Nunavut Airports
20 Year Infrastructure Needs Assessment
2014-2034

Prepared for:

Nunavut Airports
Economic Development & Transportation
Government of Nunavut
Iqaluit, NU

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1 Introduction

LPS AVIA. was retained by the Department of Economic Development and Transportation (ED&T) to prepare an update to the *20 Year Capital Needs Assessment (LPS AVIA 2005)* for the 24 public airports (with the exception of Iqaluit) owned and operated by the Government of Nunavut.

The updated 20 Year Infrastructure Needs Assessment document will enable the Government of Nunavut (GN) to plan the ongoing infrastructure maintenance and development required to meet the needs of the residents of Nunavut. The GN is committed to ensuring that these key aviation infrastructure assets do not deteriorate to the point that rehabilitation of the airports becomes prohibitively expensive, especially on a system-wide basis.

All airports require continuous maintenance and capital investment in order to maintain their operational capability, and to meet mandatory safety and licensing standards. Arctic airports in particular require considerably more ongoing investment than do southern airports of comparable size.

This assessment, which represents the view of the GN, has examined the current condition of Nunavut's airport infrastructure, assessed past rehabilitation efforts and prepared a realistic needs assessment program to ensure the continued viability and safety of the airports – which are the lifelines of the Nunavut community.

The Needs Assessment is driven by and organized into the following major categories:

- Base Infrastructure Needs (maintaining the existing plant),
- Economic Development, Policy and Planning,
- Improved Airport Accessibility,
- Safety and Regulatory Requirements.
- Societal Change
- Condition Assessment
- 20 Year Infrastructure Needs Summary

2 Base Infrastructure Needs

Nunavut has a large and dispersed inventory of assets in the 26 airports transferred from the Federal Government (via the later transfer from the GNWT).

This section establishes the baseline requirements for the maintenance of the existing airport infrastructure including buildings, airfield electrical and movement surfaces. It also provides a summary of the condition assessment of the 24 airports.

2.1 Current Asset Management Approach

The current condition of each airport is documented in an *Airport Operations Inspection Report*. This report is supposed to be prepared semi-annually by the Transportation Programs Officer/Manager and is based on field inspections of each airport site.

The Airport Operations Inspection report covers several aspects of airport infrastructure and operations including (but not limited to) the condition of the following items:

- airport movement surfaces;
- visual aids;
- groundside areas;
- air terminal buildings;
- maintenance equipment shelters; and
- the field electrical centre.

The most recent Airport Operations Inspection report for each airport, where available, was used by LPS AVIA to determine the condition of the various airfield infrastructure components. It should be noted that not every airport had an up to date inspection report available for review, consequently LPS AVIA relied on the input and experience of Nunavut Airports staff to capture the specific needs and issues at each site.

2.2 Airside Pavements

Gravel surfaced runways, taxiways and aprons have different capital and ongoing maintenance needs when compared to airports with asphalt paved surfaces. Twenty-three of the 24 airports in Nunavut have gravel runways.

Only Rankin Inlet have asphalt paved runways. The *Cambridge Bay Airport Master Plan (LPS AVIA 2010)* has recommended the gravel runway aprons and taxiways be upgraded to an asphalt surface by 2020. Consequently this requirement has been included in the Infrastructure Needs Assessment. When this has been accomplished all three Nunavut gateway airports, and the territorial hub airports receiving southern jet services, will feature asphalt paved runways.

2.2.1 Airports with Gravel Surfaces

Background

Gravel runways require considerable upkeep to ensure that safe conditions are maintained for aircraft landing and taking off. The gravel runway is a high-speed surface where aircraft routinely travel at speeds in excess of 180 km/hour.

The repeated loadings of air traffic operations, as well as variable climatic effects, can contribute to the degradation of the gravel surface over time and eventually result in defects of the gravel surface. Transport Canada Advisory Circular AC300-004 has provided a description of the typical defects encountered on gravel surfaces. They are as follows:

- **Loss of Material** – is indicated by the presence of bare spots and sub-grade material appearing on the runway surface. This defect can occur during snow removal operations or tyre action.

- Segregation - is the accumulation of loose material, lacking in fines on the runway surface. This defect can occur as a result of jet or propeller blast.
- Rutting – is the sunken track or grooves made by the passage of aircraft or vehicle tyre. This defect can be caused by loss of material during snow removal operations, or infiltration of the sub-base material into the surface layer.
- Poor Surface Drainage – is indicated by damp spots or pooling of water on the gravel surface, after rainfall or during snow melt. This defect can be caused by inadequate transverse slopes or poor drainage facilities.
- Poor Sub-surface Drainage – is indicated by soft areas on the gravel surface during spring thaw and frost heaving during winter. This defect can be caused by inadequate sub-surface drainage or a high water table.
- Frost Action – is indicated by differential heaving of the gravel surface or depressions which appear in same location during the winter. This defect can be caused by inadequate sub-grade drainage or inadequate frost protection in the pavement structure.

It is important that gravel runways, taxiways and aprons be maintained rut-free, properly sloped to drain, and free of snow to ensure the safety of aircraft using the airport. Adequate skid resistance must be developed at all times on the runway surface through proper maintenance procedures.

Achieving this requires:

- a properly developed maintenance and capital replacement program;
- a training program for all operations and maintenance staff involved; and
- a priority system for the airport.

It also requires development of policies and standards for the maintenance of all airports to a uniform territorial safety standard.

Policies & Standards

When the Arctic A, B and C Airports of Nunavut were under the ownership and direction of Transport Canada, there were formal policies in place for the maintenance and operation of the airports. The policies invoked standard practices for maintenance and development of airports known as AK manuals.

These AK manuals are no longer maintained and updated by Transport Canada as a result of the airport divestiture program. Several of these AK manuals are particularly relevant to Nunavut Arctic airports including:

AK-88-32	Airport Pavement Structural Condition Surveys
AK-67-09-280	Gravel Runways Condition Reporting Procedures and Surface Stability Test Methods
AK-76-04	Facilities Condition Inspection and Reporting System (now TP2391)
AK-68-80	Small Airports: Airside Facilities

It is recommended that Nunavut Airports enhance existing maintenance policies and develop new standard practices where applicable based on these well-proven AK manuals.

Resurfacing

Airports require gravel on a regular basis to continue operations.

Typically gravel is crushed and stockpiled at or near each airport to replenish the gravel on the runways, taxiways and aprons. The gravel is typically scraped or worn off by landing aircraft, snow clearing operations, and routine grading to shape and smooth the surface for safety, and to minimize damage to aircraft.

The typical cycle for major maintenance of arctic gravel runways is 15 years. At the beginning of the cycle, a large stockpile of gravel is created, usually by crushing; only occasionally by screening. When the gravel has been crushed, a major overlay of approximately 150 mm (6") of gravel is added to the runway to rebuild the base.

This overlay is shaped by a motor grader and compacted, usually with a wobbly wheel compactor.

For approximately the next 7 years, small quantities of gravel are drawn from the stockpile and added each year to fill holes, repair minor damage, and to maintain the aircraft manoeuvring surfaces. This annual maintenance is carried out under an Operations and Maintenance (O & M) Budget rather than the Capital Budget. Typically in the 8th year, a minor overlay is added to the runway; usually 75 to 100 mm (3" to 4") of gravel and the surface is again reshaped, and compacted. This minor overlay is carried out under the Capital Budget. Then until year 15, O & M work is carried out filling holes and grading the surface with small quantities of gravel from the stockpile. By year 15, the stockpile is usually exhausted and the cycle begins again.

It is important that the cycle be maintained. If the gravel supply runs out prematurely and is not available for maintenance and overlay, the runway surface wears away and the larger stones in the sub-base become exposed and make the runway unsafe to use. Rebuilding the runway surface after the sub-base has been exposed is <u>significantly more costly</u> than reconstruction of the base alone.

Gravel Stockpiles

The cost of creating a gravel stockpile is a significant factor in the capital cost of the operation of each airport. It generally takes approximately 2 seasons to create a gravel stockpile.

The current quantity of gravel at the stockpiles at the 23 airports was not determined in any quantitative manner during the preparation of the Infrastructure Needs Assessment. The size of each airport stockpile was based on verbal and pictorial information from staff at Nunavut Airports.

There were several airports that were identified as having either very little or no stockpiles of granular material available for airport maintenance. These airports are:

- Baker Lake;
- Clyde River;
- Igloolik;
- Pond Inlet;
- Whale Cove
- Resolute Bay; and
- Hall Beach.

It should be noted that there are currently projects underway to crush gravel in Kugluktuk and Grise Fiord.

The stockpiles in the communities listed below were reported as being adequate for performing one major overlay in the next 5 years. These are:

- Cape Dorset;
- Chesterfield Inlet;
- Coral Harbour;
- Gjoa Haven;
- Taloyoak; and
- Kugarruk.

It has also been noted that stockpile gravels are frequently pilfered for other uses given the high demand for granular material in many of the communities. Consequently the normal life expectancy of a stockpile can be reduced significantly down from the normal 15 years to 3 or 4 years. An allowance has been made for the reduced stockpile volumes in the 20-Year Infrastructure Needs Assessment update.

The amount of gravel in the stockpile is a key element in determining the life cycle of the runway.

There should be a programmed measurement of each stockpile volume on a regular basis to properly design a replacement program for the gravel.

2.2.2 Airports with Asphalt Paved Surfaces

The asphalt paved runways, aprons and taxiways at Iqaluit and Rankin Inlet Airports are maintained on an annual basis with Operations & Maintenance (O & M) funds. The O & M work typically includes crack sealing and removal of any weed growth and maintaining lateral support by shoulder maintenance. Crack sealing significantly extends the life of asphalt paving if carried out on an annual basis.

After a certain number of annual cycles, the asphalt pavement requires an overlay to refurbish it. Typically the life cycle of an asphalt airport runway pavement ranges from 10 to 15 years between overlays, depending on many different conditions and use factors.

Rankin Inlet

The last runway overlay at Rankin Inlet Airport was carried out in 2009, 5 years ago. The pavement is in average to good condition.

An asphalt overlay for the main runway in 2024 has been allowed for in the 20-Year Infrastructure Needs Assessment. It is recommended that a pavement condition survey be carried out to determine if this work should be moved forward.

2.2.3 Pavement Management Program

The Government of the Northwest Territories (GNWT) purchased and implemented a Pavement Management System to assist in maintaining both the gravel runways and the asphalt paved runways of the GNWT. The system was based on computer software sold by Deighton Systems from the United States. The Deighton Pavement Management System is well recognized as being a good system.

A pavement management system requires that an inventory of all pavement surfaces as well as condition data about the airport pavements be first input, and then regularly updated and corrected so that it can produce an ongoing management program that is realistic and effective.

When the eastern arctic airports were turned over to the Nunavut Government, the Deighton Pavement Management System software and databases were also turned over to Nunavut. The databases have not been maintained since 1999 however. That is, no condition data has been added to the database.

It is strongly recommended that this system be updated and implemented or that a similar pavement management system be used to assist in preparing the capital budgets in the future for this very significant cost component of the overall Airports Capital Budget.

2.3 Airside Electrical

2.3.1 Field Electrical Centres

Field Electric Centres (FEC) are the central locations at which electrical power is provided to the airport, transformed to the correct voltage for specialized aviation applications, and distributed to various equipment on the airside of the airport. The FEC also usually contains switching equipment and emergency power generation equipment, all housed in a small building, or a portable structure, located as near as possible to the centre of the electrical load to reduce power consumption and cost. Electrical equipment has improved dramatically since Nunavut's FECs were first installed, with major improvements in reliability, serviceability and cost efficiency.

There has been an ongoing program in the past to replace original Field Electrical Centres as they have aged. The most recent FEC replacements have taken place at Baker Lake and Chesterfield Inlet.

For the purposes of preparing the Infrastructure Needs Assessment, the study team has relied on the judgement of Nunavut Airport's staff to assess the condition and replacement time for field electrical centres.

Five FECs are scheduled for replacement in the next 5 years. This should complete the replacement of all the original FECs installed when the airports were first constructed by Transport Canada.

The major replacement / rehabilitation schedule is based on an assumed FEC life cycle of 25 years.

2.3.2 Aerodrome Lighting Systems

Aerodrome lighting systems are required for operations during periods of darkness and can provide aircraft operators with additional visual guidance on approach to a runway, especially during periods of poor visibility.

Aerodrome lighting systems have varying degrees of sophistication, depending on the level of instrumentation provided to support a runway. The airfield lighting system is an important component of the visual aids to navigation. Key components of the system include:

- **approach lighting systems** provide alignment guidance to the runway environment during low visibility or night operations;
- **precision approach path indicators** provide visual indications of the desired approach slope to the runway;
- **runway edge lights** are light fixtures placed along the full length of the runway and are in two parallel rows equidistant from the runway centreline;
- **runway threshold lights** are light fixtures similar to those used for runway edge lighting; however, they are located at the beginning of a runway surface with green lenses allowing pilots to visually identify the threshold location while on approach;
- **runway end lights** are usually co-located with threshold lighting, except with red lenses that provide pilots with a visual indication that they are approaching the end of the runway;
- **taxiway and apron edge lights** are used to provide guidance and spatial awareness to flight crew during night or reduced visibility ground operations; and
- **apron flood lighting** is used to assist flight crew in taxiing aircraft into and out of final parking positions, providing lighting suitable for passenger embarkation and disembarkation operations, as well as for aircraft servicing.

Runway edge lighting and approach lighting is essential for airport night operations and for winter operations throughout Nunavut due to the limited period of daylight and inclement weather conditions.

Similar to the program for replacement of the Field Electrical Centres, the runway lighting systems have been regularly replaced.

In most cases the original systems were installed using direct-buried wiring, which has a shorter life span than conduit systems, especially in the cold arctic climate.

The major replacement / rehabilitation schedule is based on an assumed life cycle of 25 years.

2.4 Buildings and Facilities

2.4.1 Older Air Terminal Buildings

Air Terminal Buildings (ATBs) are essential at all Nunavut airports, and all airports served by scheduled air services must have functional and reliable air terminal buildings.

Air Terminal Buildings provide an interface between the ground and air transportation systems. An ATB should provide a safe, comfortable and healthy environment for the processing of passengers and baggage, as well as for airport tenants and other users.

There are several airports at which the small, older style “freezer” buildings form the Air Terminal Building. These older buildings are near the practical end of their useful life and are generally not suitable for renovation.

For the purpose of the Infrastructure Needs Assessment, it has been assumed that these buildings will be replaced and will not be renovated. Replacement dates have been generally based on the recommendations of Nunavut Airports staff, as well as the reported age and condition of the building.

It may be prudent to study these buildings in more detail to determine if an effective renovation program could be developed which would see the ATBs restored rather than replaced. However, these building are sometimes used as community assembly buildings, so there is often community pressure to upgrade and replace the ATBs rather than renovating them.

2.4.2 Maintenance Buildings

Mobile equipment must be sheltered at all arctic airports in order to provide ready reliable service when required. In addition, airport maintenance requires various stores and spare parts be kept securely at or near the airport to support daily maintenance activity.

Very limited information is available, other than the gross square footage and the date constructed, for many of the smaller and more remote Airport Maintenance Buildings in Nunavut. The condition of the buildings and projected replacement dates in the Infrastructure Needs Assessment are generally based on recommendations from Nunavut Airport staff.

