Appendix D
RUNWAY SAFETY AREA DETERMINATION RUNWAY 17-35

August 2001
Revised March 2002
Master Plan Update
Hector International Airport

SUFFICIENCY ANALYSIS

Near the completion of the *Master Plan Update* in late 2000, the FAA requested that a *Runway Safety Area Determination* be undertaken on Runway 17-35 since the south end of the runway does not fully meet the current design standard for runway safety areas, and declared distances have not been approved for operations on the runway. Completion of the *Master Plan Update* was suspended pending resolution of the runway safety area issue.

When the last *Master Plan* was originally prepared in 1991, it was recommended that the full safety areas be achieved by acquisition of property south of 19th Avenue North and the relocation of 19th Avenue North in the 1996-2000 timeframe. This did not occur, and during the preparation of the *Master Plan Update*, it become evident that local governmental jurisdictions were not receptive to a relocation of 19th Avenue North.

The purpose of this analysis is to examine the feasibility of meeting the runway safety area standard by examining all feasible alternatives available to the Airport Authority.

Runway Safety Area Design Standards

As a certificated commercial service airport, Hector International Airport must comply with regulations outlined in *Federal Aviation Regulation (FAR) Part 139*. Section 139.309 under *Subpart D - Operations* specifically addresses safety areas. In addition, *FAA Order 5190.6A, Airport Compliance Requirements* outlines the contractual obligation of airports accepting and receiving Federal grant funds. The basic objective of these regulations and compliance requirements is to ensure safe and properly maintained airports that are operated in a manner which protects the public's interest and investment.

Order 5190.6A, Paragraph 4-17j, Conformance to FAA Criteria and Standards states: "Any facilities developed with grant funds must be constructed to the then current applicable FAA design standards..." *FAA Order 5200.8, Runway Safety Area Program*, became effective on October 1, 1999 with the objective to ensure that all runway safety areas at federally obligated airports conform to standards contained in *FAA Advisory Circular (AC) 150/ 5300-13, Airport Design*. This AC defines the runway safety area (RSA) as "A defined surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot or excursion from the runway." A related standard is the runway object free area (ROFA) which is defined as "A two dimensional ground area surrounding runways, taxiways, and taxilanes which is clear of objects except for objects whose location is fixed by function."

The RSA standard for Runway 17-35 is 500 feet wide and extends 1,000 feet beyond the runway end. The ROFA standard is 800 feet wide and extends 1,000 feet beyond the runway end. FAR Part 139.309(b) indicates that the airport shall maintain its safety area cleared and graded with no potentially hazardous ruts, humps, depressions, or other surface variations. The safety area must be drained so that water does not accumulate. It must also be capable, under dry conditions, of supporting emergency equipment and the occasional passage of aircraft without causing major damage to the aircraft. No object may be located in the safety area except those that need to be because of their function in airport operations. In those cases, they must be constructed on frangibly-mounted structures where practical. (Note: The localizer antenna, which is within the safety area at the south end of the runway, is not waived from this requirement).

Existing Conditions

Runway 17-35 serves as the primary runway on the airfield. It is concrete, 9,546 feet in length, and 150 feet in width. It is strength rated to handle any aircraft in the commercial or military fleet. The runway is equipped with precision instrument approaches from each end, high intensity edge lighting, BAK 14 arresting devices (for military aircraft), 4-box visual approach slope indicators, and medium intensity approach lights (MALSR) for each runway approach. The landing threshold on

Runway 35 is displaced 399 feet, requiring the final two stations of approach lights in the MALSR system to be imbedded in the pavement. The existing MALSR approach lights for Runway 35 were installed in 1981 and cabling may need to be replaced in the near future (pursuant to conversation with FAA Airway Facilities personnel on August 2, 2001).

Taxiway A parallels Runway 17-35 along the west side. It is 100 feet wide and serves the terminal and air cargo ramps on the west side of the airfield. Taxiway D (formerly Runway 3-21) provides access to the south end of Runway 35 from the east side. It is 75 feet wide and connects with the south end of Runway 17-35 at approximately a 45-degree angle.

The latest *Airport Facility Directory* includes no application of declared distances on the runway system, even though the landing threshold on Runway 35 is displaced. The full length of Runway 17 is available for landing/takeoff operations.

