DEMAND/CAPACITY ANALYSIS AND FACILITY REQUIREMENTS

4

Reno-Stead Airport

4.1 GENERAL

Based on the aviation forecasts developed in Chapter 3, this chapter compares the projected aviation demand to the capacity of the existing facilities at Reno-Stead Airport (RTS). This comparison is then used to determine future facility requirements needed over the 20-year planning period. The facility improvements are directly related to the forecasted aviation activity and will allow RTS and the surrounding community to be adequately prepared to accommodate the potential demand over the 20-year planning period.

4.2 AIRSPACE CAPACITY

Airspace capacity at an airport is of concern when the flight paths of traffic at nearby airports or local navigational aids (NAVAIDS) interact to adversely impact operations at the airport of study. Also of concern is the need to alter flight paths in order to avoid obstructions during aircraft approaches.

A single commercial service airport is located in close proximity to RTS. Reno-Tahoe International Airport (RNO) is located approximately 11 miles south east of RTS, and RTS lies just outside of RNO's Class C airspace. RTS and RNO are far enough from each other that air traffic is normally able to maintain adequate separation; however, the precision approach surfaces associated with RTS's Runway 32 and RNO's Runway 16R do intersect as can be seen in **Figure 4-1**.

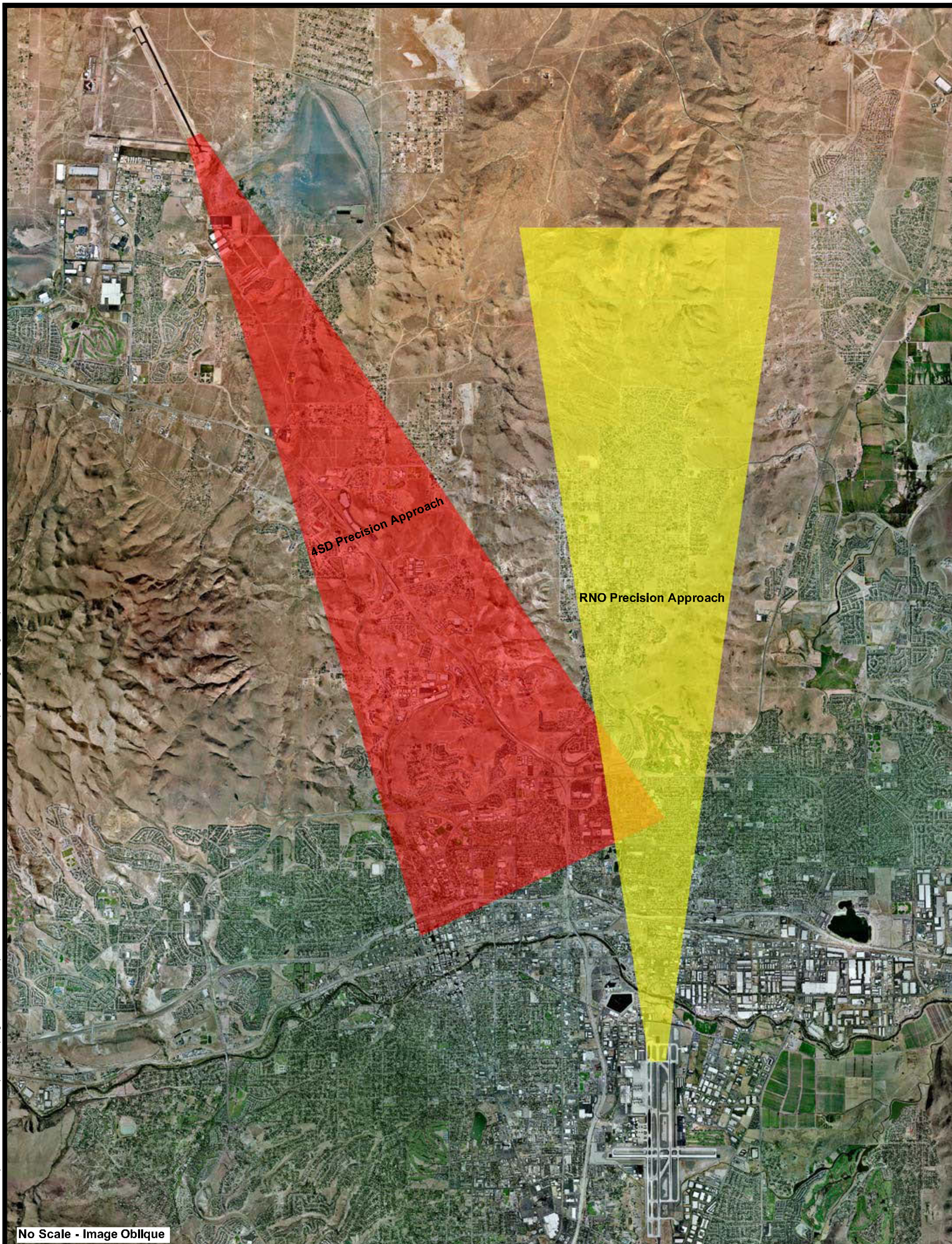
Several general aviation (GA) private- and public-use airports lie within a 50 nautical mile radius of RTS. These airports, as well as RNO, are listed in **Table 4-1**. More specific information on these airports can be found in Chapter 2 of this document.

No controlled and/or restricted military airspace is located within the immediate vicinity of RTS. The closest Military Operation Area (MOA) and restricted area can be found roughly 65 miles east southeast of RTS; both of which are associated with the Fallon Naval Air Station.

Overall, the airspace surrounding RTS is not congested by military and/or special use airspace, and GA airports in the surrounding airspace are far enough from RTS so as to not negatively impact operations.

4.3 AIRSIDE CAPACITY AND FACILITY REQUIREMENTS

The major components to be considered when determining capacity include runway orientation and configuration, runway length, and runway exit locations. Additionally, the capacity of any given airfield system is affected by operational characteristics such as fleet mix, climatology, and Air Traffic Control (ATC) procedures. Each of these components has been examined as part of the airfield capacity analysis.



Reno Stead Airport
Master Plan Update
Reno-Stead
Reno, Nevada

Precision Approach Overlaps Between RTS and RNO

Figure 4-1

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Table 4-1. Private- and Public-Use Airports in the Region

Airport Name	Distance From RTS in Nautical Miles
Commercial Service	
Reno-Tahoe International Airport (RNO)	11
General Aviation – Private-Use	
H Bar H	5
Justover Field	12
Palomino	13
Rolling Thunder	14
Air Sailing Gliderport	17
Bailey Ranch	22
Totem Pole	25
General Aviation – Public-Use	
Spanish Springs Airport (N86)	7
Sierraville-Dearwater Airport (O79)	22
Nervino Airport (O02)	24
Truckee-Tahoe Airport (TRK)	24
Carson City Airport (CXP)	29
Parker Carson STOLport (2Q5)	29
Dayton Valley Airpark (A34)	30
Tiger Field (N58)	30
Silver Springs Airport (SPZ)	33
Minden-Tahoe Airport (MEV)	40
Lake-Tahoe Airport (TVL)	47

Source: San Francisco Sectional Aeronautical Chart 2006.

4.3.1 Airfield Capacity

A demand and capacity analysis of airfield systems and facilities, such as RTS's runways and taxiways, results in separate calculated hourly capacities for Visual Flight Rules (VFR) and Instrument Flight Rules (IFR) conditions. Additionally, an annual service volume (ASV), which identifies the total annual number of aircraft operations that may be accommodated at the airport without excessive delay, is also calculated. The FAA defines total airport capacity as a reasonable estimate of the airport's annual capacity, which accounts for runway use, aircraft mix, weather conditions, etc. that would be encountered over a year's time. The parameters, assumptions, and calculations required for this analysis are included in the following sections.

4.3.1.1 Airfield Parameters and Assumptions

Runway Orientation, Utilization, and Wind Coverage

RTS has two runways (Runway 8-26 and Runway 14-32) that were evaluated to determine the overall capacity of the airfield, which is defined as the sum of capacities determined for each aircraft operation (takeoff and landing). Each operation is defined by its direction which is often influenced by wind direction and speed, available instrument approaches, airspace restrictions, and/or other operating parameters. The runway use configurations used for RTS capacity calculations considered Runways 8, 14, 26, and 32 in VFR conditions. Operations in IFR conditions were evaluated for only Runway 32, since it is the only runway with a published instrument approach.

The overall runway use was determined through a review of the recent *Runway Safety Area (RSA) Compliance Study* completed by URS Corporation in October 2008, and verified through discussion with Reno-Tahoe Airport Authority (RTAA). **Table 4-2** shows the runway utilization at RTS as presented in the RSA Study.

Table 4-2. Estimated Runway Utilization

Runway	Percent of Time
8	7.1%
26	77.2%
14	3.1%
32	12.6%
Total	100.0%

Source: Reno-Stead Airport RSA Standards Compliance Study, Final Report, October 2008, URS.

The single most important criterion for runway orientation is wind coverage. Runways should be provided at an airport to maximize the opportunity for aircraft to takeoff and land heading into the wind. When a runway orientation provides less than 95 percent wind coverage for any aircraft using the airport on a regular basis, a crosswind runway is required by the Federal Aviation Administration (FAA). According to FAA Advisory Circular (AC) 150/5300-13, *Airport Design*, the 95 percent wind coverage is computed on the basis of the crosswind not exceeding 10.5 knots and 13 knots for smaller aircraft and 16 knots and 20 knots for larger aircraft. As previously shown in Figure 2-5, Runways 8-26 and 14-32 do not individually meet the 10.5 knot crosswind coverage for the smaller aircraft. It is only with the combined wind coverage of both runways that adequate wind coverage is provided with 96.13 percent for a 10.5 knot crosswind, 97.63 percent for a 13 knot crosswind, and 98.89 percent for a 16 knot crosswind.

Aircraft Mix Index

The FAA has developed a classification system for grouping aircraft, based on size, weight, and performance. **Table 4-3**, FAA Aircraft Classifications, illustrates the classification categories as they are presented in FAA AC 150/5060-5, *Airport Capacity and Delay*. This classification system is used to develop an aircraft mix which is the relative percentage of operations conducted by each of the four classes of aircraft (A, B, C, and D). The aircraft mix is used to calculate a mix index which is then used for airfield capacity studies. The FAA defines the mix index as a mathematical expression, representing the percent of Class C aircraft, plus three times the percent of Class D aircraft (C+3D). The FAA has established mix index ranges for use in capacity calculations as listed below:

- 0 to 20
- 21 to 50
- 51 to 80
- 51 to 120
- 121 to 180

A review of the aviation demand forecast from the previous chapter shows that the likelihood of RTS growing beyond the first mix index range of 0 to 20 during the 20-year planning period is very low. This assumption is also supported by the previous RTS master plan forecast and mix index calculations. As a result, this capacity analysis has assumed that the mix index for the entire 20-year planning period will be in the first mix index range of 0-20, represented in **Table 4-4**.

Table 4-3. FAA Aircraft Classifications

Aircraft Class	Max. Cert. Takeoff Weight (lb)	Number of Engines	Wake Turbulence Classification
A	12,500 or less	Single	Small (S)
B	12,501 – 41,000	Multi	Small (S)
C	41,000 – 300,000	Multi	Large (L)
D	Over 300,000	Multi	Heavy (H)

Source: FAA AC 150/5060-5, Airport Capacity and Delay.

Table 4-4. Aircraft Mix Index Projection

Year	Total Annual Operations	Aircraft Mix Index
Base Year		
2006	64,077	0-20 %
Forecast		
2010	76,764	0-20 %
2015	82,484	0-20 %
2020	91,407	0-20 %
2025	101,843	0-20 %
2030	113,288	0-20 %

Source: FAA AC 150/5060-5, Airport Capacity and Delay and PBS&J, 2008.

Arrivals Percentage

The percentage of arrivals is the ratio of arrivals to total operations. It is typically safe to assume that the total annual arrivals will equal total departures and that average daily arrivals will equal average daily departures. Additionally, based on information obtained from the Fixed Base Operator (FBO) and RTAA records, the percentage of arrivals for RTS was estimated to be approximately 50 percent. Therefore, a factor of 50 percent arrivals was used in the capacity calculations for RTS.

Touch-and-Go Percentage

The touch-and-go percentage is the ratio of landings with an immediate takeoff to total operations. This type of operation is typically associated with flight training. The number of touch-and-go operations normally decreases as the number of total operations approach runway capacity and/or weather conditions deteriorate. Typically, touch-and-go operations are assumed to be between zero and 50 percent of total operations.

Based on information obtained from the RTAA and FBO, approximately 50 percent of all local GA operations are touch-and-go operations. Thus, it is estimated that touch-and-go operations account for approximately 30 percent of total operations at RTS. Based on this information, touch-and-go factors of 1.0 for VFR operations and 1.0 for IFR operations were selected as required by the guidelines presented in the FAA AC 150/5060-5, *Airport Capacity and Delay*. These factors will be used later in the hourly runway capacity and ASV calculations.

Taxiway Factors

Taxiway entrance and exit locations are an important factor in determining the capacity of an airport's runway system. Runway capacities are highest when there are full-length, parallel taxiways, ample runway entrance and exit taxiways, and no active runway crossings. All of these components reduce the amount of time an aircraft remains on the runway. FAA AC 150/5060-5, *Airport Capacity and Delay* identifies the criteria for determining taxiway exit factors at an airport. The criteria for exit factors are generally based on the mix index and the distance the taxiway exits are from the runway threshold and other taxiway connections. Because the mix index for RTS was calculated to be in the lower range of 0-20 throughout the 20-year planning period, only exit taxiways that are between 2,000 and 4,000 feet from the threshold and spaced at least 750 feet apart contribute to the taxiway exit factor. Taxiways that met these parameters were considered in completing the capacity calculations for all directions and for all conditions.

Taxiway exits were evaluated for operations in all directions on both Runway 8-26 and Runway 14-32. Both runways have a full parallel taxiway, and four taxiway exits were identified that meet the previously mentioned criteria. This results in a taxiway exit factor of 1.0 for VFR operations and 1.0 for IFR operations.

Instrument Approach Capability

Instrument approach capability is qualified based upon the ability of the airport to safely accommodate aircraft operations during periods of inclement weather. Weather, in this regard, is characterized by two measures, local visibility in statute miles and height of a substantial cloud ceiling above airport elevation. These two measures are termed minimums. The Instrument Landing System (ILS) Approach to Runway 32 provides this capability by enabling a precision approach.

Weather Influences

Weather data obtained from the Western Region Climatic Center identified that IFR conditions (ceilings less than 1,000 feet above ground level [AGL] and/or visibility less than 3 miles) occur significantly less than two percent of the time at RTS. Being that RTS is in VFR conditions more than 90 percent of the time, RTS will be treated as a VFR airport for capacity purposes.

4.3.1.2 Airfield Capacity Calculations

The airfield capacity calculations in this section were performed using the parameters and assumptions discussed in the previous sections. The calculations also utilize data from the preferred aviation demand forecast, as presented in Chapter 3, for portions of the capacity projections. The following sections outline the hourly capacities in VFR and IFR conditions, as well as the annual service volume for RTS.

Hourly VFR Capacity

The hourly VFR capacity for RTS was calculated based on the guidance and procedures in FAA AC 150/5060-5, *Airport Capacity and Delay*. Hourly VFR capacity was calculated to be 180 operations per hour. The following equation and calculations present the step-by-step method that was utilized to calculate the hourly VFR capacity.

<u>Hourly VFR Equation</u>

Hourly Capacity Base (C*) x Touch-and-Go Factor (T) x Exit Factor (E) = Hourly Capacity

C* x T x E = Hourly Capacity

180 x 1.0 x 1.0 = 180

The VFR hourly capacity will be used in the annual service volume calculations for RTS.

Hourly IFR Capacity

Similar to the VFR hourly capacity discussed previously, IFR hourly capacity was calculated for RTS. Since visibility is reduced during IFR conditions, substantially more spacing is required between aircraft resulting in a lower hourly capacity. The hourly IFR capacity was calculated to be 60 operations per hour. As referenced in Section 4.2 Airspace Capacity, RTS lies just outside of RNO's Class C airspace. Although the precision approach surfaces for both airports intersect, the hourly IFR capacity at RTS is not affected. The hourly IFR capacity equation and calculations are shown below.

<u>Hourly IFR Equation</u>

Hourly Capacity Base (C*) x Touch-and-Go Factor (T) x Exit Factor (E) = Hourly Capacity

C* x T x E = Hourly Capacity

60 x 1.0 x 1.0 = 60

Annual Service Volume

The ASV is the maximum number of annual operations that can occur at an airport before an assumed reasonable operational delay value is encountered. The ASV is calculated based on the existing runway configuration, aircraft mix, and the parameters and assumptions identified herein and incorporates the hourly VFR and IFR capacities calculated previously. Utilizing this information and the guidance provided in FAA AC 150/5060-5, *Airport Capacity and Delay* the ASV for existing conditions at RTS was calculated to be 299,702 operations. It should be noted that the ASV represents the existing airfield capacity in its present configuration, with one north-south runway, one east-west runway, two full-length parallel taxiway and ILS and GPS approach capabilities on Runway 32. The equation and calculations used to obtain the ASV were taken from the FAA AC 150/5060-5, and are presented below.

<u>ASV Equation</u>

Weighted Hourly Capacity (Cw) x Annual/Daily Demand (D) x Daily/Hourly Demand (H) = Annual Service Volume (ASV)

<u>ASV Calculation</u>

Cw x D x H = ASV

177.6 x 253 x 6.67 = 299,702

The current aviation demand in number of aircraft operations for the base year 2006 at RTS, as presented in Chapter 3 of this document, is 64,000 operations. This equals approximately 21.4 percent of the present ASV. According to the FAA, the following guidelines should be used to determine necessary steps as demand reaches designated levels of airfield capacity:

- 60 percent of ASV: threshold at which planning for capacity improvements should begin;
- 80 percent of ASV: threshold at which planning for improvements should be complete and construction should begin; and
- 100 percent of ASV: threshold at which the total number of annual operations (demand) that can be accommodated has been reached and capacity-enhancing improvements should be made to avoid extensive delays.

Table 4-5 illustrates the RTS's preferred aviation demand forecast and its relation to the airfield ASV.

Table 4-5. Annual Service Volume vs. Annual Demand

Year	Aircraft Mix Index	Annual Operations	Annual Service Volume	Percent of Annual Service Volume
Base Year				
2006	0-20 %	64,077	299,702	21.4%
Forecast				
2010	0-20 %	76,764	299,702	25.6%
2015	0-20 %	82,484	299,702	27.5%
2020	0-20 %	91,407	299,702	30.5%
2025	0-20 %	101,843	299,702	34.0%
2030	0-20 %	113,288	299,702	37.8%

Source: FAA AC 150/5060-5, Airport Capacity and Delay and PBS&J, 2008.

Given the current and forecasted annual operations as well as the calculated ASV for RTS, no improvements need to take place to mitigate any capacity issues foreseen over the 20-year planning period.

4.3.2 Runway and Taxiway System Design Requirements

An initial step in identifying an airport's potential runway and taxiway facility requirements is the establishment of fundamental development guidelines for the largest or most critical aircraft expected to use the facility. FAA guidance on dimensional standards is based on the Airport Reference Code (ARC) system. The ARC is defined using an alphanumeric designation, or letter designation followed by a Roman numeral. The letter designator is used to identify the Aircraft Approach Category (AAC) based on aircraft approach speeds and the Roman numeral designates the Airplane Design Group (ADG) based on wingspan. **Table 4-6** depicts the criteria used to define the ARC according to FAA Advisory Circular 150/5300-13, *Airport Design*.

Table 4-6. Airport Reference Code Breakdown

Category	Approach Speed (knots)
Aircraft Approach Category	
A	<91
B	91-121
C	121-141
D	141-166
E	>166
Airplane Design Group	
Design Group	**Wingspan (feet)**
I	<49
II	49-78
III	79-117
IV	118-170
V	171-213
VI	214-262

Source: FAA AC 150/5060-5, Airport Capacity and Delay and PBS&J, 2008.

RTS has been classified as an ARC C-III airport; and the Boeing 737-900 identified as the critical design aircraft. The critical design aircraft affects key aspects of airport design, such as sizing of runways, taxiways/taxilanes, aircraft parking areas, and hangar facilities. The critical design aircraft is traditionally the most physically demanding aircraft based at, or using the airport and having more than 500 itinerant operations annually. The aviation demand forecast clearly establishes that RTS is expected to experience more than 500 operations by C-III aircraft annually. For purposes of this report, aircraft requiring C-III design standards and weighing more than 12,500 pounds will be considered the current critical or design aircraft. The design aircraft controls design standards such as runway width, pavement strength, and runway and taxiway separations criteria.

Throughout the 20-year planning period, it is anticipated that aircraft requiring C-III design standards will frequent RTS in sufficient numbers to maintain the classification. It is therefore reasonable to maintain the current airfield facilities and plan future facilities to accommodate this level of service. Not all areas of the airfield require construction based upon these more stringent design standards. Areas of the RTS facility which are intended solely for smaller Group A and/or B aircraft, such as hangar areas and the taxilanes which serve them, should be designed for that type of aircraft.

4.3.2.1 Runway 8-26

Based on prevailing wind direction and aircraft utilization, Runway 8-26 is the most frequently used runway and has a length of 7,608 feet and a width of 150 feet which meets the standards established in FAA Advisory Circular 150/5300-13, *Airport Design,* for an airport with an ARC of C-III and a design aircraft weighing more than 60,000 pounds. Runway 8-26 pavement is currently in good condition; however, rehabilitation will be warranted within the planning period even with timely preventative maintenance. The C-III designation for Runway 8-26 also requires standard lengths and widths for the associated runway protective surfaces, including the Runway Safety Area (RSA), the Runway Object Free Area (OFA), the Obstacle Free Zone (OFZ), and the Runway Protection Zones (RPZ). Each one of these protective surfaces is depicted in detail on the Airport Layout Plan (ALP) presented in Chapter 7. Runway 8-26 is currently compliant with all of the ARC C-III protective surfaces except for the RSA criteria. Specifically, the RSA at the approach end of Runway 26 does not meet proper grading requirements. Furthermore, vegetation and unevenness in terrain yield the RSA non-compliant with standards near the west end of Runway 8-26. The *Reno-Stead Airport RSA Standards Compliance Study Final Report, October 2008* prepared by URS Corporation recommended the construction of a 575-foot extension to Runway 8 and applying declared distances. The displacement of 575 feet on both runway ends would have ensured the proper 1,000 feet of cleared and graded area beyond the runway threshold to allow for the occasional passage of aircraft without causing structural damage to the aircraft.

As the design for the RSA construction project reached 60 percent completion, current cost estimates (Reynolds, Smith & Hills, Inc., January 2010) for the recommended 575-foot extension neared $3 million. RTAA staff reconsidered the previously discounted alternatives and determined that applying declared distances and displacing the Runway 26 threshold by 314 feet would provide a better financial and operational solution. Declared distances are defined as follows:

- Takeoff Run Available (TORA) – the runway length declared available and suitable for the ground run of an aircraft taking off.
- Takeoff Distance Available (TODA) – the TORA plus the length of any remaining runway or clearway beyond the far end of the TORA.
- Accelerate Stop Distance Available (ASDA) – the runway plus stopway length declared available and suitable for the acceleration and deceleration of an aircraft aborting takeoff.
- Landing Distance Available (LDA) – the runway length declared available and suitable for an aircraft to land.

The declared distances are listed in **Table 4-7**.

Table 4-7. Declared Distances for Runway 8-26

Declared Distance	Runway 8	Runway 26
TORA	6,956	7,608
TODA	6,956	7,608
ASDA	6,956	7,608
LDA	6,956	7,294

Sources: FAA AC 150/5300-13, Airport Design, Reno-Stead Airport RSA Standards Compliance Study, Final Report, October 2008, URS and PBS&J, 2009.

