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Nunalingni Kavamatkunillu Pivikhaqautikkut
Department of Community Government Services
Ministère des Services communautaires et gouvernementaux

November 02, 2009.

Phyllis Beaulieu
Manager of Licensing
Nunavut Water Board
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Phone: (867) 360-6338, Ext. 26
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Sub: Amendment Application for Water License 3BM-KIM 0911

Dear Phyllis,
I am writing you in response to your letter of Mr. David Hohnstein, C.E.T., A/Director of Technical Services, of dated August 21, 2009 and submitting the following documents to satisfy the requirements to amend the existing water License of the Hamlet of Kimmirut.

1. The Plan for sewage disposal during construction
2. Plan for compliance and
3. Sewage effluent discharge criteria

Each item is self explanatory. Item 3 has been revised by the consultant Trow Associates Inc. They have considered the precipitation records for a 5-year, 20-year, 40-year and 100- year return period and analyzed the corresponding dilution rates based on these minimum yearly precipitation rates.

It has been recommended that the effluent criteria at the compliance point (discharge of the lower Lagoon) be based on a dilution factor for the minimum precipitation for a 40 – year return period. And the performance of the Enhanced Sewage disposal system shall be monitored at the out of the lower lagoon, KIM-6 and KIM-7.

We trust that this will satisfy the requirements to amend the existing Water license for the Municipality of kimmirut. I will appreciate if you keep me in loop of the approval process.

If you have any further question, please contact me at any time.

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Nunalingni Kavamatkunillu Pivikhaqautikkut
Department of Community Government Services
Ministère des Services communautaires et gouvernementaux

Thanks.

Bhabesh Roy, M.A.Sc., P.Eng.
Municipal Planning Engineer
Community & Government Services
Baffin Region,Government of Nunavut
P.O.Box 379,Pond Inlet, X0A 0S0
Ph-867 899 7314
Fax-867 899 7328
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Copy to : Patricio Fuentes, Regional Projects Manager, GN-CGS, Baffin Region
Johnathan Palluq, Assistant Regional Director, GN-CGS, Baffin Region
Timoon Toonoo, Regional Director,GN-CGS, Baffin Region
Matthew Hamp, Project Officer, GN-CGS, Baffin Region
Steven Burden, P.Eng., Trow Associates Inc.
Akeego Ikkidluak, SAO, Hamlet of Kimmirut

