HIGH LAKE AIRSTRIP

Assessment of Locations

May 01, 2006

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HIGH LAKE AIRSTRIP

Wolfden Resources Inc. in support of a copper-zinc-gold project 2009

Distances: Nautical Miles and feet
Bearings: Degrees True as position is in Northern Domestic Airspace
Coordinates: Geographic in Degrees Latitude and Longitude (DMS.00)
Critical Aircraft: C-130 Hercules and/or B737

Airstrip Locations

1

Threshold Coordinates
N67:29:08.65
W110:49:53.41
N67:28:20.19
W110:49:41.12
Rwy Bearing & Distance: 354 deg/4948 ft.

2

Threshold Coordinates
N67:29:06.98
W110:49:11.30
N67:28:18.86
W110:48:59.87
Rwy Bearing & Distance: 354 deg/4911 ft.

3

Threshold Coordinates
N67:26:16.86
W110:49:57.99
N67:25:28.43
W110:50:08.41
Rwy Bearing & Distance: 353 deg/4939 ft.

4

Threshold Coordinates
N67:24:33.61
W110:51:30.25
N67:25:22.05
W110:51:36.69
Rwy Bearing & Distance: 353 deg/4929 ft.

Climate Data

Climate normals or averages are taken at specific stations from 1971 to 2000 with at least 15 years of data. The closest station for comprehensive data is located at Kugluktuk (CYCO) Coppermine, NU which is 124 NM North West of the proposed airstrip locations. Average wind direction and speed is required in order to establish runway orientation and the Average wind speed noted from January to December is 16.1 km/h in a southwesterly direction, however maximum hourly speeds range from 61 – 93 km/h predominately from a northwesterly direction. The maximum gust speeds have been recorded between 74 – 106 km/h from January to December and again predominately from a northwesterly direction. Also noted, the number of days with the wind at or above 52 km/h is 14.4 over a yearly period and above 63 km/h is 4.2 and again mostly from the northwest.

Lupin, NU, located 104nm southeast of the proposed site has an Enviornment Canada contractual weather site although not as comprehensive as Coppermine(matrix below), it indicated peak gusts direction from the northwest. Also Wolfden Resources Inc. had on site wind monitoring for a period of time and data from that source indicated a more north northwesterly flow so a runway alignment in a NNW/SSE direction(bearing 350/170 deg true) would certainly be acceptable and not pose any hazards for aircraft operations

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	YR	C
Wind:														
Speed (km/h)	19	18.5	15.6	13.4	13.9	14	14.4	15.5	16.8	17.4	16.8	18.2	16.1	C
Most Frequent Direction	SW	SW	SW	SW	E	E	E	E	E	SW	SW	SW	SW	C
Maximum Hourly Speed	93	76	83	72	74	61	67	74	74	80	83	**93**		
Date (yyyy/dd)	1988/01	1978/08+	1980/03	1984/16	1986/28	1995/26	1991/25	1986/22+	2002/24	1982/27	1994/19	**1983/25**		
Direction of Maximum Hourly Speed	NW	S	NW	E	NW	NW	N	NW	NW	NW	NW	NW	NW	
Maximum Gust Speed	106	**106**	106	83	89	74	81	83	85	89	100	104		
Date (yyyy/dd)	1988/01	**1978/06**	1980/03	1984/16	1986/28	1992/11+	1988/23	1984/10+	1983/28	1982/27	1994/05	1983/26		
Direction of Maximum Gust	NW	SW	NW	E	NW	W	NW	NW	NW	NW	NW	NW	SW	
Days with Winds >= 52 km/hr	1.8	2.7	1.7	0.9	0.6	0.1	0.2	0.8	1.2	1.3	0.9	2.2	14.4	C
Days with Winds >= 63 km/hr	0.5	0.8	0.4	0.2	0.3	0	0	0.2	0.4	0.5	0.2	0.7	4.2	C

Visibility and cloud cover determines the type of instrument procedure that would best meet the needs of the intended operation in conjunction with cost effectiveness and safety requirements. Most precision approach systems such as ILS support landings with the cloud height 200-250 ft. above ground and a forward visibility of ½ - ¾ of a mile. Non precision approach are higher and the forward visibilities are also higher and cannot be less that 1 mile. Again, the closest station for comprehensive data is located at Kugluktuk (CYCO) Coppermine and hrs/month in which the visibility is greater than 5 nm predominates, consequently a non precision instrument approach procedure(NDB/DME, RNAV(GPS) with vertical guidance(LNAV/VNAV,LVP – WAAS) would certainly meet the majority of flying operations. Unfortunately Lupin did not have any data available on cloud cover and prevailing visibility