The improvements described above are currently being implemented to bring the Runway 8-26 RSA into compliance with the FAA standards. The RSA improvements will be completed by the end of calendar year 2010.

4.3.2.2 Runway 14-32

Runway 14-32 is 9,000 feet long and 150 feet wide. Runway 14-32 is the lesser used of the two runways at RTS but is critical to the overall capability of the airfield and also meets ARC C-III standards. Runway 14-32 is also currently compliant with all of the ARC C-III protective surfaces except for the RSA criteria. The *Reno-Stead Airport RSA Standards Compliance Study Final Report, October 2008* prepared by URS Corporation recommended moving the end of Runway 32 by 320 feet to the northwest and applying declared distances. The declared distances are listed in **Table 4-8**.

Table 4-8. Declared Distances for Runway 14-32

Declared Distance	Runway 14	Runway 32
TORA	8,680	9,000
TODA	8,680	9,000
ASDA	8,680	9,000
LDA	8,680	7,800

Sources: FAA AC 150/5300-13, Airport Design, Reno-Stead Airport RSA Standards Compliance Study, Final Report, October 2008, URS and PBS&J, 2009.

The improvements described above are currently being implemented to bring the Runway 14-32 RSA into compliance with the FAA standards. The RSA improvements will be completed by the end of calendar year 2010.

4.3.2.3 Runway Designations

A runway designation is identified by the whole number nearest the magnetic azimuth of the runway when oriented along the runway centerline as if on an approach to that runway end. This number is then rounded off to the nearest unit of ten. Magnetic azimuth is determined by adjusting the geodetic azimuth associated with a runway to compensate for magnetic declination. Magnetic declination is defined as the difference between true north and magnetic north. This value of magnetic declination varies over time and is dependent on global location. Change in magnetic declination is a natural process and does periodically require re-designation of runways.

Current information for magnetic declination was derived from the National Geophysical Data Center (NGDC) database in October of 2008. Magnetic Declination for the RTS area was calculated as 14°30' East changing by 0°6' West per year. True bearing for each runway were identified through the most recent Airport Layout Plan (ALP) for RTS. Magnetic bearing calculations for each RTS runway are shown in **Table 4-9** below.

Table 4-9. Runway Designation Calculation

Runway	True Bearing	Magnetic Declination	Magnetic Bearing	Runway Designation Required
8	96°43'45"	-14°30' East	82°13'15"	8
26	276°43'15"	-14°30' East	262°13'15"	26
14	154°25'2"	-14°30' East	140°55'2"	14
32	334°25'2"	-14°30' East	320°55'2"	32

Source: PBS&J, 2008

Considering the current true bearing of Runway 8-26 and 14-32 and the calculated magnetic declination for the Reno-Stead area, no re-designation of runways at RTS is required. Furthermore, assuming the declination of 14°30' East changing by 0°06' West per year remains constant, the need for re-designation of RTS runways will not be realized for another 30 to 40 years.

4.3.2.4 Runway Length Requirements

The length of a runway is a function of many factors, the most notable of which are the selection of a critical aircraft and the longest nonstop distance being flown by this aircraft from the airport of study. These factors were used as input for the FAA's Airport Design v4.2D software, utilizing the airport elevation of 5,050 feet mean sea level (MSL), a mean daily maximum temperature of the hottest month of 89.6 degrees Fahrenheit, a maximum difference in runway centerline elevation of 58.3 feet, an average length of haul of 1,000 miles, and wet and slippery runway conditions. The results are depicted in **Table 4-10.**

Table 4-10. Runway Length Requirements

Airport and Runway Data:	
Airport Elevation (MSL)	5,050
Mean Daily Maximum Temperature of the Hottest Month	89.6° F
Maximum Difference in Runway Centerline Elevation	58.3 Feet
Recommended Runway Lengths:	
Small Aircraft with Approach Speeds of Less Than 30 Knots	450 Feet
Small Aircraft with Approach Speeds of Less Than 50 Knots	1,200 Feet
Small Aircraft with Less Than 10 Passenger Seats:	
75 Percent of These Small Aircraft	4,640 Feet
95 Percent of These Small Aircraft	6,230 Feet
100 Percent of These Small Aircraft	6,400 Feet
Small Aircraft with 10 or More Passenger Seats	6,400 Feet
Large Aircraft of 60,000 Pounds or Less:	
75 Percent of These Large Aircraft at 60 Percent Useful Load	7,250 Feet
75 Percent of These Large Aircraft at 90 Percent Useful Load	9,180 Feet
100 Percent of These Large Aircraft at 60 Percent Useful Load	11,280 Feet
100 Percent of These Large Aircraft at 90 Percent Useful Load	11,580 Feet
Aircraft of More Than 60,000 Pounds:	
Traveling 1000 or Less Non-Stop Miles to Destination	8,050 Feet

Source: FAA AC 150/5325-4A, Runway Length Requirements for Airport Design.

It is evident from the runway length requirements table above that RTS's runways satisfy the length requirement for all small airplanes with up to and greater than 10 passenger seats. Both runways are capable of handling large aircraft of 60,000 pounds or less considering certain load parameters established by each aircraft's independent performance data and most importantly, are able to support operations by the airport design aircraft, 737-900, traveling less than 1,000 miles. As a result, the current runway lengths are considered adequate for the duration of the 20-year planning period.

4.3.2.5 Taxiway Requirements

A taxiway system should allow for safe and efficient movement of aircraft to and from the runways and aircraft parking/storage areas which serve the airport's facilities. The ARC C-III designations and protective surfaces mentioned previously also apply to taxiways. As traffic increases, the taxiway system can become a limiting factor of the airport overall capacity, especially if the configuration of the airport results in frequent runway crossings by taxiing aircraft, or does not provide sufficient access to airport facilities or provide bypass capability. FAA guidance found in FAA Advisory Circular 150/5300-13, *Airport Design* recommends that a taxiway system should: provide each runway with a full parallel taxiway, have as many by-passes, multiple accesses, or connector taxiways as possible to each runway end, provide taxiway run-up areas for each runway end, have the most direct routes as possible, have adequate curve and fillet radii, and avoid areas where ground congestion may occur.

The existing taxiway system at RTS, as discussed in Chapter 2, connects all runway ends to the terminal area and other airport facilities. Runway 14-32 is served by parallel Taxiway B which extends from the Runway 14 end to the Runway 32 end. Taxiway B is 50 feet wide and has 400 feet of separation from its centerline to the Runway 14-32 centerline. The 400 feet of separation and 50-foot width meets FAA ARC C-III requirements.

Runway 8-26 is served by parallel Taxiway A on the south side of the runway, adjacent to the apron. Taxiway A is 50 feet wide and has a runway centerline to taxiway centerline separation of 520 feet. Taxiway A meets and exceeds FAA ARC C-III standards.

In addition to the primary parallel taxiways, other secondary taxiways on the airfield connect the runways and taxiways to the terminal, aprons, and GA facilities. Taxiway C is located in the middle of the airfield between Runway 14-32 and Runway 8-26 and provides service to both runways. Taxiway C connects to Taxiway B and Taxiway A. Taxiway D connects the approach end of Runway 8 to the Nevada Army National Guard building and to Taxiway A; however, it only has a weight bearing capacity of 14,000 pounds to support the Nevada Army National Guard's Beech King Air aircraft.

Even though the demand capacity analysis determined that the existing facilities will be sufficient, the inclusion of additional full-length parallel taxiways for both Runway 8-26 (north side) and Runway 14-32 (east side) would increase levels of safety related to aircraft operations, especially considering RTS is currently an uncontrolled facility (no air traffic control). Furthermore, these taxiway additions would allow for development on areas of RTS that currently have no runway access, as well as allow for a more efficient flow of aircraft and ground operations. As a result, it is recommended that full parallel taxiways on the north side of Runway 8-26 and on the east side of Runway 14-32 be implemented in the 20-year planning horizon. It is also recommended that improvements to Taxiway D in the form of strengthening, adding appropriate fillet radii, and marking appropriately be performed during the planning period.

4.4 APPROACH AND NAVIGATIONAL AIDS

As discussed in Chapter 2, RTS has several navigational and visual approach aids. These consist mainly of Precision Approach Path Indicators (PAPIs), lighted windsocks, a lighted segmented circle, and an ILS. A non-precision GPS approach is also available at RTS.

Future NAVAIDS that may be considered in order to increase operational efficiency and ensure safety during IFR operations include the installation of an ILS on Runway 8-26 along with a medium-intensity approach lighting system with runway alignment indicator lights (MALSR). Considering Runway 26 is used over 72 percent of the time it is appropriate to protect this runway for use during times of inclement weather through the implementation of an ILS.

4.5 AIRFIELD LIGHTING, SIGNAGE, AND PAVEMENT MARKINGS

4.5.1 Airfield Lighting

Airport lighting aids assist pilots in identifying an airport facility and while maneuvering on the airfield. The existing lighting aids at RTS include a rotating beacon, runway end identification lights (REILs), high intensity runway lights (HIRLs), and medium intensity taxiway lights (MITLs).

Runway 14-32 and Runway 8-26 are both equipped with REILs and HIRLs. Parallel Taxiways A and B are equipped with MITLs, and no taxiway lighting exist on Taxiways C and D. As a result, the only airfield lighting improvement recommended is that MITLs should be considered for all taxiways at RTS.

4.5.2 Airfield Signage

Existing airfield signage at RTS is adequate for the current facilities; however, signage improvements should be considered in conjunction with airfield projects. For instance, the RSA improvements will require new distance remaining signs to both runways. Additionally, signage that clearly designates the terminal location may be helpful for arriving transient aircraft.

4.5.3 Pavement Markings

Each runway except for Runway 32 is marked with visual basic markings, Runway 32 is marked as precision as it has an ILS approach. All runways are marked with runway number designations, centerline stripes, and runway side stripes. The displaced threshold on Runway 14 is marked appropriately with arrows. It is recommended that the pavement marking system at RTS be evaluated with any physical change to any surface used during aeronautical activity. Pavement markings should be appropriately relocated to coincide with the completion of any runway and/or taxiway extensions and improvements or construction of an additional apron area.

4.6 AIRCRAFT APRONS AND TIE-DOWNS

Aircraft aprons are areas that provide parking for airplanes, access to the terminal facilities, fueling, and ground transportation. FAA Advisory Circular 150/5300-13, *Airport Design* provides guidelines for sizing aircraft aprons based on the number of airplanes using the airport during a busy day. At RTS, the total operations can be classified in two categories: based aircraft operations and itinerant aircraft operations. Aircraft aprons and tie-downs were analyzed for each category in accordance with FAA guidance.

A single publicly accessible aircraft parking apron exists at RTS. The apron is located directly south of Runway 8-26 and is approximately 215,000 square yards in total size of which 204,000 is paved with asphalt. The remaining 11,000 square yards of apron is constructed of concrete and used for parking of larger aircraft. Roughly 76,300 square yards of the apron is currently used as tie-down space for based aircraft, and 33,220 square yards is used as tie-down space for itinerant aircraft. The based aircraft tie-down area is located west of the temporary grandstand site and north of the T-hangars while the itinerant tie-down area is located adjacent to the FBO on the east end of the apron. During the National Championship Air Races and Air Show, nearly all of the apron is utilized: the center portion south of the apron is the site for temporary grandstands and box seating; the west end is used as the racing aircraft pit area; and the east end is used for military aircraft display. Also, the extreme east end of the apron is used to stage fire fighting aircraft during operations by the Bureau of Land Management (BLM) fire fighting support base.

It has been estimated that 20 percent of based aircraft at RTS are not in hangars and will require apron space. Sizing criteria for tie-down positions vary according to aircraft size, including space for circulation and fueling. FAA AC 150/5300-13, *Airport Design*, indicates that planning for 300 square yards for each based aircraft will provide sufficient space for a mix of aircraft. The based aircraft apron calculations are shown in **Table 4-11.**

Table 4-11. Based Aircraft Apron Requirements

	2006	2010	2015	2020	2025	2030
Total Based Aircraft	261	318	356	404	464	539
Based Aircraft on Apron (20% of total)	52	64	71	81	93	108
Total Based Aircraft Apron (sq. yards)	**15,600**	**19,200**	**21,300**	**24,300**	**27,900**	**32,400**
Existing Based Aircraft Apron (sq. yards)	76,300	76,300	76,300	76,300	76,300	76,300
Surplus / (Deficiency) in sq. yards	**60,700**	**57,100**	**55,000**	**52,000**	**48,400**	**43,900**

Source: PBS&J, 2008.

Based on the above analysis, ample apron space is available to facilitate the growing tie-down demand of local based aircraft throughout the 20-year planning period.

Itinerant apron space is intended for relatively short-term parking periods, usually less than 24 hours, as they are primarily for transient aircraft. When possible, such aprons should also be located as to provide easy access to the terminal, fueling, and ground transportation facilities. For planning purposes, the FAA provides a detailed approach to calculate the total number of peak day itinerant aircraft that can be expected on the apron at any given time. For RTS, this was calculated by adding 10 percent to the peak month average day (PMAD) activity figures from the forecast chapter to determine busy day operations. The corresponding local/itinerant split was applied to determine peak day itinerant operations (in this case 45.3 percent). It was assumed that 50 percent of transient aircraft will occupy the apron at any given time. The size of an itinerant apron should be based upon a minimum are of 360 square yards per itinerant aircraft. The itinerant aircraft apron calculations are shown in **Table 4-12.**

Table 4-12. Itinerant Aircraft Apron Requirements

	2006	2010	2015	2020	2025	2030
Busy Day Ops (PMAD OPS + 10%)	348	471	528	598	688	799
Peak Day Itinerant Operations	158	213	239	271	312	362
Transient Aircraft Positions Required	79	107	120	136	156	181
Total Transient Apron Required (sq. yards)	**28,440**	**38,520**	**43,200**	**48,960**	**56,460**	**65,460**
Existing Itinerant Apron (sq. yards)	33,220	33,220	33,220	33,220	33,220	33,220
Surplus / (Deficiency) in sq. yards	**4,780**	**(5,300)**	**(10,000)**	**(15,740)**	**(23,240)**	**(32,240)**

Source: PBS&J, 2008.

Based on the above analysis, the existing itinerant aircraft apron, as striped and equipped, is expected to experience capacity issues in the near future. It is recommended that additional tie-down positions be striped and equipped as needed using a portion of the approximately 95,000 square yards of unassigned space in the center of the apron area. The expanded tie-down area for itinerant aircraft should be located west of the FBO hangar (Aviation Classics) and east of the grandstands.

In conclusion, the existing paved aircraft apron area is adequate to meet the 20-year planning demand with only minor modifications required to facilitate increased operations.

4.7 AIRCRAFT HANGARS

Aircraft hangars provide aircraft with protection from the weather and security against vandalism or theft. In general, aircraft owners, if financially capable, prefer to store their aircraft in hangars than on the apron. Currently there are T-hangars and conventional hangars located at RTS.

T-hangars, as well as T-shelters or shade hangars, are row hangars that nest aircraft in a line, usually alternating nose to tail, maximizing utilization of available space. These are relatively low-cost hangars which provide complete or partial protection from the elements depending on whether they are open (shade hangar) or enclosed. A conventional hangar is typically a rectangular structure with sliding doors, usually accommodating more than one aircraft and having some additional space for other equipment or office space.

Requirements for hangars tend to vary greatly from airport to airport but are dependent on similar factors. These factors include: the number and type of based aircraft, local preference for hangar type, associated fees, and local climate conditions including severity of seasonal changes.

Currently 102 hangars exist at RTS and include nine T-hangar units and 93 conventional hangars. All hangars are located along the south and west sides of the aircraft parking apron. Recently, new taxilanes were developed on the west end of Runway 8-26 to facilitate the addition of 60 conventional hangars, which are expected to be built within the next one to three years.

For planning purposes, it was assumed that 80 percent of total based aircraft will require hangar space. As is the case currently, aircraft may be located in T-hangar units, small standalone hangars, or collocated with other aircraft in a larger conventional hangar. As such an average of two aircraft per hangar was applied. Discussions with RTAA staff indicate the growth in hangars at RTS would be in conventional hangars rather than T-hangar units. Therefore, the number of T-hangar units remains constant through the planning period. Hangar requirements are noted in **Table 4-13**.

Table 4-13. Aircraft Hangar Requirements

	2006	**2010**	**2015**	**2020**	**2025**	**2030**
Total Based Aircraft	261	318	356	404	464	539
Total Aircraft Hangars Required [2]	**104**	**127**	**142**	**162**	**186**	**216**
Total Existing Aircraft Hangars [1]	102	132	162	162	162	162
Surplus / (Deficiency)	**(2)**	**5**	**20**	**0**	**(24)**	**(54)**

Notes: [1] Total existing aircraft hangars include the assumption that 30 new hangars currently under construction will be available in 2010 and the remaining 30 hangars will be available in 2015.
[2]Total aircraft hangars required assumes an average of 2 aircraft per hangar.
Source: PBS&J 2008.

4.8 FUEL FLOWAGE

Two fuel storage facilities exist at RTS. One is located south of Runway 8-26 and east of the Aviation Classics hangar and contains one 12,000 gallon Jet-A tank and two 12,000 gallon 100LL (AVGAS) tanks. The other fuel storage facility is a single 12,000 gallon AVGAS tank located in the middle of the itinerant apron area and used as a self service fuel station. All the fuel facilities are currently managed by the FBO Aviation Classics.

Historical fuel flowage information was provided by RTAA staff, and was used to forecast the annual fuel demand over the planning period as well as the 14-day storage requirement over the planning period. Based on the fuel flowage projections described in Chapter 3, it is estimated that 964,307 total gallons of fuel (specifically 565,160 gallons Jet-A and 399,147 gallons AVGAS) will be sold annually by 2030. The forecast of flowage volumes are summarized in **Table 4-14.**

Table 4-14. Annual Fuel Demand

Year	Annual Non-Jet Operations	Gallons Per Operation	Annual AvGas Demand
2006	59,238	3	157,401
2010	79,434	3	238,302
2015	88,416	3	265,248
2020	100,058	3	300,174
2025	114,745	3	344,235
2030	133,049	3	399,147
Year	**Annual Jet Operations**	**Gallons Per Operation**	**Annual Jet-A Demand**
2006	4,672	40	190,638
2010	7,379	40	295,160
2015	8,851	40	354,040
2020	10,258	40	410,320
2025	11,905	40	476,200
2030	14,129	40	565,160

Source: PBS&J, 2009.

Tables 4-15 and **4-16** provide the on-site fuel storage requirements for both AVGAS and Jet-A, respectively. The gallons per operation provided in Table 4-14 was held constant. Average daily operations were determined by dividing the total annual number of operations by 365. The Peak period was determined by applying a 15 percent factor to the average daily number of operations calculated. Based on the existing convenient and reliable fuel delivery services in the region, it was assumed for planning purposes that a 14-day storage requirement would provide enough on-site capacity to meet demand during the peak period.

Table 4-15. AVGAS Fuel Storage Requirements

Year	Daily Non Jet Operations		Gallons Per Operation	14-Day Storage Requirement Gallons	
	Average	*Peak*		*Average*	*Peak*
2006	163	187	3	6,846	7,854
2010	218	250	3	9,156	10,500
2015	242	279	3	10,164	11,718
2020	274	315	3	11,508	13,230
2025	314	362	3	13,188	15,204
2030	365	419	3	15,330	17,598

Source: PBSJ 2009.

Table 4-16. Jet A Fuel Storage Requirements

Year	Daily Jet Operations		Gallons Per Operation	14-Day Storage Requirement Gallons	
	Average	*Peak*		*Average*	*Peak*
2006	7	8	40	7,280	8,400
2010	20	23	40	11,200	12,880
2015	24	28	40	13,440	15,680
2020	28	32	40	15,680	17,920
2025	33	38	40	18,480	21,280
2030	39	45	40	21,840	25,200

Source: PBS&J, 2008.

These calculations show strong growth in demand for fuel at RTS over the next 20 years. As demand increases FBOs typically react by increasing fuel shipments or expanding their on-site capacity. Space should be allocated for expansion of existing fueling facilities to meet this demand. Demand for AVGAS can be accommodated with the existing 24,000 gallon storage capacity. However, an additional Jet-A self-serve fueling system should be considered to support fuel demand of jet aircraft during the planning period. This could increase the efficiency of the fueling operations and potentially reduce fuel consumer costs. This particularly attracts price-sensitive general aviation operators and cost reductions are passed on to the consumer. Such factors should be considered in the planning process and coordinated with the FBO.

4.9 TERMINAL BUILDING & FBO

As addressed in Section 2.15 Airport Surveys and Tenant Interviews, public input and surveys indicated a strong desire for a terminal facility to provide proper pilot and passenger services, adequate pilot support, and public meeting/waiting areas at RTS. Copies of these surveys are found in Appendix B. General Aviation terminal buildings typically range from modest structures with little more than a waiting area and a telephone, to multi-story buildings with extensive amenities. A general aviation administration/terminal building should provide at the very least: office space, a waiting room for pilots and passengers, an area for food and drink vending, a public telephone, and public restrooms. RTS does have a modular building set up as a terminal building, though office space is not provided (the airport manager's office is in a different building), and the terminal overall is somewhat small. The terminal building at RTS has approximately 1,700 square feet of space which consists primarily of a pilot lounge with flight planning area, restrooms, and storage facilities. Historically, the on-site FBO has provided the bulk of terminal services offered at RTS. A new terminal building is recommended.

Appendix 5 of FAA AC 150/5300-13, *Airport Design* provides guidance for small airport buildings, including GA terminals. The primary consideration is that the facility be capable of handling the number of passengers, pilots, and visitors associated with peak hour operations. GA facility sizing can vary from 50 to 75 square feet per peak hour passenger. Considering the level of air taxi and corporate operations forecast over the 20-year planning period, a planning guide of 75 square feet per peak hour passenger was used to determine the overall terminal size at RTS.

Floor space requirements for each area are a function of the anticipated number of peak hour operations and airport users. Peak hour passengers are computed as 1.5 passengers per each local aircraft arrival and 2.5 passengers per itinerant arrival. A 55/45 percent mix of local/itinerant activity is assumed throughout the 20-year planning period. Floor space requirements, expressed in square feet per passenger, are as follows for general aviation terminal facilities: Waiting Lounge, 25; Office Space, 5; Public Conveniences, 10; Concession/Vending, 10; and Storage, Circulation, and HVAC, 25 square feet per passenger. Terminal building size requirement recommendations are shown in **Table 4-17**.

Utilizing the above referenced sizing criteria and based on the current and forecast level of demand, a 9,825 square-foot general aviation terminal will be required by 2030. This space will provide room for the airport administration offices and a better space for pilot flight planning and passenger lounging. Since the existing building is not expandable, a new replacement building is recommended.

4.10 TERMINAL AREA AUTOMOBILE PARKING

A clearly defined parking area near the airport terminal building is considered a necessity for a modern airport, and serves as a point of reference for first time visitors of the facility. The primary automobile parking area at RTS is located west of the Air Traffic Control Tower, and south of the grandstands. At the moment, roughly 3,500 square yards of unpaved area is available for the parking of automobiles in this area. This parking area is assumed to have a capacity of about 80 vehicles when the space is used at peak efficiency; however, as the parking lot is neither paved nor striped, no real control on where and how automobiles park exists. Additionally, small pockets of land are used for vehicle parking up and down the length of the aircraft apron area as they are convenient for many of the tenants. These informal spaces used by individual tenants make it difficult to quantify RTS's automobile parking capacity.

The number of automobile parking spaces required is generally calculated as a function of peak hour users as well as tenant and employee demand. However, as other areas are used for tenant and employee parking, this analysis will review only peak hour airport users. A standard of 35 square yards per automobile parking space was used to establish the requirements shown in **Table 4-18**.

