DSM

Des Moines International Airport

Future Terminal Program Definition Manual

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DES MOINES International Airport

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Chair

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1.0 Introduction

1.1 Background

In 2013, the Des Moines Airport Authority (the Authority) embarked on the process for a new terminal, replacing the existing facility that has outlasted its useful life. The Des Moines International Airport (DSM) is organized into four quadrants, each with various land uses. The existing terminal and its associated passenger uses are located in the East Quadrant with direct access off Fleur Drive which provides a direct route to downtown Des Moines to the north. The existing facility was originally built in 1948 and has had multiple additions and renovations over the years to keep up with demand. The Authority has managed to utilize the building effectively, however, tremendous growth in travel and multiple changes to processes and technologies have placed a strain on the usefulness of the building. While the existing terminal facility contains 265,000 SF, the building is constrained in many locations by adjacent functions, insufficient depths or widths for proper circulation flow and inability to accommodate future technologies. The building systems require updates and regular maintenance that would prove to be costly and, due to airside constraints, the existing concourses cannot be expanded to accommodate future demand.

1.2 Planning Process

Since 2013, the Airport has worked through a multi-step process to properly study location, sizing and criteria of a new terminal. The following studies are a culmination of this five year journey.

<u>Terminal Area Concept Plan Technical Report (September 2014; Leigh Fisher) –</u>
This study was essentially a Master Plan but with a focus on the Terminal elements. The study concluded that a new terminal is needed, with a preferred location in the South Quadrant of the airport campus. The study included concepts at both the existing terminal (East) Quadrant and the South Quadrant and included an inventory of existing conditions, forecast, facility requirements analysis, alternatives, financial capacity analysis, environmental overview and Airport Layout Plan (ALP) update.

<u>Terminal Area Concept Plan – Site Selection Study (November 2016; HNTB) -</u>
Since the completion of the 2014 Terminal Area Concept Plan, many variables had changed that required updates to determine if the south site was still the most feasible and cost effective solution to move forward. In March 2016, the Authority hired HNTB to restudy components of the Terminal Area Concept Plan to validate the existing study. That report acted as an "addendum" to the previous Terminal Area Concept Plan Technical Report (September 2014) by Leigh Fisher. This collaborative study included the following key goals:

- Functional and Efficient circulation
- Create a zoned Master Plan for the entire airport campus
- Create concepts that connect the airport to the community and create a "sense of place"
- Flexible Phasing/Construction – initial and ultimate
- Minimize relocation of existing buildings/tenants and infrastructure
- Avoid the Iowa Air National Guard (IANG) site on the North Quadrant
- Meets all requirements (terminal, airside and landside)
- Cost Effective

That study concluded that the East Quadrant was the preferred location for the new terminal. Maintaining existing infrastructure, including parking facilities and utilities, was a key factor to this decision to ensure the most cost effective solution. Many variables had changed since the 2014 study including the Iowa Air National Guard (IANG) site that now was not within the study limits and needed to be maintained in the North Quadrant. Previously, that site was utilized for relocation of tenants to clear the site for the new terminal at the South Quadrant. With this site "off-limits", it was more difficult to ensure proper separation of airport functions/tenants. Other advantages to the East Quadrant included:

- Ability to keep the passenger terminal in a completely separate quadrant
- Less relocation of the current tenants
- Maintain the connection to downtown by keeping the Fleur Drive address.

On October 11, 2016, the Board approved the East Quadrant as the preferred terminal site location. The completion of the Site Selection Study also included updated cost estimation and ultimately an update to the Airport Layout Plan (ALP).

<u>New Terminal Programming & Advanced Planning Study – Program Definition Manual (May 2018; HNTB) –</u>
Upon completion of the Site Selection Study, an Advanced Planning Study was conducted to provide a preferred alternative for the new terminal, landside, and associated airside projects at a detailed planning level. Work began on the New Terminal Programming & Planning Study in December 2016. The consultant team proceeded with refining the general layout of the overall East Quadrant site, including presentations at workshops to obtain input from DSM staff and airport stakeholders. Questionnaires and a series of stakeholder workshops were conducted in early 2017 to provide a baseline of program requirements for the new terminal. Various options were developed and measured utilizing pros/cons analysis and balanced with rough order of magnitude cost for proper decision making.

The goal of the exercise is for a final deliverable providing an in-depth program definition manual for the Airport and future design consultant(s) that would outline all planning decisions. The PDM was intended to provide detailed criteria for developing the design for the new terminal and its associated projects. The findings of this study are the product of this Program Definition Manual (PDM) in the following chapters.

1.3 Recommendations Summary

The new terminal programming was developed to accommodate 3.0 Million Annual Passengers (MAP) opening day, with the ability to expand for 4.0 MAP. The focus of the study was on the passenger elements in the East Quadrant of the airport campus with the following key factors as a focus:

- Conformance with FAR Part 77
- Flexibility of Landside and Airside elements
- Future expansion capabilities of all program elements, particularly the terminal building and parking facilities
- Single-phase terminal construction to reduce construction cost, duration and operational pain
- Ability to retain 10 contact gates and 9 RON positions throughout construction
- New terminal proximity to existing infrastructure
- Enhanced and intuitive wayfinding for vehicular circulation including longer decision points for safety purposes
- Short walking distances throughout site and ultimate building expansion
- Least construction pain or interference with operations and passenger traffic

An in-depth analysis of the preferred plan is included in Chapter 5 of this document.

1.3.1 Plan Overview

The overall program for the new terminal includes improvements beyond the terminal building, including airside and landside. The airside improvements are planned to be phased in coordination with the modifications to Runway 5/23, Taxiway Bravo and other adjacent airside projects. The landside improvements include a complete overhaul of the roadway loop, converting it to a one-way loop, starting with a new intersection off Fleur Drive. Based upon demand and future requirements, modifications to parking include a reconfigured long term lot, reclaim of existing rental car spaces as revenue generating parking stalls and a new parking structure to better connect the new terminal to the remaining parking area. New entry and exit plazas are also key elements of the landside design. Overall, safety and increased capacity are key drivers to the landside improvements. **Figure 1.1** represents the New Terminal Program major elements by phase.

1.3.2 Terminal

The new terminal will allow for 14 gates to align with 3.0 Million Annual Passenger (MAP) and eventually 18 gates to align with 4.0 MAP. Multiple locations for the new terminal were studied to ensure a high level of service for passengers, reutilization of existing infrastructure to its maximum possibility and allow for flexibility for future growth. The terminal building has been developed to align with the program requirements that recommend 295,130 SF. The layout of the building allows for ultimate flexibility for the airport and airlines operation and the ability for future airline processes and technologies. The layout is efficiently stacked at three levels which minimizes walking distances while providing easy vertical transitions for public and operational purposes. Below is a summary of spaces in the new terminal building (by level).

- Level Two (**Figure 1.2**)
    - Level Two is primarily dedicated public space and serves as the primary transition point from landside (nonsecure) to airside (secure) for passengers. A direct connection via bridge to the new parking garage is located on this level, providing a direct path without vertical transitions from parking to gate for some passengers. A large meeter/greeter public space is surrounded by landside concessions. This area also includes a glass wall allowing a view corridor from landside to airside. This provides a connection to the holdrooms/aircraft (i.e observation deck prominent historically at airports prior to 9/11) and the ability to still see passengers that have gone through security for a longer good-bye. See **Figure 1.5** for an image depicting the landside greeter/meeter area. Level Two also includes the security checkpoint and the concourse with holdrooms. **Figure 1.6** shows the view from security checkpoint to the concourse and central concession hub. Flexibility is a primary intent for the concourse with long span structural system and few walls for holdrooms and concessions; allowing these areas to blend, and eliminating the constraints of the existing concourse.
    - All spaces on Level Two include: Meeter/Greeter, Landside Concessions, Security Checkpoint, TSA Support, Concourse Circulation, Holdrooms, Airside Concessions, Restrooms & support, and Des Moines Airport Authority Administration offices.

- Level One (**Figure 1.3**)
    - Level One provides the first impression for most passengers as they arrive via car at the new terminal. The ticketing/check-in and baggage claim halls are wide open with high volume to provide a gateway to the building and to allow ample natural light. Flexibility is key to the ticketing area for ever-changing airline technologies and processes. The baggage claim area includes three (3) baggage carousels for 3.0 MAP and eventually space for a 4th carousel for 4.0 MAP. The majority of Level One is dedicated to tenant support (Airline, TSA and Airport) and includes the Inbound and Outbound baggage areas.
    - All spaces on Level One include: Airline Ticketing/Check-in, Airline Support (Ticketing Offices & Airline Operations), Building Systems, Baggage Handling (Outbound Baggage, Inbound Baggage), Baggage Claim, Des Moines Airport Conference Center, Restrooms, and Airside Vehicle Parking areas.
- Level Zero (Basement) (**Figure 1.4**)
    - Level Zero is a non-public level that provides airport and tenant support. The east end encompasses the terminal loading dock, storage and employee/goods screening areas. The checked baggage inspection system is located on this level, directly below the outbound baggage make-up area above.
    - All spaces on Level Zero include: Airport Operations, Loading Dock, Receiving, Goods Screening, Concessions Storage, Baggage Screening (CBIS, CBRA, Support) and Building Systems.

The building footprint and aircraft layout conform with the FAR Part 77 restrictions for the 14-gate and 18-gate scenarios and maintain a flexible approach to accommodate future technology. The phasing, as described further in Chapter 7, maintains 10 contact gates throughout construction and allows the new terminal to be constructed in one phase. The terminal is arranged for easy wayfinding and short walking distances for passengers, both inside the terminal and to the existing infrastructure. The passenger amenities, the adaptable spaces and ingrained flexibility for the future will establish a good to high level of service for passengers travelling through Des Moines. The terminal provides a safe and exciting experience for travelers and balances the need for future flexibility with economy to justify the initial construction costs.

1.3.3 Landside

With the main focus on capacity increase and safety, the landside elements have been developed to allow for future flexibility. The new terminal building will be located directly to the north of the existing terminal. This allows for a new roadway loop that increases the development of parking within. The existing parking structures will be maintained with a new parking structure developed directly north.

The location of the new parking structure will allow for a seamless connection from the existing garages to the new terminal. The parking garage will add 476 new parking stalls within a 4 level structure that ties directly into the existing parking garage on all levels. A pedestrian bridge will link the new terminal (Level Two) with the new parking structure (Level Two). A key determining factor for the layout of the garage was to minimize walking distances to the farthest stall. As future demand warrants, additional parking can be built directly northeast of the new garage or on the site of the existing landside terminal building (after demolition). A new exit plaza will be developed directly south of the existing garage than will allow for a merge onto the roadway loop and eliminate the existing plaza that has a short turn directly onto the roadway loop and noted as currently unsafe.

A new intersection will be built off Fleur Drive that creates a one-way circulation flow roadway loop. Duck Pond Rd will be converted to one-way traffic after the new Fleur Drive intersection and the curve around the existing Duck Pond on its way towards the new terminal building. Wayfinding will direct vehicular traffic to the new entry plaza for access to all parking (short and long term). The decision points to these exits is generous to allow for safe exit from the roadway loop without significantly reducing the possibility of the traffic to cause congestion in peak times.

The curbfront at the new terminal is separated into two areas with the personal vehicles dropoff and pickup at the inner curb and the commercial vehicles (hotel shuttles, taxi, potential for city transportation, limos) at the outer curb. Just beyond the inner curb (at the southwest end of the baggage claim) a new Ground Transportation Facility (GTF) will provide a covered area for the new Rental Car pickup/dropoff and Transportation Network Companies (TNC). Passengers will have a quick walk from baggage claim directly to this location.

A new consolidated Rental Car facility will be built in the South Quadrant on existing Economy Lot 5. A short 3 minute bus ride will take passengers directly from the GTF at the new terminal to the new Rental Car facility. The facility will include a new building with rental car company counters, offices and support. Direct access from the building radiate to the rental car ready/return areas with covered canopies over a portion of the area. Each rental car company will have its own dedicated area that is separately secured to allow for "keys in the car" ease for patrons to quickly get on their way. Its new location directly adjacent to the existing Rental

Figure 1.1 Plan Overview

1 NEW TERMINAL
2 NEW PARKING GARAGE
3 EXISTING PARKING GARAGE
4 NEW EXIT PLAZA
5 EXISTING TERMINAL
6 NEW AIRPORT ENTRANCE
7 EXISTING DUCK POND
8 RECONFIGURED LONG TERM PARKING
9 NEW ENTRY PLAZA
10 NEW DE-ICING PAD
11 FUTURE LONGTERM PARKING LOT
12 FUTURE PEDESTRIAN BRIDGE

Car Quick Turn Around (QTA) will allow for minimal car jockeying. This will ensure quicker reallocation of cars for return to ready turnaround, safer operations (less jockeying) and the location allows for future expansion possibilities.

Chapter 4 gives more detail on landside program requirements and Chapter 5 describes the preferred concept in detail.

1.3.4 Airside

The airside program for the new terminal allows for 14 contact gates at 3.0 MAP and eventually 18 contact gates at 4.0 MAP. All contact gates are sized for Group III aircraft to allow for ultimate flexibility. Upon demolition of the Employee Parking lot and General Aviation facilities, a considerable amount of new apron pavement will be required to support the new terminal. Beyond the 14 contact gates, 3 hardstand or Remain Over Night (RON) are located immediately north of the new terminal, while 6 additional RON positions will be located south of the new terminal. Due to the sloped site, the north and east portion of the new apron will be approximately 20' (at highest point) from the existing service road below. This will require significant regrading, fill and retaining wall at the east limits.

The proposed relocation of the airport terminal will require a significant amount of the existing apron pavement to be removed and reconstructed. The existing apron pavement area drains via sheet flow from south to north, adjacent to the existing terminal. Runoff is collected at various intakes and trench drains and conveyed to the Terminal Tank just north of the existing apron.

A newly proposed centralized deicing system allows for glycol collection in the existing terminal tank, creating potential reclamation opportunities. Contrary to the existing system, storm runoff and glycol-contaminated runoff will be kept separated.

The existing Storm Control Building will be demolished. Because pipes dedicated to storm flow will be kept separate from any glycol terminal tank piping, the Storm Control Building will no longer be needed.

1.3.5 Program Phasing

Phasing for the entire new terminal program has been developed to allow for incremental growth, while minimizing impact to passengers and operations for the airport and tenants. Several enabling projects are identified to allow the new terminal to begin construction. This includes several airside projects that must be completed for functional and financial reasons. The Airport has identified several airside projects involving taxiways and runways are planned to occur within the next five years outside of the limits of the New Terminal Program. These include the reconstruction of Runway 5/23 and Taxiway Bravo, new pavement at the South GA Apron, reconstruction of Taxiway Papa, a Runway 5 temporary extension and the reconstruction of the Runway 5/23 & 13/31 Intersection. While these projects are not officially part of the New Terminal Program (or included in this narrative), they do directly relate and must be worked in collaboration with the new terminal. Airside apron packages will be ongoing throughout the entire phasing duration.

The first project slated for the landside is relocation of the rental car facility to the South Quadrant, adjacent to the Rental Car Quick Turn-around Facility (QTA.) This will open 176 covered spaces and 260 surface spaces in the East Quadrant for use as general parking. In addition, it will remove the rental car traffic (rented ready and return cars and jockey cars to/from the QTA) from the roadway loop; helping to reduce capacity issues in the East Quadrant and improve overall safety.

Next, the new Cowles Drive entry across from Highview Drive will be constructed, creating a one-way traffic loop. The current Cowles Drive entry near Porter Avenue will be demolished to make way for the future roadway loop. A new exit plaza will be erected, creating a safer merge onto the roadway loop, followed by a new entry plaza east of Duck Pond Road. Before the new roadway loop can be extended, the GA facilities, Signature, associated apron pavement and employee parking lot must be relocated. A temporary roadway will connect the NE Service road to the loading dock, clearing the site for the roadway loop to extend around the future garage area.

The first apron pavement package includes most of the new terminal apron and will function as RON parking and terminal construction lay-down space when it is completed. The current terminal apron slopes significantly down from south to north and the concourse makes up for the grade change with ramps. The new pavement will raise the grade on the north end several feet higher than the existing apron to accommodate proper slope percentages and allow the new terminal departure level to remain horizontally flat without ramping for functional flexibility inside the building. Some of the new apron packages will include temporary retaining walls to divide the new higher pavement from the lower existing pavement. The second apron pavement package includes the first deice pad west of the existing concourses and replacement pavement for an area southeast of Concourse A. The third apron package on the east side of Concourse C will provide the remainder of the lay-down space for the terminal construction. When it is completed, Gate C-6 can temporarily reopen, with the aircraft parking position on the higher new apron pavement.

Meanwhile, a portion of the long-term lot, the existing entry plaza, hourly lot and temporary roadways will be demolished to clear the sites for the garage and terminal. Terminal and garage construction will commence around the same time. The garage construction will span approximately 2 years and terminal construction will take roughly 3 years to complete.

After Gate C-6 is reopened, the pavement on the north side of Concourse C can be demolished and replaced with the remaining deicing pavement as part of the fourth apron pavement package. Gates C-5 and C-7 will re-open, parking on the new deice pavement, and allow the pavement in front of C-1 and C-3 to be replaced during the fifth apron pavement package.

The new terminal will open with 10 gates on opening day, allowing the existing terminal to permanently close. Concourse C will be demolished first, enabling the new pavement in that area to be completed quicker, which allows the new terminal to add 3 more gates. Next, Concourse A and the "stem" containing security will be demolished. When that apron pavement is complete, the remaining few contact gates will be added to accommodate 14 gates.

Subsequently, the Ground Transportation Facility (GTF) that provides a loading/unloading zone for the rental car shuttle and TNC's will be constructed. After the concourse stem is demolished, the remainder of the new roadway loop can extend around the existing terminal processor and connect near the exit plaza merge lane. When funding becomes available, the landside processor, existing curb front and associated canopies will be demolished. This will allow the merging lane for commercial vehicles to extend further south to improve safety at that intersection. The demolition will also clear a large site for future parking or other terminal functions within the roadway loop.

Ultimately, the concourse will be able to expand to 18 gates when the airport reaches a 4.0 Million Annual Passenger (MAP) level. The future RONs will shift east and take up part of the parking for Economy Lot 3 while maintaining a right of way for a future Rental Car autonomous bus route.

Table 1.1 represents a brief summary of the phasing by sequence. Chapter 7 describes the phasing in detail.

Table 1.1 - Phasing Sequence

Phase 1	Landside	Site preparation for new Rental Car Facility
Phase 2	Landside	Construction of new Rental Car Facility
Phase 3	Airside	Taxiway Bravo relocation & temporary transition pavement
Phase 4	Airside	Taxiway Papa-1 temporary transition pavement
Phase 5	Landside	Cowles Drive intersection work, entry road construction, site preparation for exit plaza
Phase 6	Landside	Construction of new exit plaza, demolition of existing Cowles Drive entry
Phase 7	Landside	Construction of new entry plaza & portion of roadway loop, demolition of existing entry plaza
Phase 8	Airside	Demolition of Signature, DSM Flying Services, GA Buildings and associated apron pavement
Phase 9	Landside	Construction of temporary loading dock service road
Phase 10	Landside	Demolition of portion of existing roadway loop
Phase 11	Landside	Construction of roadway loop and curb
Phase 12	Airside	Construction of Apron Packet A (north apron piece with RON parking)
Phase 13	Landside	Demolition of portion of existing roadway loop & long-term parking
Phase 14	Airside	Construction of Apron Packet B (Deice Pad 1)
Phase 15	Landside	Construction of parking access road & additional long-term parking
Phase 16	Airside	Demolition of Concourse C east pavement
Phase 17	Landside	Demolition of existing entry plaza
Phase 18	Airside / Landside	Construction of Apron Packet C (Concourse C east), Terminal and Garage construction begins
Phase 19	Airside	Demolition of Concourse C north pavement
Phase 20	Landside	Construction of Pedestrian Bridge
Phase 21	Airside	Construction of Apron Packet D (Concourse C north)
Phase 22	Airside	Demolition of Concourse C west pavement
Phase 23	Airside	Construction of Apron Packet E (Concourse C west)
Phase 24	Landside	New Garage Opens
Phase 25	Airside / Landside	New Terminal Opens, Existing Terminal is closed
Phase 26	Landside	Demolition of Existing Terminal Loading Dock
Phase 27	Airside	Demolition of Concourse C
Phase 28	Landside	Construction of Ground Transportation Facility
Phase 29	Airside	Construction of Apron Packet F (Concourse C), demolition of Concourse A and "Stem"
Phase 30	Landside	Construction of roadway loop extension
Phase 31	Airside	Construction of Apron Packet G (Concourse A & Stem)
Phase 32	Airside	Completion of VSR & airside improvements
Phase 33	Landside	Demolition of portion of existing curbfront
Phase 34	Landside	Construction of commercial lane pavement
Phase 35	Landside	Demolition of Landside Processor
Phase 36	Landside	Construction of commercial lane extension
Phase 37	Landside	Landside improvements complete
Phase 38	Airside / Landside	Future Terminal Expansion - 18 Gate Scenario (MAP 4.0)

1.3.6 Rough Order of Magnitude Cost Estimates

The total Program Cost for the Des Moines New Terminal is summarized on **Table 1.2** and detailed in Chapter 8. The program costs include the new terminal (and associated projects), landside, airside and enabling projects directly related to the new terminal.

Table 1.2 - Program Cost Estimate Summary

Category	Cost To Owner	Contingency	Soft Cost	Total
New Terminal (incl. Demo)	$185,263,744	$37,052,749	$49,465,420	$271,781,913
Landside	$62,300,559	$12,460,112	$16,634,249	$91,394,920
Airside	$46,768,701	$9,353,740	$12,487,243	$68,609,684
Misc/Enabling Projects	$138,718	$27,744	$37,038	$203,499
TOTAL PROGRAM COST	$294,471,722	$58,894,345	$78,623,950	$431,990,016

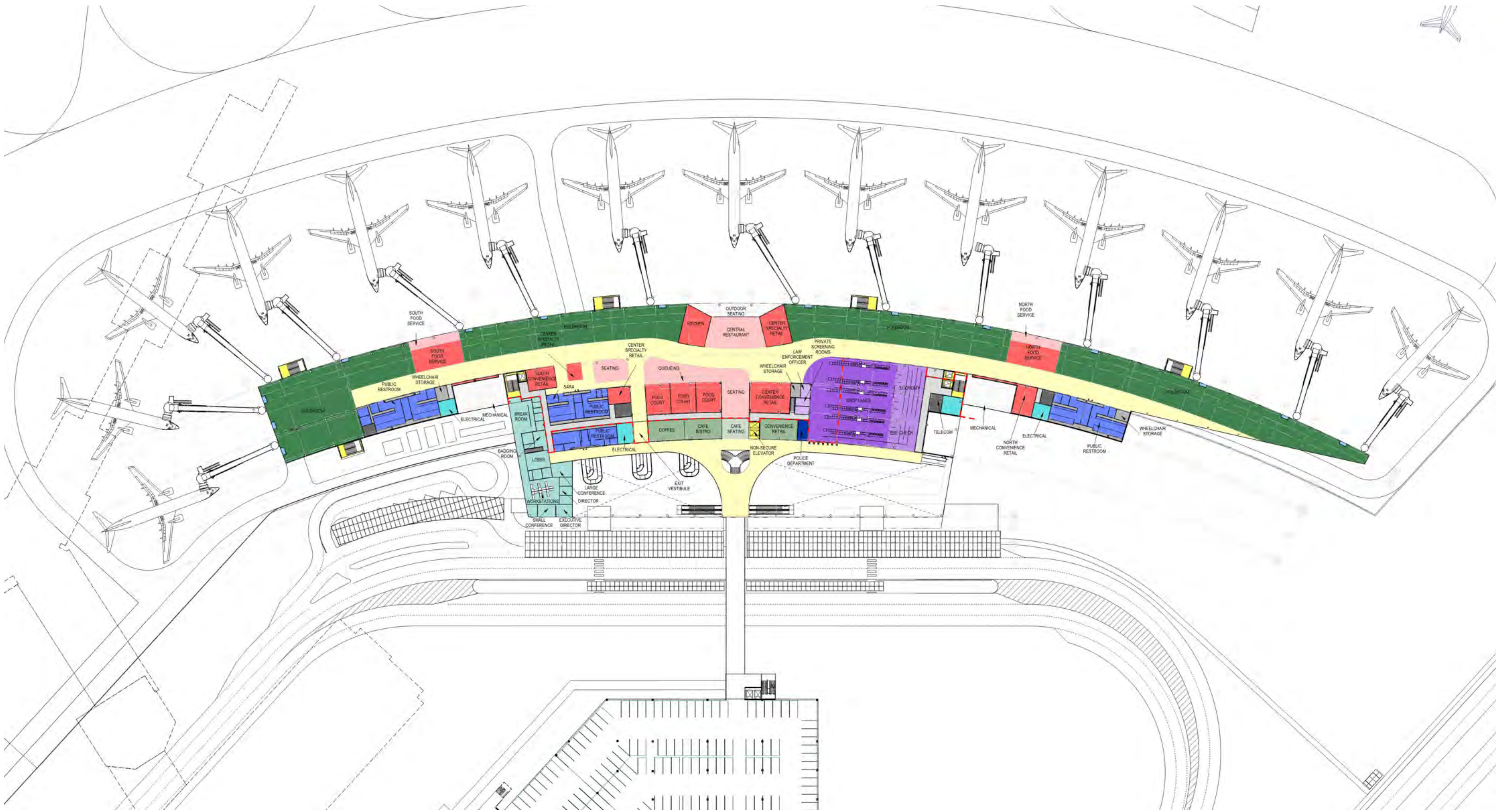
1.4 Purpose and Need

The existing terminal is currently at capacity during peak hours and an expansion is warranted to accommodate future growth in the number of passengers, future technologies and ensure a high level of service to passengers without disruption to airport and airline operations. The current airline trend is to up-gauge the size of aircraft and potentially reduce frequency, therefore the terminal is reaching and exceeding its capacity. This trend in the airline industry has created capacity issues in nearly all areas of the building including ticketing/check-in, security checkpoint, baggage handling systems and the holdrooms/concourse circulation.
Planning documents, even one as focused as this PDM, require a set of guidelines by which to evaluate progress, express expectations, guide decision-making, and measure success. The guidelines are typically developed by the entity for which the plan is being prepared since it is that entity that will own and implement the plan.

The following set of guidelines and objectives were developed in coordination with the Des Moines Airport Authority staff, board members, and key stakeholders including airlines, rental cars, parking, TSA and FAA. This was created through collaborative charrette-style worksessions. They provide a way for the DSM staff and airport stakeholders to evaluate progress, express expectations, guide decision-making, and measure success.

1. Provide a flexible gate scenario for future growth.
2. Provide a high level of customer service.
3. Meet airline/airport requirements for contact gates and passenger processing facilities.
4. Develop a terminal facility that utilizes space efficiently.
5. Develop a terminal facility that maximizes concession revenue opportunities.
6. Increase opportunities for non-airline revenue sources.
7. Maintain existing operations and minimum of 10 contact gates during construction phasing.
8. Ensure minimal walking distances.
9. Provide a cost effective solution to enable the new terminal program to move forward.

Figure 1.2 - Level 2 Plan



Level 2 Plan

Figure 1.3 - Level 1 Plan

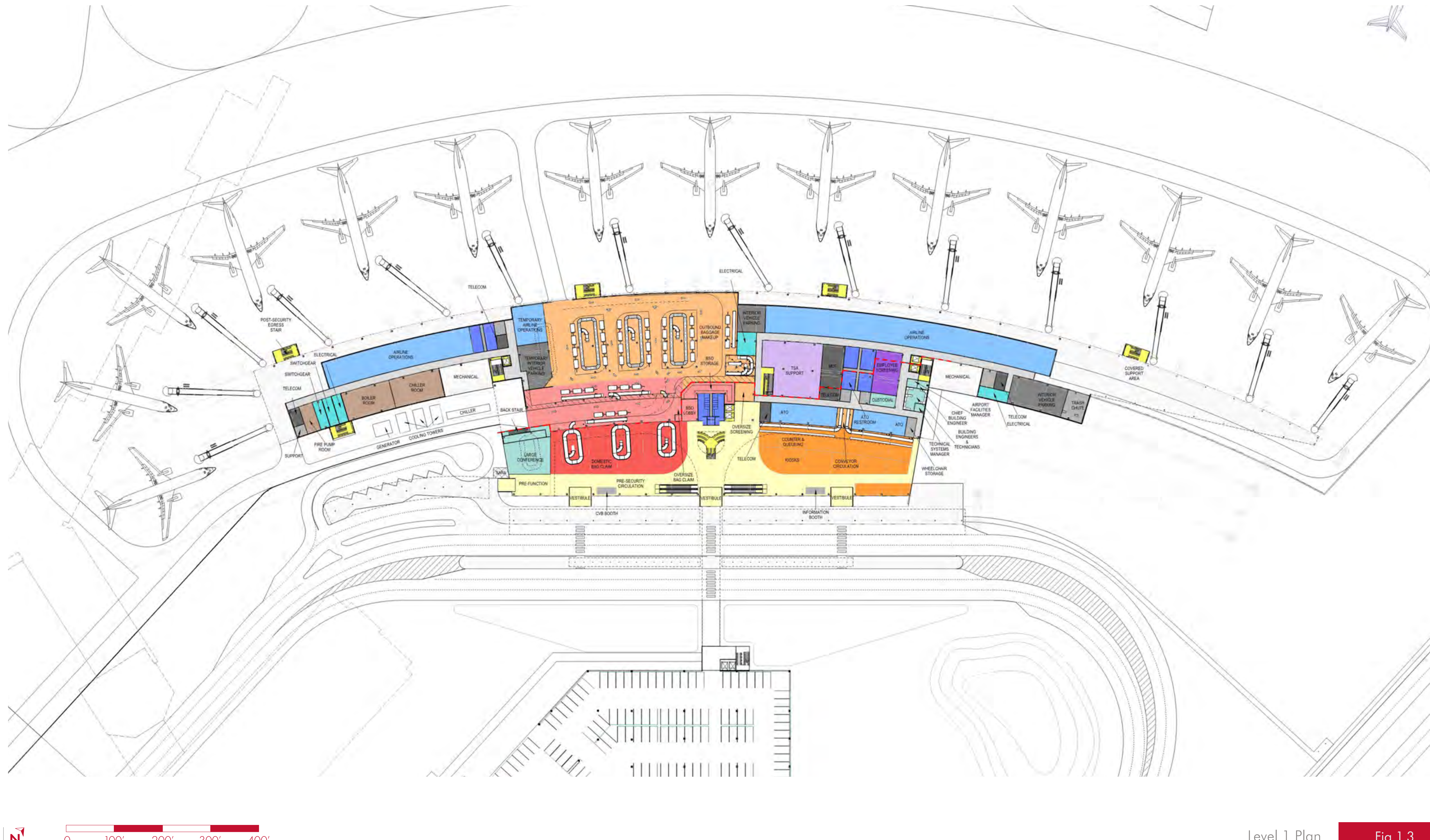


Figure 1.4 - Level 0 Plan

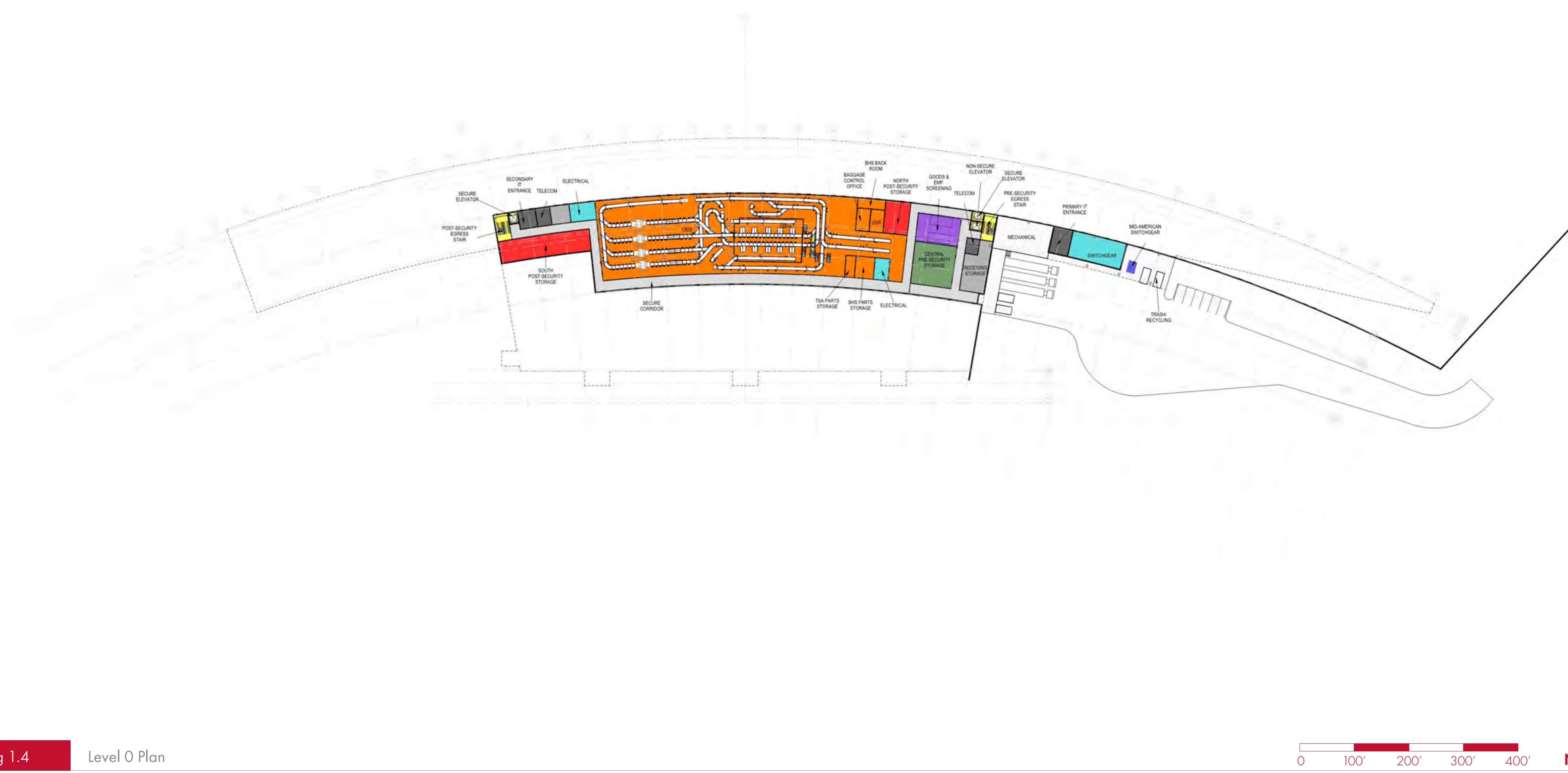


Figure 1.5 - Meeter / Greeter Space

Figure 1.6 - Central Concession Core

Fig 1.6 Central Concession Core

Chapter 2 | Forecast

2.0 Forecast

2.1 Flight Schedule

The purpose of the analysis described in this section was to perform a general review of the methodologies, assumptions and resulting forecasts in the Des Moines International Airport (DSM) Terminal Area Concept Plan Leigh Fisher Forecast (LFA) for appropriateness. The intent of the review was to identify any inconsistencies or departures in current trends from the forecasts and to provide a recommendation on whether the forecasts should be redone.

The focus of the review was on the forecast elements most relevant to the terminal plan, specifically passenger forecasts, passenger aircraft and fleet forecasts, peak activity forecasts, and contact gate and remain overnight hardstand requirements.

2.1.1 General Findings and Approach

The economic assumptions used in the LFA Forecast published in 2014 are still applicable. Essentially, the world and U.S. economies are still growing at a moderate rate, employment is increasing and unemployment levels are steady, and inflation is under control. The airline industry is financially healthy and still practicing capacity management. Fuel prices have fallen more than expected but are expected to increase again by both the FAA and the U.S. Department of Energy.

Since the original forecast assumptions are generally sound and still applicable and the annual passenger enplanement forecast is tracking well a complete revision of the forecast is not recommended. However, some industry trends, such as changes in fleet mix resulting in increases in average aircraft size, have occurred faster than anticipated. In these instances, adjustments reflecting new base year levels are recommended.

Understanding that fluctuations in airport activity above and below long-term trends have occurred in the past and are expected to continue to occur in the future, a 5 percent deviation threshold was used when evaluating the forecasts. Forecast elements for which actual (2015) activity levels were within 5 percent of the forecast were assumed to be on track and were therefore not adjusted. Conversely, forecast elements for which actual (2015) activity levels differed from the forecast by more than 5 percent were adjusted by applying the LFA forecast growth rate to the most recent actual activity level.

2.1.2 Background

Tables 2.1 and 2.2 provide historical passenger enplanements and aircraft operations at DSM over the past twenty -five years. Since the most recent downturn in 2008-2009, enplanements have grown rapidly. The 2016 estimate is extrapolated from data through August 2016 and currently shows a year over year growth rate of 5.1 percent. The forecast was developed in 2016 as a revision of the 2014 Terminal Area Concept Plan. The forecast has not been updated since 2016 that would include recent growth rates higher than 5 percent.

Table 2.1 - Historical Passenger Enplanements

YEAR	PASSENGER ENPLANEMENTS (a)		PERCENT CHANGE
1990	717,460		
1991	744,088		3.7%
1992	747,757		0.5%
1993	703,127		-6.0%
1994	707,204		0.6%
1995	797,797		12.8%
1996	905,405		13.5%
1997	860,230		-5.0%
1998	861,523		0.2%
1999	885,175		2.7%
2000	876,018		-1.0%
2001	820,741		-6.3%
2002	883,190		7.6%
2003	911,063		3.2%
2004	997,655		9.5%
2005	951,604		-4.6%
2006	978,907		2.9%
2007	992,059		1.3%
2008	952,152		-4.0%
2009	875,625		-8.0%
2010	914,587		4.4%
2011	959,997		5.0%
2012	1,038,484		8.2%
2013	1,104,749		6.4%
2014	1,157,235		4.8%
2015	1,180,764		2.0%
2016	1,240,983	(b)	5.1%

COMPOUND ANNUAL GROWTH RATE	
1990-2015	2.0%
2009-2015	5.1%

(a) LFA, Terminal Area Concept Plan, Appenidix A, Table 3-2, and Des Moines Airport Authority Traffic Statistics.

(b) Extrapolated from January through August data.

Sources: As noted and HNTB analysis.

Table 2.2 - Historical Aircraft Operations

YEAR	COMMERCIAL AIR CARRIER	COMMERCIAL AIR TAXI/ COMMUTER	COMMERCIAL SUBTOTAL	GENERAL AVIATION	MILITARY	TOTAL	PERCENT CHANGE
1990	27,426	21,575	49,001	87,908	9,229	146,138	
1991	28,228	21,728	49,956	83,429	8,619	142,004	-2.8%
1992	26,310	22,489	48,799	80,009	8,949	137,757	-3.0%
1993	27,436	23,898	51,334	71,668	7,650	130,652	-5.2%
1994	28,954	27,090	56,044	71,034	6,925	134,003	2.6%
1995	33,091	27,252	60,343	71,906	6,613	138,862	3.6%
1996	33,038	28,803	61,841	68,512	4,488	134,841	-2.9%
1997	29,333	32,872	62,205	60,752	4,174	127,131	-5.7%
1998	30,039	36,375	66,414	65,179	5,010	136,603	7.5%
1999	36,388	33,788	70,176	59,847	4,742	134,765	-1.3%
2000	34,580	33,626	68,206	54,889	4,573	127,668	-5.3%
2001	31,854	33,112	64,966	48,408	4,694	118,068	-7.5%
2002	31,759	36,239	67,998	47,316	5,201	120,515	2.1%
2003	27,961	37,685	65,646	45,360	5,357	116,363	-3.4%
2004	27,271	37,768	65,039	42,792	5,180	113,011	-2.9%
2005	23,717	37,611	61,328	41,538	3,966	106,832	-5.5%
2006	20,793	43,454	64,247	42,245	4,490	110,982	3.9%
2007	15,784	44,262	60,046	37,301	3,568	100,915	-9.1%
2008	17,761	38,161	55,922	36,981	2,955	95,858	-5.0%
2009	15,978	34,891	50,869	32,308	3,787	86,964	-9.3%
2010	15,707	31,442	47,149	32,795	3,992	83,936	-3.5%
2011	16,022	30,634	46,656	33,045	4,202	83,903	-0.0%
2012	19,626	24,574	44,200	31,962	3,874	80,036	-4.6%
2013	20,514	22,617	43,131	30,432	2,882	76,445	-4.5%
2014	23,353	18,286	41,639	27,077	811	69,527	-9.0%
2015	28,354	11,402	39,756	28,075	1,556	69,387	-0.2%
2016 (b)	-	-	-	-	-	-	-100.0%
COMPOUND ANNUAL GROWTH RATE							
1990-2015	0.1%	-2.5%	-0.8%	-4.5%	-6.9%	-2.9%	
2009-2015	10.0%	-17.0%	-4.0%	-2.3%	-13.8%	-3.7%	

(a) LFA, Terminal Area Concept Plan, Appendix A, Table 5-1, and FAA OPSNET database.

(b) Extrapolated from January through August data.

Sources: As noted and HNTB analysis.

Historical aircraft operations at DSM have been declining over the past twenty-five years. Most of the decline has been in the air taxi/commuter, general aviation, and military categories. Commuter operations have gone down as air carriers have increasingly transitioned from small turboprop aircraft to larger 50, 70 and 76-seat jets. The decline in general aviation has mirrored a national decline in general aviation activity, especially recreational and personal flying.

2.1.3 Review of Annual Passenger Enplanement Forecast

Table 2.3 and Figure 2.1 provide a comparison of actual enplanement levels with interpolated levels from the LFA forecast. As shown, actual enplanements are tracking slightly higher than forecast enplanements, through August 2016. The difference is less than 5 percent however; therefore, no adjustment to the forecast is recommended. Another consideration is that oil prices are projected to recover over the next several years. This will drive air fares higher, and thereby reduce the growth in passenger demand.

Table 2.3 - Annual Passanger Enplanement Forecast

YEAR	LFA FORECAST (a)	ACTUAL (b)	VARIANCE	RECOMMENDED (c)
2015	1,162,448	1,180,764	1.6%	1,180,764
2016	1,191,298	1,240,983	4.2%	
2017	1,218,600			1,218,600
2018	1,248,997			1,248,997
2022	1,350,700			1,350,700
2027	1,497,064			1,497,064
2032	1,660,300			1,660,300
2042	2,045,117			2,045,117
COMPOUND ANNUAL GROWTH RATE				
2015-2042	2.1%			2.1%

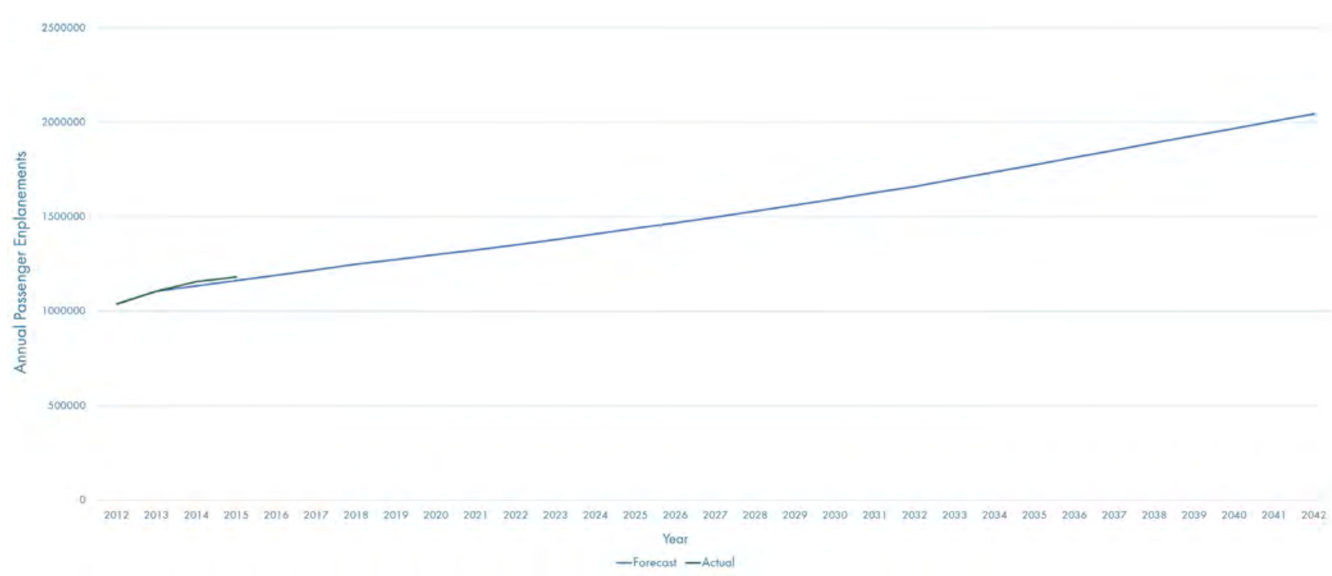
(a) LFA, Terminal Area Concept Plan. 2015 and 2016 interpolated.

(b) Table 2.1.

(c) Since variance is less than 5 percent, LFA forecast recommended without adjustment.

Sources: As noted and HNTB analysis.

Figure 2.1: Annual Passenger Enplanement Forecast



2.1.4 Review of Passenger Aircraft Departure and Fleet Mix Forecasts

Table 2.4 and Figure 2.2 provide a comparison of actual passenger aircraft departures and the associated LFA forecast. In contrast to passenger enplanements, aircraft departures are tracking 9.0 percent below the forecast. Since the difference is greater than 5.0 percent, the forecast was adjusted to reflect a lower base year level as shown in the table and figure.

Figure 2.2 - Annual Passenger Aircraft Departure Forecast

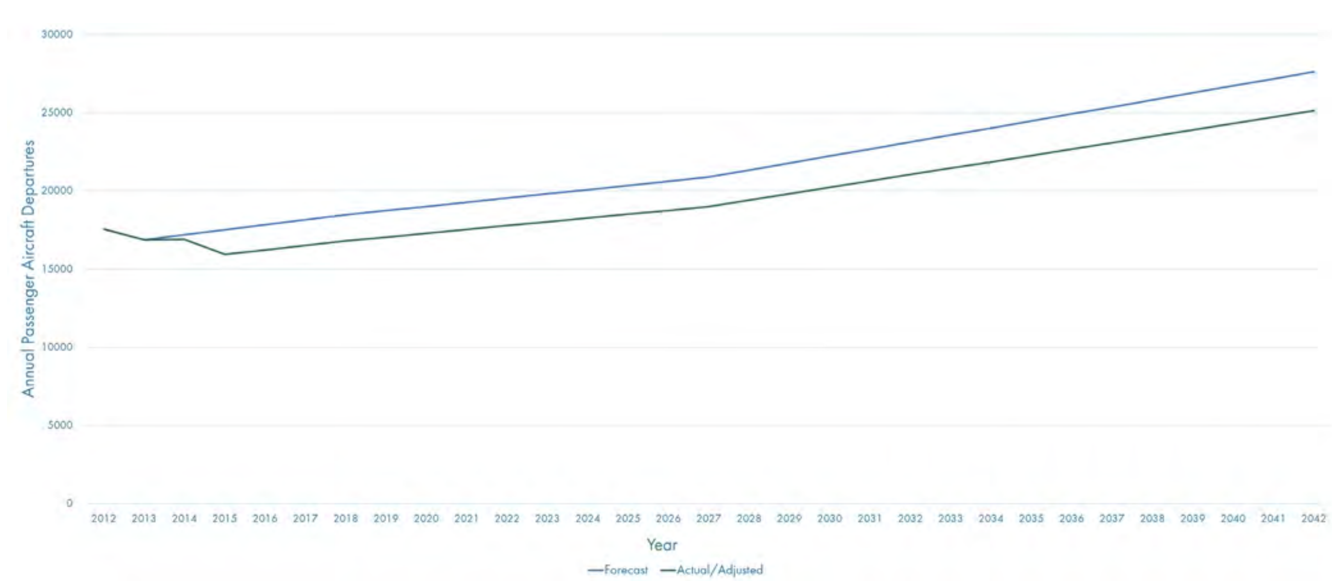


Table 2.4 - Annual Passenger Aircraft Departure Forecast

YEAR	LFA FORECAST (a)	ACTUAL (b)	VARIANCE	RECOMMENDED (c)
2015	17,509	15,930	-9.0%	15,930
2016	17,827			16,220
2017	18,146			16,510
2018	18,465			16,800
2022	19,538			17,776
2027	20,879			18,997
2032	23,125			21,040
2042	27,616			25,126
COMPOUND ANNUAL GROWTH RATE				
2015-2042	1.7%			1.7%

(a) LFA, Terminal Area Concept Plan. 2015 and 2016 interpolated.

(b) US DOT T100 database as compiled by DataBase Products, Inc.

(c) Since variance is greater than 5 percent, recommended forecast is LFA forecast adjusted by 2015 variance.

Sources: As noted and HNTB analysis.

Table 2.5 - Passenger Aircraft Fleet Mix Comparison

	2015 Fleet		2016 Fleet	
	PROJECTED (a)	ACTUAL (b)	PROJECTED (a)	ACTUAL (c)
Narrowbody				
A318	0.0%	0.0%	0.0%	0.0%
A319	4.6%	4.9%	4.8%	9.9%
A320/neo	2.7%	2.5%	2.9%	3.2%
ERJ-190 (d)	2.3%	0.0%	3.5%	0.0%
CS300 (d)	0.0%	0.0%	0.0%	0.0%
B717	0.0%	4.2%	0.0%	5.0%
B737-300	0.1%	0.3%	0.1%	1.8%
B737-700	5.0%	6.6%	5.3%	4.4%
B737-800	1.3%	1.3%	1.7%	1.7%
B737 MAX	0.0%	0.0%	0.0%	0.0%
B737-900	0.0%	0.5%	0.0%	0.3%
B757-200/300	0.0%	0.2%	0.0%	0.0%
MD-80/82/83	10.5%	8.8%	10.8%	6.9%
Subtotal	26.6%	29.3%	29.1%	33.2%
RJ More than 60 seats				
CRJ-700	9.3%	17.5%	10.9%	12.1%
CRJ-900	13.7%	26.1%	13.6%	15.8%
ERJ-170	7.3%	3.6%	8.0%	2.4%
ERJ-175	0.0%	0.5%	0.0%	11.0%
Subtotal	30.4%	47.7%	32.5%	41.3%
RJ Less than 60 seats				
CRJ-100/200	11.9%	9.5%	8.8%	12.1%
ERJ-135	12.6%	0.0%	11.2%	0.0%
ERJ-145 (44 seats)	7.8%	0.4%	7.0%	0.0%
ERJ-145 (50 seats)	10.8%	13.1%	11.4%	13.4%
Subtotal	43.1%	23.0%	38.4%	25.5%
Total	100.0%	100.0%	100.0%	100.0%

(a) Leigh/Fisher, Terminal Area Concept Plan, Appendix A, Table 6-7. Intermediate years interpolated and percentages adjusted to reflect only passenger carrier fleet.

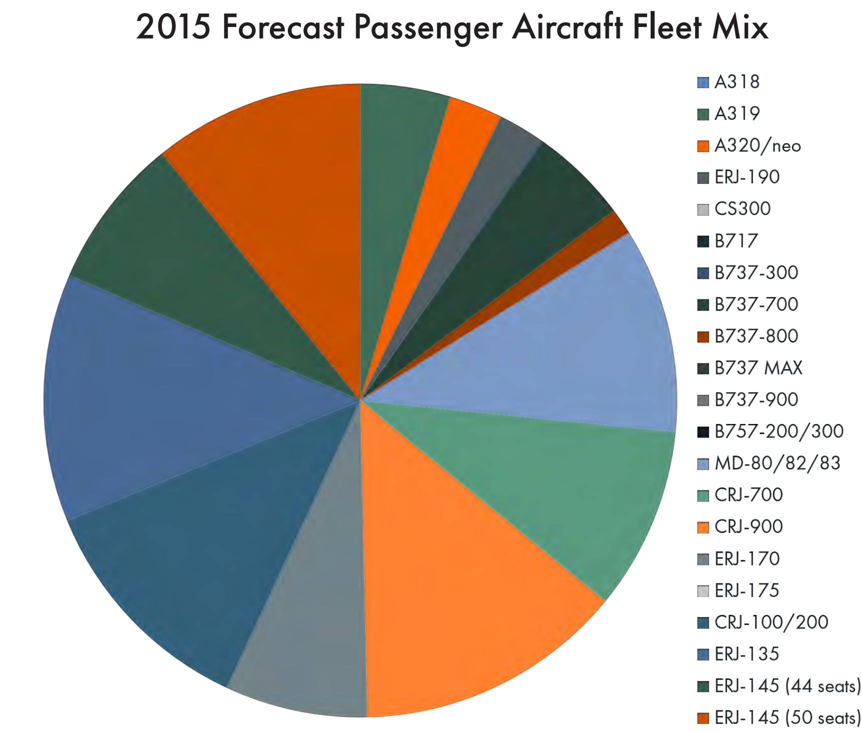
(b) USDOT T100 annual data as compiled by Database Products.

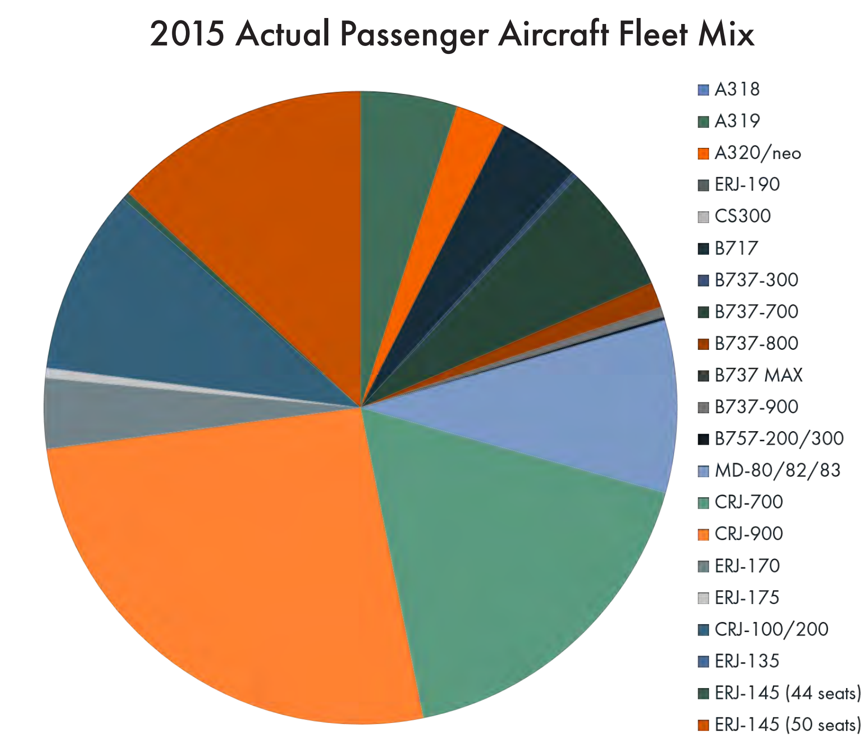
(c) June 2016 data from Official Airline Guide.

(d) Included with RJs in Terminal Area Concept Plan.

Sources: As noted and HNTB analysis.

Figure 2.3 - Passenger Aircraft Fleet Mix Comparison





The reason that aircraft departures are tracking behind LFA forecast levels is that the transition to larger aircraft, specifically the transition from 50-seat to 70- and 76-seat regional jets, is occurring faster than originally anticipated. **Table 2.5 and Figure 2.3** compare the actual 2015 and 2016 passenger aircraft fleet with the LFA forecast. As shown, the narrow-body aircraft projection is tracking well. However, actual large (more than 60 seats) regional jet aircraft departures are tracking significantly above the forecast whereas small (less than 60 seats) regional jet aircraft departures are tracking well below the forecast.

Table 2.6 provides a summary comparison of the existing fleet mix along with the LFA forecast through 2032. As shown, the current mix of large and small regional jets is very similar to the mix originally projected for 2022.

2.1.5 Peak Activity Forecasts

The appropriate sizing of most terminal building facilities is dependent on peak period passenger forecasts. **Table 2.7** and **Figures 2.4 through 2.6** compare current (June 2016) peak hour enplanement, deplanements, and enplanement plus deplanements forecasts with the original projections prepared by LFA. As shown, current peak hour deplanements vary from the forecasts by less than 5 percent, and therefore the forecasts were not adjusted. Peak hour enplanements and total passengers (enplanements plus deplanements) vary from the forecast by more than 5 percent, and they were therefore adjusted to reflect the lower base year numbers.

Table 2.6 - Summary of Passenger Fleet Projections

	2013	2015	2016	2017	2018	2022	2027	2032
Narrow-Body aircraft								
Forecast (a)	21.5%	26.6%	29.1%	31.6%	32.1%	34.1%	36.6%	39.4%
Actual (b)		29.3%	33.2%					
Difference (%)		10.4%	14.1%					
RJ More than 60 seats								
Forecast (a)	26.0%	30.4%	32.5%	34.7%	35.8%	40.1%	47.9%	55.0%
Actual (b)		47.7%	41.3%					
Difference (%)		57.0%	27.1%					
RJ less than 60 seats								
Forecast (a)	52.5%	43.1%	38.4%	33.7%	32.1%	25.7%	15.5%	5.5%
Actual (b)		23.0%	25.5%					
Difference (%)		-46.6%	-33.6%					
Total								
Forecast (a)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Actual (b)		100.0%	100.0%					

(a) Leigh/Fisher, Terminal Area Concept Plan, Appendix A, Table 6-7. Intermediate years interpolated and percentages adjusted to reflect only passenger carrier fleet.

(b) USDOT T100 annual data as compiled by Database Products for 2015 and Official Airline Guide for June 2016.

Sources: As noted and HNTB analysis.

Table 2.7 - Peak Hour Passenger Forecasts

	Peak Hour Enplanements				Peak Hour Deplanements				Peak Hour Enplanements plus Deplanements			
Year	LFA Forecast (a)	Actual (b)	Variance	Recommended (c)	LFA Forecast (a)	Actual (b)	Variance	Recommended (d)	LFA Forecast (a)	Actual (b)	Variance	Recommended (c)
2015	779				550				925			
2016	804	566	-29.6%	566	568	558	-1.7%	568	954	823	-13.7%	823
2017	828			583	585			585	983			848
2018	853			601	602			602	1,012			873
2022	928			654	655			655	1,101			950
2027	1,022			720	722			722	1,213			1,046
2032	1,147			807	810			810	1,361			1,174
2042	1,396			983	987			987	1,658			1,430
Compounded Annual Growth Rate												
2016-2042	2.1%			2.1%								

(a) LFA, Terminal Area Concept Plan

(b) Estimated using Official Airline Guide schedules and peak month load factors from US DOT T100 database as compiled by DataBase Products, Inc.

(c) Since variance is greater than 5 percent, recommended forecast is LFA forecast adjusted by 2015 variance.

(d) Since variance is less than 5 percent, LFA forecast recommended without adjustment.

Sources: As noted and HNTB analysis.

Figure 2.4 - Peak Hour Enplanement Forecast

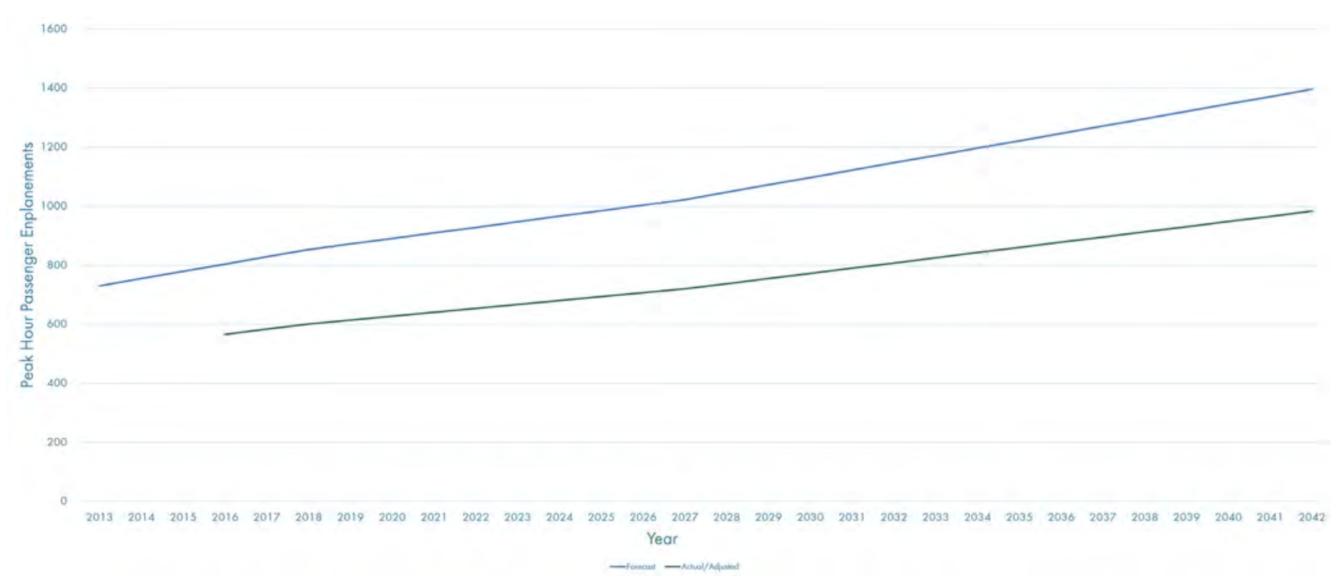


Figure 2.5 - Peak Hour Deplanement Forecast

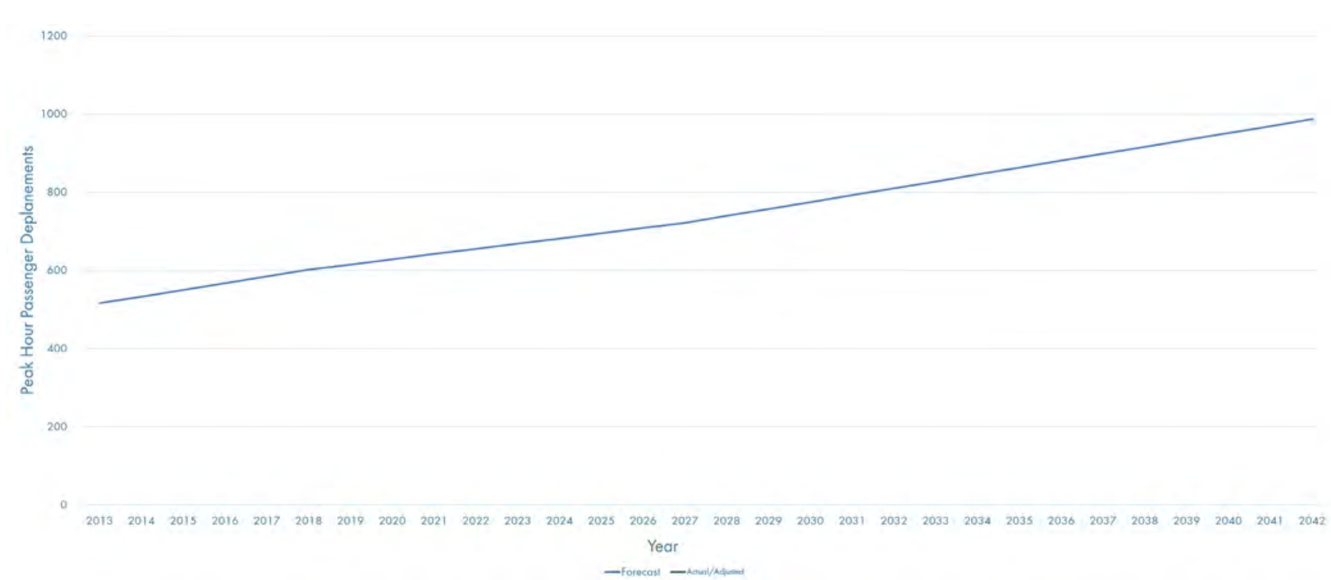
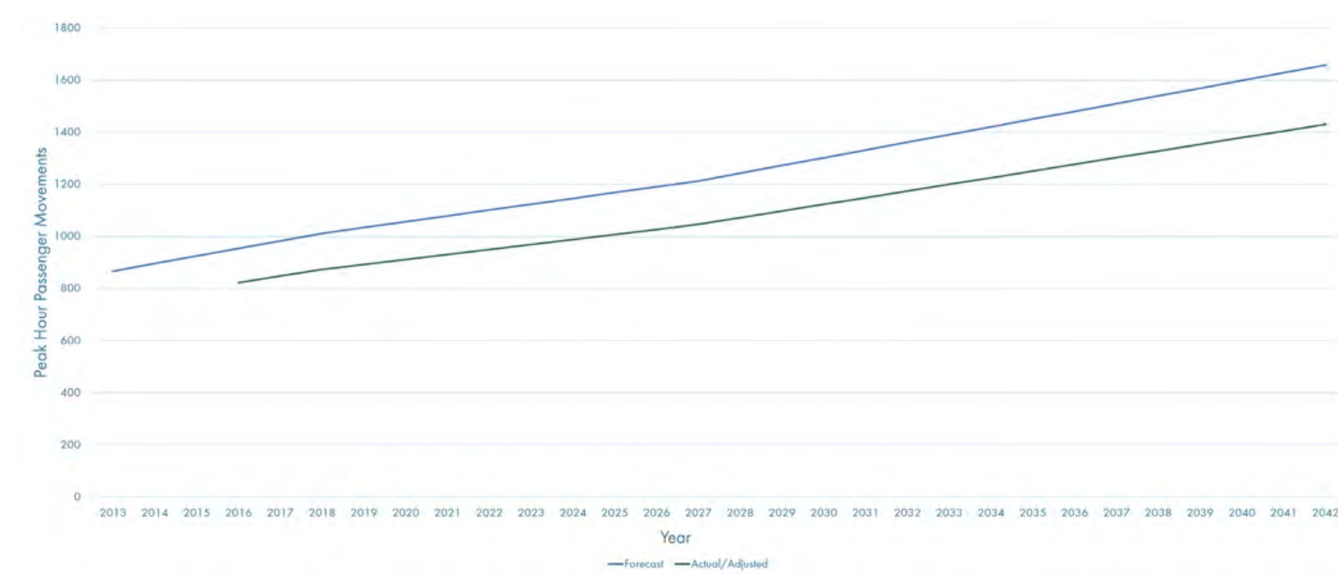


Figure 2.6 - Peak Hour Passenger Movement Forecast



2.1.6 Gate and Remain Overnight Parking Requirements

This subsection contains a review of the LFA projected gate and remain overnight (RON) parking requirements and provides adjustments to the forecast where necessary. Gate and RON requirements depend, in large part, on the passenger aircraft departure forecast. Since actual passenger aircraft departures have varied significantly from the LFA forecast, an updated gate and RON requirement forecast was prepared based on the new aircraft departure projections.

- Updated base year gate and RON requirements were based on an analysis of the June 2016 airline schedules. The updated gate and RON requirement projections incorporated the following assumptions:
    - Current gate use patterns would continue:
    - Preferential for United, Delta, American, and Southwest
- Common use for smaller carriers
- Turns per gate will continue at 2015 levels
- Ratio of RON requirements to passenger aircraft departures will continue at 2015 levels.
  No extra allowance for charter flights or irregular operations

Table 2.8 provides the updated gate and RON forecasts and **Figures 2.7 and 2.8** compare the updated forecasts with the original estimates in the LFA forecast. As shown, the updated gate requirements are slightly lower than the original forecast. The RON requirements, however, are higher by 2042.

Table 2.8 - Estimated Gate and RON Requirements

	2013	2015	2016	2017	2018	2022	2027	2032	2042
Terminal Concept Plan - Original Forecast and Gate Requirements									
Passenger Aircraft Departures									
Forecast (a)	16,871	17,509	17,827	18,146	18,465	19,538	20,879	23,125	27,616
Peak Hour			7				8.20	9.08	
Contact Gates									
Forecast (a)	11	11.4	11.6	12	12	13	14	15	18
Daily departures per Gate (a)	4.20	4.21	4.21	4.21	4.22	4.15	4.09	4.13	4.20
RON Positions (b)	-	-	-	-	-	-	-	-	7
Contact Gates + RON Positions	-	-	-	-	-	-	-	-	25
Adjusted Forecast and Gate Requirements									
Passenger Aircraft Departures									
Adjusted Forecast (c)		15,930	16,220	16,510	16,800	17,776	18,997	21,040	25,126
Adjusted Forecast - Current Gate Use Pattern (d)									
Contact Gates			11	11	11	12	13	14	17
RON Positions			6	6	7	7	7	8	9
Contact Gates + RON Positions			17	17	18	19	20	22	26
Daily departures per Gate			4.04	4.04	4.04	4.04	4.04	4.04	4.04
Daily Departures per Total Parking Positions (Gates + RON)			2.61	2.61	2.61	2.61	2.61	2.61	2.61

(a) Leigh/Fisher, Terminal Area Concept Plan, Appendix B, page 1. Intermediate years interpolated.

(b) Leigh/Fisher, Terminal Area Concept Plan Technical Report, Figure 61. RON requirements for intermediate years not available.

(c) Table 2.4.

(d) Assumes airline contact gate and RON parking utilization per daily aircraft departure remain at existing levels.

Sources: As noted and HNTB analysis.

Figure 2.7 - Contact Gate Requirements

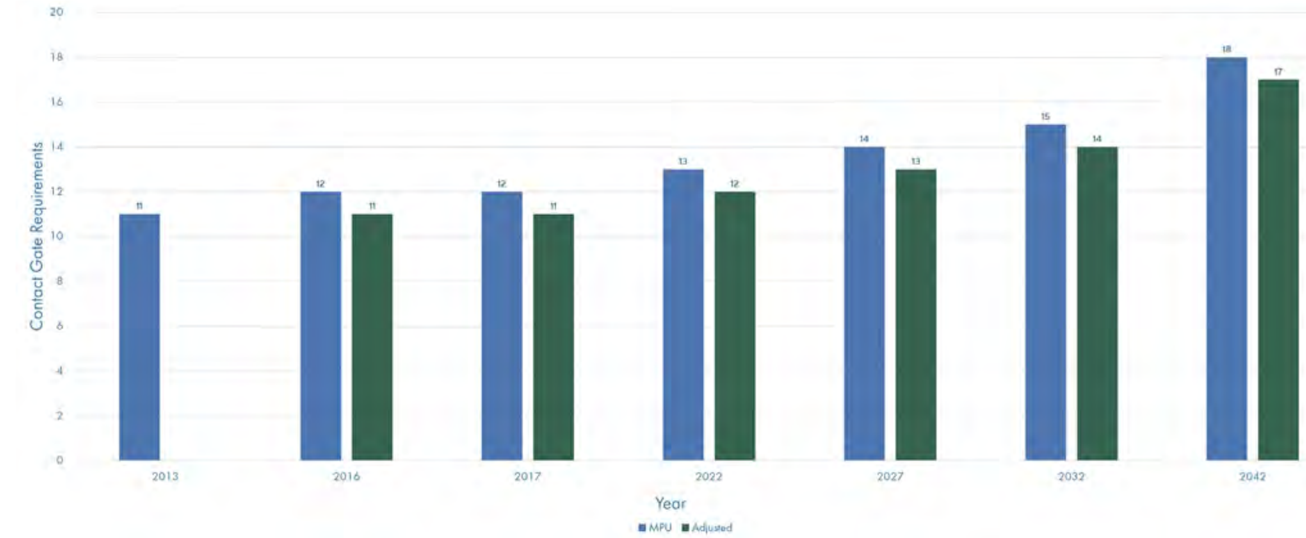


Figure 2.8 - RON Requirements (Contact Gates + Hardstands)

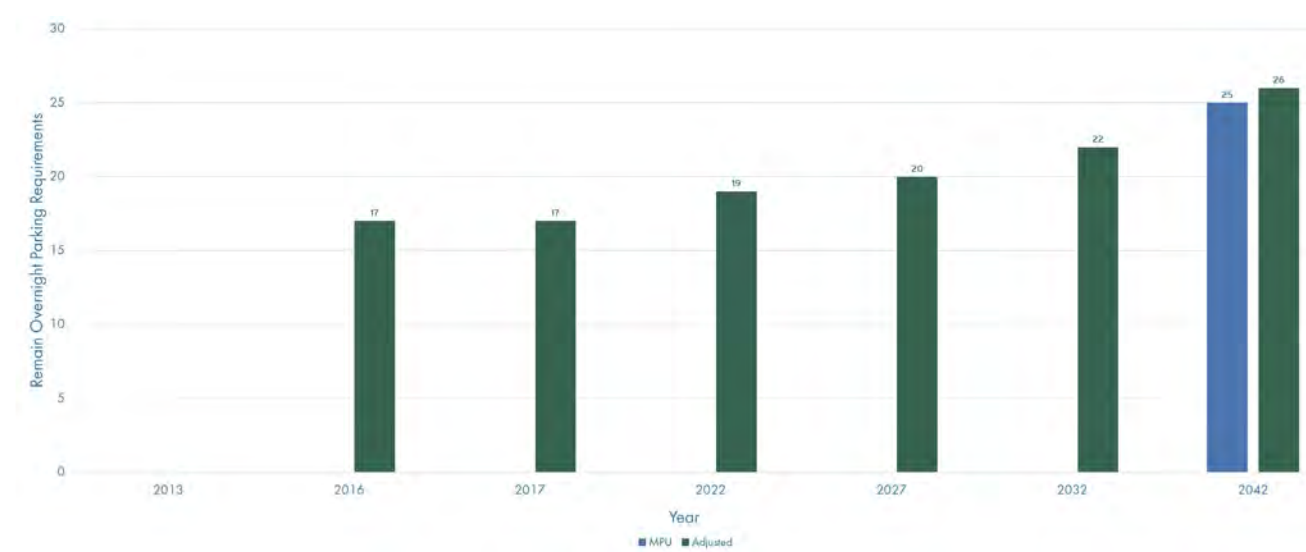


Table 2.9 - Aircraft Operations Forecasts

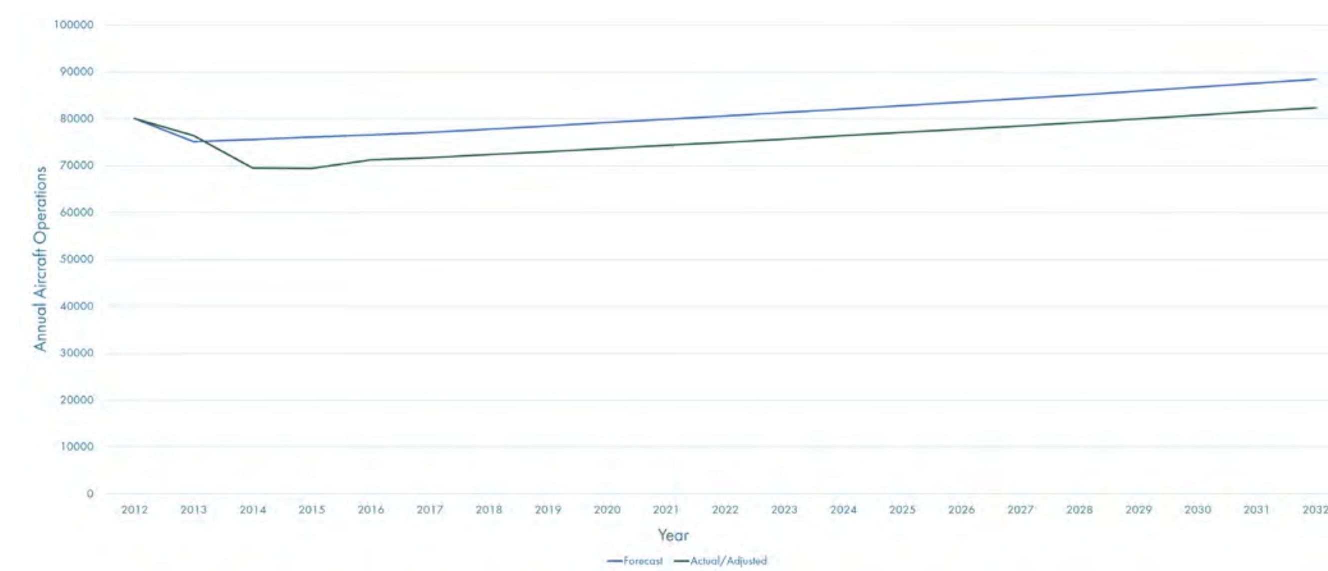
	2012	2013	2015	2016	2017	2018	2022	2027	2032
LFA Forecast (a)									
Air Carrier	19626	21200	25000	26900	28800	29820	33900	40400	47800
Air Taxi	24,574	20,900	17,850	16,325	14,800	14,360	12,600	9,200	5,200
Subtotal Commercial	44200	42100	42850	43225	43600	44180	46500	49600	53000
General Aviation	31962	29200	29450	29575	29700	29820	30300	30900	31600
Military	3,874	3,800	3,800	3,800	3,800	3,800	3,800	3,800	3,800
Total Operations	80,036	75,100	76,100	76,600	77,100	77,800	80,600	84,300	88,400
Actual/Adjusted									
Air Carrier	19,626	20,514	28,354	-					
Air Taxi	24,574	22,617	11,402	-					
Subtotal Commercial (b)	44,200	43,131	39,756	-	40,452	40,990	43,142	46,019	49,173
General Aviation (b)	31,962	30,432	28,075	-	-	-	-	-	-
Military (b)	3,874	2,882	1,556	-	-	-	-	-	-
Total Operations	80,036	76,445	69,387	-	40,452	40,990	43,142	46,019	49,173
Variance									
Air Carrier	0.0%	-3.2%	13.4%						
Air Taxi	0.0%	8.2%	-36.1%						
Subtotal Commercial	0.0%	2.4%	-7.2%	-100.0%	-7.2%	-7.2%	-7.2%	-7.2%	-7.2%
General Aviation	0.0%	4.2%	-4.7%	-100.0%	-100.0%	-100.0%	-100.0%	-100.0%	-100.0%
Military	0.0%	-24.2%	-59.1%	-100.0%	-100.0%	-100.0%	-100.0%	-100.0%	-100.0%
Total Operations	0.0%	1.8%	-8.8%	-100.0%	-47.5%	-47.3%	-46.5%	-45.4%	-44.4%

(a) Leigh/Fisher, Terminal Area Concept Plan, Appendix A, Table 6-5. Intermediate years interpolated.

