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Tahera Diamond Corporation

Air Quality Management Plan
Jericho Diamond Mine
Nunavut

Submitted to:

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Toronto, Ontario

Submitted by:

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1.0 INTRODUCTION

Tahera Diamond Corporation is required to provide an air quality management program as part of the regulatory phase of the Jericho Diamond Project permitting phase. This plan provides the basis for a management plan based on the Jericho Final Environmental Impact Assessment predictions concerning air quality impacts from mining at Jericho. The management plan includes control measures that will be initially instituted to mitigate exhaust and dust emissions and a monitoring plan to provide site data on actual vs. predicted air quality and allow for an adaptive approach to air quality management at Jericho.

2.0 EMISSION MANAGEMENT

2.1 Exhaust Sources

The Jericho final EIS (Tahera 2003) provided a list of exhaust sources for the Jericho Project. Table 2-1 reproduces that information below.

Table 2-1: Exhaust Emission Sources at Jericho

Mobile Sources	Number of Sources	hours per day	Nox (g/s)	Nox (kg/day)	Sox (g/s)	Sox (kg/day)	CO (g/s)	CO (kg/day)	CO2 (g/s)	CO2 (kg/day)
Cat 777	6	17	1.79	675	0.242	91	2.215	835	137	51638
D10 Dozer	1	7	1.09	29	0.147	4	1.345	36	83.3	2239
D9 Dozer	1	19	0.776	53	0.105	7	0.956	65	59.2	4035
Cat 992	1	7	1.53	40	0.207	5	1.89	50	117	3071
Cat 5130	1	19	1.53	103	0.207	14	1.89	127	117	7839
Service Truck	1	13	0.575	27	0.078	4	0.708	33	43.8	2050
Fuel Truck	1	6.6	0.575	14	0.078	2	0.708	17	43.8	1041
Pickup	5	4	0.383	28	0.052	4	0.472	34	29.2	2102
Cat 966E	1	5.39	0.546	11	0.074	1	0.673	13	41.7	809
Cat D300	1	9.42	0.546	19	0.074	3	0.673	23	41.7	1414
D6R Dozer	1	5.39	0.335	7	0.045	1	0.413	8	25.6	497
Total kg/day				1003		136		1240		76,734
Total t/yr	Days/yr	275		276		37		341		21,102
Stationary Sources	**Number of Sources**	**hours per day**	**Nox (g/s)**	**Nox (kg/day)**	**Sox (g/s)**	**Sox (kg/day)**	**CO (g/s)**	**CO (kg/day)**	**CO2 (g/s)**	**CO2 (kg/day)**
Plant Gen	2	24	2.85	492	1.95	337	1.21	209	254.7	44012
Camp Gen	1	24	0.66	57	0.45	39	0.28	24	58.8	5080
Shop Gen	1	24	1.756	152	1.2	104	0.74	64	156.7	13539
Ore Dryer	1	24	0.167	14	0.115	10		0	146.5	12658
Total/day				716		489		297		75289
Total t/yr				261		179		108		27,480
Grand Total				537		216		450		48,582

The camp incinerator will be an intermittent source and hence it would not be accurate to include it with the long-term continuous sources in the model. In addition, incineration could be carried out on days with good dispersion.

An incinerator that is typically used for mining camps in the north has the following emission characteristics supplied by the manufacturer:

- PM emission rate - 0.029 g/s
- SO_2 emission rate - 0.371 g/s
- NO_X emission rate - 0.571 g/s

2.2 Dust Sources

The fugitive dust sources include:

- wind erosion from active storage piles;
- wind erosion from dry fine PK beaches;
- dropping of material into trucks or onto storage piles;
- blasting;
- dust generated from vehicles travelling on the roads.

2.2.1 Stockpiles

Estimates of fugitive dust emissions from the final EIS are as follows:

Table 2-2: Fugitive Dust Emissions from Stockpiles

Stockpile	Assumed Area (ha)	TSP Emission Rate (g/s)	PM10 Emission Rate (g/s)
Waste Dump 1	21.7	5.7	2.85
Low Grade	5.4	1.42	0.71
Central Lobe	4	1.05	0.53

2.2.2 PK Beaches

Emission estimates from dry fine PK beaches were not made in the final EIS. As well, there are no applicable USEPA AP-42 emission factors available. PK will be deposited wet but exposed beaches will dry and are a potential source of fugitive dust unless kept wet.