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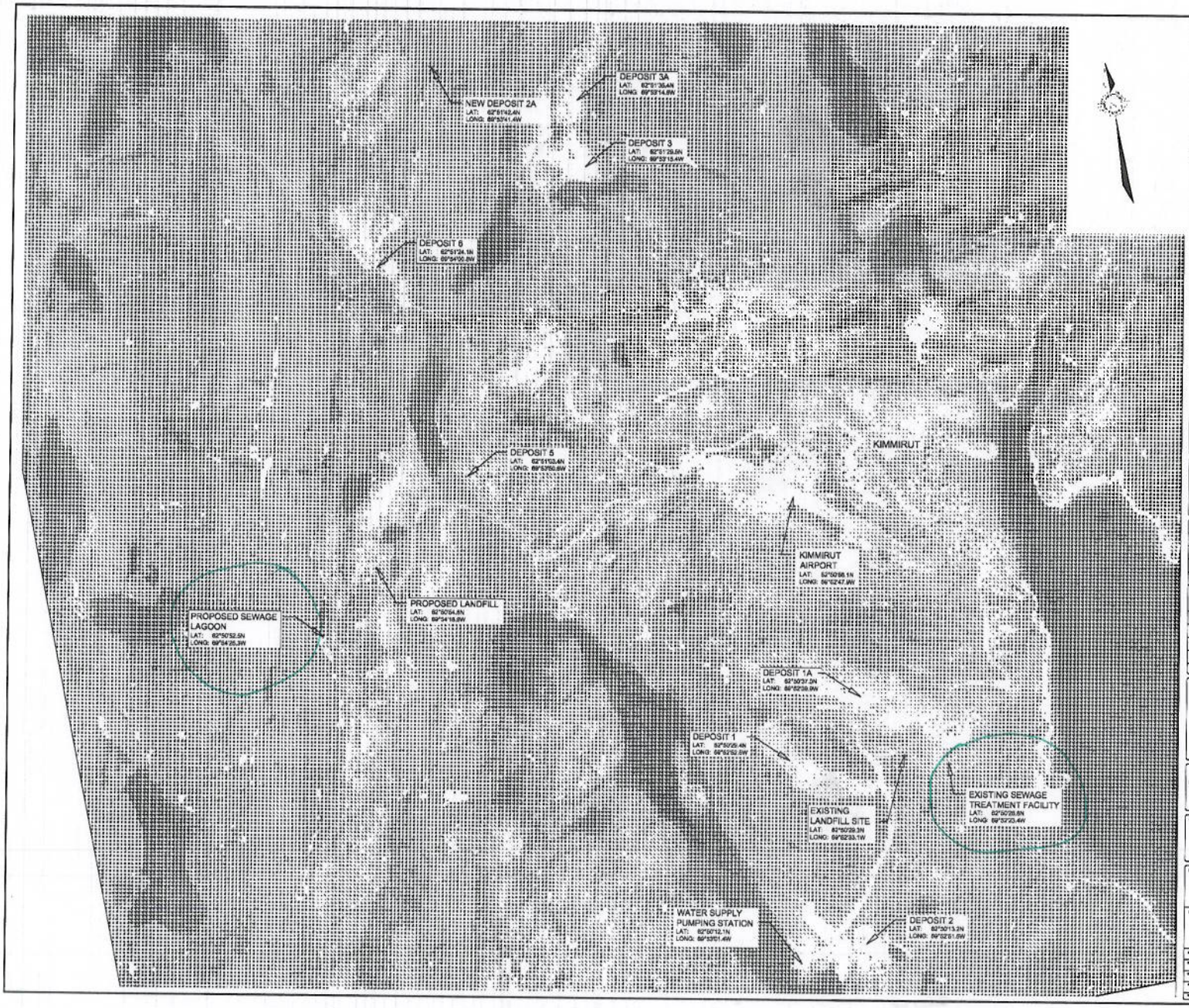
NEW DEPOSIT 2A
LAT: 62°51'42.4N
LONG: 69°53'41.4W
DEPOSIT 3A
LAT: 62°51'35.4N
LONG: 69°53'14.8W
DEPOSIT 3
LAT: 62°51'28.6N
LONG: 69°53'15.4W
DEPOSIT 6
LAT: 62°51'24.1N
LONG: 69°54'00.8W
DEPOSIT 5
LAT: 62°51'03.4N
LONG: 69°53'50.6W
KIMMIRUT
KIMMIRUT AIRPORT
LAT: 62°50'58.1N
LONG: 69°52'47.9W
PROPOSED LANDFILL
LAT: 62°50'54.8N
LONG: 69°54'18.8W
PROPOSED SEWAGE LAGOON
LAT: 62°50'52.5N
LONG: 69°54'26.3W
DEPOSIT 1A
LAT: 62°50'31.2N
LONG: 69°52'39.9W
DEPOSIT 1
LAT: 62°50'26.4N
LONG: 69°52'52.5W
EXISTING LANDFILL SITE
LAT: 62°50'29.3N
LONG: 69°52'33.1W
EXISTING SEWAGE TREATMENT FACILITY
LAT: 62°50'25.8N
LONG: 69°52'23.4W
WATER SUPPLY PUMPING STATION
LAT: 62°50'12.1N
LONG: 69°53'01.4W
DEPOSIT 2
LAT: 62°50'13.2N
LONG: 69°52'01.5W
KEY PLAN
LEGEND
PERMIT TO PRACTICE
TROW ASSOCIATES INC.
Signature
Date Feb. 4/02
PERMIT NUMBER: P 124
The association of Professional Engineers
BENCH MARK
BM 1 ELEV. = 102.72m
RE-BAR PLANTED EAST OF THE ACCESS ROAD ACROSS FROM THE SHED AND 2.8m FROM THE FACE OF THE CHAIN LINK FENCE.
NO. REVISIONS BY/YR/YR A.M.C. A.M.C.
No. DESCRIPTION DATE BY APP'D
REVISIONS
HORIZONTAL
Trow Associates Inc.
154 Colonnade Road South
Ottawa, Ont. K2E 7J5
Tel:(613)225-9460
Fax:(613)225-7337
CLIENT
GOVERNMENT OF NUNAVUT
PROJECT
KIMMIRUT WASTEWATER LAGOON
FILE
TOPOGRAPHIC MAP
DRAWN BY SAD
CHKD BY MEB
APPVD BY SLB
DATE 11/02/2006
SCALE HORIZ 1:3000
PROJECT No. 07C3000168814
DRAWING No.
T-1

