RIP RAP
(B)	TRANSITION	(H)	FINE PK FILTER
(C)	LINER BEDDING	(I)	COARSE PK
(D)	TILL FILL	(J)	OVERBURDEN
(E)	TILL FILTER	(K)	BEDROCK
(F)	ROAD SURFACE FILL		

NOTES
- DIMENSIONS ARE IN METERS UNLESS SPECIFIED OTHERWISE
- OVERBURDEN THICKNESS TO BE DETERMINED IN FUTURE SITE INVESTIGATION
- KEY TRENCH EXCAVATED TO COMPETENT OVERBURDEN (SATURATED INORGANIC PERMAFROST WHEN AVAILABLE) OR TOP OF BEDROCK

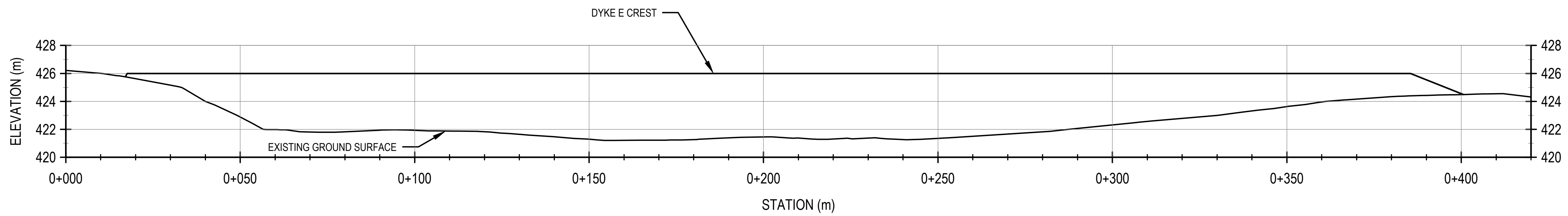
STATUS
ISSUED FOR USE

CLIENT
DE BEERS CANADA
MOUNTAIN PROVINCE DIAMONDS INC.
JDS Energy & Mining Inc.
eba A TETRA TECH COMPANY

2012 GAHCHO KUÉ EIS SUPPLEMENT
NWT, CANADA

PROFILE AND TYPICAL SECTION
DYKE D

PROJECT NO.	DWN	CKD	REV	
E14101143	DRG	GZ	0	Figure 5
OFFICE	DATE			
EDM	March 23, 2012			

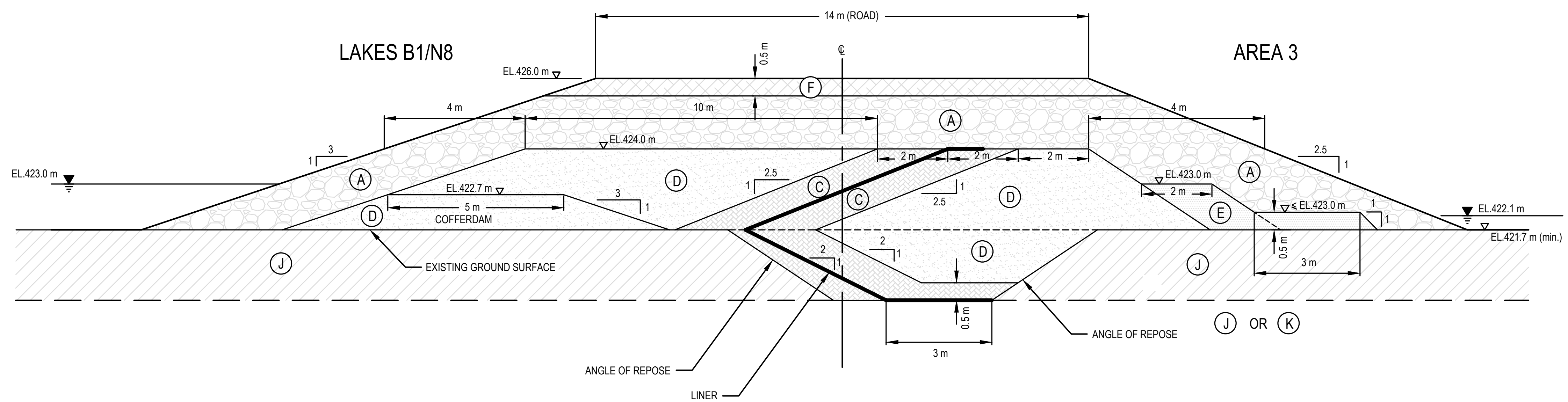


0 50 m

Scale: 1: 1 500

VERTICAL EXAGGERATION = 4x

PROFILE - DYKE E



0 5 m

Scale: 1: 150

TYPICAL SECTION - DYKE E (DIVERSION/WATER RETENTION DYKE)

(A) MINE ROCK FILL	(G) RIP RAP
(B) TRANSITION	(H) FINE PK FILTER
(C) LINER BEDDING	(I) COARSE PK
(D) TILL FILL	(J) OVERBURDEN
(E) TILL FILTER	(K) BEDROCK
(F) ROAD SURFACE FILL	

NOTES

- DIMENSIONS ARE IN METERS UNLESS SPECIFIED OTHERWISE
- OVERBURDEN THICKNESS TO BE DETERMINED IN FUTURE SITE INVESTIGATION
- KEY TRENCH EXCAVATED TO COMPETENT OVERBURDEN (SATURATED INORGANIC PERMAFROST WHEN AVAILABLE) OR TOP OF BEDROCK

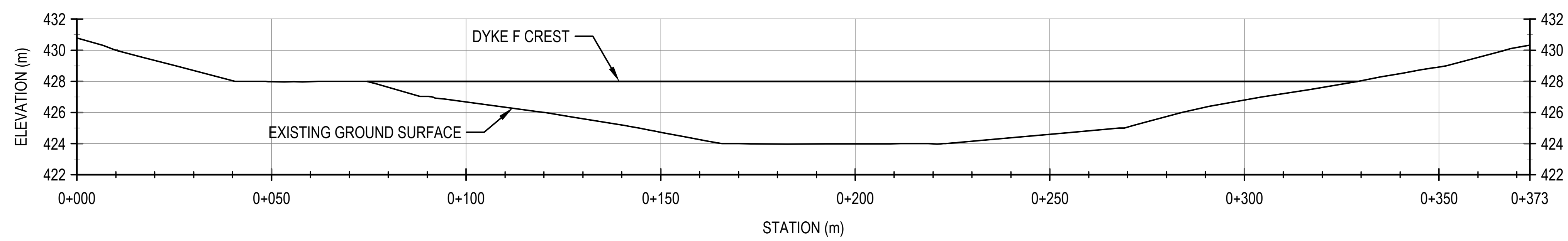
STATUS
ISSUED FOR USE

CLIENT
DE BEERS CANADA
MOUNTAIN PROVINCE DIAMONDS INC.
eba A TETRA TECH COMPANY

2012 GAHCHO KUÉ EIS SUPPLEMENT
NWT, CANADA

PROFILE AND TYPICAL SECTION
DYKE E

PROJECT NO.	DWN	CKD	REV	
E14101143	DRG	GZ	0	**Figure 6**
OFFICE	DATE			
EDM	March 23, 2012			

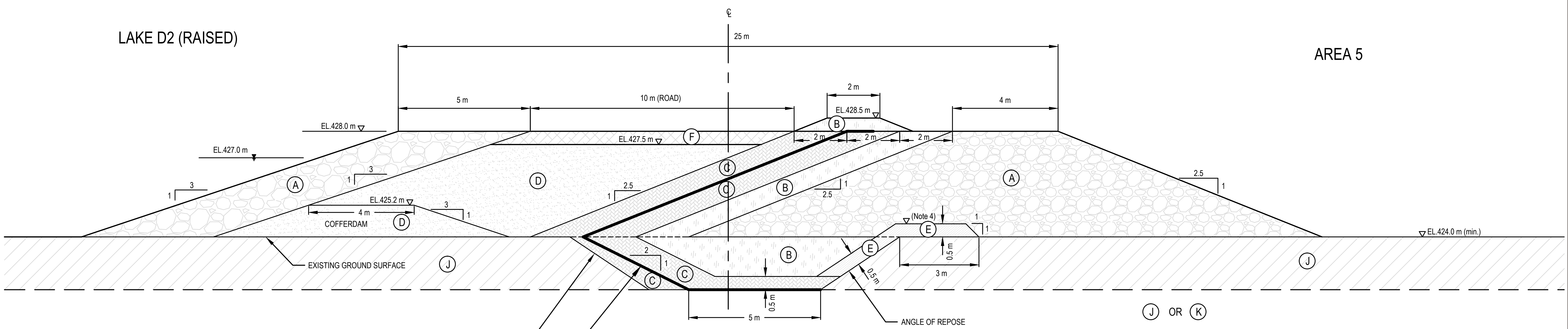


0 50 m

Scale: 1: 1 500

VERTICAL EXAGGERATION = 4x

PROFILE - DYKE F



0 5 m

Scale: 1: 150

TYPICAL SECTION - DYKE F (DIVERSION DYKE)

(A)	MINE ROCK FILL	(G)	RIP RAP
(B)	TRANSITION	(H)	FINE PK FILTER
(C)	LINER BEDDING	(I)	COARSE PK
(D)	TILL FILL	(J)	OVERBURDEN
(E)	TILL FILTER	(K)	BEDROCK
(F)	ROAD SURFACE FILL		

NOTES

- DIMENSIONS ARE IN METERS UNLESS SPECIFIED OTHERWISE
- OVERBURDEN THICKNESS TO BE DETERMINED IN FUTURE SITE INVESTIGATION
- KEY TRENCH EXCAVATED TO COMPETENT OVERBURDEN (SATURATED INORGANIC PERMAFROST WHEN AVAILABLE) OR TOP OF BEDROCK
- BLANKET FILTER TO BE PLACED WHERE GROUND SURFACE IS EQUAL TO OR BELOW THE ELEVATION OF 426 m

STATUS
ISSUED FOR USE

CLIENT

DE BEERS CANADA

MOUNTAIN PROVINCE DIAMONDS INC.

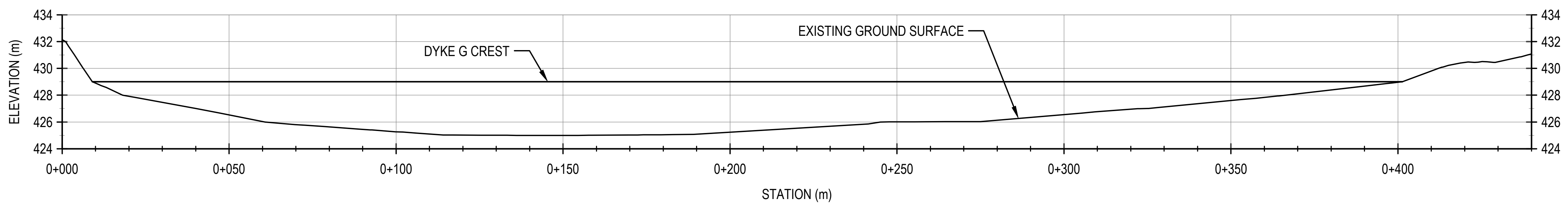
A TETRA TECH COMPANY

2012 GAHCHO KUÉ EIS SUPPLEMENT
NWT, CANADA

PROFILE AND TYPICAL SECTION
DYKE F

PROJECT NO.	DWN	CKD	REV
E14101143	DRG	GZ	0
OFFICE	DATE		
EDM	March 23, 2012		

Figure 7

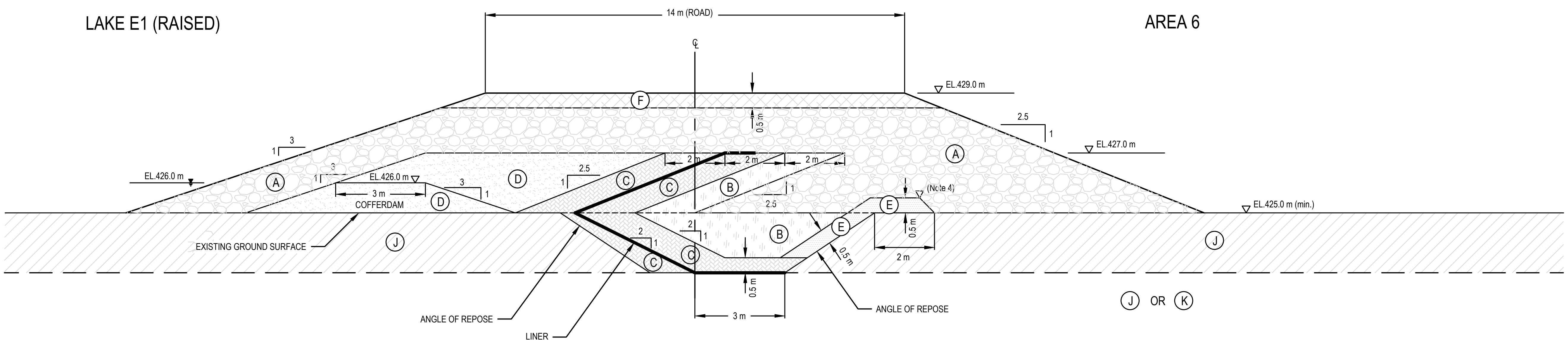


0 50 m

Scale: 1: 1 500

VERTICAL EXAGGERATION = 4x

PROFILE - DYKE G



0 5 m

Scale: 1: 150

TYPICAL SECTION - DYKE G (DIVERSION DYKE)

A	MINE ROCK FILL	G	RIP RAP
B	TRANSITION	H	FINE PK FILTER
C	LINER BEDDING	I	COARSE PK
D	TILL FILL	J	OVERBURDEN
E	TILL FILTER	K	BEDROCK
F	ROAD SURFACE FILL		

NOTES

- DIMENSIONS ARE IN METERS UNLESS SPECIFIED OTHERWISE
- OVERBURDEN THICKNESS TO BE DETERMINED IN FUTURE SITE INVESTIGATION
- KEY TRENCH EXCAVATED TO COMPETENT OVERBURDEN (SATURATED INORGANIC PERMAFROST WHEN AVAILABLE) OR TOP OF BEDROCK
- BLANKET FILTER TO BE PLACED WHERE GROUND SURFACE IS EQUAL TO OR BELOW THE ELEVATION OF 426.0 m

STATUS
ISSUED FOR USE

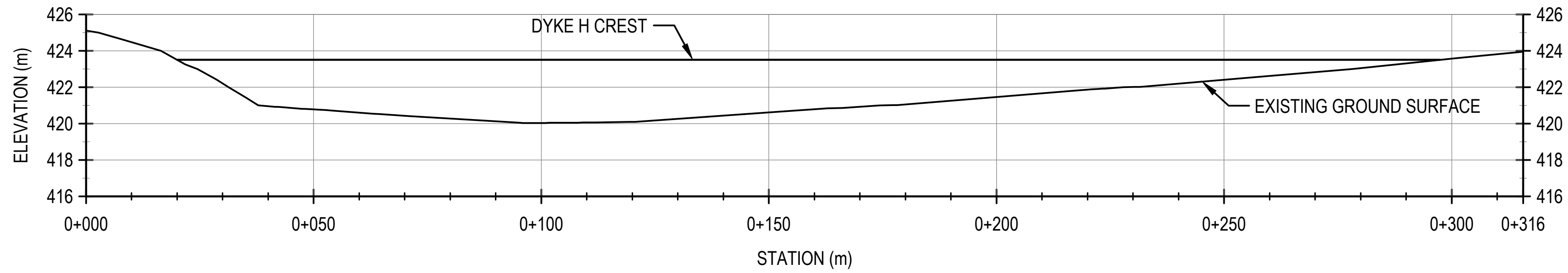
CLIENT
DE BEERS CANADA
MOUNTAIN PROVINCE DIAMONDS INC.
A TETRA TECH COMPANY

2012 GAHCHO KUÉ EIS SUPPLEMENT
NWT, CANADA

PROFILE AND TYPICAL SECTION
DYKE G

PROJECT NO.	DWN	CKD	REV
E14101143	DRG	GZ	0
OFFICE	DATE		
EDM	March 23, 2012		

Figure 8

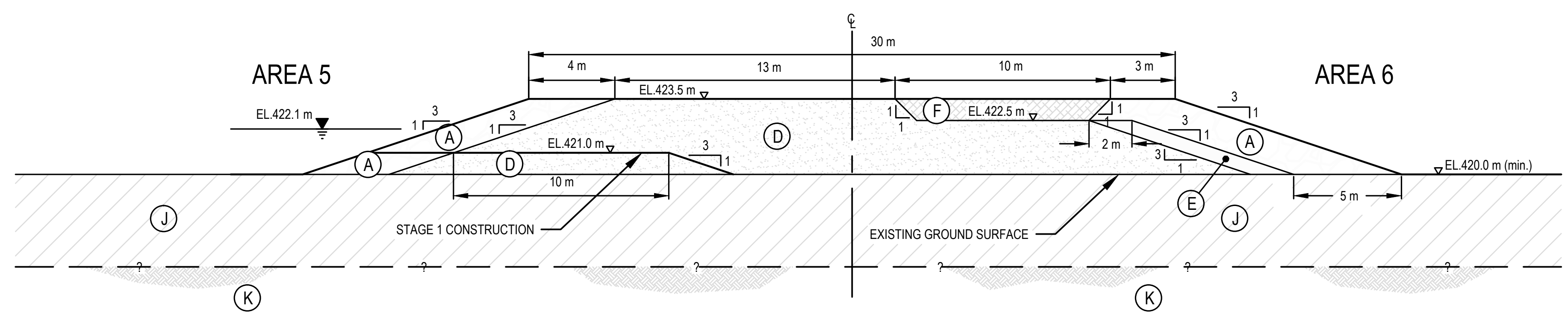


0 50 m

Scale: 1: 1 500

VERTICAL EXAGGERATION = 4x

PROFILE - DYKE H



0 10 m

Scale: 1: 300

TYPICAL SECTION - DYKE H (INTERNAL WATER RETENTION DYKE)

(A)	MINE ROCK FILL	(G)	RIP RAP
(B)	TRANSITION	(H)	FINE PK FILTER
(C)	LINER BEDDING	(I)	COARSE PK
(D)	TILL FILL	(J)	OVERBURDEN
(E)	TILL FILTER	(K)	BEDROCK
(F)	ROAD SURFACE FILL		

NOTES

- DIMENSIONS ARE IN METERS UNLESS SPECIFIED OTHERWISE
- OVERBURDEN THICKNESS TO BE DETERMINED IN FUTURE SITE INVESTIGATION

STATUS
ISSUED FOR USE

CLIENT

DE BEERS CANADA

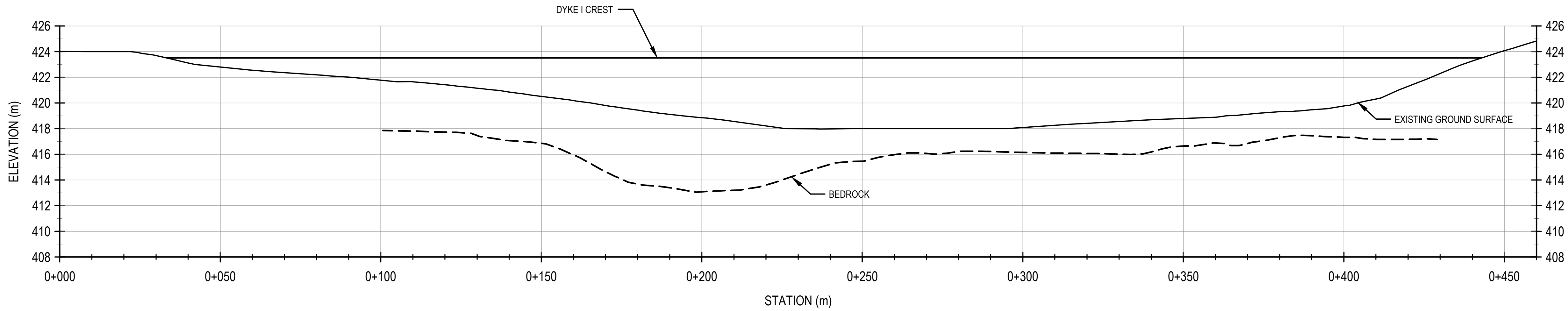
MOUNTAIN PROVINCE DIAMONDS INC.

A TETRA TECH COMPANY

2012 GAHCHO KUÉ EIS SUPPLEMENT
NWT, CANADA

PROFILE AND TYPICAL SECTION
DYKE H

PROJECT NO.	DWN	CKD	REV	
E14101143	DRG	GZ	0	**Figure 9**
OFFICE	DATE			
EDM	March 23, 2012			

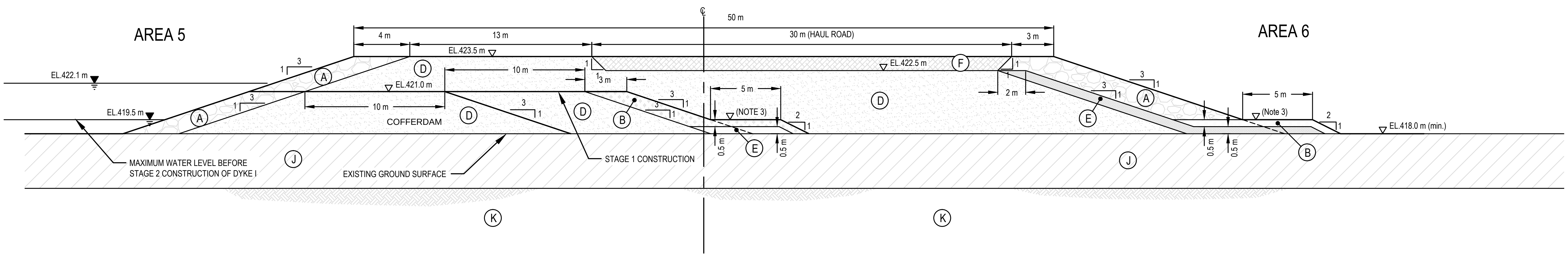


0 50 m

Scale: 1: 1 500

VERTICAL EXAGGERATION = 4x

PROFILE - DYKE I



0 10 m

Scale: 1: 300

TYPICAL SECTION - DYKE I (INTERNAL WATER RETENTION DYKE)

(A)	MINE ROCK FILL	(G)	RIP RAP
(B)	TRANSITION	(H)	FINE PK FILTER
(C)	LINER BEDDING	(I)	COARSE PK
(D)	TILL FILL	(J)	OVERBURDEN
(E)	TILL FILTER	(K)	BEDROCK
(F)	ROAD SURFACE FILL		

NOTES
- DIMENSIONS ARE IN METERS UNLESS SPECIFIED OTHERWISE
- PROFILE OF BEDROCK SURFACE ELEVATION ESTIMATED FROM AMEC 2004 GEOTECHNICAL SITE INVESTIGATION
- BLANKET FILTER TO BE PLACED WHERE GROUND SURFACE IS EQUAL TO OR BELOW THE ELEVATION OF 420.0 m

STATUS
ISSUED FOR USE

CLIENT
DE BEERS CANADA
MOUNTAIN PROVINCE DIAMONDS INC.
eba A TETRA TECH COMPANY

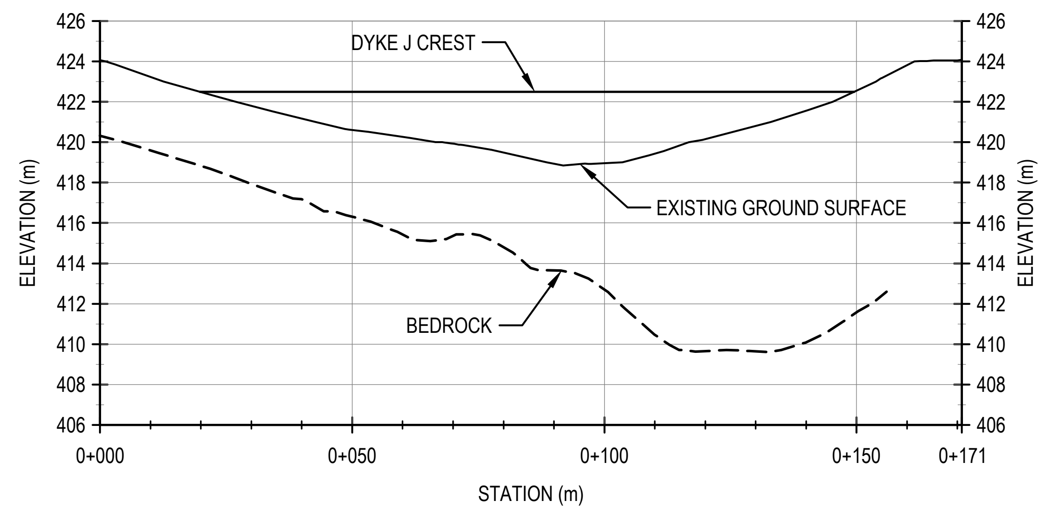
2012 GAHCHO KUÉ EIS SUPPLEMENT
NWT, CANADA

PROFILE AND TYPICAL SECTION
DYKE I

PROJECT NO.	DWN	CKD	REV
E14101143	DRG	GZ	0
OFFICE	DATE		
EDM	March 23, 2012		

Figure 10

Q:\Edmonton\Drafting\CIVIL3D\E141\E14101143\Production Drawing\Updated Dyke Design Memo March 2012\E14101143_FIG 2-16_R1.dwg [FIGURE 10] March 27, 2012 - 12:21:34 pm (BY: GAMMIE, DON)

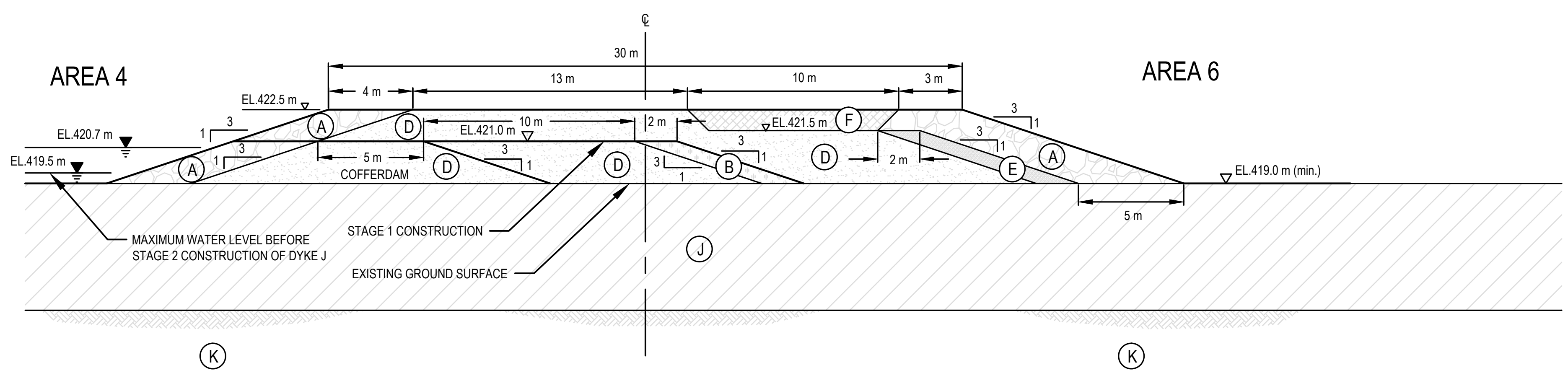


0 50 m

Scale: 1: 1 500

VERTICAL EXAGGERATION = 4x

PROFILE - DYKE J



0 10 m

Scale: 1: 300

TYPICAL SECTION - DYKE J (INTERNAL WATER RETENTION DYKE)

(A)	MINE ROCK FILL	(G)	RIP RAP
(B)	TRANSITION	(H)	FINE PK FILTER
(C)	LINER BEDDING	(I)	COARSE PK
(D)	TILL FILL	(J)	OVERBURDEN
(E)	TILL FILTER	(K)	BEDROCK
(F)	ROAD SURFACE FILL		

NOTES
- DIMENSIONS ARE IN METERS UNLESS SPECIFIED OTHERWISE
- PROFILE OF BEDROCK SURFACE ELEVATION ESTIMATED FROM AMEC 2004 GEOTECHNICAL SITE INVESTIGATION

STATUS
ISSUED FOR USE

CLIENT

DE BEERS CANADA

MOUNTAIN PROVINCE DIAMONDS INC.

A TETRA TECH COMPANY

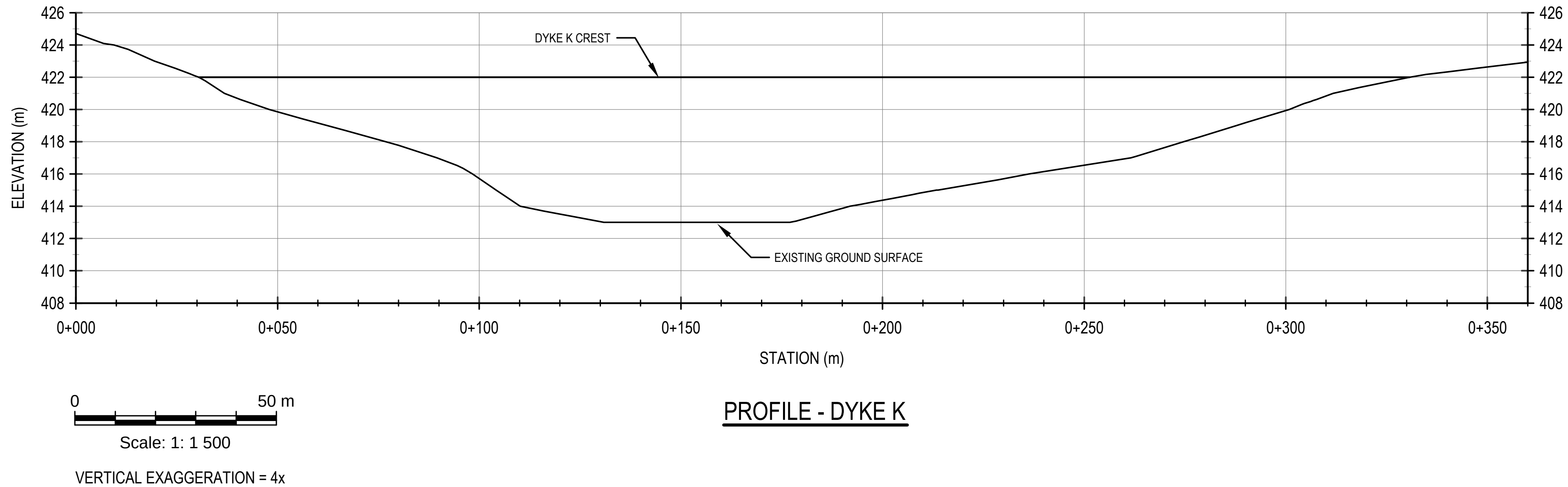
2012 GAHCHO KUÉ EIS SUPPLEMENT
NWT, CANADA

PROFILE AND TYPICAL SECTION
DYKE J

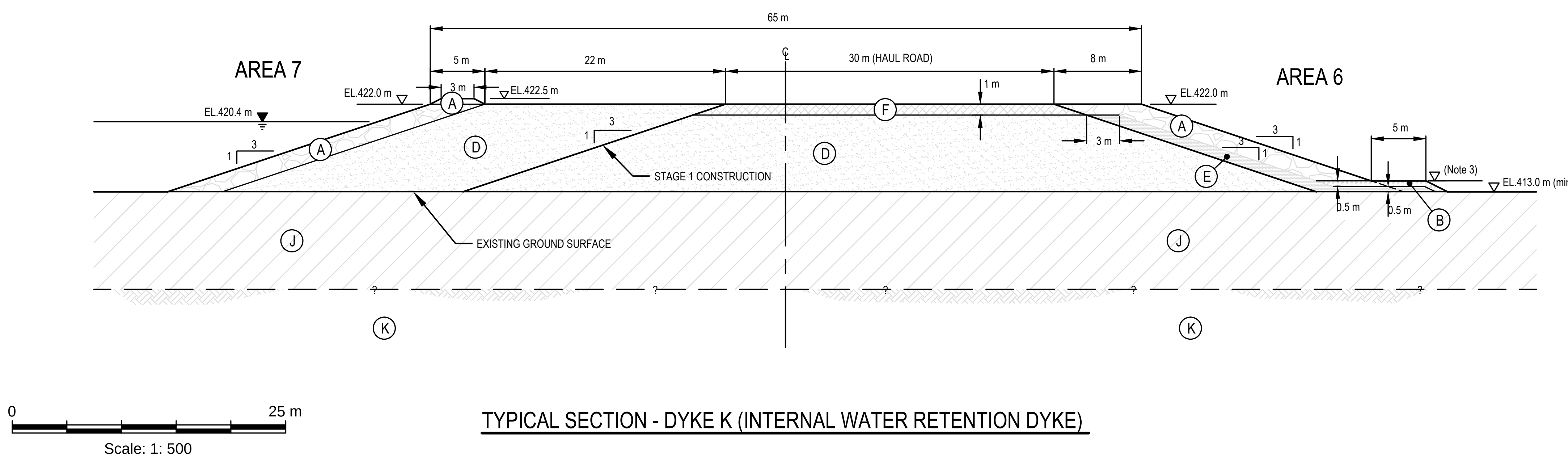
PROJECT NO.	DWN	CKD	REV
E14101143	DRG	GZ	0

OFFICE	DATE
EDM	March 23, 2012

Figure 11



PROFILE - DYKE K



TYPICAL SECTION - DYKE K (INTERNAL WATER RETENTION DYKE)

(A)	MINE ROCK FILL	(G)	RIP RAP
(B)	TRANSITION	(H)	FINE PK FILTER
(C)	LINER BEDDING	(I)	COARSE PK
(D)	TILL FILL	(J)	OVERBURDEN
(E)	TILL FILTER	(K)	BEDROCK
(F)	ROAD SURFACE FILL		

NOTES
- DIMENSIONS ARE IN METERS UNLESS SPECIFIED OTHERWISE
- OVERBURDEN THICKNESS TO BE DETERMINED IN FUTURE SITE INVESTIGATION
- BLANKET FILTER TO BE PLACED WHERE GROUND SURFACE IS EQUAL TO OR BELOW THE ELEVATION OF 416.0 m

STATUS
ISSUED FOR USE

CLIENT
DE BEERS CANADA
MOUNTAIN PROVINCE DIAMONDS INC.
eba A TETRA TECH COMPANY

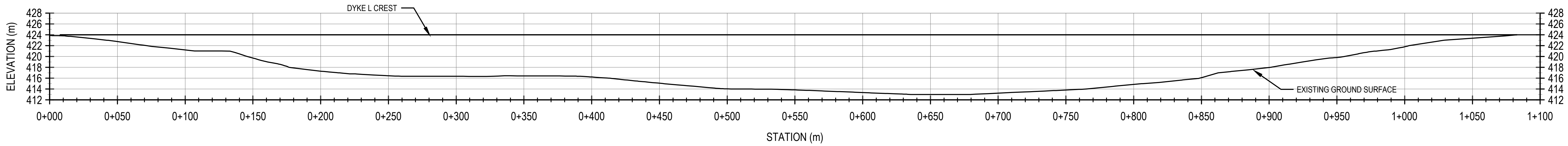
2012 GAHCHO KUÉ EIS SUPPLEMENT
NWT, CANADA

PROFILE AND TYPICAL SECTION
DYKE K

PROJECT NO.	DWN	CKD	REV
E14101143	DRG	GZ	0
OFFICE	DATE		
EDM	March 23, 2012		

Figure 12

Q:\Edmonton\Drafting\CIVIL3D\E141\E14101143\Production Drawing\Updated Dyke Design Memo March 2012\E14101143_FIG 2-16_R1.dwg [FIGURE 12] March 27, 2012 - 12:20:21 pm (BY: GAMMIE, DON)

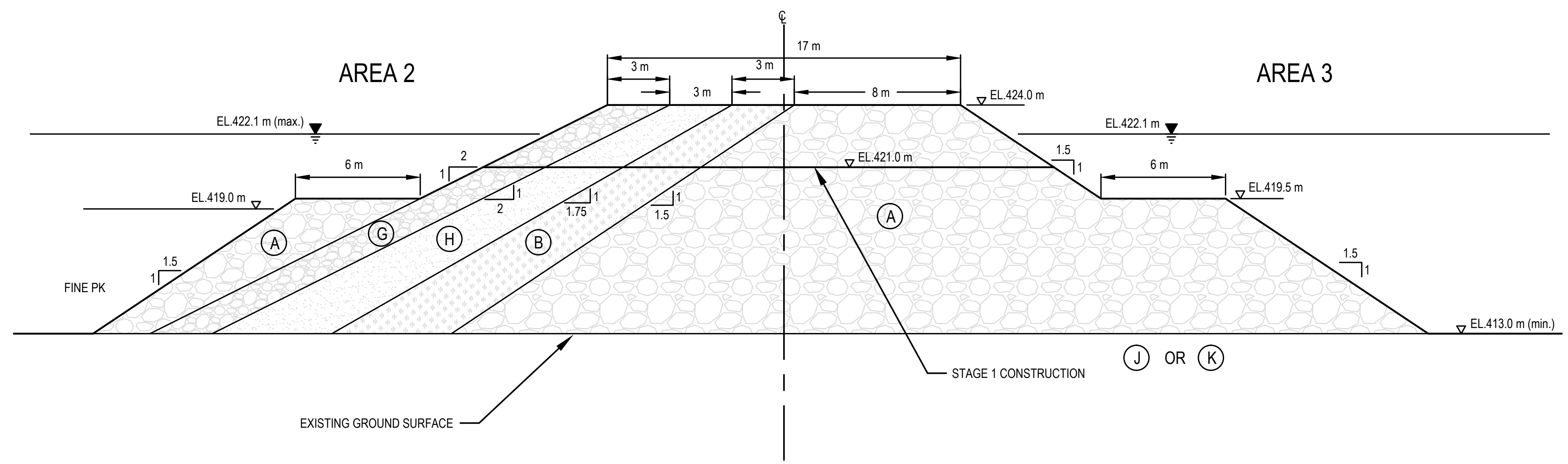


0 100 m

Scale: 1: 3 000

VERTICAL EXAGGERATION = 4x

PROFILE - DYKE L



0 10 m

Scale: 1: 300

TYPICAL SECTION - DYKE L (INTERNAL FILTER DYKE)

