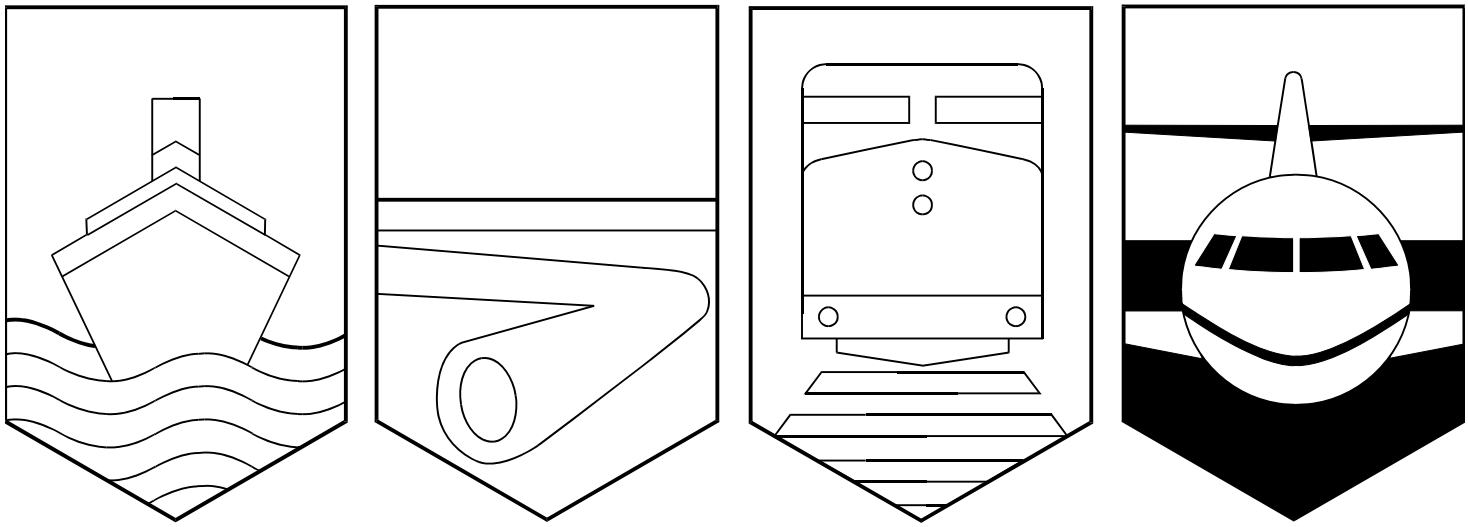
Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada



# AVIATION OCCURRENCE REPORT

## LANDING GEAR FAILURE - CAPSIZING

## ENTERLAKE AIR SERVICES LTD. (SELKIRK AIR)
## BEECH AIRCRAFT CORPORATION 3T BEECH 18 C-FSFH
## BRADBURN LAKE, MANITOBA
## 05 JUNE 1995

## REPORT NUMBER A95C0110

Canada

## MANDATE OF THE TSB

The Canadian Transportation Accident Investigation and Safety Board Act provides the legal framework governing the TSB's activities. Basically, the TSB has a mandate to advance safety in the marine, pipeline, rail, and aviation modes of transportation by:

- conducting independent investigations and, if necessary, public inquiries into transportation occurrences in order to make findings as to their causes and contributing factors;
- reporting publicly on its investigations and public inquiries and on the related findings;
- identifying safety deficiencies as evidenced by transportation occurrences;
- making recommendations designed to eliminate or reduce any such safety deficiencies; and
- conducting special studies and special investigations on transportation safety matters.

It is not the function of the Board to assign fault or determine civil or criminal liability. However, the Board must not refrain from fully reporting on the causes and contributing factors merely because fault or liability might be inferred from the Board's findings.