2.5 Airport Condition Assessments

The condition assessment of the 24 airports operated by Nunavut Airports is provided in Appendix A. The information contained in these spreadsheets forms the basis for the 20-Year Infrastructure Needs Assessment.

A summary of the immediate facility rehabilitation projects to be accomplished within the next 5 years is provided below. These projects have been developed based on consultations with Nunavut Airports staff, as well as consultations with flight crew who regularly fly into these airports.

New Air Terminal Buildings

The size, age, and failing structural and building system condition of the following ATBs requires immediate replacement with a new building. They are:

- Whale Cove;
- Chesterfield Inlet;
- Naujaat;
- Taloyoak; and
- Kimmirut – (Building is an ATCO Trailer, in need of a temporary facility until new airport is constructed).

The new air terminal buildings at Whale Cove, Chesterfield Inlet and Repulse bay will be based on the standard model air terminal building design that will be developed for the community of Taloyoak. This standard design will require minor modifications to suit the local site conditions of each location.

Expanded Air Terminal Buildings

The main gateway airports of Rankin Inlet and Cambridge Bay have both seen an increase in traffic and passenger growth. The Master Plans for each airport have recommended immediate increases in the size of the existing ATBs to accommodate the current and future passenger volumes.

Air Terminal Building Upgrades

A number of communities require substantial upgrades to their existing ATB facilities to address building system faults or major structural items. These airports are:

- Baker Lake;
- Kugluktuk;
- Kugaaruk; and
- Gjoa Haven.

In addition, there are some communities in which relatively minor repairs can restore the building to an acceptable condition. These airports are:

- Igloolik;
- Resolute Bay;
- Cape Dorset;
- Pangnirtung; and
- Sanikiluaq.

Maintenance Garages/Equipment Shelters

The following airports require new maintenance garages/equipment shelters to accommodate increased equipment inventory or to replace existing obsolete facilities:

- Arviat –4 bay garage;
- Rankin Inlet –4 bay garage;
- Pond Inlet –5 bay garage;
- Kuugaaruk – 3 bay parking shelter;
- Kugluktuk – 3 bay parking shelter;
- Taloyoak - 3 bay parking shelter;
- Gjoa Haven – 3 bay parking shelter; and
- Grise Fiord – 3 bay parking shelter.

In addition to the above airports, upgrades and/or repairs to the equipment shelters at Cambridge Bay, Baker Lake and Hall Beach will be required.

Field Electrical Centre Upgrades

Several airports require major upgrades or replacement of their existing FECs. In a few cases the airports do not have a dedicated facility that serves the role of an FEC. The airports that require work or upgrades to their existing FECs are:

- Grise Fiord;
- Kimmirut;
- Hall Beach;
- Pond Inlet;
- Sanikiluaq; and
- Clyde River.

It should be noted that design work is currently underway for the upgrade of the FEC at Hall Beach. In the case of Pond Inlet and Clyde River, the upgrade required involves connecting the Community Aerodrome Radio Stations (CARS) to the FEC.

In addition, some airports require the provision of back-up generators to provide electrical power redundancy. These are:

- Gjoa Haven;
- Kuugaaruk;
- Kugluktuk; and
- Taloyoak.

It is recommended that back-up generators be included as part of the scope of work for FEC upgrades.

Airfield Lighting System Upgrades

The airfield lighting systems of a number of airports are in need of immediate upgrades. In some cases the entire runway lighting system is required, while in other cases only a component such as flood lighting requires addressing. The airports requiring immediate upgrades are:

- Hall Beach;
- Rankin Inlet;
- Gjoa Haven;
- Grise Fiord;
- Resolute Bay; and
- Qikiqtarjuaq.

It should be noted that design work is presently underway for airfield lighting upgrades at Hall Beach and Grise Fiord. In the case of Rankin Inlet, the lighting upgrade entails improvements to parking floodlights.

3 Base Equipment Needs

3.1 Mobile Equipment

Airports depend on reliable mobile equipment for year-round maintenance activities, in support of reliable and essential scheduled air services to each community.

Mobile equipment costs considered in the Infrastructure Needs Assessment update are based on the GN capital equipment database valuations as well as recent procurement costs. The cost of freight is not considered to be a capital cost.

3.1.1 Mobile Equipment Database

Nunavut Airports has an up-to-date mobile equipment database used by staff to keep track of equipment, to plan, and to generate reports regarding replacement of the fleet. This database was used in the preparation of the Infrastructure Needs Assessment.

3.1.2 Fleet Age and Historical Replacement

Table 3-1 shows an analysis of the age and the replacement status of major pieces of mobile equipment. It also shows Nunavut Airports' recommended replacement age for the components as well as the age used for equipment replacement for the Infrastructure Needs Assessment study.

Table 3-1 - Nunavut Airports - Major Mobile Equipment Fleet Synopsis

Fleet Item/Category	Average Age of Units in Year 2014	Recommended Replacement Age (Years) - GN	Recommended Replacement Age (Years) - LPS
Truck – Runway (pickup/other)	6.4	7	8 (runway skid) 10 (other)
Truck-Dump/Plow (S/A, T/A)	14.5	15	18
Wheel Loader	8.1	15	18
Packer (Wobbly Wheel)	22.5	20	25
Motor Grader	14.5	17	20
Snow Blower	14.2	17	20
Crawler Tractor	15.4	20	N/A
Sweeper	11	15	15
Plows	21.9	N/A	28

3.1.3 Minimum Mobile Equipment Needs

In 2000, Nunavut Airports staff prepared a list of the minimum mobile equipment needed to maintain both gravel and asphalt paved runways. Maintenance includes both gravel grading and snow clearing. The required equipment is based on the total surface areas that have to be maintained on a priority basis.

Priority areas listed in the table are based on the area of the runway + the taxiway + ¼ of the apron area at each airport. The list appears to be comprehensive, reasonable and appropriate for the needs of the airports. The equipment list for gravel runways appears as Table 3-2 and for paved airports as Table 3-3.

Table 3-2 - Minimum Mobile Equipment For Paved Runways

Airports by Category	Priority Area(sq ft)	Mobile Equipment Required	Accessories/Conditions
Rankin Inlet	1,066,071	Pickup Truck	c/w JBI Unit
		#1 Plow Truck (S/A)	c/w Box, Sand Spreader & Plow
		#2 Plow Truck (S/A)	c/w Box, Sand Spreader & Plow
		#3 Plow Truck (S/A)	c/w Box, Sand Spreader & Plow
		#1 Sweepers	Tow Behind
		#2 Sweepers	Tow Behind
		#3 Sweepers	Tow Behind
		#1 Sand/Urea Spreader	Tow Behind Hopper Style
		#2 Sand/Urea Spreader	Tow Behind Hopper Style
		Wheel Loader	c/w buckets, forks, ramp hog & dozer
		#1 Snowblower	Self-propelled or loader mounted
		Motor Grader	c/w Snow Wing
		Dye Marker	Towed unit
		Tar Kettle	Towed unit
		Router Joiner	
		Trailered Air Compressor	
		Trailered Generator	
		Trailered water pump	
		Trailered Welder	
		Herman Nelson	
		Vibratory Packer	For pavement only

Table 3-3 - Minimum Mobile Equipment For Gravel Runways

Category Based on Priority Area	Airports by Category	Priority Area (sq. ft.)	Mobile Equipment Required
100,000-199999	Kimmirut Grise Fiord	150, 130 160,139	Pick-up Truck Motor grader Wobbly Wheel Packer Plow truck (S/A) Dye Marker Slip-in Water Tank
200,000-299,999	N/A		
300,000-399,999	Pangnirtung Repulse Bay Clyde River Qikiqtarjuaq	304,897 256,351 366,849 367,470	All above + Snow Blower
400,000-499,999	Sanikiluaq Igloolik Chesterfield Inlet Whale Cove Arctic Bay Cape Dorset Taloyoak Pond Inlet Arviat Baker lake Gjoa Haven	401,399 411,248 418,514 421,928 429,749 430,463 435,183 439,728 449,053 474,513 475,511	Wheel Loader 2nd Wobbly Wheel Packer
500,000-699,999	Kugaaruk Coral Harbour Kugluktuk	519,053 539,613 605,280	All Above No additional equipment
700,000-899,999	Hall Beach Cambridge Bay	845,953 849,981	
1,100,000-1,299,999	N/A		All Above No additional equipment
1,300,000-1,499,999	N/A		2nd Snow Blower
1,500,000-1,699,999	Resolute Bay	1,615,673	All Above No additional equipment

3.2 Maintenance Operations

The general maintenance of the airports in Nunavut is contracted to either private firms or the hamlets. Maintenance activities are carried out using equipment supplied by Nunavut Airports, and supplemented where necessary by renting community or contractor - owned equipment.

Currently a number of airport sites do not possess the minimum complement of maintenance equipment identified in section 3.1.3. The list of equipment is presented in Table 3-4.

The new equipment required, as well as the costs for replacement equipment, is included in the 20-year Infrastructure Needs Assessment update. An arbitrary date for this expenditure has been established as 2015.

Table 3-4 - Major Mobile Equipment Requirements

Equipment	Number Required	Airport
Truck-Dump/Plow (S/A, T/A)	3	• Rankin Inlet • Taloyoak • Chesterfield Inlet
Wheel Loader	5	• Cape Dorset • Igloolik • Kugluktuk • Repulse Bay • Sanikiluaq
Motor Grader	10	• Arviat • Cape Dorset • Gjoa Haven • Igloolik • Kugaaruk • Kugluktuk • Pangnirtung • Pond Inlet • Repulse Bay • Whale Cove
Snow Blower (attachment)	1	• Chesterfield Inlet
Sweeper	1	• Rankin Inlet

4 Transport Canada Regulations

A series of new Transport Canada regulations since 2006 are having a major financial impact on Nunavut. They significantly increase the capital costs of upgrading Nunavut's airports, with impacts varying by community:

1. New Take-off Weight Regulations may force use of smaller aircraft or require capital investments to increase runway lengths at some communities.
2. New Approach Ban regulations may impact operations in poor weather or require capital investments to improve approach aids.
3. New Runway End Safety Area regulations may either reduce usable runway lengths or require capital investments to expand runway safety areas.
4. New Safety Management Systems require greater diligence in airport operations leading to increased capital investments in security, fencing, wildlife control and other measures.
5. New Aerodrome Standards to harmonize with international rules significantly increases the capital cost of upgrading airports with more stringent clearance zones, protected areas, and design criteria after December 2014.
6. Boeing B737-200 operations will likely be curtailed in Nunavut within the short term as Boeing has capped aircraft service life, and Transport Canada will require expensive modifications if operated after 2017. Newer model jets will only use paved runways.

The total capital cost impact of new regulations on Nunavut Airports has not been fully assessed as each regulation is at a different stage of implementation.

The potential impacts of new regulations on the capital needs of Nunavut Airports are described hereafter.

4.1 Current Airport Standards

4.1.1 Airport Certification

Airports that support scheduled services must be "Certified" by Transport Canada, thereby ensuring conformance with national standards for design and safety. "Registered" airports (aerodromes) do not have to meet national standards.

Pursuant to the Canadian Aviation Regulations (CARs), Transport Canada's document TP312 4th Edition - Aerodrome Standards and Recommended Practices currently governs airport certification in Canada.

As the Airport Operator, the Government of Nunavut (GN) is responsible for the operation and maintenance of each public airport and aerodrome. The GN holds an Airport Certificate issued by Transport Canada (TC) for each certified airport, and is responsible for operating the airport in accordance with a TC-approved Airport Operations Manual (AOM) with various sub-ordinate plans. The GN is the Airport Manager for each airport and the Deputy Minister is the "accountable executive" pursuant to the Canadian Aviation Regulations.

4.1.2 Airport System Funding

There is no existing precedent for the capital funding of Nunavut Airports, beyond reference to funding provided by the Federal government before airport divestiture. Transport Canada relinquished responsibility for airports in the eastern arctic to the Government of the Northwest Territories in 1995 (Arctic A airports) and in 1991 (Arctic B and C airports).

Financial support for arctic airports was incorporated into territorial funding provided by the Federal government, and was no longer uniquely identifiable.

The GNWT relinquished responsibility for airports to the Government of Nunavut upon Nunavut's creation in 1999. Continued funding support for airports was not specifically defined at that time.

4.1.3 Airport System Best Practices

Transport Canada developed comprehensive airport operational and technical manuals (AK Manuals) based on 50 years' experience with "best practices" at airports. While AK guidance manuals may sometimes appear expensive or difficult to follow, the recommendations typically result in cost efficient airport investments by government over the longer term.

Use of AK Guidance Manuals is recommended for capital projects to ensure efficient investments at Nunavut Airports.

4.2 Current Deviations

Seven (7) of Nunavut's 26 airports have Aerodrome Operating Certificates which list "Deviations" from standards, namely TP 312 4th Edition. Certain safety related conditions exist that do not meet the normal requirements for aerodromes of this license type.

Under related new policies, Transport Canada no longer permits "Deviations" for an indeterminate length of time. Unless they are terrain-related (ie: mountains or hills intruding into safety zones), the Deviations become "Exemptions" with a time limit. Exemptions will have to be made good presenting additional capital costs for the GN.

Table 4-1 shows deviations for each airport and a preliminary assessment (by LPS AVIA) of the mitigation(s) to rectify the situation. Mitigation measures included in the Infrastructure Needs Assessment 2014 – 2034 are identified.

Table 4-1 - Aerodrome Deviations - Nunavut Airports

Location	Deviation	Mitigation
Cambridge Bay	No graded areas provided within the basic runway strip. Caution statement must be included in Canada Flight Supplement regarding 4-6 foot drop-offs.	Install new widened shoulders. (Project underway) Not in Needs Assessment
	Aircraft parked on private apron may penetrate the transitional surface. Letter of agreement required regarding operational constraints of south apron.	Relocate apron. Included in Needs Assessment
Cape Dorset	Take off/approach surface runway 307T is violated by terrain	Do Nothing (Terrain)
	Transitional surfaces are violated by mountains on both sides of the runway	Do Nothing (Terrain)
Clyde River	Power poles penetrating transition surface on each side of threshold of Runway 024T	Relocate poles. Not in Needs Assessment
	Location of apron and possible penetration of transitional surface by the tail of a parked aircraft.	Relocate Apron. Not in Needs Assessment
Kimmirut	Inadequate graded area and runway strip	Relocate Airport Included in Needs Assessment
	Violation of Transitional surfaces on both sides of runway by terrain, power lines, bldgs, and antenna.	Do Nothing (Terrain)
	No graded area at end of Runway 17, inadequate graded area at end of Runway 34	Relocate Airport Included in Needs Assessment
	Violation of the Take-off/Approach Surface at both ends of the runway.	Do Nothing (Terrain)
	A portion of the runway exceeds the allowable slope (4% versus 2%)	Relocate Airport Included in Needs Assessment

Table 4-1 (cont.) - Aerodrome Deviations - Nunavut Airports

Location	Deviation	Mitigation
Kugaaruk	Runway length is Code 3, deviation approved for physical characteristics and OLS to Code 2 standards which is limiting scheduled pax service.	Do Nothing (Terrain)
	Road penetrates approach to Runway 23T	Relocate Road Not in Needs Assessment
Pangnirtung	Mountains rising to 500 meters within 150 meters of runway	Do Nothing (Terrain)
	Reduction in strip width from 60 to 45 meters	Relocate Airport Included in Needs Assessment
	Location of the apron and possible penetration of transitional surface by tail of parked aircraft	Relocate Airport Included in Needs Assessment
	Inadequate graded area at both runway ends	Relocate Airport Included in Needs Assessment
Qikiqtarjuaq	Mountains in outer surface south-east of airport	Do Nothing (Terrain)
	Approach surface for Runway 21 penetrated by terrain	Do Nothing (Terrain)
	Aircraft parked on apron infringe transitional surface	Relocate Apron Not in Needs Assessment
Resolute Bay	Graded area Runway 17/35 undersize	Increase graded area Not in Needs Assessment
	Antennae penetrate transitional obstacle limitations (OLS).	Relocate antennae Not in Needs Assessment
Sanikiluaq	Windsock indicator Runway 27 on right side of runway instead of left.	Install second windsock Not in Needs Assessment

4.3 New Take-off Weight Regulations

Transport Canada regulations regarding new Take-off Weight Limitations for aircraft took effect in 2010.