2.2.3 Material Drops

Estimates of fugitive dust emissions from material drops from the final EIS are as follows:

Table 2-3: Fugitive Dust Emissions from Material Drops

Source	Material Dropped on Average (tonnes/s)	TSP Emission Rate (g/s)	PM10 Emission Rate (g/s)
Waste Dump 1	0.22	0.21	0.0997
Low Grade Stockpile	0.02	0.02	0.0096
Central Lobe Stockpile	0.013	0.0128	0.006
Mine Pit	0.29	0.28	0.13

2.2.4 Blasting

The emission factor for TSP is 16.8 kg/blast and for PM_{10} 8.7 kg/blast. The average blast at the open pit will be once every day or two. An average daily PM generation rate is meaningless in this case. As well, little can be done to reduce the dust generated by blasting. However, blasting dust will not add significantly to average ambient air TSP or PM_{10} and will be reduced for the general mine area as the pit deepens and will be largely eliminated when underground mining commences.

2.2.5 Mobile Equipment

Estimates of fugitive dust emissions from mobile equipment from the final EIS are as follows:

Table 2-4: PM_{10} Emission Factors for Mobile Equipment

Vehicle Type	Mean Weight (tonnes)	Number of Wheels	Mean Speed (km/hr)	Emission Factor (kg/VKT)
Cat 777 Ore Truck	114	6	30	1.06
Service Truck	50	10	15	0.39
Fuel Truck	40	10	15	0.33
Pickup	0.75	4	15	0.013

2.3 Worst-case Estimated Mine Area Concentrations of Air Contaminants

Estimates from the final EIS for the maximum production year (3) are listed in Table 2-5.

Table 2-5: Worst-case Concentrations (24 hour)

Gas	Concentration ($\mu g/m^3$)	% of Time Above	Gas	Concentration ($\mu g/m^3$)	% of Time Above
NOx	>400	<1	SO_2	>450	15
PM-10	>50	2[1]	SO_2	>900[2]	4

[1] With watering
[2] Near the open pit

2.4 Concentrations in the Pit

There will be some times when the atmosphere will be very stable and a low-level inversion will be present. During these conditions emissions can be trapped in the pit and ambient concentrations of exhaust gases and particulate matter can increase to higher levels. The operator will monitor these conditions and in the event that pollutants accumulate in the pit, mining operations will be shut down until it is safe to continue with pit work.

2.5 Management of Exhaust Emissions and Fugitive Dust

2.5.1 Exhaust Emissions

Both from an economic and environmental perspective, there is considerable benefit from keeping operating equipment performing optimally and thus minimizing wasted fuel through exhausting partially combusted hydrocarbons. Table 2-1 lists sources at Jericho. A regular maintenance schedule will be instituted by mine services and coordinated with the mining contractor to ensure mobile and stationary sources are regularly inspected and maintained. A typical maintenance schedule for mine mobile equipment is every 250 hours. Power generators will be serviced on approximately the same schedule, pursuant to manufacturer's recommendations.

It is also economically and environmentally beneficial to reduce use of diesel-fuelled equipment to the extent practical while maintaining effective and efficient operations. The ore truck schedules will be closely controlled to maximize efficiency. The use of service vehicles cannot be controlled to the same extent, but vehicles will only be used as required. Power generators must be run constantly and the only possible savings will be in keeping the diesel generators maintained.

The mine equipment maintenance schedule will be the responsibility of the mechanical foreman who will report to the contractor's mine superintendent. Processing plant equipment maintenance will be the responsibility of the plant operators who will report to the plant manager (the senior Tahera site employee). The mine superintendent and plant manager will share information to ensure all maintenance is carried out as required. The mine environmental coordinator will keep a copy of maintenance logs in the environmental file.

Triggers for action regarding exhaust emissions will be the routine maintenance schedules. Should equipment indicate signs of inefficient operation, e.g., excessive smoking, non-routine maintenance will be scheduled as soon as practical to address the issue.

2.5.2 Fugitive Dust

Fugitive dust sources at Jericho are listed in Tables 2-2 through 2-4. Mines are inherently dusty operations. The major source is dust from mobile equipment and periodically from blasting in the open pit. Dust from blasting cannot be practically controlled, but is also a short-term source of suspended particular matter, most of which is coarse in nature. There are no practical triggers for action to reduce blasting dust.