(A)	MINE ROCK FILL	(G)	RIP RAP
(B)	TRANSITION	(H)	FINE PK FILTER
(C)	LINER BEDDING	(I)	COARSE PK
(D)	TILL FILL	(J)	OVERBURDEN
(E)	TILL FILTER	(K)	BEDROCK
(F)	ROAD SURFACE FILL		

NOTES
- DIMENSIONS ARE IN METERS UNLESS SPECIFIED OTHERWISE
- OVERBURDEN THICKNESS TO BE DETERMINED IN FUTURE SITE INVESTIGATION

STATUS
ISSUED FOR USE

CLIENT

DE BEERS CANADA

MOUNTAIN PROVINCE DIAMONDS INC.

eba A TETRA TECH COMPANY

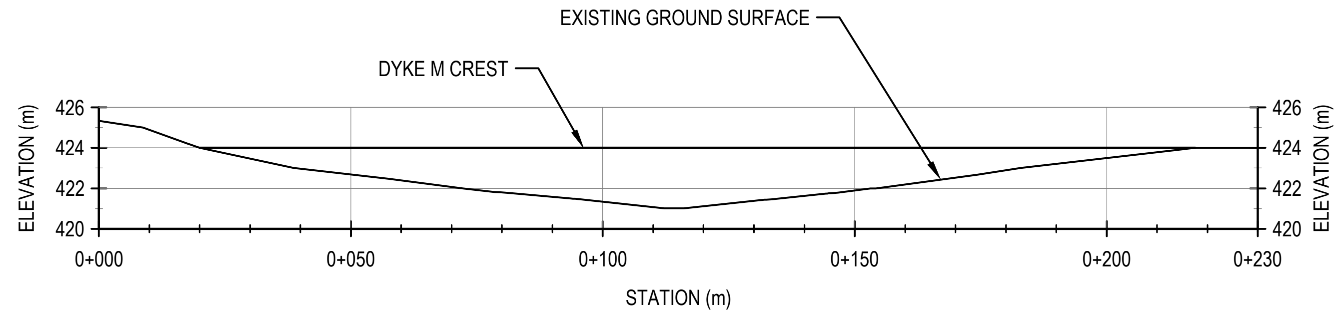
2012 GAHCHO KUÉ EIS SUPPLEMENT NWT, CANADA

PROFILE AND TYPICAL SECTION DYKE L

PROJECT NO.	DWN	CKD	REV
E14101143	DRG	GZ	0
OFFICE	DATE		
EDM	March 23, 2012		

Figure 13

Q:\Edmonton\Drafting\CIVIL3D\E141\E14101143\Production Drawing\Updated Dyke Design Memo March 2012\E14101143_FIG 2-16_R1.dwg [FIGURE 13] March 27, 2012 - 12:19:06 pm (BY: GAMMIE, DON)

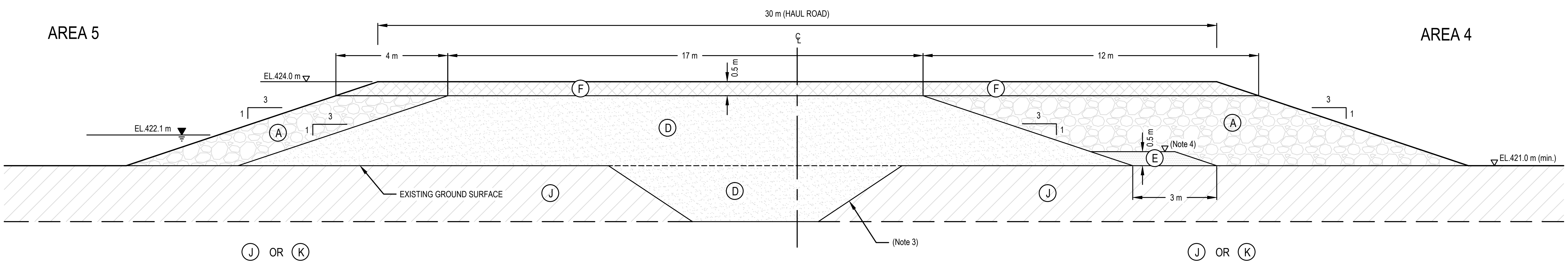


0 50 m

Scale: 1: 1 500

VERTICAL EXAGGERATION = 4x

PROFILE - DYKE M



0 5 m

Scale: 1: 150

TYPICAL SECTION - DYKE M (INTERNAL WATER RETENSION DYKE)

A	MINE ROCK FILL	G	RIP RAP
B	TRANSITION	H	FINE PK FILTER
C	LINER BEDDING	I	COARSE PK
D	TILL FILL	J	OVERBURDEN
E	TILL FILTER	K	BEDROCK
F	ROAD SURFACE FILL		

NOTES
- DIMENSIONS ARE IN METERS UNLESS SPECIFIED OTHERWISE
- OVERBURDEN THICKNESS TO BE DETERMINED IN FUTURE SITE INVESTIGATION
- REQUIREMENT AND DIMENSIONS OF KEY TRENCH DEPEND ON ACTUAL OVERBURDEN SOIL PROPERTIES
- BLANKET FILTER TO BE PLACED WHERE GROUND SURFACE IS EQUAL TO OR BELOW THE ELEVATION OF 422.0 m

STATUS
ISSUED FOR USE

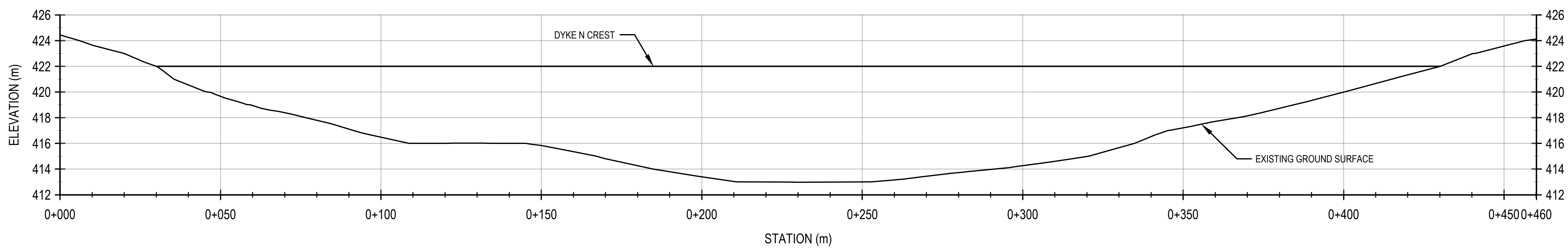
CLIENT
DE BEERS CANADA
MOUNTAIN PROVINCE DIAMONDS INC.
JDS Energy & Mining Inc.
eba A TETRA TECH COMPANY

2012 GAHCHO KUÉ EIS SUPPLEMENT
NWT, CANADA

PROFILE AND TYPICAL SECTION
DYKE M

PROJECT NO.	DWN	CKD	REV
E14101143	DRG	GZ	0
OFFICE	DATE		
EDM	March 23, 2012		

Figure 14

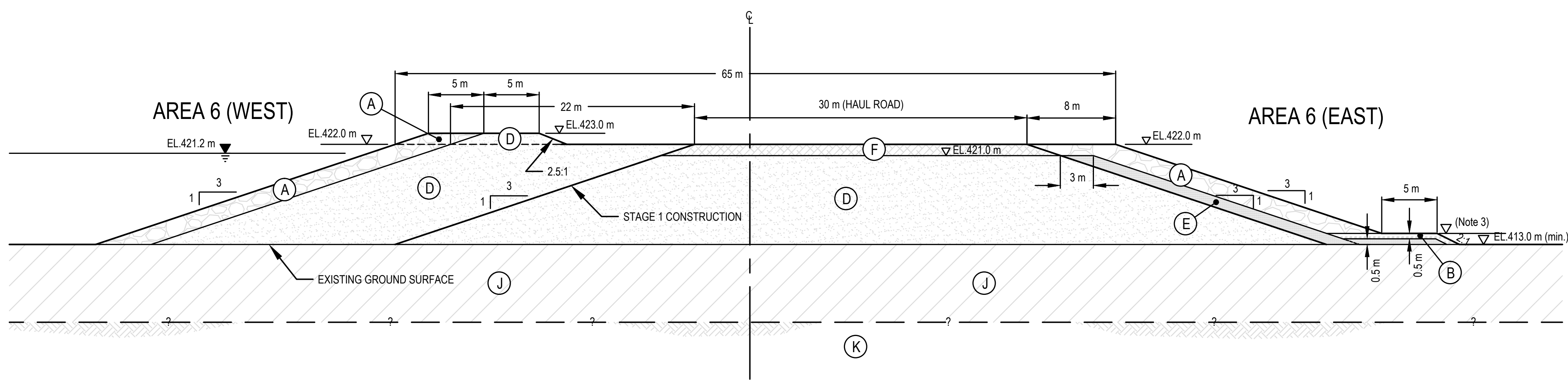


0 50 m

Scale: 1: 1 500

VERTICAL EXAGGERATION = 4x

PROFILE - DYKE N



0 25 m

Scale: 1: 500

TYPICAL SECTION - DYKE N (INTERNAL WATER RETENTION DYKE)

(A)	MINE ROCK FILL	(G)	RIP RAP
(B)	TRANSITION	(H)	FINE PK FILTER
(C)	LINER BEDDING	(I)	COARSE PK
(D)	TILL FILL	(J)	OVERBURDEN
(E)	TILL FILTER	(K)	BEDROCK
(F)	ROAD SURFACE FILL		

NOTES
- DIMENSIONS ARE IN METERS UNLESS SPECIFIED OTHERWISE
- OVERBURDEN THICKNESS TO BE DETERMINED IN FUTURE SITE INVESTIGATION
- BLANKET FILTER TO BE PLACED WHERE GROUND SURFACE IS EQUAL TO OR BELOW THE ELEVATION OF 415.0 m

STATUS
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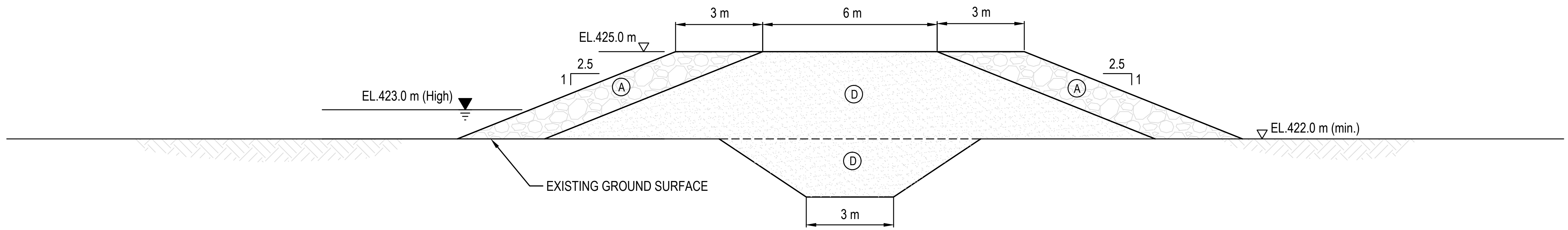
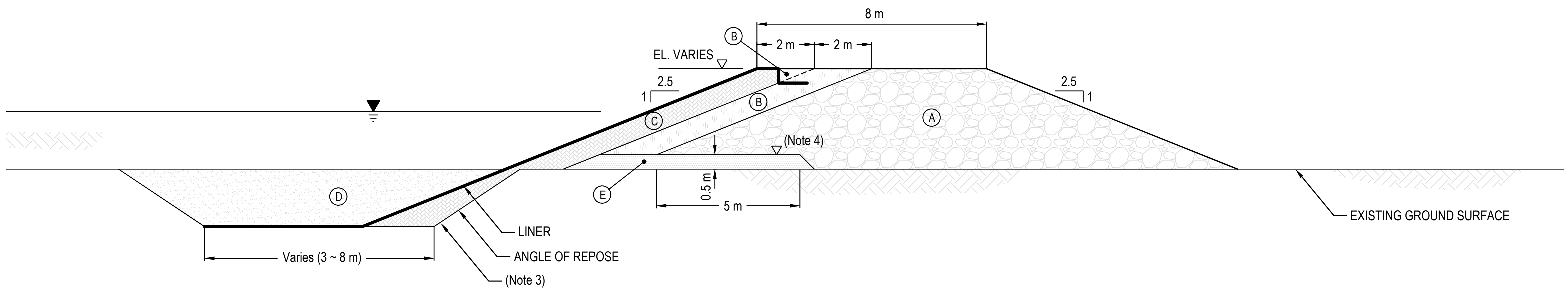
PROFILE AND TYPICAL SECTION
DYKE N

PROJECT NO.	DWN	CKD	REV
E14101143	DRG	GZ	0
OFFICE	DATE		
EDM	March 23, 2012		

Figure 15



(a) TYPICAL SECTION FOR AREA 1 PERIMETER BERMS



0 5 m
Scale: 1: 150

(b) TYPICAL SECTION FOR WATER COLLECTION POND BERMS

(A)	MINE ROCK FILL	(G)	RIP RAP
(B)	TRANSITION	(H)	FINE PK FILTER
(C)	LINER BEDDING	(I)	COARSE PK
(D)	TILL FILL	(J)	OVERBURDEN
(E)	TILL FILTER	(K)	BEDROCK
(F)	ROAD SURFACE FILL		

NOTES
- DIMENSIONS ARE IN METERS UNLESS SPECIFIED OTHERWISE
- OVERBURDEN THICKNESS TO BE DETERMINED IN FUTURE SITE INVESTIGATION
- DEPTH OF KEY TRENCH DEPENDS ON OVERBURDEN SOIL PROPERTIES
- MAXIMUM ELEVATION OF BLANKET FILTER VARIES FOR DIFFERENT WATER COLLECTION POND BERMS

STATUS
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2012 GAHCHO KUÉ EIS SUPPLEMENT
NWT, CANADA

TYPICAL SECTIONS FOR BERMS

PROJECT NO.	DWN	CKD	REV
E14101143	DRG	GZ	0
OFFICE	DATE		
EDM	March 23, 2012		

Figure 16

April 2012

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO_EC_27

Source: EIS Section: Volume 9

Subject: Down Stream Effects – Changes to Flows

EIS Section: 9.7.1.1

Terms of Reference Section:

Preamble

On page 9-172 of the July 2011 EIS document, it is indicated that the combined natural and diverted flows may exceed the 2 year flood discharge, while the rest of Volume 9 maintains that the discharge will be limited to a one in two year flood.

Request

Standard flow rates for Lake N11 were requested.

Response

The statement on page 9-172 of the 2011 EIS Update (De Beers 2011) is ambiguous and may seem to contradict other statements provided in the Environmental Impact Statement (EIS) that describe the conditions for pumped discharge to Lake N11 during dewatering and operations. The statement on page 9-172 of the 2011 EIS Update (De Beers 2011) has been revised in the updated Hydrology sub-section of Section 9 and the Project Description (Section 3) that will be provided with the 2012 EIS Supplement (De Beers 2012).

As requested, flow volumes for Lake N 11 are provided below. These include:

- estimated diversion volumes for median conditions from the WMP to Lake N11 for all years of Operations (Table DFO&EC_27-1); and

- comparisons of flow regimes during Baseline and Operations from Section 9 of the 2012 EIS Supplement (De Beers 2012; Tables DFO&EC_27-2 and DFO&EC_27--3, and Figure DFO&EC_27-1).

These flow volumes are based on the updated Project Description (De Beers 2012).

The 2-year peak discharge is expected to increase slightly at Lake N11 from the diverted D and E watersheds only and will not be affected by the diversion from Kennady Lake. Pumped discharge from Kennady Lake to Lake N11 will be managed such that the sum of the total of natural discharge at Lake N11 and pumped discharge from Kennady Lake will not exceed the 2-year (median) maximum daily flow rate at the Lake N11 outlet.

Table DFO&EC_27-1 Estimated Diversion Volumes from the Water Management Pond to Lake N11 during Operations for Median Conditions

Year	Annual Volume [m^3]
-1 (2014)	4,305,480
1 (2015)	2,637,480
2 (2016)	2,926,380
3 (2017)	3,805,380
4 – 11 (2018 to 2025)	0

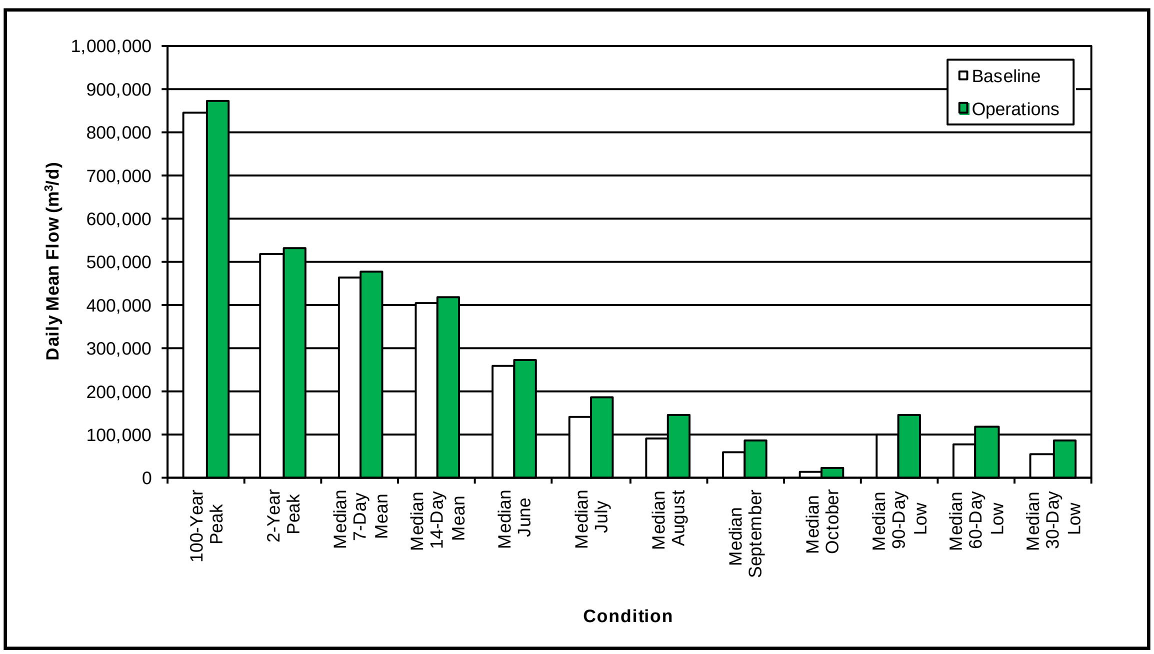
Table DFO&EC_27-2 Monthly Mean Discharges at the Lake N11 Outlet during Operations

Condition	Return Period (years)	Snapshot	Monthly Mean Discharge [m^3/d]				
			June	July	August	September	October
Wet	100	baseline	443,000	293,000	221,000	258,000	50,700
		operations	465,000	349,000	286,000	288,000	56,200
	10	baseline	359,000	215,000	147,000	123,000	28,200
		operations	378,000	268,000	203,000	154,000	34,200
Median	2	baseline	257,000	141,000	91,400	56,800	14,700
		operations	271,000	188,000	143,000	86,900	21,000
Dry	10	baseline	155,000	83,600	58,800	33,300	8,740
		operations	163,000	125,000	109,000	62,000	15,100
	100	baseline	71,900	46,900	42,600	25,900	6,400
		operations	75,300	83,700	93,100	53,800	12,800

Table DFO&EC_27-3 Derived Representative Discharges at the Lake N11 Outlet during Operations

Condition	Return Period (years)	Snapshot	Peak Daily Q [m^3/s]	7-Day Avg Peak Q [m^3/d]	14-Day Avg Peak Q [m^3/d]	30-Day Low Flow Q [m^3/d]	60-Day Low Flow Q [m^3/d]	90-Day Low Flow Q [m^3/d]
Wet	100	baseline	9.77	747,000	630,000	179,000	198,000	215,000
		operations	10.1	776,000	659,000	234,000	255,000	266,000
	10	baseline	8.22	630,000	538,000	102,000	125,000	152,000
		operations	8.42	647,000	556,000	141,000	171,000	199,000
Median	2	baseline	6.00	464,000	404,000	55,500	75,000	98,700
		operations	6.15	476,000	416,000	86,600	116,000	143,000
Dry	10	baseline	3.36	269,000	240,000	33,900	48,500	64,200
		operations	3.63	289,000	260,000	62,400	88,300	106,000
	100	baseline	0.85	85,300	81,700	25,200	36,500	45,200
		operations	1.36	125,000	119,000	53,100	76,500	85,200

Figure DFO&EC_27-1 Comparison of Effects on Lake N11 Outlet Discharges during Operations



References

De Beers (De Beers Canada Inc.). 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Information Request Number: DFO&EC_28

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Downstream Effects – Shoreline Stability

EIS Section: Volume 9

Terms of Reference Section:

Preamble:

Volume 9 of the EIS provides predictions and conclusions as to the potential effects to the downstream aquatic environment.

Request

a) Describe the potential effects to shoreline stability from the sustained flood conditions in the N, L, and M watersheds. Potential effects should consider:

   i) All watercourses and waterbodies affected by increased flows.

   ii) Effects to watercourses/waterbodies if permafrost is within the banks and shorelines is affected by the increased flows.

b) Provide mitigation measures proposed for outlets of N6 and N17, to limit the potential for erosion from increased flows. Please provide the timing of the mitigation as well. It should be clearly identified what the proposed mitigation measures are and any effects of the mitigation (e.g., reduction in littoral and riparian area due to armouring).

c) The EIS indicates that downstream areas will be “prepared” for discharge. Please explain what is meant by “prepared” and provide mitigation measures, timing and potential effects of mitigation.

Response

a) Description of potential effects

Lakes and outlets downstream of Kennady Lake that will potentially be affected by increased flows in the L, M, and N watersheds include Lakes L3 to M1 and

N11 to N1 during Construction (Dewatering), and Lakes N14 to N1 and N8 to N2 from diversion of the B, D, and E watersheds and the water management pond during Operations.

Effects of the Project on flows, water levels, and shoreline and channel erosion of lakes in the L, M, and N watersheds, are presented in Section 9 of the 2012 EIS Supplement (De Beers 2012). This section does not, however, discuss potential effects on shoreline stability from potential effects to permafrost.

Increases in mean monthly water level under median conditions, for key lakes in the L, M, and N watersheds, during Construction and Operations, are summarized in Table DFO&EC_28-1 from Section 9 of the 2012 EIS Supplement (De Beers 2012).

Table DFO&EC_28-1 Mean Monthly Increases in Water Levels during Construction and Operations for Key Lakes in the L, M, and N Watershed

Lakes	Construction (Dewatering) [m]	Operations [m]
L1	0.002 to 0.284	-
M1	0.010 to 0.246	-
N17	Baseline	0.018 to 0.037
N16	Baseline	0.008 to 0.014
N11	0.023 to 0.171	0.010 to 0.066
N1	0.008 to 0.090	0.005 to 0.032
N6	Baseline	0.006 to 0.015
N2	Baseline	0.012 to 0.040

Baseline = Lakes are not affected by the Project and remain at baseline condition.

m = metre, - = Decrease in water level.

Increases to mean monthly water levels in downstream lakes are thus expected to be very small during Operations (0.005 to 0.066 metres [m]) and the greatest increases occur during periods of low water in the late summer (i.e., the greatest differences are in the duration of inundation of stream banks and shorelines, but absolute increases in peak water surface elevations above median levels are expected to be negligible). Increases for some lakes may be greater during Construction (0.002 to 0.284 m), but again the greatest increases are expected to occur during periods of low water in the late summer. Construction period conditions are expected to last for one year in the L and M chain of lakes and two years in the N chain of lakes, during Kennady Lake dewatering.

With regards to permafrost, the Kennady and Kirk Lake watersheds are situated in the zone of continuous (90-100%) permafrost, approximately 350 kilometres (km) east-northeast of Yellowknife, proximal to the northern limit of discontinuous (50% to 80%) permafrost (NRCan 2009). Ground ice content in this zone is generally medium (<20%) to low (<10%) (NRCan 1995). Ground cover in this region is dominated by shrubs and lichens, with bare till covering bedrock closer to the margins of lakes (Golder 2010). While not measured locally, the typical active layer depth for these watersheds may be 1 to 2 m. This is based on the active layer record at Baker Lake (64°20’ N, 96°3’ W), where similar latitude, ground cover, and bedrock substrate are present (CALM 2007).

Local streams and lakes may maintain taliks, whose configuration is governed by long-term mean bed and ground surface temperatures. Given the presence of winter ice cover, existing taliks are likely confined to the central pools of surface water features, with an active layer extending beneath water body margins. This configuration has been widely described, and is well presented by Williams and Smith (1989). The depth and amplitude of an active layer are controlled by several factors including air temperature range, thermal conductivity of ground materials and hence water content, geothermal gradient, and mean annual air temperature (Williams and Smith 1989). The active layer in the Kennady and Kirk Lake region may be relatively deep due to high thermal conductivity resulting from the predominance of rock and winter ice. Good drainage during thaw periods, if permitted by large pores within the till layer, would accelerate the descent of the frost table during summer.

The characteristics of the ground cover and till substrate, during the thaw period, are more likely than permafrost to determine slope stability beneath inundating waters. This is likely, given that the permafrost table may be below the surface of contiguous bedrock. When permafrost interacts directly with surface water, especially during periods of flood, work and literature review by Scott (1978) has suggested that it remains one of many variables determining erosion at Arctic streams. The integrity and size distribution of the till layer, and increased stream velocity corresponding to water level increases, are likely to determine the extent of erosion, if any, resulting from increased water levels. If ground ice content is relatively low at this site, as suggested by the till substrate and regional ground ice characteristics (NRCan 1995), ground ice melt, if any, may not be a significant mechanism of subsidence.

b) Mitigation measures and c) preparations

Mitigation (or "preparations" as referred to in the 2012 EIS Supplement) for lakes and lake outlets downstream of Kennady Lake subject to potential erosion from increased flows is presented in the Shoreline and Channel Erosion Assessment report (De Beers 2012; Golder 2012). These include construction or enhancement of cobble-armoured channels for new diversions downstream of Kennady Lake. No mitigation is proposed for shorelines subject to small changes in mean monthly water levels, as presented in Table DFO&EC_28-1, but these areas will be monitored to identify areas of accelerated erosion during the Construction phase of the project.

Where required, mitigation for waterbodies and outlet channels within the Kennady Lake watershed include the following:

- for areas with low erosion potential, non-structural measures (i.e., development of simple erosion barriers based on field monitoring during the mine activities) are recommended;
- for areas with higher erosion potential, structural measures including modification of shoreline slopes and armouring of channel bed and banks, are recommended; and
- for outlet channels, the construction of new channels and enhancement of cobble-armoured channels for flow diversions, are recommended.

Any gaps in the report, based on updates to the water management plan associated with the mitigated Fine Processed Kimberlite Containment (PKC) Facility, as described in the 2012 EIS Supplement (De Beers 2012), are anticipated to be addressed during a 2012 field program.

References

CALM (Circumpolar Active Layer Monitoring Project). 2007. http://www.udel.edu/Geography/calm/data/webforms/c20_f.html.

De Beers (De Beers Canada Inc.). 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Golder (Golder Associates Ltd.). 2010. *Summary of Lake Outlet Data from 2007 Gahcho Kué Field Program*. Project 09-1365-1004.

Golder. 2012. *2011 Baseline Shoreline and Channel Erosion Assessment Report*. Submitted to De Beers, March 2012.

NRCan (Natural Resources Canada). 1995. *Permafrost Map of Canada*. http://atlas.nrcan.gc.ca/site/english/maps/archives/5thedition/environment/land/mcr4177.

NRCan. 2009. Permafrost Map of Canada. http://atlas.nrcan.gc.ca/site/english/maps/environment/land/permafrost.

Scott, K.M. 1978. *Effects of Permafrost on Stream Channel Behaviour in Arctic Alaska*. Geological Survey Professional Paper 1068. United States Geological Survey.

Williams, P.J. and M.W. Smith. 1989. *The Frozen Earth: Fundamentals of Geocryology*. Cambridge University Press.

Information Request Number: DFO&EC_29

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Filling and Stability of Pit Lakes

EIS Section: Section 8

Preamble:

In order to ensure water quality objectives are met upon closure, prior to reconnection of Kennady Lake to the downstream watershed, a key consideration is the thermal and chemical stratification of the pit lake basins.

Request

a) A water quality model should take into account the volume of water in each basin over time, and incorporate natural variability and thermal boundary conditions.

b) The temperature of the pre-mine groundwater at the elevation of the bottom of the pit should be considered as warmer water at the bottom of the pit can promote vertical mixing with warmer water at the bottom of the pit rising, and cooler surface waters sinking.

c) Please provide information on how long monitoring will be required to ensure that the predicted meromixis has occurred and is stable.

d) Provide an assessment of the impacts on water quality in Kennady Lake in the event that the dedicated meromixis of Tuzo pit does not occurred, and is not permanent.

e) Describe the contingencies proposed (e.g. isolation of Kennady Lake) if water quality objectives in Kennady Lake are not met.

Response

a) Details of the model development are provided in Appendix 8.II of the 2012 EIS Supplement (De Beers 2012). The model was developed to account for changes to the volume, surface area (open water and ground), and capacity in each area within Kennady Lake, which are incorporated into the site water quality model. These changes reflect the development and reclamation of mine related infrastructure, including open pits, and the dewatering of the lake. As indicated in Section 8.I.2.3 of the 2012 EIS Supplement, model predictions were made on a monthly basis under average climate conditions (i.e., 1:2 year wet [median] conditions). This was considered appropriate for the Project for the three reasons. First, as a lake-dominated system, water quality is less susceptible to inter-annual fluctuations in precipitation and temperature. Second, the majority of changes in water quality parameter concentration due to the Project are large in terms of relative change compared to baseline conditions, so natural variability would be a relatively small contributor to overall change. Finally, using mean conditions allows for a straightforward assessment of incremental changes due to the Project.

b) In the CE-QUAL-W2 (W2) hydrodynamic model, total dissolved solids (TDS) and temperature of the lake water column are incorporated to determine the thermal conditions of the lake (Section 8.I.4.1.1 of the 2011 EIS Update [De Beers 2011]). The model was used to calculate TDS, temperature and density at 1 to 3 metre (m) intervals in Tuzo pit (Appendix 8.I; De Beers 2012). Groundwater quality input to this hydrodynamic model is predicted by the hydrogeologic model (Appendix 11.6.II of the 2010 EIS [De Beers 2010]). The groundwater discharge from the hydrogeologic model was an input to the hydrodynamic model at several vertical points according to time-varying volumes and concentrations throughout the modelled time frame (Appendix 8.II; De Beers 2012).

   This hydrodynamic model and the inputs from the hydrogeologic model predict that a stable, saline bottom layer will develop in the Tuzo pit and not overturn (Section 8.8.4.2 of the 2011 EIS Update). The water quality in Kennady Lake above the Tuzo Pit will, therefore, be primarily determined by the upper 20 m of fresh water, which will be subject to temperature and wind-driven summer seasonal turnover.

c) Modelling indicates that long-term meromixis will occur in the Tuzo pit. Once refilling of the Tuzo pit is complete, the model can be calibrated to existing conditions and the stability of meromixis can be evaluated with a high level of confidence.

To confirm the projections of the water quality modeling, De Beers is currently developing a conceptual Aquatics Effects Monitoring Program (AEMP) as a component of an Environmental Monitoring Framework for the Project. The conceptual plan will include the conceptual structure and approach of site-specific monitoring associated with aquatics effects monitoring, including pit monitoring. A key objective of the Framework is to provide a basis for De Beers to engage and elicit feedback from government and communities, which will be an important element of developing the associated AEMP during the licensing phase of the Project.

d) The following two calculations were completed to provide an estimate of the whole lake TDS concentrations if the Tuzo open pit were to experience complete overturning:

   i. The water quality following complete mixing the month prior to Kennady Lake being refilled in 2034; and

   ii. The Kennady Lake water quality following complete mixing after steady-state concentrations have been achieved in Kennady Lake circa, 2204.

   The mixed whole lake TDS concentrations for these two scenarios were simulated to be approximately 1,200 and 300 mg/L, respectively. It is important to note that the numbers presented in this response are considered overly conservative and do not represent an anticipated scenario of permanent meromixis.

e) The water quality model indicates that the Kennady Lake water quality will be suitable for discharge following refilling (i.e., removal of Dyke A and reconnection of Kennady Lake to downstream waters). De Beers will monitor the water quality during operations, and if required, develop an appropriate adaptive management strategy that can be implemented prior to closure to ensure the quality of the water in Kennady Lake is acceptable for reconnection with downstream lakes following refilling. This may include storage of additional site water in the Tuzo pit, where meromixis development will isolate this water from mixing with overlying water in Kennady Lake or adjusting the rate of refilling by slowing pumping from N11.

References

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Information Request Number: DFO&EC_30

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Processed Kimberlite and Hearne Pit

EIS Section: Section 8.8.4.2, Table 8.6-4

Terms of Reference Section:

Preamble:

It is anticipated that the high TDS water associated with the kimberlite placed in the Hearne Pit will promote the development of a chemocline. In Section 8, it is stated that "If meromixis does occur in Hearne pit, the deeper water in contact with the fine processed kimberlite will be isolated and the input of the diffusive flux of metals and nutrients from the bottom of Hearne pit to the water quality in area 6 will be unlikely". Based on this, it appears that meromixis in Hearne pit should be the objective. However, it is expected that meromixis will not occur in Hearne pit (page 3-41), and the pit water will become fully mixed with water in Area 6.

Request

a) Please clarify this apparent contradiction, including an assessment of potential impacts to overall water quality in Kennady Lake if complete mixing does occur.

Response

It is acknowledged that meromixis in the Hearne Pit should be the objective to isolate any deeper high total dissolved solids (TDS) water that is present following mine operations; however, for the 2011 EIS Update (De Beers 2011), the development of a chemocline was not considered and the predictive modelling assumed a continuous diffusive flux from the fine processed kimberlite (PK) placed in the Hearne Pit to Kennady Lake. The water quality predicted in Kennady Lake after refilling (i.e., closure and into the long-term post-closure periods) presented in the 2011 EIS Update, assumed fully mixed conditions in Hearne Pit.

Since the submission of the 2011 EIS Update, the mine plan has been updated to reflect supplemental mitigation associated with the deposition of fine PK. This change has resulted in a lower volume of fine PK that will be deposited to the Fine PKC Facility in Area 2 and a higher volume of fine PK that will be deposited to the 5034 and Hearne pits. The key modification in the mine plan is a reduced footprint of the Fine PKC Facility's footprint, which no longer extends into Area 1.

As a result of this update, the mine site water balance has been revised, which required undertaking an update of the predictive water quality modelling. This update provided an opportunity to develop a hydrodynamic model specifically for Hearne Pit, particularly as high TDS water will be present in Hearne pit as it refills following mining.

This model for Hearne pit is similar to the model developed for the open Tuzo pit, and also links into the predictive water quality model. The model indicates that meromixis is expected to occur in Hearne pit, isolating the diffusive flux from the fine PK placed in the bottom of the facility. A pycnocline is projected to develop during the refilling period initially isolating approximately 4.4 Mm^3 of water from Kennady Lake. Over a 100 year period, the pycnocline is projected to migrate downwards where it will permanently isolate approximately 2.1 Mm^3 of water from mixing with Kennady Lake. Details of the hydrodynamic modeling and update water quality result for Kennady Lake are presented in the 2012 EIS Supplement (De Beers 2012).

References

De Beers. 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO&EC_31

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Dissolved Oxygen

EIS Section: Appendix 8

Terms of Reference Section:

Preamble

No preamble provided.

Request

a) Clarify if changes in the size and morphometry of the lake, as the mine components are developed over time, were taken into account.

b) Given that impacts on oxygen may be the greatest negative effect of increases in phosphorus on these systems, please clarify if the model detected changes in oxygen in only Area 8 or also in the downstream lakes, and what the extent and timing of these changes were.

c) It is implied that the large pits in Kennady Lake will provide a high-oxygen refugia. To what extent this is true is unclear; their main impact on oxygen dynamics is only to increase lake volume. The pits will have lower areal winter oxygen depletion rates, but will they effectively mix and re-oxygenate each year? As a result, they may become anoxic. The statement on page 8.V-13 that "the pits are expected to have a much deeper epilimnetic zone" is inaccurate – the depth of the epilimnion is set by air temperatures, wind, thermal radiation, etc (see Jansen et al. 2004 Environ Biol. Fishes 70: 1-22 as an example).

d) The model assessing processes potentially affecting oxygen conditions in Kennady Lake appear over-simplified. At this time it is unclear whether these simplifications under- or over-estimate the impacts. Some factors not included in their models:

i. How might inter-annual variability in primary production and other factors potentially impact oxygen conditions? Given that it only takes a single low oxygen event to have a significant impact on aquatic biota, using average conditions is not the best basis for determining impacts to oxygen. For example, Figure 8.V-1 shows considerable variability among years in oxygen conditions with depth.

ii. How well did the models predict current rates of oxygen consumption?

iii. It is unclear how Models 1 and 2 were applied to the different depth zones (Table 8.V-6). Oxygen consumption is inherently driven by sediment respiration and, hence, the sediment area/ water volume ratio

iv. What are the potential impacts of greater primary production on summer oxygen conditions, especially with climate change? A longer growing season will increase carbon inputs to sediments and potentially cause a longer period of stratification, but this will be offset by a shorter period of ice-cover. The intensity of stratification may also change. Is there any risk that cold water species may get “squeezed” by greater anoxia in deep water and the warmer epilimnion (see Schindler et al. 1996 Limnol Oceanogr. 41:1004-1017; Plumb & Blanchfield 2009 CJFAS 66:2011-2023)?

v. What is the depth distribution of cold water species like lake trout in Kennady Lake? Where do they reside relative to the thermocline in summer? Can this be determined from the hydro-acoustic surveys?

vi. Disagreements to statements in Appendix 8 include:

p. 8.V-8 In reference to Kelly et al. (1984), the authors state that “A 50% carbon metabolism is considered conservative, as winter water temperatures in Kennady Lake are cold…”. All of the lakes studied by Kelly et al. also freeze and have similar winter temperatures to Kennady Lake. The same holds true for summer hypolimnetic temperatures. The real differences between the temperate lakes studied by Kelly et al. and the lakes in this study are carbon inputs and the relative lengths of the growing season and periods of stratification and ice-cover.

p. 8.V-8: the authors imply that Model 3 provides an upper bound because it is driven by sediment oxygen demand. In reality, this is implicitly true for all the models.