(b) Data for 2012 through 2016 from Table 2.2. Forecasts were adjusted when 2016 variance exceeded 5 percent. Adjusted forecasts assume aircraft operations increase from 2016 estimated levels at same rate as in Terminal Concept Study.

Sources: As noted and HNTB analysis.

Figure 2.9 - Total Aircraft Operations Forecast



2.1.7 Total Aircraft Operations

Table 2.9 and Figure 2.9 compare actual operations with the LFA forecast of operations for the major activity categories, including commercial (air carrier plus taxi), general aviation and military. In instances where the variance was greater than 5 percent, the forecasts were adjusted by applying the original LFA growth rates to the updated base year numbers. All of the major categories were reviesd downwards. As a result, the updated forecast for 2032 is 80,243 operations, approximately 9 percent lower than the original LFA forecast.

2.2 Forecast Review Summary

The review and analyses above indicate that the LFA forecast methodologies and assumptions are generally sound and the annual passenger enplanement forecasts are on track. Some industry trends such as average aircraft size and fleet mix have occurred faster than originally anticipated and has resulted in a lower operations and gate requirements forecast. As a result of the analysis, no adjustment is recommended for the annual passenger or peak hour deplanement forecasts. However, because there have been material variances from actual and forecast levels, adjustments are recommended for passenger aircraft operations, peak hour enplanement, peak hour passenger, and gate and RON requirements forecasts

Chapter 3 | Existing Conditions

3.0 Existing Conditions

This chapter summarizes existing conditions for the Des Moines International Airport. For the purposes of this chapter, existing conditions and functional usage of the terminals are subdivided into four topical areas: Terminal Building, Airside, Site Utilities, and Landside.

Further detail regarding the existing conditions can be referenced in the 2014 Terminal Area Concept Plan Report.

Existing figures are included to show existing utilities and potential demolition required for the new terminal.

3.1 Terminal Building

The Des Moines International Airport opened its doors to commercial service in 1933 and has since been the primary, largest airport in Iowa, serving nearly all of Iowa's 3.1 million residents. The FAA ranked DSM as 83rd in number of passenger boardings across the US in 2014, serving nearly 2.5 Million Annual Passengers (MAP). Additionally, it is classified in the National Plan of Integrated Airport Systems as a primary commercial service airport, which identifies DSM as a key link in local and national air transportation. The airport's catchment area includes passengers across Iowa and parts of Missouri and Nebraska. Recently, DMAA identified that 87% of their passengers travel to fly out of DSM from within a 75-mile radius, but the remaining 13% come from the rest of Iowa. This is reflected in the airport's number of origination/destination flights, and the number of meeter/greeters that frequent the terminal. One of DMAA's main goals is to create a convenient, efficient experience for passengers, which includes providing more direct flights across the country. In 2018, the three mainline passenger airlines and three low-cost carrier airlines will offer nonstop service to 21 destinations across the nation. However, the aging terminal cannot sustain passenger growth rates because facilities are constrained and the concourse cannot expand to add more gates. Some of the constrained areas, including ticketing, security, baggage handling, holdrooms and the restrooms already constitute an inadequate level of service and will continue to decline as DSM reaches the 3.0 Million Annual Passenger (MAP) mark.

3.1.1 Space Utilization

The current terminal is three levels, with public access on Level 1 and Level 2 and airport use in the basement below the landside processor. Its total area is 264,237 SF, which is not significantly smaller than the proposed new building, however some of the spaces are in the wrong place – generally larger than needed on the "landside", before the Security Identification Display Area (SIDA) line, and smaller than required on the "airside" after security. Refer to **Table 3.1** for a detailed program of the existing space.

3.1.1.1 Level 0

Level 0 of the existing terminal is mostly made up of support space, including mechanical and electrical rooms, airport, restaurant and city storage spaces. It also includes the airport operations center and BEO parts room. A tunnel on the north end provides a non-public connection between the service elevator at the loading dock to the basement. The remaining spaces in or surrounding the basement are unexcavated. See **Figure 3.3** for more detail.

3.1.1.2 Level 1

Level 1 consists of public and non-public spaces, as represented by **Figure 3.2.** Passengers access functions such as the ticketing and baggage claim halls, the rental car counters, the large central concession core, restroom facilities, the meeter / greeter area and access to security on Level 2. On the airside, there is one holdroom that services contact gate A5. Non-public spaces include the ATO's, inbound and outbound baggage makeup, CBIS, TSA Support, MEP spaces, GSE space, and other airport and airline support spaces.

Table 3.1 - Existing Terminal Program

Space	Area
Administration	15,023 SF
Airline Operations	12,999 SF
Baggage Claim	7,462 SF
CBIS	(included in Outbound)
Circulation	47,964 SF
Concession Storage	10,371 SF
Electrical	5,129 SF
GSE Storage	5,207 SF
Holdrooms	22,010 SF
Inbound Baggage	3,313 SF
Mechanical	19,833 SF
Outbound Baggage	16,905 SF
Polic	805 SF
Post-Security Concessions	7,207 SF
Post-Security Restrooms	2,933 SF
Pre-Security Concesions	5,098 SF
Pre-Secuirty Restrooms	3,235 SF
Rental Car / Ground Transportation	4,080 SF
SSCP	7,614 SF
SSCP Queuing	2,591 SF
SSCP Support	3,723 SF
Support	24,250 SF
Support Circulation	14,200 SF
Telecom	2,571 SF
Ticketing	6,552 SF
Vertical Circulation	13,162 SF
Total	**264,237 SF**

3.1.1.3 Level 2

Level 2 is primarily public, with some back-of-house airport spaces, as displayed by **Figure 3.1.** Departing passengers circulate up to security from Level 1 and enter the airside concourse, which includes secure concessions, holdrooms, restrooms and circulation space. The administration and police offices are located primarily above ticketing on Level 2 on the non-secure side. Most of the administration space is accessed from a non-public hallway.

Figure 3.1 - Existing Terminal - Level 2 Plan

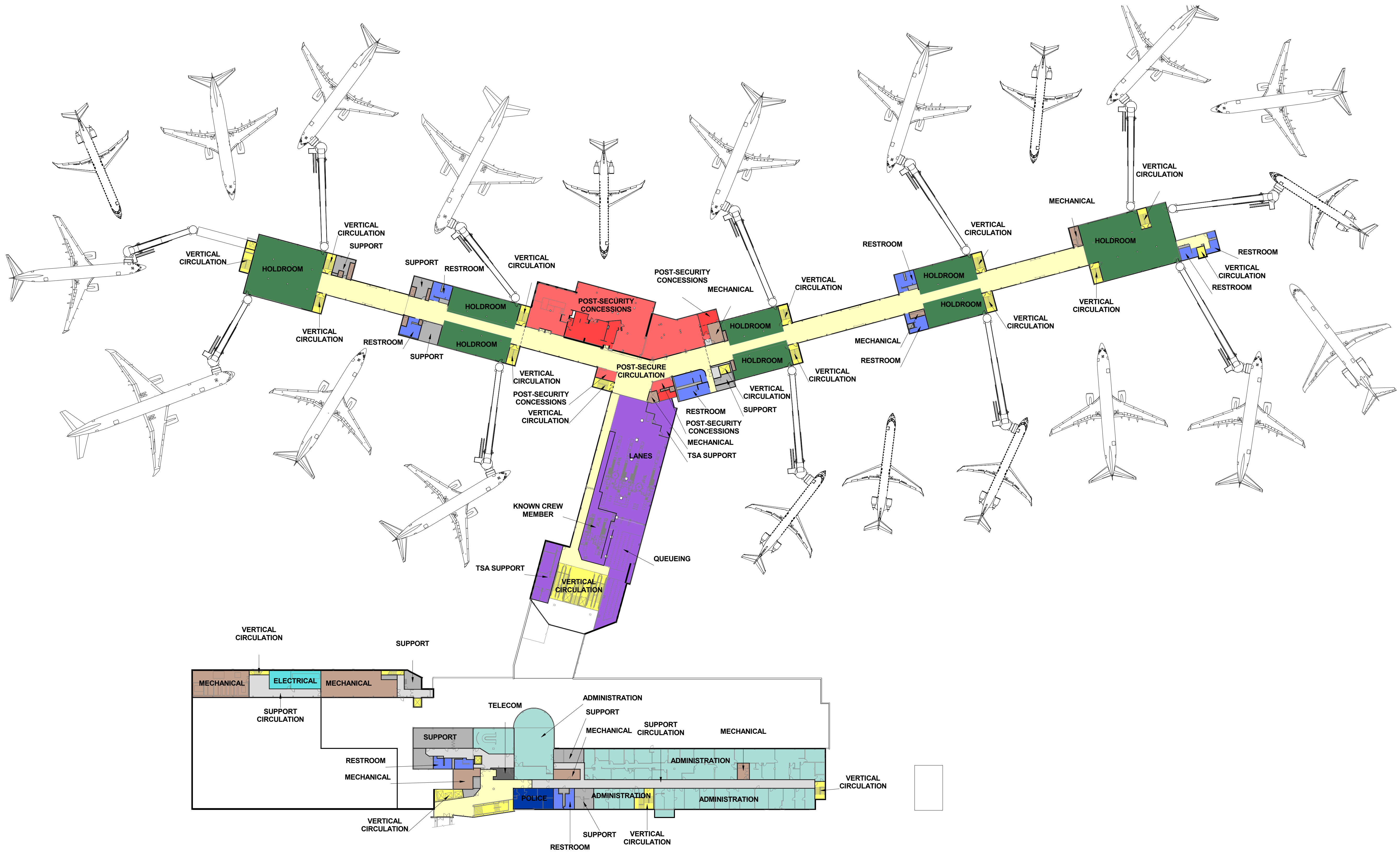


Fig 3.1 Existing Terminal - Level 2 Plan

Figure 3.2 - Existing Terminal - Level 1 Plan

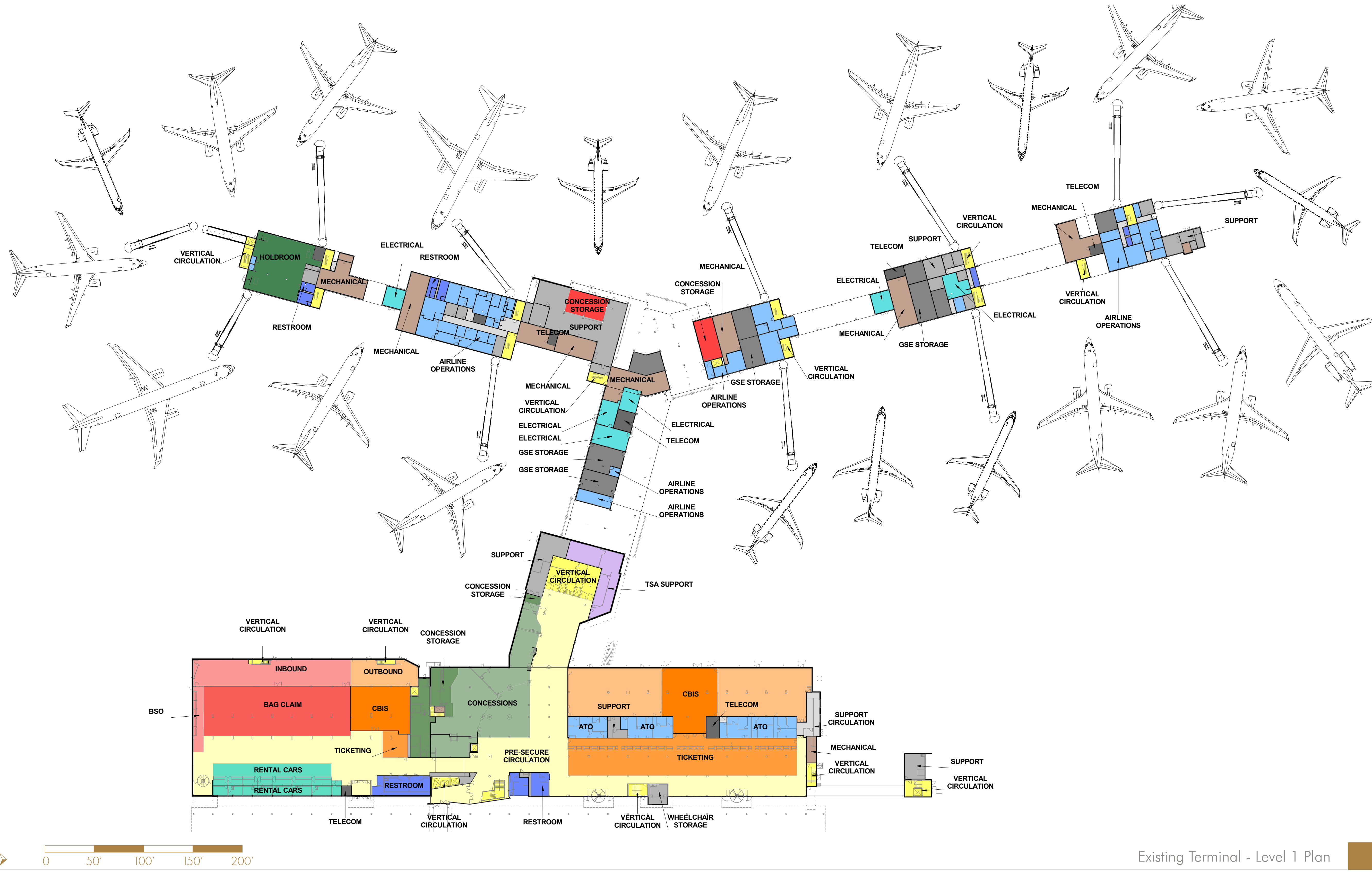
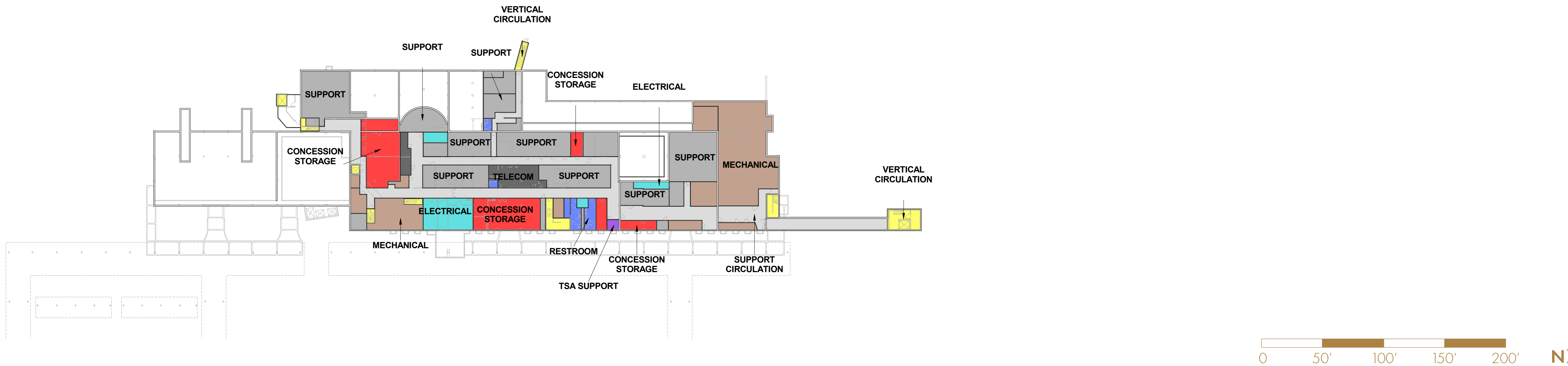


Figure 3.3 - Existing Terminal - Level 0 Plan



3.1.2 Terminal Mechanical / Electrical / Plumbing (MEP) Systems

During the planning phase, all options on the East Quadrant site were studied, including re-use of the existing terminal. A high level analysis of the impacts of re-use of the existing terminal processor ONLY is described below. This analysis assumed that the existing concourses would be demolished in their entirety.

The following sections represent items affected if the existing Terminal Building remains.

3.1.2.1 Electrical Systems

3.1.2.1.1 Power

Existing medium voltage loop will need to remain and be reconfigured for removal of the concourse. It appears that the loop could be cut with the circuits bypassing the concourse.

Normal 480 volt and 120 volt systems at the terminal/concourse intersection may need to be revised depending on panel locations. This would affect power and lighting circuits.

Will have two medium voltage loops – one for the new terminal and concourse and one for the existing terminal. Existing terminal loop is aging, but should have 10-15 years of life left.

3.1.2.1.2 Emergency Power

Existing generators for the terminal would remain and need to be maintained. Some are likely oversized with the reduced occupant/equipment load that would remain in the terminal.

May need to replace a generator or two in the 10-15 year plan.
Existing switchgear should last for another 10-15 years.

3.1.2.2 Lighting Systems

Lighting controls at terminal/concourse intersection will need to be reconfigured.
Lighting in the existing terminal would be nearing the end of its useful life in 10-15 years. Some areas will need to have new lighting installed.

3.1.2.3 Fire Alarm Systems

Existing fire alarm network will need to be revised to remove panels and devices in the concourse. The existing system in the terminal building should be able to remain.
Devices can be removed from the system without much disruption.

3.1.2.4 Heating Systems

There are three boilers located in the basement Boiler Room (age could not be determined from existing drawings). The heating water mains appear to serve the building which will remain and then also enter a tunnel which we believe goes out to the concourses. There is another boiler room in Concourse C which contains four modular boilers.

Depending on the condition of the three boilers in the existing basement, they can likely be re-used (or if necessary, refurbished) in order to serve the modified main building. In a worst-case scenario (the existing boilers are in bad shape and need to be replaced), we would remove the existing boilers and replace them with new modular boilers in the same room.
The gas service to the existing boiler room will need to be maintained.

3.1.2.5 Cooling Systems

There is an existing chiller plant located on the second floor. There are two chillers and three cooling towers (per existing drawings). There are several small condensers for localized cooling in other spots, so those would be removed or kept based on the area that it serves. The age of the chillers/towers is not stated, so they would need to be evaluated to determine if they can be re-used or if they need to be replaced. The piping appears to go out to the Concourse building via the same tunnel as the heating water.

3.1.2.6 Ventilation Systems

The portion of the building that will remain is served by a number of air handling units. It is likely that several of these AHUs are old and ready for replacement. There does not appear to be significant overlap of the ventilation system with the Concourse building, so the existing ductwork could be severed without significant impact to the existing systems.

3.1.2.7 Plumbing Systems

The domestic water service to the building would need to be maintained. There are two water heaters located in the basement of the building to remain. Depending on their age/condition, they could be re-used for the modified building. In a worst-case scenario, these water heaters would be replaced with new condensing storage water heaters.

Existing sanitary and storm outfalls for the building will need to be maintained.

3.1.2.8 Fire Protection Systems

There is a sprinkler riser room in the basement of the building that will need to be maintained.

3.2 Airside

The following subsections describe the current gate layout at DSM as well as information on ground service vehicle roads and aircraft circulation.

3.2.1 Gate Layout

The terminal is currently served by 12 aircraft contact parking positions; Gates A1 through A5 in Concourse A and Gates C1 through C7 in Concourse C. These positions allow parking for up to twelve narrow-body aircraft, as shown on **Figure 3.4**.

The terminal apron also provides off-gate aircraft parking directly adjacent to gate positions for remain-overnight (RON) aircraft (refer to **Figure 3.4**).

3.2.2 Vehicle Service Road

The Vehicle Service Road (VSR) provides access to the airfield and remote aircraft parking positions for airport service vehicles such as baggage tugs, maintenance vehicles, ground service equipment, operations vehicles, and a large array of aircraft servicing vehicles. The apron level gates are served by a 25 foot VSR that crosses beneath the terminal at Concourse C and beneath the connector between the landside processor and the concourses.

3.2.3 Aircraft Flow

DSM has two runways which are essentially identical in length and width. Runway 5/23 is 9003 feet long by 150 feet wide oriented in a northeast/southwest direction. Runway 13/31 is 9002 feet long by 150 feet wide oriented in a southeast/northwest direction. The runways intersect each other approximately 2400 feet from the northeasterly end of Runway 5/23 and 2700 feet from the southeasterly end of Runway 13/31. Since the runway lengths are equal, runway use and flow is primarily determined by wind, with aircraft generally taking off and landing into the wind. During poor weather conditions with very limited visibility and cloud height Runway 31 is used (wind permitting) as it has the best navigational aid equipment for pilots to follow in these limited conditions.

Each runway has a parallel taxiway that runs the entire length of the runway. The taxiways for each runway are located on the side of the runway closest to the terminal. This means aircraft going to or from the primary runway that is in use do not have to cross that primary runway to get to or from the terminal. They may have to cross the secondary runway, depending on flow. In general, if landing aircraft do not have to cross the secondary runway when they taxi in, departing aircraft will have to cross the secondary runway when they taxi out. Normally the traffic on the secondary runway is limited and crossings of that runway do not cause delays.

The parallel taxiways are connected to the terminal ramp by several connector taxiways. Two taxiways connect to parallel Taxiway P on the northerly edge of the terminal ramp and two other taxiways connect to parallel Taxiway D on the southerly edge of the terminal ramp. These four connector taxiways are generally adequate to allow aircraft to taxi into and out of the ramp area without causing gridlock or other delays.

The cargo area in the south quadrant of the airport has a parallel taxiway (Taxiway P) on its side of Runway 5/23 which means aircraft going into or out of the cargo area do not have to cross the primary runway when the primary Runway is 5/23. However, when the primary Runway is 13/31 aircraft going into or out of the cargo ramp will generally have to cross the primary runway for either landing or takeoff, depending on wind direction.

The general aviation area and Air National Guard area located in the north quadrant of the airport have a parallel taxiway (Taxiway D) on its side of Runway 13/31 which means aircraft going into or out of the general aviation area do not have to cross the primary runway when the primary Runway is 13/31. However, when the primary Runway is 5/23 aircraft going into or out of the general aviation area will generally have to cross the primary runway for either landing or takeoff, depending on wind direction.

Figure 3.5 shows the airfield layout for DSM

v

Figure 3.4 - Existing Terminal - Aircraft Parking Positions

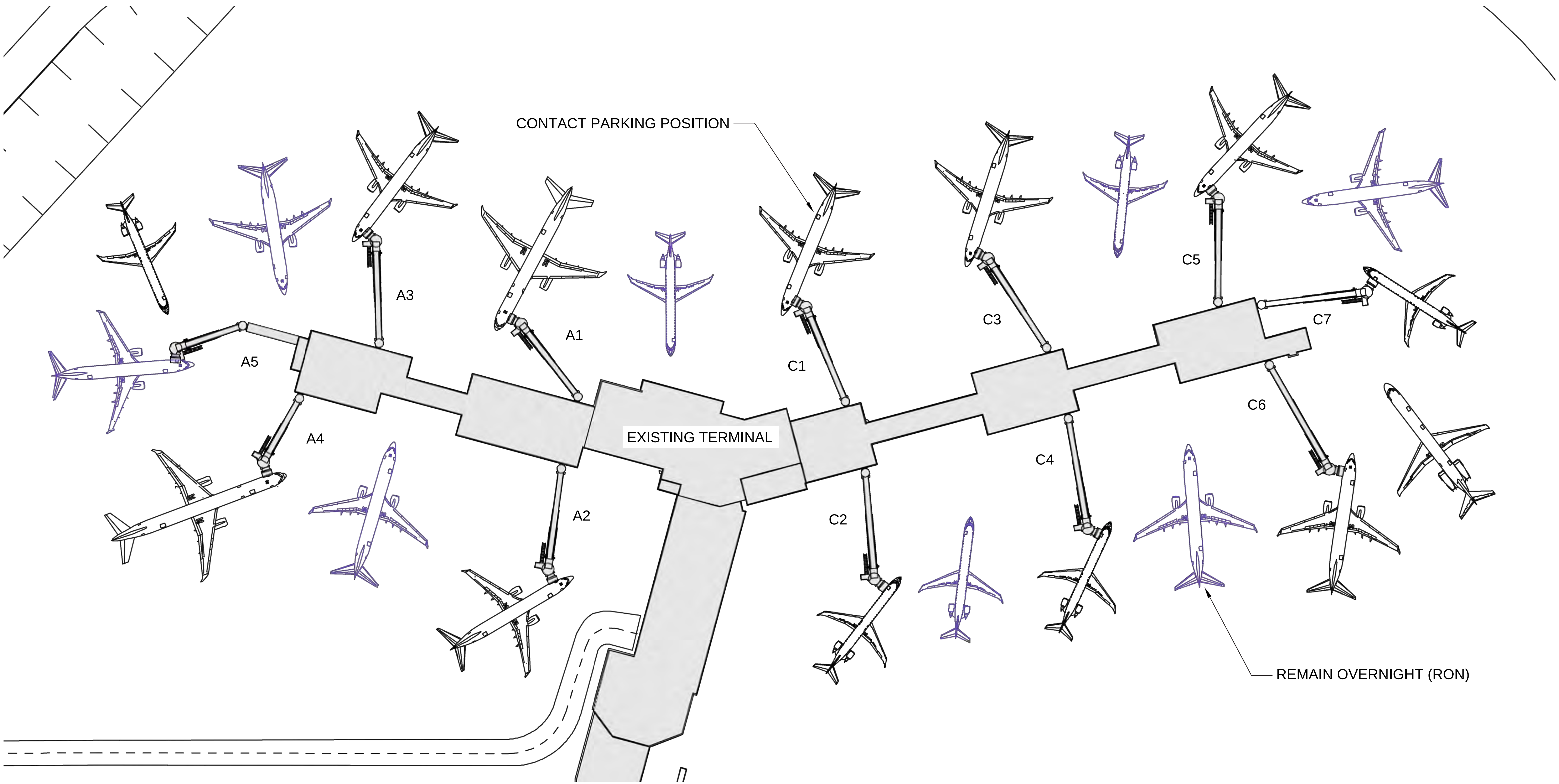


Fig 3.4 Existing Terminal - Aircraft Parking Positions

Figure 3.5 - Des Moines Airport Diagram

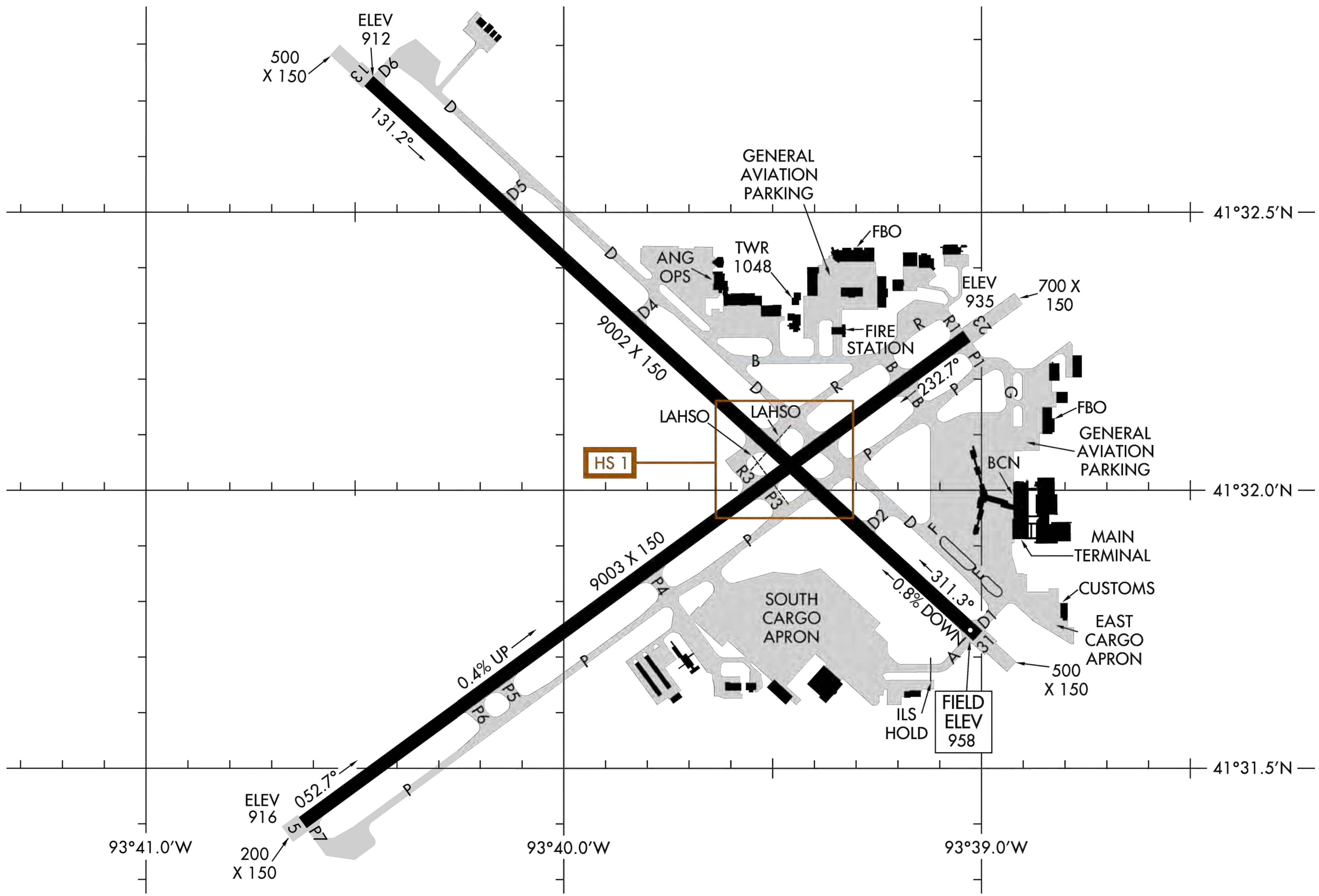
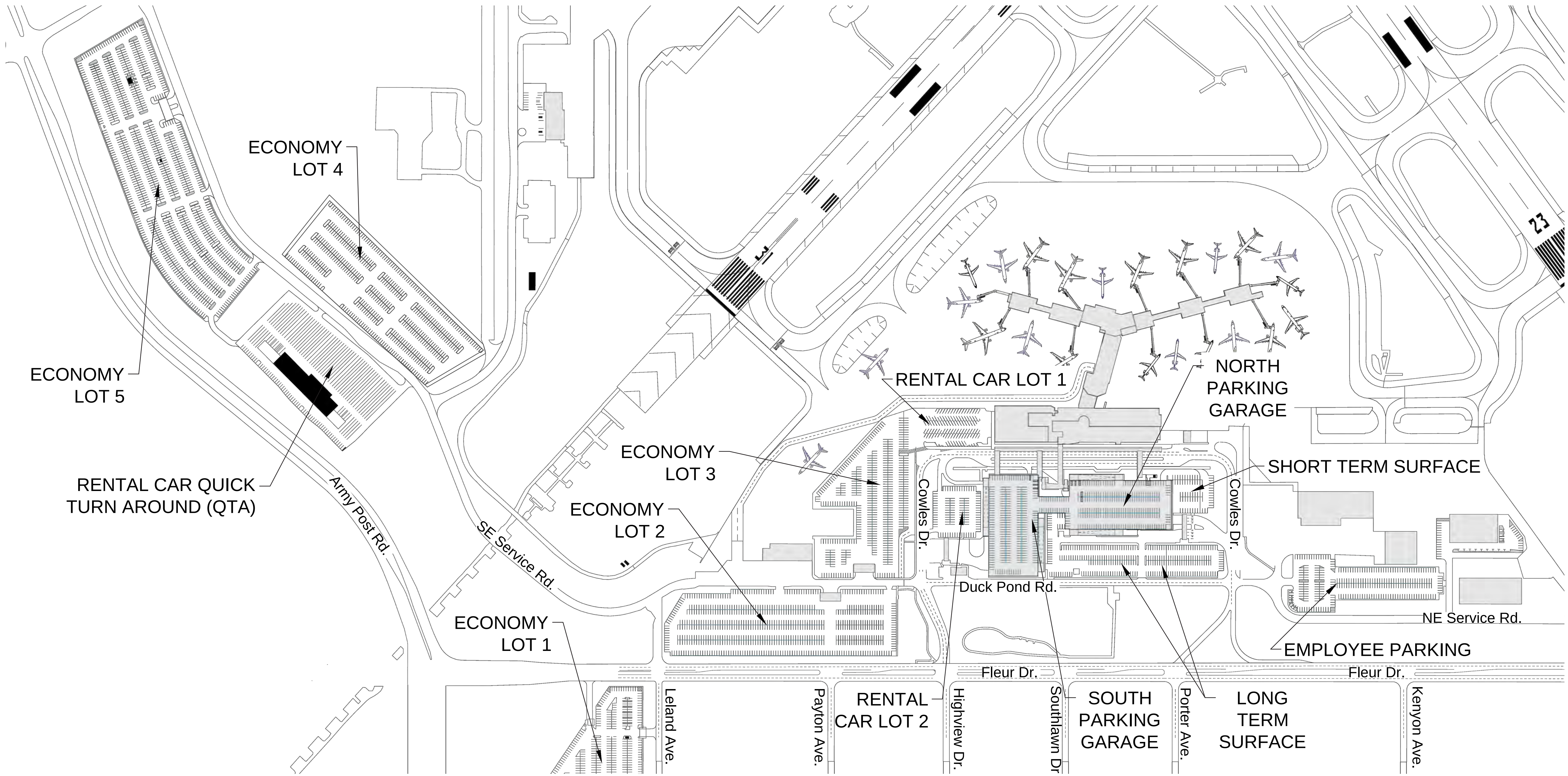


Figure 3.6 - Existing Terminal Roadway and Parking Network



 Existing Terminal - Roadway and Parking Network

0 200' 400' 600' 800' N

3.3 Landside

Existing landside facilities encompassing the roadways, curbside, parking and rental car facilities are summarized in this section.

3.3.1 Roadways

The terminal roadway network is depicted in **Figure 3.6.** As shown, the primary passenger terminal entrance is from Cowles Drive near Porter Avenue at Fleur Drive, a major north-south arterial providing regional access to the airport. A channelized right turn and an un-signalized left turn are provided off Fleur Drive. This provides access to the terminal curbside and parking facilities. Cowles Drive is two lanes approaching and leaving the curbside and three lanes after the parking exit joins the outbound roadway. The Airport exit at the intersection of Cowles Drive and Fleur Drive at Highview Drive is signalized.

Secondary access to Cowles Drive is provided from Duck Pond Road, which is a two-lane bi-directional roadway paralleling Fleur Drive from McKinley Drive on the north to Army Post Road on the south. To the south, the road becomes South Frontage road, wraps around the Runway 31 threshold, and provides access to Economy Lot #4 and the rental car service area or quick-turnaround (QTA) facility. On the north side, the road wraps around the Runway 23 threshold and provides access to the employee parking lot and general aviation complex.

3.3.2 Curbsides

Two primary curbside areas are provided for passenger pick-up and drop-off activity at the terminal. The inner lanes accommodate private vehicles dropping-off departing passengers, adjacent to the ticketing lobby, and picking-up arriving passengers, adjacent to baggage claim. While the outer curb serves most of the commercial vehicles including taxicabs, Transportation Network Company (TNC) vehicles such as Uber and Lyft, limousines, courtesy (hotel and off-airport parking) shuttles, and the Airport parking shuttle. Passengers on the outer curb are dropped-off and picked-up along a median curbside which is accessed from the terminal building by four crosswalks. The length of the inner curbside is 545 linear feet while the outer curb is 571 linear feet. The curbside configuration and allocation is depicted on **Figure 3.7**.

Additional storage space is provided along the inbound roadway and curbside for taxicabs and limousines. Eight spaces are located in a pullout on the right side of the inbound roadway prior to the terminal building. This location requires taxicabs to cross the inbound roadway to reach the designated passenger pick-up area along the outer curbside. An additional three spaces are available for limousines to stage on the left side of the outer curbside.

3.3.3 Parking

Public parking is provided both within the terminal area and in remote facilities. As shown in **Figure 3.6**, two garages, a long-term surface lot and short-term surface lot are located within the terminal roadway loop. Two economy lots (Economy Lot 2 and 3) are located just south of the terminal loop roadway, west of Fleur Drive. Additional remote Economy Lots, requiring bussing, are located further south of the terminal. As shown in **Figure 3.6**, Economy Lot 1 is located east of Fleur Drive near Army Post Road and Economy Lots 4 and 5 are located along the Airport Frontage Road adjacent to Army Post Road. Public access is provided from the intersection of SW 28th Street and Army Post Road with direct access into the terminal along the Airport Frontage Road. Economy Lot 5 is used seasonally as overflow when other lots are full. It has 1,000 spaces but 700 of these are leased to the rental car companies for storage. The lot has a direct connection to the rental car QTA facility. Employee parking is provided in a surface lot north of the terminal entrance. Additional parking is provided by off-Airport private operators including Keck Parking, east of Fleur Drive. **Table 3.2** summarizes the number of parking spaces available in each airport operated lot.

Table 3.2 - Existing Parking Supply

Facility	Number of Spaces
Terminal Area	
Short-Term Surface (Hourly)	98
North Garage Short-Term (Level 1)	243
North Garage Long-Term (Levels 2-4)	699
South Garage Long-Term (Levels 1-4)	675
Garage Connectors	78
Long-Term Surface	280
Sub-Total Terminal Area	***2,073***
Economy Parking	
Economy Lot 1	848
Economy Lot 2	648
Economy Lot 3	379
Economy Lot 4	300
Economy Lot 5	TBD

Table 3.3 - Existing Rental Car Facilities

Facility	Number of Spaces
Rental Car Lot 1	168
Rental Car Lot 2	99
South Garage Level 1	168
Total Ready-Return Stalls	***435***
Storage - Economy Lot 5	700

3.3.4 Rental Car

Seven rental car brands operate at the airport: Alamo, Avis, Budget, Dollar, Enterprise, Hertz, National and Thrifty. Customer service / rental counters are located inside the terminal in the baggage claim area and ready-return spaces are provided outside of baggage claim in three lots as depicted in **Figure 3.8**. Rental Lot 1 is a surface lot located adjacent to the terminal, Rental Lot 2 is a surface lot adjacent to the south garage and additional spaces are provided in level 1 of the South Garage. The ready-return spaces are all configured as standard 90-degree parking stalls and are utilized to park both vehicles ready for rental and vehicles being returned by customers. Spaces allocated to each company are mixed within the three lots.

The rental car service area or QTA, which provides washing and fueling facilities, is located approximately ½ mile south of the terminal, as shown on **Figure 3.6.** The QTA contains five car wash bays, seven light maintenance bays, 20 fuel pumps, and approximately 95,000 sq. ft. of stacking and storage space. Each brand is assigned a light service bay while the car washes and fuel pumps are common-use. The stacking/storage space is allocated in accordance with revenue market share. The QTA is approximately four acres and an additional 700 storage spaces are leased in Economy Lot 4. Stored vehicles are typically stacked nose-to-tail, allowing additional vehicles to be accommodated.

Figure 3.7 - Existing Terminal - Curbside Allocation

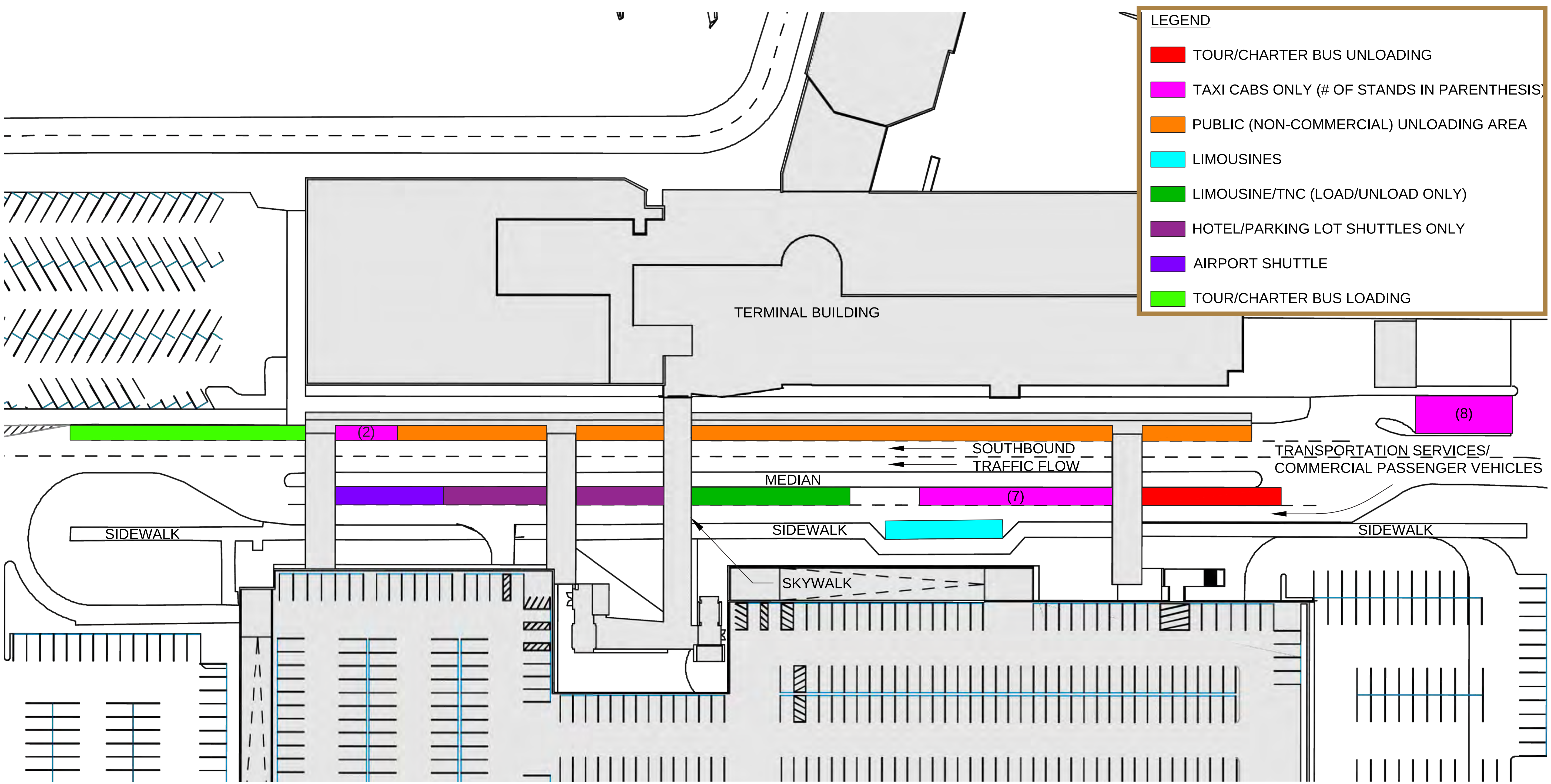


Figure 3.8 - Existing Rental Car Facilities

3.4 Site Utilities

This section reviews the existing site utilities servicing the Des Moines International Airport terminal. The preferred site location for a rental car facility was also reviewed. The utilities reviewed include site power, the domestic water supply, fire protection water supply, sanitary sewer, stormwater management infrastructure, natural gas, and fuel distribution system.

3.4.1 Site Power

MidAmerican Energy provides 13.2kV distribution power to the airport property from a transformer located on the west side of the airport employee parking lot. The distribution voltage is brought from Fleur Drive to the transformer. From the transformer conduits supply power to parking lot lighting and pay attendant booths, Signature Aviation buildings, the existing terminal, and the East Cargo.

Refer to **Figure 3.9** for existing electrical map.

3.4.2 Domestic Water Supply System

Des Moines Water Works (DMWW) provides water supply service to the airport property along Fleur Drive via two 12 inch water mains and an 8 inch water main. The 8 inch water main connects with one of the 12 inch water mains to create a loop system. Several water service lines on the airport property are shown as DMWW owned lines. Ownership of the lines may need to be addressed in the future.

Refer to **Figure 3.10** for existing water distribution map.

3.4.3 Fire Protection Water Supply System

Des Moines Water Works (DMWW) provides water supply service to the airport property along Fleur Drive via two 12 inch water mains and an 8 inch water main. The 8 inch water main branches into the fire protection water service to hangars at the air cargo apron. The 8 inch water main connects with one of the 12 inch water mains to create a loop system. The 12 inch and 8 inch water mains feed the 8 inch fire protection water service to the terminal building. Multiple fire hydrants are distributed throughout the landside and airside areas. Several water service lines on the airport property are shown as DMWW owned lines. Ownership of the lines may need to be addressed in the future

Refer to **Figure 3.10** for existing water distribution map.

3.4.4 Sanitary Sewer

The existing terminal building has two 3,000 gallon grease interceptors on the landside and two 5,000 gallon grease interceptors and one 3,000 gallon grease interceptor on the airside. There is one sanitary sewer main collector which ranges from 8 inches to 15 inches that services the Signature Aviation buildings and Concourse C. Another sanitary sewer main collector, which ranges from 10 inches to 15 inches, services the main terminal and Deicer Storage Building. Both of these sewer main collectors gravity flow to the north and east, combining in the 15" VCP sanitary sewer main that runs along Fleur Drive then crosses Fleur Drive via a 16" CIP sanitary sewer main along the south side of the Yeader Creek culvert.

Refer to **Figure 3.11** for existing sanitary sewer map.

3.4.5 Stormwater Management Infrastructure

The existing terminal site and the planned terminal site are located in the upper end of the Easter Lake/Yeader Creek Watershed. The landside and airside areas within the site generally drain north and east to the discharge point, one 4 foot by 4 foot box culvert and one 6 foot by 4 foot box culvert at Fleur Drive and Yeader Creek. The existing landside stormwater conveyance system includes storm sewer, intakes, and manhole structures. A large wet pond, located along Fleur Drive provides detention for a portion of the landside area. There are offsite areas (non-airport property), including Fleur Drive and commercial sites on the east side of Fleur Drive, that drain to the wet pond.

The existing airside stormwater conveyance system includes storm sewer, intakes, manhole structures, trench drain, and underground stormwater detention. A trench drain to the east of Concourse A collects stormwater and routes it to a diversion structure that directs stormwater into the wet pond in the summer and the underground stormwater detention facility in the winter. The underground stormwater detention facility is located north of the air carrier terminal building.

3.4.5.1 Storm Sewer System - Airside System Operation During Deicing Season

During the existing deicing season, both the Terminal Tank and the South Cargo tank volumes are slowly released to the sanitary sewer system, to comply with pollutant loading requirements of the Iowa Department of Natural Resources and the Des Moines Water Reclamation Authority.

Terminal Area - Deicing operations on the Terminal Apron are restricted, meaning deicing may only occur in the location shown in green in **Figure 3.12**.

- Storm Runoff - typically from late October to early May the storm runoff from the Terminal pavement and snow dump areas are routed to the Terminal Tank.
- Pavement Underdrainage – from late October to early June the underdrainage from the Terminal pavement is routed through a diversion structure to the Terminal Tank.

South Cargo Area - Deicing operations on the South Cargo Apron are restricted to the locations shown in green in **Figure 3.12.** The remaining east area is approximately 22.5 acres where deicing is not allowed, is of interest for this project because of its seasonal routing.

- Storm Runoff – from late October to early May the storm runoff from the east area South Cargo pavement and adjacent snow dump areas are routed to the Terminal Tank. Previously the low flow was diverted to the north tank in the South Cargo area.
- Pavement Underdrainage – the pavement underdrainage piping coincides with the surface drainage runoff patterns and empties in the same inlets of the storm runoff.

3.4.5.2 Storm Sewer System - Airside System Operation During Non-Deicing Season

Terminal Area

- Storm Runoff - typically from early May to late October the storm runoff from the Terminal pavement and snow dump areas are routed to the storm sewer toward Yeader Creek.
- Pavement Underdrainage – from early June to late October the underdrainage from the Terminal pavement is routed through a diversion structure to the storm sewer system toward Yeader Creek.

South Cargo Area

- Storm Runoff – from early May to late October the storm runoff from east area the South Cargo pavement and snow dump areas are routed to the storm sewer system toward Frink Creek.

- Pavement Underdrainage – the pavement underdrainage piping coincides with the surface drainage runoff patterns and empties in the same inlets of the storm runoff.

3.4.6 Natural Gas

MidAmerican Energy provides natural gas service to the airport property via a 4 inch gas main and another gas service located near Fleur Drive. The 4 inch gas main transitions into a 6 inch gas line that is routed thru the parking lot and parking structure to serve the existing terminal building. The second gas line services the Signature Aviation buildings.

Refer to **Figure 3.9** for existing natural gas lines map.

Figure 3.9 - Existing Electric & Gas Map

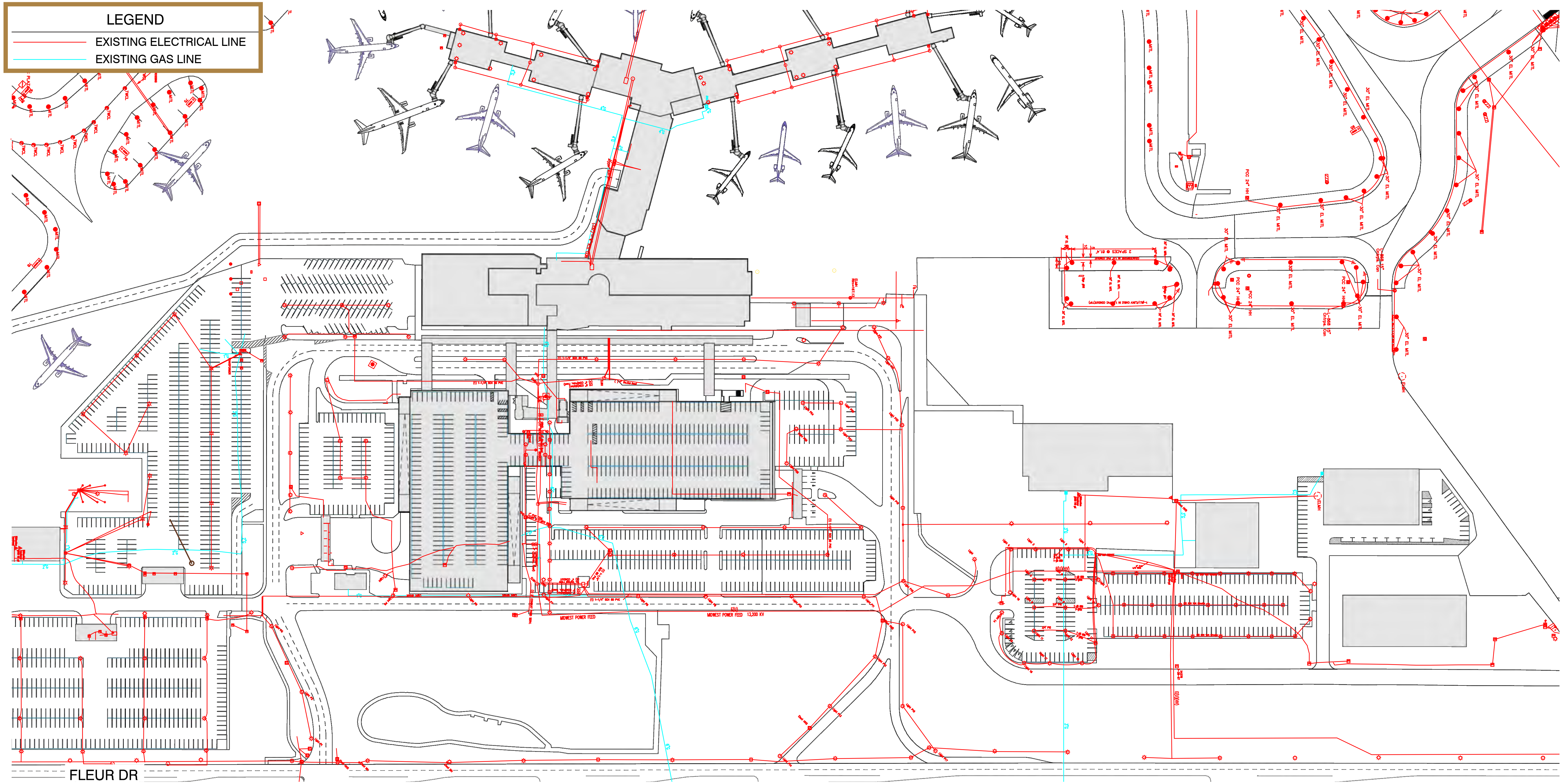


Fig 3.9 Existing Terminal - Electric & Gas Map

Figure 3.10 - Existing Terminal - Water Distribution

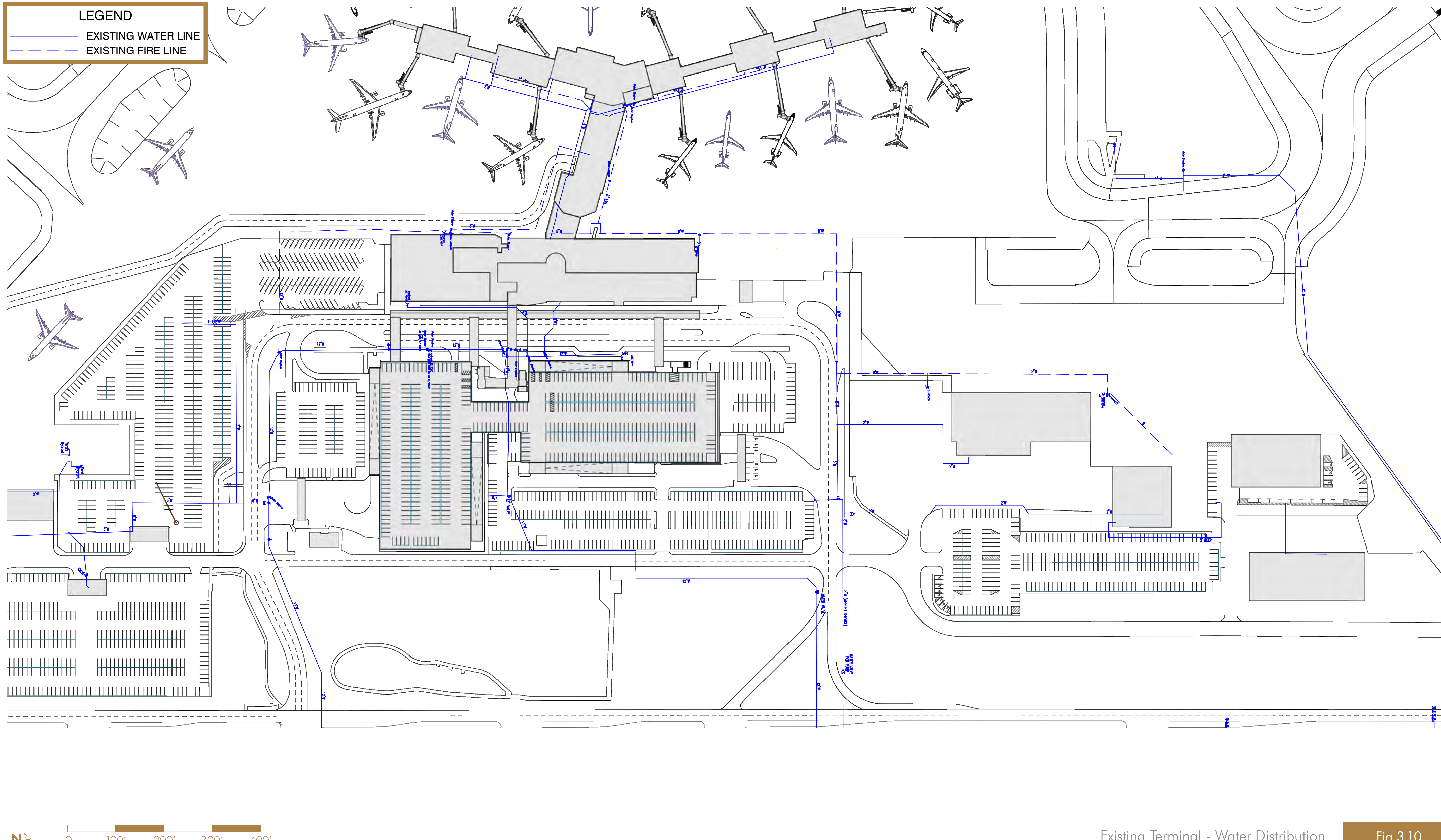


Figure 3.11 - Existing Sanitary Swer

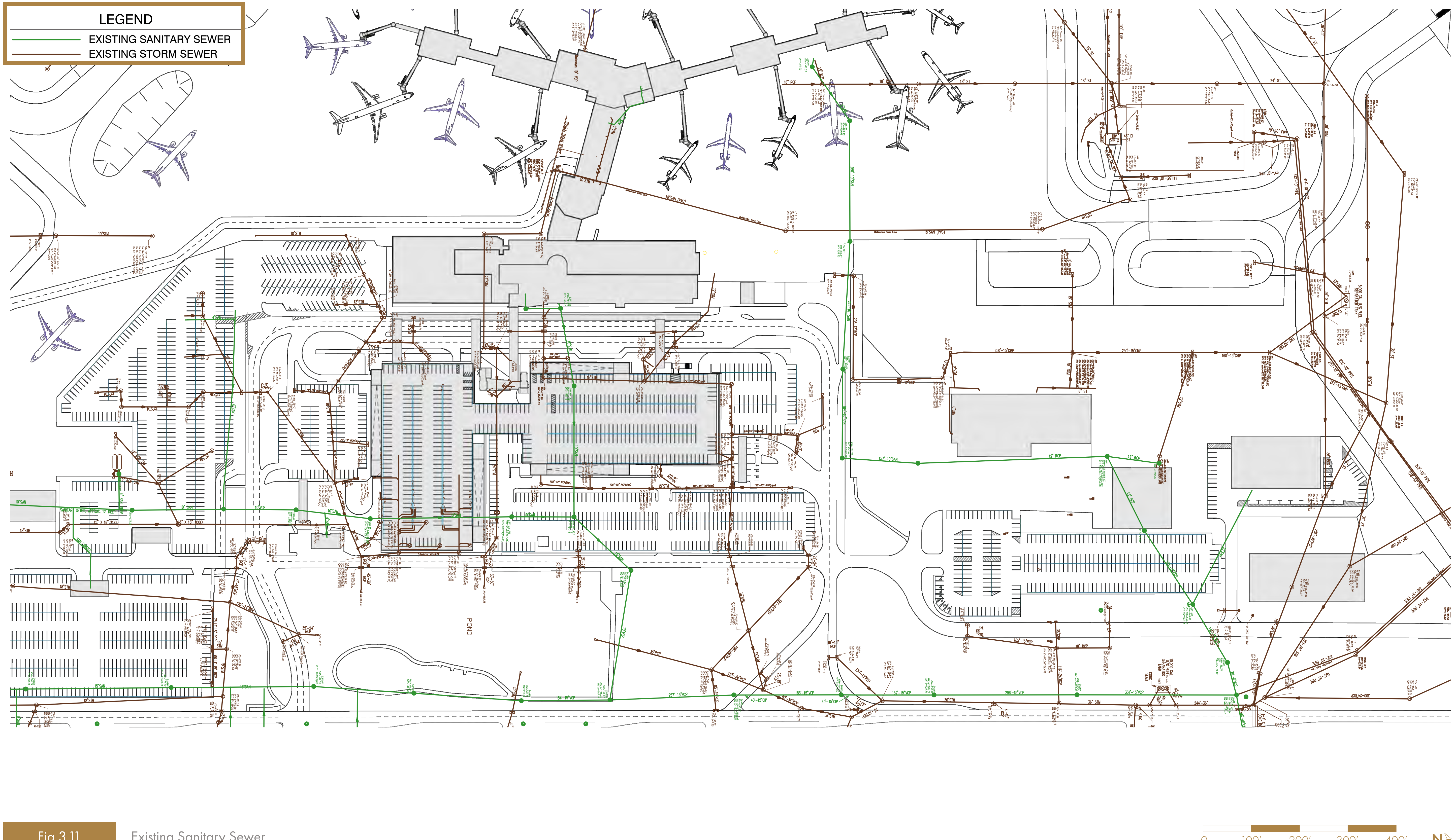
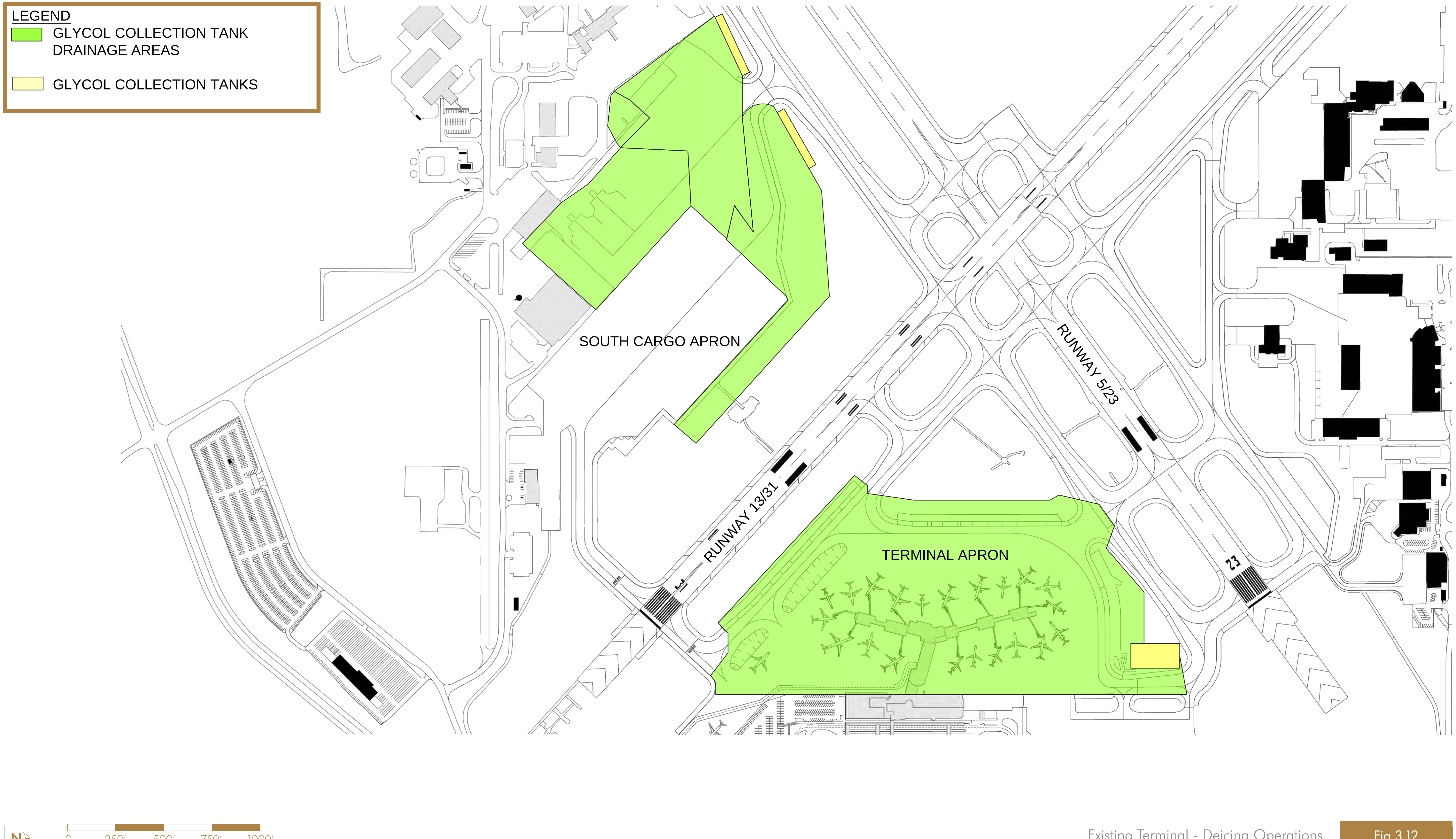


Figure 3.12 - Existing Terminal - Deicing Operations



Chapter 4 | Program Requirements

4.0 Program Requirements

4.1 Overview

Program requirements for Des Moines International Airport (DSM) new terminal were developed through analysis of existing terminal plans, accepted forecasts, the consultant's planning data and industry planning guidelines. The following summary outlines functional facility requirements for check-in and airline ticket offices, holdrooms, baggage claim and baggage offices, outbound baggage and inbound baggage make-up, and Department of Homeland Security (DHS) facilities including Transportation Security Administration (TSA) passenger security screening checkpoint and checked baggage screening facilities. Non-passenger processor facility requirements were developed for airport administration, restrooms, and other miscellaneous terminal areas.

Facility and space requirements described in this section denote passenger processing facilities for the forecast planning activity level (PAL) representative of demand for 3.0 million annual passengers (MAP) for forecast year 2027. This milestone is known as PAL 3.0.

4.2 Program Requirements Summary

Area requirements were developed by applying generally accepted industry standards for desired level of service (LOS) and performance criteria to a level of demand, typically representing peak periods of activity at each individual facility processor component or subsystem. **Table 4.1** summarizes and compares the existing terminal inventory and forecast year 2037 PAL 3.0 program requirements.

Table 4.1 - Passenger Terminal Building - Facility Program Requirements - Total Area by Function

Space	Existing Terminal SF 2016*	Proposed New Terminal Program Year 2027**
Airline Functions		
Ticketing		
Ticketing (Counters, Queuing & Kiosks)	6,552	9,800
Kiosks (Self Check-in & Bag Drop Position @ Counter)	Included in SF above	Included in SF above
Ticket Counter Queuing	-	-
Lobby (Self Service Check-in) (2-Step Process)	-	Included in SF above
Remote (Self Service Check-in)	-	-
Airline Ticket Office	4,580	3,010
Curbside Baggage Check	-	-
Departure Lounge (Gates)	22,010	39,000
Baggage Claim (SF)	7,462	8,540
Baggage Service Office/Storage	-	1,380
Outbound Baggage	16,905	22,520
Inbound Baggage	3,313	8,730
Operations/Maintenance/Storage	8,419	17,230
Clubs/VIP Room/International VIP Lounge	-	-
Subtotal Airline Functions	**69,241**	**110,210**
Concessions Space		
Food & Beverage	12,305	16,500
Convenience Retail	Included in SF above	3,840
Specialty Retail	Included in SF above	1,840
Support/Storage	10,371	4,670
Other-Rental Car, etc.	4,080	To be Located in Garage
Subtotal Concessions Space	**26,756**	**26,850**
US Customs and Border Protection		
Customs/Immigrations/Support	-	-
Subtotal U.S. Customs and Border Protection (FIS)	**N/A**	**N/A**

Space	Existing Terminal SF 2016*	Proposed New Terminal Program Year 2027**
Secure Public Area		
Security Screening Checkpoint (Includes Queuing Area)	10,205	11,820
Circulation - General	43,694	43,220
Restrooms	2,933	7,150
Subtotal Secure Public Area	**56,832**	**62,190**
Non-Secure Public Area		
Circulation		
Circulation - Ticketing	Included in SF below	Included in SF below
Circulation - Baggage Claim	Included in SF below	Included in SF below
Circulation - General	31,632	31,900
Vestibules	Included in SF above	Included in SF above
Restrooms	3,235	2,810
Others (Miscellaneous Areas)	-	-
Subtotal Non-Secure Public Area	**34,867**	**34,710**
Non-Public Area		
Airport Administration	15,023	9,320
Other (Loading Dock/Receiving/Mech. Exterior Support)	-	-
Airport - GSE/Vehicle Storage & Maintenance	29,457	8,880
TSA Offices/Support	3,723	6,410
Airport Police Station	805	250
CBIS (Checked Baggage Inspection System)	Incl'd in Outbound Bag.	23,200
Subtotal Non-Public Area	**49,008**	**48,060**
Airport Operations and Maintenance		
Airiport Operations and Maintenance	Included in SF above	Included in SF above
Mech./ Elect./IT-Comm./Plumb. & Fire Protection/Misc. Bldg Systs		
Mechanical	19,833	4,170
Electrical	5,129	5,610
IT-Communications	2,571	4,540
Plumbing & Fire Protection	Included in Mech. above	1,900
Subtotal Airport Operations, Maintenance & Misc.	**27,533**	**16,220**
Total All Areas	**264,237**	**298,240**

* HNTB analysis of DSM Programming Questionnaires and HNTB application of updated forecast

** Some terminal areas fulfill Year 2042 program requirements

4.3 Level-of-Service Standards and Performance Criteria

4.3.1 Level of Service Standards

Level of Service (LOS) is an industry accepted value system of space standards and guidelines that are used to assess performance and congestion levels within terminal facilities. The International Air Transport Association (IATA), Airport Development Reference Manual, 9th Edition was used to define the recommended LOS C standards, unless superseded by DSM Authority or airline stakeholder preferences. LOS C is typically used as a performance criteria target for most airport terminals and is recommended by IATA as the minimum design objective, as it denotes good service. For purposes of this analysis, facility requirements have been calculated to achieve the LOS C goal during peak periods of passenger demand on facilities used to process passengers and baggage, including: check-in, security screening checkpoint, baggage handling and screening systems, and holdroom areas. The passenger queuing and circulation conditions are generally defined by the IATA LOS grades as listed below in **Table 4.2**.

Table 4.2 IATA Level of Service Grades

LOS A	Excellent level of service; condition of free flow; excellent level of comfort
LOS B	High level of service; condition of stable flow; very few delays; high level of comfort
LOS C	Good level of service; condition of stable flow; acceptable; good level of comfort
LOS D	Adequate level of service; condition of unstable flow; acceptable delays for short period of time; adequate level of comfort
LOS E	Inadequate level of service; condition of unstable flow; unacceptable delays; inadequate level of comfort
LOS F	Unacceptable level of service; condition of cross flows; system breakdown and unacceptable delays; unacceptable level of comfort

Source: IATA, Airport Development Reference Manual, 9th Edition

4.3.2 Performance Criteria

Performance criteria used to establish process duration goals and space allocations were derived from IATA LOS standards, TSA standards and DSM input. These criteria were applied to generate unit requirements for passenger check-in and the security screening checkpoint. Performance criteria goals used to analyze facility requirements are indicated in **Table 4.3.**

Performance criteria used to establish process duration goals and space allocations were derived from IATA LOS standards, TSA standards and DSM input. These criteria were applied to generate unit requirements for passenger check-in and the security screening checkpoint. Performance criteria goals used to analyze facility requirements are indicated in **Table 4.3.**

Table 4.3 Performance Critera

Function	Duration	Area / Pax	Notes
Check-in			
Kiosk	1-2 Minutes	14-19 SF	
Baggage Drop	1-5 Minutes		
Full Agent Assistant	10 - 20 Minutes		
Checkpoint	10 Minutes	11 SF	Maximum wait time goal during peak period demand at checkpoint
Baggage Claim	10 Minutes	18 SF	First bag shows up at claim unit within 20 minutes after scheduled time of arrival; 16-18 SF per passenger within active retrieval area around device

4.4 Terminal

4.4.1 Check-in

Check-in is the process by which passengers obtain their boarding pass and baggage tag, if they are checking in bags, prior to proceeding to the security checkpoint to be screened. Some DSM tenant airlines have indicated use of kiosk and two-step check-in (Kiosks and baggage drops) processes for future requirements while others recognize that future technologies may eliminate kiosks altogether as people continue to use their mobile devices. The methods and technologies for which passengers obtain boarding passes and baggage tags are defined as passenger check-in attributes and when associated with passenger show-up profiles and LOS performance criteria, form a basis for check-in facility requirements.