The automobile parking requirements analysis for the terminal area reveals that the current area available for the parking of automobiles is adequate until 2020. However, a paved, striped, and clearly identifiable public parking area near the terminal area is recommended to be constructed in conjunction with the development of a new terminal building. A more in depth review of parking lot requirements should also be completed as part of the terminal development process.

4.11 GROUND ACCESS

As mentioned in Chapter 2, the primary ground access to the airport is via Highway 395. RTS is approximately three miles north of this major highway, which runs through Spokane, Washington; Reno, Nevada; and San Bernadino, California. The major arterial road to RTS from 395 is Stead Boulevard. Additional access roads to RTS include Moya Boulevard from Red Rock Road on the southwest side of RTS and Military Road from Lemmon Drive on the southeast side of RTS. All of these access roads ultimately connect to 395 to the south of RTS.

Table 4-17. Terminal Building Requirements

	Base Year			Forecast		
	2006	2010	2015	2020	2025	2030
Peak Hour Operations	38	45	49	54	60	67
Peak Hour Users	74	88	96	105	117	131
Waiting Lounge	1,850	2,200	2,400	2,625	2,925	3,275
Office Space	740	880	960	1,050	1,170	1,310
Public Conveniences	370	440	480	525	585	655
Concession/Vending	740	880	960	1,050	1,170	1,310
Storage, Circulation, HVAC	1,850	2,200	2,400	2,625	2,925	3,275
Total Area (sq. feet)	**5,550**	**6,600**	**7,200**	**7,875**	**8,775**	**9,825**
Existing (sq. feet)	1,700	1,700	1,700	1,700	1,700	1,700
Surplus / (Deficiency)	**(3,850)**	**(4,900)**	**(5,500)**	**(6,175)**	**(7,075)**	**(8,125)**

Source: PBS&J, 2008.

Table 4-18. Automobile Parking Requirements

	Base Year	Forecast				
	2006	2010	2015	2020	2025	2030
Peak Hour Airport Users	74	88	96	105	117	131
Parking Area Required (sq. yards)	**2,590**	**3,080**	**3,360**	**3,675**	**4,095**	**4,585**
Existing (sq. yards)	3,500	3,500	3,500	3,500	3,500	3,500
Surplus / (Deficiency)	**1,330**	**420**	**140**	**(165)**	**(595)**	**(1,085)**
Existing No. of Spaces	80	80	80	80	80	80
Required No. of Spaces	**59**	**70**	**76**	**84**	**93**	**104**
Surplus/ (Deficiency)	**21**	**10**	**4**	**(4)**	**(13)**	**(24)**

Source: PBS&J 2008.

Although Moya Boulevard, Stead Boulevard, and Military Road provide adequate access to RTS from Highway 365, the entrance to RTS is hidden in a maze of business and residential development and is not abundantly obvious to visitors approaching RTS. As corporate and air taxi activity, as well as overall demand, increase at RTS, a new entrance to RTS should be developed. The new entrance location should create more direct access to the new terminal building and the primary public parking area, as well as make the overall location of the airport itself evident to visitors and RTS customers through the use of additional signage. The new entrance road should avoid high-density industrial commercial real estate areas as much as possible.

Improvements of this nature would increase vehicular capacity in order to accommodate the anticipated growth of RTS as well as seasonal/event traffic associated with the National Championship Air Races and Air Show. Furthermore, a new access road and associated identity structure (terminal building) would give RTS much better frontage and presence within the community and facilitate the overall use of RTS by business, customers, and passengers.

4.12 AIRPORT SECURITY

A full perimeter fence and full perimeter unpaved road surround all airport properties with the exception of approximately 425 acres located on the ridgeline in the northeast corner of RTS. The perimeter fence is six feet tall and is effective in preventing transient animals from entering airport property. Also, a smaller inner fence surrounds the areas of airport property close to the airfield. Depictions of the fence locations can be found on the ALP set in Chapter 7.

As additional safety measures, any future property acquired by RTS should be fenced and any additional buildings or parking areas constructed on RTS property should have adequate security lighting. Also, the use of additional security cameras at key locations (i.e., remote gate locations, hangars, and corporate buildings) should be implemented.

4.13 AIRPORT RESCUE AND FIREFIGHTING

The City of Reno provides Aircraft Rescue and Fire Fighting (ARFF) services for RTS. Fire Station No. 9, owned and operated by the City of Reno, is equipped with an airport-assigned rescue vehicle that is available to RTS. Fire Station No. 9 is located less than one mile south of RTS on Mount Vida Street.

Since RTS is a GA facility and does not have commercial service, and/or Part 139 certification, ARFF services are not required to be located on RTS property. Therefore, the ARFF services provided by the City of Reno are adequate for the existing and forecast level of operations. As corporate and air taxi operations increase, RTS's fire safety needs should be monitored to ensure adequate facilities are in place to accommodate any significant change in activity.

4.14 AIR TRAFFIC CONTROL TOWER

The need for establishing air traffic control tower (ATCT) services at an airport that has historically been uncontrolled is generally associated with an increasing level of aircraft operations combined with diversity in fleet mix. Often corporate and/or military aircraft combined or interspersed with primary flight training, recreational flights and other activities using the same airfield will generate conflicts that may compromise safety unless the airspace in the immediate area of the airport (e.g., traffic pattern) is controlled.

Air Traffic Control Tower services enhance the safety of an airport's airspace and airfield by managing aircraft departure and arrival operations, ground vehicles and other activities. The benefits derived from establishing an ATCT include:

- avoidance of mid-air collisions
- prevention of other accidents (runway incursions)
- flight efficiencies

The FAA's Air Traffic Division operates air traffic control towers using both FAA owned and operated facilities and through contract agreements with qualified ATC contractors on a regional basis. This Contract Tower program has proven to be very effective in significantly reducing the cost of providing air traffic control services so that many locations which would not have otherwise been able to justify the expense of providing controlled airspace can benefit from the services of an FAA-funded Air Traffic Control Tower facility.

The justification process for FAA's funding of the operation of contract tower locations is primarily determined by a Benefit/Cost analysis. FAA Report APO 90-7, *Establishment and Discontinuance Criteria for Air Traffic Control Towers*, outlines the procedures for calculating Benefit/Cost (B/C) ratios. Costs are those direct costs associated with the annual operation of the Control Tower including labor and other expenses. Benefits are measured in terms of lives and property saved by the prevention of mid-air collisions, other accidents and the savings in flight time by providing controlled airspace around RTS. The benefit of the Control Tower must be greater than the cost (benefit/cost ratio of greater than 1.0) in order to qualify for funding under the FAA's Contract Tower program.

Construction of the Control Tower and installation of ATCT equipment is eligible for funding under the Airport Improvement Program (AIP) if the tower will be used in the Contract Tower Program and can be justified with a B/C greater than 1.0. Upon meeting this threshold, the Airport Sponsor is responsible for the design, construction, and maintenance of the ATCT facility and equipment and the FAA agrees to fund the annual cost of staffing the Tower.

4.14.1 Critical Values and Other FAA Assumptions

The FAA in the B/C analysis process uses various "critical values" that represent the generic cost of specific items and are set by the General Accounting Office (GAO). The critical values for items used in the B/C Analysis are provided in **Table 4-19**.

Table 4-19. FAA Critical Values & Assumptions

Item	Value
Statistical Life	$5,800,000
Serious Injury	$830,000
Minor Medical Injury	$18,000
GA Traveler's Time (per hour)	$32.50
Other Traveler's Time (per hour)	$27.90
Discount Rate (for net present value)	7%

Source: FAA Office of Policy and Plans (Base Year 2007).

Generally, FAA policy considers new entrants into the Contract Tower Program initially using the establishment criteria of APO 90-7 which applies the statistical means for accident risk as a primary factor in the B/C calculations. Also, for new entrants, projected operations are discounted by 7.5 percent to account for the number of operations that would not be handled by an ATCT facility open for at least 12 hours daily. The establishment period for new ATC Tower facilities entering the Contract Tower Program generally applies to the first one to two years of operation, depending on the point the control tower enters the program since the FAA calculates the B/C biennially. All subsequent calculations of the B/C ratio by the FAA after the initial establishment period are conducted using the discontinuance criteria.

While aircraft activity is associated with the benefit side of the equation, costs are represented by the initial cost of construction of the ATCT facility, annual maintenance costs and FAA's annual cost to operate the ATC as charged by the regional FAA contractor. Estimated construction costs for a Contract ATCT facility can range from $1.5 million to $3.0 million and greater, depending on the required height to meet safety standards, structure materials and other variables. A cost of $5.0 million was used as an estimate for the construction of an ATCT at RTS. Annual maintenance costs to cover utilities, equipment servicing, and other items were estimated at $25,000. Generally, under the Federal Contract Tower program, the FAA uses a figure of $450,000 which represents the average of all contract towers in the program as an estimate of the annual ATC costs for new applicants. The construction cost is only used for the initial year of operation while the annual maintenance and ATC operations costs are held constant throughout the 15-year period and are only adjusted for net present value.

It should be noted that once the Contract ATC Tower has been established, for subsequent years, the B/C calculation is conducted using a separate discontinuance criteria which considers the upper bounds of the statistical risk of accidents. Also, aircraft operations are no longer discounted by 7.5 percent in the discontinuance scenario since it is assumed that all operations handled by ATC are counted.

4.14.2 Benefit/Cost Analyses

A Benefit/Cost Analysis was developed using the airport's projection of based aircraft and the future operational activity in Chapter 3. The discounted cumulative (15-year) ATCT cost was determined to be $6,379,681. The discounted value of the ATC tower benefits is calculated to be $11,787,889 with the resultant B/C at 1.85. Under this scenario, RTS would be an eligible candidate to enter the Contract Tower Program with the FAA covering the entire operational costs of the new ATC Tower location. **Appendix C** contains the detailed calculations for the Benefit/Cost Analysis.

4.15 NON-AVIATION USE

Recognizing the value of real estate within and adjacent to RTAA property that is best suited for non-aviation use, RTS has an opportunity to capitalize on its development enabling RTAA to diversify revenue sources and utilize land to the fullest extent possible. Development of business centers, industrial parks, and commerce areas can be extremely valuable resources in the realization of that goal. Careful planning and organization of these non-aviation revenue generators can be vital to the financial independence of the airport and funding of either landside or airside improvements of the airport.

4.16 SUMMARY

This chapter has identified the general facility requirements necessary to meet the 20-year forecast of aviation demand. A summary of the general facility requirements has been compiled in **Table 4-20**. The next chapter will provide the alternatives developed in order to meet projected facility needs.

Table 4-20. Summary of Facilities Requirements

Item	Existing (2006)		Planning Stage Requirements 2010		2020		2030	
Airside Facilities								
Runway	**14-32**	**8-26**	**14-32**	**8-26**	**14-32**	**8-26**	**14-32**	**8-26**
- Length/Width	9,000'/150'	7,608'/150'	No Change		No Change		No Change	
- Strength	75,000 SW	60,000 SW	No Change		No Change		No Change	
Taxiway System								
- Runway 14-32	Full Length Parallel B		No Change		No Change		East Parallel Twy Addition	
- Runway 8-26	Full Length Parallel A		No Change		No Change		North Parallel Twy Addition	
- Other					Enhance Twy D			
Landside Facilities								
Aircraft Apron Area								
- Based Aircraft Tie-down	52 Spaces		64 Spaces		81 Spaces		108 Spaces	
- Based Aircraft Tie-down	76,300 Sq. Yd.		No Change		No Change		No Change	
- Itinerant Aircraft Tie-down	79 Spaces		107 Spaces		136 Spaces		181 Spaces	
- Itinerant Aircraft Tie-down	33,220 Sq. Yd.		43,220 Sq. Yd.		53,220 Sq. Yd.		65,000 Sq. Yd.	
Aircraft Hangars								
- T-Hangars	9		9		9		9	
- Conventional Hangars	95		118		153		207	
Fuel Facilities								
- Jet-A Tanks	12,000 Gal.		13,000 Gal.		18,000 Gal.		25,000 Gal.	
- AvGas Tanks	36,000 Gal.		No Change		No Change		No Change	
Terminal Buildings								
- Airport Terminal Building	5,550 Sq. Ft. [1]		6,600 Sq. Ft.		7,875 Sq. Ft.		9,825 Sq. Ft.	
Automobile Parking								
- Parking Spaces	80 [2]		70		84		104	
- Parking Area	3,500 Sq. Yd. [2]		3,080 Sq. Yd.		3,675 Sq. Yd.		4,585 Sq. Yd.	

Notes: 1. The existing terminal services are being provided in old and inappropriate facilities that are unable to expand. As a result, a new replacement terminal building is recommended.
2. The existing public parking area is a dirt lot which is not adjacent to the terminal facilities. As a result, a new paved parking lot adjacent to the new terminal building is recommended.
Source: PBS&J, 2009.

AIRPORT DEVELOPMENT PLAN

Reno-Stead Airport

5

5.1 GENERAL

The primary objective of this chapter is to present the overall phased development plan for the Reno-Stead Airport (RTS) to meet future facility development needs identified in Chapter 4. This chapter will present a recommended facility development plan for both aviation use and non-aviation use areas of RTS and is supplemental to the Airport Layout Plan (ALP) associated with this master plan. Airport elements that will satisfy the anticipated aviation demand and/or meet the development goals of the Reno-Tahoe Airport Authority (RTAA) have been identified and accounted for in this chapter. The development plan will be a guide for airport management in directing the future development of RTS. However, the guidelines established must be flexible enough to allow management to adapt to changing aviation demands.

5.2 APPROACH

To help formulate the recommendations for the RTS development plan, four factors which impact how the airport will develop over the 20-year planning horizon have been identified. These factors are:

- RTS plays an important role in the regional and national airport system. RTS supports many aviation activities including general aviation (GA), Nevada Army National Guard (NVANG) operations, Bureau of Land Management (BLM) Air Tanker operations, and Reno Air Racing Association (RARA) National Championship Air Races and Air Show. RTS also serves as a reliever airport for Reno-Tahoe International Airport (RNO).
- RTS has a relatively large land area (5,170 acres), the majority of which is undeveloped and located away from the immediate airfield.
- The *Reno-Stead Airport Regional Center Plan* from 2003 defined the RTS property as a Mixed-Use District. This plan envisions airport compatible development across RTS property, which in addition to aviation uses may include large scale industrial, office, commercial, and public facility developments. Additionally, the plan acknowledges that residential development and other public development such as schools and churches are incompatible land uses for RTS.
- The *Reno-Stead Airport Regional Center Plan* from 2003 also proposes a new circulation concept for the expansive airport property. This circulation concept was included in the RTS Development Plan.

The RTS development plan is presented in the following separate but interrelated functional areas:

- Airfield Elements
- Landside Elements
- Airport Development Concept
- Development Plan

5.3 AIRFIELD ELEMENTS

Runways and taxiways are, by their very nature, the focal point of an airport complex. Because of their role, restrictive placement flexibility, and the fact that they physically dominate a great deal of an airport's property, airfield facility needs are the cornerstone of airport development concepts. In particular, the runway system requires the greatest commitment of land area and is the greatest influence on the identification and development of other airport facilities.

The potential for physical expansion of an airport to accommodate airfield development is a primary factor that determines long-term expansion. Runway and taxiway systems directly affect the efficiency of aircraft movements both on the ground and in the surrounding airspace. Thus, the overall capacity of an airport to accommodate aviation activity is directly related to the efficiency and capabilities of the airfield system. Additionally, runway and taxiway systems can limit the ability of an airport to handle certain aircraft, which can directly affect the types of air service an airport can accommodate.

RTS's existing airfield configuration consists of two runways, Runway 8-26 and Runway 14-32, along with their supporting taxiways and taxilanes. These facilities accommodate the current fleet mix and air traffic levels; however, the airfield's volume of aircraft operations is projected to steadily increase throughout the planning period. Chapter 4 *Demand/Capacity Analysis and Facility Requirements* identified areas for improvement on the airfield to mitigate capacity issues while encouraging growth. These improvements are discussed in detail below.

5.3.1 Runway Improvements

The following sections outline the runway improvements that are deemed as necessary for RTS to gain maximum capacity, meet the forecast aviation demand, and provide facilities in line with the development goals of RTAA.

5.3.1.1 Implement Declared Distances on Runway 8-26 and Displace Runway 26 Threshold for RSA Compliance

Runway 8-26 is the most frequently used runway at RTS and is approximately 7,608 feet long by 150 feet wide. Section 4.3.2.1 Runway 8-26 revealed that the Runway Safety Areas (RSAs) associated with Runway 8-26 are not in full compliance with current FAA standards. To address this issue, RTAA contracted with URS Corporation to evaluate the RSAs at RTS and offer recommendations for improvements. The *Reno-Stead Airport RSA Standards Compliance Study Final Report, October 2008* prepared by URS Corporation recommended the construction of a 575-foot westerly extension to Runway 8-26 and implementing 575-foot displacements on both the 8 and 26 runway ends. As discussed in Section 4.3.2.1 Runway 8-26, the initially recommended alternative was replaced, in January 2010, with a less expensive, but better operational, solution.

The application of declared distances on Runway 8-26 and use of a displaced threshold on Runway 8-26 will allow RTS to meet takeoff requirements and overall demands of current and projected aircraft while minimizing off-airport land use impacts and obstruction concerns. A categorical exclusion (CatEx) as well as an AIP grant application for the revised project construction was submitted to the FAA in January 2010. These improvements are expected to be completed by the end of 2010. It must also be noted that during the planning period the rehabilitation of Runway 8-26's pavement, which has been in place for 15 years, would be necessary.

5.3.1.2 Implement Declared Distance on Runway 14-32 for RSA Compliance

Runway 14-32 is also designated for Group III traffic according to the ALP. Runway 14-32 was found to have a non-compliant RSA associated with Runway 32. The *Reno-Stead Airport RSA Standards Compliance Study Final Report, October 2008* prepared by URS Corporation recommends, after considering other viable alternatives, remarking the end of Runway 32 to be 320 feet farther northwest and applying declared distances to the runway. Also, minor grading work beyond the pavement edge would be required to meet RSA requirements. This action would ensure full compliance with FAA standards and provide for safer operations as RTS.

5.3.2 Taxiways

Full-length parallel taxiways in conjunction with adequate entrance and exit taxiways on a runway are necessary in order to obtain the highest level of airfield capacity. Currently, neither of the runways at RTS have dual full-length parallel taxiways. This section will explore development plans for taxiways at RTS.

5.3.2.1 Parallel Taxiways

Currently, each runway at RTS has a full-parallel taxiway associated with it. Generally dual full-length parallel taxiways are constructed when aviation development at an airport warrants the action. Although activity at RTS does not currently identify a need for dual full-length parallel taxiways, it is recommended that RTS continue to plan for their implementation. Additional parallel taxiways will help to increase capacity, provide for a safer airfield environment, and enable aviation related development in areas currently inaccessible by aircraft. Existing and future parallel taxiways should be planned and constructed to the same design criteria for the runways they are intended to serve. Being the ultimate Airport Reference Code (ARC) for each runway is C-III, taxiways should also be designed to that standard.

5.3.2.2 Rehabilitation of Taxiway D

Taxiway D at RTS is located on the west side of the airport and runs north and south connecting the NVANG apron area with the approach end of Runway 8. Currently this taxiway is designed to Group II standards and has a weight bearing capacity of only 12,500 pounds (Single Wheel Gear). This taxiway is recommended to be widened and strengthened to comply with Group III standards. This taxiway, once rehabilitated, will enable the development of hangars or other aviation uses both east and west of the taxiway, thereby providing the next logical location to expand aviation development once the areas along the southern property line are built out.

5.3.2.3 Rehabilitation of Closed Taxiway

The closed taxiway connecting the north end of Taxiway D with Taxiway C is recommended for rehabilitation. When operational, this taxiway will connect all areas of the airport more efficiently and create valuable airfield frontage for future development. This taxiway is recommended to be widened and strengthened to comply with Group III standards.

5.3.2.4 Connector Taxiways

As with parallel taxiways, connector taxiways are instrumental in allowing aircraft to exit the runway, thereby enhancing operational safety, reducing delay, and increasing overall capacity. A connector taxiway is one that links a runway to a parallel taxiway or other airside facility such as an aircraft parking apron. Guidance provided in the FAA Advisory

Circular (AC) 150/5060-5, *Airport Capacity and Delay*, recommends that a runway be equipped with a minimum of four connector taxiways, spaced at least 750 feet apart and located 2,000 to 4,000 feet from the landing thresholds, to maximize airport capacity.

The sizes, location and amounts of connector taxiways at RTS are currently sufficient. After runway improvements are completed at RTS, the connector taxiway system will continue to support a high airport capacity through adequately spaced entrances and exits to and from RTS's runway system.

5.3.3 NAVIGATIONAL AIDS

The available instrument approaches and navigational aids (NAVAIDS) at an airport have a measurable impact on overall airfield capacity, especially when considering hourly capacity under instrument meteorological conditions (IMC).

Based on a review of the existing NAVAIDS at RTS and the forecast of aviation demand, specific additions to the existing NAVAIDS and approach systems have been identified. Most notable is the implementation of an instrument landing system (ILS) approach to Runway 26. The need for an ILS on Runway 32 was previously recognized and a fully operational system has been installed by the FAA. Airspace constraints will prevent the ability to provide current technology precision instrument approach capabilities to Runway 8 and traffic does not warrant a precision instrument approach to Runway 14. However, maintaining the ability to have non-precision instrument approaches to those runways in the future as technology evolves will enhance IFR capabilities to the runways. A new ILS instrument approach to Runway 26 installed in the near term would further enhance the airfield's overall capacity during IMC. Although, GPS based precision approach systems have been growing in popularity in recent years, it is still a new and evolving technology. Planning for an ILS to the runway will preserve adequate land for any future NAVAID supporting precision approaches. Considering the limited level ground that exist beyond the Runway 26 end and the sharp elevation change, the airport should consider which approach lighting system (ALS) could provide the lowest minimums while limiting the cost associated with the ALS. Omni-Directional Approach Light System (ODALS) or Sequencing Flashing Lights (SFL) may prove to be the best solution for an ALS to complement the proposed ILS on Runway 26.

Table 5-1 shows the NAVAID requirements, according to runway, that are necessary to increase overall airport capacity and ensure operational safety during IMC. These requirements will complement the proposed runway and taxiway improvements discussed previously, to obtain the highest level of capacity.

Table 5-1. RTS NAVAIDS

Runway	Existing NAVAIDS	Proposed NAVAIDS
8	PAPI-4	Non-Precision – (ILS Backcourse, GPS and/or RNAV)
26	PAPI-4	Precision – (ILS, MALSR/ODALS/SFL)
14	PAPI-4	Non-Precision – (ILS Backcourse, GPS and/or RNAV)
32	PAPI-4, GPS, MALSR, ILS	

Source: PBS&J, 2009.

5.4 LANDSIDE ELEMENTS

Landside elements of an airport are generally those areas reserved for aircraft parking or storage, terminal facilities, vehicle parking areas, and other supporting areas not related to aircraft movements. This section will review those landside areas requiring improvement or expansion as recognized in Chapter 4.

5.4.1 Aircraft Storage Hangars

A strong demand for aircraft hangars was identified in Section 4.7 Aircraft Hangars which revealed that 114 additional hangar units are expected to be required in 2030. Recently, new taxilanes were developed on the west side of the airport to facilitate the addition of 60 conventional hangars, which are expected to be built within the next one to three years. This development is expected to meet the hangar demand through 2015.

After discussions with RTAA staff and analysis of various locations for future GA hangar development, a preferred location has been selected. The area immediately past and/or west of the current hangar development is considered the best location for the additional 54 hangars determined to be required by 2030. Since civil infrastructure such as roads and utilities already exist on the south side of the airport and based GA aircraft are found predominantly in the southwest corner, this location proved to be the most appropriate for hangar development.