Response

a) Changes in lake area morphometry were taken into account in the site water quality model (Appendix 8.I of the 2011 EIS Update [De Beers 2011]). Open water surface area and volume changes in response to draining are incorporated into the model. These changes result in decreased evaporation and residence time of drained areas. Permanent changes in the lake surface area from pit development in Areas 4 and 6 are reflected in the closure and post-closure stages of the water quality model.

Changes in stratification due to deep pit development are predicted in the hydrodynamic models (Appendix 8.I of the 2012 EIS Supplement [De Beers 2012]). These models predict the development of deep pycnoclines (chemoclines) in both the Hearne and Tuzo pits. These were taken into account in the dissolved oxygen modelling.

b) The empirical dissolved oxygen (DO) models in the 2011 EIS Update (De Beers 2011) predicted changes in under-ice DO concentrations only for post-closure Kennady Lake based on a projected steady state total phosphorus (TP) concentration of 0.018 mg/L. Projected maximum TP concentrations in the downstream lakes were lower than the concentration in Kennady Lake (0.015 mg/L and 0.013 mg/L in the L and M watershed lakes, respectively, and 0.007 mg/L in Lake 410 during the post-closure phase; Section 9.8 of the 2011 EIS Update [De Beers 2011]). DO models were not developed for downstream lakes.

Since the 2011 EIS Update, the mine plan has been updated to reflect the supplemental mitigation associated with the deposition of fine processed kimberlite (PK), and additional geochemical testing data of fine PK, which will be presented in the 2012 EIS Supplement (De Beers 2012). Using data from supplemental geochemical testing and the reduced footprint of the Fine Processed Kimberlite Containment (PKC) Facility, updated water quality modelling predicts a long-term steady-state TP concentration of 0.009 mg/L in Kennady Lake, which is approximately half of the concentrations predicted in the 2011 EIS Update. The predicted mean long-term concentrations of TP in the L and M watershed lakes are 0.009 mg/L and 0.008 mg/L, respectively; these levels are less than those presented in the 2011 EIS Update and are within the oligotrophic range. It is anticipated that the influence of projected TP concentrations on the winter DO in downstream lakes will be similar or lower than in Kennady Lake.

DO predictions for Kennady Lake are described in Part c).

c) The volume of post-closure Kennady Lake will be increased to approximately 84 Mm^3, including the pit lakes, from its pre-development volume of 38 Mm^3. In contrast, the surface area will be decreased to 7.19 km^2 from its pre-development surface area of 8.15 km^2. The final depths of Hearne pit and Tuzo pit will be approximately 100 m and 300 m, respectively. At mine closure, Hearne and Tuzo pits will be partially refilled with high-TDS water from the remaining portions of Kennady Lake, followed by low density water from local run-off and pumping from Lake N11. As a result, a pycnocline will be formed resulting in a density gradient between high-density water in the bottom layer and well-mixed low-density water in the upper layer. The stability of pit lakes was modelled using CEQUAL-W2 and a vertical slice spreadsheet model, which is described in the 2012 EIS Supplement (De Beers 2012). The combined model indicates that the pycnocline would shift downwards with time.

The empirical DO models used in the 2011 EIS Update (De Beers 2011) did not simulate oxygen profiles in pit lakes. Considering the limitations of the empirical models, a three-dimensional (3D) hydrodynamic model was developed using Generalized Environmental Modelling System for Surface waters (GEMSS®) and is presented in 2012 EIS Supplement (De Beers 2012). The GEMSS model includes the open regions of Hearne and Tuzo pits, up to a depth of 40 m.

While TP concentrations were the primary indicator parameter to predict the winter oxygen depletion rates in the empirical model assessment, all available parameters and modifiers that may influence DO concentrations were included in the GEMSS model. These parameters included nitrogen, phosphorus, phytoplankton, sediment oxygen demand (SOD), biochemical oxygen demand (BOD), re-aeration rates, decay rates, and temperature correction factors. The sensitivity analysis for this model included modifying input parameters that could directly or indirectly affect DO concentrations, one parameter variable per simulation, and analyzing the response of the model to that change. Of the 17 parameters (Table DFO & EC_31-1), rates and coefficients tested in the sensitivity analysis, only sediment oxygen demand (SOD) was identified as having the most substantial effect on DO concentrations. Therefore, three post-closure SOD scenarios were used to predict a range of potential DO concentrations in late winter periods:

- SOD Scenario 1: a SOD rate of -0.25 grams of oxygen per square metre per day (g DO/m^2/d) was used; In the calibration time period, an SOD value of -0.25 g DO/m^2/d was found to be appropriate for simulating DO, especially under ice.
- SOD Scenario 2: a 50% increase in SOD (-0.375 g DO/m^2/day) was assumed at post-closure compared to the calibration time period; and
- SOD Scenario 3: a 100% increase in SOD (-0.5 g DO/m^2/day) was assumed at post-closure compared to the calibration time period.

These SOD rates used in the sensitivity analyses (-0.25 to -0.50 g DO/m^2/d) are very conservative compared to reported literature values. Mathias and Barica (1980) reported SOD levels of -0.23 g DO/m^2/d in eutrophic lakes estimated from four sets of Canadian lakes, prairie, south-eastern Ontario, Arctic and the Experimental Lakes Area (ELA). In addition, White et al. (2008) reported an SOD level of -0.10 g DO/m^2/d in a small Arctic gravel pit lake (depth 10.7 m, area 13,355 m^2), and Matisoff and Neeson (2005) reported a summer SOD level in central Lake Eire of -0.164 g DO/m^2/d.

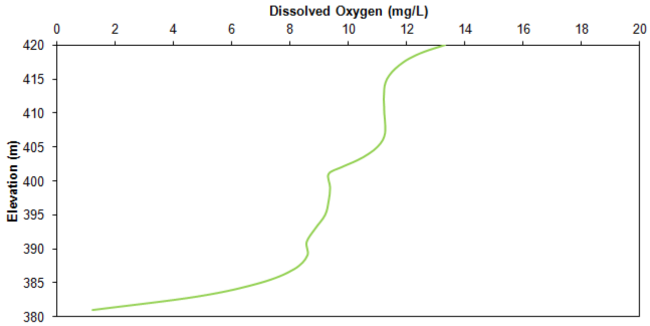
The model predicted the following results in the pit lakes:

- SOD Scenario 1: The pits in Kennady Lake are anticipated to possess a DO concentration greater than 6.5 mg/L at depths above 36 m at the end of the ice-covered season (Figure DFO&EC_31-1a). The post-closure water volume of Kennady Lake including the Tuzo and Hearne pits modelled to a depth of 40 m is 55.6 million cubic meters (Mm^3). The average volume of Kennady Lake with a DO concentration greater than 6.5 mg/L at the end of ice-covered season (i.e. just prior to ice melt) is predicted to be approximately 49.2 Mm^3 (89% of the total volume).

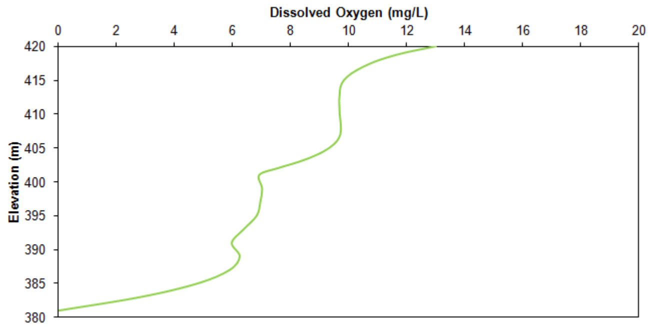
- SOD Scenario 2: The pit lakes in Kennady Lake are anticipated to possess a DO concentration greater than 6.5 mg/L at depths above 27 m at the end of the ice-covered season (DFO & EC_31-1b). This results in a volume of 44.4 Mm^3 (80% of the total volume) that has a DO concentration greater than 6.5 mg/L at the end of winter.
- SOD Scenario 3: The pit lakes in Kennady Lake are anticipated to possess a DO concentration greater than 6.5 mg/L at depths above 17 m at the end of the ice-covered season (DFO & EC_31-1c). This translates into an approximate volume of 28.6 Mm^3 (51% of the total volume) which has a DO concentration higher than the CCME water quality guideline of 6.5 mg/L.

The pre-development volume of Kennady Lake is 38 Mm^3, of which 23.8 Mm^3 possesses an average DO concentration above 6.5 mg/L at the end of winter. Compared to predicted lake volumes with DO concentrations above 6.5 mg/L under the three empirical modelled scenarios (i.e., 49.2 Mm^3, 44.4 Mm^3 and 28.6 Mm^3), the lake volume that can be considered a refugia from low DO conditions in late winter is similar or greater than under pre-development conditions.

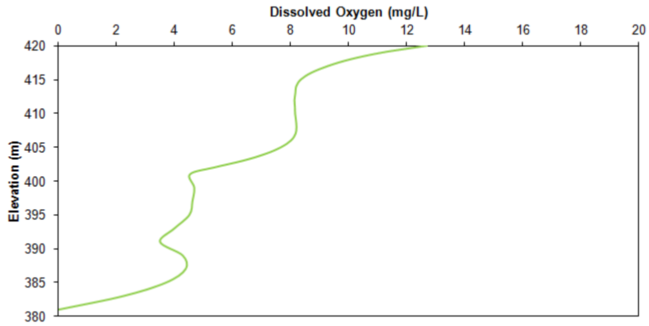
Figure DFO&EC_31-1 End-of-Winter Dissolved Oxygen Profiles in the Hearne Pit in Post-closure with a Sediment Oxygen Demand of (a) -0.250 g DO/m^2/day, (b) -0.375 g DO/m^2/day, and (c) -0.5 g DO/m^2/day.



(a)



(b)



(c)

d) We acknowledge the limitations of empirical models presented in Appendix 8.V of 2011 EIS Update (De Beers 2011). The empirical models estimated average DO concentrations in three specific depth zones of Kennady Lake, which did not separate the shallow littoral zones and did not include the extra volume of water available in the Hearne and Tuzo pits. Nevertheless, the empirical models were based on published literature and baseline data of Kennady Lake itself, and therefore, provided limited but realistic information around the predicted winter oxygen conditions in Kennady Lake during post-closure.

Since the submission of the 2011 EIS Update (De Beers 2011), a 3D hydrodynamic model was developed to address the limitations of the empirical models with respect to DO projections in late winter conditions. This modelling also took into account the updates to in the mine plan, which modified the site water balance, and chemical loading to Kennady Lake. The revised mine plan included supplemental mitigation associated with reducing footprint area of fine PK resulting in reduced long-term steady state TP concentration of 0.009 mg/L instead of 0.018 mg/L considered in the empirical models. The results of the updated DO modeling were presented for Hearne and Tuzo pits in the previous section. Some other results are presented in the following sections as they are relevant to the specific questions.

i) Inter-annual variability in primary production/TP concentrations and other influencing factors were not included in the empirical models. In the GEMSS modeling, 17 parameters, rates and coefficients as listed in Table DFO&EC_31-1 were included. Among them, only sediment oxygen demand (SOD) was identified as having the most significant effect on DO concentrations in the sensitivity analysis. Therefore, three SOD scenarios (discussed in the previous section) were used to predict a range DO profiles in late winter periods, in an attempt to capture among-year variation in primary production.

Table DFO & EC_31-1 Parameters Rates and Coefficients Applied to the Dissolved Oxygen Calibration

Description	Value Applied[a]	Units
Surface DO re-aeration formulation	Wanninkhof et al. (1991)	-
Background SOD	**-0.25**	g $O_2/m^2/d$
Temperature coefficient	1.047	-
Empirical coefficient of algae contribution to SOD	0.02	-
Empirical coefficient of CBOD_P contribution to SOD	0.07	-
Empirical coefficient of ON_P contribution to SOD	0.07	-
Factor to increase the re-aeration rate	1	-
Temperature correction for re-aeration	1.024	-
Oxygen to carbon ratio	2.67	g O_2/g C
Deoxygenation rate at 20°C	0.15	1/d
Temperature correction for deoxygenation	1.047	-
Half saturation constant for oxygen limitation	0.5	g O_2/m^3
Oxygen from dead algae	0.5	-
Settling rate of CBOD	0.08	m/d
Stoichiometric equivalent between CBOD and phosphorous	0.004	-
Stoichiometric equivalent between CBOD and nitrogen	0.006	-
Stoichiometric equivalent between CBOD and carbon	0.32	-

[a] All values are default values unless shown in bold.

DO = dissolved oxygen; SOD = sediment oxygen demand; CBOD = carbonaceous biochemical oxygen demand; P = particulate, ON = organic nitrogen; C = carbon; °C = degrees Celsius; g = grams; O_2 = oxygen; m = metre; d = day; m^2 = square metre; m^3 = cubic metre; - = dimensionless.

ii) Results of the empirical models predicting the volumetric oxygen consumption rates in three depth zones of Kennady Lake (upper 6 m, middle 6 m, and remaining bottom) were similar to those of the GEMSS modelling. While the empirical approaches calculated lake-wide average oxygen consumption rates based on TP concentrations at closure, baseline oxygen profile data were used to calculate the actual oxygen consumption rates in the three depth zones. The oxygen consumption ratios for each of the depth zones were then used to determine the late winter average DO concentrations for each of the three depth zones at closure.

The empirical model concluded that the upper 6 m under ice of Kennady Lake would have an average DO concentration greater than 6.5 mg/L at the end of the ice-covered season (6.5 mg/L of DO is the CCME water quality guideline for cold water species, excluding larval stages). The GEMSS modelling predicted similar average DO concentrations in the upper 5 to 7 m depths under ice at the end of the ice-covered season (see Appendix 8.V in the 2012 EIS Supplement [De Beers 2012]). Therefore, the results of the both empirical and hydrodynamic approaches are comparable, even though the TP input concentrations differed.

iii) As mentioned before, the empirical approach 1 (Babin and Prepas 1985) and 2 (Vollenweider 1979) calculated lake-wide average oxygen consumption rates based on the TP concentration at closure:

- Model 1: 0.036 mg/L/day in Table 8V-2; and
- Model 2: 0.047 mg/L/day in Table 8V-3 in Appendix 8.V of 2011 EIS Update.

The baseline oxygen profile data (shown in Figure 8.V-1) were used to calculate the actual oxygen consumption rates for each of the three depth zones (under upper 6 m, middle 6 m and remaining bottom depth) of Kennady Lake (Table 8.V-1). Average oxygen consumption rates were 18% (of total consumption) for upper 6 m, 38% for middle 6 m, and 44% for the remaining bottom depths of Kennady Lake (Table 8.V-1).

iv) The potential impacts of extended summer primary production due to climate change on DO conditions in post-closure Kennady Lake have not been evaluated. Based on the supplemental mitigation associated with the Fine PKC Facility presented in the 2012 EIS Supplement (De Beers 2012), the predicted long-term steady-state phosphorus concentration is projected to be 0.009 mg/L, which indicates that long-term trophic status in Kennady Lake will remain oligotrophic (i.e., of low productivity).

In most parts of Kennady Lake, summer stratification does not occur due to wind-driven circulation, especially within the shallower basins. The baseline summer oxygen profile data indicate that the DO concentrations were generally uniform throughout the water column of Areas 2 to 8 of Kennady Lake during open water conditions, with the profile concentrations ranging from 9 to 16.5 mg/L (Section 8.3.6.2.1; De Beers 2011]). As described by Mackenzie-Grieve and Post (2006), summer hypolimnetic oxygen depletion has been less of a concern in northern systems compared with southern ones, as lake trout are not usually restricted to the hypolimnion as in southern lakes. In northern lakes, DO concentrations rarely limit the availability of optimal habitat for lake trout because temperatures are cold, and lakes are usually oligotrophic (Mackenzie-Grieve and Post 2006).

The baseline temperature data collected in summer also showed similar trends in most of parts of Kennady Lake. The profiles were vertically homogeneous during most open water sampling events, indicating that the water column in Kennady Lake was typically well mixed (profile temperatures ranging from 3 to 17°C). Therefore, most of the lake would be expected to remain well-mixed, even taking into account climate change. However, as described in part v) below, seasonal thermoclines were observed between depths of 10 and 14 m during summer sampling in Area 6. As water temperatures rise in summer, adult lake trout seek the deeper, cooler (~10°C) water below the thermocline (Scott and Crossman 1973). Researchers have suggested that one of the potential outcomes of climate change may be the deepening of thermoclines (e.g., Schindler et al. 1996, Mackenzie-Grieve and Post 2006). For example, Mackenzie-Grieve and Post (2006) predicted shallower (i.e., thermocline deeper within the lake), and stronger stratification for lakes in their Yukon database; however, it should be noted that this assumed that little change in wind energy occurs with climate warming. If changes to lake stratification are predicted, then it is suggested that lake trout habitat availability will be reduced due to less of the lake volume being below the thermocline (Mackenzie-Grieve and Post 2006, Minns et al. 2009).

As described in Section 8.10.4.4.1 of the 2011 EIS Update (De Beers 2011), two indices have been used by lake managers to define lake trout habitat: optimal habitat (the volume of water 10°C or colder, with dissolved oxygen of 6 mg/L or higher); and usable habitat (the volume of water 15.5°C or colder, with a DO of 4 mg/L or higher) (MacLean et al. 1990; Evans et al. 1991; Ryan and Marshall 1994; Dillon et al. 2003). In a comparison of theoretical habitat volumes with in situ habitat use, Plumb and Blanchfield (2009) suggested that the most suitable habitat criteria for lake trout are a temperature of <12 or 15°C in combination with a DO level of >4 or 6 mg/L. Therefore, as Kennady Lake is expected to stay oligotrophic, it is expected that summer habitat for lake trout will continue to be available in Kennady Lake for the long-term, even with potential changes to the stratification.

Studies in the Experimental Lakes Area also found that lake trout utilized a wide range of temperatures up to 21°C and that lake-to-lake variation in water temperatures where lake trout occurred was considerable (Sellers et al. 1998). Furthermore, although there is a potential that climate warming may render northern lakes less suitable for lake trout (Mackenzie-Grieve and Post 2006), reduced optimal habitat does not imply local extinction (Minns et al. 2009).

It should also be noted that there is considerable uncertainty with respect to climate change scenarios, with increasing air/water temperature just being one aspect. For example, Schindler et al. (1996) indicates that the role of increased wind velocities and wind exposures should not be entirely discounted.

v) As described in Section 8.3.6.2 of the EIS, temperature profiles in Kennady Lake were vertically homogeneous during most open water sampling events, indicating that the water column in Kennady Lake was typically well mixed in summer due to wind-driven circulation. However, seasonal thermoclines were observed between depths of 10 and 14 m in Area 6 during sampling events in late July 1999, early August 2004, and July 2010.

Based on baseline studies and life history information for lake trout, it can be inferred that lake trout in Kennady Lake would be primarily found in deep, pelagic habitat during summer. As described in Section J4.4.6.2.2 of Annex J of the 2010 EIS (De Beers 2010), lake trout were captured and radio-tagged in all five basins of Kennady Lake in summer, but almost half were tagged in the basin consisting of Areas 2, 3, and 5; most of this basin (67%) is deep water habitat, with a maximum depth of 14 m (Section J4.1.1 of Annex J). Most lake trout tagged in summer moved extensively throughout Areas 2 to 7 of Kennady Lake, but avoided the shallow Area 8 in summer.

As described in Section JJ4.4.1 of Addendum JJ (De Beers 2010), the hydroacoustic surveys showed that most (53%) of the Kennady Lake fish population resided in Area 6 where there was deep water, and possibly, vertical thermoclines at the time of sampling. During the hydroacoustic survey, approximately 76% of the fish targets were recorded in Area 6 and fish were typically observed at depths greater than 10 m (Appendix JJ.I of Addendum JJ), which might indicate that fish were selecting habitat near the thermocline. Recent gill net catch data (2004 and 2010) showed similar spatial trends. Most of Area 6 (58%) is deep water habitat and includes the deepest (approximately 18 m) area in the lake (Section J4.1.1 of Annex J). The observation of high densities of fish in Area 6 may indicate that this basin is unique within Kennady Lake and characterized by summer thermoclines which can affect fish distributions in the summer (Sellers et al. 1998; Scott and Crossman 1998).

These results in Area 6 corroborate previous studies that documented lake trout concentrations in thermocline zones of stratified lakes at northern latitudes (Sellers et al. 1998; Scott and Crossman 1973). Adult lake trout are most commonly found at depths in excess of 10 m and are often found in the pelagic zone of lakes; during summer, as temperatures rise, adult lake trout seek deeper, cooler (i.e., less than 10°C) water below the thermocline (Richardson et al. 2001).

On the other hand, round whitefish inhabit a wide range of depths depending on season, age, and other species present (Steinhart et al. 2007). Adult round whitefish have been frequently been reported in depths up to 45 m in large lakes (Scott and Crossman 1973), but this species is more commonly found in shallower waters (Scott and Crossman 1973; Richardson et al. 2001). Studies indicate that round whitefish have been recorded in temperatures up to 16°C and 17.5°C (Hale 1981 cited in Steinhart et al. 2007); therefore, it appears that round whitefish do not specifically seek out colder water beneath the thermocline. In Kennady Lake, they are the most abundant large-bodied species captured in summer shoreline gill netting surveys (Section J4.4.3.1 of Annex J), and likely move throughout the lake for feeding. Round whitefish generally feed on benthic invertebrates (Scott and Crossman 1973; Richardson et al. 2001), and are therefore considered to be a demersal species (Steinhart 2007), typically found over rocky substrates (Richardson et al. 2001). However, in Kennady Lake, zooplankton appears to be an important prey for round whitefish, in addition to benthic invertebrates, which may influence their spatial distribution within the lake (Section J4.4.3.2 of Annex J).

vi) The statement indicates 50% of total carbon being metabolized in winter in general, compared to summer, and not necessarily compared the water quality parameters in Kennady Lake or temperate lakes.

Empirical approach 3 (Mathias and Barica 1980) provides the upper-bound oxygen consumption rate in the sense that it is directly related to sediment oxygen demand.

References

Babin, J., and E.E. Prepas. 1985. Modelling winter oxygen depletion rates in ice-covered temperate zone lakes in Canada. Can. J. Fish. Aquat. Sci. 42: 239-249.

CCME (Canadian Council of Ministers of the Environment). 1999. Canadian Water Quality Guidelines for the Protection of Aquatic Life: Dissolved Oxygen (Freshwater). In: Canadian Environmental Quality Guidelines, 1999, Canadian Council of Ministers of the Environment. Winnipeg, MB, Canada.

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers (De Beers Canada Inc.). 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Dillon, P.J., B.J. Clark, L.A. Molot and H.E. Evans. 2003. Predicting the Location of Optimal Habitat Boundaries for Lake Trout (*Salvelinus namaycush*) in Canadian Shield Lakes. *Canadian Journal of Fisheries and Aquatic Sciences* 60:959-970.

Evans, D.O., J. Brisbane, J.M. Casselman, K.E. Coleman, C.A. Lewis, P.G. Sly, D.L. Wales and C.C. Willox. 1991. Anthropogenic Stressors and Diagnosis of their Effects on Lake Trout Populations in Ontario lakes. Lake Trout Synthesis Response to Stress Working Group. Manuscript Report, Ontario Ministry of Natural Resources. Toronto, Ontario. 115 p.

Hale, S.S. 1981. Freshwater Habitat Relationships Round Whitefish (*Prosopium cylindraceum*). Alaska Department of Fish and Game, Contract No. 14-16-0009-79-119, Anchorage, Alaska. Reported in Steinhart, G.B., M. Mineau, and C.E. Kraft. 2007. Status and Recovery of Round Whitefish (*Prosopium cylindraceum*) in New York, USA. Final report to State Wildlife Grant T-3-1, NYSDEC, Bureau of Wildlife, Albany NY. Department of Natural Resources. 12 February 2007.

Mackenzie-Grieve, J.L. and J.R. Post. 2006. Projected Impacts of Climate Warming on Production of Lake Trout (*Salvelinus namaycush*) in Southern Yukon Lakes. *Canadian Journal of Fisheries and Aquatic Sciences* 63:788-797.

MacLean, N.G., J.M. Gunn, F.J. Hicks, P.E. Ihssen, M. Malhiot, T.E. Mosindy, and W. Wilson. 1990. Environmental and Genetic Factors Affecting the Physiology and Ecology of Lake Trout. Ontario Ministry of Natural Resources. Lake Trout Synthesis. Physiology and Ecology Working Group.

Mathias, J. and J. Barica. 1980. Factors Controlling Oxygen Depletion in Ice-covered Lakes. *Canadian Journal of Fisheries and Aquatic Sciences* 37:185-194.

Matisoff, G. and T.M. Neeson. 2005. Oxygen Concentration and Demand in Lake Erie Sediments. *Journal of Great Lakes Research* 31(Suppl. 2):284-295.

Minns, C.K., B.J. Shuter and J.L. McDermid. Regional Projections of Climate change Effects on Ontario Lake Trout (*Salvelinus namaycush*) Populations. Ontario Ministry of Natural Resources. Cimate Change Research Report CCRR-14. June 2009.

Plumb, J.M. and P.J. Blanchfield. 2009. Performance of Temperature and Dissolved Oxygen Criteria to Predict Habitat Use by Lake Trout (*Salvelinus namaycush*). *Canadian Journal of Fisheries and Aquatic Sciences* 66:2011-2023.

Richardson, E.S., J.D. Reist and C.K. Minns. 2001. Life History Characteristics of Freshwater Fishes Occurring in the Northwest Territories and Nunavut, with Major Emphasis on Lake Habitat Requirements. *Canadian Manuscript Report of Fisheries and Aquatic Sciences* 2569.

Ryan, P.A. and T.R. Marshall. 1994. A Niche Definition for Lake Trout (*Salvelinus namaycush*) and Its Use to Identify Populations at Risk. *Canadian Journal of Fisheries and Aquatic Sciences* 51:2513-2519.

Schindler, D.W., S.E. Bayley, B.R. Parker, K.G. Beaty, D.R. Cruikshank, E.J. Fee, E.U. Schindler and M.P. Stainton. 1996. The Effects of Climatic Warming on the Properties of Boreal Lakes and Streams at the Experimental Lakes Area, Northwestern Ontario. *Limnology and Oceanography* 41:1004-1017.

Scott, W.B. and E.J. Crossman. 1973. Freshwater Fishes of Canada. Fisheries Research Board of Canada, Ottawa. Bulletin 184.

Sellers, T. J., B. R. Parker, D. W. Schindler, and W. M. Tonn. 1998. Pelagic distribution of lake trout (*Salvelinus namaycush*) in small Canadian Shield lakes with respect to temperature, dissolved oxygen, and light. *Canadian Journal of Fisheries and Aquatic Sciences* 55:170-179.

Steinhart, G.B., M. Mineau, and C.E. Kraft. 2007. Status and Recovery of Round Whitefish (*Prosopium cylindraceum*) in New York, USA. Final report to State Wildlife Grant T-3-1, NYSDEC, Bureau of Wildlife, Albany NY. Department of Natural Resources. 12 February 2007.

Vollenweider, R.A. 1979. Das Nahrstoffbelastungskonzept als Grundlage fur den externen Eingriff in den Eutrophierungsprozess stehender Gewasser und Talsperren. Z. Wasser-u. Abwasser-Forschung 12: 46-56.

White, D.M., H.M. Cliverd, A.C. Tidwell, L. Little, M.R. Lilly, M. Chambers and D. Reichardt. 2008. A Tool for Modeling the Winter Oxygen Depletion Rate in Arctic Lakes. *Journal of the American Water Resources Association* 44:293-304.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO&EC_32

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Increased Mercury Levels from Flooding

Preamble

On pages 8-221-225, it is argued that flooding of lakes A3, D2, D3, and E1 will have no effect on mercury and limited impacts on nutrients. Although there is little data for systems like these, it is possible that a mercury problem could arise. In small flooded temperate systems (e.g. St. Louis et al. 2004; Hall et al. 2009), large increases in MeHg have occurred in biota. The development of reservoirs in northern regions (e.g. Lucotte et al. 1999; Hecky et al. 1991) also indicates that such systems may be highly vulnerable to Hg contamination. The “benefit” of short growing seasons and low organic matter content in flooded soils of northern systems is often offset by slow growth in affected fish populations. It is notable that maximum Hg concentrations of 0.8 and 1.4 in lake trout were found (and even higher concentrations in sculpin) from Kennady Lake and N16, which far exceed recommended consumption limits. As a result, Hg concentrations are already high in the lakes of this region (which is typical) and the contention that flooding of the Kennady Lake systems will have minimal impacts on mercury should be regarded with caution. There is a possibility that refilling of Kennady lake might also contribute to greater mercury methylation, although the risk is probably low.

Request

a) More baseline data on mercury in fish from these systems should be collected.

b) Mercury concentrations should be related to fish size and age, which was not done in the EIS.

c) Note that methyl mercury production in lakes flooded by the project may also cause mercury problems in downstream lakes and streams. Fish in lakes should be sampled for mercury (e.g. N1, N9).

Response

a) Additional baseline data on mercury in lake trout fish tissue were collected in summer 2011 from Lake N11 (n=20); these data will be reported in a technical memorandum (Golder, *In Preparation*). Lake N11 is one of the larger lakes that is downstream of “operationally-diverted” lakes (i.e., Lakes B1, D2 and D3, and E1).

Mercury concentrations in the fish tissue of lake trout from Lake N11 are within the range found previously in other lakes in the area. Lake trout in Lake N11, Kennady Lake, Lake N16, Lake 410 and Kirk Lake had mean mercury concentrations of 0.48, 0.24, 0.30, 0.30 and 0.60 milligrams per kilogram as wet weight (mg/kg ww), respectively, and maximum mercury concentrations of 1.12, 0.62, 0.94, 0.77 and 1.17 mg/kg ww, respectively.

b) Mercury concentrations were related to fish weight in Annex J of the 2010 EIS (Figure J4.4-32; De Beers 2010) using linear regression. Length and age are two other parameters that can be used for correlation analysis with mercury concentrations that will be evaluated further in the technical memorandum. A polynomial regression analysis will also be used in future to allow more rigorous statistical comparisons of mercury-to-length relationships among years (as per Tremblay et al. 1998).

c) It is anticipated that fish tissue samples will be collected from downstream lakes, such as Lake N1, as part of ongoing monitoring and the Aquatic Effects Monitoring Program (AEMP) for the Gahcho Kué Project. As stated above, Lake N11, upstream of Lake N1, was sampled for mercury in 2011. It should be noted that as a result of the supplemental mitigation associated with fine processed kimberlite deposition during operations and the reduced size of the Fine Processed Kimberlite Containment (PKC) Facility in the current mine plan, the A watershed diversion has changed and Lake N9 will no longer be receiving ”operationally-diverted” water (see Section 3 Project Description of the 2012 EIS Supplement [De Beers 2012]) for more information.

The approach to aquatic effects monitoring for the Project is still conceptual, and detailed study designs and methods, including monitoring parameters and locations, will be evaluated further through consultation with communities and regulatory agencies, and developed during the licensing phase of the Project.

References

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Golder (Golder Associates Ltd.). In Preparation. 2011 Fish Tissue Chemistry in Lake N11 of the Gahcho Kué Project. To be submitted to De Beers Canada Inc.

Tremblay G, Legendre P, Doyon J-F, Verdon R, Schetange R. 1998. The Use of Polynomial Regression Analysis with Indicator Variables for Interpretation of Mercury in Fish Data. *Biochemistry* 40:189-201.

April 2012

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO&EC_33

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Methyl Mercury vs. Total Mercury

EIS Section: Section 8

Preamble

The methods for estimating mercury in water appear to have been inappropriate, at least some of the time. The reported determinations of 0.02 and 0.06 µg/L are probably in error. Methyl mercury (not total mercury) concentrations in water should be used for the estimation of bioaccumulation factors (p. 8-352). The listed BAF (9450) is far lower than what is typically observed for methyl mercury (>10000).

Request

a) Methyl mercury (not total mercury) concentrations in water should be used for the estimation of bioaccumulation. Please correct.

Response

Methyl mercury was not measured. Total mercury was used to calculate the bioaccumulation factors (BAF), resulting in a lower BAF than one based on methyl mercury. Methyl mercury is generally a fraction of the total mercury, and measured values in lake water range from <1 to 20% methyl mercury:total mercury; higher values occur in organic rich systems (e.g., Sando et al. 2003), while values not exceeding 2% have been reported in alpine lakes with low mercury concentrations and low organic matter concentrations (Marusczak et al. 2011). The latter situation represents Kennady Lake. The reviewer is correct that methyl mercury measurements provide a better estimation of possible mercury bioaccumulation than total mercury concentrations. However, such measurements at low concentrations near analytical detection limits do not have a high level of utility.

A variety of analytical methods been used over the many years of this project with varying detection limits reported. The recent total and dissolved mercury data (2010-2011) are the most reliable as they were derived using clean sampling techniques (Teflon sampler and bottles) and low level mercury analytical methods (flow injection Au amalgamation cold vapour atomic adsorption spectrophotometry). These techniques achieved a detection limit of 0.06 micrograms per litre (µg/L) which is generally the limit for routine mercury sampling in water. Highly specialized analytical (EPA Method 1631) and sampling methods (EPA Method 1699) exist for ultra-low determination of mercury in water, but are not used for routine monitoring. For instance, the province of British Columbia has ceased routine monitoring of mercury in water and is focusing instead on measuring mercury in biota tissues (particularly fish) or sediments (Hatfield Consultants 2008).

Measurements of total and dissolved mercury in 2011 indicated that dissolved mercury concentrations were below the detection limit of 0.06 µg/L year round, while total mercury concentrations were below that detection limit under ice and rarely above it during the open water period. Even if methyl mercury concentrations in water were a maximum of 20% of total mercury concentrations, which is extremely unlikely (concentrations are likely an order of magnitude less), they would not be detected during routine monitoring using analytical techniques suitable for such monitoring. They could be detected if special investigative studies were undertaken using specialized analytical methods with ultra-low detection limits. However, the results would not be as useful as actual measurements of mercury in fish (which is almost entirely methyl Hg).

References

Sando SK, Wiche GJ, Lundgren RF, Sether BA. 2003. *Reconnaissance of Mercury in Lakes, Wetlands, and Rivers in the Red River of the North Basin, North Dakota, March Through August 2001*. Water-Resources Investigations Report 03-4078. Bismark, ND, USA, 57 pp.

Marusczak N, Larose C, Dommergue A, Paquet S, Beaulne J, Maury-Brachet R, Lucotte M, Nedjai R, Ferrari CP. 2011. *Mercury and methylmercury concentrations in high altitude lakes and fish (Arctic charr) from the French Alps related to watershed characteristics*. Sci Total Environ 409:1909-1915.

Hatfield Consultants. 2008. *Lower Columbia River Water Quality Objectives Monitoring Program - Birchbank to the International Boundary 1997-2005. Prepared for Columbia River Integrated Environmental Monitoring Program*. BC Ministry of Environment, Nelson, BC. 192 pp.

April 2012

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO&EC_34

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Downstream Effects – Predicted TSS levels

EIS Section: Volume 9

Terms of Reference Section:

Preamble

Volume 9 of the EIS provides predictions and conclusions as to the potential effects from pumping the discharge from the Water Storage Pond to Lake N11, and Area 8 of Kennady Lake. A large portion of volume 9 is dedicated to the effects

Request

a) Provide a model of predicted TSS concentrations in Kennady Lake, Lake N11 and Area 8 that includes the following:

   i. TSS concentrations within Kennady Lake Areas 2 to 5 during the dewatering process.

   ii. TSS within the Discharge to both N11 and Area 8.

   iii. Distribution of inputted TSS discharged within N11 and Area 8.

   iv. TSS loadings that Lake N11 and Area 8 will receive as a result of the discharge.

   v. Provide potential effects and impacts to the aquatic environments, including fish habitat, in N11 and Area 8, from receiving the TSS loadings identified above.

Response

De Beers will provide a response to this Information Request in a separate technical memorandum that will be submitted to the MVEIRB in April 2012.

Information Request Number: DFO&EC_35

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Downstream Effects – Pumping

EIS Section: Volume 9

Preamble

Volume 9 of the EIS provides predictions and conclusions as to the potential effects from pumping the discharge from the Water Management Pond to Lake N11 and Area 8 of Kennady Lake.