Air transport category aircraft with more than 19 passenger seats (CAR Part 705) are now required to have specific approval for gravel runway operations, or must include a 15% penalty in available runway length when calculating take-off distances.

Commuter category aircraft with 10-19 seats (CAR Part 704) must include the 15% penalty in takeoff distance plus consider the net flight profile for take-off operations.

Single engine aircraft such as the Pilatus PC12 are exempt from the new regulations.

Accelerate-stop distance requirements were introduced for commercial aircraft operations carrying more than 9 seats. New regulations also defined net take-off flight path obstacle clearance requirements. Previously many smaller aircraft serving Nunavut communities were exempted from complying with these specific regulations.

A study of the impacts when the draft regulations were first promulgated entitled *Assessment of Impact of Takeoff Weight Limitations on Nunavut Airports (LPS AVIA 2005)* found that the impacts on Nunavut Airports could include:

- the need to extend certain community runways or to relocate airports;
- a reduction in allowable loads or the cessation of operations to certain communities by aircraft such as the Twin Otter, B-99, B-100, B-200 aircraft; or
- an inability to use certain aircraft types for profitable operations at many Nunavut airports.

In the 2005 GN report, the impacts of the new takeoff weight regulation change included, among others, that:

- runway extensions may be required at critical airports to reduce the impacts of the regulation change, but the cost benefit of the extension must be demonstrated; and
- specific aircraft type exemptions may be required at certain airports for continued operations.

At a minimum Grise Fiord, Kimmirut and Pangnirtung airports were found to have restrictions imposed on design aircraft.

The Infrastructure Needs Assessment Study considers Pangnirtung and Kimmirut airports as candidates for relocation. New airport locations should mitigate the Minimum Take-off Weight regulations at these communities.

Further physical extension of the runway at Grise Fiord is not possible as the terrain is not conducive to the extension. The Infrastructure Needs Assessment does not consider this issue.

4.4 New Approach Ban Regulations

New Approach Ban regulations came into effect in December 2006. The objective was to prevent pilots initiating or continuing approaches in bad weather when visibility is below certain limits related to the operations being conducted.

The approach ban applies to all runways served by a published instrument approach, both precision and non-precision. The bulk of the changes to the previous approach ban concerned commercial operations by fixed wing aircraft. Under the new rules RVR (Runway Visual Range), Runway Visibility, and Ground Visibility became the governing criteria for the approach ban.

The Government of Nunavut commissioned a study entitled *Assessment of the Impact of the Approach Ban on Nunavut Airports (LPS AVIA 2005).* The study determined that the financial impact on Nunavut's airports would be modest and that a safety benefit would be achieved. The study identified a modest capital investment by the GN to improve visibility reporting at community and hub airports.

Upon implementation Transport Canada provided some alleviation to the new regulations in the form of an Operations Specification for use by certain commercial pilots. The applicable Ops Specs are: Ops Specs 019 (703); 303 (704); and 503 (705).

The Ops Specs authorize Flight Crew to conduct IFR approaches when visibility is less than that specified in the general approach ban placed on commercial operations. While the Ops Specs allow pilots to conduct approaches to a lower visibility, they shall not continue the approach past the FAF inbound or, where there is no FAF, the point where the final approach course is intercepted, when the visibility report is below the minimum value for that approach.

In the event that the flight crew cannot meet the conditions to apply the Ops Spec, then they must use the more restrictive approach ban limits. A general condition of the Ops Spec is to use additional technology or Pilot Monitored Approach (PMA) procedures to reduce risk in low visibility approaches.

It is understood that as of 2014 most northern operators use the PMA procedures. Operators must train their pilots on PMA procedures.

The study conducted for the GN in 2005 included a number of recommendations. Those which are still relevant in 2014 are that:

- the Approach Ban be supported in the interests of safety for the passenger;
- to minimize the impact the measurement and or observation of ground and runway visibility be as accurate as possible;
- RVRs should be installed at some critical airports to minimize the effects of overly conservative visibility observations.
- Where RVRs are not installed, other measures should be undertaken to improve consistency and accuracy of visibility observations such as calibrated visibility markers on the airport and increased training of observers;
- higher intensity approach and edge lights could be installed at critical airports which would be required to support GPS precision approaches.

In the study conducted for the GN in 2005 LPS AVIA estimated the capital cost to include:

- installation of Runway Visibility Markers at 16 Community Airports; and
- installation of RVR (Runway Visual Range) instrumentation at Rankin Inlet and Cambridge Bay hub airports.

4.5 New RESA Regulations

In 2010 Transport Canada first proposed that new regulations requiring Runway End Safety Areas (RESA) be established at airports based on recommendations of the Transportation Safety Board, and to harmonize with international standards. Transport Canada document TP312 4th edition Aerodrome Standards and Recommended Practices was to be amended accordingly. The mandatory inclusion of RESAs at airports has now been included in the new TP 312 5th Edition currently at the consultation stage.

The GN commissioned a study entitled *Runway End Safety Areas, Options and Impacts Assessment (LPS AVIA 2012).* The objective of the study was to identify the options available and impacts on Nunavut's 25 airports arising from Transport Canada's new regulations.

Implementation of RESAs at Canadian airports presents challenges in the north where runway lengths are constrained by topography, land availability and water bodies. In the absence of available land for a RESA, Transport Canada has suggested that runways could be shortened to make room for RESAs. This would reduce runway "declared distances" for take-off and landing and impact the aircraft types and payloads at community airports, especially in poor weather.

The two issues of greatest concern are the practicality and cost of implementing RESAs at each airport, and the negative impact on community air services and the cost of living.

Twenty-four (24) of Nunavut's airports have scheduled service with aircraft certified for 10 or more seats qualifying for the RESA regulation. Financial responsibility for construction of RESAs has not been addressed by Transport Canada.

The study conducted for the GN in 2012 included the following results:

- Five (5) airports were found suitable for reduced runway declared distances. These included Iqaluit, Hall Beach, Gjoa Haven, Resolute Bay and Kugluktuk.

- Construction of RESAs at seventeen (17) airports was found to be possible.

- Two airports, Kimmirut and Pangnirtung, will be so reduced in capability as to become largely ineffective and must be relocated.

If funds are not available for construction then runway distances must be reduced and the annual cost of transportation in Nunavut will rise significantly through the use of smaller size, higher cost aircraft in Nunavut.

4.6 New SMS Regulations

4.6.1 Description

Transport Canada requires airports to have an SMS (Safety Management System) in place. In 2008 and 2009, SMS regulations for airports and air navigation services providers came into force.

According to Transport Canada:
SMS is a documented process for managing risks that integrates operations and technical systems with the management of financial and human resources to ensure aviation safety or the safety of the public. A safety management system *shall include:*

(a) a safety policy on which the system is based;
(b) a process for setting goals for the improvement of aviation safety and for measuring the attainment of those goals;
(c) a process for identifying hazards to aviation safety and for evaluating and managing the associated risks;
(d) a process for ensuring that personnel are trained and competent to perform their duties;
(e) a process for the internal reporting and analyzing of hazards, incidents and accidents and for taking corrective actions to prevent their recurrence;
(f) a document containing all safety management system processes and a process for making personnel aware of their responsibilities with respect to them;
(g) a process for conducting periodic reviews or audits of the safety management system and reviews or audits for cause of the safety management system; and
(h) any additional requirements for the safety management system that are prescribed under these Regulations.

Implementation of SMS has been undertaken in four phases:

1. Gap analysis, project plan development and designation of an accountable executive;
2. Preparation of a safety management plan , manual and training;
3. Implementation of proactive processes including policies and procedures; and
4. Quality assurance reviews, development of an emergency plan and training.

An audit of an airport's SMS is required 12 months after completion of Phase 4.

During 2012 and 2013 Transport Canada inspectors assessed SMS implementation at airports to verify compliance with regulations.

4.6.2 SMS Deficiencies Review

In 2013 the GN undertook an audit of 21 airports which assessed compliance with SMS requirements. The audit identified 214 SMS deficiencies ranging in importance from a lack of runway signage to major issues such as lack of drainage, runway flooding, and obstructions to safe aircraft operations.

Deficiencies may be categorized under four headings as shown below:

Airfield Maintenance (from operations contracts)

- Electrical maintenance required at 16 airports; and
- Other maintenance actions are also required.

Potential Capital Investment Projects

- Airside signage required at 17 airports;
- Airside fencing required at 11 airports;
- Significant lighting investments at 4 airports;
- Significant drainage problems at 3 airports.

4.7 New Aerodrome Standards

In December 2012 Transport Canada released new draft regulations governing airport planning, design and operations in document *TP 312 – Aerodrome Standards and Recommended Practices 5th Edition.* The new standards are to take effect in December 2014 replacing the current TP 312 4th Edition. These new standards will have a major impact on Nunavut's airports, and on the Capital Program 2014 – 2034.

Many current standards have become outdated and a number of new standards adopted internationally are not reflected in the 4th Edition document. The need for better harmonization with TP 308 – Criteria for the Development of Instrument Procedures, and consideration of new technologies is reflected in the 5th Edition.

4.7.1 Basis for New Standards

The aerodrome standards in the 4th Edition are infrastructure-based with the prescribed standards defined by level of service, as well as the length of the runway (runway code). The 5th Edition differs fundamentally in that the standards are performance-based, and are based on a critical aircraft that is intended to use the facility and the required level of approach service (i.e. precision, non-precision, non-instrument) and minimum visibility.

A critical aircraft is the aircraft identified as having the most demanding operational requirements with respect to the determination of movement area dimensions and other physical characteristics at the aerodrome or part thereof. The 5th Edition also differs in that it does not include recommendations, or guidance that "should" be followed. All standards in 5th Edition are mandatory. TP 312 5th Edition is currently in a consultative phase with the proposed standards being subject to change prior to the anticipated publication in December 2014.

The 5th Edition uses Aircraft Group Numbers (AGNs). These group numbers categorize aircraft based on wingspan, main gear span, tail height, and approach speed. The AGN defines dimensions and offsets for airfield elements including, but not limited to runways, taxiways, and Obstacle Limitation Surfaces.

Many of the 5th Edition standards concerning airport physical characteristics differ significantly from the 4th Edition standards and the resulting impact on Nunavut airports may be significant.

The current and potential future critical aircraft for Nunavut's airports and their respective AGNs are presented in Table 4-2 below.

Table 4-2 – Aircraft Group Number by Critical Aircraft

Time	Critical Aircraft	Wing Span (m)	Outer Main Gear Span (m)	Approach Speed -V_{REF} (kts)	Aircraft Group Number (AGN)
Current	B737-200	28.35	6.39	133	IIIB
	ATR 42	24.57	4.68	104	IIIA
	DHC-6	19.82	3.82	80	II
Future	ATR 72	27.05	4.66	105	IIIA
	DHC8-400	28.42	9.54	129	IIIB
	BAE 146	26.34	5.77	125	IIIB

4.7.2 Implementation

Elements of an airport built to the standards of previous editions of TP312 are protected by a Grandfathering Clause (CAR 302.07). For example, Baker Lake Airport is certified under TP 312, 3rd Edition and is not required to meet the standards of the current 4th Edition. However, if any facility is altered (e.g.: runway, taxiway, apron) it must meet the standards in place at the time the facility is returned to service. According to Transport Canada, this clause will include airports certified to 4th Edition standards at the time the 5th Edition is implemented.

Transport Canada is proposing a 3 year transition period after the official publication of TP 312 5th Edition during which they will assist airport owners in defining the most applicable AGN to replace the former Runway Code classification of the airport. The new AGN will be based on activities currently occurring at the airport, or activities at similar airports across Canada.

4.7.3 Potential Impacts

LPS AVIA has reviewed the impact of TP 312 5th edition on Nunavut's airports and determined the new AGN for each airport. The most significant issues likely to impact the Infrastructure Needs Study 2014 – 2034 include new Runway Strip, Runway Safety Area, and Runway End Safety Area requirements.

Runway Strip

The Runway Strip is a defined area that includes the runway, which is intended to protect aircraft during take-off or landing operations. TP 312 4th Edition recommends that all objects situated on a runway strip which may endanger an aircraft should be regarded as an obstacle and should be removed. However 5th Edition will prohibit any fixed objects within the strip with the exception of specific visual aids, navigation aids, animal control devices, and arrestor beds.

The width of the runway strip will increase in many cases. For example, under TP 312 4th Edition standards, Hall Beach Airport is certified as Code 3C-NP and satisfies the 150m wide strip requirement. Under 5th Edition standards, Hall Beach Airport would be required to meet AGN IIIB standards because the critical aircraft for the airport is a B737-200. Should the runway be altered after the publication of the 5th Edition, it would be required to widen the runway strip width from 150m to 244m. In some instance, fixed objects that were once outside of the runway strip, such as terminal buildings and hangars, may fall within the strip.

Runway Safety Area

The Runway Safety Area (RSA) is an area located within the runway strip intended to reduce the risk of damage to an aircraft running off of a runway. In TP 312 5th Edition, the Runway Safety Area is equivalent to the graded portion of a runway strip, or "graded area" defined in 4th Edition. Consistent with runway strips, runway safety areas are offset a greater distance than the corresponding graded areas defined in TP 312 5th Edition. For example, the graded portion of the runway strip at Chesterfield Inlet Airport is currently 46m wide and meets 4th Edition standards for a Code 2C-NI facility. Under 5th Edition standards, the Runway Safety Area will increase to 80m wide. This increased width would require sourcing large quantities of granular material at many Nunavut airports and could also present conflict with watercourses in close proximity to runways. The potential impacts to runway strips and Runway Safety Areas are presented in Table 4-4.

Runway End Safety Area

The objective of a runway end safety area (RESA) is to have an area free of objects, other than frangible visual and navigational aids, to reduce the severity of damage to an aircraft overrunning or undershooting the runway and to facilitate the movement of rescue and fire fighting vehicles. A runway end safety area has a minimum width twice that of the associated runway, extends away from the runway, is centred on the extended runway centreline, and has a minimum length of 150 m.

The primary difference between 4th and 5th Editions concerning RESAs is that under 5th Edition, the implementation of RESAs will be mandatory. The implications of establishing RESAs at Nunavut Airports have been outlined in Section 4.5.

Other Airport Elements

As a result of implementing TP 312 5th Edition standards, a number of other airport elements are likely to be affected. The severity of the impact will vary by airport. The elements that may be impacted include, but are not limited to:

- Obstacle Limitation Surfaces;
- taxiways;
- clearways;
- declared distances;
- holding positions/holding bays;
- markings;
- lighting; and
- signage.