5.4.2 Aircraft Aprons

The single large 215,000 square yard general aviation apron at RTS is used by both based and itinerant aircraft. This apron is considered to be more than adequate to meet traffic demand through 2030; however, the allocation of space should be revised. The forecast shows a strong growth in itinerant traffic, and Section 4.6 Aircraft Aprons and Tie-Downs revealed that double the existing itinerant tie down spaces will be needed by 2030. At present, roughly 33,000 square yards of apron is reserved for itinerant aircraft, but 65,000 square yards will be required by 2030 to allow for 181 itinerant aircraft. Itinerant aircraft parking area should be increased by adding additional stripping and grommets, as needed to meet the forecast demand. Considering the BLM leased area on the apron's east edge, additional tie down markings and hardware should be added to the west of the existing itinerant apron.

5.4.3 General Aviation Terminal Building

The existing terminal facility at RTS is only 1,700 square feet (not including airport administration offices) and considered significantly undersized when considering peak hour passenger levels over the planning period. Analysis from Section 4.9 Terminal Building and FBO identified that an appropriate size for the RTS terminal building would be roughly 10,000 square feet. The existing terminal building cannot be expanded but is in a good location. Therefore, the current terminal facility should be replaced with a larger one in the same general area. In addition, Table 4-18 of this report identified approximately 104 parking spaces will be required by 2030. Development of a general aviation terminal building should include a parking area of approximately this size.

5.4.4 Air Traffic Control Tower

Section 4.14 Air Traffic Control Tower (ATCT) highlighted the eligibility of RTS to enter into the federal contract tower program. This section of the development chapter is intended to offer preliminary guidance for the most appropriate location and height of a new ATCT including examining the adequacy of the existing tower's location and height. The analysis is based on FAA guidelines and recognizes existing and planned development at the airport. The ATCT height and site selection considers the guidance set forth in FAA Order 6480.4A, *Airport Traffic Control Tower Siting Process*.

Based on the detailed ATCT Siting Analysis contained in **Appendix D**, the new ATCT should be located on the southeast side of the airport near the existing large FBO hangars and BLM operations area. The siting analysis analyzed nine different sites for development of a control tower through the use of a line-of-sight analysis. Furthermore, sites were scored based on 17 factors including: visibility of airborne and ground traffic, northern views to the primary movement areas, site area, and cost. The top scoring three sites (represented by site G, site C, and site F in Appendix E) were all located in this area of the airport as it provides the best-unobstructed vantage point for air traffic controllers at the lowest possible height. A more detailed siting study, in collaboration with the FAA, will need to be completed to identify the ultimate preferred location and height of this new facility.

5.4.5 Aviation Needs Summary

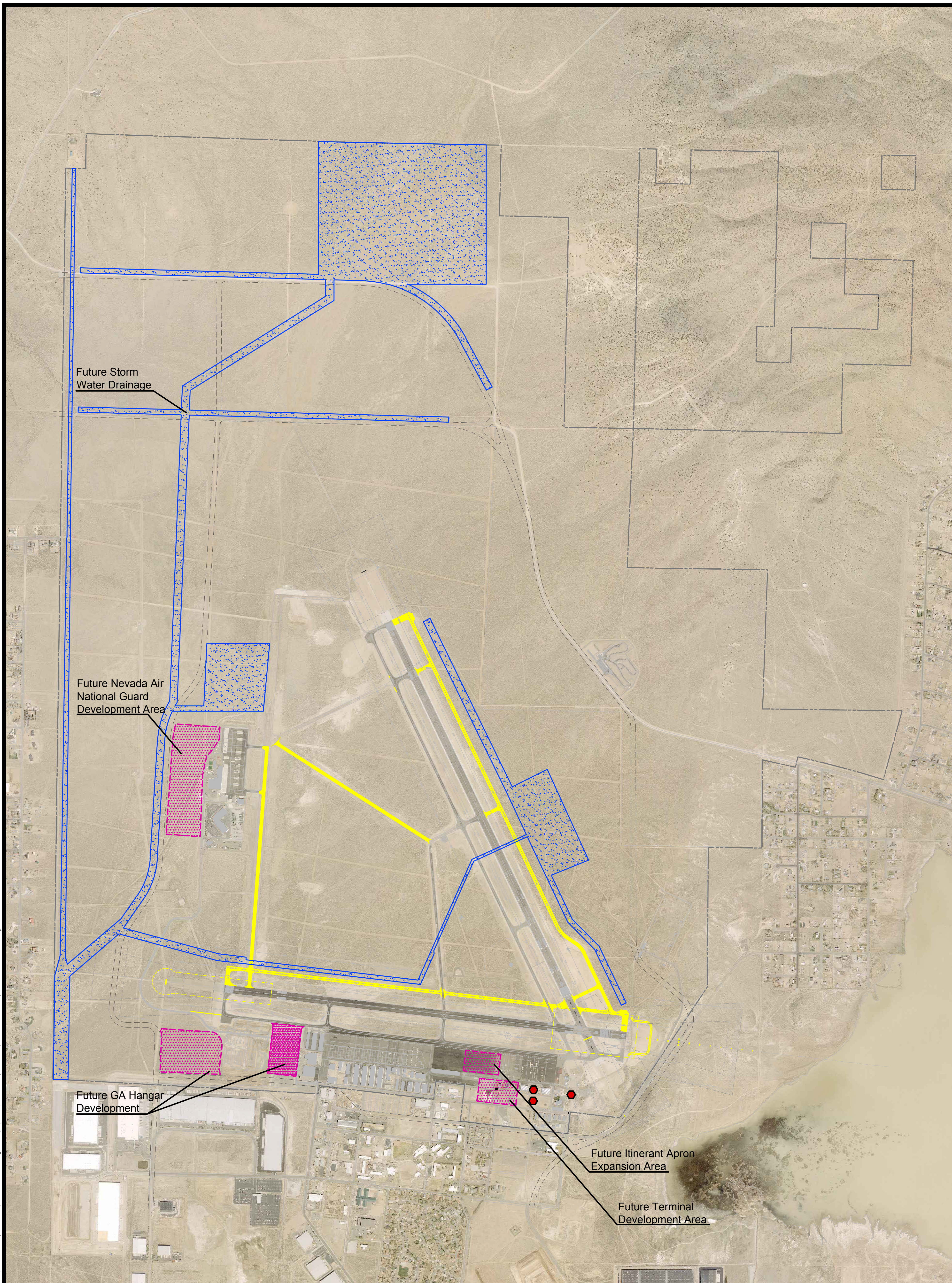
Based on the airside and landside elements discussed previously, a preferred airport development plan was created. The airport development plan provides expansion initiatives that most effectively meet the overall short, medium, and long-range aviation related requirements of RTS, in a manner which preserves a substantial amount of available land on-airport for future non-aviation development, while significantly enhancing operations safety and increasing the airfield efficiency and overall capacity at RTS. **Figure 5-1** illustrates the proposed airfield and landside improvements. It must be noted that although the determination of future military facility requirements were not part of this study, space to allow for future expansion of the NVANG was provided.

5.5 DEVELOPMENT PLAN

Airport land areas for aviation use are well defined by previous and proposed development and are those areas which offer direct access to the airfield area. However, at RTS the majority of airport property is not intended to be used for aviation purposes as most of the airport's land does not currently have or is expected to have airfield access. Maintaining adequate aviation use areas while maximizing non-aviation use areas ensures the airport can capitalize on the entirety of its land that is suitable for development. This section discusses the two genres of airport land use (aviation and non-aviation use) and the methodology for their creation at RTS. This section also discusses the two land use concepts, constrained and unconstrained. The constrained concept depicts the impact of the Reno Air Racing Association (RARA) National Championship Air Races and Air Show course safety areas, while the unconstrained concept provides for development of the airport in the event that RARA National Championship Air Races and Air Show safety areas no longer exist.

5.5.1 Aviation Use Areas

The aviation use areas are predominantly found directly adjacent to the airfield area, as shown on **Figure 5-2**. Specifically, aviation use areas are found north and south of Runway 8-26 and east and west of Runway 14-32, as well as on either side of all interior taxiways. In most cases the aviation use area is offset 1,000 feet from the airfield areas. This setback ensures adequate land is available for not only aviation related development but also for publicly accessible landside components (offices, display areas, parking, landscaping, etc.).



LEGEND

- Airside Improvements
- Landside Improvements
- Stormwater Management
- Preferred Air Traffic Control Tower Areas

0 1,750' 3,500'

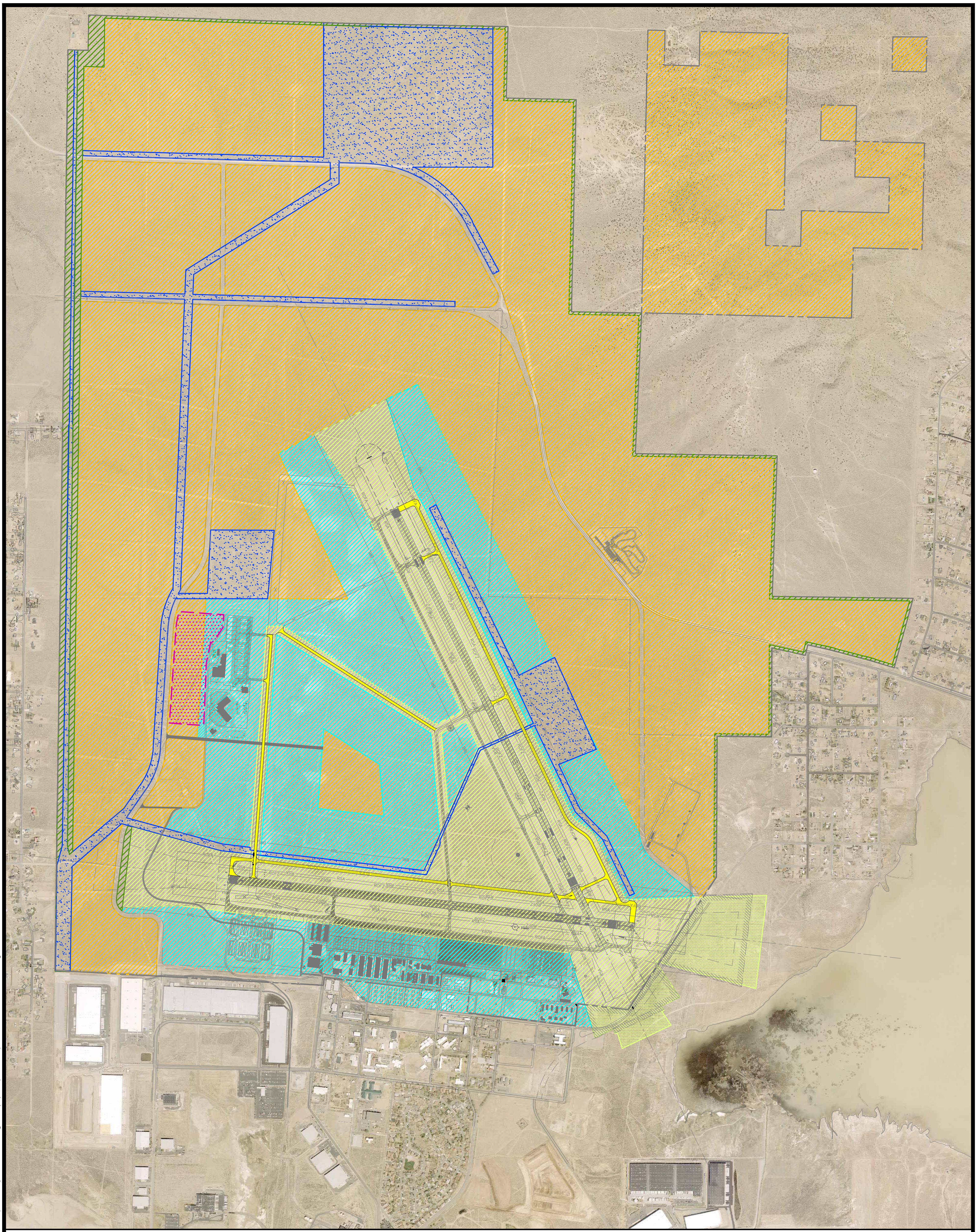
NORTH

PBSJ

Reno-Stead Airport
Reno, Nevada

Airport Development Plan

Figure 5-1



0 1,750' 3,500'

NORTH

LEGEND

- Airfield (662 Acres)
- Airfield Easement (79 Acres)
- Aviation Use (881 Acres)
- Non-Aviation Use (2,982 Acres)
- Airfield Improvements
- Buffer Space (127 Acres)
- Stormwater Management (420 Acres)
- NVANG Expansion Area

PBSJ

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Master Plan Update
Reno-Stead Airport
Reno, Nevada

General Development Plan

Figure 5-2

The aviation use development plan identifies areas labeled generally as aviation use and includes the following types of aviation related development:

- Terminal Building and associated automobile parking
- Itinerant Apron
- Light GA hangars and facilities
- Corporate GA hangars and facilities
- Industrial Aviation
- Cargo Operations
- ATCT

5.5.2 Non-Aviation Areas

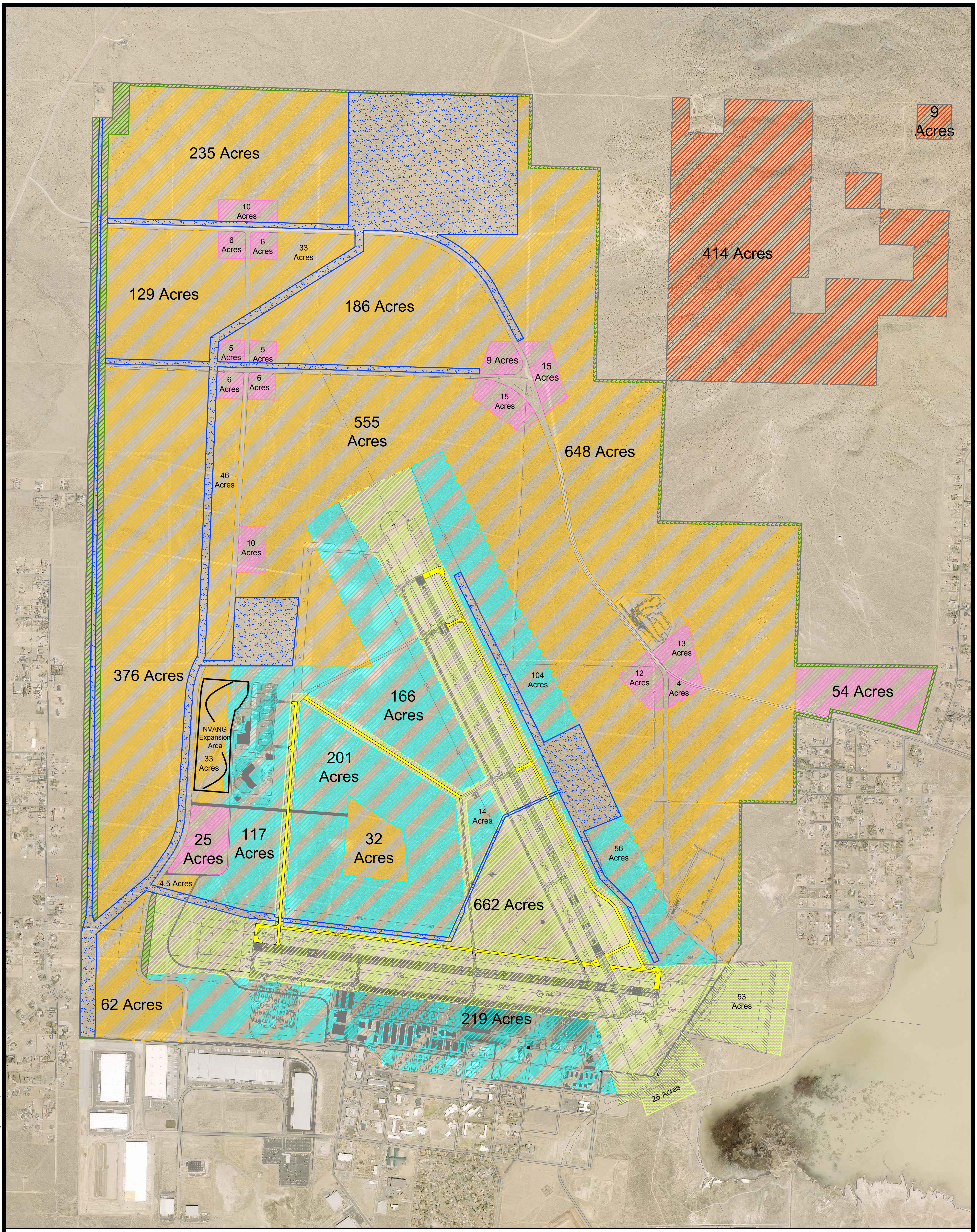
Recognizing the value of real estate within and adjacent to airport property that is not needed for aviation use, RTS has an opportunity to capitalize on its development potential enabling the airport to diversify revenue sources and utilize land to the fullest extent possible. Development of business centers, industrial parks, and commerce areas can be extremely valuable resources in the realization of that goal. Careful planning and organization of these non-aviation revenue generators can be vital to the financial independence of the airport and funding of either landside or airside improvements of the airport. The non-aviation areas are identified on Figure 5-2.

5.5.3 Unconstrained Land Use Concept

The unconstrained land use concept was developed with the understanding that there are no factors limiting the land use potential for any land within the confines of the Reno-Stead Airport property. In addition, this concept assumes all lands are available for development and that those areas could be developed at anytime in the future, including beyond the 20-year planning horizon. A graphical depiction of the unconstrained land use concept for RTS is found on **Figure 5-3**.

5.5.4 Constrained Land Use Concept

The constrained land use concept was developed with an understanding that RTS continues to host the annual National Championship Air Races and Air Show, and that areas underneath the RARA National Championship Air Races and Air Show safety areas are not suitable for development. This land use concept limits the land available for both aviation and non-aviation development, while ensuring adequate clear areas for the National Championship Air Races and Air Show courses. This land use concept provides a good starting point for identifying the location of near-term development at the airport or development which occurs while RTS hosts the National Championship Air Races and Air Show. Considering that the development of RTS property will occur over time, and that not all areas will be developed at once, this land use concept could also be viewed as a Phase I concept which ultimately develops into the unconstrained land use concept. A graphical depiction of the constrained land use concept for RTS is found on **Figure 5-4**.



LEGEND

- Airfield (662 Acres)
- Airfield Easement (79 Acres)
- Aviation Use (881 Acres)
- Industrial/Commercial (2,360 Acres)
- Airfield Improvements
- Buffer Space (127 Acres)
- Retail (199 Acres)
- Rural Residential (423 Acres)
- Stormwater Management (420 Acres)

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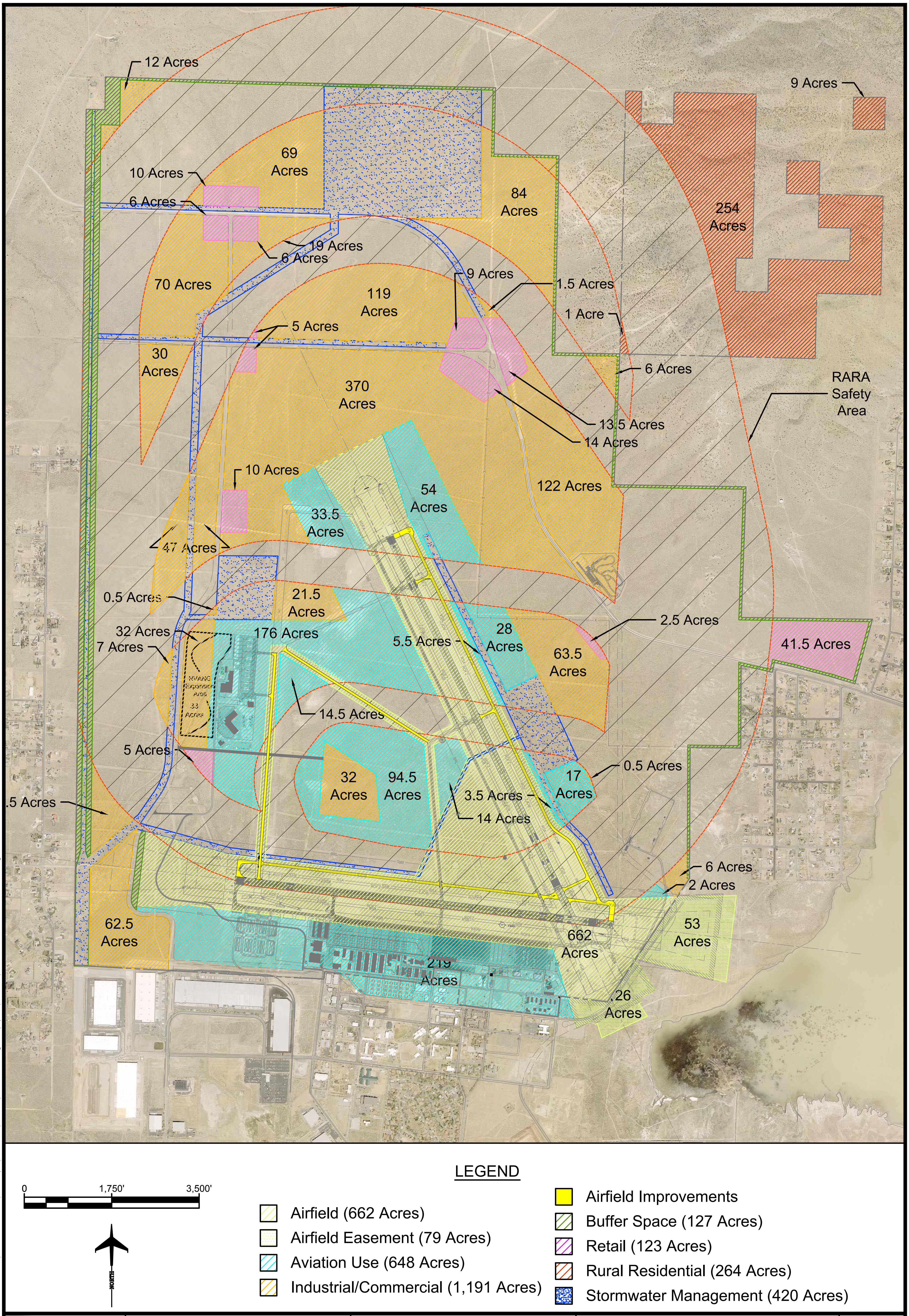
Master Plan Update
Reno-Stead Airport
Reno, Nevada

Conceptual On-Airport Development Plan Unconstrained

Figure 5-3



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Master Plan Update
Reno-Stead Airport
Reno, Nevada

Conceptual On-Airport Development Plan Constrained

Figure 5-4

5.6 SUMMARY

The development plan represents the chosen configuration of the necessary development and facility improvements that will not only meet the forecast demand but also ultimately ensure competitiveness and financial viability for RTS. Additionally, this development plan is intended to provide RTS and surrounding community with the greatest overall benefit considering the development goals of RTAA.

DRAINAGE MASTER PLAN

Reno-Stead Airport

6

6.1 INTRODUCTION & PURPOSE

The Reno–Stead Airport (RTS) is located in northwest Reno, east of U.S. Highway 395 (**Figure 6-1**). The hydrologic watershed impacting the project area is located within Washoe County and City of Reno (**Figure 6-2**).

The purpose of this drainage master plan is to serve as a guide for development of RTS property. This drainage master plan identifies location, alignment, and preliminary size of storm water control facilities on airport property which will protect aviation structures from flooding and mitigate downstream hydrologic impacts of future development of airport property. Storm water runoff control facilities are sized based on future watershed conditions which assume full build-out of the airport property (**Figure 6-3**). RTS is the current home of the National Championship Reno Air Races and Air Show which is an event held annually. The land beneath the race courses (constrained areas) cannot currently be developed due to safety concerns. This drainage master plan has attempted to locate drainage facilities within the constrained areas where possible to avoid using land currently available for development.

