Crystal Airport
2035 Long-Term Comprehensive Plan (LTCP)
Volume 1 – Narrative Report

Metropolitan Council Determination – September 2017
Final MAC Adoption – October 2017

Prepared jointly by the Airport Development, Environment, and Reliever Departments

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ES EXECUTIVE SUMMARY

ES.1 INTRODUCTION

Crystal Airport is one of seven airports owned and operated by the Metropolitan Airports Commission (MAC). The airport is located in Hennepin County, approximately seven miles northwest of downtown Minneapolis. It lies within the City of Crystal, with small portions of airport property overlapping into the City of Brooklyn Park and the City of Brooklyn Center.

The Airport plays an important role in the MAC system of airports by attracting general aviation traffic away from Minneapolis-St. Paul International Airport (MSP) to relieve congestion, which helps reduce operating costs and promotes sustainability. Crystal is the closest MAC airport to downtown Minneapolis.

During 2015, Crystal Airport had approximately 185 based aircraft and accommodated approximately 40,000 aircraft operations (takeoffs and landings). It encompasses 436 acres of land and has four runways – three paved and one turf. The primary runways, 14L-32R and 14R-32L, are 3,267 feet and 3,266 feet long, respectively, and both are 75 feet wide. The paved crosswind runway, 06L-24R, is 2,499 feet long and 75 feet wide. The turf runway, 06R-24L, is 2,123 feet long and 137 feet wide[1]. The existing airport layout is depicted in **Figure ES-1**.

The most recent Long-Term Comprehensive Plan (LTCP) for Crystal Airport prepared by the MAC and approved by the Metropolitan Council is dated December 2008, with a planning horizon year of 2025 (“2025 LTCP”). The 2025 LTCP recommended a plan to “right-size” the airfield to better align airport infrastructure and complexity with activity levels. To do this, the preferred alternative in the plan is to decommission both the turf runway (06R-24L) and south parallel runway (14R-32L), leaving a two-runway system in place. This plan not only simplifies the airfield, but opens up some property for both aeronautical and non-aeronautical development opportunities.

The purpose of the Crystal Airport 2035 Long-Term Comprehensive Plan is to validate and refresh the findings of the previous 2025 LTCP, and to extend the planning horizon for an additional ten years through 2035. The plan will provide a “road map” to guide MAC’s development strategy and capital improvements planning for Crystal Airport over the next 5-10 years by renewing aviation activity forecasts, confirming facility needs and refining alternatives identified from the previous LTCP to meet those needs.

The LTCP is an infrastructure planning tool updated on a regular basis. It is forward-looking in nature, and does not authorize actual construction. The 2035 Crystal Airport LTCP aims to:

- Right-size the airfield to match existing and forecasted activity levels;
- Preserve and, if possible, improve operational capabilities for the current family of aircraft using the facility; and
- Enhance safety by simplifying the runway and taxiway layout.

[1] Turf Runway 06R-24L is open seasonally from May through October.

A key objective for airfield improvements at Crystal Airport is to simplify the airfield geometry by reducing the number of designated "hot spots" on the airfield, which represent the areas with the greatest potential for pilot confusion and incursion errors. This is consistent with a nationwide initiative by the Federal Aviation Administration (FAA) to reduce the number of runway incursions and increase airfield safety.

A Draft 2035 LTCP for Crystal Airport was issued for public review and comment on Monday, September 12, 2016. Two public information meetings were held in September 2016 to provide information about the draft plan to interested stakeholders. The public comment period closed on Wednesday, October 26, 2016.

In response to public and stakeholder feedback, a Refined Preferred Development Alternative was developed. An Addendum to the Draft 2035 LTCP was prepared to describe the features of and rationale behind the development of the Refined Preferred Alternative and issued for public review and comment on Wednesday, March 15, 2017. A supplemental public information meeting was held in late March 2017 to provide additional information about the refined development concept to interested citizens. The second public comment period closed on Friday, April 14, 2017.

ES.2 AIRPORT ROLE

Operating within a diverse system of metropolitan area airports, Crystal Airport's primary role is to serve personal, recreational, and some business aviation users in the northwest metropolitan area, including the cities of Crystal, Brooklyn Park, Brooklyn Center, and Minneapolis. Example business services include flight training, aircraft rentals, charter flights, aircraft and propeller maintenance, sale of aircraft avionics and parts, and medical flight transportation.

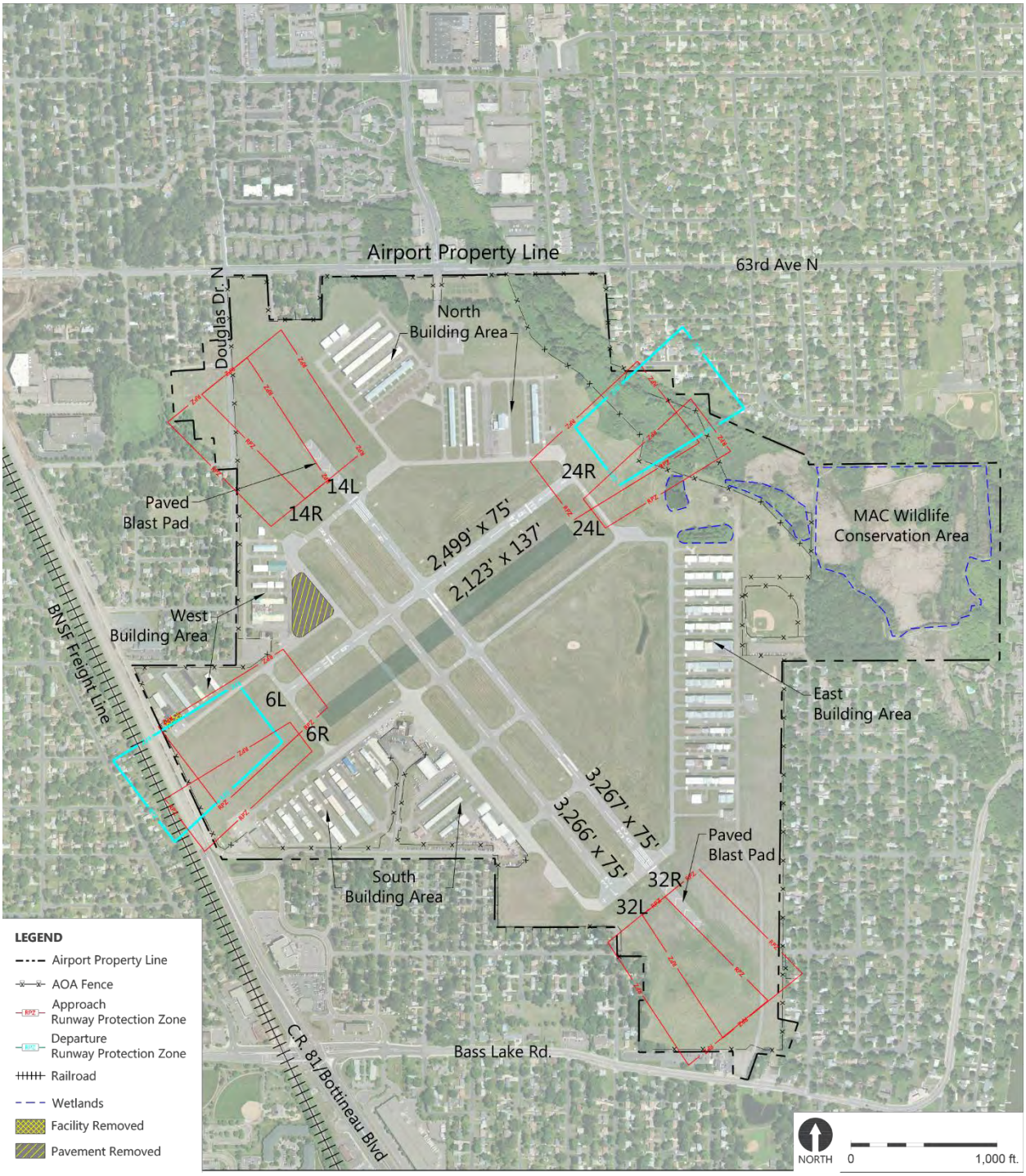
The primary role of Crystal Airport is not expected to change during the planning period. The Airport's classification will continue to be that of:

- A Complimentary Reliever in the Metropolitan Airports Commission (MAC) system;
- An Intermediate Airport per Minnesota Department of Transportation/Office of Aeronautics (MnDOT); and
- A Minor Airport per the Metropolitan Council Regional Aviation System Plan.

The aircraft mainly anticipated to use Crystal Airport – and that which it is designed for – will continue to be a family of small, propeller-driven airplanes with fewer than 10 passenger seats.

The proposed plan does not contemplate upgrading the role of Crystal Airport to accommodate a larger aircraft family or scheduled passenger or cargo flights. Nor does the plan contemplate downgrading the role of Crystal Airport.

Figure ES-1: Existing Airport Layout



ES.3 FORECASTS

Aviation activity forecasts were prepared for both based aircraft and total aircraft operations.

The forecast calculations take into account assumptions relating to the economy, fuel costs, aircraft ownership trends, general aviation fleet trends, and general aviation taxes and fees. The forecast assumes reasonable growth in all of these categories.

Along with a Base Case forecast, a range of scenarios to identify the potential upper and lower bounds of future activity levels at Crystal Airport was developed. These scenarios used the same forecast approach that was used in the Base Case, but alter the assumptions related to socioeconomic conditions to reflect either a more aggressive or more conservative outlook.

Subsequent to the preparation of the high and low forecast scenarios, an additional scenario was developed to evaluate the potential impact associated with increasing the published runway length from the existing 3,267 feet to 3,750 feet. In this extended runway scenario, the number of additional aircraft operations above the base case is approximately 314 annually, translating to approximately six additional takeoffs and landings per week. All other forecast assumptions are the same as in the base case.

Table ES-1 compares the total number of aircraft and operations under different scenarios for Crystal Airport, along with the Terminal Area Forecast (TAF) prepared by the Federal Aviation Administration (FAA).

Recent activity levels at Crystal Airport indicate that levels of based aircraft and aircraft operations have largely stabilized since 2010 after steady decreases in the 1990 to 2010 timeframe. Based on the economic outlook for both Hennepin County and the Seven-County Metropolitan Area, along with projected trends for General Aviation flying, the forecasts predict a period of stable activity levels for Crystal Airport. If current activity levels are maintained, Crystal Airport will continue to be one of the busiest airports in the state and an important component of the regional airport system.

The forecast scenarios indicate that future economic growth, fuel prices, technology, and national aviation policy may have a major impact on the development of general aviation. Absent major changes in the economy or aviation industry, small fluctuations – particularly within the developed range of scenarios – should not be construed as indicating the forecast is off course. Minor fluctuations in activity levels above or below the long-term forecast will not affect the overall recommendations of the LTCP, however, these fluctuations may require minor adjustments to the phasing of proposed improvements.

Table ES-1: Crystal Airport 2035 LTCP Forecast Summary

Year	Total Based Aircraft			Total Number of Operations				
	Base Case	High Range	Low Range	Base Case	High Range	Low Range	Extended Runway	2015 TAF
2015 (a)	185	185	185	41,838	41,838	41,838	41,838	38,917
2020	180	184	177	39,495	40,389	38,818	39,707	39,158
2025	177	184	169	39,025	40,589	37,232	39,258	39,739
2030	171	183	162	38,578	41,322	36,455	38,845	40,330
2035	171	187	158	39,904	43,507	36,732	40,218	40,931
	Average Annual Growth Rate							
	-0.4%	0.1%	-0.8%	-0.2%	0.2%	-0.6%	-0.2%	0.3%

Notes:

a) 2015 operations represent twelve months ending June 2015 and includes an estimate of nighttime activity. CY2015 tower count was 39,659 with no nighttime adjustment.

Source: HNTB Activity Forecasts and MAC analysis

ES.4 FACILITY REQUIREMENTS

Airside Facilities

Based on the aviation activity forecasts, the future critical design aircraft for Crystal Airport will continue to be represented by the family of propeller-driven aircraft with fewer than 10 passenger seats. This family of aircraft includes a diverse range of equipment types, ranging from small single-engine piston aircraft used primarily for recreational and personal flying up to larger single and twin-engine turboprop aircraft that are used more predominantly for business. Typical aircraft in the latter category include the single-engine turboprop Pilatus PC-12 and the twin-engine turboprop Beechcraft King Air 200.

Since the airport predominantly serves small airplanes (an airplane of 12,500 pounds or less maximum certificated takeoff weight), the runway designations at Crystal Airport should be those associated with small aircraft. Although aircraft with a maximum gross takeoff weight of greater than 12,500 pounds can and do occasionally use Crystal Airport (such as the Beechcraft King Air 350 turboprop), the total is well below the regular use threshold (500 operations per year) due to runway length limitations. The existing runway designations are for aircraft with a maximum gross takeoff weight of greater than 12,500 pounds.

The design objective for the primary runway is to provide a runway length that will not result in operational weight restrictions for the design family of aircraft.

Based on runway length guidance provided by the Federal Aviation Administration (FAA), the appropriate runway length at the Crystal Airport should be between 3,300 feet (to accommodate most of the aircraft types in this family, or 95% of the fleet) and 3,900 feet (to accommodate all types in the family, or 100% of the fleet).

While the guidance from the FAA serves as a good baseline, more detailed information related to runway length requirements can be derived from manufacturer performance charts published for specific aircraft types. Based on an assessment of runway length requirements for several representative aircraft types in the design aircraft family for Crystal Airport, the desired runway length was determined to be approximately 3,600 feet. This length fits into the range predicted by the FAA and will accommodate the majority of small turboprop and multi-engine piston aircraft departing at an operationally-feasible weight.

Ideally, the entire runway length would be available to accommodate all takeoff and landing distance categories (takeoff run available, takeoff distance available, accelerate-stop distance, and landing distance available). However, for the designated critical aircraft family, accelerate-stop distance (ASDA) typically emerges as the most critical (longest) length requirement to consider. Thus, the preferred concept should seek to maximize the accelerate-stop distance available.

The crosswind runways at Crystal Airport accommodate the lower crosswind capable light single-engine aircraft used primarily for personal, recreational, and flight training activities. Wind analysis indicates that the primary Runway 14-32 alignment provides the desired level of wind coverage during most, but not all, weather conditions. The crosswind Runway 06-24 alignment offers supplemental wind coverage so that the total runway system provides nearly 100 percent wind coverage in all conditions. The wind data also suggests that the strongest winds experienced at Crystal Airport frequently come from a southwesterly direction. Runway 24 is particularly well aligned to accommodate aircraft operations during these high-wind conditions; furthermore, it is the only runway with a southwest/northeast orientation in the west metropolitan area to provide this wind coverage.

At 2,500 feet, the paved crosswind runway 06L-24R is short by modern standards. However, due to constraints and obstacles at both ends of the runway, providing additional length is not feasible.

Based on manual counts taken by ATCT controllers in 2015 and 2016, the number of annual aircraft operations on turf Runway 06R-24L during the six months it is operational (May – October) is estimated to be approximately 300. This equates to an average of approximately 1.6 operations per day. During the peak operational months (May and June), operations reached an average of approximately 2.5 per day.

Proponents of the turf runway suggest that it provides several unique benefits to the metropolitan airports system, including operational advantages for tailwheel aircraft – of which approximately 26 are based at Crystal Airport – particularly during landing operations with gusty winds. It also facilitates “soft field” flight training opportunities. Now that the turf runway at the Forest Lake Airport (25D) has been paved, the closest turf runways to Crystal Airport are located approximately 30 miles away at the privately-

owned Belle ARS Sport Strip Airfield (7Y7) near Belle Plaine and the Winsted Municipal Airport (10D).

Development of a new, non-precision GPS-type instrument approach procedure for the existing Runway 32R end would enhance the operational capabilities of the airport. Planning for the establishment of this non-precision approach is recommended for consideration, if feasible.

Runway Designation/Runway Protection Zones

A total of 36 off-airport residential parcels are wholly or partially contained in the existing Runway Protection Zones (RPZs) at Crystal Airport. In addition, public roadways traverse the RPZs for Runways 06L-06R (County Road 81/Bottineau Boulevard) and Runways 14L/14R (Douglas Drive). A freight rail line also runs through the Runways 06L and 06R RPZs.

The FAA has designated lesser RPZ dimensions for runways designed to be used regularly by small aircraft with maximum certificated takeoff weights of 12,500 pounds or less (Utility Runway category). The existing and future critical aircraft expected to use Crystal Airport on a regular basis are those that have a maximum certificated gross takeoff weight of less than 12,500 pounds. Therefore, it is appropriate to use small aircraft design standards and designate the runways at Crystal Airport as Utility category. This designation allows the use of smaller-dimension RPZs than shown in the previous plan.

Also, reverting to the smaller RPZs results in larger parcels of land becoming available for aeronautical or non-aeronautical development, particularly on the existing Runway 06L end adjacent to County Road 81/Bottineau Boulevard.

Landside Facilities

According to the Base Case forecast results, the number of based aircraft is anticipated to decline slightly through 2030 and then stabilize. By 2035, the number of based aircraft is forecasted to be 171 aircraft.

At first glance, it appears that only a portion of the available hangar capacity at Crystal Airport will be filled by 2035. However, some of the available hangar stall inventory is currently leased by airport tenants to support aviation business activities other than aircraft storage. Secondly, reasonable enforcement of MAC's Maintenance Standards Ordinance in the future may result in some of the existing hangar inventory being removed. Lastly, there could be demand for construction of certain hangar types and/or sizes that are not currently available. Therefore, areas to accommodate the construction of new hangars should be considered in the plan. It is important to note that including additional hangar space in this LTCP is not a commitment to build or fund such a development. Rather, it is simply ensuring that should the indicated immediate demand lead to an actual hangar construction project, an appropriate place for them is shown in this plan and subsequent Airport Layout Plan (ALP).

Several former FBO facilities still exist at Crystal Airport, although they are currently leased to tenants who are using them for other purposes. Should demand ever warrant additional services, one or more of these facilities could be converted back to FBO use. However, the updated forecasts do not suggest that existing or anticipated future demand

levels are sufficient to support more than one full-service FBO facility at Crystal Airport. The existing Thunderbird Aviation FBO apron is relatively small, constrained, and operationally inefficient. An expansion to improve aircraft circulation patterns and the number of tie-down locations should be considered by the tenant.

The existing MAC Maintenance facilities are in good condition and provide adequate capacity to accommodate newer-generation snow removal equipment that in many cases are longer and taller than older models. An enclosed materials storage facility is programmed to be constructed to store sand and other solid materials.

ES.5 ALTERNATIVES REFINEMENT

The 2025 LTCP considered numerous concepts related to the number of runways to retain at Crystal Airport, as follows:

- Keep all four existing runways / No Build;
- Maintain two parallel runways and close the two crosswind runways;
- Maintain just one primary runway;
- Maintain one primary runway and one crosswind runway;
- Maintain two parallel runways and only one crosswind runway;
- Extend the primary runway 14L-32R by 990 feet using declared distances;
- Maintain one runway and reduce its length to 2,500 feet; and
- Airport Closure.

After reviewing all of the concepts, costs, benefits and negative considerations, the 2025 LTCP for Crystal Airport was finalized in December 2008 and recommended that the airfield be "right-sized" to match infrastructure with activity levels. As illustrated in **Figure ES-2,** the preferred alternative in the plan was to decommission both the turf (06R-24L) and south parallel (14R-32L) runways, leaving a two-runway system in place. The existing south parallel taxiway will then be converted to a full-length parallel taxiway. This plan not only simplifies the airfield, but opens up some property for both aeronautical and non-aeronautical development opportunities.

Due to the thorough nature of the alternatives analysis completed in the previous LTCP, it will not be repeated in this document. The focus of the alternatives analysis will be to identify possible refinements to the preferred alternative from the previous LTCP.

Summary of the Original Preferred Alternative

As illustrated on **Figure ES-3**, the 2035 LTCP Original Preferred Alternative for airfield improvements at Crystal Airport includes the following items:

- Carry-over items from the 2025 LTCP Preferred Alternative
    - Decommission existing Runways 14R-32L and 06R-24L (turf) to reduce airfield complexity and increase safety (call-out #1 on Figure ES-3);
    - Convert existing Runway 14L-32R into a full-length parallel taxiway and add taxiway lights (call-out #2 on Figure ES-3);

  - Preserve areas for future hangar development should demand arise (call-out #3 on Figure ES-3); and
  - Identify parcels for possible conversion to non-aeronautical revenue-generating land uses (see Figure 7-6).
- Refinements included in the 2035 LTCP Preferred Alternative
  - Update the runway designation to Utility and use small aircraft design standards to reduce RPZ dimensions (call-out #4 on Figure ES-3);
  - Convert existing paved blast pads on Runway 14L-32R to stopways, including edge lighting and additional Runway Safety Area (RSA) grading (call-out #5 on Figure ES-3);
  - Taxiway configuration changes as described in **Section 5.2.3** (call-out #6 on Figure ES-3);
  - Expand the FBO apron (call-out #7 on Figure ES-3);
  - Pursue the establishment of a new non-precision instrument approach to the Runway 32 end, if feasible (call-out #8 on Figure ES-3).

Development of the Refined Preferred Alternative

Throughout the public process, MAC made a commitment to consider the comments voiced by stakeholders and evaluate if any related adjustments to the proposed plan were feasible. A summary of public comments received is provided in **Section ES-9**.

In the spirit of this commitment, MAC evaluated several adjustments to the Original Preferred Alternative in the Draft 2035 LTCP and developed a Refined concept.

When compared with the Original Preferred Alternative, the Refined Preferred Alternative included the following adjustments:

- **Primary Runway length**: Convert portions of the paved blast pads on primary Runway 14L-32R to useable runway for a published length of 3,750 feet with declared distances in effect and extend taxiways to new runway ends.
- **Primary Runway location**: Shift the primary runway approximately 115 feet to the northwest along its centerline to locate all of the Runway Protection Zone (RPZ) for Runway 32R on MAC property, improving land use compatibility over the existing condition.
- **Turf Runway**: Retain a portion of the existing turf runway and operate it in a manner that will reduce runway crossing points, airfield complexity, and incursion potential while preserving turf operational capabilities at a metropolitan area airport.
- **Taxiway configuration changes** as recommended by Air Traffic Control Tower and Airport Operations staff to make the airfield more efficient and to further simplify geometry.

On February 20, 2017, the Metropolitan Airports Commission (MAC) Board approved staff's recommendation to update the Draft 2035 LTCP by replacing the Original Preferred

Alternative with the Refined concept and initiate a supplemental (second-round) public comment period.

After reviewing the body of public comments received during both the first and second round public comment periods, MAC staff prepared a recommendation to the Board that the Refined concept be approved as the Final Preferred Alternative for the Crystal Airport 2035 LTCP. This recommendation was made on the basis that it is responsive to the most prominent stakeholder concerns while still meeting the stated planning goals to: 1] better align airfield infrastructure to match existing and forecasted activity levels; 2] preserve and, if possible, improve operational capabilities for the current family of aircraft using the facility; and 3] enhance safety by simplifying the airfield movement area configuration.

The MAC Board approved staff's recommendation of the Final Preferred Alternative on May 15, 2017.

The improvements associated with the Final Preferred Alternative are shown on **Figure ES-4**. A side-by-side comparison of the Original and Final Preferred Alternatives is shown in **Figure ES-5**.

2035 LTCP Final Preferred Alternative Summary

The 2035 LTCP Final Preferred Alternative for improvements at Crystal Airport includes the following items, as shown in **Figure ES-4**.

- Items from the 2025 LTCP Preferred Alternative
  - Decommission existing Runway 14R-32L to reduce airfield complexity and increase safety (call-out #1 on Figure ES-4);
  - Convert existing Runway 14R-32L into a full-length parallel taxiway and add taxiway lights (call-out #2 on Figure ES-4);
  - Preserve areas for future hangar development should demand arise (call-out #3 on Figure ES-4); and
  - Identify parcels for possible conversion to non-aeronautical revenue generating land uses (see **Figure 7-6**).
- Refinements included in the 2035 LTCP Preferred Alternative
  - Update the runway designation to Utility and use small aircraft design standards to reduce RPZ dimensions (call-out #4 on Figure ES-4);
  - Convert portions of the paved blast pads on primary Runway 14L-32R to useable runway for a published length of 3,750 feet with declared distances in effect and extend taxiways to new runway ends (call-out #5 on Figure ES-4);
  - Shift the primary runway approximately 115 feet to the northwest along its centerline to locate all of the Runway Protection Zone (RPZ) for Runway 32R on MAC property, improving land use compatibility over the existing condition (call-out #6 on Figure ES-4);
  - Retain a portion of the existing turf runway and operate it in a manner that will reduce runway crossing points, airfield complexity, and incursion

potential while preserving turf operational capabilities at a metropolitan area airport (call-out #7 on Figure ES-4);

- Taxiway configuration changes as described in **Section 5.2.3** (call-out #8 on Figure ES-4);
- Expand the FBO apron (call-out #9 on Figure ES-4); and,
- Pursue the establishment of a new non-precision instrument approach to the Runway 32 end, if feasible (call out #10 on Figure ES-4).

Figure ES-2: 2025 LTCP Preferred Development Alternative

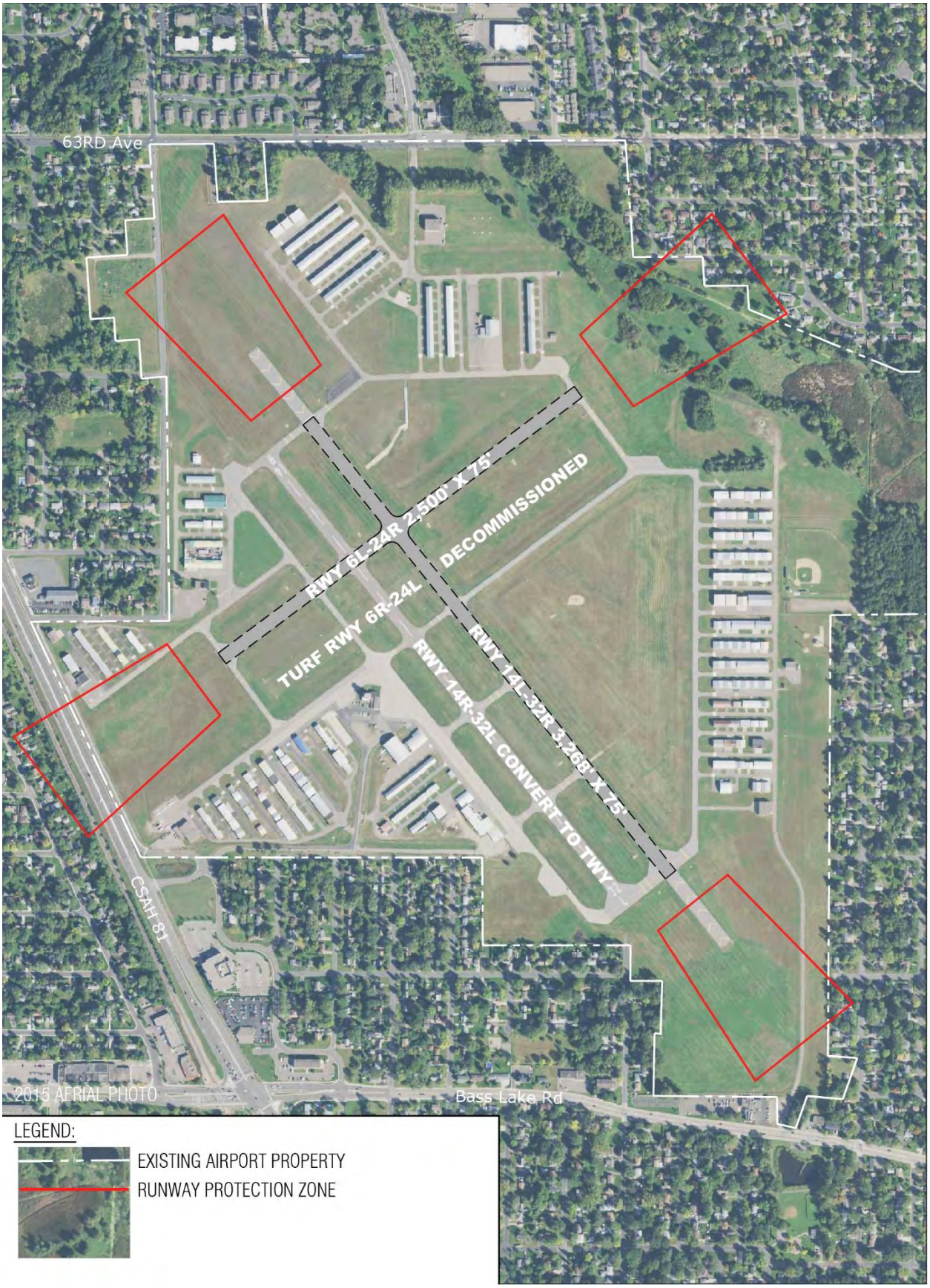


Figure ES-3: 2035 LTCP Original Preferred Alternative

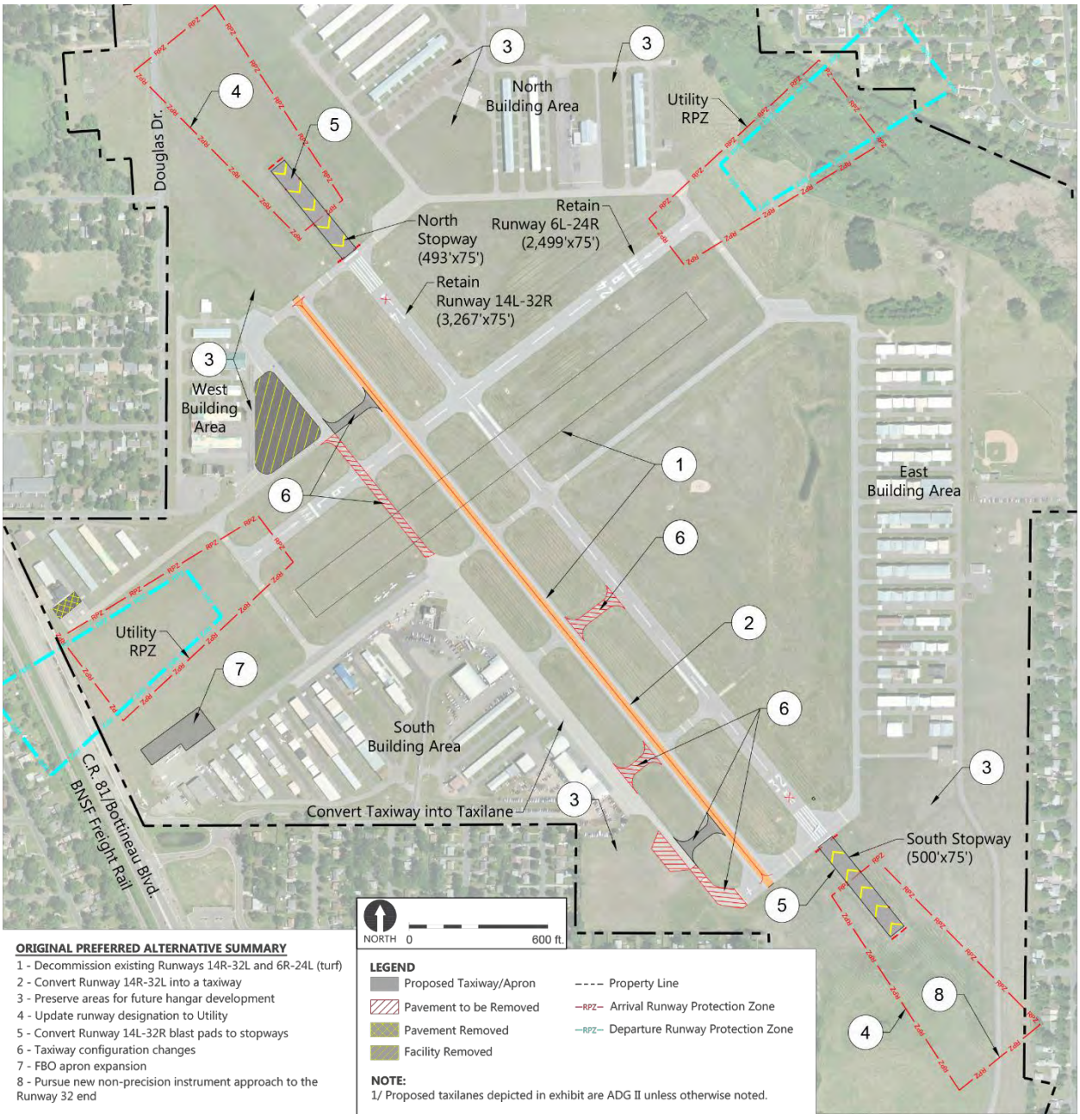
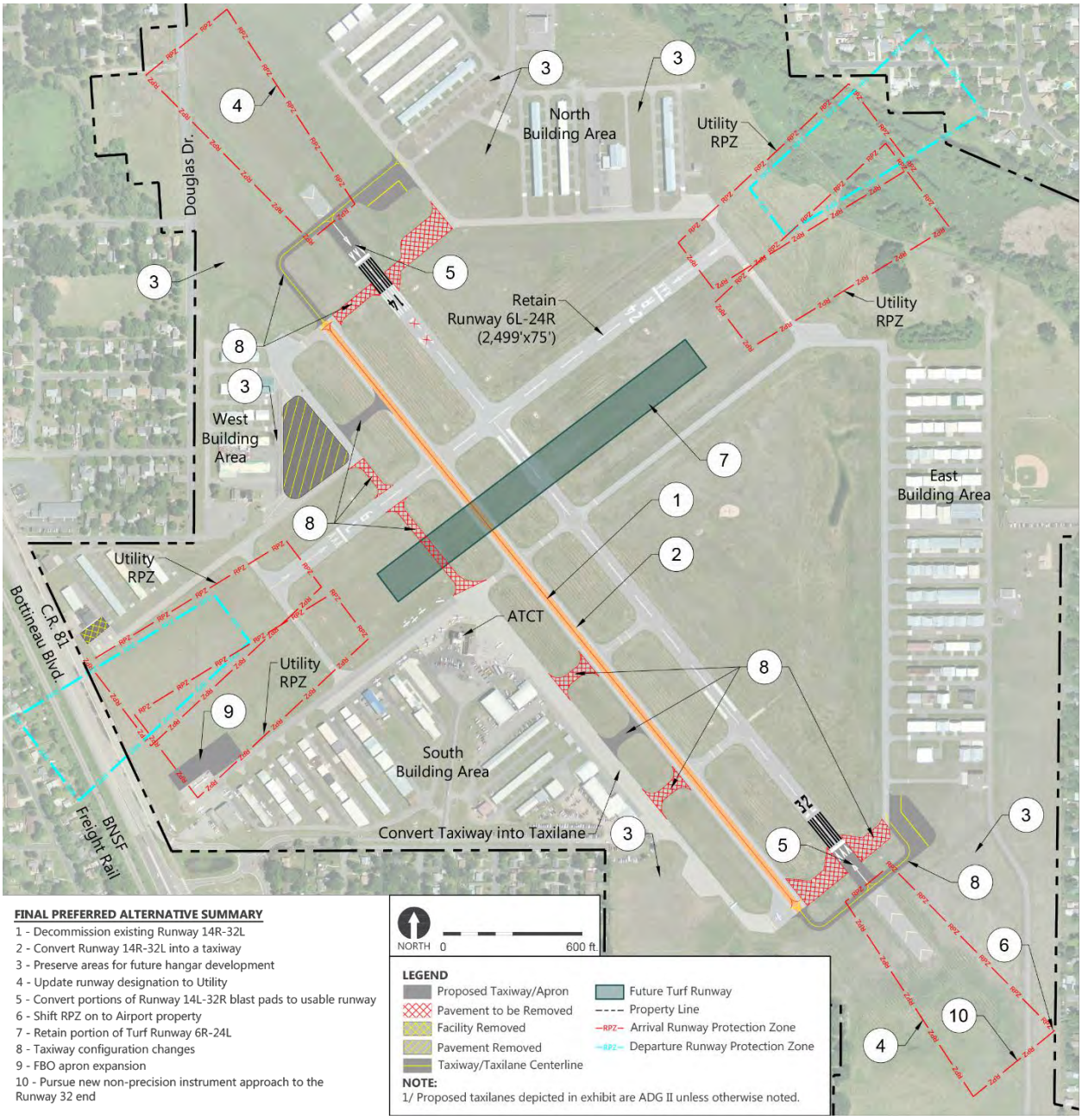


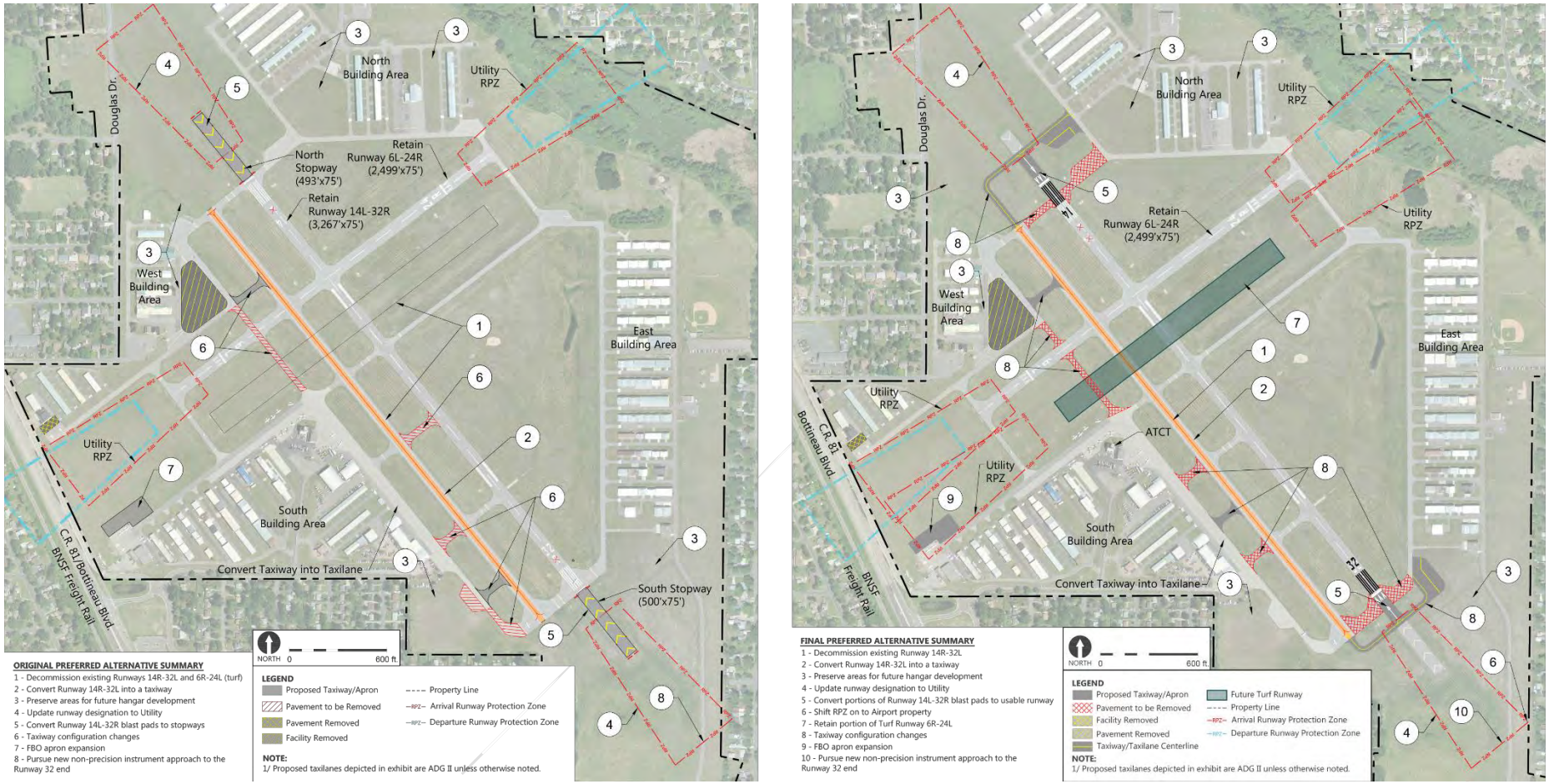
Figure ES-4: 2035 LTCP Final Preferred Alternative



FINAL PREFERRED ALTERNATIVE SUMMARY

1 - Decommission existing Runway 14R-32L
2 - Convert Runway 14R-32L into a taxiway
3 - Preserve areas for future hangar development
4 - Update runway designation to Utility
5 - Convert portions of Runway 14L-32R blast pads to usable runway
6 - Shift RPZ on to Airport property
7 - Retain portion of Turf Runway 6R-24L
8 - Taxiway configuration changes
9 - FBO apron expansion
10 - Pursue new non-precision instrument approach to the Runway 32 end

Figure ES-5: Comparison of Original and Final Preferred Alternatives



ES.6 ENVIRONMENTAL CONSIDERATIONS

Prior to any construction taking place, the MAC will complete an Environmental Assessment (EA) and/or an Environmental Assessment Worksheet (EAW) in compliance with state statutes and FAA requirements for utilizing Airport Improvement Program (AIP) grant funds. The primary environmental impact category associated with implementation of the 2035 LTCP Final Preferred Alternative is noise exposure when compared to the existing condition.

Noise

To evaluate potential aircraft noise impacts associated with the Final Preferred Alternative, MAC prepared Baseline Condition noise contours for Crystal Airport, along with 2035 Final Preferred Alternative Condition noise contours for comparison. The contours represent noise levels, expressed in the Day-Night Average Sound Level (DNL) metric. The FAA requires the DNL noise metric for determining and analyzing noise exposure to aid in the determination of aircraft noise and land use compatibility issues around United States airports.

The FAA suggests three different DNL levels (65, 70, and 75 DNL) be modeled but considers the 65 dB DNL contour line as the threshold of significance for noise impact. Sensitive land use areas (e.g., residential) around airports that are located in the 65 dB or greater DNL contours are considered by the FAA as incompatible.

The Metropolitan Council further suggests that the 60 DNL contour be included for airports in an urban environment and the 55 DNL in cases where airports are located outside the Metropolitan Urban Service Area (MUSA). Crystal Airport is within the MUSA, so the 60 DNL noise contour will be shown for advisory purposes.

In summary, when the Final 2035 Preferred Alternative Condition contours are compared to the Baseline (existing) Condition contours:

- For the 65 DNL contour, the acreage contained within the contour increases by 32 percent, and the contour contains four (4) additional residential parcels. However, three (3) residential parcels that are in the Baseline Condition contour are no longer included, resulting in only one (1) net new residential parcel in the contour. This change is driven by several factors, including consolidation of flight activity on two runways instead of four in the existing condition, the shift of the runway along its centerline to the northwest, and the runway extensions that move departing aircraft closer to the airport boundary at the start of their takeoff roll.
- For the 60 DNL contour, the acreage contained within the contour increases by 28 percent, and the contour contains 86 more residential parcels, primarily located to the southeast and northwest of the airport. Again, this change is driven by several factors, including consolidation of flight activity on two runways instead of four in the existing condition, the shift of the runway along its centerline to the northwest, and the runway extensions that move departing aircraft closer to the airport boundary at the start of their takeoff roll.

The 2035 LTCP Final Preferred Alternative noise contours are shown in **Figure ES-6**. A comparison of the Baseline and Final Preferred Alternative noise contours is shown in **Figure ES-7**.

Other Environmental Considerations

The project will have to go through an environmental review process per federal National Environmental Policy Act (NEPA) and Minnesota Environmental Policy Act (MEPA) requirements to more specifically identify the environmental footprint of the improvements before construction can begin. During that process, alternatives must be reviewed and any potential impacts must be avoided if possible. If impacts cannot be avoided, they must be minimized to the extent possible and mitigated in full compliance with federal and state requirements.

The following impact categories will be assessed during the environmental review:

- Air Quality;
- Biological resources (including fish, wildlife, and plants);
- Climate;
- Department of Transportation Section 4(f) Properties (park and recreational lands, wildlife and waterfowl refuges, and historic sites);
- Farmlands;
- Hazardous materials, solid waste, and pollution prevention;
- Historical, architectural, archeological, and cultural resources;
- Land use;
- Natural resources and energy supply;
- Noise and compatible land use;
- Socioeconomics, environmental justice, and children's environmental health and safety risks;
- Visual effects (including light emissions);
- Water resources (including wetlands, floodplains, surface waters, groundwater, and wild and scenic rivers);
- Construction impacts; and
- Cumulative effects.

An environmental review process cannot begin until there is a sufficiently detailed plan available to evaluate. MAC envisions initiating the environmental review for the proposed Crystal Airport improvements soon after the plan is reviewed by the Metropolitan Council and formally adopted by the MAC Board. A full study of these environmental impact items at this time falls outside the scope of this long-term planning document.

Figure ES-6: 2035 Final Preferred Alternative Noise Contour

Figure ES-7: Noise Contour Comparison

ES.7 LAND USE COMPATIBILITY

The proposed improvements at Crystal Airport result in changes to the noise contour (described in **Section ES.6**), along with the locations of the Runway Protection Zones (RPZs) and designated land use Safety Zones.

A Joint Airport Zoning Board (JAZB), including the Cities of Crystal, Brooklyn Park, Brooklyn Center, New Hope, Minneapolis, Robbinsdale and the Metropolitan Airports Commission, adopted an airport zoning ordinance in December 1983. The purpose of the ordinance is to protect against the construction of structures that will interfere with the operations at the airport. Although a number of homes are located within the designated safety zones, these areas were accepted as "established residential neighborhoods in built-up urban areas."

Upon adoption of the zoning ordinance by the JAZB, it was the responsibility of each individual city to adopt the ordinance and conform their zoning to the ordinance requirements. According to the City of Crystal's current Comprehensive Plan, the airport zoning regulations were adopted by the City in 1983 and one of the City's aviation policies is to continue to protect airspace in accordance with the Joint Airport Zoning Ordinance.

The Airport Zoning Ordinance for Crystal Airport establishes Safety Zones A, B, and C. The length of Safety Zone A is 2/3 of the total runway length, while Safety Zone B is 1/3 of the total runway length and extends from Zone A. Safety Zone C is a horizontal plane established 150 feet above the airport elevation for a specified distance from each runway end.

For this report, the existing size and shape of Safety Zones A and B from the Crystal Airport Zoning Ordinance were used for the purpose of analyzing Baseline (existing) land use compatibility. Where runway ends are proposed to change from the existing condition, the size and shape of safety zones will be modified from the existing condition as described in **Section 7.2.4**. The sizes, shapes and/or locations of these zones may be revised by the JAZB during an update of the Airport Zoning Ordinance for Crystal Airport.

In summary, when the 2035 Final Preferred Alternative Condition is compared to the Baseline Condition from a land use compatibility perspective:

- The Baseline Condition RPZs have 9.6 acres off-airport property, while 4.2 acres are off-airport property in the 2035 Final Preferred Alternative Condition – a reduction of 5.4 acres.
- The Baseline Condition Safety Zones have 169.0 acres off-airport property, while 108.1 acres are off-airport property in 2035 Final Preferred Alternative Condition – a reduction of 60.9 acres.
- With the exception of the eleven (11) residential parcels that remain in the 65 DNL noise contour, existing land uses around Crystal Airport are compatible with the Baseline and 2035 Final Preferred Alternative Condition and resultant airport operations considering airport noise impacts as outlined in the FAA land use guidelines. Additionally, there are 212 residential parcels in the 2035 Final Preferred Alternative Condition 60 DNL noise contour.

Figure ES-8 shows the 2035 Final Preferred Alternative RPZs, Safety Zones, and Noise Contours projected over planned future land use data. A comparison of the Baseline and Final Preferred Alternative RPZs, Safety Zones, and Noise Contours is shown in **Figure ES-9**.