4.7.4 Nunavut Airports 5th Edition Impacts

The table 4-3 below identifies the number of Nunavut airports that will be impacted by the adoption of TP 312 5th Edition as soon as facilities certified to 3rd or 4th Edition standards require alteration.

The table 4-4 on the following page provides an airport-by-airport summary of the most significant impacts at each airport.

4.7.5 Cost of New Aerodrome Standards

The **capital cost** of implementing the new standards at Nunavut's airports **will be high** and will only be known as airside improvements are implemented. When construction is contemplated all related characteristics of the facility must be improved, not just the upgrade desired by the airport owner.

It is possible to provide an advance estimate of the impacts of TP312 5th Edition at each airport at this time, but these costs will only be incurred when some form of remedial action, renovation or upgrade project is undertaken at each airport.

The new aerodrome standards have the effect of penalizing any small airport with significant additional costs should the airport wish to improve its current condition or safety standards.

Table 4-3: Summary Impact of TP312 5th Edition on Nunavut Airports

Significant Change to Standard	Number of Nunavut Airports Impacted*
Runway Strip	22
Runway Safety Area	23
Runway End Safety Area	22

*The 20 Year Capital Plan analyzed 24 Nunavut Airports. Iqaluit International Airport is not included in the analysis.

Table 4-4 – Major Impacts of TP312 5th Edition on Nunavut Airports

Airport	TP312		Runway Strip			Graded Area/Runway Safety Area		
	4th Edition Runway Code	5th Edition AGN	Current Width (m)	Width (m) - TP312 4th Edition	Width (m) - TP312 5th Edition	Current Width (m)	Width (m) - TP312 4th Edition	Width (m) - TP312 5th Edition
Arctic Bay	2C-NI	IIIA-NI	60	60	80	46	46	80
Arviat	2C-NP	IIIA-NP	90	90	150	46	46	80
Baker Lake	2C-NI	IIIA-NI	60	60	80	46	46	80
Cambridge Bay	3C-NP	IIIB-NP	150	150	244	0	90	150
Cape Dorset	2C-NP	IIIA-NP	90	90	150	46	46	80
Chesterfield Inlet	2C-NI	IIIA-NI	60	60	80	46	46	80
Clyde River	2C-NP	IIIA-NP	90	90	150	46	46	80
Coral Harbour	3C-NP	IIIA-NP	150	150	150	90	90	80
Gjoa Haven	2C-NI	IIIA-NI	60	60	80	46	46	80
Grise Fiord	1B-NI	II-NI	120*	60	80	38	38	80
Hall Beach	3C-NP	IIIB-NP	150	150	244	90	90	150
Igloolik	2C-NI	IIIA-NI	60	60	80	46	46	80
Kimmirut	1B-NI	II-NI	26*	60	80	26*	38	80
Kuugaaruk	2C-NI	IIIA-NI	60	60	80	46	46	80
Kugluktuk	3C-NI	IIIB-NI	90	90	150	80	80	150
Pangnirtung	2C-NI	IIIA-NI	45*	60	80	45	46	80
Pond Inlet	2C-NI	IIIA-NI	60	60	80	46	46	80
Qikiqtarjuaq	2C-NI	IIIA-NI	60	60	80	46	46	80
Rankin Inlet	3C-NP	IIIB-NP	152*	150	244	90	90	150
Repulse Bay	2C-NI	IIIA-NI	60	60	80	46	46	80
Resolute Bay	4C-P	IIIB-P	300	150	244	122	90	150
Sanikiluaq	2C-NP	IIIA-NP	90	90	150	46	46	80
Taloyoak	2C-NI	IIIA-NI	60	60	80	46	46	80
Whale Cove	2C-NI	IIIA-NI	60	60	80	46	46	80

5 NAV CANADA Upgrades

5.1 Introduction

Nav Canada is currently implementing advanced GNSS flight approaches at all Nunavut airports where this improved service is capable of being used. These will be of significant benefit to each community but may require **capital investments in airport improvements** to enable satellite-based approaches.

Nav Canada is a (non-share capital corporation) air navigation services provider for Canada. Nav Canada provides all facilities and services enabling the safe movement of aircraft in Canadian airspace and at public airports and aerodromes. Nav Canada also provides air navigation services in oceanic areas beyond Canadian airspace.

Nav Canada recovers the cost of providing facilities and services through user fees paid by air operators as they travel in or through Canadian airspace and airports.

Nav Canada is responsible for meeting the requirements for safe and efficient air operations in the public realm. This includes periodic system improvements and safety upgrades as these become necessary or beneficial to users and / or Nav Canada. This does not include investments at private aerodromes.

While costs exceed revenues in the north, Nav Canada considers the provision of modern air navigation services to be a number one priority in the Canadian arctic. Investments in improved communications, navigation and surveillance (CNS) services benefit Nunavut's air transportation system by providing:

- improved airport availability;
- improved mission success rates; and
- a more reliable transportation system.

Runways can be classified as either non-instrument or instrument. A non-instrument runway is intended for the operation of aircraft using visual approach procedures only. An instrument runway has visual and electronic navigation aids which permit an aircraft to conduct an instrument approach procedure to the runway in poor weather conditions. Instrument runways can be either:

- **Non-Precision** (NP) - an instrument runway with visual and non-visual aids providing at least horizontal guidance for a straight-in approach; and
- **Precision** (P) **–** an instrument runway served by an Instrument Landing System (ILS) and providing vertical and horizontal guidance to the runway to a decision height of 60 m (200 ft) or less and a visibility of 800 m (1/2 mile) or less depending on the type of ILS system utilized.

Table 5-1 lists the runways which are non-precision and non-instrument in Nunavut.

Table 5-1 – List of Non-Precision vs Non-Instrument Airports

Airport	Approach Category
Arctic Bay	NI
Arviat	NP
Baker Lake	NI
Cambridge Bay	NP
Cape Dorset	NP
Chesterfield Inlet	NI
Clyde River	NP
Coral Harbour	NP
Gjoa Haven	NI
Grise Fiord	NI
Hall Beach	NP
Igloolik	NI
Kimmirut	NI
Kugaaruk	NI
Kugluktuk	NI
Pangnirtung	NI
Pond Inlet	NI
Qikiqtarjuaq	NI
Rankin Inlet	NP
Repulse Bay	NI
Resolute Bay	P
Sanikiluaq	NP
Taloyoak	NI
Whale Cove	NI

5.2 Runway Approach Upgrades

Navigation aids are required for an aerodrome to be used under Instrument Meteorological Conditions (IMC). Navigation and approach aids increase aerodrome availability, especially during periods of darkness and/or poor visibility.

There are two types of electronic aids: terrestrial-based; and satellite-based, namely Global Navigation Satellite System (GNSS).

5.2.1 Nunavut Terrestrial Approaches

Nunavut airports have relied on terrestrial navigation aids since inception and have typically been equipped with an NDB (non-directional beacon) allowing aircraft to home into the location and then undertake a non-precision approach with limited horizontal guidance towards the runway. Aircraft have only been allowed to descend to a fairly high safe altitude in bad weather above the runway before transitioning to a visual final approach once the runway has been seen. Typically this Minimum Descent Altitude (MDA) has been 500' Above Aerodrome Elevation (AAE) and has resulted in numerous periods of airport unavailability due to poor weather, and unreliable air services.

Many terrestrial navigation aids are expensive and require significant maintenance and monitoring.

5.2.2 New Satellite Approaches

GNSS-based navigation systems are less expensive and are becoming more prevalent, especially at remote aerodromes. However they require special equipment to be carried by aircraft using the GNSS system. A Global Positioning System (GPS) approach to a runway includes waypoints defined in terms of latitude, longitude, and minimum altitudes to which an aircraft may descend.

Navigation based on ranging signals from GPS satellites provides performance levels adequate for enroute navigation and non-precision approaches. Non-precision GPS approaches offer a simple solution to providing an instrument approach to an airport without investment in terrestrial-based navigation aids.

Depending on the presence of obstructions in local airspace, non-precision GPS approaches may provide improved guidance to aircraft down to an MDA of 250' AAE, with a minimum visibility of 1 statute mile. This capability increases the availability of many Nunavut airports as well as the reliability of air service.

For more precise guidance GPS signals may be augmented or corrected, to improve the accuracy, integrity, and availability of the service. This augmentation is provided by a Wide-Area Augmentation System (WAAS) which uses a combination of GPS orbiting satellites and WAAS geostationary satellites to improve the signals provided by GPS.

WAAS-enabled approaches allow aircraft to safely descend in poor weather to even lower altitudes at Nunavut Airports further improving the availability of the airport and reliability of air service.

5.3 New LPV Approaches

5.3.1 Description

WAAS-enabled vertically-guided approach procedures are being progressively introduced by Nav Canada in Nunavut. These Localizer Performance with Vertical Guidance (LPV) approaches use WAAS lateral and vertical guidance to provide an approach similar to an Instrument Landing System (ILS). Like an ILS, an LPV has vertical guidance and is flown to a Decision Altitude (DA).

The design of an LPV approach incorporates angular guidance with increasing sensitivity as an aircraft gets closer to the runway.

When conditions do not permit an LPV approach, Nav Canada intends to introduce Lateral Navigation / Vertical Navigation (LNAV / VNAV) approaches which also provide horizontal and approved vertical approach guidance.

5.3.2 Implementation Schedule

To date Nav Canada has been upgrading runway approaches to LPV status as the period review and recertification of each existing approach has become due. In some cases the upgrades have not proceeded as other factors may currently be precluding LPV implementation.

Table 5-2 presents a list of current public approaches to Nunavut's airports in order of GNSS implementation or contemplated upgrade and implementation.

5.3.3 Co-ordination Requirements

Upgrading of approaches is dependent on a series of other enabling conditions. These include:

- *Non-precision runway classification* – this may require adjustments in runway length (based on the latest design aircraft) to reclassify a runway for higher performance operations under poorer weather conditions;
- Updated runway zoning and obstacle removal - in many cases the old NDB beacons at arctic airports are now an obstruction to lower LPV landing limits and may need to be relocated away from the airport;
- Weather observation and reporting – runway operations under instrument meteorological conditions (IMC) require certain real time weather information be available to the pilot;
- Improved lighting - this is required to ensure that adequate approach lighting is available for LPV operations in poorer visibility conditions.

It is recommended that the Government of Nunavut co-ordinate implementation of LPV approaches with Nav Canada to coincide with pre-requisite development activity at each Nunavut Airport over the next 3 to 5 years. An Approach Upgrade Implementation Plan should be jointly developed.

5.4 New Weather Systems

Provision of aviation weather observations and data recording falls within the air navigation systems responsibilities of Nav Canada.

Most airports in Nunavut have trained weather observers onsite operating a Community Aerodrome Radio Service (CARS). Funded by Nav Canada, these services are relatively high cost and only available during the hours when air services are planned and scheduled.

Nav Canada is currently considering introduction of Automated Weather Reporting Systems (AWOS) at community airports, which will operate on a 24 hour per day basis.

Varying degrees of sophistication are available in terms of aerodrome weather observation. AWOS are available that automatically observe, record, and transmit current weather data, or a weather observer can interpret instrument data and convey this information directly to pilots.

At an approximate equipment cost of $1 million per site, upgrading weather services will also require capital investments for site preparation, utilities and services to support the new Nav Canada equipment.

5.4 Upgrades to Airport Lighting

TP312E 4th edition recommends that a simple approach lighting system or omni-directional approach lighting (ODALS) be provided to serve a non-precision runway.

ODALS consist of a series of omni-directional variable white flashing capacitor discharge light units, extending approximately 450 m prior to a runway threshold.

The introduction of LPV approaches will enable certain airports to improve their minimum descent altitudes. It is recommended that ODALS be installed at the certified non-precision airports where the LPV approach limits can be improved to 250 feet MDA and visibility of 1 statute mile. Further investigations are required to determine the feasibility of installing approach lights on a site-by-site basis.

A preliminary list of candidate airports for installation of new or additional ODALS includes: Arviat, Hall Beach, Clyde River, and Sanikiluaq.

Table 5-2 – Nunavut Airport GNSS Implementation

Site Name	ICAO	Cyclical Review Date	LPV/LNAV/VANV Publication Date	Comments
Sanikiluaq	CYSK	February 7, 2013	February 7, 2013	LPV approaches for RWY 09 and RWY 27 published.
Taloyoak	CYYH	April 17, 2013	April 17, 2013	LPV approaches for RWY 15 and RWY 33 published.
Pond Inlet	CYIO		July 24, 2014	LNAV/VNAV .
Pangnirtung	CYXP		September 18, 2014	LNAV/VNAV approach not feasible. (LNAV only).
Qikiqtarjuaq	CYVM		September 18, 2014	LNAV/VNAV approach not feasible. (LNAV only).
Chesterfield Inlet	CYCS		June 15, 2015	Request for LPV's approaches for RWYs 12 & 30
Kimmirut	CYLC	July 5, 2010	June 15, 2015	Request for LPV's approaches for RWYs for 16 & 34
Arctic Bay	CYAB	August 30, 2010		LPV Request Cancelled - not in WAAS Coverage
Arviat	CYEK	November 28, 2013		Request for LPV's approaches for RWYs for 15 & 33
Baker Lake	CYBK	April 18, 2013		Request for LPV's approaches for RWYs for 16 & 34
Cambridge Bay	CYCB	February 20, 2014		Request for LPV's approaches for RWYs 13 & 31
Cape Dorset	CYTE	February 12,2009		Request for LPV's approaches for RWYs 13 & 31
Clyde River	CYCY	August 15, 2012		LPV Request Cancelled - not in WAAS Coverage
Coral Harbour	CYZS			Request for LPV's approaches for RWYs 16 & 34
Gjoa Haven	CYHK	February 20, 2014		Request for LPV's approaches for RWYs 13 & 31
Grise Fiord	CWGZ			Status unknown
Igloolik	CYGT			These are currently not on the GNSS Plan

Site Name	ICAO	Cyclical Review Date	LPV/LNAV/VANV Publication Date	Comments
Kugaaruk	CYBB	February 22, 2014		Request for LPV's approaches for RWYs 05 & 23
Kugluktuk	CYCO	February 21, 2014		Request for LPV's approaches for RWYs 12 & 30
Repulse Bay	CYUT			Request for LPV's approaches for RWYs 16 & 34
Resolute Bay	CYRB	September 17, 2013		LPV Request Cancelled - not in WAAS Coverage
Whale Cove	CYXN			Request for LPV's approaches for RWYs 15 & 33

Source: NAV CANADA

6 Airport Relocations

6.1 Introduction

A number of major capital expenditures have been studied and included in the Infrastructure Needs Assessment where appropriate. If a proposal is included in the Infrastructure Needs Assessment, a realistic schedule for the project based on past studies and any anecdotal information has been included.

6.2 Kimmirut Airport

Kimmirut Airport is among the most physically challenging airports in Canada where scheduled services are permitted to operate on a limited basis. Surrounded by high terrain, short takeoff / landing (STOL) aircraft must use special steep approaches to arrive and depart while avoiding known obstacles. There are no graded safety areas and only specially trained pilots may use the limited size runway. The airport cannot be expanded to meet safety requirements and cannot accommodate modern, multi-engine aircraft in use in the arctic. Consequently the community has limited essential access at night and during poor weather.

A study was carried out for the relocation of Kimmirut Airport in the late 1990's by the GNWT. The Nunavut Transportation Strategy considered the more complex issue of building a port at Kimmirut and relying on an overland road for connection with the territorial capital at Iqaluit. The cost of the road was generally considered to be similar to the cost of relocating the airport.