Performance of the check-in subsystems, such as the passenger queuing and the check-in process are analyzed by wait time goals for time in queue and average processing times by passenger type. The amount of time a passenger waits for service and the amount of time required to process each passenger type at a check-in position varies depending on the degree of assistance required. For this reason, passenger attributes or the methods and technologies are segmented into four categories, which include bypass, kiosk, mobile and agent. Each category utilizes various check-in equipment positions and are defined as follows:

- Bypass (Internet/Mobile Device) Check-in: Passengers who do not check bags and who are able to check-in remotely, prior to showing up at the terminal, and do not use the terminal facilities
- Mobile Check-in: Passengers who have printed their boarding pass off-site (home, hotel, office, etc.) or on their cell phone
- Kiosk Check-in: Stand-alone kiosks located in front of in line positions or remotely from the check-in counter, where passengers acquire boarding passes and/or print baggage tags
- Baggage Drop Positions: Airline staff tag and accept bags from passengers who checked in online (mobile) or at a kiosk for two-step check-in process
- Full Service (Agent) Check-in: Airline staff may assist passengers in acquiring boarding passes and where check-in bags are accepted

Computer simulation was used to analyze the number of check-in positions needed to achieve the level of service goals for check-in. Check-in requirements were calculated for each airline based on individual peak period operations. A summary of check-in position requirements is shown in **Table 4.4** and the details of the computer modeling is in **Apendix D**.

Table 4.4 Check-In Program Requirements

Facilities	Existing	PAL 3.0 Requirements
Full Service (Agent) Positions	54 (1)	25
Kiosk Positions	30 (1)	36
TOTAL POSITIONS	**84**	**61**
Bag Drop Locations	-	6
Total Linear Frontage (5ft/position)	230	175
Total Check-in Program Area (sf)	**5,910**	**9,800**

Notes:
(1) Leigh/Fisher Terminal Area Concept Plan Technical Report
Sources: As noted and HNTB Analysis

Check-in facilities in airport terminals range in configurations depending on airline operational preferences. Various configurations may include traditional linear agent counters with or without built-in self-service devices, island counters, or a mix of remote self-service devices and baggage tag check-in positions. Space requirements between these configurations may differ slightly depending on the size of equipment.

Areas that constitute the check-in area are described below:

- Check-in Position: The location where passengers are checked in by airline staff or kiosk in the check-in lobby. A single check-in counter position is assumed to be 5 feet wide (counter work area and baggage scale) and 11 feet deep from front face of check-in counter to the back wall. The depth allows for work area and take-away conveyors up to 48 inches wide that accommodate large bags.
- Transaction Area: Standing area for passengers and their baggage while conducting transactions at the check-in counter and primary cross aisle circulation for passengers moving to and from the check-in counters. The transaction area is typically 7-10 feet deep from face of check-in counter to ticketing queue boundary and represents the standing area for passengers transacting at check-in counters and primary cross aisle for passengers circulating in front of the counters.
- Check-in Queue: Holding area for passengers waiting to transact at check-in counters ranges in depth depending on LOS criteria for square footage per passenger in queue. Ticketing queues are typically defined by queue stanchions with serpentine lanes spaced 5 feet (4 feet recommended minimum) between each queue stanchion lane. Flexibility is key to the queue area success. Access flooring is one possible inclusion that creates flexibility for the airport tenants.
- Circulation Corridor/Aisle: Main circulation area for passengers and non-passengers moving between ticketing queues and other terminal functions. This area is recommended to be a minimum of 20 feet deep and free of any fixed obstruction to accommodate the cross circulation for passengers and non-passengers.

4.4.2 Airline Support Spaces

Airline support space such as offices, customer service areas and maintenance or operational facilities are reflective of airline, stakeholder and DSM input.

4.4.2.1 Airline Offices

This airline ticket office (ATO) area is accessible to airline employees from the ticket lobby area and the back of house non-public area of the terminal. The area includes airline administrative office spaces and other check-in support offices. These offices are located behind the ticket counters and provide support functions for the airline staff handling check-in. This area may include the airline station manager's office or a sales office. The requirements for these areas are generally based on existing carrier leased space or their projected requirements.

4.4.2.2 Airline Baggage Service Offices

The airline baggage service office (BSO) area is programmed to include passenger service counters, waiting areas, and storage for delayed or unclaimed baggage. The BSO area has been programmed to be common use of approximately 1,380 square feet total including customer lobby and baggage storage. The lobby will be a common shared space and the counters will be treated similar to the check-in counters. The storage area will be a separate room that contains separate lockable storage units for each airline's individual use.

4.4.2.3 Ramp Level Facilities

This area has been partially programmed based on airline and DSM input. The facilities contributing to the ramp level space are comprised of two types: covered enclosed area and covered unenclosed area. The covered unenclosed space is provided for various types of storage not requiring protection from the environment (i.e. equipment parts storage). Typical uses for covered enclosed spaces include offices, break rooms, lockers and storage areas for terminal service crews, maintenance offices, and workshops and storage areas, etc. Similar to programming of airline offices, the requirements for these areas generally based on existing carrier leased space or their projected future requirements. The current programmed covered unenclosed ramp level space is 25,700 SF and the programmed covered enclosed area totals 17,200 SF.

4.4.3 Department of Homeland Security

The Department of Homeland Security (DHS) maintains in-terminal facilities such as the security screening checkpoint and the baggage screening areas to conduct airline security screening and screening of passenger baggage. The DHS terminal facility requirements are based on the following publications:

- The Transportation Security Administration (TSA) Recommended Security Guidelines for Airport Planning, Design and Construction: Revised: May 2011
- The Transportation Security Administration, Planning Guidelines and Design Standards (PGDS) Version 5.0 for Checked Baggage Inspection System, July 9, 2015
- The Transportation Security Administration, Checkpoint Design Guide (CDG), Revision 5.1, May 7, 2014

Computer modeling was utilized to developed passenger demand based on flight schedule analysis and application of growth factor for planning years 2027 and 2042.

Detailed analysis is included in Appendix D.

Figure 4.1 Checked Baggage Inspection System

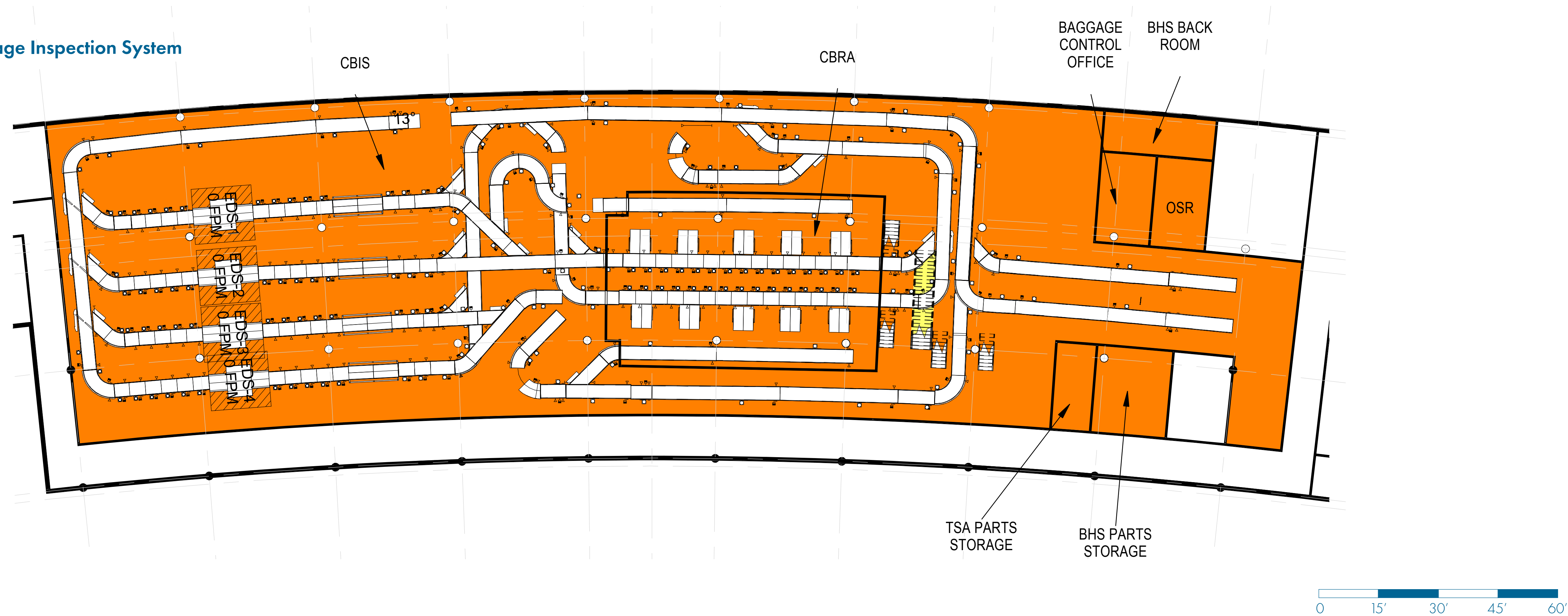


Figure 4.1 - Checked Baggage Inspection System & Figure 4.2 - Passenger Security Screening Checkpoint

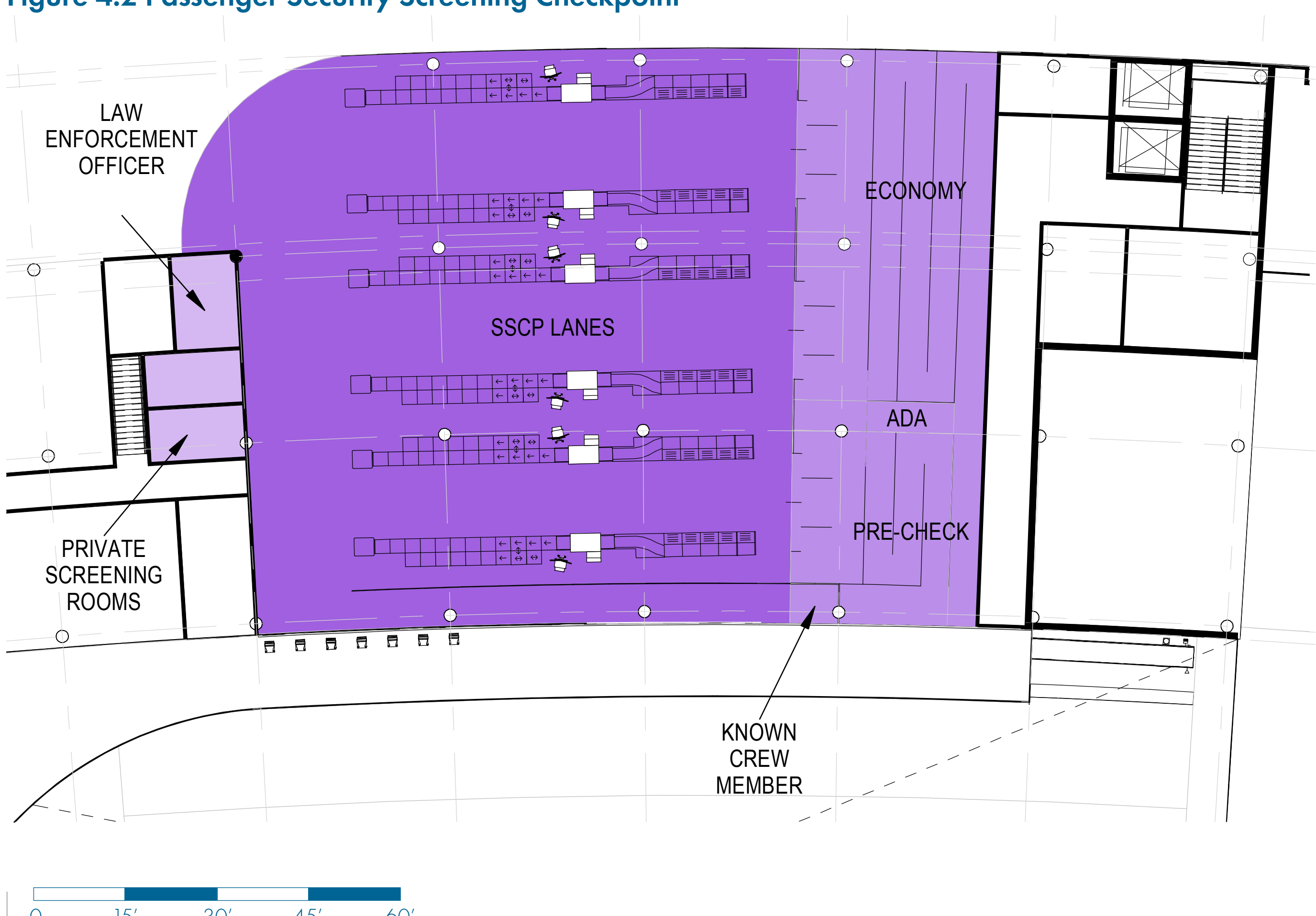
4.4.3.1 Passenger Security Screening Checkpoint and TSA Support

The security screening (SSCP) consists of x-ray units, magnetometers, advanced imaging technology (AIT) units and inspection areas. Placement of the SSCP delineates the secure and non-secure areas of the facility. While the TSA has direct responsibility for determining the size and configuration of the SSCP, TSA typically collaborates with the airport management and the management's design consultant to plan checkpoint locations and programs. The Checkpoint Design Guide (CDG), Revision 5.1, May 7, 2014 provides guidelines for developing the requirements for checkpoints in the terminal, along with the following criteria:

- TSA prescribed planning screening rate of 150 passengers per hour per lane was used for standard lanes, while TSA Pre-Check lanes have a screening rate of 250 passengers per hour.
- The required number of checkpoint lanes were developed to provide the throughput needed to maintain the TSA wait time goal of 10 minutes during the peak 10-minute demand interval of the peak hour.
- The queue area assumes 10.8 sf per passenger in queue, and provides the capacity to hold passengers for 20 minutes.
- The SSCP should be designed to accommodate Automated Screening Lane (ASL) technology.

Figure 4.2 illustrates the proposed passenger security screening checkpoint programmed and based on the TSA Checkpoint Design Guide (CDG).

Figure 4.2 Passenger Security Screening Checkpoint



4.4.3.2 TSA Checked Baggage Inspection System (CBIS)

A Preliminary program and concept have been developed for the Checked Baggage Inspection System (CBIS) that represents approximately 23,000 sf. The planned location of the CBIS is a basement area that is aligned below the proposed outbound baggage area. This basement area also includes other baggage related and building support elements such as baggage control, baggage parts, building mechanical, support, and storage. Like TSA requirements for planning and design of the security screening checkpoint, TSA also collaborates with the airport management and the management's design consultant to plan and program the CBIS, which is based on the TSA, Planning Guidelines and Design Standards (PGDS). At this juncture of completing this Program Definition Manual, the CBIS has been programmed and planned to satisfy baggage screening requirements based on the forecast activity levels of aircraft, passengers and baggage. A layout of the CBIS system is shown in **Figure 4.1.**

4.4.4 Baggage Claim

The claim devices shall be free-standing devices, completely positioned within the baggage claim hall. The devices will not penetrate the Terminal wall separating sterile from public area but fed by conveyors running overhead. Each conveyor feeding line has an automatic security door to prevent unauthorized access. The loading of bags onto the claim devices is controlled automatically by the baggage controls system in a safe manner. **Table 4.5** contains a detailed listing of the baggage handling system requirements.

Table 4.5 Baggage Handling System Requirements

	Year 2027	Year 2042	Program	Area [sf.]
Baggage Make-up	25 cart positions	32 cart positions	32 cart pos. (4 carousels)	27000
Peak hour departing bags	929	1269	1400	n.a.
Number of EDS machines		4	4	9000
Number of OSR positions		2	2	120 (1 room with two desks)
Number of BIT stations (standard)		14	14	6125 (incl. provision for support space and conveyance)
Number of BIT stations (OOG/OS)		5	5	3375 (incl. provision for support space and conveyance)
Baggage reclaim length	285 feet	380 feet	3+1 claim @ 100 ft. each	12800 (+4,800)
Baggage reclaim feed			3+1 claim feed + 1 OS area	9000 (+1,800)
Baggage support spaces	See Chapter 5.1.1.2			

4.4.5 Outbound / Inbound Baggage

The baggage handling system (BHS) shall at a minimum be based on U.S. standard BHS dimensions (i.e. 42-inch-wide belts) for standard bags and 67.5" radius for power curves.

The checked bag screening inspection system (CBIS) shall be compliant with the latest TSA requirements, specifically follow TSA's Planning Guideline and Design Standard (PGDS) applicable at the time of design.
Tug and cart lanes shall be wide enough to navigate safely with a tug and three carts configuration.

The outbound baggage system shall at a minimum be redundant for all vertical transitions between the lobby/apron level and the basement level. For all conveyance areas which require maintenance or operational access, maintenance catwalks shall be provided.

The BHS will be a common use system for all airlines operating at the airport. It shall comply to all applicable national and local codes and regulations. The BHS shall provide the required interfaces to other systems (e.g. fire alarm, card reader for to allow system operation by authorized personnel only).

Standard sized outbound baggage is checked at the two take-away ticketing conveyors in the Terminal lobby. To allow for redundant conveyance for the vertical transition, the two conveyor lines run separately from the lobby into the basement where they merge.

The Baggage Handling System (BHS) distinguishes between Standard, Out-of-Gauge and Oversize bags. Out-of-Gauge bags are bags which can be transported with the conveyance system but cannot be screened by the installed automatic bag screening equipment (EDS machines). These bags can be inducted at the regular check-in desks and shall be automatically detected by the system and routed directly to the CBRA area for screening (by-passing the EDS machines).

Oversize checked items which cannot be transported with the conveyance system (more than 54 inches in length or 30 inches in width) shall automatically be detected at the ticketing conveyor. After detecting oversize bags, the ticketing conveyor stops and signals the need to remove the bag and manually transport it to the oversize screening area. Items which are not conveyable for other reasons (e.g. weight or fragile) will be transported manually as well.

The BHS Control room shall provide sufficient space for personnel and equipment to monitor the entire baggage handling system from one centralized location.

Monitor screens in the control room shall show a graphical representation of the baggage handling system. Each baggage equipment's status shall be easily identifiable and color coded.

The control room shall be equipped with screens large enough to read equipment identifiers from 8 feet without the need to be zoomed in to the lowest level. The control room should be equipped with a raised floor. At a minimum, the following items shall be coordinated during the design phase: layout, furniture, telephones, power outlets, desk lamps, conference table, book shelves for O&M Manuals and printers location.

From the control room the operators shall be capable of communicating via radios with staff in the field to direct them to areas within the system requiring attention.

No special provisions for transfer baggage must be made for the BHS. Domestic transfer bags will be handled tail-to-tail or directly loaded onto the make-up carousels for the connecting flight.

4.4.6 Holdrooms

The holdrooms or departure lounges are located at each aircraft gate and contain seating and standing areas, airline agent check-in podiums, and queuing and circulation aisles for passenger boarding and deplaning the aircraft. Holdroom areas are typically sized based on the seating capacity of the largest aircraft using the gate. Gate assumptions and the number of active gate positions needed to support the design day flight schedule are discussed under Aircraft Gate Requirements in Chapter 2 – Forecast.

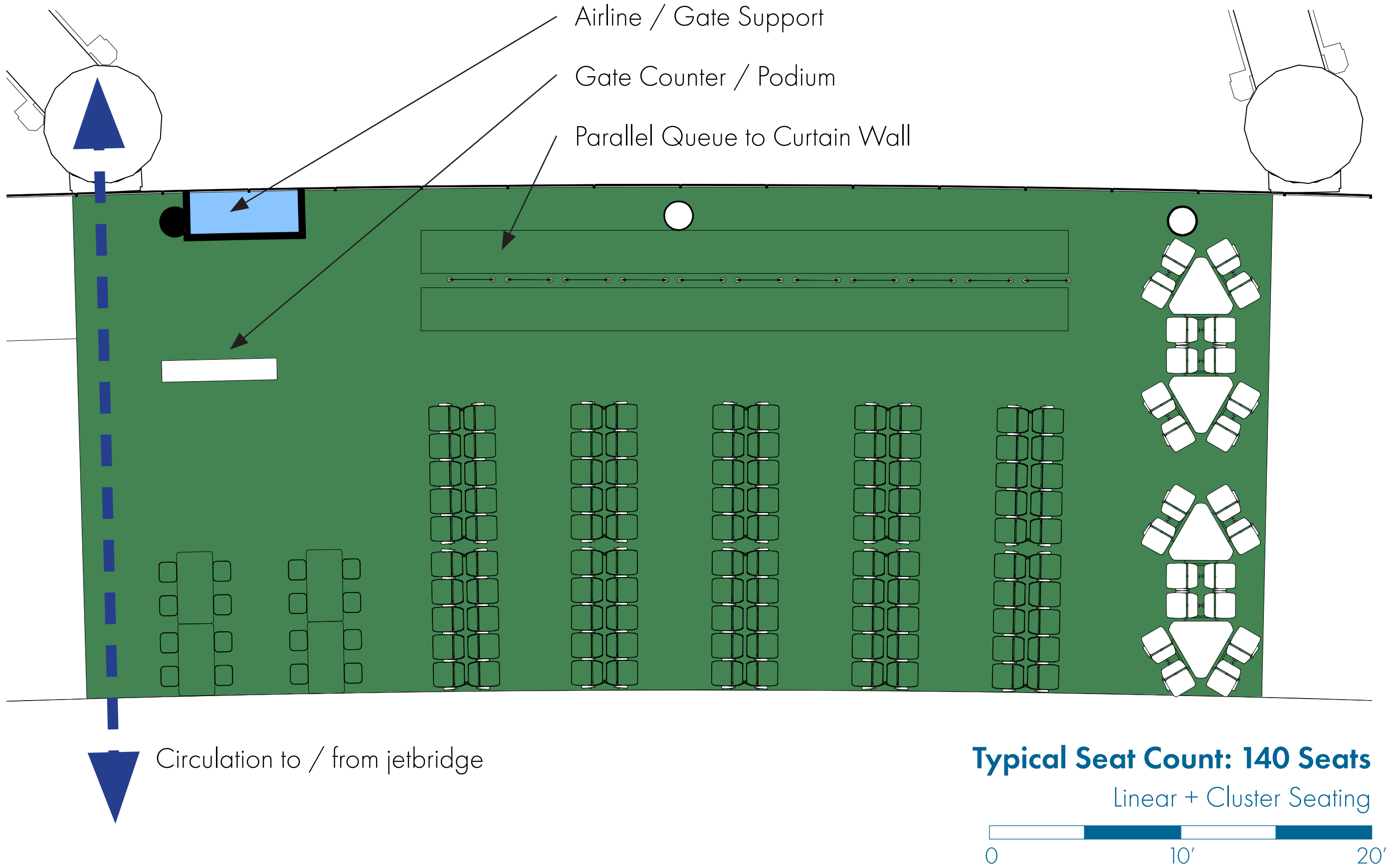
There are two principal criteria which impact level of service in holdrooms. One is the area available per passenger, and the second is the proportion of passengers able to be seated. IATA identifies the area available per passenger and assumes an equal split of seated and standing. Other and more detailed standards are being used in recognition of increased numbers of passengers requiring seating due to changing demographics and increased amounts of carry-on baggage to be accommodated in holdroom areas. There is no universally accepted standard. We have used the approach which includes elements of space per passenger (distinguishing between seated and standing passengers), and the proportion of seated passengers.

The following selected parameters were used in programming the holdrooms:

- Aircraft Load Factor: 85% factor applied to the total number of aircraft seats to determine the number enplaning passengers within the pre-boarding area
- Seated vs Standing Passengers: 90% seated at 15 sf per passenger; 10% standing at 10 sf per passenger
- Airline Agent Gate Counter: The average area of an agent counter including counter/podium, back millwork and queue area is 350 sf. A minimum assumption was made for two agent counter positions
- Boarding and Deplaning Aisles: An average assumption of three aisles per holdroom equal to 750 sf; (1) 5-ft. wide deplaning aisle x 30-ft. depth and (2) 5-ft. wide boarding aisles x 60-ft depth
- Holdroom Depth: 30-35 ft.
- Adjacency Credit: A 10% credit is applied at contiguous gates

Based on the above parameters and the forecast of aircraft type (E175 up to the A320/B737), the holdrooms have been programmed at an average size of 2,785 sf. **Figure 4.3** illustrates a space template for the recommended holdroom configuration.

Figure 4.3 Holdroom Configuration



4.4.7 Concessions

Supportable concession space projections for the replacement terminal complex at Des Moines International Airport (the Airport) were developed by AirProjects based on market-driven sales projections. The key factors analyzed to develop the projections include the following:

- Historical enplanement trends
- Historical concession sales (gross, per square foot, and per enplanement)
- Comparable airport concession program benchmarks
- Anticipated passenger flows
- Planning year enplanements for 2027 (3.0 MAP), 2032 (interim), and 2042 (4.0 MAP)

Recent enplanement trends indicate an increasing level of enplanements at the Airport, rising from 1.18 million in 2015 to 1.24 million in 2016. Enplanements are entirely domestic, with 100 percent origin and destination (O&D) traffic. American Airlines, United Airlines, and Delta Airlines comprise the Airport's top-three carriers, each enplaning between 24 percent and 30 percent of the passengers and accounting for 78 percent of the Airports' total. Southwest Airlines and Allegiant Airlines hold smaller market shares, with between 9 percent and 10 percent each.

Concession sales increased between 2015 and 2016 from $7.1 million to $8.4 million, equating to $6.05 and $6.48 per enplanement, respectively. The existing program is characterized by a significant concentration of pre-security concession space (47 percent). Pre-security sales, however, totaled just 13 percent of the concession sales in 2016.

The Airport's concession program, relative to the selected set of comparable airport programs (as measured by total enplanements, O&D mix, international/domestic mix, and market setting) demonstrates near or slightly above average performance levels across the metrics evaluated. Total sales per enplanement of $7.49 in 2016 represented both the median and average amount within the competitive set. Total concession sales (including food service and retail) ranged from $4.35 to $9.70 per enplanement among the comparable airport programs with average sales per enplanement of $7.47. Similarly, the Airport's complement of concessions space within the existing terminal totaled 14.0 square feet per 1,000 enplanements, slightly below the comparable set average of 15.0 square feet per 1,000 enplanements.

Table 4.6 DSM Concession Performance

	Area	Sales		Sales/Sq. Ft.		Sales/Enplanement	
	Sq. Ft.	2015	2016	2015	2016	2015	2016
Pre-Security							
Convenience Retail	2,087	$744,194	$685,928	357	329	0.63	0.55
Food Service	6,051	$569,597	$547,155	94	90	0.48	0.44
	8,138	$1,313,791	$1,233,082	161	152	1.11	1
Post-Security							
Convenience Retail	2,108	$2,292,717	$2,497,532	1,088	1,185	1.94	2.02
Food Service	7,111	$4,848,740	$5,535,866	682	778	4.11	4.48
	9,219	$7,141,458	$8,033,398	775	871	6.05	6.49
Total							
Convenience Retail	4,195	$3,036,911	$3,183,459	724	759	2.57	2.57
Food Service	13,162	$5,418,337	$6,083,021	412	462	4.59	4.92
Grand Total	**17,357**	**$8,455,248**	**$9,266,480**	**487**	**534**	**7.16**	**7.49**

Source: Des Moines International Airport and AirProjects, 2017

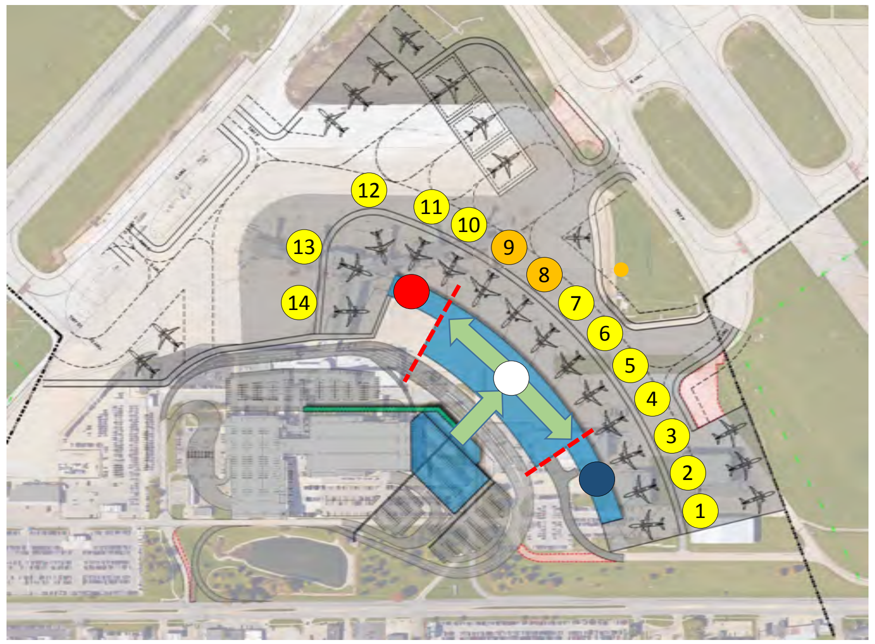
The phasing of the new terminal anticipates two major sequences. The 14-gate first phase is anticipated to support 1.5 million enplanements at its opening, increasing to 1.7 million enplanements by 2032. The plan's final and second phase will add four additional gates to the southern end of the terminal to support a forecast of 2.0 million total enplanements at the Airport.

The physical organization of the Airport's new terminal anticipates passengers moving through a central security screening checkpoint (SSCP) located on level 2 (one level above ticketing). Passengers will emerge from the SSCP into the center of the departures level and then ultimately move either north or south to their respective departure gates. This configuration provided for three distinct concession-planning zones: a core area that would include five gates and experience the maximum level of passenger exposure, a north zone that would contain four gates, and a south zone that would contain an initial complement of five gates, increasing to nine gates at the completion of the master plan's second phase.

Sales projections were developed by concession category and enplanement zone based on anticipated flows from the building exterior, flows from the security screening checkpoints through to the airside, walking distances, space additions/re-configurations, and the anticipated optimization of adjacencies within the concession offerings. Other considerations included the allocation of pre-security concession space in light of current spending patterns and consideration of the needs and wants of meeter-greeters, employees, and other members of the non-traveling public to have access to restaurants and shops.

Figures 4.4, 4.5, 4.6 - Concession Zone Definitions

Figure 4.4 - 2027 Planning Year: Concession Zone Definintions



N

Key Assumptions:

Phase 1: 14 Gates

- ✓ 1.5 Million Enplanements
- ✓ 100% Origin & Destination
- ✓ 100% Domestic

Three Concession Zones:

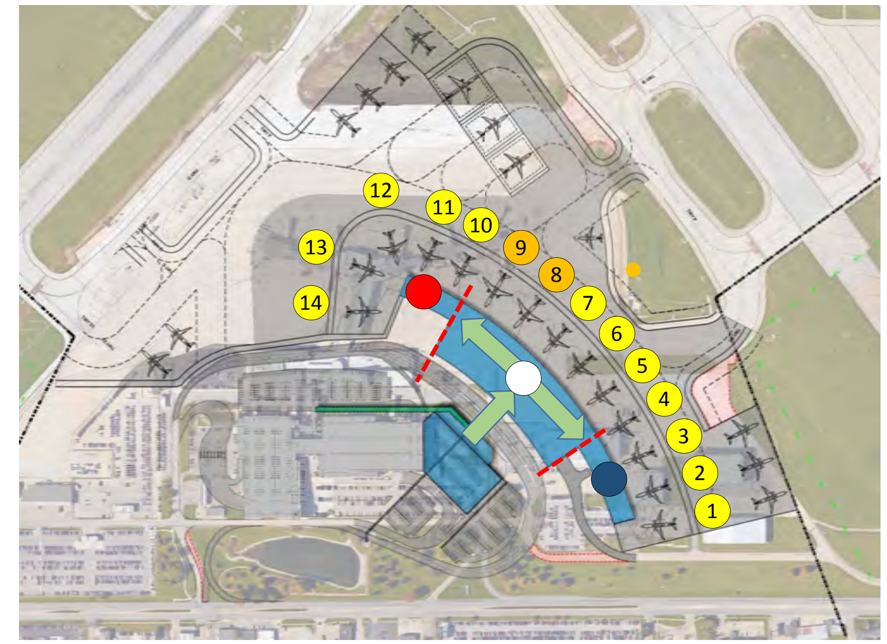
- North Gates (G1-4)
- Core Gates (G5-9)
- South Gates (G10-14)

- ✓ Single Security Checkpoint in Center of Core

Anticipated Passenger Flows

1

Figure 4.5 - 2032 Planning Year: Concession Zone Definintions



N

Key Assumptions:

Phase 1: 14 Gates

- ✓ 1.7 Million Enplanements
- ✓ 100% Origin & Destination
- ✓ 100% Domestic

Three Concession Zones:

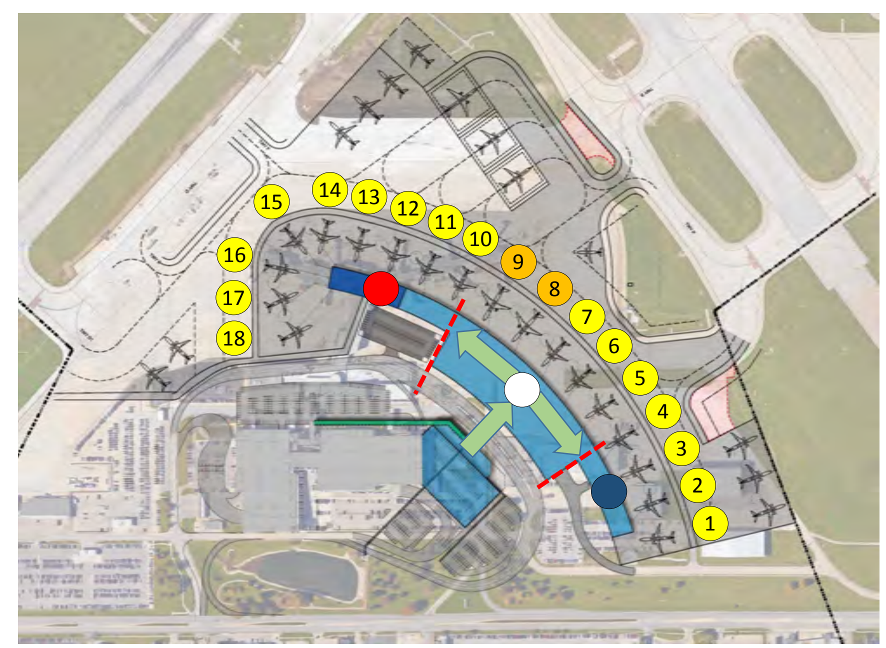
- North Gates (G1-4)
- Core Gates (G5-9)
- South Gates (G10-14)

- ✓ Single Security Checkpoint in Center of Core

Anticipated Passenger Flows

2

Figure 4.6 - 2042 Planning Year: Concession Zone Definintions



N

Key Assumptions:

Phase 2: 18 Gates

- ✓ 2.0 Million Enplanements
- ✓ 100% Origin & Destination
- ✓ 100% Domestic

Three Concession Zones:

- North Gates (G1-4)
- Core Gates (G5-9)
- South Gates (G10-18)

- ✓ Single Security Checkpoint in Center of Core

Anticipated Passenger Flows

3

Other key assumptions utilized in the analysis included the following: **Figures 4.4, 4.5 and 4.6** refer to the concession zone definitions for planning years 2027, 2032, and 2042 respectively.

- Originating and departing traffic would remain at 100 percent of enplanements, consistent with historical data
- The airport will serve entirely domestic locations only (noting that about 10 percent of the enplaning passengers are destined for an international location via a connection)
- Estimated spending per enplanement will total $9.60 (2017 dollars), which is 28 percent above the current level
- The higher level of spending reflects the potential of a new terminal with a more favorable, post-security commercial concentration and implementation of new concepts that resonate more closely with passenger wants and needs. Under these assumptions, the 2042 concession sales generated by the projected 2.0 million enplanements are estimated at $19.2 million.

From a space programming perspective, the 2042 year represents the ultimate building requirement. However, from a practical standpoint, the 2032 supportable space represents the quantity of space within the concession program's initial leasing cycle. The difference between the two numbers is space that can be used for interim, non-concession purposes, but ultimately should be earmarked for concession use. If appropriate and cost-effective, the construction of some space may be delayed for subsequent phases.

Planning year 2032 concession sales (1.7 million enplanements) are estimated at $16.3 million, as shown in **Table 4.7.** Both of these figures represent a substantial increase over 2016 sales of $8.0 million generated by 1.24 million enplanements. Productivity factors (sales per square foot) were applied to each category of estimated concession spending to calculate the market-supportable quantity of concession space. The estimates consider the balance necessary to maintain a sustainable, competitive business environment with the Airport's desire to provide a diversity of supply and appropriate levels of service. Supportable concession space is estimated at just over 21,570 square feet in 2032, increasing to 25,390 square feet in 2042, the ultimate requirement for the forecast enplanement levels in the master plan. This program estimate compares to an existing concession program of 17,357 square feet.

On a locational basis, pre-security supportable concession space is estimated at 4,000 square feet in 2032, increasing to 4,700 square feet at the 2042 enplanement level. These amounts are approximately one-half the current landside allocation of 8,138 square feet of concession space.

Within the three post-security zones defined by AirProjects, the largest amount of spending and supportable space is estimated for the core gate area. This allocation logically follows the anticipated passenger flow patterns into the center of the building, providing high-exposure, critical mass opportunities for the concession program.

Supportable concession space within the core gate zone is estimated at 14,940 square feet in 2042, representing approximately 72 percent of the total post-security concession space. This 2042 core area space allocation is approximately 2,000 square feet higher than the amount of concession space supported by the 2032 projected enplanements. While it is recommended that the full complement of core area space be developed during the initial phase, the 2,000 square feet of concession space that is not needed until 2042 should not be leased in the initial phase. This recommendation addresses the inherent challenges (and likely higher cost) of adding a relatively small quantity of space at a later date. Interim uses, such as comfortable seating areas and work stations and advertising displays, could be considered.

Supportable concession space within the North Gate and South Gate zones in 2042 is estimated at 2,400 square feet and 3,350 square feet, respectively. These totals anticipate and recognize that the concentration of concession offerings within the core gate area will intercept demand and that the relatively short walks to the farthest gates will be not be an overly prohibitive factor to passengers either stopping in the central zone initially or returning to the central zone after locating their gates. Inclusive of a storage/office/support space allocation of 4,680 square feet, total concession program requirements supported by the 2.0 million enplanements in 2042 are estimated at 30,070 square feet.

Table 4.7 Estimated Concession Sales and Supportable Space by Zone and Planning Year

	2027 Opening	2032 Planning Year	2042 Program Year
Enplanements	1.5 million	1.7 million	2.0 million
Estimated Sales			
Pre-Security	$1,890,000	$2,142,000	$2,520,000
Post-Security			
North Gates	$1,268,143	$1,437,229	$1,973,333
Core Gates	$9,346,500	$10,592,700	$11,936,556
South Gates	$1,895,357	$2,148,071	$2,770,111
Post-Security Total	$12,510,000	$14,178,000	$16,680,000
Total Concessions	**$14,400,000**	**$16,320,000**	**$19,200,000**
Supportable Concession Space			
Pre-Security	3,520	3,990	4,700
Post-Security			
North Gates	1,540	1,740	2,400
Core Gates	11,690	13,240	14,940
South Gates	2,300	2,600	3,350
Post-Security Total	15,530	17,580	20,690
Total Concessions	**19,050**	**21,570**	**25,390**
Support Space	3,510	3,980	4,680
Total Concession Program	**22,560**	**25,550**	**30,070**

Note: Excludes personal services (shoe shine, ATMs, currency exchanges, banks, etc.). Spa and salon services are categorized by AirProjects within specialty retail.
Source: AirProjects, 2017

4.4.8 Other Amenities

4.4.8.1 Des Moines Airport Authority Offices

The requirements for the airport administration area are based on information provided by senior staff during programming workshops. The current administration area has a total of 15,000 sf. A review of current and future needs and the desire to operate in a more space efficient environment resulted in the requirement for less area. The proposed terminal concept plan reflects an area of 9,320 sf or approximately 38 percent less area than the administration currently occupies. Like the existing administration office area, the proposed new area would be located at the second level of the terminal and would be accessible on the non-secure side of the terminal facility.

4.4.8.2 Conference Center

The conference center, as part of the administration area, is programmed to accommodate approximately 65 people and capable of being divided for smaller groups. While programmed to be a component of the administration, this area would have separate access apart from the administration entry and would also be accessible from the non-secure side of the terminal facility. The conference center would have a kitchen/storage area and a pre-function area. This will be a replacement for the existing Board Room and Cloud Room. Moveable millwork to create the dias of the Board Room should be incorporated. During larger events, the millwork should have the ability to relocate to the adjacent storage.

4.4.8.3 Restrooms

Public restrooms have been planned throughout the facility. Each location has been programmed to include men's and women's restrooms, janitorial services, and a separate family of companion care restroom. The total restroom program area on the non-secure side of the terminal is 2,800 sf will be centrally located within 200 feet from each end of the first level of the terminal. A second restroom core with men's and women's restrooms is located at the second level near the administration office area and the non-secure concessions areas. The second concourse (secure) area has three restroom cores that total 7,150 sf. Each of these restroom cores has men's and women's restrooms and have been planned to be no more than three gates apart in walking distance.

4.4.8.4 Loading Dock

The loading dock is an exterior support area and is not included as part of the total sf area of the terminal. Its area is approximately 1,040 sf and is capable of handling three semi-tractor trailer trucks and other receiving/dock area components such as trash compactor and recycling. Service corridor leading to the service elevator will allow deliveries and trash removal to and from all levels of the terminal.

4.4.8.5 Wheelchair Storage Areas

Four wheelchair storage areas, one at 230 sf on level one (ticketing/check-in lobby), and three at 170 sf each on level two (concourse).

4.4.8.6 Electric Cart Storage

Electric Cart Storage needs to be accommodated at the terminal's apron level. They can be dispersed between airline operations offices for airline flexibility, and should be spaced evenly throughout the apron level for quick access form all gates.

4.4.8.7 MEP and IT Services

A factor of 6.4% for mechanical, electrical, and plumbing (MEP) are assumed to occupy the total program area and 2% of the space will be dedicated to IT and communications rooms. Altogether, 8.4% of the terminal area is assumed to be allocated to MEP and IT spaces. This is comparable to industry standard planning factors and other medium size airport area facility programs.

4.4.8.8 Public and Non-Public Circulation

Circulation areas are dependent upon building configuration and the final arrangement of the terminal. Total circulation includes public, non-public and secure circulation. Recently designed and/or built medium size airports typically have 22% to 25% of their floor plan dedicated to public and non-public circulation areas. The total circulation for DSM terminal plan is estimated to be approximately 25% of the total building area.

4.5 Site - Landside

Program requirements were developed for landside facilities encompassing curbside, parking and rental car facilities.

4.5.1 Curbsides

Curbside requirements reflect the length needed to accommodate peak hour curbside pick-up and drop-off activity. Traffic counts and vehicle dwell times collected in 2013 for LeighFisher's Terminal Area Concept Planning study, adjusted with updated taxicab and TNC counts from 2017, along with the forecast of peak hour passenger growth were the basis for the calculation of curbside requirements. Vehicle dwell times, or the time a vehicle stays on the curb to load and unload passengers, has a direct correlation to the amount of curb length required. Currently the average dwell time recorded for private vehicles on the inner curb is 3 minutes for vehicles dropping off departing passengers and 8.7 minutes for vehicles picking up arriving passengers. In 2012, TNC peer-to-peer ride-hailing services such as Uber and Lyft began operations and started serving airports nationwide. The reception at airports was slow due to the complexities associated with negotiating airport fees but in 2014 they began service at DSM. Nationwide the increase in TNC use has caused a decrease in other access modes such as taxicabs, limousines, parking and rental cars with specific impacts varying by location and specific market demographics. At DSM, parking use has continued to increase in alignment with passenger growth but taxicab use has declined. The curbside length requirements account for the mode split between taxicabs, limousines and TNCs observed in 2017.

Table 4.8 summarizes the requirements for the curbside by vehicle mode.

Table 4.8 Curbside Length Requirement (feet)

	Existing	MAP 3	MAP 4
Private Vehicle / Public Curb	**400**	**550**	**675**
Commercial Curb			
TNC	100	125	175
Taxicab	120	140	140
Limousines	60	60	90
Airport Shuttle	70	70	105
Hotel/Parking Lot Shuttles	175	175	210
Tour/Charter Bus Unloading	110	110	110
Rental Car Shuttles	N/A	100	145
Subtotal Commercial	**535**	**655**	**800**

If vehicle activity on the curb is restricted to active loading and unloading only, through stricter enforcement the required curb length would be reduced. Future requirement with stricter enforcement and limited dwell times averaging a more typical 3-minutes for private vehicles, representing active loading and unloading only, would reduce the private vehicle curbside requirement to 325 and 400 feet in MAP 3 and 4 respectively.

4.5.2 Parking

Parking requirements were developed based on existing utilization of parking facilities and forecasted growth in passengers. Requirements were developed for both public and employee parking as described below.

4.5.2.1 Public Parking

To determine the need for public parking, the current utilization of each parking facility was reviewed. The peak occupancy during an average day of the peak month, determined to be October 2017 for all but the short-term lot with a peak in June 2017, was used to determine the typical number of occupied spaces or current demand by facility as shown in **Table 4.9**. The forecast growth in peak hour passengers was applied to the current demand to determine the future demand for spaces and a 10% search factor was applied to calculate the required number of spaces by type of facility presented in **Table 4.10**. This search factor accounts for the overlap of vehicles entering and leaving the parking facilities resulting in vehicles missing open parking spaces or spaces opening after a vehicle passes through a parking row or floor of the garage while looking for spaces. Requirements are summarized for short-term, long-term, close-in economy (currently Economy Lots 2 and 3 located within or adjacent to the terminal loop roadway) and remote economy (currently Economy Lots 1 and 4 which require patrons to be bussed to the terminal).

Table 4.9 Existing Public Parking Utilization

	Existing Spaces	Average Percent Occupied	Occupied Spaces
Short-Term	341	70%	239
Long-Term	1,732	90%	1,559
Economy 1	848	63%	534
Economy 2	658	86%	592
Economy 3	379	75%	307
Economy 4 (public overflow)	300	0%	0
Total	**4,258**		**3,211**

Table 4.10 Public Parking Requirements (Spaces)

	3 MAP (2027)	4 MAP (2042)
Short-Term	340	466
Long-Term	2235	3062
Economy Close-in (Lots 2 & 3)	1275	1747
Economy Remote (Lots 1 & 4)	760	1040
Total Public Parking Spaces	**4610**	**6315**

4.5.2.2 Employee Parking

Employee parking is based on the typical utilization of the existing parking lot and estimated to increase relative to overall passenger growth through the planning horizon. Future employee parking requirements are summarized in **Table. 4.11.**

Table 4.11 Employee Parking Requirements (Spaces)

	3 MAP (2027)	4 MAP (2042)
Employee	300	400

4.5.3 Rental Car

Requirements for rental car ready-return spaces were developed based on actual rental and return transactions provided by the rental car companies. These transactions were projected to increase in proportion with the forecast growth in peak hour passengers through the planning horizon. Ready space requirements are based on the existing and projected peak hour rental transactions multiplied by 2.0 to represent the need for spaces to hold a sufficient number of vehicles prior to rental. Return transactions are multiplied by 1.5 to represent the space required for vehicles stacking as they are returned prior to being moved to the quick-turn-around facilities for servicing.

Current rental car spaces are configured as typical 90-degree parking stalls and used for both rentals and returns. However, future requirements were developed for separate ready and return areas with ready spaces configured as 90-degree stalls and return spaces in a nose-to-tail configuration. Area requirements assume 320 square feet per ready-stall and 220 square feet per return stall which is inclusive of circulation.

Space and area requirements are summarized in **Table 4.12**.

Table 4.12 Rental Car Ready-Return Parking Requirements

	3 MAP (2027)	4 MAP (2042)
Stalls		
Ready	348	477
Return	246	337
Total	**594**	**814**
Area (square feet)		
Ready	111,455 sf	152,640 sf
Return	54,205 sf	74,140 sf
Total	**165,660 sf**	**226,780 sf**

Bussing operations were reviewed to determine requirements associated with a potential remote consolidated rental car facility. For high level planning purposes bus ridership is estimated at an average of 1.5 passengers per rental car transaction. This results in peak hour demand of 203 passengers leaving the terminal during the peak rental period and 155 passengers returning to the terminal from the rental car lot during the peak rental car return period in PAL 3. Table 4.5-6 summarizes the existing, MAP 3 and MAP 4 projections. Based on a 1.1 mile drive between the terminal curbside and rental car area taking approximately three minutes each way with a 5 minute dwell time on each end and busses carrying 50 passengers each, five busses are needed to maintain headways and transport all peak hour passengers

Table 4.13 Rental Car Peak Hour Passenger Estimates

	Existing	PAL 3	PAL 4
Rental passengers (outbound from terminal)	157	203	215
Return passengers (inbound from terminal)	120	155	164

4.6 Site - Airside

Program requirements were developed for airside facilities encompassing critical aircraft, runway design code, taxiways, airspace considerations, and deicing facilities.

4.6.1 Existing and Future Critical Aircraft

The FAA defines the critical aircraft for an airport as the aircraft representing a combination of the most demanding Airport Reference Code (ARC) with greater than 500 annual operations. DSM's existing critical aircraft is the Boeing 767-300, with an ARC passenger designation of D-IV and a Taxiway Design Group (TDG) of 5. The B767-300 has a maximum takeoff weight of 412,000 lbs and is primarily used for cargo operations at DSM. The terminal area is designed to meet Airplane Design Group (ADG) IV standards due to scheduled passenger operations by the B757-200 and other ADG IV aircraft. There is no anticipated critical aircraft change expected in the future. **Table 4.14** summarizes the dimension standards of the critical aircraft.

Table 4.14 Critical Aircraft Characteristics

	B757-200 (Passenger)	B767-300 (Cargo)
Length	155.2′	180.1′
Wingspan	134.6′	156.2′
Tail Height	45.1′	52.6′
Maximum Take-off Weight	255,000 lbs	412,000 lbs
Approach Speed	137 kts	145 kts
Aircraft Approach Category	C	D
Airplane Design Group	IV	IV
Taxiway Design Group	4	5

4.6.2 Runway Design Code

The FAA defines a Runway Design Code (RDC) for every runway that is in the National Airspace System (NAS). The RDC identifies the existing and future design elements of a runway and is made up of three components: Airplane Design Group (ADG), Aircraft Approach Category (AAC), and approach visibility minimums for a specific runway's critical aircraft. The AAC identifies the range of final approach speeds that can be accommodated by the runway. The ADG is a function of the wingspan and tail height dimensions of the critical aircraft. The approach visibility minimum is defined as the approved minimum horizontal and vertical visibility that the specific runway accommodates. The RDC is written as a combination of the three elements: AAC/ADG/Approach Visibility Minimum. **Table 4.15** summarizes the RDC designations at DSM.

Table 4.15 Runway Design Code Designations

Runway	RDC
5	D/IV/2400
23	D/IV/5000
13	D/IV/2400
31	D/IV/1200

Table 4.16 Taxiway Design Group Comparison

	TDG 3	TDG 4	TDG 5
Taxiway Width	50′	50′	75′
Taxiway Edge Safety Margin	10′	10′	15′
Taxiway Shoulder Width	20′	20′	30′
Taxiway Fillet Dimensions	Variable	Variable	Variable
Representative Aircraft	B737-800/900	B757-200	B767-300

Table 4.17 ADG Taxiway Standards Comparison

	ADG III	ADG IV
Taxiway/Taxilane Safety Area	118′	171′
Taxiway Object Free Area	186′	259′
Taxilane Object Free Area	162′	225′
Taxiway to Parallel Taxiway	152′	215′
Taxiway to FOMO	93′	129.5′
Taxilane to Parallel Taxilane	140′	198′
Taxilane to FOMO	81′	112.5′

FOMO – Fixed or movable object

4.6.3 Taxiways

Taxiways provide a network of pavement for aircraft to move around the airfield, connecting various airfield components and providing access to the runways and aircraft aprons. Taxiways are part of the movement area, which is an area under control by Air Traffic Control (ATC). Taxilanes connect aircraft parking positions with taxiways and are generally not part of the movement area. The geometrical design standards for taxiways and taxilanes are derived from the ADG and the Taxiway Design Group (TDG). Similar to the ADG, the FAA has defined the TDG to determine taxiway/taxilane width standards, fillet radii, and some taxiway/taxilane separations. TDG is based on the undercarriage dimensions of the critical aircraft (main gear width and main gear to cockpit distance). DSM's critical TDG is 5 which is representative of the B767-300 aircraft. The RDC defines most of the separation standards and clearance offsets. **Tables 4.16 and 4.17** compare DSM's taxiway/taxilane dimensional standards.

4.6.4 Airspace Considerations/NAVAID Critical Areas

Imaginary surfaces such as FAR Part 77 and TERPS are used to determine obstructions to navigational airspace. The exact configuration of these surfaces varies based upon the runway's type of approach/departure. Obstructions are objects that penetrate these surfaces and there are mitigative measures such as obstruction lighting, removal, and/or relocation. To the extent feasible, future obstructions should be kept clear of these surfaces. Objects such as gated or parked aircraft, buildings, and light poles should be kept clear of these surfaces. Section 5.6.2 will summarize any known impacts to these surfaces.

4.6.5 Deicing Pad

Based on discussions with the airport, it was determined that there is a future need for up to three deicing positions. These deicing pads should be able to accommodate two ADG-III aircraft and one B757-200 aircraft simultaneously. From a demand/capacity standpoint, the alternative analysis will show a footprint for these three deicing positions. The following section explains the design criteria used to develop the template for these pads.

4.6.5.1 Design Criteria - Width of Deicing Positions

The width of each deicing position is based on Table 3-1 of Advisory Circular (AC) 150/5300-14C and assumes that the deicing area will be defined as a non-movement area during deicing events, meaning that the deicing pad will not be under direct Air Traffic control. According to the AC, the width of each parking position is dimensioned from centerline of aircraft deicing position to centerline of the adjacent aircraft deicing position. The separation distance provides for two Vehicle Maneuvering Areas (VMA) of 12.5 feet each and a Vehicle Safety Zone (VSZ) of 10 feet.

The VSZ is for parked vehicles before and after deicing operations and is defined by red crosshatched pavement markings. The VSZ is where deicing trucks would typically stage while an aircraft taxis into and out of a position. Ten feet is the minimum allowable width per the AC. A width of 10 feet allows vehicles to be parked end-to-end (based on an 8.5-foot-wide vehicle); however, a 10-foot-wide VSZ does not allow added space for error under potentially dark and inclement weather conditions that are likely to be experienced at the deicing pads. Because of this, HNTB recommends 12.5-foot-wide VSZ widths to provide an additional margin of safety during deicing operations.

The width of an ADG III pad is 187 feet which allows for the 12.5-foot-wide VMA's and VSZ's. The width for the B757-200 aircraft specific pad is 207 feet.

4.6.5.2 Design Criteria - Length of Deicing Positions

The length of each position is based on the fuselage length of the most demanding aircraft expected to have regular operations at DSM plus the 12.5-foot-wide VMA's which allow service vehicles to maneuver around the entire aircraft and stay within the pad limits.

Several ADG III lengths were reviewed to protect for the longest aircraft. It was determined that the MD 90-30 length of 153 feet is an appropriate length to use for the two standard ADG III positions. Adding the two 12.5-foot-wide VMA's increases the total length of the ADG III pads to 178 feet. However, it is likely that the three pads will be collocated as is shown on the preferred development in Chapter 5. The B757-200 length is only slightly longer at 155 feet and therefore the total length of 180 feet with the added 12.5-foot-wide VMA's was used for all three deicing pads.

Chapter 5 Preferred Development Plan

5.0 Preferred Development Plan

Many options were considered for the ideal siting and layout of the new terminal building during the 2016 Site Selection Study, including a location in the east quadrant north of the existing terminal and a site in the south quadrant, where the airport's cargo facilities are located today. Ultimately, the east quadrant was selected for the new terminal site so that existing utilities and infrastructure, such as parking, could be re-used for the new terminal. Several building layouts were further studied for compliance with key factors:

- Conformance with Part 77
- Flexibility of Landside and Airside structures
- Future expansion capabilities of Landside and Airside structures
- Single-phase terminal building construction
- Ability to retain 10 contact gates and 9 RON positions throughout construction
- New terminal proximity to existing infrastructure
- Enhanced and intuitive wayfinding for vehicular circulation including longer decision points for safety purposes
- Short walking distances throughout site and ultimate building expansion
- Least construction pain or interference with operations and passenger traffic

A curved building footprint was selected because it allows the airside and landside structures to expand independently of one another, provides the shortest and safest walking distances for pedestrians, and accommodates the most flexible future expansion opportunities for all new developments.

This chapter summarizes conceptual refinement to the preferred development plan for the entire campus, including the Terminal Building, Terminal MEP Systems, Terminal IT/Communications, Site Utilities, Landside, Airside Infrastructure, and Apron Utilities.

5.1 Terminal Building

The new terminal programming was developed to accommodate 3.0 Million Annual Passengers (MAP) opening day, with the ability to expand for 4.0 MAP. Early in planning during the Programming and Planning Study, the terminal was developed as a four-level facility, with public access on the top three levels, as shown in the section diagram on **Figure 5.1A**. The original plan consisted of an efficient layout of spaces and ideal adjacencies for all functions, with sufficient space for the Des Moines Airport Authority, Airlines, Rental Cars, TSA, Concessionaires, Police and Parking stakeholders. **Figure 5.8** represents the basement level, also called Level 0, which hosted the loading dock, CBIS functions and concession storage; Level 1, as shown in **Figure 5.6**, included ticketing, baggage claim, inbound & outbound baggage makeup, airline & TSA functions and the utility courtyard; Level 2, **Figure 5.4**, comprised of the bridge from the garage, security, concessions and holdrooms; and Level 3, **Figure 5.2**, contained the administration offices, main mechanical spaces, and an observation deck.

Later in the planning process, the terminal was reorganized to only three levels for efficiency and cost reduction purposes, as shown in section on **Figure 5.1B**. The top level was removed, eliminating a large amount of curtain wall, structure, and conditioned space from the project, but the program requirements were maintained by repurposing space reserved for future use on Levels 1 and 2 temporarily for some of the Level 3 functions. The airport administration offices were relocated to the future fourth baggage claim area, the mechanical spaces were dispersed on each level of the terminal on exterior slabs, and the Level 3 observation deck was removed but the concept was maintained by opening the area in the terminal's central bay, creating a line of sight from the bridge all the way through the terminal to the parked aircraft on the apron. The following Terminal Building sections describe the final configuration of the plans for the advanced planning study. **Table 5.1** lists the program requirements and actual areas of the terminal spaces.

5.1.1 Basement Plan (Level 0)

The terminal's basement plan, as shown in **Figure 5.7**, takes advantage of the existing site grading, which slopes down about 16 feet from the south end of the terminal to the north end. This allows the terminal's loading dock, located on the north end of the structure, to enter at grade, but the south side of the basement is fully below grade. The basement level contains both secure and non-secure airport functions and is not accessible to the public.

5.1.1.1 - Checked Baggage Inspection System

All checked bags run through an automated bag screening system. Sufficient basement space is included in the program to allow for the installation of up to four bag screening machines. Bags shall be automatically fed into the screening machines and sorted downstream of the bag screening machines based on the screening result. For bags alarmed in the screening machines, the program is providing space for operator viewing time as well as for the manual resolution of the bags. After bags have been cleared by TSA, they are conveyed to the apron space for outbound make-up.

Since the bag screening system is in the basement, special attention shall be given to allow for an efficient way of installation and replacement of equipment. The program includes easy access to the loading dock, a wide corridor and roll-up doors along the corridor as sufficient access to the baggage system.

5.1.1.2 - Baggage Support

The following baggage related support spaces have been identified:

Table 5.1 - Baggage Related Support Spaces

Space	Value	By	Function
OSR control room (2 OSR operator desks plus supervisor desk)	400 sf.	TSA	Remote viewing of EDS alarmed bag images
BHS control room (2 BHS operator desks)	250 sf.	BHS/Airport	Monitoring of BHS
BHS parts storage	400 sf.	BHS/Airport	Space to store spare parts required to maintain the BHS
TSA parts storage	200 sf.	TSA	Space for TSA to store spare parts
BHS rack room	200 sf.	BHS/Airport	Space for BHS control system racks; computer equipment
Locker rooms	Covered elsewhere in program		
TSA readiness room	Covered elsewhere in program		

The baggage service office (BSO) is contiguous to the baggage claim and is easily visible to passengers in its centralized location. The airline employees manning the office will have direct access to the bag storage room behind their counters, which will contain individual locked storage areas for each airline. The BSO is also adjacent to the Oversize inbound baggage chute, which is where baggage that cannot be handled by conveyors, such as surf boards or kennels, can be deposited.

Figure 5.1A - Site Section (Pre-VE)

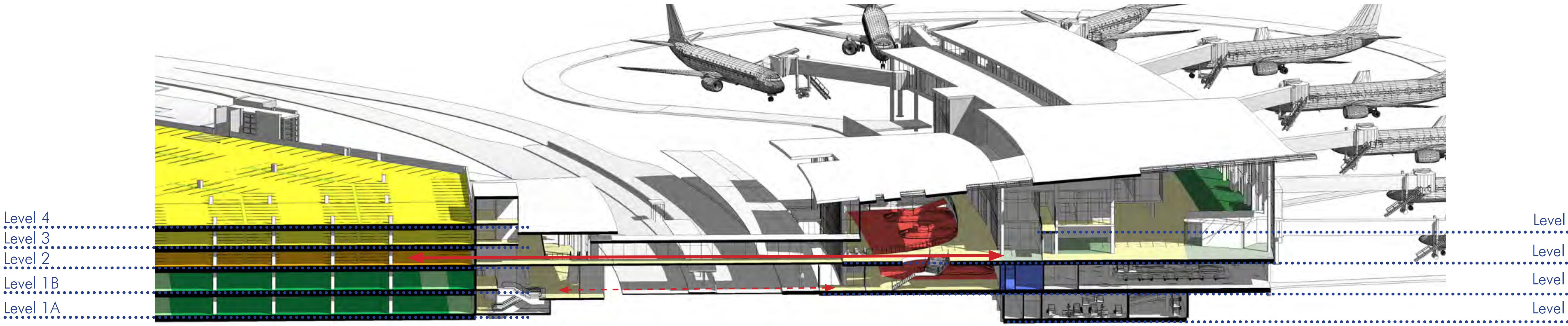
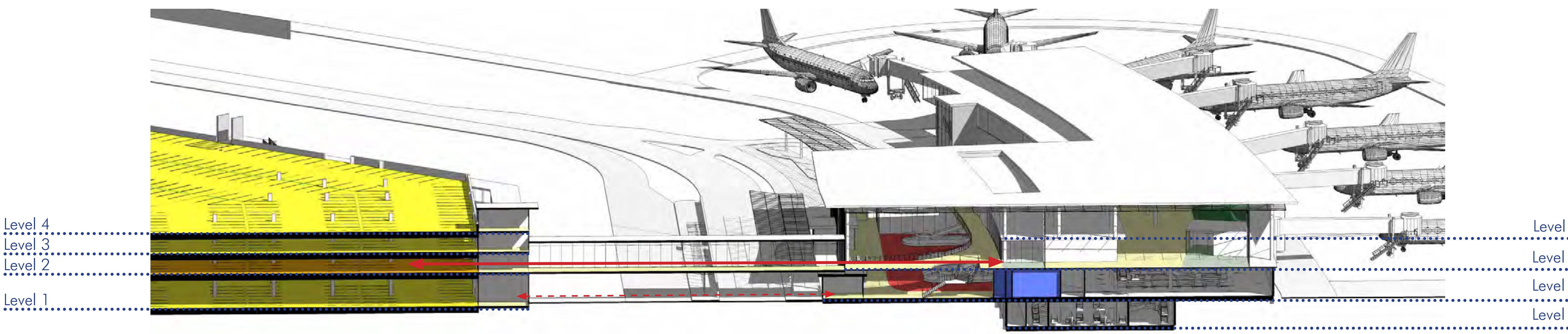


Figure 5.1B - Site Section (Post-VE)



0 30' 60' 90' 120'

Figure 5.2 - Level 3 Plan (Pre-VE)

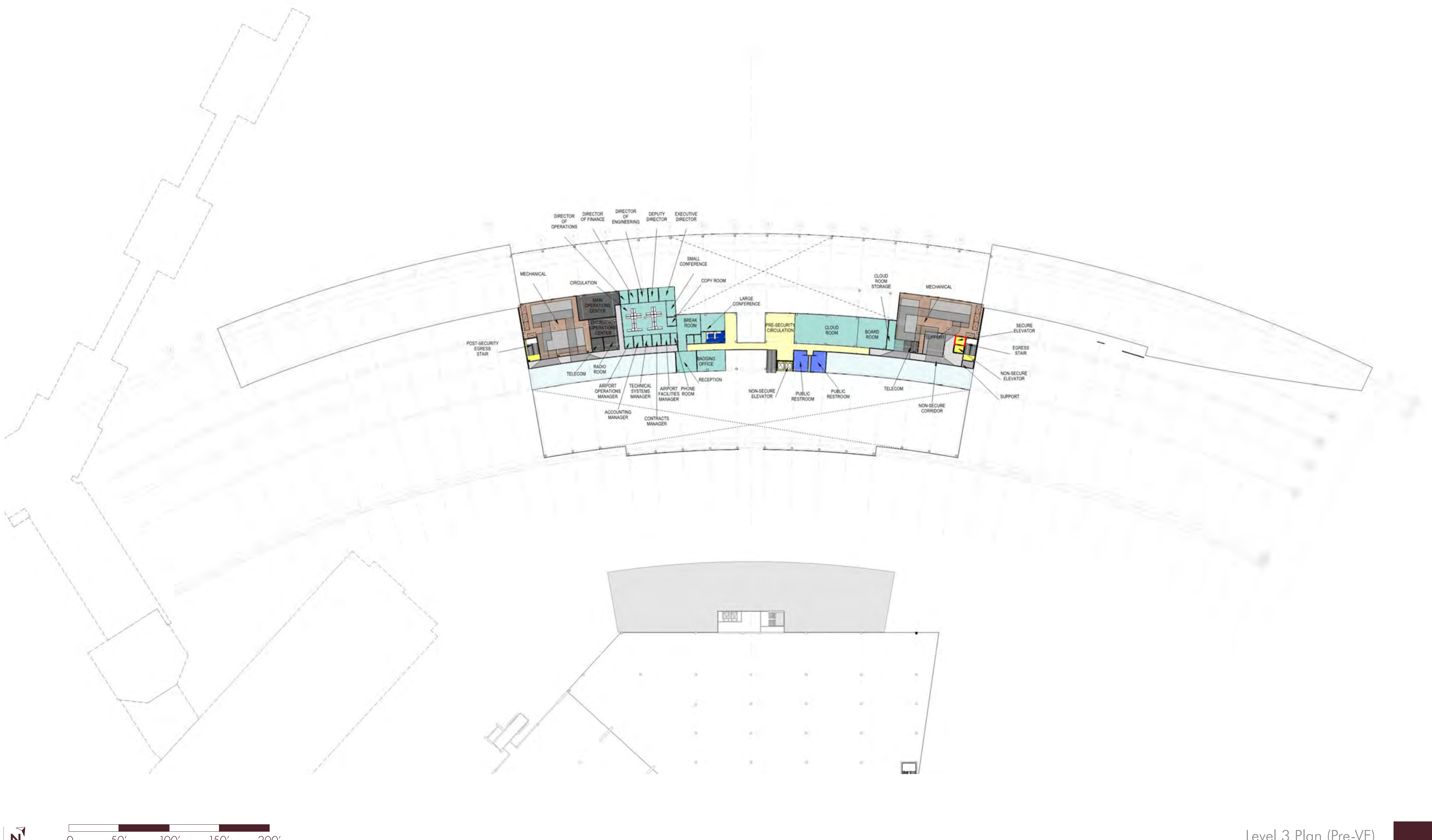
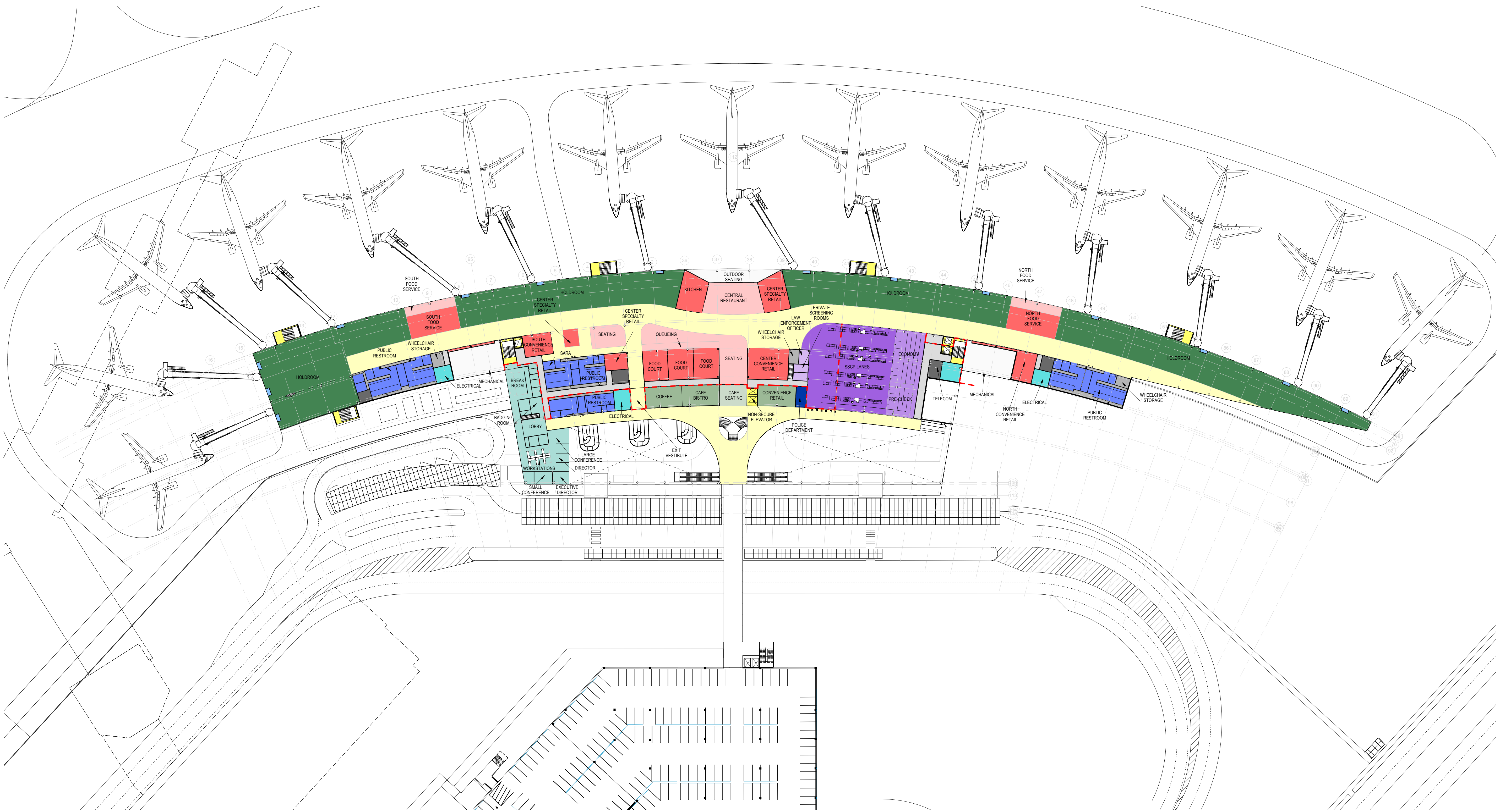


Figure 5.3 - Level 2 Plan (Post-VE)



0 50' 100' 150' 200' N

Figure 5.4 - Level 2 Plan (Pre-VE)

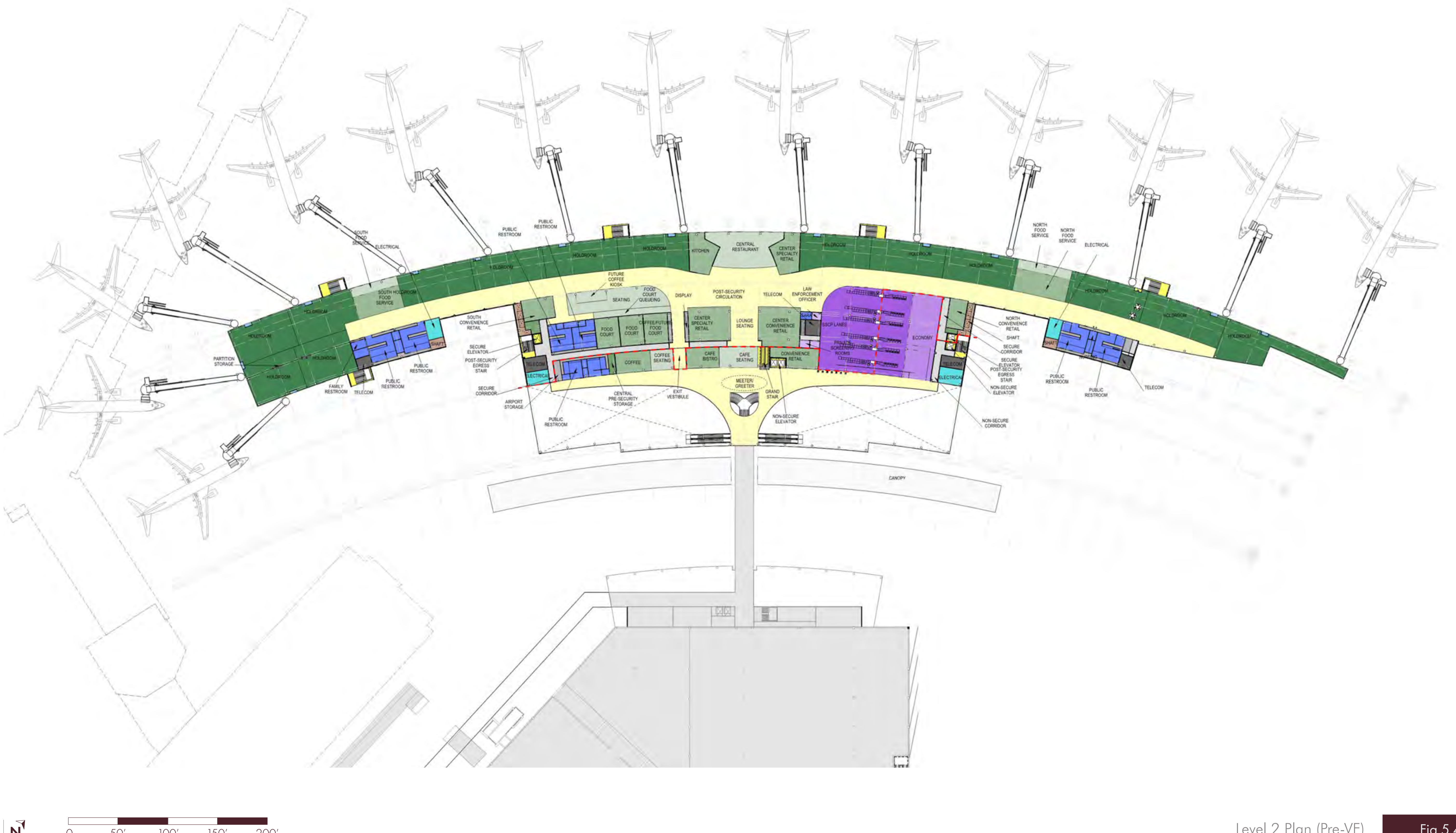


Figure 5.5 - Level 1 Plan (Post-VE)