Figure ES-8: 2035 Final Preferred Alternative RPZs, Safety Zones, and Noise Contours

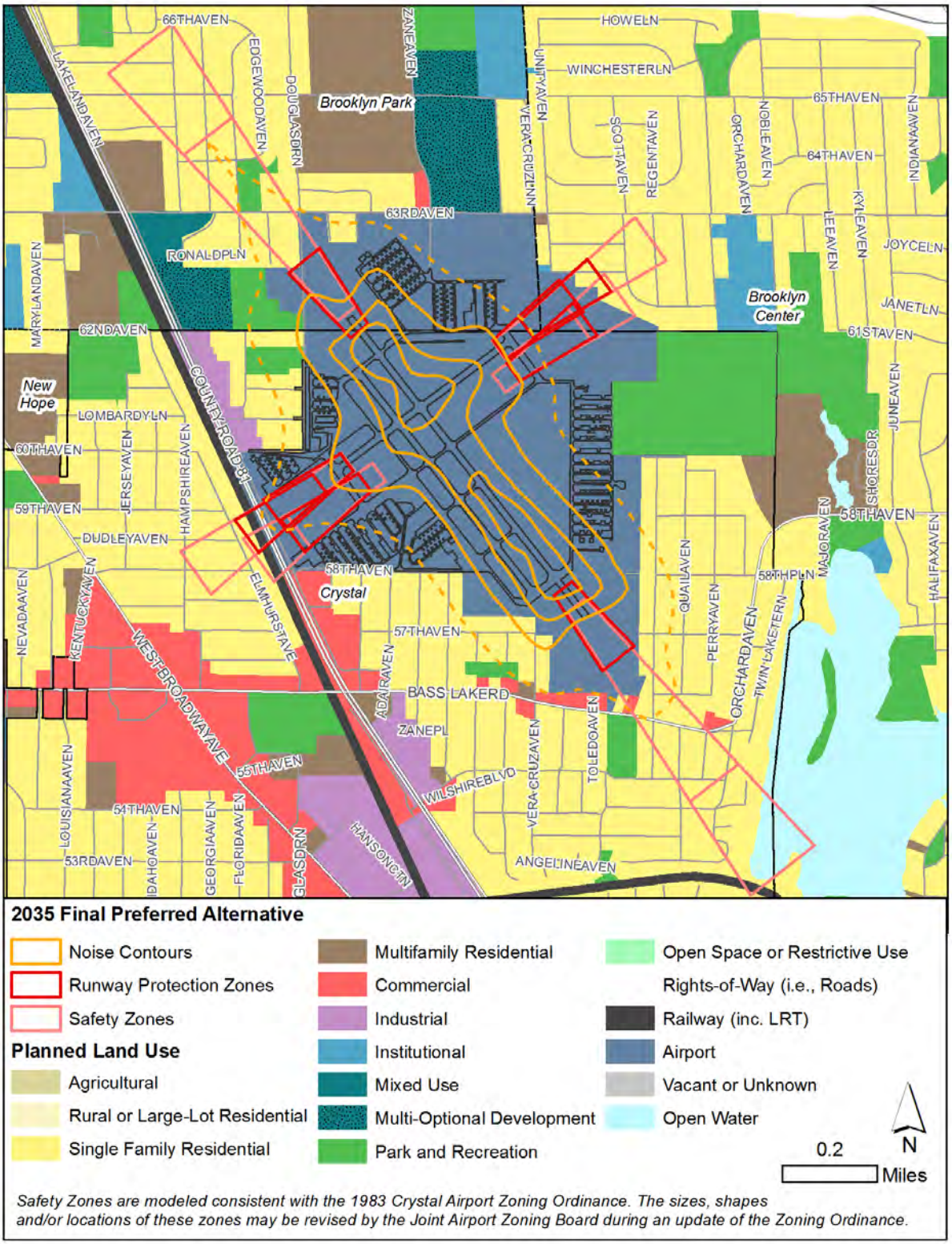
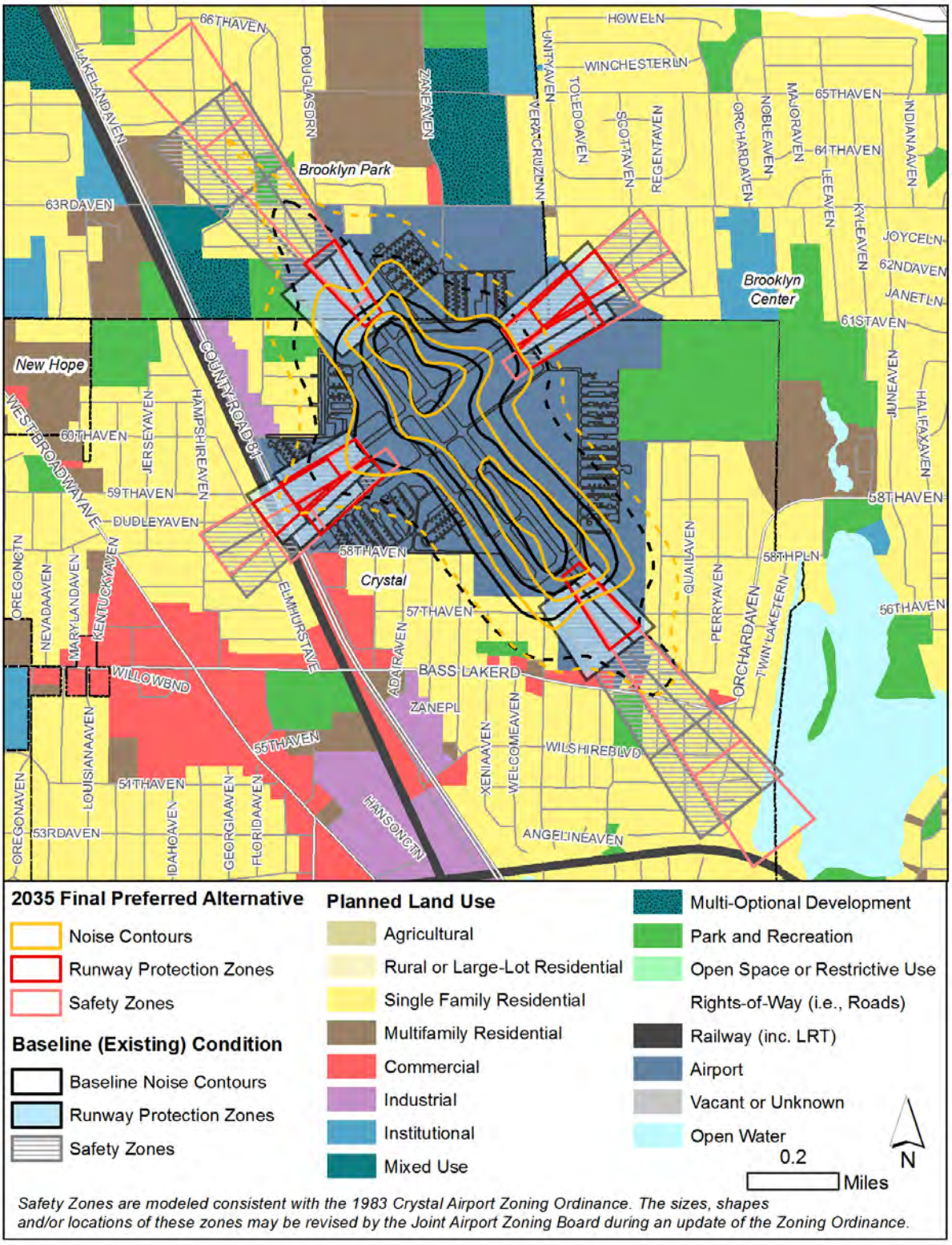


Figure ES-9: Baseline to 2035 Final Preferred Alternative RPZ, Safety Zone, and Noise Contour Comparison



ES.8 IMPLEMENTATION PLAN

The LTCP is a planning document and does not authorize construction. Adoption of the LTCP is simply the first step in the project implementation process. Before any construction can begin, the project(s) must first be depicted on an FAA-approved Airport Layout Plan (ALP), evaluated via an environmental review process, and then compete for funding through FAA and/or State grant programs. Once funding is secured, final project engineering and design will take approximately one year to complete with contractor bidding and construction following thereafter.

Near-Term Development encompasses the project elements necessary to decommission Runway 14R-32L and convert it into a full-length parallel taxiway, and to convert portions of the existing Runway 14L-32R paved blast pads to useable runway, including taxiway extensions and configuration adjustments. It is anticipated that this development will occur within the next three to five years.

Mid to Long-Term Development involves miscellaneous improvements to expand the FBO apron (by the tenant), install a self-fueling facility if this service is not provided by an FBO, and ongoing obstacle removal projects. It is anticipated that this development may occur in the 6-20 year timeframe.

Project cost estimates for the Preferred Alternative are summarized in **Table ES-2**.

Figure ES-10 illustrates the next steps for the planning and project implementation process, including at what points additional approvals are needed and at what points public feedback will be solicited.

Table ES-2: Final Preferred Alternative Cost Estimates

Item #	Project Element	Estimated Cost
Near-Term Development (Plan Years 1 - 5)		
1	Decommission Runways & Convert RWY 14R-32L into Taxiway (w/MITL)	$1,800,000
2	Convert Portions of RWY 14L-32R Paved Blast Pads to Runway	$350,000
3	Other Taxiway Improvements	$400,000
	Near-Term Development Total:	***$2,550,000***
Mid/Long-Term Development (Plan Years 6 - 20)		
4	Expand FBO Apron (Tenant Cost)	---
5	Hangar Development (Tenant Cost)	---
6	Hangar Removal(s)	$400,000
7	Obstacle Removal	$300,000
	Mid/Long-Term Development Total:	***$700,000***
	Total Development Cost:	***$3,250,000***

Notes: Cost estimates reflect 2016 pricing and include engineering costs and contingencies.

Source: SEH and MAC cost estimates

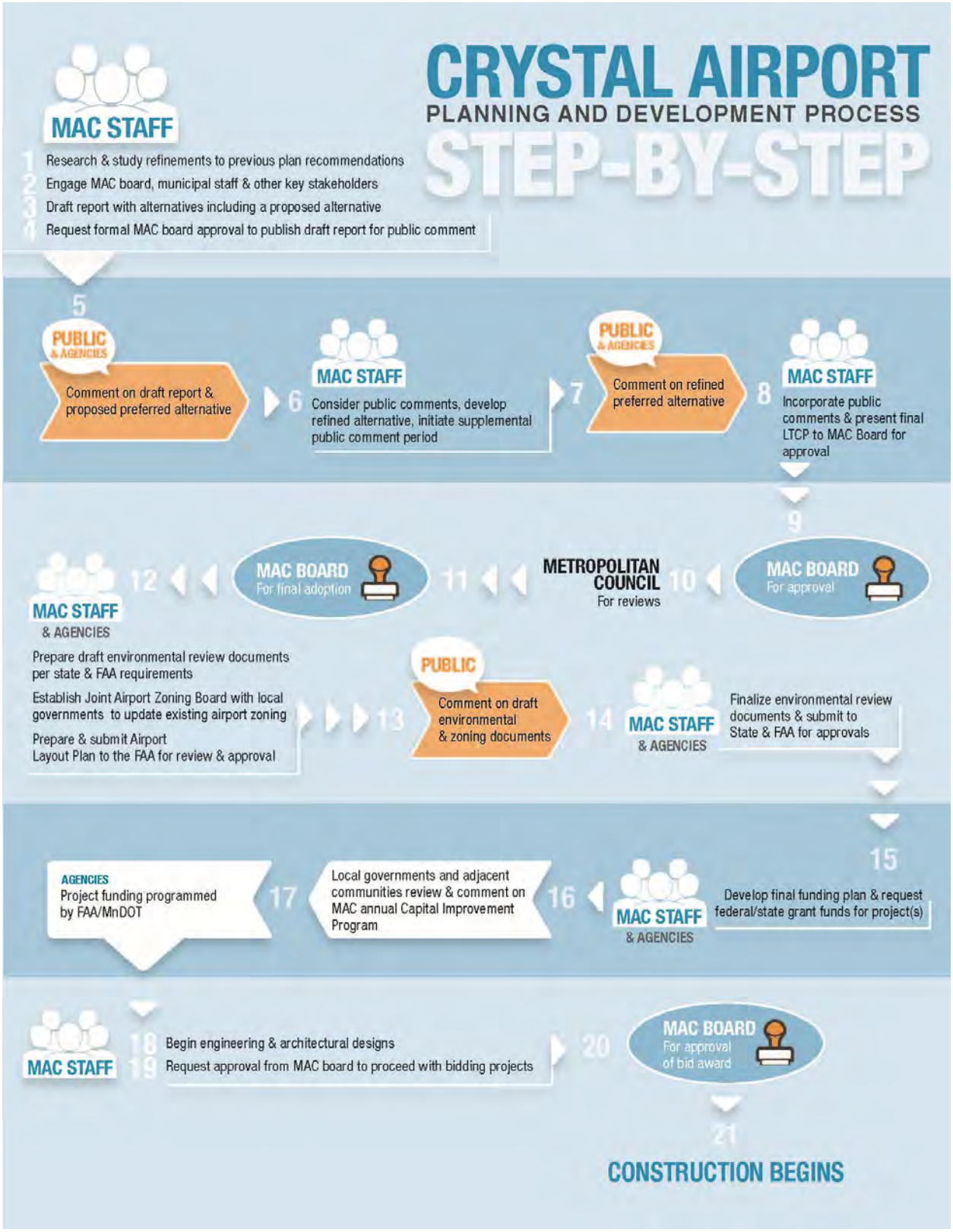
Non-Aeronautical Land Use Areas Available on Airport Property

MAC continues to analyze the potential for non-aeronautical revenue-generating development at Crystal Airport and all of its Reliever Airports. Any parcels reviewed by the MAC at the Crystal Airport will be compatible with ongoing airport operations and the MAC will work with the surrounding communities to ensure proper zoning exists. Reducing the RPZ dimensions for the runways based on small aircraft design/Utility runway standards will only increase this potential.

Retaining a portion of Turf Runway 06R-24L will likely affect the suitability of one parcel for non-aeronautical development that was identified in the Original Preferred Alternative. This parcel is located on Lakeland Avenue N immediately adjacent to the Thunderbird Aviation FBO site. However, the small size (approximately 0.8 acre) and proximity to both the aircraft parking apron and fuel tank already limit the development prospects for this parcel regardless of the disposition of the turf runway.

All airport property is currently zoned according to the adjacent cities as “Airport” land with no other noted land use. If MAC pursues non-aeronautical development, discussions will be initiated with the cities to discuss the potential uses and how the cities feel the parcels could best be utilized. If a modification is required for zoning, MAC will work with the cities to make changes as appropriate. The development of non-aeronautical uses will not only benefit MAC, but it will also generate a tax base for the local municipality in which the parcel lies, as well as address some of the aesthetic issues with some hangars at the airport.

Figure ES-10: Planning and Project Implementation Process



ES.9 PUBLIC INVOLVEMENT PROCESS

Initial stakeholder outreach efforts involved meeting with partner agencies, municipal representatives, and airport tenants before the draft LTCP report was finalized in order to provide information about the plan's purpose, process, preliminary findings, and timeline.

The next phase consisted of the first formal public review period after the draft plan was completed and the MAC Board approved it for public distribution.

The Original Draft 2035 LTCP for Crystal Airport was issued for public review and comment on Monday, September 12, 2016. Two public information meetings were held in September 2016 to provide information about the draft plan to interested stakeholders. The first round public comment period closed on Wednesday, October 26, 2016.

During the first round public comment period, the MAC received a total of 27 written comments. Of the comments, 15 were from airport tenants and users, 10 from members of the public, and 2 from municipal representatives.

Many of the airport tenants and users expressed concern over some or all elements of the plan. Notably, Thunderbird Aviation, the full-service Fixed Base Operator (FBO) at the Airport, submitted comments in opposition to the proposed plan. The top three themes based on tenants and user comments include:

- Support for keeping turf Runway 06R-24L open;
- Support for keeping south parallel Runway 14R-32L open; and,
- Support for providing additional useable length on Runway 14L-32R beyond that provided by the Stopway concept recommended in the draft plan.

The City of Crystal provided a letter of support for the LTCP Preferred Alternative, while Hennepin County requested coordination in advance of any development/redevelopment initiatives along any county roadway frontage. Of the comments from members of the general public, three were related to concerns over flight patterns and aircraft noise.

A Refined Preferred Alternative was developed by MAC staff in response to public and stakeholder feedback about the original plan. An Addendum to the Draft 2035 LTCP was prepared to describe the features of and rationale behind the development of the Refined Preferred Alternative. The Addendum was published for public review and comment on Wednesday, March 15, 2017. A supplemental public information meeting was held on March 30, 2017 to provide more information about the Refined Preferred Alternative to interested citizens. The supplemental public comment period closed on Friday, April 14, 2017.

During the supplemental public comment period, MAC received 16 additional written comments. Of the comments, 12 were from airport tenants and users, 3 from members of the public, and 1 from a municipality.

Airport users and tenants who submitted comments expressed a much greater level of support for the Refined concept than for the original alternative. In particular, preserving a turf runway at Crystal Airport was viewed as a positive factor by many tenants.

However, some continued to express reservations about the capacity implications of closing the south parallel Runway 14R-32L.

Notably, Thunderbird Aviation, the full-service Fixed Base Operator (FBO) at the Airport, submitted comments supporting the refined plan concept – a reversal from their position opposing the original plan recommendations. Key factors that enabled Thunderbird to support the Refined concept are the longer primary runway length and retention of the turf runway to facilitate flight-training opportunities.

The City of Crystal also provided a letter of support for the LTCP Refined Preferred Alternative.

Materials from stakeholder outreach meetings are reproduced in **Appendix 8**.

Appendix 9 includes a reproduction of each public comment received in its entirety. General responses were developed to address questions and comments that were consistent among the comments received. Specific responses to comments received from municipalities and agencies are also provided.

The Final Draft 2035 Crystal Airport LTCP narrative report was submitted to the Metropolitan Council for review on Monday, June 5, 2017. Under MS 473.165 and MS 473.611, the Metropolitan Council reviews LTCP's for each airport owned and operated by MAC. The Council reviews and comments on all plans for consistency with the metropolitan development guide including Thrive MSP 2040 and the Transportation Policy Plan. Metropolitan Council staff concluded that since the preferred development alternative for Crystal Airport retains its system role as a Minor general aviation facility, supports the regional aviation system, and is responsive to the needs and conditions of the airport, it is consistent with the Thrive MSP 2040 and the Transportation Policy Plan. The Full Metropolitan Council provided its determination of consistency on September 13, 2017.

The MAC Board voted to formally adopt the Crystal Airport 2035 LTCP on October 16, 2017.

SECTION 1:

INTRODUCTION AND BACKGROUND

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1. INTRODUCTION AND BACKGROUND

1.1 OVERVIEW

The Metropolitan Airports Commission (MAC) was created in 1943 by the Minnesota Legislature to promote air transportation in the seven-county metropolitan area. The MAC's 15-member board of commissioners, which sets the MAC's policies, consists of 13 appointments by Minnesota's Governor and one appointment each by the mayors of Minneapolis and St. Paul. The MAC's policies are implemented by the MAC's Executive Director/Chief Executive Officer and staff.

Crystal Airport is one of seven airports owned and operated by the MAC (**Figure 1-1**). The airport identifier is MIC. The airport is located in Hennepin County, approximately seven miles northwest of downtown Minneapolis. It lies within the City of Crystal, with small portions of airport property overlapping into the City of Brooklyn Park and the City of Brooklyn Center (**Figure 1-2**). Hennepin County Road 81 (CR 81) runs northwest/southeast adjacent to the airport on the airport's western border, Interstate 94/694 is a half-mile north of the airport, and State Highway 169 is 2-1/2 miles to the west. Crystal Airport encompasses approximately 436 acres of land – a physical footprint that has not changed since the mid-1960s.

The Airport plays an important role in the MAC system of airports and serves as a reliever airport to MSP by attracting general aviation traffic. This helps relieve congestion at MSP, which, in turn, helps reduce operating costs and promotes sustainability. Crystal is the closest MAC airport to downtown Minneapolis.

Crystal Airport began operations in 1950, and the existing airfield configuration has been in place since the mid 1960's. Due to the density of development adjacent to the airport and lack of additional land for facility development, no future expansions were contemplated and thus no long-term planning studies were undertaken.

In 1995 MAC initiated preparation of the first Long-Term Comprehensive Plan (LTCP) for Crystal Airport to evaluate future activity levels and address community questions about the long-term future of the facility through the year 2015 ("2015 LTCP"). The draft 2015 LTCP concluded that while Crystal Airport had little room for new development, it was a valuable contributor to the Metropolitan system of Airports and that closure was not a viable alternative. Although the draft plan did not recommend major development of the Airport, it did include several small projects that would enhance efficiency and aesthetics. Ultimately, the draft 2015 LTCP was never adopted by MAC or formally reviewed by the Metropolitan Council due to outstanding issues with runway obstructions and utilities.

The most recent LTCP for Crystal Airport prepared by the MAC and approved by the Metropolitan Council is dated December 2008, with a planning horizon year of 2025 (2025 LTCP). The 2025 LTCP recommended a plan to "right-size" the airfield to better align airport infrastructure and complexity with activity levels. To do this, the preferred alternative in the plan is to decommission both the turf runway (6R-24L) and south parallel runway (14R-32L), leaving a two-runway system in place. This plan not only simplifies the airfield, but opens up some property for both aeronautical and non-aeronautical development opportunities.

The purpose of the Crystal Airport 2035 Long-Term Comprehensive Plan is to validate and update, as needed, the findings of the previous 2025 LTCP, and to extend the planning horizon for an additional ten years through 2035. The LTCP is an infrastructure planning tool updated on a regular basis. It is forward-looking in nature, and does not authorize actual construction.

The plan will provide a "road map" to guide MAC's development and capital improvements planning strategy for Crystal Airport over the next 5-10 years by renewing aviation activity forecasts, confirming facility needs and refining alternatives identified from the previous LTCP to meet those needs.

A glossary of terms used throughout this report is provided in **Appendix 1**.

1.2 GUIDING PRINCIPLES

Guiding principles establish a foundation for and parameters against which planning-related decisions are evaluated. These principles provide focus and direction in formulating a recommended development plan – in this case for Crystal Airport. The principles also act as a high-level explanation of the purpose and objectives of the planning process.

By nature, these guiding principles are dynamic and may be adjusted over time.

Airport Role

Operating within a diverse system of metropolitan area airports, Crystal Airport's primary role is to serve personal, recreational, and some business aviation users in the northwest metropolitan area, including the cities of Crystal, Brooklyn Park, Brooklyn Center, and Minneapolis. Examples of business services provided at Crystal Airport include flight training, aircraft rentals, charter flights, aircraft and propeller maintenance, sale of aircraft avionics and parts, and medical flight transportation.

The primary role of Crystal Airport is not expected to change during the planning period. The Airport's classification will continue to be that of:

- A Complimentary Reliever in the Metropolitan Airports Commission (MAC) system;
- An Intermediate Airport per Minnesota Department of Transportation/Office of Aeronautics (MnDOT); and
- A Minor Airport per the Metropolitan Council Regional Aviation System Plan.

The aircraft mainly anticipated to use Crystal Airport – and that which it is designed for – will continue to be a family of small, propeller-driven airplanes with fewer than 10 passenger seats.

The proposed plan does not contemplate upgrading the role of Crystal Airport to accommodate a larger aircraft family or scheduled passenger or cargo flights. Nor does the plan contemplate downgrading the role of Crystal Airport.

Airport Infrastructure

Key airfield improvement objectives for Crystal Airport are to:

- Better align airfield infrastructure to match existing and forecasted activity levels;
- Preserve and, if possible, improve operational capabilities for the current family of aircraft using the facility; and
- Enhance safety by simplifying the runway and taxiway layout.

The planning process will ensure proposed airfield development conforms to Federal Aviation Administration (FAA) and MnDOT regulations, design standards, and system plans to the extent practical and feasible.

Wherever prudent, development plans will make use of existing facilities through renewal, modernization and/or infill development.

Stakeholder and Community Engagement

The planning process will seek to foster consensus among stakeholders, including tenants and users, the FAA, MnDOT, the Metropolitan Council, the Metropolitan Airports Commission, and local governmental bodies.

Airport development and maintenance plans should consider the objectives of local governmental bodies, including partnering with these bodies to promote regional economic development and local land use compatibility.

The planning process will include a public involvement program to inform and educate interested parties of possible plans for Crystal Airport's future and any associated community impacts, and to consider community feedback received.

Land Use Compatibility & Environmental Considerations

A significant investment has been made in Crystal Airport, warranting the need to protect the facility from new non-compatible off-airport developments that could impact existing and future operations at the Airport.

Existing zoning and land use controls should be maintained, unless otherwise modified, to facilitate the long-term plan implementation in a manner that acknowledges the urban nature of the neighborhoods surrounding Crystal Airport and encourages compatible development.

In service to all parties, operation and development of Crystal Airport will promote initiatives to incorporate environmental stewardship and infuse sustainable thinking.

Financial Viability

Development at Crystal Airport will continue to be self-funded by users of the airport and aviation system; no local sales or property taxes will be used to fund airport improvements.

- All facility improvements will be funded through pursuing FAA and MnDOT grants first, with MAC funding as a secondary source.

- Future development at Crystal Airport should promote financial self-sufficiency to the maximum extent practical, including strategies to encourage tenant investments in facility improvements and/or new facilities, and other non-aeronautical revenue generation.

1.3 AIRPORT HISTORY

The first airfield in the Crystal area began operations in the early 1920s, when Eugene Shank moved his flying service to an open field near the intersection of West Broadway and 49th Avenue N, about one mile to the southwest of the current Crystal Airport. Closed by World War II, the site of Shank's Flying Service is now a city park and memorial garden.

During the mid-1940's, two sites were considered as possible locations for a new MAC airport in the northwest metropolitan suburbs. The first site was located to the north of the City of Crystal, while the second site was further to the south. While MAC first focused on the northern site, other influences ultimately led to the selection of the south site for the airport. In December 1948, MAC initiated efforts to acquire the property for Crystal Airport and by 1949 had approved plans for the construction of a stabilized base for a northwest-southeast runway, aprons, and taxiways. In 1950, MAC awarded contracts for the construction of an administration building and runway lights and flight operations began. By 1952, Crystal Airport consisted of a 2,500-foot long by 75-foot wide paved northwest-southeast runway, a parallel turf runway, and two crosswind northeast-southwest turf runways. The existing Administration Building was in place, as were the adjacent aprons and edge taxiways.

During the early 1950's, activity at Crystal Airport began to increase dramatically. MAC recognized that additional land was needed for runway extensions and better approach protection. In October 1951, MAC approved the acquisition of 34 additional acres of land for these purposes. To further protect runway approaches and to provide additional buffer space to adjacent residential developments, the purchase of the northeast and southeast corners of the airport was approved by MAC in March 1954.

By 1961, the primary runway had been extended to its current length and the northernmost crosswind runway was paved at a length of 2,500-feet long by 75-feet wide. Taxiways leading to the East and West Building Areas were also established.

By 1968, the turf northwest-southeast runway had been paved and the taxiway leading to the North Building Area was in place. Except for paved overruns that were added to Runway 13L-31R (now 14L-32R) in the early 1990's, the airfield configuration at Crystal Airport has remained unchanged from the late 1960s. Airport plans throughout the 1960s and early 1970s contemplated an extension of both northwest-southeast parallel runways to a length of 3,750 feet, but these extensions were removed from the plans in 1978.

After a series of aircraft accidents in 1982, a Tri-City Commission was formed. The Commission was made up of representatives from MAC, airport users, and the cities of Crystal, Brooklyn Park and Brooklyn Center. It was charged with heightening awareness of pilots and citizens with regard to the Airport and the surrounding environment.

Several flight schools, charter services, and aircraft repair stations have done business at Crystal Airport over the years. Crystal Shamrock, established in 1959 by partners Lee

Gilligan, Lyle Norman, and Robert Peterson, was one of the more dynamic operations. Gilligan established a flight school that allowed pilots to be trained and eligible for a Private Pilot Certificate in just five hours of training. Crystal Shamrock's flight training program was instrumental in training many pilots who went on to airline and corporate flying careers. Later, in 1972, Crystal Shamrock acquired two DC-3 aircraft to be used in an air taxi role. Typical charter flights for these aircraft included Canadian fishing trips and transporting college sports teams. Crystal Shamrock closed in 2007.

In 1951, Ken Maxwell established Maxwell Aircraft Service, otherwise known as the "Prop Shop", at Crystal Airport. Today, it is the oldest active business at the Airport and is known nationwide as a leader in the servicing and overhauling of aircraft propellers and governors.

The existing FBO, Thunderbird Aviation, began operations at Crystal Airport in 1975 through the purchase of Lakeland Flight Services. Throughout the 1980s and 1990s, Thunderbird became a recognized leader in its core business of flight training. To meet the influx of demand for new pilots, Thunderbird started the Academy College of Aviation that offered a two-year career-focused degree program in aviation and provided financial aid to assist students with flying costs. Although new pilot starts slowed dramatically after the events of 9/11, flight training remains as one of Thunderbird's major activities at Crystal Airport.

Table 1-2 summarizes key airfield development milestones at Crystal Airport. **Figure 1-3** illustrates the progression of airfield pavement construction at Crystal.

Table 1-1: Airfield Development Timeline

Year	Development
1950-1952	Runway 14L-32R constructed 2,500 feet long, with full-length parallel taxiway. The air traffic control tower, administration building, and taxiways on either side also constructed along with airport access road.
1957	Runway 06L-24R constructed with full-length parallel taxiway. Access road to the west building area also constructed.
1960-1961	Runway 14L-32R and parallel taxiway extended to current length. East building area and west building area taxiways constructed.
1968	Runway 14R-32L constructed. Access roads constructed to the east and north building areas.

Source: MAC records

Several additional historical airport planning records are reproduced in **Appendix 2**.

1.4 AIRPORT CLASSIFICATION AND CONTEXT

The definition of "classification" for an airport differs slightly between the MAC, FAA, MnDOT, and the Metropolitan Council.

1.4.1 MAC Classification

In January 2006, the MAC accepted the *Recommendations Regarding the Future Operation and Development of the Reliever Airport System* prepared by the MAC Reliever Airports Task Force. That document identifies Crystal Airport as a "complimentary reliever" in the MAC-owned airport system. Other "complimentary reliever" airports listed are Airlake Airport in Lakeville and Lake Elmo Airport in Washington County. The other MAC-owned relievers, the St. Paul Downtown Airport, the Anoka County – Blaine Airport and the Flying Cloud Airport in Eden Prairie, are "primary relievers". By the MAC's definition, this "primary reliever" classification identifies them as better equipped to serve small business jets and corporate aircraft in addition to general aviation.

1.4.2 FAA Classification

The FAA's *National Plan of Integrated Airport Systems (NPIAS)*[2] identifies airports that are significant to national air transportation. Airports designated as part of the *NPIAS* are eligible for FAA Airport Improvement Program (AIP) funding. The *NPIAS* is updated by the FAA every two years and comprises all commercial airline service airports, reliever airports and qualifying general aviation airports.

In cooperation with the aviation community, the FAA completed two top-down reviews of the existing network of general aviation facilities included in the *NPIAS*. The results of these efforts are contained in the May 2012 report titled *General Aviation Airports: A National Asset (ASSET 1)* and the March 2014 report entitled *ASSET 2: In-Depth Review of 497 Unclassified Airports*[3].

As part of these efforts, the FAA documented the important airport roles and aeronautical functions these facilities provide to their communities and the national airport system. These functions include emergency preparedness and response, direct transportation of people and freight, commercial applications such as agricultural spraying, aerial surveying and oil exploration, and many others. Many of these functions cannot be supported efficiently or economically at larger commercial service airports.

The latest version of the *NPIAS*, which was released in September 2014 and covers the five-year period between 2015 and 2019, identifies both a Service Level and Asset Role for each airport in the plan. The Service Level describes the type of service the airport currently provides to the community and is anticipated to provide at the end of the five-year planning period. The Asset Role was assigned using operational categories developed in the *ASSET 1* report.

[2] Additional information is available at: http://www.faa.gov/airports/planning_capacity/npias/reports/

[3] Additional information is available at: http://www.faa.gov/airports/planning_capacity/ga_study/

In the 2015-2019 *NPIAS*, the FAA classifies Crystal Airport as follows:

- Service Level: Reliever

  The FAA has encouraged the development of high-capacity general aviation airports in major metropolitan areas. These specialized airports, called relievers, provide pilots with attractive alternatives to using congested commercial airports. They also provide general aviation access to the surrounding area. To be eligible for reliever designation, these airports must be open to the public, have 100 or more based aircraft, or have 25,000 annual itinerant operations.

- Asset Role: Regional

  Regional airports support regional economies by connecting communities to statewide and interstate markets. These airports accommodate a full range of regional and local business activities. They serve corporate and multi-engine aircraft, as well as single-engine propeller aircraft.

Definitions for other FAA airport classification categories are provided in the Glossary of Terms (**Appendix 1**) under the term “Airport Classifications”.

1.4.3 MnDOT Classification

MnDOT classifies Crystal Airport as an Intermediate Airport. Intermediate Airports have a paved and lighted primary runway that is less than 5,000 feet in length. These airports are capable of accommodating all single-engine aircraft, some multi-engine aircraft (including turboprops), and some business jets. Intermediate Airports serve as landing facilities for flight training, aircraft maintenance, and general aviation aircraft up to the smaller business jet size.

Of the other relievers in the MAC system, Airlake and Lake Elmo are also classified as Intermediate Airports per MnDOT criteria. Definitions for other MnDOT airport classification categories are provided in the Glossary of Terms (**Appendix 1**) under the term “Airport Classifications”.

1.4.4 Metropolitan Council Classification

The Metropolitan Council has been involved in aviation system planning since the 1970s. The Council develops a regional development framework every 10 years, the most recent being Thrive MSP 2040, which was adopted in 2014. The regional transportation policy plan (TPP) which provides transportation policy guidance to regional governmental units is updated every four years. Included in the TPP is the aviation system plan, which is updated every eight years. The Council prepares and maintains the plan, which provides strategies to help the Twin Cities enhance access to domestic and international markets. The last update to the Regional Aviation System Plan was the 2030 Twin Cities Aviation System Technical Report (December 2009). The Council works closely with the Metropolitan Airports Commission (MAC) and other airport owners to ensure that the region's airports provide state-of-the-art, secure and affordable services for business and leisure travelers, freight transport and general aviation activities. The Council coordinates aviation planning and community development with local, state and federal governmental units, airport users and citizens.

The Metropolitan Council classifies Crystal Airport as a Minor Airport. Under this definition, the airport has a primary runway length between 2,500 and 5,000 feet, with either a precision or non-precision approach. The airport can accommodate personal use and recreational aircraft, business general aviation and air taxi traffic, flight training and military operations. All of the other relievers in the MAC system, with the exception of the St. Paul Downtown Airport, are classified as Minor Airports per Metropolitan Council criteria. Definitions for other Metropolitan Council airport classification categories are provided in the Glossary of Terms (**Appendix 1**) under the term "Airport Classifications".

1.4.5 Airport Context

According to the latest *Minnesota State Aviation System Plan (SASP)*[5] published in 2013, Crystal Airport is one of 83 Intermediate Airports in the state. Of these 83 Intermediate Airports, Crystal Airport ranked:

- 3rd in terms of the number of total based aircraft; and
- 2nd in terms of the number of general aviation aircraft operations.

Only South St. Paul/Fleming Field has more aircraft operations, while only South St. Paul/Fleming Field and Lake Elmo Airport have more based aircraft. If activity at Crystal Airport is compared to all airports in the state, not just peer Intermediate airports, it still ranks in the top 10 for aircraft operations and in the top 5 for based aircraft.

The SASP identifies Crystal Airport as one of the airports in the State potentially needing a runway extension based on the operational requirements of the airport's critical aircraft.

[5] Additional information available at: http://www.dot.state.mn.us/aero/planning/sasp.html

Figure 1-1: Metropolitan Airports Commission Airports in the Seven-County Area

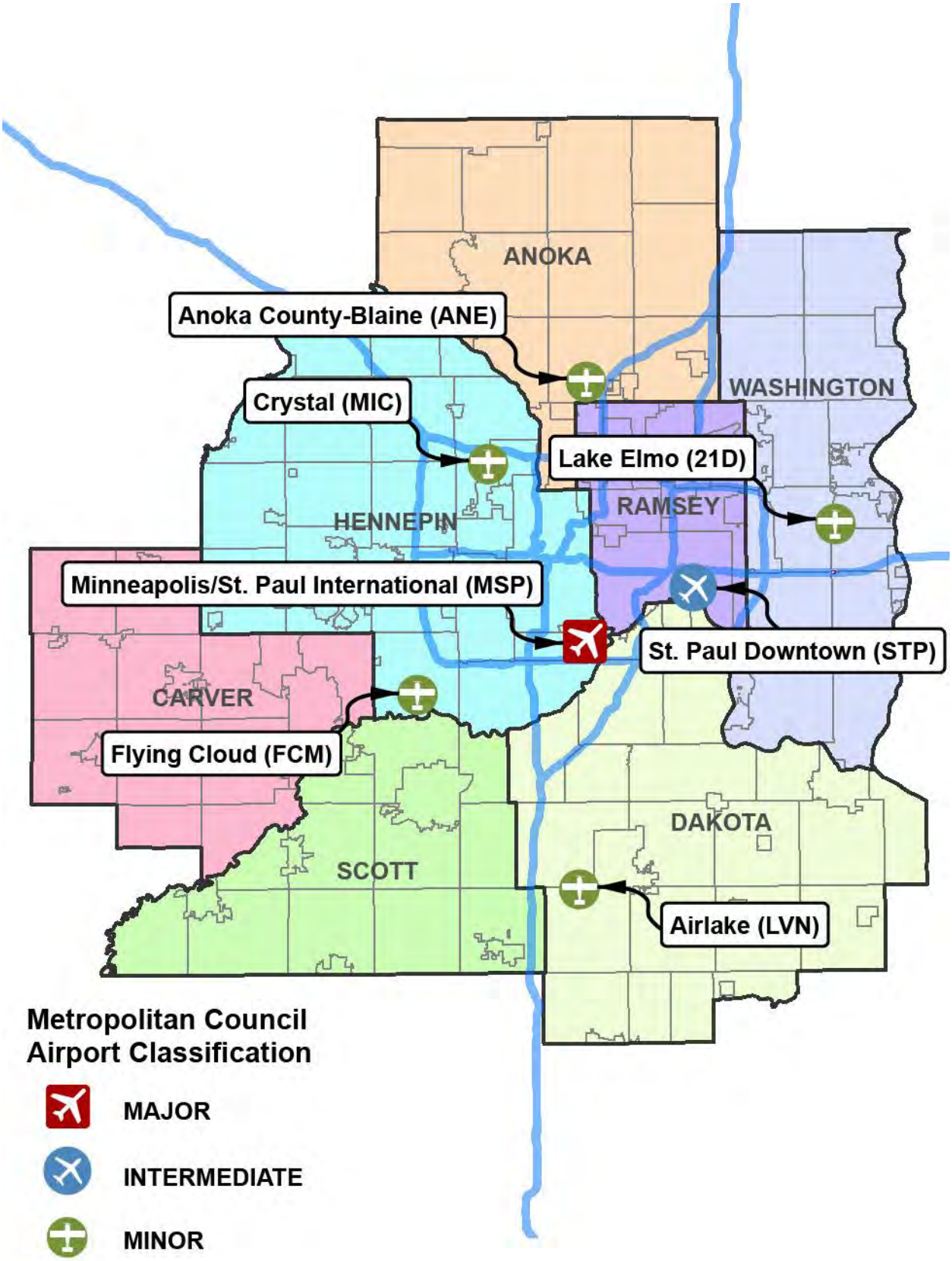


Figure 1-2: Airport Vicinity

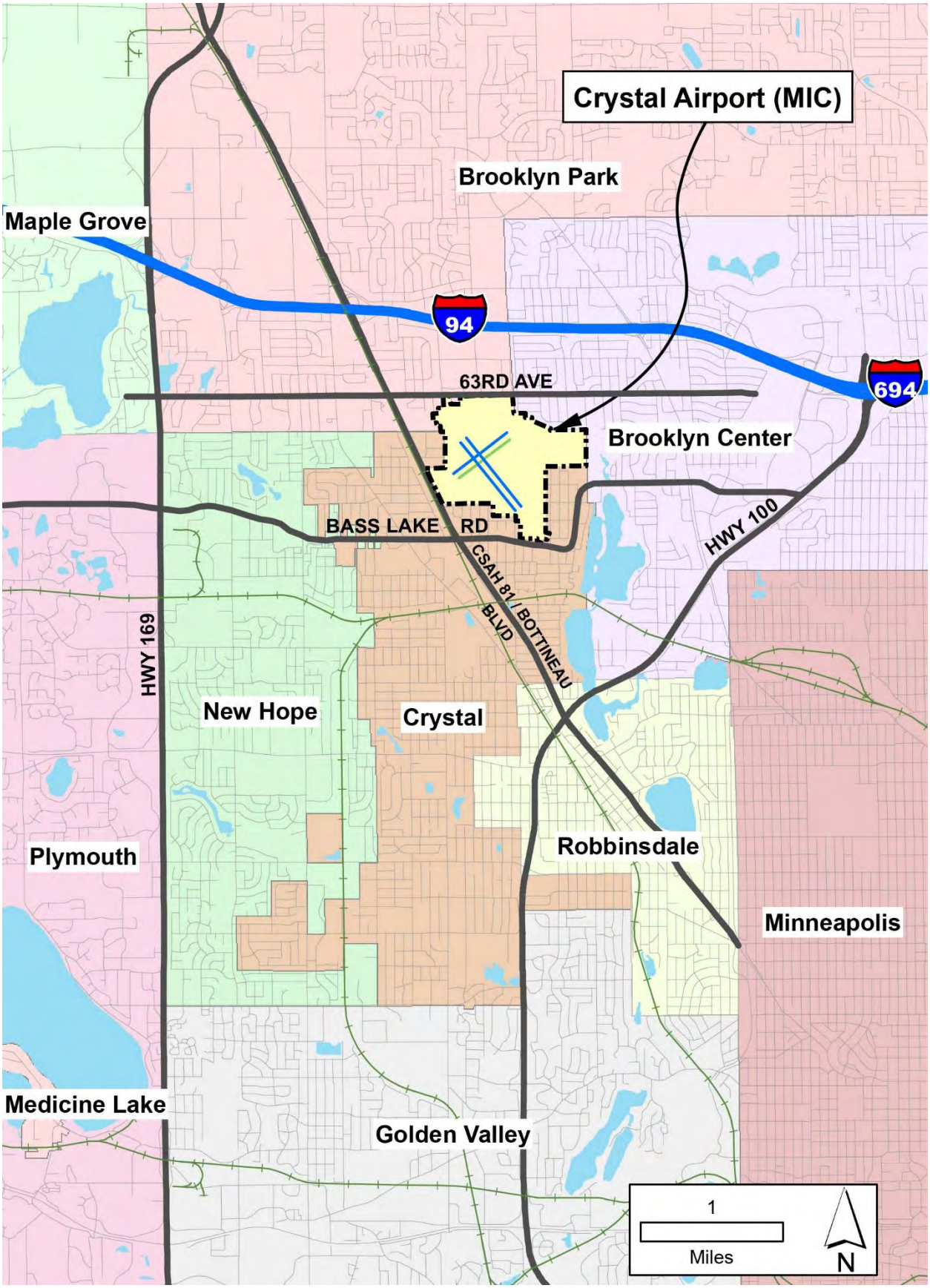
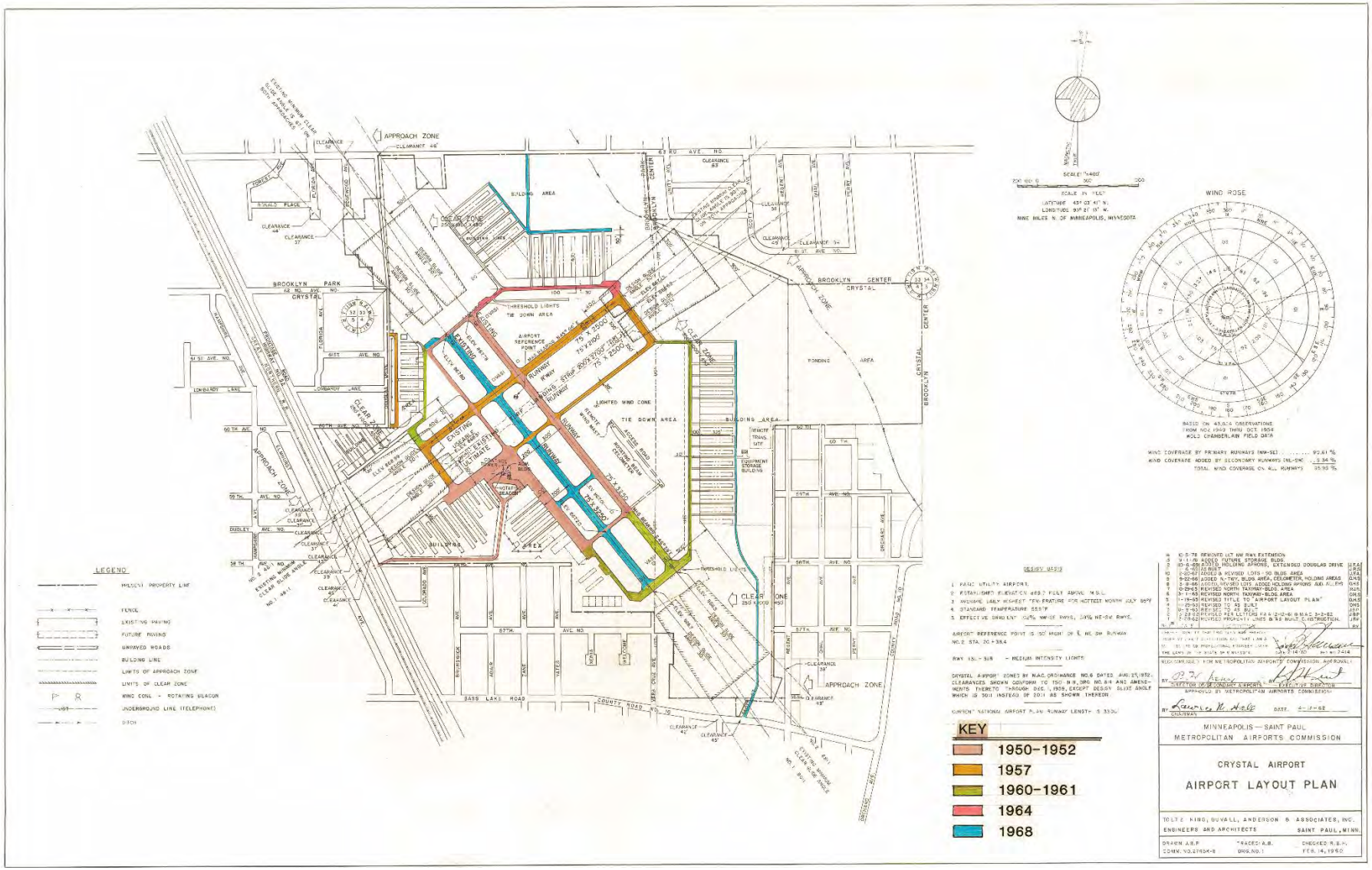


Figure 1-3: Crystal Airport Airfield Development Progression



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SECTION 2:

EXISTING CONDITIONS

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2. EXISTING CONDITIONS

2.1 INTRODUCTION

This chapter summarizes the existing facility, land use, infrastructure, and environmental data that are relevant to the preparation of this LTCP. The information presented in this chapter is current as of June 2016, except where noted.

2.2 IMPROVEMENTS SINCE LAST LTCP

The following facility improvements have been completed at Crystal Airport since the completion of the last LTCP:

- Reconstruction of Runway 14L-32R, including segments of Taxiway E connectors in the Runway Safety Area and paved blast pads, and new runway lighting in 2008;
- Reconstruction of taxilanes in the West and South Building Areas in 2009;
- Rehabilitation of hangar alleyways in the North Building Area in 2011;
- Reconstruction of Taxiway A from Taxiway F to the FBO, and rehabilitation of Taxiway A between Taxiways E and F, in 2012;
- Airfield Signage and Electrical System improvements in 2012;
- Reconstruction of portions of Taxiway C, B, and E4, along with removal of former Crystal Shamrock FBO apron, in 2014;
- Installation of a Precision Approach Path Indicator (PAPI) visual glideslope indicator system for Runway 14L in 2014 (by FAA); and
- Demolition of a portion of the former Helicopter Flight Inc. (HFI) hangar in 2016.

2.3 EXISTING AIRSIDE FACILITIES

Airside facilities include the operational aircraft areas of runways, taxiways, and aprons. These are areas where vehicular traffic is generally not allowed due to safety concerns of mixing with aircraft. Airside facilities also include airfield lighting and navigational aids.

2.3.1 Pavement Areas and Design Standards

Crystal Airport has four runways – three paved and one turf. The primary runways, 14L-32R and 14R-32L, are 3,267 feet and 3,266 feet long, respectively, and both are 75 feet wide. These runways have a full-length parallel taxiway (Taxiway E) with four sets of connectors (Taxiways E1 through E4). The Taxiway E system varies in width between 30 and 40 feet. The paved crosswind runway, 06L-24R, is 2,499 feet long and 75 feet wide. The Runway 06L landing threshold is displaced by 388 feet, while the Runway 24R landing threshold is displaced by 386 feet, to clear off-airport obstructions. The turf runway, 06R-24L, is 2,123 feet long and approximately 137 feet wide[6]. These runways

[6] Turf Runway 06R-24L is open seasonally from May through October.

also have a full-length parallel taxiway (Taxiway A) that is 30 feet wide. There are also taxiways connecting the north, east, and west building areas to the runway ends.

The Runway 14L and 32R ends feature a paved blast pad[7]. These paved blast pads are not considered to be useable pavement when calculating aircraft takeoff or landing distance requirements.

The airport has several apron areas that are used primarily for aircraft maneuvering between parking and taxiways. Run-ups and pilot checks can also be performed in these areas. Aprons areas are primarily associated with existing or former commercial operations, including the following:

- South Building Area:
  - Thunderbird Aviation FBO apron (southwest end of Taxiway A);
  - Public apron (southwest of ATCT/Administration Building);
  - North of Sixty apron (southeast of ATCT/Administration Building);
  - Maxwell (under private lease); and
  - North Memorial Air Care (under private lease).
- West Building Area:
  - The former Crystal Shamrock FBO apron has been removed.
- North Building Area:
  - Former Flying Scotchman FBO apron (under private lease).

The existing airport layout is depicted in **Figure 2-1**.

All of the airfield areas at Crystal Airport are asphalt, with the exception of the turf runway. Pavements vary in age, thickness, and structural section. Over time, pavement overlays, rehabilitation, reconstruction and/or crack repair methods have changed the characteristics of the pavement from section to section.

The Airport Pavement Management Program for the MAC Relievers has included periodic pavement condition inspections, most recently in 2013. The inspections were completed in accordance with FAA guidelines and utilized the Pavement Condition Index (PCI) Method.

PCI evaluation includes a visual inspection of pavements and assignment of a numerical indicator that reflects the structural and operational condition of the pavement, including the type, severity, and quantity of pavement distress. The numerical PCI value range for a specific, distinct section of airfield pavement can be defined as follows:

- PCI 81-100: Pavement in Excellent Condition (No or Minor Stress) – 30 percent of existing pavement areas;

[7] The Runway 14L paved blast pad is 493 feet long, while the Runway 32R paved blast pad is 500 feet long.

- PCI 61-80: Pavement in Satisfactory Condition (Minor Stress) – 17 percent of existing pavement areas;
- PCI 41-60: Pavement in Fair Condition (Moderate Stress) – 7 percent of existing pavement areas;
- PCI 21-40: Pavement in Poor Condition (Major Stress) – 46 percent of existing pavement areas; and
- PCI 0-20: Pavement in Serious Condition (Failed) – No airfield pavement areas fall within this classification.

An exhibit depicting the condition of pavements by PCI at Crystal Airport is provided in **Figure 2-2**.

Table 2-1 provides a summary of existing runway characteristics at Crystal Airport.

Table 2-1: Existing Runway Characteristics

Runway Characteristics	14L-32R		14R-32L		06L-24R		06R-24L	
Runway Length (feet)	3,267		3,266		2,499		2,123	
Runway Width (feet)	75		75		75		137	
Published Pavement Strength (lbs.)								
Single-Wheel Loading (SW)	13,000		13,000		12,500		12,500	
Pavement Type	Asphalt		Asphalt		Asphalt		Turf	
Effective Gradient	0.04%		0.04%		0.08%		0.09%	
	14L	32R	14R	32L	06L	24R	06R	24L
Runway End Elevation (ft. AMSL)	868.5	867.2	868.1	866.9	869.2	867.1	868.9	867.0

Notes:

The physical design strength of paved runways is 30,000 lbs. (single-wheel loading)

The Runway 06L landing threshold is displaced by 388 feet. The Runway 24R landing threshold is displaced by 386 feet.

Source: AGIS Aeronautical Survey (2013); FAA Airport Master Record; MAC Records

FAA Design Standards

FAA airport design standards provided in Advisory Circular (AC) 150/5300-13A, Change 1, *Airport Design,* provide basic guidelines for a safe and efficient airport system. Conformity to the FAA's standards ensures that aircraft in a particular category can safely operate at the airport.

Planning improvements to an existing airport requires the selection of one or more "design aircraft" that represent a collection, or composite family, of aircraft that are intended to be accommodated by the airport on a regular basis[8]. In the case of an airport with multiple runways, a design aircraft is selected for each runway.

For the purposes of airport geometric design, the design aircraft is classified by three parameters:

- Aircraft Approach Category (AAC): A classification of aircraft based on a referenced approach landing speed;
- Airplane Design Group (ADG): A classification of aircraft based on wingspan and tail height; and
- Taxiway Design Group (TDG): A classification of aircraft based on main landing gear width and cockpit-to-main-gear distance.