Request

a) Provide a conceptual design for the diffusers proposed to discharge to Lake N11 and Area 8.

b) Provide predicted velocities of discharge from the discharger and extent of area affected by the increased velocities (zone of turbulence).

c) Provide mitigation for potential scour and erosion caused by the diffusers. It is indicated that mitigation measures will be applied to prevent flushing and stranding of fish within the downstream watercourses.

d) Please provide information on flows that will be discharged throughout the ramp up and ramp down operations, and the timing in which these events occur.

e) Please identify the extent of the mixing zone.

Response

a) Provide a conceptual design for the diffusers proposed to discharge to Lake N11 and Area 8.

The end-of-pipe discharge points for the lake dewatering operations will be placed at relatively deep water locations in Lake N11 and Area 8 so as to minimize the potential impact to lake bottom sediments. Although not yet designed, simple diffuser structures are contemplated to dissipate the energy of pipeline discharge to further reduce potential erosive energy. Two examples are the use of floating pontoon/barge diffusers at the pipeline discharge point, and a simple end-of-pipe baffle attachment to dissipate the energy outward and upward from the end of the pipeline. In the former, water energy is dissipated on the deck of the pontoon before cascading into the lake, which has been used at Diavik Mine.

The requirement of engineered energy dissipation and erosion protection measures at the pipeline discharge outlets will depend on local site conditions (e.g., original lake/channel bed materials, water depth around the discharge location, etc.), pumped discharge rates, the discharge location relative to the shore line, the number of pipelines, and other site specific considerations. The installation of diffusers may not be required if favourable natural conditions exist over the pipe discharge outlet areas.

b) Provide predicted velocities of discharge from the discharger and extent of area affected by the increased velocities (zone of turbulence).

The maximum end-of-pipe discharge velocities are estimated to be approximately 3.5 metres per second (m/s). The diffuser options proposed above at the end of the pipe under these proposed discharge rates would reduce the water velocity substantially. As described above, the dewatering plan is to discharge at deeper water sections in Lake N11 and Area 8. As such, the zone of turbulence would be localized in terms of depth and area near the discharge outlet. It is expected that turbulent water flow associated with the discharge would quickly attenuate and become largely laminar within a short distance from the diffuser outlet.

c) Provide mitigation for potential scour and erosion caused by the diffusers. It is indicated that mitigation measures will be applied to prevent flushing and stranding of fish within the downstream watercourses.

The main purpose of using pipe diffusers is a mitigation strategy to promote energy dissipation, reduce potential lakebed/channel erosion, and limit associated effects to fish. The primary mitigation is to locate the pipeline discharge point in sufficiently deep water to minimize the potential impact to lakebed erosion. Although not anticipated, further mitigation for preventing potential scour and erosion (e.g., placing a layer of erosion protection riprap over the affected lakebed or channel) would be applied, if necessary.

The natural channel outlets for Lake N11 and Area 8 are located at the opposite ends from the proposed pipeline discharge locations. As such, the discharge energy is fully dissipated and no erosion would at the outlet channels and surges that could potentially cause the flushing and stranding of fish further downstream are not expected to occur.

d) Please provide information on flows that will be discharged throughout the ramp up and ramp down operations, and the timing in which these events occur.

The water management plan as described in Section 3 (Project Description) of the 2012 EIS Supplement (De Beers 2012) proposes a maximum discharge rate of less than 0.9 cubic metres per second (m^3/s) to Lake N11 and less than 1.0 m^3/s to Area 8. The outlets of Lake N11 and Area 8 are on opposite ends of the lake from the pipeline discharge points. Instantaneous water additions/deletions into Lake N11 and Area 8 caused by pumping start-up and shutdown procedures will be fully attenuated over the expanse of the receiving water bodies, such that a corresponding instantaneous surge/drawdown of water at the Lake outlets would not occur.

e) Please identify the extent of the mixing zone.

The mechanical mixing zone would be relatively small and is expected to be within 20 m from the discharge locations.

References

De Beers (De Beers Canada Inc.). 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Information Request Number: DFO&EC_36

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Downstream Effects–Modeling of Impacts

EIS Section: 9.4 Water Management Plan Summary

Preamble

The EIS document implies that the only potential impacts to diversion lakes are changes in water level and fish migration patterns. In fact, the diversions will re-route water so that flow patterns, residence time, etc., will be radically altered. Lake communities intimately reflect their place in the landscape and these changes in system hydrology may have considerable impacts. At present, these impacts are very difficult to predict.

Request

a) Please describe the potential impacts to the aquatic environment resulting from changes to flow patterns and residence time in the downstream lakes. Please also describe measures proposed to mitigate these impacts.

Response

The effects of the upper Kennady Lake watershed diversions to the N watershed on fish migrations and communities in the B, D, and E watersheds are assessed in Section 8.10.3.3 of the 2011 EIS Update (De Beers 2011). The assessments of changes to hydrology and water quality for the diversion lakes were reviewed and incorporated into Section 8.10.3.3 of the 2011 EIS Update (De Beers 2011). As the A watershed diversion has been revised due to the supplemental mitigation associated with the Fine PKC Facility, the effects on fish and fish habitat for the A watershed diversion are assessed in Section 8 of the 2012 EIS Supplement (De Beers 2012).

The effect of watershed diversions on flows, water levels and channel/bank stability in streams and smaller lakes in the Kennady Lake watershed is provided in Section 8.7.3.3 of the 2011 EIS Update (De Beers 2011). As described in this section, following construction of the dykes, the lakes will fill to their new level through natural drainage.

Because of the increase in proportion of lake water surface area for raised lakes, greater evaporative losses are expected and the mean annual water yield from the watersheds will be reduced. The predicted filling time is three years for Lakes D2 and D3 and one year for Lake E1. Water levels will increase (Lakes A1 and A2 by 1.7 m, Lake D2 by 1.6 m, Lake D3 by 2.8 m, and Lake E1 will increase by 0.8 m). The annual outflow and nominal water level of Lake B1 will not change. Annual variation in water levels in the raised lakes will be similar to pre-diversion values. As described in Section 8.10.3.3 of the 2011 EIS Update (De Beers 2011), raising the water levels in the diversion lakes will result in increased lake habitat area. Raised water levels may create a benefit to fish residing in these lakes during mine construction and operations. These benefits will be manifested largely from the additional space and increased amount of overwintering habitat for all resident species. Populations of northern pike and ninespine stickleback may also benefit from the increased spawning and rearing habitat in areas with flooded vegetation.

Changes to residence time and lake surface area described above also have the potential to affect water quality. The effects to water quality in the diversion lakes are described in Section 8.6.2.3 of the 2011 EIS Update under the secondary pathway of *Release or generation of nutrients, mercury, or other substances into Lakes A3, D2, D3 and E1 from flooded sediments and vegetation may change water quality, and affect aquatic health and fish*. As described in this section, although there is potential for temporary changes to surface water and sediment quality with the raising of lakes, changes in water and sediment quality are predicted to be minor relative to baseline conditions. As such, residual effects to fish are anticipated to be negligible.

Therefore, taking into account the hydrological and water quality changes associated with flows and residence time in the diversion lakes, as well as the effects on fish migration, effects on fish communities are as described in Section 8.10.3.3 of the 2011 EIS Update (De Beers 2011). It is expected that the diversion watersheds will support self-sustaining populations of fish species, such as Arctic grayling, northern pike, burbot, slimy sculpin, and ninespine stickleback.

The effects of the diversions to flows and water levels in the N watershed lakes located downstream of the operational diversions are described in Section 9.7.3.2 of the 2011 EIS Update (De Beers 2011). As a result of the combined diversions, small increases in water levels and lake areas are expected compared to baseline in the N watershed lakes. As described in Section 9.10.3.2.2 of the 2011 EIS Update, the increases in water level and lake area in the N watershed lakes are small (i.e., less than 10 cm in depth and less than 1% in surface area) and within natural variability; as a result, no effects on fish and fish habitat would be expected. The effects from the changes to residence time and lake surface area on water quality in these lakes is assessed in Section 9.6.2.1.2 of the 2011 EIS Update under the secondary pathway of *Changes in flow paths may change water quality and fish habitat in the receiving N lakes (i.e., suspended sediments, major ions, metals, and nutrients concentrations), and affect aquatic health and fish*. As described in this section, changes to water and sediment quality and fish habitat in the N lakes are expected to be minor; as such, residual effects to fish are predicted to be negligible.

Mitigation for hydrological changes includes the design of the constructed diversion channels. Flows from the raised lakes to the N watershed will occur over natural drainage courses based on topographic lows between the lakes or require construction of diversion channels to connect the lakes. Diversion outlet structures will be designed and managed to provide an outflow rating curve that approximates the natural outflow rating curve, to the extent possible, during construction and operations. The channels will be designed and constructed to prevent erosion and to maintain stability in permafrost, and to provide fish passage and spawning habitat between the re-aligned lakes. Furthermore, a monitoring and mitigation program for the raised lakes will be incorporated in an adaptive management plan for shoreline erosion. For water quality, preparation of the areas to be flooded will be undertaken, where necessary, to limit the potential for long-term nutrient and metals releases to the lakes and mercury methylation.

References

De Beers (De Beers Canada Inc.). 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Information Request Number: DFO&EC_37

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: TDS for N11

EIS Section: Section 9, page 391

Terms of Reference Section:

Preamble

Increased TDS levels are predicted for Lake N11 and Lake 410, although they are predicted not to affect fish.

Request

a) Please provide the expected TDS levels for lakes between Kennady Lake and Lake 410.

Response

a) The Total Dissolved Solids (TDS) concentrations for the range of lakes between Area 8 and Lake 410, and Lake N11 and Lake 410 are presented graphically in Figure DFO&EC_37-1.

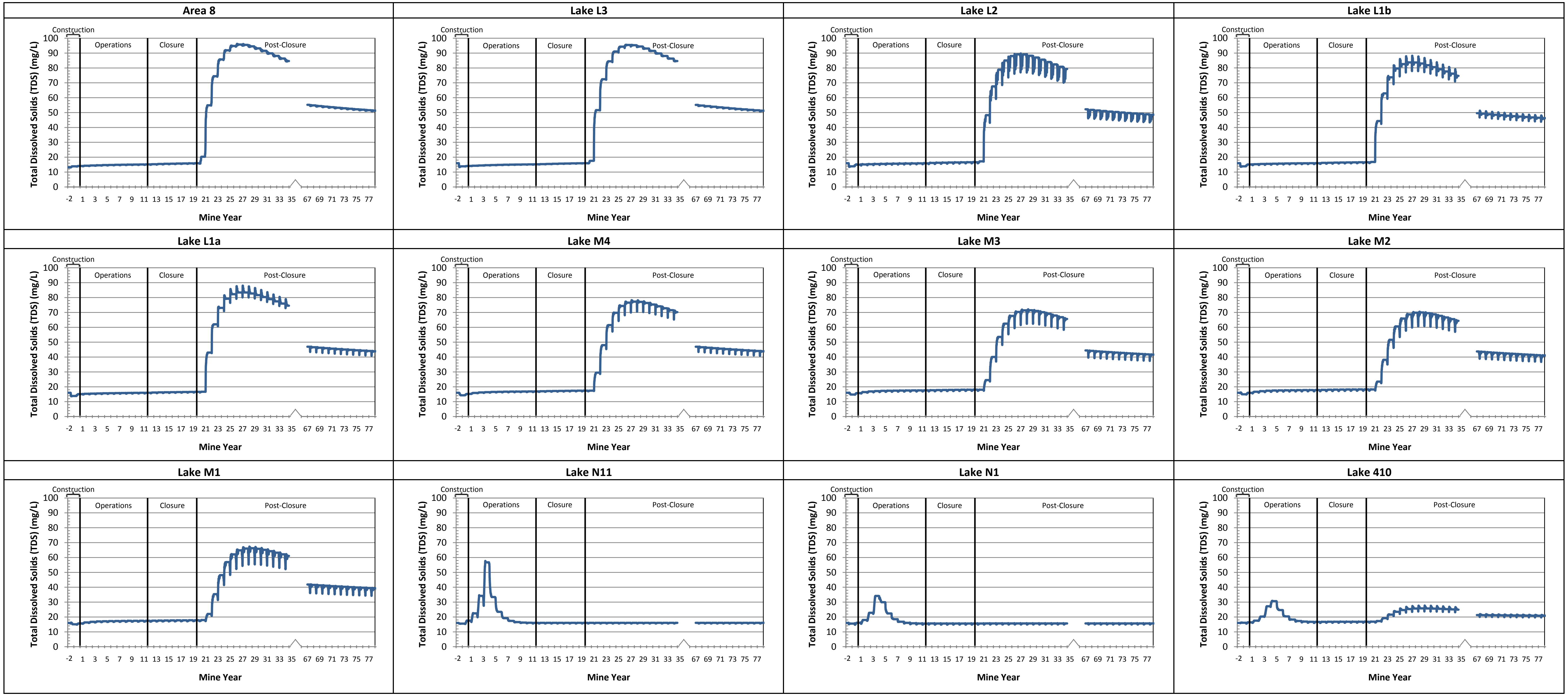
The TDS plots for the transitionary lakes between Area 8 and Lake 410, and Lake N11 and Lake 410, which are the assessment lakes in the EIS, were developed with data derived from the GoldSim water quality model used to predict water quality in the assessment lakes under construction, operations and closure phases of the Project. The model tracks the attenuation of all water chemistry parameters through the series of downstream lakes and watersheds linking Kennady Lake with Lake 410. The model assumes fully mixed conditions in these lakes.

Additional information regarding the water quality model, and the assumptions associated with the water balance, the watershed component, and the chemistry source terms, is provided in Appendix 8, Section 8 of the 2012 EIS Supplement (De Beers 2012).

References

De Beers (De Beers Canada Inc.). 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Figure 1: Expected TDS concentrations in lakes betweem Kennady Lake and Lake L410



GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO&EC_38

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Diversion Channels

EIS Section: Section 8

Preamble

Diversion channels will be constructed to allow fish passage, prevent erosion and sediment issues, and provide spawning and rearing habitat for species such as Arctic Grayling. If water quality is met in Kennady Lake they would be decommissioned and natural drainage would be restored.

Request

a) Clarify what specific habitat features will be included in the diversion channels as a contingency in case natural drainage cannot be restored due to poor water quality in Kennady Lake. These features would need to be incorporated into the stream design to allow them to stabilize over time and have improvements made if necessary, rather than waiting until refilling of Kennady Lake was finished.

b) Please describe additional options considered for water diversion and their potential impacts.

Response

a) The current surface water diversion plan includes construction of three diversion dykes (Dykes E, F, and G) to divert surface runoff water from the B, D, E watersheds to the N watershed. This plan utilizes natural channels that are readily available to pass the flows to the N watershed without additional channel excavation. Depending on the natural site conditions at the diversion channels, engineered erosion protection measures and fish habitat enhancements features may be required at some locations. At the end of operations, Dykes E, F, and G will be removed and natural drainage will be restored. In the unlikely event where the original natural drainage to

Kennady Lake cannot be restored, design and installation of habitat enhancement features in the temporary channels will be conducted.

Under the current mine plan, the construction of excavated diversion channels is not contemplated. However, as described in Section 8.10.3.3 of the 2011 EIS Update (De Beers 2011), new stream channels connecting Lake B1, and the raised Lakes D2 and D3, and E1 (created by the installation of Dykes E, F, and G) to the N watershed will be evaluated to make sure that they provide spring spawning and rearing habitat for Arctic grayling and allow the seasonal passage of fish between lakes that approximates natural conditions. These streams will be temporary, as Dykes E, F, and G will be removed at the end of the operations period, and the flows returned to Kennady Lake through the original stream channels. Any enhancements required to improve the newly formed natural outlet channels will be designed during the detailed engineering design phase.

The goal of the design enhancements will be to prevent erosion and maintain stability in permafrost, and to provide physical fish habitat features where they do not exist. Physical fish habitat features of these channels will include:

- bank and bottom substrates will consist predominantly of cobble, boulder and gravel to allow Arctic grayling spawning and to limit erosion;
- riffle and pool sequencing; and
- slopes, channel depths, and widths will be sufficient to allow fish passage throughout the open-water season; designs will ensure that water velocities in spring will be low enough to avoid creating barriers and that sufficient flow is present in late summer/fall to allow fish to move to overwintering habitat downstream, if necessary.

All channel enhancement designs will be developed with consultation with Fisheries and Oceans Canada (DFO).

For any fish habitat enhancement features that will be installed during the construction of the channels, monitoring would be conducted during operations. After Dykes E, F, and G are removed at closure, water from the B, D, and E watersheds would once again flow to Kennady Lake and the temporary diversion streams would no longer be required.

b) Additional options considered for water diversion and potential impacts are included in the Alternatives Analysis, Section 2 of the 2012 EIS Supplement [De Beers 2012]). For example, a variation to the plan is to pump the water from an upstream lake to a downstream lake through a pipeline, instead of using the natural channels with required engineering enhancements to pass the flows, as proposed in the current plan. The option with actively pumping is costly, prone to risk of mechanical break-down, and would not provide fish habitat or allow for the seasonal migration of fish.

References

De Beers (De Beers Canada Inc.). 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO&EC_39

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Alternative Means of Carrying out the Project – Alternative Rock Piles

EIS Section: Project description

Terms of Reference Section:

Preamble

The placement of waste rock piles, processed kimberlite, and other mining by-products has implications on the overall project foot-print, losses of fish habitat, and reclamation options. Losses of fish habitat will require appropriate compensation in the form of habitat gains. Avoiding losses to fish habitat through project redesign can minimize overall impacts to fish habitat.

Request

a) Please provide alternatives for placement of mine rock and PK, including Areas 6 and 7, quarries, etc.

Response

The project development plan is designed to minimize total effects and overall risk to the environment. Development alternatives were selected that met this broad objective which may contradict the specific goal to only minimize permanent losses to fish habitat within the Kennady Lake Basin, which is a subset the effects assessment.

An analysis specific to alternative for storage of mine rock and processed kimberlite materials is included in the 2010 EIS, Section 2.3.3 (De Beers 2010). Options that were considered in previous mine plans are discussed and assessed. A more detailed alternative analysis report for the placement of mined and processed materials will be submitted as a standalone report in 2012.

In general, the EIS project plan was deemed the best alternative based on Technical feasibility, Economic viability, and Environmental protection. Maximum use of mined pit volumes for material storage is a beneficial environmental aspect, and part of every alternative. The alternatives analysis dealt with volumes of material which cannot be stored in the pits.

Alternatives assessed included placement of materials on land, or alternatively locations within the controlled area, but impinging on areas that were originally lake.

- Mine Rock – over the mine life, the mine rock volume consists of approximately 226 million tonnes of mostly Granite. Approximately 80 million tonnes is permanently stored in the 5034 pit, and the remainder forms the largest volume of material to be hauled and stored.
- Coarse PK – is processed kimberlite with a particle size greater than 0.3 mm. approximately 24 million tonnes. Coarse PK is stored on land, close to the process plant. Some material is used for reclamation, deposited with mine rock piles and some may be stored in the mined-out pits.
- Fine PK – is processed kimberlite with a particle size less than 0.3 mm. approximately 8 million tonnes. Fine PK will be stored permanently in the pits after year 5 when the first pit is available. Surface storage is required for production prior to that time which is 3.3 million tonnes.

The Alternatives analysis shows that multiple and significant advantages favour storage of the materials within the controlled area. Most importantly, the plan defined in the alternatives analysis is the minimum watershed area required to support technical, economic, and environmental criteria. This basin contains Areas 2 to 7 of Kennady Lake. Therefore, placement of materials within the controlled area is designed to be efficient, economic and placed with anticipation of final closure.

A disadvantage of the plan is direct effects to fish habitat within the basin which are subject to a compensation plan included in the EIS.

Advantages which supported this alternative include:

- Minimization of the project physical footprint and containment of drainage – The advantage of keeping the disturbance limited to the area within the controlled area. Long term storage of materials outside of the controlled area exposes a larger area and additional watersheds to possible effects. Even though some areas of Kennady Lake are harmfully affected, the total area of influence from the project is minimized and naturally contained.
- Transport of the materials to storage areas farther from their point of origin is energy intensive, requires additional roads, and requires more fuel, trucks, dust generation, etc. As designed, storage facilities are permanent, and close to the source of the materials.
- Fine PK is fully contained in the controlled area. For other alternatives requires the containment of fine PK outside of the controlled area which rely on permanent engineered structures that pose a technical challenge for stability and possible uncontrolled seepage along with environmental risk in the long term. Alternate location in Area 6 poses a risk to adjoining watersheds, and alternate locations in Area 7 would alter the natural drainage pattern from Kennady Lake to Area 8.

Other advantages of the proposed Project development plan are further detailed in the alternatives analysis report (to be submitted as a standalone report in 2012).

References

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

Information Request Number: DFO&EC_40

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Impacts to Littoral Habitat – N11

EIS Section: Volume 8-160

Preamble

Supplemental pumping from Lake N11 will be used to refill Kennady Lake at closure. No more than 20% of the normal annual flow will be diverted per year to ensure there is enough water to support downstream aquatic systems in the N watershed. However, impacts to the littoral habitat within Lake N11 do not seem to be considered.

Request

a) What is the predicted impact to the littoral habitat in Lake N11 during the refilling of Kennady Lake?

Response

The effects to Lake N11 from pumping to refill Kennady Lake were assessed in Section 9 (Downstream Water Effects) of the 2011 EIS Update (De Beers 2011), not in Section 8 (Kennady Lake and Watershed).

As described in Section 9.7.4.1 of the 2011 EIS Update (De Beers 2011), the total annual average diversion from Lake N11 will be on the order of 3.7 million cubic metres per year (Mm^3/y), which represents no more than 20% of the normal annual flow to Lake N1. The 20% cut-off will be used to ensure that sufficient water remains in Lake N11 to support downstream aquatic systems in the N watershed. At no time will the diversion cause discharge from Lake N11 to drop below that which occurs under a 1-in-5 year dry condition.

The resulting effects on littoral habitat in Lake N11 were assessed in Section 9.10.4.2 of the 2011 EIS Update (Effects of Changes in Water Levels in Lakes Downstream of Kennady Lake to Fish and Fish Habitat). As described in this section, the largest change compared to baseline for Lake N11 is in July, with a decrease in depth of 7 centimetre (cm) and a corresponding change in lake area of less than 1%. As the decreases in water levels in Lake N11 during closure (i.e., refilling of Kennady Lake) are small, they were considered unlikely to have a substantive effect on littoral zone fish habitat or benthic invertebrate communities in the lake. Although the water balance for the Project was revised to reflect the supplemental mitigation associated with the Fine Processed Kimberlite Containment (PKC) Facility, the effects on the littoral habitat of Lake N11 were as presented in the 2011 EIS Update and described above (see the 2012 EIS Supplement).

References

De Beers (De Beers Canada Inc.). 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Information Request Number: DFO&EC_41

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Carrying Capacity of Lakes

EIS Section: Volume 8-390

Preamble

Lakes in A, B, C, D, and E watersheds have a carrying capacity limited by low nutrient availability. During operations it is thought that fish will be able to disperse into the N watershed through constructed diversion channels if the carrying capacity in the likes of the A, B, C, D, and E watershed are exceeded.

Request

a) Please provide rationale as to how the lakes in the N watershed (presumably also at their carrying capacity) will able to support additional fish migrating from other watersheds.

Response

The carrying capacity of the N watershed lakes would not change as a result of the diversions; therefore, it is not expected that these fish movements would increase the overall fish production within the N watershed lakes.

The effects of the upper Kennady Lake watershed diversions to the N watershed on fish migrations and communities in the B, D, and E watersheds are assessed in Section 8.10.3.3 of the 2011 EIS Update (De Beers 2011). As the A watershed diversion has been revised due to the supplemental mitigation associated with the Fine PKC Facility, the effects on fish and fish habitat for the A watershed diversion are assessed in Section 8 of the 2012 EIS Supplement (De Beers 2012).

As described in Section 8.10.3.3 of the 2011 EIS Update, the changes to fish migrations for lakes diverted to the N watershed include the potential effects on fish movements for spawning and rearing, as well as the potential dispersion of fish from the Kennady Lake watershed into the N watershed. Fish populations will persist within the diverted lakes; it is also anticipated that some fish will move from these upper Kennady Lake watershed lakes into the diversion channels and then into the N watershed lakes. Fish would also be expected to move from the N watershed into the diversion lakes. As described in Section 9.6.2.1.2 of the 2011 EIS Update under the secondary pathway of *Changes in flow paths may change water quality and fish habitat in the receiving N lakes (i.e., suspended sediments, major ions, metals, and nutrients concentrations), and affect aquatic health and fish,* the diversion of the B, D, and E watersheds are not expected to change migration patterns of fish in the N watershed, such that populations of fish are negatively affected.

However, as described in Section 8.10.3.3 of the 2011 EIS Update, the placement of the dykes will prevent out-migrations of juvenile and young-of-the-year fish to Kennady Lake. Prevention of downstream emigration to Kennady Lake is expected to have a minor effect on fish populations in lakes upstream of the dykes. These lakes have a carrying capacity, which, like all lakes in the Kennady Lake area, is limited by low nutrient availability. The lakes can be assumed to be at their natural carrying capacity and will remain at or near this carrying capacity during mine operations, regardless of whether fish can emigrate to Kennady Lake. If the carrying capacity is exceeded, the constructed diversion channels would allow for the fish to disperse to lakes in the N watershed.

However, it is not expected that there would be any population-level changes in the N watershed from the movement and out-migration of fish from the diversion lakes. The diversion and N watershed lakes would continue to maintain the existing fish populations' habitat needs. Any additional fish that move into the N watershed lakes may be consumed by predatory fish (potentially leading to increased growth), or may survive, but limit growth of the other fish due to sharing of the food resources (i.e., more fish, but smaller due to the limitations of the food supply). Access to various habitat types and the ability to move within the system would be accommodated.

References

De Beers (De Beers Canada Inc.). 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

April 2012

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO&EC_42

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Sediment Quality

EIS Section: 8.3.6 Surface Water

Terms of Reference Section:

Preamble

Flocculants may have implications for re-establishing lake as viable fish habitat.

Request

Clarify where flocculants will be used and mitigation for distribution of flocced sediments throughout the basin (e.g. areal extent, estimate the total amount [area X depth]).

Please provide a predicted measure of the chemistry of flocculent sediment in Kennady Lake.

Response

a) Flocculants will be used in the process plant (2010 EIS Sections 3.6.3 and 3.6.4.3.2 [De Beers 2010]) to promote the settling of fine particles to allow recirculating use of process water. Settled solids containing flocculants will be pumped as a slurry to the fine PK disposal facility (Area 2) or the mined-out 5034 and Hearne pits.

The quantity and quality of fine PK containing flocculants is further described in Section 3.7.4.1 of the 2012 EIS Supplement (DeBeers 2012). Fine PK will be deposited in the Fine PKC Facility in Area 2 for the first five years followed by disposal in the 5034 pit for two years and the Hearne pit thereafter.

The surface areas and depths of the fine PK disposal areas will be:

- Fine PKC Facility is 71.6 ha, average depth is 7 m, maximum depth 15 m;

- 5034 pit is 4.6 ha, maximum depth is 64 m; and
- Hearne pit is 6.6 ha, maximum depth is 102 m.

The Area 2 facility is segregated from the water management pond by a filter dyke. Flocculated sediments will settle behind (upstream side) of the filter dyke. Reclamation plans call for the complete filling and covering of the Area 2 facility such that, at closure, the area will be a land mass. Minimal amounts of flocculated sediments are expected to pass through the filter dyke (2012 EIS Supplement [De Beers 2012, Section 3.7.4.3]).

The fine PK flocculated sediments placed in the 5034 pit will be covered over with 100 m of mine rock and prior to closure and re-flooding of the area. The flocculated fine PK sediments are also placed in the bottom of the mined-out Hearne pit. At mine closure, the sediment level is expected to be approximately 100 m below the re-flooded lake level (2012 EIS Supplement [De Beers 2012, Sections 3.7.5.3]).

In addition to the thickening of the fine PK, flocculants may be used in the final stages of Kennady Lake dewatering of Areas 6 and 7 and for the treatment of mine pit water during the early years of mine operations. If required, water from Areas 6 and 7 will be treated in-line as it is pumped to the water management pond (Area 5) for flocculation and settling in the water management pond before being subsequently discharged to Lake N11 (Section 3.9.4.1, De Beers 2010). A pervious dyke may be constructed within Area 5, if required to assist settling of the treated water pumped from Areas 6 and 7. The dyke would consist of the northeastern edge of the West Mine Rock Pile (toe of the pile) and be constructed of mine rock. The dyke would create a sheltered settling zone area to reduce any impacts caused by northerly winds. This settling area would also retain flocculated sediments within the area that will eventually be covered by the West Mine Rock Pile.

Flocculated sediments are not expected to migrate from the Area 2 Fine PK Facility or the settling pond covered by the West Mine Rock Pile into the water management pond area that will be later. Flocculated sediments placed in the bottom of the mined out 5034 pit will be covered with over 100 m of mine rock. Flocculated sediments placed in the bottom of the Hearne pit and the top surface of the lake bottom sediments are expected to be 100 m below the lake surface once upon mine closure after the lake is refilled. The aerial extent and depth of flocculated sediments in other areas of Kennady Lake are negligible.

b) As discussed in response to Request a), flocculated sediments in areas to be reclaimed as fish habitat at closure are negligible, and therefore, the geochemistry of lake bottom sediments in the water management pond at closure is expected to be essentially the same as pre-development lake bottom sediments geochemistry.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO&EC_43

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Nitrification of the L and M Watershed

EIS Section: Volume 9

Terms of Reference Section:

Preamble

It is indicated that the L and M watersheds will change from oligotrophic to mesotrophic conditions, after Dyke A has been breached. One source of increased nutrients is from the fine processed kimberlite facility (FPKC).

Request

a) What mitigation measures is De Beers considering to reduce the release of phosphorous from the FPKC?

b) What are the contingency plans should the phosphorous released be higher than predicted or if the mitigation measures are not effective?

Response

a) Environmental design features and mitigation strategies to reduce the potential for effects to water quality in Kennady Lake after closure have been incorporated into the design of the Project. These include aspects of the water management plan prior to refilling (e.g., transferring a large proportion of water stored within the Controlled Area to Hearne and Tuzo pits, sequestration of PAG rock within the pits or within the mine rock pile, and active monitoring of water quality during operations and through refilling to confirm EIS predictions). Supplemental mitigation associated with the management of fine PK material, as identified in the 2011 EIS Update (De Beers 2011), is the primary mitigation that has been considered to reduce phosphorus loadings to Kennady Lake following closure. No additional mitigation has been considered.

Concentrations of phosphorus are projected to increase in Kennady Lake in post-closure, with the main source of total phosphorus loadings being the Fine PKC Facility. Since the submission of the 2011 EIS Update (De Beers 2011), the mine plan has been updated to reflect supplemental mitigation associated with the deposition of fine PK. This change has resulted in a lower volume of fine PK that will be deposited to Area 2 and a higher volume of fine PK that will be deposited to the 5034 and Hearne pits. As a result, the Fine PKC Facility's footprint has been reduced by omitting Area 1, which included Lakes A1 and A2 in the 2010 EIS (De Beers 2010). This reduction in size reduces the long-term phosphorus loadings from the facility to Kennady Lake. This strategy would reduce the Fine PK surface area by approximately half, effectively reducing the phosphorus loadings from the facility.

On-going geochemical testing of site-specific PK material has also identified that the source term phosphorus loading from fine PK material is not as high as reported in the 2011 EIS Update (De Beers 2011). Phosphorus loading was determined from a limited set of PK material, which has been supplemented by additional PK material sourced from drill cores for the site. Geochemical testing of this material has been undertaken since 2011, and the results of this testing along with the original testing results have been used to update the loading from the updated Fine PKC Facility. The updated source term inputs have been used in the water quality modeling to predict long-term steady state water chemistry in Kennady Lake and downstream waters.

The supplemental water quality modeling incorporating the updated Fine PKC facility footprint and the most recent geochemical test results indicate the expected long-term steady state total phosphorous concentrations will be approximately 0.009 mg/L. This means that predicted changes of phosphorus in Kennady Lake will not result in a trophic change.

The updated Project Description (Section 3) and water quality modelling of Kennady Lake (Section 8) will be presented in the EIS Supplement (De Beers 2012), which will be submitted to the Board in 2012.

b) Contingency measures are not considered necessary in the closure conditions to reduce phosphorus loadings to Kennady Lake.

In response (a) above, it was stated that the most recent water quality predictions indicate that no additional mitigation is required and the water quality in Kennady Lake at refilling is expected to be suitable for reconnection with Area 8, and downstream waters. However, De Beers is committed to monitor the site water quality in Areas 3 and 5 during operations, which will receive the loading from the Fine PKC Facility, closure (i.e. the refilling period) and post-closure. In the event that monitored water quality during operations and closure indicates a shift from EIS projections, contingencies during operations and closure (refilling) through adaptive management processes may be considered. These include flexibility in the water management plan to isolate and sequester water in the Hearne and Tuzo pits that is not acceptable for discharge (during operations and early refilling) or reduce refilling time.

References

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO&EC_44

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Downstream Effects – Effects to Fish

EIS Section: Volume 9

Terms of Reference Section:

Preamble

It is predicted that there will not be any impacts to Lake Trout populations, despite predicted changes to the L and M watersheds including a substantial reduction in flows during operations and closure (and subsequent increase in temperatures), and changing the watersheds from oligotrophic to mesotrophic conditions at post-closure.

Request

a) It is identified that Lake Trout overwintering habitat may be reduced at post-closure due to the rapid increase in nutrients in the L and M watersheds. Please provide an outline of a monitoring program to verify this prediction and describe contingencies to manage greater than predicted impacts.

b) It is predicted that at post closure in the L and M watershed Arctic Grayling spawning habitat may be impaired from increased algal growth. How far downstream is increased algal growth predicted? Please provide an [*incomplete sentence*]

c) Please assess how the use of a water treatment plant could reduce nutrient inputs, and the extent of the algal growth downstream.

d) Please provide details of how areas flooded by the dewatering of Areas 2-7 of Kennady Lake will be “prepared” prior to flooding to reduce the amount or organic material.

e) Please provide details on how changes in flows, riverine morphology or decrease in water levels will be addressed through mitigation of design features.

f) Area 8 of Kennady Lake does not appear to be assessed for the effects of long term water withdrawal from the area which will be exacerbated by limited flow coming into Area 8 after pumping has ceased. Please provide a full assessment on this Effects Pathway and a fish and fish habitat assessment of Area 8.

g) Please explain how the Pathway Assessment resulted in a ranking of 'secondary' for the Effects Pathway "alteration of groundwater regime with pit development may change surface water levels and water quantity in downstream lakes, and affect fish habitat" when mitigation or environmental design features are not provided.

h) It is predicted that there will be measureable changes to water quality and water levels as a result of a change in groundwater flow regime in response to the creation of the pits. Please provide a full assessment on this Effects Pathway.

i) Provide a fish and fish habitat assessment on downstream watercourses and waterbodies where measureable differences in water levels are likely to occur.

Response

a) It was predicted in Section 9.10.4.3.2 of the 2011 EIS Update (De Beers 2011), that due to increased nutrients, there may be small reductions in overwintering habitat availability or suitability at post-closure for fish species remaining in the M lakes throughout the winter as a result of the nutrient enrichment predicted. However, based on the supplemental mitigation associated with the Fine Processed Kimberlite Containment (PKC) Facility presented in the 2012 Environmental Impact Statement (EIS) Supplement (De Beers 2012), the predicted mean long-term concentrations of phosphorus in L and M watershed lakes are 0.009 milligrams per litre (mg/L) and 0.008 mg/L, respectively, which indicates that long-term trophic status will remain oligotrophic (i.e., less than 0.010 mg/L); these levels are less than that presented in the 2011 EIS Update (De Beers 2011). As a result, any changes to overwintering habitat in these downstream lakes would be very small, or potentially not measurable; no effects on fish would be expected.

The Aquatics Effects Monitoring Program (AEMP) is currently being developed. However, it is expected that monitoring of water quality of downstream lakes will be part of the program, which will include winter under-ice dissolved oxygen measurements. The AEMP will allow for adaptive management, so that any unexpected adverse impacts to the aquatic ecosystem identified through the AEMP could be addressed (i.e., implementation of additional mitigation or compensation, as required). The AEMP will be developed with regulatory and stakeholder input.

b) It was predicted in Section 9.10.4.3.2 of the 2011 EIS Update that the potential for growth of algae on the streambed of streams in the L and M watersheds downstream of Kennady Lake could reduce suitability and availability of spawning habitat for Arctic grayling (De Beers 2011). However, based on the supplemental mitigation associated with the Fine PKC Facility presented in the 2012 EIS Supplement (De Beers 2012), these streams are predicted to remain oligotrophic, and not mesotrophic as presented in the 2011 EIS Update (De Beers 2011). As a result, changes to Arctic grayling spawning habitat would be less than presented in the 2011 EIS Update (De Beers 2011). As described in the Response to DFO&EC_47, although the streams would likely be more productive compared to existing conditions, any changes to Arctic grayling spawning habitat in relation to increase nutrients and attached algal growth, would be expected to be not measurable.

c) Due to the supplemental mitigation associated with the Fine PKC Facility, the long-term steady state phosphorus levels are less than those presented in the 2011 EIS Update (De Beers 2011). As described for part (b) above, no measurable changes to Arctic grayling spawning habitat are expected due to algal growth in the streams downstream of Kennady Lake. A water treatment plant was determined not to be required given that nutrient inputs and resulting algal growth is not expected to affect fish spawning habitat.

d) Mitigation measures (or “preparations” as referred to in the 2011 EIS Update) for lakes and lake outlets subject to potential erosion from increased flows or lake levels are presented in the 2011 Shoreline and Channel Erosion Assessment Report (Golder 2012). For areas with low erosion susceptibility, non-structural measures (i.e., development of simple erosion barriers based on field monitoring during the mine activities) were recommended. For areas with higher erosion susceptibility, structural measures including modification of shoreline slopes and armouring of channel bed and banks, were recommended.

e) Mitigation for changes in flows, water levels and channel morphology in the downstream watershed are described in Sections 9.7 and 9.10 of the 2011 EIS Update (De Beers 2011). A summary is provided below:

Dewatering

- Discharges to Lake N11 will be managed such that the discharge at the outlet of Lake N1 during dewatering will approximate the 2-year flood discharge.
- Discharge directed downstream of Area 8 will be restricted to the 2-year flood level.
- Runoff forecasting based on snowcourse surveys and short-term rainfall forecasts will be undertaken to ensure that the cumulative effect of runoff and dewatering discharges does not exceed discharge targets.
- Pumping will begin as the peak flows in the spring begin to recede, and as a result, there will not be a drastic change in flow condition during pumping start-up (i.e., ramping up from a low baseflow to a peak flow will not occur).
- All of the pumping will be discharged into lakes, which will act to further attenuate any sudden changes in stream discharge downstream and minimize flushing potential, as well as potential for scouring.
- When pumping is stopped at the end of each season, lake levels will recede gradually, attenuating sudden and rapid declines in stream discharge.