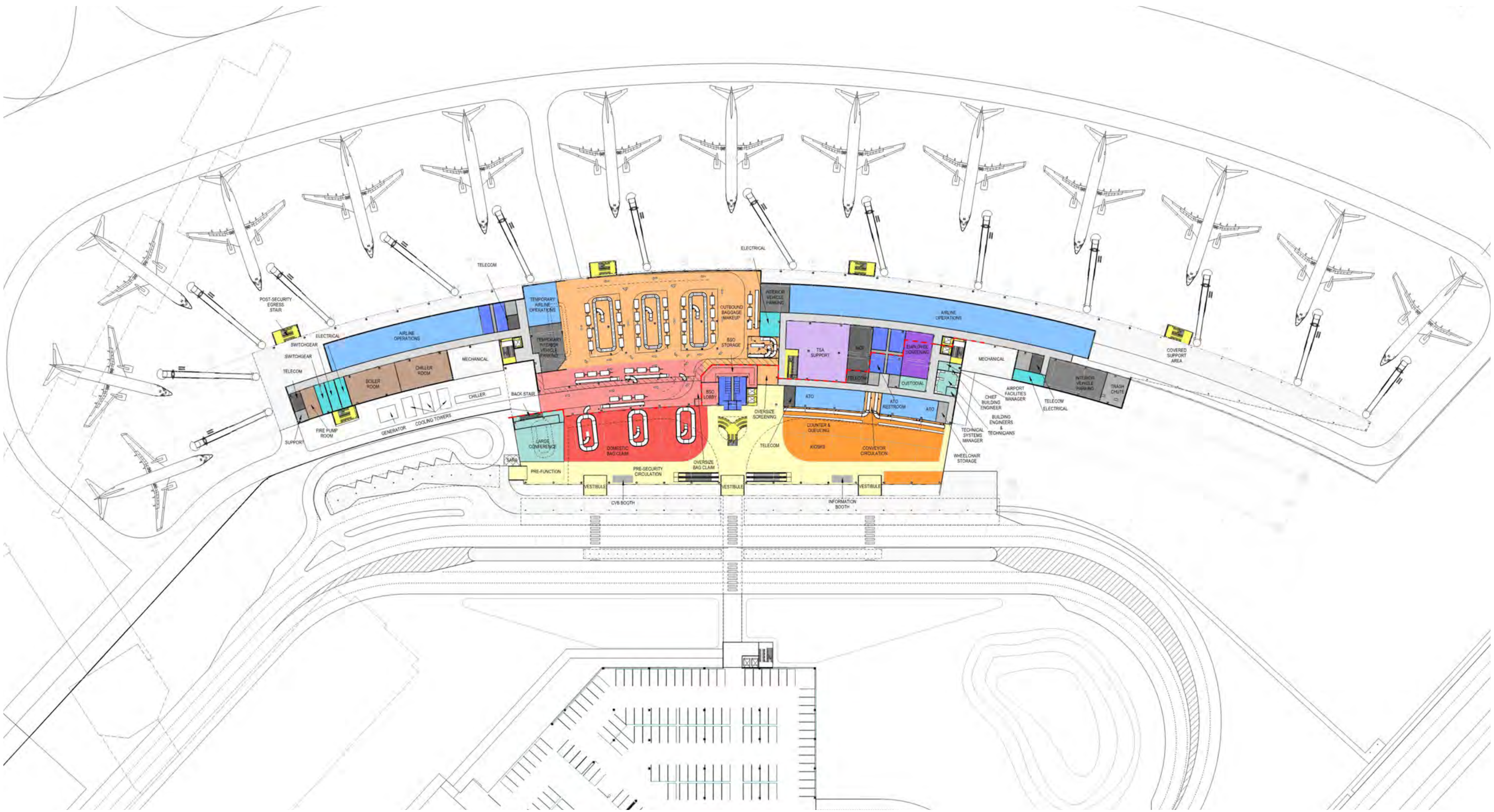


Fig 5.5 Level 1 Plan (Post-VE)

0 50' 100' 150' 200' N

Figure 5.6 - Level 1 Plan (Pre-VE)

Figure 5.7 - Level 0 Plan (Post-VE)

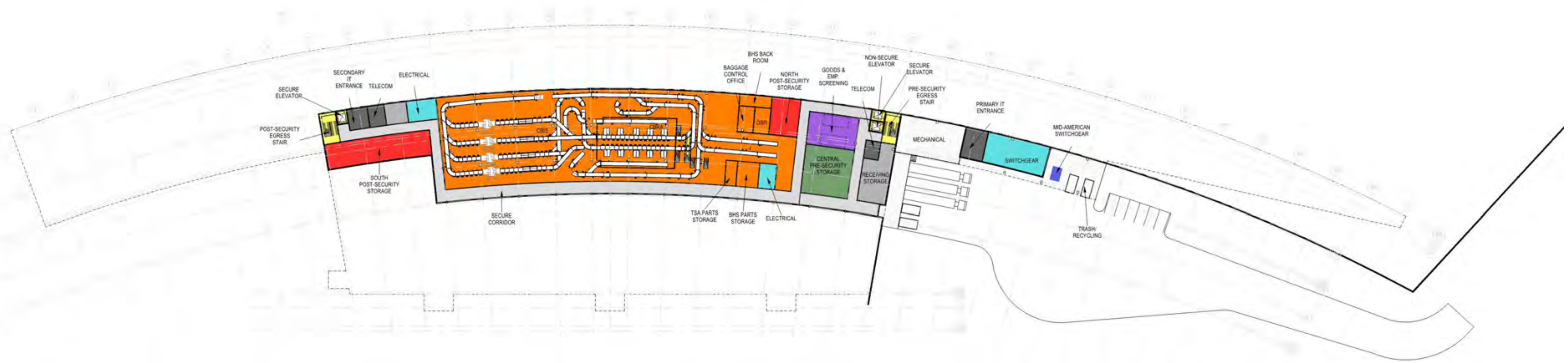
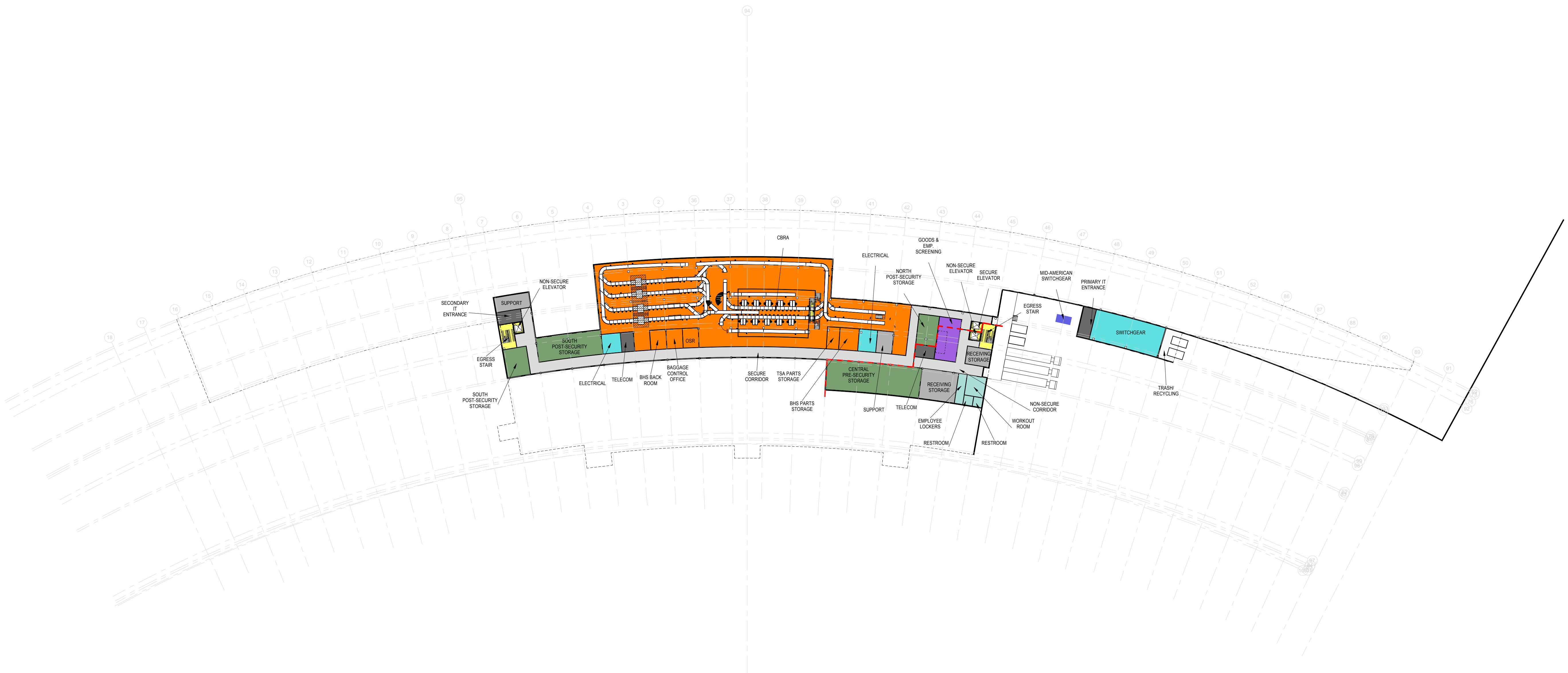


Fig 5.7 Level 0 Plan (Post-VE)

Figure 5.8 - Level 0 Plan (Pre-VE)



5.1.1.3 Loading Dock

The Loading Dock is located on the north side of the site and is accessed from the northeast service road parallel to Fleur Drive. Because the existing grading for the new terminal site slopes downwards from south to north, the loading dock is at grade on the north side of the building. However, the curb and new roadway loop to the east of the loading dock are elevated so they are at grade with Level 1, which hides the dock from public view. The raised loading area can host a total of 5 parking positions for trucks, with 3 spaces reserved for deliveries and 2 spaces used for trash and recycling dumpsters. The loading area has direct access to an indoor receiving storage room, that will contain items temporarily before they are screened. The airside trash dumpsters are located just north of the loading dock and will sit below the Level 1 trash room. The loading dock area also provides exterior access to several service rooms, including the main switchgear room, the primary IT entrance, and an exterior screened mechanical space. The Mid-American Switchgear is located a covered location at the loading dock near the main switchgear room. The loading dock provides a turnaround area for trucks and 6 parking positions for airport and TSA staff. The parking area can expand for additional parking spaces in the future.

5.1.1.4 Concession Support

Concession support space needs for storage, offices, and employee areas are estimated at 4,680 square feet for the 2.0 million enplanement level projected for the 2042 planning year. This total equates to just under 16 percent of operating concession area and is based on the mix of food service and retail uses identified in Section 4.4.8 under a market-rate lease assumption. Concession support space in the opening year (2027, 1.5 million enplanements) is estimated at 3,510 square feet, or approximately 1,100 square feet less than the allocation in 2042.

Non-secure concessions storage is located adjacent to the goods and employee screening and is easily accessible from the loading dock. The central pre-security storage area is also near the non-secure elevator, so goods can be quickly transferred vertically after they are screened. The majority of concession storage is located on the secure side, with about a third of the total secure storage near the north secure elevator, and two thirds close to the south secure elevator. This allows all concession goods storage and trash to be transported vertically to airside concession areas without being transported through public areas.

These storage areas are well-located within the terminal building with respect to the vertical circulation and servicing routes at either end of the core gate area. These locations will shorten routes for resupply and trash removal, which is more important given the limited rear corridor circulation routes in the post-security environment. Notwithstanding the lack of nearby support space on the departures level, some food service locations may use a limited quantity of their back-of-house space for internal storage to mitigate this situation.

5.1.1.5 Airport Support

Airport support and storage spaces are sprinkled throughout all three levels of the terminal on both sides of the SIDA line and are linked by non-public support circulation corridors to the vertical circulation cores. The two main vertical circulation cores are located on opposite ends of the building's core to create easy access to all points of the building. They are directly connected on Level 0 by a non-public secure support corridor, which is where airport and concession employees will transport trash and goods. This main support corridor is wide enough to accommodate a fork lift and provides a straight run from the loading dock to the Custom Baggage Inspection Service (CBIS) area, so that any large machinery can be easily replaced as needed. The south vertical circulation core contains an airside elevator and egress stair that span from Level 0 up to Level 2, and the north vertical core contains an egress stair and two elevators, separated by the SIDA line, so that the support corridors on all levels can be accessed on either the secure or non-secure side.

5.1.1.6 Employee/Goods Screening

The new terminal has two Employee/Goods Screening areas, one on Level 0 near the loading dock, and the second on Level 1 behind ticketing. The screening area on Level 0 is easily accessible from the loading dock and will provide the connection between the non-secure and secure support corridors. It is also located adjacent to the north vertical circulation core for easy access to all levels. The Level 0 screening area will have one screening machine opening day and has the space for a second screening device in the future.

5.1.1.7 Mechanincal/Electrical/Plumbing (MEP) Spaces

The mechanical room containing the Air Handling Unit for the basement is located below consecutive mechanical rooms on Level 1 and 2. Each space is semi-enclosed behind exterior screens, allow them to vent directly to the outdoors while maintaining coverage. The AHU room on Level 0 has exterior access from the loading dock area. The main switchgear is also located in the loading dock area. The Mid-American Switchgear space is adjacent to it. Two other electric spaces are dispersed on Level 0 for full coverage. There are no restrooms located on Level 0.

5.1.2 Check-in/Arrival Level Plan (Level 1)

The check-in / arrival level, as shown in **Figure 5.5** consists of both public and non-public functions. The passenger vehicle and commercial vehicle curbs are at grade with this level, providing quick and easy access for passengers to ticketing and from the baggage claim area. The main public areas on this level, located along the east façade, are double height, naturally lit spaces, which will create a profound sense of arrival for passengers entering the building. The open volume also provides a direct visual link from ticketing to security on Level 2, which establishes intuitive wayfinding for passengers. The public vertical circulation to/from Level 2 is centrally located and clearly evident from the lobby. Non-secure passengers will also have access to the information booths, located along the east curtain wall between the main vestibules for good visibility. A side vestibule near the baggage claim caters to passengers using the Ground Transportation Facility (GTF), which will accommodate a loading/unloading zone for the Rental Car shuttles and Transportation Network Companies (TNC's.) On opening day and up to 4.0 MAP, the fourth baggage claim area will be temporarily utilized for the Des Moines Airport Authority (DMAA) main conference space. Level 1 also serves many airport and airline functions on the non-public side, including TSA support, Outbound and Inbound Baggage Makeup areas, DMAA office space, MEP systems, employee screening, and airline operations spaces.

5.1.2.1 Ticket Lobby

The layout and shape of the ticketing lobby was planned predominately for future technology flexibility. The check-in process is constantly evolving so the new terminal must be able to adapt and accommodate the airlines needs opening day to the foreseeable future. Across the industry, ticketing counters are becoming less necessary as more and more people check-in through mobile devices and skip the ticket counter altogether. Many airports are adopting self-bag tag and kiosk check-in services, which reduces the need for the standard ticket counter length, but increases the need for additional space in front of the counters. For new terminals, this results in shorter, deeper check-in spaces. The new check-in plan allows for about 30' more depth from the front façade to the ticket counter than the current terminal, which provides adequate space for kiosks and self-bag drop technologies of the future and eliminates the congestion in queueing that the current terminal experiences during their peak times.

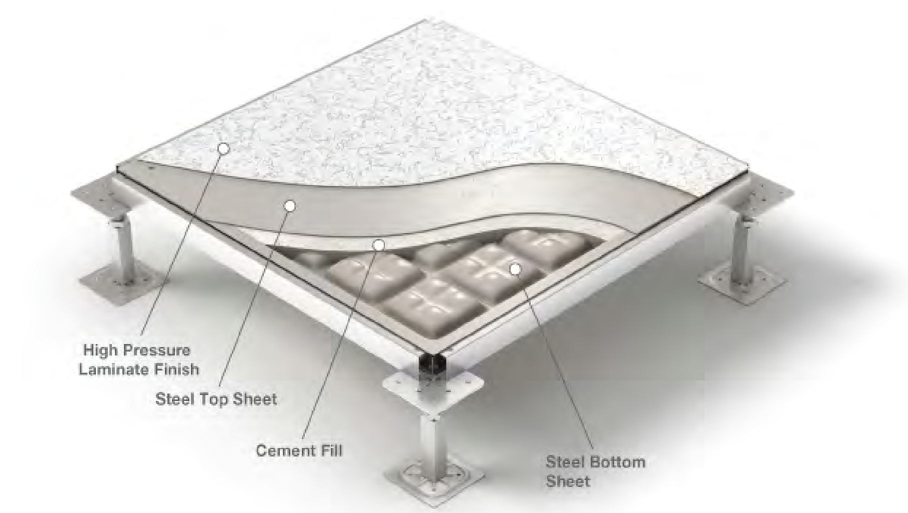


Fig 5.9 Access Flooring Diagram - Source: http://raisedaccessfloors.com

Access flooring, as shown in **Figure 5.9**, is a flooring system that provides simple access to the electrical and communication lines required for kiosks or other free-standing devices. This system provides the flexibility for the airlines to easily change their check-in processes as needed. Additionally, common use technology provides the airport more flexibility by allowing the number of ticket counters and kiosks to fluctuate by airline per demand. This approach is also superior from a maintenance standpoint; if one machine breaks down, there is built-in redundancy and another machine can become available. Additionally, the airport can operate a single common use system much more easily than multiple proprietary systems controlled by the airlines. The space behind the counters will operate similarly to the current terminal – the airline employee will place the checked bags onto a conveyor behind them, which will take the bags to the CBIS system located on Level 0. The flexibility of the layout will allow future the airport/airlines to move to self-bag drop as it becomes more common.

5.1.2.2 Airline Ticket Offices

The Airline Ticket Offices (ATO's) are located directly behind ticketing and are accessed by a support corridor with entry points on either side of ticketing, creating short walking distances for airline employees from the check-in area. The modular office structure will create a simple MEP layout and allow the airlines to easily adjust the amount of space they lease. The ATO's have close adjacency to non-public, common-use restrooms and the wheelchair storage, located on the north side of ticketing.

5.1.2.3. Transportation Security Administration (TSA) Support

The TSA has a large, centrally located support space on Level 1 which connects their staff directly between their functions on Level 0 and Level 2. A stair on the south side of the office extends to Level 2 behind TSA's private screening rooms and Law Enforcement Officer (LEO) space, allowing staff to quickly transition between security and their support spaces on Level 1. The stair also leads down to Level 0 to the CBIS and CBRA rooms. The TSA support space on Level 1 has a short walking distance to the shared restroom core on the secure side which is convenient for their staff.

5.1.2.4 Baggage Claim

The baggage claim area requires three carousels for opening day and will expand to four devices when the airport reaches 4.0 MAP. The fourth carousel space will be temporarily used for DMAA conference space. The existing baggage claim currently supports 188 LF of presentation length where passengers can pick up their bags, but the new plan offers 285 LF on opening day and 380 LF when the fourth claim is opened.

The DMAA opted for flat-plate claim devices rather than sloped-plate, which constitutes a higher level of service for passengers because it is easier to pull bags off a level surface. Conveyors six feet above Level 1 will feed the inbound bags to the carousels from above, so that no bag can pass back through the secure wall. Once the bag is transferred to the claim device, it will continue to circulate on the public side until it picked up.

The active claim and waiting areas around the carousels are significantly larger than the current terminal's space, and have been designed to pull passengers away from the general circulation area. By locating the end of the feed conveyor on the left side of the carousel, the bags will circulate in a clockwise motion around the device, arriving near the general circulation path east of the baggage claims last. Generally, passengers want to pick up their bags as soon as they arrive on the carousel, so the ideal waiting spaces are on either side of the carousels, instead of at the front end nearer to the circulation space. This will greatly reduce the apparent congestion in the baggage claim area.

5.1.2.5 Baggage Service Office

The baggage service office (BSO) is contiguous to the baggage claim and is easily visible to passengers in its centralized location. All airlines will be located in this office with common-use millwork and will have direct access to the common bag storage room behind their counters, which will contain individual locked storage areas for each airline. The BSO is also adjacent to the Out of Gage (OOG) inbound baggage chute, which is where baggage that cannot be handled by conveyors, such as surf boards or kennels, can be deposited.

5.1.2.6 Des Moines Airport Conference Center

The DMAA Conference Center will replace the functions of the existing terminal's Board Room and the Cloud Room. Its divisible walls can divide the large room into three separate conference spaces, to accommodate more intimate meetings and provide more flexibility to the airport staff. The pre-function space for very large meetings that take up the entire enclosed space can spill out to the circulation space in front of the conference space and temporarily blocked off from public circulation. The conference center is connected to the DMAA office space on the level above by a back staircase, that will provide the staff easy access up and down, and link the conference space with the office kitchenette. The excess tables and chairs can be stored in the large closet along the west wall. The Airport's Board Room will function in this space and is intended to have a similar "U" shaped millwork setup. This millwork shall be moveable to place in the storage closet when not in use. The conference center will have updated technology and monitors for use as conference or board related functions. This conference space is located in the future fourth baggage claim space that will be needed when the airport reaches 4.0 MAP. At that point, the conference center will be relocated as part of the 4-gate expansion project, estimated to occur around 2040.

5.1.2.7 Outbound Baggage

The outbound baggage room is located on the apron level just above the baggage screening system. Three make-up devices with a staging capacity of 8 carts per device are provided. A fourth carousel can be added in the future.

The two conveyor main lines for bags from the basement level merge above the apron level. Bags shall be read by an Automatic Tag Reader (ATR) and the baggage system is automatically routing the bags to the baggage make-up device. It is anticipated that bag sortation by airline is sufficient. Bag sorting to the make-up devices shall be automatic handled by the baggage control system. The last make-up carousel on the main line is dedicated as no-read (run-out) device. The baggage system shall run high enough over the apron level to allow for unobstructed tug and cart traffic below.

The space between the make-up devices is sufficient to allow tugs to pass between them with carts staged on either carousel.

5.1.2.8 Inbound Baggage

Three baggage claim devices with individual baggage feed lines will be provided in the baggage claim hall. Each claim unit provide minimum 100' of bag presentation length for passengers. Additional space and provisions are made to add a fourth claim unit in the future.

The loading conveyors are located on the apron level allowing adjacent to the baggage make-up room. The loading conveyors are placed so that each loading position can be reached by tug and cart without interference from adjacent baggage claim loading operation or traffic.

5.1.2.9 Oversize Baggage

A dedicated location for oversize bags is provided on the apron level. This prevents the vertical transport of bags into the basement and back to apron level for sortation. Bags are manually transported to the dedicated oversize screening location where the bags are processed by the TSA. After TSA has cleared the bags, the cleared bags are manually transported to a oversize hand-over location at which airlines can pick-up the bags.

5.1.2.10 Restrooms (Public and Back of House)

A public restroom core is located on the non-secure side of Level 1 to serve passengers utilizing ticketing and baggage claim areas. The men's and women's restrooms have door-less portals that block visibility from general circulation outside the restroom through to the stalls, but allow passengers barrier-free navigation into and out of the restrooms. The stalls are six feet deep to accommodate passengers with bags and the circulation space beyond the stall is at least eight feet wide. This restroom core also includes one family restroom, a janitor's closet with a local water heater and a walk-in plumbing chase accessed through the janitor's closet.

Three non-public restroom cores are provided for employees working in the back of house spaces on Level 1. One set of restrooms is located on the non-secure side behind ticketing for airline ticketing agents and airport engineers. A secure restroom core is located behind the landside restrooms and shares a plumbing chase. This restroom core is utilized by airline ramp employees for the north gates and all TSA staff. The last restroom on this level is south of the outbound baggage makeup area on the secure side and serves airline ramp employees manning the south gates. Each of these restroom cores include a men's and women's restroom including shower facilities, janitor's closet and walk-in plumbing chase.

5.1.2.11 Employee Offices/Airport Operations/Building Maintenance

The DMAA building engineers and technicians occupy an office space behind ticketing on Level 1. This space has personal offices for the Airport Facilities Manager, Chief Building Engineer, and Technical Systems manager, with cubicle space for the building engineers and technicians. The patrons have access to secure and non-secure spaces and the north vertical circulation core, to quickly access the concourse or the basement. The custodial office space is adjacent to the airport engineering offices, accessed from the non-secure support corridor.

5.1.2.12 Mechanical/Electrical/Plumbing Spaces

The Air Handling Unit Rooms are located on either side of the main terminal building to ensure the shortest lateral duct runs possible. The AHU room on the north side of the building is accessed through the secure service corridor and is elevated on a "balcony" above the AHU space on Level 0. The south AHU room is located at grade and is accessible from the secure service corridor. It vents to the mechanical courtyard space beyond the screened wall.

Two switchgear rooms are located on the south side of the building, with additional electrical rooms spaced evenly throughout Level 1.

Each restroom core is supplied with a janitor's closet that has access to walk-in plumbing chases. The janitor's closets are large enough to accommodate local water heaters.

5.1.2.13 Wheelchair Storage Areas

The Level 1 wheelchair storage area is located on the north side of the airline ticket offices for convenient access for ticketing agents and near the landside public elevator core

5.1.2.14 Employee Screening

Employee Screening on Level 1 handles mostly employee screening, while goods screening happens below on Level 0 near the loading dock. This screening checkpoint processes Airline ramp employees, DMAA staff needing access to the airside, TSA employees, concession workers, and other contracted staff. The checkpoint is located on the north side on Level 1 for simple access for airside employees.

5.1.2.15 Trash Chutes

Airside trash will be collected on the apron and navigated to the trash room on the north end of Level 1, which sits above the airside trash & recycling dumpsters in the loading dock area. Items can be deposited into two separate trash chutes in the trash room, which will be directed to the dumpsters below.

5.1.2.16 Ground Service Equipment (GSE) Parking/Charging

Ground Service Equipment (GSE), including aircraft and baggage tractors, baggage handling conveyors, baggage carts, cabin service vehicles and catering vehicles, service aircraft parked at the terminal between flights. Aircraft tractors push departing aircraft back into the taxi-lanes for a faster, more concise, and safer environment on the ramp. Without the tractors, aircraft would exert a significant amount of energy using reverse thrusters to push back from the gate, which is hazardous to the terminal, the GSE and the ramp employees. The GSE fuel the aircraft, provide auxiliary power, restock the aircraft's food & beverage supply, and load or unload baggage. When the GSE and aircraft tractors are not in use, they can be parked under the 15'-0" overhang from Level 2 or within the "Interior Vehicle Parking" spaces, located in the same structural band as the Airline Operations offices for flexibility. Larger exterior covered spaces are available for additional storage on the north and south ends of the terminal, where the concourse overhead extends beyond the enclosed space on Level 1.

5.1.3 Departure Concourse Plan (Level 2)

The departure concourse level incorporates many of the passenger functions, including concessions, meeter / greeter, the security screening checkpoint, departure lounges and restrooms as shown in **Figure 5.3**. These functions were planned to accommodate peak numbers of passengers, establish flexibility, enable future expansion and provide a good passenger level of service.

The existing terminal was only sized for 50-seat regional jets, but today receives aircraft over three times that size, as shown in **Figure 5.10**. This includes 737-800s, averaging 154 seats and A321s, which can hold an average of 180 seats. Larger aircraft are trending nationwide because of the increasing volume of travelling public and the pilot shortage, so terminals of the future need to be able to accept these aircraft. The new concourse is sized to accommodate Group III aircraft at all 14 gates. The wingtip-to-wingtip distance (20' minimum) and space between parking positions determines the length of the concourse. The planning study included layouts with both 25' and 20' wingtip separation. It was determined that 20' was acceptable. The departure lounges are spaced evenly with the gates and are sized appropriately to comfortably seat the growing number of passengers.

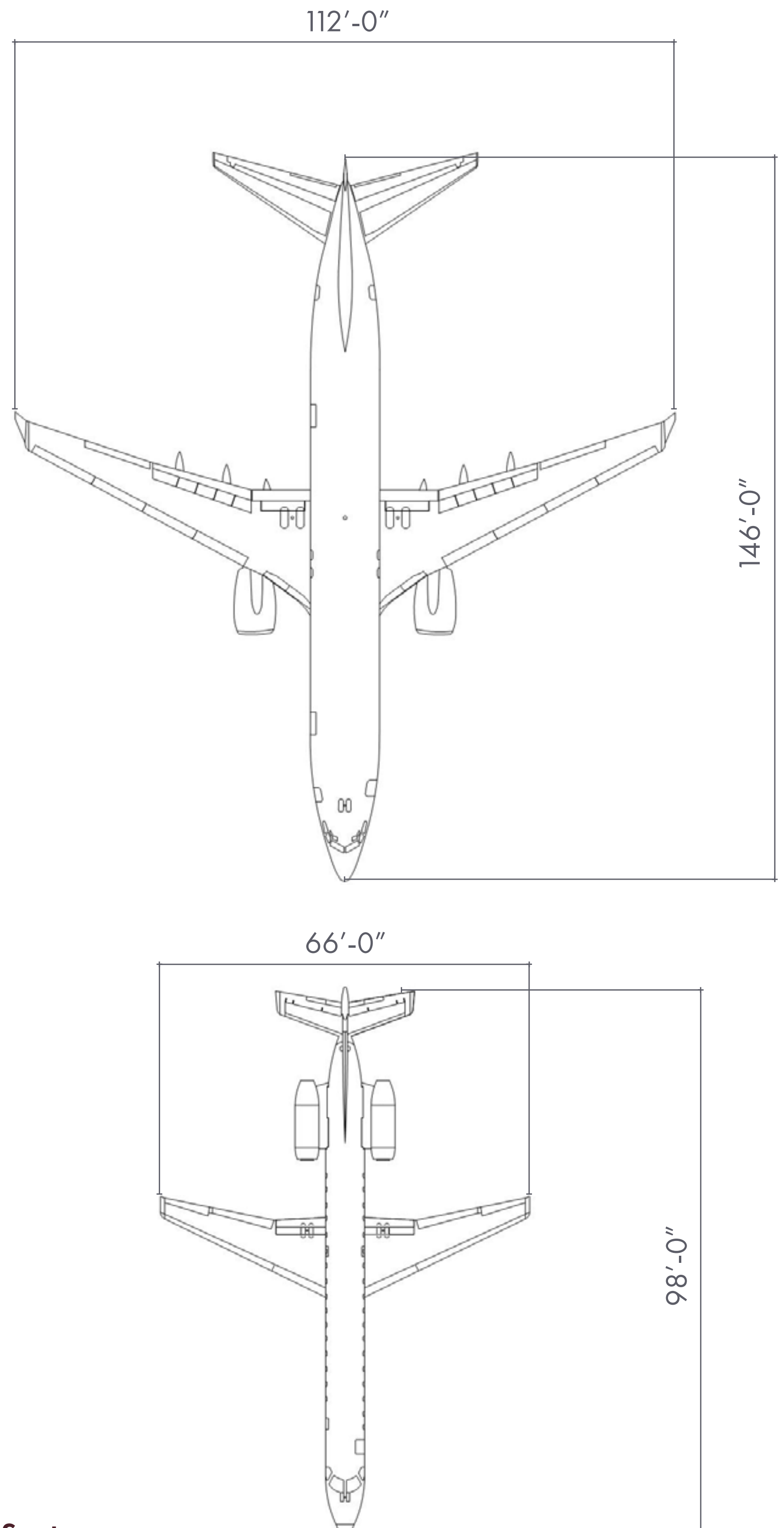
The concourse structure spans 55 feet from the curtain wall glass to the face of the hard-walled concessions. This open area creates an inherently flexible zone for the holdrooms, circulation and blended concessions, ensuring the airside is not physically constrained or restricted for future needs. The departure lounges are contiguous so that seating can overflow into adjacent holdrooms if one flight is particularly full. Additionally, because the space along the curtain wall is free from barriers, so the passenger's line of sight from adjacent departure lounges or nearby concessions to their gate is unobstructed. Patrons are free to keep shopping or dining before the boarding process begins, which helps reduce over-crowding in the holdrooms and generates more revenue for the concessions. Security screening, concessions and circulation areas also provide flexibility for future uses, as described later in this section.

Each end of the existing terminal's concourses extends to the limits of the Part 77 restriction set by the runways, which eliminates the possibility of future expansion and justifies the need for a new terminal. The positioning of the proposed terminal on the north side the site enables the expansion of the future 18-gate scenario while avoiding the constraints of Part 77.

The concourse level is divided evenly between 7 gates on the north concourse and 7 gates on the south concourse for the 14-gate scenario, resulting in a relatively similar number of passengers utilizing each end of the concourse and minimizing walk distances. The concessions, restrooms, circulation, holdrooms, and ramp service spaces below have been sized appropriately to constitute a proficient level of service for all passengers, regardless of which gate they utilize. The main concession core is situated in the central node between the branching concourses. The skylight, natural daylight, and larger volume of space, as further described in Chapter 6, create an exciting, vibrant atmosphere that all passengers can experience. People exiting security enter this space before proceeding to their gates, and the arriving passengers pass through it on their way to the concourse exit. Passengers on the landside also have a view of this space and can see beyond to the aircraft centered on the building's axis. An expansive window below the terminal's central skylight divides the landside and airside areas, but it provides a unique opportunity for the non-travelling public and meeter greeters to view their companions arriving at the terminal, or see them off after they pass through security. A bridge connects the hourly parking on Level 2 of the new garage to the meeter greeter area, providing a convenient connection for travelers not needing to check a bag and a journey from car to gate without vertical transitions.

The following sections describe the spaces on the departure level in further detail.

Figure 5.10 - Aircraft Comparison



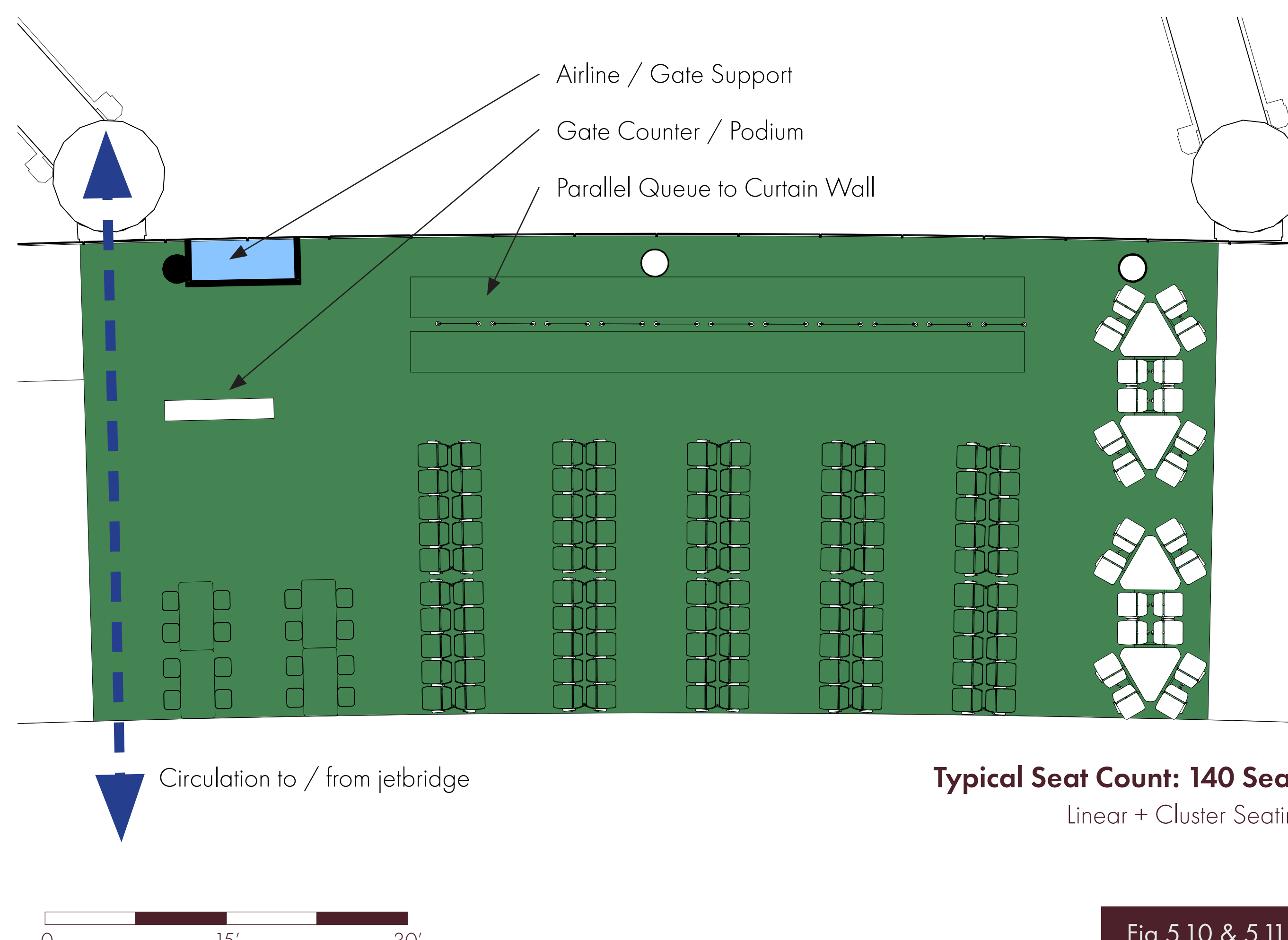
737-800 = 154 Seats
A321 = 180 Seats

Regional Aircraft = 50 Seats

5.1.3.1 Departure Lounges/Holdrooms

The departure lounges in the existing terminal are severely undersized and are separated by circulation spaces and other barriers, which results in over-crowded holdrooms that spill into the circulation path. Passengers navigate to gates beyond with significant difficulty and often have a tough time finding a seat in the holdrooms. The new plan provides sufficient space in each departure lounge for passengers and locates holdrooms contiguously, so particularly full flights can spill over into adjacent holdrooms rather than blocking circulation traffic. Each holdroom, as shown in **Figure 5.11**, is sized to accommodate 140 seats, which is derived from a 180-passenger flight with a load factor of 90%, with 85% of the passengers seated and 15% standing. The holdrooms incorporate tandem seating and different types of cluster seating to maximize seating usage. The tandem seating is perpendicular to the circulation space for ease of access and to allow passengers to navigate through to the queuing aisles parallel to the glass. Positioning the queuing area against the glass significantly reduces congestion in the circulation space and allows deplaning passengers to more easily by-pass those waiting to get on the plane. Arriving passengers proceed on a direct path from the jet bridge to the circulation space that is unobstructed by seating or other barriers. The gate counter is located adjacent to the jet bridge door so airline employees can efficiently scan tickets to expedite the boarding process. The curved shape of the building enables the departure lounges on the northern half of the concourse to enjoy views to the downtown area of Des Moines, which helps to enhance the sense of place for the terminal, as further addressed in Chapter 6. The southern-most holdroom space can be segregated as a "international holdroom" in the event of an emergency landing for international flights. The space can be divided from the rest of the concourse by a hung track-wall system that recesses into closets when not in use. The divert holdroom has direct access to two family restrooms. Diverts are commonplace at DSM with its close proximity to two hub airports, Minneapolis St. Paul (MSP) and Chicago O'Hare (ORD).

Figure 5.11 - Holdroom Layout



Typical Seat Count: 140 Seats
Linear + Cluster Seating

Fig 5.10 & 5.11

Figure 5.12 - Administration Offices Level 1 Plan

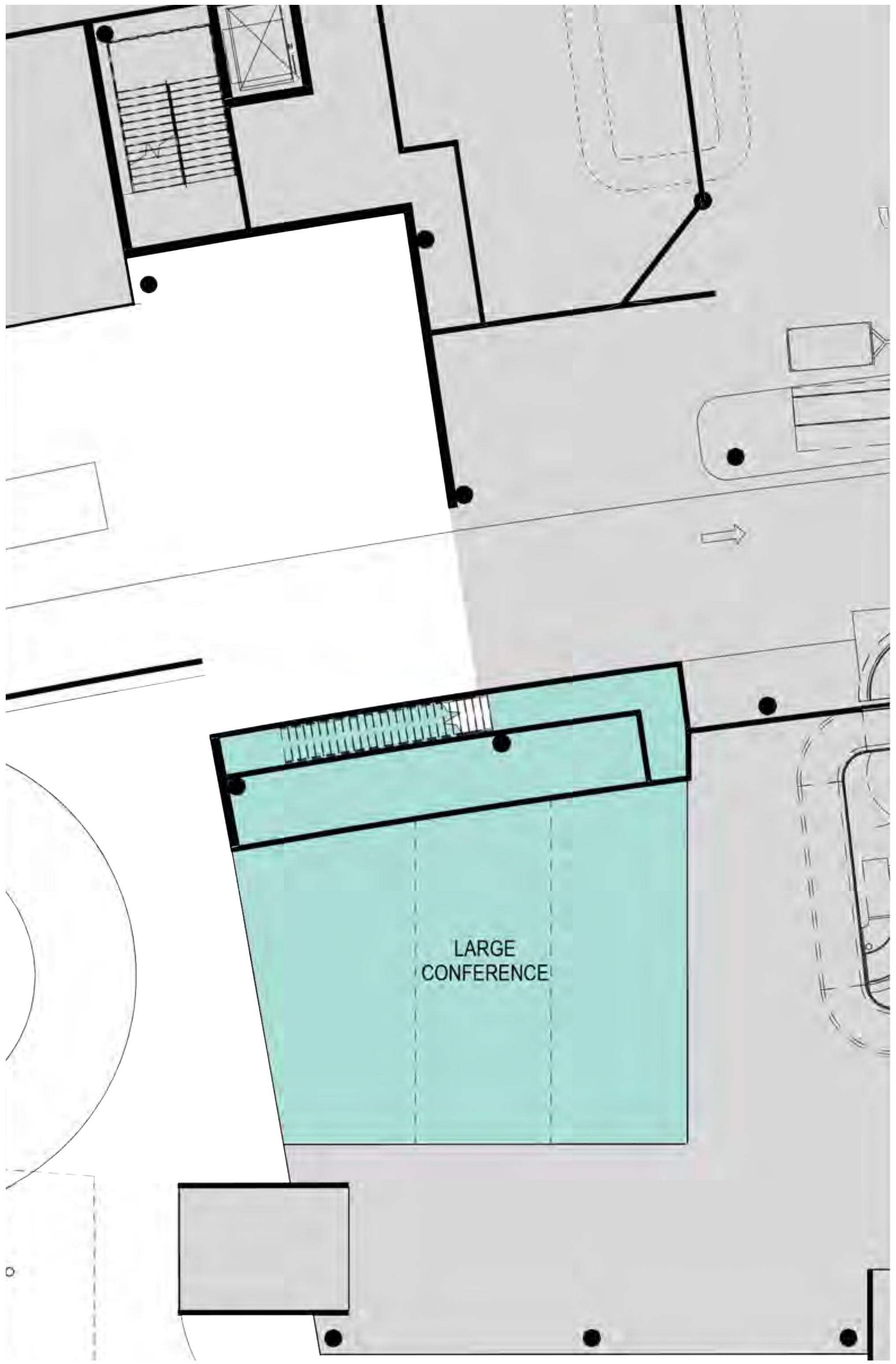


Figure 5.13 - Administration Offices Level 2 Plan

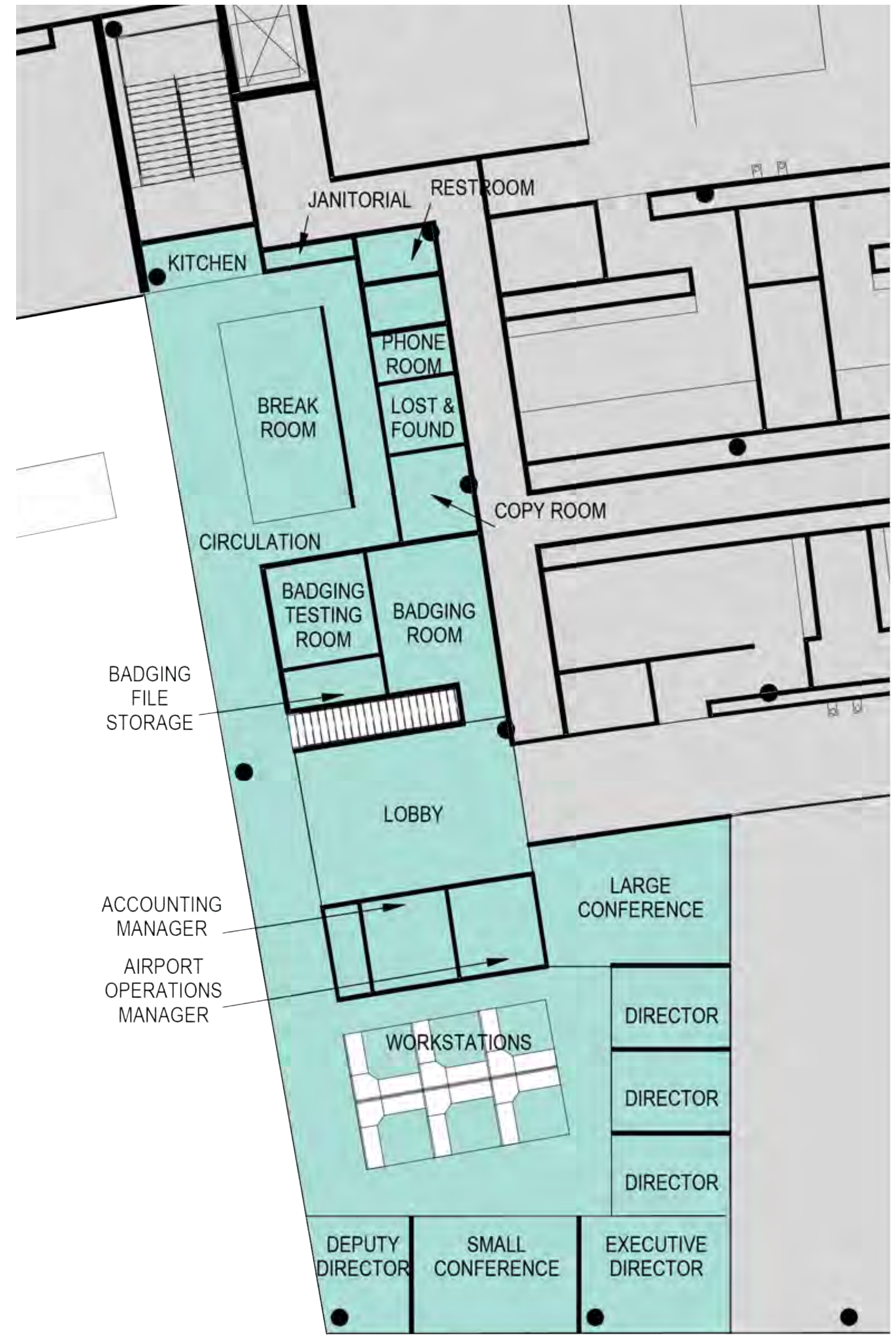


Table 5.2 Des Moines Airport Authority Administration Program

	Must Remain in Terminal - Level 1	ARFF	New Admin Area (Preferred in Terminal)	Office vs. Workstation
EMPLOYEE LOCKERS		200		
RESTROOM		300		
WORKOUT ROOM		300		
TECHNICIANS	192			WKSTN - 3
BUILDING ENGINEERS	128			WKSTN - 2
CHIEF BUILDING ENGINEER	120			OFFICE - 1
CUSTODIAL	320			
ACCOUNTING MANAGER			120	OFFICE - 1
AIRPORT ACCOUNTANTS			128	WKSTN - 2
AIRPORT FACILITIES MANAGER	120			OFFICE - 1
AIRPORT OPERATIONS MANAGER		120		OFFICE - 1
BADGING OFFICE			440	
BREAK ROOM/ENTRY AREA			300	
CIRCULATION	200		1725	
CIRCULATION (VERTICAL)			245	
CONFERENCE (DIVISIBLE)			2122	
CONFERENCE (PRE-FUNCTION)			600	
CONFERENCE STORAGE/KITCHEN			420	
CONTRACTS MANAGER			64	WKSTN
COPY ROOM/EQUIPMENT ROOM			120	
DEPUTY DIRECTOR			140	OFFICE - 1
DIRECTOR OF ENGINEERING			140	OFFICE - 1
DIRECTOR OF FINANCE			140	OFFICE - 1
DIRECTOR OF OPERATIONS			140	OFFICE - 1
EXECUTIVE DIRECTOR			228	OFFICE - 1
JANITORIAL			20	
KITCHEN			80	
LARGE CONFERENCE (OFFICE)			430	
MARKETING / AIRLINE SERVICE WKSTN			64	
PHONE ROOM			36	
RECEPTION/ ENTRY AREA			500	WKSTN - 1
RESTROOM			300	
SMALL CONFERENCE			270	
LOST & FOUND ROOM			20	
LOCKABLE STORAGE ROOM			20	
SUPPORT			80	
TECHNICAL SYSTEMS MANAGER	120			OFFICE - 1
EMERGENCY OPERATIONS CENTER		128		WKSTN - 2
MAIN OPERATIONS CENTER		0		WKSTN - 2
OPERATIONS STAFF		192		WKSTN - 3
RADIO ROOM		0		
TOTAL	**1200**	**1240**	**8892**	

5.1.3.2 Meeter/Greeter

The Des Moines airport has a larger meeter / greeter population because of the significant amount of their passengers travelling to the airport from areas outside the city of Des Moines. People drive to the airport from all over the state, even including parts of Nebraska and Missouri. Conventional taxis or TNC services are not viable options for those travelers, so people opt to drive their own vehicles or ride with their companions. Typically, meeter / greeters picking up arriving passengers park in the hourly lot and walk to the terminal to wait for their companion. The meeter / greeter area in the existing terminal is constantly utilized and justifies the need for the same function in the new terminal. The new location is situated on the landside balcony on level 2 and can be accessed from hourly parking on Level 2 of the new garage by a bridge that spans over the curb front and roadway. The bridge removes pedestrian traffic from the crosswalks and creates a safer environment for pedestrians and vehicles. Meeter/greeters waiting in their designated area can see through the glass wall dividing landside and airside to the arriving passengers on the other side.

5.1.3.3 Des Moines Airport Authority Offices

The Des Moines Airport Authority staff members manage operations, oversee maintenance and handle financial aspects for the airport. They require office space in the new terminal building with easy access to secure and non-secure spaces. In the original 4-Level terminal plan, their space was allocated on Level 3 along with some mechanical spaces and an observation deck. Through the value-engineering process, their space was condensed and relocated to Levels 1 and 2 in the future fourth baggage claim area. The building & technicians' offices were relocated to a non-secure space on Level 1 behind the ATO's and some of the operations staff will move to available space in the ARFF Station. Their main conference space on Level 1 in the future fourth bag claim area will periodically host public functions and is flexible for a variety of events. It is connected to their private office space directly by a back of house stair.

The front office area overlooks the baggage claim on Level 1 and hosts most of the staff offices. Also included in this area are two smaller conference spaces, a lockable storage room and most of the staff workstations. See **Figures 5.12** and **5.13** for a detailed plan of the administration spaces, and **Table 5.2** for the list of administration private offices and workstations and their respective locations. The administration space is accessed through an entry lobby with reception and a waiting area. The badging office and associated spaces are also accessed through the lobby. The staff space includes a kitchenette, break room, copy room, phone room, lost & found room, janitorial room and 2 restrooms.

Table 5.3 - Supportable Space Comparison to Existing Concession Space

	2027	2032	2042	Existing Plan	Plan Variance to 2042 Supportable
Enplanements	1.5 million	1.7 million	2.0 million		
Pre-Security	3520	3990	4700	3400	72%
Post-Security					
North Gates	1540	1740	2400	2735	114%
Core Gates	11690	13240	14940	14039	94%
South Gates	2300	2600	3350	2759	82%
Post-Security Total	15530	17580	20690	19533	94%
Total Concessions	19,050	21,570	25,390	22,933	90%
Support Space	3510	3980	4680	4417	94%
Total Program	22,560	25,550	30,070	27,350	91%

Note: Excludes personal services (shoe shines, ATMS, currency exchanges, banks, etc.). Spa and salon services are categorized by AirProjects within specialty retail.

Source: Airprojects, Inc. 2017

5.1.3.4 Non-Secure Concessions

While the overwhelming majority of enplaning passengers will delay their concession spending until after the security checkpoint, a much smaller market exists to serve arriving passengers, meeter-greeters, employees, and other visitors to the airport. The pre-security concession spaces are conveniently located adjacent to the meeter-greeter area on level 2, situated above and overlooking the check-in and baggage claim spaces. Concession allocations include spaces for a coffee shop, café bistro and a convenience retail store. An adjacent seating area will serve the café and provide a comfortable location for meeter-greeters, providing long views through a glass wall, across the entire post-security terminal core.

5.1.3.5 Secure Concessions

As detailed in **Section 4.4.7**, the airside concessions have been divided into three planning areas, the north, central core, and the south zones. As depicted in **Figure 5.14**, each zone includes food service and convenience retail spaces, while specialty retail is located only in the central core, to ensure maximum levels of passenger exposure.

Food service locations in the north and south zones are not envisioned as hard-walled spaces, but rather are blended into holdrooms, allowing customers to maintain a line-of-sight to their gates. While envisioned for lighter fare, these spaces should provide utility and ventilation flexibility to accommodate a wide variety of food service options. Convenience retail spaces in the north and south zones are located directly across from these food service units. These hard-walled units include an extended wall space along the concourse that will enhance visibility of these locations.

The central core contains four retail locations, a three-unit food court, and a marquee, sit-down restaurant location that includes both indoor and outdoor seating. This restaurant's indoor seating lies adjacent to the curtain wall, providing direct views out to aircraft, along the same central axis from the pre-security meeter-greeter area. The outdoor seating will be a shared space, equally accessible to dining patrons and other passengers in the central core.

Table 5.4 - Comparison of Plan Concession Allocations to Supportable Space by Category

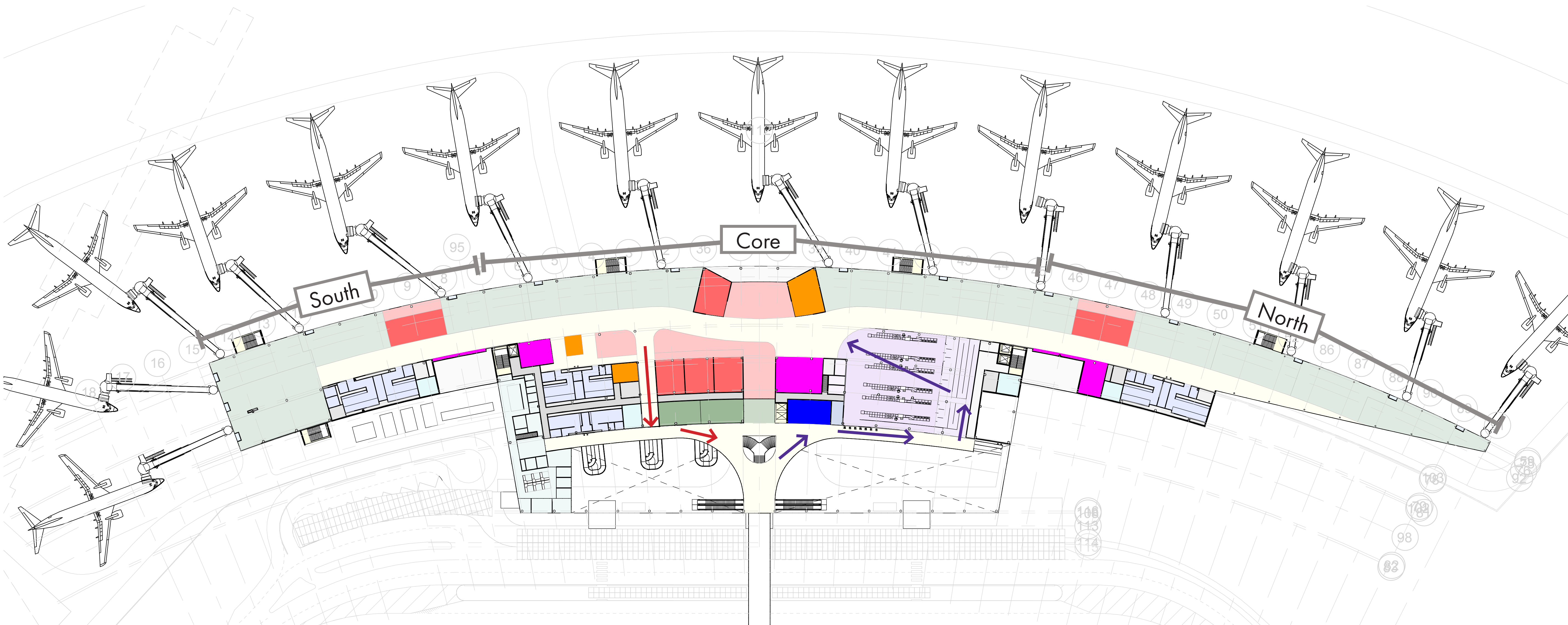
	2027	2032	2042	2042 Allocation	Current Plan	Plan Allocation	Plan Variance to 2042 Supportable
Pre-Security							
Food Service	2880	3260	3840	15%	2485	11%	65%
Convenience Retail	640	730	860	3%	915	4%	106%
Specialty Retail				0%		0%	
Pre-Security							
Total	3990	3990	4700	19%	3400	15%	72%
Post-Security							
Food Service	10200	11560	13600	54%	14604	64%	107%
Convenience Retail	2560	2890	3400	13%	3090	13%	91%
Specialty Retail	2700	3130	3690	15%	1839	0.8%	5%
Post-Security							
Total	15530	17580	20690	81%	19533	85%	94%
Total Concessions							
Food Service	13080	14820	17440	69%	17089	75%	98%
Convenience Retail	3,200	3,620	4,260	17%	4,005	17%	94%
Specialty Retail	2770	3130	3690	15%	1839	0.8%	5%
Total Concessions	19,050	21,570	25,390	100%	22,933	100%	90%
Support							
Pre-Security Support	670	760	900	0.4%	0	0%	0%
Post-Security Support	2,840	3,220	3,780	15%	4,417	19%	1%
Total Support	3510	3980	4680	18%	4417	19%	94%
Total Program	22560	25550	30070		27350		91%

Note: Excludes personal services (shoe shines, ATMs, currency exchanges, banks, etc.). Spa and salon services are categorized by AirProjects within specialty retail.
Source: AirProjects, Inc. 2017

Table 5.3 and **Table 5.4** further detail the concession plan allocation program for the new terminal and provide comparison against estimated supportable space. The allocation of concession space by category reflects efforts to align estimated capital requirements with the availability of anticipated funding. Plan reductions to specialty retail and pre-security food service were primarily impacted due to the downsizing of the terminal. Overall, however, the reductions were carefully considered, reflecting a desire to maintain the quantity of post-security food service, while minimally reducing the allocation of convenience retail.

The allocation of concession space by category reflects efforts to align estimated capital requirements with the availability of anticipated funding. Plan reductions to specialty retail and pre-security food service were primarily impacted due to the downsizing of the terminal. Overall, however, the reductions were carefully considered, reflecting a desire to maintain the quantity of post-security food service, while minimally reducing the allocation of convenience retail.

Figure 5.14 - Overview of Concession Allocaation Plan by Type



- Secure Food Service
- Secure Convenience Retail
- Secure Specialty Retail
- Non-Secure Food Service
- Non-Secure Convenience Retail

N
0 50' 100' 150' 200'

5.1.3.6 Balcony

The central airside restaurant is equipped with an outdoor seating area which provides a view to the parked aircraft on the apron and the airfield beyond. This balcony area requires 10' of non-combustible tempered safety glass with a 1-HR fire assembly rating to protect passengers from fumes and noise generated by the aircraft.

The balcony is recessed to align with the exterior curtain wall and is covered by the concourse roof overhead. The recessed solid walls that frame the balcony provide an opportunity for the kitchen to vent to the exterior, without having to penetrate the exterior curtain wall glass.

5.1.3.7 Security Screening Checkpoint (SSCP)

The Security Screening Checkpoint (SSCP) requires five screening lanes opening day, but has the width to accommodate a sixth screening machine in the future. The SSCP sizing has been validated by passenger modelling as shown in the Appendix. The screening area is large enough to support TSA's automated screening lanes (ASL's) which require more length than the conventional screening machines, but process passengers at a much quicker rate. TSA has direct access to two private screening rooms and utilize a back of house stair adjacent to the screening area to access their office spaces on Level 1. SSCP accommodates a Known Crew Member (KCM) lane to permit TSA to identify crewmembers and allow them to pass through security efficiently.

The queuing area incorporates abundant space for Economy, Pre-check and ADA lanes. Queuing is accessed from the Level 2 balcony which overlooks ticketing on Level 1. This area also acts as over-flow queue. Passengers who aren't checking a bag can by-pass ticketing on Level 1 and use the kiosks on Level 2 adjacent to screening to print their tickets or check in. This streamlined process creates a better Level of Service for the travel-savvy passengers and helps reduce congestion on Level 1

5.1.3.8 Airport Police

The airport police base is situated beside the Security Screening Checkpoint with space for two cubicles. Their presence and direct visibility adds to the discernible security for the terminal. Their checkpoint has direct access to the landside and airside so they can quickly reach any area within the building.

The Law Enforcement Officer (LEO) space is located at the exit of SSCP and has direct views to the security lanes as well as the majority of the concourse.

5.1.3.9 Restrooms

The airside restrooms are distributed along the concourse so that passengers walk a maximum of 3 gates to access a restroom core. The landside restroom is located near the concourse exit vestibule and is visible from the meeter / greeter area. Doorless entries are provided for the men's and women's restrooms to provide a barrier free entry. The entry, the ample circulation space within the restroom and the 6' stalls help accommodate passengers with luggage. Each restroom core also includes a drinking fountain, mothers room and family restroom. The janitor's closet at each restroom core provides access to walk-in plumbing chases for easy maintenance.

5.1.3.10 Family Restrooms

Two family restrooms and a mother's room are provided at each restroom core for passenger convenience. They are accessed from the general circulation instead of from within the men's or women's restrooms. Two family restrooms at the south restroom core are directly connected to the divert holdroom so when the holdroom is segregated from the rest of the concourse, detained passengers still have access to restrooms.

5.1.3.11 Pet Relief Areas

Two Service Animal Relief Areas (SARA) are provided in the terminal. The non-secure SARA is located outside, south of baggage claim on Level 1 and the secure SARA is situated adjacent to the central restroom core on the concourse. Refer to the FAA Service Animal Relief Area Guidelines and Best Practices for more information on the SARA requirements.

5.1.3.12 Wheelchair Storage Areas

Three wheelchair storage areas are provided at the concourse level with easy staff access. The north and south storage areas are adjacent to the respective restroom cores, and the central location is near the SSCP exit.

5.1.3.13 Mechanical/Electrical/Plumbing (MEP) Systems

The mechanical spaces are located at each level on exterior "balcony" spaces. They are semi-enclosed behind exterior screens which allow them to vent directly to the outdoors but maintain partial-coverage. The balconies are stacked at each level on either side of the building core so that the mechanical ducts can span from centralized locations to each end of the concourse and to the building's center core.

Four electrical rooms are dispersed throughout the concourse level to shorten conduit and cable lengths. Two electrical rooms are accessed from the landside and two are accessed from the airside.
Each restroom core is supplied with a janitor's closet that has access to walk-in plumbing chases. The janitor's closets are large enough to accommodate local water heaters.

5.1.3.14 Information Technology (IT) Spaces

Information Technology Intermediate Distribution Frame (IDF) rooms are strategically located throughout the terminal to ensure complete coverage by connecting telecommunication lines to each area. The size of the IT rooms are proportional to the amount of area they support. There are four IDF's on Level 2, five on Level 1, and two on Level 0. The Main Distribution Frame (MDF) is located on the secure side of Level 1 in a centralized back of house space. This room serves to connect telecommunication lines entering the building at the Primary and Secondary IT entrances on Level 0 with the terminal's internal network.

5.1.3.15 Circulation

Circulation paths are identified on both sides of the Security Identification Display Area (SIDA) line to help passengers quickly navigate to and from their gates to all the critical passenger functions. Neighboring spaces to the main circulation path, such as the holdrooms, are sized appropriately so passengers do not block circulation during peak times. The concourse is single loaded, so the circulation areas are 20' wide on either end of the building and expand to over 30' wide in the central concession core. The 55' roof span covering the circulation and holdroom areas establishes long sight lines and easy wayfinding for passengers locating their gates or exiting the airside through the exit vestibule.The landside circulation on Level 2 provides ample room for passengers navigating to security and for meeter / greeters waiting for their companions to arrive from the secure side.

5.1.4 Terminal Building Summary

The terminal layout aligns with the goals identified at the beginning of this chapter. The building footprint and aircraft layout conform with the Part 77 restrictions for the 14-gate and 18-gate scenarios and maintain a flexible approach for to accommodate future technology. The phasing, as described further in Chapter 7, maintains 10 contact gates throughout construction and allows the new terminal to be constructed in one phase. The terminal is arranged for easy wayfinding and short walking distances for passengers, both inside the terminal and to the existing infrastructure. The new roadway loop, as highlighted in Section 5.5, provides longer decision points for vehicles entering the site. The passenger amenities, the adaptable spaces and ingrained flexibility for the future establish a great level of service for passengers travelling through Des Moines. The terminal provides a safe and exciting experience for travelers and balances the need for future flexibility with economy to justify the initial construction costs.

5.2 Terminal MEP Systems

This section presents the recommended terminal Mechanical/Electrical/Plumbing (MEP) system development for the Des Moines International Airport New Terminal Building. Equipment capacities and sizing are based on serving approximately 300,000 SF of conditioned space, plus approximately 27,000 SF of snowmelt area.

General Building Design Criteria and Assumptions

- Building Code – International Building Code – Latest Version
- National Electrical Code - Latest Version
- Mechanical Code - International Mechanical Code - Latest Version
- Plumbing Code - International Plumbing Code - Latest Version
- Energy Conservation Code - ASHRAE 90.1 or International Energy Conservation Code - Latest Version
- Fire Protection Code - International Fire Code - Latest Version
- Fuel Gas Code - International Fuel Gas Code - Latest Version

5.2.1 Cooling Systems

Based on the current plans, the peak cooling load for the new terminal building is estimated to be 900 tons.

A new chilled water system will be installed. The chiller plant will consist of three (3) water-cooled chillers and one (1) air-cooled chiller. The water-cooled chillers will be magnetic bearing centrifugal machines with dual compressors. Each of the water-cooled chillers will be sized for 300 tons (net output). The air-cooled chiller will be a screw machine with a remote evaporator bundle. The air-cooled chiller will be sized for 300 tons (net output). The inclusion of the air-cooled chiller in the plant will provide the staff with the flexibility to service small cooling loads in the building during winter, spring, or summer months when the condenser water system may be drained. The air-cooled chiller will have a minimum ambient design temperature of -10°F.

The chilled water system will be a variable-primary pumping system. The pumps will be base-mounted end suction type. Variable frequency drives will be provided to minimize pumping energy. There will be three primary pumps in the chilled water system, each sized at 50% of the full load (900 GPM) to provide N+1 redundancy. Flow meters for each chiller and a minimum flow control valve will be provided to help ensure the minimum flow through each chiller while it is operating.
A new condenser water system will be installed. The condenser water system will consist of (3) cooling towers, each sized for 300 tons. The cooling towers will be crossflow design.

The condenser water system will be configured to allow variable flow. The pumps will be base-mounted end suction type. Variable frequency drives will be provided to minimize pumping energy. There will be three condenser water pumps, each sized at 50% of the full load (1350 GPM) to provide N+1 redundancy. A remote indoor or underground condenser water sump may also be evaluated as budget and space constraints allow to capture condenser water during freezing conditions instead of taking it to drain. This would provide water and chemical savings and operational flexibility during spring and fall months.

This chiller and cooling tower configuration will provide N+1 redundancy. In the event one of the water-cooled chillers is offline, the air-cooled chiller can be utilized in conjunction with the other water-cooled chillers to meet the full load of 900 tons. In the event the air-cooled chiller is offline, the three water-cooled chillers can meet the 900-ton load. In the event a cooling tower is offline, the air-cooled chiller can be used in conjunction with two water-cooled chillers and cooling towers to meet the 900-ton load.

The terminal building will include several spaces that will require mechanical cooling all year round such as electrical rooms and IT rooms. These spaces will be provided with dedicated cooling units, either connected to the chilled water system or DX split system units, and may be served by both if required for redundancy in critical applications.

Chilled water piping 2" and smaller will be copper with soldered joints and fittings, steel with screwed joints and fittings. Shutoff valves will be ball type, and check valves will be swing type. Piping 2-1/2" and larger will be Schedule 40 black steel with butt-welded, mechanically coupled, or flanged joints. Shutoff valves will be butterfly type, and check valves will be double-door type. Chilled water piping will be provided with fiberglass or elastomeric cellular foam (Armaflex) insulation. Condenser water piping will be Schedule 40 black steel with butt-welded, mechanically coupled, or flanged joints. Shutoff valves will be butterfly type. All piping systems and equipment will be labeled.

5.2.2 Heating Systems

Based on the current plans, the peak heating load for the new terminal building is estimated to be 17,000 MBTUH. This total includes the building heating load and the heating load associated with the snowmelt system.

A new heating water boiler system will be installed. The boilers will be natural gas fired, and will be high-efficiency condensing type. The boiler plant will include three 6,000 MBH input condensing boilers and two 3,000 MBH input condensing boilers. This boiler configuration will provide N+1 redundancy. The boilers will not be dual fuel.

The boilers will have modulating burner controls. ASME CSD-1 safety controls will be provided for remote shutdown. Hot water temperature will be reset based on outdoor air temperature. A boiler management system consisting of controllers capable of starting, stopping, and modulating all boilers will be provided to maximize the efficiency of the boiler plant.

A snowmelt system will be provided for the front entry sidewalks and crosswalks. A heat exchanger, pumps, and separate glycol piping system will be provided to serve the snowmelt system.

The heating water system will be a variable-primary pumping system. The pumps will be base-mounted end suction type. Variable frequency drives will be provided to minimize pumping energy. There will be four primary pumps in the heating water system; three pumps sized at 50% of the full load (570 GPM each, total load is 1,140 GPM) to provide N+1 redundancy. A fourth pump sized at 25% of the load (285 GPM) will be used for better turndown during reduced summer load conditions.
Heating water piping 2" and smaller will be copper with soldered joints and fittings. Shutoff valves will be ball type, and check valves will be swing type. Piping 2-1/2" and larger will be Schedule 40 black steel, with butt-welded, mechanically coupled, or flanged joints, or Type L copper piping with soldered joints. Shutoff valves will be butterfly type, and check valves will be double-door type. Condensate piping for condensing type boilers will be neutralized before entering the sanitary waste system. Heating water piping will be provided with fiberglass insulation. All piping systems and equipment will be labeled.

5.2.3 HVAC Systems

The primary HVAC systems serving the new terminal building will be variable air volume (VAV) air handling units. The air handling units (AHUs) will provide cooled and dehumidified supply air to VAV boxes with hot water reheat coils and, where necessary to meet the heating load, fan-powered VAV boxes with hot water reheat coils.

Based on the current plans, the peak airflow load for the new terminal building is estimated to be 400,000 CFM. This equates to approximately 1.30 CFM/SF of space. The AHUs will be custom built and installed outside of the building in the mechanical spaces identified on the preliminary drawings. There are currently five spaces allocated for AHUs, although it may be necessary to divide this into more AHUs to accommodate coordination and constructability.

The AHUs will include the following components: return fans, pre-filters, outside air damper, return air damper, relief air damper, total energy recovery wheel with bypass, pump hot water heating coil, chilled water cooling coil, and supply fans. The supply and return fan sections will utilize fan arrays to provide redundancy. Each supply and return fan in the arrays will be provided with a VFD to allow off-peak savings (one VFD per fan). Humidification is not anticipated for general space conditioning.
Return air will be ducted from the served spaces to the air handling units. A plenum return air system will be used as the design of the building allows to minimize space needs and cost while still providing for good air circulation in each space. Exhaust will be provided for code-required spaces such as toilet rooms, kitchen, and food service areas. Grease exhaust ductwork and fans will be provided where required for the restaurant, kitchen, and food court areas. All exhaust fans will be located on the roof. Make-up air for the kitchen exhaust hoods will be provided via the outside air supplied through the main air handling units as transfer air, where possible. Dedicated make-up air units will be provided in spaces where transfer air is not available or equipment operating schedules may not allow.

Supply ductwork will be galvanized steel and will be insulated with fiberglass insulation wrap. Return and transfer ductwork will be galvanized steel and will be insulated in fiberglass liner for improved sound attenuation. General exhaust ductwork will be galvanized steel and will be insulated within 10' of roof penetrations with fiberglass insulation wrap. Moisture laden exhaust ductwork from showers will be aluminum. Grease-laden kitchen exhaust ductwork will be all-welded black iron or a UL listed pre-manufactured ductwork system. Kitchen exhaust ductwork will be routed out of the building within 2-hour rated architectural enclosures or UL listed fire-wrap insulation. Dishwasher exhaust ductwork will be all-welded stainless steel. All equipment will be labeled.

5.2.4 Temperature Control Systems

A new direct digital control (DDC) system will be provided for the new terminal building. All new HVAC and plumbing equipment will be connected to the DDC system. The DDC system will be BACnet open protocol. The existing campus system is Siemens. Siemens will be the basis of design for the DDC system, but other manufacturers will be considered as alternate bids.

5.2.5 Plumbing Systems

A new domestic water service will be provided for the terminal building. The domestic water service entrance will be in the water entrance room on Level 1. Redundant backflow preventers and a water meter will be provided at the domestic water service entrance.