Dry PK beaches will form in the PKCA during normal operations. Toward the end of PK operation, up to 50% of the PKCA footprint may be dry beaches. Dusting in summer will be controlled by water spray if problematic. Winter dust control will be effected to the extent possible through spraying PK beaches with water just before freeze up. The trigger for action will be significant dusting of the area surrounding the PKCA. Significance will be determined on a case-specific basis. When practical to do so and if reclamation trials indicate probable success, dry beaches that are no longer inundated by supernatant water during operations will be revegetated by direct planting on the PKCA surface, as is being tried at EKATI™.

Dust from stockpiles is not expected to be problematic. However, should dust exposure of workers rise above Workers' Compensation Board (WCB) regulations, watering will be instituted when practical. If visual inspection and environmental monitoring indicate significant concentrations of dustfall due to stockpiles, watering will also be instituted when practical. Significance will be determined on a case-specific basis.

Dust from material dumps is not expected to be problematic. Dust from material dumps is also difficult to control except through dumping practices. Long end dumps which can generate significant amounts of dust will not occur at Jericho, since both ore and waste rock will be dumped in lifts and spread with a dozer. Should dust concentrations increase above WCB regulated levels, watering will be instituted when practical.

Dust from mobile equipment tires will be controlled principally by road watering which will be carried on constantly by mine services during dry periods in the summer. Dust suppressant additives will be considered if practical for the Jericho site. The experience of EKATI™ and other diamond mines with these suppressants will be monitored. There are periods in the winter when snow cover will ablate from roads when dust cannot be practically controlled, however. Speed reduction by service vehicles will be the principal way of controlling dust during such periods.

2.5.3 Open Pit

Due to the potential for inversions, particularly during winter, carbon dioxide monitors will be operated continuously in the pit. In the event that carbon dioxide builds unacceptably, operations will cease and the pit will be evacuated. This is expected to occur at most once or twice per winter (Nuna Logistics, pers. comm.). Monitoring the carbon dioxide monitors will be the responsibility of the senior mine shift foreman. A log of carbon dioxide concentrations will be kept on file by the mine environmental coordinator.

3.0 EMISSION RE-MODELLING

Environment Canada requested that the dispersion model for Jericho be re-done using site meteorology and CALPUFF rather than ISC3. This in order to most advantageously site PM monitors. However, the minimum one year of meteorological data including air stability (*sigma-theta*) will not be available prior to mine construction and therefore an alternate proposal is to site the PM monitors based on the windrose and dispersion modelling available (presented in the final EIS air quality report), conduct the modelling once requisite site meteorology is available and then move the monitors should that be indicated. While moving the monitors will produce a break in the data such that pre- and post-moving data cannot be directly compared, it will not impair the primary purpose of the monitors, which is to provide a management tool for further mitigation of dust generation should that be indicated.

4.0 AIR QUALITY MONITORING

Air quality monitoring was proposed in the Jericho final EIS. That proposal is included here with the addition of proposals for PM monitoring stations.

4.1 PM-2.5 and PM-10

Dual Partisol™ samplers will be used that simultaneously monitor PM-10 and PM-2.5. Their limitation in placement is the requirement for AC power to operate. Two monitors will be installed as shown on Figure 4-1. Environment Canada will be consulted prior to installation to ensure the agency's concerns are taken into consideration. Samplers will be installed by a qualified consultant who will also train the mine environmental coordinator in operation and maintenance of the equipment. The environmental coordinator will be responsible for monitoring and reporting.

4.2 Lichen Metals Concentrations

An initial survey of lichen metals levels was conducted by Tahera and reported in the final EIS. For operations, this survey will be expanded to eight stations as shown on Figure 4-2. Stations will be located at near (1 – 2 km) and far (8 – 12 km) from the mine site and at directions of prevalent and non-prevalent wind flows as indicated by the windrose data presented in the final EIS (Figure 4-2 insert). To tie results to the baseline sample, the site sampled in 2000 will be resampled during surveys as an additional station. The locations given are approximate because suitable lichen communities will need to be located proximate to the locations shown on the map. As well, locations in the lee of hills will not be chosen due to the probability of wind eddies distorting results (either shielding or concentrating airborne particulates).

The most common fruiticose lichen at Jericho was found to be *Flavocetraria cucullata* and that species was sampled for the 2000 survey. It is proposed to continue to use this species if possible for the operational monitoring. At any rate, the same species, or combination of species (as is done at EKATI™ [ABR 1999]) will be sampled at all sites.