Operations

- During operations, all contact water, including Project site contact water and inflows to the dewatered lake bed will be collected in the Water Management Pond (WMP) (Areas 3 and 5). In general, this will reduce flows in Kennady Lake Area 8 during spring runoff.

- In the diversion watersheds, the diversion outlet structures will be designed to approximate the natural hydrograph to the extent possible, and to manage the water level regime of the diverted lakes. Diversion channels will be designed and constructed to prevent erosion and sedimentation.
- When pumping from the WMP to Lake N11 does occur, mitigation as described above for dewatering will be applied.
- A Downstream Flow Mitigation Plan is currently being developed to mitigate any habitat losses due to reduced flows. The plan will be finalized through consultation with Fisheries and Oceans Canada (DFO).

As described in the response to Part d) above, additional mitigation measures for lakes and lake outlets that may be subject to potential erosion from increased flows are presented in the 2011 Shoreline and Channel Erosion Assessment Report (Golder 2012).

f) The assessment of effects of water withdrawal from Area 8 was provided in the 2011 EIS Update Section 8.6.2.3 under the secondary pathway of *Extraction of potable water requirements for the Project may change surface water levels in Area 8, and affect fish habitat* (De Beers 2011). As described in this section, the potable water supply from Area 8 is a small annual supply volume compared to the volume of Area 8 and predicted outflows during construction and operations; therefore, this was expected to result in a small change in water level to Area 8, a minor change to available fish habitat, and negligible residual effects to fish.

However, due to the supplemental mitigation associated with the Fine PKC Facility, the water balance for the Project has been updated. An assessment of the effects of the potable water withdrawals on fish and fish habitat in Area 8 is included in the 2012 EIS Supplement (De Beers 2012). A summary is provided below.

The changes in Area 8 water depth and lake area under open-water conditions during operations and potable water withdrawals compared to baseline are shown in Table DFO&EC_44-1. The largest changes are predicted to occur in operations during July, with decreases in lake depth of 13 cm, which corresponds to a 1% change in lake area. The reductions in depth are attenuated throughout the summer, with smaller changes predicted for other months.

The changes in Area 8 water depth and lake area under ice-covered conditions compared to baseline are shown in Table DFO&EC_44-2. The reduction in water levels under the ice are small, with a maximum decrease of 12 cm in depth and 2.9% in under-ice wetted area predicted during construction; in operations, the changes are less, with a maximum decrease in depth of 5 cm and under-ice wetted area of 1.3%.

Similar to the assessment provided in Section 8.6.2.3 of the 2011 EIS Update (De Beers 2011), operating Kennady Lake as a closed system (combined with potable water withdrawals) is expected to result in a minor change to water level in Area 8. However, the small change in littoral area (approximately 2% of the surface area of Area 8) would have a negligible effect on the availability of fish and benthic invertebrate habitat. Changes to water quality, including under-ice dissolved oxygen levels, are expected to be negligible relative to baseline conditions. As a consequence, residual effects to fish habitat and fish (including the availability of overwintering habitat in Area 8) are predicted to be negligible.

Table DFO&EC_44-1 Projected Changes in Area 8 Water Depth and Lake Area Under Open Water Conditions

	Open Water											
	May		June		July		August		September		October	
	Change in Depth [m]	Change in Area [%]	Change in Depth [m]	Change in Area [%]	Change in Depth [m]	Change in Area [%]	Change in Depth [m]	Change in Area [%]	Change in Depth [m]	Change in Area [%]	Change in Depth [m]	Change in Area [%]
Dewatering	-0.005	-0.04%	0.018	0.14%	0.124	0.95%	0.181	1.39%	0.149	1.15%	-0.027	-0.20%
Operations	-0.014	-0.10%	-0.108	-0.83%	-0.131	-1.01%	-0.106	-0.82%	-0.095	-0.73%	-0.074	-0.57%

Note: Takes into account close-circuiting of Areas 2 to 7 of Kennady lake and potable water withdrawals.

m = metres; % = percent.

Table DFO&EC_44-2 Projected Changes in Area 8 Water Depth and Under-Ice Wetted Area Under Ice-Covered Conditions

Snapshot	Ice-Covered													
	November		December		January		February		March		April		May	
	Change in Depth [m]	Change in Area [%]	Change in Depth [m]	Change in Area [%]	Change in Depth [m]	Change in Area [%]	Change in Depth [m]	Change in Area [%]	Change in Depth [m]	Change in Area [%]	Change in Depth [m]	Change in Area [%]	Change in Depth [m]	Change in Area [%]
Dewatering	-0.016	-0.41%	-0.033	-0.83%	-0.050	-1.25%	-0.066	-1.65%	-0.083	-2.07%	-0.100	-2.47%	-0.117	-2.90%
Operations	-0.007	-0.18%	-0.015	-0.37%	-0.023	-0.56%	-0.030	-0.74%	-0.037	-0.93%	-0.045	-1.11%	-0.052	-1.30%

Notes: Takes into account close-circuiting of Areas 2 to 7 of Kennady lake and potable water withdrawals. Assumes uniform 2 m thick ice cover from Nov 1st to May 31st, to be conservative.

m = metres; % = percent.

g) The pathway *Alteration of groundwater flows from dewatering Kennady Lake may change surface water levels in nearby lakes, and affect water quantity and quality, fish habitat, and fish* was considered to be a secondary pathway as the residual effects from the alteration of groundwater flows to water quality, fish habitat and fish were predicted to be negligible. As described in Section 8.6.1 of the 2011 EIS Update (De Beers 2011), secondary pathways are those that could result in a measurable and minor environmental change, but would have a negligible residual effect on a valued component (VC) relative to baseline or guideline values (De Beers 2011). Although mitigation may be applied to some of the identified secondary pathways to reduce or minimize the residual effects, mitigation is not required to be present in secondary pathways; in some cases, the degree of change caused by the Project is so small that the effects on the VC would be negligible in the absence of mitigation.

On the other hand, no linkage pathways are those where the pathway is removed by environmental design features and mitigation so that the Project results in no detectable environmental change and residual effects to a VC relative to baseline or guideline values. No linkage pathways require mitigation to "break the link' in the pathway analysis.

h) A full assessment of predicted changes to water quality and quantity as a result of a change in groundwater flow regime in response to the creation of the pits is provided in the 2010 EIS Section 11.6: Subject of Note: Permafrost, Groundwater and Hydrogeology (De Beers 2010). Results of this analysis pertaining to the effects of pit creation are described in Section 11.6.4.1.1 of the 2010 EIS (De Beers 2010). Two pathways are assessed that pertain to this request: *Alteration of the groundwater regime that results from pit development may result in decreased groundwater discharge rates to other lakes*, and *Removal of saline groundwater inflow from the mine pits may cause changes to groundwater quantity and quality*. Each pathway is discussed briefly below.

Pathway 1: *Alteration of the groundwater flow regime that result from pit development may result in decreased groundwater discharge rates to other lakes*

Dewatering of Kennady Lake and mining in the open pits will induce groundwater flow from all directions towards these areas. This is expected to result in small volumes of water from lakes with flow through taliks to flow towards the pit. Water levels in lakes without flow through taliks are not expected to be affected by mining of the open pits.

The dewatering and pit development is predicted to cause a maximum reduction in groundwater discharge of 100 cubic metres per day (m^3/d). This reduction is considered small in comparison to the net precipitation to lake surfaces, which is in the order of 2,400 m^3/d, on average.

The key conclusions presented in Section 11.6.4.1.1 of the 2010 EIS indicate the following (De Beers 2011):

- “Climatic inputs to the area vastly overwhelm the magnitude of the change potential induced by mine pit development,”
- “Although change to groundwater flow direction and intercepts are likely, no measureable effects are anticipated in the receiving environment,” and
- “This pathway was determined to have negligible residual effects on valued components,”

Pathway 2: *Removal of saline groundwater inflow from the mine pits may cause changes to groundwater quantity and quality*

Development of the open pits will induce groundwater to drain towards these facilities, which could result in upwelling of connate water stored into the deeper bedrock to flow towards the pit. Connate water is characterized by higher total dissolved solids (TDS) concentrations and is expected to result in more saline water flowing into the open pits. The predicted groundwater concentrations flowing to each pit are provided in Table 11.6-5 in Section 11.6.4.1.2 of the 2010 EIS (De Beers 2011).

During operations, water draining to the open pits will be directed to the Water Management Pond (WMP) until Year 8 of operations, at which point there is the option for the groundwater flow to the Tuzo pit to be pumped directly to the process plant. Management of the pit inflows through the WMP is expected to result in increased TDS concentrations during operations in the WMP.

At closure, approximately 24 million cubic metres (Mm^3) of site water stored in the WMP, Area 6, and Area 7 will be directed to the Tuzo pit to expedite flooding of this facility. The available storage capacity in Kennady Lake will subsequently refill with surface water runoff, groundwater inflow, and supplemental water pumped from Lake N11. This water is expected to have a lower TDS concentration than the water directed to the Tuzo pit. As a result, meromixis is expected to occur in the Tuzo pit (see Section 8.8.2.3 of the 2011 EIS Update [De Beers 2011]) isolating a large component of the site water containing higher concentrations of TDS.

Following refilling of Kennady Lake, TDS concentrations are expected to remain elevated compared to baseline conditions as a result of continual drainage from the Fine PKC Facility and the mine rock piles. A detailed assessment of the expected changes to the surface water quality, including the projected results, is provided in Section 8.8 of the 2011 EIS Update (De Beers 2011). Due to the supplemental mitigation associated with the Fine PKC Facility, the revised water quality modelling and results are presented in Section 8 of the 2012 EIS Supplement (De Beers 2012).

i) A fish and fish habitat assessment was completed for downstream watercourses and waterbodies where measurable differences in water levels are likely to occur. This assessment is provided in the 2011 EIS Update, Sections 9.10.3.1 to 9.10.3.2 for construction and operations, and Section 9.10.41 and 9.10.4.2 for closure and post-closure (De Beers 2011). Due to the supplemental mitigation associated with the Fine PKC Facility, the water balance was subsequently updated for the Project. However, there are no changes to the overall conclusions of the assessment to fish and fish habitat in streams and lakes downstream of Kennady Lake; additional details can be found in the 2012 EIS Supplement (De Beers 2012).

Note, however, that in both the 2011 EIS Update and EIS Supplement, the assessment of effects of the reduced flows on fish and fish habitat was completed under a scenario of no additional flow augmentation downstream of Area 8 (De Beers 2011, 2012). As described in the response to DFO&EC_59, a Downstream Flow Mitigation Plan is currently under development and will be finalized through additional consultation with DFO.

Reference

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Golder (Golder Associates Ltd.). 2012. 2011 Shoreline and Channel Erosion Assessment Report. Report No. 11-1365-0001/DCN-048. Submitted to Mackenzie Valley Environmental Impact Review Board. March 2012.

April 2012

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO&EC_45

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Potential Pathway for Effects to Fish Downstream of Kennady Lake during Closure

EIS Section: Volume 9

Preamble

Table 9.6-4 presents the "Potential Pathways for downstream Effects to Water Quality and Fish during Closure".

Request

a) There are numerous potential impacts to fish and fish habitat resulting from breaching a dyke. Some of these include sedimentation and erosion of downstream shorelines, flushing of fish downstream, and exposing eggs and larval fish in the littoral areas upstream. These impacts may occur from removing any of the dykes. Please provide a decommissioning plan for the removal of the dykes, discharge rates, including timing, methods, sediment and erosion control, monitoring).

b) Table 9.6-4 has indicated that to mitigate changes in water quality, aquatic health and fish, Dyke A will not be breached until specific water quality criteria are met. It has been identified elsewhere in Volume 9 that watersheds L and M are predicted to change from oligotrophic to mesotrophic conditions, rapidly, after Dyke A has been breached. How would incorporation of a water treatment plant reduce the extent of downstream effects, the recovery time of Kennady Lake; and the length of time before the waters within Areas 3-7 of Kennady Lake meet specific water quality objectives prior to breaching Dyke A?

Response

a) The following is the conceptual decommissioning plan of the dykes and berms during mine closure.

After the end of mine life, the water elevations in all water storage areas within Areas 2 to 7 will be lowered to 417.0 metres (m) by siphoning the water from Areas 3 and 5, west of Area 6, and Area 7, to the mined-out Tuzo Pit. After the water elevations are lowered, a portion of the dyke crest for each of Dykes B, N, and K will be excavated down to an elevation of 417.0 m to create a temporary spillway for runoff water flowing from the upstream side to the downstream side during the early years of mine closure. The downstream slopes around the excavated sections will be flattened to a tentative slope of 10(H):1(V). A layer of 1 m thick erosion protection material will be placed over both the excavated dyke crests and flattened downstream slopes. The excavated section width will depend on hydraulic requirements and other considerations. Tentative minimum widths of 50 m, 100 m, and 150 m were selected at this stage for Dykes N, K, and B, respectively. The remaining portions of Dykes B, N, and K will be lowered to a top crest elevation of 418.0 m to minimize fish habitat losses associated with the dykes.

A section (100 m width) of Dyke L crest close the northwest abutment will be lowered down to an elevation of approximately 421.0 m to create a drainage path for any excess water freely flowing from Area 2 to Area 3. The fine processed kimberlite (PK) surface will be completely covered with a closure cover consisting of a minimum of 1 m mine rock over 1 m coarse PK after mine closure. The maximum final fine PK surface elevation in the area close to the lowered section will be approximately 417.0 m, which is about 4 m below the lowered dyke crest. Migration of fine PK solids from Area 2 into Area 3 is not expected, with almost no water head crossing Dyke L, and the relatively low final elevation of the fine PK, which is covered with a minimum of 2 m of the closure cover. Dyke J will be lowered to a top crest elevation of 418.0 m to minimize fish habitat losses associated with the dykes.

Dykes D, H, I, and M are not technically required after early mine closure when the water elevations in Area 2, 3 and 5 are initially lowered down to 417.0 m and all of the Kennady Lake basins are later refilled to the original lake elevation of 420.7 m. These dykes will remain in place after mine closure. The berms for water collection ponds will not be needed after the end of mine life and will be completely submerged below water under the water elevation of 420.7 m in the restored basins. The berms can remain in place after mine closure.

Decommissioning of Dykes B, N, K, L, J, D, H, I, and M mentioned above will not have effects to downstream water quality and fish because the decommissioning activities will only have limited effects within the internal water management system, which is isolated from the downstream environment prior to the decommissioning of Dyke A. Breaching or lowering of Dykes B, N, K, L, and J will be carried out under dry construction conditions with no water flowing through the excavated sections during decommissioning.

Based on the current closure plan, a total of four external water diversion dykes (Dykes A, E, F, and G) will be breached during mine closure to return the watershed flows to their pre-development conditions. Dyke E will be breached during early mine closure to allow the runoff water from the catchment area of Lakes B1 to B4 to flow into Area 3. Dyke F will be breached during early mine closure to allow the runoff water from the catchment area of Lakes D2 to D10 to flow into Area 5. Dyke G will be breached during early mine closure to allow the runoff water from the catchment area of Lakes E1 and E3 to flow into west of Area 6. Depending on the actual water quality in the overall water management system at the end of mine operations, and the projected water quality for the restored Kennady Lake after mine closure, the schedule to breach these dykes can be adjusted accordingly. Dyke A will be the last dyke to be breached during final mine closure once the water quality in the restored Kennady Lake meets discharge criteria. A section of an internal low berm over a saddle between Lake A1 and Area 3 will be breached to allow water from Lake A1 to naturally flow into Area 3 before or after Dyke A is breached.

The following conceptual procedures can be applied to limit the impacts to fish and fish habitat during decommissioning of the external water diversion dykes and berm:

- When feasible, pumping the water to be drained through a pipeline over the dyke before dyke decommissioning to lower the upstream water elevation to a pre-development condition, such that a majority of the decommissioning earth work can be carried out under dry construction conditions;
- Measures including controlling discharge rates can be taken during the pumping to limit the erosion of downstream channels and potential impacts to fish and fish habitat. As stated in Section 9 of the 2011 EIS Update (De Beers 2011), the risk of flushing or stranding fish during the start-up and shutdown of pumping is considered to be negligible, due to the environmental design features (i.e., ramp-up and ramp-down) in the pumping plan and the natural attenuation of rapid changes in stream discharge provided by lakes in the watershed;
- Fish screens can be used at pipe water intakes to limit the fish entering into the intakes when required. The fish screens will be designed according to the Fisheries and Oceans Canada (DFO) *Freshwater Intake End-of-Pipe Fish Screen Guideline*;
- When required, fish nets can be placed upstream of the dyke to reduce the risk of flushing of fish downstream until the water in the internal water management system has met specific water quality criteria;
- Preferably, draining the ponded upstream water can be carried out during the season when the least impacts to fish and fish habitat are expected, e.g., late fall or early winter when natural runoff is none or limited and the risk to expose eggs and larval fish in the littoral areas upstream is minimized;
- When required, before excavating the underwater portion of the dyke section, a temporary cofferdam can be placed upstream of the dyke to limit the water flowing through the excavation area during construction;
- For Dyke A, excavation of the central portion (including the core) of the dyke can be completed before the removal of the outermost portions of the upstream and downstream shells, which provide some confinement of the suspended solids when the central portion of the dyke is

removed. In addition, turbidity barriers (e.g., silt curtains), prior to excavating the underwater portion of the dyke section, can be installed on either side of the dyke alignment to protect Kennady Lake water quality during construction. Given the shallow water (less than 2 m) at the proposed Dyke A location, installation and maintenance of the turbidity barrier is expected to be straightforward;

- If required, erosion protection materials can be placed over the breached dyke sections to protect the restored flow channels from erosion and sediment generation; and
- Water quality will be monitored during dyke decommissioning. Should water quality not meet regulatory requirements, additional contingency measures can be taken to resolve issues. These would include: 1) installing additional turbidity barriers, 2) constructing a temporary filter berm to retain the excess suspended solids and allow the clean water to pass through, or 3) pumping the water with high levels of total suspended soils (TSS) to a temporary polishing pond to be constructed at the site.

The downstream slopes of breached Dykes B, N, and K are to be flattened and 1 m of erosion protection material is to be placed over the excavated dyke crests (2011 EIS Update, Section 8, Attachment 8.I.2 [De Beers 2011]).

b) Results of water quality modelling indicate that the Kennady Lake water quality will be suitable for discharge following refilling, allowing removal of Dyke A to reconnect Kennady Lake to downstream waters.

As described in Section 9.10.4.3 of the 2011 EIS Update (De Beers 2011), increased nutrient concentrations are predicted in the downstream watersheds after reconnection to Kennady Lake. The predicted mean long-term concentrations of phosphorus in the L and M watershed lakes were 0.015 milligrams per litre (mg/L) and 0.013 mg/L, respectively. These projections were indicative of a mesotrophic trophic status. However, based on the supplemental mitigation associated with the Fine Processed Kimberlite Containment (PKC) Facility and additional geochemical testing results presented in the 2012 EIS Supplement (De Beers 2012), the updated predictions for mean long-term concentrations of total phosphorus in the L and M watershed lakes are 0.009 mg/L and 0.008 mg/L, respectively. These values indicate that trophic status will remain oligotrophic (i.e., total phosphorus concentrations of less than 0.010 mg/L) in these lakes over the long term. Consequently, a water treatment plant is not anticipated to be required.

De Beers will monitor water quality during operations, and if required, develop an appropriate adaptive management strategy that can be implemented prior to closure to ensure the quality of the water in Kennady Lake will be acceptable for reconnection with downstream lakes following refilling.

Furthermore, as described in Section 8.11.1.3.3 of the 2011 EIS Update (De Beers 2011), recovery of Kennady Lake is expected to occur relatively quickly. Using supplemental pumping from Lake N11, Kennady Lake is expected to be refilled after approximately eight years. The expected time frame for recovery of the phytoplankton community is estimated to be within five years after refilling is complete, taking into consideration that the phytoplankton community will begin to develop during the eight to nine year refilling period. The zooplankton community development is predicted to follow recovery of the phytoplankton community (i.e., within the first 5 to 10 years). Recovery of the benthic invertebrate community is also expected to be within the first 10 years following refilling. After development of the forage fish community, which would likely begin to develop during the refilling period, the larger-bodied predatory species, such as northern pike and lake trout, would colonize. These large-bodied fish species are expected to colonize the refilled lake areas shortly after refilling, but it will take time for the populations to build, and then to stabilize. For northern pike, this may take up to 50 or 60 years, and for lake trout 60 to 75 years. These predictions of stabilization of the population for northern pike and lake trout are based on approximately 15 years for the development of the supporting food webs, and allows for the completion of two complete life cycles of these long-lived species. Arctic grayling which are faster growing and shorter lived are predicted to develop and reach stability more rapidly.

References

De Beers (De Beers Canada Inc.). 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO&EC_46

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Kennady Lake – Limited Overwintering Post Closure

EIS Section: Volume 8-450

Preamble

It is stated in the EIS "*Although cisco may be able to access Kennady Lake in post-closure, this species is unlikely to become permanently established in Kennady Lake due to overwintering habitat limitations*". This is a concern as overwintering habitat is limiting in the area.

Request

a) Please provide a summary of the reasons that overwintering habitat in the refilled Kennady Lake is to be limited. Also, please provide measures that could be implemented to address these overwintering habitat limitations.

Response

The statement cited in the preamble is from the 2010 EIS (De Beers 2010); however, this section was subsequently updated as part of the 2011 EIS Update (De Beers 2011). In Section 8.11.3.3, Page 8-473, of the 2011 EIS Update, this conclusion was no longer included, as suitable overwintering habitat conditions for this species are expected in the refilled Kennady Lake.

As described in Section 8.11.3.3 of the 2011 EIS Update (De Beers 2011), it is unclear why cisco do not appear to be present in Kennady Lake, as suitable physical habitat and food availability appear to be present for this species. It is expected that if cisco migrate into the refilled lake, they may become established. As a cold-water salmonid, overwintering habitat requirements for this species would be similar to lake trout and round whitefish, both of which are expected to have suitable habitat conditions for overwintering in the refilled Kennady Lake (Sections 8.10.4.4.1 and 8.11.1.3.3 of the 2011 EIS Update [De Beers 2011]). Furthermore, due to the supplemental mitigation associated with the Fine PKC Facility proposed in the 2012 EIS Supplement (De Beers 2012), nutrient levels in the refilled lake are predicted to be lower than those presented in the EIS Conformity Response Update; as a result, potential effects on overwintering habitat for cold-water fish species are expected to be less than described in the EIS Conformity Response Update. See the 2012 EIS Supplement (De Beers 2012) for additional details.

References

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO&EC_47

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Closure – Arctic Grayling Habitat

EIS Section: Section 9, page 391

Preamble

Quantification of habitat losses to fish habitat is necessary to determine appropriate measures to offset these losses.

Request

a) Please describe what a "small" change to the suitability and availability of Arctic Grayling spawning and rearing habitat is in the L and M Watershed. Provision of a proportion or percentage would be helpful.

Response

As described 9.10.4.3.2 of 2011 EIS Update (De Beers 2011), based on the increased nutrients in the downstream system, there is a potential for increased algal growth on the substrate in the streams of the L and M watersheds. However, as described in this section, any effect of the increased productivity on Arctic grayling spawning was expected be minimal. The streams typically freeze to the bottom in the winter and spawning occurs during a period of high flow, both of which would act to scour the previous accumulations of algae from the substrate. In addition, the short incubation time of eggs in the substrate also would limit the potential effects of increased algal growth on the substrate. As a result, any change in spawning habitat was expected to be small, as these streams would continue to provide Arctic grayling spawning habitat for fish from Kennady Lake and downstream watersheds, and no measurable change to the abundance of the Arctic grayling population would be expected as a result of changes to spawning habitat.

However, based on the supplemental mitigation associated with the Fine PKC Facility presented in the 2012 EIS Supplement (De Beers 2012), these streams are predicted to remain oligotrophic, and not mesotrophic as presented in the

2011 EIS Update (De Beers 2011). As a result, changes to Arctic grayling spawning habitat would be less than presented in the 2011 EIS Update. Although the streams would likely be more productive compared to existing conditions, any changes to Arctic grayling spawning habitat would be expected to be not measurable.

The updated water quality projections, and effects to fish and fish habitat will be provided in the 2012 EIS Supplement, which will be submitted to the MVEIRB in 2012.

References

De Beers (De Beers Canada Inc.). 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Information Request Number: DFO&EC_48

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Closure - Pike

EIS Section: Section 8, page 20

Preamble

Northern Pike are predicted to be one of the species that will inhabit Kennady Lake post closure but aquatic habitat required by various life stages of this species is expected to be minimal

Request

a) Has DeBeers considered an active re-vegetation program to address this habitat deficiency as part of closure planning?

Response

De Beers does not plan on actively re-vegetating the shoreline of Kennady Lake, as it is predicted that re-vegetation will occur naturally (i.e., from the water management pond, and from the dewatered and refilled lake areas). As the closure water management plan involves progressively refilling the lake, it is expected that the re-vegetation will occur rapidly. As described in Section 11.7.10.2 of the 2010 EIS (De Beers 2010), a vegetation monitoring and follow-up plan will be developed associated with the dewatering and refilling of Kennady Lake. As well, monitoring for fish habitat (including macrophytes) will be conducted as part of the post-closure monitoring of the recovery of Kennady Lake. Using adaptive management, if macrophyte communities are not developing, a plan may be developed and implemented to initiate their establishment and growth.

Vegetation in Kennady Lake is rare, related to the availability of suitable habitat for the growth of vegetation (i.e., the lack of fine sediment around the periphery of the lake). As described in Section 8.3.8.2.1 of the 2010 EIS and Section J.4.1.1 of Annex J (De Beers 2010), the nearshore habitats of Kennady Lake are primarily composed of clean cobble and boulder substrates; these substrates are generally found along exposed shorelines where wind and wave actions function to reduce silt accumulation. Aquatic vegetation in Kennady Lake is extremely limited and is typically restricted to a narrow fringe of sedges in protected embayments and at tributary mouths where sediments have accumulated. A narrow band of terrestrial vegetation is typically inundated in spring when water levels in the lake rise, but this habitat usually exists for only two to three weeks during the peak spring freshet.

Vegetation is rare in Areas 2, 3, 4, and 5 and is primarily located at the mouth of stream D1, and along the perimeter of the island separating Areas 3 and 4. The western arm of Area 6 provides more sheltered habitat and has some areas of aquatic vegetation. Area 7 includes two small shallow (< 2 m) bays with relatively abundant aquatic vegetation along the south shore.

A described in Section 8.11.1.3.3 of the 2011 EIS Update (De Beers 2011), because Kennady Lake does not support a substantial aquatic plant community due to physical factors and climate, it is unlikely to do so in the future. However, as a result of the increased nutrients in the refilled lake, there may be an increase in aquatic macrophyte growth, which would improve the availability of suitable spawning and rearing habitats for northern pike in Kennady Lake. It is expected that during post-closure, macrophytes will re-establish on the sheltered shoreline areas that are currently suitable for macrophytes; however, due to increased nutrient availability, the macrophyte areas may be larger or better established. However, as the substrate is the limiting factor in the distribution of aquatic vegetation in Kennady Lake, it is unlikely that a substantial increase in macrophytes will occur during post-closure. Additional re-vegetation efforts (i.e., transplants) are also considered unlikely to be successful, due to the substrate limitations.

References

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

Information Request Number: DFO&EC_49

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Closure - "New Equilibrium"

EIS Section: Section 9, page 392

Preamble

Returning the Project area, including downstream watersheds, to a stable functioning ecosystem should be the desired endpoint of closure.

Request

a) Please describe the predicted "new equilibrium" that will be reached in the L and M watersheds after post-closure. How long will it take to be established?

Response

The “new equilibrium” referred to in Section 9.10.4.5 of the 2011 EIS Update (De Beers 2011) refers to adjustment of the downstream aquatic ecosystem to the increase in nutrient levels along a gradient from Kennady Lake to Lake 410 after reconnection with the refilled Kennady Lake. Predicted nutrient levels in the 2011 EIS Update were indicative of a gradient in trophic status from mesotrophic in the L watershed to oligotrophic in Lake 410.

As described in Section 9.10.4.3 of the 2011 EIS Update (De Beers 2011), the increase in nutrient concentrations would initially increase primary productivity in downstream lakes and streams, which would subsequently increase secondary productivity and biomass of the zooplankton community, as well as an increase in benthic invertebrate abundance and biomass. Due to the increase in the food base for fish and potentially in the small-bodied forage fish community, there may also be increased growth and production in large-bodied fish species reflective of the gradient in predicted nutrient concentrations from Stream K5 to Lake 410. Due to the potential lag in the bottom-up response of the food web, the effects of increased nutrients on the growth and production of large-bodied species may not be measurable for several years. To provide an indication of the time period for the system to equilibrate, a literature review of experimental fertilization studies is provided below.

Lake fertilization studies have shown that primary production increases almost immediately, along with increases in zooplankton biomass (LeBrasseur et al. 1978; Johnston et al. 1999). Whole lake fertilization experiments performed at small oligotrophic lakes in Saqvaqjuac, in the Canadian central arctic, from 1978 to 1983 also showed that the response by the phytoplankton was immediate and sustained (Welch et al. 1989). Chironomid emerging biomass also responded immediately to increased phytoplankton production, reaching equilibrium in the following year (Welch et al. 1988).

The response by invertebrates, however, may be delayed by several years relative to that by phytoplankton, as observed by Hershey (1992) in an experimentally fertilized lake. In an arctic lake in Alaska, O’Brien et al. (2005) also found that after a two year time lag, the snail *Lymnaea elodes* increased in the treated lake sector, but chironomids did not. In the Saqvaqjuac fertilization experiments in the Canadian central arctic, the response of macroinvertebrates was slower than that of the phytoplankton and zooplankton, beginning in the second year of fertilization (Jorgenson et al. 1992); these authors concluded that the increased primary production from the fertilization of arctic lakes increased the production of macrobenthos in turn, with the equilibrium response time approximately twice the generation time of each species, ranging from two years from Chironomidae, four years for *Gammarus*, and even longer for Trichoptera. However, in a stream fertilization experiment, Johnston et al. (1990) found that although the mean standing crops of benthic invertebrates were similar at control and fertilized sites during the first two months of enrichment, the standing crops at the fertilized sites increased to three to five times the control sites by the end of the first year of fertilization.

Studies have found that the response of fish populations to experimental fertilization is more variable. Furthermore, for some experiments, the long-term effects on growth and production have not been tracked due to the short time-frame of the study. Immediate increases in growth upon enrichment have been reported in some of the fertilization experiments. For example, Johannessen et al. (1984) found that the length and weight of brown trout increased during the three seasons of lake fertilization in Norway. In an experimentally fertilized British Columbia coastal lake, Hyatt and Stockner (1985) found that the weight of two-year old sockeye during fertilization years to be approximately twice that of untreated years, reflective of the increased zooplankton abundance in the lake. Johnston et al. (1999) also found rainbow trout growth to be increased during the first year of fertilization in a montane lake in British Columbia. Similarly, in a study of whole-river fertilization of the Keough River, British Columbia, Johnston et al. (1990) found that salmonid fry weights were increased during treatment years compared to non-treatment years.

During fertilization experiments conducted at in a small, oligotrophic lake in Alaska, Lienesch et al. (2005) found that lake trout growth and average size increased as fertilization progressed, likely due to increased food availability. These authors also found that there were changes to the size structure of the lake trout population.

Some studies, however, have shown a lag in the response of the fish population to fertilization. For example, in a four year lake fertilization study in the Experimental Lakes Area in northwestern Ontario, Mills (1985) found that growth of lake whitefish was greater in the fertilized lake basin than the control basin during the second through fourth year of fertilization; the lake whitefish also had greater recruitment and production during that time period. Growth of the lake whitefish in the fertilized basin peaked during the seventh and eighth years of fertilization (Mills et al. 1987); the authors also found increased survival of young fish (i.e., > age 1) in the fertilized basin compared to the control. In the Saqvaqjuac fertilization experiments in the Canadian central arctic, fish populations increased in P&N Lake as a result of the fertilization, but in keeping with their relatively long life cycles, had not stabilized at the time of the last sampling in 1983 (i.e., five years after the start of fertilization) (Jorgenson et al. 1992).

Based on these studies, it is expected that the lower trophic levels will respond to the nutrient gradient very quickly (i.e., within the first one to two years) after reconnection. However, the fish community will likely take longer to respond to the increased food supply and transition to equilibrium, due to the differences in individual fish species and life histories (i.e., feeding preferences, movement patterns), as well as taking into account top down mechanisms, such as prey-dependent predation. It is expected that although there may be increased growth in some of the fish species/life stages within a few years, it may be a decade or more for the populations to stabilize at the new level.

However, based on the supplemental mitigation associated with the Fine PKC Facility presented in the 2012 EIS Supplement (De Beers 2012), these streams are predicted to remain oligotrophic, and not mesotrophic as presented in the 2011 EIS Update (De Beers 2011). Although increased productivity would still be expected, changes would be less than presented in the 2011 EIS Update. The updated water quality projections, and effects to fish and fish habitat will be provided in the EIS Supplement (De Beers 2012), which will be submitted to the MVEIRB in 2012. Although the expected change in productivity is expected to be less than originally presented, the time for the fish populations to stabilize to the new level is expected to be similar under both scenarios.

References

De Beers (De Beers Canada Inc.). 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Hershey, A.E. 1992. Effects of Experimental Fertilization on the Benthic Macroinvertebrate Community of an Arctic Lake. *Journal of the North American Benthological Society* 11(2):204-217.

Hyatt, K.D. and J.G. Stockner. 1985. Responses of Sockeye Salmon (*Oncorhynchus nerka*) to Fertilization of British Columbia Coastal Lakes. *Canadian Journal of Fisheries and Aquatic Sciences* 42:320-331.

Johannessen, M., A. Lande and S. Rognerud. 1984. Fertilization of 6 Small Mountain Lakes in Telemark, Southern Norway, International Association of Theoretical and Applied Limnology Proceedings. 22:673-678. Cited in Dillon, P.J., B.J. Clark and H.E. Evans. 2004. The Effects of Phosphorus and Nitrogen on Lake Trout (*Salvelinus namaycush*) Production and Habitat. In Boreal Shield Watersheds: Lake Trout Ecosystems in a Changing Environment. Gunn, J.M., R.J. Steedman and R.A. Ryder, (eds). Lewis Publishers. CRC Press. 2004. *pp*. 119-131.

Johnston, N.T., C.J. Perrin, P.A. Slaney and B.R. Ward. 1990. Increased Salmonid Growth by Whole-river Fertilization. *Canadian Journal of Fisheries and Aquatic Sciences* 47:862-872.

Johnston, N.T., M.D. Stamford, K.I. Ashley and K. Tsumura. 1999. Responses of Rainbow Trout (*Oncorhynchus mykiss*) and Their Prey to Inorganic Fertilization of an Oligotrophic Montane Lake. *Canadian Journal of Fisheries and Aquatic Sciences* 56:1011-1025.

Jorgenson, J.K., H.E. Welch and M.F. Curtis. 1992. Response of Amphipoda and Trichoptera to Lake Fertilization in the Canadian Arctic. *Canadian Journal of Fisheries and Aquatic Sciences* 49: 2354-2362

LeBrasseur, R.J., C.D. McAllister, W.E. Barraclough, O.D. Kennady, J. Manzer, D. Robinson and K. Stevens. 1978. Enhancement of Sockeye Salmon (*Oncorhynchus nerka*) by Lake Fertilization in Great Central Lake: Summary Report. *Journal of the Fisheries Research Board Canada* 35: 1580-1596.

Lienesch, P.W., M.E. McDonald, A.E. Hershey, W.J. O'Brien and N.D. Bettez. 2005. Effects of a Whole-lake Experimental Fertilization on Lake Trout in a Small Oligotrophic Arctic Lake. *Hydrobiologia* 548:51-66.

Mills, K.H. 1985. Responses of Lake Whitefish (*Coregonus clupeaformis*) to Fertilization of Lake 226, the Experimental Lakes Area. *Canadian Journal of Fisheries and Aquatic Sciences* 42: 129-138.

Mills, K.H., S.M. Chalanchuk, L.C. Mohr and I.J. Davies. 1987. Responses of Fish Populations in Lake 223 to 8 years of Experimental Acidification. *Canadian Journal of Fisheries and Aquatic Sciences* 44 (Suppl. 1) 114-125.