A water pressure booster assembly will be installed to maintain domestic and makeup water pressures downstream of water treatment devices. The domestic water booster system will be a skid package with multiple booster pumps and VFDs. The domestic water pressure booster system will be located in the water entrance room on Level 1.

New natural gas water heaters with storage will be installed in the Boiler Room on Level 1. Hot water will be generated, stored, and distributed at 140°F. Remote anti-scald mixing valves will be provided at each fixture as required by code. The need for water softening or treatment will be determined once a comprehensive water analysis has been completed. The domestic hot water system will be recirculated throughout the entire facility. Public handwashing sinks and sensor operated faucets will have the recirculation piping routed down the wall and connected to the hot water piping within two feet of the fixture. Distributed point-of-use water heating systems may also be evaluated for potential improved energy efficiency and cost savings as compared to a central system with recirculation.
Plumbing fixtures (lavatories, water closets, urinals) will be porcelain type. Fixture colors and types will be selected with the Owner and Architect. Sensor-operated flush valves and sensor-operated faucets will be provided for public restrooms and will be hard-wired. Manual flush valves and manual faucets will be provided for private restrooms. Cold, tempered, hot, and hot water recirculation piping above-ground will be Type L copper with 100% lead-free solder. Insulation will be glass-fiber with all-service jacket. Shutoff valves will be located at all major branch and all final use locations. All piping systems and equipment will be labeled.

Sanitary piping will be routed from the new fixtures to mains routed below Level 0. The quantity, size, and location of the sanitary main exits from the building will be coordinated with the civil site engineer as the design progresses. It is anticipated that the main sanitary outfalls from the building will be located on the northeast portion of the building. It is anticipated that all sanitary drainage will flow by gravity to the mains outside of the building – no central sewage ejector pumps will be required (although elevator sump pumps will be required which will discharge to sanitary). Grease interceptors will be provided for the kitchen and concession areas as required per the Des Moines Metropolitan Waste Reclamation Authority. Above ground sanitary piping will be cast iron or Type M copper. Below ground sanitary piping will be cast iron. Grease-laden sanitary piping will be stainless steel. All sanitary and vent piping and equipment will be labeled.

Storm piping will be routed from the new roof drains to mains routed below Level 0. The quantity, size, and location of the storm main exits from the building will be coordinated with the civil site engineer and building architecture as the design progresses. It is anticipated that the main storm outfalls from the building will be located on the east side of the building. Secondary roof overflow drains will be piped down inside chases to lambs' tongue fittings and will spill onto grade. A sand/oil interceptor will be provided at the loading dock for the storm drainage before it connects to the site storm piping. Drain tile will be provided around the perimeter of the basement at the foundation. The drain tile will be connected to a duplex sump pump and discharged to the site storm system. Above ground storm piping will be cast iron or Type M copper. Below ground storm piping will be cast iron. Insulation will be glass-fiber with all-service jacket. All storm piping and equipment will be labeled.

A new gas service entrance will be provided for the terminal building. The existing gas main located outside the building will be tapped, and a meter with pressure regulator furnished and set by the local utility. Inside the building, natural gas will be routed in at 2.0 psig to serve the boilers, water heaters, kitchen equipment, and emergency generators. The natural gas service entrance will be located outside the Boiler Room on Level 1. Natural gas piping will be Schedule 40 black steel pipe with threaded connections for 2" and under sizes and with butt-welded connections for 2-1/2" and larger sizes. All natural gas piping and equipment will be labeled.

5.2.6 Fire Protection Systems

A new fire protection service will be provided for the terminal building. The fire service entrance will be in the water entrance room on Level 1. Redundant backflow preventers will be provided at the fire water service entrance. The new terminal building will be provided with an automatic sprinkler system per NFPA 13. A standpipe system will not be required since the highest floor level is not more than 30 ft above the lowest level of fire department vehicle access (IBC 2015, 905.3.1). At this time, no hydrant static or residual pressure and flow test data has been obtained from the local fire department. However, it is anticipated that the new terminal building will not require a fire pump. The new building will be light hazard classification in general, with areas of higher hazard classification such as storage rooms. Dry fire protection systems will be provided where sprinkler piping is subject to freezing (overhangs, canopies, etc.). Double interlock pre-action systems or clean agent fire suppression systems will be provided in the main IT rooms. Smaller satellite IT rooms will be provided with coverage via the wet pipe sprinkler system.
Wet piping 2" and smaller will be Schedule 40 black steel with screwed or flanged joints. Wet piping 2-1/2" and over will be Schedule 40 black steel with mechanically roll-grooved joints. For wet piping 2-1/2" and over, Schedule 10 black steel piping may be considered as a budgetary consideration as the design progresses. Dry piping will be Schedule 40 galvanized steel with screwed or flanged joints 2" and smaller, and screwed, flanged, or mechanically coupled grooved joints 2-1/2" and larger. All fire protection piping and equipment will be labeled.

5.2.7 Power Systems

5.2.7.1 Utility Service

A new automatic throw over (ATO) switch will be provided by the utility company. The ATO will serve a new medium voltage substation located inside the new terminal. The ATO will be served from two separate lines. One side of the ATO will be served from a new feeder originating along Fleur Drive from the north and the second feeder will be served from the south. Medium voltage feeders from the new ATO switch will be routed in a looped fashion throughout the terminal to each new substation. New 13.2kV to 480 volt unit substations will be located on each floor to serve the 480 volt loads in that area. In general, a unit substation will be located in the north half and another in the south half for each floor. Refer to conceptual one-line **Figure 5.15** diagram for a potential layout. The unit substations will range in size from 150 kVA to 500 kVA depending on the equipment and area being served. The utility company will provide the medium voltage automatic throw over switchgear and primary conductors.

All new conduits outside the limits of construction will be directionally bored and will be a minimum of 5" HDPE. Conduit within the limits of construction will be PVC, Schedule 40, reinforced, concrete encased and will be a minimum 4". Conduit routing requirements will be based on direction from the civil engineer to coordinate with other utilities. Manholes will be provided for all conduit runs in excess of 500' and where required by the utility company. 100% spare capacity will be provided for all primary conduits. Secondary service feeders will extend from the new automatic throw over switch to the new service-rated switchgear located in the main electrical room. Underground conduits will be installed in a concrete encased duct bank. Metering will be installed on the exterior of the building outside the main electrical switchgear room in accordance with the utility company requirements. A secondary service with exterior meter will be provided for the fire pump. The service will be routed outside the building to the fire pump controller. Any conduits routed within the building will be concrete encased or will use MI conductors.

Figure 5.15 - Electric One-Line Diagram

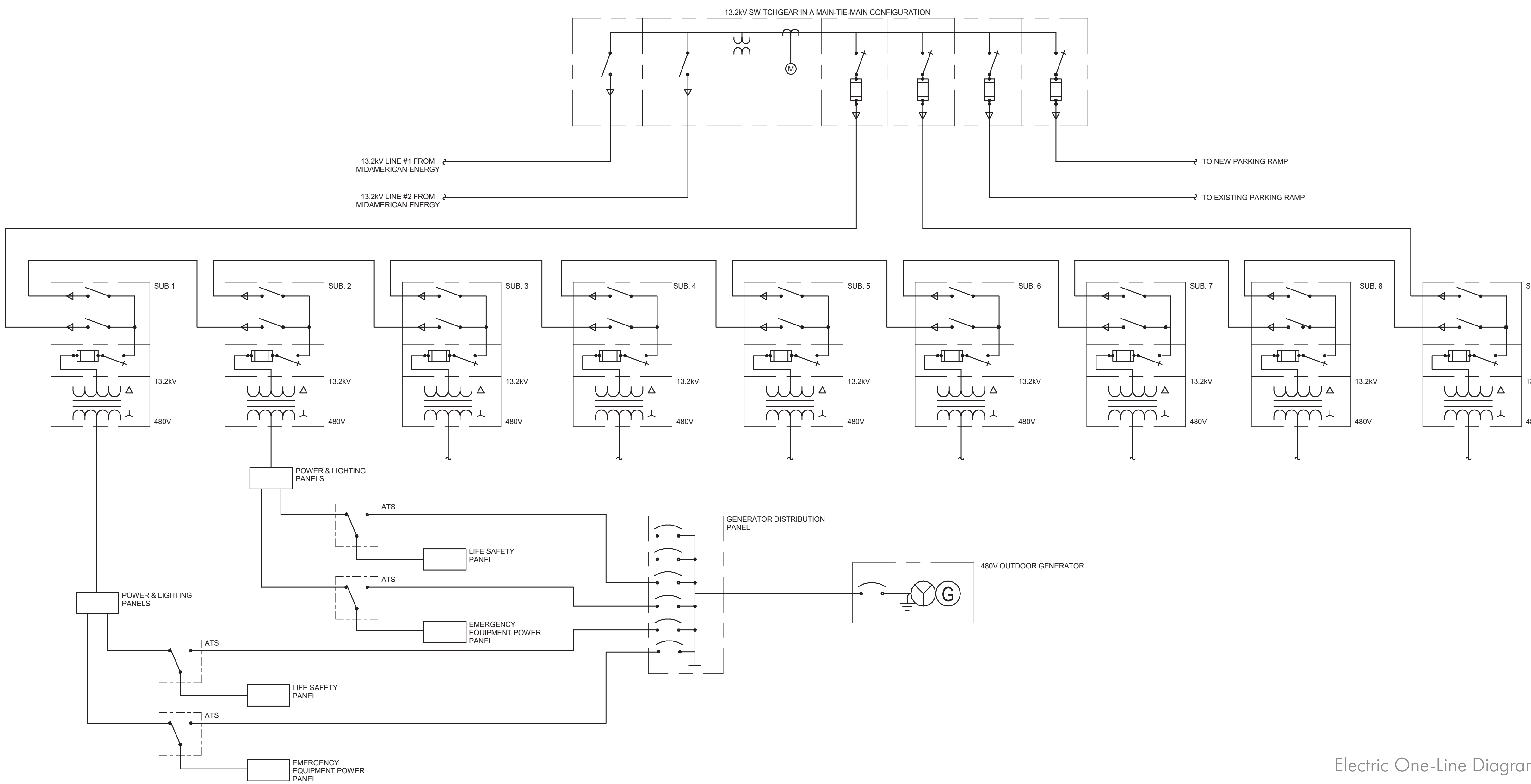


Table 5.5 Emergency Power Load Separation

Load Type	Life Safety - Priority 1 Permanent Generator	Priority 2 - Permanent Generator	Priority 3 - Portable Generator(s)
General Building Items:			
Fire Alarm System	✓		
Path of egress lighting interior and exterior at min of 1 foot-candle average.	✓		
Public restroom lighting	✓		
All building lighting			✓
Automatic exit doors	✓		
All exit signs	✓		
Electrical/mechanical rooms (selected equipment)		✓	
Passenger elevators at mezzanine		✓	
Non-secure elevators at north - south		✓	
Minimum required exterior public lighting at the land side.	✓		
Ticket counter computers, min. 6 counters (one each airline)		✓	
Police department		✓	
Sump pumps	✓		
Minimum required exterior apron lighting (air side) design includes one fixture per gate.		✓	
Mechanical systems and associated controls for tug traffic exhaust/ ventilation system	✓		
Refrigeration and machine room ventilation	✓		
Fire Pump Room	✓		
Communications:			
Public address system equipment; including speakers	✓		
Visual paging system for FIDS and BIDS monitors. (See UPS note below)	✓		
FIDS and BIDS monitors. (See UPS note below)	✓		
All telecom rooms and MDF (i.e., Main, North and South) are fed by local panel which is on generator power, and each equipment rack is fed by local UPS.	✓		
Security System (All CCTV, Security Access doors)		✓	
North & South telecom room fire suppression:	✓		
Main telecom closet fire suppression	✓		
Passenger boarding bridges supplied with enough power to operate motors on a min. of 2 bridges simultaneously (not including bridge AC or Aircraft Power)		✓	
Passenger boarding bridge lighting		✓	
Airline operations (Min lighting and workstations)		✓	
Emergency radio operations room	✓		
Main operations center	✓		
TSA Emergency Power Requirements:			
CBIS/CBRA Equipment		✓	
Outbound conveyor system			✓
Outbound carousels (2 units)			✓
X-ray - Middle 2 lanes (passenger screening)		✓	
OSR Control room		✓	
BHS Control room		✓	
SCCP - Middle 2 lanes (passenger screening)		✓	
Passenger checkpoint lighting	✓		
Inbound & Outbound baggage lighting		✓	
CBIS/CBRA lighting and HVAC		✓	
TSA data room fire suppression	✓		
TSA data room cooling and equipment		✓	
Full TSA Operation			✓
Inbound Carousel (one to run at a time)		✓	

5.2.7.2 Main Distribution

The unit substations located in each electrical room on each floor will have 13.2 kV to 480 volt transformers with integral circuit breaker type switchboards rated at 480/277 volt, 3phase, 4wire with a main circuit breaker. On the medium voltage side, the feeders will be installed in a loop fashion.

The switchboards will use fixed-mounted power circuit breakers with a microprocessor-based breaker tripping system and electric metering capability. Spare spaces will be provided to accommodate future loads. The distribution panel switchboard switchgear will be provided with ground fault protection. A digital power meter will be provided on the load side of the main overcurrent protection device within each unit substation. The digital power meters will be connected to the BMS for centralized power monitoring.

5.2.7.3 Generator

A 500 to 1,000 kW, standby rated, natural gas emergency generator rated at 480/277 volt, 3phase, 4wire will be provided. The generator will be located in a weatherproof, sound-attenuated enclosure located on the south side of the terminal. The generator will be provided with a natural gas line from the utility company. The generator will be provided with one fully rated output breaker. The circuit breaker will serve a generator distribution switchboard located in the main electrical room that will serve the life safety equipment throughout the building and the optional emergency loads. The generator switchboard will have dedicated vertical sections for each branch of the emergency power system: life safety and equipment in accordance with the National Electrical Code. Remote generator annunciator will be provided in the main security room to allow 24/7 monitoring.

5.2.7.4 Emergency Distribution

The generator switchboard will be rated at 480/277 volt, 3phase, 4wire with a main circuit breaker. The generator switchboard will use fixed-mounted power circuit breakers with a microprocessor-based breaker tripping system and electric metering capability. Spare spaces will be provided to accommodate future loads. Life safety and equipment loads will be served by separate transfer switches. Transfer switches serving life safety and equipment loads will be 3-pole, open transition, by-pass isolation type.

Table 5.5 is intended to clarify what is required by code to be on a backup power system and what additional building systems are recommended to be put on the generator(s), without dramatically increasing cost, to allow the airport to operate albeit in a reduced level of service mode. The loads will be separated into life safety, priority and secondary standby systems. **Table 5.6** is intended to show what systems or areas will not have emergency power back up and which systems or areas not planned to have emergency power backup.

Finally, we will identify all other systems which would be supported from external generation systems for an extended emergency situation and would keep the airport in a fully functional mode. Each panel on the emergency distribution system will have surge suppression to meet National Electrical Code requirements. Emergency generator(s) system will be located outside the building in a weather proof enclosure. The loads will be separated into 3 categories as follows:

- Priority 1: Life safety equipment - those required by code supplied by the permanent generator. Loads will have a power source within 10 seconds of utility failure.
- Priority 2: Priority power needs - those that assist in operating a facility and are powered by the permanent generator. Loads will have a power source in about 30 seconds of a utility failure.
- Priority 3: Secondary Standby needs - Items and equipment powered by one or more portable generators brought to the site during long term power outages and connected through the main switchgear.

Table 5.6 Systems Without Emergency Power

	Areas without Emergency Power	Areas Planned without Emergency Power
Chillers and building HVAC systems other than those specifically listed above.	✓	
Baggage conveyance system are only on Priority 3.	✓	
Accounting manager office		✓
Airport facilities manager office		✓
Airport operations manager office		✓
Airport storage		✓
Baggage control office		✓
Board room		✓
Break room		✓
BSO lobby		✓
Building engineer's office		✓
Cafe		✓
Cafe bistro		✓
Center convenience retail		✓
Central restaurant		✓
Chief building engineer		✓
Cloud room		✓
Cloud room storage		✓
Coffee		✓
Coffee kiosk		✓
Coffee seating		✓
Conference room		✓
Contracts manager		✓
Convenience retail		✓
Copy room		✓
Custodial		✓
Deputy director office		✓
Director of finance office		✓
Director of operations office		✓
Dock		✓
Employee lockers		✓
Enforcement officer office		✓
Executive director office		✓
Food court		✓
Food court queueing		✓
Food service		✓
Future coffee kiosk		✓
Kitchen		✓
Law office		✓
North food service		✓
Observation		✓
Receiving storage		✓
Reception		✓
Retail		✓
South food service		✓
Spare parts room		✓
Specialty retail		✓
Storage		✓
Technical systems manager office		✓
Wheelchair storage		✓
Workout room		✓

5.2.7.5 Uninterruptible Power Supply (UPS)

All communication equipment listed as Priority 1 or Priority 2 will require and is being provided with an uninterruptible power supply (UPS). Uninterruptible power supplies will be sized to support a minimum of 20 minutes of operation. Additionally, each equipment cabinet will contain several power distribution modules to provide electrical power to equipment for redundancy purposes. Remote equipment such as FIDS and BIDS monitors that support Visual Paging will have individual UPS support specified with each monitor and located in proximity to the monitor location.

5.2.7.6 Normal Distribution

New normal power branch lighting loads will be served from new 208/120 volt, 3phase, 4wire branch circuit panels. These panels will be connected to new circuit breakers installed in the unit substations.

5.2.7.7 Main Distribution

Distribution equipment will be provided with dead front construction, copper bussing, and sized with a minimum of 15% spare circuits. Transformers will meet the 2016 Department of Energy efficiency standards. Transformers will have copper windings, and will be rated for 115°C temperature rise over ambient. Transformers will be installed on concrete housekeeping pads. Variable frequency drives will be provided with manual bypass to allow equipment to run in a manual fashion should the electronics fail.

Transfer switches will be automatically operated with microprocessor-based controls to start the generator, transfer loads, and exercise generator. Transfer switches will be three pole, with bypass isolation. A surge suppression system will be provided on each unit substation switchboard (Category "C" SPD), as well as on all branch and distribution panelboards (Category "B" SPD). All wire will be copper.

An electrical load study, including short circuit analysis, voltage drop, arc flash and selective coordination, will be required to be carried out on the entire power system. This study will be performed by the selected manufacturer of the distribution equipment. Feeder sizes will be increased as required to limit voltage drop from the service entrance to the branch circuit panel to not more than 2%.

5.2.7.8 Branch Distribution

Branch circuit panels serving lighting and receptacle loads will use molded case, thermal magnetic type circuit breakers. Branch circuit panelboards will be sized with a minimum of 20% spare circuits. Where panelboards are flush mounted or installed in closets less than 2′ deep, five empty 1″ conduits will be stubbed into an accessible location above the ceiling for future use. Branch circuit panelboards will be provided with door-in-door construction with copper bussing.

Branch circuit design will be based on a maximum of 1,900 volt amperes per 20 ampere, 120 volt circuit, and 4,400 volt amperes per 20 ampere, 277 volt circuit. 277 volts will be used for all general-purpose lighting. All receptacles will be specification grade with stainless steel cover plates. All receptacles in public lobbies and waiting areas will be tamper resistant type.

GFCI receptacles will be provided in exterior locations, locations within 6′-0″ of all sinks, and at water coolers and vending. GFCI receptacles with weatherproof, heavy duty in-use covers will be provided on the exterior of the building and near all roof-mounted mechanical equipment. Fifty percent (50%) of receptacles in open and private offices will be connected to vacancy sensors serving the lighting. These devices will differ in color. Devices will be red in color for emergency circuits.

Minimum wire size will be #12 for power circuits and #18 for controls circuits. A dedicated neutral conductor will be provided in all branch circuits. Feeder sizes will be increased as required to limit voltage drop from the branch circuit panel to the terminal device to not more than 3%. Not more than three computer workstations will be served by a common circuit.

Dedicated circuits will be provided to serve the following equipment:

1) Refrigerators
2) Freezers
3) Copiers
4) Microwave
5) Coffee brewers
6) Equipment with a load greater than 10 amps

5.2.7.9 Motor Connection and Control

Motors 3/4 horsepower and larger will be served at 480 or 208 volt, 3phase, 3wire. Motors less than 3/4 horsepower will be served at 120 volt, 1phase, 2wire as applicable. Heating, ventilation, air conditioning, and other mechanical loads will generally be served at 480 volt, 3phase, 3wire. Fans and large pumps will be controlled by VFDs. Smaller motors will be controlled by full voltage starters or manual starters as required.

5.2.7.10 Grounding System Requirements

A grounding system and equipment grounding will be provided per National Electrical Code Article 250 for transformers, motor starters, panelboards, switchboards, transfer switches, wiring systems, etc. A green insulated equipment ground copper conductor, sized per National Electrical Code 250.122, will be run with all feeders and branch circuit homeruns.

5.2.7.11 Electronic Metering

A power monitoring system will be provided. This power monitoring system will consist of electronic power monitoring devices on designated distribution panels. The metering system will be equipped with system display units for displaying data from the power monitoring devices and will be capable of displaying information on a facility computer via the local area network. The system will be provided with a network data and unique IP addresses. Gateways will be provided for meters without internet communication functionality.
The power monitoring system will be provided to obtain the following information at all meters:

1) Monitor and record load profiles, and chart energy consumption patterns.
2) To calculate and record the following:
    - Load factor
    - Peak demand periods
    - Consumption correlated with facility activities
    - The system will be capable of the following features:
    - Power Monitors
    - Provide permanently installed instrument for power monitoring. As a minimum, the system will provide RMS real-time measurements for:
        - Current: Each phase, neutral, average of three phases, and percent unbalance
        - Voltage: Line-to-line each phase, line-to-line average of three phases, line-to-neutral each phase, line-to-neutral average of three phases, line-to-neutral percent unbalance
        - Power: Per phase and three-phase total
        - Reactive Power: Per phase and three-phase total
        - Apparent Power: Per phase and three-phase total
        - Power Factor: Per phase and three-phase total
        - Displacement Power Factor: Per phase and three-phase total
        - Frequency
        - THD: Current and voltage
        - Accumulated Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute)
        - Incremental Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute)
        - Conditional Energy: Real kWh, reactive kVARh, apparent kVAh (signed/absolute)

5.2.7.12 Identification of Electrical System

Labeling for Raceways
1) 600 Volts and Below Normal: White letters on black background indicating feeder identification and voltage
2) 600 Volt and Below Emergency: White or black letters on red background indicating feeder identification and voltage
3) Fire Alarm: Red letter on white background indicating "FIRE ALARM"
4) Temperature Control: White or black letters on blue background
5) Grounding: White letters on green background indicating "GROUND" and equipment and designation
6) Security System: Blue letters on yellow background indicating "Security"
7) Telephone System: Green letters on yellow background indicating "Telephone"

For all EMT conduit, provide color conduit as follows:
1) Fire Alarm System: Red
2) Normal Power Distribution System: Silver
3) Emergency Power Distribution System: Orange
4) Temperature Controls, Motor Controls and Other Control Systems: Blue
5) Low Voltage and Telephone: Purple
6) Sound and Intercom: Black
7) Security: Yellow
8) Grounding: Green

Labeling Instructions
1) Indoor Equipment: Self-adhesive, engraved laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2" high letters on 1-1/2" high label. Where two lines of text are required, use labels 2" high.
2) Elevated Components: Increase size of labels and letter to those appropriate for viewing from the floor.
3) Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
4) Equipment to be labeled:
    - Panelboards
    - Switchgear
    - Switchboards
    - Transformers
    - Power-generating units
    - Transfer switches
    - Variable speed controllers
    - Contactors
    - Enclosed switches
    - Enclosed circuit breakers
    - Enclosed controls (starters)
    - Enclosures and electrical cabinets
    - Access doors and panels for concealed electrical items
    - Emergency system boxes and enclosures
    - Color coding of equipment nameplates will be as follows:
        - Normal Power: Black plate with white lettering
        - Emergency Power Standby: Red plate with white lettering
        - Fire Alarm: White plate with red lettering
        - Temperature Controls: Blue plate with white lettering
        - Grounding: Green plate with white lettering
5) Each receptacle will be identified as to the circuit and panelboard from which it is fed. This will be identified both inside the junction box (permanent magic marker) and on the cover plate.
6) All junction, pull, and connection boxes will be provided with identification on the cover. Identification will be neatly handwritten with permanent magic marker denoting the wiring system, voltage, and panel and circuit numbers
7) Panelboard directories will be created using Microsoft Word, and the typed printout should be provided in each panel. The Word file will be turned over to the Owner upon completion of the project
8) Firestopping: All penetrations to fire rated wall will be fire stopped and labeled.
9) Lightning Protection System: A UL 96A master label lightning protection system will be provided for the new build ings and all roof-mounted equipment. All down conductors will be concealed within the building construction.

5.2.8 Lighting Systems

Lighting design for this project will meet current Illuminating Engineering Society recommended illuminance targets. Additional mandatory controls for lighting that include manual switching, automatic controls to reduce lighting levels, and day lighting controls will be installed. All luminaires will have a Correlated Color Temperature (CCT) of 4100°K and a minimum Color Rendering Index (CRI) of 80.

5.2.8.1 Lighting System Components

Interior Luminaires will utilize LED luminaires for general lighting throughout the building including downlights, low illumination areas, accent areas, and areas requiring dimming. LED luminaires will be provided with dimmable drivers and will have a minimum rated life of 50,000 hours (LED board and driver). All conductors serving luminaries will be in conduit.

Exterior Luminaires will utilize LED luminaires with low temperature drivers located in exterior applications at exit doors, parking lots, and along walkways and drives. Egress doors will be provided with luminaires with two LED boards and drivers to provide code-required egress lighting. Exterior lighting will use full cutoff type luminaires to minimize light trespass.

Lighting controls will comply with the applicable energy code. Automatic shutoff will be achieved using a combination of BAS/timeclock controlled and lighting contactors, vacancy sensors, and occupancy sensors. A vacancy sensor controlling lighting with dimmable drivers will come on automatically to 50% and manually to 100%. Lighting controls will be installed in areas listed in the table below. Required manual override switches will be installed in each individual room. Momentary contact switches will be provided to interface with the vacancy sensors in most rooms. Refer to the table below for areas requiring dimming and multi-level switching.

Dimming daylight harvesting will be used in large open areas with an abundance of natural daylight as required per the applicable energy code.

Emergency egress lighting will be served from the life safety branch of the emergency power system (exterior mounted generator). Exit signs will be edge lit LED type luminaires served from the life safety branch. Emergency battery-powered wall pack luminaires will be provided in the transfer switch rooms, electric rooms, fire pump rooms, security rooms and the electrical service entrance room.

Average Illumination Levels: The average maintained illuminance levels are indicated in the **Table 5.7**.

Table 5.7 Lighting Maintained Illuminace Levels

Area Description	Luminaires	Controls	Illuminance Levels
Typical Room Spaces			
Task Light	Under cabinet light luminaires will be provided on all upper cabinets.	Luminaires will have integral rocker switches when a single luminaire is used, and a wall switch when multiple luminaires are grouped together.	
Multi-Stall Toilet Rooms	Down lights and recessed perimeter cove light on wet wall	Key switch with ceiling-mounted vacancy sensor	15 to 25 foot-candles
Single Stall Bathrooms	Down lights and recessed perimeter cove light on wet wall Down lights and vanity luminaire	Wall switch type vacancy sensor	15 to 25 foot-candles
Small and Medium Conference Rooms	2'x4' dimmable direct/indirect type luminaires 2'x4 dimmable volumetric type luminaires and dimmable down lights	Manual dimmers with ceiling-mounted vacancy sensors	30 to 50 foot-candles
Large Conference Rooms	Linear suspended with 40% up and 60% down distribution. LED downlights at perimeter.	Manual dimmers with ceiling-mounted vacancy sensors	30 to 50 foot-candles
Storage Rooms	Recessed acrylic lens luminaires in rooms with ceilings, suspended industrial luminaires in rooms without ceilings	Wall switch type vacancy sensor	10 foot-candles
Janitors Closets	Recessed acrylic lens luminaires in rooms with ceilings, suspended industrial luminaires in rooms without ceilings	Wall switch type vacancy sensor	15 foot-candles
Mechanical/Electrical/IT Rooms	4' suspended industrial luminaires	Timer type wall switch	25 to 30 foot-candles
Open Concourse Areas	Down lights and recessed linear with some long throw up-lights	Wall switch type vacancy sensor	25 to 30 foot-candles
Private Office	2'x4' or 2'x2' dimmable direct/indirect type luminaires 2'x4' or 2'x2' dimmable volumetric type luminaries	Multi-level switching will wall-mounted vacancy sensors Manual dimmers with ceiling-mounted vacancy sensors	30 to 50 foot-candles
Food Court Areas	Down lights, decorative pendants and recessed linear	Wall switch type vacancy sensor	25 to 30 foot-candles
Stairs	Linear wall-mounted luminaires at each landing	Integral occupancy sensor	20 foot-candles
Lobby	Down lights, architectural wall sconces, and architectural pendants	Centralized lighting control system Timeclock/BAS via lighting contactor	15 to 30 foot-candles
Lobby/Meet Greet	Down lights, architectural wall sconces, and architectural pendants at the reception desk	Controlled by motor-operated circuit breakers/relays and networked control stations	15 to 30 foot-candles
Exterior Lighting			
Sidewalk	Pole-mounted LED pedestrian scale luminaires LED bollards	Centralized lighting control system or Timeclock/BAS via lighting contactor	0.5 to 1 foot-candles
Entry Canopy	Down lights, architectural wall sconces.	Centralized lighting control system or Timeclock/BAS via lighting contactor	5 to 10 foot-candles
Parking Lot	Pole-mounted LED area luminaires	Centralized lighting control system or Timeclock/BAS via lighting contactor	0.5 to 1 foot-candles
Exterior Exits	Wall pack luminaires	Centralized lighting control system or Timeclock/BAS via lighting contactor	5 to 10 foot-candles

5.2.9 Fire Alarm System

A complete NFPA 72 compliant addressable fire alarm system will be installed. The main fire alarm panel will be installed within the main electrical room. Additional remote LCD annunciators will be located at the main entrances and as required by the local fire department. Notification appliance circuit panels will be sized for 24 hours of standby operation and 15 minutes of alarm. System notification will consist of ADA- and NFPA-compliant audio (voice), visual, and combination audio/visual devices. Dual strobes, consisting of clear for fire alarm and amber for emergency communication system (ECS) alert, will be provided.

System initiation will consist of individually addressable analog smoke and heat detectors, addressable fire pull stations, and sprinkler system flow switches. Smoke detectors will be located in mechanical room, electrical rooms, storage rooms, equipment rooms, elevator equipment rooms, elevator lobbies, and areas open to the corridor. Duct-type smoke detectors to close smoke dampers and shut down air distribution systems will be provided. Heat detectors will be provided in janitors' closets, kitchens, elevator machine rooms, elevator shafts, and some mechanical rooms. Pull stations will be located within a travel distance of 200 feet and at select exterior exits as required by the fire department. Door unlocking and hold-open devices will be provided for corridor doors per the life safety plans and applicable codes. Sprinkler water flow detection and valve position annunciation will be provided.

All fire alarm system wiring will be installed in red-colored conduit. NAC and SLC circuits passing through, but not serving, a 2 hour fire/smoke compartment will be routed in a 2 hour rated chase or will use MI cables.

5.3 Terminal IT/Communication

This section presents recommended steps that can be taken to prepare the general IT systems for the eventual new Passenger Terminal Building (PTB) development and recommendations for maintenance of existing Information and Communications Technology (ICT) Systems, Operational Systems, and Security Systems. Due to the fact that the extended Early Works phasing pushes PTB development out past typical IT systems life cycles, we recommend focus be given to high-level IT objectives intended to support and simplify the eventual migration process.

5.3.1 Recommended High-Level IT Objectives

Re-phasing of the new Passenger Terminal Development (PTD) has pushed most of the IT systems work out well past the general systems lifecycles, which typically spans 5 years. Consequently, all critical IT planning and development recommendations in preparation of the new Passenger Terminal Building (PTB) are premature at this stage of the project. In lieu of identifying specific IT planning and development criteria, Ross & Baruzzini, Inc. (R&B) recommends, as an alternative, identifying high-level IT objectives to act as "vision statements" guiding general IT early-works initiatives based on scheduled updates and enabling projects with scope that impact IT connectivity and pathways until timing of the new PTB development process matures to point that warrants IT planning involvement.

The corresponding benefit to each initiative is the value of applying a continuous process improvement that integrates into the overall PTB program. This is of strategic importance to the Airport Authority (Authority) since it maintains IT best practices, mitigates operational risks and provides readiness processes assuring the current system architecture provides the level of resiliency required given the multiple phases encompassing the current the program.

The recommended baseline to establish a viable starting point, prior to when IT planning and development associated with PTB program begins in earnest, includes the following initiatives which can be started at any time ahead of the early-works phases:

5.3.1.1 IT Master Plan

We recommend that the Authority maintain an IT Master Plan that is coordinated with and continually updated with the overall PTB development project to ensure seamless coordination upon initiation of IT scope. An IT Master Plan attempts to provide a long-term (5-10 year) guide to systems development including identification of critical updates and upgrades requirements and development of long-term budgets. Maintaining an up-to-date IT Master Plan would greatly simplify future coordination between IT and construction activities.

5.3.1.2 Systems Secondary Backup

Existing Systems Secondary Backup / Disaster Recovery support capabilities at North and South IDFs should be maintained and enhanced as part of the capital planning process to assure available funding dollars to act as Secondary Data Center(s) (SDC) supporting the current Data Center at the Main Terminal and the eventual Data Center planned as part of the new PTB. Either combined or separately, the intended goal of these sites is to be fully capable of supporting critical Authority operations in the event the primary Data Center is unavailable for any reason.

5.3.1.3 Fully Redundant Fiber Ring

Continued initiatives are needed and necessary to establish a fully-redundant fiber ring supporting all Authority facilities and tenants. The ultimate goal being a simplified, documented and fortified Authority-owned and managed fiber optic ring that interconnects all Authority network nodes; especially North IDF, South IDF, the Main Terminal, and the eventual PTB.

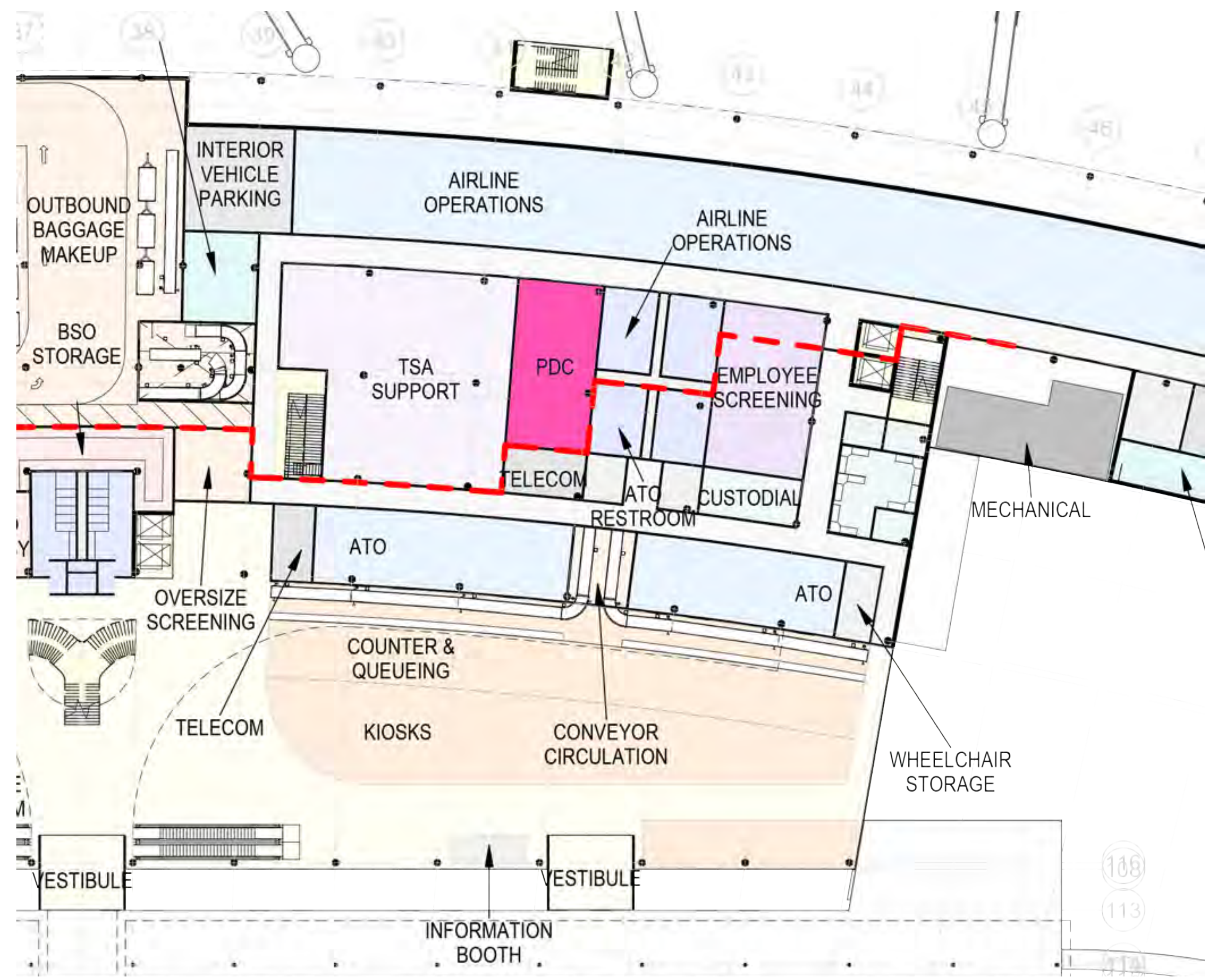
5.3.1.4 Reduced Dependency on Main Terminal Data Center

As the early-works and enabling projects progress toward site development and construction of the new PTB, the need to transition primary IT systems from the existing Main Terminal Data Center to the new Primary Data Center in the new PTB should be planned as part of the Early Works. The inherent operational risks and readiness processes associated with this task can be eased by the Authority slowly reducing its operational dependency on the existing Data Center in the years leading up to the new PTB development.

5.3.1.5 New Primary Data Center (PDC)

Ultimately the primary IT systems supporting the Airport and overall site will be migrated to a new Primary Data Center (PDC) developed in parallel or ahead of the new PTB, shown in **Figure 5.16**. R&B's recommendation is for the PDC to be geographically separate from the PTB. The added cost, may not be supportable in the current project budget, therefore a fortified position within the PTB represents an acceptable alternative. The fully-redundant Fiber Ring and primary service entrances should be routed to this PDC.

Figure 5.16 - Primary Data Center



N
0 25' 50' 75' 100'

5.3.2 Early-Works Phases (1-11)

Early-Works include all phases up to the actual construction of the new Passenger Terminal Building (PTB). Based on the current phasing plan, this process is to occur over 11 stages and take in excess of 7 years. This timeline significantly impacts any recommendations related to Information and Communications Technologies (ICT) systems. Lifecycles for ICT systems and general ICT trends are typically considered in 5 years increments. It is not in the Authority's best interest to predict where the industry will be at this point of time. Focus should be on taking any available and meaningful steps during the early works phases in support the previously noted high-level IT objectives.

The Authority will proceed to maintain and update the existing systems as they see fit to support the current business of the Authority and Main Terminal operations without significant consideration for the future PTB development. Given the extended duration of the initial phases of the project, there is little to no benefit to tailoring systems needs to meet an unknown and undefined future PTB. The primary customer of the Information and Communication Technologies (ICT) systems is and will remain the Main Terminal for the mid to long-term.

For planning purposes, the existing infrastructure is maintained during the initial eleven (11) phases associated with the PTD. It will be beneficial to the Authority during this stage to implement sections of an updated fiber ring to leverage available enabling opportunities where practical. The Authority should focus on the high-level objectives versus specifics. Therefore, the goal during Phases 1 – 11 is to maintain existing telecom services and, where possible, plan and build new infrastructure to support future PTB development. Initiatives for consideration include:

- Maintain existing service entrances and plan for new primary entrance to PTB once design is developed sufficiently
- Maintain existing fiber OSP through any impacting early works and implement sections of future fiber ring where possible.
- Reduce Authority dependency on the existing Data Center in the existing Main Terminal.

5.3.3 Systems Overview

Following is a list of known existing systems in operation at the Airport Main Terminal and overall site. For simplicity these have been grouped into four categories: ICT systems, Airport Operations Systems, Security & Life-safety Systems, and Facility Management Systems. These systems will represent the base-line for system requirements. Future additions and modifications to existing systems will need to be considered as the Early Works design phases begin.

Information and Communications Technologies (ICT) Systems & Infrastructure

- Structured Cabling Network – Inside Plant (SCN-ISP).
- Structured Cabling Network – Outside Plant (SCN-OSP).
- Data Network Equipment (DNE/LAN)
- Virtual Server Environment (VSE)
- Mass Storage System (MSS)
- Master Clock System (MSC)
- IP Telephony (VoIP)
- Red & Yellow Phone Systems
- Phone Audio recording system
- Wireless Data Network (WDN)
- Public Wi-Fi
- Airport Operations & Public Safety Radio
- Radio Console System
- Distributive Antenna System (DAS)
- Board recording system
- Internet Protocol Television (IPTV)
- Public Address System (PAS)

Airport Operational Systems

- Airport Operational Database (AODB)
- Resource Management System (RMS)
- Common Use Systems (CUS/CUPPS/CUSS)
- Electronic Video Info. Displays (EVIDS/FIDS/BIDS)
- Parking Access Revenue Control System (PARCS)
- Commercial Vehicle Management System (CVMS)

Security & Life-Safety Systems

- Security Access Control System (SACS)
- Identity Management System (IDMS)
- Video Surveillance System (VSS)
- Security Screening Checkpoint (SSCP)
- Hold Baggage Screening (HBS)
- Fire Alarm System (FAS)

Facility Management Systems

- Runway Surface Monitoring
- Lightning Warning System (LWS)
- Fuel Tank Monitoring
- Fuel Usage System
- Building Management System (BMS)
- Telephone Billing System
- Baggage Handling System (BHS)
- Safety Management System (SMS)

5.3.4 Utilization of Existing Systems

Whenever relevant, existing systems (in good standing with the Authority's IT department) will be utilized in the development and fit-out of the new PTB and surrounding facilities. Existing systems represent a known factor and, if evaluated to be capable of eventually supporting the entire Airport, including the new PTB and support facilities, should be utilized. Criteria for utilization include:

- The system(s) shall be readily expandable to support the expected growth of the overall Airport site over the next 5-10year planning horizon,
- The system(s) shall have adequate local technical support from firms (preferably multiple) in good standing with the Authority,

Figure 5.17 - Recommended Infrastructure Architecture

5.3.5 System Migration

System Migration will play a major role in the new PTB development, commissioning, and operation. Where possible, existing systems should be expanded to cover the new PTB and related Airport facilities and migrated from the existing Main Terminal Data Center to the Primary Data Center in the new PTB. This process will need to be coordinated with construction phasing to minimize risk during cutover and allow the systems at the new PTB to be tested and commissioned without impact on existing operations. To this end, we recommended that the Authority work to minimize its dependency on the Main Terminal's Data Center as the development of the new PTB approaches.

Depending the final phasing of the PTB development, the new PTB systems may need to be brought online and tested in an environment separate from the existing Main Terminal systems regardless of whether the system is to be an expansion or a new system. The intent is to provide some separation for system testing and commissioning in an environment that is segregated from the active systems operating the Main Terminal. Once Operational Readiness and Testing (ORAT) is complete the systems can undergo a hard or soft cutover that will primarily depend on the nature of the overall project phasing.

5.3.6 Network and Infrastructure Recommendations

A fully functional passive and active network infrastructure shall be provided in conjunction with the new PTB development. Size and capacity will be determined as the PTB development progresses but the goal is to provide a highly redundant, highly available, and highly expandable communication backbone. **Figure 5.17** depicts a standard three-layer topology recommended for typical connectivity between Floor Distributors (FDs), Building Distributors (BDs), and Campus Distributors (CDs) or Data Centers.

Space planning efforts within the proposed new PTB have incorporated a typical state-of-the-market approach to network distribution based on the aforementioned three-layer approach. The PDC will be incorporated into the facility and may support both the CD and BD level of the network. FDs are planned throughout the facility to provide full coverage based on a maximum 80m horizontal length for copper data cabling.

The Structured Cabling Network (SCN) provides the physical infrastructure to accomplish the above. The SCN shall be designed to adapt to ever-changing aviation operations and passenger requirements. The intent is to create systems that are capable of adapting to change with minimal disruption to the operating facilities. Equipment will be standardized to the greatest extent possible to simplify long term maintenance and operations. The infrastructure will provide fiber optic cabling throughout the Terminal buildings to allow for day one connectivity as well as providing sufficient extra capacity for future expansion.

- All terminals, support buildings, and general Authority facilities connected by the backbone network require an optical fiber backbone cabling system to transmit signals between the Entrance Facilities (EFs) interfacing the Airport to exterior internet services, CDs, BDs, FDs and the smaller Telecommunications Enclosures (TEs).
- All backbone cabling system shall be installed in a star/mesh topology from each EF to each CD, between each BD and from all FDs to each BD.
- Core and Distribution Switches shall be implemented in a redundant configuration.
- Floor Distributors shall be redundantly connected to two Building Distributors.

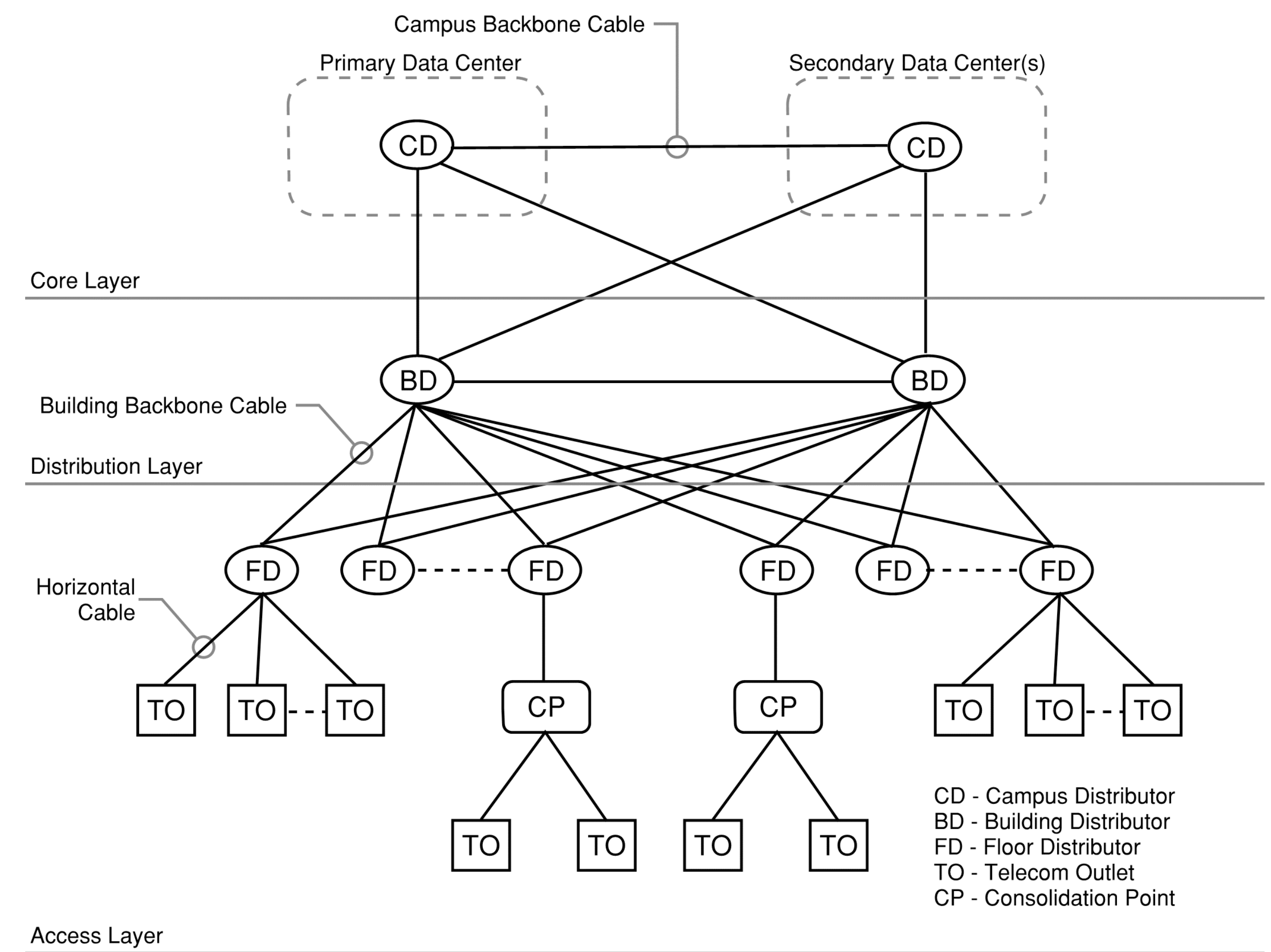
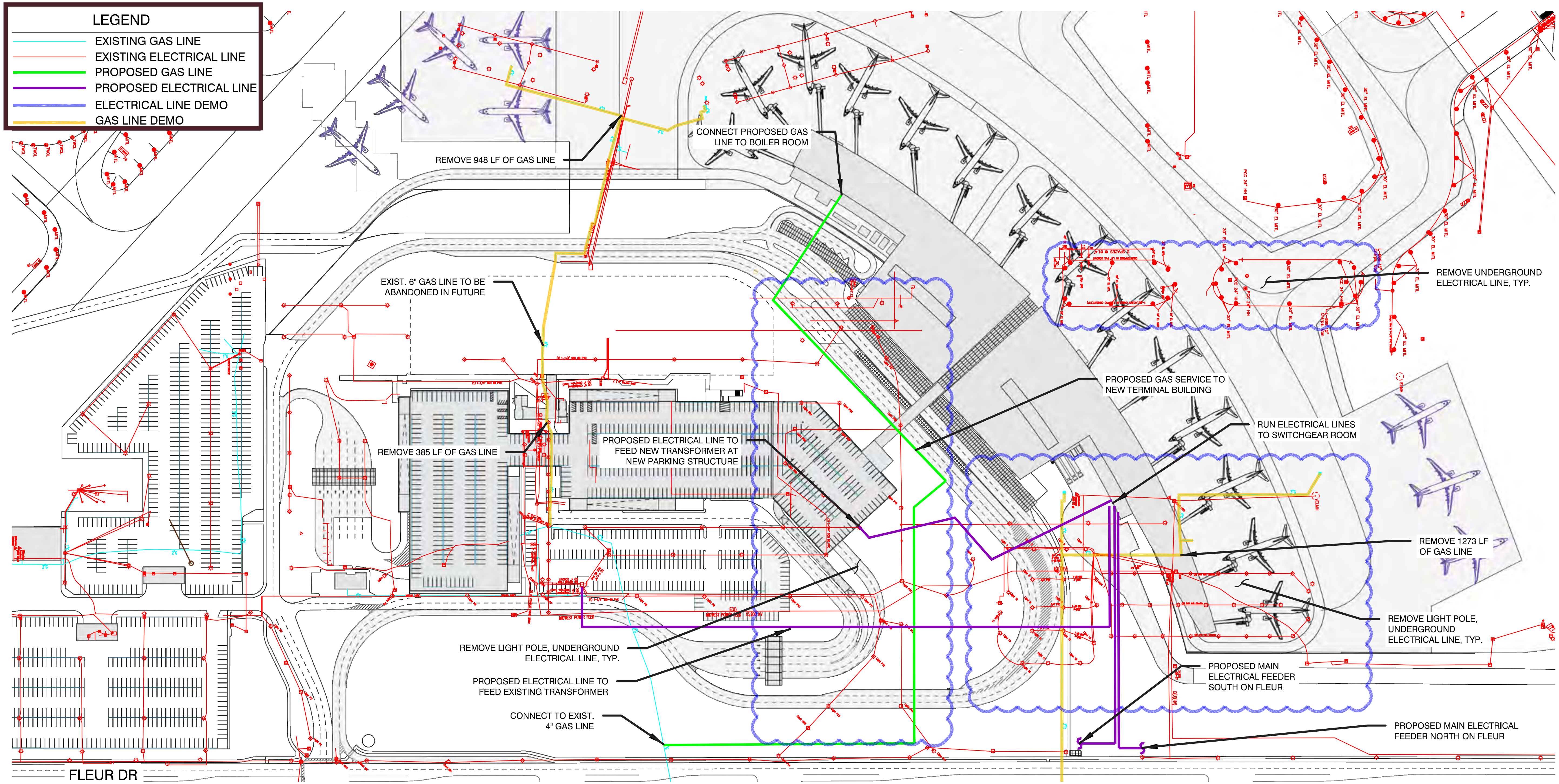


Figure 5.18 - Demo & Proposed Electric & Gas



5.4 Site Utilities

This section presents the recommended site utility development for the Des Moines International Airport.

5.4.1 Site Power

MidAmerican Energy owns and maintains the primary electrical distribution system that serves the airport property. Two new MidAmerican Energy main 13.2 kV electrical feeders from Fleur Drive, one from the south and one from the north, are proposed to serve the new terminal improvements. The feeders will be routed to the proposed switchgear room in the new terminal building. From the switchgear room, electrical power will be routed to facilities for utilization.

Light poles and associated underground electrical lines will be demolished during construction activities at locations generally indicated on **Figure 5.18**. There are four buildings that are part of Signature Aviation that will be demolished along with associated electrical lines to the buildings.

Care should be taken during construction phasing so that utilities can be placed before concrete work to minimize concrete disturbance and lessen expense of replacing new concrete. Electrical lines to the existing terminal and other facilities should be protected during construction. Only demolish electrical lines once a building or the terminal is no longer in use.
Refer to **Figure 5.18** for proposed site power map.

5.4.2 Site Communication/IT

Please refer to Section 5.3 Terminal IT/Communications for detailed information on recommendations for utilizing existing pathways and locations of suggested new pathways in order to minimize disruption during construction activities.

5.4.3 Water System

There are four buildings that are part of Signature Aviation that will be demolished along with associated water distribution lines to the buildings. A new 12 inch water main is proposed to maintain the existing loop system by connecting to the existing 8 inch and 12 inch water mains. A 6 inch domestic water line and 8 inch fire protection water line will serve the new terminal building. A new fire protection water line will also service the expanded parking structure.

Care should be taken during construction phasing so that utilities can be placed before concrete work to minimize concrete disturbance and lessen expense of replacing new concrete. Water lines to the existing terminal and other facilities should be protected during construction. Only demolish water lines once a building or the terminal is no longer in use.
Refer to **Figure 5.19** for proposed water system map.

5.4.4 Sanitary Sewer System

A temporary sanitary sewer main is required to maintain service to Concourse C during construction of the new terminal. The existing sanitary sewer main serving the Signature Aviation buildings and Concourse C will be demolished. Existing grease interceptors will be demolished.

The new terminal will be served with a new sanitary sewer service that will be routed from the loading dock area to the existing sanitary sewer main connection. Grease interceptors that will serve the terminal will be located in the loading dock area and be served with the new sanitary sewer service. A new sanitary sewer service will be extended to the parking garage expansion to serve a new sand and oil separator.

Care should be taken during construction phasing so that utilities can be placed before concrete work to minimize concrete disturbance and lessen expense of replacing new concrete. Sanitary sewer lines to the existing terminal should be protected during construction. Only demolish sanitary sewer lines once a building or the terminal is no longer in use.

Refer to **Figure 5.20** for proposed sanitary sewer lines map. See **Table 5.8** for conceptual sanitary sewer pipe information and **Table 5.9** for conceptual sanitary sewer structure information.

Table 5.8 - Conceptual Sanitary Sewer Pipe Information

Pipe ID	Pipe Structure								Slope
	U/S	D/S	Pipe Material	Pipe Dia. (IN)	Pipe Length (FT)	Rim U/S	Invert U/S	Invert D/S	
Proposed Parking Garage Service									
SAN P-5	Garage	SAN-3	SAN	6	91	929.65	923.37	922.46	1.00%
SAN P-4	SAN-3	SAN-2	SAN	6	412	934.00	922.36	917.90	1.08%
Proposed Terminal Building Service									
SAN P-3	Terminal	SAN-2	SAN	10	89	924.00	918.79	917.90	1.00%
SAN P-2	SAN-2	SAN-1	SAN	10	340	924.71	917.80	914.40	1.00%
SAN P-1	SAN-1	EX SAN-3	SAN	10	204	920.00	914.30	912.09	1.08%
141'-10" RCP	EX SAN-3	EX SAN-2	RCP	10	141	941.13	911.38	896.06	10.87%
70'-8" VCP	EX SAN-2	EX SAN-1	SAN	10	70	909.70	896.06	895.18	1.26%
Temporary Service to Concourse C									
SAN P-8	EX SAN-6	SAN-5	SAN	10	88	943.71	933.92	933.04	1.00%
SAN P-7	SAN-5	SAN-4	SAN	10	396	943.84	932.94	928.98	1.00%
SAN P-6	SAN-4	EX SAN-5	SAN	10	396	943.84	928.88	924.82	1.03%
15" RCP	EX SAN-5	EX SAN-4	SAN	15	172	944.24	924.52	919.90	2.69%
195'-10" RCP	EX SAN-4	EX SAN-3	SAN	10	183	944.10	919.90	912.82	3.87%

Figure 5.19 - Demo & Proposed Water

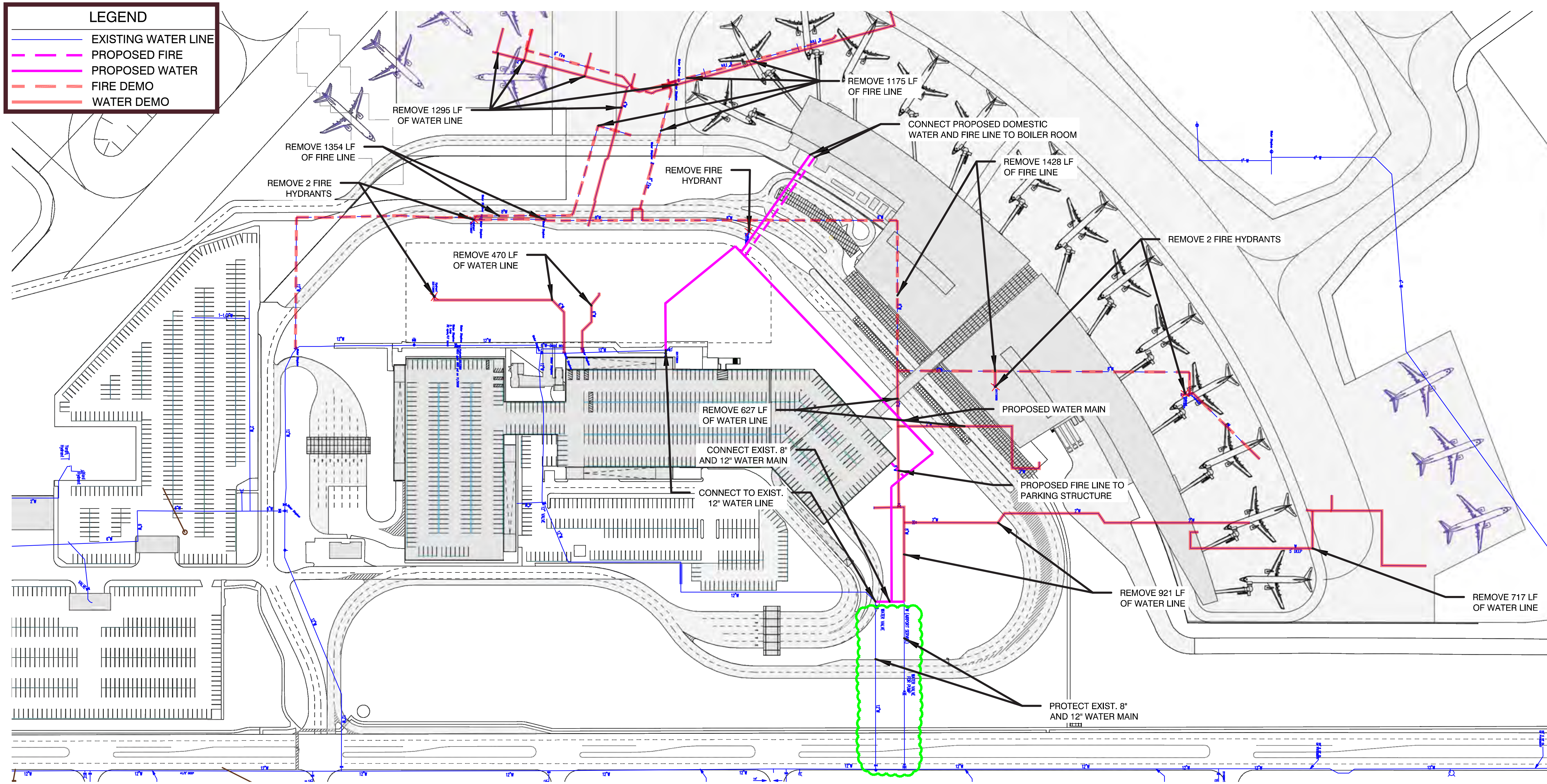


Figure 5.20 - Demo & Proposed Sanitary Sewer

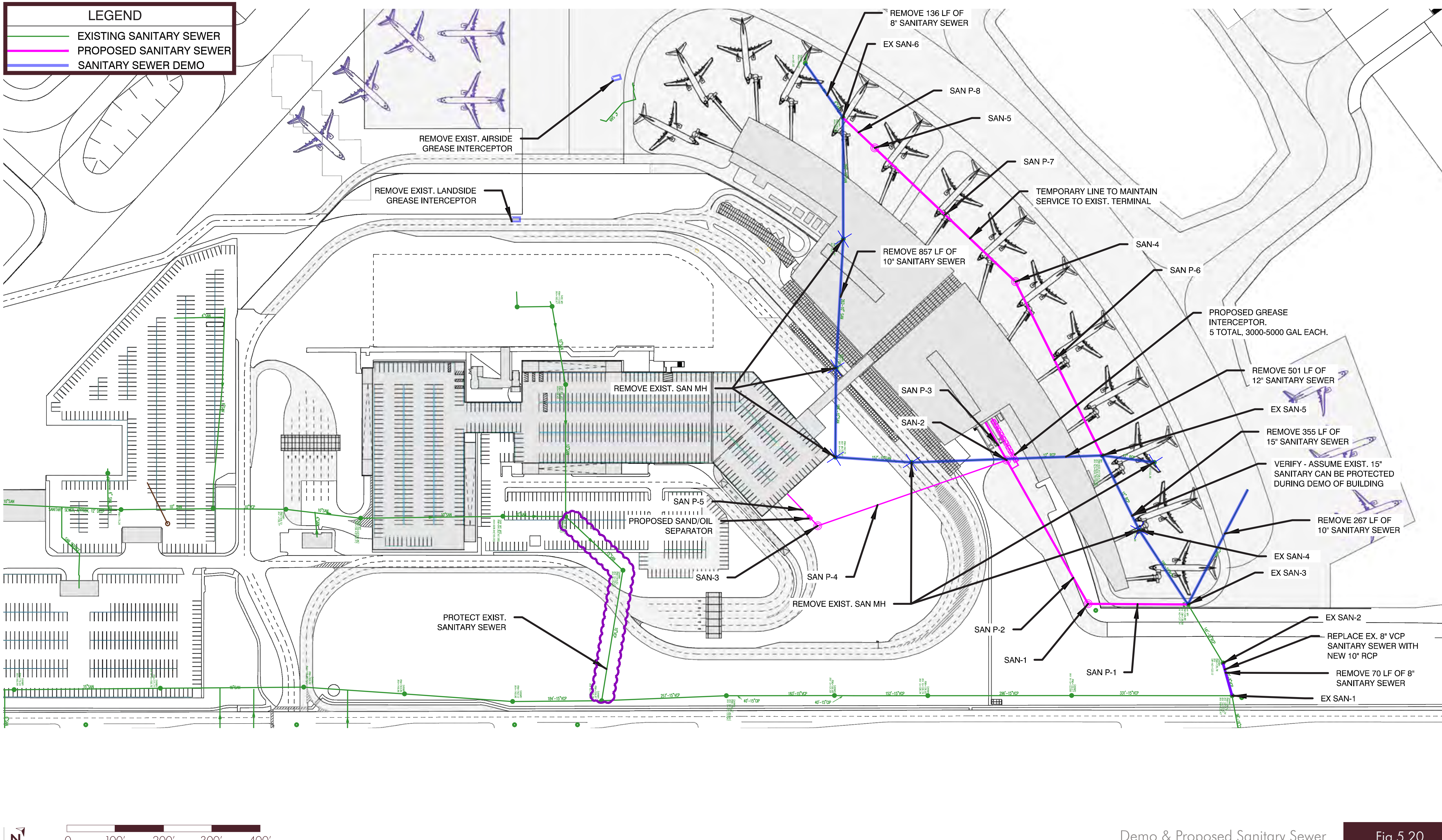


Table 5.9 - Conceptual Sanitary Sewer Structure Information

Structure ID	Structure Type	Rim	Invert IN	Invert IN	Invert OUT
Proposed Parking Garage Service					
SAN-3	48" Circular Sanitary Sewer Manhole (SW-301)	934.00	922.46	N/A	922.36
Proposed Terminal Building Service					
SAN-2	48" Circular Sanitary Sewer Manhole (SW-301)	924.71	917.90	917.90	917.80
SAN-1	48" Circular Sanitary Sewer Manhole (SW-301)	920.00	914.40	N/A	914.30
Temporary Service to Concourse C					
EX SAN-6	Existing Sanitary Manhole	943.71	933.92	N/A	933.92
SAN-5	48" Circular Sanitary Sewer Manhole (SW-301)	943.84	933.04	N/A	932.94
SAN-4	48" Circular Sanitary Sewer Manhole (SW-301)	943.84	928.98	N/A	928.88
EX SAN-5	Existing Sanitary Manhole	944.24	924.82	N/A	924.52
EX SAN-4	Existing Sanitary Manhole	944.10	919.90	N/A	919.90
EX SAN-3	Existing Sanitary Manhole	941.13	912.82	912.09	911.38
EX SAN-2	Existing Sanitary Manhole	909.70	896.06	N/A	896.06
EX SAN-1	Existing Sanitary Manhole	903.36	895.18	894.45	UNKNWN

5.4.5 Apron Grading and Drainage

The proposed relocation of the airport terminal will require a significant amount of the existing apron pavement to be removed and reconstructed. The existing apron pavement area drains via sheet flow from south to north, adjacent to the existing terminal. Runoff is collected at various intakes and trench drains and conveyed to the Terminal Tank just north of the existing apron.

Apron grading and drainage is governed by FAA and NFPA Design Criteria. FAA Advisory Circular 150/5300-13A "Airport Design" states that apron grades for aircraft approach category D apron pavement cannot exceed one percent, while maximum grade change cannot exceed two percent. In addition, the apron pavement grades are required to drain away from the terminal building especially in aircraft fueling areas.

NFPA Code 415 "Standard on Airport Terminal Buildings, Fueling Ramp Drainage, and Loading Walkways" requires that the minimum apron grade shall be 1%, the apron pavement needs to drain away from the building, and no drainage or collection structures can be located within 50 ft of the building face. The 50 ft collection structure criteria is in place to assure that there won't be any surface runoff collection points within 50 ft of any building face in the event of a fuel spill. Additionally, NFPA code specifies that use of open-grate drainage trenches as collection means shall not be over 125 ft in length with a minimum interval of 6 ft between sections to act as fire stops, and that each section shall be individually drained through underground piping.

Construction of the new terminal will impact the existing grading patterns, and drainage collection points on the apron. While the transition to a centralized deicing area on the west side of the apron adds to the complexity of the apron drainage, overall efforts were implemented to maintain as much of the existing grading patterns as possible.

The overall grading pattern will need to be altered slightly from the existing northerly direction to accommodate the geometry of the proposed terminal building. While generally flowing from south to north, the proposed grading pattern flows away from the newly aligned terminal to the northwest. In order to accommodate NFPA requirements, pavement grades from the southern end of the terminal flow away from the building for 100', at which point a break is introduced and grading becomes positive until tie-in to the existing pavement is attained. The demolished pavement limit off the southern end of the existing terminal was utilized to define the proposed limit to the south. The proposed apron grading and drainage improvements are illustrated in **Figure 5.21**.

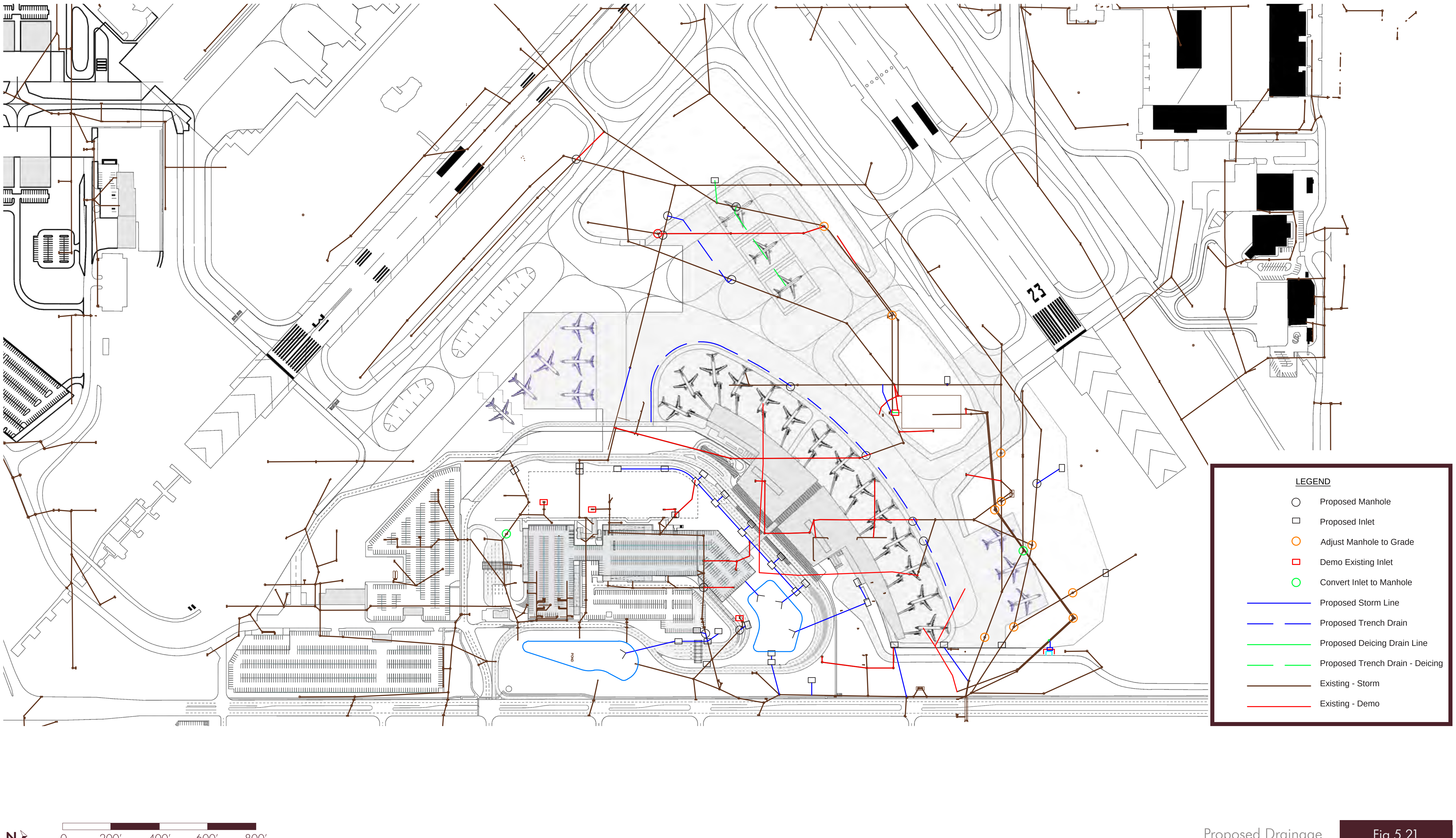
5.4.5.1 Storm Sewer System - Landside

The proposed landside improvements were conceptualized based on the interim and future conditions, with the understanding that the interim condition may be permanent. The proposed grading allows the reuse of most storm drainage pipes. Refer to **Figure 5.20** for landside storm sewer system layout.

The existing duck pond has approximately 1.5' of 100-year event freeboard. For the proposed condition, the existing outlet structure can be modified and some perimeter pond grading can be utilized to accommodate additional storage volume and maintain the existing peak discharge flow rate.

The proposed sump region north of the parking facility can serve as a dry storm water detention area to prevent increases in the peak flow rate offsite and as a water quality event best management practice (BMP) using select vegetative plantings and staged outlet structure. Because water fowl are a hazard to aircraft, this dry detention can also be designed to compensate for the increased runoff caused by the net increase of impervious surface on the airside.

Figure 5.21 - Proposed Drainage



5.4.5.2 Storm Sewer System - Airside System Operation During Deicing System

During the proposed deicing season, the Terminal Tank volume will be left to accumulate for outside entity collection, via cistern and submersible pump reclamation. The South Cargo tank volumes will still be slowly released to the sanitary sewer system, to comply with pollutant loading requirements of the Iowa Department of Natural Resources and the Des Moines Water Reclamation Authority.

Terminal Area

- Storm Runoff - the storm runoff from the Terminal pavement and all non-deicing snow dump areas will be routed to the storm sewer system toward Yeader Creek.
- Pavement Underdrainage – the underdrainage from the all non-deicing area terminal pavement is routed to the storm sewer system toward Yeader Creek.

Terminal Deicing Area - Deicing operations on the Terminal Apron are restricted, meaning deicing may only occur in the location shown in green in **Figure 5.22**.

- Storm Runoff - typically from late October to early May the storm runoff from the Terminal Deicing pavement and the adjacent snow dump areas are routed to the Terminal Tank, and collected by a third party.
- Pavement Underdrainage – from late October to early May the underdrainage from the Terminal Deicing pavement is routed to the Terminal Tank, and collected by a third party.

South Cargo Area - Deicing operations on the South Cargo Apron will not change, as compared to the Existing.

- Storm Runoff – year-round, the storm runoff from east area the South Cargo pavement and snow dump areas are routed to the storm sewer system toward Frink Creek.
- Pavement Underdrainage – the pavement underdrainage piping coincides with the surface drainage runoff patterns and empties in the same inlets of the storm runoff.

