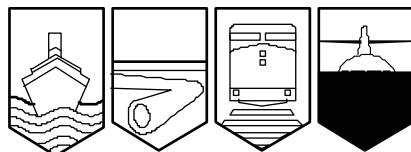


Transportation Safety Board
of Canada



Bureau de la sécurité des transports
du Canada

AVIATION INVESTIGATION REPORT
A02O0272



RISK OF COLLISION

NAV CANADA
TORONTO AIRPORT CONTROL TOWER
TORONTO/LESTER B. PEARSON INTERNATIONAL AIRPORT
TORONTO, ONTARIO
25 AUGUST 2002

Canada

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

Aviation Investigation Report

Risk of Collision

NAV CANADA
Toronto Airport Control Tower
Toronto/Lester B. Pearson International Airport
Toronto, Ontario
25 August 2002

Report Number A02O0272

Synopsis

At 0936 eastern daylight time, a Cessna TU206G amphibious float-equipped aircraft, registration C-GGSG, was approximately three nautical miles west of Toronto/Lester B. Pearson International Airport (LBPIA), Ontario, on approach to Runway 05, and was cleared to land and hold short of Runway 33L. About one minute later a Northwest Airlines McDonnell Douglas DC-9-51 aircraft, registration N773NC (Flight No. NWA971) was authorized to taxi to position on Runway 33L for departure. Shortly thereafter, the airport controller advised NWA971 that a Cessna 206 would land and hold short of Runway 33L, and then issued the take-off clearance.

After the Cessna 206 touched down on Runway 05, the controller issued taxi instructions to the pilot, with instructions to hold short of Runway 33L. The Cessna pilot then informed the controller that he was going around because of a landing gear problem. The controller immediately instructed the Cessna pilot to commence a hard left turn. At the same time the Northwest Airlines flight crew, just after becoming airborne, observed the Cessna and initiated a right turn. The spacing between the aircraft was approximately 100 feet lateral and 100 feet vertical over the threshold of Runway 15R, with NWA971 being higher. There were no injuries as a result of this incident.

Ce rapport est également disponible en français.

© Minister of Public Works and Government Services 2004
Cat. No. TU4-12/2004E
ISBN 0-662-36682-4

1.0	Factual Information	1
1.1	History of the Flight	1
1.2	Personnel Information	2
1.2.1	Cameron Air Service Cessna 206 C-GGSG	2
1.2.2	Northwest Airlines McDonnell Douglas DC-9 N773NC	3
1.2.3	Air Traffic Controller	3
1.3	Aircraft Information	4
1.3.1	Cameron Air Service Cessna 206 C-GGSG	4
1.3.2	Northwest Airlines McDonnell Douglas DC-9 N773NC	5
1.4	Meteorological Information	5
1.5	Aids to Navigation	5
1.6	Communications	5
1.7	Aerodrome Information	6
1.7.1	General	6
1.7.2	GTAA Guidelines for the Use of Runways 15R/33L and 15L/33R	6
1.7.3	Air Traffic Control Tower Personnel Staffing	6
1.8	Organizational and Management Information	7
1.8.1	Sequential and Simultaneous Operations on Intersecting Runways	7
1.8.1.1	General	7
1.8.1.2	Sequential Intersecting Runway Operations	7
1.8.1.3	Simultaneous Intersecting Runway Operations	7
1.8.2	NAV CANADA Bulletin ATCI: 2000-1	8
1.8.3	Squawk 7700	9
1.8.4	Airline Pilots Association, International (ALPA) Position on SIRO/LAHSO .	9
1.8.5	TC's Air Traffic Services Standards Division Audit and Inspection Responsibilities	10
1.9	Additional Information	11
1.9.1	Aerodrome Charts	11
1.9.2	Wake Turbulence Separation	11

TABLE OF CONTENTS

2.0	Analysis	13
2.1	General	13
2.2	Cessna 206 Pilot's Actions	13
2.3	Airport Controller's Actions	13
2.4	NWA971 Flight Crew Actions	15
3.0	Conclusions	17
3.1	Findings as to Causes and Contributing Factors	17
3.2	Findings as to Risk	17
3.3	Other Findings	18
4.0	Safety Action	19
4.1	Action Taken	19
4.1.1	Eagle Aircraft Inc.	19
4.1.2	Transport Canada	19
4.1.3	Transportation Safety Board of Canada	19
4.1.4	Jeppesen Sanderson	20
5.0	Appendices	
	Appendix A - Toronto/LBPIA Site Map and Conflict Depiction	21
	Appendix B - List of Supporting Reports	23
	Appendix C - Glossary	25

1.0 *Factual Information*

1.1 *History of the Flight*

The Cessna 206 aircraft was on a visual flight rules (VFR)¹ charter flight from Georgian Bay, Ontario, to Toronto/LBPIA with one pilot and three passengers on board. While sequencing the Cessna 206 for arrival, the airport controller asked the pilot if he was able to land and hold short of Runway 33L. The pilot acknowledged that he could do so. At 0936:15², the controller cleared the Cessna to land on Runway 05 and hold short of Runway 33L and advised that there would be a Boeing 737, American Airlines Flight 449 (AAL449), departing Runway 33L. At 0936:44, AAL449 was cleared for take-off on Runway 33L and the aircraft took off. (See Appendix A).