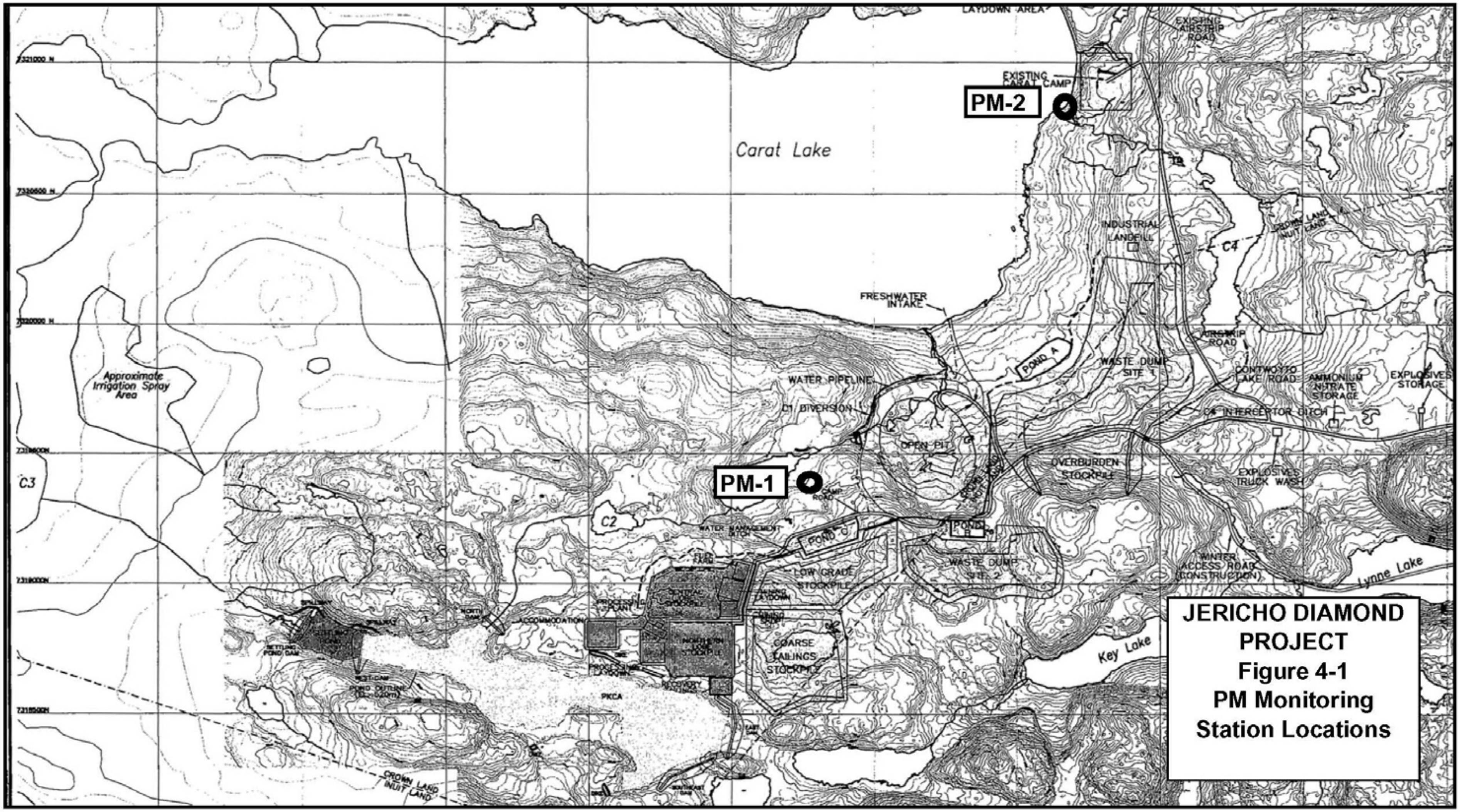
Initial sampling will be prior to operations start up (Year 0) and the survey will be repeated every three years until mine closure at Year 9 (Years 0, 3, 6 and 9). Sampling and reporting will be the responsibility of the mine environmental coordinator and samples will be collected in late July or early August each year. At the first sample period when stations are being established, a botanist consultant will be engaged to provide information on the plant community compositions at the sites. To be consistent with baseline vegetation studies, 5 m square plots will be used to determine species (see the vegetation report in the final EIS).