5.4.5.3 Storm Sewer System - Airside System Operation During Non-Deicing Season

Terminal Area

- Storm Runoff - the storm runoff from the Terminal pavement and all non-deicing snow dump areas will be routed to the storm sewer system toward Yeader Creek.
- Pavement Underdrainage – the underdrainage from the all non-deicing area terminal pavement is routed to the storm sewer system toward Yeader Creek.

Terminal Deicing Area

- Storm Runoff - from early May to late October the storm runoff from the Terminal deicing area pavement and snow dump areas can either be routed to the Terminal Tank for slow release to the sanitary sewer or routed to the storm sewer toward Yeader Creek.
- Pavement Underdrainage – from early June to late October the underdrainage from the Terminal deicing area pavement can either be routed to the Terminal Tank for slow release to the sanitary sewer or routed to the storm sewer toward Yeader Creek.

South Cargo Area

- Storm Runoff – year-round, the storm runoff from east area the South Cargo pavement and snow dump areas are routed to the storm sewer system toward Frink Creek.
- Pavement Underdrainage – the pavement underdrainage piping coincides with the surface drainage runoff patterns and empties in the same inlets of the storm runoff.

5.4.5.4 Storm Sewer System - Airside Terminal Tank

The existing Building 11 is used to test glycol levels in the tank. The basement of Building 11 is known as the Diversion Structure, and includes valves to divert both the direct flow and underdrain flow to either the Terminal Tank or to the pipe system leading to Yeader Creek depending if it is the deicing season or not. For the proposed condition, the sampling-works will need to be relocated to a vault, off the apron. The Diversion Structure will no longer be needed. The glycol collection piping, direct and underdrainage, will be combined in a manhole near the deicing pads, and that pipe will be conveyed directly to the Terminal Tank. The pipes dedicated to storm flow will be kept separate from any glycol Terminal Tank piping. The Terminal Tank level sensor will remain in the SE tank hatch. Refer to **Figures 5.23 and 5.24**.

The outlet valving is shown on Sheet M-2 of the 1999 CDM plans as the Flow Control Vault detail (refer to **Figure 5.25**). It includes sampling appurtenances that are connected to Building 11. For the proposed condition refer to **Figure 5.26**. The 10" west-to-east pipe connecting to the Terminal Tank groundwater underdrain system needs to be disconnected. With relatively concentrated glycol being collected in the Terminal Tank, no cross-connections with the storm or groundwater pipe systems can exist. Since the existing 10" plug valve near the Terminal Tank Flow Control Vault is more reliable to control the contents of the tank, it needs to be in the normally closed position, and the pinch valve in the vault can be left in the normally open position to better extend its life. A proposed plug valve is recommended near the cistern, to direct flow to the cistern or to the sanitary sewer.

For the proposed condition, the Terminal Tank is expected to contain more concentrated glycol levels due to deicing activities restricted only to the designated deicing area. The underdrains and snow dump ditches in the deicing area will also be routed to the Terminal Tank, as separate from the piping of the remainder of the apron.

Depending on market conditions for recycling glycol, provisions have been conceptualized for an outside entity to draw from a proposed cistern connected to the Terminal Tank. As shown in **Figures 5.27 and 5.28**, a cistern is proposed outside the fence for a collection truck to draw the glycol using a submersible pump. Some datum relative elevations of the system are as follows:

- 152.75ft – Top Inside of Terminal Tank
- 134.33ft – Bottom of Terminal Tank
- 131.74ft – Terminal Tank Discharge Invert
- 150.00ft – Approximate Elevation of Service Road
- 124.00ft – Approximate Invert of Existing Sanitary
- 128.00ft – Approximate Elevation of Fleur Road
- 140.00ft – Approximate Height of Collection Truck

Considerations:

1. An all gravity system is not possible. If a pull-off was constructed off of Fleur Road at the Yeader Creek culvert, the top of truck would be at elevation ~140ft (128+12), which is higher than the bottom of Terminal Tank (131.74ft).
2. The airport could opt to require the outside party to supply their own submersible pump.
3. The pump must be submersible, because suction lift is limited to ~25ft vertically.
4. A diversion structure could be installed, to provide flexibility to either allow a controlled release to the sanitary sewer or a full release to the offline cistern.
5. It is not recommended to use a valve near the cistern, in-lieu of the existing Terminal Tank plug valve, otherwise the gravity line will pressurize and glycol exfiltration into the groundwater may occur.
6. A new pressurized line could be installed from the Terminal Tank to the point of collection, to reduce the airport personnel logistical efforts.
7. The cistern would overflow if the plug valve was accidentally left open and the existing 4,000,000 gallon tank was 85% full.
8. Cistern overflows can be prevented with an upstream weir to sanitary diversion or an altitude valve.
9. A "water budget" could be conducted to determine the storm / snow and glycol use conditions it would take to fill the existing tank. Pre-project acreage to the existing tank is approximately 72 acres and the proposed acreage is approximately 29 acres.
10. Intuitively, it is unlikely there would ever be a system overflow, because it is unlikely the airport would wait for it to be 85% full (3.4Mgal) to be emptied. A collection truck typically has the capacity of 5,000 to 9,000 gallons.
11. The airport could opt for the collection truck to pull directly from the existing tank, eliminating any new infrastructure outside the fence.

Figure 5.22 - Proposed Deicing Area

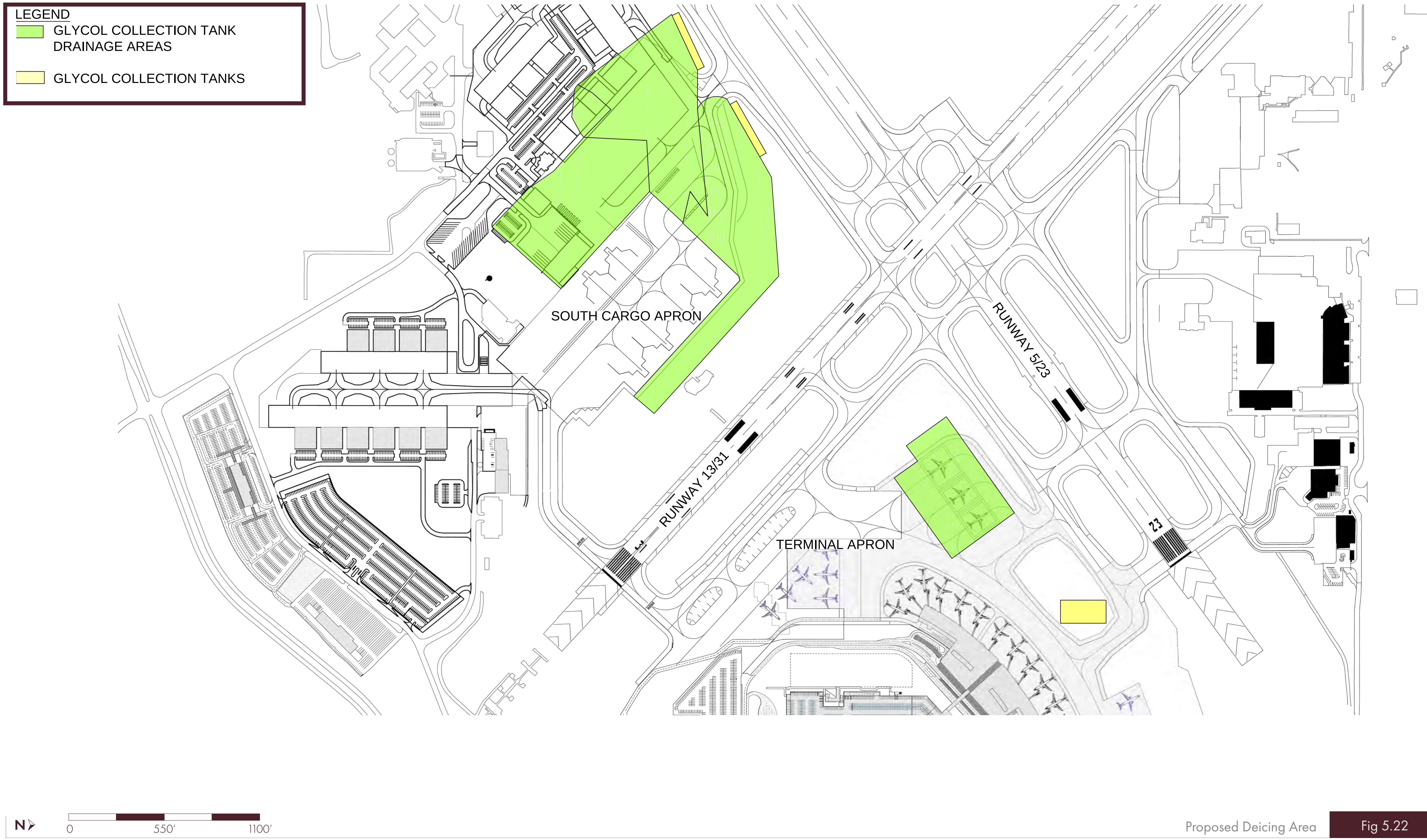


Figure 5.23 - Existing Terminal Tank Area

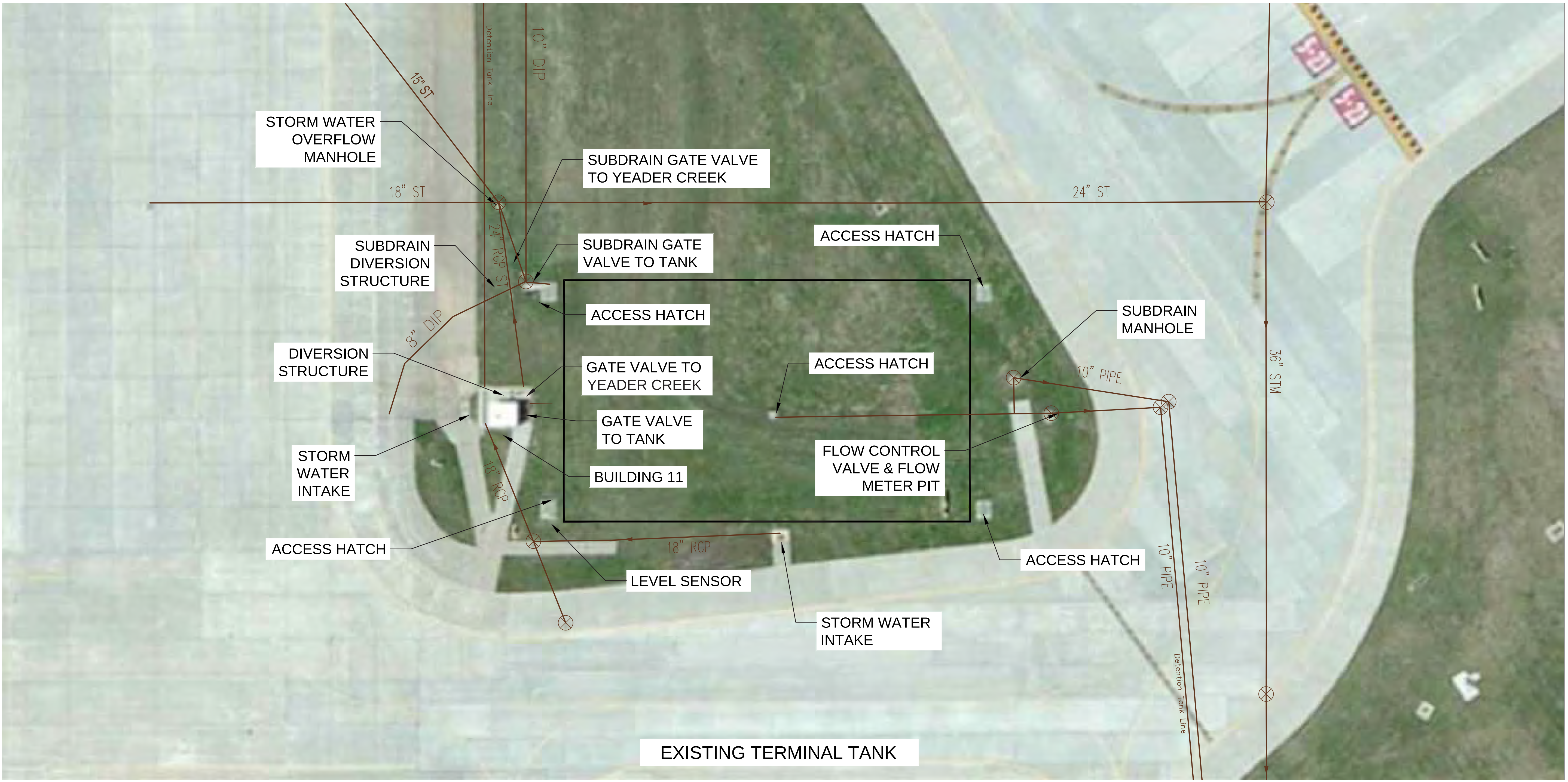
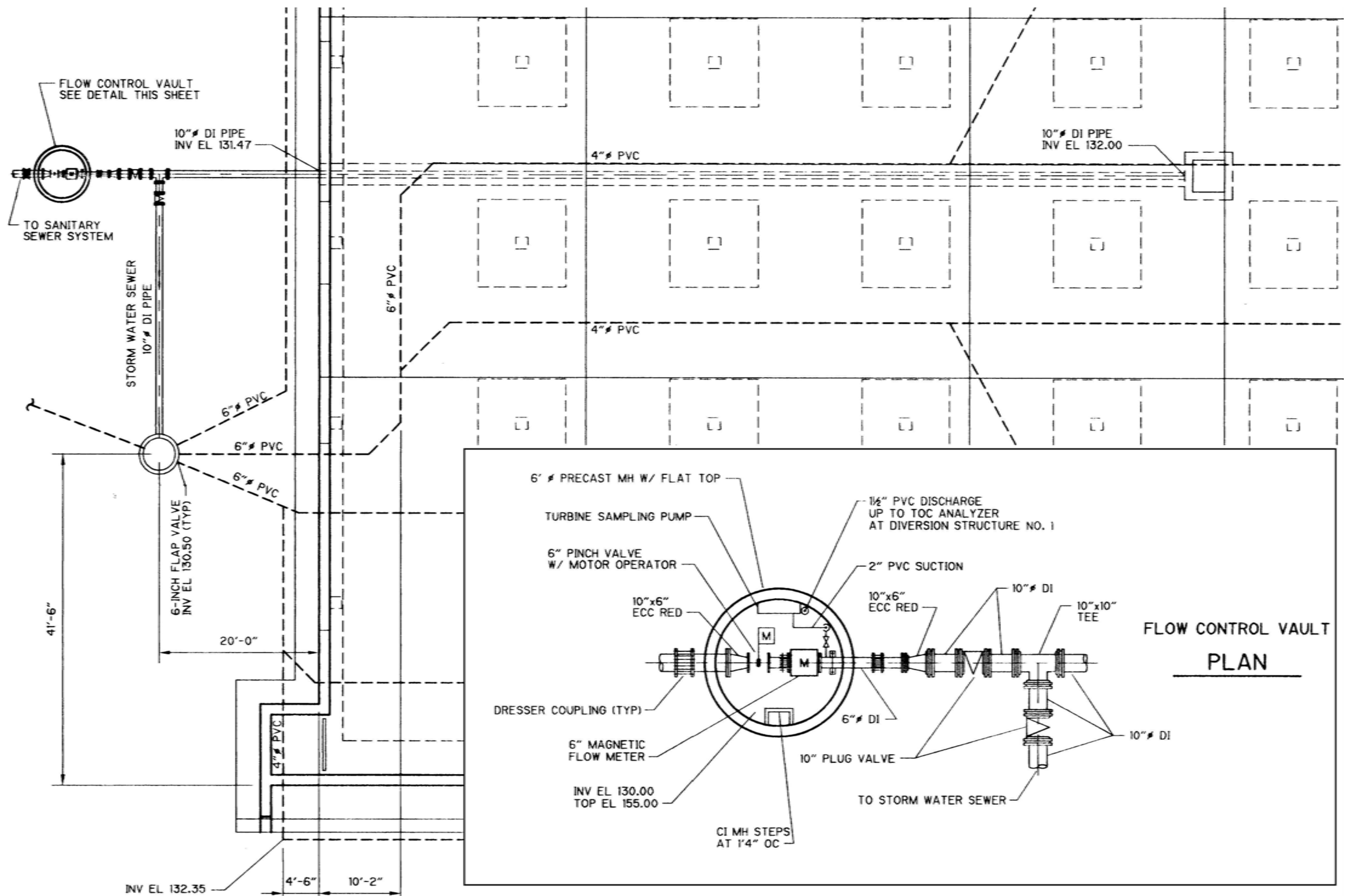


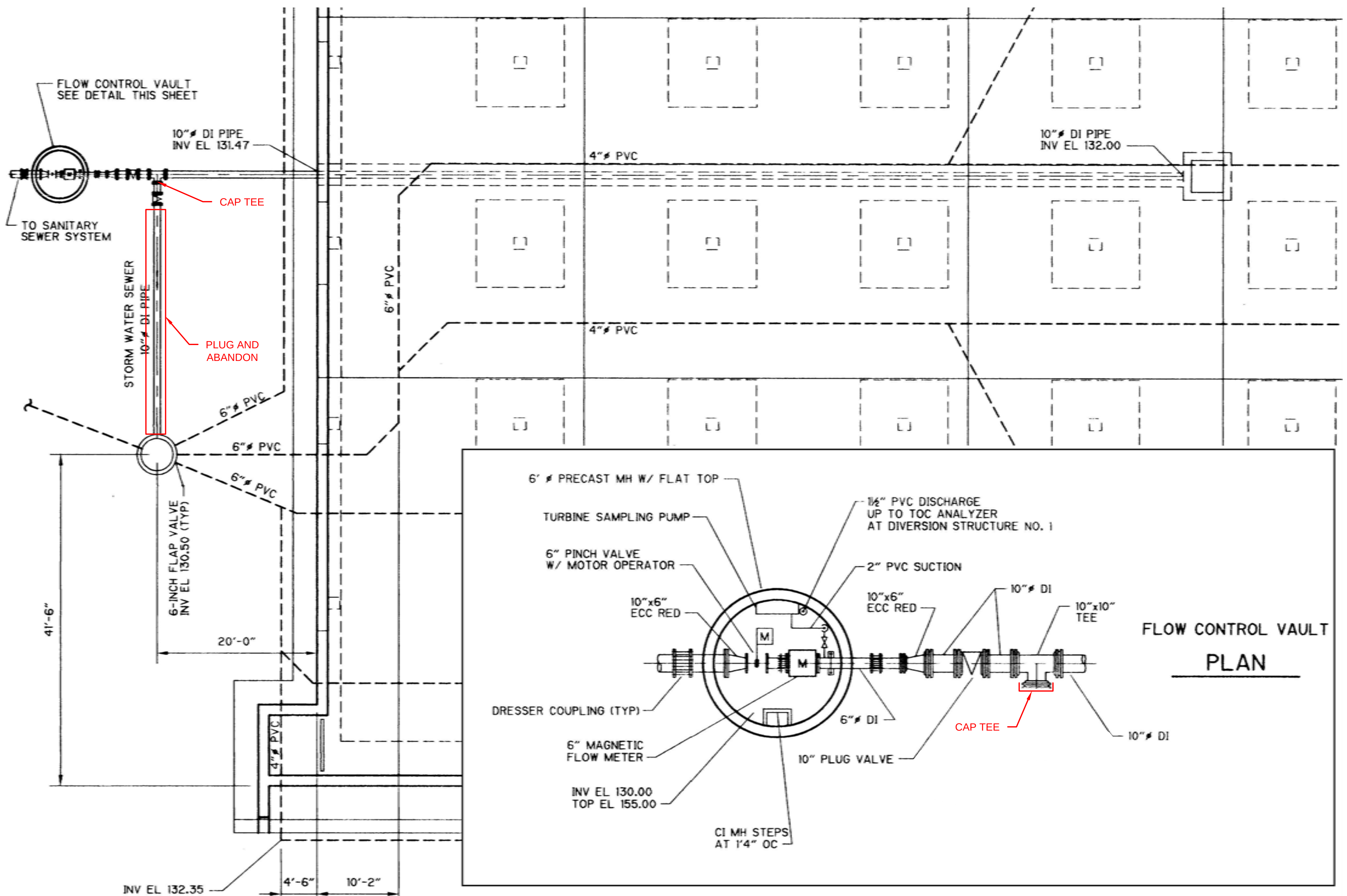
Figure 5.24 - Proposed Terminal Tank Area

Figure 5.25 - Existing Terminal Tank Outlet Piping



EXISTING TERMINAL TANK OUTLET PIPING

Figure 5.26 - Proposed Tank Outlet Piping



PROPOSED TERMINAL TANK OUTLET PIPING

Figure 5.27 - Proposed Glycol Collection Plan

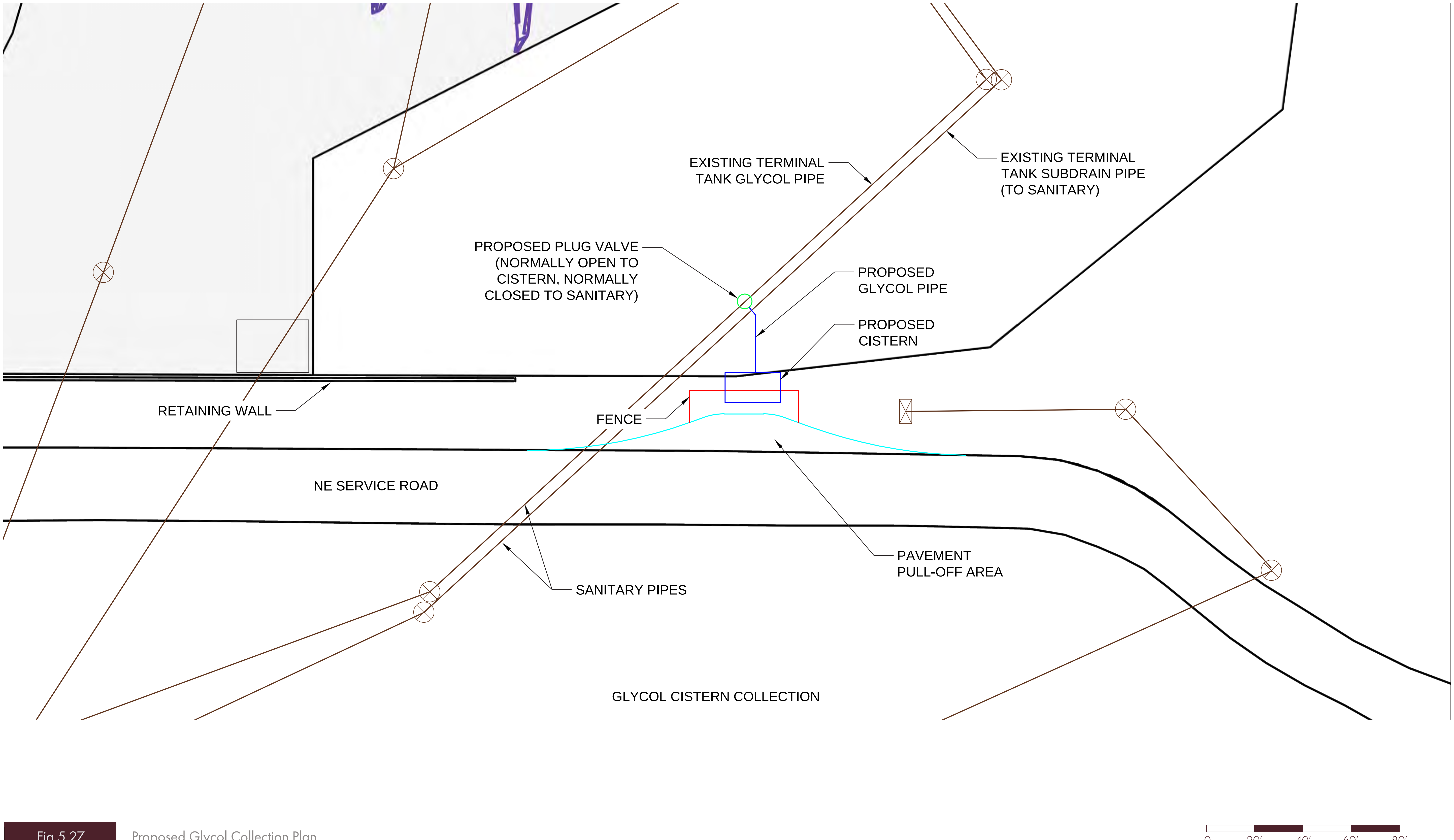
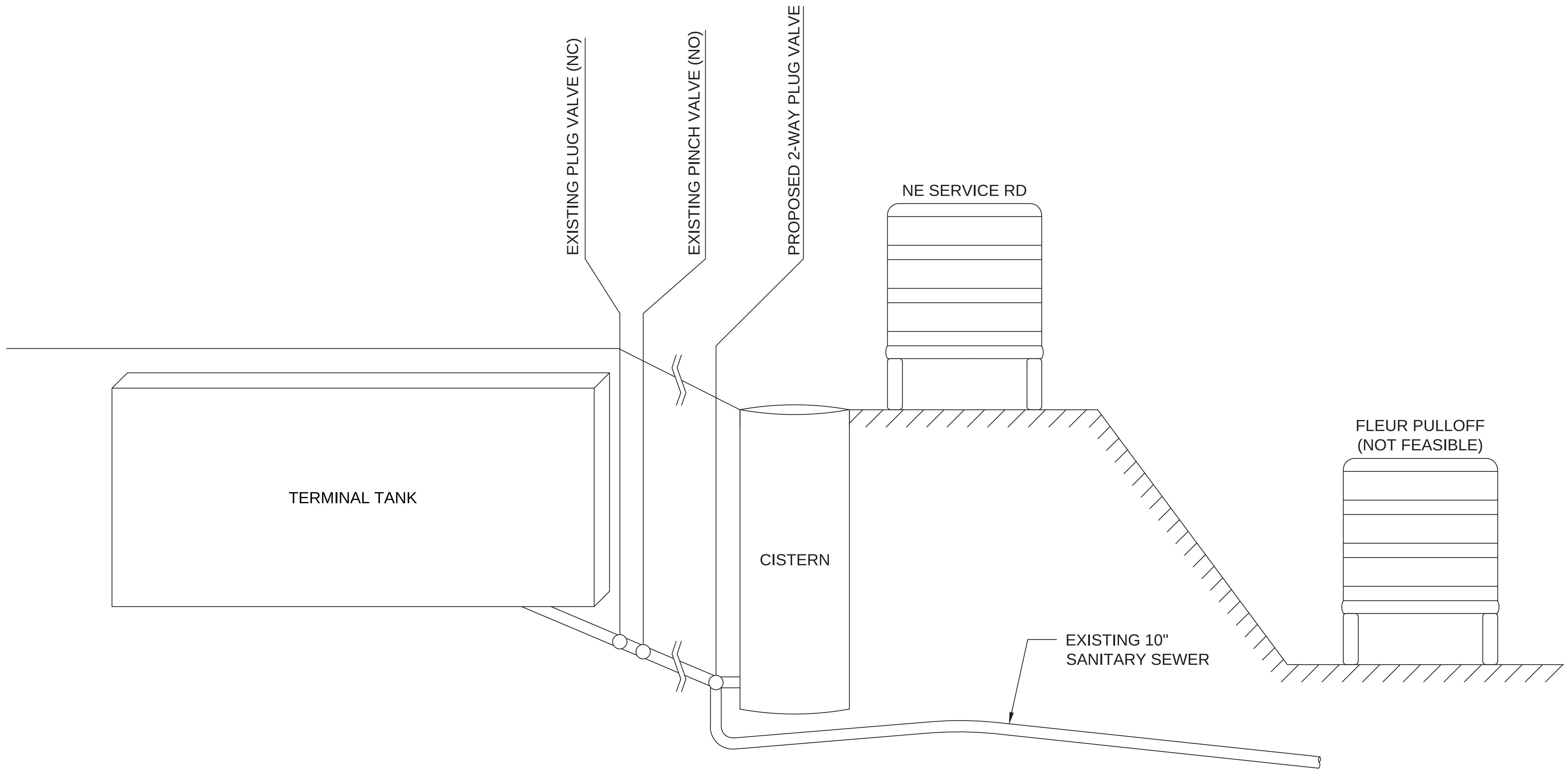


Fig 5.27 Proposed Glycol Collection Plan

Figure 5.28 - Proposed Glycol Collection Elevation



GLYCOL COLLECTION ELEVATION VIEW

5.4.5.5 Storm Sewer System - Airside Storm and Glycol Pipe Systems

Where new pavement is proposed, the underdrainage system will be replaced. The construction phasing affects the layout of the underdrainage system. Additionally, the underdrains in the deicing are separate from the rest of the terminal, because they are directed to the Terminal Tank. It could be stipulated that the construction of the deicing drainage area only occur between the end of July to the end of September. Even though deicing typically ends in early May, during June and July the existing underdrains are still conveying glycol to the tank.

The concept includes the reuse of many of the existing storm and sanitary pipes. This assumes the pipe class, material and condition are acceptable. To reduce the risk of unexpected repairs and related pavement replacement, in the next design phase, it is recommended that as-built pipe data sheets are made available and the pipe is closed-circuit television (CCTV) inspected for defects. The pipe can then be verified for reuse.

The proposed deicing area in the northwest region of the Main Terminal apron is the only area where deicing may occur. To reduce the amount of storm water runoff into the deicing area coming from the south, trench drains are proposed along its southern edge. Each of the three deicing pads will have a sump inlet for glycol runoff collection, and the northwestern snow dump area will have an inlet, conveyed in a separate piping system to the Terminal Tank.

According to the 1987 Brice Petrides Donohue plans there is an existing 5,000-gallon Fuel Separator tank buried 20ft deep, northeast of the Terminal Tank, that is intended to contain fuel spills (refer to **Figure 5.29**). This is not a typical Oil Water Separator (OWS), because it does not appear to include coalescing devices to separate oil that are suspended in water. There is a west-to-east 36" storm pipe and a 15" south-to-north storm pipe that are both connected to it by additional 10" outflow pipes in upstream catch basins. From the surveyed invert elevations (see **Figure 5.30**) the primary route (lower invert) on the 36" pipe is the 36" bypass and the primary route on the 15" pipe is the 10" tank pipe. It appears the 36" pipe was not connected as intended, because more common low flows should pass through the tank, to contain spills.

It is assumed the tank is steel, and because it is 30 years old, it may not be in adequate shape for reuse. Additionally, if it has not been maintained, it may be full of sediment and oils. The Fuel Separation tank could be replaced with an Oil Water Separator, in the same location. If fueling is restricted only to aircraft at the gates, a separate storm sewer system could be constructed for that area. By installing a trench drain system aft of the gated aircraft along the proposed Terminal Building, storm runoff and fuel spills would be conveyed through the trench drain's connection to the existing 15" south-to-north storm pipe. The outlet to the trench drain could be fitted with a closure device (sluice gate or valve) to immediately isolate fuel spills. Because the 15" south-to-north storm outlet pipe is routed to the proposed OWS northeast of the Terminal Tank, it will provide containment redundancy if trench closure does not occur.

If the tank is replaced, it is recommended to construct an adequate Oil Water Separator that can handle the passage of storm water within the area where fueling is allowed, so that manual closures are not required.

5.4.6 Natural Gas

MidAmerican Energy proposes to connect a new gas service line to feed the new terminal building at the existing 4 inch gas main located near Fleur Drive. They propose to abandon the existing 6 inch gas service to the existing terminal building in the future. Gas service to the existing parking structure shall be maintained. The existing gas service to the Signature Aviation buildings will be demolished.

Refer to **Figure 5.18** for proposed natural gas map.

5.4.7 Utility Infrastructure (Tenants)

Concession activities will need utilities including HVAC, plumbing, fire sprinklers, electrical power, lighting, controls, and information technology systems connections. Heating and cooling, ventilation, and grease duct systems will be part of HVAC. Plumbing for the food concessions will include grease interceptors, interior plumbing to the grease interceptors, sanitary sewer pipe from the grease interceptors to the sanitary sewer line. See Section 5.4.4 Sanitary Sewer System for more information. Interior electrical power and interior communications lines will be needed to each tenant space. Submeters will be needed for electrical, gas, and water services for each tenant.

5.4.8 Utility Infrastructure (Car Rental)

A new car rental building is proposed within the existing car rental parking lot. Further analysis is required to verify existing utility connections are adequate for the proposed building.

There is an existing water service line that feeds a fire hydrant and parking attendant building at the car rental parking lot. This water service line is extended from the 16 inch water main along Army Post Road.

The parking attendant building is served with a 4 inch sanitary sewer service line that ties into the 8 inch public sanitary sewer main along SW 28th Street.

There are electrical lines for the parking lot lighting as well as service to the parking attendant building. There is a transformer at the northwest corner of the parking lot.

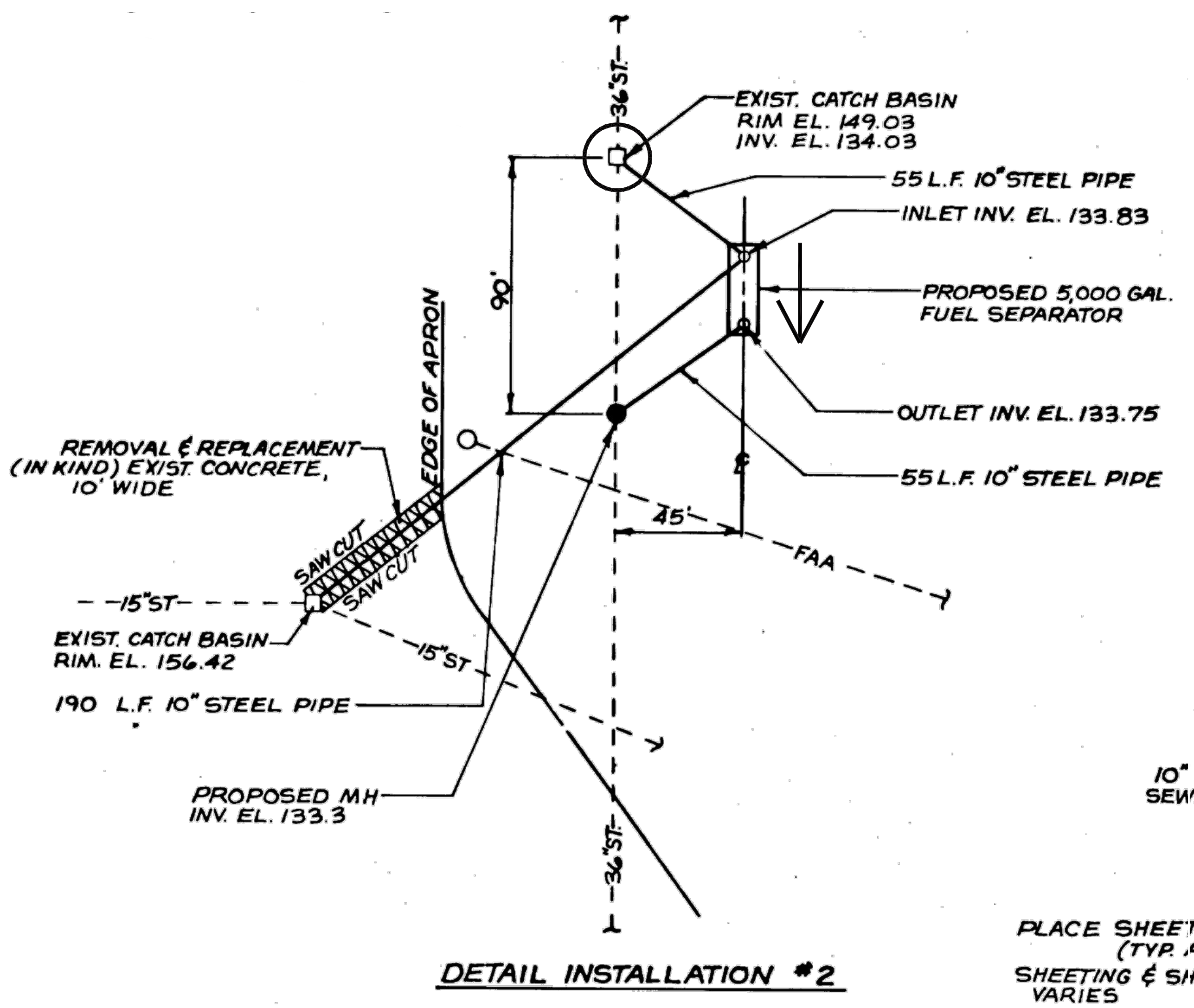
There is a communications pathway that runs along S Frontage Road. There is a communications manhole at the northwest corner of the parking lot.
There is currently no gas service within the parking lot area or to the parking attendant building.

The site generally is sloped south and stormwater runoff is collected via a storm sewer system (12 inch – 36 inch) located along the south edge of the parking lot. The storm sewer drains to the southwest corner of the site. Further analysis is required to verify any adverse impacts to the existing stormwater management facilities created by the proposed car rental building.
Refer to **Figure 5.31** for existing utilities at the proposed car rental building site.

5.4.9 Fueling Operations

Fueling operations will be maintained in a manner like the existing configuration. Fuel storage tanks located in the south quadrant of the airfield will continue to be utilized and jet fuel will be delivered to the terminal apron via the SE Service Road. Refer to **Figure 5.32**.

Figure 5.29 - Existing Oil-Water Separator Plan



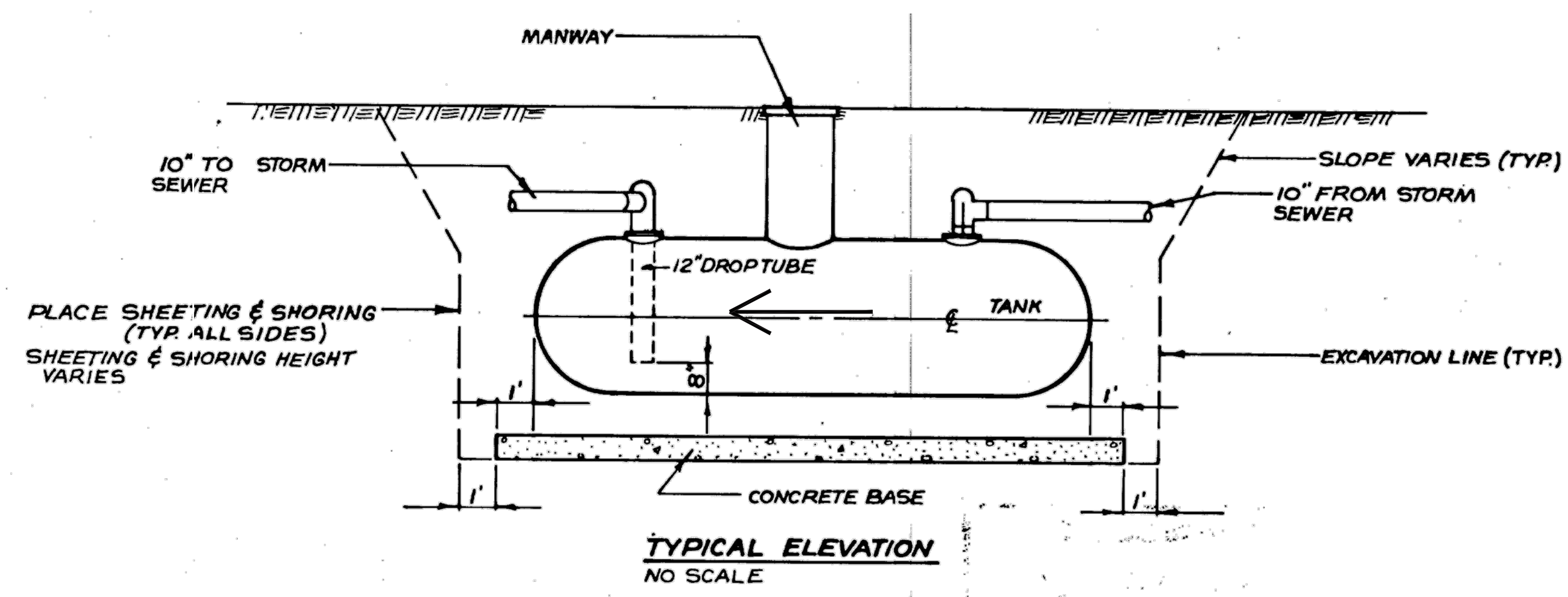


Figure 5.30 - Oil-Water Separator Survey

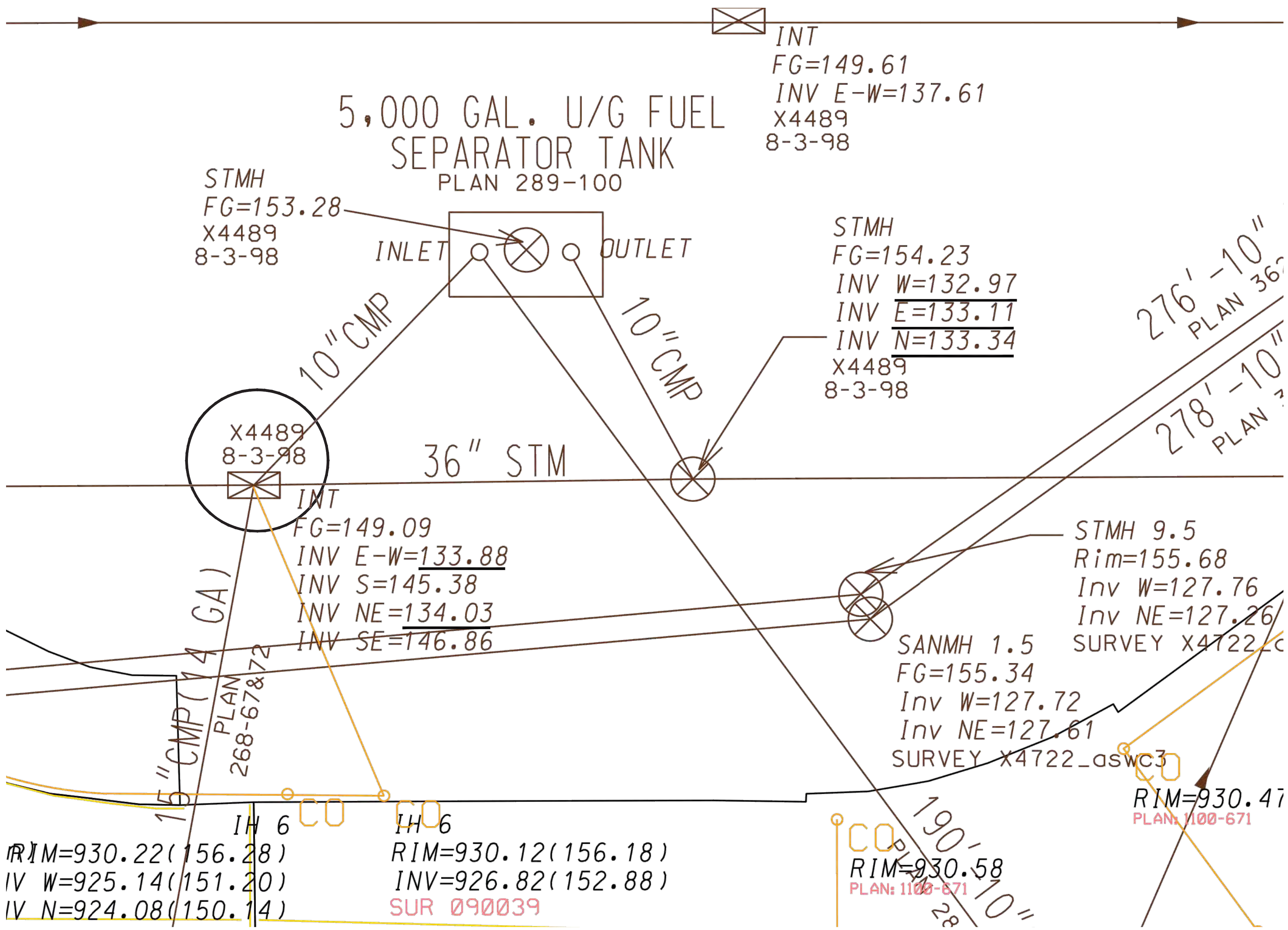


Figure 5.31 - Rental Car Utilities

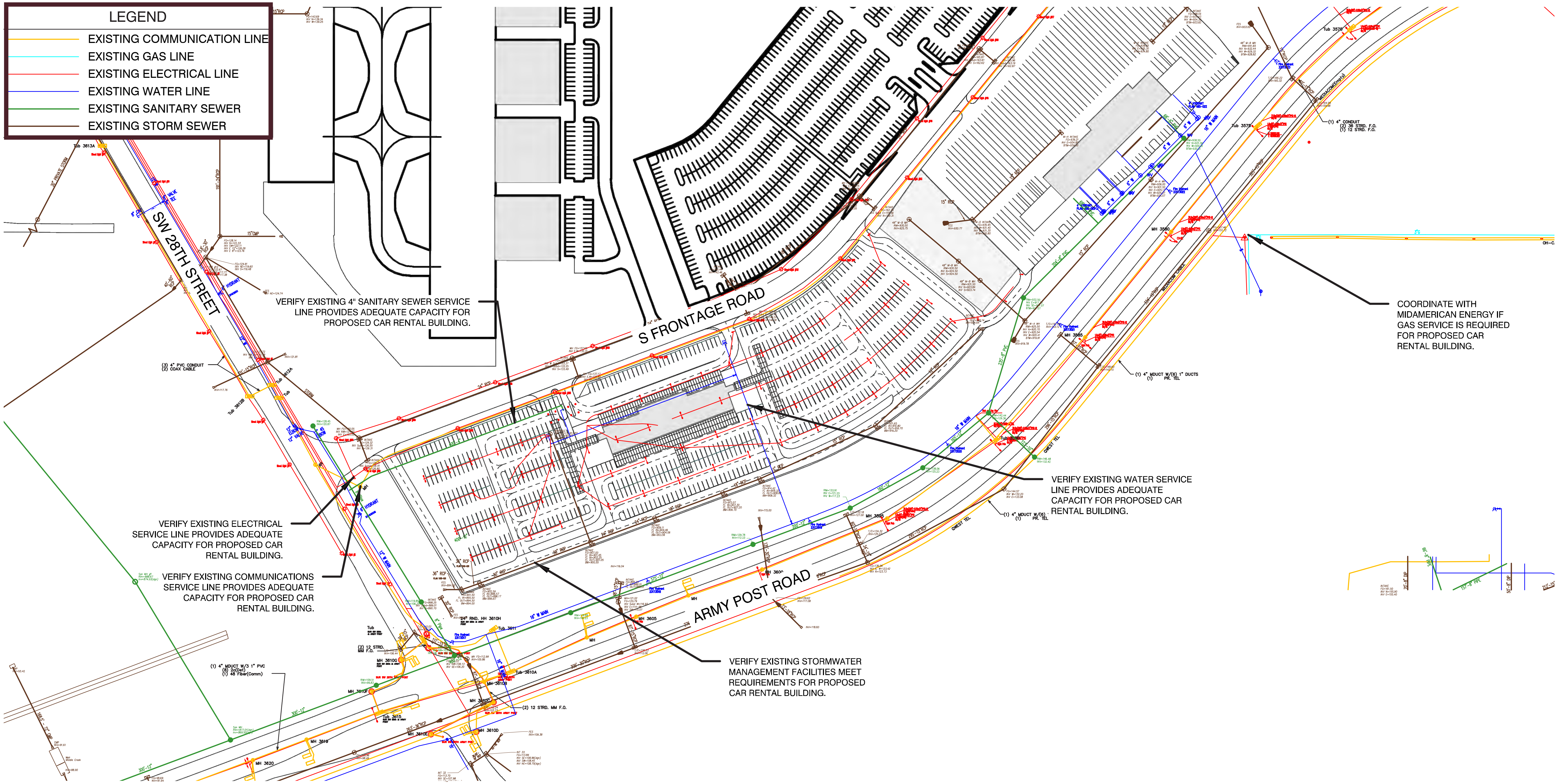


Figure 5.32 - Fueling Operations

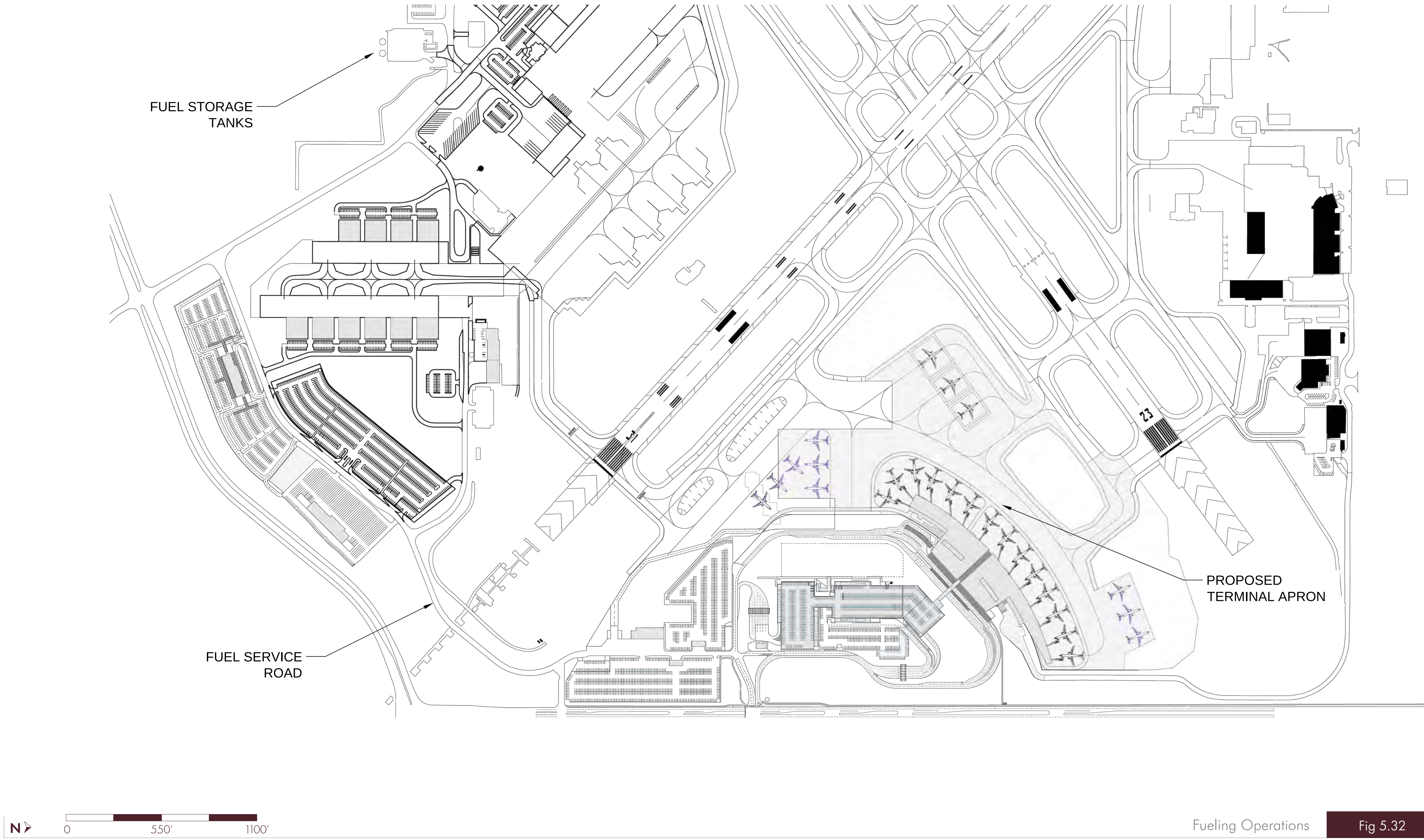


Figure 5.33 - Roadway Layout

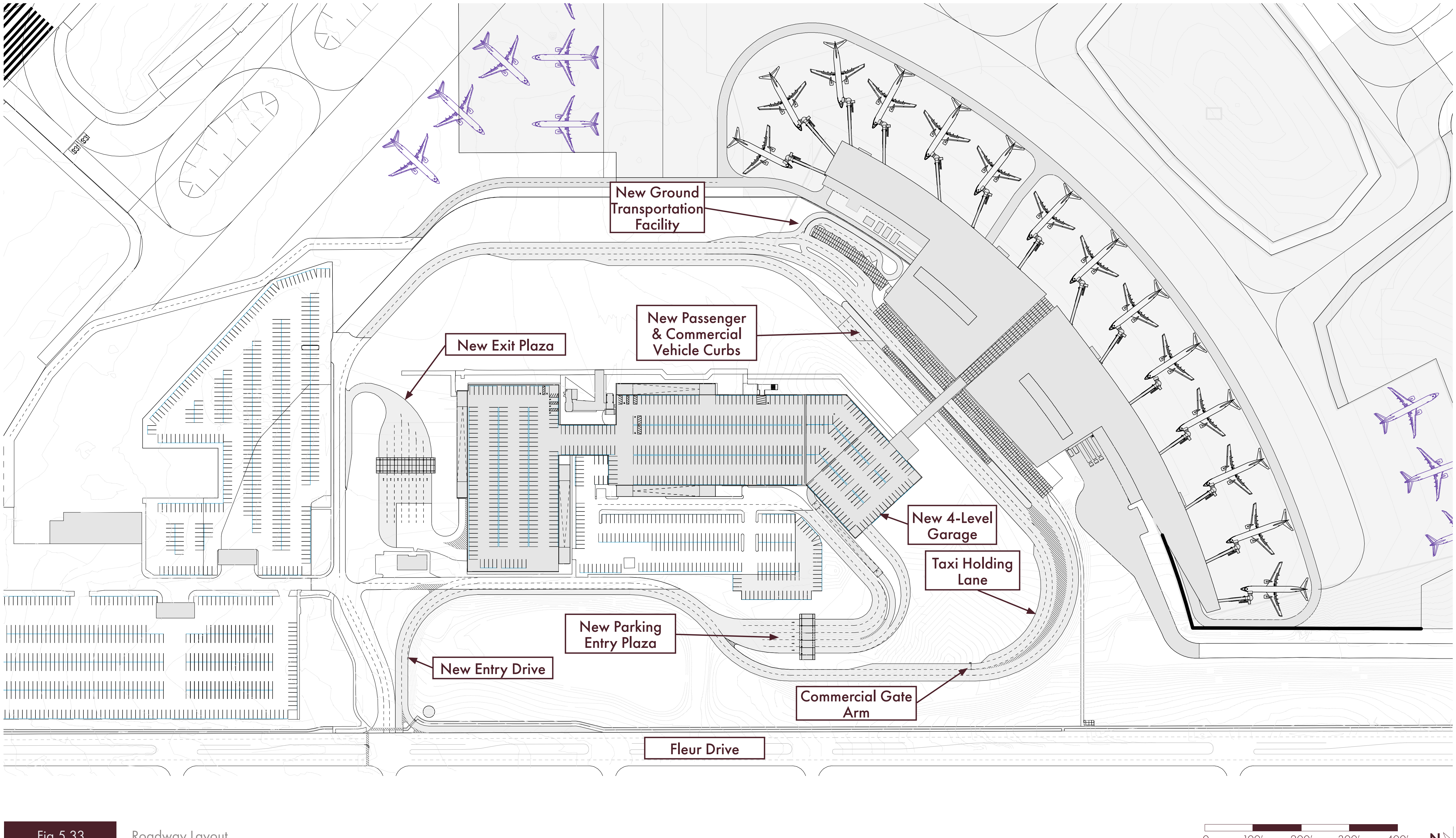


Fig 5.33 Roadway Layout

5.5 Landside

5.5.1 Roadways

The current terminal curbside roadway has three 10 feet wide lanes serving private vehicles and two 10 feet wide lanes serving commercial vehicles. Standard practices dictate a minimum of three lanes for a curbside providing a lane for loading-unloading passengers, a lane for vehicles to maneuver in and out of the curbside and allow double parking for passenger pick-up and drop-off during the peak periods and one lane for vehicles to travel through the curbside. Based on the projected vehicle demand six lanes are provided adjacent to the new terminal with a 15 feet wide median splitting the lanes. Three lanes will serve private vehicle activity on the inner curbside adjacent to the terminal and three lanes will serve commercial vehicle curbside activity along the median. The roadway lanes are proposed at 12 feet in width to allow more space for vehicle maneuverability, offering a higher level of service and more comfortable vehicle operating conditions along the roadway.

The proposed terminal roadway loop geometry accommodates the option of keeping the existing landside processor building as the design of the roadway avoids the existing footprint. Refer to **Figure 5.33** for roadway layout. This configuration utilizes the existing terminal curbside as the exit roadway and allows the terminal to be demolished at a later phase.

The new configuration provides a single signalized entry and exit point from Fleur Drive. Vehicles approaching from the north and south will use the intersection of Cowles and Fleur at Highview Drive to access the terminal area. Secondary access from the parking and rental car facilities to the south will continue to be provided along the South Frontage Road and Duck Pond Road.

5.5.2 Curb

The terminal curb provides 550 ft along the inner curb for private vehicle passenger loading and unloading. The proposed outer median curb provides over 550 ft of length for commercial vehicle loading and unloading. Commercial vehicle operations along the curbside consist of taxicabs, limousines, and various shuttles. The Ground Transportation Facility, located off the terminal's western end, provides 15 spaces for transportation network companies (TNCs) vehicles and two spaces for rental car buses. The configuration allows one rental car bus to arrive at the terminal prior to the previous bus departing the curbside enabling one bus to always be actively loading passengers. The Ground Transportation Facility is discussed in greater depth in **Section 5.5.3**. For proposed allocation of curb space refer to **Figure 5.34 And Table 5.10**.
Access to the outer commercial vehicle curb is restricted to authorized users and a gate arm is located at the split between the inner and outer curb to prevent the public from traversing this curb. Transponders on authorized vehicles will activate the gate arm. Additional linear parking spaces are provided along the outer curb access roadway past the gate arm for taxi staging prior to the curbside active passenger pick-up areas.

Table 5.10 - Curb Requirements

	Curb Lengths	Required	Actual
(red)	Passenger	550	550
(purple)	Taxi/Limo	170	200
(light blue)	TNC	100	260
(green)	Rental Car Bus	100	130
(dark blue)	Shuttles	355	355

*Room for Expansion in MAP 3

Figure 5.34 - Curb Lengths

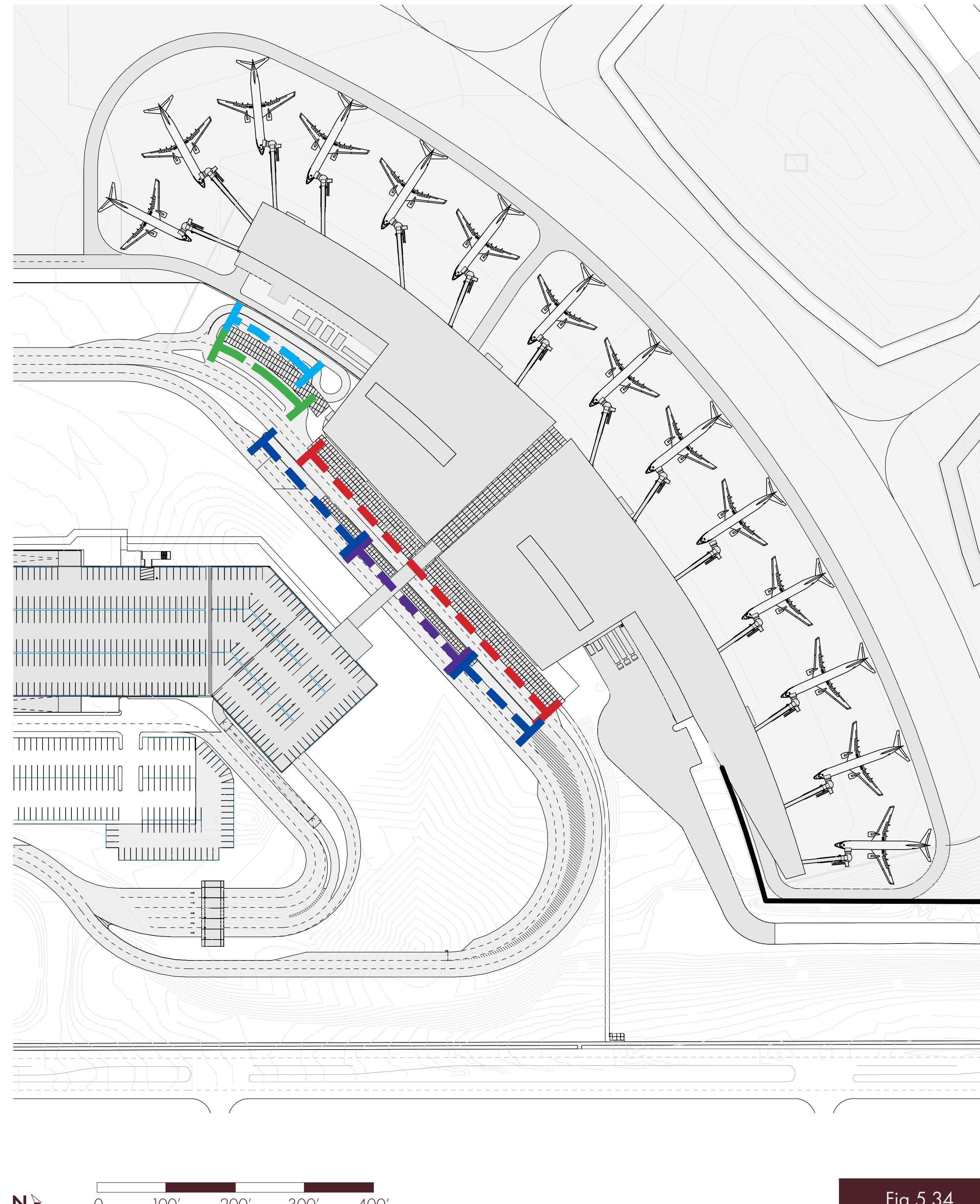


Fig 5.34

Figure 5.35 - Ground Transportation Facility

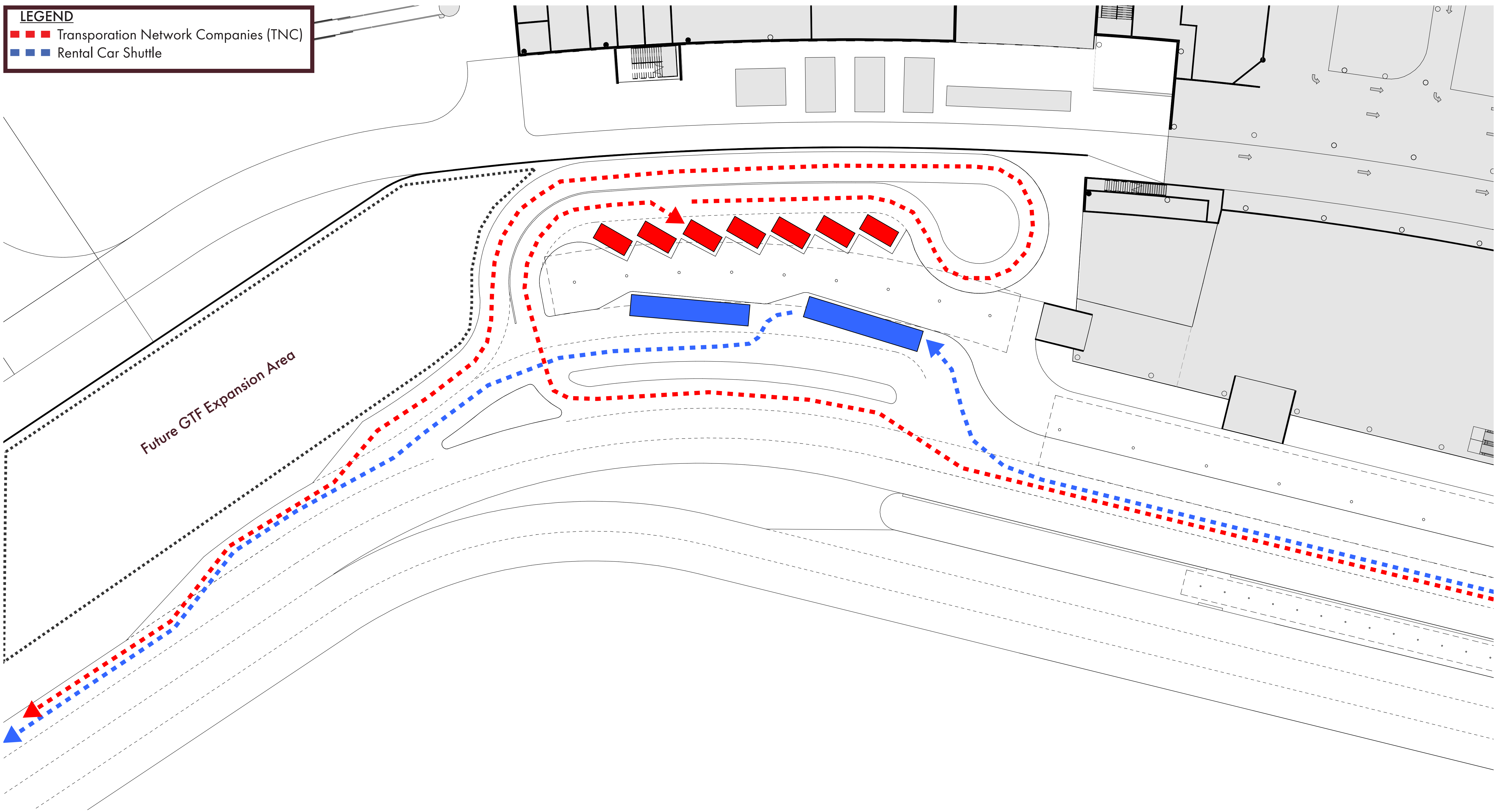


Fig 5.35 Ground Transportation Facility

5.5.3 Ground Transportation Facility (GTF)

The new terminal implements a Ground Transportation Facility (GTF) near baggage claim on the south side of the new processor. This is convenient for passengers arriving at the terminal since wayfinding is simple, they are protected from the weather by an overhead canopy and they can easily walk directly to the GTF after picking up their bags, without making a level change or crossing a busy street. The GTF's location reduces the number of pedestrians crossing the curb, which improves safety and decreases congestion.

The GTF offers drop-off/ pick-up 7 spaces for Transportation Network Company (TNC) vehicles and 2 bus slips for the RAC shuttle and charter busses, as shown in **Figure 5.35**. The TNC's only use the GTF as a loading/unloading zone and are not permitted to park in this area. The GTF can be expanded to the south as needed in the future.

5.5.4 Rental Cars

The Rental Car Companies (RAC's) require a significant amount of space for the 3.0 and 4.0 MAP projections. The RAC's prefer a consolidated secure lot for ready and return vehicles so they can leave the keys in the cars for passenger convenience. They also favor close proximity between the Rental Car Lobby space and their individual vehicle storage areas to implement short walking distances for customers.

The current rental car lots are divided between three separate areas, as shown in **Figure 5.36**, making wayfinding for customers very difficult. The lots are restricted by the loop road, the economy lot, and other parking facilities, and take away valuable parking space on the first Level of the south garage and other close-in parking. The RAC's operations are further restricted because they cannot secure their lots, so all customers must pick up their keys at the counter instead of going directly to their rental car. Inside the terminal, the RAC counters are positioned across from the baggage claim area, which creates heavy congestion during peak-hour times. In the airport improvement plan, the RAC's are relocated to the South Quadrant, which allows the airport to reclaim parking spaces in the garage and circulation space within the terminal, which will greatly improve the passenger level of service (LOS) and extend the useful life of the current building.

Prior to the cost-cutting exercise described in **Section 5.1**, the rental car lobby and vehicle storage areas were located across the passenger/commercial curb from the terminal, easily accessible from the pedestrian bridge. The new garage was originally planned for 5 levels; the top three were designated for parking and aligned with Levels 2, 3 and 4 of the north garage, and the bottom two levels split access to Level 1 of the existing garage and were allocated for rental car storage as shown in **Figure 5.1A**. The rental car storage area absorbed the entire space on Level 1 of the existing garage in addition to the first two levels of the garage. Although this location was ideal for the Rental Car companies, their storage area would have no room to expand for the MAP 4.0 requirements within the roadway loop.

By relocating the rental car facility to the South Quadrant, the airport will save a significant amount of capital cost. The new lobby and rental car storage areas will be located adjacent to their current Quick Turn-Around (QTA) Facility in the Economy 5 lot, which is already paved and equipped with some utilities. The direct access to the QTA, as shown in **Figure 5.37**, will improve RAC staff efficiency, eliminate RAC jockey traffic from the roadway loop and provide one consolidated location for all RAC operations.

The RAC companies can move to this new site as soon as the new rental car lobby is constructed, which would greatly alleviate congestion in the east quadrant and improve customer LOS. The RAC re-location will kick-start the airport project phasing, as described in detail in Chapter 7.

Passengers will reach the new RAC facility by taking a 3-minute shuttle ride from the new terminal's GTF, as described previously in Section 5.5.3, and shown in **Figure 5.38**. The new RAC lobby, as depicted in **Figure 5.39**, will be one level facility, roughly 14,500 SF, and include space for RAC offices, counters, queuing, restroom facilities and mechanical space. Customers will be dropped off by the shuttle on the north side of the building to enter the lobby or walk directly to the RAC lots. Inside the lobby, passengers will be directed through side vestibules to each of the rental car lots.

Each RAC area is segregated and accessed from the new ring road, which encircles the entire lot and connects directly to the QTA facility. Customers can by-pass Fleur Drive when picking up or dropping off their cars and utilize Army Post Road to gain access to the Rental Car site. Airport signage will direct passengers to the new location for easy wayfinding.

5.5.4.1 MEP Systems for New Rental Car Buildings

This section presents the recommended Mechanical/Electrical/Plumbing (MEP) system development for the new Rental Car Building at the Des Moines International Airport. The new rental car building is approximately 15,000 square feet (SF). The new Rental Car Building is planned on the airport site to be located near the existing Quick Turn Around Building, which will remain. As such, it is assumed that the new Rental Car Building will not include garage, service, or car wash spaces. This section assumes that the Rental Car Building is primarily an office/lobby type occupancy utilized by the rental car vendors.

5.5.4.1.1 HVAC Systems

The primary HVAC systems serving the new rental car building will be packaged variable air volume (VAV) rooftop air handling units. The rooftop units (RTUs) will provide cooled and dehumidified supply air to VAV boxes with electric reheat coils and, where necessary to meet the heating load, fan-powered VAV boxes with electric reheat coils.

Based on the current plans, the peak airflow load for the new rental car building is estimated to be 15,000 CFM. The RTUs will be packaged units installed on the roof.

The RTUs will include the following components: return fan, pre-filters, outside air damper, return air damper, relief air damper, gas burner, DX cooling coil and associated condensing unit, and supply fan. The supply and return fans will be provided with VFDs to allow off-peak savings (one VFD per fan). Energy recovery is not anticipated for the RTUs.

Return air will be ducted from the served spaces to the air handling units. A plenum return air system will be used as the design of the building allows to minimize space needs and cost while still providing for good air circulation in each space. Exhaust will be provided for code-required spaces such as toilet rooms, kitchen, and food service areas. All exhaust fans will be located on the roof.

5.5.4.1.2 Temperature Controls Systems

A new direct digital control (DDC) system will be provided for the new rental car building. All new HVAC equipment will be connected to the DDC system. The DDC system will be BACnet open protocol. The existing campus system is Siemens. Siemens will be the basis of design for the DDC system, but other manufacturers will be considered as alternate bids.

5.5.4.1.3 Plumbing Systems

A new domestic water service will be provided for the rental car building. A backflow preventer and water meter will be provided at the domestic water service entrance. A domestic water pressure booster system is not anticipated.

New natural gas water heaters with storage will be provided for the rental car building. Hot water will be generated, stored, and distributed at 140°F. Remote anti-scald mixing valves will be provided at each fixture as required by code. The need for water softening or treatment will be determined once a comprehensive water analysis has been completed. The domestic hot water system will be recirculated throughout the entire building. Public handwashing sinks and sensor operated faucets will have the recirculation piping routed down the wall and connected to the hot water piping within two feet of the fixture. Distributed point-of-use water heating systems may also be evaluated for potential improved energy efficiency and cost savings as compared to a central system with recirculation.