### INDEPENDENCE

To enable the public to have confidence in the transportation accident investigation process, it is essential that the investigating agency be, and be seen to be, independent and free from any conflicts of interest when it investigates accidents, identifies safety deficiencies, and makes safety recommendations. Independence is a key feature of the TSB. The Board reports to Parliament through the President of the Queen's Privy Council for Canada and is separate from other government agencies and departments. Its independence enables it to be fully objective in arriving at its conclusions and recommendations.

Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada



# Aviation Occurrence Report

# Landing Gear Failure - Capsizing

# Enterlake Air Services Ltd. (Selkirk Air)
# Beech Aircraft Corporation 3T Beech 18
# C-FSFH
# Bradburn Lake, Manitoba
# 05 June 1995

# Report Number A95C0110

*Synopsis*

During the float-equipped aircraft's take-off run, the pilot noticed a yaw to the left. The pilot corrected the yaw, but it recurred and worsened. The left float separated from the aircraft, the left wing struck the water, and the aircraft capsized, coming to rest on its left wing tip in about 15 feet of water. The pilot and the six passengers were not injured; they exited the aircraft and swam to shore. The aircraft sustained substantial damage.

The Board determined that the left front swivel fitting attachment bolt probably moved out of position because the securing nut was either not installed or came off in service. A series of failures ensued, culminating in the separation of the left float from the aircraft.

Ce rapport est également disponible en français.

# *Table of Contents*

## 5.0 Appendices

# 1.0 Factual Information

## 1.1 History of the Flight

The Beech 18 seaplane was departing a fishing camp at Bradburn Lake, Manitoba, for its third flight of the day en route to the operator's base at Selkirk. After boarding the passengers and loading the baggage for the flight, the pilot taxied the aircraft to a position near the southwest shore of the lake and started the take-off run on an approximate heading of 015 degrees true. During the take-off run, after the aircraft was "on the step," the pilot noticed a yaw to the left. He corrected the yaw with the aircraft's rudders and with differential engine power. Shortly thereafter, at about 60 miles per hour[1] (mph)[2], the yaw recurred and worsened. The left float separated from the aircraft and the left wing struck the water. The aircraft turned sharply to the left, stopped in the water, and came to rest on its left wing tip in about 15 feet of water. The pilot and the six passengers were not injured; they exited the sinking aircraft and swam to shore. The accident occurred at 1040 central daylight saving time (CDT)[3] during daylight hours at latitude 51˚55'N and longitude 95˚35'W.

## 1.2 Injuries to Persons

| | Crew | Passengers | Others | Total |
|---|---|---|---|---|
| Fatal | - | - | - | - |
| Serious | - | - | - | - |
| Minor/None | 1 | 6 | - | 7 |
| Total | 1 | 6 | - | 7 |

## 1.3 Damage to Aircraft

The aircraft sustained substantial damage when the left float separated and the aircraft stopped in the water and capsized.

## 1.4 Other Damage

The pilot's and the passengers' baggage was damaged by water when the aircraft capsized.

---

[1] Units are consistent with official manuals, documents, reports, and instructions used by or issued to the crew.

[2] See Glossary at Appendix C for all abbreviations and acronyms.

[3] All times are CDT (Coordinated Universal Time [UTC] minus five hours) unless otherwise noted.

## *1.5 Personnel Information*

| | Captain |
|---|---|
| Age | 47 |
| Pilot Licence | CPL |
| Medical Expiry Date | 01 Sep 95 |
| Total Flying Hours | 9,000 |
| Hours on Type | 700 |
| Hours Last 90 Days | 33 |
| Hours on Type Last 90 Days | 33 |
| Hours on Duty Prior to Occurrence | 4 |
| Hours Off Duty Prior to Work Period | 13 |

The pilot had about 6,000 hours of seaplane flying experience. He was working his seventh season with this operator and was certified and qualified for the flight in accordance with existing regulations.