6.2 PROCEDURES & CRITERIA

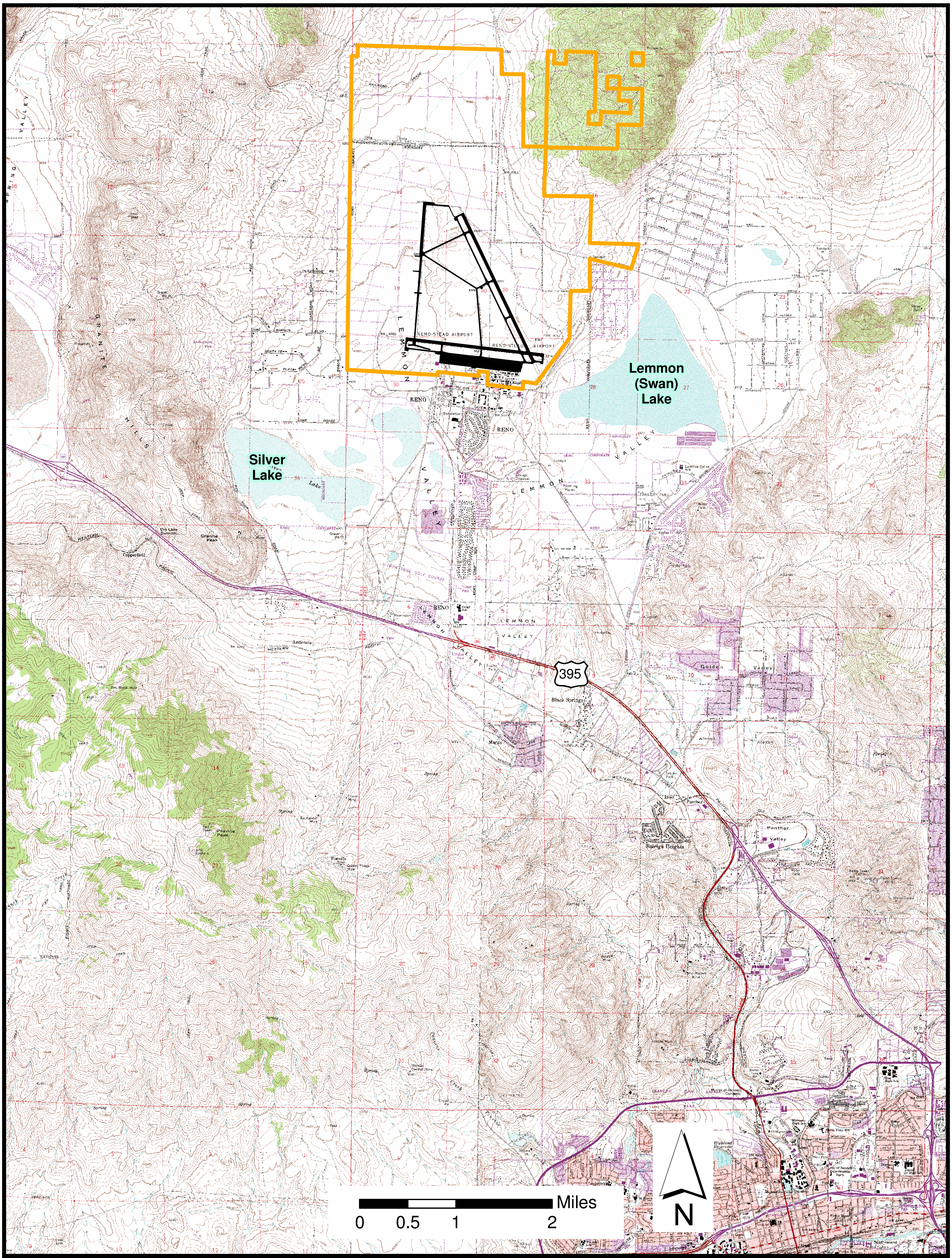
6.2.1 Previous Studies

The following studies identified in **Table 6-1** contain the most recent prior analyses of storm water drainage in the Silver Lake and Swan or Lemmon Lake watersheds which were used in this effort.

Table 6-1. Previous Drainage Reports

Year	Report Title	Description
2007	North Valleys Flood Control Hydrologic Analysis and Mitigation Options Reno, Nevada Volumes I and II	This report summarizes the existing watershed conditions for Silver and Swan Lakes, discusses current Federal Emergency Management Agency (FEMA) flood zones and the impact of future development on current FEMA flood zones, and develops various alternatives to mitigate impacts of future development on Silver and Swan Lake watersheds.
2000	Drainage Master Plan, Stead, Nevada	This study developed 5-year and 100-year, 24-hour Flood Hydrograph Package (HEC-1) models for Silver and Swan Lake watersheds.

The North Valleys Flood Control Hydrologic Analysis (NVFCHA) HEC-1 files were obtained from the City of Reno and used as base models for Silver and Swan Lake watersheds in this analysis.



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Airport Property

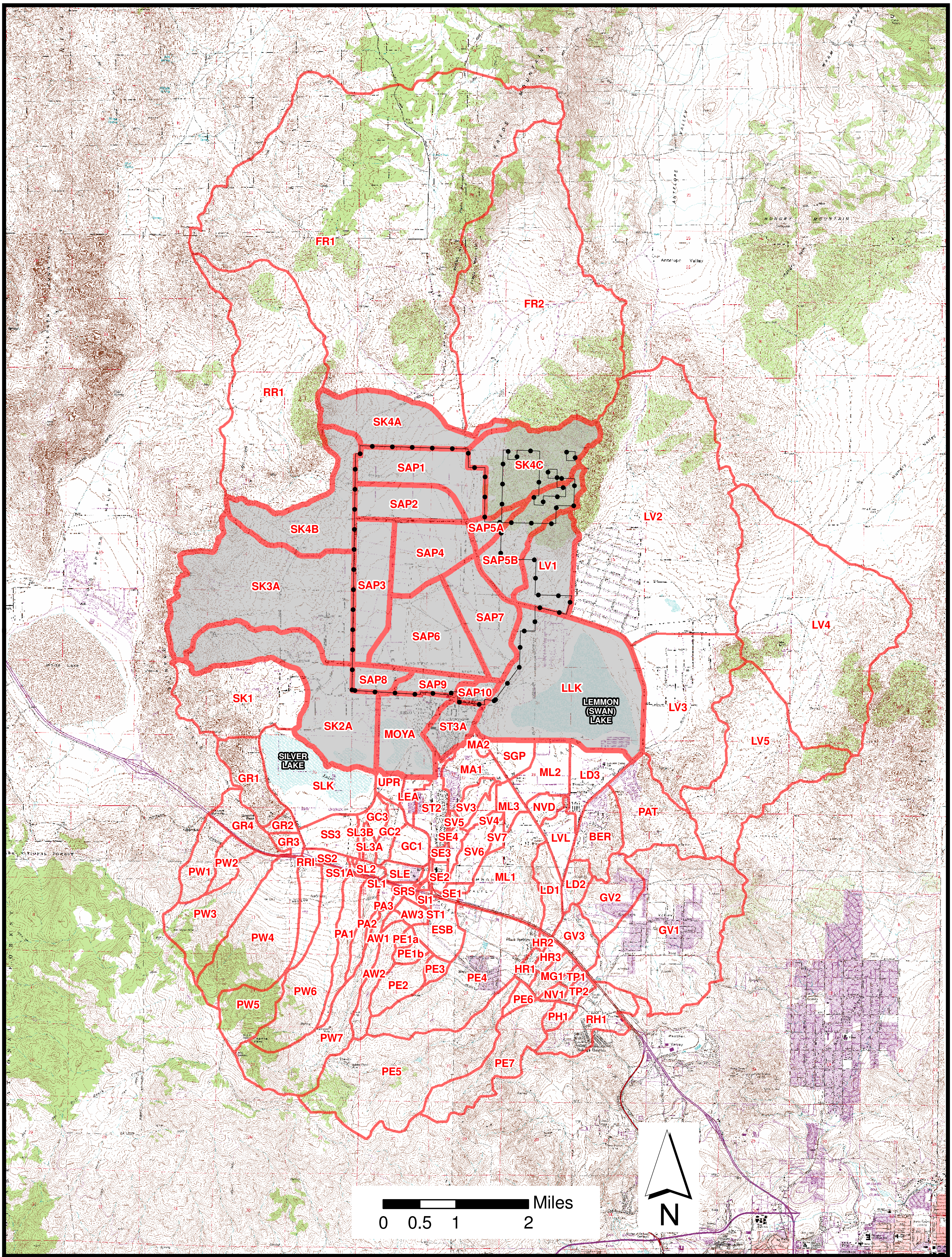
existing

PBSJ

Reno-Stead Airport
Reno, Nevada

Area / Vicinity Map
Map

FIGURE
6-1



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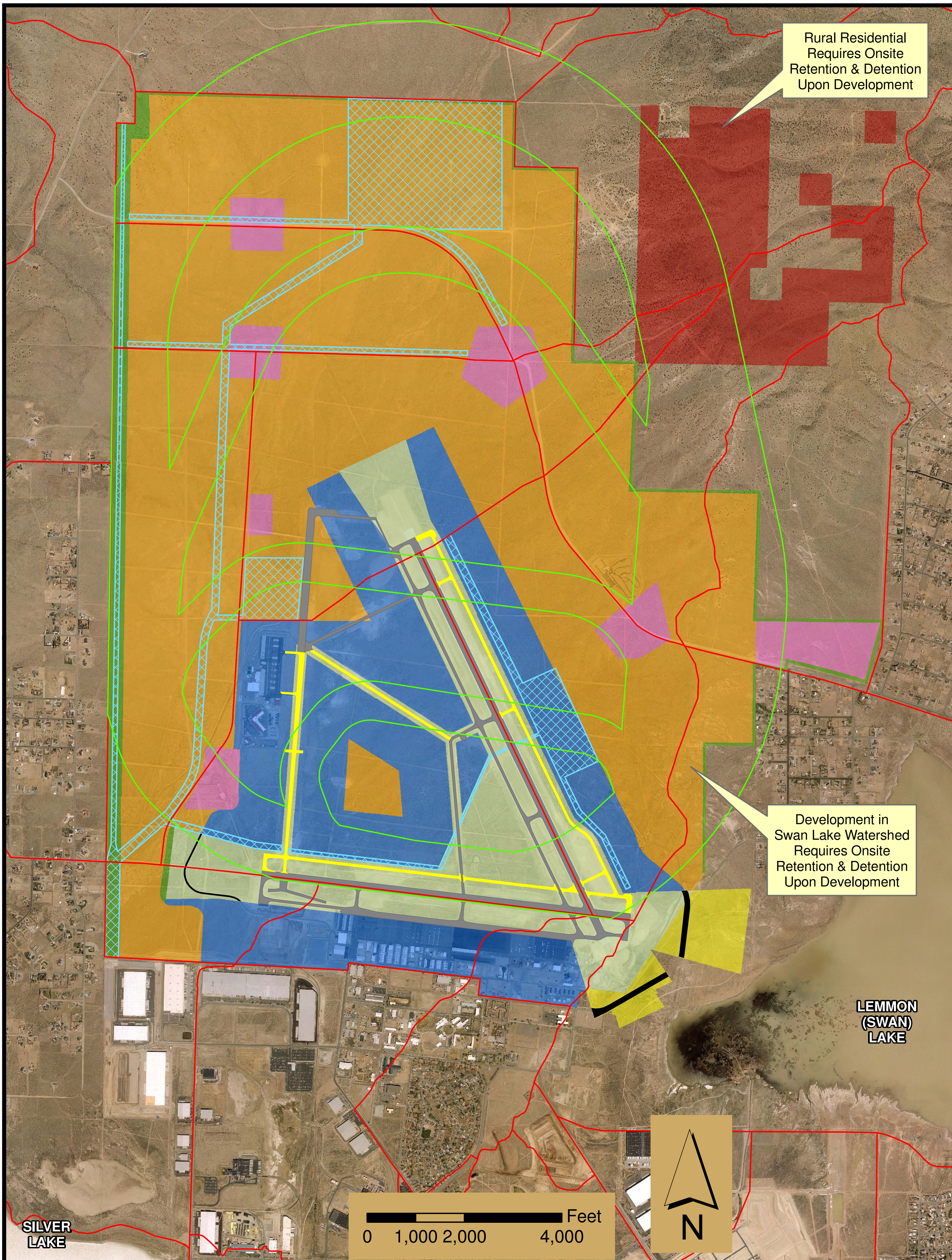
Airport Property

Watershed Boundaries

Prior Study Sub-basin

Revised Sub-basin

PBSJ	Reno - Stead Airport Reno, Nevada	Overall Watershed Map	FIGURE 6-2



Legend

- RARA Constrained Areas
- Watershed Boundaries
- Drainage Improvements
- Existing Pavement
- Proposed Pavement
- Airfield Improvements
- Aviation Use
- Industrial/Commercial
- Retail
- Airfield
- Airfield Easement
- Buffer Space
- Rural Residential

PBSJ	Reno - Stead Airport Reno, Nevada	Proposed Condition Land Use Map	FIGURE 6-3

6.2.2 Compliance with the Truckee Meadows Regional Drainage Manual

Since RTS is located within a closed hydrographic basin, control of storm water runoff as a result of future development is a critically important issue due to the potential adverse impacts created downstream. Development at RTS must comply with Washoe County, City of Reno and Section 709.2 of the Truckee Meadow Regional Drainage Manual (TMRDM) which states that:

> *Runoff from within the Silver Lake and Swan Lake (aka Lemmon Lake) hydrographic basins will ultimately discharge to the Silver Lake Playa or the Swan Lake Playa, respectively. A detailed hydrologic analysis and resultant water surface elevation (in the playa) produced by the 1% chance precipitation event was the subject of a detailed study performed by Quad Knopf (Refer to: North Valleys Flood Control Hydrologic Analysis and Mitigation Options, Volumes I and II; Quad Knopf, March 30, 2007, prepared for the Washoe County Regional Water Planning Commission and the City of Reno). This study shows that any increases in runoff volume due to development (or loss of flood plain storage due to development) will impact the FEMA regulated water surface elevation in the playas. Future development shall account for the increased volume of runoff generated (within the basin), as well as for flood plain storage volumes within the 100-year flood plain. Development within these basins shall require a hydrology report identifying required mitigation, if any, to maintain the water surface elevations within the playas for the 1% chance event (no net increase allowed). Volumetric analysis is to be based on the 100-year, 10-day storm event, while routing of peak flows shall be based on the 100-year, 24-hour storm event. See Reno Municipal Code 18.12.1703(g) and Washoe County Development Code Article 416 for restrictions on closed basins. Due to zoning overlays which regulate the proximity of structures and land uses adjacent to the White Lake Playa (Cold Springs Area)…*

The hydrologic analysis completed for and the preferred solution identified for this master plan shows that the future watershed condition 100-year, 24-hour peak flows downstream of the airport property will not exceed the existing watershed condition flow rates. Future on-site flows increase due to additional impervious surface created by development, and these flows are reduced to existing flow rates by the recommended solution. The preferred drainage alternative and two discarded alternatives are discussed in Section 6.3.

6.2.3 Hydrologic Procedures

Sub-basins used in the NVFCHA study were imported into a Geographic Information System (GIS) for the RTS Master Plan Update (Master Plan) development plan and sub-divided to create hydrologic (HEC-1) concentration points within the airport property and to develop multiple basins of similar hydrologic characteristics. Sub-basins were divided based on a combination of topographical information and planned roadway locations.

Two storm durations were used for the drainage master plan to satisfy the requirements of the TMRDM: a 100-year, 24-hour event to determine peak flows and a 100-year, 10-day event to determine runoff volume. The 100-year design storm is a storm event that has a one percent chance of occurring in any given year. HEC-1 Version 4.1 (dated June 1998) was used for the hydrologic modeling. The existing watershed condition 100-year, 24-hour model (Ex-24hr.Dat) developed for the drainage master plan was based on existing condition land use and vegetation cover as outlined in the NVFCHA. The watershed in the NVFCHA model (SLV-SWN_NEWCOV_100_10_2005.DAT) was subdivided to add sub-basins SAP1 through SAP10 (**Figure 6-4**) on the airport property. Sub-basin routing lengths were recomputed. The remaining hydrologic parameters were unchanged from the NVFCHA. The proposed watershed condition 100-year, 24-hour HEC-1 model (Prop-24hr.Dat) was developed by changing the land uses and routing parameters of the existing condition model to reflect planned land uses and drainage patterns for the fully developed or unconstrained condition. **Figure 6-5** shows the proposed condition HEC-1 sub-basins and routing reaches. All HEC-1 models are included in **Appendices E-1 and E-2**.

6.2.3.1 Precipitation

National Oceanic and Atmospheric Administration (NOAA) 14 values were used in the NVFCHA study and input into the HEC-1 model to develop the 100-year, 24-hour design storm. These same inputs were used for this master plan. Point precipitation values are adjusted by applying Depth Area Reduction Factors (DARF). The DARF decreases the point rainfall values to represent an average depth of rainfall over the entire storm area, the larger the storm area the lower the average rainfall. Each DARF ratio is for a specific storm size or tributary area. Hydrologic models were run with several DARF ratios. DARF values used in the previous NVFCHA study were used for the 100-Year, 24-Hour HEC-1 models in this drainage master plan. These values were interpolated from Figure 605 of the TMRDM.

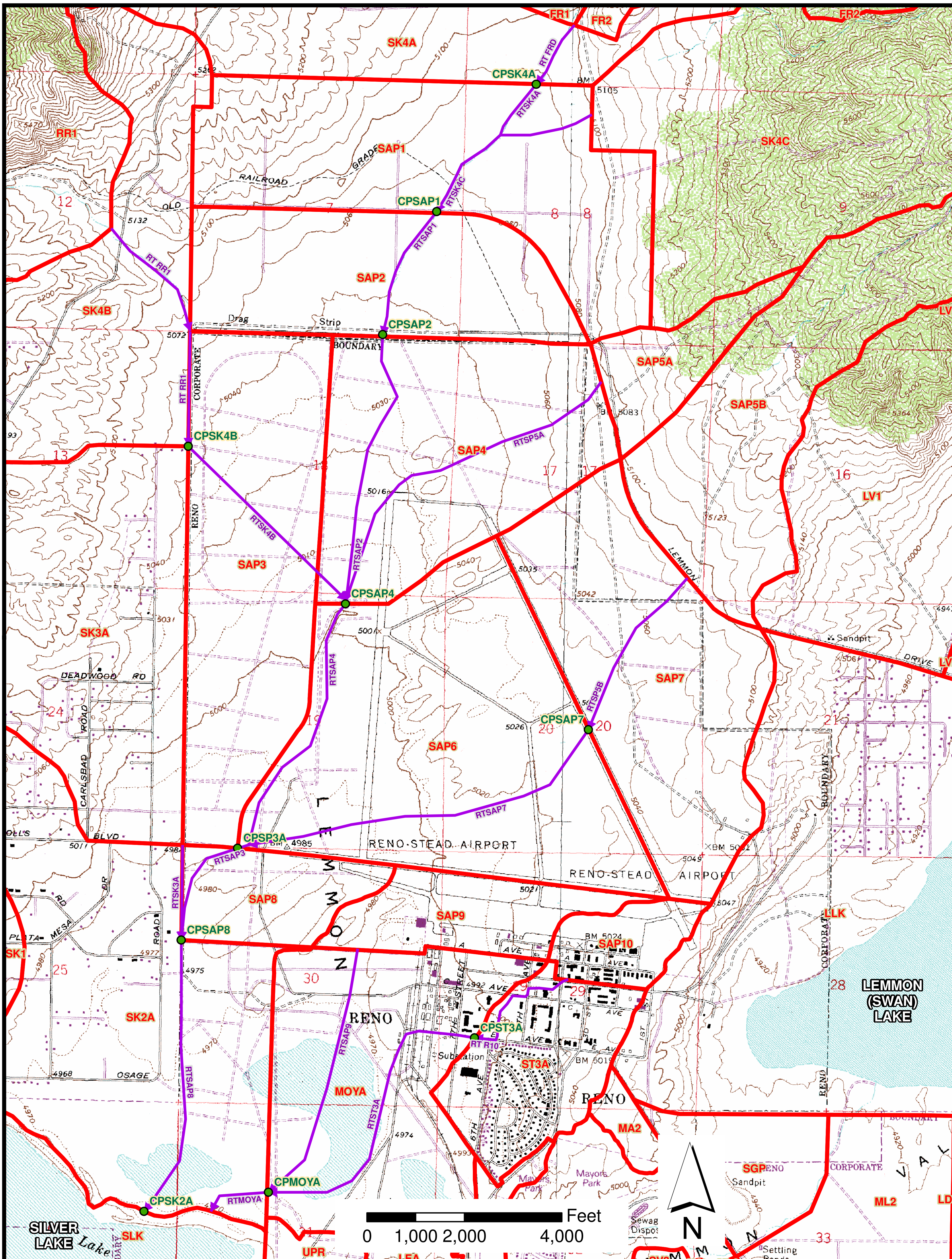
6.2.3.2 Curve Number

Soil classification information was derived from the United States Department of Agriculture/Natural Resources Conservation Service (USDA/NRCS) web soil survey and the Soil Survey of Washoe County, South Part. Hydrologic Soil Groups were determined from the web survey for use in the curve number (CN) calculations and are illustrated in **Figure 6-6**. The web soil survey information used in the analysis is located in Appendix E-1. Additionally, vegetation coverage (noted in the NVFCHA study), the proposed development plan (shown in Figure 6-3) and Table 702 of the TMRDM were all used to determine CNs. **Table 6-2** provides a summary of the proposed CNs used for the proposed condition modeling.