During the final approach, the pilot of the Cessna 206 selected the landing gear down; however, the right main landing gear green light did not illuminate, indicating that the right main landing gear had not extended or that it had extended but did not lock into position. The pilot continued the approach and recycled the landing gear in an attempt to receive the appropriate landing gear indication. Upon completion of the landing gear recycling, the aircraft was in the landing flare and the pilot again observed an inappropriate landing gear indication for landing. The aircraft voice gear advisory system also sounded.

Northwest Airlines Flight 971 (NWA971), a McDonnell Douglas DC-9-51 aircraft with 2 flight crew, 3 cabin crew, and 104 passengers on board was conducting an instrument flight rules (IFR) scheduled flight from Toronto/LBPIA to Minneapolis, Minnesota, U.S.A. At 0937:17, NWA971 was authorized to taxi to position and hold on Runway 33L and was advised that the Cessna 206 aircraft was about to touch down on Runway 05 and would be holding short of Runway 33L.

At 0938:00, NWA971 was cleared for take-off and seven seconds later the flight crew began the take-off roll. The controller did not advise the pilot of the Cessna 206 that a DC-9 aircraft was departing from Runway 33L. The Cessna 206 touched down momentarily at 0938:36, approximately 1680 feet past the threshold of Runway 05, with approximately 3350 feet of runway remaining prior to the intersection of Runway 33L. The controller saw the touchdown, assumed the aircraft had landed, and instructed the pilot to continue taxiing on Runway 05. He

¹ See Appendix C - Glossary for abbreviations and acronyms.

² A.I.P. Canada Section RAC 4.4.9 (b) (v) states in part: "... Having accepted the hold-short clearance, **pilots are obligated to remain 200 feet short of the closest edge of the runway being intersected**. If, for any reason, a pilot is unsure of being able to comply with a hold-short clearance, the pilot must advise ATC immediately of non-acceptance of the clearance; **it is far better to be safe than sorry**."

³ All times are EDT (coordinated universal time [UTC] minus four hours), unless otherwise noted.

also reminded the pilot to hold short of Runway 33L. Eight seconds later, the pilot announced that he was going around because of a landing gear problem. The controller immediately instructed the Cessna pilot to commence a hard left turn to a heading of 290°. During the go-around, the Cessna 206 passengers observed the McDonnell Douglas DC-9 aircraft on its take-off run, and the front seat passenger alerted the pilot to the conflict.

The point of rotation of NWA971 was near taxiway Foxtrot 2, and, as the aircraft commenced its climb, the first officer, the pilot flying, observed the approaching Cessna 206 aircraft. He alerted the captain and took immediate evasive action to the right. A review of the recorded radar data indicated that the spacing between the aircraft was approximately 100 feet laterally and vertically over the threshold of Runway 15R.

After the incident, the Cessna 206 was vectored west and south of Toronto/LBPIA to a landing in the harbour at Toronto Island, and the DC-9 aircraft proceeded to Minneapolis, as planned.

1.2 *Personnel Information*

1.2.1 *Cameron Air Service Cessna 206 C-GGSG*

	Captain
Pilot Licence	Commercial
Medical Expiry Date	01 December 2002
Total Flying Hours	7500
Hours on Type	6500
Hours Last 90 Days	240
Hours on Type Last 90 Days	50
Hours on Duty Prior to Occurrence	2
Hours Off Duty Prior to Work Period	24

The Cessna pilot held a Commercial Pilot Licence and was the owner/operator of Cameron Air Service, which operated a fleet of three Cessna 206 aircraft and two Cessna 208 Caravan aircraft. He had been a licensed pilot for 25 years and had accumulated a total of 7500 hours. Most of his flying hours were on the occurrence aircraft type. The occurrence flight was his first flight of the day and he had had the previous 24 hours off duty.

1.2.2 Northwest Airlines McDonnell Douglas DC-9 N773NC

	Captain	First Officer
Age	41	41
Pilot Licence	Airline Transport	Airline Transport
Medical Expiry Date	N/A	N/A
Total Flying Hours	11 000	13 000
Hours on Type	7000	3000
Hours Last 90 Days	180	200
Hours on Type Last 90 Days	180	200
Hours on Duty Prior to Occurrence	2	2
Hours Off Duty Prior to Work Period	11	11

The Northwest Airlines captain held an Airline Transport Pilot Licence. He was seated in the left seat of the McDonnell Douglas DC-9-51 aircraft and was the designated pilot not flying.

The Northwest Airlines first officer held an Airline Transport Pilot Licence. He was seated in the right seat of the aircraft and was the designated pilot flying.