## *1.6 Aircraft Information*

| | |
|---|---|
| Manufacturer | Beech Aircraft Corporation |
| Type and Model | 3T (Beech 18) |
| Year of Manufacture | 1943 |

| | |
|---|---|
| Serial Number | 43-35481 |
| Certificate of Airworthiness (Flight Permit) | Issued 15 June 1984 |
| Total Airframe Time | 15,748 hr |
| Engine Type (number of) | Pratt & Whitney R-985-AN-14B (2) |
| Propeller/Rotor Type (number of) | Hamilton Standard 22D30 (2) |
| Maximum Allowable Take-off Weight | 8,725 lb |
| Recommended Fuel Type(s) | 100 LL |
| Fuel Type Used | 100 LL |

The weight of the aircraft at take-off was about 300 pounds under the certified gross weight of the aircraft, and the centre of gravity was within the prescribed limits. The aircraft was equipped with EDO 56-7850A floats, each of which was attached independently to the aircraft fuselage with five struts; the design does not incorporate a spreader bar[4]. The aircraft is a low-wing design, and the wing and engine cowlings limit the view of the floats from inside the aircraft in flight, and from some positions on the water during a walkaround. The main entry/exit door is located in the left rear area of the fuselage. The pilot reportedly checked the float struts before departing on the first flight of the day. Neither the aircraft's flight manual nor its operating manual states the maximum amount of down wind component that is acceptable for take-off with the aircraft.

## *1.7 Meteorological Information*

The weather observed at 1100 CDT at Little Grand Rapids, Manitoba, 16 miles southwest of the site, was as follows: 4,500 feet scattered clouds, visibility 15 miles, winds 240 degrees true at 13 knots. Witnesses reported that the winds at the time of the occurrence were out of the south at less than 10 knots and not gusty, and the surface of the water had light rippled waves.

## *1.8 Wreckage and Impact Information*

Examination of the aircraft after the occurrence revealed that the left float's front and rear vertical struts were still attached to the float, but their top fittings (at the aircraft nacelle) were twisted and showed signs of overload failure. The eyebolt fitting of the diagonal side strut failed at the swivel fitting where it attaches to the float. The rear side strut upper attachment bolt at the fuselage was twisted, and the rear swivel fitting bolt, by which the swivel and the diagonal strut are attached to the rear float mount pad, was broken. The mounting pad on the float showed signs of metal smearing. The front side strut was still attached to the fuselage; the attaching bolt was in place and the fitting showed little damage. The float end of the front side strut incorporates a swivel fitting, which attaches to a mounting pad on the float. Neither the front left swivel fitting nor the corresponding mounting pad showed evidence of damage or distortion; the mounting bolt and nut were not recovered.

[4] Appendix A contains a diagram of the aircraft and its float, strut, and strut fitting arrangement.

## *1.9 Float Installation*

The *Bristol Float Service Manual* specifies that castellated nuts secured with cotter pins are required for the strut mounting bolts. The operator reported that castellated nuts and cotter pins were used in the float installation. The float installation manual specifies 14 bolts with castellated nuts for each float; 10 bolts and nuts for the left float were recovered. Nine of these bolts were installed with fibre self-locking nuts. In order for a self-locking nut to lock securely, the thread of the bolt must pass fully through the end of the nut. It was noted that several of the bolts securing the struts and fittings did not pass fully through the end of the securing nut.

Experience has shown that float fitting bolts left in service for longer than two years tend to deteriorate from the effects of wear and corrosion.

## *1.10 Tests and Research*

The front side strut swivel fitting and the corresponding float mounting pad, and the rear swivel fitting with the attached end of the diagonal strut eyebolt were submitted to the TSB Engineering Branch for examination. After examination of the front swivel fitting and mounting pad, the Engineering Branch concluded that the attaching bolt probably did not break, but moved out of position, either because the nut was not installed or because it came off during service. The bore of the front float mounting pad showed circumferential markings in a narrow band centred approximately one-half inch from the aft end. These marks appeared to have been made recently, and their form was consistent with the threads of an AN7 bolt, which was the type specified for the missing attachment bolt. The Engineering Branch concluded that the marks were probably made by side loads on the assembly while the bolt was partially withdrawn. The bolt that attaches the rear swivel fitting to the rear mounting pad was found bent and broken by a combination of shear and tensile loading, with no evidence of progressive failure. The swivel fitting was twisted but not broken. The eyebolt attaching the swivel fitting to the diagonal strut was found to be bent and broken and the fracture surfaces were typically 45-degree slant fractures characteristic of tensile overload. Moderate surface corrosion was found on the inner wall of the bolt and on its fracture surfaces. Some of the internal corrosion may have been present before the fracture, but it had not significantly reduced the thickness of the bolt wall or contributed to the fracture. There was no evidence of pre-cracking or progressive failure.