6.3 Pangnirtung Airport

The *Pangnirtung Airport Relocation Study LPS AVIA* 2003 addressed relocation of the airport from the fiord side location to the plateau above the community. Justifications for the relocation includes:

Safety:

- poor weather - high wind speeds, low cloud ceilings, and limited horizontal visibility;
- mountains towering to 1,000 m. (3,200') adjacent to the 2 km (1.25 mi.) wide fiord;
- mechanical turbulence such that pilots will not approach if cross winds exceed 5 kts;
- limited navigation and communication aids due to the surrounding mountains;
- limited weather observations at fiord level;
- limited light as Pangnirtung is located adjacent to the Arctic Circle;
- limited reliability due to rapidly changing weather conditions.

Community:

- constrained air services due to sub-standard airport size;
- limited economic activity due to air service constraints;
- resulting constraints to modernization of Baffin Island air service network;
- lack of available and accessible land in community for development;
- proximity of the runway to schools, community facilities, businesses and housing;
- public safety perceptions with respect to airport location and essential air services;

- desire to obtain highest and best use of land in centre of community.

Physical:

- narrow site location of the community between the shoreline and mountains;
- limited availability of shoreline land and high tidal range; and
- limited access to interior lands.

Pursuant to past Transport Canada practice onsite weather observations were conducted near the proposed new plateau site to gather actual weather data to confirm the location and orientation of the proposed new airport. It was found that the prevailing winds were considerably different than those predicted by aviation meteorological practices. The actual winds were found to prevail in a direction requiring reorientation of the runway at right angles to the orientation of the fiord. Initial assessment confirmed that an airport with the new runway orientation could still be developed at the revised plateau location.

In the event that relocation cannot be funded, it is recommended that the earlier study be expanded to address the most practical expansion possible at the current airport site.

6.4 Pond Inlet Airport

Expansion in economic activity in North Baffin, increasing interest in tourism, a GN study to lower the isolation and cost of living of high arctic communities, and the growing political interest by government in confirming high arctic sovereignty have together given rise to the concept of developing a jet-capable airport centrally located at or near Pond Inlet. The current Airport is unlikely capable of expansion to accommodate a suitably long runway. It is recommended that a feasibility study be undertaken to determine the cost and benefits of constructing a new high arctic hub airport at Pond Inlet for civil and military purposes.

7 Runway Overlays and Extensions

7.1 Overlay Requirements

7.1.1 Immediate

Cape Dorset

In the Spring of 2013, significant flooding occurred across the width of the runway with approximately 1,100 feet of length being seriously compromised and rendered un-usable. This section had to be closed for approximately one month as it was unable to support the weight of aircraft and was unsuitable for operations. This temporary closure resulted in smaller, older aircraft with reduced payloads being used by airlines with consequent increases in air transportation costs, and degradation in service to the community.

Each time the runway floods, the cost of the final remedial solution will increase, as the amount of damaged area increases and the severity of the damage increases.

It is recommended that the overlay and repairs to this runway take place as soon as possible.

Grise Fiord

The last major rehabilitation of the runway surface occurred in 1992. A major overlay was identified as being required in the Nunavut Transportation Strategy tabled in 2000. The runway surface was noted as being in poor condition in the Nunavut Airports Capital Needs Study in 2005.

A major immediate overlay was recommended to rehabilitate the runway surfaces. Currently the runway has soft areas, exposed rocks and loose gravel, as well as drainage issues. It is unsuitable for current use by PC-12 MEDEVAC services.

7.1.2 Short Term

A number of airports require runway, taxiway and apron gravel overlays to rehabilitate the existing pavement structure and/or to address systemic drainage issues. The airports are:

- Clyde River;
- Hall Beach;
- Pond Inlet;
- Pangnirtung;
- Gjoa Haven;
- Whale Cove;
- Qikiqtarjuaq;
- Kugaaruk; and
- Kugluktuk.

It should also be noted that the rehabilitation of the Hall Beach airside surfaces is currently in the design phase. A design has been completed for the Clyde River airside surfaces rehabilitation, and this project has been submitted to Transport Canada as an Airports Capital Assistance Program (ACAP) funding request. A preliminary design has also been completed for Grise Fiord airside rehabilitation.

7.1.3 Medium Term

Cambridge Bay

The 5,000 foot gravel runway at Cambridge Bay is only suitable for older gravel capable Boeing 737-200 or smaller turboprop aircraft, and is not long enough to allow those jet aircraft to operate without restrictions.

Given that many of these Boeing 737-200 gravel capable aircraft will be retired in the next few years, the runway at Cambridge Bay will require paving or use of an alternative surface to gravel, in order to maintain jet service with more modern aircraft (alternative runway surface technologies are detailed in Chapter 8).

7.2 Runway Extension Requirements

The available runway length can constrain the takeoff weight of an aircraft. Specific factors that have to be taken into account when assessing aircraft takeoff performance include obstacle clearance, critical engine failure, runway conditions and characteristics as well as the environmental conditions present on the day of operation.

The environmental conditions that can affect takeoff performance include wind effects, pressure altitude, and temperature, as well as runway condition based on environmental conditions.

Landing distances are also affected by the above factors, but usually to a lesser extent than the required takeoff distances.

There are a number of airports which have runways that are shorter than optimum for the aircraft that they currently serve. It is recommended that studies be undertaken to determine the feasibility of extending these runways

7.2.1 Immediate

Pangnirtung

The extension of the runway at the Pangnirtung Airport is an interim measure (until construction of a new airport) that can be potentially implemented to improve the payload performance of aircraft serving the community.

There are significant physical and regulatory constraints, as well as community concerns that will need to be addressed.

It is recommended that planning and engineering studies be undertaken to determine if an extension is possible. The costs for extension were not included in the 20-Year Infrastructure Needs Assessment.

7.2.2 Short Term

Arviat

The current runway length of 4,000 feet at the Arviat Airport is currently too short for jet service. In addition, the length and gravel surface of the runway may impose some payload restrictions on the larger turboprop aircraft such as the ATR-72 and the DHC8-Q400. Given the community's continued population growth and importance, larger aircraft will be required over time to provide economical air services.

It is therefore recommended that planning and engineering studies be undertaken to determine the feasibility and cost of extending the runway to accommodate larger aircraft types. The costs for extension were not included in the 20-Year Infrastructure Needs Assessment.

Clyde River

The current runway length of 3,401 feet at the Clyde River Airport will impose payload restrictions on the larger turboprop aircraft such as the ATR-72 and DHC8-Q400. These aircraft types will be increasingly be used in the North because of their increased payload capability and operating economics.

It is therefore recommended that planning and engineering studies be undertaken to determine the feasibility and cost of extending the runway to accommodate larger aircraft types. The costs for extension were not included in the 20-Year Infrastructure Needs Assessment.

7.2.3 Medium Term

Cambridge Bay

The Cambridge Bay Airport is an essential air transport facility that supports the life and economic vibrancy of the Cambridge Bay community and to a secondary extent, the wider Kitikmeot region. It also plays a national role in support of sovereignty and Canada's defence of its Arctic interests.

The ability to accommodate both future jet aircraft types will require both paving (addressed in the previous section) and a runway extension.

Based on the recommendations from the Cambridge Bay Airport Master Plan, it is recommended that the next phase of this project should include the extension of the runway to a minimum of 6,000 feet and runway paving.

8 Runway Surface Alternatives

8.1 Introduction

Gravel runways preclude the use of modern jets, as newer civilian aircraft are not designed for gravel operations. Gravel runways also impose performance penalties on aircraft due to the reduced surface strength of the gravel runway (compared to a hard surface). This results in an increased rolling resistance of the aircraft tyres which results in increased takeoff distances and accelerate-stop distances.

In addition gravel surfaces can subject an aircraft to damage from the stones, dust and debris, as well as increase the risk of ingestion of foreign objects into the aircraft's engines.

There are some innovative technologies currently being used to mitigate or eliminate the operational impacts of operating from unpaved surfaces. These are explored in greater detail in the sections below.

8.2 New Surface Technologies

8.2.1 Chip Seal

Chip seals are a form of surface treatment that are applied to granular pavements or previously treated granular structures to provide a wearing surface and for waterproofing purposes. Chip seals can provide a high friction wearing course, help seal small cracks and ultimately extend the life of a granular pavement structure.

The Saskatchewan Ministry of Highways and Infrastructure has had recent success using chip seals on a number of the remote northern airports they currently operate. Their process of applying a chip seal includes the application of a binder in the form of hot asphalt cement, cut back asphalt or emulsified asphalt immediately followed by the application of a graded aggregate. Once the aggregate has been evenly spread on the binder material, a rubber-tired roller is used to compact and seal. Then a sweeper is used to clear any loose or excess gravel once the binder has dried, approximately 48 to 72 hours. A second coat is typically applied 10 days after the first coat, providing a double seal and enhancing the strength of the wearing course. According to the Ministry of Highways and Infrastructure, Saskatchewan, a properly applied chip seal should have a lifespan of at least 10 years with very minimal maintenance compared to a similar granular pavement structure.

There are a number of limitations with respect to a chip sealed runway which include:

- the inability of an aircraft to perform locked wheel turns without incurring damage to the runway surface;
- the amount of extra construction equipment needed for its application (oil distributor, sweeper, material spreader, and oil storage) compared to gravel runway construction;
- Transport Canada does not consider a chip sealed runway the same as asphalt, and therefore gravel runway limitations are still applied to a surface treated runway.
- The cost may vary greatly by location as a result of mobilization of special equipment.

It should be noted that chip seals are not a substitute for quality runway construction and maintenance. Chip sealing an airfield surface is a consideration when deciding on the most effective method for improving the performance of a granular pavement structure. However, other items such as proper drainage and quality granular materials should also be considered.

It is recommended that the Government of Nunavut consider the feasibility of Chip Seal surfacing at selected airports in Nunavut.

8.2.2 Aircraft Landing Surfaces

Large high performance, fuel efficient jet aircraft require paved runways for safe operations, and to prevent damage to the aircraft. Some older generation jet aircraft such as the B727-100 and B737-200C were certified for gravel operations by their manufactures however these have gradually been withdrawn from service as the aircraft reached the end of their design lives.

Within the next four (4) years it is expected that only a few gravel capable BAE-146 variants will remain in operation.

Asphalt paved runways are extremely expensive to construct and maintain in Nunavut and need major reconstruction at a maximum of 15 year intervals. Maintenance and upkeep is expensive.

Nunavut has two airports with asphalt paved runways, at Iqaluit and Rankin Inlet. All other airports have gravel surfaces which are generally suitable for the type of aircraft and air services which access the communities.

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However there are several communities in Nunavut where paved runways could facilitate economic development and growth in the region surrounding the airport. These include:

- Cambridge Bay – the western Kitikmeot gateway airport to Nunavut, a site of economic and military importance and location of the new High Arctic Research Station;
- Resolute Bay – traditional centre of high arctic exploration and a site of military training and staging importance; and
- Pond Inlet – a potential high arctic mining and tourism hub, and a site of strategic military importance on the Northwest passage.

Low levels of traffic and government funding make it unlikely these communities will receive asphalt paved runways in the foreseeable future.

It is recommended that the Government of Nunavut consider all potential options in bringing about improvements to aircraft landing surfaces, particularly in hub airports

9 Economic Development, Policy and Planning

9.1 Economic Development

9.1.1 Introduction

The airports in Nunavut are the lifelines of the communities and the supply lines for economic growth and development.

For economic development to occur in Nunavut, a sound, reliable, safe and relatively inexpensive transportation system is required. Nunavut relies upon marine and air transportation systems. Only air transportation provides year-round access to all of Nunavut. Marine systems are limited in reliability (only available part of the year) and do not have access to landlocked areas. Over land transportation is used predominantly for local travel.

The air transportation system is vital to any future economic development in Nunavut. A reliable air transportation system requires a number of key elements. Air services must be available and be reliable. To be reliable they must enjoy airports which are well maintained and safe. This requires adequate budgets be established to maintain the existing airports in a safe condition without running down the infrastructure, facilities and equipment.

To feed increasing economic development in Nunavut, there is a need to expand some airports' capabilities, both now and in the future. The economic development opportunities must be identified early to allow for infrastructure modifications to be budgeted, planned for, designed and built. The need for master planning and/or development planning at each Nunavut Airport is described in Section 9.3 and should include major economic development input, in addition to other stakeholder input. Policies and standards must to be established so adequate funds are available annually and cannot be diverted from maintaining the airports in a continuously safe and reliable condition.

9.2 Policy Development

The Nunavut Transportation Strategy prepared in 2001 and updated in 2006 outlined the official transportation strategy and developmental goals for a variety of transportation modes, including aviation. Implementation policies should be put in place based on the approved strategies contained within these documents. Of particular relevance to the Infrastructure Needs Assessment, the policies and standards identified in Table 9-1 should be developed.

Table 9-1 - Policy Development Requirements

Policy Area	Requirement	
Asset Management	Policy required	
Minimum Equipment Requirements for Airports	Policy required	Standards required
Maintenance Standards for Airport Plant	Policy required	Standards required
Maintenance Standards for Mobile Equipment	Policy required	Standards required
Master or Development Planning for Airports	Policy required	Standards required

Nunavut Airports staff are hampered because they do not have formal policies and standards for the situations identified in Table 9-1. As a result, they cannot properly defend the budgets they request for maintaining the territorial airport system. They cannot prioritize their requirements in the budget process in a way which ensures that the long-term objective of providing a safe and reliable transportation system are achieved.

9.3 Development Planning

Approved and accepted Master Plans and Development Plans should underpin every Infrastructure Needs Assessment study.

The preparation and updating of Master Plans for all airports in Canada, including the Arctic A, B and C airports, was a Transport Canada policy prior to the transfer of the Arctic Airports to the GNWT and later to Nunavut.

The original Transport Canada policy required preparation of a Master Plan for all airports with a 15 to 20 year planning horizon, and with regular review and update undertaken every 5 years. The "Master Planning" process for airports as instituted originally for the Nunavut Airports by Transport Canada has not been kept up since transfer. The Government of Nunavut has not implemented a consistent policy in respect of airport planning to date. Currently only the Rankin Inlet, Cambridge Bay and Baker Lake Airports have master plans prepared within the last 5 years. It is strongly recommended that master plans/development plans be developed for the remaining 19 airports.

Master and Development Planning should consider the economic as well as the physical and social impact of the airports on the Nunavut communities they serve. Without proper approved planning documentation, airport staff are unable to effectively plan, prioritize and obtain funding for their projects.

A policy document mandating Master Planning and/or Development Planning for all airports should be prepared and approved by the Department of Economic Development & Transportation of the Government of Nunavut. This policy document should include mandatory review periods and updating of the plans to maintain good stewardship and wise investment strategies for the Government of Nunavut.

10 20 Year Infrastructure Needs Summary

10.1 Funding the Infrastructure Needs Assessment

10.1.1 Historic Funding

General capital funding data for the last 5 years for Nunavut Airports was available through archived GN budget data. This data revealed that approximately $30 million has been allocated to airport capital expenditure projects since 2010 (this excludes capital expenditure for Iqaluit Airport during that time period). This represents an average budget of $6 million per year allocated over 24 airports, or approximately $250,000 per airport. This budget figure has been supplemented with occasional Federal Government Programs like the Building Canada Fund launched in 2007, and from Transport Canada's Airport Capital Assistance Program.