The selected AAC, ADG, and desired approach visibility minimums (generally expressed in statute miles or feet) are combined to form the Runway Design Code (RDC) for a particular runway. The RDC is used to determine the standards that apply to a specific runway and parallel taxiway to allow unrestricted operations by the design aircraft under defined meteorological conditions.

The Airport Reference Code (ARC) is a designation that signifies the airport's highest RDC. The ARC is used for planning and design only and does not limit the aircraft that may be able to operate safely on the airport.

In the case of Crystal Airport, the existing design aircraft is represented by the family of propeller-driven aircraft with fewer than 10 passenger seats. This is an FAA-defined category of aircraft with similar operating characteristics. Design parameters associated with this aircraft family are as follows:

- AAC: A/B (approach speed less than 121 knots);
- ADG: I/II (wingspan up to but not including 79 feet and tail height less than 30 feet);
- TDG: 2 (main landing gear width 20 feet or less and cockpit-to-main gear distance less than 64 feet); and
- Approach visibility minimums: 5,000 feet, which corresponds to visibility minimums of not lower than one statute mile.

[8] Regular use is considered as at least 500 or more annual itinerant operations of the runway by the critical design aircraft.

From an airfield facility requirements perspective, this composite aircraft family is represented by the Beechcraft King Air 200 (ARC B-II), Pilatus PC-12 (ARC A-II), and the Piper PA31 Navajo (ARC B-I). Based on these parameters, the Airport Reference Code (ARC) for Crystal Airport is B-II.

The corresponding RDC for Runway 14L-32R is A/B-II-5,000. According to the FAA, for airports with two or more runways, it is often desirable to design all airport elements to meet the requirements of the most demanding RDC and TDG. In order to preserve operational flexibility, the RDC for Runways 14R-32L and 06L-24R will also be designated as A/B-II-5,000. The RDC for turf Runway 6R-24L is A-I-VIS (visual).

Table 2-2 summarizes selected FAA runway design standards for RDC A/B-II-5,000 facilities. In some cases, the FAA has designated a less stringent standard for runways designed to be used regularly by small aircraft with maximum certificated takeoff weights of 12,500 pounds or less. Variations in the standards for small aircraft are noted with parentheses in **Table 2-2**.

Runway Safety Areas, Object Free Areas, and Obstacle Free Zones

The Runway Safety Area (RSA) is a defined surface surrounding the runway prepared or suitable for reducing the risk of damage to aircraft in the event of an undershoot, overshoot, or excursion from the runway.

Existing RSAs at Crystal Airport extend 300 feet beyond each runway end and are 150 feet wide. The existing RSAs meet FAA standards for the specified RDC.

The Runway Object Free Area (ROFA) is an area centered on the runway provided to enhance the safety of aircraft operations by remaining clear of objects, except for objects that need to be located in the ROFA for air navigation or aircraft ground maneuvering purposes.

Existing ROFAs at Crystal Airport extend 300 feet beyond each runway end and are 500 feet wide. The existing ROFAs meet FAA requirements for the specified RDC.

The RSA and ROFA layout is depicted in **Figure 2-3**.

The Runway Obstacle Free Zone (ROFZ) is three-dimensional airspace along the runway and extended runway centerline that is required to be clear of obstacles, including aircraft, for protection of landing takeoff operations from the runway and for missed approaches.

Existing ROFZs at Crystal Airport extend 200 feet beyond each runway end and are 250 feet wide based on the location of the runway hold short markings on the connector taxiways. The existing ROFZs meet FAA requirements for the specified RDC, but only for small aircraft. To meet the requirements for large aircraft, the ROFZs would have to be 400 feet wide and the hold short lines moved to match this distance.

Table 2-2: FAA Runway Design Standards

Design Standard	RDC A/B-II-5,000	Dimension (Fig. 2-3)
Runway Protection		
Runway Safety Area (RSA)		
Length Beyond Departure End (feet)	300	R
Length Prior to Threshold (feet)	300	R
Width (feet)	150	B
Runway Object Free Area (ROFA)		
Length Beyond Runway End (feet)	300	R
Length Prior to Threshold (feet)	300	R
Width (feet)	500	A
Runway Obstacle Free Zone (ROFZ)		
Length Beyond Runway End (feet)	200	n/a
Width (feet)	400 (250)	C
Runway Separation		
Centerline to Holding Position (feet)	200 (125)	n/a
Centerline to Parallel Taxiway (feet)	240	n/a
Centerline to Aircraft Parking (feet)	250	n/a

Notes:

Standards listed are for visibility minimums not less than one mile

Standards in parenthesis are for utility runways designated to accommodate small aircraft

See Figure 2-3 for a graphical depiction of these dimensions

Source: FAA Advisory Circular 150/5300-13A, Change 1

Runway Protection Zones

The Runway Protection Zone (RPZ) is an area at ground level prior to the threshold or beyond the departure runway end to enhance the safety and protection of people and property on the ground. According to the FAA, this is best achieved through airport owner control over RPZs. Control is preferably exercised through the acquisition of sufficient property interest in the RPZ and includes clearing of RPZ areas, and maintaining them clear, of incompatible objects and activities. The FAA expects airport sponsors to take all possible measures to protect against and remove or mitigate incompatible land uses in the RPZ.

The RPZ is trapezoidal in shape and centered about the extended runway centerline. It is comprised of two components. The Central Portion of the RPZ extends from the

beginning to the end of the RPZ at a width equal to the width of the ROFA. The Controlled Activity Area is the remaining area of the RPZ on either side of the Central Portion. The RPZ dimension for a given runway end is defined by the RDC. The RPZ layout is depicted in **Figure 2-3**.

Based on the current runway designations (see **Section 2.3.5**), RPZs at Crystal Airport have dimensions as listed in **Table 2-3**:

Table 2-3: Existing RPZ Dimensions

Runway End	Distance from End (feet)	Inner Width (feet)	Outer Width (feet)	Length (feet)
Runway 06L	200	500	700	1,000
Runway 24R	200	500	700	1,000
Runway 06R (Turf)	200	250	450	1,000
Runway 24L (Turf)	200	250	450	1,000
Runway 14L	200	500	700	1,000
Runway 32R	200	500	700	1,000
Runway 14R	200	500	700	1,000
Runway 32L	200	500	700	1,000

Notes:

Runway 06L-24R has both approach and departure RPZs in place due to the landing threshold displacements.

Source: FAA Advisory Circular 150/5300-13A, Change 1; FAA Airport Master Record

In 2012, the FAA issued Interim Guidance to clarify its policy on what constitutes a compatible land use within an RPZ and how to evaluate proposed land uses that would reside in an RPZ[9]. Coordination with the FAA in the form of an Alternatives Analysis is required when any of the following land uses would enter the limits of the RPZ due to a triggering airfield project, an off-airport development proposal, or other operational change at the airport:

- Buildings and Structures;
- Recreational Land Uses;
- Transportation Facilities, including rail facilities, public roadways, and vehicular parking facilities;
- Fuel storage facilities;
- Hazardous materials storage;

[9] Additional information available at: https://www.faa.gov/airports/planning_capacity/media/interimLandUseRPZGuidance.pdf

- Wastewater treatment facilities; and
- Above-ground utility infrastructure, including solar panel installations.

The existing RPZ's at Crystal Airport include several land uses that are not automatically considered compatible under the FAA's current guidance. However, since these land uses predate the FAA's current guidance, they are acceptable to remain as an existing condition.

- Existing Runway 14L and 14R Ends: Douglas Drive and two (2) private residential parcels. Douglas Drive is designated as a local road that provides access to the airport and adjacent residential development. By definition, a local roadway serves less than 1,000 vehicles per day. Although no recent traffic study is known to exist for this section of Douglas Drive, vehicle counts taken on other local roadways in the vicinity of the Airport suggest average daily traffic levels in the range of 300 – 500 vehicles. There are no current plans to increase the capacity of this roadway.
- Existing Runway 32R and 32L Ends: Eight (8) off-airport residential parcels. A non-public airport access roadway will continue to traverse the 32R RPZ as well, but this road is access controlled such that it only accommodates airport-related traffic.
- Existing Runway 06L and 06R Ends: County Road 81 (Bottineau Boulevard), freight rail (BNSF), ten (10) private residential parcels.
- Existing Runway 24L and 24R Ends: Sixteen (16) off-airport residential parcels.

In early 2014, the Hennepin County Regional Railroad Authority submitted an RPZ Alternatives Analysis to FAA for the proposed construction of the Bottineau Transitway (Blue Line Extension) Light Rail Transit (LRT) corridor adjacent to and within the existing BNSF freight rail line that runs parallel to County State Aid Highway (CASH) 81 and traverses the Runway 06L RPZ. This analysis considered alternatives such as tunneling the LRT Transitway under the RPZ, realigning it outside of the RPZ, or shortening Runway 06L-24R to shift the RPZ so that the LRT Transitway would be clear. The study concluded that constructing the LRT Transitway within the existing BNSF right-of-way was the preferred option due to cost and operational impracticalities associated with the alternatives. FAA concurred with the conclusions of the RPZ Alternatives Analysis in a letter provided on November 24, 2014. Further information about the Bottineau Transitway (Blue Line Extension) LRT corridor is available via the following link:

http://www.metrocouncil.org/Transportation/Projects/Current-Projects/METRO-Blue-Line-Extension.aspx

Runway Separation Standards

For Runway 14R-32L, the separation distance to parallel Taxiway E is currently 214 feet, deficient of the 240-foot FAA criteria by 26 feet. Analyzing the existing condition further, the wingtip of the representative critical design aircraft (Beechcraft King Air 200 with a 58-foot wingspan[10]) taxiing on Taxiway E remains clear of the ROFZ by approximately 60 feet. Thus, the existing runway to taxiway separation is considered adequate for the type

[10] The standard King Air B200 wingspan is 54.5 feet. A winglet-equipped King Air B200 wingspan is 57.9 feet.

of aircraft that operate at the airport. If Runway 14R-32L is converted into a parallel taxiway as recommended in the 2025 LTCP, this deviation from standards would be eliminated. Further, it would have a separation distance of 300 feet to Runway 14L-32R, exceeding the FAA criteria for the specified RDC.

For Runway 06L-24R, the separation distance to partial parallel Taxiway B is currently 225 feet, deficient of the 240-foot FAA criteria by 15 feet. The wingtip of a King Air 200 taxiing on Taxiway E remains clear of the ROFZ by approximately 70 feet. Thus, the existing runway to taxiway separation is considered adequate considering the type of aircraft that operate at the airport. A formal Modification to Design Standards will be sought from the FAA to document this condition as this configuration is not expected to change in the long-term plan.

For turf Runway 06R-24L, the separation distance to parallel Taxiway A is currently between 215 feet (south of Taxiway E) and 250 feet (north of Taxiway E). The section south of Taxiway E is deficient of the 240-foot FAA criterial by 25 feet. As with the instances above, the wingtip of a King Air 200 taxiing on Taxiway A remains clear of the ROFZ. A formal Modification to Design Standards will be sought from the FAA to document this condition if the turf runway remains in operation.

Runway Shoulders

Runway shoulders are intended to provide a transition surface between the runway pavement and the adjacent surface, to support aircraft running off the pavement, provide blast protection, and enhance erosion control and drainage. For RDC A/B-II-5,000, the required runway shoulder width is 10 feet. Crystal Airport provides 10-foot wide stabilized turf shoulders on both runways.

Taxiway Standards

The FAA design standard for TDG-2 width is 35 feet. Taxiway widths at Crystal Airport currently range from 30 to 75 feet wide. Taxiways A, B, C, D, and E are 30 feet wide[11]. These taxiway widths are deficient by five feet for this TDG. Connector Taxiway E1 is 75 feet wide, while Connector Taxiways E2, E3, and E4 are 40 feet wide. These taxiways exceed FAA width criteria for the specified RDC[12].

The Taxiway Safety Area (TSA) width for ADG II aircraft is 79 feet, which is met for all taxiways.

The Taxiway Object Free Area (TOFA) width for ADG II aircraft is 131 feet (65.5 feet each side of centerline), which is met for all taxiways expect in the following areas:

- Taxiway A to east apron edge/movement area line is 56 feet;
- Taxiway E to south apron edge/movement area line is variable from 43 to 60 feet; and
- Taxiway C to north apron edge/movement area line is 48 feet.

[11] When these taxiways were originally designed and constructed, airport design standard for a basic utility airport specified a 30-foot taxiway width.

[12] The current MAC standard for minimum taxiway width at the Reliever Airports is 40 feet.

Analyzing the existing condition further, the wingtip of the representative critical design aircraft (Beechcraft King Air 200 with a 58-foot wingspan) requires a TOFA of approximately 51 feet (58-foot wingspan X 0.7 + 10 feet). Therefore, some adjustments to the location of the apron edge/movement area line may be warranted.

The FAA-recommended Taxilane OFA width is 115 feet for ADG II. However, based on when they were built, the majority of the hangar areas at Crystal Airport were designed for smaller ADG I aircraft, and therefore offer less Taxilane OFA (79 feet).

Paved or stabilized shoulders are recommended along taxiways. ADG II aircraft require 15-foot shoulders. Existing taxiways at Crystal Airport provide 15-foot stabilized turf shoulders.

Table 2-4 summarizes selected FAA taxiway design standards for Taxiway Design Group 2/Airplane Design Group II facilities.

Airfield Geometry

Improving runway safety continues to be one of the FAA's highest priorities, and the agency is working with airport sponsors to further reduce runway risks through risk-based decision making. Risk factors that contribute to runway incursions[13] may include unclear taxiway markings, airport signage, and more complex issues such as the runway or taxiway layout.

At Crystal Airport, the legacy airfield configuration with two sets of parallel runways, results in a degree of complexity that can be a contributing factor to pilot confusion and runway incursions. **Figure 2-4** provides a diagram showing the location of designated Hot Spots at Crystal Airport, which are designated locations on an airfield where heightened attention by pilots and drivers is necessary due to a complex or confusing configuration.

Reducing the number of Hot Spots by simplifying the airfield layout and reducing the number of runway crossings for aircraft and vehicles should be a key consideration when evaluating future airfield development concepts.

[13] Runway incursions occur when an aircraft, vehicle, or person enters the protected area of an airport designated for aircraft landings and take offs.

Table 2-4: FAA Taxiway Design Standards

Taxiway Design Standard	TDG-2 / ADG-II
Taxiway Width (feet)	35
Taxiway Edge Safety Margin (feet)	7.5
Taxiway Shoulder Width (Turf) (feet)	15
Taxiway Protection	
Taxiway/Taxilane Safety Area Width (feet)	79
Taxiway Object Free Area Width (feet)	131
Centerline to Object (feet)	65.5
Wingtip Clearance (feet)	26
Taxilane Object Free Area Width (feet)	115
Centerline to Object (feet)	57.5
Wingtip Clearance (feet)	18
Taxiway Centerline Separation (feet)	105
Taxilane Centerline Separation (feet)	97

Notes:

Taxilanes provide access from taxiways to aircraft parking areas.

Taxilanes are designed for low speed and precise taxiing, making reduced clearances acceptable.

Source: FAA Advisory Circular 150/5300-13A, Change 1

2.3.2 Lighting and On-Airport Navigational Aids

Navigational aids (NAVAIDS) and runway lighting are intended to guide pilots from point to point, increase the visibility of runway features, and control runway activity both on the ground and in the air.

Runways 14L-32R and 06L-24R are lighted with Medium Intensity Runway Edge Lights (MIRLs) to increase the visibility of runway edges during nighttime or restricted-visibility conditions. The runway edge lights are white, except on instrument runways where yellow replaces white on the last 2,000 feet or half the runway length, whichever is less, to form a caution zone for landings. The lights marking the ends of the runway emit red light toward the runway to indicate the end of runway to a departing aircraft and emit green outward from the runway end to indicate the threshold to landing aircraft. The runway

lights operate on a photocell so they are on low intensity during nighttime hours. Radio control offers pilots the choice to click them to medium intensity.

Runway 14L-32R has Runway End Identifier Lights (REILs) at each end. REILs are synchronized flashing lights to help pilots visually acquire the runway end as they approach for landing.

There is currently no taxiway lighting at Crystal, with the exception of the taxiway connector exits from Runway 14L-32R, which are lit. All taxiways have blue guidance reflectors.

Runway 14L is equipped with a Precision Approach Path Indicator (PAPI), while Runways 32R, 06L, and 24R are equipped with older technology Visual Approach Slope Indicators (VASIs). These systems use a combination of red and white lights visible at certain angles that help pilots determine an appropriate descent glide slope that will result in the aircraft crossing the landing threshold at a height of approximately 20 to 45 feet. **Table 2-5** provides information about the PAPI and VASI units at Crystal.

Table 2-5: Visual Glideslope Indicators

Runway	Visual Glide Slope Indicator Type	Visual Glide Slope Angle (degrees)	Threshold Crossing Height (feet)
Runway 14L	PAPI	4.0	30
Runway 32R	VASI	3.5	34
Runway 06L	VASI	4.0	27
Runway 24R	VASI	3.5	29

Source: Ricondo & Associates, FAA records

These visual glide slope indicators are owned and maintained by the FAA. The REILs and PAPI are operated by radio control along with the runway lights.

Runways 14R-32L and 6R-24L are not lighted, nor do they have navigational aids.

The airport also has a Remote Transmitter/Receiver (RTR) site that is owned and operated by the FAA. The antennae are located on the east side of the airport adjacent to the hangar area. An RTR is used to boost the airport radio signals so that pilots can file a flight plan from the airport.

The airport has a lighted airfield beacon and a lighted wind cone.

2.3.3 Airspace

The national airspace structure is complex and requires the use of highly technical air traffic control (ATC) procedures. Airspace is either controlled or uncontrolled. Controlled airspace is managed by ground-to-air communications, NAVAIDS and air traffic services. **Figure 2-5** provides a graphical overview of the National Airspace System.

The Crystal Airport is located in what is considered Class D controlled airspace when the Airport Traffic Control Tower is open (7:00 am to 9:00 pm from October 1 to April 30 and 7:00 am to 10:00 pm from May 1 to September 30) and Class E airspace during the other times. Runways 14R-32L and 6R-24L are closed to aircraft operations when the Airport Traffic Control Tower is closed.

Class D airspace is under the jurisdiction of a local Airport Traffic Control Tower (ATCT). The purpose of the ATCT is to sequence arriving and departing aircraft and direct aircraft on the ground. Aircraft operating within this area are required to maintain radio communication with the ATCT. It is normally a circular area with a radius of five miles around the airport and extends upward from the surface to about 2,500 feet AGL. The ceiling elevation of Crystal's Class D airspace is 3,400 feet MSL (2,531 feet above the airport elevation of 869 feet).

When the ATCT at Crystal is closed, the airspace classification is Class E. Class E airspace is a general category of controlled airspace that is intended to provide air traffic service and separation for Instrument Flight Rules (IFR) aircraft from other aircraft. IFR means that the pilot is certified to fly under Instrument Meteorological Conditions (IMC) (less than three miles visibility and/or 1,000 foot ceilings). Pilots rated only for Visual Flight Rules (VFR) can operate in Class E airspace only when visibility is three statute miles and above and cloud heights are 1,000 feet above ground level (AGL) and higher. These pilots are not required to maintain contact with ATC. Class E airspace extends to 18,000 feet mean sea level (MSL) and generally fills in the gaps between other classes of airspace in the United States.

When the ATCT is closed, services are provided by Minneapolis Terminal Radar Approach Control (TRACON) located at Minneapolis-St. Paul International Airport, and assisted by the Flight Service Station (FSS) at Princeton, Minnesota. Aircraft operating at Crystal when the ATCT is closed are advised to broadcast their intentions and monitor Common Traffic Advisory Frequency (CTAF) frequency, which is also the UNICOM frequency (120.7). Pilots making instrument approaches or departures are in contact with the ATCT or Minneapolis TRACON.

The Crystal Airport also lies under Minneapolis/St. Paul International Airport's (MSP) Class B Airspace which consists of controlled airspace extending upward from different floor elevations to a ceiling height of 10,000 feet MSL. There are very specific operating instructions and rules pilots must follow when flying within this airspace. Crystal Airport lies under the area where the floor elevation is 4,000 feet MSL. As long as pilots stay below 4,000 feet they remain outside this MSP Class B airspace.

Figure 2-6 shows the airports, airspace and navigational aids in the vicinity of Crystal Airport.

The local traffic pattern altitude at Crystal Airport is 1,869 feet above Mean Sea Level (MSL), which is 1,000 feet above the airport elevation. All traffic patterns operate in standard left hand flow. When the winds are calm (less than 5 knots), the preferred runway is 14L. Intersection takeoffs at Crystal Airport are discouraged at all times, and prohibited between the hours of 10:00pm and 7:00am.

A voluntary Noise Abatement Plan is in place to promote aircraft operating procedures that help reduce aircraft noise and overflights for residents living near Crystal Airport. Pilots may also reference the pilot guide for easy access to noise abatement information. The pilot guide is available at:

http://www.macnoise.com/sites/macnoise.com/files/pdf/mic_nap.pdf

2.3.4 Approach Instrumentation

Crystal Airport has two non-precision instrument approaches that can be used during Instrument Meteorological Conditions. The first is a VOR or GPS-A approach that is not aligned with a specific runway end and requires a circling maneuver to land. The second approach is an RNAV (GPS) approach to Runway 14L. There are no on-site navigational aids associated with the RNAV (GPS) approach.

Table 2-6 summarizes the approach minimums for these approaches. The instrument approach charts for these procedures are reproduced in **Figure 2-7**.

Table 2-6: Instrument Approach Minimums

Runway Approach	Ceiling (ft. AGL/MSL)	Visibility (Miles)
RWY 14L RNAV GPS		
Straight-In	512 / 1,380	1.0
Circling	511 / 1,380	1.0
VOR or GPS-A		
Straight-In	---	---
Circling	491 / 1,360	1.0

Notes:

Minimums listed for Approach Category B aircraft

AGL - Above Ground Level; MSL - Mean Sea Level

Source: FAA Instrument Approach Procedure Charts

Crystal Airport has standard IFR takeoff minimums (one statute mile for aircraft having two or less engines), with the exception that Runway 6R-24L is not available for instrument takeoffs. Obstacle Departure Procedures are published for Runways 06L, 14L and 14R; however, none of them require a climb gradient greater than the standard 200 feet per nautical mile.

2.3.5 14 CFR Part 77 Airspace Surfaces

Regulations for the protection of airspace around a public-use civilian or military airport are specified in 14 CFR Part 77 *Safe, Efficient Use, and Preservation of the Navigable Airspace* (Part 77). These defined surfaces are used by the FAA to identify obstructions to airspace around an airport facility. Part 77 surfaces are comprised of primary, approach, transitional, horizontal and conical three-dimensional imaginary surfaces. **Figure 2-8** illustrates these surfaces in a general nature; their exact configuration varies based upon the category and type of approach to the runway. Obstructions are defined as objects that penetrate these surfaces. Mitigation measures such as obstruction marking/lighting, removal or relocation may be required for obstructions that are studied and not determined to be a hazard to air navigation.

The requirements for filing an aeronautical study with the Federal Aviation Administration (FAA) for proposed structures in the vicinity of Crystal Airport vary based on a number of factors: site elevation, structure height, proximity to an airport, and frequencies emitted from the structure, etc. The FAA provides a "Notice Criteria Tool" on its Obstruction Evaluation/Airport Airspace Analysis (OE/AAA) website that can be used to determine if an aeronautical study is warranted. The OE/AAA website can be accessed via the following link:

https://oeaaa.faa.gov/oeaaa/external/portal.jsp

The Airport Layout Plan (ALP), which will be developed and published separately from this report, depicts the location and future disposition of known obstructions to Part 77 surfaces.

Based on Part 77 criteria, runways are categorized as either Utility or Other-Than-Utility (OTU). A Utility Runway is a runway that is constructed for, and intended to be used by, propeller-driven aircraft of 12,500 pounds maximum gross weight and less. An OTU Runway is a runway that is intended to be used by propeller-driven aircraft with a maximum gross weight greater than 12,500 pounds and/or jet aircraft of any gross weight. All paved runways at Crystal Airport are currently designated as OTU, while the turf runway is designated as Utility.

Table 2-7 provides dimensional information for selected 14 CFR Part 77 surfaces.

Table 2-7: Existing 14 CFR Part 77 Surface Dimensions

Part 77 Surface	RWY 14L	RWY 32R	RWY 14R	RWY 32L	RWY 06L	RWY 24R	RWY 06R	RWY 24L
Primary Surface								
Width (feet)	500		500		500		250	
Length Beyond End (feet)	200		200		200		0	
Approach Surface								
Inner Width (feet)	500	500	500	500	500	500	250	250
Outer Width (feet)	3,500	1,500	1,500	1,500	1,500	1,500	1,250	1,250
Length (feet)	10,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Slope	34:1	20:1	20:1	20:1	20:1	20:1	20:1	20:1
Part 77 Category	OTU-NP	OTU-V	OTU-V	OTU-V	OTU-V	OTU-V	Utility-V	Utility-V

Notes: OTU - Other Than Utility; V - Visual Approach; NP - Non-Precision Approach

Source: 14 CFR Part 77

2.4 EXISTING LANDSIDE FACILITIES

Landside facilities include aircraft storage hangar areas, aprons, Fixed Base Operator (FBO) areas, terminal buildings, airport maintenance equipment storage areas, roadway access to the airport, and vehicle parking areas.

2.4.1 Fixed Base Operator (FBO)

Historically, Crystal Airport has had up to four FBOs in operation at one time. Currently, there is one full-service FBO. The full-service FBO, Thunderbird Aviation, is located at the southwest corner of the South Building Area at the end of Taxiway A **(Figure 2-9)**. Services offered by Thunderbird Aviation include fueling, aircraft maintenance, aircraft storage and line services, aircraft sales, flight training, aircraft rental, charters, pilot accessory sales, and car rentals. Thunderbird sells 100LL and Jet A fuel. The 100LL fuel tank and dispensing equipment is located at the southwest edge of the FBO apron. The Jet A fuel tank and dispensing equipment is located to the east of the Airport Traffic Control Tower/Administration Building[14]. Thunderbird Aviation provides into-plane fueling services via trucks.

Thunderbird Aviation offers aircraft parking and storage as one of its services with both indoor storage and outdoor apron/tie-down parking available. Outdoor apron storage typically accommodates short-term parking for visiting aircraft or for parking of planes awaiting maintenance or other services. It can also be used for long-term storage of aircraft. The existing FBO apron is relatively small and is often congested due to its configuration.

The capacity of the apron is limited to six single or small twin-engine aircraft simultaneously, and fewer if a larger twin-engine piston or turboprop is parked. The fuel dispensing equipment located at the southwest edge of the apron limits expansion potential in that direction. Expansion is further constrained by the FBO building and hangars to the east.

For outdoor parking, the FBO also has a grass tie-down area. Tie-downs are small metal rings set into the pavement or grass with ropes that tie to the underside of wings and the aircraft tail. Most planes being stored outdoors want tie-downs to protect the aircraft from wind damage. In Minnesota, pilots prefer indoor storage for both long and short-term periods because of the summer storms with wind and hail, and in the winter because of cold and snow. Grass tie-down areas are unavailable in the winter months. The FBO offers tie-down service on an as-requested basis, and it is estimated that there is space for six aircraft.

North of Sixty Aviation, located in the south building area, provides some partial FBO services such as aircraft storage and some self-service fueling.

Two former FBO facilities still exist at Crystal Airport, although they are currently leased to tenants who are using them for aeronautical purposes other than a public FBO. Should

[14] The Jet A fuel tank and dispensing equipment is still owned and operated by North of Sixty Aviation. Thunderbird Aviation purchases jet fuel from North of Sixty.

demand ever warrant additional services, one or more of these facilities could be converted back to FBO use.

2.4.2 Hangar Storage Areas

Crystal Airport currently has four distinct hangar storage areas – the South, West, North, and East Building Areas (**Figure 2-9**).

The original South Building Area is located on the south side of the airport, and is divided into a west half and an east half by the entrance road to the Airport Traffic Control Tower and administration building. The South Building Area is home to the full-service FBO (Thunderbird Aviation), a partial-service FBO (North of Sixty Aviation), plus individual storage hangars. The storage hangars consist of five T-hangars with 42 storage spaces with 41 conventional storage hangars of various sizes. The conventional hangars include one operated by North Memorial Air Care for medical helicopter maintenance and storage, another for Maxwell Aircraft Services, and another by North of Sixty Aviation. In total, the South Building Area contains 65 hangar buildings that provide storage spaces for approximately 116 aircraft.

The West Building Area consists of five T-hangars with 26 storage spaces, and 12 conventional storage hangars of various sizes. In addition, an office/administration building currently operated by Wentworth Aircraft (the former Crystal Shamrock FBO building) is in this area. In total, the West Building Area contains 17 hangar buildings that provide storage spaces for approximately 45 aircraft. During 2016, a portion of the hangar formerly used by HFI was demolished due to its poor condition. The remaining portion of this hangar is used by MAC for airport equipment storage.

The North Building Area contains seven T-Hangars with 90 storage spaces and four conventional hangars of various sizes, including the former Flying Scotchman FBO hangar that is currently under a private lease. In total, the North Building Area contains 11 hangar buildings that provide storage spaces for approximately 100 aircraft. There is room for an additional row of T-Hangars, and several conventional hangars, within the developed portions of the North Hangar Area with taxilane access. Other amenities in this area include an aircraft washing pad and an indoor restroom facility.

The East Building Area contains three T-Hangars with 10 storage spaces and 63 conventional hangars of various sizes. In total, the building area contains 66 buildings that provide storage spaces for approximately 96 aircraft. There is also an indoor restroom facility adjacent to the East Building Area.

MAC allows tenants to sublease space within a hangar if they choose. However, not all tenants sub-lease extra hangar space, nor is it required for them to do so. For this reason, the number of aircraft storage spaces is presented as a range. The low occupancy scenario assumes minimal sub-leasing of available space in conventional hangars, while the maximum occupancy scenario assumes that all available space in conventional hangars is sub-leased. The practical capacity scenario is an average of the low and high scenarios to represent the variance in tenant hangar occupancy practices.

Other factors affecting indoor storage spaces at Crystal Airport include:

- Several airport tenants have leased hangar stalls at Crystal Airport to support growth in aeronautical-related businesses that do not involve aircraft storage. As of July 2016, approximately 34 hangar stalls were leased for aeronautical purposes other than aircraft storage.
- MAC adopted a Reliever Airports Maintenance Standards Ordinance in 2011 to provide standards for the structural integrity, aesthetics, and maintenance of leased property and improvements at the Relievers, including Crystal. Ongoing enforcement of the Maintenance Standards Ordinance going forward will improve the compliance rate, resulting in improved functionality and aesthetics of tenant facilities.

Table 2-8 summarizes the aircraft hangar storage capacity at Crystal Airport.

Table 2-8: Indoor Aircraft Storage Summary

Hangar Types	Buildings	Spaces - Low Occupancy	Spaces - Maximum Occupancy	Spaces - Practical Capacity
South Building Area				
T-Hangars	5	42	42	42
Conventional Hangars	41	64	83	74
Subtotal	*46*	*106*	*125*	*116*
West Building Area				
T-Hangars	5	26	26	26
Conventional Hangars	12	18	19	19
Subtotal	*17*	*44*	*45*	*45*
North Building Area				
T-Hangars	7	90	90	90
Conventional Hangars	4	8	11	10
Subtotal	*11*	*98*	*101*	*100*
East Building Area				
T-Hangars	3	10	10	10
Conventional Hangars	63	74	98	86
Subtotal	*66*	*84*	*108*	*96*
Total T-Hangars	**20**	**168**	**168**	**168**
Total Conventional Hangars	**120**	**164**	**211**	**188**
Total Hangars	**140**	**332**	**379**	**356**

Notes:

Approximately 34 hangar stalls are leased by tenants to support aeronautical business functions other than aircraft storage

Source: MAC Data and Field Observations

2.4.3 Maintenance and Equipment Areas

MAC has three maintenance and equipment storage areas at Crystal (see **Table 2-9**). They are located in the South, North, and East Building Areas, as shown on **Figure 2-9**. The North and South buildings each have a small office and restroom/shower facilities for the maintenance crew. The building on the north side of the airport is the newest on the airfield, constructed in 1993.

Table 2-9: MAC Maintenance Buildings

Location	# of Equipment Bays	Equipment Fuel
South Building Area	4	None
North Building Area	6	Diesel
East Building Area	3	None

Notes: Additional equipment is stored in the former HFI hangar

Source: MAC

The administration building shares space with the maintenance facility in the South Building Area, and is adjacent to the air traffic control tower. There are two large office areas in addition to the restroom and break room.

2.4.4 Roadway Access and Vehicle Parking Areas

As shown in **Figure 1-2**, the Crystal Airport lies in Hennepin County, within the City of Crystal and partially in Brooklyn Park and Brooklyn Center. Primary roadway access comes off of County Road 81 (Bottineau Boulevard). Bass Lake Road provides access from CR 81 on the south, and 63rd Avenue provides access from CR 81 on the north. The east building area can be accessed from Bass Lake Road. The east frontage road from CR 81 is used to access the west building area. Interstate 94/694 is a half-mile north of the airport, Highway 169 is 2.5 miles to the west, and Highway 100 is 2 miles to the southeast. These main roads link the airport to the metropolitan area and the entire region. Drive time to downtown Minneapolis is approximately 10 minutes.

The FBO parking lot can accommodate approximately 20 vehicles. The former FBO sites also have parking available for any future uses of those spaces. The Airport Traffic Control Tower and administration building parking lot has approximately 40 vehicle parking spaces for employees and visitors.

Most of the aircraft storage hangars are accessed via alleyways that connect to taxiways/taxilanes, with tenants parking inside or adjacent to their individual hangars.

2.4.5 Park/Conservation Area

In 1970, MAC entered into an agreement with the Cities of Crystal and Brooklyn Center, through their respective conservation commissions, in cooperation with area school districts, to lease approximately 40 acres of airport property for the purpose of developing an open-space area to provide environmental, nature study, and wildlife preservation facilities for community education and enjoyment. As Shingle Creek flows through this area, it is primarily used for storm water management and drainage purposes. Several public walking trails have been established around and through the site.

2.5 AIRPORT ENVIRONMENT

This section highlights the airport environment, including available utilities, drainage, and local services provided.

2.5.1 Drainage

Crystal Airport is located on relatively flat land. Soils are generally comprised of sand, gravely sand and loamy sand overlain by thin deposits of silt loam or organic sediment. Most of the airfield drains to the northeast, into a DNR wetland (639W). This then drains south to Twin Lakes, which is located approximately 0.3 miles downstream from the airport. The remaining areas of the airport drain internally to the west and south sides of the airport, infiltrating into the ground. Stormwater from surrounding residential areas flows onto airport property. About 920 acres of Crystal, Brooklyn Center, Brooklyn Park and New Hope flow directly into the DNR wetland 639W from the north at 63rd Avenue. Another 120 acres drain into the airport at various locations. **Figure 2-10** shows the general ditch drainage, direction of flows, and inventoried wetland areas.

The airport lies within the jurisdiction of the Shingle Creek Watershed Management Commission (SCWMC). This commission was formed in 1982 under a Joint Powers Agreement between the Cities of Crystal, Brooklyn Park, Brooklyn Center, and is governed by a nine-member board. Their responsibility is protecting and managing the water resources within the watershed.

There are several small wetland areas around the airport, making up about 3 acres. This is in addition to the very large 420-acre DNR-regulated wetland 639W, of which 37 acres lie within airport property. The City of Crystal has implemented some changes within this wetland area to improve the quality of water flowing into Twin Lakes. The smaller wetlands are regulated under the Wetland Conservation Act by the neighboring cities as the local governmental units (LGUs). There is at least one Department of Natural Resources (DNR) regulated wetland on site. A field delineation was completed in 1998.

Each of the three cities has their own flood insurance rate maps. The maps for Brooklyn Park and Brooklyn Center generally identify the northeast wetland area and the inlet channel from 63rd Avenue as being within the 100-year floodplain. The Crystal maps do not show any 100-year floodplain areas at the airport, however, it is expected that the wetland complex and outlet channel also lie within the 100-year floodplain boundary. There have been no reports of historical flooding at the airport.

The MAC has a Multi-Sector General stormwater discharge Permit (MSGP) from the Minnesota Pollution Control Agency (MPCA) and maintains a Stormwater Pollution Prevention (SWPP) Plan and a voluntary Spill Prevention Control and Countermeasure (SPCC) Plan. These documents include Best Management Practices (BMPs) for protecting the stormwater conveyances, wetlands, and groundwater related to MAC industrial activity. Permit details along with water quality results for Crystal Airport (Permit MNR0539X7) can be found on the following website:

http://cf.pca.state.mn.us/water/stormwater/isw/search.cfm

Depending on FBO and tenant activities, they may be required to obtain and maintain their own MSGP from the MPCA, along with other requirements, such as an SPCC plan.

Chemicals used in deicing activities at airports is of national concern because of the potential effects on receiving water bodies. There is little to no aircraft deicing at Crystal Airport. Most aircraft can be stored inside heated hangars prior to takeoff or cannot fly when icing conditions exist, which reduces the need for glycol use. The MAC uses minor amounts of urea or other types of pavement deicing materials applied only on runways during icing conditions. The amount is, on average, less than approximately 2,000 pounds annually. Salt is not used due to its corrosive nature. Sand is used on a limited basis depending on weather conditions. Stormwater runoff from paved surfaces is routed through on-airport ditches that act as infiltration and sediment basins. This provides some treatment in addition to rate and volume control of flow off the airport. Given these efforts and minor use of deicers, the potential impact on water quality from the airport is minimal.

2.5.2 Utilities

Crystal Airport currently lies within the Metropolitan Urban Service Area (MUSA) for sanitary sewer service and has both water and sanitary systems available for tenants. These utilities were installed in 1999 after MAC adopted its Sanitary Sewer and Water Policy in 1998. This policy was subsequently revised in October 2000. The maintenance buildings, administration building and Airport Traffic Control Tower all have connections to the sewer and water. There are two restroom facilities available on the airport for tenants to use in lieu of connecting their individual hangar to the utilities. However, many of the tenants did connect, and most have the services available for connection should they decide to construct a bathroom inside their hangar.

The sewer and water pipes connect to the City of Crystal system in all building areas except for the North Building Area, which connects to the City of Brooklyn Park system. MAC has an agreement with the City of Brooklyn Park for the on-going maintenance and cost for future connections to the utilities. To date, no agreement has been executed between MAC and the City of Crystal. The city responds to any MAC or tenant requests for service, which is then paid for by the requesting party. Each city bills the tenants, MAC (for maintenance and administration buildings) and the FAA (for the Airport Traffic Control Tower) directly on a monthly or quarterly basis.

Most tenants at the Airport have either electric or natural gas service. The electrical lines are above ground in some locations at the airport, and below ground in others. The tenants are billed directly by the utility companies.

The West Metro Fire – Rescue District provides emergency services for Crystal Airport, including fire and rescue. Police and law enforcement is provided by the individual cities surrounding the airport.

2.6 OFF-AIRPORT LAND USE

One of the most significant challenges facing airports today is the presence of incompatible land use, either adjacent to the airport or in runway flight paths. Working closely with municipal officials, airport users, developers, and any nearby residents, airports can reduce these types of conflicts through the use of zoning regulations that disallow certain types of nearby development.

The Crystal Airport is located in an area of relatively dense residential development. Crystal, Brooklyn Park and Brooklyn Center have zoning jurisdiction in and around the airport. All three cities have adopted Comprehensive Plans that address land uses in the vicinity of Crystal Airport. Links to these Comprehensive Plans are provided in **Section 7.3**.

In general the land use and zoning all around the airport is predominantly single-family residential. There are areas to the north in Brooklyn Park zoned Business Park, Neighborhood Retail Business, Townhouse and multiple family residential. In addition, there is an area along Highway 81 in Crystal zoned General Commercial.

A Joint Airport Zoning Board (JAZB), including the Cities of Crystal, Brooklyn Park, Brooklyn Center, New Hope, Minneapolis, Robbinsdale and the Metropolitan Airports Commission, adopted an airport zoning ordinance in December 1983. The purpose of the ordinance is to protect against the construction of structures that will interfere with the operations at the airport. Although a number of homes are located within the designated safety zones, these areas were accepted as “established residential neighborhoods in built-up urban areas.” Upon adoption of the ordinance by the JAZB, it was the responsibility of each individual city to adopt the ordinance and conform their zoning to the ordinance requirements. According to the City of Crystal’s current Comprehensive Plan, the airport zoning regulations were adopted by the City in 1983 and one of the City’s aviation policies is to continue to protect airspace in accordance with the Joint Airport Zoning Ordinance. A copy of the Crystal Airport Joint Airport Zoning Ordinance is provided in **Appendix 7**.

Existing land uses in the vicinity of Crystal Airport are depicted on **Figure 2-11**.

2.7 ECONOMIC IMPACTS

Development at Crystal Airport will continue to be self-funded by users of the airport and aviation system; no local sales or property taxes are or will be used to fund airport improvements.

MAC expends between $500,000 and $600,000 annually to operate and maintain Crystal Airport to a high level of safety and operational efficiency with no direct cost to local taxpayers.

MAC-owned land that is not leased to airport users or tenants is exempt from property taxes under State law. Leaseholds and the structures located within those leases are subject to property taxes which are paid by the tenants.

Hennepin County assesses property taxes on hangar owners based on the taxable market value of the hangars. For 2015, the total property tax billed on hangars at Crystal Airport was approximately $80,000.00. Of these tax revenues, the largest recipient is the City of Crystal, which received approximately $26,000.00 from airport tenants. The local school district (ISD 281 Robbinsdale) received approximately $26,000.00 in revenue as well, and Hennepin County approximately $23,000.00. The remaining tax revenues supported Hennepin County Parks, Metro Transit, and the Metropolitan Council.

MnDOT Aeronautics provides an Airport Economic Impact Calculator to estimate the economic value of airports in the State: (http://www.dot.state.mn.us/aero/econimpactcalc.html).

According to output obtained from this tool, the total economic impact from activity occurring at Crystal Airport is approximately $81,000,000 annually and accounts for approximately 250 jobs in the county.

This is based on the following activity inputs:

- $570,000 average annual operations and maintenance (O&M) expenses;
- $400,000 average annual capital expenses;
- Tenant activities: 62 full-time employees, 20 part-time employees, 8 owned aircraft;
- 70 annual transient overnight aircraft;
- 380 annual charter visitors; and
- One non-profit organization aircraft (Civil Air Patrol).

Figure 2-1: Airport Layout

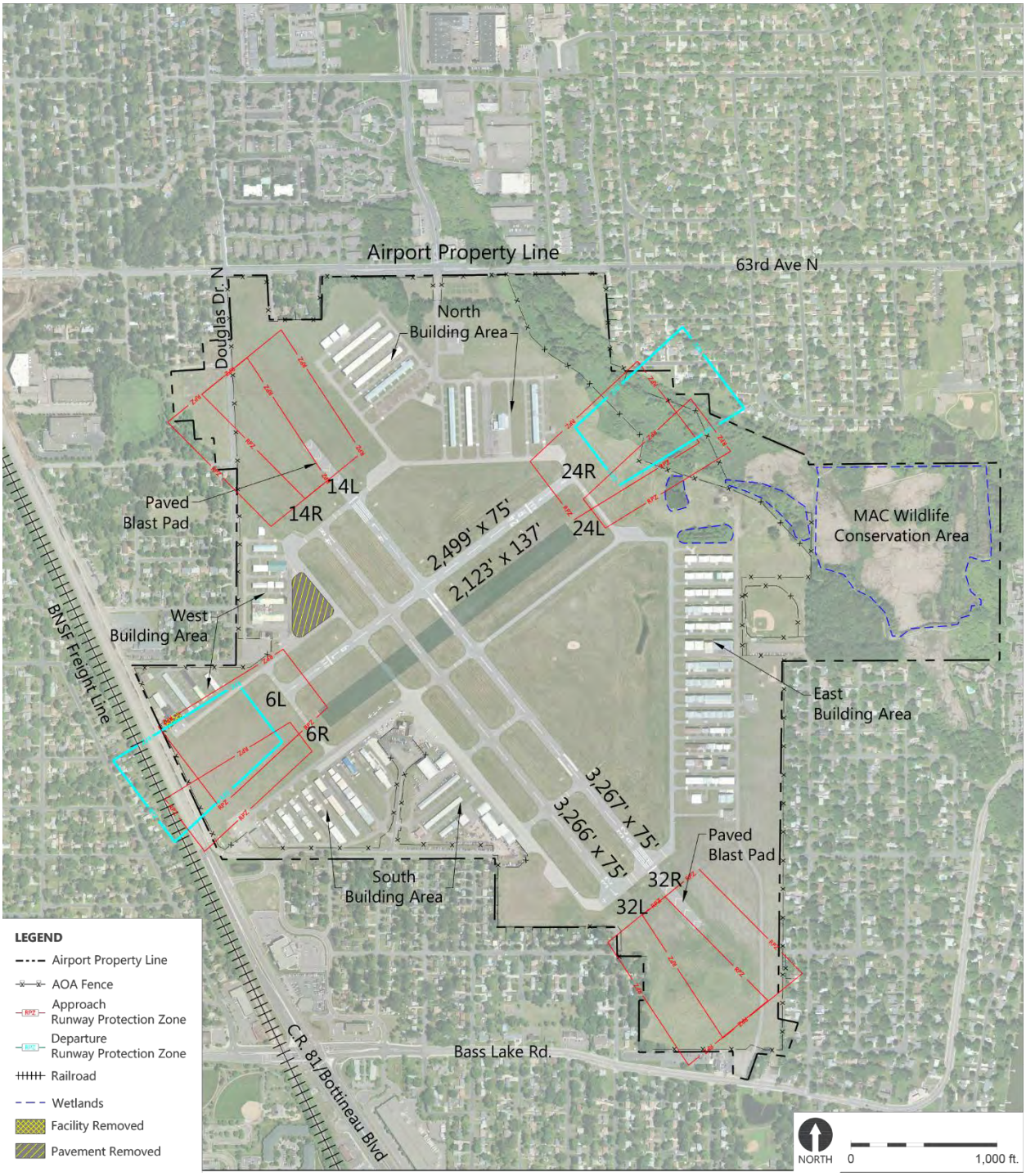


Figure 2-2: Crystal Airport Pavement Condition Index (2014 PCI)

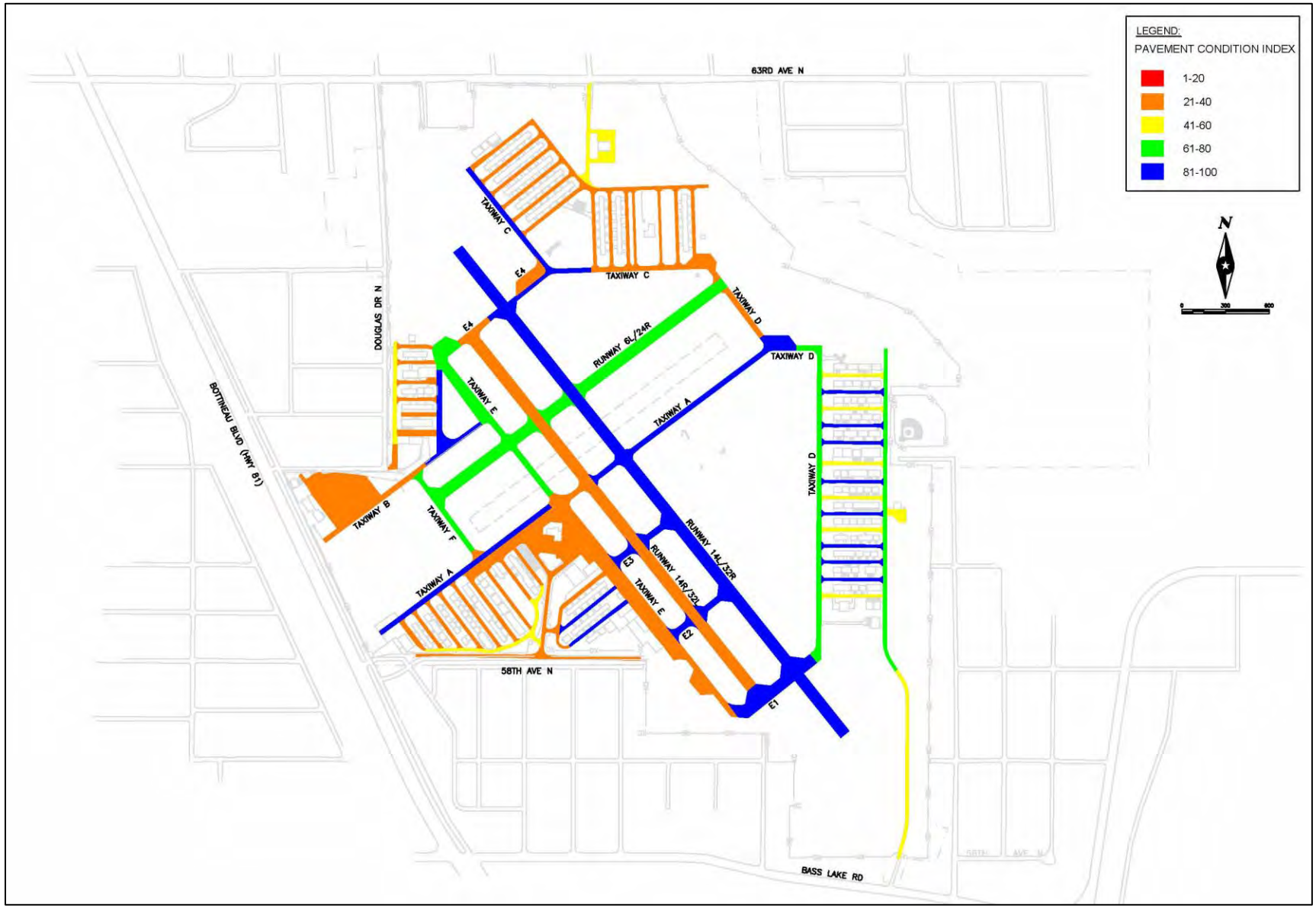


Figure 2-3: Runway Safety Area, Object Free Area, and Protection Zone Key Map

(See Table 2-2 for dimensions)