## *1.11 Inspection Schedule*

The *Beech Maintenance Manual* does not have a seaplane section. The *Bristol Service Manual* for the EDO 56-7850 floats for the Beech 18 provides that the floats are to be removed for inspection every 500 hours or every end of season, whichever comes first.

The operator is a Transport Canada Approved Maintenance Organization (AMO). The AMO's Beech 18 inspection program approval specifies that the float struts and attachment are to be checked for cracks and general condition, and attaching bolts for security, every 100 hours. There is no specific requirement in the inspection approval for the struts to be removed for inspection every 500 hours or end of season. Among the conditions attached to the approval are the following:

a) the operator is not absolved from responsibility for ensuring that the aircraft is maintained in an airworthy condition;

b) the operator shall ensure that the aircraft is in compliance with all component life limits and other applicable mandatory requirements;

c) the operator shall evaluate for applicability to the program, all recommendations made by the manufacturer of the aircraft and their installed engines, propellers and appliances, as published in maintenance manuals, recommended schedules service bulletins and other technical documents. Where appropriate, the operator shall initiate amendment action. All amendments shall be approved by the Minister.

According to Transport Canada records, the operator's inspection approval was not amended to incorporate the Bristol inspection provisions.

Some Transport Canada inspectors recommend that operators of the accident aircraft type remove the floats every two years to inspect the struts.

According to the maintenance records for the aircraft, the floats and attachment struts were last removed for inspection in April 1988. Since that time, the aircraft's float attachment fittings have reportedly been inspected annually and attachment bolts replaced on condition. All of the float attachment bolts recovered and examined showed little evidence of wear or corrosion. The aircraft had flown about 1,160 hours between April 1988 and the time of the accident.

## *1.12 Survival Aspects*

Before commencing the take-off, the pilot completed a passenger briefing, in which he mentioned, among other items, the location of the life-jackets mounted on the fuselage of the aircraft above the passenger seats and the locations of the aircraft exits. The passengers were not required to don the life jackets before take-off. After the float separated from the aircraft and while the aircraft was settling in the water, the pilot exited via the overhead hatch and attempted unsuccessfully to open the main cabin door at the rear of the fuselage. The passengers exited the cabin through the overhead hatch and stood on the wing of the sinking aircraft as the pilot re-entered the aircraft, transmitted a distress call from the aircraft's very high frequency (VHF) radio, and retrieved five life-jackets from their positions on the fuselage adjacent to the passenger seats. The pilot and four of the passengers donned the life-jackets and swam to the nearest shore, a distance of about 500 feet. Two of the passengers swam to shore without life-jackets. The pilot and one of the passengers walked and swam back to the fishing camp, returned with a boat, and took the party back to the camp.

# 2.0 Analysis

## 2.1 Take-off Direction

The combination of wind direction and take-off direction produced a tail-wind component of 5 to 10 knots during the take-off run. However, the aircraft does not have any published downwind take-off limits, and the wind and water conditions at take-off imposed no unusual stresses on the aircraft. Therefore, the pilot's choice of take-off direction did not contribute materially to the occurrence.

## 2.2 Aircraft Loading

Because the weight of the aircraft was under the maximum gross weight and the centre of gravity of the aircraft was within the prescribed limits, the loading of the aircraft did not impose any unusual stresses on the aircraft, or contribute materially to the occurrence.