O'Brien, W.J., M. Barfield, N. Bettez, A.E. Hershey, J.E. Hobbie, G. Kipphut, G. Kling and M.C. Miller. 2005. Long-Term Response and Recovery to Nutrient Addition of a Partitioned Arctic Lake. *Freshwater Biology* 50: 731-741.

Welch, H.E., J.K. Jorgenson and M.F. Curtis. 1988. Emergence of Chironomidae (Diptera) in Fertilized and Natural Lakes at Saqvaqjuac, N.W.T. *Canadian Journal of Fisheries and Aquatic Sciences* 45:731-737.

Welch, H.E., J.A. Legault, and H.J. Kling 1989. Phytoplankton, Nutrients, and Primary Production in Fertilized and Natural Lakes at Saqvaqjuac, N.W.T. *Canadian Journal of Fisheries and Aquatic Sciences* 46:90-107.

Information Request Number: DFO&EC_50

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Closure - Fish Exclusion

EIS Section: Section 8, page 405

Preamble

The presence of fish will influence dyke removal activities. For guidance on fish salvage please refer to the following report: *Tyson, J.D., W.M. Tonn, S. Boss, and B.W. Hanna. 2011. General fish-out protocol for lakes and impoundments in the Northwest Territories and Nunavut. Can. Tech.Rep. Fish. Aquat. Sci. 2935: v + 34 p.*

Request

a) It is stated that at closure dykes B, D and E will be removed. How will fish, including small bodied fish, be excluded from Kennady Lake until the water has met specific water quality criteria? How does this affect the timing of when these dykes are removed?

Response

Dykes B and D referred to in the Request above are not removed at closure. As per Table 3.9-1 of Section 3.9.3 of the 2010 Environmental Impact Statement (EIS; De Beers 2010), Dyke B is an internal water retention dyke separating Areas 3 and 4 that is breached at Year 11; Dyke D is a permanent water retention dyke located north of Area 2. It is our understanding that the Request is actually referring to the dykes that divert the upper B, D, and E watersheds away from Kennady Lake during operations (i.e., Dykes E, F, and G), and the effects associated with removing these dykes at the end of operations. As a result, the response below is focused on addressing the removal of Dykes E, F, and G.

Under the mine plan, as described in Section 3 of the 2012 EIS Supplement (De Beers 2012), the dykes that separate the upper B, D, and E watersheds from

Kennady Lake will be removed during the initial stages of refilling, allowing Kennady Lake to refill using both the natural drainage runoff from the upper watersheds and supplemental water pumped from Lake N11. Prior to, and during the refilling process, De Beers will track the water quality within Kennady Lake and use adaptive management to make decisions with respect to dyke removal, in consultation with regulatory agencies. If monitoring indicates that water quality is not acceptable in Kennady Lake, De Beers have the option to defer the removal of the dykes, or restore the dykes, to identify the issue and determine appropriate mitigation to address the problem. The trade-off associated with these options is that it would delay the refilling and recovery of Kennady Lake. The time for refilling would be extended by up to two years; as well, the lack of colonization of the forage fish base would delay the recovery of the fish community, potentially by another two to five years.

As described in Section 8.11.1.3.3 of the 2011 EIS Update (De Beers 2011), during refilling, exclusion measures may be used to limit the initial migration of fish from the upper sub-watersheds into Kennady Lake. These exclusion measures would target large-bodied fish, including sensitive fish species, such as lake trout. Small-bodied forage fish species, such as lake chub, slimy sculpin, and ninespine stickleback, would potentially pass through the exclusion structures; these fish species are less sensitive to water quality changes including increased total suspended solids (TSS), and would form a forage fish base for the lake recovery. Once the dykes have been breached and the exclusion measures removed, fish from the reconnected upper watersheds would be able to move back into and out of Kennady Lake. Based on water quality modelling, it is predicted that once Kennady Lake is refilled, water quality in the lake will be suitable for fish (see De Beers 2012).

The exclusion measures have not yet been selected, but would be based on structures that have been used for fish exclusion or screening for other projects. It is anticipated that these structures will be selected during the detailed design for the closure stage of the Project, which will include consultation with the regulatory agencies, including Fisheries and Oceans Canada (DFO).

References

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Information Request Number: DFO&EC_51

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Closure - Sediment and Water Management

EIS Section: Section 8

Terms of Reference Section:

Preamble

The quality of water discharged to and from Kennady Lake is of utmost importance to the receiving ecosystem. The quality of sediment will have an influence on water quality.

Request

a) What criteria will be used to determine if sediment quality in the former Water Management Pond is acceptable for Kennady Lake to be (*reconnected to downstream waters*)?

Response

The criteria that will be used to evaluate sediment quality in the water management pond (Areas 3 and 5) and its acceptability to allow the reconnection of the refilled Kennady Lake to downstream waters will be developed during the detailed design phase of the Aquatics Effects Monitoring Program (AEMP). The monitoring program would also include other areas of Kennady Lake and receiving waterbodies throughout operations and during the refilling period. Sampling locations within Kennady Lake would include Areas 3 and 5 over the course of operations and closure (refilling), as well as other areas of Kennady Lake that are filled in the latter stages of operation (i.e., the southwest arm of Area 6 and Area 7) and during closure.

Potential sediment quality issues that would be considered in the design phase of an AEMP, including potential monitoring options, are outlined in the following:

(1) Sediment contamination resulting in toxicity to organisms living in the sediments (e.g., benthic invertebrates) through ingestion of sediments and/or through exposure via pore water; and

For this option, sediment chemistry will be compared to both sediment quality AEMP-scaled effects levels (e.g., based on CCME Interim Sediment Quality Guidelines (CCME 1999) or Threshold Effects Level) and to reference/background chemistry to determine any contaminants of potential concern (COPCs). The requirement to implement any adaptive management will be determined based on a level of change to sediment chemistry relative to defined effects levels.

Sediment toxicity tests may also be conducted with appropriate organisms using Environment Canada protocols if any COPCs are identified (e.g., exceedances of benchmarks). In addition, resident infaunal populations will be assessed to determine if there are differences from reference or background conditions.

Decisions regarding this option will be made based on the outcomes of this monitoring following weight of evidence assessment procedures outlined in the Environment Canada sanctioned document: 2008 Canada-Ontario Decision-Making Framework for Assessment of Great Lakes Contaminated Sediment (Environment Canada and Ontario Ministry of the Environment 2008).

(2) Potential release of contaminants from sediments to overlying waters at concentrations exceeding CCME water quality guidelines that could be toxic to organisms living on and above the sediments.

It is anticipated that this option will be examined by measurement of water column concentrations of contaminants immediately above *in situ* sediments (e.g., comparisons to CCME water quality guidelines [CCME 1999]), similar measurements on extracted cores over time, water column toxicity tests, and examination of water column populations – in other words, a similar approach will be taken for the water column as for the sediments.

Over the course of the operations and closure phases, monitoring will identify the onset of sediment quality issues that may suggest a potential sediment contamination problem that has the potential to exert an adverse effect to aquatic biota well before the lake is refilled. Strategies to ameliorate potential contamination issues will be incorporated into the adaptive management plan.

In addition, mitigation strategies and environmental design features have been incorporated into the mine plan to reduce the potential for an accumulation of potential contaminants in Kennady Lake during operations. As a result, it is anticipated that the sediment quality in the Kennady Lake will be similar to pre-development conditions. Some examples of these features include:

- A filter Dyke L will be constructed between the Fine PKC Facility in Area 2 and Area 3 to retain the fine PK solids in Area 2, and to allow the excess water in the Fine PKC Facility to seep through the dyke into the water management pond. This will reduce the loading of total suspended solids (TSS) from the facility to the water management pond.

- Water pumped to the water management pond from Areas 6 and 7, Area 2 and water transfers from the pits may also be treated with in-line flocculants to reduce the TSS in the water management pond. A specific area in the southern region of Area 5 is designed to allow the flocculant to settle from this pumped water inflow. A pervious dyke may be constructed within this region, to assist settling of treated water pumped from Areas 6 and 7. The dyke would consist of the north-eastern edge of the West Mine Rock Pile (toe of the pile) and be constructed of mine rock. The dyke would create a calm area to reduce any impacts of northerly winds in the settling zone for flocculated sediments to settle. More specifically, if the wind direction aligns with the long fetch from Area 3 and causes increased wave heights, the dyke would be constructed to reduce the effect of the wind and limit waves. This settling area would also contain flocculated sediments within the area that will eventually be covered by the West Mine Rock Pile.

References:

CCME (Canadian Council of Ministers of the Environment). 1999 (with updates to 2010). Canadian Environmental Guidelines. Winnipeg, Manitoba.

Environment Canada and Ontario Ministry of the Environment. 2008. Canada-Ontario Decision-Making Framework for Assessment of Great Lakes Contaminated Sediment. ISBN 978-0-662-46147-0. Catalogue No. En164-14/2007E. PIBS No. 6223e

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO&EC_52

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Closure - Post-closure Releases of Metals and Phosphorus

EIS Section: Section 8, pages 8-19 and 8-20; Section 9.8.2.2; Section 10.5.3

Terms of Reference Section:

Preamble

The concentrations of phosphorus being flushed from the mine waste piles and PK into the lake water are projected to increase until reaching a steady state during post-closure. The additional phosphorus is predicted to change the trophic status from its current oligotrophic state to that of mesotrophic. The EIS states that "DeBeers is committed to incorporating additional mitigation to achieve a long-term maximum steady-state total phosphorus concentration of 0.018 mg/L in Kennady Lake." (p. 8-19). Three approaches to mitigation have been identified, but details of implementing mitigation have not been provided.

Metals are also predicted to increase in concentration after closure, with cadmium chromium and copper exceeding water quality guideline values. The source is predicted to be groundwater and geochemical sources.

Request

a) Please describe mitigation measures that will be used to reduce total phosphorus levels to a maximum of 0.018 mg/L in Kennady Lake post-closure.

b) Cadmium, copper, and chromium are projected to exceed water quality guidelines in the main areas of Kennady Lake following closure. What mitigation measures are proposed to address this?

Response

a) Concentrations of total phosphorus (TP) are projected to increase in Kennady Lake in post-closure, with the main source being the Fine PKC Facility. Since the submission of the 2011 EIS Update (De Beers 2011), the mine plan has been updated to reflect supplemental mitigation of the deposition of fine PK. As a result, the Fine PKC Facility's footprint has been reduced by 83 hectares (ha) through limiting the extension of the facility into Area 1, which included Lakes A1 and A2. This reduction in size allowed for a reduction in the long-term phosphorus loadings from the facility. This strategy would reduce the surface area of fine PK in the facility by approximately half, effectively reducing the potential for phosphorus loadings from the facility by an equivalent amount.

On-going geochemical testing of site-specific PK material has also identified that the source term phosphorus loading from fine PK material is not as high as reported in the 2011 EIS Update (De Beers 2011). Phosphorus loading was determined from a limited set of PK material, which has been supplemented by additional PK material sourced from drill cores for the site. Geochemical testing of this supplemental material has been undertaken since 2011, and the results of this testing along with the original testing results have been used to update the loading from the updated Fine PKC Facility. The updated source term inputs have been used in the water quality modeling to predict long-term steady state water chemistry in Kennady Lake and downstream waters.

The most recent water quality predictions indicate that no additional mitigation is required and the water quality in Kennady Lake at refilling is expected to be suitable for reconnection with Area 8, and downstream waters. However, De Beers is committed to monitoring the site water quality in Areas 3 and 5 during operations, which will receive the loading from the Fine PKC Facility, closure (i.e. the refilling period), and post-closure. In the event that monitored water quality during operations and closure indicates a shift from EIS projections or identifies a potential water quality issue, contingencies during operations and closure (refilling) through adaptive management processes may be considered. These include flexibility in the water management plan to isolate and sequester water that is not acceptable for discharge in Hearne and Tuzo pits (operations and early refilling) or reduce refilling time (refilling) to allow time to address and manage any issue.

b) Mitigation to minimize changes to water quality and effects to aquatic health include environmental project design features, as well as the water management plan. The mine and solid waste management plans and the water management plan are presented in Sections 3.7 to 3.9 of the Project Description (De Beers 2012).

In the aquatic health assessment, maximum concentrations of total cadmium and chromium were predicted to remain below the Chronic Effects Benchmark (CEB) identified for each substance (see De Beers 2011, Section 8.9.3.2.1); as a result, the predicted increases in the concentrations of these substances were expected to have a negligible effect on aquatic health in Kennady Lake under closure and post-closure conditions. Maximum concentrations of total copper and iron were projected to be above their respective benchmarks at one or more points during closure and post-closure. Based on a review of the CEBs and the concentrations predicted, the potential for adverse effects to aquatic life (i.e., aquatic vegetation, aquatic invertebrates, and fish) in Kennady Lake from copper or iron was considered to be low.

Based on the supplemental mitigation associated with the Fine PKC Facility, the water quality model was revised. The results of the revised water quality modelling were used to update the aquatic health assessment of the 2012 EIS Supplement (De Beers 2012). The results of this revised assessment are summarized below.

Based on comparisons to baseline concentrations and federal water quality guidelines for the protection of aquatic life, 12 substances of potential concern (SOPCs) were selected to further evaluate the potential for aquatic health effects due to direct waterborne exposure. Maximum water concentrations of total antimony, barium, beryllium, cadmium, chromium, cobalt, manganese, strontium, vanadium, fluoride, and total dissolved solids are predicted to remain below the CEB identified for each substance. Thus, the predicted increases in the concentrations of these 11 SOPCs are expected to have a negligible effect on aquatic health in Kennady Lake under closure and post-closure conditions. The maximum concentration of total copper is projected to be above respective CEBs at one or more points during closure and post-closure. However, based on a review of the CEBs and the concentrations predicted, the potential for adverse effects to aquatic organisms in Kennady Lake from copper is considered to be low, and residual effects to aquatic communities are expected to be negligible; follow-up monitoring will be undertaken to confirm this evaluation.

References

De Beers (De Beers Canada Inc.). 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Information Request Number: DFO&EC_53

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Closure - PKC Runoff

EIS Section: Section 8 Section 10.4.2.1.2

Terms of Reference Section:

Preamble

Mine waste material will be subject to runoff, and inundated with lake water post-closure. It is not clearly detailed what the potential impacts will be on water quality from runoff during re-filling of Kennady Lake, nor of the weathering of waste material at the edge of the lake.

Request

a) Please provide details on the impacts of mine waste being inundated with lake water and the long-term impacts of this configuration, taking weathering into account.

b) Please provide details on this design compared to other alternatives.

c) Runoff from the fine PKC, mine rock, coarse PK, plant site, etc. will go into Kennady Lake to assist the refilling. Please provide an estimate of water quality parameters in this runoff, and demonstrate how using this runoff will not present long term water quality concerns in Kennady Lake.

Response

a) The impacts of the mine waste being inundated with lake water were considered as part of the water quality assessment in the 2011 EIS Update (De Beers 2011). The assessment of the potential effects of mine rock and processed kimberlite (PK) material storage to the water quality of Kennady Lake was determined through consideration of runoff and seepage from the mine rock piles and processed kimberlite facilities, contact with the inundated area of these facilities, and diffusive flux from in-pit disposal (Section 8.8 of the 2011 EIS Update). Taking into account the water quality predictions, the

Project is expected to have low or negligible effects on aquatic health in Kennady Lake during closure and post-closure from changes in the chemical constituents of water quality (Section 8.9 of the 2011 EIS Update). As a result, the projected impacts of the Project on the suitability of water within the Kennady Lake watershed to support a viable and self-sustaining aquatic ecosystem are considered to be not environmentally significant (Section 8.14 of the 2011 EIS Update).

A description of methods used to predict the effects from mine rock and processed kimberlite material storage, including the water quality modelling, to the water quality of Kennady Lake is provided below.

As per the waste management plan, as presented in the Project Description, Section 3 of the 2010 EIS (De Beers 2010), coarse PK will be placed in the Coarse PK Pile located on land adjacent to the Area 4 basin and mine rock will be stored permanently in the West and South Mine Rock Piles located adjacent to Area 5 and Area 6, respectively. A portion of these materials will be deposited on land and a portion will be submerged.

Since the submission of the 2011 EIS Update, the mine plan has been updated to reflect supplemental mitigation associated with the deposition of fine PK to reduce potential loading of phosphorus. This change has resulted in a lower volume of fine PK that will be deposited to the Fine Processed Kimberlite Containment (PKC) Facility. Therefore, the Fine PKC Facility's footprint has been reduced to Area 2, which will be separated from Kennady Lake by a permeable dyke (Dyke L). The reduction in the size of the facility reduces the surface area of the Fine PKC Facility by approximately half as it no longer includes Area 1. As part of this supplemental mitigation, a larger volume of fine PK will also be deposited to the 5034 and Hearne pits. The updated Project Description that details the supplemental mitigation is provided in Section 3 of the 2012 EIS Supplement (De Beers 2012).

Effects to water quality in Kennady Lake from these facilities were assessed through the evaluation of surface drainage and seepage estimates, and potential geochemical loading through water contact with the waste rock materials. Drainage volumes from these facilities were calculated based on the land surface area of the facility during mining and post-closure phases (EBA 2011). All runoff and seepage from the Coarse PK and Mine Rock Piles to Kennady Lake were assigned the source term water quality representative of coarse PK and mine rock, respectively. A description of the source water quality assigned to these materials is provided in Appendix 8.III of the 2012 EIS Supplement.

For the Fine PKC Facility, seepage modelling (EBA 2012) indicates that a component of the total drainage from the Fine PKC Facility will flow through saturated fine PK and part of the cover, which is also expected to be saturated. In the Kennady Lake water quality assessment, flow through saturated mine materials was assigned a source term based on the results of saturated column tests. These tests allow the measurement of drainage chemistry resulting from weathering and leaching of the saturated material (MEND 2009). Details of the saturated column tests are provided in Appendix 8.III of the 2012 EIS Supplement. The source water quality assigned to unsaturated and saturated fine PK is provided in Appendix 8.III of the 2012 EIS Supplement (De Beers 2012).

Hydrodynamic modelling developed as part of the 2012 EIS Supplement (De Beers 2012) was used to determine the potential for diffusive flux of exposed fine PK material deposited in Hearne pit at a depth greater than 100 m from the lake surface. This model was similar to that developed for Tuzo pit, detailed in Appendix 8.II of the 2012 EIS Supplement. The modelling projects that meromixis will occur in the Hearne pit, isolating any potential diffusive flux from the fine PK placed in the bottom of the pit.

Water quality in Kennady Lake in closure and post-closure was derived using a flow and mass-balance water quality model, developed in GoldSim™, for a range of water chemistry parameters. Updated water quality modelling provided in the 2012 EIS Supplement is based on the updated mine plan that reduces the size of the Fine PKC Facility and on-going geochemical testing results of mine rock and PK material. The water quality model input values for Kennady Lake during closure and post closure assume that:

- runoff and seepage from mine rock piles and process kimberlite facilities occur in the absence of permafrost (i.e., completely thawed conditions); and
- more conservative higher-end (higher concentration) geochemistry test results have been applied to the water quality model to determine chemical loads from the storage facilities and in-pit disposal.

While conservative assumptions were used in the assessment to provide confidence that changes to water quality will not be worse than projected in Kennady Lake, they also provide an upper bound in order to develop adequate mitigation. In addition, operational conditions are such that permafrost is expected to aggrade into the piles and decrease contact and reactivity with air and water, thereby providing natural mitigation to potential geochemical loading to Kennady Lake, although this is not included in the modelling.

Predicted water quality is based on several inputs (i.e., surface flows, groundwater flows and seepage, background water quality and geochemical characterization), all of which have inherent variability and uncertainty. As such, it is suggested that water quality predictions should not be used to predict absolute concentrations, but rather as a planning tool and to develop monitoring plans (Appendix 8.I, Attachment 8.I.5; De Beers 2011). It is anticipated that runoff and seepage from the reclaimed facilities will be monitored during operations to compare to EIS predictions. If it is identified that the quality of runoff or seepage varies from the predictions, adaptive management strategies will be triggered.

b) Additional options considered for the placement of mine rock and PK material are included in the Alternatives Analysis, Section 2 of the 2012 EIS Supplement (De Beers 2012). Various design options were considered that included the development of on-land facilities for mine rock and PK material, deposition of material into reclaimed basins within Kennady Lake, and in-pit disposal of waste material.

The current mine plan, including the deposition of waste material generated by the Project, was selected because it allows for a more compact disturbance footprint and the sequestering of mine waste in the available mined out pits. This design minimises long term impact on water quality through closure and post-closure. The design also includes smaller rock piles than on-land alternatives through the efficient use of mine rock and PK as pit backfill and the effective use of local topography to form part of the boundary of the Fine PKC Facility. The backfilling of the 5034 pit with mine rock and PK, and the partial backfilling of Hearne pit with fine PK, will also shorten the refilling time for Kennady Lake at closure. Backfilling also provides an effective means of disposing of potential PAG rock. The design includes the progressive reclamation of the Fine PKC Facility and Coarse PK Pile during mine operations.

c) Humidity cell and saturated column testing was conducted on samples of mine rock from the Project to assess the water quality of runoff from mine facilities, including the Coarse PK Pile, mine rock piles, and Fine PKC Facility. The maximum of the 75th percentile concentrations from supplemental testing or the maximum from initial testing in the first five and last five weeks of testing were used to represent the freshet and steady-state drainage water qualities. The water quality source terms for mine rock and PK material are presented in Table 8.I-4 of the 2011 EIS Update (De beers 2011).

A mass load from the Mine Rock, Coarse PK Piles, and the Fine PKC Facility to Kennady Lake was determined by multiplying the assigned water quality by the simulated volumes draining from each facility (EBA 2011). The mass loads were subsequently mixed in Kennady Lake, which also captures natural runoff, to evaluate changes to water quality. The results of the water quality assessment, which are presented in Section 8.8 of the 2012 EIS Supplement (De Beers 2012), were carried into the aquatic health assessment to evaluate the potential for effects to aquatic health.

A comparison of the maximum parameter concentrations in Kennady Lake following closure based on the revised water quality modelling completed for the 2012 EIS Supplement (De Beers 2012) to baseline concentrations and federal water quality guidelines for the protection of aquatic life was completed. Twelve substances of potential concern (SOPCs) were selected to further evaluate the potential for aquatic health effects due to direct waterborne exposure. Maximum water concentrations of total antimony, barium, beryllium, cadmium, chromium, cobalt, manganese, strontium, vanadium, fluoride, and total dissolved solids are predicted to remain below the chronic effects benchmarks (CEB) identified for each substance. Thus, the predicted increases in the concentrations of 11 of these SOPCs are expected to have a negligible effect on aquatic health in Kennady Lake under closure and post-closure conditions. The maximum concentration of total copper is projected to be above respective CEBs at one or more points during closure and post-closure. However, based on a review of the CEBs and the concentrations predicted, the potential for adverse effects to aquatic organisms in Kennady Lake from copper is considered to be low, and residual effects to aquatic communities are expected to be negligible; follow-up monitoring will be undertaken to confirm this evaluation.

References

De Beers (De Beers Canada Inc.). 2010. *Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N.* Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

EBA. 2011. Updated Summary of Water Management and Balance during Mine Operation, Gahcho Kué, NWT (for updated fine PK disposal plan – Option 2). EBA File: E14101143.

EBA. 2012. Seepage Analysis for Fine PK in Area 2 (Updated Fine PK Management Plan – Option 2) Gahcho Kué Diamond Project. EBA File: E14101143.

MEND. 2009. Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials. MEND Report 1.20.1. December 2009.

Information Request Number: DFO&EC_54

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Closure - PKC Facility Design

EIS Section: Section 10.4.2.2

Terms of Reference Section:

Preamble

The current design for the fine processed kimberlite facility incorporates permafrost formation by the encouragement of air circulation. However it is not quantified what impact this design could have on the amount of seepage from the facility and the likelihood of acid rock drainage and metal leaching formation in the event that permafrost does not form or if it degrades in the future. It is noted that weathering of the cover material will occur over time, however there is no estimate of the length of time this process would take to occur or what impact this will have on potential seepage from the facility.

Request

a) Please provide further details on the long-term impacts of the fine processed kimberlite facility design on the amount of seepage from the facility.

Response

a) As stated in Page 8-306 of the 2011 EIS Update (De Beers 2011), projections of water quality in Kennady Lake did not include the development and persistence of permafrost conditions within the mine rock piles, the Coarse PK Pile, and the Fine PKC Facility. It was assumed that seepage quantities from these facilities would be representative of no permafrost conditions, and provide seasonal geochemical loading to Kennady Lake after closure. It is recognized that frozen layers will establish during the development of these facilities and that permafrost will likely continue to develop following closure, which will result in lower rates of seepage through the facilities and geochemical loading to Kennady Lake than simulated in the 2011 EIS Update (De Beers 2011). However, as the assessment of impacts to the suitability of the water quality to support aquatic life includes time periods that extend into the long-term (i.e., 200 years), the assessment was designed to represent potential future climatic conditions where there would be no permafrost.

As summarized in Section 3.7.4.4 of the 2012 EIS Supplement (De Beers 2012), all of the 61 PK samples submitted for geochemical analyses are non-acid generating with substantial excess neutralization capacity. For the samples tested, a maximum sulphide concentration of 0.09 wt% sulphide was observed. The pH of the PK humidity cell leachate was neutral to alkaline and the samples were not expected to release acidity over time.

The main objective of the closure cover over the Fine PK Facility is to reduce surface erosion and prevent dust generation. This cover may also help permafrost development in the fine PK. However, this would be an added benefit. Natural weathering of the granite mine rock cover would be very slow (e.g., millennia).

Further details on the seepage and water quality from the fine PK are discussed in the 2012 EIS Supplement Section 8 and Appendix 8.I (De Beers 2012).

References

De Beers (De Beers Canada Inc.). 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Information Request Number: DFO&EC_55 (Note: source document states DFO IR#55 as the information request number, for consistency DFO&EC_55 has been retained)

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Fish Habitat Compensation

EIS Section: Volume 9

Terms of Reference Section:

Preamble

Fish habitat compensation will be required to offset losses to habitat as a result of various aspects of the Project. A thorough understanding of habitat losses will be required to develop a viable habitat compensation plan. The following information requests relate to various habitat related impacts.

Request

a) Area 8 and downstream is indicated to be a high quality forage area for Lake Trout. Access to this area will be reduced once Dyke A is built, and during operations and closure when flows are substantially reduced. Please provide quantification of habitat harmfully altered, disturbed or destroyed and update the conceptual compensation plan accordingly.

b) A water intake is proposed for Lake N11 and to be located within a rock structure to avoid the need for screens (Table 9.6-4). Please provide information on the timing of installation of the water intake, a habitat assessment of the area within which the water intake is proposed, a conceptual design, and a plan to prevent the impingement and entrainment of fish.

c) Please clarify if a permanent diversion from Lake A3 to the N watershed is proposed. Clarify if the use of an existing watercourse proposed or the creation of a diversion channel (table 9.6-4)?

d) Please provide a conceptual design of the channel, complete with the rock armour proposed to limit erosion to natural rates.

e) Provide an assessment of the potential for of increases in mercury regarding flooded areas proposed as habitat compensation.

f) Please clarify if the following lakes or water courses are expected to experience impacts to fish and fish habitat: Lakes A5-A7 - fine pkc facility, Lake Kb4 and Stream Kb4 - coarse PK pile, Streams A1-A3, A5-A7 - fine pkc facility.

g) Please submit HSI models for watercourse segments and assessment of habitat losses.

h) Please clarify what portion of Tuzo pit was considered in the preliminary net gains described on page 3.II-28 of the CCP.

i) Loss of streams D1 and D2, in addition to the loss of suitable spawning habitat in D3, will eliminate all natural spawning in D watershed. The loss of stream E1 will do the same for E watershed. Please describe the design alternatives considered to minimize this impact.

Response

a) Area 8 and downstream is indicated to be a high quality forage area for Lake Trout. Access to this area will be reduced once Dyke A is built, and during operations and closure when flows are substantially reduced. Please provide quantification of habitat harmfully altered, disturbed or destroyed and update the conceptual compensation plan accordingly.

Area 8 and downstream areas are not considered to be high quality forage habitat for lake trout. As described in Section 8.10.3.4 of the 2011 EIS Update (De Beers 2011), Area 8 is a long (about 4 km), narrow (typically less than 500 m wide), and shallow (generally less than 4 m deep) basin. Results of the radio-telemetry program in Kennady Lake showed that lake trout migrating from the Kennady Lake outlet (Stream K5) to the main basins of Kennady Lake (i.e., Areas 2 to 7), moved quickly through Area 8, presumably because habitat conditions were more suitable in Areas 2 to 7. As described in Annex J, Section J4.4.6.2 of the 2010 EIS (De Beers 2010), radio-tagged lake trout moved within Areas 2 to 7 in summer, and avoided the shallow Area 8. In spring, a small number of lake trout were found to migrate for a short time into Area 8 near the outlet of Kennady Lake, presumably to feed on congregations of spawning Arctic grayling. However, although some feeding may occur in the area near the outlet in spring, the majority of feeding and rearing habitat for lake trout is within the main basins of Kennady Lake. Compared to the main basins of Kennady Lake and other large lakes in the area (e.g., Lakes 410, N11, N16, N17), Area 8 would be considered sub-optimal habitat for lake trout.

As a result of water management during operations and closure, flows downstream of Kennady Lake will be reduced compared to baseline. As described in Section 9.10 of the 2011 EIS Update (De Beers 2011) and Section 9 of the 2012 EIS Supplement (De Beers 2012), the assessment of effects of the reduced flows on fish and fish habitat was completed under a scenario of no additional flow augmentation downstream of Area 8. However, a Downstream Flow Mitigation Plan is currently under development to mitigate any habitat losses due to reduced flows. The flow augmentation that will be implemented will allow for migration of large-bodied species, including lake trout, within the downstream watershed and Area 8. As a result of the Downstream Flow Mitigation Plan, it is expected that there will not be a harmful alteration, disruption or destruction of Area 8 or the downstream habitat resulting from the reduction in flows. A conceptual flow mitigation plan, as well as the habitat compensation plan, was presented to Fisheries and Oceans Canada (DFO) on February 21, 2012. Comments received regarding the plans are being incorporated, and will be finalized through additional consultation with DFO and input from communities.

b) A water intake is proposed for Lake N11 and to be located within a rock structure to avoid the need for screens (Table 9.6-4). Please provide information on the timing of installation of the water intake, a habitat assessment of the area within which the water intake is proposed, a conceptual design, and a plan to prevent the impingement and entrainment of fish.

A conceptual design of the water intake in Lake N11 is not yet available for the Project. As per Table 9.6-4 of Section 9 of the 2011 EIS Update (De Beers 2011), the intake will be designed with best practices to prevent the impingement and entrainment of fish. The option of using a rock structure to avoid the need for screens, or in combination with screens, will be evaluated; infiltration gallery-type designs are commonly used for water intakes across Canada. If fish screens are used to limit the fish entering into the water intake, the screens would be designed according to the DFO *Freshwater Intake End-of-Pipe Fish Screen Guideline*. The selection of the intake site and assessment of the habitat at the site will be completed during the detailed design phase of the Project.

A specific application for approval to construct the intake will be developed once a footprint and site have been finalized, which will account for the timing of construction and location of the intake within the lake. The intake design will also include consideration of approach velocities across the screen or infiltration gallery, such that the DFO end-of-pipe guidelines for the species and life stages of fish expected to be in contact will be met to mitigate for the potential of impingement and entrainment of fish.

c) Please clarify if a permanent diversion from Lake A3 to the N watershed is proposed. Clarify if the use of an existing watercourse proposed or the creation of a diversion channel (table 9.6-4)?

As a result of the supplemental mitigation associated with the Fine PKC Facility, a permanent diversion from Lake A3 to the N watershed is no longer proposed. As described in Section 3.9.2 of the 2012 EIS Supplement, during mine operations, the A watershed will be isolated from Kennady Lake and the Fine PKC Facility through the construction of three low, till berms and a permanent saddle dam (Dyke A1) between the A watershed and Area 2 of Kennady Lake. During operations, natural watershed flows through the A watershed will be managed via a pipeline to Area 8 via Lake J1b. At closure, Lake A1 will be reconnected to Area 3 of Kennady Lake.

d) Please provide a conceptual design of the channel, complete with the rock armour proposed to limit erosion to natural rates.

As per Part c) above, there will not be a permanent diversion channel from Lake A3 to the N watershed. The runoff from the A watershed is planned to be pumped to Area 8 via Lake J1b during operations, and later allowed to flow into Area 3 through a natural, low saddle after a section of the low berm between Area 3 and Lake A1 is removed. If required, erosion protection materials may be placed over the saddle area to protect the channel from erosion and sediment generation.

e) Provide an assessment of the potential for of increases in mercury regarding flooded areas proposed as habitat compensation.

An assessment of the effects of flooding soils and vegetation around the diversion lakes associated with the Project operations is included in Section 8.6.2.3 of the 2011 EIS Update (De Beers 2011) under the secondary pathway: *Release or generation of nutrients, mercury, or other substances into Lakes A3, D2, D3 and E1 from flooded sediments and vegetation may change water quality, and affect aquatic health and fish*. This pathway has been updated in the 2012 EIS Supplement (De Beers 2012) to exclude Lake A3 as a lake that will be raised because the updated Fine PKC Facility will be limited to Area 2 as a result of mitigation associated with the deposition of fine PK.

The potential for increases in mercury specifically related to compensation lakes was not included, as the raising of lake levels for compensation was included in the EIS as a potential compensation option only. The finalization of compensation options will be part of the development of the detailed fish habitat compensation plan, which will be developed through ongoing discussions with DFO, and with input from local communities. However, the effects associated with the raising of lakes for fish habitat compensation would be as described in the pathway above, and summarized below.

Mercury concentrations in fish in the raised compensation lakes would not be expected to increase high enough to impair the health of the fish or any wildlife that may eat these fish because of the following:

- The raised lakes are located in the headwaters of the Kennady Lake watershed which limits the input of mercury from upstream sources.
- The vegetation in the areas to be inundated is generally low lying tundra lying over a cobble and boulder substrate with limited soil. Prior to inundation, the area will be surveyed, and where necessary, some preparation of the area through removal of vegetation assemblages

other than tundra (e.g., shrubs) may be considered to reduce the amount of organic material potentially available.

- The number of piscivorous fish (i.e., lake trout, burbot, and northern pike) initially expected to be present in the raised lakes is low and these higher trophic level fish have the greatest potential to accumulate mercury into their tissue.
- Arctic grayling, slimy sculpin, and ninespine stickleback, (i.e., the fish species most likely to initially inhabit the diverted watersheds) are planktivores or benthivores and, therefore, are low on the food chain which lowers the potential for mercury accumulation in their tissues.
- Mercury concentrations in non-piscivorous fish typically peak in 4 to 5 years and then return to pre-impoundment concentrations usually within 10 to 15 years after flooding (Schetagne et al. 1997, cited in Legault et al. 2004; Bodaly et al. 1997).
- The area flooded in relation to the lake size is small which will limit the potential for impact over the whole lake.

While the possibility for increased mercury methylation rates exists, given the modifying factors mentioned above, any potential for increased mercury concentrations is likely minimal. However, monitoring of water quality, sediment quality and fish tissue will be incorporated into the monitoring programs for the Project to confirm this prediction.

f) Please clarify if the following lakes or water courses are expected to experience impacts to fish and fish habitat: Lakes A5-A7 - fine pkc facility, Lake Kb4 and Stream Kb4 - coarse PK pile, Streams A1-A3, A5-A7 - fine pkc facility.

Lake Kb4 and Stream Kb4 are included under permanent losses associated with the Coarse PK pile, and are considered in the Conceptual Compensation Plan (CCP, EIS Appendix 3.II, Section 3.II.5.1 of the 2010 EIS [De Beers 2010]); these losses will also be included in the detailed habitat compensation plan.

As a result of the supplemental mitigation associated with the Fine PKC Facility, the A watershed will be diverted as described in the 2012 EIS Supplement (De

Beers 2012). The effects on fish and fish habitat associated with the A watershed diversion are assessed in Section 8 of the 2012 EIS Supplement (De Beers 2012). Clarifications for the A watershed diversion are as follows.

- Lakes A5 – A7 and Stream A3 will not be affected by the Fine PKC Facility.
- Stream A1 will be a permanent loss associated with the Project due to the placement of Dyke A1.
- Stream A2 will be flooded from the raising of the lake levels of Lakes A1 and A2.

Updated calculations of habitat losses associated with the Project are included in the 2012 EIS Supplement and will be used in the development of the detailed habitat compensation plan. The detailed habitat compensation plan is under development through consultation with DFO and with input from local communities.

g) Please submit HSI models for watercourse segments and assessment of habitat losses.

HSI models for watercourse segments are being developed as part of the detailed fish habitat compensation plan associated with the Project. When the models have been developed, they will be discussed with DFO for input. The approach associated with the calculation of habitat losses and gains for waterbodies and watercourses associated with the Project will be discussed with DFO prior to the finalization of the plan.

h) Please clarify what portion of Tuzo pit was considered in the preliminary net gains described on page 3.II-28 of the CCP.

The area of Tuzo pit referenced in Table 3.II-21 on page 3.II-58 of the CCP in the 2010 EIS (De Beers 2010) includes the entire area of the pit that is re-submerged at closure. The extension of the top bench around the Tuzo pit is not included in this area, but rather is part of Option 10 in the CCP. These areas will be further delineated to identify habitat gains within each area as part of the detailed compensation plan that is currently under development.

i) Loss of streams D1 and D2, in addition to the loss of suitable spawning habitat in D3, will eliminate all natural spawning in D watershed. The loss of stream E1 will do the same for E watershed. Please describe the design alternatives considered to minimize this impact.

The B, D, and E watersheds will be diverted to the adjacent N watershed to reduce the volume of runoff entering the controlled areas of Kennady Lake. The watersheds will be diverted by constructing earth-fill dykes in their outlet channels to increase their lake elevation so that they flow through natural drainage into the N watershed.