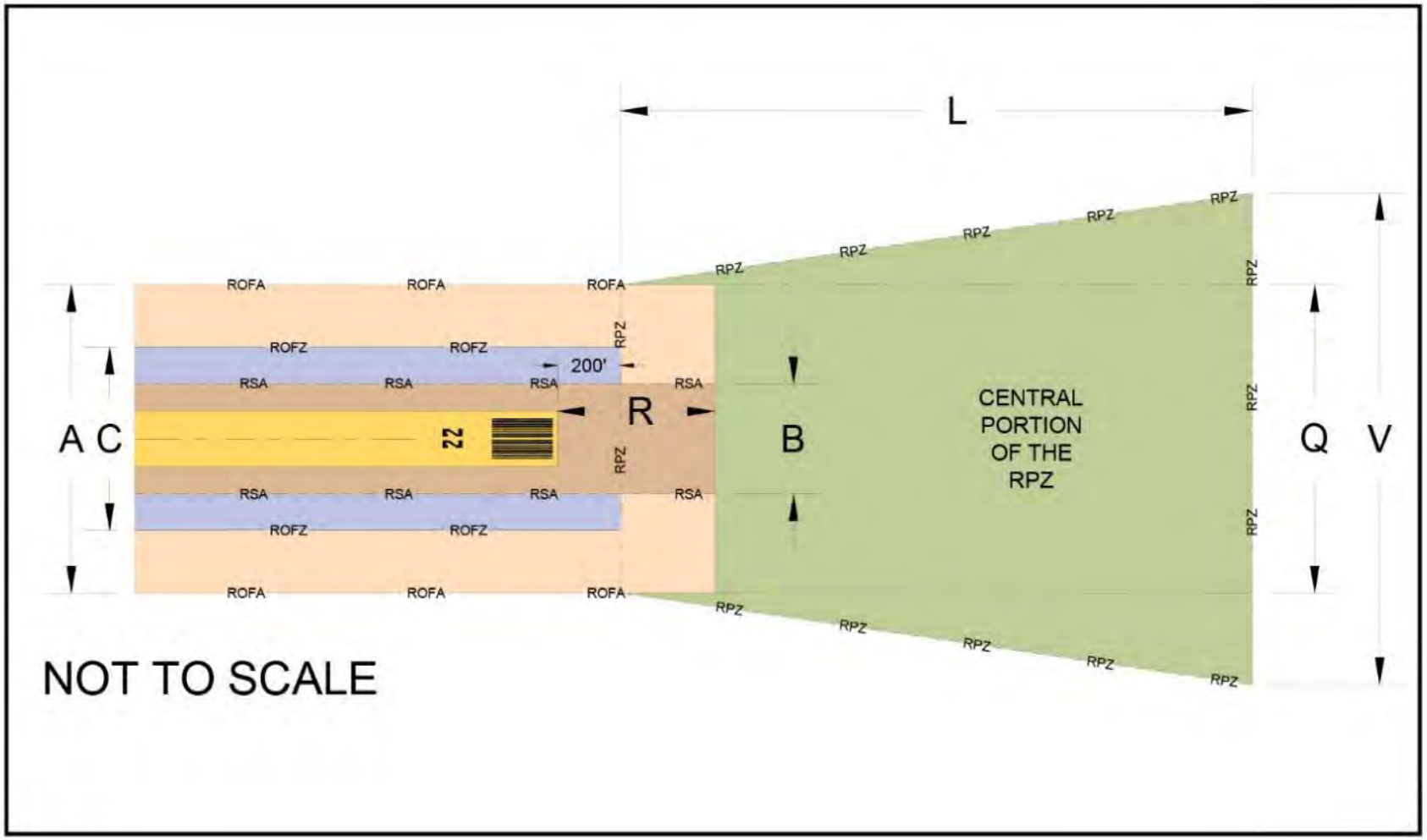


Figure 2-4: Crystal Airport Designated Hot Spots

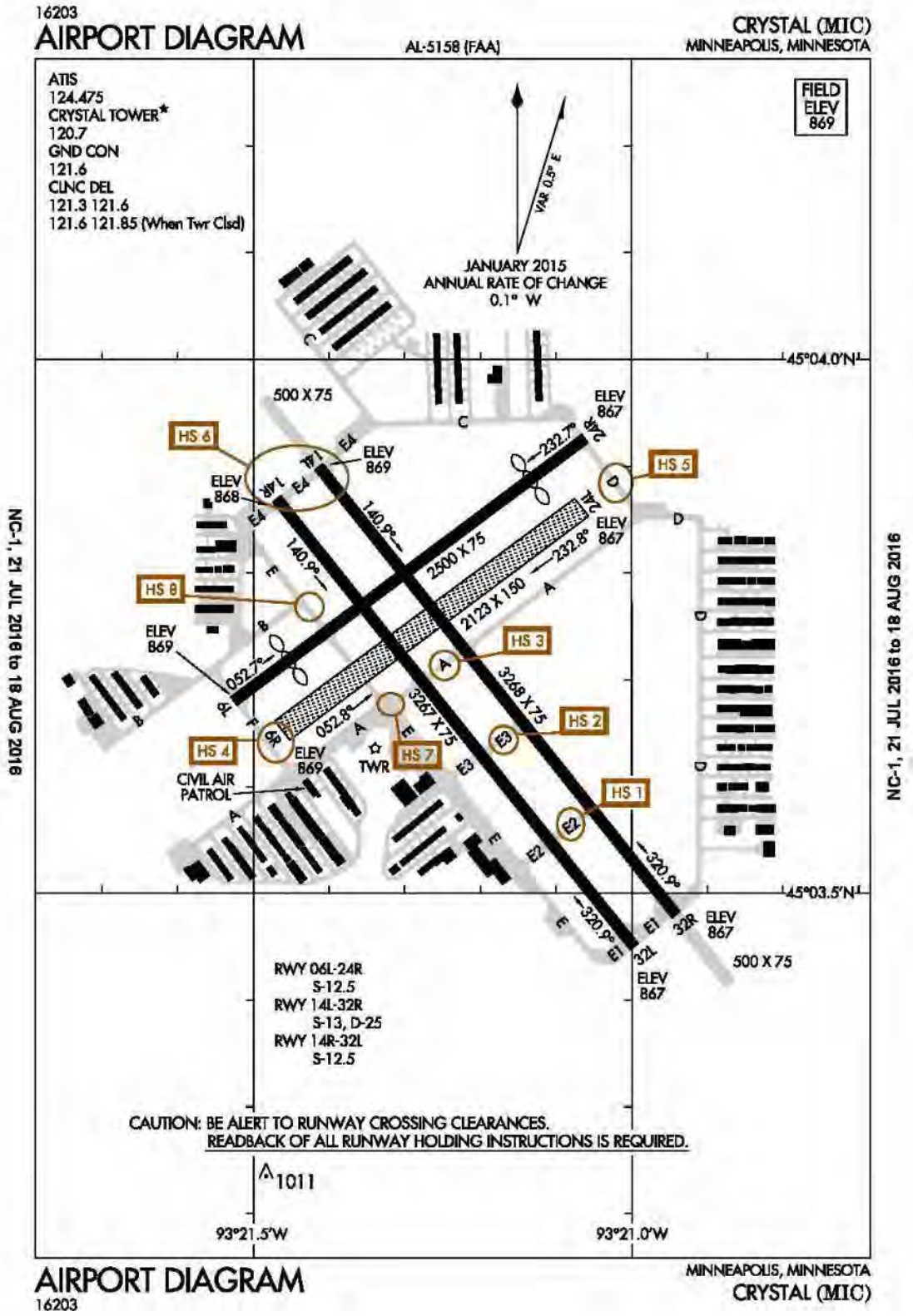


Figure 2-5: National Airspace System Overview

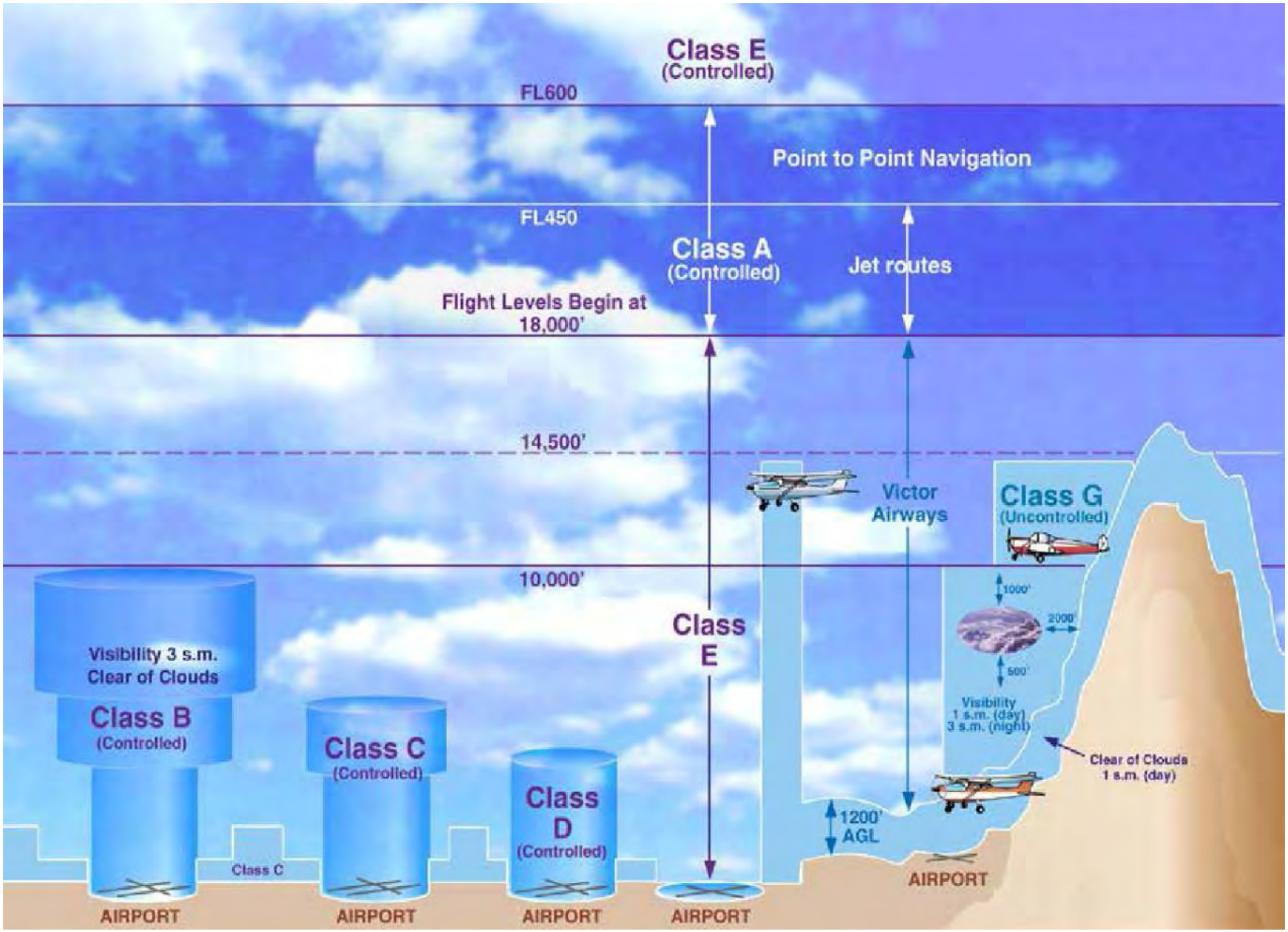


Figure 2-6: Regional Airspace

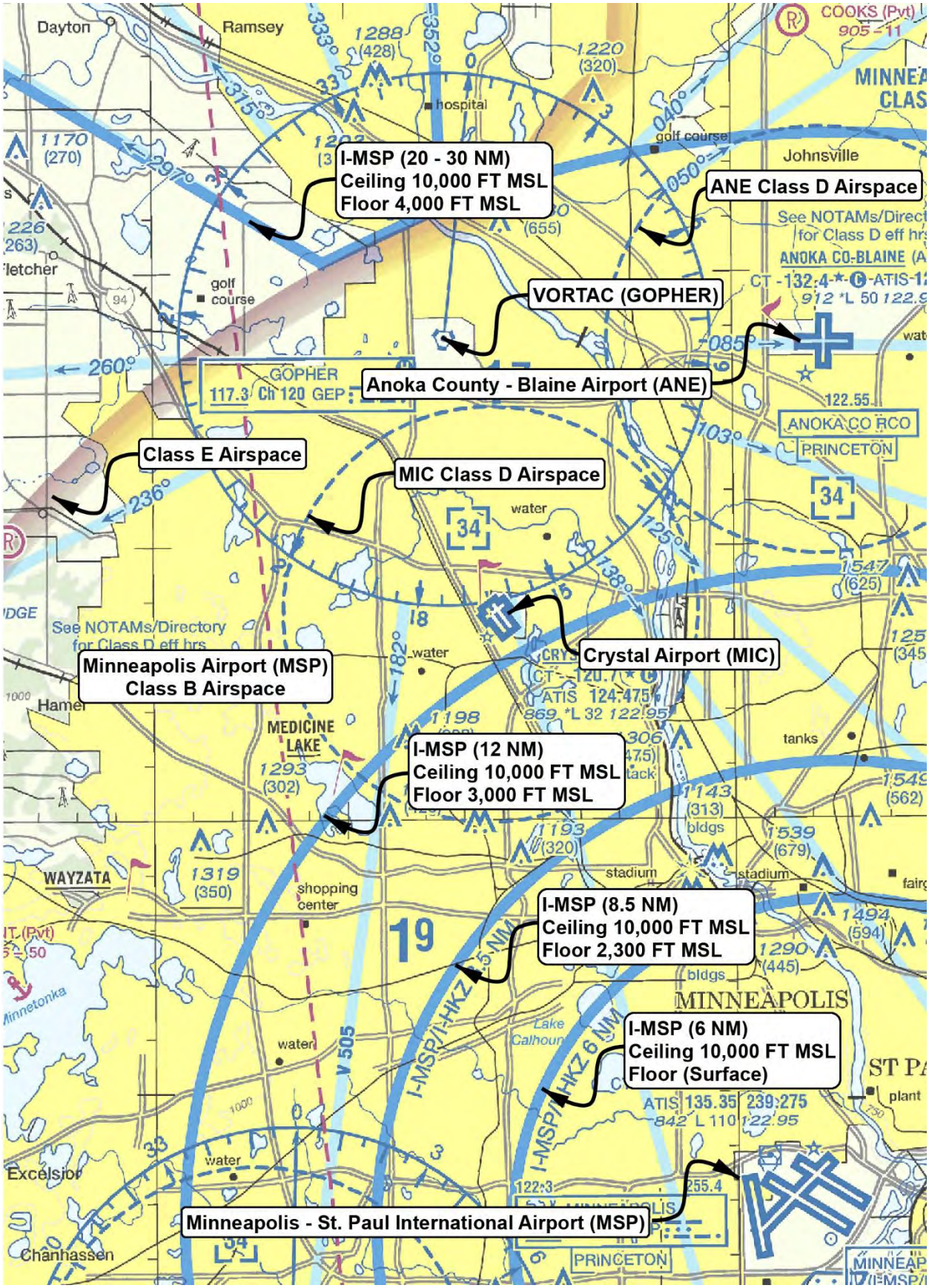
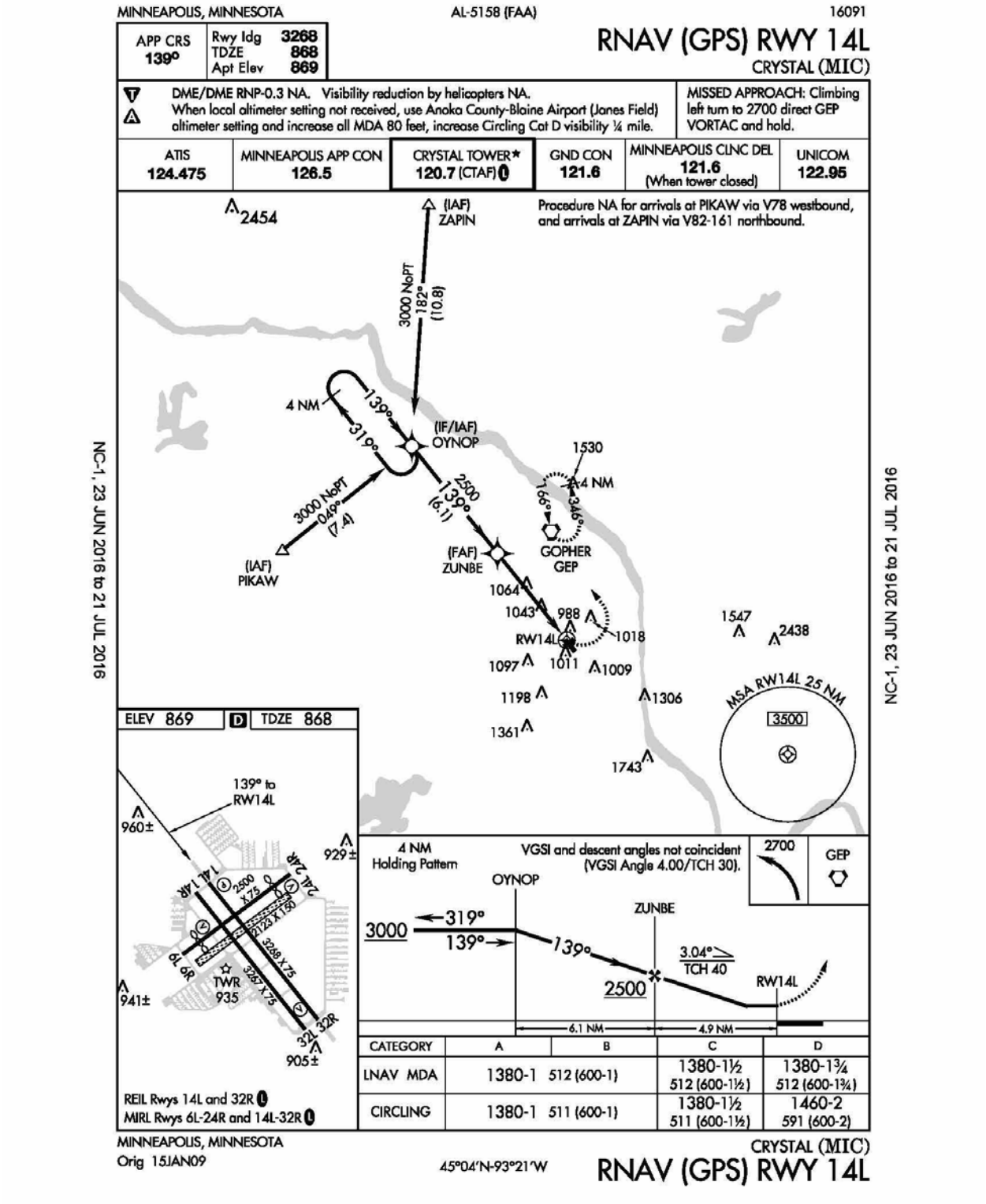


Figure 2-7: Instrument Approach Procedures



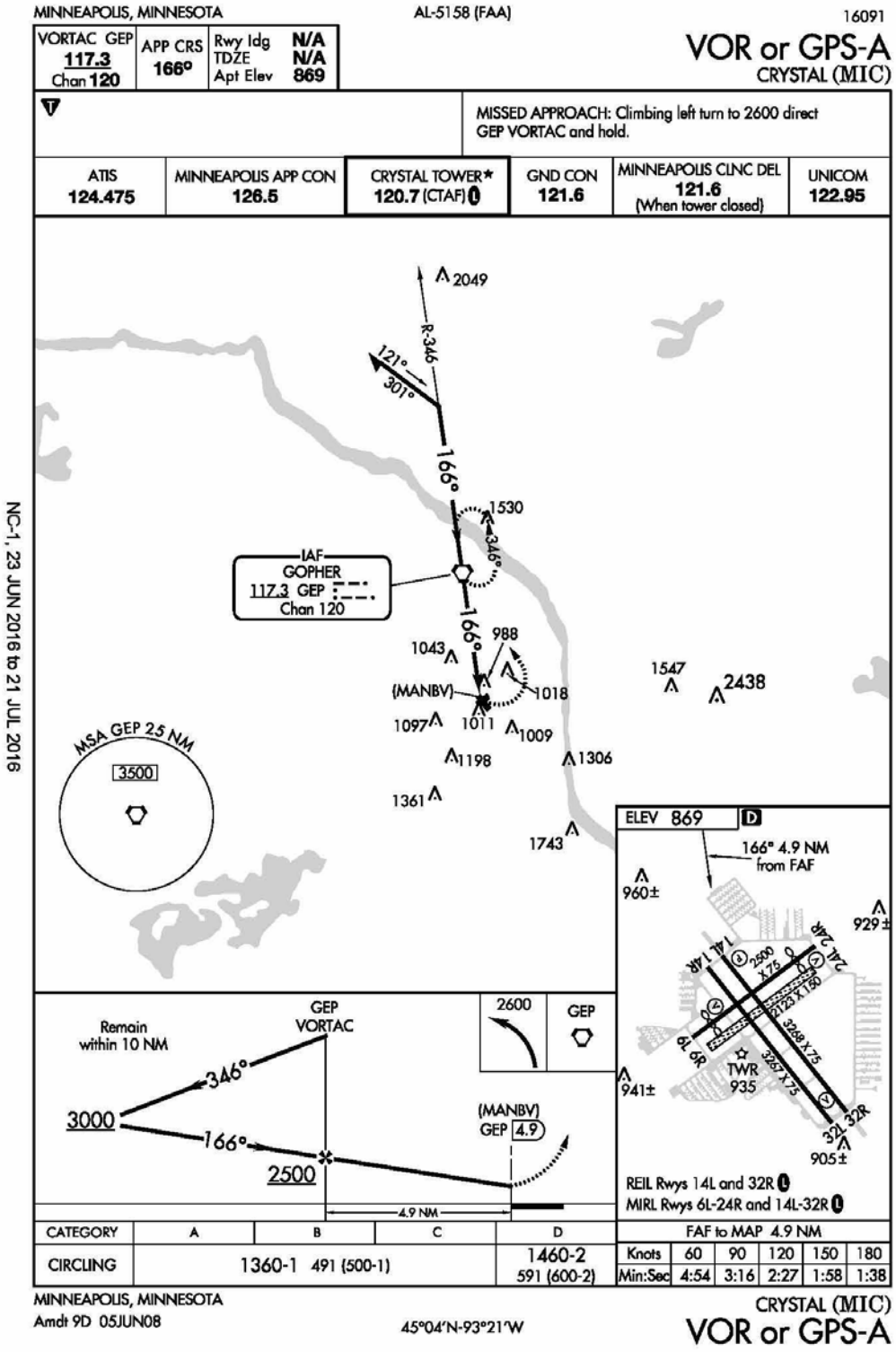

MINNEAPOLIS, MINNESOTA
AL-5158 (FAA)
16091
VOR or GPS-A
CRYSTAL (MIC)
VORTAC GEP 117.3 Chan 120
APP CRS 166°
Rwy Idg N/A
TDZE N/A
Apt Elev 869
MISSED APPROACH: Climbing left turn to 2600 direct GEP VORTAC and hold.
ATIS 124.475
MINNEAPOLIS APP CON 126.5
CRYSTAL TOWER* 120.7 (CTAF)
GND CON 121.6
MINNEAPOLIS CLNC DEL 121.6 (When tower closed)
UNICOM 122.95
NC-1, 23 JUN 2016 to 21 JUL 2016
2049
R-346
121°
301°
166°
1530
IAF
GOPHER
117.3 GEP
Chan 120
988
1043
(MANBV)
1018
1097
1011
1009
1198
1306
1361
1743
1547
2438
MSA GEP 25 NM
3500
ELEV 869
D
166° 4.9 NM from FAF
960±
929±
941±
905±
TWR 935
14L-32R
14L-32R
6L-24R
6L-24R
2500 X 75
2123 X 150
3268 X 75
3267 X 75
REIL Rwys 14L and 32R
MIRL Rwys 6L-24R and 14L-32R
Remain within 10 NM
GEP VORTAC
346°
3000
166°
2500
2600
GEP
(MANBV)
GEP 4.9
4.9 NM
CATEGORY A B C D
CIRCLING 1360-1 491 (500-1) 1460-2 591 (600-2)
FAF to MAP 4.9 NM
Knots 60 90 120 150 180
Min:Sec 4:54 3:16 2:27 1:58 1:38
MINNEAPOLIS, MINNESOTA
Amdt 9D 05JUN08
45°04'N-93°21'W
CRYSTAL (MIC)
VOR or GPS-A

Figure 2-8: FAR Part 77 Airspace Surfaces

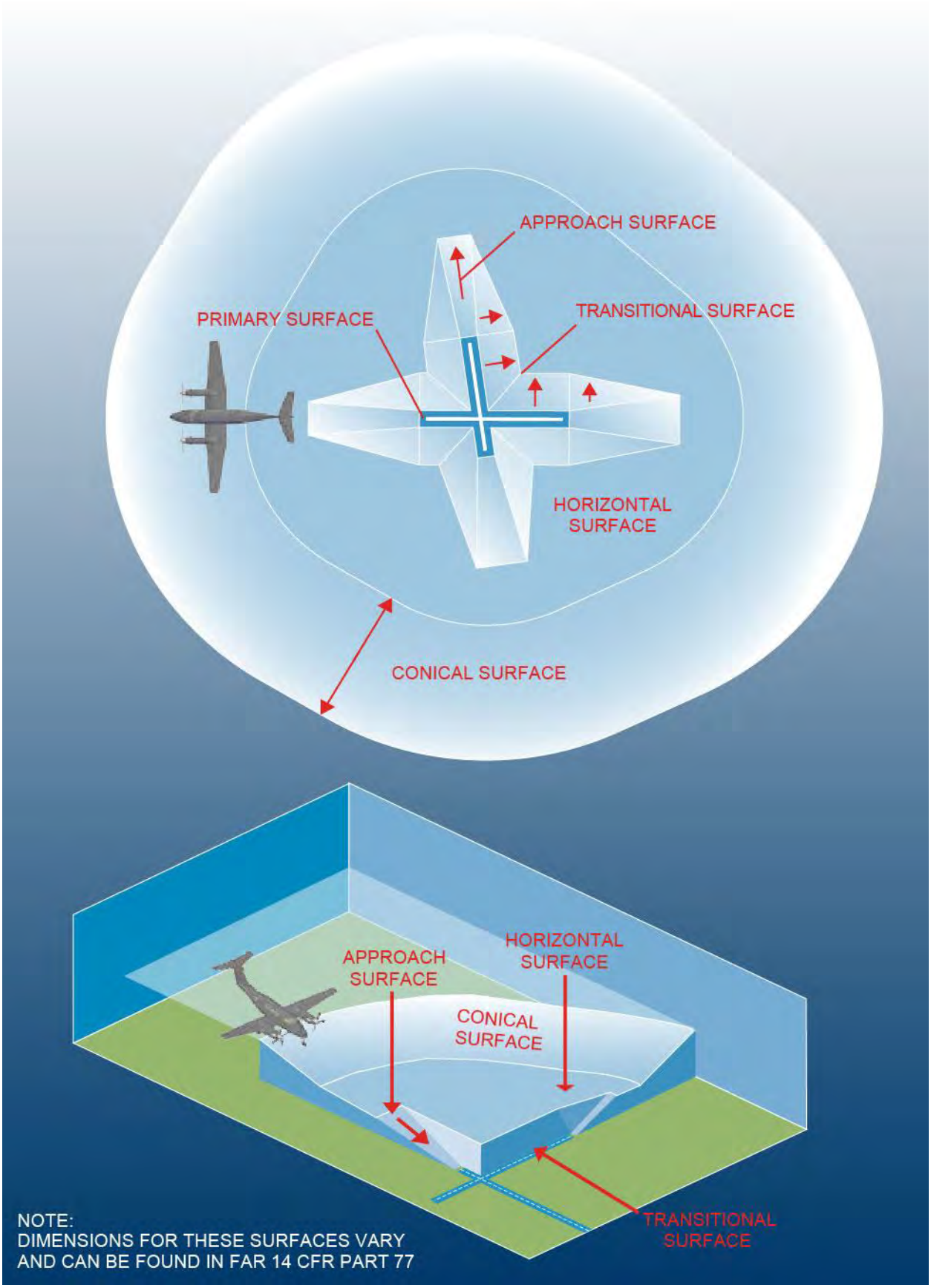
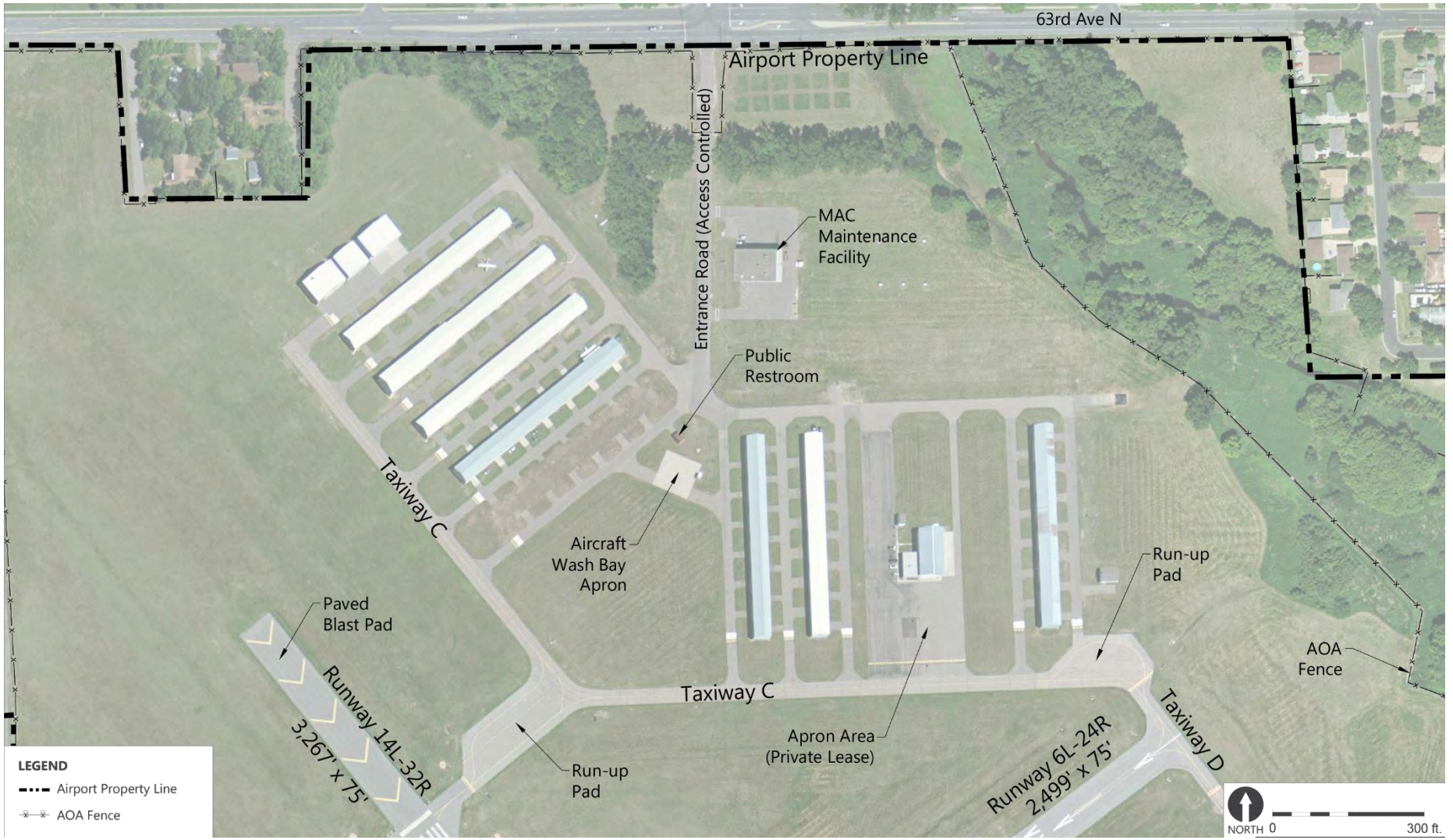


Figure 2-9: Crystal Airport Building Areas

South Building Area

West Building Area

North Building Area



East Building Area

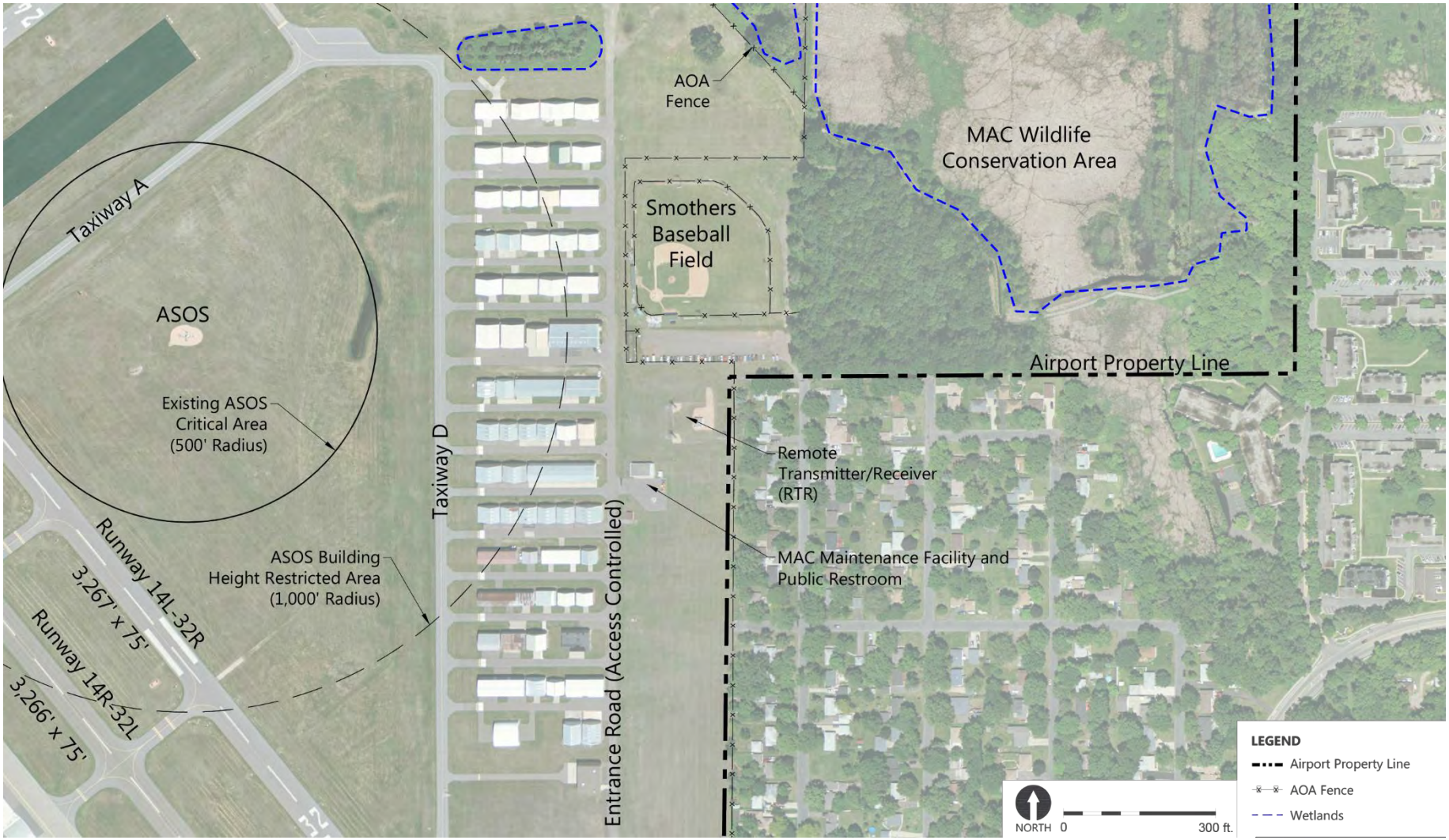


Figure 2-10: Airport Drainage and Wetlands

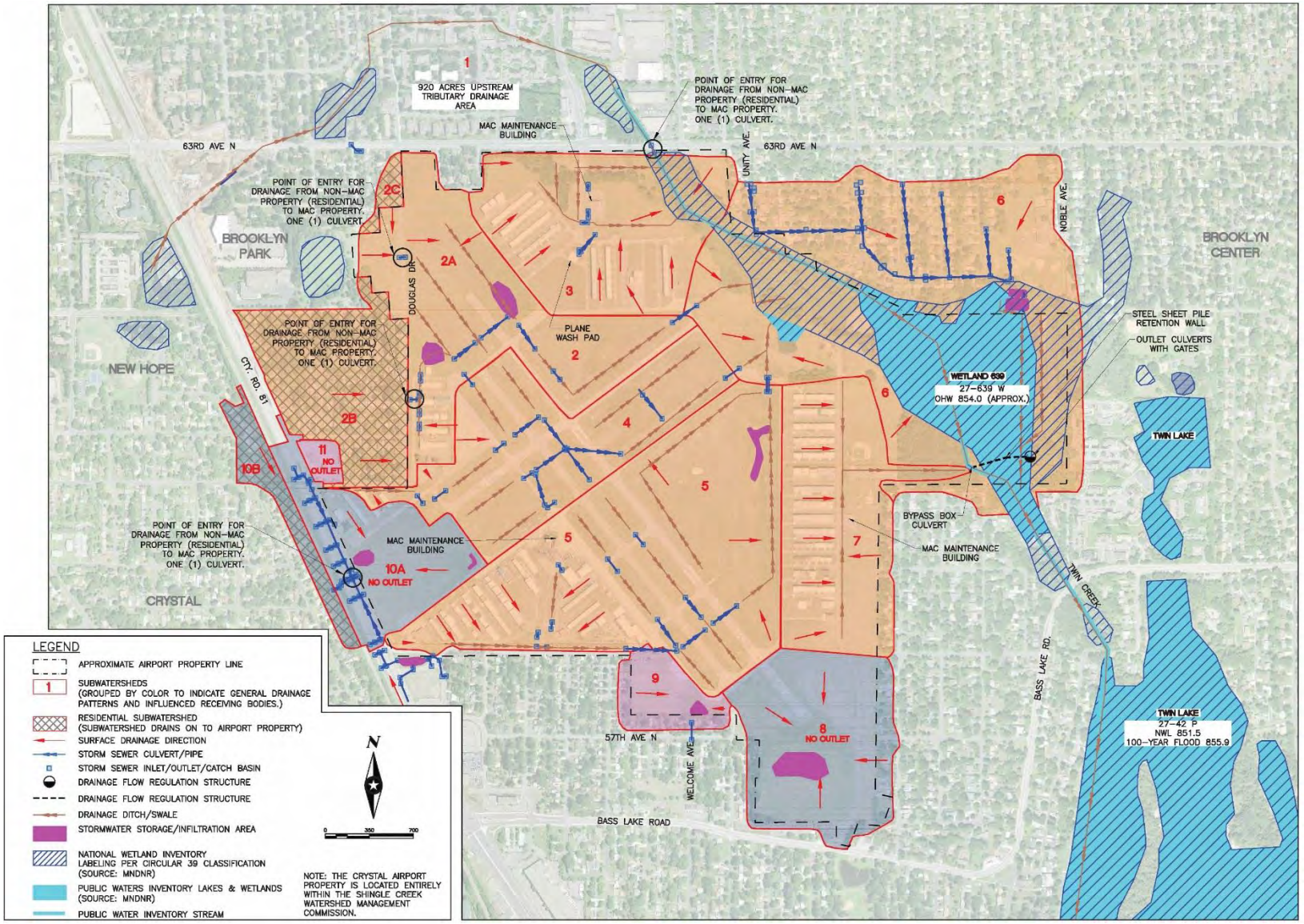
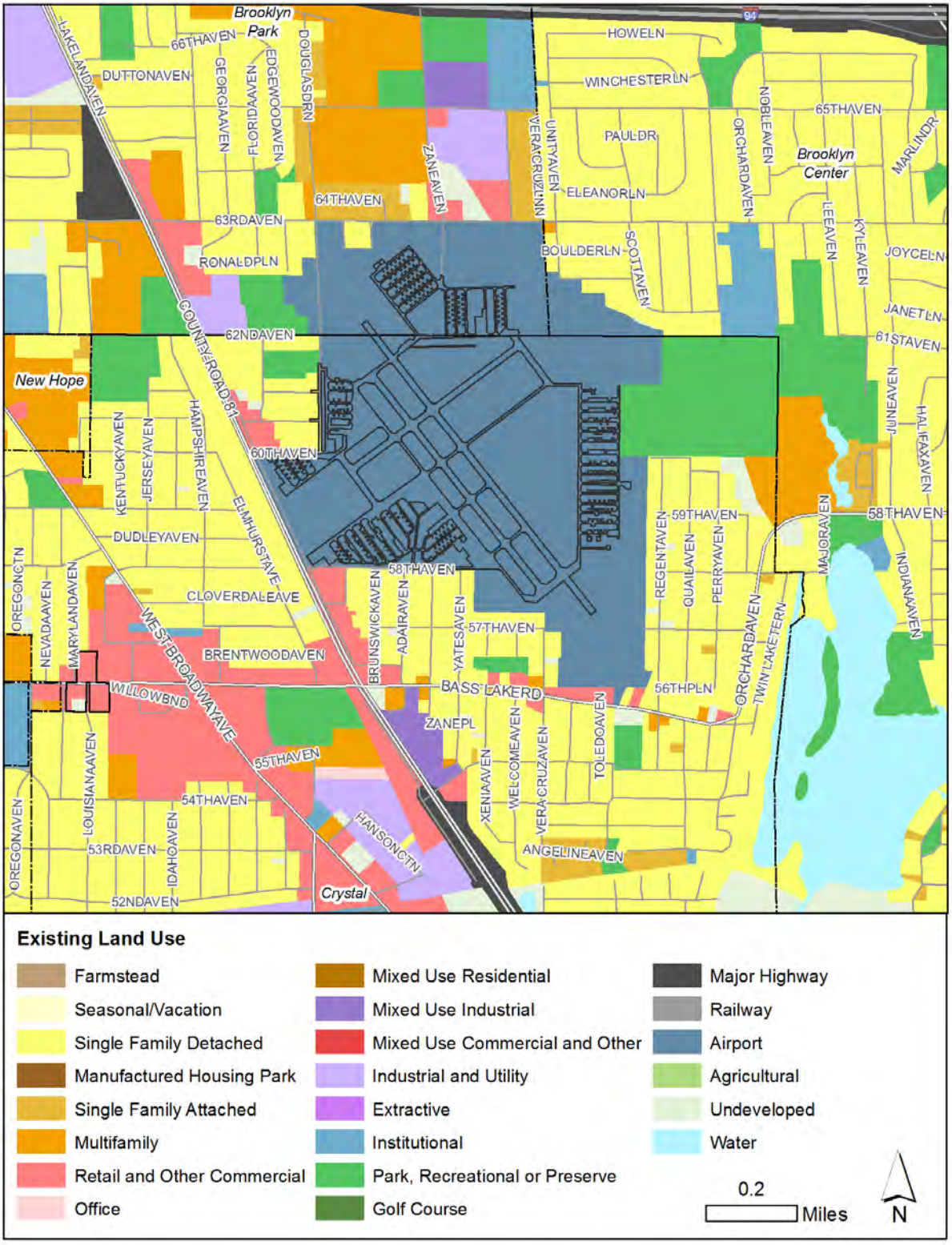


Figure 2-11: Existing Off-Airport Land Use



SECTION 3:

AVIATION FORECASTS

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3. AVIATION FORECASTS

3.1 INTRODUCTION

This chapter summarizes the LTCP activity forecast for Crystal Airport. The base year is represented by the twelve months ending June 2015 and forecasts were prepared for 2020, 2025, 2030, and 2035. These forecasts assume an unconstrained demand for aviation services but assume that the type of aircraft that can fly in and out of the airport is constrained by the lengths of the existing runways. The chapter begins with a description of the forecast approach, followed by a discussion of the forecasts for based aircraft and aircraft operations, and then concludes with a set of alternative forecast scenarios.

The assumptions inherent in the following calculations are based on data provided by the MAC, federal and local sources, and professional experience. Forecasting, however, is not an exact science. Departures from forecast levels in the local and national economy and in the aviation industry would have a significant effect on the forecasts presented herein.

A summary of the methodology used to prepare the aviation activity forecasts is presented in **Appendix 3**. The complete *Minneapolis-St. Paul Reliever Airport: Activity Forecasts – Technical Report (October 2015)* that contains full forecast development documentation can be downloaded from the MAC website through the following link:

https://metroairports.org/General-Aviation/General-Aviation-Documents/MSP-Reliever-Technical-Report-10-30-2015.aspx

3.2 HISTORICAL ACTIVITY LEVELS

The total number of aircraft based at Crystal airport declined from 1990 to 2015. The total counts stayed above 300 aircraft before 2000 but declined to around 185 recently. Aircraft operations fell more rapidly than based aircraft over the same period, indicating reduced utilization for those aircraft that remained based at MIC.

A number of factors have contributed to the decline. These include the slowing economy, increased fuel prices and other operating costs, and reduced interest in recreational flying by younger generations.

Table 3-1 summarizes historical based aircraft and aircraft operations at Crystal Airport.

Table 3-1: Historical Activity Levels

Year	Based Aircraft	Aircraft Operations
1990	324	189,906
1995	327	172,024
2000	296	176,554
2005	265	71,704
2010	219	44,229
2011	199	43,986
2012	219	48,220
2013	189	42,308
2014	185	41,117
2015	185	41,838(a)

Notes:

(a) Twelve months ending June 2015. Includes estimate of nighttime activity.

Source: MAC Records, HNTB Activity Forecasts

Through the late 1990s, a significant amount of Crystal's aircraft operations were attributable to robust levels of flight training activity – a role that the Airport was well-suited to fill. However, the events of 9/11 and the subsequent economic downturn rippled through the aviation industry and resulted in diminished demand for flight training.

As illustrated in the exhibit on the following page, the number of local aircraft operations[15] at Crystal Airport declined rather drastically between 2000 and 2010, illustrating the impact that the end of the flight training boom had on total activity at Crystal Airport. Although itinerant aircraft operations[16] declined as well, the reduction was not nearly as dramatic as in local activity.

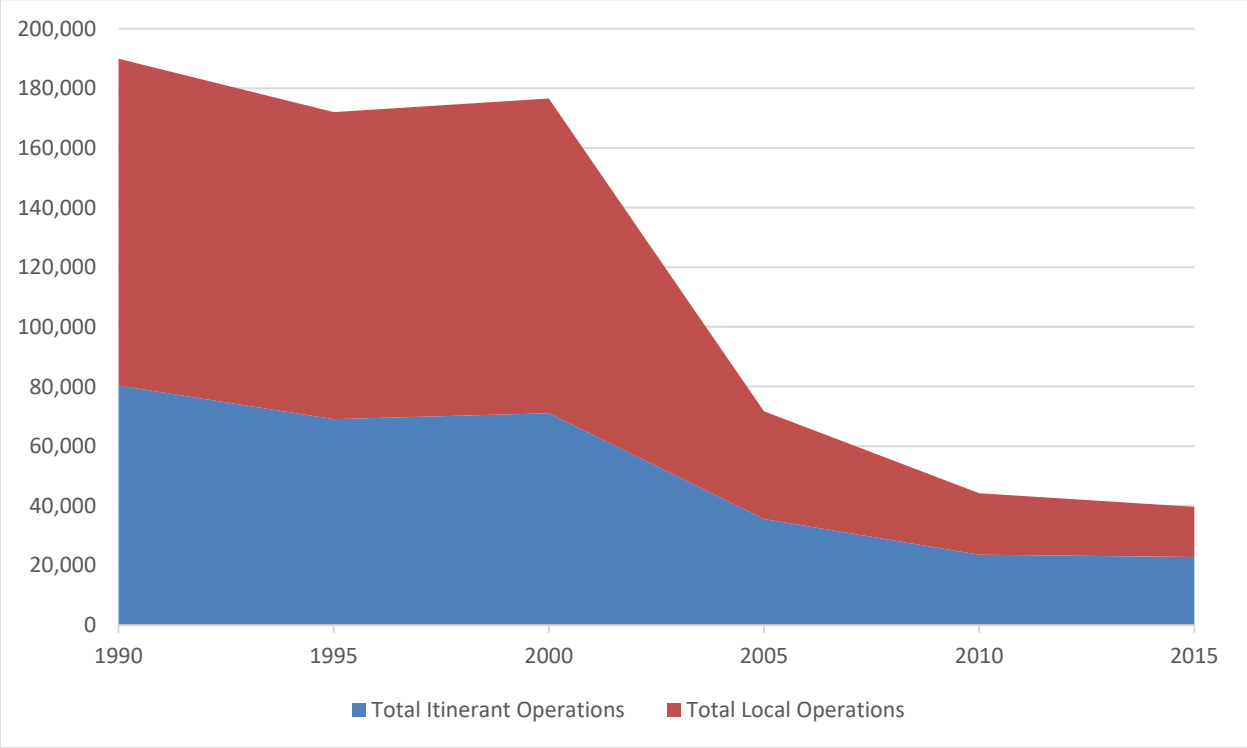
In 1995, the operational mix of traffic at Crystal Airport was approximately 60% local and 40% itinerant. By 2015, these trends had reversed, with 58% of the traffic itinerant and 42% local.

During 2015, FAA records indicate that approximately 2,400 flights at Crystal Airport, or about 6% of total operations, filed an instrument flight plan. Aircraft operating on an instrument flight plan are more likely to fly for a business-related purpose than aircraft filing visual flight plans.

[15] Local operations are those operations performed by aircraft that remain in the local traffic pattern, execute simulated instrument approaches or low passes at the airport, and the operations to or from the airport and a designated practice area within a 20−mile radius of the tower.

[16] Itinerant operations are operations performed by an aircraft, either IFR, SVFR, or VFR, that lands at an airport, arriving from outside the airport area, or departs an airport and leaves the airport area.

Local vs. Itinerant Operational Trends (1990-2015)



3.3 SOCIOECONOMIC PROJECTIONS

Population forecasts from the Metropolitan Council and per capita income forecasts from Woods & Poole Economics were used to develop hybrid income forecasts for each county in the metropolitan area. The income forecasts were used to estimate the share of based aircraft growth accounted for by each county. A summary of key socioeconomic projections for Hennepin County is provided in **Table 3-2**.

Table 3-2: Hennepin County Socioeconomic Growth Trends

Socioeconomic Indicator	Hennepin County 2013 - 2035			
	2013	2035	Change	% Growth
Population	1,198,778	1,407,582	208,804	17%
Employment	1,090,069	1,330,651	240,582	22%
Real Personal Income	$73,616,213	$122,619,582	$49,003,369	67%
Per Capita Personal Income	$61,409	$87,114	$25,705	42%

Source: HNTB Activity Forecasts

A comparison of the projected socioeconomic indicator growth rates for Hennepin County, the Seven-County Metropolitan Area, and the United States as a whole is presented in **Table 3-3**.

Table 3-3: Comparison of Project Socioeconomic Growth Rates

Socioeconomic Indicator	Average Annual Growth Rates 2013 - 2035		
	Hennepin County	7-County Metro	United States
Population	0.8%	0.8%	0.9%
Employment	1.1%	1.1%	1.2%
Real Personal Income	2.3%	2.2%	2.2%
Per Capita Personal Income	1.5%	1.3%	1.3%

Source: HNTB Activity Forecasts

Based on this analysis, Hennepin County is expected to experience near-average growth in population and employment, and above-average growth in income throughout the forecast period. These trends can be viewed as an overall positive indicator for the continued viability of aviation demand in the vicinity of Crystal Airport.