## 2.3 Float Separation

Because the eyebolt fitting connecting the diagonal strut to the rear swivel fitting was found bent and broken in overload, with no pre-existing damage, it is likely that the fitting failed during the float separation sequence, but did not initiate the failure.

After examination of the front swivel fitting and mounting pad, the Engineering Branch concluded that the attaching bolt probably did not break, but moved out of position, either because the nut was not installed or because it came off during service. Given that the pilot reportedly checked the float fittings before departing the first flight of the day, it is likely that the bolt moved out of the fitting during the two flights completed on the day of the occurrence. Because of the low-wing design of the aircraft, the location of the main entry/exit door, and the seaplane landing gear configuration, a defect in the area of the forward float fittings would be less noticeable than in other aircraft designs. In light of the lack of damage to the front diagonal strut fittings and the overload failure damage found in the other float fittings, it is likely that the departure of the bolt from the front swivel fitting initiated the sequence of failures that resulted in the separation of the float from the aircraft during the occurrence.

## 2.4 Fasteners

Because the bolt and nut connecting the front swivel fitting to the float mounting pad were not recovered, no definitive statement can be made about the type of nut that was installed. However, 9 of the 10 float fitting bolts for which castellated nuts were specified were recovered with fibre locking nuts, and it is possible that this bolt was also secured with a fibre locking nut. Several of the left float fittings that were recovered had less than one thread of bolt extension past their fibre-locking nuts, and it is possible that the missing bolt lost its nut because the nut did not lock securely, and departed from the bolt in service.

All of the float attachment bolts and nuts that were recovered were in good condition, with little evidence of wear or corrosion. It is likely that the missing bolt and nut were inspected and replaced at

the same intervals as the other attachment bolts, and were probably not worn or corroded to the extent that they contributed to this occurrence.

## *2.5 Inspection Schedule*

The Bristol float service manual specifies an inspection schedule which is more rigorous than the one called for in the Transport Canada approved inspection schedule. Although the operator's inspection approval conditions require it to incorporate "other applicable mandatory requirements" of components installed in its aircraft and amend its inspection schedule accordingly, there is no record of changes to the inspection schedule to reflect the Bristol inspection provisions. Transport Canada did not insist on these provisions and reportedly encouraged some operators to incorporate an inspection schedule which differed from the Bristol inspection requirements.

## *2.6 Survival Aspects*

Although the passengers did not wear their life-jackets during the take-off, the pilot's pre-take-off briefing and his actions in retrieving five of the life-jackets as the aircraft was sinking contributed to the survival of the passengers.

# 3.0 Conclusions

## 3.1 Findings

1. The pilot was certified and qualified for the flight in accordance with existing regulations.

2. The pilot's choice of take-off direction did not contribute materially to the occurrence.

3. Although the left front swivel fitting attachment bolt was not recovered after the occurrence, it was probably not worn or corroded to an extent that contributed to the occurrence.

4. It is likely that the left front swivel fitting attachment bolt moved out of position, during or before the take-off run, because the securing nut was either not installed or came off in service.

5. The departure of the left front swivel fitting attachment bolt initiated a series of failures that resulted in the separation of the float from the aircraft during the take-off run.

6. The aircraft's low-wing design and landing gear configuration made it less likely that defects in the area of the forward float fittings would be noted during service and operation.

7. The operator's Beech 18 inspection schedule did not incorporate the Bristol inspection requirements for EDO 56-7850 floats.

8. Transport Canada did not insist that the component manufacturer's inspection requirements be included in the operator's Beech 18 inspection schedule.

9. Nine of the 10 float fitting bolts for which castellated nuts were specified were recovered with fibre locking nuts.

## 3.2 Causes

The left front swivel fitting attachment bolt probably moved out of position because the securing nut was either not installed or came off in service. A series of failures ensued, culminating in the separation of the left float from the aircraft.