5/14

Trow

Trow Associates Inc.
154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Telephone: (613) 225-9940
Facsimile: (613) 225-7337
E-mail: ottawa@trow.com
Web Site: www.trow.com

Reference: OTCD00018881A

October 30, 2009

Mr. Bhabesh Roy, M.A.Sc., P.Eng.
Municipal Planning Engineer
Community & Government Services
Baffin Region, Government of Nunavut
P.O. Box 379
Pond Inlet, NU X0A 0S0

Via Facsimile:
867-899-7328

Effluent Criteria at the Compliance Point
Kimmirut Sewage Lagoon

Dear Mr. Roy:

Further to the conference call on February 13th, 2009 regarding the Water Licence for the Kimmirut Sewage Lagoon, and subsequent comments received on our first submission, the following outlines our recommendations with regards to the location of the compliance point, the effluent criteria for the Kimmirut enhanced sewage treatment facility and the hydrological study of the wetlands.

Compliance Point Location

As per the Hamlet of Kimmirut's Water Licence 3BM-KIM0911, we proposed that the compliance point for the sewage treatment system be at the outlet of the lower lagoon, as this constitutes the last point of operator control over the facility. The rationale for the effluent criteria at the compliance point is based on the Guidelines for Discharge for Treated Municipal Wastewater in the Northwest Territories 1992, note 12 for table 4.1 which states "where wetlands are used as part of the treatment system, limits shall be chosen to suit the point of measurement and control". This point is interpreted to mean the effluent criteria shall take into consideration the additional treatment the effluent will receive in the wetlands when determining the effluent criteria at the compliance point. Therefore, the effluent criteria at the compliance point will be set by determining the effluent strength allowable at the compliance point that will result in the effluent strength required at the end of the wetlands.

Effluent Criteria

To determine the recommended effluent criteria at the compliance point, the following process was undertaken to account for runoff from the surrounding watershed:

1. Set criteria for the effluent at the end of the enhanced sewage treatment facility (i.e. the end of the wetlands).
2. Based on the removal rates of BOD_5 and TSS from the Kimmirut Wetlands Planning Study, determine the maximum concentrations for the effluent released from the lower lagoon (the compliance point).

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3. Determine the average yearly precipitation.
4. Determine the reduction in the precipitation for various return periods to account for dry years.
5. Determine the percentage of precipitation which contributes to the runoff, i.e. the runoff coefficient.
6. Determine the dilution for the effluent based on the various return periods and runoff coefficient.
7. Recommend the effluent criteria based on the above calculations.

Step 1 – Set Effluent Criteria at the end of the Enhanced Wastewater Treatment Facility

We have assumed an effluent criteria of 45 mg/L of BOD_5 and 45 mg/L total suspended solids (TSS) at the end of the wetlands, based on the reference to similar criteria at the end of wetlands for the Cape Dorset facility during the conference call.

Step 2 – Calculate Maximum Effluent Concentrations for the Compliance Point

The Kimmirut Wetlands Planning Study prepared for this project estimated a quality of effluent at the end of the wetlands of 38 mg/L BOD_5 and 39 mg/L TSS, based on an influent quality of 230 mg/L and 245 mg/L BOD_5 and TSS respectively. Assuming a proportional removal rate to achieve the 45 mg/L and 45 mg/L effluent quality criteria, the influent entering the wetlands would require a level of 272 mg/L BOD_5 and 288 mg/L TSS.