1.2.3 Air Traffic Controller

Controller Position	Airport Controller
Age	39
Licence	Airport Rating
Medical Expiry Date	01 May 2003
Experience	
- as a Controller	14 years
- in Present Unit	3 years
Hours on Duty Prior to Occurrence	4.5
Hours Off Duty Prior to Work Period	15

The airport controller started his air traffic control career in the military in 1988 and became a civilian air traffic controller in 1991. He had controlled at Toronto/LBPIA for 3 years. On the day of the occurrence, he had been on duty for 4 ½ hours and, after returning from a break, had worked in the airport control position for 45 minutes. He had been off duty for 15 hours prior to the start of his shift.

1.3 Aircraft Information

1.3.1 Cameron Air Service Cessna 206 C-GGSG

Manufacturer	Cessna
Type and Model	TU206G
Year of Manufacture	1980
Serial Number	U20605852
Certificate of Airworthiness (Flight Permit)	Issued 14 July 1986
Total Airframe Time	4044 hours
Engine Type (number of)	Teledyne Continental IO-550-F (1)
Propeller/Rotor Type (number of)	McCauley D3A34C402 (1)
Maximum Allowable Take-off Weight	1633 kg
Recommended Fuel Type(s)	100 LL
Fuel Type Used	100 LL

Inspection of the landing gear by Eagle Aircraft Inc., based at Toronto/City Centre Airport, revealed that the right main gear actuator link, P/N: 3A05518-001, was broken off at the end of the threaded shank. When the actuator runs to the end of its travel, the jam nut at the end of the threaded shank rests against the stop. The over-centre travel then makes the jam nut act as the fulcrum, causing a slight bending moment on the link. The numerous cycles caused the link to crack and finally break. The jam nut was also interfering slightly with the stop.

1.3.2 Northwest Airlines McDonnell Douglas DC-9 N773NC

1.3.2 Northwest Airlines McDonnell Douglas DC-9 N773NC	
Manufacturer	McDonnell Douglas
Type and Model	DC-9-51
Year of Manufacture	1978
Serial Number	47775
Certificate of Airworthiness (Flight Permit)	N/A
Total Airframe Time	45,551 hours
Engine Type (number of)	Pratt & Whitney JT8D-17 (2)
Propeller/Rotor Type (number of)	N/A
Maximum Allowable Take-off Weight	121 000 lb
Recommended Fuel Type(s)	Jet A
Fuel Type Used	Jet A

1.4 Meteorological Information

The Aviation Routine Weather Report (METAR) for Toronto/LBPIA issued at 1300 hours UTC reported the wind from 360° true at 9 knots, visibility 15 statute miles, a few clouds at 4000 feet, a few clouds at 25 000 feet, temperature 21°C, dew point 16°C and the altimeter setting 29.95 in. Hg. The weather at the time of the occurrence was good visual meteorological conditions (VMC) and was not considered to be a factor.

1.5 Aids to Navigation

There were no reported problems with the aids to navigation.

1.6 Communications

There were no communications equipment discrepancies noted or reported that would have contributed to the occurrence, and neither aircraft experienced communications malfunctions or difficulties. The NWA971 flight crew reported that they heard the controller communication directed to the Cessna 206 pilot; however, the Cessna 206 pilot's response was not heard.

1.7 Aerodrome Information

1.7.1 General

The Toronto/LBPIA has five main runways. The fifth runway was under construction at the time of the occurrence and was commissioned on 19 October 2002. The orientation and length of the runways are depicted in Appendix A. The distance from the threshold of Runway 05 to the intersection of Runway 33L is approximately 5030 feet. The distance from the threshold of Runway 33L to the intersection of Runway 05 is approximately 7424 feet. At the time of the occurrence, all runways were bare and dry.

The following operations can be conducted under simultaneous intersecting runway operations (SIRO), now commonly called land and hold short operations (LAHSO):

- Land 05 hold short 33R/15L
- Land 33R hold short 05/23
- Land 33L hold short 05/23

1.7.2 GTAA Guidelines For The Use Of Runways 15R/33L and 15L/33R

Runways 33L and 33R are not available for routine departure and arrival operations because of restrictions imposed by the Greater Toronto Airports Authority (GTAA) for noise mitigation purposes. The use of north/south runways continues to be a noise sensitive issue for the GTAA and, as a result, GTAA provided NAV CANADA with guidelines for the use of these runways.

As a result of the closure of the south parallel runway for construction the GTAA stipulated either a single-runway or crossing-runway operation. The air carriers prefer not to use Runway 05 for departures because the taxi distance from the ramp to Runway 05 is considered excessive and adds considerably to taxi times and wear and tear on the aircraft.

1.7.3 Air Traffic Control Tower Personnel Staffing

The Toronto/LBPIA tower staffing was established for north tower, north ground, south tower, south ground, clearance delivery and supervisor positions. The south tower and south ground positions were closed because of the runway configuration in use, that is, aircraft departures from Runway 33L and aircraft arrivals on Runway 05. The supervisor was conducting an over-the-shoulder check on the ground controller at the time of the occurrence. The north tower controller assessed the traffic volume to be light; however, the operation was complex because of the runway configuration. Near the time of the occurrence, the north tower controller's workload consisted of approximately 15-20 departure aircraft and two arrival aircraft.