10.1.2 ACAP

A significant source of funding to supplement the Nunavut budget for airports is the federally sponsored Airport Capital Assistance Program (ACAP). It was established concurrently with the National Airports Policy, and introduced in1995. The program provides assistance to airports in financing capital projects related to safety, asset protection and operating cost reduction. Funds are provided at Transport Canada's discretion for projects on a priority basis, with very limited funding available compared to the number of requests from Canadian airports. Priorities include:

1st Priority: Safety-related airside projects such as rehabilitation of runways, taxiways, aprons, associated lighting, visual aids, sand storage sheds, utilities to service eligible items, related site preparation costs including directly associated environmental costs, equipment and equipment shelters which are necessary to maintain the airport's level of Aircraft Firefighting Services or Aircraft Emergency Intervention Services protection as required by regulation.

2nd Priority: Heavy airside mobile equipment (safety related) such as runway snowblowers, runway snowplows, runway sweepers, spreaders, winter friction testing devices.

3rd Priority: Air terminal building/groundside safety related - such as sprinkler systems, asbestos removal, barrier-free access.

Nunavut has been moderately successful in obtaining ACAP funding in recent years, primarily for airside rehabilitation and airfield lighting upgrade projects.

10.1.3 Other Federal Infrastructure Initiatives

The Federal Government has recently initiated a program designated as the New Building Canada Plan (NBCP). This NBCP is a $53 billion plan for investments in provincial, territorial and municipal infrastructure.

A component of that plan is New Building Canada Fund (NBCF) which will provide a $14 billion fund to support projects which promote economic development, job creation and productivity.

The NBCF includes an allocation for northern infrastructure projects that applies specifically to Yukon, Nunavut and the Northwest Territories. Approximately $419 million over the next 10 years has been allocated to Nunavut in particular.

10.1.4 P3 Partnerships

It has been suggested that with future economic development in the Nunavut area, consideration be given to considering P3 partnerships for the development or expansion of airport facilities.

Development of airports is a costly undertaking and cooperation between the Government of Nunavut and an industrial partner may be worth considering.

Following are excerpts from the Industry Canada's website explaining P3 partnerships:

What is a P3 Partnership?

"A Public-Private Partnership is a co-operative venture for the provision of infrastructure or services, built on the expertise of each partner that best meets clearly defined public needs, through the most appropriate allocation of resources, risks, and rewards.

In a public private partnership, the public sector maintains an oversight and quality assessment role while the private sector is more closely involved in actually delivery of the service or project.

Public-Private Partnerships can be categorized based on the extent of public and private sector involvement and the degree of risk allocation between the two. All partnerships have a unique risk/reward allocation. Public-private partnerships can take many forms:"

What are the Benefits of a P3 Partnership?

"A successful P3 builds on the experience of each partner to meet clearly defined needs and provide a net benefit (or value for money) to the general public through the appropriate allocation of resources, risks and rewards. It will involve unbundling the costs and the risks inherent in delivering the project and allocating them to the partner best able to absorb and mitigate them. This is different (and preferable) to not accounting for all of the real costs associated with a service and allocating all risks to either the public or the private sector partner.

The ability of the public and private sector partners to efficiently and effectively mitigate each risk should govern the allocation of each risk."

TABLE CA-1

Nunavut Airports - 20 Year Infrastructure Needs Assessment 2014-2034

Condition Assessment Summary

Arctic Bay Airport

Item/Facility	Last Rehabiltated or Constructed	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
Airside Pavements					
Apron (8,100 m2)	2011	Good	Low	Stockpile owned by contractor.	
Taxiway (2,000 m2)	2011	Good	Low	Minor Overlay	2019
Runway (35,900 m2)	2011	Good	Low	Major Overlay+Replenish Stockpile	2026
Groundside Pavements					
Access Road	2011	Good		Hamlet	N/A
Parking lot	2011	Good		Maintain with O&M funds	
Airside Electrical					
FEC	2011	Good	Low	Replacement required outside of 20 year timeline	2036
Airfield Lighting	2011	Good	Low		
Buildings & Other Facilities					
ATB:		Good	Low	Replacement required outside of 20 year timeline	2046
Building Envelope					
H & V	2011				
Finishes	2011				
Electrical	2011				
Maintenance Building	2011	Good			
Mobile Equipment					
Truck - Runway (pickup/other)	2012			Ford F1-50	2020/2028
Truck	2006			GMC Sierra	2015/2023/2031
Truck	2006			GMC Sierra	2015/2023/2031
Truck - Dump	1986			LT8000 Ford	2015/2032
Truck - Dump	1992			LT9000 Ford	2015/2033
Truck - Plow	2000			FL80 Freightliner	2018
Trailer	1995			TA20 Craig Trailer	N/A
Case Loader	1997			Case 821B Loader	2015/2033
Caterpillar Loader	2005			950G Caterpillar Loader	2023
Motor Grader	1999			160 H Caterpillar	2019
Snowblower - Mounted	1995			Transferred from Nanisivik	2015
Packer - Wobbly Wheel	2001			Transferred from Nanisivik	2026
Packer - Vibratory	1998			Transferred from Nanisivik	N/A
Dozer	1998			D6R Caterpillar	2018
					TOTAL

TABLE CA-2 **Nunavut Airports - 20 Year Infrastructure Needs Assessment 2014-2034**

Condition Assessment Summary **Arviat Airport**

Item/Facility	Last Rehabiltated or Constructed	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
Airside Pavements					
Taxiway/Apron (12,100 m2)	2012			Stockpile adequate for 10 years.	
Runway (36,600m2)	2012	N/A	Low	Minor Ovelay	2020
				Major Overlay + Replenish Stockpile	2027
Groundside Pavements					
Access Road				Hamlet	N/A
Parking lot				Maintain with O & M funds	
Airside Electrical					
FEC		Good			
Runway Edge Lighting	2010			Airfield Lighting Replaced in 2010.	2035
Approach Lighting					2035
ODALS	2010	Good			2035
Buildings & Other Facilities					
ATB (309 m2):	1993 (1992)	Poor	Medium		
Building Envelope				Building requires internal and external painting	2018
H & V					
Finishes					
Electrical					
Maintenance Building			High	New 4 Bay Garage Required	2016
Mobile Equipment					
Truck - Pickup	2013			Ford F1-50	2021/2029
Wheel Loader	2009			Case 821E	2027
Packer - Wobbly Wheel	1991				2016
Packer - Wobbly Wheel	1998				2023
Truck - Plow	2013			Freightliner 108SD	2031
Marker - Dye Markers	1980				N/A
Motor Grader				New addition to inventory	2015

TABLE CA-3

Nunavut Airports - 20 Year CapitalInfrastructure Assessment 2014-2034

Condition Assessment Summary

Baker Lake Airport

Item/Facility	Last Rehabilitated or Constructed or Purchased	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
Airside Pavements					
Apron (32,200 m2)	2012			Apron Expanded by 16,500 sq.m in 2012	
Taxiway (2,400 m2)		N/A	High	Stockpile Required.	2016
Runway (38,400 m2)	2003	Good		Minor overlay from stockpile	2020
				Replenish Stockpile. Major Overlay	2027
Groundside Pavements					N/A
Access Road		N/A		Hamlet	
Parking lot		N/A		Maintain with O & M funds	
Airside Electrical					
FEC	2013	Good		Replacement required outside of 20 year timeline	2038
Runway Edge Lighting	2013				2032
Buildings & Other Facilities					
ATB:	1986	Poor	High	534 sq. m. Needs major renovation and expansion	2016
Building Envelope					
H & V					
Finishes					
Electrical					
Maintenance Building	1986			Large 7 bay garage. Condition Should be evaluated	
Mobile Equipment					
Truck - Pickup	2012			Ford F1-50	2020/2028
Truck - Runway (pickup/other)	2001			GMC Silverado K1500	2015/2023/2031
Truck - Dump/Plow T/A	1991			Ford LT8000	2015/2033
Trailer - Flat Deck	1970			ATCO Trailer	N/A
Wheel Loader	1991			Caterpillar 950F	2015/2033
Motor Grader	1981			Champion 740A	2026
Crawler Tractor	1986			Caterpillar D7G	N/A
Snowblower - Self-Propelled	2007			Larue 7460	N/A
Packer - Wobbly Wheel	1969				2015
Packer - Wobbly Wheel	2003			WRT PT13	2028
Water Pump	1986			Wisconsin 40MGV	N/A

TABLE CA-4

Nunavut Airports - 20 Year Infrastructure Needs Assessment 2014-2034

Condition Assessment Summary

Cambridge Bay Airport

Item/Facility	Last Rehabilitated or Constructed or Purchased	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
Airside Pavements					
Taxiway/Apron (13,230 m2)	1988			Current Gravel stockpile is 2,500 cu.m	
Runway (70,104 m2)]	1988	Medium	N/A	Runway, Taxiway and Apron are currently being resurfaced. Project completion 2015	
				Minor Overlay	2023
				Replenish Stockpile and Major Overlay	2030
					N/A
Groundside Pavements					
Access Road	N/A			Road may be re-routed under current airport imporvements project.	
Parking lot	N/A				
Airside Electrical					
FEC	1993	Poor		Airfield Electrical being upgraded under current airport improvements project. Completion 2015	N/A
Runway Edge Lighting	1993	Poor		Furture replacemnet will be outside of 20 year timeline	N/A
					N/A
Buildings & Other Facilities					
ATB:	1993 (1992)	Fair		Expansion required to accommodate future growth	2016
H & V					
Finishes					
Electrical					
Baggage Carousel	N/A				
Maintenance Building	1959/1985	Fair	Medium	Maintenance garage update required	2016
Mobile Equipment					
Truck - Runway (pickup/other)	1998			Ford F1-50	2015/2023/2031
Truck - Runway (pickup/other)	2000			Ford F1-50	2015/2023/2031
Truck - Runway (pickup/other)	2009			Ford F1-50	2017/2025
Truck - Runway (pickup/other)	2009			GMC Sierra	2017/2025
Truck - Dump/Plow S/A	1994			International Plow Truck	2015/2033
Truck - Dump/Plow T/A	2011			International Plow Truck	2029
Truck - Tanker	1974			West/Star Water Tanker	N/A
Wheel Loader	2010			950H Caterpillar	N/A
Motor Grader	1994			720R	2014
Dozer	1973			D7F	2014
Snowblower - Mounted	1993			LM220	N/A
Packer - Wobbly Wheel	1984				2014
Packer - Wobbly Wheel	2000				2025
Marker - Dye Markers	1993				N/A
Hopper/Spreader	1993			95139	N/A

TABLE CA-5

Nunavut Airports - 20 Year Infrastructure Needs Assessment 2014-2034

Condition Assessment Summary

Cape Dorset Airport

Item/Facility	Last Rehabilitated or Constructed or Purchased	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
Airside Pavements					
Taxiway/Apron (7,470 m2)	1995			Stockpile sufficient for only 1 overlay	
Runway (36,570 m2)	1995	Poor	High	New Stockpile + major Overlay + runway repair	2015
				Minor Overlay	2023
				Replenish Stockpile + major Overlay	2030
Groundside Pavements					
Access Road	N/A			Hamlet	N/A
Parking lot	N/A			Traffic Circulation issues with current layout. Adjust with O&M funds	
Airside Electrical					
				Airside Electrical cost includes items below	2024
FEC	1996	Good	Low	Estimated 10 year life remaining.	2024
Runway Edge Lighting	1996		Low	Estimated 10 year life remaining.	2024
Buildings & Other Facilities					
Building Envelope					
ATB (316 m2):	1995	Poor	Medium	Refurbish ATB	2016
H & V					
Finishes					
Maintenance Building	1975	Average	High	Extension by 2 bays required	2016
Mobile Equipment					
Truck - Runway (pickup/other)	2012			Ford F150	2020/2028
Truck - Runway (pickup/other)	2000			Ford F150	2015/2023/2031
Truck - Runway (pickup/other)	2010			GM Silverado	2018/2026
Truck - Dump/Plow S/A	2005			IHC Dump/Plow Truck M5600 4x4	2023
Snowblower - Self-Propelled	1999			Vohl DV904	2024
Packer - Wobbly Wheel	1976				2015
Packer - Wobbly Wheel	2000				2025
Packer - Vibratory	1987				N/A
Plow - Special	1993				N/A
Wheel Loader				New addition to inventory	2015
Motor Grader				New addition to inventory	2015

TABLE CA-6 **Nunavut Airports - 20 Year Infrastructure Needs Assessment 2014-2034**

Condition Assessment Summary

Chesterfield Inlet Airport

Item/Facility	Last Rehabilitated or Constructed or Purchased	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
Airside Pavements					
Taxiway/Apron (6,450 m2)	1985			Culvert required to address drainage issues	
Runway (32,910 m2)	1985	Fair	High	Stockpile good for another 5 year.	
				Replenish Stockpile + Minor Overlay	2019
				Stockpile + Major Overlay	2027
Groundside Pavements					
Access Road		N/A		New Access road required (include with ATB)	N/A
Parking lot		N/A		Maintain with O & M funds	
Airside Electrical					
FEC	2013	Good		Rehabillitated under ACAP in 2013	N/A
Runway Edge Lighting	2013	Good		Rehabillitated under ACAP	N/A
Buildings & Other Facilities					
ATB:	1984	Poor	High	New Air Terminal Building Required	2018
Building Envelope					
H & V					
Finishes					
Electrical					
Maintenance Building	N/A				
Mobile Equipment					
Truck - Runway (pickup/other)	2007			Ford F150 - needs replacing	2015/2023/2031
Loader	2013			Caterpillar 938K	N/A
Motor Grader	2009			Volvo	2029
Packer - Wobbly Wheel	1980				2015
Packer - Wobbly Wheel	2001			WRT	2026
Marker - Dye Markers	1985			Konc	N/A
Plow Truck				New addition to inventory	2015
Snow Blower Attachment				New addition to inventory	2015

TABLE CA-7

Nunavut Airports - 20 Year Infrastructure Needs Assessment 2014-2034

Condition Assessment Summary

Clyde River Airport

Item/Facility	Last Rehabilitated or Constructed or Purchased	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
Airside Pavements					
Taxiway/Apron (8,280 m2)	2003			New Stockpile creation and Runway Overlay Required. ACAP application under review.	2015
Runway (32,010 m2)	2003	Poor	High	Minor Overlay from Stockpile	2023
				Major Overlay	2030
Groundside Pavements					N/A
Access Road		N/A		Hamlet	
Parking lot		N/A		Maintain with O & M funds	
Airside Electrical					
				Airside Electrical cost includes items below	
FEC	1998	unknown	Medium	Replace at end of life (25 years)	2023
Airfield Lighting	1998			Replace at end of life (25 years)	2023
Buildings & Other Facilities					
ATB:				206 m2	
Building Envelope		unkown	High	Investigate ATB condtion	N/A
Finishes					
Electrical					
Maintenance Building	1978			New Building Required in Fuuture	2018
Access Road	2004			O & M	
Mobile Equipment					
Truck - Runway (pickup/other)	2007			Ford F150	2015/2023/2031
Truck - Runway (pickup/other)	2013			Ford F150	2021/2029
Truck - Dump/Plow S/A	1989	Poor		Freightliner FLC112425D	2007/2025
Motor Grader	2000			Caterpillar 140H	2020
Snowblower - Self-Propelled	2010	Good		Laure T60	N/A
Packer - Wobbly Wheel	1980	Spare		Bros R67-BW	2015
Packer - Wobbly Wheel	2003	Good		WRT PT13	2028
Plow - One Way	1989	Good			N/A