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	C
Visibility (hours with): Visibility (hours with):													
< 1 km	21.2	29.8	18.6	23.6	27.9	9	11.1	5.9	4.8	9.1	11.8	11.8	D
1 to 9 km	138.3	129.8	122.9	101.1	74.9	23.2	26	27.7	45	106	97.9	97.9	D
> 9 km	584.6	516.1	602.5	595.3	641.2	687.8	706.9	710.4	670.2	628.9	610.3	610.3	D
Cloud Amount (hours with): Cloud Amount (hours with):													
0 to 2 tenths	298.4	261.5	290	240.6	171	188.4	146.1	111.1	80.2	105.5	200.2		D
3 to 7 tenths	136	130.8	132.5	120.3	106.3	151.6	181	155.6	105.7	89.9	140.8		D
8 to 10 tenths	309.6	285.4	321.5	359.1	466.7	380.1	416.9	477.4	534.1	548.6	379.1		D

Complete dataset is available from Environment Canada at: http://www.climate.weatheroffice.ec.gc.ca/climate_normals/index_e.html

Airstrip Configuration

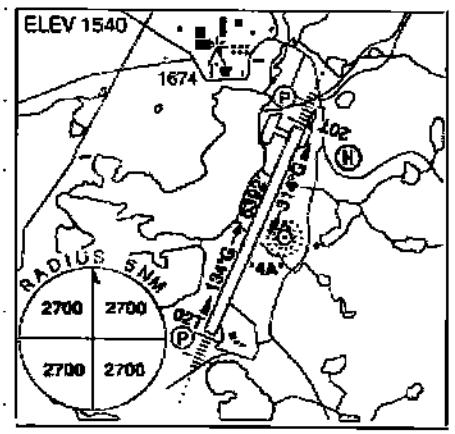
If the intent is to operate B737, the present calculated runway length(1500m, 4920ft) may be a little short although final confirmation should be sought from a company such as Canadian North and/or First Air who operate B737 into northern gravel airstrips. DDMI(Diavik,NT CDK2) and BHP Billiton(Ekati,NT CYOA) utilize heavy aircraft in support of their mining operations and as indicated in the configuration sketches below runway lenghts are in excess of 5000ft. Also Diavik and Ekati are registered airstrips in the Canada Flight Supplement(Nav Canada) and are not required to meet certification standards as it relates to runway clearways, stopways and safety ends. However they meet the requirements as outlined in the Canadian Air Regulations Series 300 Registered Aerodromes(http://www.tc.gc.ca/CivilAviation/Regserv/Affairs/cars/Part3/Subpart1.htm) .

Cambridge Bay,NU and Kugluktuk,NU as an example, operate under Transport Canada certification standards and are owned by the Government of Nunavut.