1.8 *Organizational and Management Information*

1.8.1 *Sequential and Simultaneous Operations on Intersecting Runways*

1.8.1.1 *General*

Air traffic control (ATC) procedures allow for sequential and/or simultaneous operations on intersecting runways. These operations differ in the controllers' application of ATC procedures, and ATC advisories will specify the type of operation(s) in progress.

1.8.1.2 *Sequential Intersecting Runway Operations*

The *Air Traffic Control Manual of Operations* (ATC MANOPS), Section 352.4, instructs controllers to separate an arriving aircraft from another aircraft using an intersecting runway, or non-intersecting runway if flight paths intersect. This is done by ensuring that the arriving aircraft does not cross the landing threshold or flight path of the other aircraft until a preceding departing aircraft has passed the intersection or flight path or turned to avoid any conflict.

ATC MANOPS 352.5 instructs controllers to separate a departing aircraft from an aircraft using an intersecting runway, or non-intersecting runway if flight paths intersect. This is done by ensuring that the departing aircraft does not begin its take-off roll until a preceding arriving aircraft has taxied off the landing runway, completed the landing roll and will hold short of the intersection (the preceding aircraft need not be stopped as long as it has decelerated to taxi speed before the succeeding aircraft begins the take-off roll and it will not enter the runway or cross the flight path being used by the departing aircraft), passed the intersection, or crossed over the departure runway.

1.8.1.3 *Simultaneous Intersecting Runway Operations*

ATC MANOPS 352.6 states that controllers may authorize simultaneous landings or a simultaneous landing and a take-off on intersecting runways provided the procedure is approved in unit directives and other specified weather and operational conditions exist.

Aeronautical Information Publication (A.I.P. Canada) Section RAC 4.4.9(b) lists three of the conditions as follows:

- The landing distance available (LDA), measured from the threshold or displaced threshold to 200 feet short of the nearest edge of the runway being intersected, must be published in the *Canada Air Pilot* and in the *Canada Flight Supplement*. (The information would appear on the aerodrome charts of each publication.)

- ATC shall broadcast LAHSO advisories, including LDAs, through an automatic terminal information service (ATIS) or voice advisory, well in advance of the final approach descent.
- ATC must include specific directions to hold short of an intersecting runway.

The ATC MANOPS uses the term simultaneous intersecting runway operations (SIRO). The simultaneous use of Runway 05 for landings and Runway 33L for take-offs was not authorized in unit directives.

Currently, there are no provisions in the *Canadian Aviation Regulations* (CARs) for LAHSO. When CARs were developed, LAHSO procedures were not included with the exception of aerodrome marking and signage considerations. LAHSO procedures were agreed to and standardized in 1991, and were published in *Air Navigation System Policy Document* (TP 9474). Operations procedures were then included in the ATC MANOPS and the A.I.P. Canada. With privatization of the air navigation system in 1996, TP 9474 was no longer in effect and operational procedures for LAHSO continued to be governed by the ATC MANOPS and the A.I.P. Canada. The operational implementation for LAHSO was governed by the *Air Navigation Services and Airspace Policy and Procedures Manual* and the *Air Traffic Services Administration and Management Manual*.

Notice of Proposed Amendments 2001-260 to 2001-263 were developed as LAHSO regulations for consideration by the Canadian Aviation Regulation Advisory Council (CARAC); however, unanimous agreement by all in the working group could not be reached. Transport Canada (TC) has since decided to withhold the consultation process and to conduct a risk assessment of LAHSO. The risk assessment process is ongoing and will be evaluated at a future CARAC working meeting.

1.8.2 NAV CANADA Bulletin ATCI: 2000-1

NAV CANADA issued Information Bulletin ATCI: 2000-1, effective 20 July 2000, entitled “Airline Pilots Association Position on SIRO”, which states in part:

The Airline Pilots Association (ALPA) has recommended that its pilot members not accept clearances that involve the use of simultaneous intersecting runway operations (SIRO) in Canada and the USA. This information bulletin will provide operational personnel with background information on SIRO and the reasons for the difficulties they have experienced recently as a result of this recommendation.

ALPA'S Concerns:

SIRO in Canada is not governed by regulation except for the CARs, Part III standards, with respect to aerodrome markings and signage. By working within the Canadian regulatory system and by participating in the FAA LAHSO procedures development process, ALPA officials believe they have identified minimum standards of safety against which SIRO must be measured before air carrier pilots accept SIRO.

The minimum safety standards as described by ALPA officials deal with adequate landing distances, markings and signs, rejected landing procedures, pilot training and runway conditions. It is ALPA's belief that these standards have not been addressed in Transport Canada's recently proposed change to the CARs or by the actions already taken by the FAA for LAHSO.

1.8.3 *Squawk 7700*

NAV CANADA issued *Squawk 7700* NP 8493, an Air Traffic Services bulletin, effective 26 October 2000, entitled "Deviation from Established ATS Procedures". It states in part:

It is the responsibility of **all ATS personnel** to adhere to established procedures. You may deviate from a procedure **if the situation warrants** but, if you do, the outcome cannot be predicted with any certainty if all the elements in planning, executing, and monitoring are not satisfied.