Table 6-2. 100-Year, 24-Hour Land Use Summary

Land Use	Curve Numbers				Additional % Impervious
	A	B	C	D	
Aviation Use	89	92	94	95	5
Industrial/Commercial	81	88	91	93	0
Retail	89	92	94	95	0
Airfield	35	49	61	68	Varies
Buffer Space	Based on Ex. Cond. Zones				0

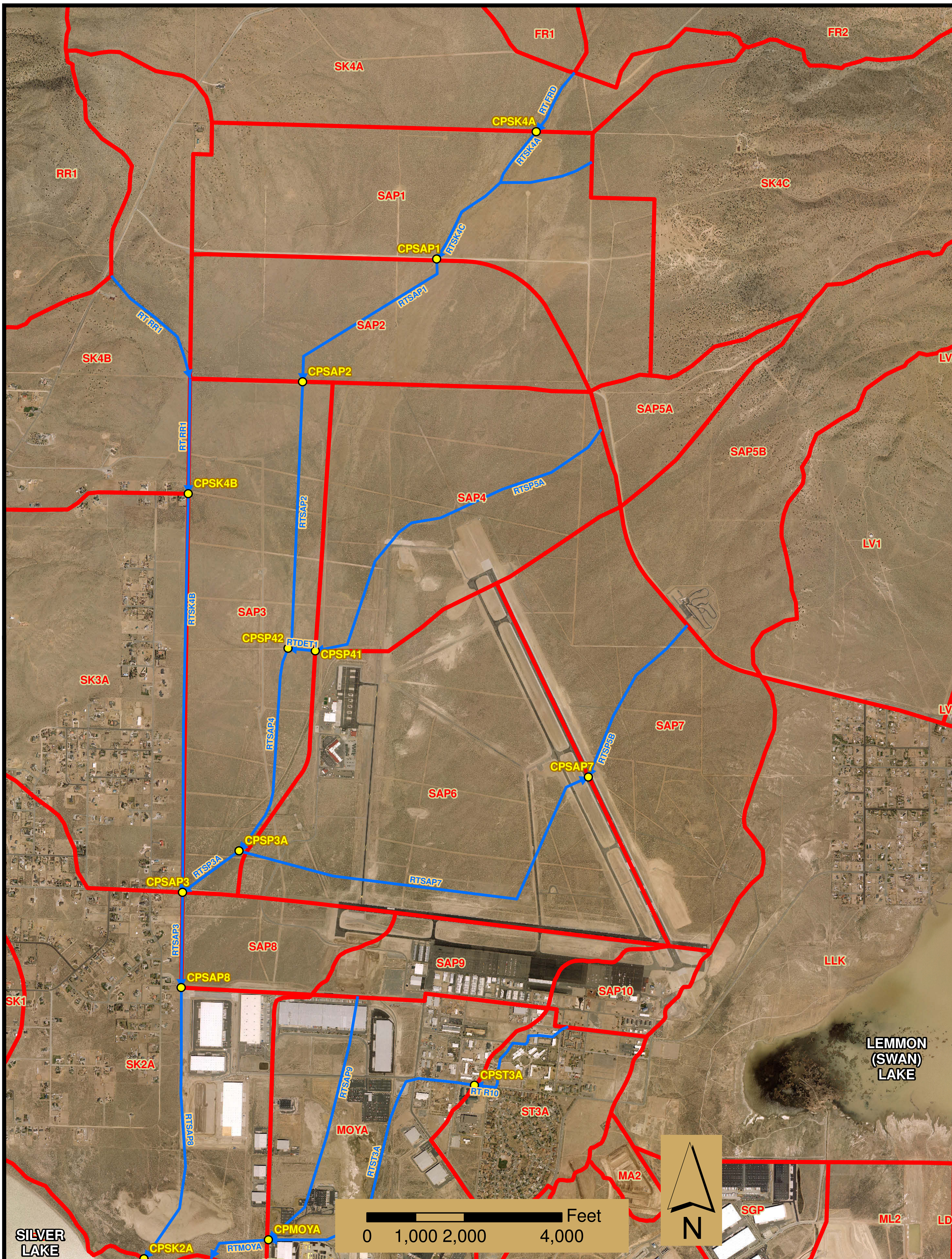
Sub-basins outside the airport property were modeled as they were in the NVFCHA study, however, the CNs were adjusted back from the 10-day runoff event back to 24-hour CNs, using Table 2-3 from TR-60, Earth Dams and Reservoirs.



Legend

- HEC-1 Concentration Pt.
- Routing Reach
- Watershed Boundaries

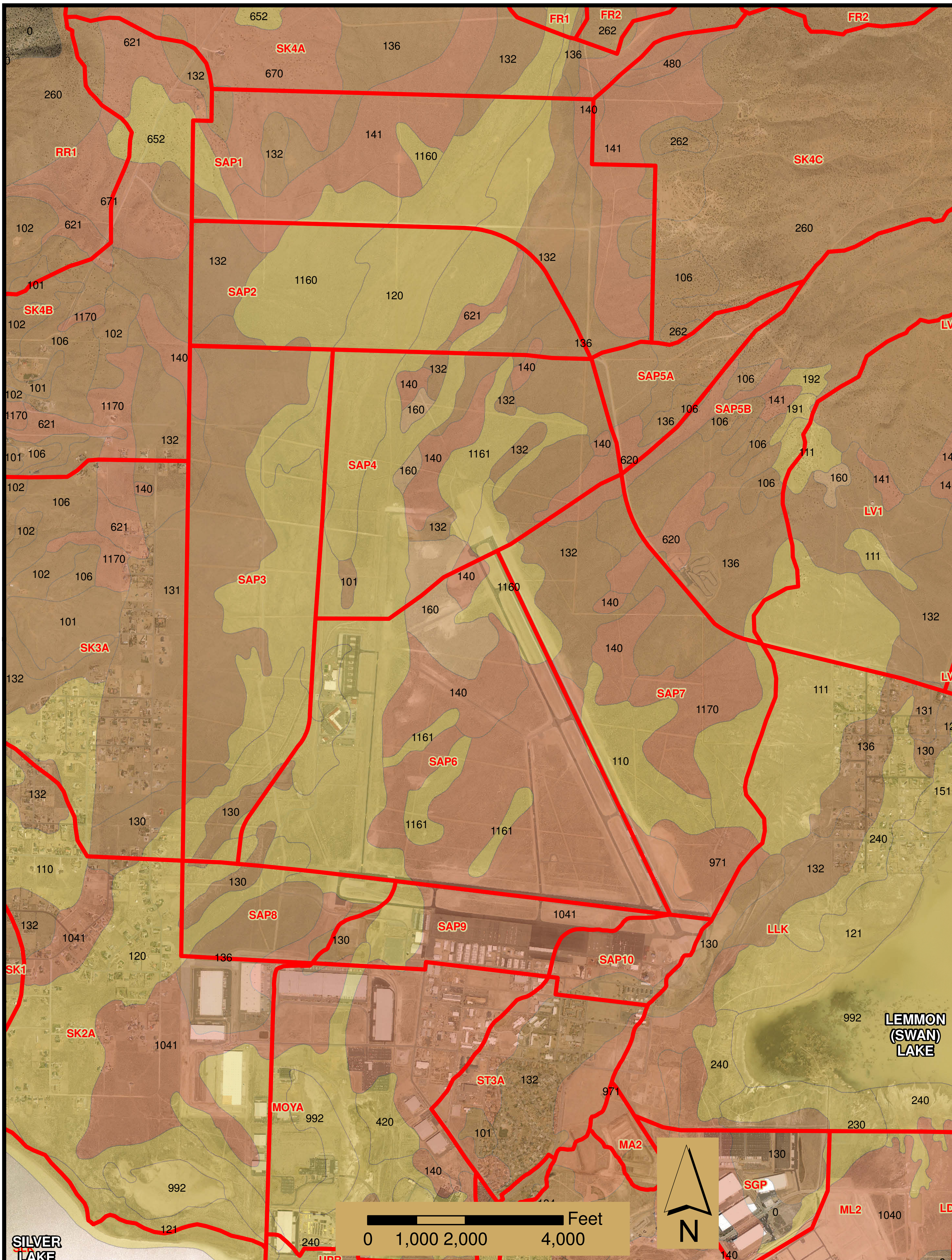
PBSJ	Reno - Stead Airport Reno, Nevada	Existing Condition Watershed Map	FIGURE 6-4



Legend

HEC-1 Concentration Pt.
Routing Reach
Watershed Boundaries

PBSJ	Reno - Stead Airport Reno, Nevada	Proposed Condition Watershed Map	FIGURE 6-5



Legend

Watershed Boundaries **Hydrologic Soil Group** B D

A C

PBSJ	Reno - Stead Airport Reno, Nevada	Soils Map	FIGURE 6-6

6.2.3.3 Lag Time

Lag times (TLAG) were determined for each sub-basin within the airport property based on equations 709 and 710 of Section 705.3 of the TMRDM. Existing watershed condition lag times were based on undeveloped CN values and velocities. Lag times for the developed watershed condition were based on full build-out CN values and velocities from impervious surfaces. Lag times for sub-basins smaller than 1 square mile and with slopes less than 10 percent were calculated based on $TLAG = 0.6T_c/60$. Lag times for sub-basins larger than 1 square mile or with slopes greater than 10 percent were calculated based on the United States Bureau of Reclamation equation, $TLAG = 22.1Kn(L\ L_c/S^{0.5})^{0.33}$. Lag times for sub-basins LV1 and LLK were used from the NVFCHA. Lag time calculations are included on the Standard Form 2 in Appendix E-1.

6.2.4 Hydraulic Procedures

Culvert capacities were estimated using the U.S. Department of Transportation, Federal Highway Administration Hydraulic Design Series Number 5 (Hydraulic Design of Highway Culverts) Charts 1B and 8B. These inlet control charts estimate culvert capacity based on available headwater and assume inlet control for the 100-year, 24-hour flow. Proposed channels were sized using Bentley's FlowMaster software which uses Manning's equation to estimate a normal depth for the 100-year, 24-hour flow.

6.3 HYDROLOGIC ANALYSIS

The RTS property drains to two closed basins, Silver Lake and Swan Lake. As described in Section 6.2.2, the TMRDM requires the hydrologic master plan for the airport property to analyze the 100-year, 24-hour storm event and the 100-year, 10-day storm event to ensure no adverse impact to the surrounding areas. Section 709.2 of the TMRDM cites the NVFCHA as the source for current water surface elevation produced by the one percent chance precipitation event and shows that any increases in runoff volume from development within the watershed will likely impact the FEMA regulated water surface elevations in the Silver Lake and Swan Lake playa areas (Appendix E-2). The RTS property does not extend into the FEMA 100-year flood plains, however any increase in 100-year runoff (peak and volume) from future development planned within the airport property could affect the FEMA 100-year flood plain level. This drainage master plan incorporates planned future land uses to determine the potential impacts from future development and has identified several major drainage improvements that are needed to mitigate the increased 100-year, 10-day storm runoff volumes, and the increased 100-year, 24-hour storm peak flows. The following hydrologic analysis is intended to show that the proposed drainage improvements will fully mitigate the hydrologic impacts of future development of airport property (Figure 6-3) and the 100-year water surface elevations of Silver Lake and Swan Lake playas will not be increased. **Table 6-3** summarizes the main hydrologic models referenced and created for this drainage master plan.

Three alternatives were initially developed to a preliminary stage to determine the benefits and constraints of each (see **Table 6-4**). Based on the drainage alternatives workshop held with Reno Tahoe Airport Authority (RTAA) staff on April 4, 2009, Alternative 1 was determined to have substantial benefits versus constraints as compared to the other alternatives. **Appendix E-3** includes the workshop memorandum which provides a full description of the benefits and constraints of the discarded alternatives.

Alternative 1 utilizes one large (± 200 acres) retention area at the north end of the airport property to reduce 100-year, 10-day runoff volumes, and two smaller (± 40 acres each) detention facilities closer to the runways to reduce 100-year, 24-hour peak runoff rates. All three of these basins will be below finished grade so as not to require a dam safety permit. This alternative will be referred to as the proposed condition for the purpose of the master plan.

Table 6-3. Summary of HEC-1 Models

Author	HEC-1 Model	Description / Use
NVFCHA	SLV-SWN_NEWCOV_100_10_2005.DAT	Base model used for 100-year, 24-hour drainage master plan models.
PBS&J	Ex-24hr.DAT	Drainage master plan existing watershed condition model based on NVFCHA model with CNs converted to 24-hour CNs, rainfall reduced to 24-hours, 5 minute computation intervals, and sub-divided RTS sub-basins. Used to establish existing watershed condition for 100-year, 24-hour analysis.
PBS&J	Prop-24hr.DAT	Drainage master plan developed watershed condition model based on Ex-24hr.DAT with developed condition lag times, CNs, and routing reaches. Used to demonstrate retention and detention basin abilities to reduce 100-year, 24-hour peak flow increases from development of airport property.
NVFCHA	SLV_LUMP_NEWCOV_25_2005.DAT	Base model used for 100-year, 10-day drainage master plan models.
NVFCHA	SWN_LUMP_NEWCOV_25_2005.DAT	Base model used for 100-year, 10-day drainage master plan models.
PBS&J	Slv-lump-uc.DAT	Master plan developed watershed condition model based on NVFCHA model with updated percent imperviousness based on proposed land uses. Used to determine runoff volume increase to Silver Lake from future airport development.
PBS&J	Swn-lump-uc.DAT	Drainage master plan developed watershed condition model based on NVFCHA model with updated percent imperviousness based on proposed land uses. Used to determine runoff volume increase to Swan Lake from future airport development.
PBS&J	RETEN.DAT	Drainage master plan developed watershed condition model for retention basin located at the northern property boundary of the RTS. Used to demonstrate the proposed retention basin's infiltration potential.

Table 6-4. Alternatives Matrix

	Alternative 1	Alternative 2	Alternative 3
Army Guard operations – less likely to impact			X
Drainage improvement land possibly shared with Washoe Co.	X		
Drainage improvements located largely in constrained areas	X	X	
Impact to neighbors – less likely need for vector control	X		
Infiltration tests – less likely to impact lake levels	X		
Land development – less drainage burden on smaller parcels	X	X	
Land development – less impact to prime areas	X		X
Likely to avoid need for larger, impervious basins	X		
Maintenance – Ease of access	X	X	
Operational safety – potentially reduced bird strike risk	X		X
Probability of successful property drainage	X	X	
Temporary drainage – less likely to need substantial features	X		
Western Property 300 foot buffer - best utilization		X	
	Preferred Alternative	**Discarded**	**Discarded**

6.3.1 100-Year, 24-Hour Analysis

Existing drainage patterns within RTS generally drain from the northeast to the southwest (Figure 6-4). The undeveloped portion of the property is generally covered with a mix of sagebrush with grass understory. The vast majority of the property drains to Silver Lake. Only a small portion of the airport property located within sub-basins LV1 and LLK drain to Swan Lake. The proposed improvements perpetuate existing drainage patterns as can be seen in Figure 6-5. It was also assumed in the HEC-1 analysis that proposed development would not change the sub-basin boundaries between Silver and Swan Lakes.

NVFCHA HEC-1 model SLV-SWN_NEWCOV_100_10_2005.DAT was used as the base model for the 100-year, 24-hour modeling. This model was modified in the following ways for the master plan 100-year, 24-hour analysis:

- Sub-basins SK2 through SK4, MOY, and ST3 were subdivided into sub-basins SK4A through SK4C, SAP1 through SAP10, SK2A, and SK3A.
- Percent impervious coverage was increased for sub-basins LLK and LV1 to simulate future development.
- 10-day CN values were converted to 1-day CN values and reflected on the HEC-1 LS cards.
- The rainfall duration was reduced to 24 hours on the HEC-1 PH cards.

- The computation interval was reduced to 5 minutes to increase the accuracy of the calculated output.

Table 6-5 shows the results of the 100-year, 24-hour HEC-1 modeling. CPSK2A is used as the combination point at Silver Lake, and CP LLK is used for the combination point at Swan Lake. The table shows that the runoff from the proposed development is reduced from 3,532 cubic feet per second (cfs) to 3,530 cfs (reduction of two cfs) to Silver Lake. This reduction in runoff peak is due to the retention basin and two detention basins that have been included as a part of the master plan to the Silver Lake watershed. The Rural Residential parcel at the northeast corner of the property was not included in the regional analysis for Silver Lake. Prior to development, this parcel will have to incorporate onsite detention and retention to ensure no adverse impacts downstream. Runoff to Swan Lake is increased from 6,665 cfs to 6,862 cfs (increase of 197 cfs). No regional retention or detention options were analyzed for the Swan Lake watershed due to the limited amount of airport property within the watershed and the proximity to the lake. Prior to development of the parcels within sub-basins LV1 and LLK, the site design will have to incorporate onsite detention to prove that the 100-year, 24-hour peak flow is not increased to neighboring parcels and the 100-year, 10-day runoff volume is not increased as described in Section 6.3.2.

The proposed retention basin at the north end of the airport property will not only serve to reduce the 100-year, 10-day runoff volume as described in Section 6.3.2, it will also work in conjunction with the two detention basins to reduce peak flows during the 100-year, 24-hour event. Modeling of the retention basin for the 100-year, 24-hour event does not account for infiltration due to the shorter storm duration, however infiltration will occur during the event and further reduce downstream peak flows. Detention basin DETEN1 is located within sub-basin SAP4 and achieves a peak storage of 136 acre-feet. DETEN2 is located within sub-basin SAP7 and achieves a peak storage of 170 acre-feet. DETEN1 is conceptually modeled with a 36-inch reinforced concrete pipe (RCP) outlet fitted with a 5.5 square foot restrictor plate. This will allow the basin to fill within one foot of the spillway elevation, and drain 90 percent of its storage capacity within 48 hours after the event. DETEN2 is conceptually modeled with a 7-foot by 3-foot reinforced concrete box culvert (RCBC) outlet fitted with an 8.5 square foot restrictor plate. This will also allow the basin to maintain 1 foot of freeboard and drain 90 percent of its storage capacity within approximately 33 hours after the event.

These basins have been located as far from active runways as possible to reduce the threat of bird strikes. Draining the basins in a relatively short period will also reduce the bird strike threat as well as minimize any vector control issues. Attempts were made to relocate DETEN1 further from the Nevada Army National Guard, however moving the basin west of the Moya Road extension reduced its benefit due to the topography and the large amount of flow contributing from the northern sub-basins. There was concern that water within DETEN2 would cause reflection issues and interfere with the Instrument Landing System (ILS), however that risk should be minimized due to the depth of the basin below grade and the relatively short drain time. The assumption was made that both of the detention basins will be classified as regional detention basins under the guidelines of Section 1302.1 of the TMRDM. At the time of final design, sediment storage within or upstream of each basin should be provided for as described in Section 6.5.

Table 6-5. 100-Year, 24-Hour HEC-1 Summary

HEC-1 Node	Existing Q (cfs)	HEC-1 Node	Proposed Q (cfs)
CPSAP1	2,348	CPSAP1	2,352
CPSAP2	2,386	CPSAP2	1,129
CPSAP4	2,895	CPSP42	1,187
CPSP3A	3,127	CPSP3A	2,350
CPSAP8	3,325	CPSAP8	2,785
SAP9	108	SAP9	195
SAP10	94	SAP10	146
CPSK2A	3,532	CPSK2A	3,530
LV1	304	LV1	442
LLK	3,177	LLK	3,249
CP LLK	6,665	CP LLK	6,862

See Appendix E-1 for complete HEC-1 summary output.

6.3.2 100-Year, 10-Day Analysis

NVFCHA HEC-1 models SLV_LUMP_NEWCOV_25_2005.DAT and SWN_LUMP _NEWCOV_25_2005.DAT were used as representative of the existing condition 100-year, 10-day runoff volumes for Silver and Swan Lake respectively. These models were then modified to incorporate increased impervious surface area that would result from the development of the airport property. **Table 6-6** shows that by developing the airport property, approximately 2,356 acre-feet of added runoff volume would impact Silver Lake and 74 acre-feet of added runoff volume would impact Swan Lake. This added volume would raise the Silver Lake water surface elevation from 4971.74 to 4973.54 and the Swan Lake water surface elevation from 4922.94 to 4922.99. Therefore, to avoid impacting the 100-year water surface elevations of the lakes, an onsite retention basin was incorporated into the drainage master plan at the north end of the airport property to mitigate for this increased runoff volume.

Table 6-6. 100-Year, 10-Day HEC-1 Summary

HEC-1 Node	Existing Runoff Vol. (ac ft)	Proposed Runoff Vol. (ac ft)	Volume Increase (ac ft)
SILVER	7,210	9,566	2,356
SWAN	6,956	7,030	74

See Appendix E-2 for HEC-1 summary output.

The conceptual retention basin modeled for this drainage master plan is located at the northern property boundary of the airport and primarily receives flow from sub-basins FR1 and FR2. Results from retention basin model (RETEN.DAT, Appendix E-2) show that 2,390 acre-feet can be infiltrated in the retention basin, mitigating for the 2,356 acre-feet of increased runoff volume (not including the Rural Residential parcel) in the Silver

Lake watershed. The RETEN.DAT model has incorporated four pump cards to represent the amount of infiltration that is likely to take place during the 10-day event. These long term infiltration rates were determined from a series of pilot infiltration tests. This is the same calibrated methodology that was used in the NVFCHA study. The pumping rates (WP cards in HEC-1 model) were based on long term infiltration rates of 0.6 to 2.3 inch/hour (identified in the NVFCHA study for this location) at depths of 4 feet or less. Ponding depths within the retention basin are designed for a maximum of 7 feet (with one foot of freeboard) which with the increased head will likely infiltrate more than what was estimated in the HEC-1 model. In addition to the infiltration at the retention basin, it is anticipated that the detention basins will also infiltrate stormwater runoff, however this volume was not included in the analysis. Consequently, the resulting calculations are slightly conservative.

In the Swan Lake watershed, individual retention and detention sites will need to be completed with the development of each airport parcel. The small amount of airport property that is located within the Swan Lake watershed is very close to Swan Lake itself. This master plan assumes that any parcel within the Swan Lake watershed (sub-basins LV1 or LLK) will require detailed analysis at the time of design to ensure no adverse impact to the Swan Lake 100-year water surface elevation. This master plan has estimated that approximately 74 acre-feet of retention will be required on these parcels to mitigate this increase in runoff volume.

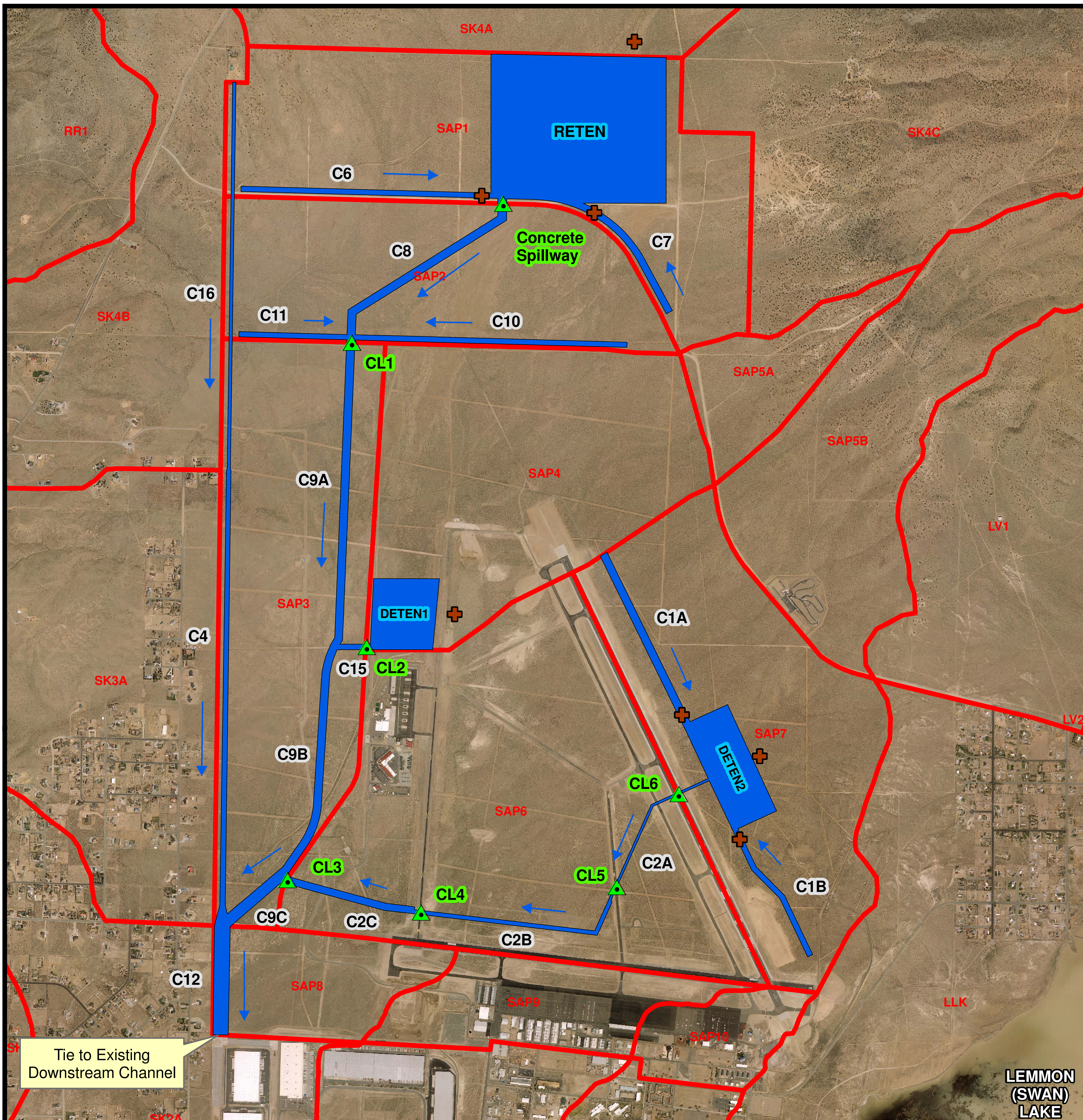
6.4 HYDRAULIC ANALYSIS

Preliminary channel and culvert sizing was based on the 100-year, 24-hour runoff event. Channels were assumed to be a minimum of 4 feet deep with a normal flow depth of 3 feet or less. This will provide for a minimum of 1-foot of freeboard in all locations. All channels were assumed to be riprap lined due to the erodible soils. Culverts were sized based on inlet control charts. RCBCs were assumed to be needed in most locations. The heights of these RCBCs were assumed to be 3 feet and operate with a headwater/depth of 1.0. This will continue to provide the 1-foot of channel freeboard at the culvert headwalls. Standard RCBC sizes were assumed as shown in **Figure 6-7**. Hydraulic backup calculations are included in **Appendix E-4**.