3.4 BASE CASE FORECAST

Forecasts include based aircraft and operations for each major category: single-engine piston, multi-engine piston, turboprop, jets, helicopters, sport aircraft, experimental, and other. It was assumed that the share of each county's registered aircraft in every aircraft category based at all of the airports under study will remain constant.

In the Base Case forecast scenario, the number of based aircraft at Crystal Airport is projected to decline slightly, from 185 aircraft in 2015 to 171 aircraft in 2035. The dominant aircraft in the fleet, piston engine aircraft, are projected to decline, consistent with the *FAA Aerospace Forecast Fiscal Years 2015-2035*. Helicopters and experimental aircraft are expected to increase but not fast enough to offset the decline in the piston category.

Table 3-4 provides a summary of the based aircraft forecast.

Operations at Crystal Airport are projected to decrease slightly from 41,838 in 2015 to 39,904 in 2035, an average annual decrease of approximately 0.2 percent. Increases are projected in all categories except single-engine and multi-engine piston aircraft, for which the anticipated decrease in the based aircraft offsets slightly higher utilization forecasted by the FAA.

Table 3-5 provides a summary of the aircraft operations forecast.

Table 3-4: Summary of Based Aircraft Forecast (Base Case)

Aircraft Category	2015	2020	2025	2030	2035	AAG
Single-Engine Piston	154	148	143	138	136	-0.6%
Multi-Engine Piston	14	14	14	12	12	-0.8%
Turboprop	0	0	0	0	0	0.0%
Jets	0	0	0	0	0	0.0%
Helicopter	2	2	3	3	3	2.0%
Other	15	16	17	18	20	1.4%
Total	*185*	*180*	*177*	*171*	*171*	*-0.4%*

Notes:

AAG - Average Annual Growth Rate from 2015 to 2035

Other category includes experimental and light sport aircraft types

Source: HNTB Activity Forecasts

Table 3-5: Summary of Aircraft Operations Forecast (Base Case)

Aircraft Category	2015	2020	2025	2030	2035	AAG
Single-Engine Piston	35,039	32,046	30,993	30,283	30,633	-0.7%
Multi-Engine Piston	2,460	2,398	2,398	2,116	2,235	-0.5%
Turboprop	89	90	96	109	126	1.8%
Jets	8	10	12	14	16	3.5%
Helicopter	829	1,002	1,142	1,440	1,440	2.8%
Other	3,413	3,949	4,384	4,774	5,454	2.4%
Total	*41,838*	*39,495*	*39,025*	*38,736*	*39,904*	*-0.2%*

Notes:

AAG - Average Annual Growth Rate from 2015 to 2035

Other category includes experimental and light sport aircraft types

Source: HNTB Activity Forecasts

The percentage of operations occurring in August, the peak month at Crystal Airport, was estimated from FAA air traffic control tower records. Average Day Peak Month (ADPM) operations were estimated by dividing by 31 days. Peak hour operations were obtained from the FAA Distributed Operations Network (OPSNET). The peak hour percentage in the peak month over the past four years has averaged 18.4 percent. As depicted in **Table 3-6**, peak hour operations are projected to fluctuate between 27 and 29 operations.

Table 3-6: Peak Period Forecasts (Base Case)

Peak Periods	2015	2020	2025	2030	2035
Annual Operations	41,838	39,495	39,025	38,736	39,904
Peak Month Operations	4,865	4,592	4,538	4,486	4,640
ADPM Operations	157	148	147	145	150
Peak Hour Operations	29	27	27	27	28

Notes:

ADPM - Average Day of the Peak Month

Source: HNTB Activity Forecasts

3.5 FORECAST SCENARIOS

Historically, general aviation activity has been difficult to forecast, since the relationships with economic growth and pricing factors are more tenuous than in other aviation sectors, such as commercial aviation. This uncertainty is likely to carry over into the near future, given the volatility of fuel prices and the continued shift in GA from personal and recreational use to business use. To address these uncertainties, and to identify the potential upper and lower bounds of future activity at the study airports, detailed high and low scenarios are presented. These scenarios use the same forecast approach that was used in the base case, but alter the assumptions to reflect either a more aggressive or more conservative outlook.

The high forecast scenario is based on the assumption that income would grow 0.5 percent per year faster than in the base case. All other assumptions are the same as in the base case. The low forecast scenario is based on the assumption that income would grow 0.5 percent more slowly each year than under the base case.

Subsequent to the preparation of the high and low forecast scenarios, two additional scenarios were developed to evaluate the potential impact associated with the following alternative airfield development concepts:

- Designating the existing blast pad pavement beyond each end of Runway 14L-32R as stopway. Pavement designated as stopway can be considered as useable length for decelerating an aircraft during an aborted takeoff. Stopway pavement can be used for accelerate-stop distance calculations, but not for other takeoff or landing distance calculations. Stopways do not change the published runway length, nor are they intended to attract aircraft types different

than those operating at the airport today. However, the availability of stopways may result in a small increase in aircraft operations from some users who find the existing runway length to be limiting based on accelerate-stop distance criteria. In the stopway scenario, the number of additional aircraft operations above the base case is approximately 230 annually by 2035, translating to just over four additional takeoffs and landings per week. Of the additional operations, the majority are expected to be turboprops (approximately three-quarters), with the remaining increase coming from light business jet aircraft. All other forecast assumptions are the same as in the base case.

- Converting portions of the existing paved blast pads on each end of Runway 14L-32R to useable runway to provide a published runway length of 3,750 feet. Due to the constrained nature of the airport, however, this will require the implementation of declared distances, meaning that not all of the published pavement would be available for landing and takeoff movements in each direction. With the increase in published runway length (from 3,267 feet to 3,750 feet), the number of additional aircraft operations above the base case is estimated to be approximately 314 annually by 2035, translating to approximately six additional takeoffs and landings per week. As with the stopway scenario, the majority of additional operations are expected to be from turboprop aircraft.

A comparison of the aircraft operations forecasts associated with the Base Case, Original Preferred Alternative (Stopway Scenario), and Refined Alternative (Extended Runway) scenarios is provided in **Table 3-7**.

Table 3-7: Aircraft Operations Forecast Comparison

Year	Aircraft Operations Forecast			Change from Base Case	
	Base Case	Stopway Scenario	Extended Runway (3,750')	Stopway Scenario	Extended Runway (3,750')
2015 (a)	41,838	41,838	41,838	0	0
2020	39,495	39,652	39,707	157	212
2025	39,025	39,196	39,258	171	233
2030	38,578	38,774	38,845	196	267
2035	39,904	40,135	40,218	231	314

Source: HNTB Activity Forecasts and MAC analysis

Table 3-8 compares the total number of based aircraft and operations under different scenarios for Crystal Airport. The base case and extended runway scenario LTCP forecasts are consistent with the FAA 2015 Terminal Area Forecast (TAF) as they differ by less than 10 percent in the 5-year forecast period and 15 percent in the 10-year forecast period. More detailed fleet mix tables for each forecast scenario are presented in **Appendix 3**.

Table 3-8: Forecast Comparison by Scenario

Year	Total Based Aircraft			Total Number of Operations						Variance from TAF (Operations)	
	Base Case	High Range	Low Range	Base Case	High Range	Low Range	Stopway Scenario	Extended Runway	2015 TAF	Base Case	Extended Runway
2015	185	185	185	41,838	41,838	41,838	41,838	41,838	38,917	8%	8%
2020	180	184	177	39,495	40,389	38,818	39,652	39,707	39,158	1%	1%
2025	177	184	169	39,025	40,589	37,232	39,196	39,258	39,739	-2%	-1%
2030	171	183	162	38,578	41,322	36,455	38,774	38,845	40,330	-4%	-4%
2035	171	187	158	39,904	43,507	36,732	40,135	40,218	40,931	-3%	-2%
Average Annual Growth Rate											
	-0.4%	0.1%	-0.8%	-0.2%	0.2%	-0.6%	-0.2%	-0.2%	0.3%		

Notes:

TAF - 2015 Terminal Area Forecast published by FAA

Sources: HNTB Analysis.

3.6 FORECAST SUMMARY

Recent activity levels at Crystal Airport (per **Table 3-1**) indicate that levels of based aircraft and aircraft operations have largely stabilized since 2010 after steady decreases in the 1990 to 2010 timeframe. Based on the economic outlook for both Hennepin County and the Seven-County Metropolitan Area, along with projected trends for General Aviation flying, the forecasts predict a period of stable activity levels for Crystal Airport. If current activity levels are maintained, Crystal Airport will continue to be one of the busiest airports in the state and an important component of the regional airport system.

The forecast scenarios indicate that future economic growth, fuel prices, technology, and national aviation policy may have a major impact on the development of general aviation. Absent major changes in the economy or aviation industry, small fluctuations – particularly within the developed range of scenarios – should not be construed as indicating the forecast is off course. Minor fluctuations in activity levels above or below the long-term forecast will not affect the overall recommendations of the LTCP, however, these fluctuations may require minor adjustments to the phasing of proposed improvements.

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SECTION 4:

FACILITY REQUIREMENTS

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4. FACILITY REQUIREMENTS

4.1 INTRODUCTION

This chapter describes the facility requirements needed to accommodate the demand forecasts for year 2035. The sections of this chapter are intended to:

- Describe relevant design criteria;
- Present airfield requirements in context of the critical aircraft;
- Review NAVAID requirements;
- Identify general aviation facility requirements;
- Review parking and airport access needs;
- Review obstruction issues; and
- Present miscellaneous requirements for the airport.

4.2 CRITICAL AIRCRAFT FAMILY DESIGN CRITERIA

Based on the aviation activity forecasts, the future critical design aircraft for Crystal Airport will continue to be represented by the family of propeller-driven aircraft with fewer than 10 passenger seats. This family of aircraft includes a diverse range of equipment types, ranging from small single-engine piston aircraft used primarily for recreational and personal flying up to larger single and twin-engine turboprop aircraft that are used more predominantly for business aviation. Typical aircraft in the latter category include the single-engine turboprop Pilatus PC-12 and the twin-engine turboprop Beechcraft King Air 200. **Figure 4-1** depicts several aircraft within this family by their Approach Category and Design Group, while **Table 4-1** highlights physical characteristics for representative types.

As with the existing condition, design parameters associated with this aircraft family will continue to be as follows:

- Aircraft Approach Category (AAC): A/B (approach speed less than 121 knots);
- Airplane Design Group (ADG): I/II (wingspan up to but not including 79 feet and tail height less than 30 feet); and
- Taxiway Design Group (TDG): 2 (main landing gear width 20 feet or less and cockpit-to-main gear distance less than 64 feet).

FAA airfield design standards for this family of critical aircraft are summarized in **Table 2-2** of the Existing Conditions chapter.

Table 4-1: Representative Types in Critical Aircraft Family

Aircraft Type	Configuration	Wingspan	Maximum Takeoff Weight (lbs.)	Typical Passenger Seats
Beechcraft King Air B200	MET	57' 11"	12,500	7-9
Pilatus PC-12	SET	53' 04"	10,450	7-9
Cessna 441 Conquest II	MET	49' 04"	9,850	6-9
Piper PA-31T Cheyenne	MET	42' 08"	9,000	6-8
Cessna 421C	MEP	41' 01"	7,450	6-8
Piper PA-31-350 Chieftain	MEP	40' 08"	7,000	5-7
Cessna 414A	MEP	44' 01"	6,750	6-8
Cessna 310	MEP	36' 11"	5,500	4-6
Beechcraft Baron 58	MEP	37' 10"	5,400	4-6
Piper PA-30 Twin Comanche	MEP	36' 00"	3,725	4-6

Notes:

MET - Multi-Engine Turboprop, SET - Single-Engine Turboprop, MEP - Multi-Engine Piston

The standard King Air B200 wingspan is 54'6". A winglet-equipped King Air B200 wingspan is 57'11" as listed.

Source: Aircraft Manufacturer Data

4.3 METEOROLOGICAL DATA, WIND COVERAGE, AND RUNWAY ORIENTATION

Weather conditions have a significant influence on the operational capabilities at an airport. Wind speed and direction help determine runway orientation. Temperature plays a role in determining runway length; higher temperatures in the summer months result in longer runway length requirements. Cloud cover and low visibility are factors used to determine the need for navigation aids and instrument approaches.

Aircraft generally take off and land directly into the wind, or at least as directly into the wind as a given runway alignment allows. Crosswind runways are used when the wind is blowing perpendicular to the primary runway. Because small, single-engine aircraft have less power and are lighter than larger aircraft, they often have the most pressing need for crosswind runways.

The FAA recommends that the primary runway provide at least 95 percent wind coverage for the aircraft anticipated to use the airport. If the primary runway does not provide this level of coverage, a crosswind runway may be justified.

Because larger, heavier and more powerful aircraft need a crosswind runway less often than smaller, lighter and less powerful ones, different winds speeds are used in the crosswind runway analysis for different aircraft. These different wind speeds are called crosswind components. Crosswind components are defined by wind direction and speed taken at a right angle to a runway.

Per FAA criteria, the maximum allowable crosswind component for Reference Code A/B-I aircraft is 10.5 knots and 13 knots for Reference Code A/B-II aircraft.

Available data from the Crystal Airport Automated Surface Observing System (ASOS) was obtained to analyze the amount of wind coverage provided by the current runway system.

Table 4-2 summarizes the wind coverage of runways for the applicable crosswind components and weather conditions:

Table 4-2: Wind Coverage Summary

Wind Coverage	All Weather Conditions	VFR Conditions	IFR Conditions
10.5 Kt. Crosswind Component			
Runway 14-32	**95.3%**	**95.3%**	94.9%
Runway 06-24	87.0%	86.4%	90.3%
Both Runways	**99.0%**	**99.0%**	**99.0%**
13 Kt. Crosswind Component			
Runway 14-32	**97.9%**	**98.0%**	**97.7%**
Runway 06-24	92.9%	92.6%	94.6%
Both Runways	**99.9%**	**99.9%**	**99.9%**
Total Number of Hourly Observations	107,269	90,626	17,473

Notes: Bold numbers reflect 95% or greater wind coverage

Source: MIC ASOS Wind Data 2006 - 2015

This analysis indicates that the Runway 14-32 alignment provides the desired 95 percent wind coverage for both crosswind component categories and during all weather and VFR conditions, but not under IFR conditions. The crosswind Runway 06-24 alignment offers supplemental wind coverage so that the total runway system provides nearly 100 percent wind coverage in all conditions. When considered on a stand-alone basis, the Runway 14-32 alignment provides better wind coverage than the Runway 06-24 alignment, confirming that the primary runway alignment provides optimal wind coverage.

An evaluation of the all-weather wind rose data (see **Figure 4-2**) suggests that the strongest winds experienced at Crystal Airport frequently come from a southwesterly direction. Runway 24 is particularly well aligned to accommodate aircraft operations during these high-wind conditions; furthermore, it is the only runway with a southwest/northeast orientation in the west metropolitan area to provide this wind coverage.

Table 4-3 evaluates the wind coverage provided by the specific runway end orientations.

Table 4-3: Wind Coverage By Runway End

Wind Coverage	All Weather Conditions	VFR Conditions	IFR Conditions
10.5 Kt. Crosswind Component			
Runway 14	53.4%	52.5%	57.9%
Runway 32	56.7%	57.4%	53.0%
Runway 06	46.6%	43.4%	**64.2%**
Runway 24	55.4%	57.7%	42.2%
13 Kt. Crosswind Component			
Runway 14	54.5%	53.6%	59.0%
Runway 32	58.2%	58.9%	54.5%
Runway 06	48.5%	45.2%	**66.3%**
Runway 24	59.5%	**62.1%**	44.3%
Total Number of Hourly Observations	107,269	90,626	17,473

Notes: Bold numbers reflect 60% or greater wind coverage

Source: MIC ASOS Wind Data 2006 - 2015

This data suggests that during IFR conditions, the best wind coverage is provided by the Runway 06 alignment, followed by Runway 14 and then Runway 32. However, the Runway 06 end is not eligible for establishment of a straight-in instrument approach procedure due to its short length[17].

Another important factor to consider when planning facilities at airports is temperature. The standard used is the mean daily maximum temperature of the hottest month at the Airport. For Crystal Airport, the hottest month of the year is typically July. Based on long-term temperature trends available from the National Climatic Data Center (NCDC) reporting station at Crystal Airport for the 20-year period between 1981 and 2010, the mean maximum daily temperature in the month of July is 83.4° F (28.5° C).

4.4 AIRFIELD CAPACITY

Airfield capacity is defined as the maximum number of operations that can be accommodated by a particular airfield configuration during a specified interval of time when there is constant demand. Annual service volume (ASV) is one capacity measure and the average hourly capacity is another.

The Annual Service Volume (ASV) for a given airport is the annual level of aircraft operations that can be accommodated with minimal delay. For an airport with annual operations below its ASV, delay is minimal within one to four minutes per operation.

[17] FAA criteria sets forth a minimum runway length of 2,400 feet for establishment of a straight-in instrument approach procedure.

Anything above four minutes of delay per operation can result in increased congestion that can adversely impact airfield capacity.

An airfield system's capacity is determined by a multitude of various factors, including prevailing winds and associated orientation of runways, number of runways, taxiway system, fleet mix, operational characteristics of based aircraft and weather conditions.

Crystal Airport's ASV is currently estimated to be 355,000 operations annually, which is well above its current and projected future levels of annual operations. A typical two-runway system with one primary and one crosswind runway, as recommended for Crystal Airport in the previous LTCP, provides an ASV of approximately 220,000 aircraft operations. This level of capacity would still be more than sufficient to accommodate the projected level of aircraft operations in a safe, efficient manner. Even if the high forecast level of operations materializes (approximately 43,500), the airport will operate at less than 20 percent of its annual service volume.

In response to the user concern about the peak-hour capacity of the proposed two-runway system, further analysis was conducted. Using a spreadsheet-based capacity modeling tool recently developed by the Airport Cooperative Research Program (ACRP)[18], the maximum hourly capacities of the proposed runway configuration at Crystal were estimated. The tool takes into account a variety of factors such as runway configuration, touch and go volume, and aircraft separation buffers between departing and arriving aircraft. Due to the configuration of the airfield, it operates more efficiently and thus has more capacity when aircraft are landing and taking off to the south versus the north. The results of this analysis are provided in **Table 4-4** below:

Table 4-4: Hourly Airfield Capacity Calculations

Airfield Operation	VFR Operations/Hour	IFR Operations/Hour
North Flow (Runways 32, 06)		
Low Range	85	63
High Range	89	63
South Flow (Runways 14, 24)		
Low Range	61	45
High Range	87	45

Notes:

Low range assumes Visual Departure-Arrival Separation of 2.0 NM.

High range assumes Visual Condition Departure-Arrival Separation of 1.5 NM.

Source: MAC analysis using ACRP Report 79 Spreadsheet Capacity Model

[18] Per ACRP Report 79, *Evaluating Airfield Capacity*

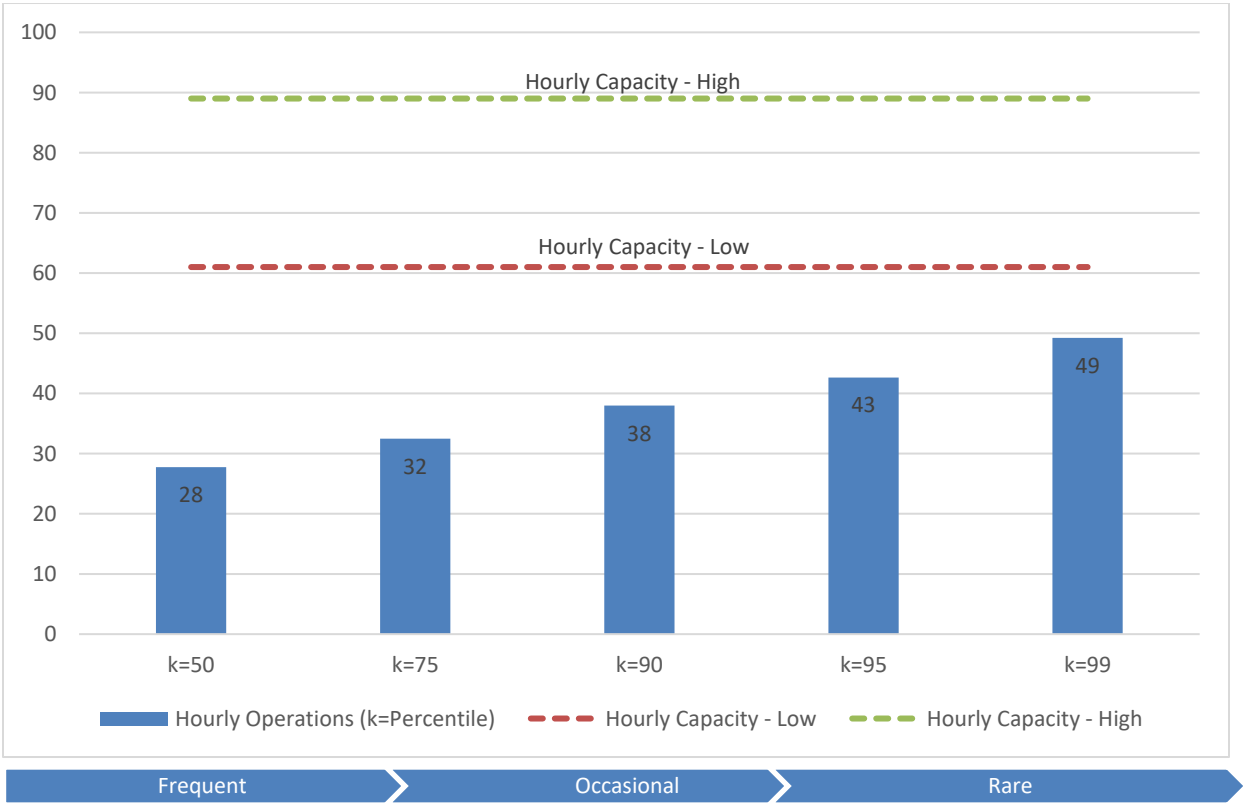
Based on hourly operations data available from MAC's flight tracking system, MACNOMS, and from the Air Traffic Control Tower observations, current peak-hour operations at Crystal appear to range between 30 and 50 operations.

- Peak hours with 30-39 operations are somewhat frequent (about 200 hours over the last 3 years);
- Peak hours with 40-49 operations occur occasionally (about 30 hours in the last 3 years); and
- Peak hours with 50 or more operations do occur but rarely (about 3 hours in the last 3 years).

Special event days, such as the annual Crystal Airport Fly-In, were excluded from this analysis due to the atypical operational profile of aircraft movements during these events.

The relationship between airfield capacity and demonstrated peak hourly demand is shown in the following exhibit.

Peak Hourly Airfield Capacity and Demand



With the gap that remains between demonstrated demand volumes of 30-50 movements per hour and an airfield that can handle approximately 61-89 VFR movements per hour, there does not appear to be an operational need to keep the south parallel runway in service.

Based on this assessment, the proposed two-runway airfield will be able to accommodate future peak-hour demand levels, which are projected to remain relatively stable over the

planning period, and could even accommodate some growth. Specifically, the LTCP high-range forecast acknowledges that aircraft operations could grow to a level that is approximately ten percent above the base case forecast if better-than-expected regional economic conditions materialize. Even if the existing busiest-hour demand levels were increased by ten percent, resulting in a peak of approximately 55 hourly operations, this would still be below the predicted airfield capacity level of approximately 61-89 VFR operations per hour.

In summary, Crystal Airport has adequate runway capacity to support all of the forecast scenarios. This means that additional runway capacity will not be a contributing factor to any airport improvements throughout the planning period.

4.5 AIRFIELD FACILITY REQUIREMENTS

4.5.1 Runway Requirements

Runway length requirements are based on several factors, including the type of aircraft using or expected to use an airport, temperature, airport elevation, wind direction and velocity, and runway gradient. In addition, runway surface conditions also impact runway requirements. This last factor is an important consideration for determining runway lengths at airports in northern climates where wet and icy conditions exist.

FAA Advisory Circular (AC) 150/5325-4B, *Runway Length Requirements for Airport Design*, recommends identifying a critical family of aircraft. Although this methodology is general in nature, it recognizes that there is uncertainty about the composition of the airport's fleet mix during the forecast period. Determining runway length based on an aircraft family ensures the greatest measure of flexibility.

As noted in **Section 4.2**, the future critical design aircraft for Crystal Airport will continue to be represented by the family of propeller-driven aircraft with fewer than 10 passenger seats. Based on an assessment of fleet mix at Crystal Airport, the aircraft types that use the facility on a regular basis have maximum gross takeoff weights of less than 12,500 pounds. From an airfield facility requirements perspective, this composite aircraft family is represented by the Beechcraft King Air 200 (ARC B-II), Pilatus PC-12 (ARC A-II), and the Piper PA-31 Navajo (ARC B-I).

Although aircraft with a maximum gross takeoff weight of greater than 12,500 pounds can and do occasionally use Crystal Airport (such as the Beechcraft King Air 350 turboprop), the total is well below 500 operations per year due to runway length limitations. Therefore, the critical design aircraft for Crystal Airport should be designated as small aircraft. This is a change from the existing runway designations, which are for aircraft with a maximum gross takeoff weight of greater than 12,500 pounds.

The design objective for the primary runway is to provide a runway length that will not result in operational weight restrictions for this family of aircraft.

The corresponding Runway Design Code (RDC) for the primary runway should be A/B-II-5,000[19] (small aircraft). According to the FAA, for airports with two or more runways, it

[19] 5,000 feet corresponds to visibility minimums of not lower than one statute mile.

is often desirable to design all airport elements to meet the requirements of the most demanding RDC and TDG. In order to preserve operational flexibility, the RDC for the crosswind runway will also be designated as A/B-II-5,000 (small aircraft).

Primary Runway

Figure 2-1 in FAA AC 150/5325-4B provides recommended runway lengths for small propeller-driven airplanes with fewer than 10 passenger seats. The calculations consider airport elevation above mean sea level, mean daily maximum temperature of the hottest month and percentage of the overall fleet (family of aircraft) to be accommodated. A copy of this figure is reproduced in **Appendix 4**.

Based on runway length guidance provided by the FAA AC, the appropriate runway length at the Crystal Airport should be between 3,300 feet (to accommodate most of the aircraft types in this family, or 95% of the fleet) and 3,900 feet (to accommodate all types in the family, or 100% of the fleet).

In the AC, the FAA states that "if the fleet mix to operate at the airport is known, consult the manufacturer's literature to determine actual runway length requirements." To comply with this guidance, staff assessed manufacturer's performance charts from several representative aircraft types using, or expected to use, Crystal Airport. The following conditions were assessed:

- Accelerate-stop distance (the runway length declared available and suitable for the acceleration and deceleration of an aircraft aborting a takeoff).
- Temperature of 83.5°F (the mean daily maximum temperature of the hottest month at the airport).
- Field elevation of 869 feet above mean sea level (AMSL).
- A 5-knot headwind.
- Typical takeoff flap settings.

Table 4-5 summarizes takeoff length requirements for the representative aircraft types in the critical aircraft family for Crystal Airport. Takeoff distance requirements are presented for several different takeoff weights representing percentages of the aircraft's total useful load[20]. Representative aircraft performance charts used for this analysis are reproduced in **Appendix 4**.

[20] Useful load is defined as the aircraft maximum takeoff weight minus the aircraft empty weight. An aircraft's useful load can be used to transport either fuel or payload (passengers, baggage, and/or cargo).

Table 4-5: Takeoff Length Requirements (Accelerate Stop Distance)

Aircraft Type	Maximum Takeoff Weight (lbs.)	Takeoff Distance (ft.) for % Useful Load			
		100%	90%	75%	60%
Beechcraft King Air 200	12,500	3,700	3,600	3,400	3,200
Pilatus PC-12	10,450	3,900	3,700	3,400	3,000
Cessna 441 Conquest II	9,850	4,000	3,900	3,800	3,600
Piper PA-31T Cheyenne	9,000	3,600	3,500	3,300	3,000
Subtotal Turboprops		*3,800*	*3,675*	*3,475*	*3,200*
Cessna 421C	7,450	4,000	3,700	3,200	2,700
Piper PA-31-350 Chieftain	7,000	3,700	3,600	3,300	3,100
Cessna 414A	6,750	4,600	4,300	3,700	3,200
Cessna 310	5,500	4,000	3,600	3,100	2,700
Beechcraft Baron 58	5,400	3,500	3,400	3,300	3,200
Piper PA-30 Twin Comanche	3,725	3,300	3,200	2,900	2,700
Subtotal Multi-Engine Piston		*3,850*	*3,633*	*3,250*	*2,933*
Average Length		*3,830*	*3,650*	*3,340*	*3,040*

Notes: Takeoff Distance based on Accelerate/Stop length from aircraft performance manuals.

Takeoff distance calculations based on the following conditions:

Temperature = 83.4°F, Field Elevation = 869 feet MSL, Wind = 5-knot headwind component, Flaps = Typical takeoff

Source: Aircraft Performance Manuals/Data

Based on this assessment, the desired primary runway length for Crystal Airport is approximately 3,600 feet. This length fits into the range predicted by the FAA guidance and will accommodate the majority of small turboprop and multi-engine piston aircraft departing at a weight representing 90 percent of their useful load. Using the 90 percent of useful load criteria is considered appropriate given that aircraft in this family do not routinely need to depart at their maximum takeoff weight to complete a typical flight mission.

Ideally, the entire runway length would be available to accommodate all takeoff and landing distance categories (takeoff run available, takeoff distance available, accelerate-stop distance, and landing distance available). However, for the designated critical aircraft family, accelerate-stop distance (ASDA) typically emerges as the most critical (longest) length requirement to consider. Thus, the preferred concept should seek to maximize the accelerate-stop distance available.

The FAA establishes 75 feet as the required width for RDC A/B-II-5,000 runways. Runway 14L-32R is currently 75 feet wide. This width should be maintained in the future.

To ensure consistency with the critical design aircraft, it is recommended that the 14 CFR Part 77 designation for Runway 14L-32R revert to the "Utility" category. This action will result in the pavement strength being reported as 12,500 pounds, but does not restrict the capability of the runway to occasionally accommodate aircraft with a maximum gross takeoff weight greater than 12,500 pounds.

Crosswind Runways

The FAA acknowledges that even if the 95 percent crosswind coverage standard is achieved for the design airplane family, certain airplanes with lower crosswind capabilities may not be able to use the primary runway under all conditions. In these cases, a crosswind runway can be justified. The runway length for crosswind runways is based on the recommended length for the lower crosswind capable airplanes using the primary runway.

At Crystal Airport, the lower crosswind capable aircraft include light single-engine aircraft used primarily for personal, recreational, and flight training activities. At 2,500 feet, crosswind runway 06L-24R is short by modern standards. However, due to constraints and obstacles at both ends of the runway, it does not appear that providing additional length is feasible.

Runway 06L-24R is currently 75 feet wide, which meets design criteria for RDC A/B-II-5,000. It is recommended that the existing width of 75 feet be maintained throughout the planning period.

It is envisioned that Runway 06L-24R, as the crosswind runway, will also revert to a 14 CFR Part 77 "Utility" category and meet FAA design standards for small aircraft.

Existing turf Runway 06R-24L is 2,123 feet long and 137 feet wide. As the distance between the edges of Runway 06R-24L and adjacent paved crosswind Runway 06L-24R is less than 200 feet, simultaneous same direction VFR operations are not authorized. The runway is not lit to accommodate night operations.

Proponents of the turf runway suggest that it provides several unique benefits to the metropolitan airports system, including operational advantages for tailwheel-type aircraft – of which approximately 26 are based at Crystal Airport – particularly during landing operations with gusty winds. It also facilitates "soft field" flight training opportunities. Now that the turf runway at the Forest Lake Airport (25D) has been paved, the closest turf runways to Crystal Airport are located approximately 30 miles away at the privately-owned Belle ARS Sport Strip Airfield (7Y7) near Belle Plaine and the Winsted Municipal Airport (10D).

Based on manual counts taken by ATCT controllers in 2015 and 2016, the number of annual aircraft operations on the turf runway during the six months it is operational (May – October) is estimated to be approximately 300. This equates to an average of approximately 1.6 operations per day. During the peak operational months (May and June), operations reached an average of approximately 2.5 per day. The Runway Design Code (RDC) is A-I-Visual (small aircraft).

Based on the known fleet mix of tailwheel-type aircraft based at Crystal, many existing turf runway operations are conducted by aircraft with an approach speed of less than 50 knots (e.g., Aviat A-1B/C Husky, Cessna 140, Aeronca 7AC Champ, and Piper J-3 Cub).

Runway Separation Standards

In the future, a minimum of 240 feet of separation should be provided between runways and parallel taxiways.

Runway Shoulders

For RDC A/B-II-5,000, the required shoulder width is 10 feet. The airport provides 10-foot wide turf shoulders on both runways. All future conditions should continue to meet or exceed FAA standards.

Runway Safety Areas, Object Free Areas, and Obstacle Free Zones

The existing Runway Safety Areas (RSAs) and Runway Object Free Areas (ROFAs) at Crystal Airport meet FAA standards for RDC A/B-II-5,000. All future conditions should continue to meet or exceed FAA standards.

The existing ROFZs meet FAA requirements for the specified RDC for small aircraft (250 feet wide). All future conditions should continue to meet or exceed FAA standards.

Runway Protection Zones

As described in **Section 3.2.1**, a total of 36 off-airport residential parcels are wholly or partially contained in the existing Runway Protection Zones (RPZs) at Crystal Airport. In addition, public roadways traverse the RPZs for Runways 06L-6R (County Road 81/Bottineau Boulevard) and Runways 14L/14R (Douglas Drive). A freight rail line also runs through the Runway 06L-06R RPZs.

As shown in **Table 2-2**, the FAA has designated lesser RPZ dimensions for runways designed to be used regularly by small aircraft with maximum certificated takeoff weights of 12,500 pounds or less (Utility Runway designation).

Implementation of the previous LTCP preferred development alternative would reduce incompatible RPZ land uses by decommissioning Runways 14L-32R and 06R-24L, but would not improve RPZ compatibility off the remaining runway ends.

By reverting to the smaller-dimension RPZs off each runway end, the number of impacted residential parcels can be reduced further. As the designated critical design aircraft at Crystal Airport is the family of small propeller-driven aircraft with fewer than ten passenger seats, it is appropriate to use the smaller-dimension RPZs.

A non-public airport access roadway will continue to traverse the Runway 14R RPZ, but this road is access controlled such that it only accommodates airport-related traffic. The Runway 14L RPZ will also continue to contain a portion of Douglas Drive. Douglas Drive, however, is a low volume, local roadway. Thus, the probability of an airplane accident within the outer edge of the RPZ where the road is located, when a vehicle is present is very low. Realignment of the road outside of the RPZ is not a viable option given the location of existing residential development and adjacent transportation corridors immediately west of the airport, including Bottineau Boulevard, Lakeland Avenue, a

freight rail line, and the planned Bottineau Light Rail Transit Line. In 2016, FAA reviewed this condition and concurred that Douglas Drive does not need to be realigned outside of the RPZ.

Reasonable efforts should be made to prevent incompatible land uses from being introduced within RPZs. In the event that incompatible land uses cannot be reasonably mitigated, or new incompatible uses are proposed, an RPZ Alternatives Analysis should be prepared and submitted to the FAA to assess whether the proposed land uses could increase safety risk levels at the airport and result in incompatible land uses.

Runway Edge Lighting
It is recommended that the existing Medium-Intensity Runway Lights (MIRL) be maintained on Runways 14L-32R and 06L-24R.

Navigational Aids
Currently, there is a PAPI system on Runway 14L. It is recommended that the VASIs on the other runway ends be replaced with PAPIs during the planning period.

Currently, there are REILs on both ends of Runway 14L-32R. It is recommended REILS be added to both ends of Runway 06L-24R during the planning period.

Airfield Geometry
As outlined in **Section 2.3.1**, reducing the number of Hot Spots by simplifying the airfield layout and reducing the number of runway crossings for aircraft and vehicles should be a key consideration when evaluating future airfield development concepts.

4.5.2 Taxiway Requirements

As noted in **Section 4.2**, the existing and future critical design aircraft family for Crystal Airport is within the parameters of the FAA's Taxiway Design Group (TDG) 2 (main landing gear width 20 feet or less and cockpit-to-main gear distance less than 64 feet).

Taxiway Width
The FAA design standard for TDG-2 width is 35 feet. Taxiways A, B, C, D, and E are 30 feet wide. This means these taxiway widths are deficient by five feet. As taxiway reconstruction projects become necessary, the MAC will widen the pavement to at least 35 feet and consider further widening to the MAC Reliever Airport standard of 40 feet.

Taxiway Safety and Object Free Areas
The existing Taxiway Safety Areas (TSAs) and Taxiway/Taxilane Object Free Areas (TOFAs) at Crystal Airport meet or exceed FAA standards, with the exception of the conditions noted in **Section 2.3.1**. All future conditions should meet or exceed FAA standards.

Taxiway Shoulders
Paved or stabilized shoulders are recommended along taxiways. TDG II aircraft require 15-foot stabilized shoulders. Crystal Airport has 15-foot wide turf shoulders on its taxiways, which should be maintained.

Taxiway Connectors

Taxiway connectors should be present to facilitate efficient aircraft exit off of the supported runway, to reduce incursions and to minimize time on runway. However, several of the connector taxiways provide direct access from an aircraft apron to a runway. FAA has issued guidance stating that it is not desirable to design taxiways that lead directly from an apron to a runway without requiring a turn, as these configurations can lead to confusion when a pilot typically expects to encounter a parallel taxiway but instead accidently enters a runway. Options to improve these geometry items will be considered when preparing airfield development concepts.

This, and other recent guidance related to taxiway design best practices contained in FAA AC 150/5300-13A, Change 1 will be utilized for plans to convert existing Runway 14R-32L into a full-length parallel taxiway.

Taxiway Lighting

It is recommended that the potential for installation of taxiway edge lighting be considered in the future, particularly for the future full-length parallel taxiway to Runway 14L-32R. This would improve safety during the evening and after a light snow fall and also aid pilots that are unfamiliar with the airport.

4.5.3 Instrument Approaches

Crystal Airport has two non-precision instrument approaches that can be used during Instrument Meteorological Conditions. The first is a VOR or GPS-A approach that is not aligned with a specific runway end and requires a circling maneuver to land. The second approach is an RNAV (GPS) approach to Runway 14L with one-mile visibility minimums.

Upgrading instrument approach capabilities to provide minimums of less than one mile are not contemplated with this plan due to the corresponding increase in the dimensions of the RPZs that would have to be provided.

Development of a new, non-precision GPS-type instrument approach procedure to Runway 32R would enhance the operational capabilities of the airport. Planning for the establishment of these non-precision approaches is recommended for consideration. GPS has made it possible to provide instrumentation to almost any runway end at relatively low cost because on-airport equipment is not required.

4.5.4 Obstacles

The FAA recently consolidated its position, notification process, and mitigation process for obstacles identified as penetrations to the 20:1 Visual Area Surface. The FAA has long maintained the position that airports should keep obstacles clear, marked, or lit for those that penetrate a variety of surfaces including Part 77, Threshold Siting Surface, and TERPS Departure Surface, among others. While these other surfaces are dealt with as instrument procedures are developed, the 20:1 Visual Surface Area can be widely applied to all airports. As such, a formal procedure and process was outlined to notify airports of the obstacles that the FAA identifies that penetrate the 20:1, and required a period of review and mitigation to enable procedures to remain in place.

In late 2016, approximately 55 trees were removed from properties in the vicinity of Crystal Airport. These trees were identified as those that penetrated, or nearly

penetrated, existing runway airspace obstacle clearance surfaces. These trees were removed at no cost to the property owners, who were also compensated for the assessed value of the removed tree(s). Homeowners are allowed to replace removed trees; however, they are encouraged to plant lower-growth species that will not grow to become airspace obstacle clearance penetrations.

Additional trees and brush were removed on airport property to ensure that airspace surfaces remain clear from vegetation.

Due to the amount of vegetation in the vicinity of Crystal Airport, tree growth is assessed on an ongoing basis and a removal program is needed during a runway improvement project or approximately every ten years.

FAA has established requirements for airport sponsors to develop an "Obstacle Action Plan" (OAP) that details how and when each of the approach and departure surfaces will be cleared and maintained. As this is a new requirement, the OAP for Crystal Airport will be developed along with the Airport Layout Plan (ALP).

4.6 LANDSIDE FACILITY REQUIREMENTS

4.6.1 Hangar Facilities

Crystal Airport, like all of the MAC airports, has a wide variety of hangar sizes. Over the years, the MAC has attempted to standardize the size of hangars within new hangar areas. However, aircraft also come in many different sizes, and trying to accommodate every one leads to variability. As depicted in **Table 2-8**, Crystal Airport is estimated to have approximately 356 indoor aircraft storage spaces. This number includes an assumption that some, but not all, airport tenants sublease extra space for additional aircraft within their hangar.

Tenants own their hangars and lease the ground space from the MAC. Currently, it is the MAC's policy that no tenant can lease more space than they can justify with actual aircraft ownership. This practice has reduced the number of large hangar demands, and subsequently, reduces some of the subleasing opportunities at the airport.

According to the Base Case forecast results reported in **Table 3-4**, the number of based aircraft is anticipated to decline slightly through 2030 and then stabilize. By 2035, the number of based aircraft is forecasted to be 171 aircraft.

At first glance, it appears that only a portion of the available hangar capacity at Crystal Airport will be filled by 2035. However, some of the available hangar stall inventory is currently leased by airport tenants to support aviation business activities other than aircraft storage. Secondly, reasonable enforcement of MAC's Maintenance Standards Ordinance in the future may result in some of the existing hangar inventory being removed. Lastly, there could be demand for construction of certain hangar types and/or sizes that are not currently available. Therefore, areas to accommodate the construction of new hangars should be considered in the plan.

It is important to note that including additional hangar space in this LTCP is not a commitment to build or fund such a development. Rather, it is simply ensuring that should

the indicated immediate demand lead to actual hangar construction, an appropriate place for them is shown in this plan and subsequent Airport Layout Plan (ALP).

If a new hangar area is constructed, utility installations will be included in the project, including electricity, telephone/telecommunications, and natural gas. The issues related to sanitary sewer and water are discussed in **Section 6.3**.

4.6.2 Fixed Base Operator

Two former FBO facilities still exist at Crystal Airport, although they are currently leased to tenants who are using them for other purposes. Should demand ever warrant additional services, one or more of these facilities could be converted back to FBO use. However, the updated forecasts do not suggest that existing or anticipated future demand levels are sufficient to support more than one full-service and one partial-service FBO facility at Crystal Airport.

As noted in **Section 2.4.1**, the existing FBO apron is small, constrained, and operationally inefficient. An expansion to improve aircraft circulation patterns and the number of tie-down locations should be considered by the tenant if the turf runway is decommissioned.

4.6.3 Airport Access, Roadway Circulation, and Parking

At this time, airport access and parking facilities appear to be adequate. Primary roadway access comes from County Road 81/Bottineau Boulevard, which continues to see increases in the average daily traffic every year. Airport entrances currently have passing and turning lanes, which should be maintained.

4.6.4 Maintenance and Fuel Storage Areas

The existing MAC Maintenance facilities are in good condition and provide adequate capacity to accommodate newer-generation snow removal equipment that in many cases are longer and taller than older models. An enclosed materials storage facility is programmed to be constructed to store sand and other solid materials.

According to a recently-completed building assets report, the MAC facilities will require approximately $2,100,000 of renewal investments through 2035. **Appendix 5** includes a listing of the specific renewal investment items identified for the Crystal Airport Maintenance facilities.

4.6.5 Security Requirements

There is a fence that runs along the airport boundary all around the airport. Six access-controlled gates provide access to the hangar areas. Access into the gates is achieved with a pin code. All gates are clearly marked that unauthorized access to the airport is prohibited.

At this time, there is no demand or requirement for security-related improvements at the airport. This should be monitored, however, in future long term plan updates if there are any changes to national aviation security recommendations or local issues generate a need for such improvements.

Figure 4-1: Representative Aircraft Types

Airport Reference Code A-I (Maximum Takeoff Weight (MTOW) less than or equal to 12,500lbs

Aircraft	MTOW (lbs.)	Approach Speed (knots)	Wingspan	Tail Height	Aircraft Type
Cessna 172	2,550	62	36' - 1"	8' - 11"	Single-Engine
Cirrus SR22 	3,400	78	38' – 4"	8' - 11"	Single-Engine
TBM 850	7,394	85	41' - 7"	14' - 4"	Single-Engine Turboprop
Diamond DA42	4,189	79	44' - 4"	8' - 2"	Multi-Engine
Eclipse 550	6,000	77	37' - 11"	11' - 0"	Very Light Jet

Airport Reference Code A-II (Maximum Takeoff Weight (MTOW) less than or equal to 12,500lbs

Aircraft	MTOW (lbs.)	Approach Speed (knots)	Wingspan	Tail Height	Aircraft Type
Pilatus PC-12 	10,450	87	53' - 4"	14' - 0"	Single-Engine Turboprop
Cessna Caravan 208	8,000	79	52' - 1"	14'-11"	Single-Engine Turboprop

Airport Reference Code B-I (Maximum Takeoff Weight (MTOW) less than or equal to 12,500lbs

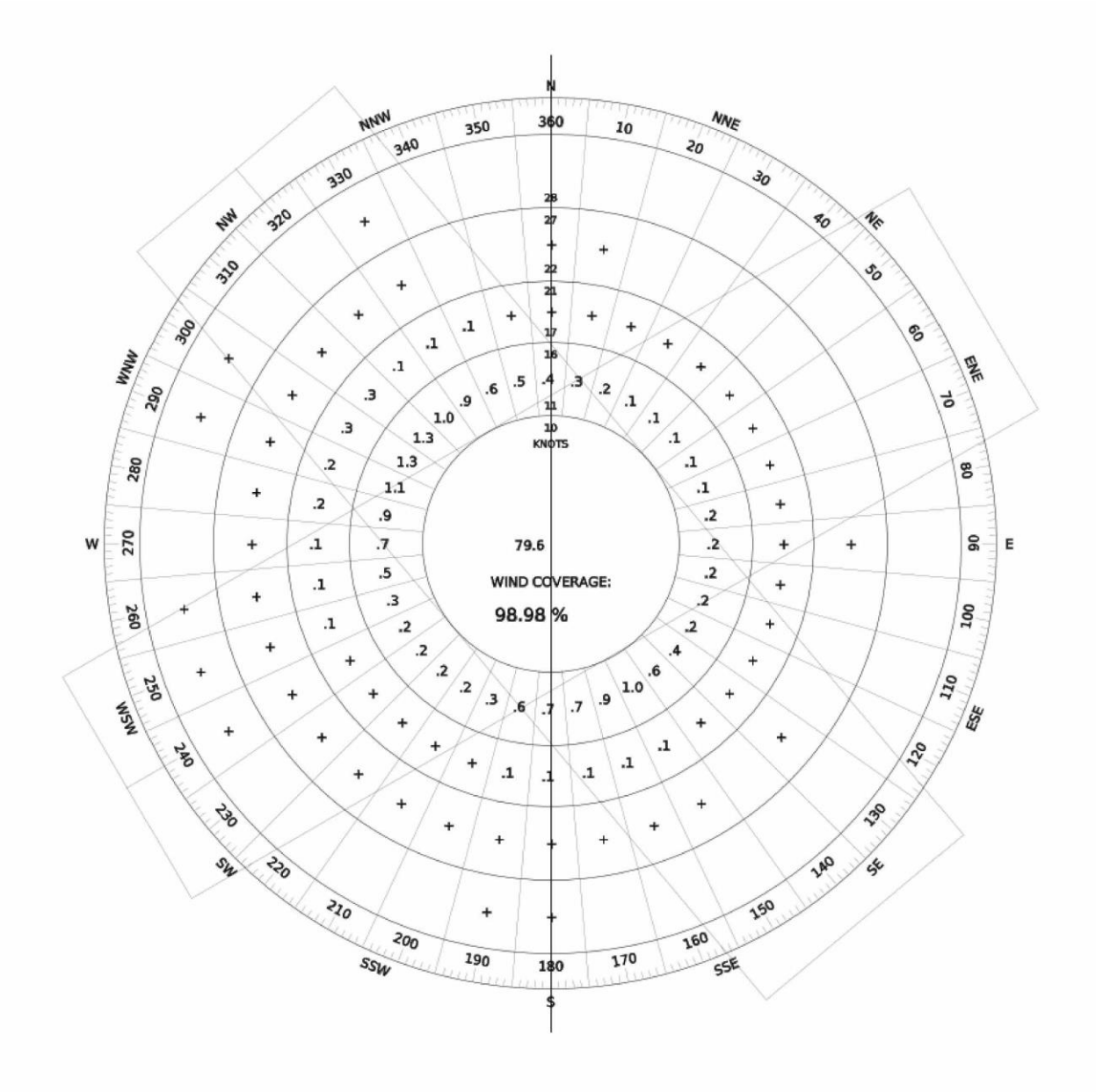
Aircraft	MTOW (lbs.)	Approach Speed (knots)	Wingspan	Tail Height	Aircraft Type
Piper PA-30 Twin Comanche	3,600	95	36' - 0"	8' - 2"	Multi-Engine
Piper PA-31T Cheyenne	9,000	98	42' - 8"	12' - 9"	Multi-Engine Turboprop
Piper PA-31-350 Chieftain 	7,000	96	40' - 8"	13' - 0"	Multi-Engine
Cessna 414A	6,785	94	44' - 2"	11' - 6"	Multi-Engine
Cessna 421C	7,450	96	41' - 1"	11' - 5"	Multi-Engine
Cessna Citation Mustang	8,645	95	43' - 2"	13' - 5"	Very Light Jet

Airport Reference Code B-II (Maximum Takeoff Weight (MTOW) less than or equal to 12,500lbs

Aircraft	MTOW (lbs.)	Approach Speed (knots)	Wingspan	Tail Height	Aircraft Type
Raytheon Beechcraft King Air 200	12,500	103	57' - 11"	14'-10"	Multi-Engine Turboprop
Cessna 441 	9,850	99	49' - 4"	13' - 2"	Multi-Engine Turboprop

Figure 4-2: Crystal Airport All-Weather Wind Rose (2006-2015)

10.5 knot crosswind component



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SECTION 5:

ALTERNATIVES ANALYSIS

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5. ALTERNATIVES ANALYSIS

5.1 INTRODUCTION

The previous LTCP considered numerous concepts related to the number of runways to retain at Crystal Airport, as follows:

- Keep all four existing runways / No Build;
- Maintain two parallel runways and close the two crosswind runways;
- Maintain just one primary runway;
- Maintain one primary runway and one crosswind runway;
- Maintain two parallel runways and only one crosswind runway;
- Extend the primary runway 14L-32R by 990 feet using declared distances;
- Maintain one runway and reduce its length to 2,500 feet; and
- Airport Closure.