There is always an associated increase in the risk of separation losses or collisions when these situations occur; therefore, **ad hoc deviations from established procedures as a normal method of operation for the sole purpose of expediting air traffic should be avoided**. If there is a continuous need to disregard or alter a procedure then it may not be as effective or efficient as it could be and a change may be warranted.

1.8.4 *Airline Pilots Association, International (ALPA) Position on SIRO/LAHSO*

One of ALPA's continuing concerns with LAHSO is the need for acceptable rejected landing procedures. For the purposes of LAHSO, a rejected landing may occur when the pilot in command elects to go-around, having determined that a full stop landing at the hold short point is not assured because of an emergency situation, an unsafe condition on the runway of

intended landing exists, or the aircraft is not properly configured to complete a full-stop landing within the LDA. In Canada, there are no published procedures for aircraft to follow in the event a go-around is necessary after the pilot has accepted a hold-short clearance.

The A.I.P. Canada Section RAC 4.4.9 (c), NOTE states:

During sequential and/or simultaneous operations, ATC procedures and pilot compliance with clearance conditions will ensure aircraft separation (i.e., spacing between aircraft). Notwithstanding this, conflicts between aircraft may occur, particularly at runway intersections, if a pilot does not comply with a clearance or is unable to comply as a result of unforeseen circumstances, such as missed approaches, misjudged landings, balked landings or brake failures. In these circumstances, ATC will endeavour to provide traffic advisories and/or instructions to assist pilots with collision avoidance.

1.8.5 TC's Air Traffic Services Standards Division Audit and Inspection Responsibilities

To ensure the continued safe operation of the Canadian air navigation system, TC has created the Office of Air Navigation Services and Airspace Safety Oversight, tasked with the custody of the air navigation and airspace safety oversight policy and program. The goal of the safety oversight function is to advance safety by:

- continuously monitoring the national civil air navigation system and environment;
- reducing the likelihood of accidents and incidents; and
- discouraging non-compliant behaviour or practices.

Air traffic services audits are conducted as required and results are forwarded to NAV CANADA for information and corrective action, as required.

In September 2001, TC conducted a regulatory inspection of the Toronto Control Tower. The purpose of this inspection was to verify compliance with established requirements in keeping with the procedures described in the ATC MANOPS. General airport control procedures were reviewed with a special focus on the provision of simultaneous intersecting runway operations / land and hold short operations.

A review of recorded communications relating to LAHSO operations revealed deviations from the ATC MANOPS. Subsequently, NAV CANADA issued Operations Bulletin No. 01-72 as a mandatory briefing for staff in order to ensure compliance with the ATC MANOPS direction

concerning the following issues: use of LAHSO if the braking action reported is less than good, correct traffic information exchange during sequential and LAHSO operations, and the alternation between sequential and simultaneous operations.

1.9 Additional Information

1.9.1 Aerodrome Charts

The *Canada Air Pilot* aerodrome chart for Toronto/LBPIA presents a text box entitled “LDA for Simultaneous Runway Operations”. The text box indicates the LDA for three different runway configurations, but the LDA from the threshold of Runway 05 to the intersection of Runway 33L is not depicted. Therefore, at the time of the occurrence, the use of LAHSO was not authorized for arrivals on Runway 05 and departures off Runway 33L.

A review of the Jeppesen charts (used by the Northwest Airlines flight crew) revealed that LAHSO is depicted for Canadian airports by use of a text table with the terminology “Additional Runway Information”. Runway useable lengths (or in Canada, LDA) applicable to LAHSO is depicted as follows:

Threshold to Intersecting Runway terminology is used for 14 Canadian airports, and **LAHSO Distance** terminology is specifically identified for 2 Canadian airports. There is no LAHSO data depicted for 2 Canadian airports which authorize LAHSO operations. The title used on the Jeppesen chart for Toronto/LBPIA is **Threshold to Intersecting Runway**.

1.9.2 Wake Turbulence Separation

Either four miles or three minutes wake turbulence separation is required between a light aircraft (Cessna 206) and a medium aircraft (B737 or DC-9). Low, slow flying aircraft are at an increased risk of loss of control and collision with the ground when flying into a wake vortex from a preceding aircraft.

2.0 *Analysis*

2.1 *General*

The Cessna pilot's decision making and airmanship, as well as the controller's use of ad-hoc procedures were significant factors contributing to this occurrence. The analysis will concentrate on the interactions between the Cessna 206 aircraft pilot, the airport controller, and the NWA971 flight crew.

2.2 *Cessna 206 Pilot's Actions*

While being sequenced for arrival at Toronto/LBPIA, and within three miles of the runway, the Cessna 206 pilot accepted a LAHSO clearance for a landing on Runway 05. Although, in theory, a pilot in this situation should have referred to the airport diagram and determined whether this was an approved procedure, it is not unreasonable to expect a pilot to assume it is approved. Firstly, the pilot had little time to review the aerodrome chart, and the aircraft was close to landing. Secondly, the controller initiated the LAHSO request, and the pilot would, in all likelihood, assume that the request to land and hold short was a legitimate clearance.