6.5 EROSION CONTROL

Soils within the airport property are subject to erosion even at very low flows and mild velocities. At the time of final design, additional erosion control measures will need to be evaluated and incorporated to provide for the maintainability of all drainage structures and ensure that the structures continue to function as planned. It is recommended to avoid designing unlined channels for this area. The drainage master plan has assumed that all three basins will have riprap on their side slopes and that all channels will be fully riprap lined. Additional alternative linings can be investigated at the time of final design, and the need for cutoff walls or other measures should be investigated. This drainage master plan assumes that all three basins will be classified as regional basins. Section 1302.1 of the TMRDM recommends that each basin is designed for three years of sediment storage. This drainage master plan assumes that at the time of final design, these volumes will be determined and potentially incorporated into the design and discussed with the airport staff and the City of Reno. Potential sediment storage areas are shown on Figure 6-7.

Strong winds in the area tend to accumulate tumble weeds within the drainage structures. Final design should assess the need for trash racks at all culvert crossings



Riprap Trapazoidal Channels

Channel	Bottom Width (ft)	Maximum Flow Depth (ft)	Upstream Depth (ft)	Downstream Depth (ft)	Side Slopes (H:1V)	HEC-1 Node	Flow (cfs)	Cont. Area (sq mi)
C1A	50	3	4	7	3	1/2 of CPSAP7	805	0.92+/-
C1B	40	3	4	7	3	1/2 of CPSAP7	805	0.92+/-
C2A	20	3	4	4	3	RTSAP7	98	1.83
C2B	50	3	4	4	3	CPSAP6	897	3.17
C2C	100	3	4	5	3	CPSAP6	897	3.17
C4	55	3	4	7	3	CPSK3A	1133	8.73
C6	30	3	4	10	3	1/2 of CPSAP1	1176	11.76+/-
C7	60	3	4	10	3	1/2 of CPSAP1	1176	11.76+/-
C8	90	3	10	10	3	RETEN	1089	23.52
C9A	80	3	10	10	3	CPSP42	1187	25.31
C9B	110	3	10	5	3	CPSP3	1526	26.24
C9C	165	3	5	7	3	CPSP3A	2350	29.41
C10	30	3	4	10	3	1/2 of SAP2	462	0.35+/-
C11	15	3	4	10	3	1/2 of SAP2	462	0.35+/-
C12	240	3	7	6	3	CPSAP8	2785	38.38
C15	3	3	7	10	3	DETEN1	60	1.10
C16	35	3	4	4	3	CPSK4B	707	5.57

Culverts

Culvert	Size	HEC-1 Node	Flow (cfs)	Cont. Area (sq mi)
CL1	(11) 7 ft x 3 ft RCB	CPSAP2	1129	24.21
CL2	36 in RCP w/ Restrictor Plate	DETEN1	60	1.10
CL3	(11) 7 ft x 3 ft RCB	CPSAP6	897	3.17
CL4	(11) 7 ft x 3 ft RCB	CPSAP6	897	3.17
CL5	(4) 7 ft x 3 ft RCB	RTSAP7	98	1.83
CL6	(2) 7 ft x 3 ft RCB w/ Restrictor Plate	DETEN2	98	1.83

Retention & Detention Basins

Basin (HEC-1 Node)	Storage Volume (ac-ft)	Bottom Area (ac)	Side Slopes (H:1V)	Depth to Storage (ft)	Depth to Overflow (ft)	Total Basin Depth (ft)	Flow In (cfs)	Flow Out (cfs)	Cont. Area (sq mi)
RETEN	1224	150.1	3	7	8	10	2352	1089	23.52
DETEN1	187	30.2	3	5	6	7	1033	60	1.10
DETEN2	211	34	3	5	6	7	1609	98	1.83

N

0 1,000 2,000 4,000 Feet

Legend

- Potential Sediment Storage Areas
- Proposed Culverts
- Drainage Improvements
- Watershed Boundaries

PBSJ

Reno - Stead Airport
Reno, Nevada

Proposed Drainage Improvements Map

FIGURE 6-7

and evaluate the sensitivity of channel/culvert clogging on the drainage system. Regular maintenance will be essential to ensuring that channels and culverts maintain their capacity and that the detention and retention basins continue to function as planned. In addition to regularly scheduled maintenance, the major drainage facilities should be cleaned annually at a minimum, and after every significant runoff event. Channels and culverts should be inspected for deposited sediment, erosion areas, and debris clogging to ensure conveyance capacity is maintained. The detention and retention basins should be inspected for deposited sediment, erosion areas, and debris accumulation to ensure that detention and retention volumes are not slowly reduced over time. Channels and basins near undeveloped areas are most likely to be subject to sediment deposition.

The retention basin at the north end of the property should be coordinated with Washoe County to potentially move the basin partially or wholly on Washoe County property or allow for the construction of a sediment basin within Washoe County property just upstream of the retention basin.

6.6 CONCLUSIONS

This drainage master plan is intended to serve as a guide for future airport planning and development needs and to provide a framework for future drainage design. The drainage master plan has developed drainage facilities to a conceptual level, has located drainage facilities within constrained areas where possible, and shown that future development can be accomplished as long as the identified drainage improvements are constructed. Maintenance access has not been specifically designated for the drainage improvements identified, however given the planned land uses of industrial/commercial, and airport use, it was assumed that there will be acceptable areas for maintenance access incorporated at the time of final design.

It is not possible to determine in what order the airport property will develop and over what period of time the development will occur. This drainage master plan assumes that major drainage improvements will be constructed as the airport property is developed. Each development will be responsible for developing the neighboring drainage channels and culverts, identifying any temporary drainage improvements necessary, and determining what portion of the detention or retention basins will need to be constructed prior to site development. The airport also has the ability to construct drainage infrastructure in advance of developing a specific area. In this scenario the site developer would only need to develop the onsite drainage system. Cost estimates for the preferred drainage alternative are included in **Appendix E-5** and summary cost information is provided in Chapter 8 Capital Improvement Program.

AIRPORT LAYOUT PLAN

7

Reno-Stead Airport

7.1 GENERAL

This chapter is intended to serve as an overview of the Airport Layout Plan (ALP) set required as part of the master planning process by the Federal Aviation Administration (FAA). This drawing set provides input required to determine the eligibility of proposed airport improvement projects. Generally, the FAA will not provide financial assistance for projects that are not depicted on the ALP. The drawings comprising the ALP illustrate the current 2009 facilities at Reno-Stead Airport (RTS) and the proposed developments for the near-, mid-, and long-term planning periods (2009-2030).

The ALP set has been prepared in conformity with the criteria described in FAA AC 150-5070-6B, *Airport Master Plans*, FAA AC 150/5300-13, *Airport Design,* and is adherent to the FAA Western-Pacific Region's ALP checklist.

The ALP set for RTS includes the following individual drawing sheets:

1. Cover Sheet
2. Existing Facilities
3. Airport Data Sheet
4. Airport Layout Plan
5. Terminal Area Plan
6. Runway 8-26 Approach and RPZ Plans
7. Runway 14-32 Approach and RPZ Plans
8. Runway 8-26 Part 77 Surfaces
9. Runway 14-32 Part 77 Surfaces
10. Part 77 Surfaces
11. Land Use
12. Airport Property Map

7.2 COVER SHEET

The cover sheet, shown on **Sheet 1 of 14**, serves as an introduction to the ALP set. It includes the name of the airport, a location map, vicinity map, and an index of drawings included in the ALP set.

7.3 DRAWING OF EXISTING FACILITIES

The drawing of existing facilities is a graphic representation, to scale, of the airport in its current configuration (year 2009). This drawing shows all existing airport facilities, their location, pertinent dimensions and clearance information, and the runway and taxiway infrastructure. The Existing Airport Facilities drawings are shown in **Sheet 2 of 14** and **Sheet 3 of 14**.

7.4 AIRPORT LAYOUT PLAN DRAWING

The ALP is the primary planning document for the airport and is a graphic representation, to scale, of existing and proposed airport facilities, their location, dimensional and clearance data, and the overall infrastructure of the airport including runways, taxiways, and aprons. A Data Sheet is typically used when space is not available within the ALP set for the necessary tabular information regarding the airport and its facilities, which is the case for the RTS ALP. The FAA refers to the ALP and Data Sheet when considering grant applications for development assistance and when reviewing potential impacts from off-airport development within the vicinity of the airport.

The ALP set was developed in accordance with the design criteria and guidelines contained in FAA Advisory Circulars 150/5300-13, *Airport Design,* and 150/5070, *Airport Master Plans,* as well as FAA Western-Pacific Region's ALP checklist. The information and analyses presented in the previous chapters of this report discuss the design requirements that pertain to RTS and have been incorporated into the ALP. **Sheet 4 of 14** represents the airport Data Sheet, while **Sheet 5 of 14** and **Sheet 6 of 14** illustrate the Airport Layout Plan for RTS.

7.5 TERMINAL AREA PLAN

The Terminal Area Plan presents an enlarged area of the ALP at a scale of 1"=200' and illustrates existing and proposed facilities. This area is typically comprised of the terminal building, gates, aircraft parking apron, and automobile parking, corporate hangars, and non-aviation related development areas. The Terminal Area Plan is shown in **Sheet 7 of 14**.

The Terminal Area Plan includes the portion of the airfield located to the south of Runway 8-26. The future development shown on the Terminal Area Plan includes: additional itinerant tie-down positions, future general aviation hangar development, and the new terminal facility concept.

7.6 RUNWAY APPROACH AND RPZ PLAN

The RPZ and approach profile drawing shows both plan and profile views for each runway's RPZ and approaches as shown on the ALP. The purpose of these plans is to locate and document existing objects, which represent obstructions to navigable airspace and the existing and proposed approach slopes for each runway. Additionally, the drawing shows the ground profile and terrain features along the extended centerline at each runway end. Notable objects in the vicinity are shown in the plan and profile drawings for each runway end and tabulated with heights and disposition, as appropriate on the subsequent ALP sheet. These drawings are supplemental to the Airport Airspace Plan. The Runway Approach and RPZ Plan Drawing is shown in **Sheet 8 of 14** for Runway 8-26 and **Sheet 9 of 14** for Runway 14-32.

7.7 AIRPORT AIRSPACE PLAN

FAR Part 77, *Objects Affecting Navigable Airspace,* prescribes airspace standards, which establish criteria for evaluating navigable airspace. Airport imaginary surfaces are established relative to the airport and runways. The size of each imaginary surface is based on the runway category with respect to existing and proposed visual, non-precision, or precision approaches for that runway. The space and dimensions of the respective approach surfaces are determined by the most demanding, existing or proposed, approach for each runway. The imaginary surfaces definitions include:

- **Primary Surface** – A rectangular area symmetrically located about the runway centerline and extending a distance of 200 feet beyond each runway threshold. Its elevation is the same as that of the runway.

- **Horizontal Surface** – An oval shaped, flat area situated 150 feet above the published airport elevation. Its dimensions are determined by using 10,000-foot arcs (entered 200 feet beyond each runway end) connected with a line tangent to those arcs.

- **Conical Surface** – A sloping area whose inner perimeter conforms to the shape of the horizontal surface. It extends outward for a distance of 4,000 feet measured horizontally, and slopes upward at 20:1.

- **Transitional Surface** – These surfaces extend outward and upward at right angles to the runway centerline and centerline extended at a slope of 7:1 from the sides of the primary surface and from the sides of the approach surface. Transitional surfaces for those portions of the precision approach surface, which project through and beyond the limits of the conical surface, extend a distance of 5,000 feet measured horizontally from the edge of the approach surface at right angles to the runway centerlines.

- **Approach Surface** – This surface begins at the ends of the primary surface and slopes upward at a predetermined ratio while at the same time flaring out horizontally. The width and elevation of the inner ends conform to that of the primary surface, while the slope, length, and outer width are determined by the runway service category and existing or proposed instrument approach procedures.

Sheet 10 of 14 shows the Part 77 Airspace Plan for RTS associated with Runway 8-26 and **Sheet 11 of 14** shows the Part 77 Airspace Plan for RTS associated with Runway 14-32. **Sheet 12 of 14** depicts the outermost portions of the Part 77 surfaces which were unable to fit within the scaled limits of either **Sheet 10 of 14** or **Sheet 11 of 14**.

7.8 LAND USE

The purpose of the land use plan is to identify all potential development areas on the airport's property and identify the best location for various types of development. The land use development plan for RTS identifies both aviation and non-aviation uses. Aviation use is primarily found surrounding the runway and taxiway system, while non-aviation use is located away from the airfield. Non-aviation use is comprised of industrial/commercial, retail, buffer space, and general rural uses. **Sheet 13 of 14** depicts the airport's Land Use Plan.

7.9 AIRPORT PROPERTY MAP

The Airport Property Map shows areas of existing airport sponsor ownership and areas proposed for ownership or release. The map also shows easements, buildings, aprons, fences, roads, and other features of concern. Tracts are shown for depiction purposes only and this map is not to be used for survey or land acquisition purposes. Property information includes ownership, location, purpose, book and page/reception and Federal involvement. The Airport Property Map is shown on **Sheet 14 of 14.**

CAPITAL IMPROVEMENT PROGRAM

Reno-Stead Airport

8

8.1 INTRODUCTION

The preceding chapters have identified the projects necessary for the Reno-Stead Airport (RTS) to accommodate the forecast levels of demand. As discussed in Chapter 4 Demand/Capacity Analysis and Facility Requirements and Chapter 5 Airport Development Plan, specific improvements to both airside and landside elements of the RTS are recommended for implementation over the planning period. The projects included in the development plan form the basis of RTS's capital improvement program (CIP).

The CIP includes projects that represent the facility's planned growth over the next 20 years. Additionally, the proposed facilities reflect strategic development initiatives intended to maximize the safety and utilization of the airport. As part of the development process, project phasing and cost estimates are developed and included in the CIP in order to manage and plan for the implementation requirements associated with these development projects.

8.2 DEVELOPMENT PHASING

This section applies a general schedule to the proposed airport development projects. The schedule represents a prioritized airport development plan to meet forecast increases in aviation demand and/or economic development initiatives. Projects that appear in the first phase are of greatest importance and have the least tolerance for delay. Additionally, some projects included in an early phase may be a prerequisite for other planned improvements in a later phase. The development phasing for RTS has been divided into three phases as follows:

- Phase I: (0-5 years), 2009-2013
- Phase II: (6-10 years), 2014-2018
- Phase III: (11-20 years), 2019-2028

The phasing of individual projects should undergo periodic review to determine the need for changes based upon variation in forecast demand, available funding, economic conditions, and/or other factors that influence airport development. It should be noted that other projects not foreseen in this report may be identified in the future and would therefore, likely necessitate changes in the phasing of projects and the overall CIP. Further, the projects and overall development identified in the CIP, though tied to a timetable, will only occur once the demand and/or need is demonstrated for each project. Phasing for the projects included in the development plan is shown in **Table 8-1.**

Table 8-1. Airport Capital Improvement Program

Proposed Development Program	Phase I 2009-2013	Phase II 2014-2018	Phase III 2019-2028
Runway 8-26 RSA Compliance	✈		
Runway 14-32 RSA Compliance	✈		
Stormwater Drainage Improvements	✈		
Itinerant Aircraft Expansion	✈		
Taxiway D Rehabilitation	✈		
Terminal Building & Parking Development	✈		
ILS and Approach Lighting System Runway 26		✈	
Air Traffic Control Tower Implementation		✈	
Runway 8-26 Rehabilitation		✈	
Hangar Development			✈
Closed Taxiway Rehabilitation			✈
Future Parallel Taxiways			✈
Itinerant Aircraft Expansion			✈

Source: PBS&J, 2009.

8.3 DEVELOPMENT CONSIDERATIONS

In order to determine the approximate funding requirements for the planning period, it is necessary to identify the potential development costs associated with the selected airport development plan.

The cost estimates presented in the following pages are based upon adjusted 2009 dollars and are calculated for order-of-magnitude purposes only. Actual construction costs will vary based upon inflation, variations in labor and changes in the type or cost of materials used, as well as other unforeseeable economic factors. Furthermore, federal grant assistance and eligibility may also vary from year to year. Therefore, a review of the development costs and overall CIP should occur as conditions warrant.

Based on the construction of all projects outlined in Chapter 5 Development Plan and depicted on the Airport Layout Plan (ALP), the construction costs in dollars are summarized in **Table 8-2**. This table is based upon current federal eligibility criteria only and does not represent a commitment for funding by the respective funding sources. The local column depicts the Reno Tahoe Airport Authority (RTAA) share of the costs, which may be shared with other entities (i.e., current and future tenants, third party developers, etc.) depending on the development and/or funding approach applied to each project.

Detailed 20-year cost estimates for development Phases I through III, including planning, construction, engineering, and total overall development costs, are found in **Appendix F** of this report.

Table 8-2. Summary of Cost Estimates – Full Build-Out

Development Period	Total	Federal (FAA)	Local (RTAA)	Other
Phase I (2009– 2013)	$120,703,000	$11,670,550	$7,126,450	$101,906,000
Phase II (2014 – 2018)	$31,014,000	$29,720,000	$1,294,000	$0
Phase III (2019 – 2028)	$51,720,000	$49,134,000	$2,586,000	$0
Total Estimated Development Costs	**$203,437,000**	**$90,524,550**	**$11,006,450**	**$101,906,000**

Notes:

The funding amounts and project eligibility presented are based on current FAA guidelines but do not constitute approval, acceptance or a commitment of funding by the FAA and should only be used for planning and budgeting purposes.

Source: PBS&J, 2009.

8.4 CAPITAL IMPROVEMENT PROGRAM

The objective of this section is to outline the CIP for RTS for the next 20 years and provide a brief description of the projects included. Special attention has been placed on the first five years of the CIP. These projects slated for immediate implementation have been identified as critical to RTS in terms of providing adequate facilities to meet the needs of its users.

On the following pages, projects are identified and denoted in each phase of RTS's CIP as shown in **Tables 8-3**, **8-4** and **8-5** and **Figures 8-1 through 8-4**.

Table 8-3. Capital Improvement Program Phase I (2009-2013)

Year	Project Description and Title	Estimated Total Cost	Funding Sources	
2010	**<u>Runway 8-26 RSA Compliance – Runway Extension & Declared Distances</u>** The *Reno-Stead Airport RSA Standards Compliance Study Final Report, October 2008* prepared by URS Corporation recommended, after considering other viable alternatives, the construction of a 575-foot westerly extension to Runway 8-26 and implementing 575-foot threshold displacements on both the 8 and 26 runway ends. This project will ensure adequate RSA length beyond each runway end, thereby providing a safer operating environment for aircraft.	**$ 6,500,000**	Federal (FAA)	95% or $6,175,000
			Local	5% or $325,000
			Other	$0
2010	**<u>Runway 14-32 RSA Compliance – Declared Distances</u>** The *Reno-Stead Airport RSA Standards Compliance Study Final Report, October 2008* prepared by URS Corporation recommends, after considering other viable alternatives, relocating the end of Runway 32 by 320 feet and applying declared distances. Also, minor grading work beyond the pavement edge would be required to meet RSA requirements beyond the pavement. Similar to the RSA compliance effort for Runway 8-26, this project will ensure adequate RSA length beyond each runway end, thereby providing a safer operating environment.	**$ 1,011,000**	Federal (FAA)	95% or $960,450
			Local	5% or $50,550
			Other	$0
2011	**<u>Drainage Improvements</u>** To enable future development of primarily non-aviation land uses at RTS a conceptual drainage master plan was established to manage the peak stormwater flows during times of heavy rains. The hydrologic analysis completed for this master plan shows that the future watershed condition 100-year, 24-hour peak flows downstream of the airport property will not exceed the existing watershed condition flow rates. Future on-site flows increase due to development. These flows are reduced to existing flow rates by two detention basins and one retention basin.	**$ 101,906,000**	Federal (FAA)	$0
			Local	$0
			Other	100% or $101,906,000

Table 8-3. Capital Improvement Program Phase I (2009-2013) (Continued)

Year	Project Description and Title	Estimated Total Cost	Funding Sources	
2012	Itinerant Aircraft Expansion – Additional 28 Tiedown Positions At present roughly 33,000 square yards of apron is reserved for itinerant aircraft, but 43,200 square yards will be required by 2015 to allow for 120 itinerant aircraft. Itinerant aircraft parking area should be increased by adding additional striping and grommets, as needed to meet the forecast demand. Considering the BLM leased area on the apron's east edge, additional tie down markings and hardware should be added to the west of the existing itinerant apron.	**$ 80,000**	Federal (FAA)	95% or $76,000
			Local	5% or $4,000
			Other	$0
2012	Taxiway D Rehabilitation Taxiway D at RTS is located on the west side of the airport and runs north and south connecting the NVANG apron area with the approach end of Runway 8. Currently this taxiway is designed to Group II standards and has a weight bearing capacity of only 12,500 pounds (Single Wheel Gear). This taxiway is recommended to be widened and strengthened to comply with Group III standards. This taxiway, once rehabilitated, will enable the development of hangars or other aviation uses both east and west of the taxiway, thereby providing the next logical location to expand aviation development once the areas along the southern property line are built out.	**$ 4,378,000**	Federal (FAA)	95% or $4,159,100
			Local	5% or $218,900
			Other	$0
2012	Terminal Building Development and Parking The existing terminal facility at RTS is only 1,700 square feet and considered significantly undersized when considering peak hour passenger levels over the planning period. Analysis from Section 4.9 *Terminal Building and FBO* identified that an appropriate size for the RTS terminal building would be roughly 10,000 square feet. The existing terminal building cannot be expanded but is in a good location. Therefore, the current terminal facility should be replaced with a larger one in the same general area. Also, adequate parking should be provided around the terminal so as to encourage patrons to park away from aircraft aprons as much as possible.	**$ 6,828,000**	Federal (FAA)	$300,000
			Local	95% or $6,528,000
			Other	$0
Subtotal for 2010			**$7,511,000**	
Subtotal for 2011			**$101,906,000**	
Subtotal for 2012			**$ 11,286,000**	
PHASE I SUBTOTAL			**$ 120,703,000**	