Alternatives Identification

As indicated earlier, one of the most critical design standards is the runway safety area. There are four basic means of achieving safety area compliance. The first, and most straightforward, is to fully meet the design standards by providing for the clearing and grading of the runway safety area and object free area off the runway ends. This is certainly the most desirable as long as physical, environmental, and economic considerations can be reasonably accommodated.

The second alternative is to shift the threshold(s) of the runway to effectively relocate the RSA and the ROFA within the available graded and cleared area. This is accomplished by either relocating or displacing the runway threshold(s). The result (if only the south threshold is relocated) is a reduction in the length of runway available for takeoffs and landings. This option must be weighed against not only the costs of physically implementing the relocation or displacement, but also its effects on the operational capabilities of the airfield, and the constraints it places on the current users of the airport. If equivalent runway is replaced on the north end, then the potential impacts of the shift at the south end are mute.

A third alternative is the implementation of an engineered materials arresting system (EMAS). These systems have recently been placed on runways at Little Rock National Airport and Minneapolis-St. Paul International Airport. EMAS is not to be considered a substitute for (or equivalent) to any length of RSA and does not affect declared distance calculations. The FAA will consider EMAS only if the determination is made that providing an acceptable safety area is not feasible.

The fourth alternative would be to modify the design standards. This is the least desirable option to the FAA and would be approved only if the other options are proven

to be infeasible and it is proven that modifying the standard will not unnecessarily endanger lives or property.

Alternative A - Provide Full RSA and ROFA Beyond Existing Runway End

The *Master Plan* completed in 1991 (and previous airport layout plan drawings) depict this alternative, which involved the acquisition of property south of 19th Avenue North and the relocation of the road to provide full RSA and ROFA. This project was originally estimated (in 1991 dollars) to cost $774,000. However, costs were not included for relocation of navigational aids (including the localizer and glide slope antenna) and approach lighting. The cost for this project has been updated, with the additional items included. The current estimate is $3,000,000, although cost for land acquisition was not included in this estimate. The land south of 19th Avenue North is owned by North Dakota State University, and it is unknown if the property can be acquired or obtained through land exchange. (Note: During the latter stages of the *Master Plan Update*, members of the Planning Advisory Committee indicated that this alternative would not be acceptable to local jurisdictions.)

Alternative B - Displace or Relocate Runway Threshold

This alternative involves displacement or relocation of the threshold on Runway 35 to create adequate safety areas. The existing localizer antenna at the south end is only 265 feet from the end of the runway (665 feet from the displaced threshold). The antenna must be a minimum of 1,000 feet from the runway end to meet design standards. In addition, there should be adequate separation between the localizer and the 1,000-foot MALSR bar to prevent interference (assumed to be a minimum of 50 feet). Alternatives can be examined with or without relocation of the localizer antenna.

At this time, the airport does not have a perimeter road around the south end of the runway. Previous planning has recommended that a road be established at the south end to allow traffic to move between the east and west sides without interfering with aircraft (or potential for runway incursions). Therefore, any relocation or displacement of the runway threshold should take this into consideration, and provide for the future establishment of the perimeter road.

With consideration to leaving the localizer in its existing location, the existing 399-foot displacement of the landing threshold would need to be increased a minimum of 735 feet to clear the localizer (and as much as 800 feet to create a buffer between the localizer and 1,000-foot MALSR bar). This will require relocation of the MALSR, glide slope antenna, and VASI. The physical end of Runway 17 will need to coincide with the displaced threshold to create adequate safety area at the south end of the runway. Existing pavement may remain, with the remaining runway south of the threshold

designated as taxiway (with FAA approval). This creates adequate area behind the localizer to place a future perimeter road.

Runway/taxiway edge lighting will need to be adjusted, and the MALSR lights will need to be imbedded in pavement from the threshold to the end of the taxiway. It is possible to retain the full length of the runway for takeoff to the north; however, landings in both directions and takeoffs to the south will be reduced to 8,746-8,811 feet, depending upon the buffer between the localizer and the 1,000-foot light bar. (Note: Displacement of landing thresholds to achieve safety areas involves the use of declared distances to define the effective runway length available for takeoff and landing. Publication of declared distances for an airport requires the prior approval of the FAA. Furthermore, the FAA Great Lakes Region policy on use of declared distances is outlined in *PPM 5300.2*, Paragraph 2.a.(1): "The use of declared distances for airport design shall be limited to cases of existing constrained airports, where it is impracticable to extend the runway safety area (RSA), the runway object free area (ROFA) or the runway protection zone (RPZ) in accordance with the design standards contained in Chapter 2 and 3 of *Advisory Circular 150/5300-13*. This does not preclude utilizing the declared distance concept for runway extensions at or modifications of an existing constrained airport.").