When the pilot of the Cessna 206 observed that the right main landing gear green light did not illuminate, it would have been prudent for him to communicate the information to the controller, including the possibility that a go-around would be required. The difficulties with the landing gear system certainly presented the possibility that the pilot would have to go around or that the aircraft could not land on Runway 05 and stop before the intersection of Runway 33L.

2.3 *Airport Controller's Actions*

Sequencing of arriving and departing traffic using intersecting runways requires precise timing and an appreciation of aircraft performance capability on the part of the controller. To maximize the flow rates for departures and arrivals, clearances must be issued so the spacing between aircraft is optimized. The controller had to contend with a high departure demand from Runway 33L and a low arrival rate on the crossing runway, Runway 05. Only sequential operations are available to the controller when using 33L/05 runway pairing.

There are differences in the two types of procedures, which essentially depend on when an arriving aircraft crosses the landing threshold and when a departing aircraft crosses the intersection of the two runways. In either sequential or simultaneous operations, both aircraft may be in receipt of a landing or a take-off clearance. For sequential operations, the controller must ensure that the landing aircraft does not cross the threshold of the landing runway until the departing aircraft has crossed the intersection of the two runways, or the departing aircraft does not commence the take-off roll until the landing aircraft has safely landed and has slowed

to taxi speed or has stopped prior to the intersection. Although not specifically required, the controller may pass traffic information to the restricted aircraft, that is, the aircraft required to hold short of the intersection. The controller was using this type of operation between the Cessna 206 and the American Airlines Boeing 737 (AAL449) that departed just prior to NWA971. AAL449 departed Runway 33L and crossed the intersection of Runway 05 well before the Cessna 206 crossed the threshold of Runway 05. Traffic information was passed to both AAL449 and the Cessna 206.

The Cessna 206 is a relatively slow aircraft and was 2.5 miles from the threshold when AAL449 departed. The controller then authorized the next aircraft in sequence, NWA971, to taxi to the take-off position on the runway. Continuing with sequential operations, he would have had to wait until the Cessna 206 had landed and slowed to taxi speed before issuing a take-off clearance to NWA971; the wait would have been approximately 45-50 seconds. This would have assured the required spacing between the two aircraft.

With a line of approximately 15-20 aircraft waiting for departure, the controller made a conscious decision to transition from a sequential to a simultaneous operation. The controller was, from previous controlling experiences with small aircraft, aware of the performance capability of the Cessna 206, and that the available runway from the threshold of Runway 05 to the intersection with Runway 33L was adequate for the aircraft to land. He did not accurately assess the possibility of a go-around when planning the use of simultaneous procedures. With the Cessna 206 already cleared to land, with the restriction to hold short of Runway 33L, the controller issued traffic information and a departure clearance to NWA971. NWA971 read back the clearance and continued with a rolling take-off, while the Cessna 206 was just crossing the threshold of Runway 05. The controller did not advise the pilot of the Cessna 206 that an aircraft was departing from an intersecting runway, as required by ATC MANOPS 352.6(I). The controller was now using LAHSO reserved for simultaneous operations, which were not authorized for this runway pair.

The controller was not aware that the pilot of the Cessna 206 was experiencing landing gear problems and, thinking the aircraft had landed and was on the roll out, issued taxi instructions to the Cessna pilot and repeated the instruction to hold short of Runway 33L. With approximately 3350 feet of runway remaining prior to the intersection of Runway 33L, the Cessna pilot commenced a go-around, and so informed the controller. The two aircraft were now both heading for the intersection of the two runways. The controller immediately told the Cessna pilot to turn left. However, he did not advise the pilot of the conflicting traffic, nor did he instruct the Cessna pilot to remain clear of Runway 33L.

The risk of the Cessna 206 aircraft encountering the wake vortex of either the previously departed Boeing 737 or the McDonnell Douglas DC-9 aircraft was not considered by the controller.

The controller, as a result of the long line of aircraft awaiting departure, used an unauthorized procedure in an effort to maintain a high traffic flow rate. This increased the risk of collision in the event of a go-around by the arriving aircraft because of the proximity of the runway intersection to the runway threshold. The controller's decision was reinforced by his previous operational experience controlling small aircraft such as the Cessna 206, which led him to believe that the Cessna pilot would have no trouble complying with the hold short clearance.

2.4 NWA971 Flight Crew Actions

As the crew of NWA971 waited in line for take-off sequencing, they heard the communication between the controller and AAL449 referencing the Cessna 206 which was cleared to land on Runway 05 and hold short of Runway 33L. After AAL449 departed, the controller then passed traffic information on to the NWA971 flight crew, advising them that the Cessna 206 was about to touch down and that it would hold short of Runway 33L. The controller then cleared NWA971 to take off from Runway 33L, and the flight crew accepted a LAHSO clearance. Again, as for the Cessna pilot, the crew would, in all likelihood, accept the clearance as legitimate. The crew did not recall hearing the report by the pilot of the Cessna 206 that he was commencing a go-around; both aircraft were on the same frequency. Upon recognition of the impending conflict, the flight crew took appropriate evasive action and then proceeded to their destination.