Figure 5.36 - Existing Rental Car Facilities

Fig 5.36 Existing Rental Car Facilities

Figure 5.37 - Rental Car Site Plan

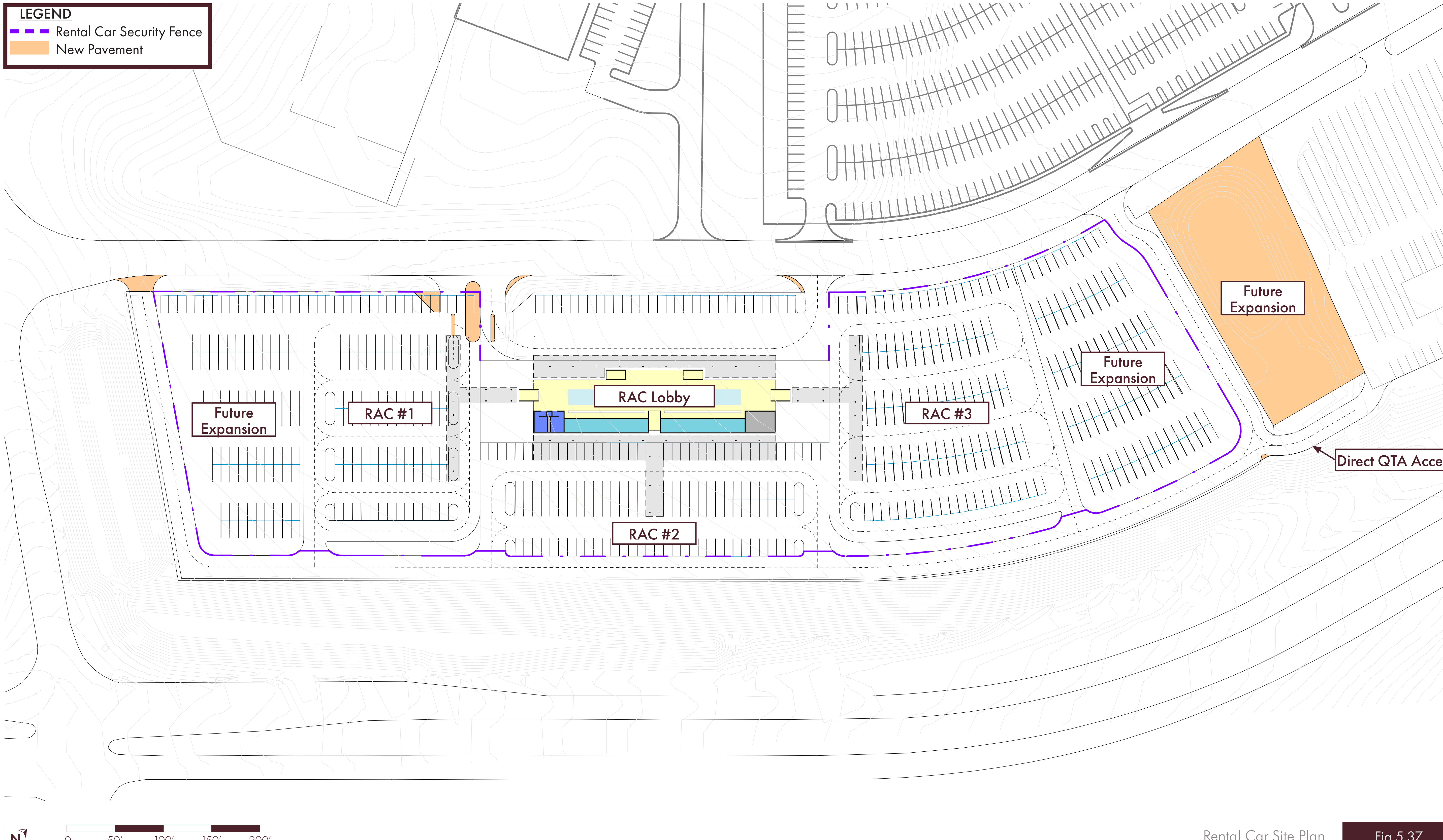


Figure 5.38 - Rental Car Shuttle Route

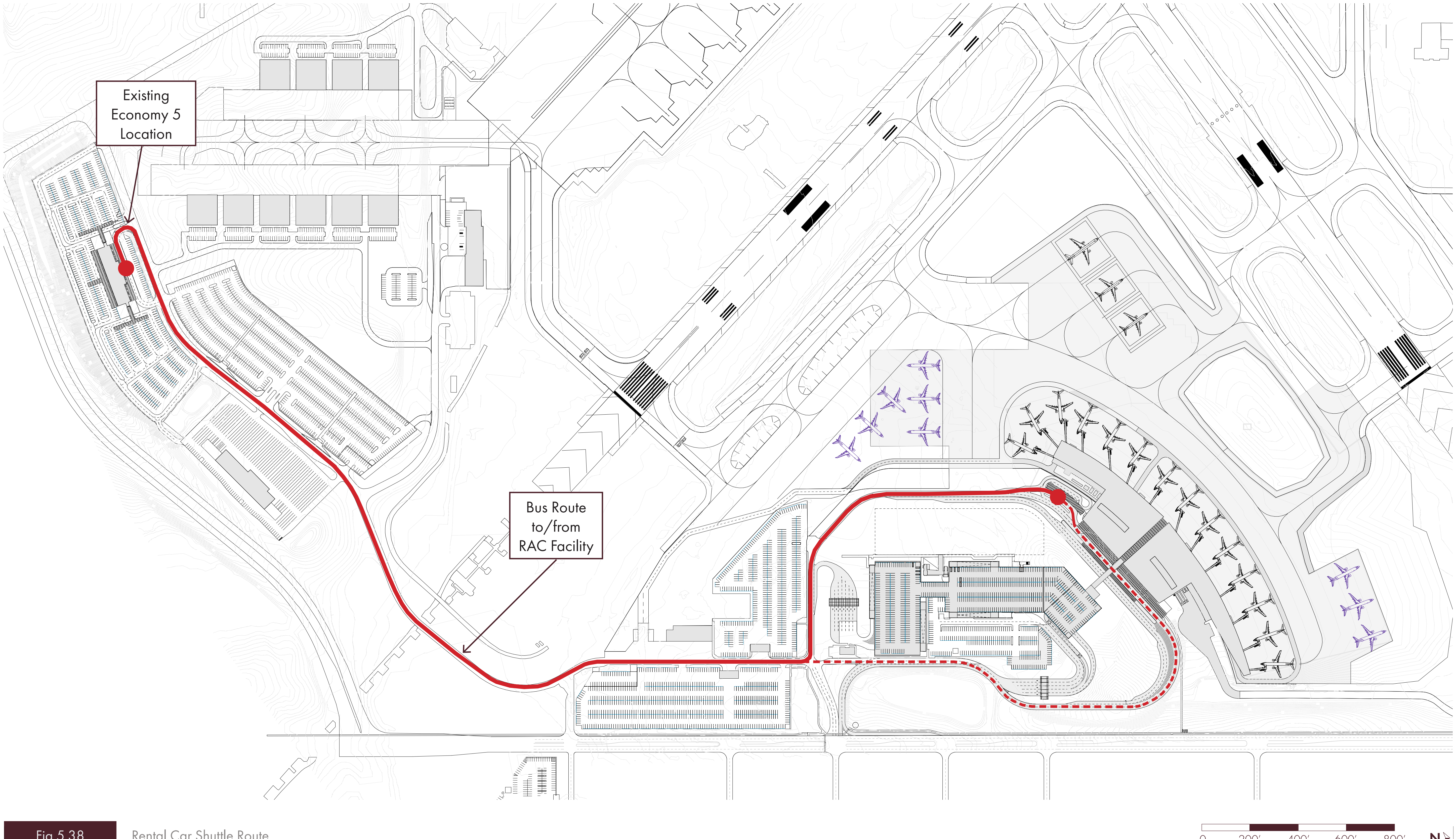
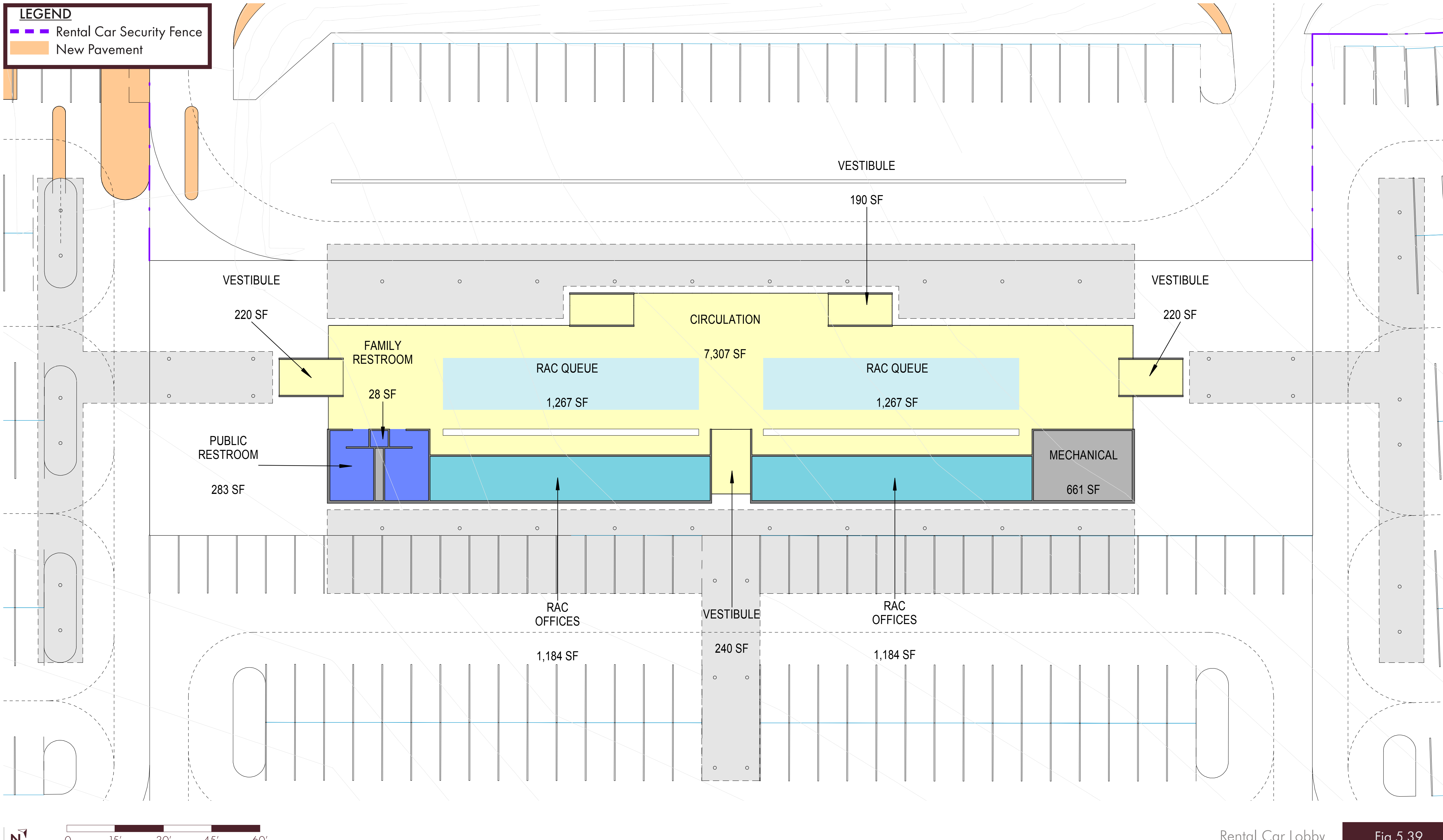


Fig 5.38 Rental Car Shuttle Route

Figure 5.39 - Rental Car Lobby



Plumbing fixtures (lavatories, water closets, urinals) will be porcelain type. Fixture colors will be selected by the Owner and Architect. Sensor-operated flush valves and sensor-operated faucets will be provided for public restrooms. Manual flush valves and manual faucets will be provided for private restrooms.

Sanitary piping will be routed from the new fixtures to mains below the rental car building. The quantity, size, and location of the sanitary main exits from the building will be coordinated with the civil site engineer as the design progresses. It is anticipated that all sanitary drainage will flow by gravity to the mains outside of the building – no central sewage ejector pumps will be required. Storm piping will be routed from the new roof drains to mains below the rental car building. The quantity, size, and location of the storm main exits from the building will be coordinated with the civil site engineer as the design progresses. Secondary roof overflow drains will be piped down inside chases to lambs' tongue fittings and will spill onto grade.

A new gas service entrance will be provided for the rental car building. The existing gas main located outside the building will be tapped, and a meter with pressure regulator furnished and set by the local utility. Inside the building, natural gas will be routed in at 14" w.g. to serve the water heaters and rooftop units.

5.5.4.1.4 Fire Protection Systems

A new fire protection service will be provided for the rental car building. A backflow preventer will be provided at the fire water service entrance.

The new terminal building will be provided with an automatic sprinkler system per NFPA 13. A standpipe system is not anticipated.

At this time, no hydrant static or residual pressure and flow test data has been obtained from the local fire department. However, it is anticipated that the new rental car building will not require a fire pump.

The new building will be light hazard classification in general, with areas of higher hazard classification such as storage rooms.

Dry fire protection systems will be provided where sprinkler piping is subject to freezing (overhangs, canopies, etc.).

5.5.4.1.5 Power Systems

A new medium voltage feeder will be routed from the utility company to a new pad mounted transformer. This transformer will be owned and maintained by the utility company and will serve a new 480-volt switchboard within the Rental Car Facility.

The 480-volt switchboard will serve HVAC loads, lighting and a step-down transformer for 120-volt loads.

An emergency generator will not be provided for the Rental Car Facility.

A lightning protection system will not be installed.

5.5.4.1.6 Lighting Systems

All interior and exterior lighting will be LED. Interior lights will be controlled via a lighting control panel and vacancy sensors.

Emergency egress lighting and exit signs will be battery operated with integral batteries.

5.5.4.1.7 Fire Alarm System

A fire alarm system will be installed to meet NFPA 72. Smoke and heat detectors will be installed in normally unoccupied spaces. Pull stations will be installed at the exit doors. Horn/strobes will be utilized for occupant notification.

5.5.5 Transportation Network Companies (TNC)

The Transportation Network Companies (TNC), including Uber, Lyft and other rideshare companies, will share the designated GTF curb with the rental car shuttle. Passengers using the ride-sharing program walk a short distance from the baggage claim to the pick-up / drop-off location which is covered by a canopy.

The TNC's remain outside the airport's geofence until they receive a rideshare request so they do not cause excess congestion on the roadway loop and curb. They utilize passenger vehicle lanes to access a one-way loop, which takes them to their designated loading spaces, as shown in **Figure 5.35.**

5.5.6 Parking

The airport currently offers long- and short-term parking in garage and surface spaces within the roadway loop, with economy parking slightly further out. Parkers can walk or ride a shuttle to the terminal from the economy lots. The two four-level garages, opened in 1998/1999, include long term parking on levels 2-4, hourly parking on Level 1 of the north garage and rental car on Level 1 of the south garage. Both garages are consistently full during the work week, so the airport improvement plan requires additional parking to meet demand while also planning for the future and considering the impact of autonomy.

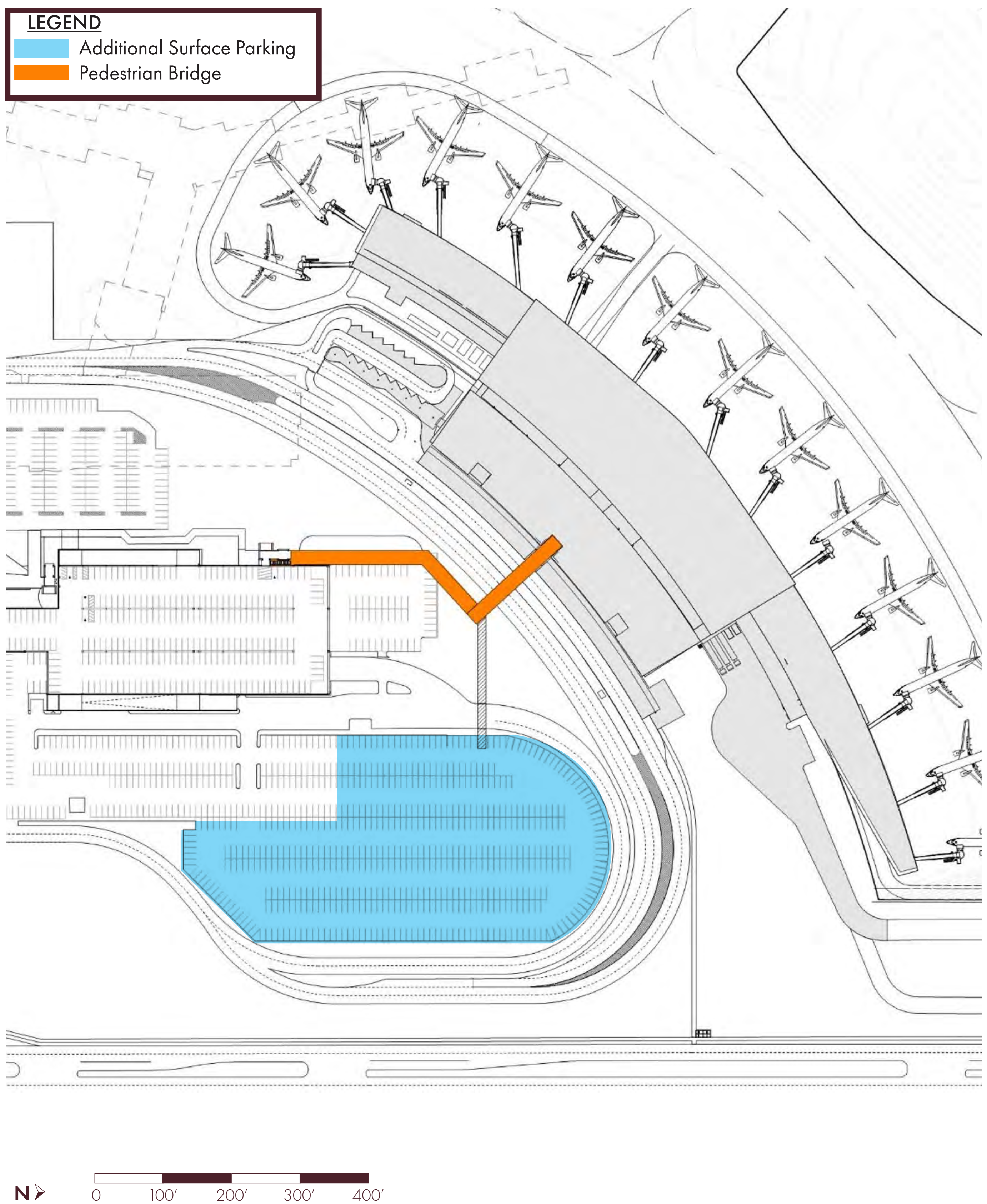
Autonomous vehicles and advanced technology will change the way people travel. Instead of driving their own vehicles, people may opt to use an autonomous vehicle, bypassing the parking process. Therefore, new garages should be designed with larger floor-to-ceiling heights and flat, opposed to sloped, floor plates to provide future flexibility for alternate uses when autonomous vehicles become more prevalent. These cars will likely still need parking, charging/fueling and cleaning locations, so remaining garages could potentially provide for those functions. A new parking structure should be able to accommodate additional and increased electrical load.

Nationally, airports are still constructing parking structures to enhance their parking capacity or replace older garages. For example, OMA's new 2,000 space public parking garage and new rental facility is under construction; BUR is planning a new 4,000 space garage as part of the terminal replacement project; and PSP is designing a new rental car garage, while expanding their public parking lots. Des Moines experiences similar demands and constructing a new garage is necessary despite the impact of autonomous vehicles in the next few decades.

Before the Value Engineering (VE) process that began in September 2017, DMAA was considering a 5-level garage which included the rental car facility and lobby. Levels 2, 3 and 4 were dedicated to parking and aligned with the north garage levels for continuous vehicular flow. Rental Car operations were split between Levels 1A and 1B in the new garage and Level 1, as described in 5.5.4. Ultimately, this option was eliminated due to cost.

Multiple options were evaluated during the VE process for parking within the roadway loop, including a "no-garage" option. When the Rental Car companies move south, DSM re-captures 260 spaces on Level 1 of the south garage, and surface parking can make up the remaining required spaces. Refer to **Figure 5.40** which represents the space that would be required for the additional surface parking.

Figure 5.40 - Surface Parking Alternate



This option has two main advantages: the airport saves capital costs by not building the garage and the existing entry plaza can be reused, which also reduces cost. However, there are several major disadvantages that outweigh the cost savings. One of DMAA's main goals is to increase safety for pedestrians crossing the curb. With the surface lot option, long-term parkers utilizing the new surface lot would likely walk on the most direct path to the terminal, which means they would cross two lanes of traffic at the entry plaza, then 6 additional lanes in front of the terminal, which increases risk of an accident on the curb and causes more vehicular congestion, as drivers need to stop more frequently for pedestrians crossing the roadway lanes. The wayfinding would also be more difficult for parkers since there is no access to the new bridge from the ground level besides through Stair Tower 1, which would be difficult to see from the new surface lot. Additionally, the airport cannot generate nearly as much revenue with surface parking as they could with structured parking.

Several options were evaluated for the new garage location, as shown in **Figure 5.41**. Some of the options were advantageous because they saved the existing entry plaza or were ideal for construction phasing. Ultimately, a concept closely resembling the pre-VE solution, was selected because it created the shortest walking distances for parkers to the terminal and created a barrier between surface parking and the terminal, so more pedestrians would use the bridge to cross the road. It also has room to expand north in the future if needed.

The new garage contains 4 parking levels with 476 stalls. Together with the new re-configured long-term lot, providing 141 new spaces, and the reclaimed spaces on Level 1 of the south garage, the new garage will exceed the MAP 3 parking space requirement of 2,575 spaces within the roadway loop. The garage can be expanded in the future by adding structural bays on the north end to meet the MAP 4 parking requirement.

Each level of the new garage will align with the north garage so vehicles can flow continuously into the new garage. Levels 3 and 4 are dedicated to long-term parking, with spaces on Level 1 reserved for premium long-term parkers. Those patrons will access the spaces from a separate entry west of the short term-ramp to Level 2. Level 2 of the new garage will consist of short-term/hourly parking. This area can expand into the north garage if the demand increases, as shown in **Figure 5.42**. Meeter/greeters will have direct access from parking in the hourly lot, across the bridge to the meeter/greeter area located on Level 2 without having to make a level change. Parkers on Levels 1, 3 or 4 have convenient access to the elevator core or stair tower on the west side of the new garage to access the bridge level.

The entry plaza will be relocated as part of the garage construction, as further described in Chapter 7. It will be situated parallel to Fleur Drive and will allow for longer decision times as drivers navigate through the new roadway loop system. Long-term parkers will generally use the west entry lanes, while short-term parkers will be directed to the eastern entry lanes.

5.5.6.1 MEP Systems for the Expanded Parking Structure

This section presents the recommended Mechanical/Electrical/Plumbing (MEP) system development for the expanded parking structure at the Des Moines International Airport.

5.5.6.1.1 HVAC Systems

The expanded parking structure will include elevator lobbies and stairwell. New split system DX heat pump units will be provided for the elevator lobbies to provide heating and cooling for the spaces. The outdoor units will be located on the roof of the elevator lobby at the top of the parking structure.

The stairwell will be provided with electric unit heaters for heating and an exhaust fan for cooling. The exhaust fan will be located on the roof of the stairwell at the top of the parking structure. A louver will be provided on the lowest level of the stair to open and allow air into the stairwell when the fan is activated.

Figure 5.41 Garage Location Options

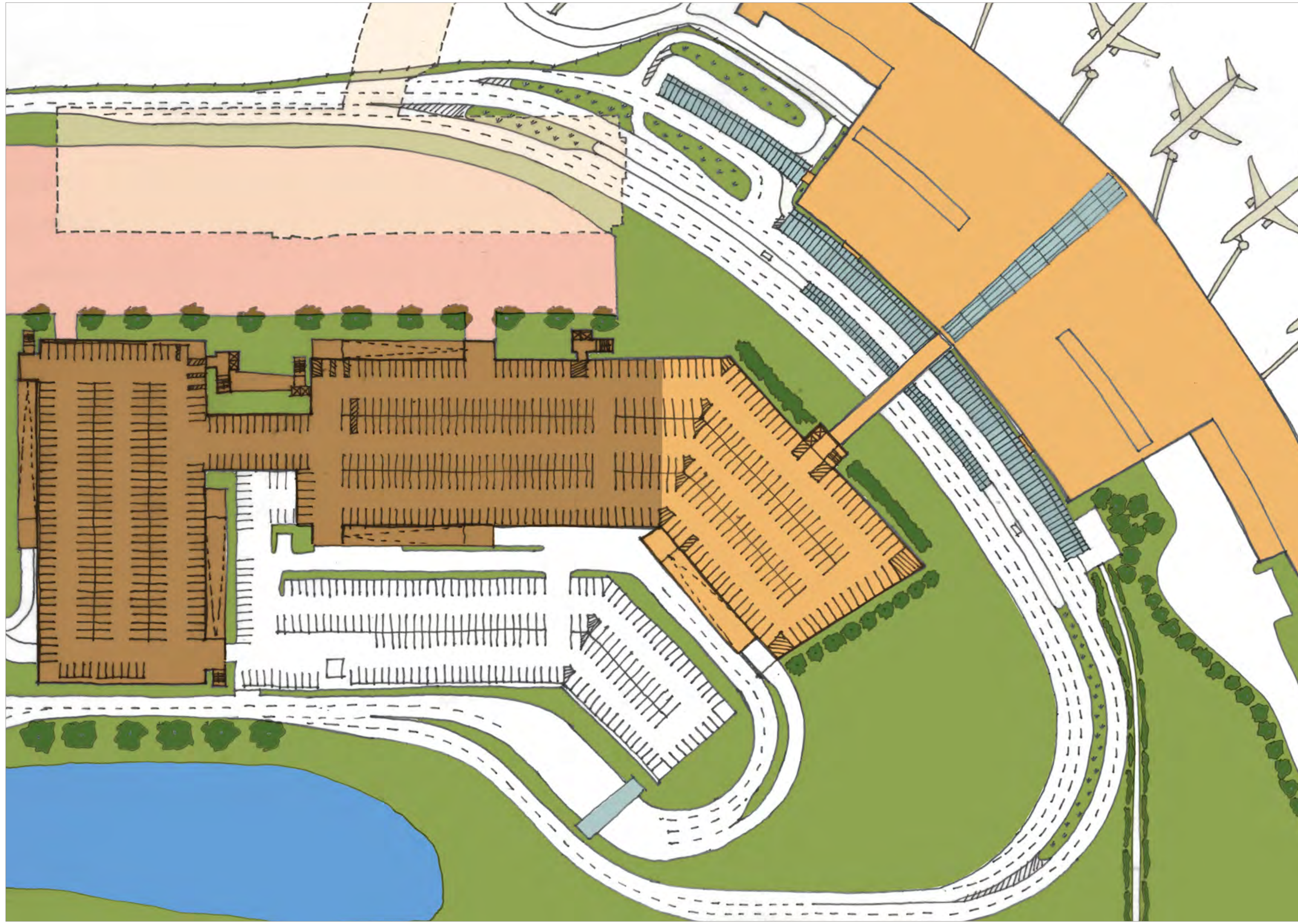
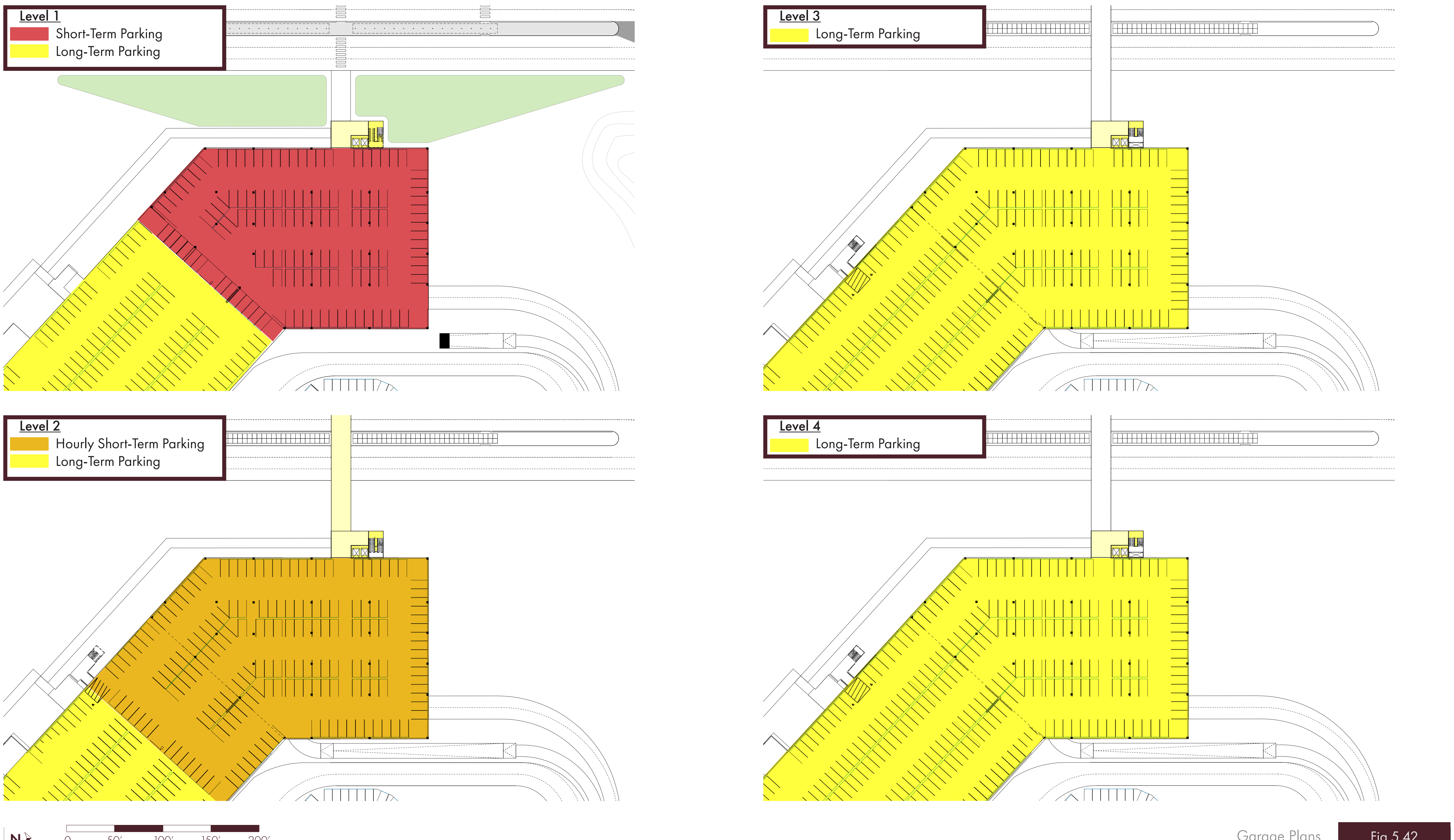


Fig 5.41 Garage Location Options

Not To Scale N

Figure 5.42 - Garage Plans



5.5.6.1.2 Plumbing Systems

The expanded parking structure will include many new drains. The drains located on the top floor of the parking structure will be routed to the site storm system and the drains on all the lower levels will be routed to the site sanitary system. Prior to connecting the drains to the site sanitary and storm systems, the drainage must pass through an oil/sand interceptor per code.

New sanitary and storm connections will be provided to the site sanitary and storm systems. Preliminary site investigation revealed that the existing parking structure may have its drains connected only to the site storm system. To bring this up to code, the drains on the lower levels of the parking structure will need to be re-routed through an oil/sand interceptor to the site sanitary system. The existing drains on the top level of the parking structure can remain piped to the site storm system through an oil/sand interceptor.

5.5.6.1.3 Fire Protection Systems

It is anticipated that the manual dry standpipe system serving the existing parking structure can be extended to serve the expansion.

5.5.6.1.4 Power Systems

A new medium voltage feeder will be routed from the new medium voltage switchgear located in the new Terminal Building. A new pad mounted transformer will be installed near the parking ramp to serve a new 480-volt switchboard within the Parking Ramp.

The 480-volt switchboard will serve HVAC loads, lighting and a step-down transformer for 120 volt loads.

An emergency generator power feed from the Terminal Building will be routed to the Ramp for egress lighting and other life safety loads.
A lightning protection system will not be installed.

5.5.6.1.5 Lighting Systems

All interior and exterior lighting will be LED. Interior lights will be controlled via a lighting control panel and vacancy sensors. During the daytime, the outside row of lights will be turned off to conserve energy.

Emergency egress lighting and exit signs will be powered from the generator located at the Terminal Building.

5.5.6.1.6 Fire Alarm System

A fire alarm system will be installed to meet NFPA 72. Smoke and heat detectors will be installed in normally unoccupied spaces. Pull stations will be installed at the exit doors. Horn/strobes will be utilized for occupant notification.

5.5.7 Cowles Drive Intersection

The first phase to kick-start the landside roadway improvements is the reconstruction of the Cowles Drive intersection across from Highview Drive. This intersection, which is currently the airport exit, will provide a new entry road to the campus north of the existing exit and create a one-way loop. The existing entry across from Porter Avenue will be decommissioned and demolished.

The new entry will include a new right turn lane for the south-bound traffic on Fleur, a new left-turn lane for north-bound traffic on Fleur, and new stoplights. For the south-bound traffic turning right, new pavement will be added for a 250'-0" deceleration lane that will continue through the entry loop portion without a merge. North-bound traffic entering the airport requires a new 150' left turn lane that will replace the curb and planting strip in place today. Vehicles will turn left onto a dedicated lane on the new entry road to avoid collisions with the incoming traffic entering from the new south-bound turn lane.

See **Appendix G** for additional information on the intersection and the traffic study.

5.6 Aircraft Infrastructure

In this section of the manual, airside infrastructure refers to the airside elements involved in servicing the aircraft and connecting the aircraft to the building. These elements include the aircraft parking layout, ground service equipment placement and use, passenger boarding bridges, and impacts to imaginary surfaces (Part 77). Each of these elements is described in greater detail in the following subsections.

5.6.1 Aircraft Parking Layout

The contact gates for the new terminal were arranged to comply with Part 77 limitations, provide flexibility for the airlines and the airport, and allow future expansion within the East Quadrant.

The fourteen gates required for MAP 3 comply with Part 77 restrictions for Runway 5/23, and the four additional gates for MAP 4 will not surpass Part 77 restrictions for Runway 13/31.

The new plan can accommodate a Group III aircraft (A321, 737-900ER) at each contact gate position, which creates gating flexibility for the airlines and provides opportunities for common use technology on the concourse. Some of the gates near the southern end of the concourse could potentially integrate larger, Group IV aircraft.

The aircraft positions are spaced 20' apart and rotated as far north as possible on the site to ensure the terminal can open with 10 gates. As a result, the aircraft on the north end of the concourse will be easily visible to passengers driving south on Fleur to arrive at the airport. The arrangement also locates the 7th gate position (from the north) on the building's centerline, so non-ticketed airport visitors can enjoy a view to the aircraft from the landside meeter/greeter area. The aircraft layout is split evenly between 7 gates on the north end and 7 gates on the south end, so that operations, MEP demand, concessions and holdrooms can be relatively similar on both ends of the building.

The new pavement will be raised significantly on the north side of the site to eliminate major sloping on the apron and ramps within the concourse. As a result, the new apron pavement will require a retaining wall along Fleur Road. The baseline option retaining wall, as shown in **Figure 5.43**, is 20' tall along at its highest point and extends 600' to the north, parallel to Fleur Road, receding to a 10' height. To reduce the retaining wall presence along a main public artery, an alternate option was studied during the Value Engineering process, as represented in Figure 5.43. By relocating the service road closer to Fleur Road, the retaining wall can move west and most of the elevation change can be made up in the grading. The sloped grade could be covered with landscaping or native grasses. A retaining wall would still be necessary; however, its average height would be 4' to 6' tall, with an 8' maximum height parallel to Fleur. Ultimately, the alternate was not selected to move forward with because of the estimated cost of additional fill material. This can be revisited during design.

The back-of-tail vehicle service road (VSR) connects all 14 gates to the inbound and outbound baggage makeup areas. The inbound tugs can access the inbound baggage drop off area from a central location which is convenient for aircraft utilizing the northern gates, or from a south entry point near the Ground Transportation Facility on the landside for easy access for tugs servicing the southern gates.

5.6.2 Analysis

A preliminary Part 77 study was conducted to ensure the proposed terminal concept does not penetrate the imaginary surfaces per FAA design standards. Elevation data utilized for this analysis consists of existing LIDAR information supplied by Des Moines Airport Authority.

Six proposed remain overnight (RON) aircraft positions at the southern end of the apron were analyzed based on proximity to Runway 31. Aircraft tails for three aircraft that pose the greatest likelihood of Part 77 surface penetration all appear to stay below the transitional surface. **Figure 5.44** illustrates the scenario. Additionally, all gated aircraft appear to stay below Part 77 transitional surfaces for both Runway 31 and Runway 23.

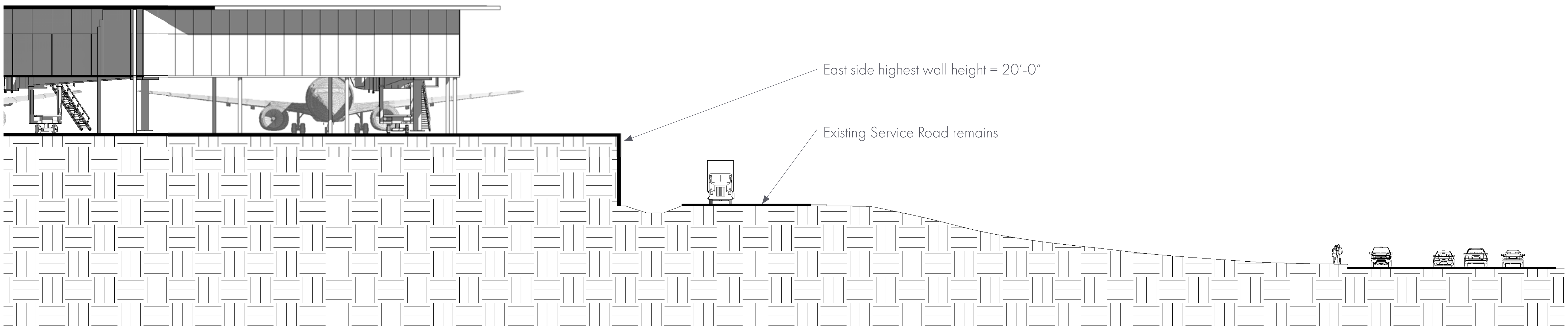
Reanalysis of the RON/hardstand parking positions on the apron's southern end is recommended during the design phase.

5.6.3 Passenger Boarding Bridges

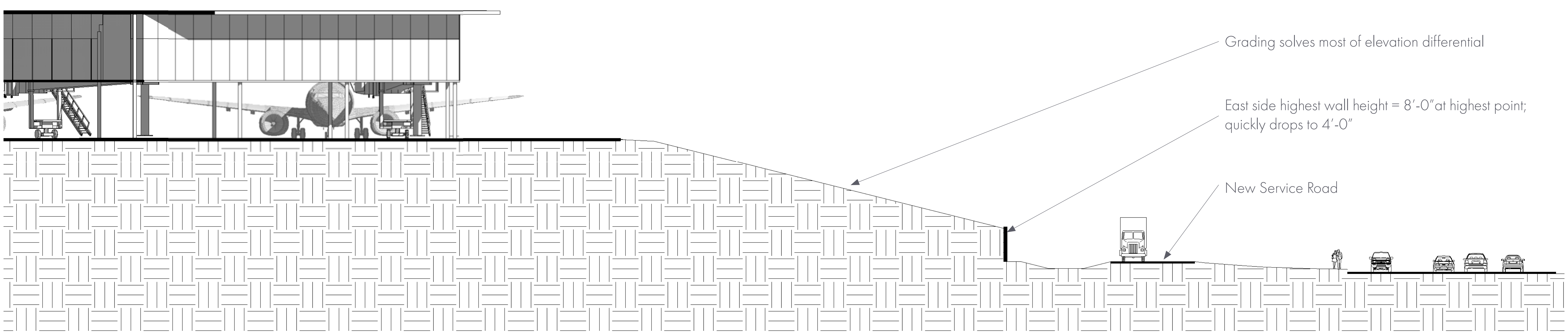
Each holdroom is connected to a passenger boarding bridge (PBB) which allows passengers to transition from the concourse to the aircraft at an accessible slope, no greater than 8.33%. The rotunda is anchored near the concourse façade and pivots from that point to reach the appropriate sill height for multiple types of aircraft. The PBB's include three telescoping sections that retract slightly when the aircraft pushes back from the gate.

Figure 5.43 - Retaining Wall Options

Baseline Option Wall

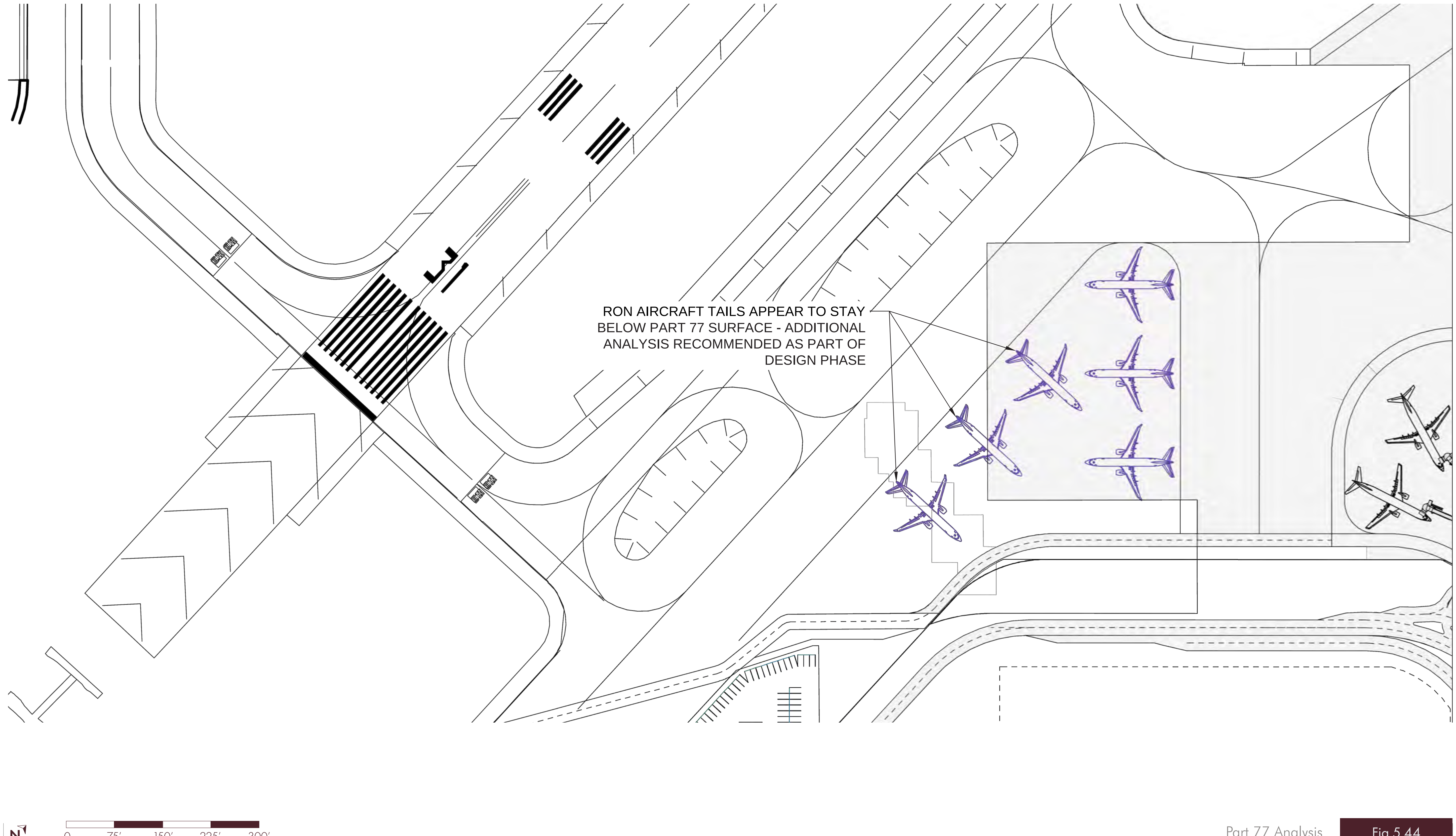


Alternate Option Wall



0 30' 60' N

Figure 5.44 - Part 77 Analysis



Chapter 6

Program
Concept
Design
Criteria

6.0 Program Concept Design Criteria

This chapter summarizes the design criteria that the selected design firm should take into consideration as the program moves forward through design and construction. Sections of this chapter address the architectural vision for the terminal, governing codes and standards that need to be met during design, incorporation of an Art Program into the final design, wayfinding for the new terminal, and suggestions regarding Best Practices and Sustainability. Key factors the design firm should focus on while completing the final design include:

- Function
- Aesthetics
- Intuitiveness
- Affordability
- Future Expansion Capability
- Flexibility
- Maintainability

6.1 Architectural

The Des Moines International Airport has the unique opportunity of public visibility from the landside and airside of the new Terminal Building. Unique to a few airports, the airside concourse and parked aircraft will be observed from Fleur Drive, one of the primary roadways providing access to and from the Des Moines Central Business District, presenting an opportunity and the responsibility for the new Terminal Building to symbolize the vibrancy and strength of the Des Moines metropolitan area. The massing and volume of the Terminal Building is essential to the success of providing a symbolic statement to the community and visitors. The preliminary architectural rendering from Fleur Drive demonstrates one strategy to provide for these requirements.

The location of the Terminal building also offers views to the downtown skyline from the concourse. It is important that the design firm embrace this unique opportunity to enhance the travelers' experience.

Interior planning should focus on the experience of passengers and their greeters. As demonstrated in the preliminary architectural renderings, wayfinding for arriving and departing passengers should be clear and intuitive. In addition, the views from the non-secured landside to the secured airside of the terminal and aircraft beyond should be provided to enhance the experience of travelers and guests, requiring the Security Checkpoint to be conveniently located and accessible without serving as the visual focal point of users.

6.1.1 Level of Finish

A planning level list of finishes has been established for the purposes of proper cost estimation. It is the intention that the future design team will work with the Airport to determine the appropriate finish and architectural aesthetics of the building. The materials chosen shall be cost efficient and provide sufficient durability to withstand use over time. Human scaled surfaces should be impact and tamper resistant to avoid issues with maintainability. Below represents an initial list of anticipated finishes. This should be reviewed in coordination with Chapter 8 for cost estimation purposes.

Exterior

- Glazing
    - Four-sided Structurally glazed curtainwall system, thermally broken, glass composition: IGU - ¼" + 1/2" air space+ ¼" – low-e Solarban 70XL60 coated on #2
- Opaque wall assemblies - Metal wall panel system
    - Basis of design – Dri-design
- Roof
    - Metal roof system where the sloped roof plane can be seen from grade.
    - Roofs not seen from grade should a be a single ply membrane.
- Exterior Sunscreen at east façade
    - For improved daylight control, an exterior sunscreen is planned for the east façade between the terminal and the curbside pickup. This will improve the interior condition of the ticketing and baggage areas as well as reduce the damaging UV light on interior finishes. The sunscreen will minimize direct sunlight and glare into the landside portion of the terminal reducing heat gain and glare, making for a more comfortable user experience.
    - Louver size and spacing to be confirmed when design begins. Material finish not to include steel components to minimize long-term maintenance costs.

Interior

- Floor
    - Mixture of Carpet Tile and Terrazzo floor finishes at all public spaces.
        - Holdrooms shall be carpet
        - Circulation paths to be terrazzo or other similar durable material. Alternative floor finishes should be explored at the start of design that may include but not limited to polished concrete.
- Ceiling at Terminal
    - Ceiling systems through the public spaces should create a monolithic ceiling plane to emphasize the roof curvature and it's varying heights throughout the terminal. Products may include but are not limited to:
        - Acoustic perforated wood ceiling on suspension system (ie ACGI Ceiling System)
        - Metal acoustical roof / floor deck ceiling system (ie Epic Metals)
        - Acoustical ceiling tile (ACT) should be limited to back of house and office functions.
- Guardrails
    - Glass guardrails with stainless steel brackets and 1 ¼" OD stainless steel handrails.
- Interior Storefront
    - System for interior storefront to match aesthetic and finish of exterior glazing system

6.1.2 Architectural Intent

This section offers the preliminary architectural renderings used in planning and layout of the new terminal. It was important to develop renderings to identify how functional areas inside and outside the terminal building would operate and to demonstrate the level of finish for detailed cost estimation at the planning level.

Figure 6.1 through **Figure 6.4** demonstrate the vision for the symbolic importance of the Terminal Building from Fleur Drive, and the transparency and welcoming characteristics of the landside approach. The interior renderings demonstrate the importance of transparency from the meeter/greeter area to the secure airside and the light filled volume of the gates and holdroom areas.

Detailed phasing diagrams can be found in Chapter 7 that depict the level of detail required from existing conditions to final completion. This will be helpful due to the complexity of building the terminal north of the existing terminal in several phases while continuing to operate flights out of the existing facility during construction. The existing terminal processor will remain a prominent mass on the site during and after the new terminal's construction until its point of demolition.

Figure 6.1 - Exterior Rendering - View from Fleur Drive

Fig 6.1 Fleur Drive

Figure 6.2 - Exterior Rendering - Landside

Figure 6.3 - Interior Rendering - Landside Meeter/Greeter

Fig 6.3 Interior Through Bridge

Figure 6.4 - Interior Rendering - Concourse

Interior Exiting SSCP

6.1.3 Art Program

Integrated/permanent art works are generally large scale and are installed as part of the architecture or landscape, with the intent of being permanent and lasting the life of the architecture. Alternatively, artwork can be of a smaller scale and distributed throughout the airport at key passenger locations and intersections.

Requirements for public art and organizations assisting with arts programs have changed in recent years. The Iowa Art in State Buildings program was repealed by the Iowa legislature effective July 1, 2017. The Metro Arts Alliance of Greater Des Moines, a decades-old nonprofit and past partner with the airport that funded central Iowa artists and arts education, has shut down its operation as of August 2017.

The DSM International Airport has noted the importance of art in the new terminal. They will work with the design architect to determine suitable locations for large and/or small permanent installations as well as requirements for their design. Budget and scope will need to be confirmed at the start of design.

6.1.4 Wayfinding

Airports can be complex and difficult spaces to navigate. Numerous factors affect public perception and levels of customer service with the associated airport. As the airport continues to evolve, it is important that its wayfnding and signage systems be designed to accommodate changes in a holistic manner. It must be understood that regardless of an individual facility's demarcation, wayfnding pathways extend to and from the surrounding roadways, parking, curbsides, terminals, and concourse areas. Facility architecture, services, functions, and amenities, as well as vertical and horizontal routes, must always be carefully considered and viewed as part of the airport's interconnected and overall wayfnding system. A solid understanding of graphic/visual cues and human behavioral responses to wayfnding processes is paramount, and the established wayfnding system must also function seamlessly, within the built environment, without user hesitation or confusion, regardless of which area of the airport is being navigated.

It is important for wayfinding signs and graphics adhere to a basic guideline of copy styles/sizes, maintain consistent terminology, use recognizable and universally accepted symbols, incorporate uniform color systems, and utilize consistent recognizable sign types. Note that industry standard wayfnding and signage factors are also covered in additional detail within the following documents:

- Guidelines for Airport Signing and Graphics, Terminal and Landside
- ACRP Report 52, Wayfnding and Signing Guidelines for Airport Terminals and Landside
- Americans with Disabilities Act, 2010 ADA Standards for Accessible Design, Latest Revisions
- Manual on Uniform Traffic Devices (MUTCD), Latest Edition/Revision

The following are general descriptions of the evaluation criteria used for analyzing the a wayfnding program:

Signage Philosophy
Establish an integrated framework that would produce one comprehensive, holistic, and aesthetically attractive signage system that can be easily identified, understood, and followed.

Standard Terminology
Experience the same terms and sign types from one facility/area to the next, which will assist in rapid public comprehension of various airport functions/destinations. Message content must be in layman's language, equally understandable by first-time and frequent travelers.

Message and Sign Type Hierarchy
Clear and concise information presented by primary, secondary, and tertiary sets of messages greatly improves efficient passenger flow. Utilizing a system of consistent sign types organized by and placed within the environment, based on message priority, also contributes to increased wayfnding efficiency.

Color Coding
Colors have great effect on human behavior and deciphering of wayfinding information. Thoughtful consideration and consistent, disciplined implementation should always be utilized when using a color within a wayfnding sign system.

Symbols
The use of short verbal messages in combination with symbols is typically more effective than the use of messages or symbols alone. The use of consistent graphic representations and sizing of symbols and arrows maintains system cohesion and rapid information deciphering. Limiting the number of arrows at a given decision point also greatly improves information processing and passenger flow.

Scale of Copy
In a fast paced, often congested environment such as an airport, a conservative distance of 25 feet of viewing distance to each inch of capital letter height should be used for pedestrian copy.

Sign Placement
Placement of signs at key decision points and in the direct line-of-sight of the traveling public reduces decision times. A reasonable range of 75 to 125 feet between major directional overhead signs is acceptable and meets the general intent of ADA guidelines using 3 inch to 4 inch high capital letters. Placing signs at regular intervals within longer contained corridors reinforces wayfnding information and also improves traffic flow.

6.2 Governing Codes and Standards

The project will require that the new structure adhere to all current codes and standards applicable to this type of building. The sources of the applicable codes and standards are spread among several national, state, and local jurisdictions with each having some involvement in the design and construction of the Des Moines International Airport. While all applicable codes, guidelines, standards, and governing authorities may not be listed in this subsection, it is the responsibility of the design architect/engineer of record to address all applicable codes, standards, and guidelines set forth by governing authorities with jurisdiction over the project. Industry standards were not listed individually, but information can be accessed through the following industry websites.

The following are a list of aviation industry affiliations that have standards that must be adhered to in the program design.

- Airports Council International-North America: www.aci-na.org
- American Association of Airport Executives: www.aaae.org
- Airport Consultants Council: www.acconline.org
- Transportation Research Board - Airport Cooperative Research Program: www.trb.org/ACRP

Following is a list of governing authorities, and applicable codes and standards. Design team to confirm updated codes at start of design.

- The City of Des Moines
- U.S. Environmental Protection Agency
- American Society of Heating, Refrigerating and Air Conditioning Engineers
- Federal Aviation Administration

- Transportation Security Administration Checkpoint Design Guidelines (CDG)

Governing Codes, City of Des Moines
- International Building Code, 2015
- International Existing Building Code, 2015
- International Mechanical Code, 2015
- National Electrical Code, 2014
- International Fire Code, 2015
- International Fuel Gas Code, 2015
- Uniform Plumbing Code, 2015 (The City of Des Moines is also obligated to enforce the Iowa State Plumbing Code)
- ACCESSIBILITY - DIVISION 7 of the IOWA STATE BUILDING CODE, IOWA STATE ACCESSIBILITY CODE, 2015 IBC and ANSI A117.1-2009 EDITION
- Accessibility –
    - 2010 ADA Standards – US Department of Justice
    - Division 7 of the Iowa State Building Code,
    - International Building Code, 2015
    - ANSI A117.1 – 2009 Edition
- International Energy Conservation Code, Iowa State Energy Code, 2015

6.3 Best Practices/Sustainability

Sustainable designs establish a balance between social, economical and environmental factors – between people, prosperity and the planet. Within the triple bottom line cycle, the benefits propagate naturally into other areas. For example, a company or community's commitment to environmental stewardship calls for built environments with strong connections to the outdoors, abundant natural daylight, cleaner air and lessened dependency on energy sources and supplied water. In turn, people who interact with such facilities are healthier and feel a greater connection to their environment. As a result, these companies and communities benefit from a healthier workforce, greater productivity, lower utility costs and a satisfying environment that propagates continued and increased steward-ship of human and natural resources.

In general terms, sustainable design can be defined as meeting the needs of today without compromising the ability of future generations to meet their needs. Below is general framework on approaching a sustainable project:

Order of Operations For Sustainable Design
Similar to the mathematical idea of Order of Operations, sustainable design has its own order of operations to be effective. Without this order of operations, the cost of implementing the strategies increases and the effectiveness of the strategies decreases.

Understand Climate and Place
Understand temperature, humidity, diurnal temperature swings, precipitation amounts and distribution, snowfall, wind speed and direction, air quality, landscape features, vegetation, surrounding obstructions, etc.

Reduce Loads
Analyze what loads or system requirements there are in the design and seek to systematically reduce them or accurately define them rather than inflate them.

Use Free Energy
Look to use free sources of energy to further minimize loads and dependence on mechanical systems such as using the sun for heat and natural ventilation to cool where appropriate.

Use the Most Efficient Technology Possible
Look to mechanical or technological solutions and specify the most efficient and elegant solution possible. A number of tools are used to measure success in achieving sustainability in projects. Among them are the LEED rating system, Well Building Standard and the Living Building Challenge.

Building Form and Envelope
Integral with the siting of a building is the application of either active or passive solar design concepts. Active solar collection captures "free" energy through the use of a solar collector, converting the sun's energy into either electricity or heat for use elsewhere in the building. Passive solar design captures the heat of the sun through windows, allowing direct solar radiation into the building envelope during the winter and shading the building in the summer.

Within the proposed building's envelope, or "skin," higher levels of insulation than are currently fashionable are recommended to increasing R-values and energy efficiency. Similarly, recent innovations in glazing technologies allows the designer to "tune" the performance of the building envelope by using different types of glass on different facades, determined according to solar orientation. Glass strategies effect energy use by providing a wide range of choices in shading coefficients and u-values either to encourage or discourage the admission of solar energy into the building.

Life Cycle Costing
Life cycle costing and "value" analysis are key elements in the design process. Evaluating alternative design schemes, material selections, systems and equipment throughout the design process begins with big picture items – basic building materials, key systems, etc. and with each design stage proceed to fine-tune earlier decisions. First cost - or construction cost - is usually foremost in everyone's mind, especially during the design process as capital costs are fixed. However, this first cost represents just a small portion of the amount that will ultimately be invested and expended over the life of the facility. Understanding this will include a thorough understanding of the life cycle impact. Ultimately, the decisions will be made in conjunction with the client to best suit their short term and long-term needs. The criteria to consider when evaluating options and alternatives are: capital cost, life expectancy, maintenance cost, energy and operating cost, direct or passive load upon other building systems, and the user health and productivity cost/benefit. The last criteria in particular, considers the impact of the environment on the health and well-being of its occupants.

6.4 Environmental

LEED (Leadership in Energy and Environmental Design)

The U.S. Green Building Council's LEED® (Leadership in Energy and Environmental Design) Rating System is a method of documenting a building's performance in five key areas that impact humans and the environment: sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality.

The Airport has determined that LEED certification is not desired. However, the design of the new terminal shall still utilize the same sustainable principles in regards to LEED without the documentation required.
Although a building may not be certified under the LEED rating system, the new terminal can utilize the following credits as a guideline to developing the design:

- Community Connectivity
    - Provide location on site for public transportation (see DART's current bus stop locations and how they may need to be adjusted for the new terminal)
- Alternative Transportation
    - Provide spaces designated for low-emitting vehicles and electric car charging stations
- Protect and Restore Habitat
    - Plant native landscape species where areas are converted back to vegetation
- Stormwater Quality Control
- Stormwater Quantity Control
- Heat Island Effect
    - Both at the roof level and at ground level
- Light Pollution Reduction
- Water Use Reduction
    - Utilize low-flow plumbing fixtures
    - Strategize site plant species to minimize irrigation
- Enhanced Commissioning
    - Commissioning building systems during design, construction and after will ensure the designed system is functioning as efficient as possible
- Implementing a recycling system that allows for the option to recycle at all trash locations
- Recycled Materials
- Regionally sourced materials
- Utilize low-emitting construction materials to improve the indoor environmental quality
- Controllably of systems
    - Provide occupant controls at back of house functions for thermal comfort and lighting
- Daylight and views
    - Maximize daylight to public and private spaces

The preliminary environmental statement is provided in the Appendix E. The Airport will commence the Environmental Assessment in 2018 that will further define the environmental impacts of this program.

Chapter 7 | Phasing

7.0 Phasing

The new terminal program phasing revolves around a few key objectives as listed below:

- Retain 10 contact gates and 9 Remain Overnight (RON) positions throughout construction
- Construct the new terminal building as one construction project to open with 10 gates
- Minimize the construction impact to the airport and its passengers

Most of the phasing is sequential, depending on a previous phase to reach completion before the next can occur, and several of the major milestones, including the garage construction, new terminal construction, and demolition portions of the existing terminal depend on funding. Construction durations have been estimated with associated years however this document will reference their sequential order only. Refer to **Table 7.1** for an overview of the project phasing.

The following sections summarize the phasing sequencing as an overview (Section 7.1) and in more detail (Section 7.2).

7.1 Phasing Overview

The Airport has identified several airside projects involving taxiways and runways that are planned to occur within the next five years and outside of the limits of the New Terminal Program. These include the reconstruction of Runway 5/23 and Taxiway Bravo, new pavement at the South GA Apron, reconstruction of Taxiway Papa, a Runway 5 temporary extension and the reconstruction of the Runway 5/23 & 13/31 Intersection. These projects are not included in the phasing sequence associated with this document, but must take place before other airside pavement construction can commence. Projects on the landside can proceed regardless of the airside projects and may start whenever funding becomes available.

The first project slated for the landside is relocation of the rental car facility to the South Quadrant, adjacent to the Rental Car Quick Turn-around Facility (QTA.) This will open 176 covered spaces and 260 surface spaces in the East Quadrant for use as general parking. In addition, it will remove the rental car traffic (rented ready and return cars and jockey cars to/from the QTA) from the roadway loop which helps to extend the life of the existing terminal.
Next, the new Cowles Drive entry across from Highview Drive will be constructed, creating a one-way traffic loop. The current Cowles Drive entry near Porter Avenue will be demolished to make way for the future roadway loop. Anew exit plaza will be erected, creating a safer merge onto the roadway loop, followed by a new entry plaza east of Duck Pond Road. Before the new roadway loop can be extended, the General Aviation facilities, associated apron pavement and employee parking lot must be relocated. A temporary roadway will connect the NE Service road to the loading dock, clearing the site for the roadway loop to extend around the future garage area.

The first apron pavement package includes most of the new terminal apron and will function as RON parking and terminal construction lay-down space when it is completed. The current terminal apron slopes significantly down from south to north and the existing concourse makes up for the grade change with ramps. The new pavement requires raising the grade on the north end several feet higher than the existing apron. Some of the new apron packages will include temporary retaining walls to divide the new higher pavement from the lower existing pavement. The second apron pavement package includes the first deice pad west of the existing concourses and replacement pavement for an area southeast of Concourse A. The third apron package on the east side of Concourse C will provide the remainder of the lay-down space for the terminal construction. When it is completed, Gate C-6 can temporarily reopen, with the aircraft parking position on the higher new apron pavement.
Meanwhile, a portion of the long-term lot, the existing entry plaza, hourly lot and temporary roadways will be demolished to clear the sites for the garage and terminal. Terminal and garage construction will commence around the same time. The garage construction will span approximately 2 years and terminal construction will take roughly 3 years to complete.

Table 7.1 - Phasing Sequence

Phase 1	Landside	Site preparation for new Rental Car Facility
Phase 2	Landside	Construction of new Rental Car Facility
Phase 3	Airside	Taxiway Bravo relocation & temporary transition pavement
Phase 4	Airside	Taxiway Papa-1 temporary transition pavement
Phase 5	Landside	Cowles Drive intersection work, entry road construction, site preparation for exit plaza
Phase 6	Landside	Construction of new exit plaza, demolition of existing Cowles Drive entry
Phase 7	Landside	Construction of new entry plaza & portion of roadway loop, demolition of existing entry plaza
Phase 8	Airside	Demoition of Signature, DSM Flying Services, GA Buildings and associated apron pavement
Phase 9	Landside	Construction of temporary loading dock service road
Phase 10	Landside	Demolition of portion of existing roadway loop
Phase 11	Landside	Construction of roadway loop and curb
Phase 12	Airside	Construction of Apron Packet A (north apron piece with RON parking)
Phase 13	Landside	Demolition of portion of existing roadway loop & long-term parking
Phase 14	Airside	Construction of Apron Packet B (Deice Pad 1)
Phase 15	Landside	Construction of parking access road & additional long-term parking
Phase 16	Airside	Demolition of Concourse C east pavement
Phase 17	Landside	Demolition of existing entry plaza
Phase 18	Airside / Landside	Construction of Apron Packet C (Concourse C east), Terminal & garage construction begins
Phase 19	Airside	Demolition of Concourse C north pavement
Phase 20	Landside	Construction of Pedestrian Bridge
Phase 21	Airside	Construction of Apron Packet D (Concourse C north)
Phase 22	Airside	Demolition of Concourse C west pavement
Phase 23	Airside	Construction of Apron Packet E (Concourse C west)
Phase 24	Landside	**New Garage opens**
Phase 25	Airside / Landside	**New Terminal opens**, Existing Terminal is closed
Phase 26	Landside	Demolition of Existing Terminal loading dock
Phase 27	Airside	Demolition of Concourse C
Phase 28	Landside	Construction of Ground Transportation Facility (GTF)
Phase 29	Airside	Construction of Apron Packet F (Concourse C), demolition of Concourse A and "Stem"
Phase 30	Landside	Construction of roadway loop extension
Phase 31	Airside	Construction of Apron Packet G (Concourse A & Stem)
Phase 32	Airside	Completion of VSR & airside improvements
Phase 33	Landside	Demolition of portion of existing curbfront
Phase 34	Landside	Construction of commercial lane pavement
Phase 35	Landside	Demolition of Landside Processor
Phase 36	Landside	Construction of commercial lane extension
Phase 37	Landside	Landside improvements complete
Phase 38	Airside / Landside	Future 18-gate scenario (MAP 4.0)

After Gate C-6 is reopened, the pavement on the north side of Concourse C can be demolished and replaced with the remaining deicing pavement as part of the fourth apron pavement package. Gates C-5 and C-7 will re-open, parking on the new deice pavement, and allow the pavement in front of C-1 and C-3 to be replaced during the fifth apron pavement package.
The new terminal will open with 10 gates on opening day, allowing the existing terminal to permanently close. Concourse C will be demolished first, enabling the new pavement in that area to be completed quicker, which allows the new terminal to add 3 more gates. Next, Concourse A and the "stem" containing security will be demolished. When that apron pavement is complete, the last fourteenth gate will be added.

Subsequently, the Ground Transportation Facility (GTF) that provides a loading/unloading zone for the rental car shuttle and TNC's will be constructed. After the concourse stem is demolished, the remainder of the new roadway loop can extend around the existing terminal processor and connect near the exit plaza merge lane.

When funding becomes available, the landside processor, existing curb front and associated canopies will be demolished. This will allow the merging lane for commercial vehicles to extend further south to improve safety at that intersection. The demolition will also clear a large site for future parking or other terminal functions within the roadway loop.

Ultimately, the concourse will be able to expand to 18 gates when the airport reaches a 4.0 Million Annual Passenger (MAP) level. The future RONs will shift east and take up part of the parking for Economy Lot 3 while maintaining a right of way for a future Rental Car autonomous bus route.

7.2 Phasing Sequence

The following sections describe the airport phasing in greater detail. The phasing is intended to explain the conceptual level of sequencing for terminal, garage, apron and roadway construction and should be revisited by the design and construction teams.

7.2.0 Existing

The existing east quadrant layout is represented by **Figure 7.0**. The concourses provide 12 contact gate positions with 9 RON locations dispersed between. Two additional remote RON locations are provided south of Economy Lot 3. Today, the aircraft deice at the gate, so glycol fluid is collected from a large footprint. Additionally, the FAA Runway Incursion Mitigation (RIM) program has identified Taxiway Bravo as a potential risk because aircraft navigate directly from the apron straight across Taxiway Papa to Runway 5/23, making only one turn onto the runway.

The existing concourse is restricted from future expansion by the FAR Part 77 limits set by the runways. The landside processor is seventy years old so upkeep and maintenance has become very difficult. Additionally, functions throughout the terminal are misplaced, undersized and cannot expand where necessary.

The landside infrastructure is also restricted. Today, the rental car companies are divided between 3 separate unsecure lots, meaning rental car companies cannot leave keys in the cars for quick passenger through-put and the wayfinding is difficult for customers. The rental car companies are severely restrained from growth within the roadway loop because the airport needs space for parking. One of the rental car lots is located on the first level of the south garage, which takes away valuable covered parking for passengers. The airport needs to accommodate a significant amount of additional parking spaces within the next few years but are out of room within the constraints of the current loop road. The roadway itself is also posing problems. The existing entry to Cowles Drive forces drivers to make very quick decisions, often leading to congestion. Curbside, pedestrians cross the road in dangerous locations and vehicles park on the curb, which significantly slows traffic in front of the terminal. Additionally, Duck Pond Road is two-way, which creates an unsafe intersection at the Cowles Drive Exit.

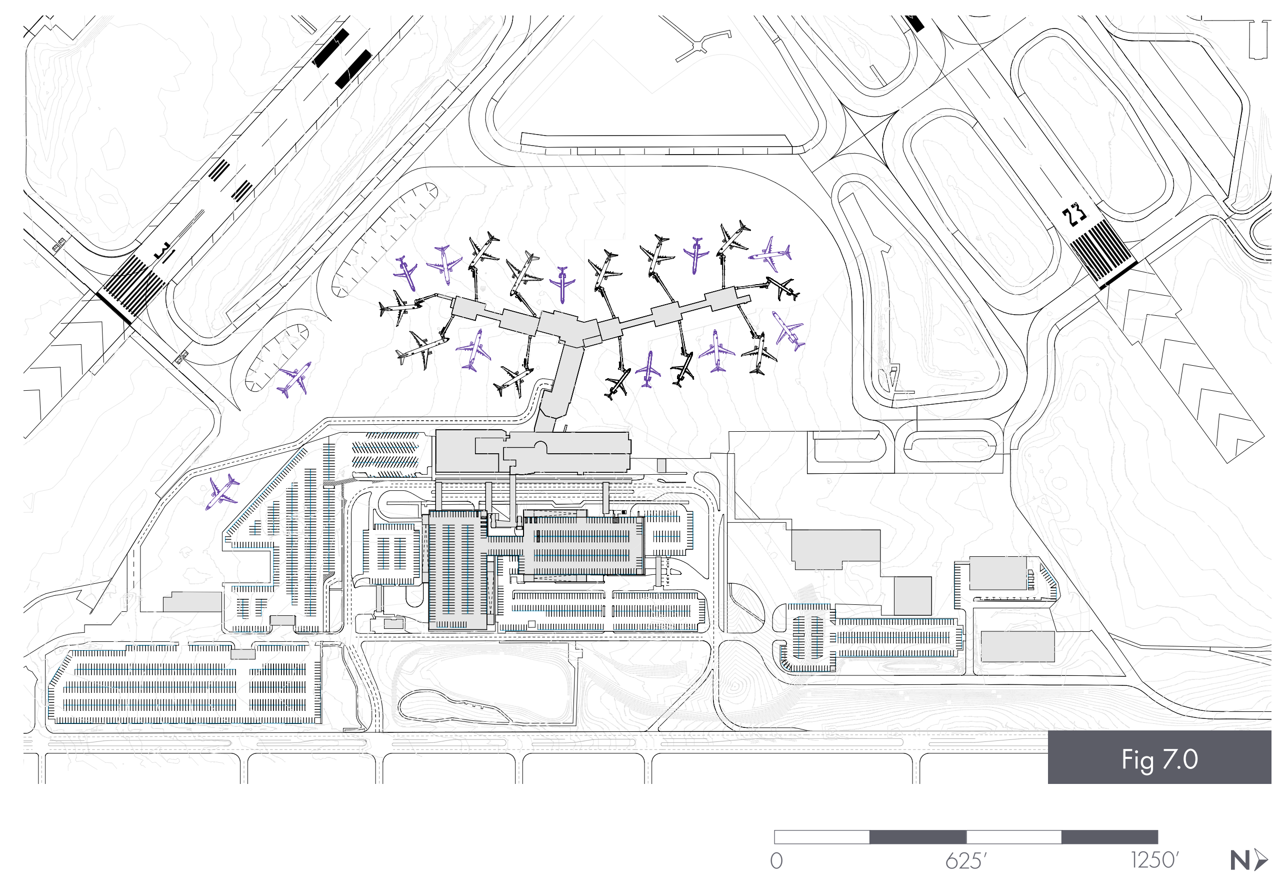


Fig 7.0

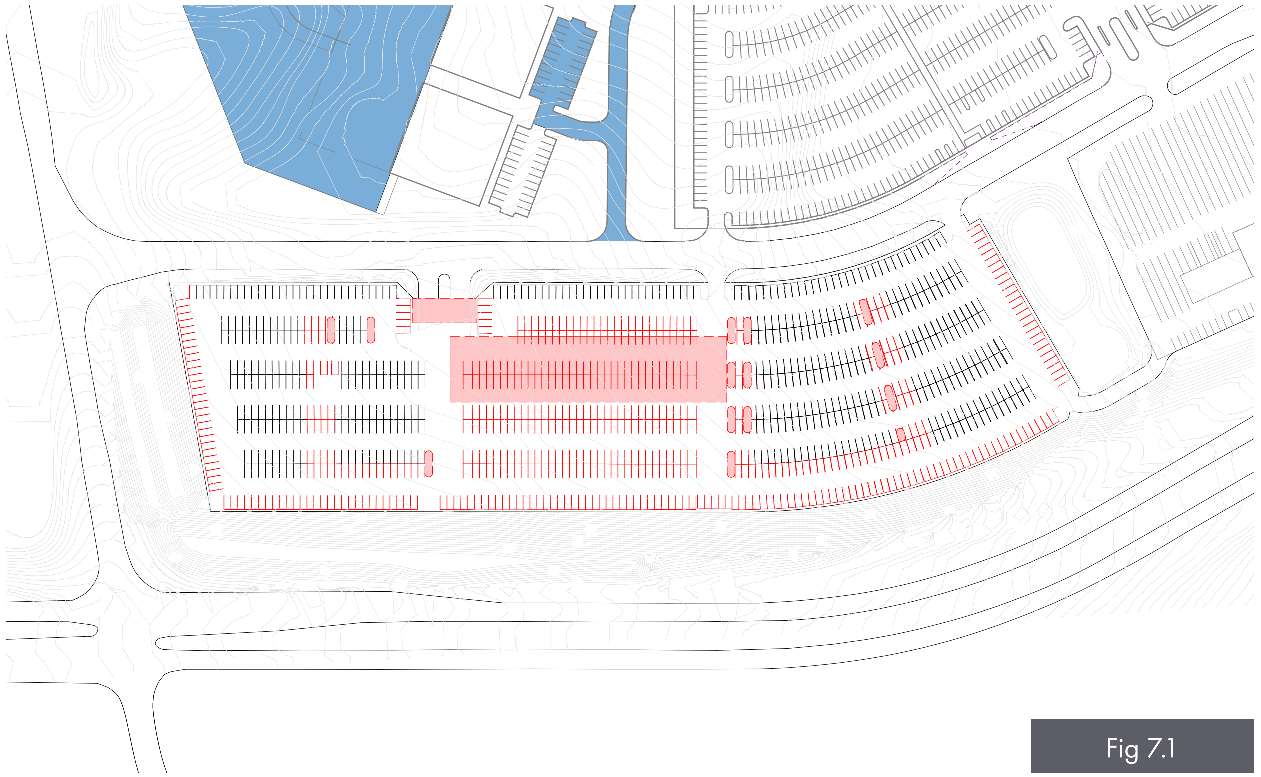


Fig 7.1

7.2.1 Phase 1 (Landside)

The first step to mitigate congestion at the landside is to relocate the rental car company parking lots. This will open 176 covered spaces on Level 1 of the south garage and 260 spaces in the current rental car lots for general parking. The new location for the rental car lobby and holding lots is existing Economy Lot #5, south of their QTA and has access from Army Post Road, as exhibited in **Figure 7.1**. This an ideal location as rental car jockeys can quickly transfer cars back and forth between facilities, the parking lot is already equipped with utilities, and the parking pavement already exists. The utilities will need to be retrofitted to accommodate a building on the site and part of the pavement will need to be demolished and regraded for the new building and its foundations. The pavement striping along the perimeter of the surface lot needs to be removed to integrate the ring road. Customers as well as jockeys will utilize this road to navigate in and out of the individual rental car lots. Additionally, striping will be removed/relocated as needed by each rental car company. The canopy with the ticket dispensers for the current economy lot will also be demolished in this phase.