Relocation of the threshold will provide similar runway length for landings and takeoffs in each direction (8,746-8,811 feet), if the localizer is not relocated. However, the ability to use greater length for takeoffs on Runway 35 is lost, since all pavement south of the threshold will need to be removed (a portion will need to remain for blast protection) In addition, new entrance taxiways will need to be constructed at the threshold, and lighting will once again need to be adjusted. The MALSR lights may consist of a traditional above-ground system at the runway end, eliminating the need for imbedded lights (which create additional problems in northern climates).

Another alternative which may be considered involves the relocation of the localizer. If the localizer is relocated, it is possible to reduce the amount of runway pavement lost to operations. The localizer can be relocated farther to the south, while protecting area for a perimeter road. Assuming a 50-foot buffer between the localizer and the 1,000-foot MALSR bar, a 100-foot buffer can be reserved north of the perimeter fence for a road. This alternative, which will involve relocation of all approach lighting and navigational aids at the runway end, will maintain 9,000 feet of usable runway in both directions. Once again, if a displaced threshold were to be used, and pavement retained for departures on Runway 35, declared distances would need to be employed, and prior approval would be required from the FAA. Relocation of the threshold eliminates the need to use declared distances, but requires the need to construct new entrance taxiways. Costs have been estimated at $3.9 million.

If Runway 17-35 is shortened to 9,000 feet, consideration needs to be given to its potential impact on existing or future users. The master plan evaluated runway length requirements for the existing (and potential future) fleet aircraft. Only the 747 aircraft

needs more than 9,000 feet, and the 747-400F requires 9,500 feet on a 90-degree day, flying a 6,000 nautical mile stage length. Consideration should be given to providing replacement runway on the north end, to maintain the runway's capability in serving such aircraft in the future (400 feet can be provided without relocation of the localizer).

Alternative C - Install EMAS

Engineered Materials Arresting Systems (EMAS) is an option that can be considered if traditional methods to provide the standard safety area are not feasible or practical. As indicated earlier, it is not meant to be considered a substitute for (or equivalent) to any length of runway safety area, and does not affect declared distance calculations.

EMAS is designed to stop an aircraft overrun by exerting predictable deceleration forces on the landing gear as the EMAS material crushes. It must be designed to minimize the potential for structural damage to aircraft, since such damage could result in injuries to passengers and/or affect the predictability of deceleration forces.

EMAS is located beyond the end of the runway, centered on the extended centerline. It typically is designed to begin at some distance beyond the runway end to avoid damage by jet blast or short landings. The minimum width of EMAS shall be the width of the runway, plus any sloped area as necessary. The system should be designed to decelerate jet aircraft expected to use the runway at exit speeds of 70 knots or less without imposing loads that exceed the aircraft's structural design limits.

A cost estimate for installation of an EMAS system at the south end of the runway was obtained from the manufacturer. The cost of the arrestor bed was estimated at $3.4 million, and with additional site preparation the total cost was $3.7 million. The navaid and lighting relocations added nearly $1 million to this alternative, bringing the total cost to $4.6 million. The alternative preserves the option of developing a perimeter road around the south end of the runway.

Conclusions

Following development of alternatives and cost estimates, a meeting was held in Bismarck on March 4, 2002 for the purpose of reaching a conclusion on the final alternative to be placed on the airport layout drawing. Attending this meeting were representatives of the Municipal Airport Authority (and their consultants), the Federal Aviation Administration, and the North Dakota Aeronautics Commission. Taking into consideration the needs of current users, and the fact that a full RSA (without modifications to design standards or use of declared distances) is preferable, the parties were in agreement that the threshold at the south end (and connecting taxiways) should be relocated, providing 9,000 feet of useable runway in both directions. However, a 400-foot extension of the runway/taxiway should be depicted on the north

end of the runway, for possible needs beyond a ten-year forecast. As described in the preceding paragraphs, this will also require relocation of navaids and lighting; therefore, the FAA will begin coordination with the Airway Facilities Division to expedite programming. The consultants were directed to proceed with finalization of the *Master Plan Update* and the airport layout plan drawings, depicting this alternative.