Step 3 – Determine Yearly Precipitation Rates

When setting effluent criteria at the end of the sewage lagoon, consideration must be given to dilution through runoff. As Climatic Normals are not available for Kimmirut, precipitation records for Iqaluit were used. Based on the Climatic Normals for Iqaluit, the average annual precipitation for Kimmirut is estimated at 412 mm.

Step 4 – Determine Annual Precipitation for Various Return Periods

In determining the rate of dilution from precipitation, consideration must be given to yearly variance in the total precipitation.

Trow's original recommendation for adjusting the effluent criteria in our February 2009 letter was to reduce the precipitation rates to a 1:20 year minimum precipitation event, and provide an allowance for a non conformance to be reviewed based on precipitation records. In response to comments received, Trow suggests a 1:40 year event be used to calculate the dilution factor and the clause regarding reviewing of precipitation records be removed.

In the *"City of Iqaluit Raw Water Supply and Storage Review"* completed by Trow in 2004 an analysis was performed on precipitation data as recorded at the Iqaluit climate station from 1950 to 2001 to quantify the variability in yearly total precipitation. The percent of years with total precipitation less than, or equal to, the particular annual total precipitation were calculated. Results of this analysis are presented in the table below.

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Table 1: Probability analysis on total yearly precipitation data from 1950 to 2001

Cumulative Percent of Years with Total Precipitation < X mm (%)	Total Annual Precipitation (mm)	Cumulative Percent of Years with Total Precipitation < X mm (%)	Total Annual Precipitation (mm)
100.0	645.1	48.9	412.8
97.8	636.7	46.8	412.7
95.7	613.0	44.6	401.1
93.6	565.1	42.5	397.1
91.4	538.4	40.4	396.0
89.3	529.6	38.2	386.1
87.2	523.1	36.1	379.4
85.1	501.0	34.0	377.8
82.9	481.4	31.9	366.9
80.8	474.7	29.7	360.4
78.7	474.0	27.6	356.5
76.5	469.2	25.5	350.5
74.4	467.5	23.4	347.6
72.3	466.2	21.2	345.6
70.2	458.0	19.1	338.5
68.0	454.1	17.0	338.4
65.9	442.8	14.8	335.4
63.8	442.2	12.7	335.3
61.7	436.8	10.6	334.1
59.5	431.1	8.5	330.0
57.4	430.7	6.3	313.0
55.3	429.0	4.2	306.9
53.1	428.7	2.1	294.5
51.0	426.6	0.0	266.3

A 5-year return represents an event for which there is a probability of 20% that a lower annual precipitation total could be observed in any given year. Similarly, there is a probability of 1% that less precipitation than the 100-year return total annual precipitation will occur in any given year. Return frequencies for annual precipitation were established based on 5-year, 20-year, 40-year and 100-year return periods and are listed in table below.

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Table 2: Total Precipitation for Return Frequencies

Return Period	Total Yearly Precipitation
5-year (1:5)	340 mm
20-year (1:20)	310 mm
40-year (1:40)	295 mm
100-year (1:100)	280 mm

Step 5 – Determine the Runoff Coefficient for the Watershed

In addition, in reviewing our previous recommendations and background documentation, it was realized that dilution rates should also be adjusted to reflect runoff rates from arctic watersheds. As part of the *"City of Iqaluit Raw Water Supply and Storage Review"* the average yearly runoff ratios for the Apex River Basin were summarized and are shown in the table below. However, these ratios exhibit significant year-to-year variability, attributable to a wide range of factors including, but not limited to: total yearly snowfall, total yearly rainfall, temperature extremes, total degree days above 0 degrees and receipt of incoming solar radiation.

Table 3 - Yearly Runoff Ratios for the Apex River Basin

Year	Total Annual Flow (m^3)	Total Annual Precipitation (m^3)	Runoff/Precip Ratio
1982	11,927,000	25,552,800	0.467
1983	13,119,000	23,166,000	0.566
1985	21,000,000	28,161,900	0.746
1986	27,336,000	27,769,950	0.984
1988	20,292,000	19,544,850	1.038
1989	14,200,000	23,230,350	0.611
1990	21,700,000	22,101,300	0.982
1991	14,800,000	21,083,400	0.702
1992	14,000,000	19,796,400	0.707
1994	19,600,000	21,463,650	0.913
		Average	*0.772*

The average runoff ratio for the Apex River was calculated to be 0.77 with a minimum of 0.47 and a maximum of 1.038. For the purpose of calculating effluent criteria the average runoff ratio of 0.77 will be used.