Configuration Examples

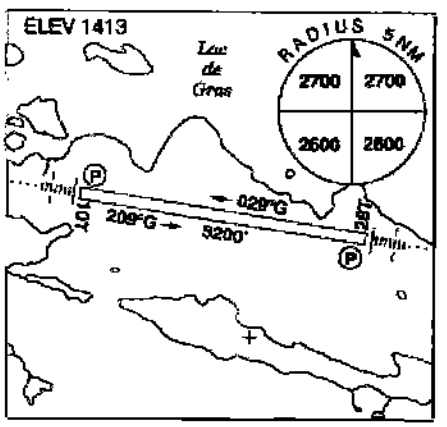
Ekati, NT

CYOA



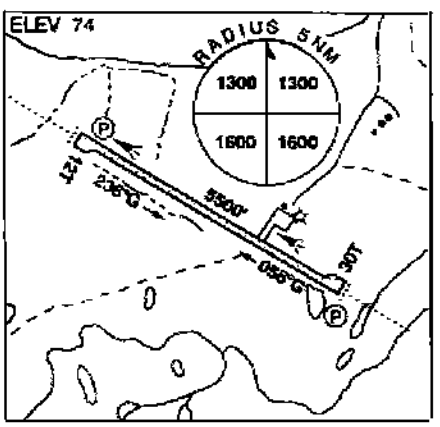
Diavik,NT

CDK2



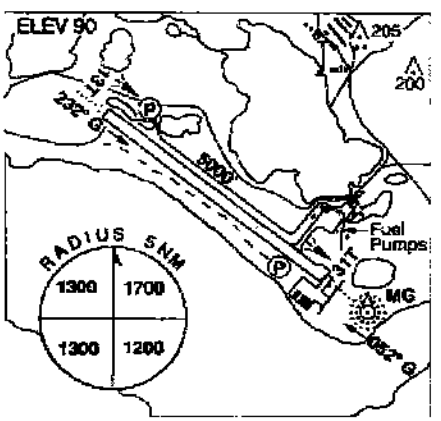
Kugluktuk,NU

CYCO



Cambridge Bay, NU

CYCB



Instrument Approach Procedures

There are no major terrain issues such as high hills surrounding the proposed site (position #1) nor is it located in a valley. The airstrip elevation is in the 600-700ft range and the terrain to the SE/SW is in the 1200-1900ft range. Various design methods can be used such as final approach alignment and step-down fix to get over/around terrain, however the approach 1:50,000 chart design will be the final verification.

In order for a landing surface to be authorized for the lowest possible minima, certain runway or airstrip physical characteristics are required. For the purpose of this assessment it is assumes that a non – precision(no vertical guidance) type of instrument procedure will be utilized. NDB in combination with Distance Measuring Equipment(DME) or RNAV(GPS). If the landing surface cannot meet the requirements as shown below – highlighted in red and based on the wingspan of the critical aircraft(B737), the lowest authorized landing minima will be 500 above ground level. Consequently a complete survey of the chosen landing site is required.

Obstacle Limitation Surface (OLS). A surface that establishes the limit to which objects may project into airspace associated with an aerodrome so that aircraft operations at the aerodrome may be conducted safely. Obstacle limitation surfaces consist of the following:

1. *Take-off/Approach Surface.* An incline plane beyond the end of the runway and preceding the threshold of a runway. The origin of the plane comprises:
    a. An inner edge of specified length (strip width), perpendicular to and evenly divided on each side of the extended centre line of the runway, and beginning at the end of the runway strip;
    b. Two sides originating at the ends of the inner edge, diverging uniformly at a specified rate in the direction of take-off;
    c. The elevation of the inner edge is equal to the elevation of the threshold.
2. *Transitional Surface.* A complex surface sloping up at a specified rate from the side of the runway strip and from part of the take-off/approach surface. The elevation of any point on the lower edge of the surface is:
    a. Along the side of the take-off/approach surface, equal to the elevation of the take-off/approach surface at that point; and,
    b. Along the runway strip, equal to the elevation of the centreline of the runway, perpendicular to that point.

Strip. An area of specified dimensions enclosing a runway, intended to reduce the risk of damage to aircraft running off a runway, and to protect aircraft flying over it during take-off and landing operations.

AERODROME PHYSICAL CHARACTERISTICS
Minimum Requirements

	TYPE OF RUNWAY							
	Non-Instrument Runway				Non-Precision Runway			
AIRCRAFT SIZE (Based on wing span)	Up to but not including 15 m (49 ft)	15 m (49 ft) up to but not including 24 m (79 ft)	24 m (79 ft) up to but not including 36 m (118 ft)	36 m (118 ft) up to but not including 52 m (171 ft)*	Up to but not including 15 m (49 ft)	15 m (49 ft) up to but not including 24 m (79 ft)	**24 m (79 ft) up to but not including 36 m (118 ft)**	36 m (118 ft) up to but not including 52 m (171 ft)*
	CHARACTERISTICS							
Strip Specifications:								
Strip width (each side of centre line)	30 m (98.5 ft)	30 m (98.5 ft)	45 m (148 ft)	75 m (246 ft)	45 m (148 ft)	45 m (148 ft)	**75 m (246 ft)**	150 m (492 ft)
Strip length (Prior to threshold and beyond departure end)	30 m (98.5 ft)	60 m (197 ft)	60 m (197 ft)	60 m (197 ft)	60 m (197 ft)	60 m (197 ft)	**60 m (197 ft)**	60 m (197 ft)
Approach / Take-off Slopes and Dimensions:								
Length of the inner edge	60 m (197ft)	60 m (197 ft)	90 m (295ft)	150 m (492ft)	90 m (295ft)	90 m (295ft)	**150 m (492ft)**	300 m (984ft)
Distance from threshold	30 m (98.5ft)	60 m (197 ft)	60 m (197 ft)	60 m (197 ft)	60 m (197 ft)	60 m (197 ft)	**60 m (197 ft)**	60 m (197 ft)
Divergence (minimum each side)	10%	10%	10%	10%	10%	10%	**15%**	15%
Length (minimum)	2500 m 8202 ft	2500 m 8202 ft	2500 m 8202 ft	2500 m 8202 ft	2500 m 8202 ft	2500 m 8202 ft	**3000 m 9843 ft**	3000 m 9843 ft
Slope (maximum)	5% (1:20)	4% (1:25)	2.50% (1:40)	2.50% (1:40)	3.33% (1:30)	3.33% (1:30)	**2.50% (1:40)**	2.50% (1:40)
Transition Surfaces (Slope)	20.00% (1:5)	20.00% (1:5)	14.30% (1:7)	14.30% (1:7)	14.30% (1:7)	14.30% (1:7)	**14.30% (1:7)**	14.30% (1:7)