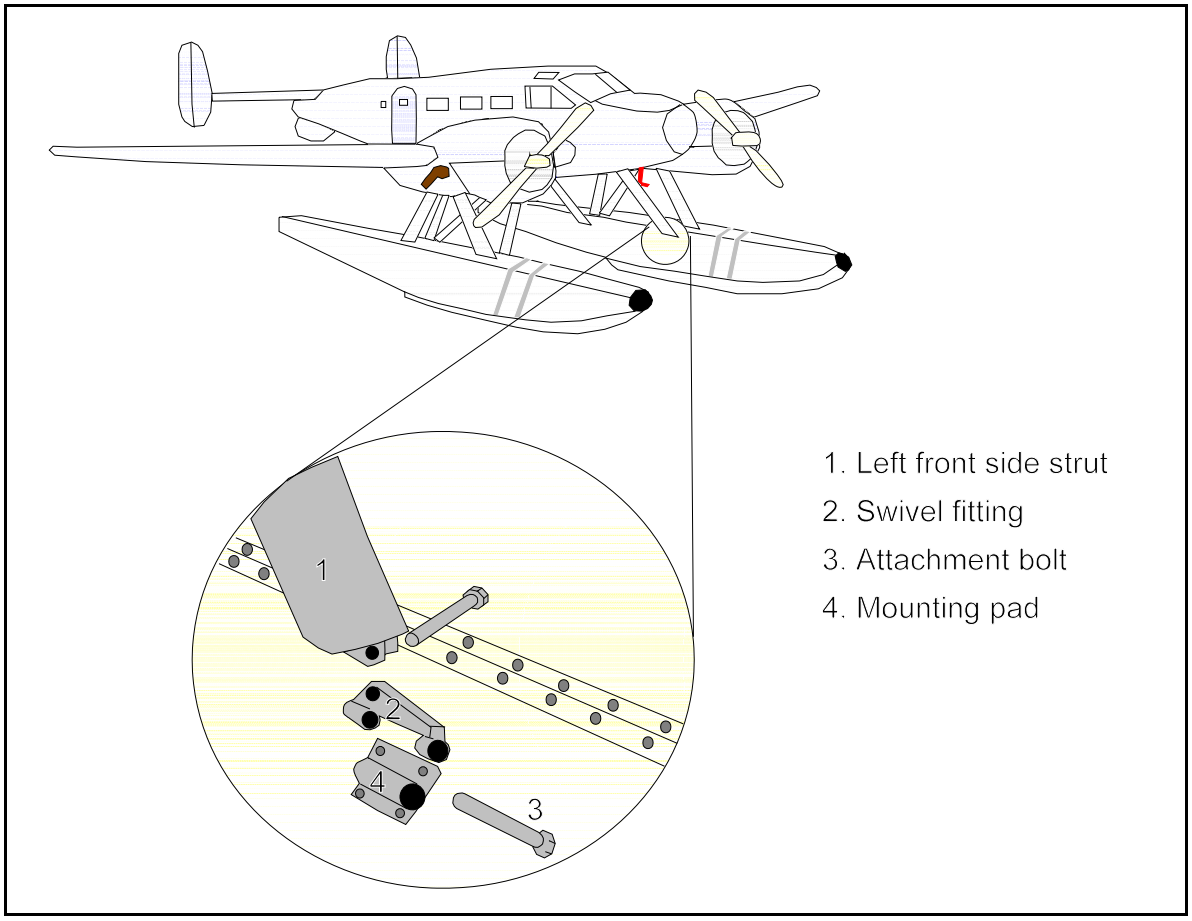
# 4.0 Safety Action

## 4.1 Action Taken

The Bristol inspection requirement for EDO floats calls for removal and inspection of the floats every 500 hours, or at the end of each float-flying season. Transport Canada (TC) did not require that the component manufacturer's inspection criteria be incorporated into the approved inspection schedule. A TSB Aviation Safety Advisory was forwarded to TC indicating that TC may wish to review the direction it provides to Approved Maintenance Organizations (AMOs) with regards to following the manufacturer's inspection requirements.

*This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson John W. Stants, and members Zita Brunet and Maurice Harquail, authorized the release of this report on 28 February 1996.*

# *Appendix A - Float Strut Detail*



# *Appendix B - List of Supporting Reports*

The following TSB Engineering Branch Report was completed:

LP 96/95 Float Attachment Fittings.