After reviewing all of the concepts, costs, benefits and negative considerations, the preferred alternative formally adopted by the Commission for the Crystal Airport in December 2008 is to maintain a primary runway and a crosswind runway. This alternative provides the best environment for airport users operationally, provides for the maximum wind coverage, and maintains a more balanced noise contour.

Due to the thorough nature of the alternatives analysis completed in the previous LTCP, it will not be repeated in this document. The focus of this chapter will be to identify possible refinements to the preferred alternative from the previous LTCP.

5.2 ALTERNATIVES REFINEMENT

5.2.1 Refinement Objectives

Key objectives behind the analysis of refinements to the preferred development alternative include the following:

- Maintain ARC B-II aircraft design standards (small aircraft/Utility runway) and one-mile non-precision visibility minimums;
- Provide additional accelerate-stop distance available length (3,600 feet) to better meet existing and future tenants' operational needs and further improve safety;
- Maintain or improve upon existing Runway Protection Zone land use compatibility;
- Clear, improve, and/or mitigate approach and departure surface penetrations where feasible; at a minimum, maintain existing conditions;
- Improve airfield safety by reducing the rate of and risk for runway incursions; and

- Reduce off-airport land-use impacts.

5.2.2 2025 LTCP Preferred Alternative

The 2025 LTCP for MIC was finalized in December 2008 and recommended that the airfield be "right-sized" to match infrastructure with activity levels. To do this, the preferred alternative in the plan is to decommission both the turf (6R-24L) and south parallel (14R-32L) runways, leaving a two-runway system in place. The existing south parallel runway will then be converted to a full-length parallel taxiway. This plan not only simplifies the airfield, but opens up some property for both aeronautical and non-aeronautical development opportunities.

The 2025 LTCP Preferred Alternative is shown in **Figure 5-1.**

The concept of maintaining one primary and one crosswind runway results in the following:

2025 LTCP Preferred Alternative	
Advantages	**Disadvantages**
• Maintains maximum utility of the airport for all uses by keeping a crosswind runway • Provides maximum wind coverage • Accommodates future hangar development opportunities • Allows for non-aeronautical development • Maintains a balanced noise contour • Potential redevelopment of hangar areas would improve aesthetics	• Allows a lesser amount of non-aeronautical development potential than other options • Annual service volume drops to 230,000 operations • Minimal reduction in O&M costs • Legislative and FAA approval required for runway closures
Estimated Development Cost: $2,800,000.00[21]	

5.2.3 Preferred Alternative Refinements Evaluated

Runway Designation/Runway Protection Zones

As outlined in **Section 4.5.1**, the existing and future critical aircraft expected to use Crystal Airport on a regular basis are those that have a maximum certificated gross takeoff weight of less than 12,500 pounds. Therefore, it is appropriate to use small aircraft design standards and designate the runways at Crystal Airport as Utility category. This designation allows the use of smaller-dimension Runway Protection Zones (RPZs) than shown in the previous plan.

Also, reverting to the smaller RPZs results in larger parcels of land becoming available for aeronautical or non-aeronautical development, particularly on the existing Runway 06L end adjacent to County Road 81/Bottineau Boulevard.

[21] Includes costs to reconstruct existing Runway 14L-32R and paved blast pads, which was completed in 2008

Convert Paved Blast Pads to Stopways

The Runway 14L and 32R ends feature a paved blast pad. As currently designated, these paved blast pads are not considered to be useable pavement when calculating aircraft takeoff or landing distances.

However, pavement designated as stopway can be considered as useable length for decelerating an aircraft during an aborted takeoff. Stopway pavement can be used for accelerate-stop distance calculations, but not for other takeoff or landing distance calculations.

Designating stopways for Runway 14L-32R may allow some aircraft to depart at a higher takeoff weight when accelerate-stop distance is a limiting factor, and will promote safety by formally making this pavement available for use in the event of an aborted takeoff attempt. Stopways do not change the published runway length, nor are they intended to attract aircraft types different than those operating at the airport today. However, as outlined in **Section 3.5**, the availability of stopways may result in a small increase in aircraft operations from users who find the existing runway length to be limiting based on accelerate-stop distance criteria.

By converting the Runway 14L-32R paved blast pads to stopways, an accelerate-stop distance of nearly 3,800 feet can be provided, fulfilling the facility requirement recommendation. The published runway length will remain as 3,267 feet. Activating the stopways will include the addition of stopway edge lighting (red unidirectional lights), relocating the existing runway threshold lights to be outboard of the pavement footprint, and grading the Runway Safety Area (RSA) beyond the stopway ends.

With this concept, the total number of off-airport residential parcels contained in the Runway Protection Zones (RPZs) will be reduced from 36 to 17. The Runway 14R RPZ will only impact a portion of one residential parcel and does not include any residential dwellings. The remaining 16 parcels are in the RPZs associated with the crosswind runway.

The Stopway concept is shown in **Figure 5-2**.

Convert Runway 14L-32R Paved Blast Pads to Stopways	
Advantages	**Disadvantages**
• No change to runway ends (published runway length does not change) • No change to existing Runway Protection Zone locations o FAA has determined that no RPZ Alternatives Analysis is required • No increase to existing pavement footprint • Limited operational impacts during construction • Limited capital cost impacts • Stopway marking and lighting may make the runway environment more conspicuous, both in the air and on the ground, further enhancing pilot situational awareness and runway safety	• Implements declared distances, increasing complexity • Public perception of "expansion" to accommodate larger aircraft • Stopways do not increase LDA, TORA or TODA
Estimated Development Cost: $200,000.00	

Convert Paved Blast Pads to Runway

Another concept evaluated for the 2035 LTCP considers the impacts of converting the paved blast pads on each end of Runway 14L-32R to useble runway pavement for use by aircraft beginning the takeoff roll or completing the landing rollout, along with displaced landing thresholds to improve Runway Protection Zone (RPZ) compatible land use compliance. Taxiway extensions would be added to the ends of the existing blast pad pavement to make it accessible for aircraft taking off and landing. Declared distances would be applied and published, which increases the accelerate-stop distance (ASDA) to approximately 4,267 feet and also increases the takeoff distance available (TODA), landing distance available (LDA), and takeoff run available (TORA).

The Runway Conversion concept is shown in **Figure 5-3**.

Although this concept maximizes the operational capabilities of the existing airport footprint, the potential for the improved airfield to attract aircraft types larger than the targeted design aircraft family, specifically those with a maximum certificated takeoff weight greater than 12,500 pounds, is too great. This concept was not selected as the Preferred Alternative as it would likely result in regular use by larger aircraft – thus changing the role of Crystal Airport, something that MAC is not seeking to do since nearby Flying Cloud and Anoka County-Blaine Airports are already equipped to handle these types of aircraft.

Convert Runway 14L-32R Paved Blast Pads to Runway	
Advantages	**Disadvantages**
• Exceeds recommended ASDA length (4,267 feet vs. 3,600 feet) • Optimizes use of existing runway and blast pad pavement surfaces • Increases LDA and TORA/TODA; optimizes operational capability for airport users • Provides airport control over RPZ property; public road and private property are outside of RPZ • Airspace surface shift to displaced thresholds may reduce obstacle impacts • Additional marking and lighting may make the runway environment more conspicuous, both in the air and on the ground, further enhancing pilot situational awareness and runway safety	• Changes runway ends with published runway length of 4,267 feet • Increased perception of expansion beyond stated requirements • May attract aircraft types outside of design aircraft family/utility category (larger turboprops and small jets) • Increases existing pavement footprint by adding taxiway extensions • Capital costs to add runway lights, taxiway extensions/lights, safety area/object free area grading, displace landing threshold including additional lighting, VGSI relocation and flight testing, etc. • Operational impacts during construction (displaced thresholds in particular) • Potential noise contour footprint increase due to aircraft starting the takeoff roll closer to residential areas
Estimated Development Cost: $2,770,000.00	

Convert Portions of Existing Runway 14L-32R Paved Blast Pads to Runway (Refined Concept)

During the first public comment period, several airport users, along with some public commenters, encouraged MAC to consider an "in-between" increase in the primary runway length to make Crystal Airport more attractive to some of the more sophisticated business-use aircraft types that occasionally use the facility today, but that would not likely attract larger aircraft types on a regular basis. Other users suggested that converting the paved blast pads to useable runway pavement, instead of stopways, would yield safety and operational benefits to all users by increasing takeoff and landing lengths available, and not just the accelerate-stop distance.

Based on this feedback, MAC developed a Refined concept for primary Runway 14-32 that would convert portions of the existing paved blast pads on each end to useable runway. The concept currently being evaluated would result in a published runway length of 3,750 feet, which is close to 500 feet longer than the existing runway and within the FAA's recommended runway length range of 3,300 to 3,900 for the design aircraft family of small propeller-driven aircraft with fewer than 10 passenger seats.

The revised runway length concept is shown in **Figure 5-4**.

Unlike the Stopway concept, all aircraft users would benefit from having additional useable runway pavement available for takeoff and landing movements (approximately 3,500 feet) in the Refined concept. Due to the constrained nature of the airport, however, this will require the implementation of declared distances, meaning that not all of the published pavement would be available for landing and takeoff movements in each

direction. Declared distances do add a layer of complexity to the airfield operational environment for pilots, but staff believes this complexity can be overcome through education and awareness efforts.

Table 5-1 identifies the available runway length for each of the following declared distance categories:

- Takeoff Run and Takeoff Distance Available (TORA/TODA): Runway length declared available and suitable for the ground run of a departing aircraft, past liftoff to the start of the takeoff climb; and,
- Landing Distance Available: Runway length declared available and suitable for landing an aircraft; and,
- Accelerate-Stop Distance Available: Runway length declared available and suitable for acceleration of an aircraft to takeoff speed and then deceleration associated with an aborted takeoff.

Table 5-1: Refined Runway Concept Declared Distances

Declared Distance Category	Runway Length (feet)	
	14L	32R
Takeoff Run/Takeoff Distance Available (TORA/TODA)	3,509	3,508
Landing Distance Available (LDA)	3,508	3,509
Accelerate-Stop Distance Available (ASDA)	3,750	3,750

Source: Ricondo & Associates and MAC analysis

The Refined concept also shifts the entire primary runway approximately 115 feet to the northwest along its centerline to locate all of the Runway Protection Zones (RPZ) for Runway 32R on MAC property. In the existing condition, and in the Stopway concept, a corner of the Runway 32R RPZ extended beyond the property boundary onto private residential property.

Advantages and disadvantages of this revised runway length concept are summarized below:

Convert Portions of Runway 14-32 Paved Blast Pads to Runway (3,750 feet)	
Advantages	**Disadvantages**
• Achieves recommended runway lengths for all takeoff and landing movements; enhances operational capability and safety for the design aircraft family • Optimizes use of investments already made in existing runway and blast pad pavement surfaces • All primary runway RPZs are located on airport property, improving off-airport land use compatibility • Airspace surface shift to displaced Runway 32 landing threshold reduces some off-airport obstacle impacts • Runway extensions may result in departing aircraft achieving higher altitudes over airport property before overlying neighborhoods	• Perception of airport role expansion to accommodate larger aircraft types • Taxiway extensions add pavement to maintain • Higher development costs associated with runway shift marking/lighting changes, displaced threshold marking/lighting, and taxiway extensions/lighting • Operational impacts during construction • Airspace surface shift to new Runway 14 end and displaced landing threshold may require additional obstacle (tree) removals • Runway extensions move departing aircraft closer to the airport boundary at the start of takeoff roll, increasing ground noise for neighborhoods closest to the airport boundary • Longer Safety Zones
Estimated Development Cost: $2,550,000.00	

The anticipated construction cost for the near-term improvements included in the Refined concept is approximately $250,000 more than the improvements contained in the Stopway concept. This extra cost is primarily associated with runway marking and light adjustments associated with the conversion of existing blast pad pavement to runway and shifting the runway to the northwest, along with constructing taxiway extensions to the shifted runway ends.

With this concept, it is likely that some additional tree removal will be required to maintain clear runway airspace obstacle clearance surfaces. Specific trees will be identified at the time that the runway improvements are designed based on updated survey data. The following factors will influence the scope of future tree removal programs:

- Runway 32R (southeast end): As a result of the proposed runway configuration and shift to the northwest along its centerline, and recommendation to pursue a non-precision instrument approach to this end, the protected airspace approach surfaces will likely shift to become slightly wider to the southeast of the airport. At a 20:1 slope, this shift should provide an additional 5-6 feet of clearance to the southeast of the airport when compared to the existing condition.
- Runway 14L (northwest end): As a result of the proposed runway configuration and shift to the northwest along its centerline, the airspace obstacle clearance surfaces will likely shift to become slightly lower (approximately 5-6 feet) to the northwest of the airport.
- Turf Runway 6R-24L: The approaches to the retained portion of the turf runway will need to be kept clear of vegetation. However, since the runway length is

proposed to be shortened, the airspace obstacle clearance surfaces will shift accordingly and offer greater clearances than in the existing condition.

Due to the amount of vegetation in the vicinity of Crystal Airport, tree growth is assessed on an ongoing basis and a removal program is needed during a runway improvement project or approximately every ten years.

Turf Runway 06R-24L (Refined Concept)

The previous plan proposed to close and decommission the seasonal turf Runway 06R-24L and this recommendation was carried forward into the Original Draft 2035 LTCP that was presented to the public.

A key objective for airfield improvements at Crystal Airport is to simplify the airfield geometry by reducing the number of designated "hot spots" on the airfield, which represent the areas with the greatest potential for pilot confusion and incursion errors. This is consistent with a nationwide initiative by the Federal Aviation Administration (FAA) to reduce the number of runway incursions and increase airfield safety. Of the eight existing airfield "hot spots" at Crystal Airport, three of them are associated with taxiways crossing turf Runway 06R-24L.

Based on the volume of comments received on this item, MAC decided to explore two additional concepts that would preserve some form of turf operational area for pilots while still seeking to reduce overall airfield complexity and the number of designated hot spots associated with the turf runway. These concepts include:

- Allowing aircraft to land in a designated turf area adjacent to a paved runway, within that paved runway's operational environment, at the pilot's own risk; or
- Reducing the length of the current turf runway so that aircraft on Taxiways F and D would no longer penetrate the turf runway's safety area, object free area, or approach surface. The remaining turf runway length would be approximately 1,670 feet.

MAC requested that the FAA review these concepts and render a determination as to whether or not they comply with current airport design standards and could be approved on the Airport Layout Plan (ALP) for Crystal Airport.

The FAA's preliminary review indicated that they would not support allowing an aircraft to land in a designated turf area adjacent to a paved runway, as this practice would not comply with current airport design standards. However, the concept of reducing the length of the existing turf runway so that aircraft on Taxiways F and D would remain clear of the turf runway's protected surfaces appears to have merit to reduce the number of formal runway crossings, thereby, reducing incursion potential.

Coordination with airport users suggests that the proposed 1,670-foot length of the turf runway will be adequate to accommodate operational needs.

Although further review will be required during Airport Layout Plan (ALP) development, this concept is now being incorporated into the 2035 LTCP.

The revised turf Runway 06R-24L concept is shown in **Figure 5-5**.

Taxiway Configuration

The 2025 LTCP Preferred Alternative contemplated converting the existing Runway 14R-32L pavement into a full-length 40-foot wide parallel taxiway, but did not suggest any other taxiway configuration changes.

The following taxiway changes were included in the Original Preferred Alternative:

- Convert existing Taxiway E to the southeast of Taxiway A into an apron-edge taxilane. This will provide additional useable apron frontage due to the less-demanding object free area.
- Removing the section of existing Taxiway E between Taxiway A and Taxiway B that crosses Runway 06L-24R. This section of pavement will be redundant with the full-length parallel taxiway in place, and removing it will eliminate a runway crossing where incursions may occur.
- Remove the section of existing Taxiway E3 between Runway 14L-32R and the future parallel taxiway (existing Runway 14R-32L). This will eliminate an instance where a taxiway leads directly from an apron to a runway.
- Remove the section of existing Taxiway E2 between Taxiway/Taxilane E and the future parallel taxiway (existing Runway 14R-32L). This will eliminate another instance where a taxiway leads directly from an apron to a taxiway.
- Extend Taxiway B between Taxiway/Taxilane E and the future parallel taxiway (existing Runway 14R-32L).
- Install lighting on the future parallel taxiway (existing Runway 14R-32L) to promote situational awareness during low-visibility conditions. In addition, enhanced centerline markings and/or surface painted markings at select locations may help to further mitigate the risk of incursions.

Based on input received by Air Traffic Control Tower and Airport Operations staff during the first comment period, the following taxiway system adjustments were included in the Refined Preferred Alternative to make the airfield more efficient and to further simplify geometry:

- Retain connector Taxiway E3 between primary Runway 14L-32R and the future parallel taxiway (existing south parallel runway). This will help to facilitate the efficiency of aircraft exiting the runway after landing.
- Remove connector Taxiway E2 and E3 between Taxiway E and the future parallel taxiway (existing south parallel runway) to eliminate direct apron-to-runway access. These connectors will be replaced with a single new connector located between the removed connector sections.
- Remove existing runway end connectors as they would be located too close to the new runway ends to facilitate efficient snow removal.
- Offset the Taxiway B extension between Taxiway F and the future parallel taxiway (existing south parallel runway) to provide additional distance before the Runway 6L-24R hold short position.

The proposed taxiway configuration changes are shown on **Exhibit 5-6**.

In addition, a user suggestion was made to add on-airport service roads around runway ends so that vehicles (including fuel trucks) do not have to cross active runways to reach hangar areas. This recommendation has merit and will be evaluated further during the subsequent environmental review and Airport Layout Plan (ALP) preparation phases.

5.3 PREFERRED ALTERNATIVE REFINEMENTS

After reviewing the body of public comments received during both the first and second round public comment periods, MAC staff prepared a recommendation to the Board that the Refined concept be approved as the Final Preferred Alternative for the Crystal Airport 2035 LTCP. This recommendation was made on the basis that it is responsive to the most prominent stakeholder concerns while still meeting the stated planning goals to: 1] better align airfield infrastructure to match existing and forecasted activity levels; 2] preserve and, if possible, improve operational capabilities for the current family of aircraft using the facility; and 3] enhance safety by simplifying the airfield movement area configuration.

The 2035 LTCP Final Preferred Alternative for improvements at Crystal Airport includes the following items, as shown in **Figure 5-7**.

- Items from the 2025 LTCP Preferred Alternative
  - Decommission existing Runway 14R-32L to reduce airfield complexity and increase safety (call-out #1 on **Figure 5-7**);
  - Convert existing Runway 14R-32L into a full-length parallel taxiway and add taxiway lights (call-out #2 on **Figure 5-7**);
  - Preserve areas for future hangar development should demand arise (call-out #3 on **Figure 5-7**); and
  - Identify parcels for possible conversion to non-aeronautical revenue generating land uses (see **Figure 7-6**).
- Refinements included in the 2035 LTCP Preferred Alternative
  - Update the runway designation to Utility and use small aircraft design standards to reduce RPZ dimensions (call-out #4 on **Figure 5-7**);
  - Convert portions of the paved blast pads on primary Runway 14L-32R to useable runway for a published length of 3,750 feet with declared distances in effect and extend taxiways to new runway ends (call-out #5 on **Figure 5-7**);
  - Shift the primary runway approximately 115 feet to the northwest along its centerline to locate all of the Runway Protection Zone (RPZ) for Runway 32R on MAC property, improving land use compatibility over the existing condition (call-out #6 on **Figure 5-7**);
  - Retain a portion of the existing turf runway and operate it in a manner that will reduce runway crossing points, airfield complexity, and incursion potential while preserving turf operational capabilities at a metropolitan area airport (call-out #7 on **Figure 5-7**);
  - Taxiway configuration changes as described in **Section 5.2.3** (call-out #8 on **Figure 5-7**);

- Expand the FBO apron (call-out #9 on **Figure 5-7**); and,
- Pursue the establishment of a new non-precision instrument approach to the Runway 32 end, if feasible (call out #10 on **Figure 5-7**).

Finally, it is important to note that the LTCP is a planning document and does not authorize any construction. Adoption of the LTCP is only the first step in the project implementation process. Before any construction can begin, the project(s) must first be evaluated through an environmental review process and then compete for funding through Federal Aviation Administration and/or State grant programs. In order to compete effectively for funding, the project(s) must have solidly documented justification. Once funding is secured, final project engineering and design will take approximately one year to complete. Based on this timeline, it is feasible that construction could occur sometime between 2018-2019 timeframe (subject to change).

Figure 5-1: 2025 LTCP Preferred Alternative

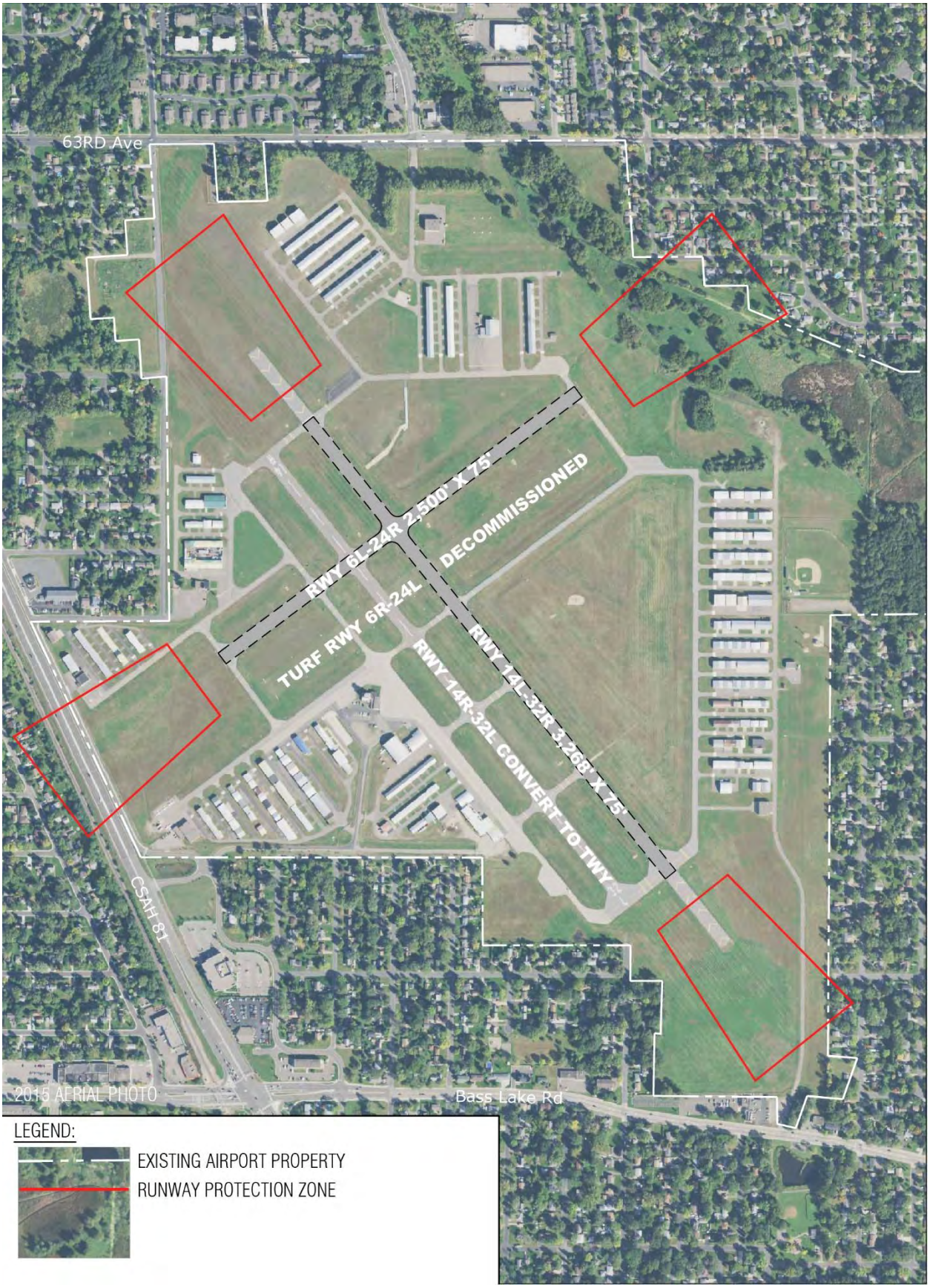


Figure 5-2: Convert Paved Blast Pads to Stopways

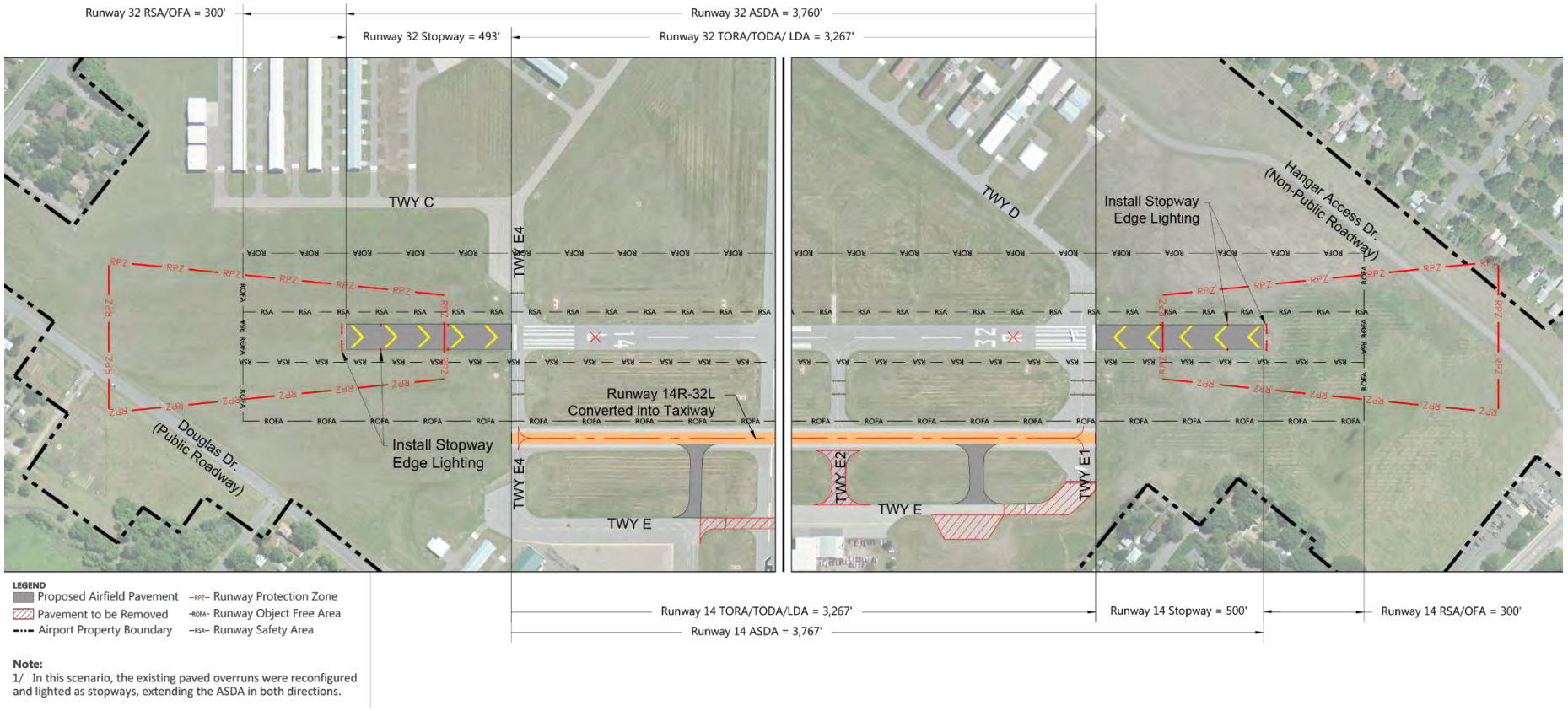


Figure 5-3: Convert Paved Blast Pads to Runway

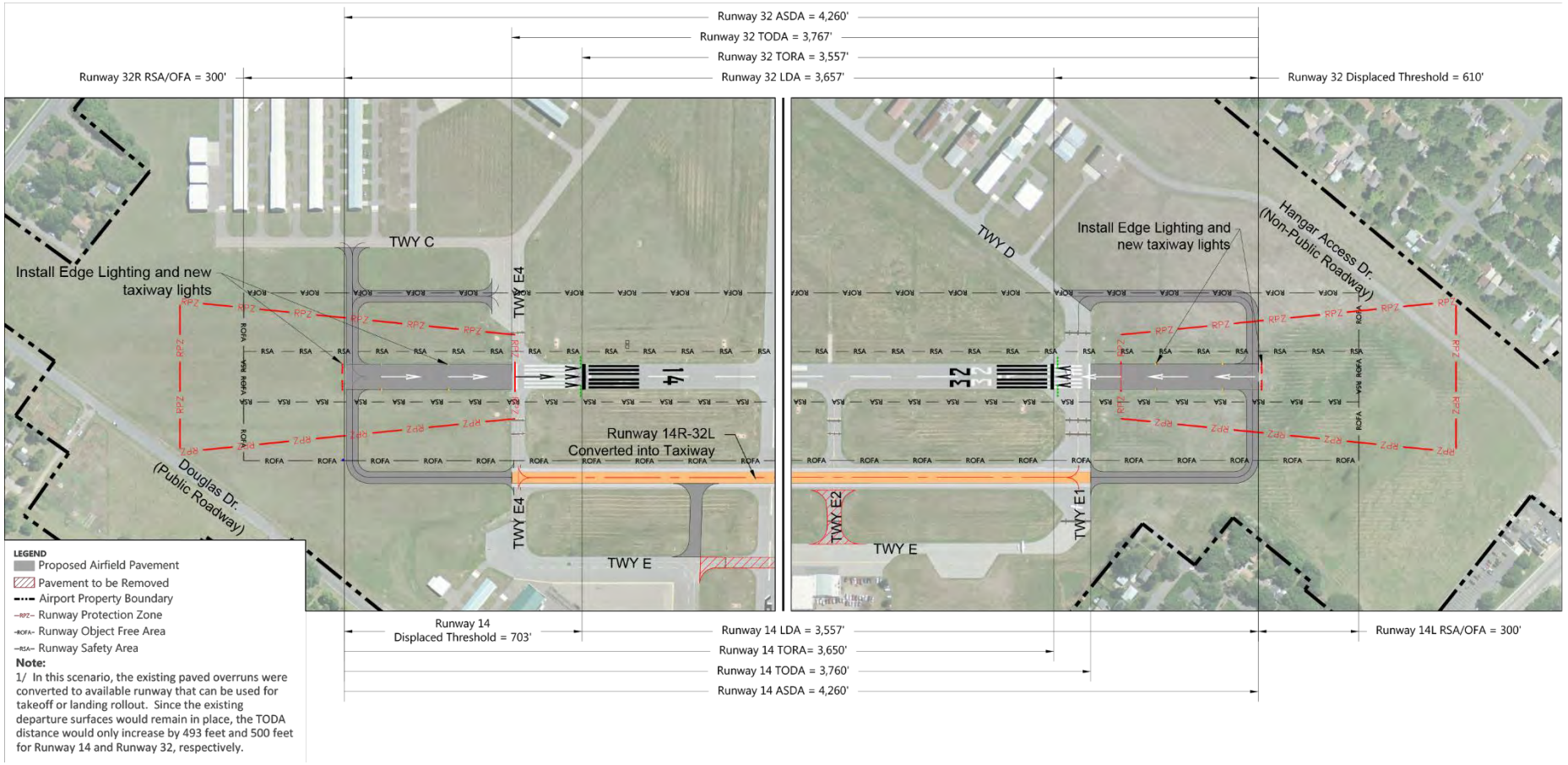


Figure 5-4: Convert Portions of Paved Blast Pads to Runway (Refined Concept)

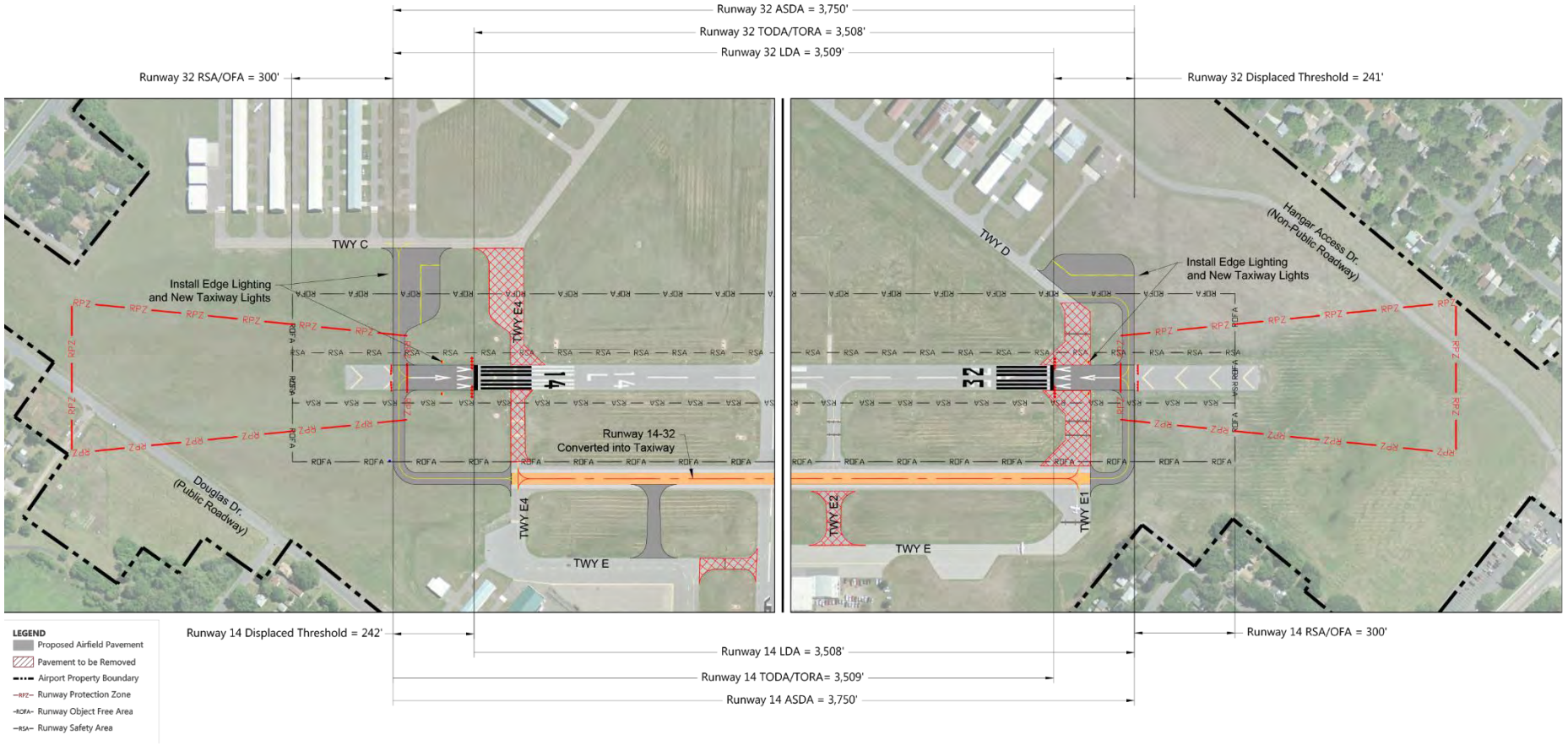


Figure 5-5: Turf Runway 06R-24L (Refined Concept)

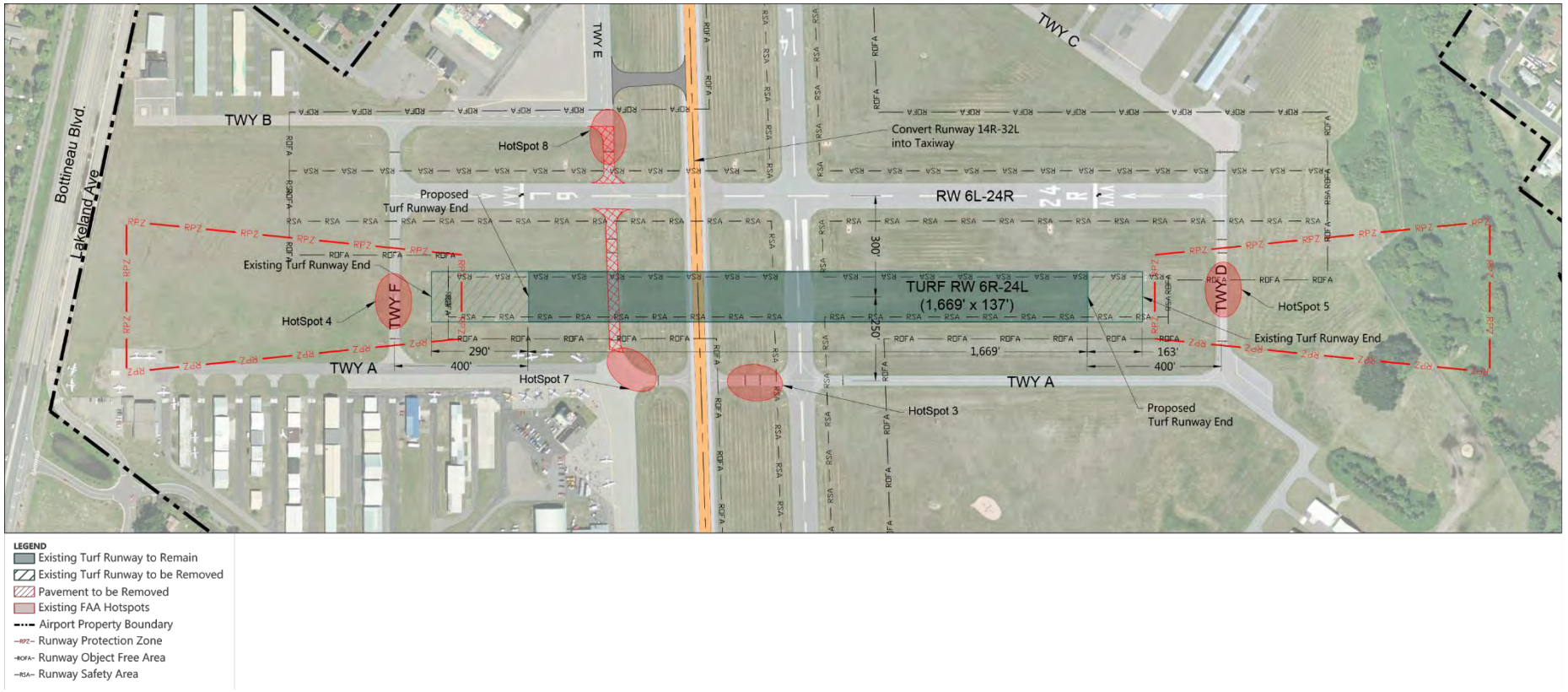


Figure 5-6: Taxiway Configuration Changes

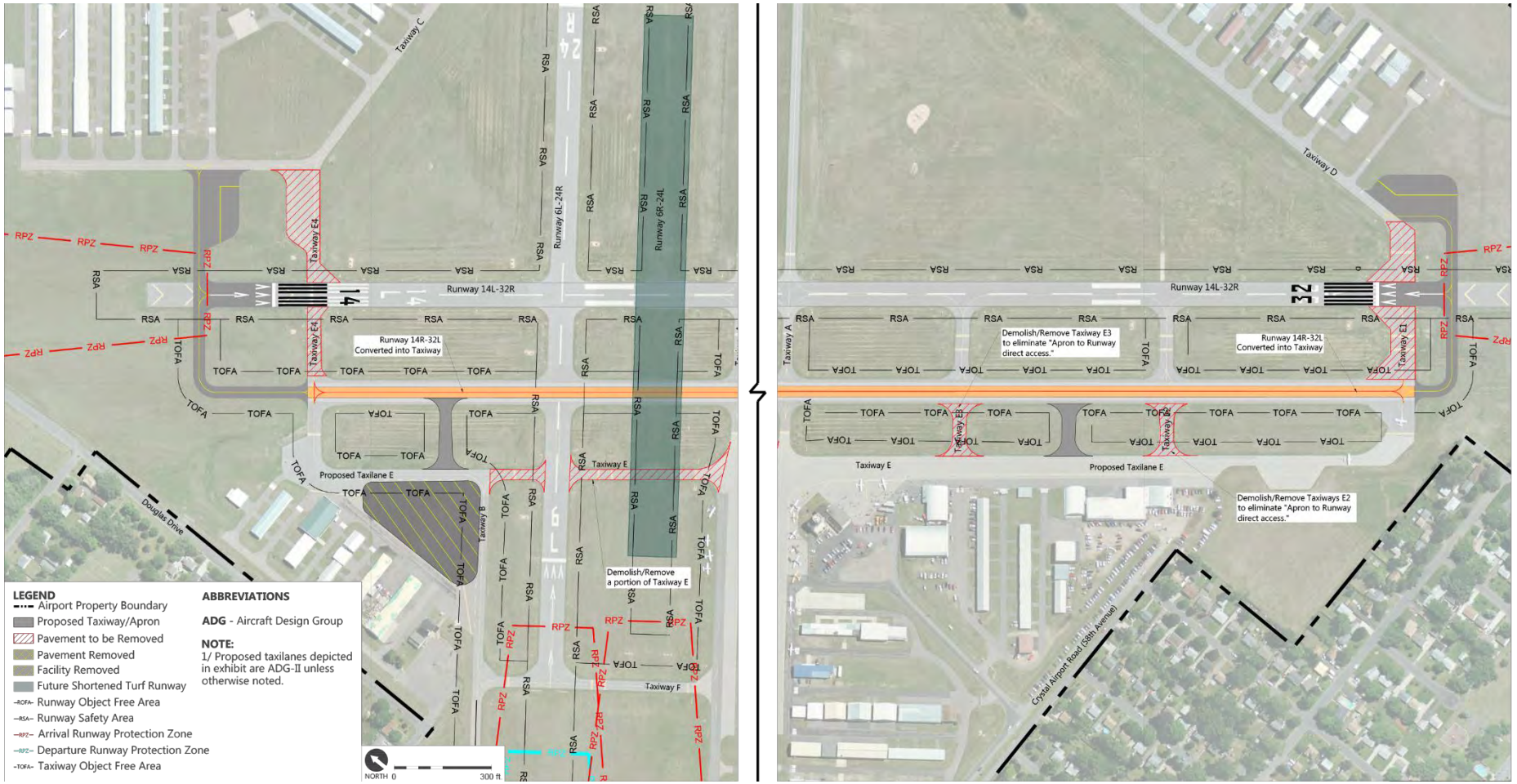
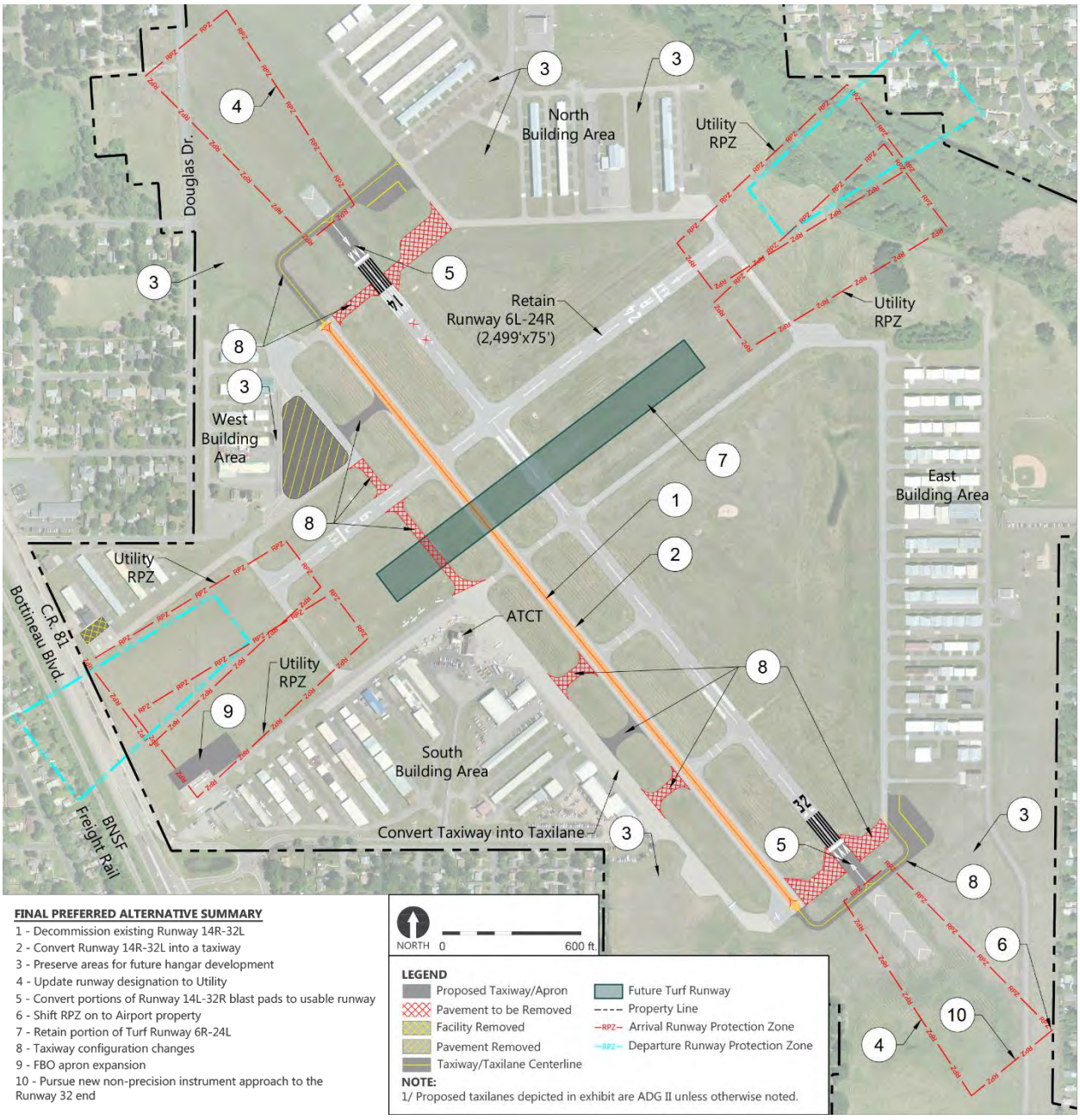


Figure 5-7: 2035 LTCP Final Preferred Alternative Overview



SECTION 6:

ENVIRONMENTAL CONSIDERATIONS

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6. ENVIRONMENTAL CONSIDERATIONS

6.1 INTRODUCTION

An integral part of the airport planning process focuses on the manner in which the airport and any planned enhancements to the facility pose environmental impacts. This chapter provides a high-level introductory assessment of potential environmental implications of the planned operation and development of Crystal Airport. Prior to any construction taking place, the MAC will complete an Environmental Assessment (EA) and/or an Environmental Assessment Worksheet (EAW) in compliance with state statutes and FAA requirements for utilizing Airport Improvement Program (AIP) grant funds.

6.2 AIRCRAFT NOISE

6.2.1 Quantifying Aircraft Noise

Basics of Sound

Sound is a physical disturbance in a medium; a pressure wave typically moving through a fluid - air. A sound source vibrates or otherwise disturbs the air immediately surrounding the source, causing variations in pressure above and below the static (at-rest) value of atmospheric pressure. These disturbances force air to compress and expand setting up a wavelike movement of air particles that move away from the source. Sound waves, or fluctuations in pressure, vibrate the eardrum creating audible sound.

The decibel, or dB, was introduced as a measure of sound pressure level that is compressed into a convenient range, the tremendous span of human sensitivity to pressure. Using a logarithmic relationship, and the ratio of sensed pressure compared against a fixed reference pressure value, the dB scale accounts for the range of hearing with values from 0 to around 200. Most human sound experience falls into the 30 dB - 120 dB range.

Decibels are logarithmic, and thus cannot be added directly. Two identical noise sources each producing 70 dB do not add to a total of 140 dB, but to 73 dB. Each time the number of sources is doubled, the sound pressure level is increased 3 dB.

- 2 sources: 70 dB + 70 dB = 73 dB
- 4 sources: 73 dB + 73 dB = 76 dB
- 8 sources: 76 dB + 76 dB = 79 dB

The just-noticeable change in loudness for normal hearing adults is about 3 dB. That is, changes in sound level of 3 dB or less are difficult to notice. A doubling of loudness for the average listener of A-weighted sound is about 10 dB[22]. Measured, A-weighted sound levels changing by 10 dBA effect a subjective perception of being “twice as loud”.[23]

Figure 6-1 provides the noise levels for various common sources.

[22] A-weighted decibels represent noise levels that are adjusted relative to the frequencies that are most audible to the human ear.

23 Peppin and Rodman, Community Noise, p. 47-48; additionally, Harris, Handbook, Beranek and Vér, Noise and Vibration Control Engineering, among others.

Day-Night Average Sound Level (DNL)

In 1979 the United States Congress passed the Aviation Safety and Noise Abatement Act. The Act required the Federal Aviation Administration (FAA) to develop a single methodology for measuring and determining airport noise impacts. In January 1985 the FAA formally implemented the Day-Night Average Sound Level (DNL) as the noise metric descriptor of choice for determining long-term community noise exposure in the airport noise compatibility planning provisions of 14 C.F.R. Part 150. Additionally, FAA Order 1050.1, *"Environmental Impacts: Policies and Procedures"* and FAA Order 5050.4, *"National Environmental Policy Act (NEPA) Implementing Instructions for Airport Actions,"* outline DNL as the noise metric for measuring and analyzing aircraft noise impacts.

As detailed above, the FAA currently requires the DNL noise metric to determine and analyze noise exposure and aid in the determination of aircraft noise and land use compatibility issues around United States airports. Because the DNL metric correlates well with the degree of documented community annoyance from aircraft noise, DNL has been formally adopted by most federal agencies dealing with noise exposure. In addition to the FAA, these agencies include the U.S. Environmental Protection Agency (EPA), U.S. Department of Defense, U.S. Department of Housing and Urban Development, and Veterans Administration.

The DNL metric is calculated by cumulatively averaging sound levels over a 24-hour period. This average cumulative sound exposure includes the application of a 10-decibel penalty to sound exposures occurring during the nighttime (10:00 PM to 7:00 AM). The night sound exposures are increased by 10 decibels because nighttime noise is more intrusive.

Figure 6-2 provides examples of typical DNL levels in various environments.

The FAA currently considers the 65 dB DNL contour line as the threshold of significance for noise impact. As such, sensitive land use areas (e.g., residential) around airports that are located in the 65 dB or greater DNL contours are considered by the FAA as incompatible structures.

Integrated Noise Model (INM)

The FAA's Integrated Noise Model (INM) version 7.0d was used for evaluating aircraft noise impacts in this plan.

The model utilizes flight track information, runway use information, operation time of day data, aircraft fleet mix, standard and user defined aircraft profiles, and terrain as inputs. The INM model produces DNL noise exposure contours that are used for land use compatibility maps.