4.3 Vegetation Transects

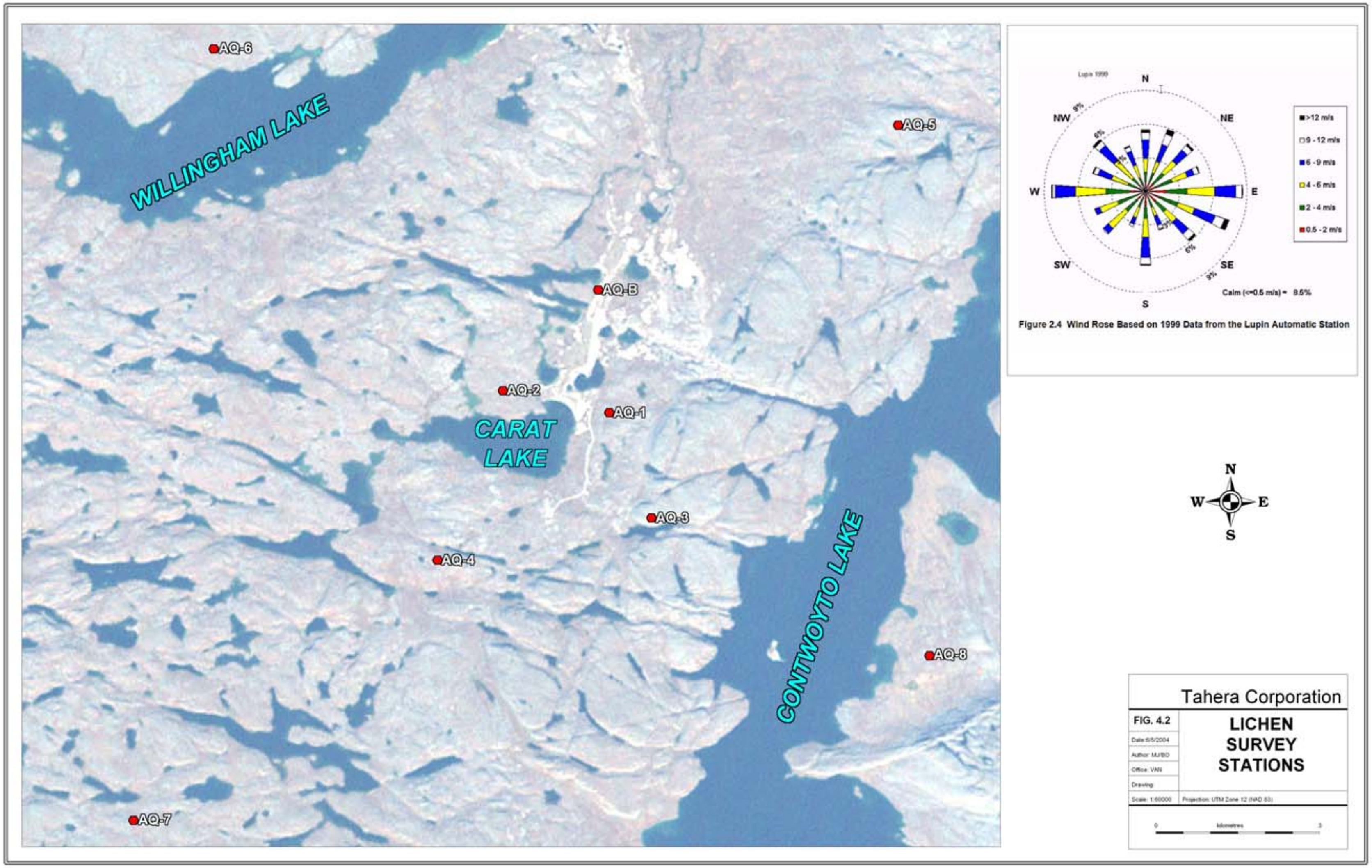
Two transects were sampled in 2000 for plant community composition (Figure 4-3). Transects were located west of the airstrip and southeast of the portal. One-meter quadrats were inventoried at 10 m intervals up to 100 m. Transect zero points were adjacent to the airstrip and portal access road. The purpose of the sampling was to obtain baseline information on plant communities. The purpose of operational sampling will be to monitor the effects of near-source dust on plant communities.