The loss of stream habitat downstream of the dykes is assessed in Section 8.10.3.3 of the 2011 EIS Update (De Beers 2011). As described in this section, the loss of these streams will eliminate all natural spawning habitat for Arctic grayling in these watersheds. However, it should be noted that natural spawning habitat will continue to be available in the diversion lakes for fish species that spawn in lakes.

The mine plan, does not contemplate the construction of excavated diversion channels from the raised lakes to the N watershed. However, as described in Section 8.10.3.3 of the 2011 EIS Update (De Beers 2011), the new stream channels will be evaluated to make sure that they provide spring spawning and rearing habitat for Arctic grayling and allow the seasonal passage of fish between lakes that approximates natural conditions. These streams will be temporary as Dykes E, F, and G will be removed at the end of the operations period, and the flows returned to Kennady Lake through the original stream channels. Any enhancements required to stabilize the channels or improve fish habitat in the newly formed natural outlet channels will be designed during the detailed engineering design phase. Alternatives to the Project design that relate to not including the diversion of the B, D, and E watersheds are provided in Section 2 of the 2012 EIS Supplement (De Beers 2012) and also the Alternatives Analysis report, which will be submitted to the Board in 2012.

References

Bodaly, R.A., V.L. St. Louis, M.J. Paterson, R.J.P. Fudge, B.D. Hall, D.M. Rosenberg and J.W.M. Rudd. 1997. Bioaccumulation of Mercury in the Aquatic Food Chain in Newly Flooded Areas. In A*. Sigel and H. Sigel (eds.) Metal Ions in Biological Systems. Vol. 34*. Mercury and Its Effects on Environmental Biology. Marcel Dekker, Inc. pp. 259-287.

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Schetagne, R., J.-F. Doyon and R. Verdon. 1997. *Summary Report: Evolution of Fish Mercury Levels at La Grande Complex, Québec (1978-1994)*, Joint Report of the Direction principale communication et Environnement, Hydro-Québec, and Groupe-conseil Génivar Inc. cited in Legault, M., J. Benoit and R. Berube. 2004. Impact of Reservoirs. *In*: Boreal Shield Ecosystems: Lake Trout Ecosystems in a Changing Environment. J.M. Gunn, R.J. Steedman, and R.A. Ryder eds. Lewis Publishers, Boca Raton, FL.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO&EC_56 (Note: source document states DFO IR#56 as the information request number, for consistency DFO&EC_56 has been retained)

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Alternative Means of Carrying out the Project – Measures to Offset Loss of Fish Habitat

EIS Section: Conceptual no-net-loss plan

Terms of Reference Section:

Preamble

The Policy for the Management of Fish Habitat (DFO 1986) is the guiding policy for the administration of the Habitat Provisions of the *Fisheries Act*. The guiding principle of this DFO Policy is "No-net-loss of fish habitat". This is accomplished by habitat losses being offset by habitat gains through compensation initiatives. To date, the habitat compensation options proposed to offset losses associated with Kennady Lake are not sufficient. As indicated in the EIS, the length of time that it will take for Kennady Lake to return to a stable state is predicted to be 50 to 75 years post mine closure. Since a habitat loss of for this duration would, for all intents and purposes, be permanent from a fish habitat perspective, habitat enhancement features within Kennady Lake would not be considered in the assessment of offsetting habitat losses, but rather in returning Kennady Lake to a functioning ecosystem post closure. Further, losses associated with small fish bearing lakes and creeks flowing into Kennady Lake have not been taken into account.

Request

a) Please propose additional options to offset losses to fish habitat in Kennady Lake, as well as associated fish bearing lakes and creeks that may be isolated or otherwise impacted.

Response

De Beers believes that the proposed habitat compensation options are appropriate; however, De Beers is committed to continuing to work with Fisheries and Oceans Canada (DFO) and communities on the finalization of options, as part of the development of the detailed fish habitat compensation plan to achieve no net loss of fish habitat.

As described in the Conceptual Compensation Plan (CCP, Appendix 3.II) of the 2010 EIS (De Beers 2010), construction and operation of the mine will cause harmful alteration, disruption, or destruction (HADD) of fish habitat in the Kennady Lake watershed. The affected habitat areas include portions of Kennady Lake and adjacent lakes within the Kennady Lake watershed that will be permanently lost, portions that will be physically altered after dewatering and later submerged in the refilled Kennady Lake, and portions that will be dewatered (or partially dewatered) but not otherwise physically altered before being submerged in the refilled Kennady Lake.

As described in the CCP, the permanently lost habitat areas and the physically altered and re-submerged areas will be compensated for by the proposed fish habitat compensation works. Compensation options have been proposed and will be evaluated in step with the evolution of the Project. Additionally, meetings between De Beers and DFO have occurred including site visits by DFO. Selection of proposed options included consideration of DFO's hierarchy of compensation preferences as outlined in the DFO *Policy for Management of Fish Habitat* (DFO 1986), *Habitat Conservation and Protection Guidelines* (DFO 1998), and *Practitioner's Guide to Habitat Compensation* (DFO 2006). The proposed compensation plan consists of combination of options, generally falling into two categories: habitat creation, and habitat enhancement structures. The proposed options include the following: Options 1b and 1c (increasing aquatic habitat by raising water level and lake area/volume in lakes west of Kennady Lake); Option 10 (widening top bench of mine pits to extend onto previous land areas); Options 3 and 4 (enhancement features in Areas 6, 7 and 8); and Option 8 (Dyke B habitat structure). Additional details on why these options were selected are provided below.

The raising of lake levels (Options 1b and 1c) increases lake depth, volume and surface area, and allows for connections to formerly non-fish-bearing waters. These options create a large amount of aquatic habitat in an area where compensation is difficult to achieve. The creation of new areas of aquatic habitat would be expected to increase fish production, as well as providing additional rearing, spawning, foraging, and overwintering habitat for fish species that inhabit the Kennady Lake watershed. Option 1b is located close to the site, and would be implemented during operations, which will allow for effective monitoring and adaptive management during the operational period when crews and equipment are on site. The raising of lake level options are permanent, and once established, will not require ongoing maintenance.

The habitat enhancement structures in Kennady Lake will be designed and constructed to maximize habitat in the 0 to 4 m depth range (i.e., where the high quality habitat in the lake currently exists, which is kept clean of silt and fine organic debris by wave-generated currents). The structures will be designed to provide spawning, rearing, and/or foraging habitat for the fish community that will re-establish in Kennady Lake after closure. As well, the additional in-lake spawning habitat may help with the re-establishment of species that spawn on rocky shoal habitat, such as lake trout and round whitefish, and will help to offset any losses or alterations of shoreline habitat associated with the placement of facilities as part of the Project (e.g., mine rock piles, pits, etc.). The structures will be located at the site, which will allow for the effective use of equipment and personnel for both construction and monitoring efforts. Furthermore, some of the structures will be built in areas that are dewatered (i.e., in the dry), which will allow for a more effective implementation of the design and placement of material. The structures will also be permanent and will not require ongoing maintenance once established.

The dewatered, but otherwise physically unaltered areas that will be re-submerged will provide habitats post-closure that will have the same physical characteristics as those areas had prior to Project development. However, De Beers acknowledges that these areas will not be re-submerged until at or near the end of mine operations, and therefore, fish will not be able to use the habitat in the fully or partially dewatered areas for approximately 20 years, taking into account the dewatering, operations, and refilling phases of the Project. Therefore, De Beers recognizes that there is a temporal component to the HADD associated with the dewatered and re-submerged areas, and from preliminary discussions with DFO, that compensation will be required for these areas. De Beers is committed to continuing to work with DFO on the appropriate type of compensation for these areas as part of the ongoing development of the detailed fish habitat compensation plan. In addition, the communities will be consulted on the final habitat compensation plan.

However, in terms of the timeline for the recovery of Kennady Lake referred to in the Preamble, the physical and chemical environment of Kennady Lake will be suitable for aquatic life and a functioning aquatic ecosystem will develop shortly after refilling. As described in Section 8.11.1.3.3 of the 2011 EIS Update (De Beers 2011), the lower trophic communities will develop during refilling, with the development of the phytoplankton community is expected to be within the first five years, zooplankton community within the first five to 10 years, and the benthic invertebrate community within 10 years.

After development of the forage fish community, which would establish shortly after refilling, the larger-bodied predatory fish species such as northern pike and lake trout would colonize. These fish species are expected to initially colonize the refilled lake areas shortly after refilling and dyke removal to feed on the forage base; however, it will take time for their populations to build as the fish reproduce, and then to stabilize. Due to species interactions, it is expected that the slow growing species, such as northern pike and lake trout, will take a number of years before the populations stabilize at the carrying capacity; this is expected to be about 50 to 60 years for northern pike, and 60 to 75 years for lake trout. As described in Section 8.11.1.3.3 of the 2011 EIS Update (De Beers 2011), these predictions of stabilization of the population for northern pike and lake trout are based on approximately 15 years for the development of the supporting food webs, and allows for the completion of two complete life cycles of these long-lived species. Arctic grayling, which are faster growing and shorter lived, are predicted to develop and reach stability within Kennady Lake more rapidly. However, as fish will colonize the lake shortly after refilling, it is expected that in-lake structures put in place prior to lake refilling would be utilized by fish much sooner than 50 to 75 years and may in fact help the re-establishment of the fish community. As a result, De Beers believes in-lake habitat enhancement structures remain appropriate compensation options for the Project. As described above, the finalization of options will be completed as part of the development of the detailed compensation plan that will include consultation with DFO and the communities.

Due to the supplemental mitigation associated with the Fine PKC Facility, the quantification of habitat losses associated with the Project has been updated, and will be included as part of the development of the detailed compensation plan. Although De Beers believes that all losses associated with the Project have been taken into account, finalization on what is included in the HADD will occur through discussions with DFO during the development of the detailed plan.

References

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

DFO (Fisheries and Oceans Canada). 1986. The Department of Fisheries and Oceans Policy for the Management of Fish Habitat. Presented to Parliament by the Minister of Fisheries and Oceans. October 7, 1986.

DFO. 1998. Habitat Conservation and Protection Guidelines Developed from the Policy for the Management of Fish Habitat (1986). Second Edition (1998). Ottawa, Ontario.

DFO. 2006. Practitioners Guide to Habitat Compensation, Developed from the Policy for the Management of Fish Habitat (Habitat Policy) (1986).

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO&EC_57 (Note: source document states DFO IR#57 as the information request number, for consistency DFO&EC_57 has been retained)

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Impacts to Fish and Fish Habitat – Temporal Scale

EIS Section: 8.10.4

Terms of Reference Section:

Preamble

DFO disagrees that the losses of fish and fish habitat in Kennady Lake during operation can be considered temporary, given the long time period over which the harmful alteration, disruption and/or destruction of fish habitat will occur and the uncertainty as to when, or if, the fish habitat will return to full function.

Request

a) In addition to shorter term impacts, please describe the habitat impacts that would be expected to endure for longer than a period of several months in the context of a non-temporary HADD and describe the proposed methods to mitigate and/or offset these losses.

Response

As described in the Conceptual Compensation Plan (CCP, Appendix 3.II) of the 2010 EIS (De Beers 2010), construction and operation of the mine will cause harmful alteration, disruption, or destruction (HADD) of fish habitat in the Kennady Lake watershed. The affected habitat areas include portions of Kennady Lake and adjacent lakes within the Kennady Lake watershed that will be permanently lost, portions that will be physically altered after dewatering and later submerged in the refilled Kennady Lake, and portions that will be dewatered (or partially dewatered) but not otherwise physically altered before being submerged in the refilled Kennady Lake.

The areas that are dewatered (or partially dewatered), but otherwise physically unaltered before being re-submerged include: portions of Kennady Lake Areas 3 through 7 (those parts that are not either permanently lost or physically altered); Lake D1; and streams D1, D2, and E1. The dewatered, but otherwise physically unaltered areas that will be re-submerged will provide habitats after closure that will have the same physical characteristics as those areas had prior to Project development.

De Beers acknowledges that these areas will not be re-submerged until at or near the end of mine operations, and therefore, may be considered a non-temporary HADD of greater than several months, as per the Request above. Mitigation for these impacts includes the progressive reclamation strategy for the closure water management of Kennady Lake, where portions of the lake that are isolated are refilled to natural water levels as early as possible (see Section 3.9.7.2 of the 2010 EIS [De Beers 2010]), and supplemental pumping from Lake N11 to reduce the re-fill period. From discussions with Fisheries and Oceans Canada (DFO), it is recognized that compensation will be required for these areas. De Beers is committed to continuing to work with DFO on coming to agreement on the appropriate type of compensation for these areas as part of the ongoing development of the detailed fish habitat compensation plan.

References

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO&EC_58 (Note: source document states DFO IR#58 as the information request number, for consistency DFO&EC_58 has been retained)

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Fish Habitat Compensation – Structure

EIS Section: 8.10.4

Terms of Reference Section:

Preamble

It is proposed in the EIS that construction of habitat structures will increase fish production.

Request

a) Reviews of the effects of habitat structures for enhancing fish productivity are equivocal (e.g. Roni et al. 2008 N. Am. J. Fish. Manag. 28:856-890; Whiteway et al. 2010 CJFAS 67: 831-861; Smokorowski et al. 2007 Env. Rev. 15:15-41). Such structures clearly attract fish, but may or may not increase total population sizes. Other compensation ideas should be considered.

b) With regards to the use of impounded habitat as compensation, the flooding of systems may lead to other problems such as increases in mercury in fish, greater anoxia, etc. Other compensation options should be considered.

Response

a) Although there are limited quantitative or long-term monitoring studies in the literature demonstrating the effectiveness of constructed habitat structures, some research studies suggest that constructed fish habitat is a means of improving fish habitat, thereby increasing fish density and biomass (e.g., Fitzsimons 1996). In-lake habitat structures are, therefore, considered appropriate for achieving no net loss in the compensation plan.

The Conceptual Compensation Plan (CCP, Appendix 3.II) of the 2010 EIS (De Beers 2010) describes the various options considered for providing compensation and presents a proposed fish habitat conceptual compensation plan to achieve no net loss of fish habitat according to Fisheries and Oceans Canada's (DFO's) Fish Habitat Management Policy (DFO 1986, 1998, 2006). As described in the CCP, the proposed fish habitat compensation plan consists of a combination of compensation options; the in-lake habitat structures proposed are intended to enhance fish habitat and are only one of the methods being proposed to achieve no net loss of fish habitat for the Project.

As part of the CCP, permanent in-lake habitat structures are proposed as habitat enhancements to increase the amount of high quality fish habitat, increase habitat diversity, and support the fish community that will be re-established in Kennady Lake after closure. The options for in-lake habitat enhancement structures include Options 3 and 4 (construction of habitat enhancement features in Areas 6, 7, and 8) and Option 8 (the Dyke B habitat structure).

Studies have shown that constructed fish habitat may improve fish habitat and increase fish density and biomass in both lake and stream habitats. For example, Fitzsimons (1996) concluded that construction of artificial reefs may be one means of enhancing reproduction and restoring stocks of lake trout in the Great Lakes. Fitzsimmons (1996) also noted that under certain circumstances, artificial reefs that attract lake trout also have the potential to improve lake trout reproduction. Whiteway et al. (2010) used a meta-analysis to test the effectiveness of 211 in-stream restoration projects and concluded that stream restoration projects increased physical fish habitat and also increased salmonid density and biomass; these authors also highlighted the potential for instream structures to create better fish habitat and increase the abundance of salmonids. Upon review of 345 studies on the effectiveness of stream rehabilitation and noting that firm conclusions were difficult to make due to short duration and limited scope of evaluation, Roni et al. (2008) concluded that instream habitat improvement has proven effective for increasing habitat and increasing local fish abundance in many circumstances. Rosenfeld and Hatfield (2006) suggest that salmonid abundance can be increased through habitat construction, but that the constructed habitat must increase the habitat that is limiting. Although noting that the linkage between fish habitat and productive capacity is complex and not quantitatively well documented, Smokororoski and Pratt (2007) generalized that increasing habitat complexity had a positive influence on fish diversity and sometimes abundance.

In low productivity lakes like Kennady Lake, encouraging lake trout to spawn on multiple reefs (through the construction of additional finger reefs and/or other structures) may provide greater accessibility of limited zooplankton resources (i.e., food supply) per individual juvenile lake trout, resulting in higher survival and higher overall numbers of juveniles (Fitzsimmons 2012, pers. comm.). Experiments by McAughey and Gunn (1995) and Gunn and Sein (2000) demonstrate that lake trout will actively seek out alternate spawning sites when traditional habitat is lost and that artificial spawning sites could be utilized to replace traditional lake trout spawning areas that have been lost. The findings of Bronte et al. (2002) suggest that lake trout year-class strength is defined at early life stages (i.e., first four months) and that lake trout visit multiple spawning sites during the spawning season.

Based upon the above reviews, it is expected that enhancing fish habitat in Areas 6, 7, and 8 with constructed reefs and other permanent habitat structures will increase the quality and diversity of fish habitat in Kennady Lake. This enhancement has a good likelihood of increasing species diversity and abundance, and contributes to the achievement of the habitat goals and the re-establishment of the fish community in the refilled Kennady Lake. Additional details on why the in-lake habitat enhancement structures were selected as options proposed in the compensation plan are provided in the response to DFO&EC_56.

As a result, De Beers believes that in-lake structures are appropriate as habitat compensation options; however, De Beers is committed to continuing to work with DFO and local communities on the finalization of options, as part of the development of the detailed fish habitat compensation plan to achieve no net loss of fish habitat.

b) De Beers believes that the raising of lake levels are appropriate options for achieving no net loss in the compensation plan. The raising of lake levels (Options 1b and 1c) increases available aquatic habitat by increasing lake depth, volume and surface area, and allows for connections to formerly non-fish-bearing waters. Additional details on why the raising of lake levels were selected as options proposed in the compensation plan are provided in the response to DFO&EC_56.

It is recognized that flooding of sediments and vegetation may release or generate nutrients, mercury, or other substances, which has the potential to affect water quality and fish. An assessment of the effects of flooding soils and vegetation around the diversion lakes associated with the Project operations is included in Section 8.6.2.3 of the 2010 EIS Update (De Beers 2011) under the secondary pathway of *Release or generation of nutrients, mercury, or other substances into Lakes A3, D2, D3 and E1 from flooded sediments and vegetation may change water quality, and affect aquatic health and fish* (De Beers 2010).

As described Section 8.6.2.3 of the 2011 EIS Update, the gradual flooding of the riparian habitat associated with the raising of these lakes may result in a surge in nutrient concentrations, particularly in the nearshore region of the lakes (De Beers 2011). However, it is not expected that there will be any long term effect on the nutrient dynamics in these lakes. Similarly, the release of metals from the sediment of newly flooded areas is anticipated, either from the suspension of sediment (i.e., particulate metals associated with sediment particles) or during low oxygen conditions at the sediment water interface associated with under-ice conditions in the shallow lakes (i.e., dissolved metals). However, any elevation in the concentration of metals associated with total suspended solids (TSS) from these sources is anticipated to be temporary, and it is not expected that there will be any long term effect on the metals dynamics in these lakes. As described in the response to DFO&EC_55, part e), mercury concentrations in fish in the raised compensation lakes would not be expected to increase high enough to impair the health of the fish or any wildlife that may eat these fish. Monitoring programs would be conducted in raised lakes identified for fish habitat compensation to confirm these predictions.

As a result, De Beers believes that raising lake levels is appropriate as habitat compensation options; however, De Beers is committed to continuing to work with DFO and local communities on the finalization of options, as part of the development of the detailed fish habitat compensation plan to achieve no net loss of fish habitat.

References

Bronte, C.R., S.T. Schram, J.H. Selgeby and B.L. Swanson. 2002. *Reestablishing a Spawning Population of Lake Trout in Lake Superior with Fertilized Eggs in Artificial Turf Incubators*. North American Journal of Fisheries Management 22:796-805.

De Beers (De Beers Canada Inc.). 2010*. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N.* Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

DFO (Department of Fisheries and Oceans). 1986. *Policy for the Management of Fish Habitat*. Department of Fisheries and Oceans. Ottawa, ON.

DFO. 1998. *Guidelines for the Protection of Fish and Fish Habitat: the placement and design of large culverts*. A report prepared by Fisheries and Oceans Canada, Maritimes Region. Final draft April 1, 1998.

DFO. 2006. *Practitioners Guide to Habitat Compensation for DFO Habitat Management Staff*. Version 1.1 Updated December 4, 2006.

Fitzsimons, J.D. 1996. *The Significance of Man-Made Structures for Lake Trout Spawning in the Great Lakes: Are they a Viable Alternative to Natural Reefs?* Canadian Journal of Fisheries and Aquatic Sciences 53 (Suppl.1):142-151.

Fitzsimmons, J.D., pers. comm. 2012. Telephone conversation with Trevor Rhodes, Golder Associates. February 14, 2012.

Gunn, J.M. and R. Sein. 2000. *Effects of Forestry Roads on Reproductive Habitat and Exploitation of Lake Trout in Three Experimental Lakes*. Canadian Journal of Fisheries and Aquatic Sciences. 57(Suppl. 2): 97–104.

McAughey, S.C. and J. M. Gunn. 1995. *The Behavioural Response of Lake Trout to a Loss of Traditional Spawning Sites*. Proceedings of the International Conference on Restoration of Lake Trout in Laurentian Great Lakes. pp.375-383.

Roni, P., K. Hanson and T. Beechie. 2008. *Global Review of the Physical and Biological Effectiveness of Stream Habitat Rehabilitation Techniques*. North American Journal of Fisheries Management 28:856-890.

Rosenfeld, J.S. and T. Hatfield. 2006. *Information Needs for Assessing Critical Habitat of Freshwater Fish*. Canadian Journal of Fisheries and Aquatic Sciences 63:683-698.

Smokorowski, K.E. and T.C. Pratt. 2007. *Effect of a Change in Physical Structure and Cover on Fish and Fish Habitat in Freshwater Ecosystems – a Review and Meta-Analysis*. Environmental Review 15:15-41.

Whiteway, S.L., P.M. Biron, A. Zimmermann, O. Ventoer and J.W.A. Grant. 2010. *Do In-Stream Restoration Structures Enhance Salmonid Abundance? A Meta-Analysis*. Canadian Journal of Fisheries and Aquatic Science 67:831-841.

April 2012

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO&EC_59

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Downstream Flow Mitigation Plan

EIS Section: Volume 9

Terms of Reference Section:

Preamble

Changes to natural flow regimes have the potential to negatively impact downstream aquatic biota in a variety of ways. Limiting these changes and mitigating resultant impacts will be essential in minimizing the overall potential negative effects of the Project.

Request

a) Please provide a downstream flow mitigation plan including, but not restricted to, the following:

- Effect to Arctic Grayling spawning, rearing, feeding and overwintering habitat from a substantial reduction in daily discharges and flows through Stream K5
- Temporal boundaries used for the assessment of downstream effects.
- Potential impacts to Lake N11 and downstream from maintaining the N11 discharge at the 5 year dry flow condition.
- Assessment of potential effects caused by changes to the flood regime using minimum and maximum water depths and velocities modeled for June to August discharge.
- Information used for the qualitative assessment of effects on bank/ shoreline stability.
- Mitigation measures to address potential stranding/ flushing of fish due to ramp up and ramp down during downstream discharge.
- Potential effects of sustaining two year flood levels on beds of receiving waterbodies/ watercourse for three consecutive months.

- When the flows will return to 'baseline' fall conditions after sustained high discharges from June to October, how the flows will be ramped down and over what period of time, and the implications to natural flow variation cues to Arctic Grayling to find overwintering habitat.
- Natural flow range during September and October in comparison to predicted flows.
- Methods to measure flow at N1 to determine if falls within the daily maximum, and contingency measures if the daily maximum is exceeded.
- Concise rationale and data to support conclusion that there will be negligible effects on Young of Year Arctic Grayling.
- Monitoring to ensure suitable habitat for Young of Year Arctic Grayling, and contingency measures if it is not.
- Monitoring to ensure that Arctic Grayling spawning is not affected during dewatering.
- Mitigation to address predicted negative effect from increased barriers to fish passage during operations.
- Rationale to support prediction that there will be no sediment and erosion related effects in Lake N11 and Lake N1 due to increased water levels.
- Descriptions of all lakes in the L and M watershed that are expected to have reduced overwintering habitat for fish as a result of reduced flows
- Predicted loss of riparian and littoral habitat due to reduced flows.
- Clarification on whether barriers to fish passage in N11 are expected as there were contradictory statements in the EIS.
- Baseline minimum and maximum flow at the outlet of Lake N11.
- Impacts downstream of Kennady Lake when diversion channels are decommissioned and all water is directed back into Kennady Lake with no outflow during the refilling period.
- References that confirm Slimy Sculpin are not sensitive to changes in water depths and velocities as indicated in Section 9, page 329 of the EIS.

- Erosion monitoring, including how the information will be used (e.g. adaptive management).
- Clarification on extent of downstream effects. It is indicated that the downstream extent of effects is estimated to be between Area 8 and Lake 410. However this statement on page 391 of Section 9 is followed by another that indicates that both phosphorous uptake by biota and sequestration in the sediments, and nutrient related effects on fish and fish habitat are not expected in Kirk Lake or downstream of Kirk Lake even though Kirk Lake is approximately 12 km downstream of Lake 410.

Response

A Downstream Flow Mitigation Plan (the Plan) is currently under development. A conceptual Plan was presented to Fisheries and Oceans Canada (DFO) on February 21, 2012. Comments received regarding the Plan are being incorporated, and the plan will be finalized through additional consultation with DFO. All of the items mentioned above will be addressed during consultation and/or in the final Plan submitted to DFO for review and approval. Potential impacts within the N, L, and M watersheds as a result of implementation of flow mitigation measures will be discussed in the Plan.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO&EC_60

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Area 1–Alternative Processed Kimberlite Disposal

EIS Section: EIS Analysis Session Presentations

Terms of Reference Section:

Preamble

Area 1 was previously slated to contain processed kimberlite (PK), with Lakes A1 and A2 being removed from the drainage basin. Under the revised scenario, all PK will be contained in Area 2, with some on land, but within the sub-watershed adjacent to Area 1. Water quality modeling included the dewatering of Area 1 lakes.

Request

a) Please provide details of how the use of the revised PK disposal alternative will affect hydrology, modeled water quality, water balance, and closure configuration, and a comprehensive analysis of the associated effects.

b) Please describe additional options considered for placement of mine rock and processed kimberlite, including the option of using Areas 6 and 7.

Response

a) Additional details on hydrology water balance and closure configuration and associated effects will be provided in the 2012 EIS Supplement (De Beers 2012, Sections 8, 9, and 10).

b) Please refer to the response provided in DFO&EC_39.

References

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Information Request Number: DFO&EC_61 (Note: source document states DFO IR#61 as the information request number, for consistency DFO&EC_61 has been retained)

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Area 8 Water Withdrawal

EIS Section: Section 8 page 202

Terms of Reference Section:

Preamble

Area 8 is proposed as the potable water source for the camp, and it is predicted that the water withdrawal may change water levels and affect fish habitat. To mitigate this effect, freshwater usage will be limited by recycling elsewhere. While this will help, it is important to know the volume of Area 8 in order to address how much water can be removed. If measures were introduced to minimize water withdrawal, Lake Trout and Round Whitefish may persist in Area 8 until reconnection with Kennady Lake is possible.

Request

a) Follow the *DFO Protocol for Winter Water Withdrawal from Ice-covered Waterbodies in the NWT and NU*. As this protocol assumes that recharge will occur during the open water season and Area 8 will be used throughout the year as the water source, staff gauges should be used to set minimum water levels that protect littoral habitat.

Response

In order to establish a winter withdrawal limit for a given waterbody, the DFO *Protocol for Winter Water Withdrawal from Ice-Covered Waterbodies in the Northwest Territories and Nunavut* (the Protocol) outlines the following criteria, which are applicable to Area 8 of Kennady Lake for withdrawal activities:

- In one ice-covered season, total water withdrawal from a single waterbody is not to exceed 10% of the available water volume calculated using the appropriate maximum ice thickness provided in the Protocol.

- Only waterbodies with maximum depths that are ≥ 1.5 metres (m) than their corresponding maximum expected ice thickness should be considered for water withdrawal. Waterbodies with less than 1.5 m of free water beneath the maximum ice are considered to be particularly vulnerable to the effects of water withdrawals.

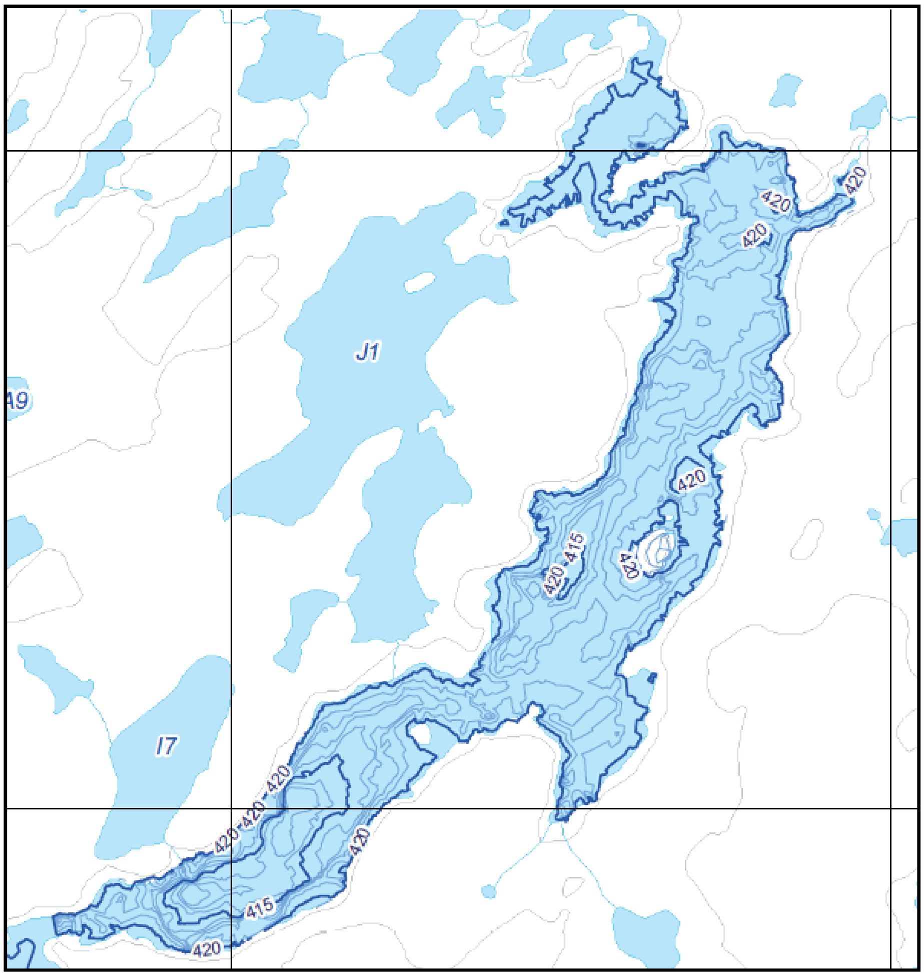
Parameters for Area 8 relevant to the Protocol are summarized in Table DFO&EC_61-1, derived based on available bathymetry data for Area 8 and the most conservative ice thickness of 2.0 m provided in the Protocol. This ice thickness is applicable to Kennady Lake where ice is typically up to 2 m thick as presented in Section 8.3.8.2 of the 2011 EIS Update (De Beers 2011). The bathymetry of Area 8 is shown in Figure DFO&EC_61-1, which is extracted from Figure H5.9-1 in Annex H of the 2010 EIS (De Beers 2010).

Table DFO&EC_61-1 Relevant Parameters of Area 8 of Kennady Lake to the Protocol

Parameter	Value		Comment
	Open Water	Under Ice (2.0 m)	
Volume of free water [m^3]	3,490,000	1,290,000	Derived from available bathymetry data (Figure DFO&EC_61-1)
10% of volume of free water [m^3]	349,000	129,000	-
Closed-circuited mean annual outflow volume [m^3]	1,410,000	0	Sum of mean monthly outflow volumes presented in Table 8.6-2 of the 2010 EIS (De Beers 2010)
Maximum depth of free water [m]	10.2	8.2	Derived from available bathymetry data (Figure DFO&EC_61-1)

m= metre; m^3= cubic metre.

Figure DFO&EC_61-1 Bathymetry of Area 8 of Kennady Lake



Volumes of 60,000 cubic metres per year (m^3/yr)(construction phase) and 27,000 m^3/yr (operations phase) will be withdrawn from Area 8 of Kennady Lake. Based on available bathymetry data, a withdrawal volume of 60,000 m^3 (constructions) corresponds to less than 5% of the volume of free water under a conservative uniform ice cover of 2.0 m. With a maximum depth of 8.2 m, Area 8 greatly exceeds the 1.5 m maximum depth criteria under ice conditions referred to in the Protocol.

Taking into account the updated water balance for the Project associated with the supplemental mitigation for the Fine Processed Kimberlite Containment (PKC) Facility, the expected change in stage and surface area from water withdrawals during the construction and operations phases over winter are presented in Section 8 of the 2012 EIS Supplement (De Beers 2012) and are reproduced in Tables DFO&EC_61-2 and DFO&EC_61-3. These tables show a maximum decrease of 0.12 m in depth and 2.9% in under-ice wetted area during the construction phase. During operations, the changes are less, with a maximum decrease in depth of 0.05 m and under-ice wetted area of 1.3%. The closed-circuited mean annual outflow volume of Area 8 exceeds the withdrawal volumes, indicating that recharge of Area 8 will occur annually.

The withdrawal activities, therefore, meet all criteria of the Protocol. In addition, staff gauges will be installed to monitor the water levels to protect littoral habitat.

Table DFO&EC_61-2 Expected Change in Depth in Area 8 Over Winter from Water Withdrawal Activities

Phase	November	December	January	February	March	April	May
Construction	-0.016	-0.033	-0.050	-0.066	-0.083	-0.100	-0.117
Operations	-0.007	-0.015	-0.023	-0.030	-0.037	-0.045	-0.052

Table DFO&EC_61-3 Expected Change in Under-Ice Wetted Area in Area 8 Over Winter from Water Withdrawal Activities

Phase	November	December	January	February	March	April	May
Construction	-0.41%	-0.83%	-1.25%	-1.65%	-2.07%	-2.47%	-2.90%
Operations	-0.18%	-0.37%	-0.56%	-0.74%	-0.93%	-1.11%	-1.30%

References

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO&EC_62 (Note: source document states DFO IR#62 as the information request number, for consistency DFO&EC_62 has been retained)

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Area 8 Water Intakes

EIS Section: Section 8, page 227

Terms of Reference Section:

Preamble

DeBeers is anticipating localized mortality of small fish species/ early life stages due to impingement/ entrainment in the intake screen for the water pump. Screens should be designed to protect the fish species and life stages that are found in Area 8.

Request

a) Design the fish screen based on the criteria in *the DFO Freshwater Intake End-of-Pipe Fish Screen Guideline*.

Response

Yes, the design of the fish screen in Area 8 will be based on the DFO *Freshwater Intake End-of-Pipe Fish Screen Guideline* criteria. As per Table 8.6-1 in Section 8.6.2.1 of the 2011 EIS Update (De Beers 2011), appropriate sized fish screens following DFO guidelines will be used on the pump intakes in Area 8 to limit fish entrainment.

References

De Beers. 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

Information Request Number: DFO&EC_63

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Area 8 Zone of Turbulence Around Diffuser

EIS Section: Section 8, page 198

Terms of Reference Section:

Preamble

Use of a diffuser has been identified as a mitigation measure to prevent erosion from the pumped discharge to Area 8. However, potential impacts to fish from the turbulence created by the diffuser have not been assessed.

Request

a) Provide an assessment of potential effects to fish from the zone of turbulence around the diffuser.

Response

Due to mitigation measures associated with the diffusers, physical fish habitat disruption from turbulence associated from the diffuser is not expected; as a result, this was considered a No Linkage pathway in Sections 8.6.2.2 and 9.6.2.1 of the 2011 EIS Update (De Beers 2011a). Fish will be also able to avoid the immediate vicinity of the diffuser, as habitat conditions elsewhere in Area 8 or Lake N11 would likely be more favourable.

As described in the response to DFO&EC_35, if required, engineered measures (constructed channel outfall or diffusers) will be used to reduce the erosive energy of water pumped to Lake N11 or Area 8. The requirement of engineered energy dissipation and erosion protection measures at the pipeline discharge outlets will depend on local site conditions (original lake/channel bed materials, water depth around the discharge location), discharge rate, discharge location relative to the shoreline, number of pipelines, and other site specific considerations. The evaluation of energy dissipation and erosion protection measures and the design of associated structures will be carried out during the detailed engineering design stage.

As described in Section 9.6.2.1.1 of the 2011 EIS Update, diffusers, if required, will be placed as close to the surface as possible over the deepest portion of the lake to increase the distance between the outfall and the bottom sediments (De Beers 2011a). Although some sediment may initially be mobilized despite these measures, the extent of this effect is likely to be limited to the zone of turbulence immediately adjacent to the diffuser, and is likely to quickly diminish after sediments in the zone of turbulence are mobilized and become re-deposited farther away from the outfall.

As the resuspension of bottom sediments is expected to be limited, dissolved oxygen depletion due to increased biological oxygen demand is not expected. Monitoring results from Snap Lake, collected prior to the 2011 upgrades, indicate that dissolved oxygen levels have been increasing and total suspended solids (TSS) levels have remained low since the installation and operation of the diffuser (De Beers 2011b, De Beers 2011c). As well, monitoring at Snap Lake indicates that the diffuser has not caused scouring of lake sediments.