This report is available upon request from the Transportation Safety Board of Canada.

# *Appendix C - Glossary*

| | |
|---|---|
| AMO | approved maintenance organization |
| CDT | central daylight saving time |
| CPL | Commercial Pilot Licence |
| hr | hour(s) |
| lb | pound(s) |
| LL | low lead |
| mph | miles per hour |
| N | north |
| TC | Transport Canada |
| TSB | Transportation Safety Board of Canada |
| UTC | Coordinated Universal Time |
| VHF | very high frequency |
| W | west |
| ' | minute(s) |
| ° | degrees |

# TSB OFFICES

**HEAD OFFICE**

**HULL, QUEBEC***
Place du Centre
4th Floor
200 Promenade du Portage
Hull, Quebec
K1A 1K8
Phone (819) 994-3741
Facsimile (819) 997-2239

**ENGINEERING**
Engineering Laboratory
1901 Research Road
Gloucester, Ontario
K1A 1K8
Phone (613) 998-8230
24 Hours (613) 998-3425
Facsimile (613) 998-5572

**REGIONAL OFFICES**

**GREATER HALIFAX, NOVA SCOTIA***
Marine
Metropolitain Place
11th Floor
99 Wyse Road
Dartmouth, Nova Scotia
B3A 4S5
Phone (902) 426-2348
24 Hours (902) 426-8043
Facsimile (902) 426-5143

**MONCTON, NEW BRUNSWICK**
Pipeline, Rail and Air
310 Baig Boulevard
Moncton, New Brunswick
E1E 1C8
Phone (506) 851-7141
24 Hours (506) 851-7381
Facsimile (506) 851-7467

**GREATER MONTREAL, QUEBEC***
Pipeline, Rail and Air
185 Dorval Avenue
Suite 403
Dorval, Quebec
H9S 5J9
Phone (514) 633-3246
24 Hours (514) 633-3246
Facsimile (514) 633-2944

**GREATER QUÉBEC, QUEBEC***
Marine, Pipeline and Rail
1091 Chemin St. Louis
Room 100
Sillery, Quebec
G1S 1E2
Phone (418) 648-3576
24 Hours (418) 648-3576
Facsimile (418) 648-3656

**GREATER TORONTO, ONTARIO**
Marine, Pipeline, Rail and Air
23 East Wilmot Street
Richmond Hill, Ontario
L4B 1A3
Phone (905) 771-7676
24 Hours (905) 771-7676
Facsimile (905) 771-7709

**PETROLIA, ONTARIO**
Pipeline and Rail
4495 Petrolia Street
P.O. Box 1599
Petrolia, Ontario
N0N 1R0
Phone (519) 882-3703
Facsimile (519) 882-3705

**WINNIPEG, MANITOBA**
Pipeline, Rail and Air
335 - 550 Century Street
Winnipeg, Manitoba
R3H 0Y1
Phone (204) 983-5991
24 Hours (204) 983-5548
Facsimile (204) 983-8026

**EDMONTON, ALBERTA**
Pipeline, Rail and Air
17803 - 106 A Avenue
Edmonton, Alberta
T5S 1V8
Phone (403) 495-3865
24 Hours (403) 495-3999
Facsimile (403) 495-2079

**CALGARY, ALBERTA**
Pipeline and Rail
Sam Livingstone Building
510 - 12th Avenue SW
Room 210, P.O. Box 222
Calgary, Alberta
T2R 0X5
Phone (403) 299-3911
24 Hours (403) 299-3912
Facsimile (403) 299-3913

**GREATER VANCOUVER, BRITISH COLUMBIA**
Marine, Pipeline, Rail and Air
4 - 3071 Number Five Road
Richmond, British Columbia
V6X 2T4
Phone (604) 666-5826
24 Hours (604) 666-5826
Facsimile (604) 666-7230

*Services available in both official languages