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Step 6 – Determine the Dilution of the Effluent

The average annual precipitation which falls within the drainage area of the enhanced sewage disposal system is 48,108 m^3. Based on a runoff coefficient of 0.77, the total runoff entering the Enhanced Wastewater Treatment Facility (lagoons) will be 37,043 m^3. The projected sewage generation rate for the year 2028 is 33,195 m^3, therefore the average dilution rate of the effluent is 47%. This rate varies during the time of discharge between approximately 44% and 52%.

The following table summarizes the estimated minimum yearly precipitation for a 5- year, 20- year, 40- year and 100- year return period, and the corresponding dilution rates based on the these minimum yearly precipitation rates.

Table 4: Average Dilution Rates

Return period	Estimated Precipitation (mm)	Percentage of Average Precipitation	Average Dilution Rate	Range of Dilution Rates
Average	412		48%	44% - 52%
5- year	340	82.5%	52%	49% - 57%
20- year	310	75.25%	54%	51% - 59%
40- year	295	71.6%	55%	52% - 60%
100- year	280	68%	57%	54% - 62%

Based on the estimated required effluent quality at the end of the lagoon of 272 mg/L and 288 mg/L of BOD_5 and TSS respectively, to meet the goal of 45 mg/L BOD_5 and 45 mg/L TSS and the dilution rates listed above, the following tables summarizes the required effluent criteria which will have to be met at the compliance point, based on the average precipitation and the 5 year, 20 year and 100 year return period minimum precipitation.

Table 5: Diluted BOD_5 Limits for Return Periods

Return Period	Average Dilution	Average BOD_5	Range of BOD_5
Average	48%	130 mg/L	120 - 141 mg/L
5- year	52%	141 mg/L	133 - 155 mg/L
20- year	54%	147 mg/L	139 - 160 mg/L
40- year	55%	150 mg/L	141 – 163 mg/L
100- year	57%	155 mg/L	147 - 169 mg/L

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Table 6: Diluted TSS Limits for Return Periods

Return Period	Average Dilution	Average BOD_5	Range of BOD_5
Average	48%	138 mg/L	127 - 150 mg/L
5- year	52%	150 mg/L	141 - 164 mg/L
20- year	54%	156 mg/L	147 - 170 mg/L
40- year	55%	158 mg/L	150 - 173 mg/L
100- year	57%	164 mg/L	156 - 179 mg/L

Step 7 – Recommendations Regarding Effluent Criteria

We recommend the effluent criteria at the compliance point (the discharge of the Lower Lagoon) be based on a dilution factor for the minimum precipitation for a 40 year return period In recognizing the variance of runoff during the discharge period, we recommend the discharge criteria be based on the average of the three samples taken during the discharge period. It should also be recognized that the dilution rates are based on historical data for Iqaluit.

In summary, we recommend the water licence adopt the following clauses:

1. The performance of the Enhanced Sewage Disposal System shall be monitored at the outlet of the Lower Lagoon, KIM-6 and KIM-7.

2. All effluent discharged from the Enhanced Sewage Disposal Facility at the Monitoring Program Stations KIM-6 and KIM-7 shall not exceed the following effluent quality limits based on an average of samples taken throughout the discharge period, put forth in the Water Licence 3BM-KIM0911:

Table 7: Effluent Discharge Criteria

Parameter	Maximum Average Concentration
BOD_5	150 mg/L
Total Suspended Solids (TSS)	160 mg/L
Faecal Coliforms	1×10^6 CFU/100mL
Oil and Grease	No visible sheen
pH	Between 6 and 9

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Hydrological Study

As part of the February 13th, 2009 conference call, Trow indicated that we would review the potential of determining a dilution factor for the wetlands. As detailed above, there are no records of precipitation available for Kimmirut, therefore any calculation of dilution would have to be based on several assumptions. These assumptions and the yearly differences in precipitation rates would introduce enough uncertainty to the calculated dilution rates to make them ineffective in measuring the performance of the wastewater treatment system.