The dewatering schedule is shown in Table 8.7-6 in Section 8.7.3.2.1 of the 2011 EIS Update (De Beers 2011a). As described in Sections 8.7.3.2.1 and 3.9 of the 2011 EIS Update, during dewatering (Years -2 to -1), Kennady Lake will be dewatered to both Lake N11 and Area 8 through active pumping; however, active pumping to Area 8 will cease when the water quality in Area 7 approaches specific water quality criteria for discharge (De Beers 2011a). During operations, annual pumped discharge from the WMP to Lake N11 will continue as long as the water quality meets specific water quality criteria for discharge. As a result, it is expected that the dewatering discharge to Area 8 will occur for a maximum of two seasons during the construction phase of the Project only. It is expected that the discharge to Lake N11 will occur for approximately six or seven seasons.

During the dewatering period, the remainder of the lake, as well as stream habitat, would continue to be available for fish. Although fish may avoid the immediate vicinity of the diffuser, the use of diffusers during dewatering would be expected to have a negligible effect on fish use of the habitat in Area 8 or Lake N11.

If diffusers are determined to be the most effective method to mitigate the erosive energy of the discharge into Area 8 and Lake N11, the site selection and final design will consider minimizing effects to fish habitat, both in terms of water quality and habitat avoidance due to the zone of turbulence. Monitoring data from the Snap Lake Project is currently being collected and compiled since completion of the diffuser upgrades in September 2011. Benefits from the Snap Lake diffuser may be incorporated into the design for the Gahcho Kué Project and detrimental effects, if any, can be evaluated for mitigation.

References:

De Beers. (De Beers Canada Inc.). 2011a. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2011b. *2011 Annual Report in support of the Aquatic Effects Monitoring Program Water License (MV2001L2-0002), Snap Lake Project. Snap Lake Project*. Submitted to the Mackenzie Valley Land and Water Board.

De Beers. 2011c. *2011 Snap Lake Dissolved Oxygen Report*. Snap Lake Project August 2011. Submitted to Fisheries and Oceans Canada.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO&EC_64 (Note: source document states DFO IR#64 as the information request number, for consistency DFO&EC_64 has been retained)

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Area 8 Overwintering Habitat

EIS Section: Section 9, page 93-96

Terms of Reference Section:

Preamble

Overwintering is a sensitive time for fish and limited resources often make overwinter habitat critical.

Request

a) With overwintering habitat being limited after Kennady Lake is dewatered and other lakes possibly being at carrying capacity, has DeBeers considered measures to improve the overwintering potential of Area 8 as a temporary mitigation measure during operations and refilling at closure (e.g. aerators, clearing snow to increase light penetration)? In addition, please describe any other feasible measures considered to mitigate impacts to overwintering habitat.

Response

As described in Section 8.10.3.4 of the 2011 EIS Update (De Beers 2011), suitable overwintering habitat does exist in Area 8. Although winter dissolved oxygen concentrations were lower in Area 8 compared to Areas 3, 5, and 6, baseline water quality data indicate that dissolved oxygen concentrations exceeding 6 mg/L are present at depths less than 4 m (2010 EIS, Section 8.3.6.2.1 and Annex I [De Beers 2010]). Radio-telemetry studies also showed that lake trout were able to overwinter in Area 8 in the winter of 2004/05 (De Beers 2010, Annex J, Section J4.4.6.2.2). Although fish will no longer be able to access alternative overwintering refugia in Areas 2 through 7, no change in overwintering habitat conditions during operations would be expected within Area 8 compared to baseline. The change in under-ice lake levels in Area 8 during operations is small (i.e., < 0.12 m, see the 2012 EIS Supplement [De Beers 2012]) and no change in trophic status is predicted.

Alternate overwintering habitat will continue to be available in some of the deeper downstream lakes, such as Lake I1 with a maximum depth of 11 m, Lake M2 (5.7 m), Lake M3 (7.5 m), Lake M4 (13 m), as well as Lake 410 (9.1 m). The situation will also be partially mitigated by the additional overwintering habitat in the area resulting from the raising of water levels in Lakes A1-A2, D2, D3, and E1. The A, B, D, and E watershed diversions will increase lake areas and depths (Table DFO&EC_64-1), which will increase the amount of overwintering habitat for resident species.

Table DFO&EC_64-1 Pre-Diversion (Baseline) and Post-diversion (Operations) Lake Areas and Depths in Diverted Lakes of the A, B, D and E Watersheds

Lake	Lake Area (ha)		Maximum Depth (m)	
	Baseline	Operations	Baseline	Operations
A1	34.5	53.8(a)	8.0	9.7(a)
A2	3.1		1.1	
D2	12.5	104 (a)	1.0	4.6(a)
D3	38.4		3.0	
E1	20.2	27.0	3.9	4.7

(a) Raised water levels will result in one lake
ha = hectare; m = metre.

In general, many mitigative approaches have been used to mitigate for low winter dissolved oxygen levels, including: snow removal, mechanically cutting holes in ice, pumping water onto ice, water level manipulation, fish population manipulation, and artificial aeration (Fast 1994). In the case of Kennady Lake, many of these techniques are not practical due to excessive cost, environmental conditions, or the size and trophic status of the lake. These approaches are described below.

Snow removal, which increases the amount of light penetration resulting in increased photosynthesis and correspondingly increased dissolved oxygen, is most successful and practical in eutrophic lakes with deep snow cover (Merna 1969). Kennady Lake tends to be windswept with low snow depths and is oligotrophic. Barica et al. (1986) examined the efficacy of snow removal to increase dissolved oxygen levels to prevent winterkill of fish and concluded that they would hesitate to recommend snow clearing as an economically viable method for large lakes. Barica et al. (1986) also concluded that in eutrophic lakes in Manitoba, greater than 15% of the surface area of the lake would need to be cleared of snow to have a significant effect on winter dissolved oxygen. The effect of snow removal would be maximized in eutrophic lakes where bacterial decomposition in sediments would be higher than oligotrophic lakes that have less sediments and associated organic matter.

Mechanically cutting holes in ice to facilitate oxygen transfer between lake waters and the atmosphere is possible, however, could cause a further heat drain if extended periods of open water are required (Fast 1994). In addition, maintenance of the holes through the winter would be difficult, especially under arctic conditions, and could potentially be a safety concern near an active mine site.

Pumping water over ice is meant to achieve both a reduction in snow or ice thickness to allow for light penetration, and to provide a means for gas exchange between lake water and atmospheric conditions when the pumped water returns to the lake (Merna 1969). Due to the extreme cold temperatures in winter, it is likely that pumping water over the ice would result in rapid freezing of the water and thickening of the ice, and removal of the water available for overwintering. As discussed above, maintaining holes through the ice to pump sufficient amounts of water to aerate the lake likely would not be feasible.

Raising the water level in Area 8 could potentially increase overwintering habitat; however, this is not considered a viable option due to cost and the fact that the lake levels would not increase much during operations due to the reduced inflows. Raising the water level in Area 8 was considered as a potential fish habitat compensation option in the Conceptual Compensation Plan (De Beers 2010, Section 3, Appendix 3.II). This option (Option 9) consisted of construction of several impounding dykes to raise Area 8 and Lakes L2, L3 and L13 to 422 masl. However, although the dykes could be constructed early in the Project development, there would still be reduced inflows to Area 8 and reduced outflows from Area 8, which would limit the value of the compensation habitat in the operational period. As well, this option would have a high cost due to the distance of structures from the mine area and the location of fill materials, would also enlarge the area of disturbance for the Project, and would likely result in fish passage problems between Area 8 and downstream habitats. As a result, this was not a preferred option for the compensation plan.

Fish populations may be manipulated through stocking and/or fertilization, which can increase fish numbers and/or carrying capacity through increased primary productivity. However, stocking or fertilization of Area 8 would not be an effective means to increase overwintering habitat during operations. Stocking fish is not a viable option when lakes are at carrying capacity. Fertilization of lakes with nitrogen and phosphorus can increase primary productivity, which can lead to increases in dissolved oxygen due to photosynthesis. However, a high level of productivity can also cause dissolved oxygen depletion under the ice due to biochemical oxygen demand, leading to anoxic conditions.

The most common method of artificial aeration for winterkill prevention involves air injection from a line or point sources (Fast 1994). Aeration systems keep an area free from ice and allow oxygen from the air to mix with the open water. The two common types of aeration systems are: a sub-surface unit or “bubbler”, or the surface agitator (MNDNR 2003). Bubblers force air through a hose to a diffuser located near the bottom of the lake, creating air bubbles. The air bubbles cause upward currents that bring the warmer water up from the bottom of the lake and melt the ice. Surface agitators float on the water and contain a propeller or a sprayer that sprays water onto the ice, which creates a current that circulates the water to keep the ice open. Implementation of an artificial aeration system in Area 8 would be very expensive (power supply and ongoing maintenance required), and likely prone to difficulties due to the extreme temperatures and ice conditions. It can also represent a health and safety issue, with possible maintenance of open water areas in the vicinity of the aeration units with the remainder of the lake being ice covered (i.e., danger to snow machine travel on the ice). Some studies have also found higher rates of oxygen consumption during artificial circulation (Ashley 1983; Ashley 1987; Fast 1994).

In summary, De Beers has considered several mitigation measures to increase overwintering habitat in Area 8 during operations, but do not believe at this time that it is required, or that economically viable means of proven enhancement methods are available.

References:

Ashley, K.I. 1983. Hypolimnetic Aeration of a Naturally Eutrophic Lake: Physical and Chemical Effects. *Canadian Journal of Fisheries and Aquatic Sciences* 40: 1342-1359.

Ashley, K.I. 1987. Artificial Circulation in British Columbia: Review and Evaluation. B.C. Fisheries Branch Technical Report No. 78. 34 p.

Barica, J., J. Gibsona and N.D. Howard. 1983. Feasibility of Snow Clearing to Improve Dissolved Oxygen Conditions in a Winterkill Lake. *Canadian Journal of Fisheries and Aquatic Sciences* 40:1526-1531.

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Fast, A.W. 1994. Winterkill Prevention in Lakes and Ponds Using Artificial Aeration. *Reviews in Fisheries Science* 2:23-77.

Merna, J.W. 1969. Aeration of Winterkill Lakes. Michigan Department of Conservation. Research and Development Report No. 11. 14pp.

Minnesota Department of Natural Resources (MNDNR). 2003. Aerating Lakes To Reduce Fish Winterkill. State of Minnesota, Department of Natural Resources.

Information Request Number: DFO_EC_65

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Area 3 Following Dewatering

EIS Section: Volume 2

Terms of Reference Section:

Preamble

The alternatives assessment identifies the preferred option of retaining a portion of the remnant Kennady Lake as a water management pond. Area 3 would be used to receive mine water, treated camp wastewater, surface runoff, and processed kimberlite supernatant and would provide make-up water for the process plant.

The EIS does not provide a description of the conditions in Area 3 at the time it would be designated as the Water Management Pond.

Request

a) Please provide a detailed description of the water quality conditions and physical fish habitat conditions in Area 3 following the initial 3m lake drawdown, and the modeling used to identify concentrations of key water quality parameters (including TSS, DO, metals) as well as physical habitat losses/alterations including alterations to sediments.

Response

The 2011 EIS Update (De Beers 2011) does not provide a description of the conditions in the Water Management Pond (WMP) (i.e., Areas 3 and 5), as these areas were not considered to have water quality conditions suitable for fish during operations. In fact, these areas would be a component of the controlled area, which represents the isolated region of Kennady Lake from which the Project operations will be conducted. As discussed in Section 8.10.3.2 of the 2011 EIS Update, dewatering of the main basins of Kennady Lake (i.e., Areas 2 to 7) is required to allow mining of the three diamond-bearing kimberlite pipes located under the lake-bed. Dyke A will be constructed at the narrows separating Areas 7 and 8 to allow the dewatering of Areas 2 through 7 while maintaining similar lake levels in Area 8. During operations, Areas 6 and 7 will be completely dewatered and Areas 2 through 5 will be partially dewatered. Areas 2 to 5 will be dewatered to the maximum extent possible, i.e., until total suspended solids (TSS) in the Kennady Lake water increases to a level that no longer meets the regulatory requirement for the discharge quality. However, it is estimated that a 3 metre (m) drawdown can be achieved before suspension of lake-bottom sediments would result in TSS levels that are too high to discharge to Lake N11. If possible, the water level will be drawn down further.

As per Section 8.10.3.2 of the EIS, although Areas 2 to 5 will only be partially dewatered, the depth and water quality conditions (including elevated suspended sediment concentrations) in these areas will not be suitable to support a fish community. Fish will also be removed during the fish salvage, and will not be present during mine operations. As a result, the potential effects on fish and fish habitat in the isolated and partially dewatered areas of Kennady Lake were not included in the EIS.

Water and sediment quality conditions in the WMP following the initial dewatering were also not assessed as part of the EIS. Water quality modelling, however, was conducted for the refilled Kennady Lake at closure, which took into account key constituents present in the WMP during the operational period.

However, in response to the IR, a summary of the expected water quality and fish habitat conditions in the partially dewatered areas (primarily Areas 3 and 5) as a result of the dewatering at the time it would be designated as the WMP, is described below.

Water Quality

A summary of expected water quality conditions in Areas 3 and 5 following dewatering is provided below. This summary is based on updated water quality modelling to reflect supplemental mitigation associated with the deposition of fine

PK, which has resulted in an updated water balance and new loadings to Kennady Lake, and TSS modelling of Ares 3 and 5.

Total Suspended Solids and Turbidity

As the water level is drawn down 3 m in Kennady Lake, the TSS modelling suggests localized areas of high TSS and turbidity will occur in shallow areas along the downwind shorelines. Although TSS discharge criteria for receiving waterbodies is in the order of approximately 25 milligrams per litre (mg/L) (or less depending upon regulatory conditions), localized areas of the isolated and dewatered Kennady Lake will have concentrations greater than 100 mg/L for a few days (Golder 2012, *in preparation*). Wind-induced mixing would also cause elevated levels of TSS throughout most of the basin for longer periods of time.

The modelling of TSS was based on three linked systems. The first system predicted wave geometry for single wind storms on the lake by applying the classic forecasting equations for waves in shallow water, as presented in U.S. Army Corps of Engineers (1984). Secondly, the modelling used equations developed by Sheng and Lick (1979) to predict wind-induced resuspension of bed sediment for shallow water areas in Lake Erie, which were successfully applied by Laenen and LeTourneau (1996) in Upper Klamath Lake, Oregon. Finally, the modelling employed the Generalized Environmental Modelling System for Surface waters (GEMSS®) (ERM 2012) to simulate hydrodynamic dispersion of TSS in the lake.

Increases in TSS and turbidity in the drawn-down Kennady Lake will likely be related to resuspension of the silt and clay from new source areas as they become exposed to disturbance within the lake. The maximum depth of the disturbance caused by a water wave sufficient to cause suspension of sediment is referred to as the resuspension zone. Modelling shows that this depth in Kennady Lake is approximately 2 m (Golder 2012, *in preparation*), which means that sediment below 2 m remains, for the most part, undisturbed by wave shear forces. In Kennady Lake before draw down, much of the finer sediment material has been winnowed from the resuspension zone over the years and deposited in deeper zones of the lake beneath the resuspension zone. Drawing Kennady Lake down, especially below 2 m, will expose new areas of the lake bed to resuspension activity. Modelling suggests that after a drawdown of 3 m, a single wind storm with wind speeds of 6 metres per second (m/s) over a 6 hour (h) period has the potential to cause elevated TSS in the order of 50 mg/L to 1,000 mg/L on the downwind shore for 2 to 30 days after the occurrence of the storm, with elevated levels of TSS lasting until the lake freezes (Golder 2012, *in preparation*). On average, 16 storms with wind speeds of at least 6 m/s and durations greater than 6 h occur each year (based on weather data from Snap Lake Mine). The potential, then, is for much greater long-term TSS concentrations in the lake as a result of multiple storms than is predicted by a single storm.

Settling tests of Kennady Lake bed sediment showed that the clay materials contribute to long-term turbidity and TSS. In the isolated and partially dewatered lake, it is expected that wind and wave action would keep the levels elevated over long periods of time. De Beers plans to undertake additional sediment testing to better characterize the lake bed and sediment resuspension dynamic prior to dewatering.

Dissolved Oxygen

In the open-water season, dissolved oxygen levels in Areas 3 and 5 are expected to be similar to existing conditions. However, under ice-covered conditions, the decrease in water levels in the isolated and partially dewatered lake would lead to a decrease in under-ice water volume and increased sediment oxygen demand from the changes to volume and lake bed sediment surface area ratio. Currently, the maximum depth in Areas 3 and 5 is approximately 15 m and based on a 3 m drawdown, the maximum depth of the isolated and partially dewatered lake would be approximately 12 m. The undisturbed mean depth of 6 m (defined as the ratio of lake surface area to lake volume) would be reduced to a mean depth of approximately 4.5 m after a 3 m drawdown. This would translate into an under-ice depth of less than 10 m, and a 40% decrease in under-ice volume.

An empirical relationship was used to provide an estimate of winter oxygen depletion rates. Winter oxygen depletion rates were estimated based on the ratio of sediment surface area and water volume following Mathias and Barica (1980) before and after the partial dewatering of Areas 3 and 5. The results indicate that dissolved oxygen demand under ice-covered conditions could be increased by up to 30% due to dewatering, based on the reduced ratio of lake volume to surface area of the lake bed sediment.

Metals

The water quality in Areas 3 and 5 during the dewatering phase is similar to baseline conditions, with the exception of slightly higher total dissolved solids (TDS) associated with increased evaporation due to limited inflows and smaller surface area of Areas 3 and 5, and higher particulate constituents (i.e., metals) associated with increasing TSS concentrations.

Habitat Conditions

It is expected that within a short period of time, the habitat conditions for fish will change considerably as a result of the dewatering of Kennady Lake. It should be noted that, as described above, fish will be removed from Kennady Lake prior to and during dewatering. However, to address the IR, the following description provides an indication of potential habitat conditions in the isolated and partially dewatered basin if fish were to remain during and following dewatering.

Suspended Sediment

As the water level in Kennady Lake is drawn down, localized areas of high TSS and turbidity would be present, especially in shallow areas and along sheltered shorelines. At this point, it is expected that habitat conditions in the partially dewatered areas of Kennady Lake would become unsuitable for fish due to increasingly higher turbidity and TSS levels. After discharge criteria are no longer met, TSS levels in localized areas will remain high for extended periods of time. As mixing would cause TSS to be elevated throughout most of the basin, habitats with refuge from elevated suspended sediment would become more limited, or not available.

There is a potential for substantial effects on primary productivity as a result of the increased turbidity, which would in turn affect the secondary productivity. The change in the lower trophic communities would reduce the food base for fish. Fish foraging success would also be reduced due to the decreased light penetration in water.

Overwintering Habitat

As described above, the dissolved oxygen demand in Areas 3 and 5 under ice-covered conditions could be increased by up to 30% due to dewatering; this change would lead to a reduction in overwintering habitat compared to baseline. Although overwintering habitat may be available in deeper pockets, the habitat suitability and availability will likely be reduced. The lower dissolved oxygen levels, combined with potentially elevated suspended sediment (as discussed above) would further degrade winter habitat conditions.

Littoral Habitat

The dewatering program will expose shoreline habitat and littoral area. As described in Section J4.1.1 of Annex J of the 2010 EIS (De Beers 2010), the current habitat in Kennady Lake can be classified into three types:

- shallow, nearshore habitat within the zone of freezing and ice scour (i.e., less than 2 m deep);
- nearshore habitat deeper than the zone of ice scour but subject to wave action that prevents excessive accumulation of sediments (i.e., greater than 2 m but less than 4 m in depth); and
- deep, offshore habitat with substrate generally consisting of a uniform layer of loose, thick organic material and fine sediment (i.e., greater than 4 m in depth).

The nearshore habitat is primarily boulder/cobble, generally found along exposed shorelines where wind and wave action keep shorelines free of silt. Calmer areas protected from prevailing winds (i.e., embayments, leeward sides of islands) have more fine sediment within the substrate. In general, substrates are increasingly embedded and covered with sediment with increasing depth.

As a result of the dewatering, littoral zone habitat will be exposed. Based on the estimated 3 m drawdown, approximately three-quarters of the littoral zone in Areas 2 to 5 would be exposed. De Beers is currently undertaking additional work to provide the changes (i.e. areas) to littoral habitat in Areas 3 and 5. The exposure of littoral zone habitat would cause a decrease in food availability (i.e., benthic invertebrates, forage fish base), as well as rearing/feeding habitat for juvenile life stages.

Spawning Habitat

Due to reduction in lake levels, most of the high quality lake trout and round whitefish spawning habitat would be exposed. Most of the high quality lake trout and round whitefish shoreline spawning habitat in Kennady Lake is in 2 to 4 m depth range, where it is kept free of silt and fine organic debris by wave-generated currents, but below the zone of ice scour. Once the lake level is reduced, the lake bed would still be subject to 2 m of ice scour; beyond this zone, the substrate is composed primarily of loose, organic sediment which would not be suitable for lake trout and round whitefish spawning. Furthermore, due to the resuspension of lake bed sediments, any remaining substrate suitable for spawning would also be affected by increased sedimentation, which has the potential to infill interstices and smother embryos, and cause localized oxygen deficiencies in deeper interstitial water due to decomposition of organic material.

Due to the drawdown in lake level, in-lake habitat with aquatic vegetation would also be exposed. As a result, no in-lake spawning habitat would be present for northern pike; this would also affect spawning for ninespine stickleback. Aquatic vegetation in Kennady Lake is extremely limited and typically restricted to narrow fringe of sedges in shallow, protected embayments and at tributary mouths where sediments have accumulated.

As a result of lowering lake levels and establishing the controlled area, no access would be available to tributary streams for spawning or spawning migrations. Kennady Lake Arctic grayling spawn primarily in streams downstream of Kennady Lake (i.e., in the L and M watersheds); however, spawning also occurs in the A, B, and D watersheds. Kennady Lake northern pike primarily spawn in the D watershed located on the western side of Kennady Lake (Annex J). Access to downstream habitats would be prevented from the installation of Dyke A between Areas 7 and 8 to allow for the dewatering to occur. The upper watersheds will be diverted away from Kennady Lake to establish the controlled area, and as a result, access to these watersheds would not be available.

Summary

Overall, following the dewatering program, the habitat conditions in the isolated and partially dewatered lake would be unsuitable for fish, as it would be a highly disturbed and substantially altered environment. The increased turbidity and TSS from the resuspension of lake-bottom sediments would be expected to result in habitat conditions that would cause adverse effects on fish if they were to remain in the isolated and partially dewatered lake; the potential effects could include major physiological stress, or even paralethal or lethal effects (as per Newcombe and Jensen 1996). The reduction in the suitability and availability overwintering habitat, combined with the potential for increased suspended sediment, would likely produce winter habitat conditions that would cause stress on fish, if they were present, such that there would be effects on the populations of sensitive species. Habitat conditions in the isolated and partially dewatered Kennady Lake for spawning and rearing/feeding for lake trout, round whitefish, northern pike, and Arctic grayling would also be severely compromised due to the exposure of littoral zone and shoreline spawning habitat, as well the prevention of access to spawning habitat.

Therefore, De Beers plans to conduct a fish salvage to remove fish from Areas 2 to 7 of Kennady Lake prior to and during dewatering.

Habitat Losses

As described in the Conceptual Compensation Plan (CCP, Appendix 3.II) of the 2010 EIS (De Beers 2010), construction and operation of the mine will cause harmful alteration, disruption, or destruction (HADD) of fish habitat in the Kennady Lake watershed. The habitat areas which form the WMP are included in the CCP under the category of: dewatered (or partially dewatered) but not otherwise physically altered before being submerged in the refilled Kennady Lake. The dewatered, but otherwise physically unaltered areas that will be re-submerged will provide habitats after closure that will have similar physical characteristics, including sediment characteristics, as those areas had prior to Project development.

However, De Beers acknowledges that these areas will not be re-submerged until at or near the end of mine operations. From discussions with Fisheries and

Oceans Canada (DFO), it is recognized that compensation will be required for these areas. De Beers is committed to continuing to work with DFO and communities on coming to agreement on the appropriate type of compensation for these areas as part of the ongoing development of the detailed fish habitat compensation plan.

References

De Beers (De Beers Canada Inc.). 2010. Environmental Impact Statement for the Gahcho Kué Project. Volumes 1, 2, 3a, 3b, 4, 5, 6a, 6b, 7 and Annexes A through N. Submitted to Mackenzie Valley Environmental Impact Review Board. December 2010.

De Beers. 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

ERM. 2012. Generalized Environmental Modeling System for Surfacewaters (GEMSS®). http://www.erm-smg.com/gemss.html

Golder. 2012. Sediment Resuspension Modelling Report. Technical Memo. In preparation.

Laenen, A. and A.P. Letourneau. 1996. Upper Klamath Basin Nutrient Loading Study-Estimate of Wind-Induced Resuspension of Bed Sediment During Periods of Low Lake Elevation. US Geological Survey Open-File Report 95-414. Portland, OR, USA. 11 pp.

Mathias, J. and J. Barica. 1980. Factors Controlling Oxygen Depletion in Ice-covered Lakes. *Canadian Journal of Fisheries and Aquatic Sciences* 37:185-194.

Newcombe, C.P. and J.O.T Jensen. 1996, Channel Suspended Sediment and Fisheries: A Synthesis for Quantitative Assessment of Risk and Impact. *North American Journal of Fisheries Management* 16:693-727.

Sheng, Y.P. and W. Lick. 1979. The Transport and Resuspension of Sediments in a Shallow Lake. *Journal of Geophysical Research* 84:1809-1826.

US Army Corps of Engineers. 1984. Chapter 3 Wave and Water Level Predictions. In Shore Protection Manual, Volume 1. Department of the Army Waterways Experiment Station. Washington, DC, USA. p. 55-77.

Information Request Number: DFO&EC_66

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Water Treatment Contingencies

EIS Section: Volume 3, Section 3.9.1; Section 9 (various); Tables 9.6-4, 9.8-4;

Terms of Reference Section:

Preamble

Treatment of mine water, surface runoff, processed kimberlite supernatant, and other contact water is through the use of the Water Management Pond (WMP). In various sections of the EIS, reference is made to discharging water from the WMP to downstream waterbodies provided specific water quality criteria are met. For example, Section 3.7.5.1 states that part of the water management strategy is to allow for the discharge of water from the WMP to Lake N11, provided the water quality is acceptable for release. Criteria for release have not been specified, nor the extent to which the downstream receiving environment may be altered. The EIS provides maximum concentrations for a range of total and dissolved parameters in Lake N11, but does not identify whether this is a whole-lake average or localized maxima around the diffuser.

The mined-out pits will receive excess water from the WMP once that volume is available, and from that point on it is anticipated any poor quality water would remain sequestered in the lower layers of the pit following refilling.

Request

a) Please provide an alternatives assessment for water treatment, which considers the need to treat for a range of parameters prior to discharge to the downstream receiving environment. An analysis should be provided of the benefits or improvements represented by implementing treatment.

Response

The alternatives analysis report (Alternative Analysis Report will be submitted as a standalone report in 2012) has shown that active water treatment does not replace the need for a Water Management Pond (WMP). If the quality objectives are met with natural clarification within the WMP and other water management tools within the controlled area, the need for active water treatment becomes a later stage contingency.

Parameters for discharge, mixing zones and monitoring points will be determined and regulated as part of the water licensing process. Until those parameters are determined, is has been assumed that the total suspended solids (TSS) discharge criteria for receiving waterbodies will be in the order of approximately 25 milligrams per litre (mg/L). Limits for TDS of water that could be discharged from the WMP was determined by modelling of acceptable receiving water body quality, which in turn was based on effects to the aquatic environment and fish. The modelling showed that water deemed acceptable for discharge during operations is expected to meet a quality, that when discharged to Lake N11 would cause not detrimental effects.

The objective of the Water Management Plan addresses water quality in two ways:

- High TSS water is to be clarified and discharged as required to attain the required balance in the WMP.
- High TDS water is to be held for as long as possible until it can be permanently sequestered in the bottom of the pits at closure.

The operation of the WMP and water management for the Project has several objectives that must be balanced. Water of acceptable quality is discharged from the WMP in order to maintain capacity for efficient management of water used by the Project. Water must remain in the WMP and to re-fill the basin once mining is complete. Lower quality water would be permanently sequestered in the lower sections of the mined out pits at closure. The goal is to use controlled discharge as a management tool.

Active mechanical water treatment is a later stage contingency option to the passive WMP approach. Compared to passive methods, it is costly, energy intensive, and produces a waste by-product stream that requires additional handling.

The alternatives analysis has determined that active water treatment would not eliminate the need for a water treatment pond. Furthermore, the configuration of the Kennady Lake basin allows for a large enough WMP in Areas 3 and 5 to relegate a water treatment plant to a later stage contingency option rather than a complex and costly requirement.

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO&EC_67

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Alternative Means of Carrying out the Project–Water Management

EIS Section: Project description

Terms of Reference Section:

Preamble

How water is managed is a concern for downstream fish and fish habitat, and water quality.

Request

a) Please describe additional water management options considered, including the options of using Areas 6 and 7 for water storage, and alternative routing options for discharge from Area 1.

Response

An alternative analysis will be submitted as a standalone document in April 2012 detailing the additional water management options.

April 2012

GAHCHO KUÉ PROJECT ENVIRONMENTAL IMPACT STATEMENT
INFORMATION REQUEST RESPONSES

Information Request Number: DFO_EC_68

Source: Fisheries and Oceans Canada and Environment Canada (DFO&EC)

Subject: Downstream Effects – Definitions

EIS Section: Volume 9

Terms of Reference Section:

Preamble

There are a number of terms which are used but do not appear to be defined. Defining these terms is essential when considering potential impacts, mitigation and residual effects.

Request

Please define the following terms:

a) Long Term - Context: Pg 9-18 of the July 2011 EIS states “Average long-term concentrations…”

b) Desired - Context: Pg 9-140 of the July 2011 EIS states “Abundance and Persistence of Desired populations…”

c) Please clarify if a specific population or population size is “desired".

d) Persistence - Context: Pg 9-140 of the July 2011 EIS states “Abundance and Persistence of Desired populations…”

Response

a) “Long-term” as referred to on page 9-18 of the 2011 Environmental Impact Statement (EIS) Update (De Beers 2011) relates specifically to water quality predictions. For water quality, the long-term relates to the time that steady state conditions for water quality parameters have been achieved, i.e., parameter concentrations have reached equilibrium and do not change over time or are continually balanced in terms of inflows and outflows. For most parameters, steady state is achieved approximately 70 years after construction.

Two examples are shown that support this definition. Figure DFO&EC_68-1 shows the predicted total phosphorus (TP) concentrations in Lake N11 over time, based on the water quality data presented in the 2012 EIS Supplement (De Beers 2012). The figure shows that concentrations of phosphorus are projected to increase in Lake N11 during operations from active water management pond discharge. Pumped discharge from the water management pond to Lake N11 will cease after Year 4. As a result, phosphorus concentrations are projected to return to concentrations consistent with background concentrations, or steady state conditions, relatively quickly during closure (i.e., within three years).

Figure DFO&EC_68-2 shows the projected TP concentrations in Kennady Lake over time. The figure shows that concentrations of phosphorus are projected to increase due to loading to the WMP during operations and loading from the waste storage facilities after closure (note that the assessment case does not include the development of permafrost in the storage facilities). For this case, the phosphorus concentrations are projected to reach steady state conditions by 70 years after construction.

Figure DFO&EC_68-1 Predicted Total Phosphorus Concentrations in Lake N11 (from the 2012 EIS Supplement)

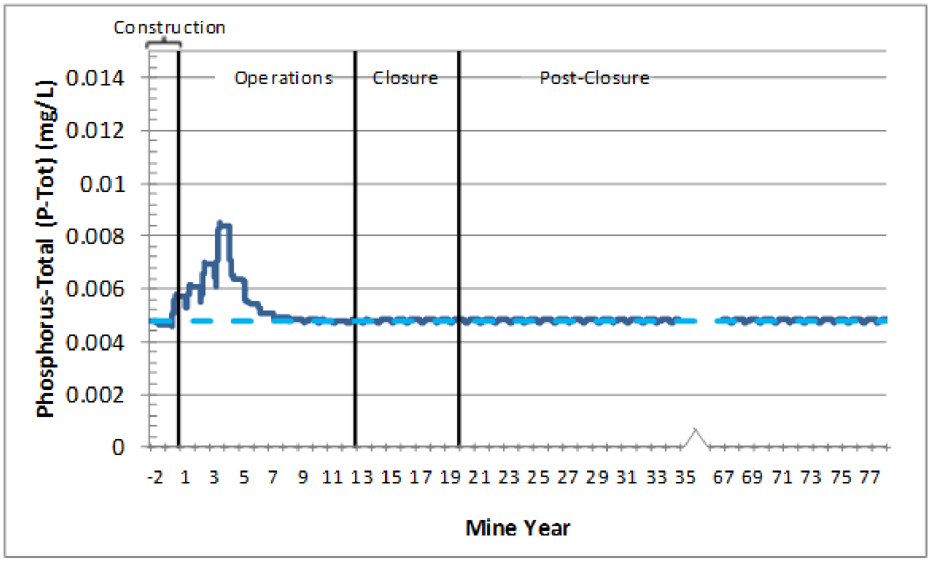
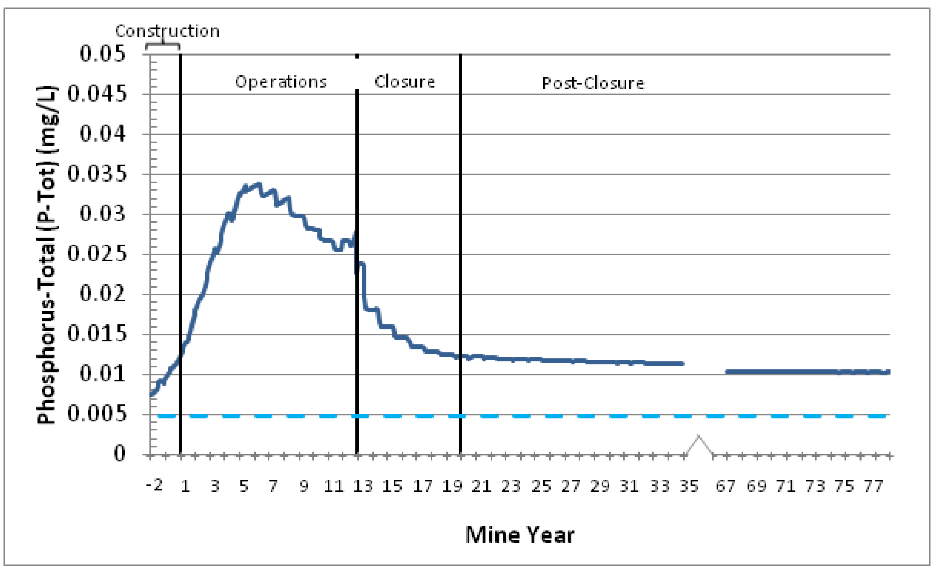


Figure DFO&EC_68-2 Predicted Total Phosphorus Concentrations in Kennady Lake (from the 2012 EIS Supplement)



b) In the context of Pg 9-140 in the 2011 EIS Update (De Beers 2011), “desired” refers to the populations of lake trout, northern pike and Arctic grayling that are considered as being important to people and perceived to have value. In the EIS, these three individual fish species were chosen as VCs to be representative of the fish that could be potentially affected as a result of Project activities (see also the response to DFO&EC_3). Their selection was based on their value to Aboriginal communities, their abundance and dominance in Kennady Lake and adjacent watersheds, and the ecological niche they represent (i.e., life history, habitat requirements, food source).

c) In each case, a specific population is desired (i.e., population of lake trout, population of northern pike, and population of Arctic grayling). The assessment endpoints of *Abundance and Persistence of Desired Populations of Lake Trout, Arctic Grayling and Northern Pike* take into account the sustainability of the population of each of these fish species. The population that is desired is one that is sustainable, i.e., where the abundance and distribution of the fish species will be maintained (or persist) into the future, such that there will be continued opportunities for traditional and non-traditional use by people (see also definition of persistence). Population size is a factor that is incorporated into “abundance” and is a key criterion in the magnitude ratings (Sections 8.14 and 9.13 of the 2011 EIS Update).

d) The assessment endpoints for fish in Sections 8, 9, and 10 of the 2011 EIS Update are the *Abundance and Persistence of Desired Populations of Lake Trout, Arctic Grayling and Northern Pike*. In the assessment endpoints, “persistence” refers to the sustainability of the population. A sustainable population is one where the abundance and distribution will be maintained (or persist) into the future, such that there will be continued opportunities for traditional and non-traditional use by people (e.g., Hooper et al. 2005).

References

De Beers (De Beers Canada Inc.). 2011. Environmental Impact Statement for the Gahcho Kué Project. Volumes 3a Revision 2, 3b Revision 2, 4 Revision 2, and 5 Revision 2. Submitted to the Mackenzie Valley Environmental Impact Review Board in Response to the Environmental Impact Statement Conformity Review. July 2011.

De Beers. 2012. Environmental Impact Statement Supplemental Information Submission for the Gahcho Kué Project. Submitted to the Mackenzie Valley Environmental Impact Review Board. April 2012.

Hooper, D.U., F.S. Chapin, J.J. Ewel, A. Hector, P. Inchausti, S. Lavorel, J.H. Lawton, D.M. Lodge, M. Loreau, S. Naeem. B Schmid, H. Setala, A.J. Smstad, J. Vandermeer and D.A. Wardle. 2005. Effects of biodiversity on ecosystem functioning: a consensus of current knowledge. *Ecological Monographs* 75:3-35.