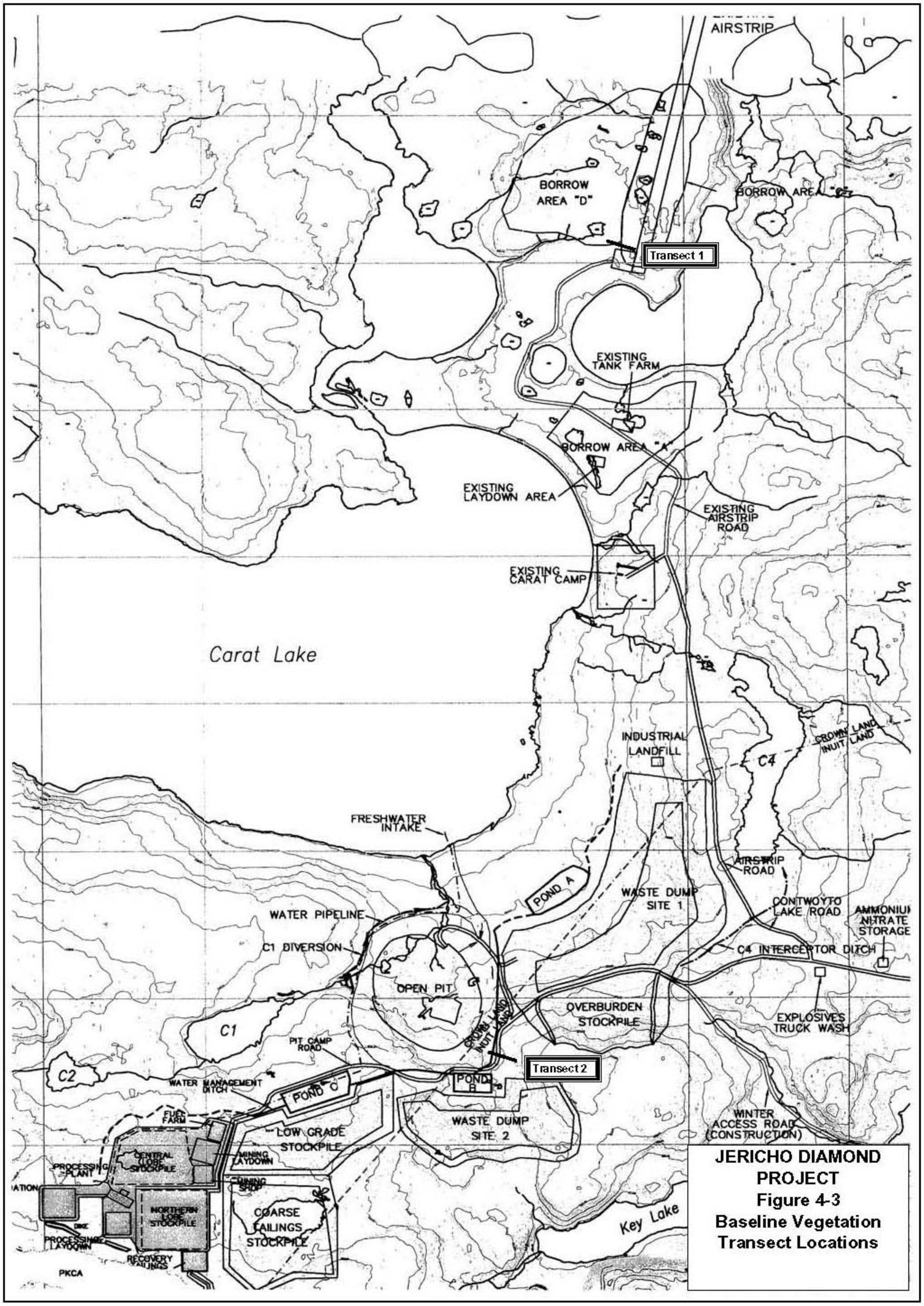
Transects were marked with stakes so that locations could be recovered. Quadrats were divided into 10 cm square subdivisions and the percent cover of plant species were noted for each subdivision. Total cover for the 1 m square quadrats were then calculated from subtotals.

These transects will be resampled each three years of operation co-incident with lichen metals surveys. A period of three years was chosen to coincide with other indirect air quality sampling and because of the nature in which plants grow in the Arctic; many plants only flower and produce seed every two years.