NOTE * : aircraft of 52 m (171 ft) and wider will be evaluated individually.

CAUTION: THE INFO PRESENTED BELOW IS SUBJECT TO FURTHER EVALUATION AND AMENDMENT AS MORE DETAIL ON SUCH THINGS AS TOPOGRAPHY/SITE SURVEY BECOMES AVAILABLE.

The airstrip located at **position #4** would provide the most challenge as terrain is the highest on the final approach heading in the northerly direction. Also, information provided suggests the mine site and associated structures will be 1 km west of the camp site and that would put it in the final approach location as well. Consequently, the landing minima would be high and it is quite possible there could be a penetration of the 1:40 missed approach slope from the opposite end and a calculated climb gradient may be required . The use of final step-down fix and turning missed approach procedures for aircraft approaching from the opposite end could be done and the task is not insurmountable but it does add to the complexity of the procedure especially for heavier jet aircraft, consequently this location is not recommended.

The Airstrip located at **position #3** appears to be in some type of a gully as the terrain rises to 1000ft aprx 2200ft east of this strip and the strip elevation is 650 ft, consequently this site may have difficulty meeting the non-precision aerodrome physical characteristics as highlighted in red above. If such is the case, then a 500ft Agl height is the lowest the procedure can de designed(for the northerly approach) and this would be much the same as the airstrip located at **position #4** Also, there is a possibility of a penetration of the 1:40 Diverse Departure slope taking off in a southerly direction and a calculated climb gradient may be required also. As well , the mine site and associated structures are located very close to the final approach on the northerly heading but may be far back as not to be an issue. There would be no clear advantage with this site over the one located at **position #4.**

Airstrips located at **positions #1 & #2** probably would appear to offer the best options although for an approach heading south **position #2** may be better as the highest terrain is about 1.75 nm from the end of the airstrip and conversely position #1 may be better for an approach heading north. It is certainly possible there may be a difference of 300ft and better that ½ mile in landing minima with **positions #1 & #2** compared to **positions #3 & #4.** Also **positions #1 & #2** could be better suited to RNAV(GPS) based on WAAS as time progresses.

The basic data provided would certainly suggest that none of the four selected sites would pose a safety problem for aircraft operations and recommend as follows POSITION 1:

Length:	5000 - 6000 ft range X 150 ft hard packed gravel(wouldn't recommend less that 5000ft)
Rwy Bearing:	NNW/SSE - 350/170 Deg True
Lighting:	Medium intensity edge lights and threshold end lights Lighted wind cone.
Approach Lights:	AN(SSALR) High Intensity Precision Approach Path Indicator P3 system for eye to wheel height up to 45ft(B737, C130).
WX & Comm:	Certified weather observation(AWOS) to provide hourly weather reports Air to Ground communication to provide inbound aircraft with traffic info and airstrip conditions.
Navigation Aids:	For redundancy purposes an NDB with DME would certainly be recommended due to the high Northern Latitude.
Runway Surface Assessment:	Assessed to non-precision criteria as outlined in the above matrix as this will enable the lowest landing minima of 250ft HAT(Height above Threshold)
Instrument Procedures:	RNAV(GPS) with vertical guidance supplemented with a conventional NDB/DME procedure.

Reference Documentation:
TP-308 Criteria For The Development of Instrument Approach Procedures
TP-312 Aerodrome Standards and Recommended Practices