The noise analysis contained in this plan was started prior to the FAA's release of the Aviation Environmental Design Tool (AEDT). Noise analyses beginning after this release will use AEDT.

6.2.2 Noise Contour Development

The noise contours presented in this document were developed using INM Version 7.0d. The contours represent noise contours, expressed in DNL. The FAA currently suggests

that three different DNL levels (65, 70, and 75 DNL) be modeled but considers the 65 dB DNL contour line as the threshold of significance for noise impact. The Metropolitan Council suggests that the 60 DNL contour be included for airports in an urban environment and the 55 DNL in cases where airports are located outside the Metropolitan Urban Service Area (MUSA). Crystal Airport is within the MUSA, so the 60 DNL noise contour will be shown for advisory purposes.

The Metropolitan Airports Commission (MAC) owns and operates a Noise and Operations Monitoring System (MACNOMS) at Minneapolis-St. Paul International Airport (MSP). In addition to monitoring noise levels at 39 remote noise monitoring towers located around MSP, the system collects flight track data to approximately 40 miles around MSP up to 20,000 feet. Crystal Airport is located approximately 14 miles from MSP. As such, flight track data in the vicinity of Crystal Airport were provided by MACNOMS to aid in the INM input file development process.

MACNOMS flight track data from the 12-month period ending in August 2015 was used to develop the Baseline Condition INM Inputs. Due to the existing constraints in the flight tracking system in the vicinity of Crystal Airport, acquisition and availability of detailed flight track data is reduced. However, for the year ending August 2015, MACNOMS reported approximately 23,533 aircraft operations in the vicinity of Crystal Airport which represents approximately 56 percent of total estimated operations in 2015. This provided an adequate data sample for purposes of contributing to the construction of the INM inputs.

The following details the methodology utilized in developing the data inputs for the INM contour modeling.

Aircraft Activity Levels

As summarized in **Table 3-7** in **Chapter 3**, the total number of Crystal Airport operations in the Baseline Condition is estimated to be 41,838 and the 2035 Final Preferred Alternative Condition forecast number of total operations is 40,218.

Fleet Mix

Using the MACNOMS flight track data available in the vicinity of Crystal Airport for a 12-month period ending August 2015, various data processing steps were taken to develop the Baseline Condition fleet mix. The flight track analysis process began by first excluding all MSP air carrier jet flight tracks. Then all flight tracks with a start point or end point that did not fall within a 5km (3.1 mile) radius and 1km (0.6 mile) ceiling (above ground level) around Crystal Airport were filtered out of the data. If the starting point of a track was within the radius and ceiling thresholds, it was considered a departure operation. If the endpoint of a track was within the radius and ceiling thresholds, it was considered an arrival operation. If both start and end points of a track were within the radius and ceiling thresholds, it was considered a touch and go operation. The aircraft type information from the MACNOMS flight track system was then adjusted to reflect the number of operations per aircraft category from the Base Case Year 2015 operations estimates, as described in **Appendix 3** to develop the Baseline Condition fleet mix. The Baseline Condition fleet mix was then modified to reflect the forecast assumptions outlined in **Chapter 3** to arrive at the projected Forecast 2035 fleet mix.

A summary of the Baseline Condition and Forecast 2035 fleet mixes is provided in **Table 6-1**. A more detailed presentation of the Baseline Condition and 2035 Final Preferred Alternative Condition aircraft fleet mixes is provided in **Appendix 6**.

Day/Night Split of Operations

Based on the MACNOMS flight track data for Crystal Airport, the split of day and nighttime operations was determined. Daytime hours are defined as 7:00 AM to 9:59:59 PM and nighttime hours are 10:00 PM to 6:59:59 AM.

The day/night operations distribution derived from the MACNOMS flight track data was then applied to the total number of operations to develop the Baseline Condition day/night split.

The Baseline Condition day/night split was used to arrive at the 2035 Final Preferred Alternative Condition day/night split. The day/night split is not expected to change significantly throughout the forecast period.

A summary of the Baseline Condition and 2035 Final Preferred Alternative Condition day/night splits is also provided in **Table 6-1**. A more detailed presentation of the Baseline Condition and 2035 Final Preferred Alternative Condition day/night splits is provided in **Appendix 6**.

Table 6-1: Summary of Average Daily Flight Operations

Average Daily Flight Operations	Day	Night	Total	% of Total Operations
Baseline Condition				
Helicopter	1.8	0.4	2.2	2.5%
Multi-Engine Piston	5.6	0.2	5.8	6.5%
Single-Engine Piston	71.6	2.7	74.3	82.8%
Experimental	6.6	0.6	7.2	8.0%
Turboprop	0.2	0.0	0.2	0.2%
Jet	0.0	0.0	0.0	0.0%
Total	*85.8*	*3.9*	*89.7*	*100.0%*
% of Total Operations	*95.7%*	*4.3%*	*100.0%*	
2035 Final Preferred Alternative Condition				
Helicopter	3.6	0.2	3.8	4.4%
Multi-Engine Piston	5.0	0.2	5.2	6.0%
Single-Engine Piston	61.4	3.5	64.9	74.8%
Experimental	11.6	0.0	11.6	13.3%
Turboprop	0.9	0.0	0.9	1.1%
Jet	0.3	0.0	0.3	0.4%
Total	*82.8*	*3.9*	*86.7*	100.0%
% of Total Operations	*95.5%*	*4.5%*	*100.0%*	

Notes: Totals may not add due to rounding

Source: MACNOMS Data Analysis, HNTB Activity Forecasts

Runway Use

Using the Crystal Airport flight track data, a runway use analysis was conducted. Runway assignments were made utilizing trapezoids off the end of each runway to determine on which runway a flight operated. Each trapezoid runs along the axis of the centerline beginning at the runway end and extending 5km (3.1 miles). The trapezoid is 500m (.31 miles) wide at the runway end and 1,800m (1.1 miles) wide at the extent furthest from the runway. For the purpose of the runway use analysis, the last five or first five data points of each flight track in the vicinity of Crystal Airport were analyzed relative to the runway trapezoids.

Since Crystal Airport has closely-spaced parallel runways, runway assignments employ a best-fit methodology to more accurately assign the runway for each flight operating at the Crystal Airport. This process calculates the spatial distance between the flight track and the runway centerlines and selects the runway that has the shortest distance differential.

In cases when the last five radar points of a track were in the vicinity of Crystal Airport, and at least one of the radar points was located within a respective runway trapezoid, the track was assigned as an arrival operation on that runway. Conversely, in cases when the first five radar points were in the vicinity of Crystal Airport, and at least one of the radar points was located within a respective runway trapezoid, the track was assigned as a departure operation on that runway. In cases when the last five and first five radar points were in the vicinity of Crystal Airport, and at least one of the last and at least one of the first radar points were located within a respective runway trapezoid, the track was assigned as a touch and go operation on the respective runway(s).

The Baseline Condition runway use assumptions were then adjusted to arrive at the projected 2035 Final Preferred Alternative runway use. All new jet and turboprop aircraft operations in the 2035 Final Preferred Alternative Condition are assigned to Runway 14-32. Operations on Runway 14R-32L in the Baseline Condition were moved to Runway 14L-32R in the 2035 Final Preferred Alternative Condition.

A summary of the Baseline Condition and 2035 Final Preferred Alternative Condition runway use percentages is provided in **Table 6-2**. A more detailed presentation of the Baseline Condition and 2035 Final Preferred Alternative Condition runway use is provided in **Appendix 6**.

Flight Tracks

The Baseline Condition INM flight track locations were developed based on the trends established by the MACNOMS flight tracks that met the fleet mix data sample criteria for Crystal Airport.

The Baseline Condition INM flight tracks were then adjusted to reflect the future airfield configuration and runway ends per the Final Preferred Alternative, as detailed in **Chapter 5**. Specifically, flight tracks related to Runways 14R-32L were removed and aircraft previously assigned to these tracks were moved to corresponding flight tracks on Runways 14L-32R.

Figures depicting flight track locations and additional detail related to flight track use for the Baseline and 2035 Preferred Alternative Conditions are provided in **Appendix 6**.

Table 6-2: Summary of Average Annual Runway Use

Average Annual Runway Use %	Arrivals			Departures			Touch and Gos		
	Day	Night	Total	Day	Night	Total	Day	Night	Total
Baseline Condition									
Runway 06L	3.5%	3.6%	3.5%	3.5%	2.4%	3.5%	5.2%	0.0%	5.1%
Runway 06R	0.5%	0.0%	0.5%	0.6%	0.0%	0.6%	0.0%	0.0%	0.0%
Runway 14L	36.9%	41.7%	37.2%	27.2%	28.5%	27.3%	23.8%	50.0%	24.7%
Runway 14R	5.9%	0.3%	5.6%	9.4%	6.4%	9.3%	14.6%	0.0%	14.1%
Runway 24L	0.5%	0.0%	0.5%	0.6%	0.0%	0.6%	0.0%	0.0%	0.0%
Runway 24R	11.8%	3.2%	11.3%	9.6%	3.7%	9.4%	13.9%	0.0%	13.4%
Runway 32L	9.8%	15.5%	10.1%	16.6%	6.1%	16.1%	16.6%	0.0%	16.0%
Runway 32R	31.1%	35.7%	31.3%	32.5%	52.9%	33.3%	25.9%	50.0%	26.7%
2035 Final Preferred Alternative Condition									
Runway 06L	2.2%	1.6%	2.2%	3.1%	0.7%	3.0%	8.2%	0.3%	7.8%
Runway 06R	1.3%	0.0%	1.2%	1.6%	0.0%	1.5%	0.0%	0.0%	0.0%
Runway 14L	42.2%	41.0%	42.2%	38.2%	54.8%	38.9%	36.8%	42.2%	37.1%
Runway 24L	1.3%	0.0%	1.2%	1.6%	0.0%	1.5%	0.0%	0.0%	0.0%
Runway 24R	8.9%	1.2%	8.6%	7.6%	6.3%	7.6%	11.8%	15.0%	12.0%
Runway 32R	44.0%	56.1%	44.5%	47.9%	38.2%	47.5%	43.2%	42.5%	43.2%

Notes: Totals may not add due to rounding

Source: MACNOMS Data Analysis

6.2.3 Baseline Condition Noise Impacts

In the Baseline Condition noise contours there are 10 residential structures located within the 65 DNL noise contours around Crystal Airport, and another 126 residential structures contained within the 60 DNL contour[24]. Residential structures are typically considered incompatible within the 65 DNL noise contour, but compatible within the 60 DNL contour. The 65 DNL contour contains approximately 64.3 acres, mostly on airport property, while the 60 DNL contour contains approximately 146.8 acres. The entire 70 and 75 DNL contours are contained on the airport property, essentially overlying the areas immediately adjacent to the runways. The 70 and 75 DNL contours contain 46.6 and 20.2 acres respectively.

The Baseline Condition noise contours are shown in **Figure 6-3**.

A summary of the Baseline Condition noise impact is provided in **Table 6-3**.

Table 6-3: Baseline Condition Noise Impact Summary

Noise Impact Summary by Contour	75 DNL	70 DNL	65 DNL	60 DNL
Baseline Condition				
Contour Overall Area (Acres)	20.2	46.6	64.3	146.8
Contour Contained on Airport?	Yes	Yes	No	No
Number of Residential Structures	0	0	10	126

Source: MAC Analysis

6.2.4 2035 Final Preferred Alternative Condition Noise Impacts

In the 2035 Final Preferred Alternative noise contours there are 11 residential structures located within the 65 DNL noise contours around Crystal Airport, and another 212 residential structures contained within the 60 DNL contour. The 65 DNL contour contains approximately 84.8 acres, mostly on airport property, while the 60 DNL contour contains approximately 187.8 acres. The entire 70 and 75 DNL contours are contained on the airport property, essentially overlying the areas immediately adjacent to the runways. The 70 and 75 DNL contours contain 45.5 and 24.9 acres respectively.

The 2035 Final Preferred Alternative noise contours are shown in **Figure 6-4**.

A summary of the 2035 Final Preferred Alternative noise impact is provided in **Table 6-4**.

[24] In the draft report, 123 single-family homes were reported to be inside the Baseline 60 DNL noise contour. Due to updated county parcel data, this number will grow by three single-family residences to 126. Two parcels were converted from Vacant Land-Residential to Residential with the homes being recently built on the properties. One parcel was not listed as a Residence in the county parcel data, however further discussions with the City of Crystal have clarified its use as a single-family residence.

Table 6-4: 2035 Final Preferred Alternative Condition Noise Impact Summary

Noise Impact Summary by Contour	75 DNL	70 DNL	65 DNL	60 DNL
2035 Final Preferred Alternative				
Contour Overall Area (Acres)	24.9	45.5	84.8	187.8
Contour Contained on Airport?	Yes	Yes	No	No
Number of Residential Parcels	0	0	11	212

Source: MAC Analysis

A comparison of the Baseline and 2035 Final Preferred Alternative noise contours is shown in **Figure 6-5**. **Table 6-5** provides a comparison of noise impacts from the Baseline to the 2035 Final Preferred Alternative Condition.

Table 6-5: Noise Contour Comparison (Baseline to 2035 Final Preferred Alternative)

Noise Impact Comparison by Contour	75 DNL	70 DNL	65 DNL	60 DNL
Change from Baseline to 2035 Final Preferred Alternative				
Contour Overall Area (Acres)	4.7	-1.1	20.5	41.0
Percentage Change	23%	-2%	32%	28%
Number of Residential Parcels	0	0	1	86

Source: MAC Analysis

In summary, when the 2035 Final Preferred Alternative Condition contours are compared to the Baseline (existing) Condition contours:

- For the 65 DNL contour, the acreage contained within the contour increases by 32 percent, and the contour contains four (4) additional residential parcels. However, three (3) residential parcels that are in the Baseline Condition contour are no longer included, resulting in only one (1) net new residential parcel in the contour. This change is driven by several factors, including consolidation of flight activity on two runways instead of four in the existing condition, the shift of the runway along its centerline to the northwest, and the runway extensions that move departing aircraft closer to the airport boundary at the start of their takeoff roll.
- For the 60 DNL contour, the acreage contained within the contour increases by 28 percent, and the contour contains 86 more residential parcels, primarily

located to the southeast and northwest of the airport. Again, this change is driven by several factors, including consolidation of flight activity on two runways instead of four in the existing condition, the shift of the runway along its centerline to the northwest, and the runway extensions that move departing aircraft closer to the airport boundary at the start of their takeoff roll.

6.3 SANITARY SEWER AND WATER

Crystal Airport currently lies within the Metropolitan Urban Service Area (MUSA) for sanitary sewer service and has both water and sanitary system available for tenants[25].

Development of any new hangar areas will include extension of existing water and sanitary sewer services.

6.4 WETLANDS

As noted in **Section 2.5.1**, the airport lies within the jurisdiction of the Shingle Creek Watershed Management Commission (SCWMC). This commission was formed in 1982 under a Joint Powers Agreement between the Cities of Crystal, Brooklyn Park, Brooklyn Center, and is governed by a nine-member board. Their responsibility is to protect and manage water resources within the watershed.

Any projects completed at the airport require conformance with the SCWMC, as well as Wetland Conservation Act (WCA) and/or DNR regulations regarding wetlands. If wetland impacts are suspected with MAC projects, avoidance, minimization efforts and appropriate mitigation will be assessed.

No wetland impacts are anticipated with implementation of the 2035 Final Preferred Alternative.

6.5 OTHER ENVIRONMENTAL CONSIDERATIONS

The MAC will conduct an environmental review per federal National Environmental Policy Act (NEPA) and Minnesota Environmental Policy Act (MEPA) requirements to more specifically identify the environmental footprint of the proposed improvements before construction can begin. During this process, alternatives must be reviewed and any potential impacts must be avoided if possible. If impacts cannot be avoided, they must be minimized to the extent possible and mitigated in full compliance with federal and state requirements.

The following impact categories will be assessed during the environmental review:

- Air Quality;
- Biological resources (including fish, wildlife, and plants);
- Climate;
- Department of Transportation Section 4(f) Properties (park and recreational lands, wildlife and waterfowl refuges, and historic sites)[26];

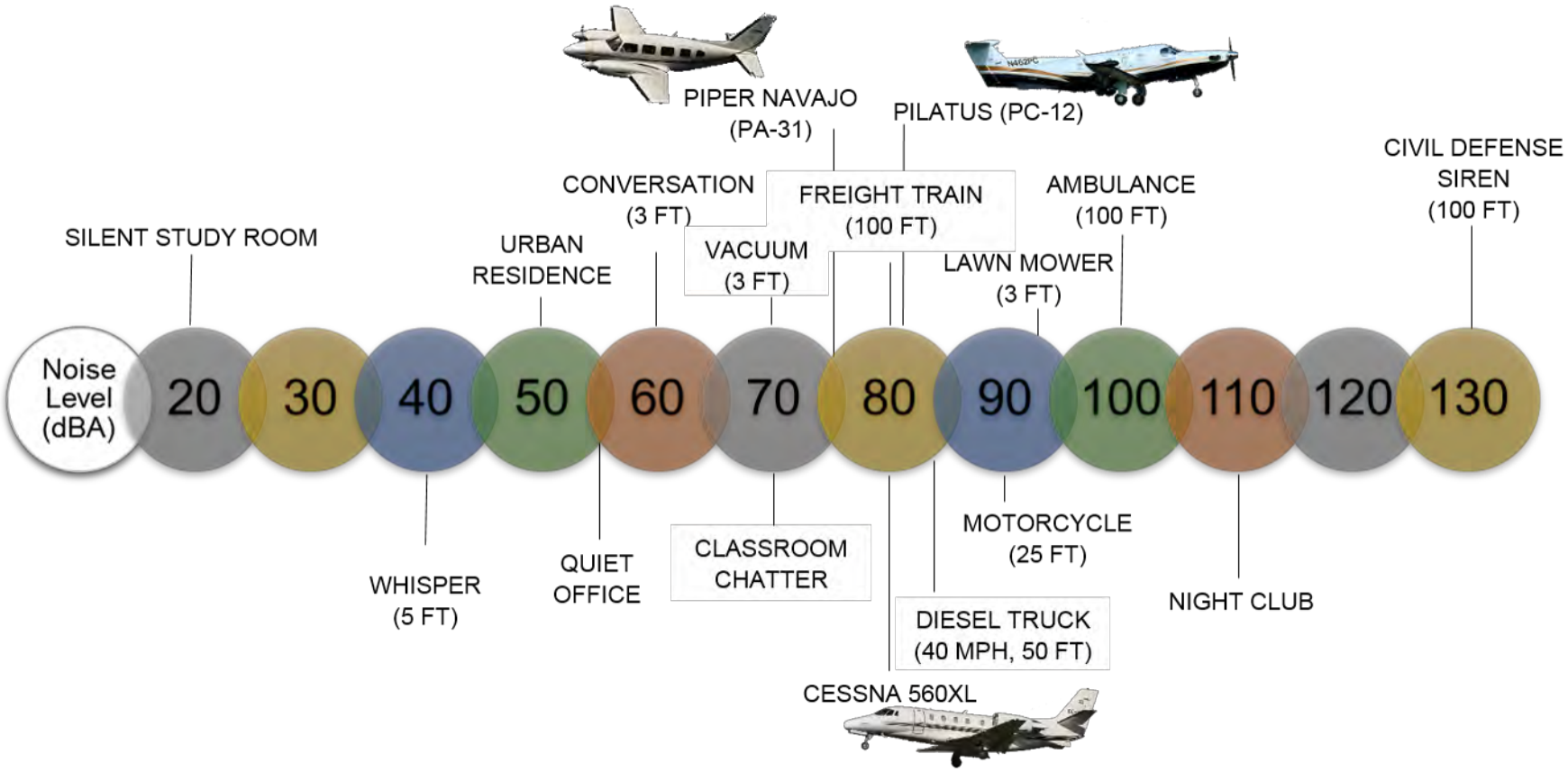
[25] One tenant is not connected to municipal utilities due to lack of tie-in capabilities.

[26] The Crystal Lakes Regional Trail adjacent to the west side of the Airport will be evaluated as a Section 4(f) resource.

- Farmlands;
- Hazardous materials, solid waste, and pollution prevention;
- Historical, architectural, archeological, and cultural resources;
- Land use;
- Natural resources and energy supply;
- Noise and compatible land use;
- Socioeconomics, environmental justice, and children's environmental health and safety risks;
- Visual effects (including light emissions);
- Water resources (including wetlands, floodplains, surface waters, groundwater, and wild and scenic rivers);
- Construction impacts; and
- Cumulative effects.

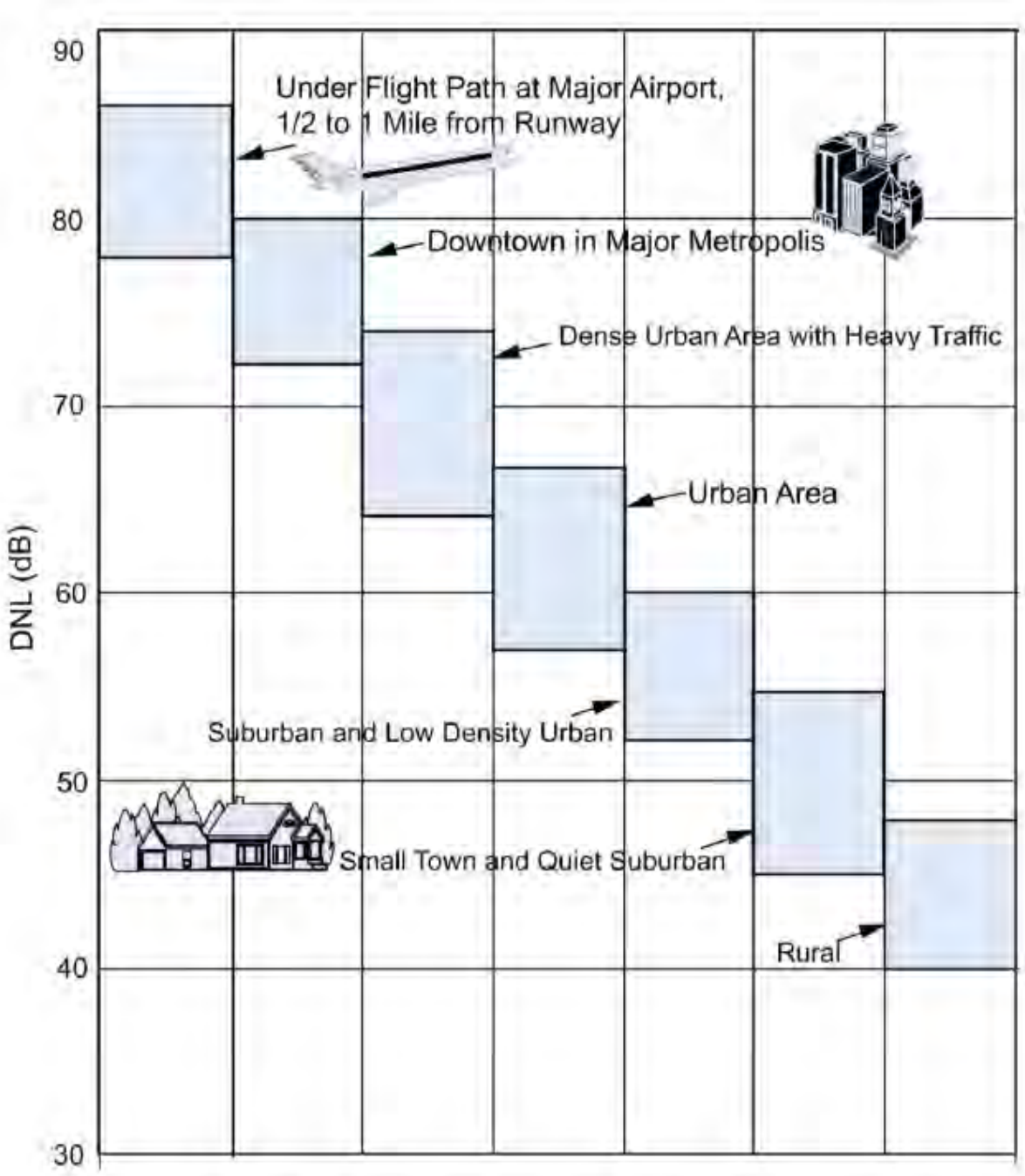
An environmental review process cannot begin until there is a sufficiently detailed plan available to evaluate. MAC envisions initiating the environmental review for the proposed Crystal Airport improvements soon after the plan is reviewed by the Metropolitan Council and formally adopted by the MAC Board. A full study of these environmental impact items at this time falls outside the scope of this long-term planning document.

Figure 6-1: Sound Levels of Typical Noise Sources



Source: Aircraft sound levels are average measured L_{max} values for arrival events at MSP remote monitoring towers 5 and 6 between January 2010 and May 2017 for the aircraft type depicted. RMT 5 is 1.28 miles from the arrival threshold of Runway 12R. RMT 6 is .90 miles from the arrival threshold of Runway 12L.

Figure 6-2: Typical Outdoor Community Day-Night Average Sound Levels



Source: U.S. Department of Defense. Departments of the Air Force, the Army, and the Navy. 1978. *Planning in the Noise Environment.* AFM 19-10. TM 5-803-2, and NAVFAC P-970. Washington, D.C.: U.S. DoD.

Figure 6-3: Baseline Condition Noise Contours

Figure 6-4: 2035 Final Preferred Alternative Noise Contour

Figure 6-5: LTCP Noise Contour Comparison

SECTION 7:

LAND USE COMPATIBILITY

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7. LAND USE COMPATIBILITY

7.1 INTRODUCTION

Planning for the maintenance and development of airport facilities is a complex process. Successfully developing airports requires insightful decision-making predicated on various facts that drive the need for the development of additional airport infrastructure. Furthermore, these efforts should consider surrounding community land uses. Airports cannot be developed in a vacuum; the development effort must consider the needs of the surrounding populations and the land uses in the area surrounding the airport. The success of airport planning relies on close consideration and coordination of surrounding land use to ensure compatibility with the community surrounding the airport.

As city governments are responsible for the development and enhancement of city infrastructure, airport proprietors are responsible for the federally-endorsed enhancement of our nation's airport system. Airport operators would be remiss in their duties if such efforts did not consider the land use consequences of decisions made regarding airport development.

This chapter evaluates the land use implications of the planned operation and development of Crystal Airport.

7.2 LAND USE COMPATIBILITY CRITERIA

The Federal Aviation Administration (FAA) has established Land Use Compatibility criteria in 14 CFR Part 150 detailing acceptable land uses around airports considering noise impacts in terms of DNL. In the case of airports located in the Minneapolis-St. Paul Metropolitan Area, additional criteria also must be evaluated in relation to noise exposure as established by the Metropolitan Council's Transportation Policy Plan (TPP).

7.2.1 Federal Aviation Administration Land Use Compatibility Guidelines

Federal guidelines for compatible land use that take into account the impact of aviation noise have been developed for land near airports. They were derived through an iterative process that started before 1972. Independent efforts by the FAA, U.S. Department of Housing and Urban Development, U.S. Air Force, U.S. Navy, U.S. Environmental Protection Agency and other Federal agencies to develop compatible land use criteria were melded into a single effort by the Federal Interagency Committee on Urban Noise in 1979, and resulted in the FICUN *Guidelines* document (1980). The *Guidelines* document adopted DNL as its standard noise descriptor, and the Standard Land Use Coding Manual (SLUCM) as its standard descriptor for land uses. The noise-to-land use relationships were then expanded for FAA's Advisory Circular (AC) 150/5020-1, *Noise Control and Compatibility Planning for Airports*. The current individual agency compatible land use criteria have been, for the most part, derived from those in the FICUN *Guidelines*. Only certain categories of these guidelines[27] pertain to airport environments.

[27] Federal Interagency Committee On Noise (FICON), "Federal Agency Review of Selected Airport Noise Analysis Issues" (1992), pp. 2-6 to 2-7.

In 1985 the FAA adopted 14 C.F.R. Part 150 outlining land use compatibility guidelines around airports. **Table 7-1** provides the land use compatibility guidelines as established by the FAA.

According to FAA standards, areas with noise levels less than 65 DNL are considered compatible with residential development.

Table 7-1: FAA Aircraft Noise and Land Use Compatibility Guidelines

Land Use	Yearly day-night average sound level (DNL) in decibels					
	Below 65	65-69	70-74	75-79	80-84	Over 85
Residential						
Residential, other than mobile homes and transient lodgings	Y	N(1)	N(1)	N	N	N
Mobile home park	Y	N	N	N	N	N
Transient Lodgings	Y	N(1)	N(1)	N(1)	N	N
Public Use						
Schools	Y	N(1)	N(1)	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoriums, and concert halls	Y	25	30	N	N	N
Governmental services	Y	Y	25	30	N	N
Transportation	Y	Y	Y(2)	Y(3)	Y(4)	Y(4)
Parking	Y	Y	Y(2)	Y(3)	Y(4)	Y
Commercial Use						
Offices, business and professional	Y	Y	25	30	N	N
Wholesale and retail–building materials, hardware and farm equipment	Y	Y	Y(2)	Y(3)	Y(4)	N
Retail trade–general	Y	Y	25	30	N	N
Utilities	Y	Y	Y(2)	Y(3)	Y(4)	N
Communication	Y	Y	25	30	N	N
Manufacturing and Production						
Manufacturing, general	Y	Y	Y(2)	Y(3)	Y(4)	N
Photographic and optical	Y	Y	25	30	N	N
Agriculture (except livestock) and forestry	Y	Y(6)	Y(7)	Y(8)	Y(8)	Y(8)
Livestock farming and breeding	Y	Y(6)	Y(7)	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y

Land Use	Yearly day-night average sound level (DNL) in decibels					
	Below 65	65-69	70-74	75-79	80-84	Over 85
Recreational						
Outdoor sports arenas and spectator sports	Y	Y(5)	Y(5)	N	N	N
Outdoor music shells, amphitheaters	Y	N	N	N	N	N
Nature exhibits and zoos	Y	Y	N	N	N	N
Amusements, parks, resorts and camps	Y	Y	Y	N	N	N
Golf courses, riding stables, and water recreation	Y	Y	25	30	N	N

**The designations contained in this table do not constitute a Federal determination that any use of land covered by the program is acceptable or unacceptable under Federal, State, or local law. The responsibility for determining the acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests with the local authorities. FAA determinations under part 150 are not intended to substitute federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise compatible land uses.*

Table Key

SLUCM	Standard Land Use Coding Manual.
Y (Yes)	Land use and related structures compatible without restrictions.
N (No)	Land use and related structures are not compatible and should be prohibited.
NLR	Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
25, 30, or 35	Land use and related structures generally compatible; measures to achieve NLR of 25, 30, or 35 dB must be incorporated into design and construction of structure.

Table Notes on Following Page

Table Notes

(1) Where the community determines that residential or school uses must be allowed, measures to achieve outdoor to indoor Noise Level Reduction (NLR) of at least 25 dB and 30 dB should be incorporated into building codes and be considered in individual approvals. Normal residential construction can be expected to provide a NLR of 20 dB, thus, the reduction requirements are often stated as 5, 10, or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year round. However, the use of NLR criteria will not eliminate outdoor noise problems.

(2) Measures to achieve NLR of 25 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(3) Measures to achieve NLR of 30 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(4) Measures to achieve NLR of 35 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(5) Land use compatible provided special sound reinforcement systems are installed.

(6) Residential buildings require an NLR of 25.

(7) Residential buildings require an NLR of 30.

(8) Residential buildings not permitted.

Source: 14 CFR Part 150

7.2.2 Metropolitan Council Land Use Compatibility Guidelines

The Metropolitan Council has developed a set of land use planning guidelines for responsible community development in the Minneapolis-St. Paul Metropolitan Area. The intent is to provide city governments with a comprehensive resource with regard to planning community development in a manner that considers adequacy, quality and environmental elements of planned land uses.

Specifically, the Minnesota State Land Planning Act, the underlying law that requires local units of government to prepare a comprehensive plan and submit it for Metropolitan Council review, was enacted in 1976. By 1980, all community plans had been approved. The 1973 Aviation Chapter of the Metropolitan Development Guide was updated in 1977. In 1983, the Metropolitan Council amended the Aviation Policy Plan to include "Land Use Compatibility Guidelines for Aircraft Noise."

In 1994, the Land Planning Act of 1976 had been amended to require communities to update their comprehensive plans at least every 10 years. Therefore, all Metropolitan Development Guide chapters were updated by December 1996.

Under the 1976 legislation, communities designated land uses and defined the zoning applicable to the particular land use parcel; the zoning took precedence. The land use measure was a request that local jurisdictions review existing zoning in Airport Noise Zones to determine their consistency with the regional compatibility guidelines, and rezone the property for compatible development if consistent with other development factors. This policy changed in 1994.

Under the amended Land Planning Act, communities determine the land use designation, and the zoning must be consistent with that designation. Thus, the communities had to re-evaluate designated use, permitted uses within the designation, zoning classifications, and adequacy.

In 2004 the Aviation Policy Plan was incorporated into the Transportation Policy Plan (TPP) of the Metropolitan Development Guide. In January 2015 the Metropolitan Council adopted the 2040 TPP land use compatibility guidelines for all metropolitan system airports that are included in the TPP.

In the case of airports located in the Minneapolis-St. Paul Metropolitan Area, the Metropolitan Council Development Guidelines in relation to airport noise exposure need to be considered. The TPP provides land use guidelines based on four noise zones around an airport. The following provides the Metropolitan Council's description of each noise zone:

- Zone 1 – Occurs on and immediately adjacent to the airport property. Existing and projected noise intensity in the zone is severe and permanent. It is an area affected by frequent landings and takeoffs and subjected to aircraft noise greater than 75 DNL. Proximity of the airfield operating area, particularly runway thresholds, reduces the probability of relief resulting from changes in the operating characteristics of either the aircraft or the airport. Only new, non-sensitive land uses should be considered – in addition to preventing future noise problems the severely noise-impacted areas should be fully evaluated to

determine alternative land use strategies including eventual changes in existing land uses.[28]

- Zone 2 – Noise impacts are generally sustained, especially close to runway ends. Noise levels are in the 70 to 74 DNL range. Based upon proximity to the airfield, the seriousness of the noise exposure routinely interferes with sleep and speech activity. The noise intensity in this area is generally serious and continuing. New development should be limited to uses that have been constructed to achieve certain exterior-to-interior noise attenuation and that discourage certain outdoor uses.[29]
- Zone 3 – Noise impacts can be categorized as sustaining. Noise levels are in the 65 to 69 DNL range. In addition to the intensity of the noise, location of buildings receiving the noise must also be fully considered. Aircraft and runway use operational changes can provide some relief for certain uses in this area. Residential development may be acceptable if it is located outside areas exposed to frequent landings and takeoffs, is constructed to achieve certain exterior-to-interior noise attenuation, and is restrictive as to outdoor use. Certain medical and educational facilities that involve permanent lodging and outdoor use should be discouraged.[30]
- Zone 4 – Defined as a transitional area where noise exposure might be considered moderate. Noise levels are in the 60 to 64 DNL range. The area is considered transitional since potential changes in airport and aircraft operating procedures could lower or raise noise levels. Development in this area can benefit from insulation levels above typical new construction standards in Minnesota, but insulation cannot eliminate outdoor noise problems.[31]
- Noise Buffer Zones: Additional area that can be protected at the option of the affected community; generally, the buffer zone becomes an extension of noise zone 4. At MSP, a one-mile buffer zone beyond the DNL 60 has been established to address the range of variability in noise impact, by allowing implementation of additional local noise mitigation efforts. A buffer zone out to DNL55 is optional at those reliever airports with noise policy areas outside the MUSA.[32]

The listed noise zones also use the DNL noise exposure metric. The Metropolitan Council Land Use Compatibility Guidelines for Aircraft Noise are provided in **Table 7-2**.

The Metropolitan Council suggests that the 60 DNL contour be used for planning purposes in areas inside the MUSA. As Crystal Airport is located within the MUSA, the 60 DNL contour is provided in the context of evaluating Land Use Compatibility considerations.

[28] Metropolitan Council 2040 Transportation Policy Plan, Appendix L, January 2015.
[29] Ibid.
[30] Ibid.
[31] Ibid.
[32] Ibid.

Table 7-2: Metropolitan Council Land Use Compatibility Guidelines for Aircraft Noise

Land Use Category	New Development and Major Redevelopment					Infill Development and Reconstruction or Additions to Existing Structures				
	Noise Exposure Zones					Noise Exposure Zones				
	1 DNL 75+	2 DNL 74-70	3 DNL 69-65	4 DNL 64-60	Buffer Zone	1 DNL 75+	2 DNL 74-70	3 DNL 69-65	4 DNL 64-60	Buffer Zone
Residential										
Single / Multiplex with Individual Entrance	INCO	INCO	INCO	INCO		COND	COND	COND	COND	
Multiplex / Apartment with Shared Entrance	INCO	INCO	COND	PROV		COND	COND	PROV	PROV	
Mobile Home	INCO	INCO	INCO	COND		COND	COND	COND	COND	
Educational, Medical, Schools, Churches, Hospitals, Nursing Homes	INCO	INCO	INCO	COND		COND	COND	COND	PROV	
Cultural / Entertainment / Recreational										
Indoor	COND	COND	COND	PROV		COND	COND	COND	PROV	
Outdoor	COND	COND	COND	COND		COND	COND	COND	COMP	
Office / Commercial / Retail	COND	PROV	PROV	COMP		COND	PROV	PROV	COMP	
Services										
Transportation-Passenger Facilities	COND	PROV	PROV	COMP		COND	PROV	PROV	COMP	
Transient Lodging	INCO	COND	PROV	PROV		COND	COND	PROV	PROV	
Other Medical, Health & Educational	COND	PROV	PROV	COMP		COND	PROV	PROV	COMP	
Other Services	COND	PROV	PROV	COMP		COND	PROV	PROV	COMP	
Industrial / Communication / Utility	PROV	COMP	COMP	COMP		PROV	COMP	COMP	COMP	
Agriculture Land / Water Areas / Resource Extraction	COMP	COMP	COMP	COMP		COMP	COMP	COMP	COMP	

Notes: Table Key on Following Page

Table Key:

COMP - "Compatible" - Uses are acoustically acceptable for both indoors and outdoors.
PROV - "Provisional" - Uses that should be discouraged if at all feasible; if allowed, must meet certain structural performance standards to be acceptable according to MS 473.192 (Metropolitan Area Aircraft Noise Attenuation Act). Structures built after December 1983 shall be acoustically constructed so as to achieve interior sound levels as follows (per Metropolitan Council's 2040 Transportation Policy Plan, Appendix L, Table L-4):

Residential, Educational and Medical = 45 dBA Interior Sound Level

Cultural, Entertainment, Recreational, Office, Commercial, Retail and Services = 50 dBA Interior Sound Level

Industrial, Communications, Utility, Agricultural Land, Water Areas, Resource Extraction = 60 dBA Interior Sound Level

Each local government unit having land within the airport noise zones is responsible for implementing and enforcing the structure performance standards in its jurisdiction.

COND - "Conditional" - Uses that should be strongly discouraged; if allowed, must meet the structural performance standards, and requires a comprehensive plan amendment for review of the project under the factors described in the Metropolitan Council's 2040 Transportation Policy Plan, Appendix L, Table L-3.

INCO - "Incompatible" - Land uses that are not acceptable even if acoustical treatment were incorporated in the structure and outsides uses restricted.

Source: Metropolitan Council 2040 Transportation Policy Plan, Appendix L - January 2015.

7.2.3 Crystal Airport Zoning Ordinance and Safety Zones

A zoning ordinance to regulate the height of structures and trees and the use of property in the vicinity of Crystal Airport was adopted by the MAC in September 1952. A copy of this zoning ordinance is included in **Appendix 7**.

A Joint Airport Zoning Board (JAZB), including the Cities of Crystal, Brooklyn Park, Brooklyn Center, New Hope, Minneapolis, Robbinsdale and the Metropolitan Airports Commission, adopted an airport zoning ordinance in December 1983. The purpose of the ordinance is to protect against the construction of structures that will interfere with the operations at the airport. Although a number of homes are located within the designated safety zones, these areas were accepted as "established residential neighborhoods in built-up urban areas."

Upon adoption of the zoning ordinance by the JAZB, it was the responsibility of each individual city to adopt the ordinance and conform their zoning to the ordinance requirements. According to the City of Crystal's current Comprehensive Plan, the airport zoning regulations were adopted by the City in 1983 and one of the City's aviation policies is to continue to protect airspace in accordance with the Joint Airport Zoning Ordinance.

In the existing Airport Zoning Ordinance for Crystal Airport, the following safety zone dimensions are listed:

- Runways 13L-31R and 13R-31L (now Runways 14L-32R and 14R-32L)
  - Safety Zone A = 2,167 feet
  - Safety Zone B = 1,083 feet
  - Total Safety Zone = 3,250 feet[33]
- Runways 5L-23R and 5R-23L (now Runways 06L-24R and 06R-24L)
  - Safety Zone A = 1,400 feet
  - Safety Zone B = 700 feet
  - Total Safety Zone = 2,100 feet[34]

The zoning surfaces included in the ordinance are shown in **Figure 7-1**.

7.2.4 MnDOT Aeronautics Safety Zones

The State of Minnesota Department of Transportation, Office of Aeronautics (MnDOT) has established regulations that control the type of development allowed off runway ends in order to prevent incompatible development. These guidelines are meant to be used to establish zoning ordinances to protect areas around an airport.

The most restrictive areas created by MnDOT regulations are called Safety Zones A and B. The recommended safety zones should exist off each runway end and follow the approach zones out to the total length of the respective runway. The length of Safety

[33] The published runway length for these runways was 3,250 feet at the time the zoning ordinance was adopted.

[34] The beginning point of Zone A extends outward from a point 200 feet from the displaced thresholds on these runways in place at the time the zoning ordinance was adopted.

Zone A is 2/3 of the total runway length; Safety Zone B is 1/3 of the total runway length and extends from Safety Zone A. There is also an area called Safety Zone C, which is a horizontal plane established 150 feet above the established airport elevation for a specified distance from each runway end.

A complete description and copy of the Minnesota Rules Chapter 8800 Department of Transportation Aeronautics Section 2400 Airport Zoning Standards can be accessed via the following website link: https://www.revisor.mn.gov/rules/?id=8800.2400.

MnDOT has undertaken efforts to update the state's airport zoning regulations. It is anticipated that revisions to the statutes governing airport zoning will be submitted for consideration during a future Minnesota Legislative session. The administrative rules used to implement the zoning regulations and define the particulars of the Safety Zones will likely be updated after the statutory changes are complete.

Once Crystal Airport's future development plan is finalized, and the process to update the state's airport zoning regulations is complete, MAC intends to re-convene the Joint Airport Zoning Board (JAZB). Through a collaborative process, the JAZB will seek to update the existing Airport Zoning ordinance (see **Section 7.2.3**), in accordance with state statutes and administrative rules, that considers land uses around Crystal Airport to achieve a balance between providing a reasonable level of public safety and facilitating compatible off-airport development.

For this report, the existing size and shape of Safety Zones A and B from the Crystal Airport Zoning Ordinance were used for the purpose of analyzing Baseline (existing) land use compatibility. Where runway ends are proposed to change from the existing condition, the size and shape of safety zones will be modified from the existing condition as follows:

- Runway 14L-32R: Safety Zones begin 200 feet from the shifted runway ends and extend for a length of 3,750 feet (the proposed runway length). Safety Zone A will extend for 2/3 of the length, and Safety Zone B for the remaining 1/3 of the length.
- Runway 6R-24L (turf): Safety Zones begin 200 feet from the shifted runway ends and extend for a length of 1,669 feet (the proposed runway length). Safety Zone A will extend for 2/3 of the length, and Safety Zone B for the remaining 1/3 of the length.

The sizes, shapes and/or locations of these zones may be revised by the JAZB during an update of the Airport Zoning Ordinance for Crystal Airport.

MnDOT Aeronautics promotes the preservation of Clear Zones off runway ends to enhance operational safety of aircraft and to protect life and property in runway approach areas. The MnDOT Clear Zones are shown in **Figure 7-2**. MnDOT Clear Zones should be kept clear of incompatible land uses to the extent practical.

7.3 LAND USE COMPATIBILITY ANALYSIS

The Crystal Airport is located in Hennepin County, northwest of the City of Minneapolis. The airport is bordered by three cities, Crystal to the west, south and east of the airport,

Brooklyn Park to the northwest and Brooklyn Center to the northeast. The airport is bordered by primarily residential land uses to the north, east and south. A commercial corridor along County Road 81 is located to the west of the airport. As noted above, the City of Crystal adopted the Airport Zoning Ordinance addressing structural height and land use in the vicinity of the Crystal Airport.

The City of Crystal 2030 Comprehensive Plan was updated in 2009, and amended in 2011. The plan contains a section (Chapter M) on aviation pertaining to Crystal Airport. In the plan, the City of Crystal reiterates that closure of the airport and redevelopment of the site is its long-term policy goal. However, the city recognizes that it does not have the authority to close Crystal Airport, and set forth several aviation policies aimed at protecting airspace in accordance with the 1983 Joint Airport Zoning Ordinance. The full plan can be accessed via the following website link:

http://www.crystalmn.gov/docs/plan_and_zoning/complete_packet.pdf

The Cities of Brooklyn Park and Brooklyn Center also maintain Comprehensive Plans that address land uses and transportation infrastructure in the vicinity of Crystal Airport. The full Comprehensive Plans for the adjacent townships can be accessed from the website links below:

- Brooklyn Park

  http://citysearch.brooklynpark.org/website/comdev/Planning/CompletedCompPlan12-31-08.pdf

- Brooklyn Center

  http://www.cityofbrooklyncenter.org/index.aspx?nid=606

7.3.1 Existing Condition Land Use Compatibility

In general, the area around the airport is primarily residential with areas of commercial/industrial and park/open space land uses. Residential uses border portions of airport property to the north, east, south and west. Commercial/industrial uses border County Road 81 along the west side of the airport. Much of the commercial/industrial uses in the vicinity of the airport, along County Road 81, are on the east side of the road.

Land Use Compatibility and Airport Noise Considerations

Figure 7-3 illustrates the Baseline Condition RPZs, Safety Zones, and Noise Contours over existing land use data provided by the Metropolitan Council.

With the exception of the 10 residential structures located in the 65 DNL noise contour at the southwest corner of the airport, existing land uses around Crystal Airport are compatible with airport operations considering airport noise impacts as outlined in the FAA land use guidelines in **Table 7-1**. Additionally, there are 126 residential structures in the 60 DNL noise contour. Per the Metropolitan Council land use guidelines in **Table 7-2**, new residential developments in the 60 DNL noise contour are considered incompatible and in cases of infill are considered conditional which, if allowed, must meet certain structural performance standards.

Land Use Compatibility and Existing Runway Protection/Safety Zones

The existing RPZs and Safety Zones A and B for Runways 14R-32L, 14L-32R, 06L-24R, and 06R-24L at Crystal Airport encompass areas of airport property in addition to commercial/industrial, single and multi-family residential, park area, and undeveloped land uses.

The existing RPZ's at Crystal Airport include several land uses that would not be considered compatible under the FAA's current guidance. However, since these land uses predate the FAA's current guidance, they are acceptable to remain as an existing condition.

- Existing Runway 14L and 14R Ends: Douglas Drive and two (2) private residential parcels. Douglas Drive is designated as a local road that provides access to the airport and adjacent residential development. By definition, a local roadway serves less than 1,000 vehicles per day. Although no recent traffic study is known to exist for this section of Douglas Drive, vehicle counts taken on other local roadways in the vicinity of the Airport suggest average daily traffic levels in the range of 300 – 500 vehicles. There are no current plans to increase the capacity of this roadway.
- Existing Runway 32R and 32L Ends: Eight (8) private residential parcels. A non-public airport access roadway will continue to traverse the 32R RPZ as well, but this road is access controlled such that it only accommodates airport-related traffic.
- Existing Runway 06L and 6R Ends: County Road 81 (Bottineau Boulevard), freight rail (BNSF), ten (10) private residential parcels.
- Existing Runway 24L and 24R Ends: Sixteen (16) private residential parcels.

Table 7-3 provides existing land use acreages encompassed by the Baseline Condition RPZs and Safety Zones.

Table 7-3: Baseline Condition Land Use Impacts

Land Use Acreage	RWY 14L	RWY 32R	RWY 14R	RWY 32L	RWY 06L APP (DEP)*	RWY 24R APP (DEP)*	RWY 06R	RWY 24L
Baseline Condition								
Runway Protection Zone (Acres)	*13.8*	*13.8*	*13.8*	*13.8*	*13.8 (13.8)*	*13.8 (13.8)*	*8.0*	*8.0*
Airport	13.8	13.5	12.5	12.9	13.8 (10.3)	13.8 (10.6)	7.6	8.0
Multifamily Residential	-	-	-	-	-	-	-	-
Park/Recreational/Preserve	-	-	1.0	-	-	-	-	-
Retail/Commercial	-	-	-	0.2	-	-	-	-
Single Family Residential	-	0.3	0.3	0.7	(3.5)	(3.2)	0.4	-
Undeveloped	-	-	-	-	-	-	-	-
Water	-	-	-	-	-	-	-	-
Safety Zone A (Acres)	*23.2*	*23.2*	*23.2*	*23.2*	*10.3*	*10.3*	*10.3*	*10.3*
Airport	11.6	10.4	10.5	10.2	8.1	8.3	8.7	9.3
Multifamily Residential	0.2	1.3	-	0.9	-	-	-	-
Park/Recreational/Preserve	1.8	-	2.0	1.4	-	-	-	-
Retail/Commercial	-	0.5	-	1.5	-	-	-	-
Single Family Residential	9.6	10.8	10.7	7.7	2.2	2.0	1.6	0.9
Undeveloped	-	0.2	-	1.5	-	-	-	-
Water	-	-	-	-	-	-	-	-
Safety Zone B (Acres)	*19.7*	*19.7*	*19.7*	*19.7*	*8.3*	*8.3*	*8.3*	*8.3*
Airport	-	-	-	-	-	-	-	-
Multifamily Residential	-	-	2.1	-	-	-	-	-
Park/Recreational/Preserve	1.9	-	0.4	-	-	-	-	-
Retail/Commercial	-	-	-	-	-	-	-	-
Single Family Residential	17.8	18.7	17.1	19.7	8.3	8.3	8.3	8.3
Undeveloped	-	-	-	-	-	-	-	-
Water	-	1.0	-	-	-	-	-	-

Notes: Totals may not add due to rounding.

*Runway 6L-24R has both approach and departure RPZs in place due to the threshold displacements.

Source: MAC Analysis

7.3.2 2035 Final Preferred Alternative Land Use Compatibility

The 2035 Final Preferred Alternative for Crystal Airport includes the closure of the south parallel Runway 14R-32L, reconfiguring (shortening) the turf parallel crosswind Runway 06R-24L, and extending/shifting primary Runway 14L-32R. These developments result in changes to the noise contour, RPZs and Safety Zone considerations.