Reno Stead Airport
Reno, Nevada

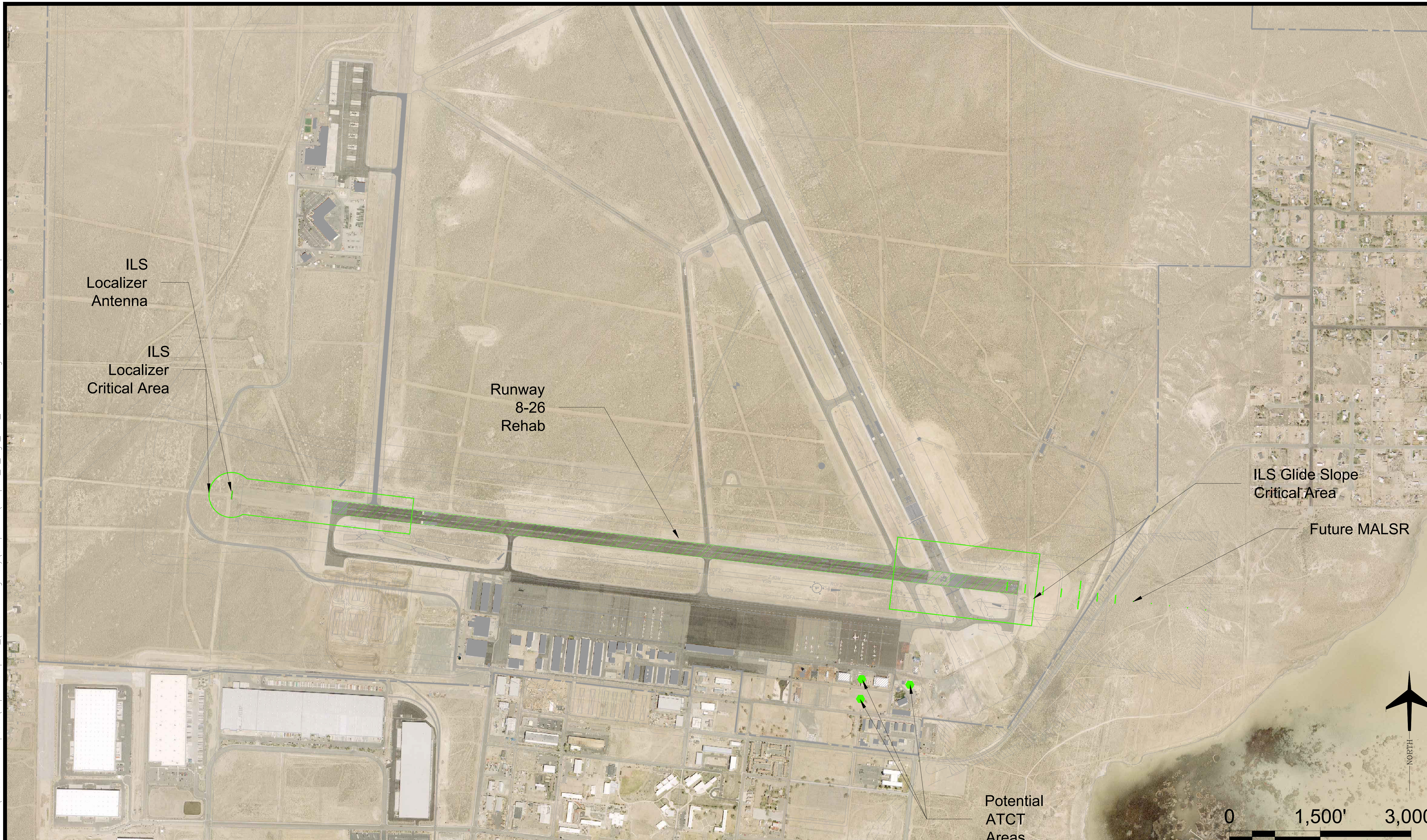
Phase I
Development Plan

Figure
8-1

Table 8-4. Capital Improvement Program Phase II (2014-2018)

Year	Project Description and Title	Estimated Total Cost	Funding Sources	
2016	Runway 8-26 Rehabilitation Runway 8-26 pavement would be rehabilitated in order to maintain level of safety for aircraft operations.	$20,880,000	Federal (FAA)	95% or $19,836,000
			Local	5% or $1,044,000
			Other	$0
2017	ILS and Approach Lighting System for Runway 26 The new ILS instrument approach to Runway 26 will enhance the airfield's overall capacity during instrument meteorological conditions.	$ 5,134,000	Federal (FAA)	100% or $5,134,000
			Local	$0
			Other	$0
2017	Air Traffic Control Tower Implementation The development of an Air Traffic Control Tower will allow for controlled airspace around RTS and increase safety of air operations at the field. *	$ 5,000,000	Federal (FAA)	95% or $4,750,000
			Local	5% or $250,000
			Other	$0
Subtotal for 2016				**$ 20,880,000**
Subtotal for 2017				**$ 10,134,000**
PHASE II SUBTOTAL				**$ 31,014,000**

*Air Traffic Control Tower costs range from $1,450,000 to 8,250,000. An estimate of $5,000,000 was applied for this cost estimate.



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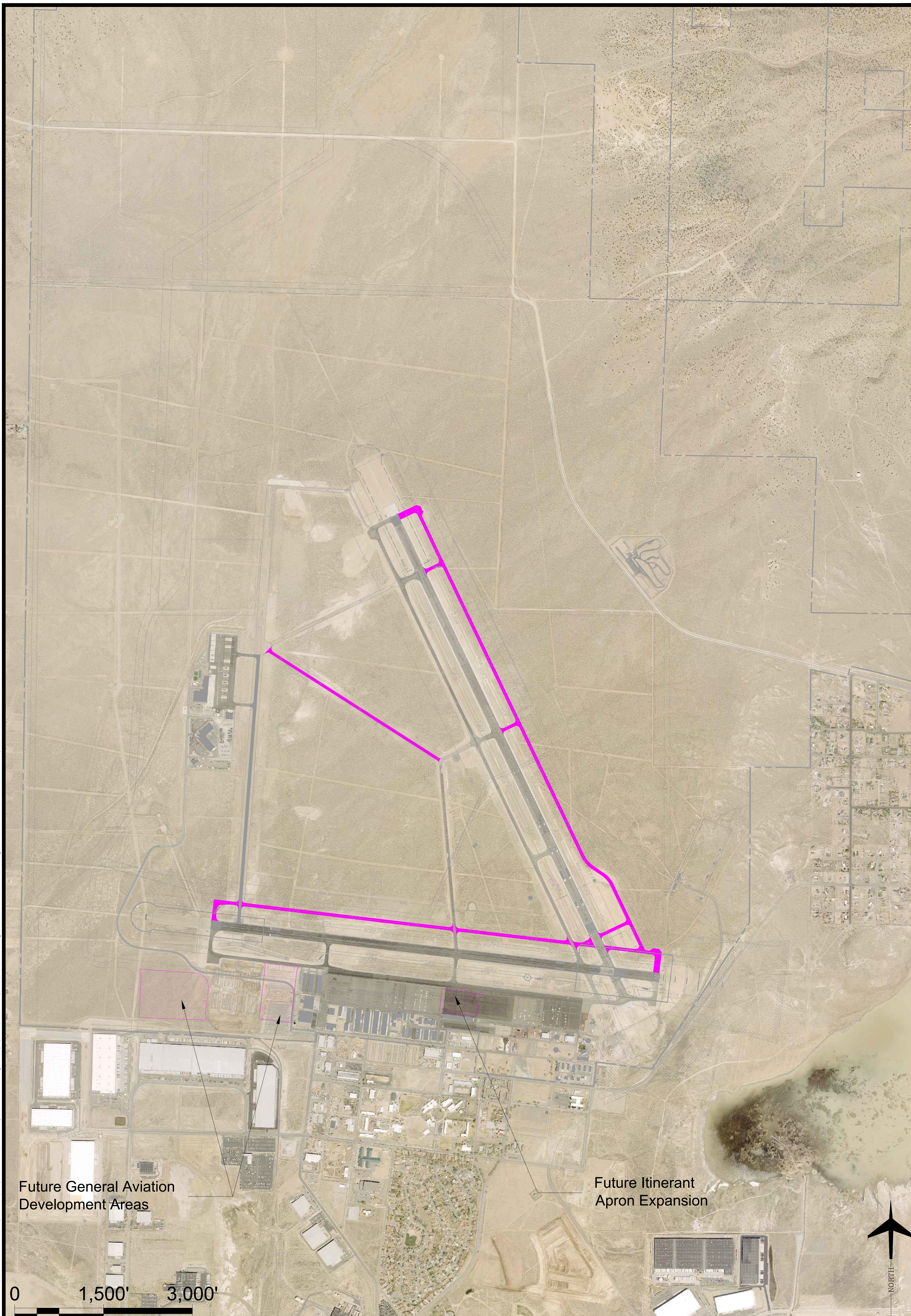
Master Plan Update
Reno-Stead Airport
Reno, Nevada

Phase II
Development Plan

Figure
8-2

Table 8-5. Capital Improvement Program Phase III (2019-2028)

Year	Project Description and Title	Estimated Total Cost	Funding Sources	
2024	Hangar Development 54 additional hangars will be needed by 2030 to facilitate the anticipated growth in based aircraft at RTS. The area immediately west of the current hangar development is considered the best location for the additional 54 hangars determined to be required by 2030. Since civil infrastructure such as roads and utilities already exist on the south side of the airport and based GA aircraft are found predominantly in the southwest corner, this location proved to be the most appropriate for hangar development.	$ 7,541,000	Federal (FAA)	95% Or $7,163,950
			Local	5% or 377,050
			Other	$0
2024	Closed Taxiway Rehabilitation The closed taxiway connecting the north end of Taxiway D with Taxiway C is recommended for rehabilitation. When operational, this taxiway will connect all areas of the airport more efficiently and create valuable airfield frontage for future development. This taxiway is recommended to be widened and strengthened to comply with Group III standards.	$ 7,130,000	Federal (FAA)	95% or $6,773,500
			Local	5% or $356,500
			Other	$0
2024	Future Parallel Taxiways Each RTS runway is recommended to be equipped with dual parallel taxiways in the future. Additional parallel taxiways help to increase capacity, provide for a safer airfield environment, and enable aviation related development in areas currently inaccessible by aircraft. Existing and future parallel taxiways should be planned and constructed to the same design criteria as the runway it is intended to serve. Being the ultimate Airport Reference Code (ARC) for each runway is C-III, taxiways should also be designed to that standard.	$ 36,740,000	Federal (FAA)	95% or $34,903,000
			Local	5% or $1,837,000
			Other	$0
2024	Itinerant Aircraft Apron Expansion At present roughly 33,000 square yards of apron is reserved for itinerant aircraft, but 65,000 square yards will be required by 2030 to allow for 181 itinerant aircraft. A 10,000 square yard addition is scheduled in phase one and therefore 22,000 additional square yards of itinerant apron will need to be added by 2030 to provide a total of 65,000 square yards. Itinerant aircraft parking area should be increased by adding additional striping and grommets, as needed to meet the forecast demand. Considering the BLM leased area on the apron's east edge, additional tie down markings and hardware should be added to the west of the existing itinerant apron.	$ 309,000	Federal (FAA)	95% or $293,550
			Local	5% or $15,450
			Other	$0
Subtotal for 2024				**$ 51,720,000**
PHASE III SUBTOTAL				**$ 51,720,000**

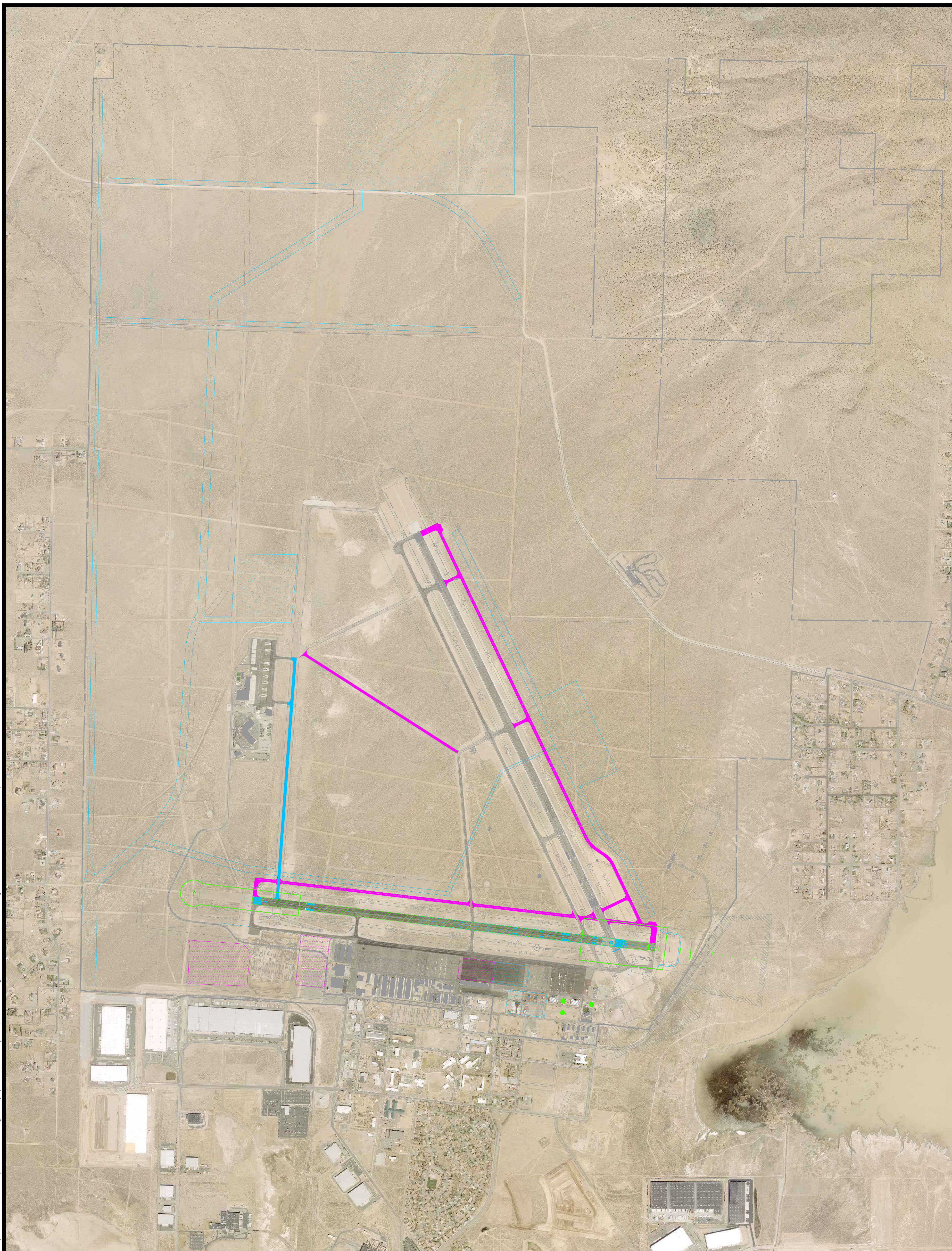


PBS&J

Reno Stead Airport
Reno, Nevada

Phase III
Development Plan

Figure
8-3



Legend

- PHASE I (2009-2013)
- PHASE II (2014-2018)
- PHASE III (2019-2028)

0 1,750' 3,500'

NORTH

PBS&J	Reno Stead Airport Reno, Nevada	Phases I, II, III Development Plan	Figure 8-4

8.5 IMPLEMENTATION

The purpose of this section is to analyze RTS's historical and projected revenue and expenditures and determine whether it is financially viable to implement the airport Master Plan's capital improvement program (CIP). The objective of this updated financial analysis is twofold:

- Estimate the capital and operating costs for the various components that comprise the CIP.
- Determine if it is feasible for the airport to generate sufficient revenues to cover capital and operating costs.

8.5.1 Historical Airport Financial Data

8.5.1.1 Revenue Sources

Fiscal year revenues were collected over an historical five-year period. As presented in **Table 8-6**, the major sources of airport revenue are generated from airport rentals. Other sources include fuel flowage and landing fees and concession revenue from the National Championship Air Races and Air Show. Within a five-year period, airport revenue has fluctuated with a decrease within the period of fiscal year 2004 to 2006 and followed by a large jump in fiscal year 2007. Overall, during this period, revenues increased at an average annual growth rate of .99 percent.

8.5.1.2 Expenses

As presented in **Table 8-7**, expenses cover salary and benefits, utilities and communications, purchased services (including consultants), materials and supplies, and administrative costs. Within a five-year period, expenses have increased at an average annual growth rate of 6.1 percent.

Table 8-6. Historical Revenues

	FY2004	FY2005	FY2006	FY2007	FY2008
Aircraft Fees					
Fuel Flowage	$8,208	$10,154	$16,119	$16,725	$16,855
Landing Fees	$10,246	$2,209	$8,836	$11,936	$21,216
Fixed Base Operators	$24,680	$23,390	$22,127	$28,239	$18,751
Concession					
RARA	$26,096	$22,717	$23,465	$20,291	$22,173
Other	$0	$0	$0	$1,518	$258
Rentals					
Building	$67,734	$60,796	$59,069	$66,295	$68,568
Hangar	$239,071	$238,587	$191,174	$236,591	$242,345
Airfield	$45,528	$49,117	$47,276	$44,456	$51,099
Land	$128,703	$136,887	$166,372	$172,846	$139,514
Sewer Use Fee	$4,904	$8,588	$7,467	$6,767	$8,698
Wash Rack	$363	$132	$86	$226	$231
Mini Warehouse	$10,061	$10,925	$9,740	$10,216	$9,985
Other	$18,865	$18,577	$24,100	$28,456	$14,343
Total Revenue	**$584,459**	**$582,079**	**$575,831**	**$644,562**	**$614,036**

Source: RTAA, 2009.

Table 8-7. Historical Expenses

	FY2004	FY2005	FY2006	FY2007	FY2008
Personnel Services	$457,222	$425,306	$484,549	$475,066	$542,441
Utilities and Communications	$54,802	$62,192	$76,728	$77,160	$63,656
Purchased Services	$58,071	$34,203	$31,438	$24,721	$25,546
Materials and Supplies	$75,134	$71,368	$101,588	$95,612	$105,782
Administrative Expense	$1,978	$4,842	$2,579	$2,886	$2,680
Fixed Assets	$48,739	$3,950	$34,862	$205,141	$196,164
Total Expenses	**$695,946**	**$601,861**	**$731,744**	**$880,586**	**$936,269**

Source: RTAA, 2009.

During the period cited, expenditures exceeded revenue. **Table 8-8** summarizes the historical revenues, expenses, and losses. Since RTS is part of an airport system that includes the Reno-Tahoe International Airport, the shortfall in operations and maintenance cost recovery at RTS is subsidized by the overall revenue generating capabilities of the RTAA.

Table 8-8. Historical Financial Analysis

	FY2004	FY2005	FY2006	FY2007	FY2008
Total Revenues	$584,459	$582,079	$575,831	$644,562	$614,036
Total Expenses	$695,946	$601,861	$731,744	$880,586	$936,269
Annual Profit (Loss)	($111,487)	($19,782)	($155,913)	($236,024)	($322,233)

Source: RTAA, 2009.

8.5.2 Projected Revenue and Expenses

Revenues that RTS generates in the future will be derived primarily from the same sources it generates from today, including: landing fees, fuel flowage fees, building leases, land leases, and revenue from FBO operations. Based upon existing aviation lease agreements, current construction of hangars on the airport, and assuming any vacant buildings are leased, annual fiscal year revenues were estimated during the planning period and are presented in **Table 8-9**. Revenues were increased based on language contained in existing lease agreements which calls for annual increases based on the Consumer Price Index (CPI). For the purposes of this analysis, total revenues were projected using a CPI of 3.5 percent (based on 2008). Total expenses were projected to increase applying an average annual growth rate from fiscal year 2007 to fiscal year 2008, which was calculated to be 6.3 percent.

Table 8-9. Projected Revenue and Expenses

	FY 2010	FY 2015	FY 2020	FY 2025	FY 2030
Total Revenues	$657,770	$1,406,224	$1,552,849	$1,726,993	$1,933,822
Total Expenses	$1,085,958	$1,058,420	$1,438,144	$1,954,099	$2,655,161
Annual Profit (Loss)	($428,188)	$347,804	$114,705	($227,106)	($721,339)

Source: PBS&J, 2009.

As can be seen in Table 8-9, projected revenues will not exceed expenditures as activity continues to increase at the airport without more aggressive utilization of the land and facilities available. It should also be mentioned that RTS is and can continue to be subsidized by RNO, if necessary. Additional revenue generation at the airport is very likely from the development of commercial/industrial areas on –airport over the planning period. RTS has what most airports in the U.S. do not have and that is available and developable land. If 20 acres of available land was developed every two years, projected revenue would be $250,000. This potential revenue source is added to the Table 8-9. As shown, the additional revenue allows RTS to support all expenses in the near- to mid-term. It is anticipated that operating revenues will outpace expenses in the long-term.

8.5.3 Capital Program Funding Sources

8.5.3.1 Federal Funding

The Airport receives development funding from the Federal Aviation Administration (FAA) through the Airport Improvement Program (AIP). The FAA funds General Aviation (GA) airport development projects by two means: GA entitlement and AIP discretionary funds. Airports typically receive AIP discretionary funding for federally eligible projects such as:

- New runways, taxiways, and non-exclusive use aprons
- Reconstruction of runways, taxiways, and non-exclusive aprons
- Navigational aids
- Federal air traffic control towers (ATCT)
- Passenger terminal buildings (non revenue areas only)
- Primary airport access roads
- Land acquisition

Eligible FAA projects costs at RTS are covered up to 95 percent; the remaining 5 percent is the responsibility of the RTAA. The 1999 reauthorization of the AIP legislation (AIR 21) set aside, for the first time, GA entitlement funding specifically reserved for GA airports. Eligible airports (including RTS) may receive up to $150,000 per year.

8.5.3.2 Local Funding

The balance of project costs, after consideration has been given to federal and state grants, is typically funded through the airport sponsor's local resources. Reno-Tahoe

Airport Authority (RTAA) operates and maintains both Reno-Tahoe International Airport (RNO) and RTS. RTAA has created a "special" fund that sets aside 35 percent of the gaming revenues generated at RNO to cover the local share costs of these projects at RTS. Historically, revenues of approximately $850,000 to $900,000 annually have been placed in this fund which has easily covered the local share cost of capital improvements.

8.5.3.3 Other Funding

Several assistance and funding programs not related to FAA are available to airports. These include:

- Economic Development Assistance Grants (EDA) – Managed by the US Department of Commerce – grants are made available to assist in financing industrial park development.
- Transportation Act of the 21st Century (TEA-21) – Airports eligible for access road development and intermodal-related projects.
- Small Cities Community Development Block Grant (CDBG) Section 108 Loan Guarantee Program – Offered by the Nevada Commission on Economic Development, this program provides a mechanism for small cities to access funds for larger community development projects. Both the City of Reno and City of Sparks are listed as CDBG entitlement cities, which allows the City to determine how CDBG money is spent assuming certain general federal requirements are met.
- Private Third Party Financing - Many airports use private third party financing when the planned improvements will be primarily used by a private business or other organizations. Such projects are not ordinarily eligible for Federal funding. Projects of this kind typically include hangars, FBO facilities, fuel storage, exclusive aircraft parking aprons, industrial aviation use facilities, non-aviation office/commercial/industrial developments, and various other projects. Private development proposals are considered on a case-by-case basis. Often, airport funds for infrastructure, preliminary site work, and site access are required to facilitate privately developed projects on airport property.

8.5.4 Summary

Revenues the airport generates now and in the future will come primarily from commissions on services provided, hangar and building rental fees, and land leases. Additional revenues will come from landing fees on aircraft, and terminal fees. Construction of new hangars to meet the existing demand represents significant opportunities to generate additional revenue. However, the greatest opportunity for financial sustainability rests with the successful marketing and overall development of the airport. There is approximately 3,000 acres of land that is available for non-aviation development which over time will generate a substantial revenue stream.

The revenues and expenses associated with the different funding sources available vary significantly and thus, further analysis of the financial feasibility of each project will be necessary prior to the time of grant application and overall project implementation.