TABLE CA-8 **Nunavut Airports - 20 YearInfrastructure Needs Assessment 2014-2034**

Condition Assessment Summary **Coral Harbour Airport**

Item/Facility	Last Rehabilitated or Constructed or Purchased	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
Airside Pavements					
Taxiway/Apron (9,800 m2)	2013				
Runway (45,800 m2)	2013	N/A	Low	Minor Overlay	2020
				Replenish Stockpile and Major Overlay	2028
Groundside Pavements					
Access Road				Hamlet	
Parking lot				Maintain with O & M funds	N/A
Airside Electrical					
				Airside Electrical cost includes items below	
FEC	2006	Good	Low		2031
Runway Edge Lighting	2006	Good	Low		2031
Buildings & Other Facilities					
ATB:	2007			309 m2.	
Building Envelope				Replacement required outside of 20 year timeline	N/A
H & V					
Finishes					
Electrical					
Maintenance Building	2003			None. Housed in hamlet	
Mobile Equipment					
Truck - Runway (pickup/other)	2013			Ford F150	2021/2029
Truck - Runway (pickup/other)	2008			Ford F150	2017/2024/2032
Truck - Dump/Plow S/A	1980			Mack Truck RM6114-X	2016/2032
Truck - Dump/Plow S/A	2001			IHC 5600i 4x4	2019
Wheel Loader	2004			Volvo L110E	2022
Motor Grader	1996			Champion 720A	2016
Dozer	2010			D6T Caterpillar	2032
Snowblower - Self-Propelled	2002			Vohl DV904	2022
Packer - Wobbly Wheel	1968			Pneumatic WP67	2015
Packer - Wobbly Wheel	2003			WRT PT13	2028
Snowblower - Self-Propelled	2000			Vohl	N/A

TABLE CA-9 **Nunavut Airports - 20 Year Infrastructure Needs Assessment 2014-2034**

Condition Assessment Summary **Gjoa Haven Airport**

Item/Facility	Last Rehabilitated or Constructed or Purchased	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
Airside Pavements					
Taxiway/Apron (6,930 m2)	1997	Poor	High	Replenish Stockpile + Major Overlay	2016
Runway (40,230 m2)	1997	Poor	High	Minor Overlay from Stockpile	2024
				Major Overlay + Stockpile	2031
Groundside Pavements					
Access Road				Hamlet	
Parking lot				Maintain with O & M funds	N/A
Airside Electrical					
FEC	1999	Good	High	Back-up generator for FEC	2015
Runway Edge Lighting	1999	Poor	High	Airfield lighting repairs + PAPI replacement	2015
Buildings & Other Facilities					
ATB:	2009	Fair	High	Air Terminal Building Repairs	2016
Building Envelope					
H & V				Need to upgrade mechanincal and electrical systems	
Finishes					
Electrical		Poor	High		
Maintenance Building	N/A		High	New 3 Bay Parking Shelter required	2016
Mobile Equipment					
Truck - Runway (pickup/other)	2003			Ford F-150	2015/2023/2031
Truck - Runway (pickup/other)	2011			GMC Sierra	2017/2024/2032
Snowblower - Mounted	1998			Tenco TC202 LM	2018
Packer - Wobbly Wheel	1975			WRT	2015
Packer - Wobbly Wheel	1998			WRT PT13	2023
Truck - Plow	2007			IHC 5600I	2025
Packer - Vibratory	1993			Bomag	2015
Loader	2012			938K Caterpillar	2030
Snowblower - Mounted	2013			Laure D60	N/A
Grader				New addition to inventory	2015

TABLE CA-10 **Nunavut Airports - 20 Year Infrastructure Needs Assessment 2014-2034**

Condition Assessment Summary

Grise Fiord Airport

Item/Facility	Last Rehabilitated or Constructed or Purchased	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
Airside Pavements					
				New stockpile is currently being crushed	
Taxiway/Apron (2,700 m2)	1992	Poor	High	major overlay from stockpile + runway repairs	2015
Runway (13,662 m2)	1992	Poor	High	Minor Overlay and New Stockpile	2023
				Major Overlay and New Stockpile	2030
				(Need to have 6,000 cu.m of stockpile on hand at all times due to maintenance needs.	
Groundside Pavements					N/A
Access Road				hamlet	
Parking lot				Maintain with O & M funds	
Airside Electrical					
			High	Airside Electrical cost includes items below	
FEC	1983			Requires replacement	2015
Runway Edge Lighting	1983			Requires replacement	2015
Threshold lighting	1970	Poor		Requires replacement	2015
Buildings & Other Facilities					
ATB:	1999	Poor	High	146 sq. m.	
H & V				Replace ATB	2035
Finishes					
Electrical					
Maintenance Building	N/A		High	New 3 Bay Parking Shelter	2015
Mobile Equipment					
Truck - Runway (pickup/other)	2010			GMC Silverado	2018/2026
Truck - Runway (pickup/other)	2001			GMC Silverado	2014/2022/2030
Motor Grader	1997			Champion 710A	2017
Packer - Wobbly Wheel	1980			APCO/TAMPO	2014
Packer - Wobbly Wheel	2003			WRT PT13	2028
Truck - Plow/Dump	1986			IHC Paystar 5070	2014/2032
Plow	1987			Frink 440SK8	N/A

TABLE CA-11

Nunavut Airports - 20 Year Infrastructure Needs Assessment 2014-2034

Condition Assessment Summary

Hall Beach Airport

Item/Facility	Last Rehabilitated or Constructed or Purchased	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
Airside Pavements					
Taxiway/Apron (30,733 m2)	2002				
Runway (70,104 m2)	2002	Poor	High	Stockpile and major runway overlay. ACAP application to be submitted	2015
				Minor Overlay from Stockpile	2023
				Replenish Stockpile + Major Overlay	2030
Groundside Pavements					
Access Road				Hamlet	N/A
Parking lot				maintain with O & M funds	
Airside Electrical					
				Airside Electrical cost includes items below	
FEC	1982	Poor		New FEC + back-up generator (included with airfield lighting upgrade) Design underway	2015
Runway Edge Lighting	1982	Poor		Airfield lighting upgrade. Design Underway	2015
Buildings & Other Facilities					
ATB (401 m2):	1982	Poor		ATB requires exterior rehabilitiation	2015
Building Envelope					
H & V		Poor	High		
Electrical					
Maintenance Building	1982	Average	High	Needs rehab (may be done with O & M)	2015
Mobile Equipment					
Truck - Runway (pickup/other)	2009			GMC Sierra	2017/2025/2033
Truck - Runway (pickup/other)	2001			GMC Silverado	2014/2022/2030
Truck - Dump/Plow S/A	2000			Freightliner	2108
Wheel Loader	1995			Case 721B	2014/2032
Motor Grader	2006			Volvo G720B	2025
Snowblower - Mounted	1996			SMI 4200	2016
Packer - Wobbly Wheel	1976				2015
Packer - Wobbly Wheel	2001			WRT PT13	2026
Snow Blower	2013			D50 Laure	N/A
Plow - Angle/Dozer	2010			Caterpillar D6T	N/A
Water Tank - Trailered	1986			Westank	N/A

TABLE CA-12 **Nunavut Airports - 20 Year Infrastructure Needs Assessment 2014-2034**

Condition Assessment Summary **Igloolik Airport**

Item/Facility	Last Rehabilitated or Constructed or Purchased	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
Airside Pavements					
Taxiway/Apron (7,560 m2)	1997	Poor	High	Major Overlay and Replenish Stockpile	2015
Runway (34,740 m2)	1997	Poor	High	Minor Overlay	2023
				Major Overlay and Replenish Stockpile	2031
Groundside Pavements					N/A
Access Road				Hamlet	
Parking lot				Maintain with O & M funds	
Airside Electrical					
				Airside Electrical Costs includes items below	
FEC	2003	Good		Expect further 10 years of life	2023
Runway Edge Lighting	2003	Good		Expect further 10 years of life	2023
Buildings & Other Facilities					
ATB:					
Building Envelope		Poor	High	Rehab ATB	2017
Finishes					
Electrical					
Maintenance Building	N/A				
Mobile Equipment					
Truck - Runway (pickup/other)	2001			GMC Silverado	2014/2022/2030
Truck - Runway (pickup/other)	2011			GMC Silverado	2019/2026
Truck - Dump/Plow S/A	1998			Ford L8513	2016
Snowblower - Self-Propelled	1994			Vohl DV1104	2015
Packer - Wobbly Wheel	1976			Rollmaster	2015
Packer - Wobbly Wheel	2003			WRT PT13	2028
Packer - Vibratory	1992			Bomag BW6	N/A
Plow - One Way	1998			Tenco TC95	N/A
Marker - Dye Markers	1976			CL120752	N/A
Motor Grader				New addition to inventory	2014
Loader				New addition to inventory	2014

TABLE CA-13 **Nunavut Airports - 20 Year Infrastructure Needs Assessment 2014-2034**

Condition Assessment Summary **Kugaaruk Airport**

Item/Facility	Last Rehabilitated or Constructed or Purchased	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
Airside Pavements					
Taxiway/Apron (7,585 m2)	1995			Current stockpile 4,500 cu.m	
Runway (45,720 m2)	1995	Poor	High	Minor Overlay from Stockpile	2015
				Major Overlay + Replensih Stockpile	2023
				Minor Overlay from Stockpile	2031
Groundside Pavements					
Access Road				Hamlet	N/A
Parking lot				Mainatain with O & M funds	
Airside Electrical					
				Airsdie Electrical cost includes items below	
FEC	1997	Good		Replace FEC + back-up generator	2022
Runway Edge Lighting	1997			Replace Runway Edge Lighting	2022
Buildings & Other Facilities					
ATB:	1976	Poor		ATB upgrade required	2016
Building Envelope				Walls in need of repair	
Finishes		Poor	High		
Electrical				Major mechanical and electrical upgrades required	
Maintenance Building	N/A		High	New 3 Bay Parking Shelter	2015
Mobile Equipment					
Truck - Pickup	2010			Chevrolet Silverado	2018/2026
Truck - Plow	1983			International Plow Truck	2014/2032
Loader	2013			Caterpillar 938K	2031
Packer - Wobbly Wheel	1981			WRT PT13	2015
Packer - Wobbly Wheel	2003			WRT PT13	2028
Snowblower - Self-Propelled	2004			Vohl snowblower	2024
Motor Grader				New addition to inventory	

TABLE CA-14 **Nunavut Airports - 20 Year Infrastructure Needs Assessment 2014-2034**

Condition Assessment Summary **Kugluktuk Airport**

Item/Facility	Last Rehabilitated or Constructed or Purchased	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
Airside Pavements					
Taxiway/Apron (33,490 m2)	1995			Stockpile is being replenished by Hamlet	
Runway (50,280 m2)	1995	N/A	High	Minor Overlay	2016
				Major Overlay + Replenish Stockpile	2023
				Minor Overlay	2030
Groundside Pavements					
Access Road				Hamlet	N/A
Parking lot		Average		Maintain with O & M funds	
Airside Electrical					
				Airside Electrical costs incudes items below	
FEC	1997	Good		Repalce FEC + backup generator	2022
Runway Edge Lighting	1997			Replace Runway Edge Lighting	2022
NDB					
Buildings & Other Facilities					
ATB:		Poor	High	ATB Upgrade required	2016
H & V					
Finishes					
Electrical					
Maintenance Building	N/A			New 3 Bay Parking Shelter required	2016
Mobile Equipment					
Truck - Runway (pickup/other)	1999			Ford F1-50 (ED&T)	2014/2022/2030
Truck - Runway (pickup/other)	2009			Chevrolet Silverado	2014/2022/2030
Truck - Plow	2007			IHC International Plow Truck	2025
Snowblower - Self-Propelled	1999			Vohl DV904-600R	2019
Packer - Wobbly Wheel	1975				2015
Packer - Wobbly Wheel	1999			WRT PT13	2024
Marker - Dye Markers	1990				N/A
Motor Grader				New addition to inventory	2015
Loader				New addition to inventory	2015

TABLE CA-15

Nunavut Airports - 20 Year Infrastructure Needs Assessment 2014-2034

Condition Assessment Summary

Kimmirut Airport

Item/Facility	Last Rehabilitated or Constructed or Purchased	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
New Airport					2020
Airside Pavements					
Taxiway/Apron (1,350 m2)	2012	N/A	High	Apron Rehabilitated commenced in 2012	N/A
Runway (13,317 m2)	2012	Good		Runway Rehabilitation commenced in 2012	N/A
					N/A
Groundside Pavements					
Access Road				Hamlet	
Parking lot				Maintain with O & M funds	
Airside Electrical					
FEC	1976	Poor	High	Decomission when new airport constructed	N/A
Runway Edge Lighting	1976				
Buildings & Other Facilities					
ATB:	1976	Poor	High	Construct Temporary ATB	2015
Building Envelope					
Finishes					
Electrical					
Maintenance Building	1976				
Mobile Equipment					
Truck - Runway (pickup/other)	2009			GMC Sierra	2017/2025/2033
Truck - Dump/Plow S/A	1992			Ford LS9000	2015/2033
Motor Grader	2003			Volvo G720B	2023
Wheeled Loader	2011			Caterpillar 938H	2029
Snow Blower - Mounted	2012			Laure Snowblower	N/A
Packer - Wobbly Wheel	2010			WRT	N/A
Packer - Wobbly Wheel	1976			Roll master	2015
Plow - Angle/Dozer	1992			Frink 2812P	N/A
Snow Bucket	2011			5 YRD	N/A
Snow Bucket	2011			3.45 YRD	N/A
Forks	2011				N/A
Dozer Plow	2011				N/A

TABLE CA-16

Nunavut Airports - 20 Year Infrastructure Needs Assessment 2014-2034

Condition Assessment Summary

Pangnirtung Airport

Item/Facility	Last Rehabilitated or Constructed or Purchased	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
New Airport					2020
				Airport Relocation Study Update	2015
			High	New Airport Infrastructure & Road (unit costs increased from 2003 price to reflect increases in grannualr material)	2020
Airside Pavements					
Taxiway/Apron (4,805 m2)	2013	Average		Runway recently resurfaced.	
				Runway surface still requires further work	
				Minor overlay	N/A
Runway (26,520 m2)	2013	Average			
Groundside Pavements					
Access Road	N/A			None	N/A
Parking lot	N/A			Maintain with O & M funds	N/A
Airside Electrical					
FEC	1997	Good	Low	Adequate until new airport is construted	N/A
Runway Edge Lighting				Estimated 10 years of life remaining	N/A
Buildings & Other Facilities					
ATB:	1994	Good	Medium	Minor rehabilitation required	2015
Building Envelope					
H & V					
Finishes					
Electrical					
Maintenance Building	N/A			None. Housed in Hamlet	
Mobile Equipment					
Truck - Runway (pickup/other)	2002			GMC Silverado	2014/2022/2030
Truck - Runway (pickup/other)	2011			GMC Silverado	2019/2026
Loader	2012			938K	2030
Truck - Dump/Plow S/A	2008			L9500 Sterling	2026
Snowblower - Self-Propelled	1987			Vohl DV904	2007
Packer - Wobbly Wheel	1992			WRT PT13	2017
Compactor	1997			Dynopac Vibratory compactor	N/A
Motor Grader				New addition to inventory	2015