The pilots of participating aircraft may not be aware of the type of operation, sequential or simultaneous, the controller is conducting. The aerodrome chart used by the Northwest Airlines crew depicted LDA for runway pairs specifically authorized for LAHSO; however, there was no specific identification of LAHSO terminology in the chart depiction. Reference to LAHSO terminology may have increased the flight crew's awareness of authorized operations. Further, the LAHSO procedure employed by the controller was not included on the ATIS or other ATC advisories. This omission was not sufficient to alert the pilots that LAHSO was not an authorized procedure for this runway pairing and that the procedure should not have been accepted.

3.0 *Conclusions*

3.1 *Findings as to Causes and Contributing Factors*

1. Because of the backlog of departing traffic and in an effort to expedite departures, the controller chose to use land and hold short operations (LAHSO) instead of sequential runway operations, which ultimately resulted in a near collision.
2. The controller used LAHSO procedures between a departing and arriving aircraft on a runway pair for which this procedure was not authorized.
3. The Cessna pilot had a landing gear problem; however, he did not advise the controller of the problem or of the risk that he may not be able to land on Runway 05 and stop before the intersection of Runway 33L.
4. The controller did not advise the Cessna pilot that a DC-9 aircraft was departing from Runway 33L at the same time the Cessna 206 was landing on Runway 05.
5. The controller did not advise the Cessna pilot of conflicting traffic when he issued evasive instructions, and he did not instruct the Cessna pilot to remain clear of Runway 33L.
6. The controller did not accurately assess the possibility of a go-around when planning the use of simultaneous procedures.

3.2 *Findings as to Risk*

1. The aerodrome chart used by the Northwest Airlines flight crew did not specifically identify LAHSO terminology in the depiction of LAHSO data for Toronto/ Lester B. Pearson International Airport, and, as a result, the flight crew may not have been aware of which LAHSO operations were authorized.
2. There are no published air traffic control (ATC) procedures for aircraft to follow in the event a go-around is necessary by a landing aircraft after the pilot has accepted a hold short clearance and is unable to comply with the restriction.
3. The risk of an encounter by the Cessna 206 aircraft with the wake vortex of either the previously departed Boeing 737 aircraft or the DC-9 aircraft was not considered by the controller or the Cessna pilot.

3.3 *Other Findings*

1. The LAHSO procedure used by the controller was not included on the automatic terminal information service (ATIS). This omission was not sufficient to alert the pilots of either aircraft that LAHSO was not an authorized procedure for this runway pair.
2. Because of restrictions imposed for noise mitigation purposes, runways 33R and 33L are not available for routine departure and arrival operations, which exacerbates the complexity of air traffic control operations.

4.0 Safety Action

4.1 Action Taken

4.1.1 Eagle Aircraft Inc.

Eagle Aircraft Inc., based at Toronto/City Centre airport, conducted a maintenance inspection on the Cessna 206, C-GGSG, upon its arrival at Toronto Island. The aircraft maintenance engineer submitted to Transport Canada a service difficulty report (SDR), control number CF20020906001, which related information about the failure of the right main gear actuator link.

4.1.2 Transport Canada

As a result of this occurrence, Transport Canada, in September 2002, conducted an on-site regulatory audit of the Toronto/LBPIA air traffic control tower. The objective of this audit was to examine the unit's compliance with the *Canadian Aviation Regulations* (CARs) and associated standards, including a review of the corrective action plans following the previous audit and inspection.

The audit findings revealed a non-conformance to the CARs and the associated Canadian Domestic Air Traffic Control Separation Standards in that a tower controller authorized an aircraft to depart a runway while an arriving aircraft was landing on an intersecting runway resulting in a loss of separation where both aircraft converged in close proximity to each other. A detection Notice was filed with Transport Canada Ontario Region Enforcement Branch for further action. The audit findings also identified two observations dealing with administrative elements not pertaining to this occurrence.