JERICHO DIAMOND PROJECT
Figure 4-1
PM Monitoring Station Locations


AQ-6
WILLINGHAM LAKE
AQ-5
AQ-B
AQ-2
AQ-1
CARAT LAKE
AQ-3
AQ-4
CONTWOYTO LAKE
AQ-8
AQ-7
Lupin 1999
N
NE
E
SE
S
SW
W
NW
9%
6%
3%
>12 m/s
9 - 12 m/s
6 - 9 m/s
4 - 6 m/s
2 - 4 m/s
0.5 - 2 m/s
Calm (<=0.5 m/s) = 8.5%
Figure 2.4 Wind Rose Based on 1999 Data from the Lupin Automatic Station
N
W
E
S
Tahera Corporation
FIG. 4.2
LICHEN SURVEY STATIONS
Office: VAN
Drawing
Scale: 1:60000
Projection: UTM Zone 12 (NAD 83)
0
3



JERICHO DIAMOND PROJECT
Figure 4-3
Baseline Vegetation Transect Locations

5.0 MONITORING DATA ASSESSMENT AND CORRECTIVE ACTION

5.1 Data Assessment

Landlords (DIAND and KIA), as well as Department of Sustainable Development, DFO, Environment Canada, and communities participating in the community liaison committee will be interested in results of biophysical monitoring. Therefore a comprehensive annual report containing all the year's data plus analyses is proposed. The main report will be non–technical, with any technical treatment of results appended. Thus the general public will be able to gain an appreciation of monitoring results at the Jericho Project, specifically whether impact predictions were borne out and how effective proposed mitigation measures were in reducing or eliminating environmental impacts from the Project. At the same time, technical appendices will satisfy agency (and company) needs for scientific analyses of results. Where applicable and available, traditional knowledge gathered by others will be used as an aid in results interpretation and modification of management approaches, should this prove desirable and practical. The report will be made available to interested agencies and the community liaison committee within six months of the end of each calendar year, or on a schedule agreed to by the government and general public stakeholders listed above. Reporting will be the responsibility of the mine environmental coordinator.

5.2 Corrective Action

The purpose of the monitoring will be to ascertain whether impact predictions made for the EIS are correct or whether changes are different or undetectable. The course of action initiated by monitoring results will depend on circumstances but will include responses listed in Table 5-1.

Table 5-1: Corrective Action Responses to Air Quality Monitoring

Monitoring Result	Response
PM results at the mine site exceed criteria	Additional control measures will be examined and implemented where possible.
Lichen metal levels at near field sites exceed CCME guidelines and those at far field sites do not	Additional air quality control measures will be examined and implemented if practical
Lichen metal levels at control sites exceed CCME guidelines	Mine influence is indicated. Additional control sites will be established to better estimate background metals concentrations
Vegetation transects at either location show impacts from dustfall	Additional control measures will be examined and implemented where possible.
Issues raised by regulators	Discussion with regulators to satisfactorily resolve issues
Issues raised by local communities	Discussion with the community liaison committee to develop satisfactory resolution of issues

6.0 AIR QUALITY MANAGEMENT PLAN AUDITING AND CONTINUAL IMPROVEMENT

Despite careful planning, it is highly probable that certain components of the Air Quality Management Plan will need to be modified. It will therefore be necessary to audit or review the plan to pinpoint those components that need to be corrected, adjusted or upgraded. Not only the operational aspects of the plan, but any paperwork that deals with the plan will be reviewed. A goal will be to continuously audit all aspects of the plan for effectiveness. In general, the ISO-14001 protocols will be followed.

Throughout the mine life, as policies and regulations change and technology advances, the Air Quality Management Plan will be modified to address changes and to benefit from technology advances where benefits can be clearly demonstrated. The number one objective will always remain maintaining compliance with regulations governing the Project.

Formal evaluations of the Air Quality Management Plan will be documented, deficiencies noted in the report, and progress in addressing deficiencies tracked in writing. Responsibilities to address deficiencies and accountabilities will be assigned and deadlines for addressing required changes will be set. The Jericho Mine site supervisor (mining contractor or Tahera employee, to be determined) will assume overall responsibility for the process; authorization for expenditures may be required from other management personnel.

REFERENCES

ABR. 1999. Air Quality Monitoring at the EKATI™ Diamond Mine Using Vegetation and Lichens as Bioindicators.

Tahera Diamond Corporation. 2003. Jericho Diamond Project Final Environmental Impact Statement.