TABLE CA-17

Nunavut Airports - 20 Year Infrastructure Needs Assessment 2014-2034

Condition Assessment Summary

Pond Inlet Airport

Item/Facility	Last Rehabilitated or Constructed or Purchased	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
Airside Pavements					
Taxiway/Apron (8,625 m2)	1990	Average	High	Major Overlay Required, due to soft spots on apron	2016
				Minor Overlay	2024
				Major Overlay and Replenish Stockpile	2031
Runway (36,570 m2)	1990	Average			
Groundside Pavements					N/A
Access Road	N/A			Hamlet	N/A
Parking lot	N/A			Maintain with O & M funds	N/A
Airside Electrical					
				FEC + Edge light replacement costs only	
FEC	1998		Low	Replace at end of life	2023
Runway Edge Lighting	1998		Low	Replace at end of life	2023
ODALS				Required (per Richard Mackenzie) - both ends runway	2016
Buildings & Other Facilities					
ATB:	2007	Good	Low	Replacement required outside 20 year timeline	N/A
Building Envelope					
H & V					
Finishes					
Electrical					
Maintenance Building	N/A		High	New 5 Bay Parking Shelter required	2016
Mobile Equipment					
Truck - Runway (pickup/other)	2013			Ford F250	2021/2029
Truck - Runway (pickup/other)	2003			Ford F150	2015/2023/2031
Truck - Dump/Plow S/A	2011			International 5600	2029
Snowblower - Self-Propelled	1998			Vohl DV904	2023
Packer - Wobbly Wheel	2010			WRT PT13	N/A
Packer - Wobbly Wheel	1998			WRT PT13	2023
Loader	2013			938K Caterpillar	2031
Motor Grader				New addition to inventory	

TABLE CA-18 **Nunavut Airports - 20 Year Infrastructure Needs Assessment 2014-2034**

Condition Assessment Summary **Qikiqtarjuaq Airport**

Item/Facility	Last Rehabilitated or Constructed or Purchased	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
Airside Pavements					
Taxiway/Apron (5,137 m2)	2000		High	Apron juts into ocean. Rapid deterioration. Emergency Work done in 2013 to address runway flooding. Culverts on site to be installed.	
Runway (31,770 m2)	2000	N/A	High	Stockpile good for 1 more major overlay	
				Minor Overlay	2015
				Major Overlay + Replenish Stockpile	2022
				Minor Overlay	2031
Groundside Pavements					
Access Road	N/A			Hamlet	
Parking lot	N/A			Maintain with O & M funds	
Airside Electrical					
				Airside Electrical costs include items below	
FEC	1997	Good	Medium	Replace FEC (relocate away from Bay)	2022
Runway Edge Lighting	1997	Good	Medium	Airfield Lighting Upgrade	2022
Buildings & Other Facilities					
ATB:	2013	Poor	High	Replacement required outside 20 year timeline	
Building Envelope					
H & V					
Finishes					
Electrical					
Maintenance Building	2004	Good		Located in Hamlet	N/A
Mobile Equipment					
Truck - Runway (pickup/other)	2009			GMC Sierra	2017/2025/2033
Truck - Dump/Plow S/A	1996			Ford LS8000	2014
Motor Grader	2002			Volvo G730 VHP	2022
Snowblower - Self-Propelled	2001			Vohl DV904	2021
Snowblower	2011			T60 Laure	N/A
Packer - Wobbly Wheel	1975			Tampo R13	2014
Packer - Wobbly Wheel	2010			WRT	N/A
Packer - Vibratory	1977			Dynapac CH47	N/A
Plow - One Way	1996			Frink 440-SK	N/A

TABLE CA-19 **Nunavut Airports - 20 Year Infrastructure Needs Assessment 2014-2034**

Condition Assessment Summary **Rankin Inlet Airport**

Item/Facility	Last Rehabilitated or Constructed or Purchased	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
Airside Pavements					
Apron A (16,500 m2)	2013	Good	Low	Apron Expanded in 2013. Rehab in 15 years	2028
Runway (70,104 m2)	2009	Good	Low	Assess Rwy in 10 years. Assume rehab required in 15 years	2024
Taxiway A (3,979)	2013	Good	Low	Rehab in 15 years	2028
Taxiway B (5,290)	2013	Good	Low	Rehab in 15 years	2028
Groundside Pavements					N/A
Access Road	N/A	Average		Hamlet	
Parking lot	1999	Good		Parking Area requires expansion (include with ATBexpansion)	2015
Airside Electrical					
FEC	2013	Good		FEC equipment upgraded in 2013	
Runway Edge Lighting	2013			Runway lighting upgraded in 2013	
	N/A				
Buildings & Other Facilities					
ATB:	1995	Poor	High	Major Rehab/Extension	2018
Building Envelope				Rehab and Expand ATB	
H & V					
Finishes					
Electrical					
Maintenance Building	1999	Good			
	1993 (1992)	Good		New 4 Bay Garage required	2018
Mobile Equipment					
Truck - Administrative (pickup/suburban/other)	2010			Chevrolet Silverado	2018/2026
Truck - Dump/Plow S/A	2013			Ford F250 Heavy Duty Work Vehicle	2021/2029
Truck - Pickup	2007			Ford F150	2015/2023/2031
Truck - Pickup	2009			Chevrolet Silverado	2017/2025/2033
Truck - Dump/Plow S/A	2001			IHC	2019
Wheel Loader	1991			Cat 950F	2014/2032
Wheel Loader	2010			Cat 950H	2028
Hopper/Spreader	2003			Trackless MT5TD	N/A
Motor Grader	1984			Champion 720A	2015
Snowblower - Mounted	2002			Vohl DV4000	2022
Sweeper - Towed Behind	2005			Vohl Towed	2020
Sweeper - Towed Behind	2001			Vohl Towed	2016
Plow/Dump	2006			Mauler PV350	2024
Grader	2013			Caterpillar 140AWD	N/A
Snowblower - Mounted	2013			Tenco 202	N/A
Generator Set	1993			Yamaha	N/A
Tar Kettle	1994			Craftco 100DC	N/A
Tar Kettle	2010			Craftco EZ100	N/A
Joint Router	1996			Craftco 200	N/A
Hopper/Spreader	1994			Highway P8	N/A
Hopper/Spreader	2002			Batts T110C	2020
Truck- Plow				New addition to inventory	2015
Sweeper				New addition to inventory	2015

TABLE CA-20

Nunavut Airports - 20 Year Infrastructure Needs Assessment 2014-2034

Condition Assessment Summary

Repulse Bay Airport

Item/Facility	Last Rehabilitated or Constructed or Purchased	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
Airside Pavements					
Taxiway/Apron (6,075 m2)	2013			Stockpile good for 10 years	
Runway (31,080 m2)	2013	Good	Low	Minor Overlay + Replenish Stockpile	2021
		Good		Major Overlay + Replenish Stockpile	2028
Groundside Pavements					N/A
Access Road	N/A			None	
Parking lot	N/A			Maintain with O & M funds	
Airside Electrical					
				Airside electrical costs includes items below	
FEC	1997	Good	Low	Replace FEC	2022
Runway Edge Lighting	1997	Good	Low	Replace upgrade the PAPI, runway edge lights LED	2022
Buildings & Other Facilities					
ATB:				New ATB required	2017
Building Envelope		Poor	High		
H & V					
Finishes					
Electrical					
Maintenance Building	N/A			None. Housed in Hamlet	
Mobile Equipment					
Truck - Pickup	2007			Ford F150	2015/2023/2031
Truck - Plow	2009			Sterling L9500	2027
Snowblower - Self-Propelled	1991			Vohl DV1104C	2015
Packer - Wobbly Wheel	2010			WRT	N/A
Packer - Wobbly Wheel	1983				2015
Packer - Vibratory	1981				N/A
Marker - Dye Markers	1980				N/A
Motor Grader				New addition to inventory	2015
Loader				New addition to inventory	2015

TABLE CA-21

Nunavut Airports - 20 Year Infrastructure Needs Assessment 2014-2034

Condition Assessment Summary

Resolute Bay Airport

Item/Facility	Last Rehabilitated or Constructed or Purchased	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
Airside Pavements					
Taxiway/Apron (56620 m2)	2008			Needs gravel stockpile and minor overlay	2016
Runway (120,841 m2)	2008	N/A	High	Major Overlay and replenish stockpile	2024
New Taxilane C				Minor Overlay from stockpile	2031
					N/A
Groundside Pavements					
Access Road	N/A			Maintain with O & M funds	
Parking lot	N/A			Maintain with O & M funds	
Airside Electrical					
FEC	1998			good for another 15 years	2031
Runway Edge Lighting				Airfield Lighting Upgrade	2015
VASI	1991			Replace VASI with PAPA	2015
Buildings & Other Facilities					
ATB:	1998	Good	Low	648 sq. m in 1998	
Building Envelope					N/A
H & V					
Finishes					
Electrical					
Maintenance Building	1999	Good			N/A
Old Fuel distribution System	N?A		Medium	Site remediation required, need to remove pipes equipment and tanks	2015
Mobile Equipment					
Truck - Administrative (pickup/suburban/other)	1989			GMC Suburban	2014/2022/2030
Truck - Runway (pickup/other)	1996			Ford F250 Super Duty Pick up	2014/2022/2030
Truck - Runway (pickup/other)	2003			Ford F250 Super Duty Pick up	2014/2022/2030
Truck - Trades (pickup/van/other)	2008			Ford F150	2016/2024/2032
Truck - Trades (pickup/van/other)	2012			Ford F150	2020/2028
Truck - Dump/Plow S/A	1991			IHC Paystar 5070	2015/2033
Truck - Dump/Plow S/A	2012			Freightliner	2030
Truck - Tractor	1979			GMC Brigadier J9500	N/A
Truck - Dump	1979			Arnes Dump	2015/2033
Water Truck	1983			F6000 Med Duty	N/A
Wheel Loader	2006			Caterpillar 950H	2024
Wheel Loader	2013			Caterpillar 950K	2031
Motor Grader	1995			Champion 740	2015
Snowblower - Mounted	1972			Larue D60B	N/A
Snowblower - Self-Propelled	1986			Norland Idaho 2EC-52	2015
Packer - Wobbly Wheel	1981				2015
Packer - Wobbly Wheel	1981				2015
Packer - Wobbly Wheel	2005			WRT	2030
Plow - Special	1991			Frink R09M	N/A
Plow - Special	1996			Frink R09M	N/A
Welder	1978			Cannox BR300	N/A
Forklift	1973			Hyster H80C	N/A
Screening Plant	1990			Coney	N/A
Special	2008			Wausau WRO 10	N/A

TABLE CA-22 **Nunavut Airports - 20 Year Infrastructure Needs Assessment 2014-2034**

Condition Assessment Summary **Sanikiluaq Airport**

Item/Facility	Last Rehabilitated or Constructed or Purchased	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
Airside Pavements					
Taxiway/Apron (8,880 m2)	2013	Average	Medium	Gravel Stockpile required, with minor overlay	2016
				Minor overlay	2024
Runway (34,740 m2)	2013	Average		Gravel stcokpile and major overlay	2031
Groundside Pavements					N/A
Access Road	N/A			None	
Parking lot	N/A			Maintain with O & M funds	
Airside Electrical					
				Airside Electrical costs includes items below	
FEC	1997	Average	Medium	Replace FEC.	2022
Runway Edge Lighting	1997			Replace Runway Edge Lighting	2022
Buildings & Other Facilities					
ATB:				206 sq. m.	
Building Envelope		Poor	High	Minor Rehab of ATB	2015
H & V					
Finishes					
Electrical					
Maintenance Building	2010				
Mobile Equipment					
Truck - Runway (pickup/other)	2000			Ford F150	2015/2023/2031
Truck - Runway (pickup/other)	2010			GMC Silverado	2018/2026
Truck - Dump/Plow T/A	1989			Freightliner FLC112425D	2014/2032
Truck - Dump/Plow T/A	2013			Freightliner 108 SD	2031
Motor Grader	2004			Caterpillar 140H	2024
Snowblower - Self-Propelled	1997			Vohl DV904	2022
Packer - Wobbly Wheel	1977				2015
Packer - Wobbly Wheel	2000			WRT PT13	2025
Packer - Vibratory	1991			Bomag BW6	N/A
Plow - One Way	1989			Frink 440SK8F	2017
Loader				New addition to inventory	2015

TABLE CA-23

Nunavut Airports - 20 Year Infrastructure Needs Assessment 2014-2034

Condition Assessment Summary

Taloyoak Airport

Item/Facility	Last Rehabilitated or Constructed or Purchased	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
Airside Pavements					
Taxiway/Apron (8,775 m2)	2013		Low	Minor overlay from stockpile	2022
Runway (33,000 m2)	2013	N/A	Low	Major overlay and new stockpile	2029
Groundside Pavements					N/A
Access Road	N/A			None	
Parking lot	N/A			Maintain with O & M funds	
Airside Electrical					
FEC	2013	Good		Airfield Lighting/Electrical Replaced I 2013	N/A
Runway Edge Lighting	2013				N/A
Buildings & Other Facilities					
ATB:	1980	Poor		Needs immediate replacement	2015
Building Envelope					
H & V		Poor	High		
Finishes					
Electrical					
Maintenance Building	N/A			New 3 Bay Parking shelter	2015
Mobile Equipment					
Truck - Runway (pickup/other)	2010			GMC Silverado	2018/2026
Grader	2008			Volvo	2028
Wheel Loader	2012			938K	2030
Snowblower - Mounted	1994			Vohl LM220	2015
Packer - Wobbly Wheel	1980			WRT PT13	2015
Packer - Wobbly Wheel	2001			WRT PT13	2026
Packer - Vibratory	1997			Bomag BW6	N/A
Marker - Dye Markers	1981			C120752	N/A
Truck-Plow				New addition to inventory	2015

TABLE CA-24

Nunavut Airports - 20 Year Infrastructure Needs Assessment 2014-2034

Condition Assessment Summary

Whale Cove Airport

Item/Facility	Last Rehabilitated or Constructed or Purchased	Current Condition 2014	Priority or Status	General Comments	Estimated End of Life Cycle
Airside Pavements					
Taxiway/Apron (6,678 m2)	2000	Poor	High	New Stockpile and Major Overlay	2015
Runway (36,570 m2)	2000	Poor	High	Minor Overlay from stockpile	2023
				Replenish stockpile + major overlay	2031
Groundside Pavements					
Access Road	N/A			Full overlay (stockpile should cover)	N/A
Parking lot	N/A			Maintain with O & M funds	
Airside Electrical					
				Airside Electrical cost includes items below	
FEC	2000	Good		Replace FEC	2025
Runway Edge Lighting	2000			Replace Runway Edge Lighting	2025
Buildings & Other Facilities					
ATB:	1986	Poor	High	New ATB	2018
Building Envelope					
H & V					
Finishes					
Electrical					
Maintenance Building	2013	Good		New Parking Shelter	N/A
Mobile Equipment					
Truck - Runway (pickup/other)	2003			Ford F150	2014/2022/2030
Truck - Runway (pickup/other)	2010			GMC Sierra	2018/2026
Wheel Loader	2006			Cat 950H	2024
Truck - Plow	1988			International Plow Truck	2014/2032
Snowblower - Mounted	1999			Vohl LM220	2019
Packer - Wobbly Wheel	1982			WRT PT13	2015
Packer - Wobbly Wheel	2003			WRT PT13	2021
Motor Grader				New addition to inventory	2015