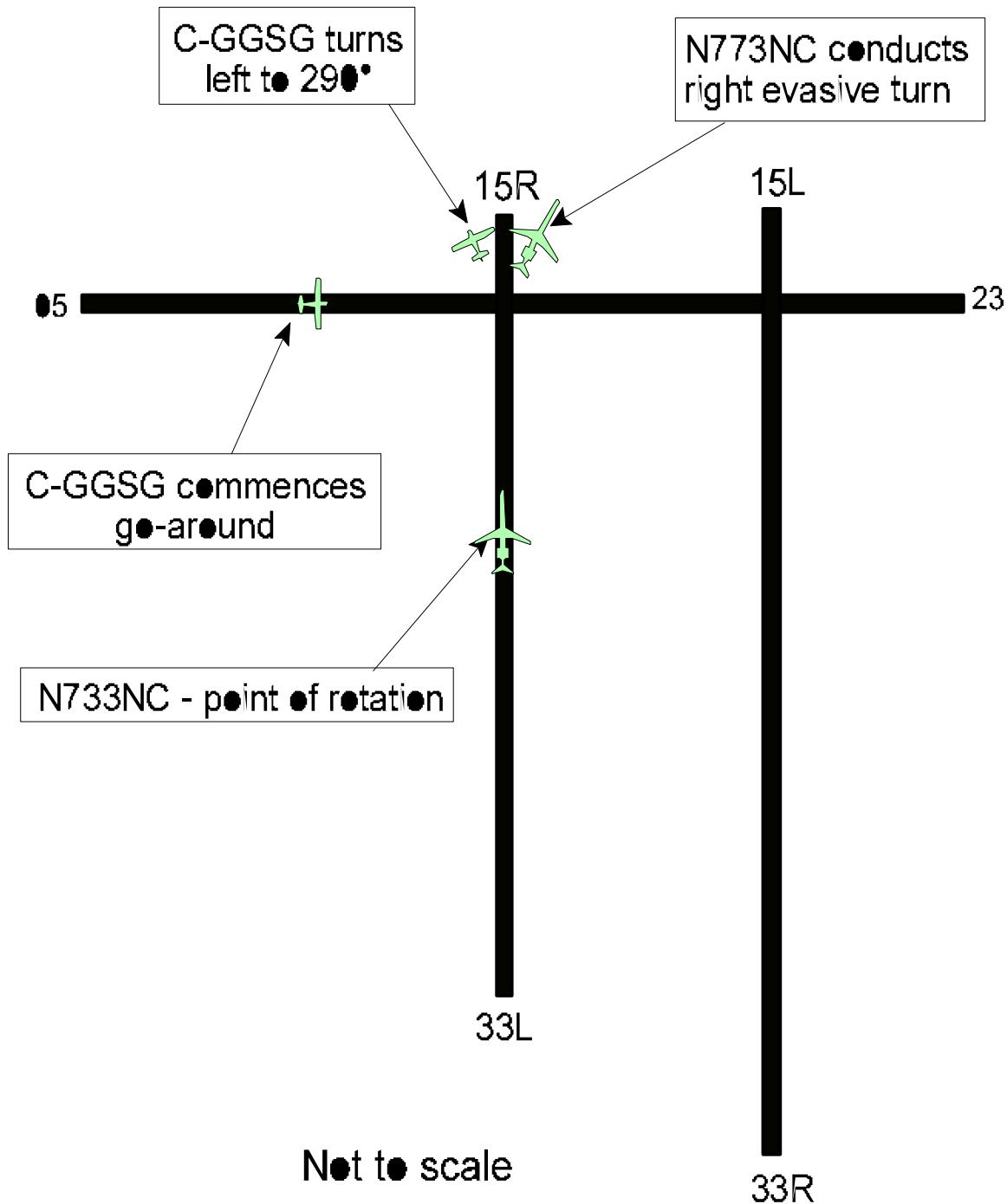
4.1.3 Transportation Safety Board of Canada

On 19 November 2002, the Transportation Safety Board of Canada issued an Occurrence Bulletin to Transport Canada noting that land and hold short operations (LAHSO) awareness is not maximized in the presentation of LAHSO data on all *Canada Air Pilot* charts and some Jeppesen charts, in that there is no specific identification of LAHSO terminology on any of the applicable charts.

4.1.4 *Jeppesen Sanderson*

The applicable Jeppesen charts, *Canada Air Pilot* charts, and A.I.P. Canada Section RAC 4.4.9 “Operations on Intersecting Runways” were reviewed by the Jeppesen Chart & Display Standards group. It was decided that the column title for available landing distances for simultaneous runway operations depicted on the Jeppesen Airport Additional Runway Information band be titled “LAHSO Distance” instead of “Threshold to Intersecting Runway”. Revision of affected charts began on 03 October 2003.

This report concludes the Transportation Safety Board’s investigation into this occurrence. Consequently, the Board authorized the release of this report on 26 November 2003.

Appendix A - Toronto/LBPIA Site Map and Conflict Depiction

Appendix B - List of Supporting Reports

The following TSB Engineering Branch Report was completed:

LP 094/02 - Examination of Right Gear Actuator Link.

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

Appendix C - Glossary

A.I.P. Canada	<i>Aeronautical Information Publication</i>
ALPA	Airline Pilots Association, International
ATC	air traffic control
ATC MANOPS	<i>Air Traffic Control Manual of Operations</i>
ATIS	automatic terminal information service
ATS	Air Traffic Services
CARs	<i>Canadian Aviation Regulations</i>
CARAC	Canadian Aviation Regulation Advisory Council
EDT	eastern daylight time
FAA	Federal Aviation Administration
GTAA	Greater Toronto Airports Authority
IFR	instrument flight rules
in. Hg	inches of mercury
LAHSO	land and hold short operations
LBPIA	Toronto/Lester B. Pearson International Airport
LDA	landing distance available
LL	low lead
P/N	part number
SIRO	simultaneous intersecting runway operations
TC	Transport Canada
TSB	Transportation Safety Board of Canada
U.S.A.	United States of America
VFR	visual flight rules
VMC	visual meteorological conditions
°	degrees
°C	degrees Celsius