2035 Final Preferred Alternative Land Use Compatibility and Airport Noise Considerations

Figure 7-4 provides the 2035 Final Preferred Alternative RPZs, Safety Zones, and Noise Contours over planned land use data provided by the Metropolitan Council.

There are minor changes proposed in future land uses within the 2035 noise contours: in the City of Brooklyn Park, northwest of the airport, areas of multifamily are planned to be converted to single family; an area of open space is planned for multi-optional development; in the City of Crystal, a small area of existing single family use west of the airport is planned for conversion to industrial use and small pockets of multifamily and undeveloped areas are planned to be converted to single family residential.

The Final Preferred Development Alternative continues to include residential structures in recognized airport noise areas, as outlined in both the FAA land use guidelines in **Table 7-1** and the Metropolitan Council land use guidelines in **Table 7-2**, around Crystal Airport.

The FAA requires that structures potentially eligible for sound insulation (i.e., within the 65 dB DNL noise contour) be evaluated to determine whether the interior noise levels are high enough to warrant sound insulation treatment. Structures already reducing interior noise exposure to 45 dB or less, are ineligible for sound insulation treatment. The MAC intends to address this issue as part of the required environmental documentation process that will be conducted to implement the preferred development alternative outlined in this plan. It is anticipated that the properties located in the 65 DNL contours around the Crystal Airport would be tested in accordance with American Society of the International Association for Testing and Materials (ASTM) standards using a methodology agreed upon by the MAC and the city or cities in which the homes reside.

Land Use Compatibility and 2035 Final Preferred Alternative Runway Protection/Safety Zones

The 2035 Final Preferred Alternative RPZs and Safety Zones A and B for Runways 14R-32L, 14L-32R, 06L-24R, and 06R-24L at Crystal Airport continue to encompass areas of airport property in addition to commercial/industrial, single and multi-family residential, park area, and undeveloped land uses; however, the area encompassed by these zones is reduced as two of the four existing runways are proposed to be decommissioned.

Additional analysis was conducted relative to the planned land uses around Crystal Airport as provided by the Metropolitan Council. The proposed changes in land uses within the Final Preferred Alternative RPZs and Safety Zones include a small area within the Runway 14L Safety Zone A, where existing multi-family residential is planned to become single family residential and within the Runway 32R Safety Zone A, where small pockets of multi-family residential are planned to become single family residential and an undeveloped area is planned to be converted to commercial use.

Table 7-4 provides existing land use acreages encompassed by the 2035 Final Preferred Alternative Condition RPZs and Safety Zones.

Table 7-5 provides a comparison of on-airport and off-airport land use impacts from the Baseline to the 2035 Final Preferred Alternative Condition.

A comparison of the Baseline and Final Preferred Alternative RPZs, Safety Zones, and Noise Contours is shown in **Figure 7-5**.

Table 7-4: 2035 Final Preferred Alternative Land Use Impacts

Land Use Acreage	RWY 14L	RWY 32R	RWY 06L APP (DEP)*	RWY 24R APP (DEP)*	RWY 06R	RWY 24L
2035 Final Preferred Alternative						
Runway Protection Zone (Acres)	*8.0*	*8.0*	*8.0 (8.0)*	*8.0 (8.0)*	*8.0*	*8.0*
Airport	8.0	8.0	8.0 (5.8)	8.0 (6.0)	8.0	8.0
Multifamily Residential	-	-	-	-	-	-
Park/Recreational/Preserve	-	-	-	-	-	-
Retail/Commercial	-	-	-	-	-	-
Single Family Residential	-	-	(2.2)	(2.0)	-	-
Undeveloped	-	-	-	-	-	-
Water	-	-	-	-	-	-
Safety Zone A (Acres)	*26.9*	*26.9*	*10.3*	*10.3*	*8.0*	*8.0*
Airport	7.3	8.8	8.1	8.3	8.0	8.0
Multifamily Residential	0.1	1.1	-	-	-	-
Park/Recreational/Preserve	3.5	-	-	-	-	-
Retail/Commercial	-	0.4	-	-	-	-
Single Family Residential	16.0	16.5	2.2	2.0	-	-
Undeveloped	-	0.1	-	-	-	-
Water	-	-	-	-	-	-
Safety Zone B (Acres)	*22.5*	*22.5*	*8.3*	*8.3*	*6.6*	*6.6*
Airport	-	-	-	-	3.8	4.8
Multifamily Residential	-	-	-	-	-	-
Park/Recreational/Preserve	-	-	-	-	-	-
Retail/Commercial	-	-	-	-	-	-
Single Family Residential	22.5	14.1	8.3	8.3	2.8	1.7
Undeveloped	-	0.1	-	-	-	0.1
Water	-	8.3	-	-	-	-

Notes: Totals may not add due to rounding.

*Runway 6L-24R has both approach and departure RPZs in place due to the threshold displacements.

Source: MAC Analysis

Table 7-5: Change in Land Use Impacts (Baseline to 2035 Final Preferred Alternative)

Land Use Impacts	RWY 14L	RWY 32R	RWY 14R	RWY 32L	RWY 6L APP (DEP)*	RWY 24R APP (DEP)*	RWY 6R	RWY 24L
Change from Baseline to 2035 Final Preferred Alternative								
Runway Protection Zone (Acres)	*-5.8*	*-5.8*	*-13.8*	*-13.8*	*-5.8 (-5.8)*	*-5.8 (-5.8)*	*0.0*	*0.0*
On-Airport	-5.8	-5.5	-12.5	-12.9	-5.8 (-4.5)	-5.8 (-4.6)	0.4	0.0
Off-Airport	0.0	-0.3	-1.3	-0.9	0.0 (-1.3)	0.0 (-1.2)	-0.4	0.0
Safety Zone A (Acres)	*3.7*	*3.7*	*-23.2*	*-23.2*	*0.0*	*0.0*	*-2.3*	*-2.3*
On-Airport	-4.3	-1.6	-10.5	-10.2	0.0	0.0	-0.7	-1.3
Off-Airport	8.0	5.3	-12.7	-13.0	0.0	0.0	-1.6	-1.0
Safety Zone B (Acres)	*2.8*	*2.8*	*-19.7*	*-19.7*	*0.0*	*0.0*	*-1.7*	*-1.7*
On-Airport	0.0	0.0	0.0	0.0	0.0	0.0	3.8	4.8
Off-Airport	2.8	2.8	-19.7	-19.7	0.0	0.0	-5.5	-6.5

Notes: Totals may not add due to rounding.

*Runway 6L-24R has both approach and departure RPZs in place due to the threshold displacements.

Source: MAC Analysis

In summary, when the 2035 Final Preferred Alternative Condition is compared to the Baseline Condition from a land use compatibility perspective:

- The Baseline Condition RPZs have 9.6 acres off-airport property, while 4.2 acres are off-airport property in the 2035 Final Preferred Alternative Condition – a reduction of 5.4 acres.
- The Baseline Condition Safety Zones have 169.0 acres off-airport property, while 108.1 acres are off-airport property in 2035 Final Preferred Alternative Condition – a reduction of 60.9 acres.
- With the exception of the eleven (11) residential parcels that remain in the 65 DNL noise contour, existing land uses around Crystal Airport are compatible with the Baseline and 2035 Final Preferred Alternative Condition and resultant airport operations considering airport noise impacts as outlined in the FAA land use guidelines. Additionally, there are 212 residential parcels in the 2035 Final Preferred Alternative Condition 60 DNL noise contour.

7.4 NON-AERONAUTICAL LAND USE AREAS AVAILABLE ON AIRPORT PROPERTY

MAC continues to analyze the potential for non-aeronautical revenue-generating development at Crystal Airport and all of its Reliever Airports. Any parcels reviewed by the MAC at the Crystal Airport will be compatible with ongoing airport operations and the MAC will work with the surrounding communities to ensure proper zoning exists. Retaining a portion of Turf Runway 6R-24L will likely affect the suitability of one parcel for non-aeronautical development that was identified in the Original Preferred Alternative. This parcel is located on Lakeland Avenue N immediately adjacent to the Thunderbird Aviation FBO site. However, the small size (approximately 0.8 acre) and proximity to both the aircraft parking apron and fuel tank already limit the development prospects for this parcel regardless of the disposition of the turf runway. **Exhibit 7-6** illustrates potential non-aeronautical development parcels.

All airport property is currently zoned according to the adjacent cities as “Airport” land with no other noted land use. If MAC pursues non-aeronautical development, discussions will be initiated with the cities to discuss the potential uses and how the cities feel the parcels could best be utilized. If a modification is required for zoning, MAC will work with the cities to make changes as appropriate. The development of non-aeronautical uses will not only benefit MAC, but it will also generate a tax base for the local municipality in which the parcel lies, as well as address some of the aesthetic issues with some hangars at the airport.

Figure 7-1: Existing Crystal Airport Zoning Ordinance Surfaces

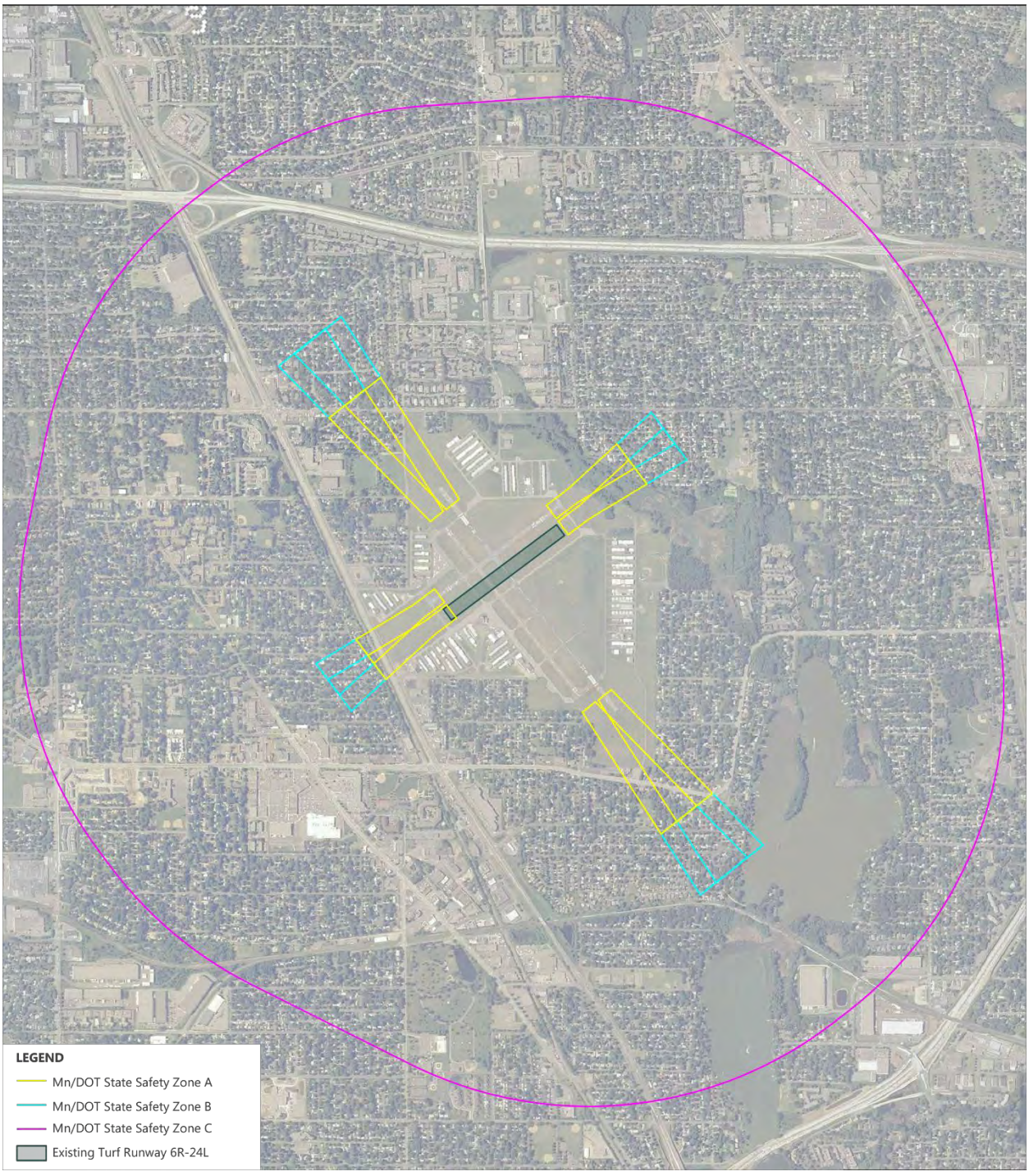
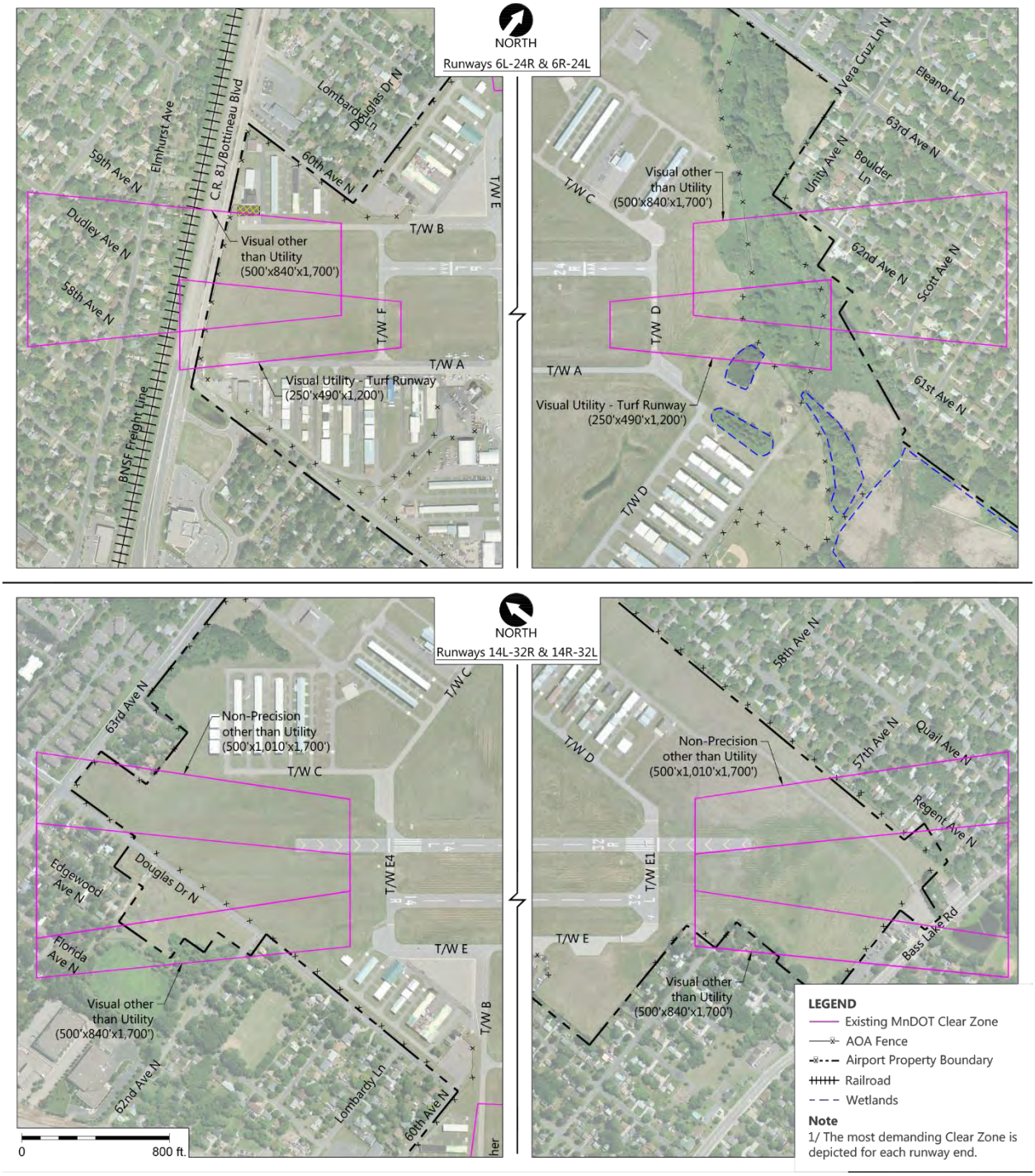


Figure 7-2: MnDOT Clear Zones

Existing Condition Clear Zones



Future Condition Clear Zones

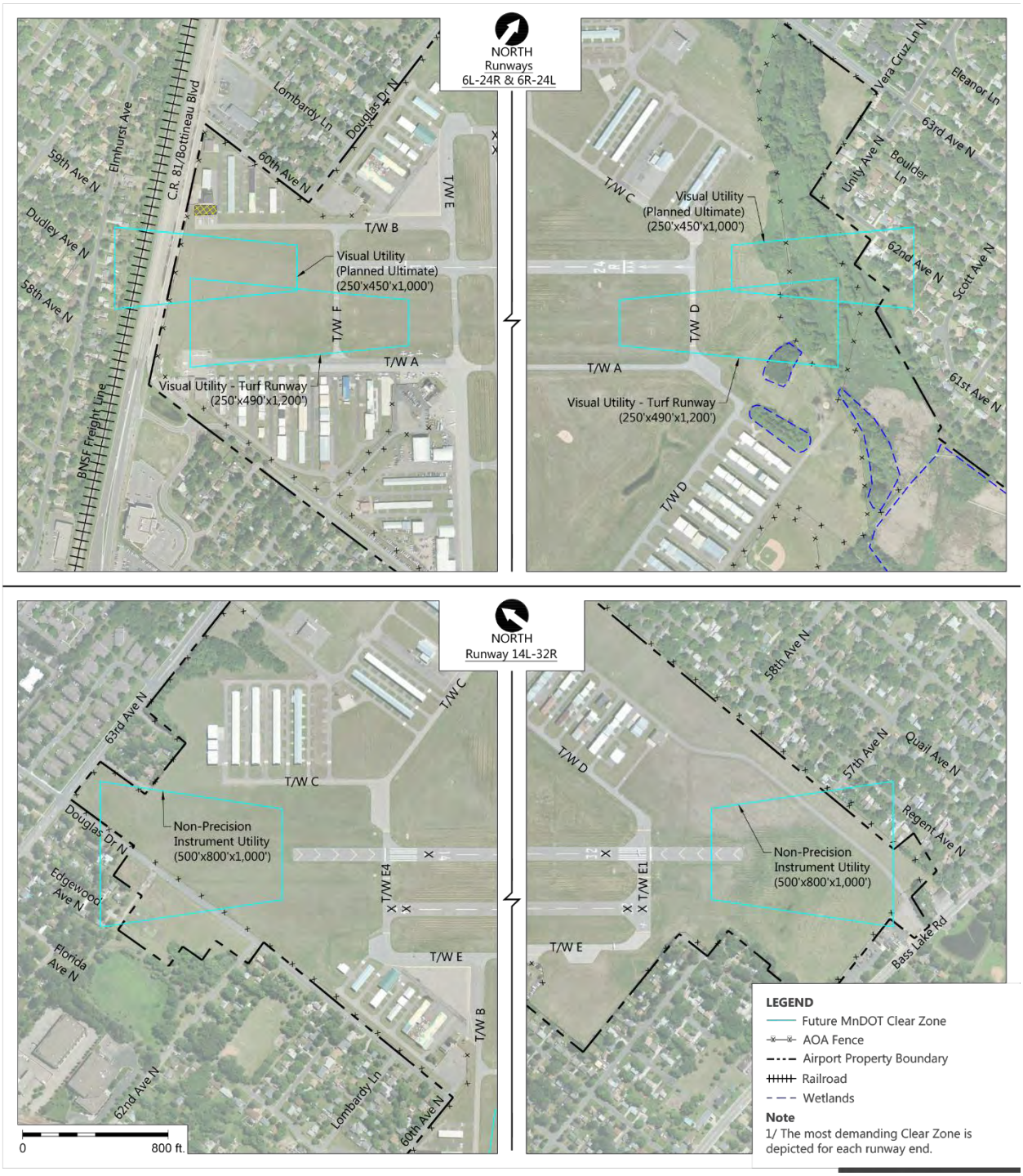


Figure 7-3: Baseline Condition RPZs, Safety Zones, and Noise Contours

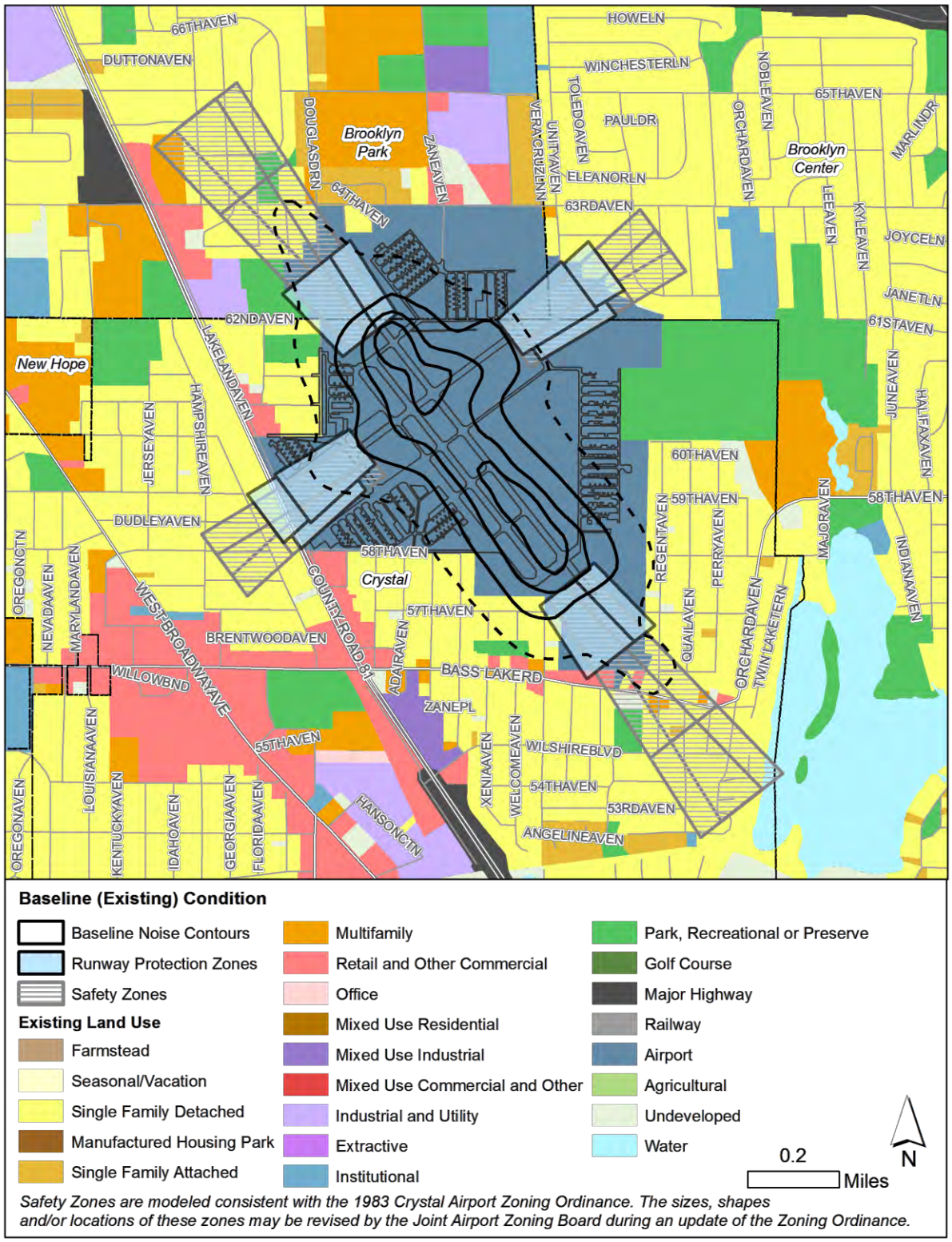


Figure 7-4: 2035 Final Preferred Alternative RPZs, Safety Zones, and Noise Contours

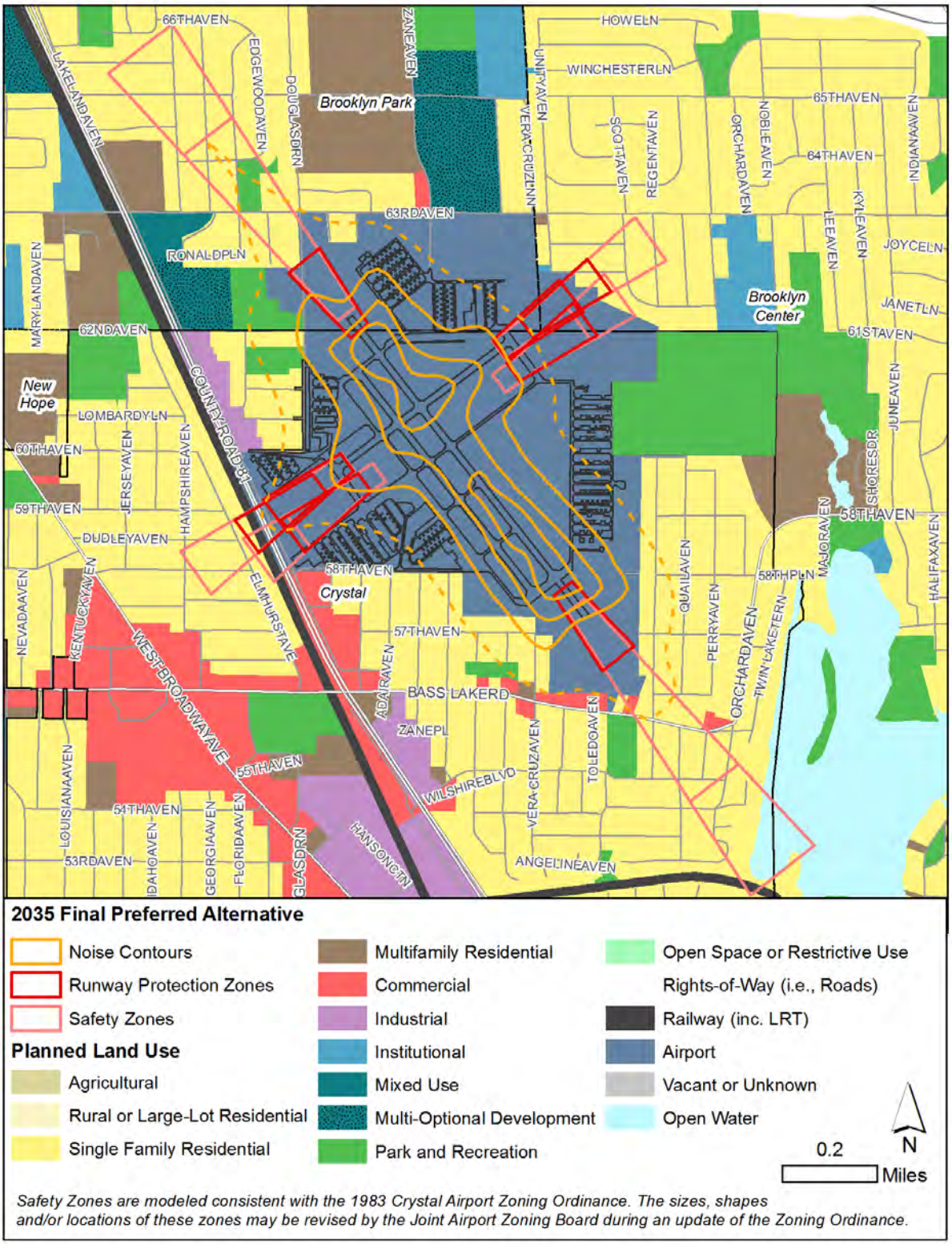


Figure 7-5: Baseline to 2035 Final Preferred Alternative RPZ, Safety Zone, and Noise Contour Comparison

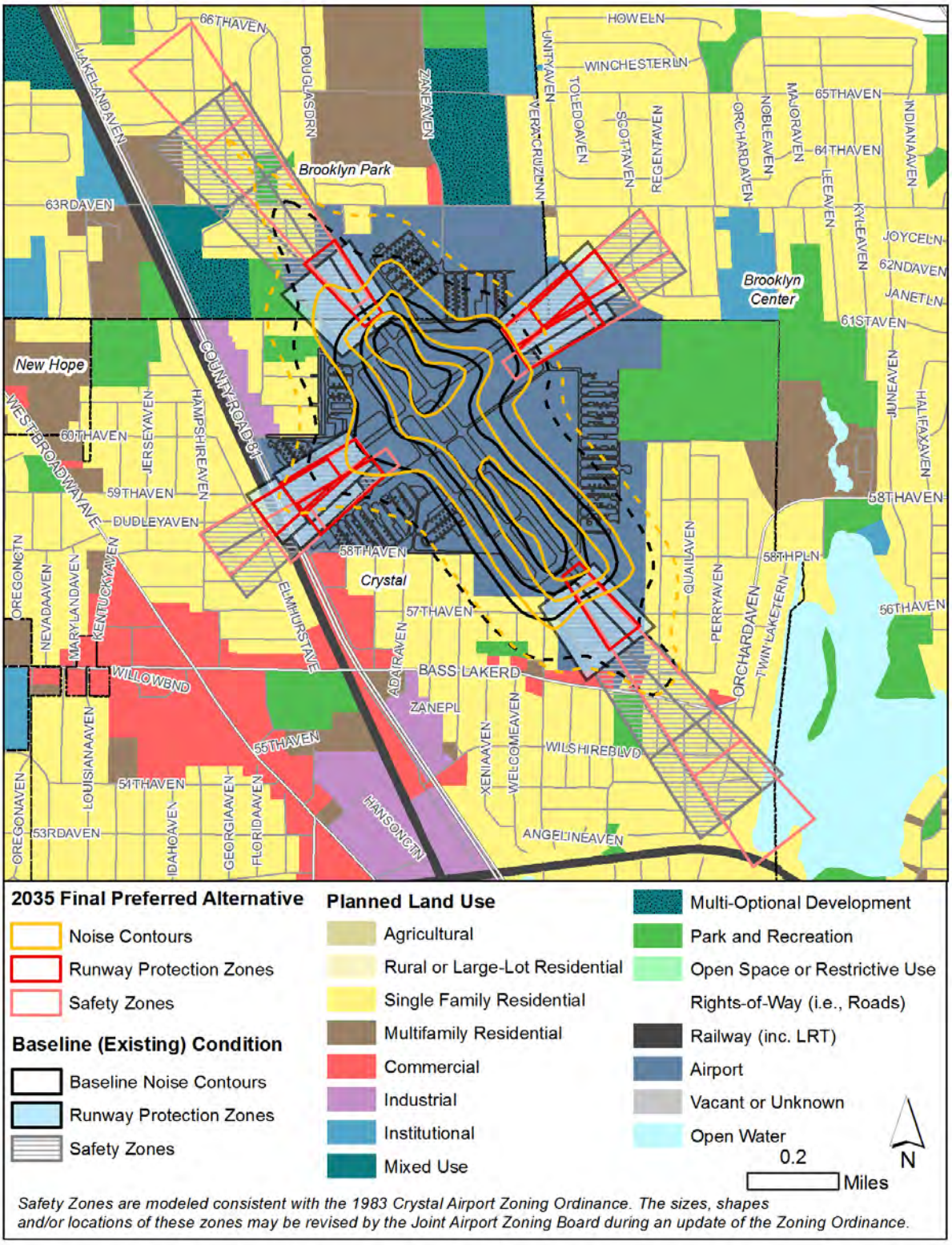
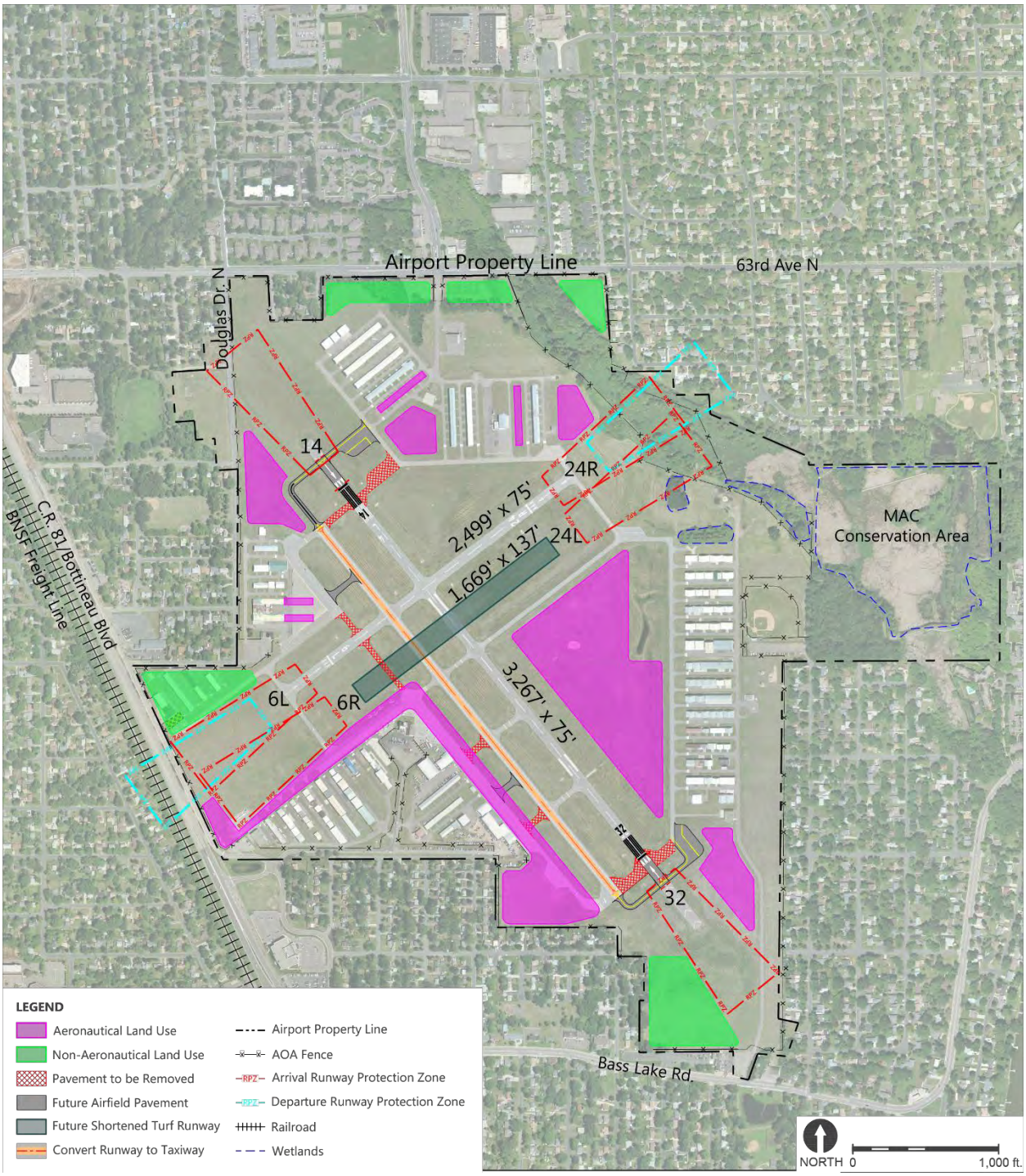


Figure 7-6: Aeronautical and Non-Aeronautical Development Parcels



SECTION 8:

IMPLEMENTATION PLAN

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8. IMPLEMENTATION PLAN

8.1 INTRODUCTION

This chapter provides information related to the estimated costs and potential phasing for the 2035 Preferred Alternative at Crystal Airport.

The LTCP is a planning document and does not authorize construction. Adoption of the LTCP is simply the first step in the project implementation process. Before any construction can begin, the project(s) must first be depicted on an FAA-approved Airport Layout Plan (ALP), evaluated via an environmental review process, and then compete for funding through FAA and/or State grant programs. Once funding is secured, final project engineering and design will take approximately one year to complete with contractor bidding and construction following thereafter.

8.2 CAPITAL IMPROVEMENT PROGRAM COSTS AND FUNDING SOURCES

Project cost estimates for the 2035 Preferred Alternative are summarized in **Table 8-1**.

Near-Term Development encompasses the project elements necessary to decommission Runway 14R-32L and convert it into a full-length parallel taxiway, and to convert portions of the existing Runway 14L-32R paved blast pads to useable runway, including taxiway extensions and configuration adjustments. It is anticipated that this development will occur within the next three to five years.

Mid to Long-Term Development involves miscellaneous improvements to expand the FBO apron (by the tenant), install a self-fueling facility if this service is not provided by an FBO, and ongoing obstacle removal projects. It is anticipated that this development may occur in the 6-20 year timeframe.

A combination of traditional airport funding sources and financing mechanisms including federal Airport Improvement Program (AIP) grants, state Airport Construction Program grants, and local MAC monies could be used to fund implementation of the Preferred Alternative. It is anticipated that a majority of the funding would come in the form of AIP discretionary grants, which are awarded to airports on the basis of priority and available funding.

The MAC maintains an ongoing Capital Improvement Program (CIP) which assigns projects to a given year, currently looking out seven years to 2022. Projects in the current CIP related to implementation of the Final Preferred Alternative include:

- Runway 14R-32L & Taxiway E Modifications in 2018; and
- Long-Term Comprehensive Plan (LTPC) Update in 2022.

Other projects in the CIP for Crystal Airport include the following:

- Materials Storage Building in 2017;
- Alleyways Pavement Rehabilitation in 2018 and 2020;

- Taxiways Pavement Rehabilitation in 2019;
- MAC Building Improvements in 2020; and,
- LED Edge Lighting Upgrade in 2021 and 2022.

However, these timelines may vary according to the environmental review process and availability of funding sources.

This summary provides a guide for the MAC when planning the CIP, which is updated on an annual basis. Costs for Reliever Airport projects must be programmed carefully to ensure all necessary funding is available. Those projects that will be eligible for federal or state funding will be placed in years when the opportunity to receive such funds is greatest. Projects that are not eligible for federal or state funds must have other funding sources identified prior to implementation.

Table 8-1: Final Preferred Alternative Cost Estimates

Item #	Project Element	Estimated Cost
Near-Term Development (Plan Years 1 - 5)		
1	Decommission Runways & Convert RWY 14R-32L into Taxiway (w/MITL)	$1,800,000
2	Convert Portions of RWY 14L-32R Paved Blast Pads to Runway	$350,000
3	Other Taxiway Improvements	$400,000
	Near-Term Development Total:	***$2,550,000***
Mid/Long-Term Development (Plan Years 6 - 20)		
4	Expand FBO Apron (Tenant Cost)	---
5	Hangar Development (Tenant Cost)	---
6	Hangar Removal(s)	$400,000
7	Obstacle Removal	$300,000
	Mid/Long-Term Development Total:	***$700,000***
	Total Development Cost:	***$3,250,000***

Notes: Cost estimates reflect 2016 pricing and include engineering costs and contingencies.

Source: SEH and MAC cost estimates

8.3 STAKEHOLDER ENGAGEMENT AND PUBLIC INFORMATION PROCESS

In order to fulfill the Guiding Principle related to Stakeholder and Community Engagement, a series of meetings will be conducted throughout the development of the 2035 LTCP for Crystal Airport.

The initial phase of stakeholder outreach efforts involved meeting with partner agencies, municipal representatives, and airport tenants before the draft LTCP report was finalized in order to provide information about the plan's purpose, process, preliminary findings, and timeline. Materials from these initial stakeholder outreach meetings are reproduced in **Appendix 8**.

Initial stakeholder outreach meetings are listed in **Table 8-2**.

Table 8-2: Initial Stakeholder Engagement Meetings

Audience	Materials Covered	Date	Location
FAA, MnDOT, Met Council	LTCP Process, Review of Alternatives, Preliminary Findings	5/24/2016	FAA
Pilot Group Meeting	LTCP Process, Review of Alternatives, Preliminary Findings	6/8/2016	Airport
MAC Reliever Advisory Council	LTCP Process, Review of Alternatives, Preliminary Findings	6/14/2016	MAC
FAA	LTCP Status Update	6/29/2016	FAA
Municipal Planners (Cities, County)	LTCP Process, Review of Alternatives, Preliminary Findings	7/15/2016	Crystal City Hall
MAC PD&E Committee	LTCP Process, Review of Alternatives, Preliminary Findings	8/1/2016	MAC
Pilot Group/Tenant Meeting	LTCP Process, Review of Alternatives, Preliminary Findings	9/6/2016	Airport
Crystal City Council	LTCP Overview	9/8/2016	Crystal City Hall

The next phase consisted of the first formal public review period after the draft plan was completed and the MAC Board approved it for public distribution.

The Original Draft 2035 LTCP for Crystal Airport was issued for public review and comment on Monday, September 12, 2016. Two public information meetings were held in September 2016 to provide information about the draft plan to interested stakeholders. The first round public comment period closed on Wednesday, October 26, 2016.

During the first round public comment period, the MAC received a total of 27 written comments. Of the comments, 15 were from airport tenants and users, 10 from members of the public, and 2 from municipal representatives.

Many of the airport tenants and users expressed concern over some or all elements of the plan. Notably, Thunderbird Aviation, the full-service Fixed Base Operator (FBO) at the Airport, submitted comments in opposition to the proposed plan. The top three themes based on tenants and user comments include:

- Support for keeping turf Runway 06R-24L open;
- Support for keeping south parallel Runway 14R-32L open; and,
- Support for providing additional useable length on Runway 14L-32R beyond that provided by the Stopway concept recommended in the draft plan.

The City of Crystal provided a letter of support for the LTCP Preferred Alternative, while Hennepin County requested coordination in advance of any development/redevelopment initiatives along any county roadway frontage. Of the comments from members of the general public, three were related to concerns over flight patterns and aircraft noise.

A Refined Preferred Alternative was developed by MAC staff in response to public and stakeholder feedback about the original plan. An Addendum to the Draft 2035 LTCP was prepared to describe the features of and rationale behind the development of the Refined Preferred Alternative. The Addendum was published for public review and comment on Wednesday, March 15, 2017. A supplemental public information meeting was held on March 30, 2017 to provide more information about the Refined Preferred Alternative to interested citizens. The supplemental public comment period closed on Friday, April 14, 2017.

During the supplemental public comment period, MAC received 16 additional written comments. Of the comments, 12 were from airport tenants and users, 3 from members of the public, and 1 from a municipality.

Airport users and tenants who submitted comments expressed a much greater level of support for the Refined concept than for the original alternative. In particular, preserving a turf runway at Crystal Airport was viewed as a positive factor by many tenants. However, some continued to express reservations about the capacity implications of closing the south parallel Runway 14R-32L.

Notably, Thunderbird Aviation, (the full-service Fixed Base Operator (FBO) at the Airport, submitted comments supporting the refined plan concept – a reversal from their position opposing the original plan recommendations. Key factors that enabled Thunderbird to support the Refined concept are the longer primary runway length and retention of the turf runway to facilitate flight-training opportunities.

The City of Crystal also provided a letter of support for the LTCP Refined Preferred Alternative.

Appendix 9 includes a reproduction of each public comment received in its entirety. General responses were developed to address questions and comments that were consistent among the comments received. Specific responses to comments received from municipalities and agencies are also provided.

Figure 8-1 illustrates the next steps for the planning and project implementation process, including at what points additional approvals are needed and at what points public feedback will be solicited.

Table 8-3 provides a summary of the stakeholder engagement and public meetings that have occurred since the initial outreach phase.

Table 8-3: Additional Stakeholder Engagement Meetings

Audience	Materials Covered	Date	Location
Brooklyn Park City Council	LTCP Overview	9/12/2016	Brooklyn Park City Hall
Brooklyn Center City Council	LTCP Overview	9/26/2016	Brooklyn Center City Hall
Public	LTCP Overview/Public Information Meeting	9/27/2016	Crystal Community Center
Public	LTCP Overview/Public Information Meeting	9/29/2016	Brooklyn Park City Hall
FAA	LTCP Status Update	11/8/2016	FAA
Crystal Air Traffic Control Tower	LTCP Technical Discussion	11/15/2016	Airport
MAC Reliever Airports Advisory Council	LTCP Status Update	12/13/2016	MAC
Crystal Runway Safety Action Team (RSAT)	LTCP Status Update	12/21/2016	Crystal Community Center
Pilot Group Meeting	LTCP Refined Development Alternative Overview	1/26/2017	Airport
Municipal Planners (Cities, County)	LTCP Refined Development Alternative Overview	1/27/2017	Crystal City Hall
MAC PD&E Committee	LTCP Refined Development Alternative Overview	2/6/2017	MAC
Thunderbird Aviation	LTCP Status Update	3/21/2017	Thunderbird
FAA	LTCP Status Update	3/22/2017	FAA
Public	LTCP Refined Concept Overview/Public Information Meeting	3/30/2017	Odyssey Academy School
MAC PD&E Committee	LTCP Summary and Recommendation	5/1/2017	MAC

The Final Draft 2035 Crystal Airport LTCP narrative report was submitted to the Metropolitan Council for review on Monday, June 5, 2017. Under MS 473.165 and MS 473.611, the Metropolitan Council reviews LTCP's for each airport owned and operated by MAC. The Council reviews and comments on all plans for consistency with the metropolitan development guide including Thrive MSP 2040 and the Transportation Policy Plan. Metropolitan Council staff concluded that since the preferred development

alternative for Crystal Airport retains its system role as a Minor general aviation facility, supports the regional aviation system, and is responsive to the needs and conditions of the airport, it is consistent with the Thrive MSP 2040 and the Transportation Policy Plan.

Obtaining the full Council's determination of consistency involved presentations to four standing committees as well as the Full Council, as outlined in **Table 8-4**. The Full Metropolitan Council provided its determination of consistency on September 13, 2017 (**Figure 8-2**).

Table 8-4: Metropolitan Council Consistency Determination Meetings

Council Body	Date	Action Requested	Result
TAC Planning	July 13, 2017	Review & Recommend	Passed unanimously
Technical Advisory Committee	August 2, 2017	Review & Recommend	Passed unanimously
Transportation Advisory Board	August 16, 2017	Review & Recommend	Passed unanimously
Transportation Committee	August 28, 2017	Review & Recommend	Passed unanimously
Full Council	September 13, 2017	Review & Determine	Passed unanimously

Notes: Agendas, background materials, and public comments from these meetings are available at http://www.metrocouncil.org. Enter "Crystal Airport" into the search menu for a list of available meeting/agenda items.

The MAC Board voted to formally adopt the Crystal Airport 2035 LTCP on October 16, 2017.

Figure 8-1: Planning and Project Implementation Process

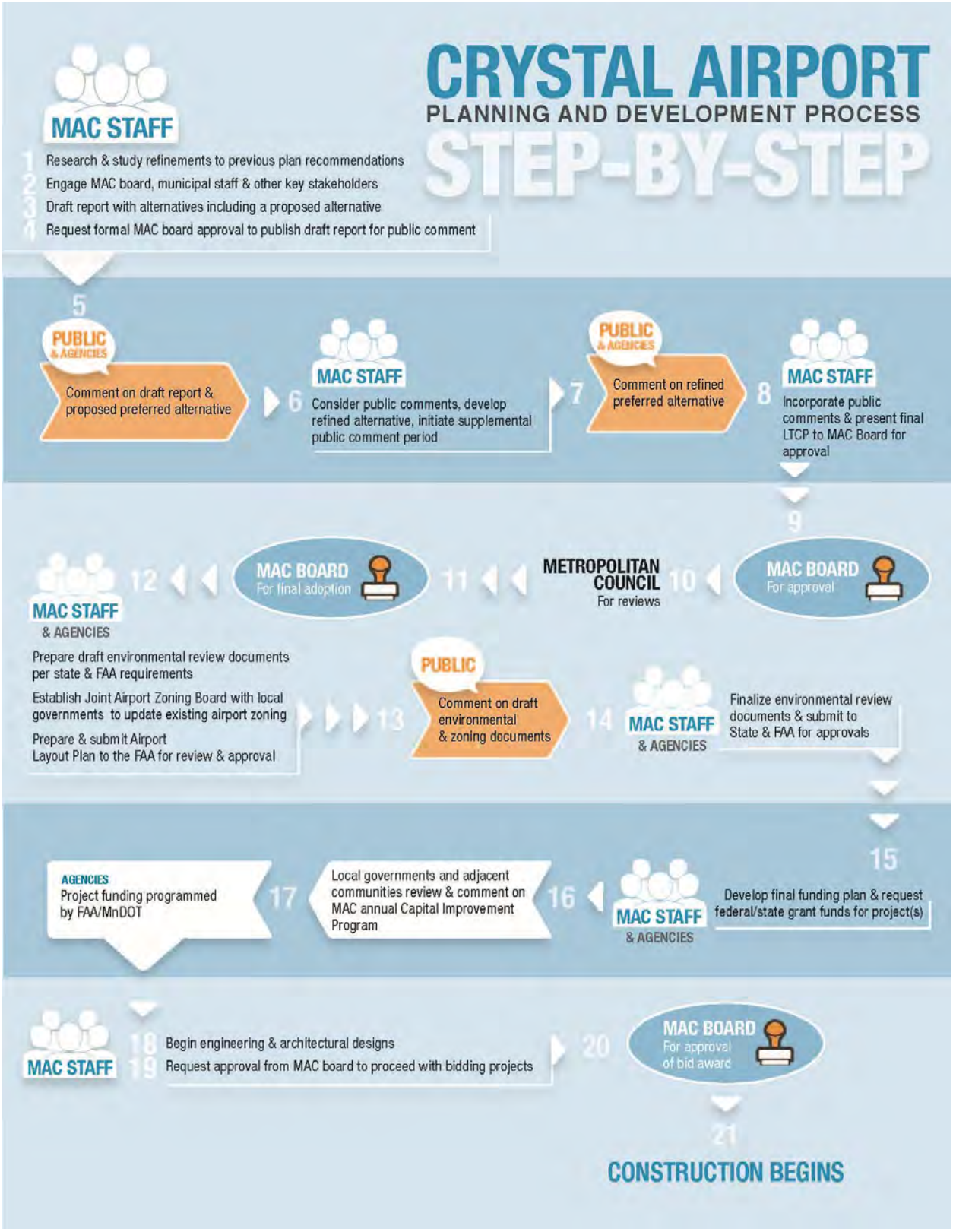

Figure 8-2: Metropolitan Council Consistency Determination Letter

September 18, 2017

Mr. Brian Ryks, Executive Director
Metropolitan Airports Commission
6040 28th Ave. South
Minneapolis, MN 55450-2799

RE: Crystal Airport Long Term Comprehensive Plan
Business Item 2017-191

Dear Mr. Ryks:

The Metropolitan Council, at its meeting on September 13, 2017 took action on the Metropolitan Airports Commission's request for determination of the Crystal Airport Long Term Comprehensive Plan (LTCP). The Metropolitan Council determined that the LTCP conforms to regional systems and is consistent with Council policies.

Sincerely,

Wes Kooistra, Regional Administrator

cc: Dan Boivin, Chair - Metropolitan Airports Commission
Katie Rodriguez, Chair - Metropolitan Council - Transportation Committee

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