Should you have additional questions or require additional information please do not hesitate to contact Steven Burden at 613-225-9940 ext. 257.

Yours truly,

Trow Associates Inc.

Stephen A. Douglas
Senior Designer
Infrastructure Services

Steven L. Burden, P.Eng.
Project Manager
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NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN KATIMAYINGI
OFFICE DES EAUX DU NUNAVUT

File: 3BM-KIM0911/Amendment

August 21, 2009

Mr. Bhabesh Roy, M.A.Sc., P.Eng.
Municipal Planning Engineer
Community Government Services
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X0A 0S0
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Acting Senior Administrative Officer
Hamlet of Kimmirut
PO Box 120
Kimmirut, Nunavut
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By Email: RBhabesh@GOV.NU.CA

Subject: Amendment Application for Water Licence 3BM-KIM0911

Dear Mr. Roy,

The Nunavut Water Board (NWB or Board) is in receipt of comments regarding your application for amendment of the above-cited municipal water licence (Licence) from Indian and Northern Affairs Canada (INAC), Environment Canada (EC), and the Government of Nunavut Department of Environment (GN-DOE) on July 27, 2009.

The comments can be obtained from our ftp site, Username: public, Password: registry at the following link:
ftp://nunavutwaterboard.org/PRUC/3%20MUNICIPAL/3B/3BM%20-%20Municipality/3BM-KIM0911/2%20ADMIN/3%20SUBMISSIONS/2009%20Amendment/

The NWB has reviewed the submissions and after taking into consideration the comments made by parties, the NWB would like to provide the Government of Nunavut Community Government Services (GN-CGS) an opportunity to provide a response to the comments before making a determination on the application. In providing its response, the GN-CGS should pay particular attention to parties' comments regarding the following:

1. The plan for sewage disposal during construction;
2. Plan for compliance; and
3. Sewage effluent discharge criteria.

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The NWB notes INAC's comments regarding the first issue in which INAC acknowledges that, although plans for the development of an enhanced sewage disposal system have been submitted, a plan to address sewage disposal during the construction of the enhanced system has not been submitted to the Board for approval including firm timetables for construction and implementation related to the Plan. INAC also indicates that it does not condone the release of untreated sewage directly into the environment.[1]

Furthermore, INAC provided comments on the Plan for Compliance in which INAC notes that it is not assured that the construction of the Enhanced Sewage Disposal System will occur during this upcoming year due to funding. INAC therefore recommends that the Licensee immediately submit a Plan, including firm timetables for construction and implementation, which addresses the issue of raw sewage disposal, to the NWB for approval.[1]

In addition, the NWB notes that both EC and INAC commented on the issue of the proposed sewage effluent discharge criteria and Trow's recommendation that the water licence include a clause that states that the water licence be amended such that in the event results of the monitoring program exceed the proposed effluent criteria, the precipitation records will be reviewed to determine the actual rate of dilution and the effect it would have on the monitoring samples. Both parties expressed concern with this recommendation and EC indicated that following the February 13th teleconference, Trow was to provide an estimate of upstream lake flows to identify the effect of flow on effluent quality predictions.[1,2] This information has not been received by the NWB.

In order to proceed with the licence renewal process, a response to the above three issues is requested from the Licensee by **Friday August 28th, 2009**. Please submit your response to the NWB's Manager of Licensing, Phyllis Beaulieu at licensing@nunavutwaterboard.org. If you have any questions regarding the above, please do not hesitate to contact the undersigned at (780) 443-4406, or dts@nunavutwaterboard.org.

Yours truly,

Original signed by:

David Hohnstein, C.E.T.
Director of Technical Services

DH\tla

Cc: Akeego Ikkidluak, Acting SAO, Hamlet of Kimmirut
Qikiqtani Distribution list

[1] Letter from Tanya Trenholm, INAC, to Phyllis Beaulieu, NWB, Re: 3BM-KIM0911 – Hamlet of Kimmirut – Application for Amendment, dated July 27, 2009.
[2] Letter from Carrie Spavor, EC, to Richard Dwyer, NWB, Re: Amendment Application for Water Licence 3BM-KIM0911, dated July 27, 2009.

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