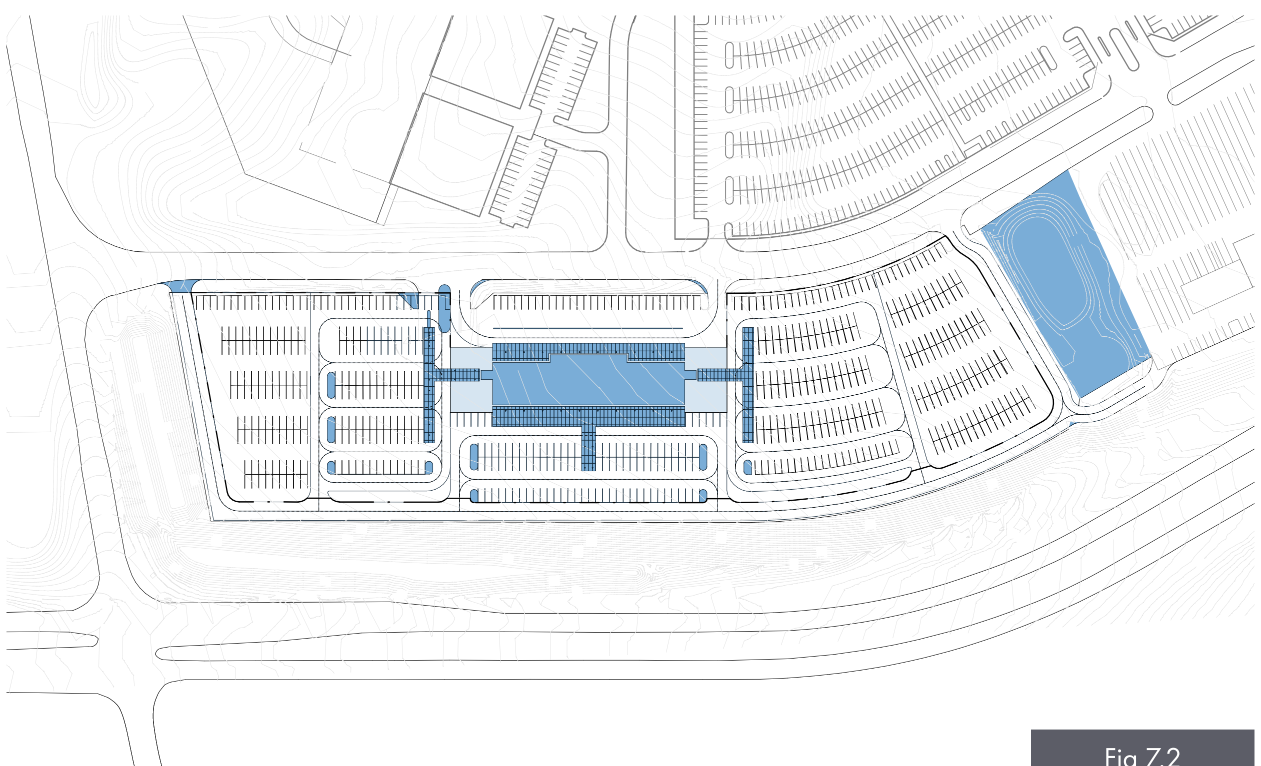


Fig 7.2

7.2.2 Phase 2 (Landside)

The new rental car building, as shown in **Figure 7.2**, will include a drop-off area for the rental car shuttle on the east side of the building and covered walkways from the building in each direction to connect customers to the individual rental car lots. Some additional pavement will be required across the site; at the entry and exit points for the rental car shuttle to accommodate the bus turning radius, at the ring-road exit, and near the QTA for future growth and over-flow parking. Relocation of the existing detention pond and regrading of the site (between Economy Lot #5 and the QTA) must be complete prior to completion of the new pavement.

7.2.3 Phase 3 (Airside)

Figure 7.3 depicts the relocation of Taxiway Bravo, which will correct the RIM issue caused by the direct connection of the terminal apron and the runway. The project will be constructed in conjunction with the reconstruction of the northeast end of Runway 5/23, which will raise the pavement 2'-6" to comply with FAA regulations. Most of the new pavement for Taxiway Bravo will be permanent, but the southwest end requires a temporary wedge to connect the new elevated pavement to the existing apron. The temporary pavement will be replaced in a later phase.

The aircraft parking positions at Concourse C will be modified in this phase to accommodate another parking position between C3 and C5A. Refer to Figure 7.3 for the current aircraft layout. The parking positions at C1, C3, C5A and C5B will rotate to be perpendicular with Concourse C. This configuration will make room for another Aircraft Design Group (ADG) III parking position, referred to in this document as C3B. The existing C3 position will be referred to as C3A.

To replace the pavement for Taxiway Bravo, Gate C7 will be temporarily shut down. The C5 jet-bridge can still be utilized, but is limited to service at C5A only. The C5B, C7A and C7B positions are not available during this phase.

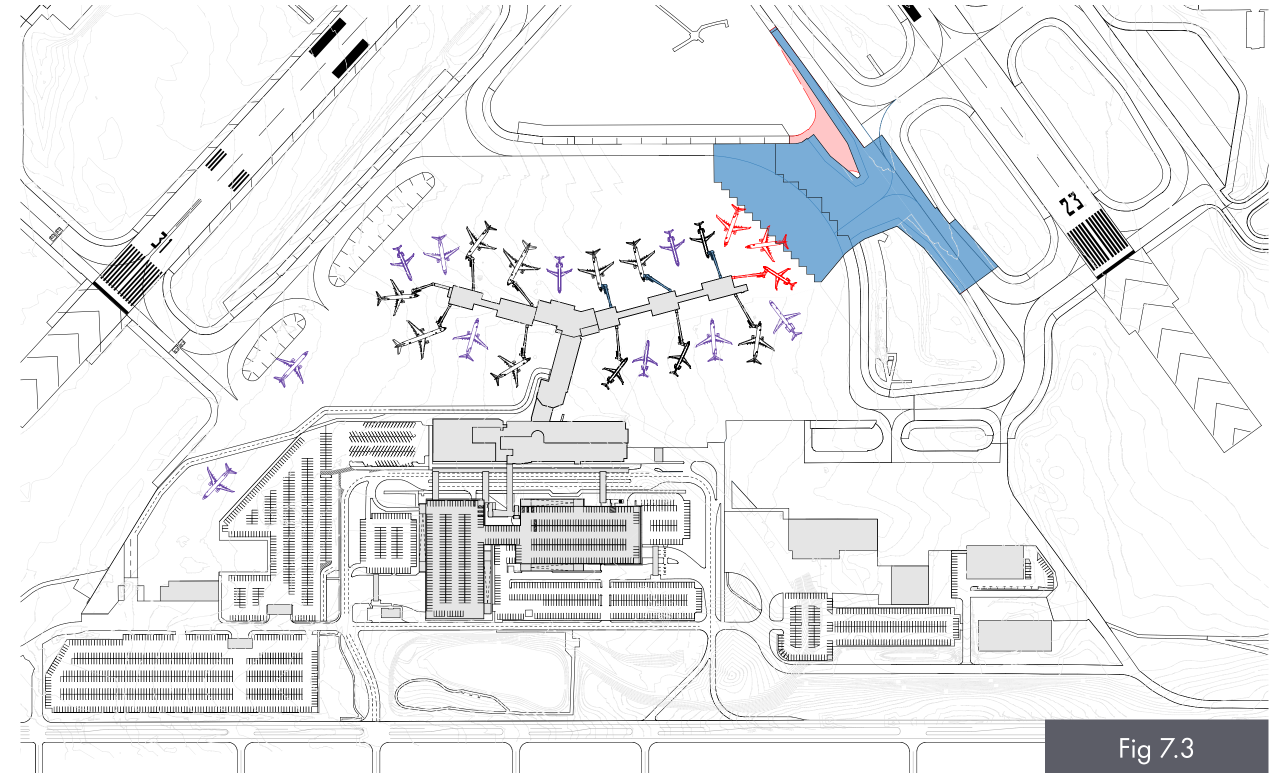


Fig 7.3

7.2.4 Phase 4 (Airside)

The elevated portion of Taxiway Bravo, Taxiway Papa and Runway 5/23 reconstructed in Phase 3 will be connected to the apron pavement by an overlay/hot-mix asphalt (HMA) transition pavement. This pavement links the end of Runway 5/23 to the northern end of Taxiway Papa, as represented in **Figure 7.4**. This overlay will be replaced during a later phase. The construction during this phase does not impact any of the aircraft parking positions at the terminal.

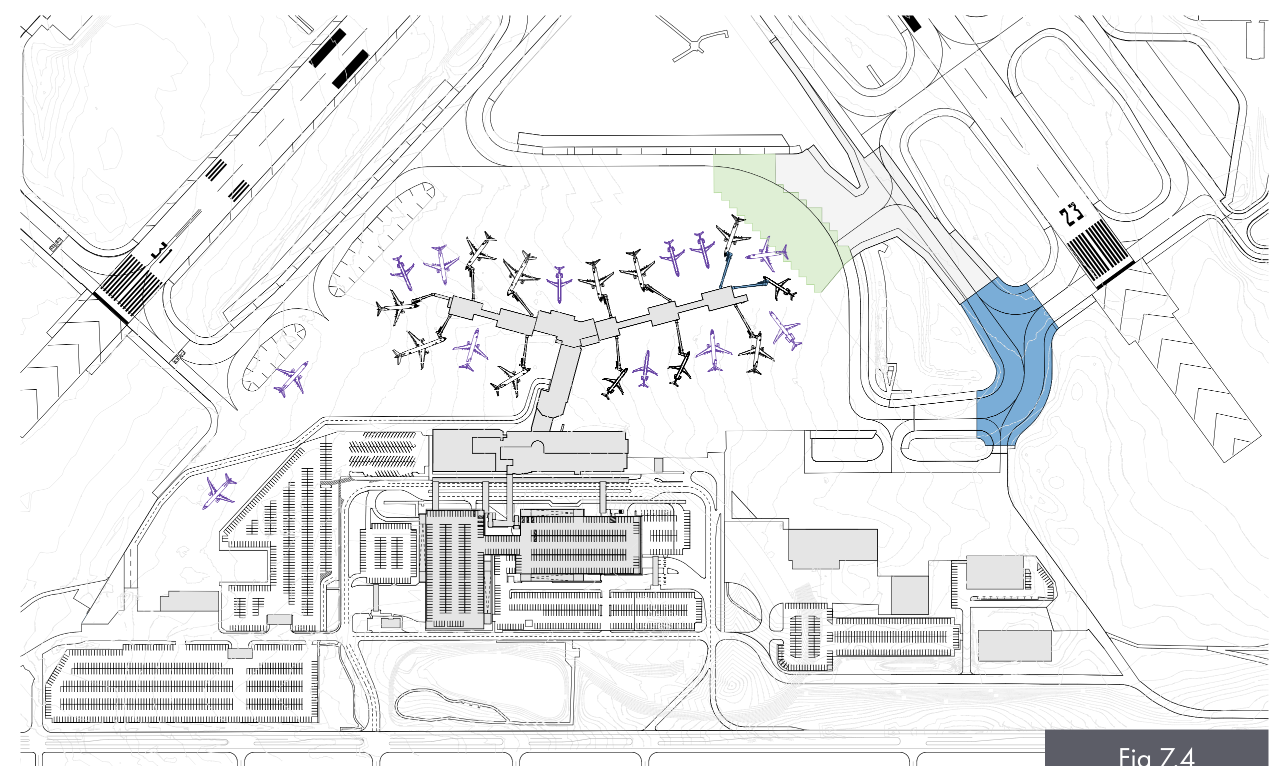


Fig 7.4

0 625' 1250' N

7.2.5 Phase 5 (Landside)

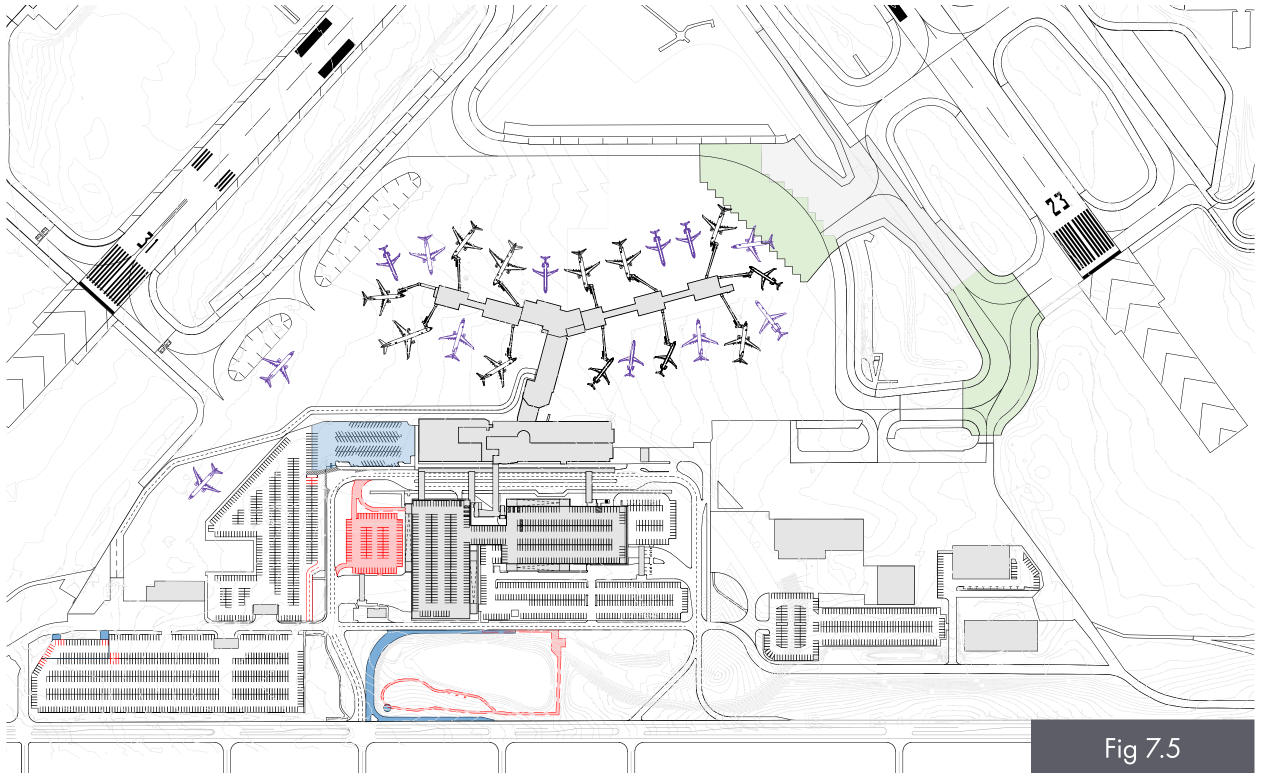


Fig 7.5

After the Rental Car facility is relocated to the south quadrant, work on the roadway loop can commence, as shown in **Figure 7.5.** The spaces in the existing rental car lots are converted to parking, which expands Economy Lot 1, creates a new opportunity for parking in the lot directly south of the terminal and opens more parking spaces on Level 1 of the south garage. The surface lot south of the garage and west of the exit plaza is demolished during this phase to clear the site for the new exit plaza.

A new airport entry road will be constructed directly north of the Cowles Drive exit, which will collect vehicles travelling from both directions on Fleur. It will provide a longer deceleration lane for southbound traffic than the current entry provides today. The Cowles/Fleur intersection will be reconfigured to allow northbound traffic on Fleur to turn left onto the new entry drive. See Section 5.5.6 and Appendix G for more detail on the intersection work and traffic study. When the new entry is constructed, Duck Pond Road will be converted from a two-way to a one-way (northbound) street which will create a safer roadway loop with longer decision points. The path around the duck pond will need to be demolished to make room for the new entry drive, and create space for a third lane on the east side of Duck Pond Road, which will help divide parking and drop-off/pick-up traffic.

7.2.6 Phase 6 (Landside)

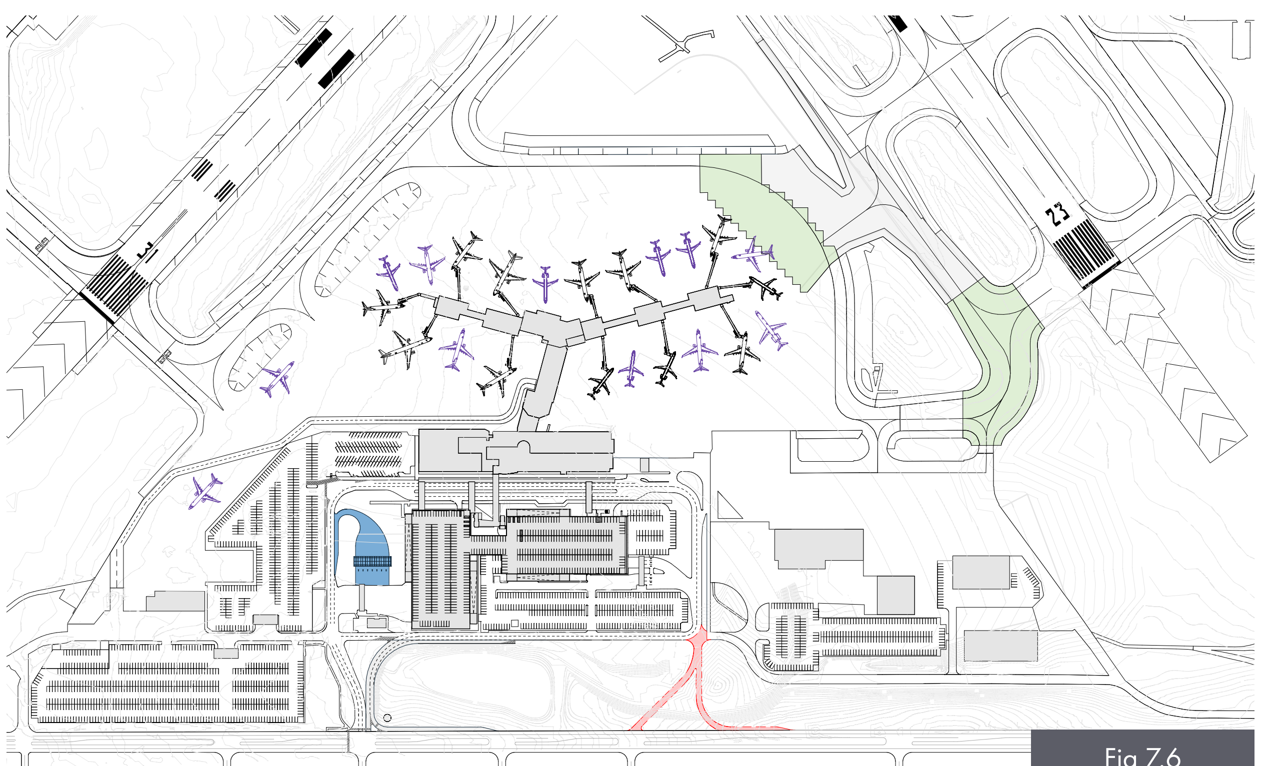


Fig 7.6

As **Figure 7.6** demonstrates, once the new entry road is completed, the existing north entry to Cowles Drive across from Porter Avenue can be demolished. This will clear a site for the construction of the new roadway loop.

Construction for the new exit plaza will also start during this phase. Once completed, the exit plaza will host 7 vehicle lanes, expanding the length and width of the current queue. After drivers have paid, they will merge into one lane, which will turn 180 degrees to meet the roadway loop. Today, drivers make a hard left from 6 lanes, which is dangerous and creates a difficult merge. The new exit plaza solves these issues.

N 0 625' 1250'

7.2.7 Phase 7 (Landside)

Figure 7.7 shows the north four lanes of the new exit plaza operating, which will allow for the demolition of the current exit plaza. The remaining three lanes will open in a later phase.

The new entry plaza and first portion of the roadway loop will be constructed to the east of Duck Pond Road. The first phase of the roadway loop will extend to near the northeast service road, but several enabling projects must take place before the next portion of the roadway can be built. The first step to clear the site is to demolish the employee parking lot and start demolition of the Signature Hangar building. Employee parking will move to Economy Lot 1, and Signature's new facility, as well as the other Corporate / GA functions will be relocated to the south quadrant.

The north portion of the hourly lot on the north side of the garages will be demolished to accommodate the new temporary road in Phase 9.

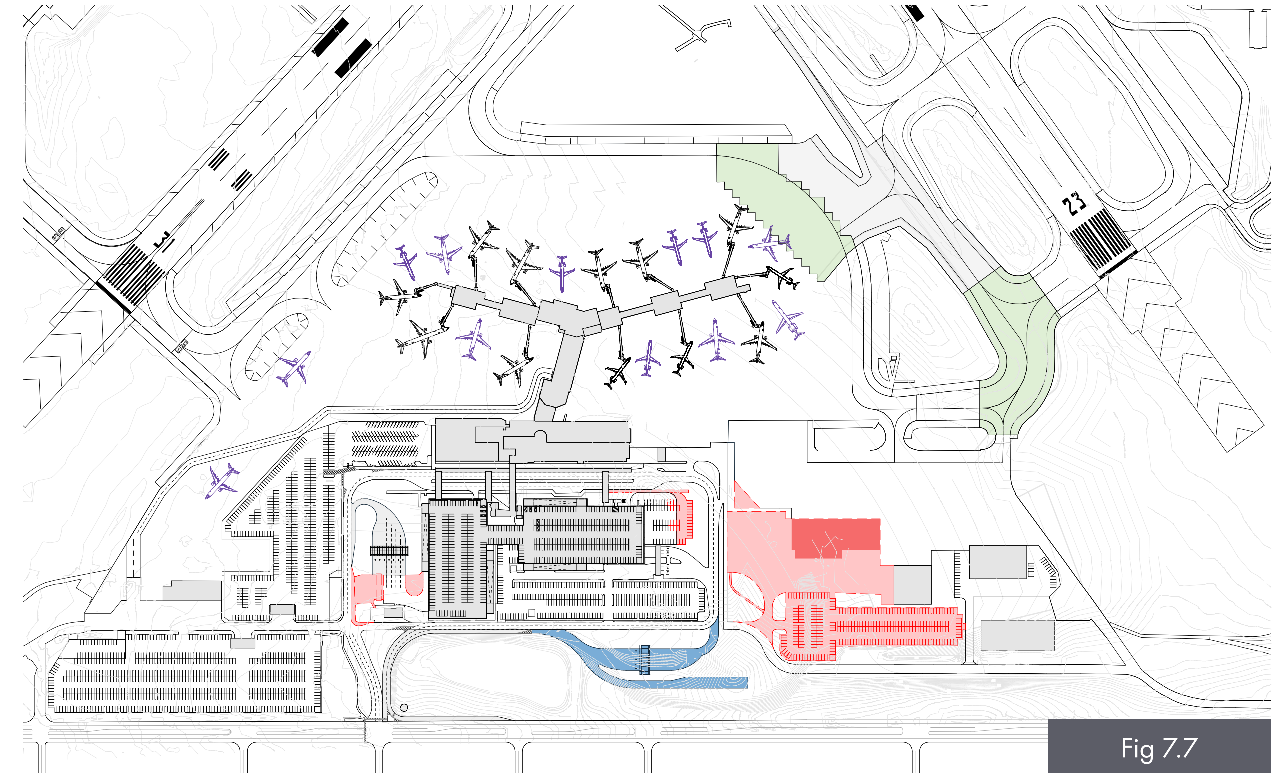


Fig 7.7

7.2.8 Phase 8 (Airside)

The Signature, DSM Flying Services and other General Aviation structures will be demolished along with a significant portion of apron pavement north of Concourse C, represented by Figure 7.8. The temporary HMA transition pavement on the north end of Taxiway Papa constructed during Phase 4 and apron pavement unneeded for aircraft movement will be removed. This area will be re-graded for the higher apron elevation for the new terminal.

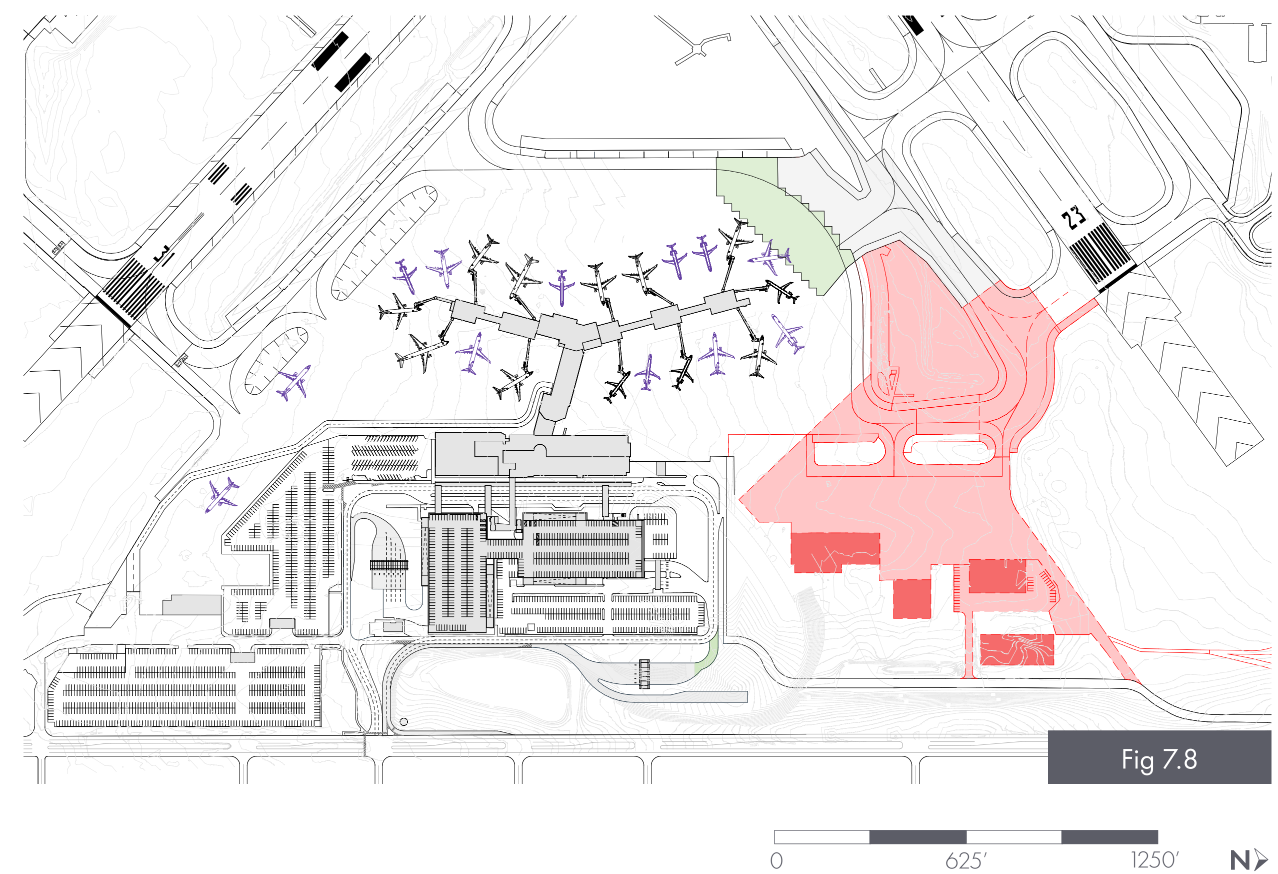


Fig 7.8

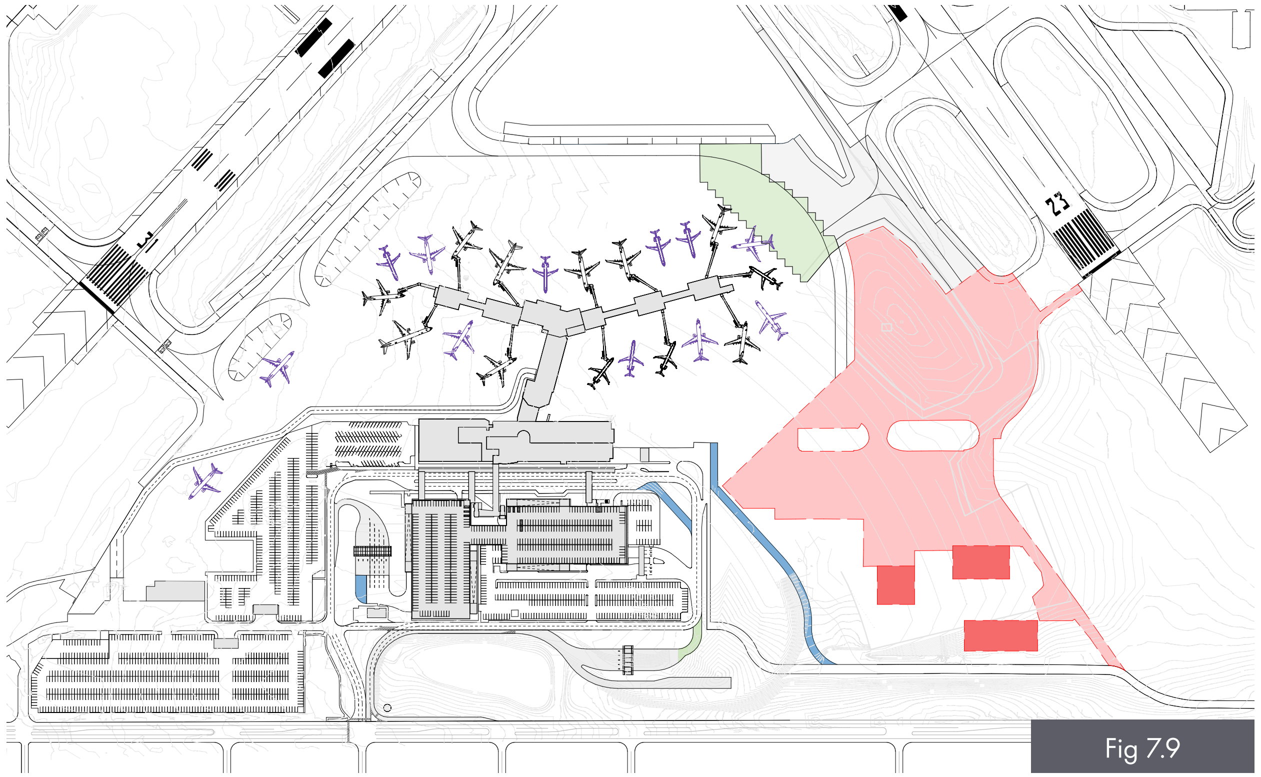


Fig 7.9

7.2.9 Phase 9 (Landside)

The next enabling projects for the roadway loop, demonstrated in **Figure 7.9**, include re-routing the service road and a portion of the existing roadway loop. The new temporary pavement for the service road will be poured alongside the elevated grading for the new curbside, which will connect the loading dock to a point further north on the existing service drive. This will eliminate truck traffic from the roadway loop temporarily. New temporary pavement will also be installed near the existing terminal curb front to re-route passenger traffic so that a portion of the existing roadway loop can be demolished.

When the existing exit plaza canopy has been removed, the final piece of pavement can be constructed for the new exit plaza, which will open the last three lanes for passenger use.

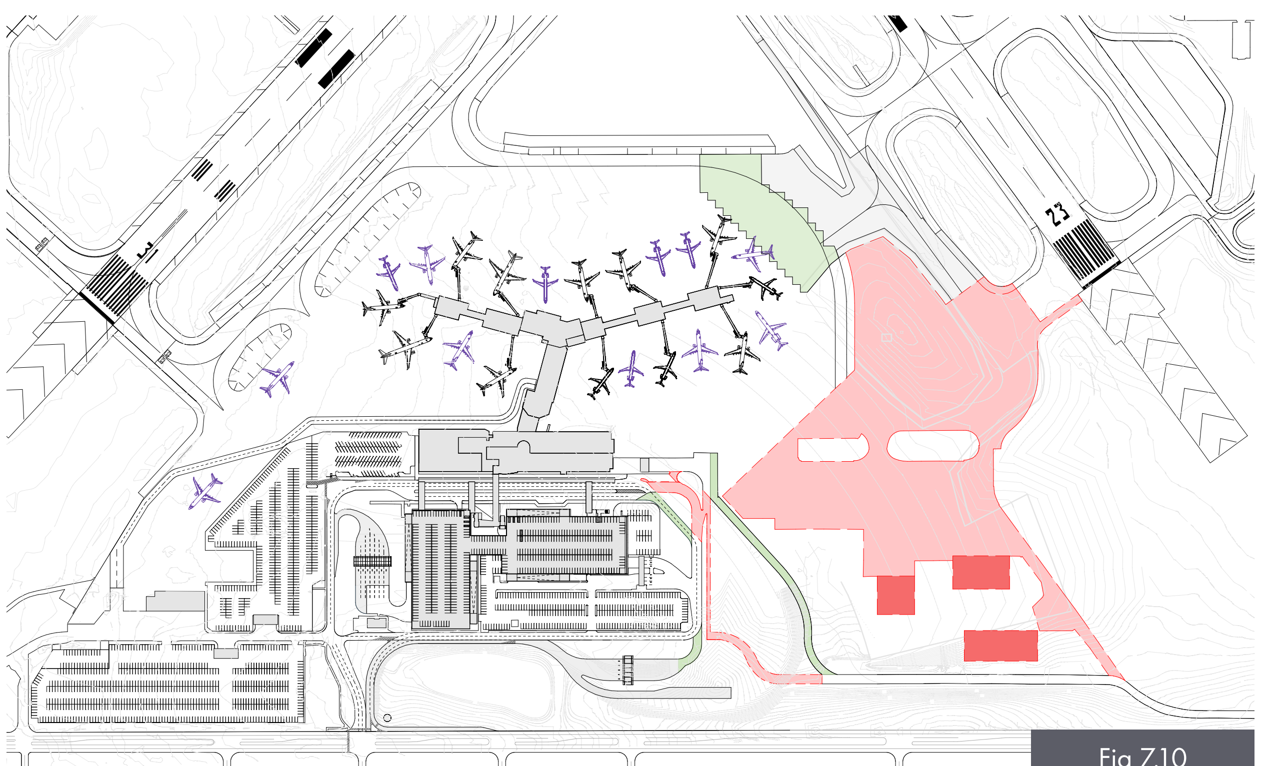


Fig 7.10

7.2.10 Phase 10 (Landside)

With the new temporary loading dock connection completed, the existing loading dock entry, exit and a north portion of Cowles Drive can be demolished, as shown in **Figure 7.10**. Passenger traffic to the existing curb will utilize the temporary pavement installed during Phase 9.

7.2.11 Phase 11 (Landside)

Figure 7.11 indicates the construction of the next phase of the new roadway loop and curb. This can take place after enabling projects demonstrated in Phase 8,9 and 10 are completed. The new roadway loop will connect back to the existing terminal curb-front until the airside concourses are demolished in Phase 29. Once opened, passenger traffic to the curbs will use this connection for several years.

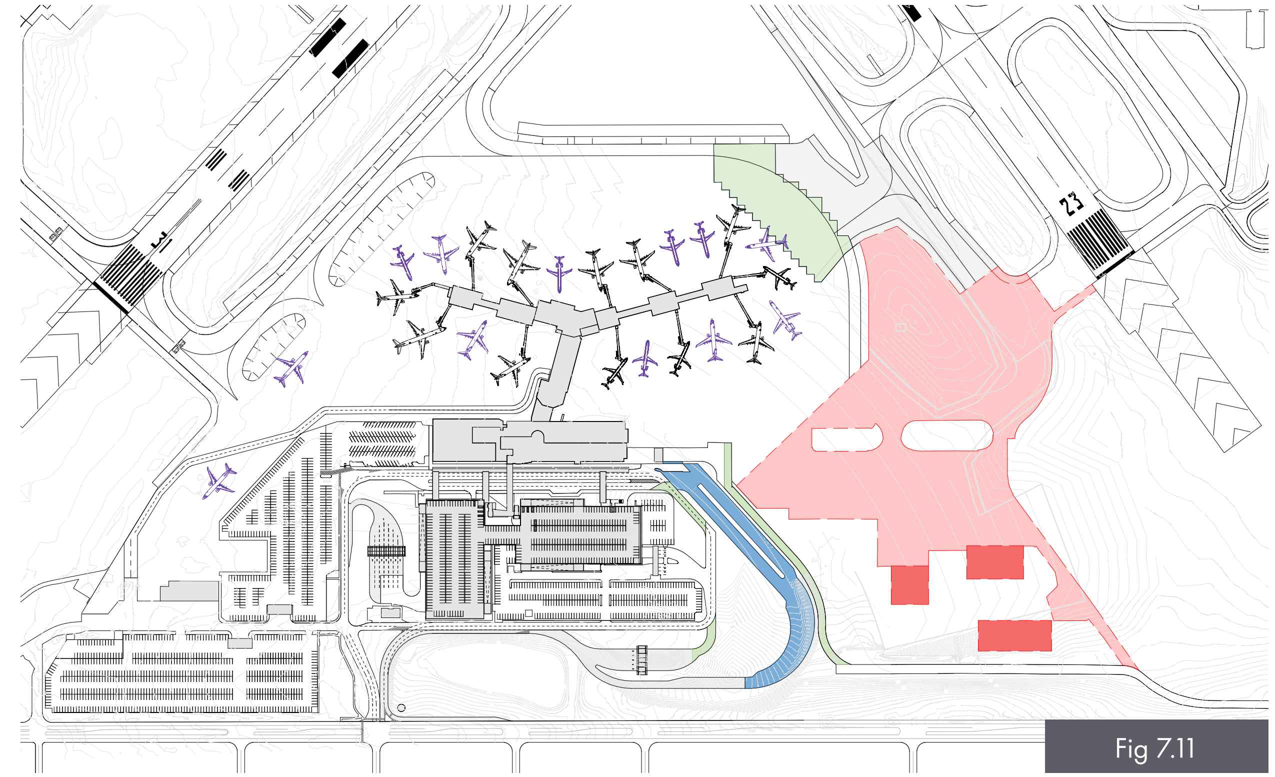


Fig 7.11

7.2.12 Phase 12 (Airside)

The current site drops significantly from south to north, which forces the existing terminal to utilize ramps on the departure and apron levels, which greatly restricts the airport's flexibility. The new apron pavement will be level across the face of the new terminal and will slope away from the building perpendicular to the new concourse. To make the new apron relatively flat, the pavement will be elevated substantially on the north end, around 20 feet higher than the existing grade. Aircraft utilizing the existing apron pavement can only access the new pavement by navigating around Taxiway Papa; they cannot directly cross onto the new pavement from the existing apron. The apron will be replaced in several phases, which will be referred to as Package A- G in this document. Each of these phases will require temporary retaining walls between the new pavement and existing pavement to make up the difference in elevation.

Figure 7.12 presents the construction of Apron Package A. This portion of pavement is the largest section that can be constructed in one phase. When it is completed, it will act as construction lay-down space for the new terminal and offer 6 RON parking positions. Retaining walls are needed around the east and south sides of this new apron pavement. On the east side, a permanent retaining wall will separate the apron from the service road, as represented in **Figure 7.40**.

Another option was considered to diminish the retaining wall height. By moving the wall closer to Fleur Drive, some of the elevation difference could be reconciled by grading, as delineated by **Figure 7.41**, which would significantly reduce the retaining wall height by around 12'. However, the estimated cost for additional fill required and realignment of the service drive slightly outweighed the estimate for the taller retaining wall. This alternative may be reconsidered in design when more factors are known.

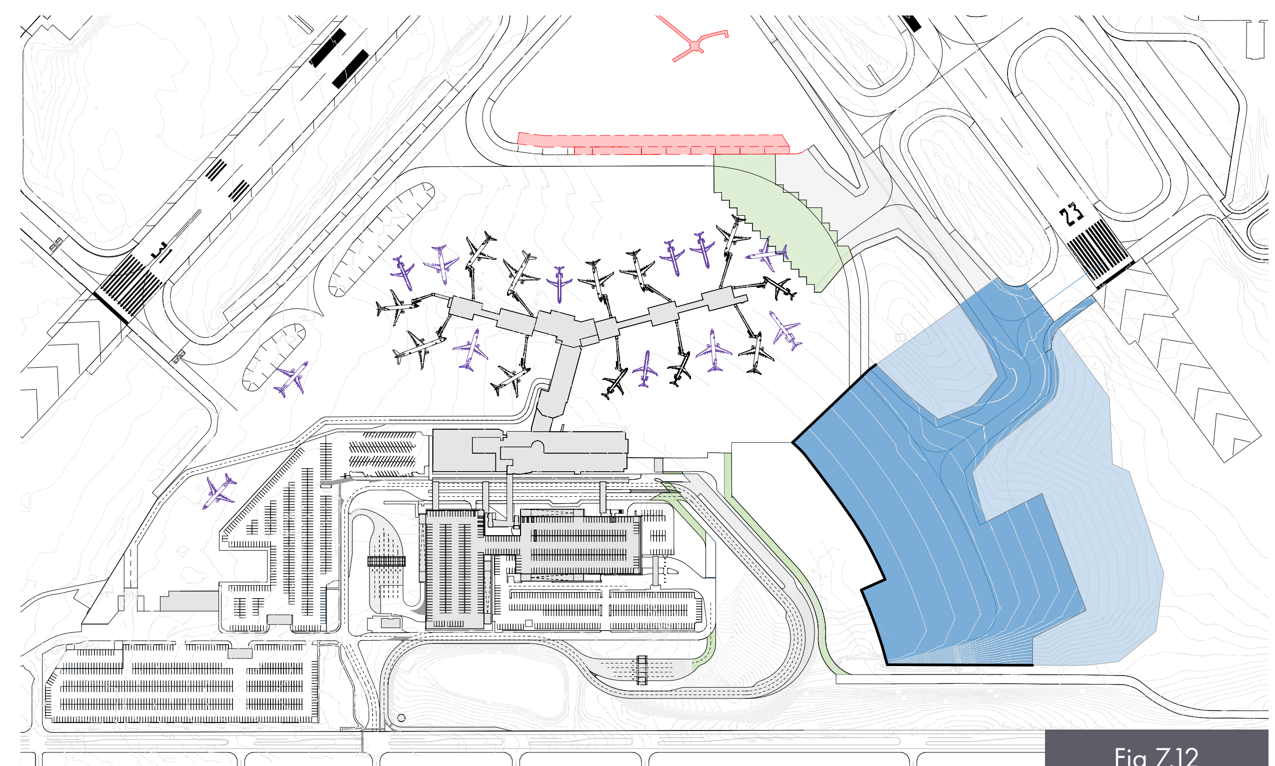


Fig 7.12

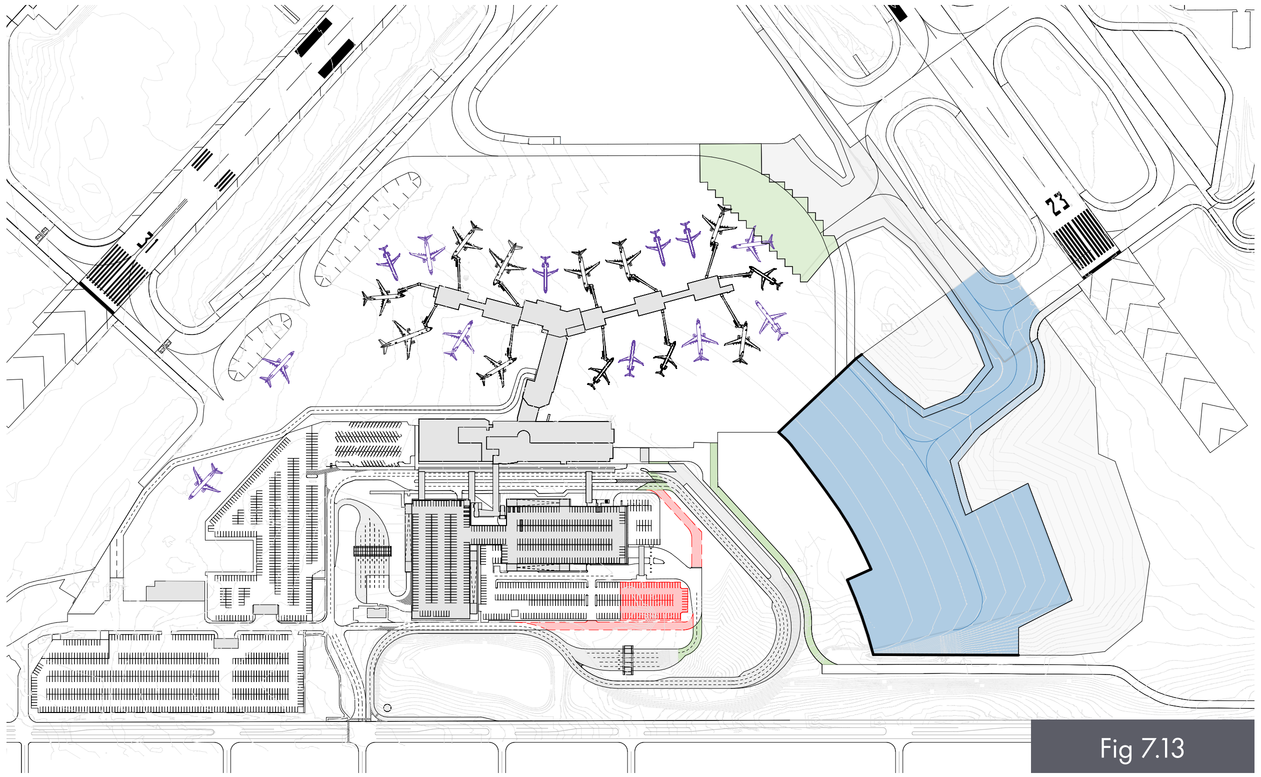


Fig 7.13

7.2.13 Phase 13 (Landside)

While Apron Package A is still under construction, work on the Landside will continue, to facilitate the new garage construction. The first enabling projects that will take place are depicted by **Figure 7.13**. After Phase 11 is completed, the passenger traffic is re-routed trough the new roadway loop connection to the existing curb, and parkers utilize the new entry plaza. This permits the removal of the temporary connector roadway constructed in Phase 9 and the demolition of a portion of Duck Pond Road. The north side of the long-term parking lot will also be removed during this phase to make way for the new garage.

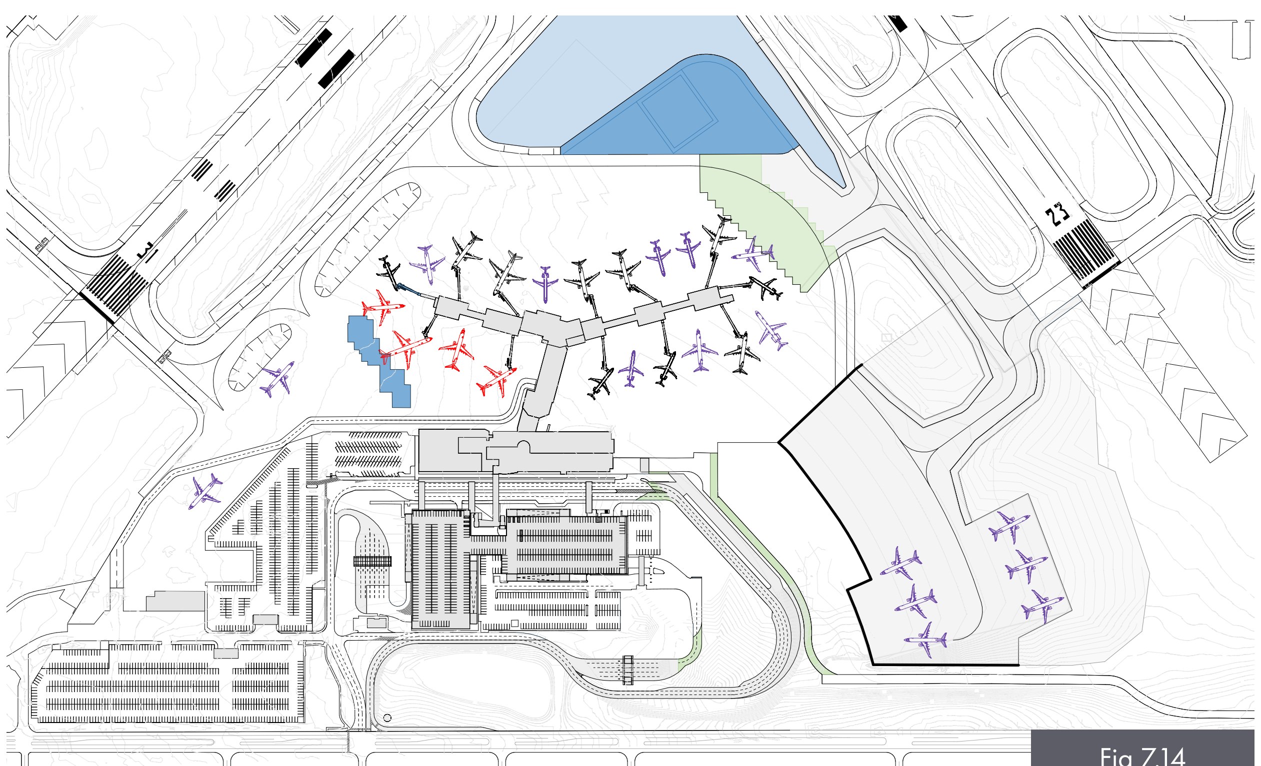


Fig 7.14

N 0 625' 1250'

7.2.14 Phase 14 (Airside)

Apron Package B includes the construction of a new deice pad south of Taxiway Bravo and the replacement of a small portion of pavement on the southeast side of Concourse A. While that pavement is being fixed, parking positions A2, A4A, A4B and A5B are unavailable, as shown in **Figure 7.14.** Gate A5 will service position A5 only.

As part of the terminal project, deicing operations will be consolidated to one area, which will reduce the amount of catchment pavement and increase the concentration of recyclable glycol fluid. Today, aircraft de-ice at their gate, which forces the airport to collect and filter glycol fluid from a larger area, which produces a watered-down glycol solution that is harder to repurpose. **Figure 7.14** exhibits the construction of the first deice pad, which will temporarily be used for RON parking when it is completed. This new pavement does not require any retaining walls.

7.2.15 Phase 15 (Landside)

Figure 7.15 depicts the next set of enabling projects to clear the site for the new garage. New pavement will be constructed to connect the parking entry plaza to the existing drive leading to the north garage ramp. It will by-pass the existing entry plaza on the south side. New surface parking will be infilled in the space between the new pavement and the entry plaza to maximize the amount of long term surface parking on the site.

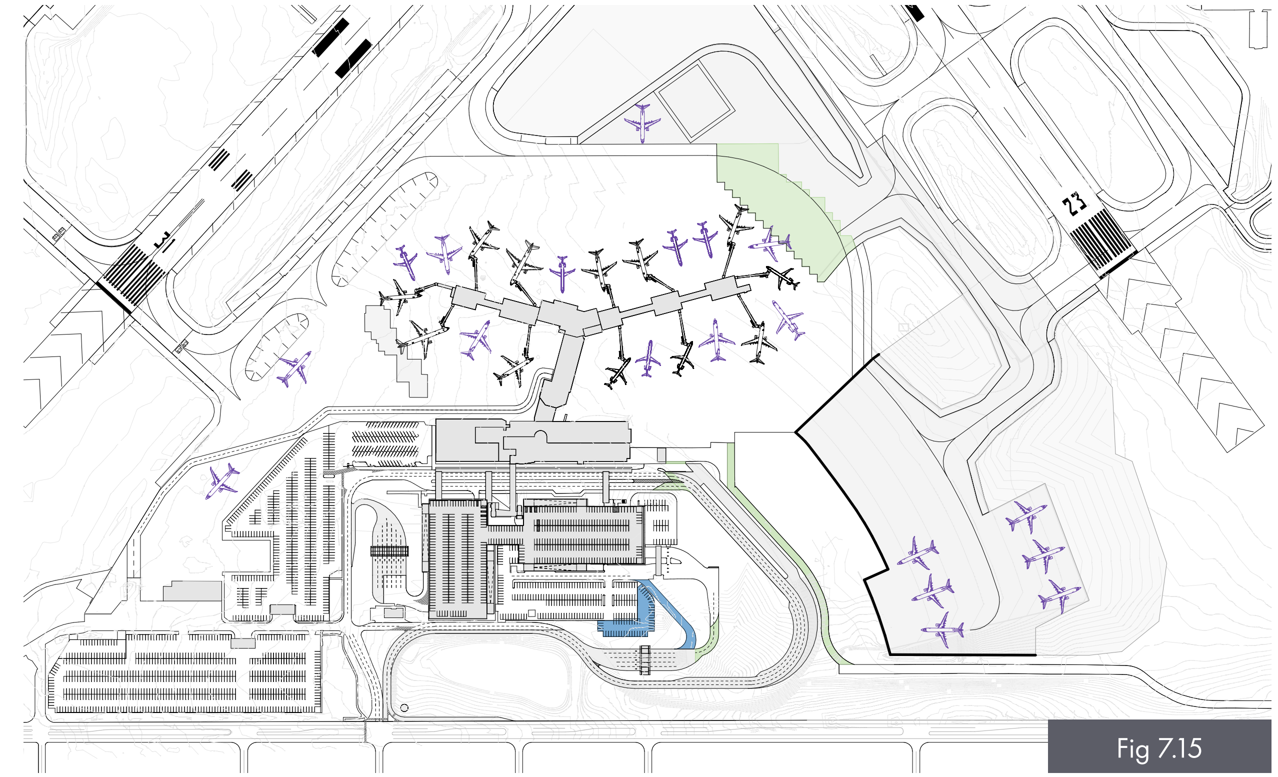


Fig 7.15

7.2.16 Phase 16 (Airside)

When the east A-Gates are re-opened, site preparation can begin for Apron Package C, which will replace the pavement on the northeast side of the C concourse, referred to in **Figure 7.16.** During demolition and construction, Gates C2, C4, and C6 and their associated parking positions will not be available. Gates C2 and C4 will be permanently closed and their jet bridges can be removed. Gate C6 (Position C6A) will reopen after the completion of Apron Packet C. Throughout this phase, Position C7B needs to be rotated so it can adequately pull in and push out of the parking position. It can only be used for RON parking because the jet bridge cannot reach the port side.
During demolition, a portion of the existing apron pavement near the processor will be retained for temporary use as a turn-around area for trucks using the loading dock.

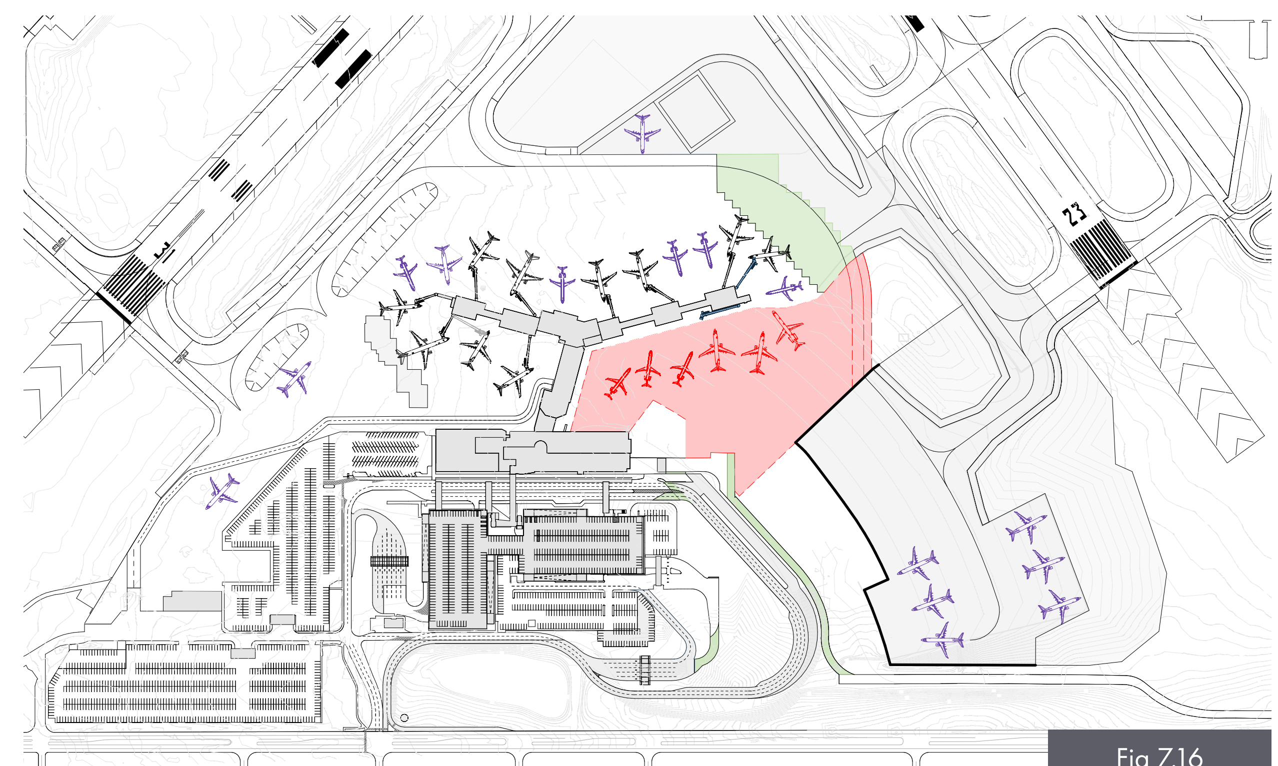


Fig 7.16

0 625' 1250' N

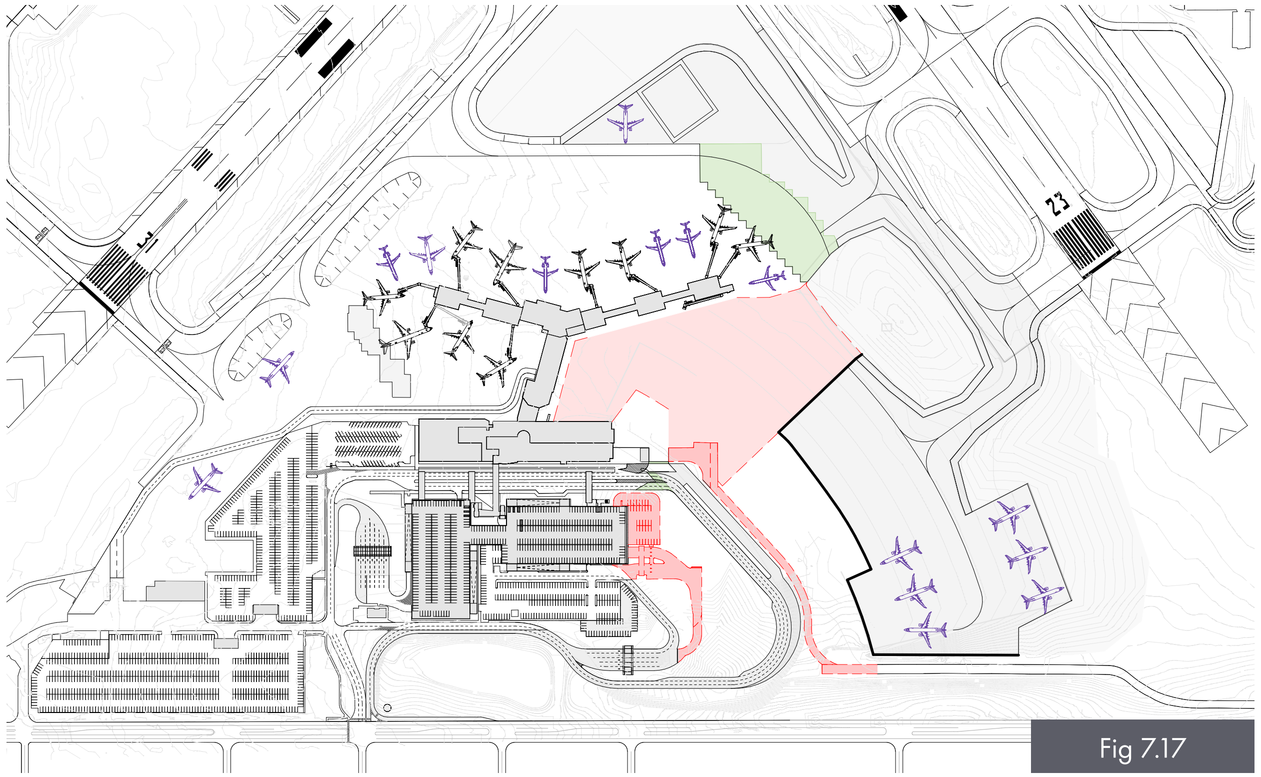


Fig 7.17

7.2.17 Phase 17 (Landside)

Delivery and service vehicles will temporarily utilize the passenger roadway loop to access the loading dock and turn-around space during this phase, as represented in **Figure 7.17**. This will allow the temporary loading dock road, constructed in Phase 9, to be demolished to clear the site for the new terminal.
The existing entry plaza and hourly lot will be demolished in this phase, which will complete the site-clearing effort for the new garage.

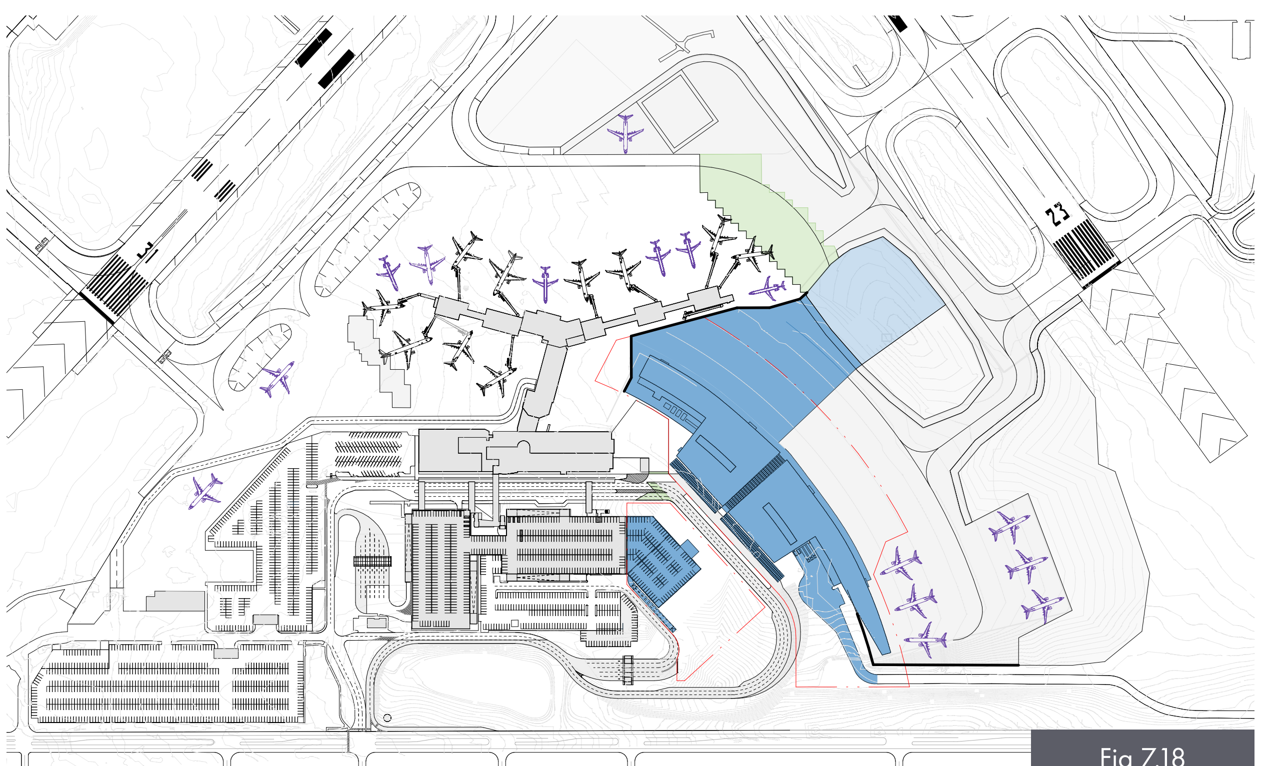


Fig 7.18

7.2.18 Phase 18 (Airside / Landside)

Garage and terminal construction will commence after their sites are cleared and funding becomes available. As demonstrated in **Figure 7.18,** site and silt fencing will be erected around the two project sites to restrict public access and inhibit sediment and site debris from drifting into occupied areas. Additionally, Apron Package C will be constructed to replace the pavement on the northeast side of Concourse C and provide additional construction lay-down space for the terminal construction. This new pavement will terminate close to Concourse C and will require a small temporary retaining wall to bridge the elevation difference between the new and existing apron pavements. Once completed, the jet bridge for Gate C6 can be reopened, but the aircraft will access the gate by circulating around Taxiway Papa. Aircraft are not able to navigate directly between the new and existing apron pavements.

N 0 625' 1250'

7.2.19 Phase 19 (Airside)

After Apron Package C is completed and Gate C6 comes back online, demolition for Apron Package D can begin, as displayed in **Figure 7.19.** As part of this apron package, the temporary pavement constructed during Phase 3 will be demolished with a portion of the existing pavement around the north side of the C Concourse. Positions C7B, C7A and C5B and Gate C7 cannot be utilized and Gate C5 can only service C5A. Additionally, Taxiway Bravo is not accessible throughout this phase.

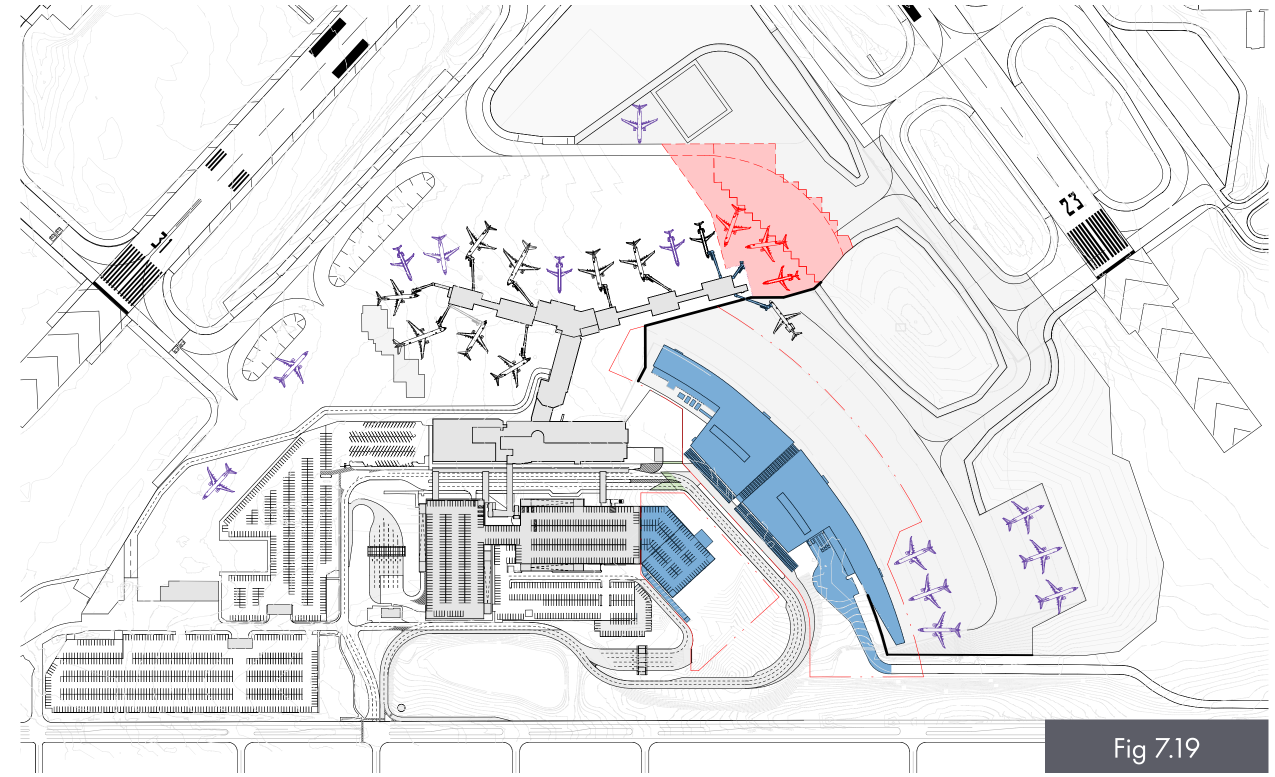


Fig 7.19

7.2.20 Phase 20 (Landside)

At some point during the terminal and garage construction, the pedestrian bridge linking the two projects will be erected, shown in **Figure 7.20.** Special precautions are necessary to protect public vehicular traffic passing below during this phase. The timing of this erection should be coordinated by the contractor to best fit within the overall sequence.

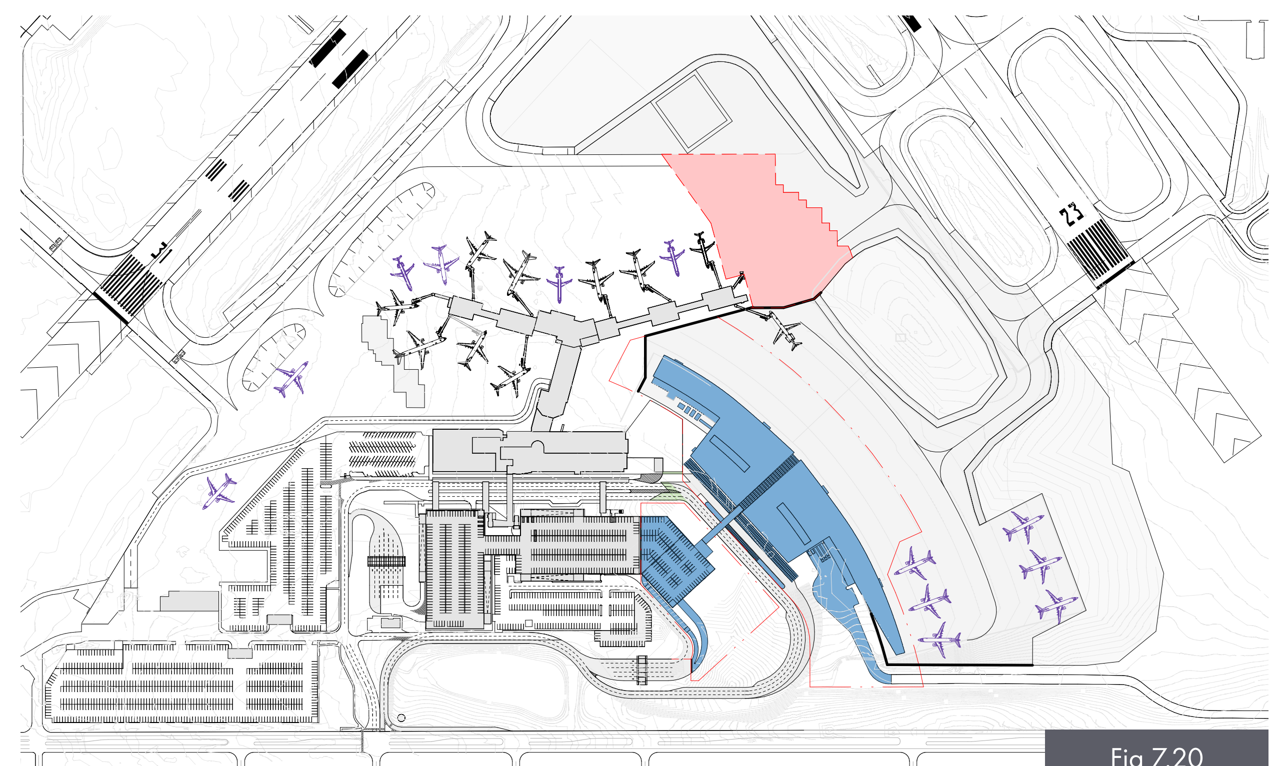


Fig 7.20

0 625' 1250' N

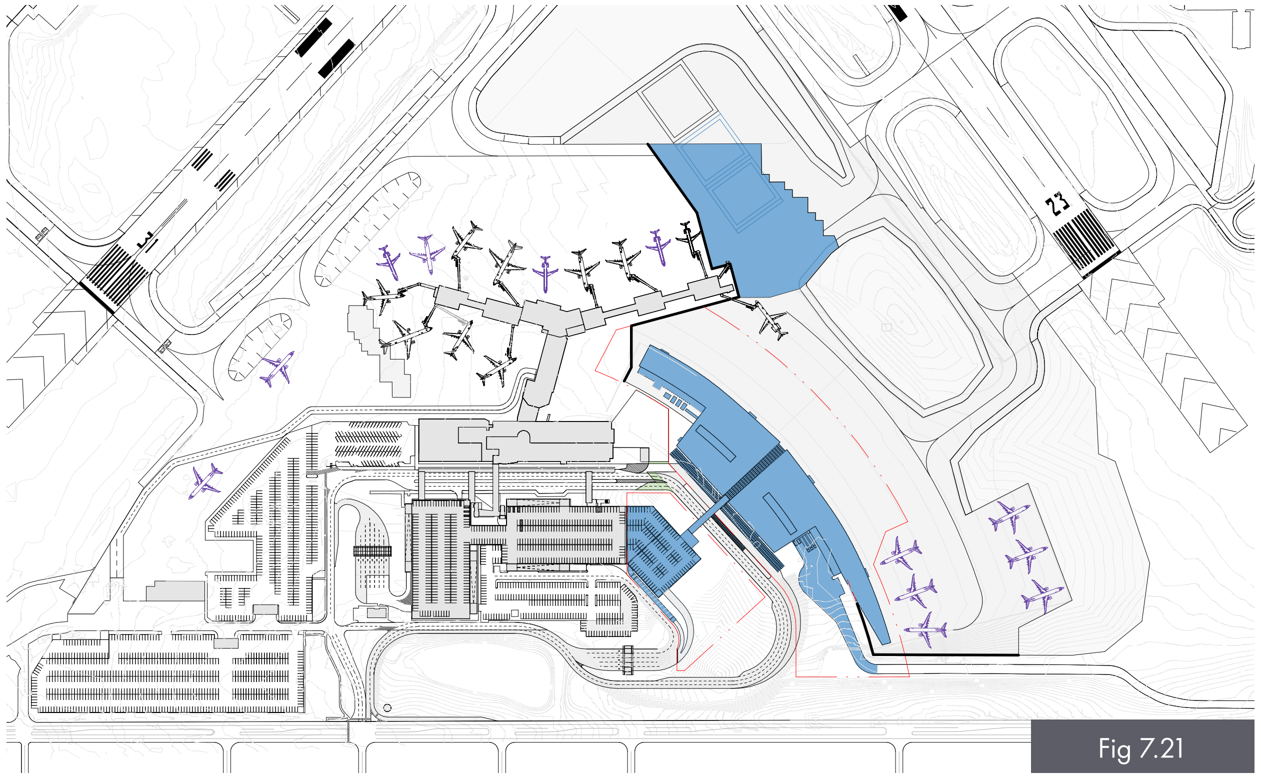


Fig 7.21

7.2.21 Phase 21 (Airside)

The new pavement poured for Apron Package D will complete the new deice area and connect Taxiway Bravo to the new, elevated apron pavement from Apron Package C. During this phase, as represented in **Figure 7.21**, positions C7B, C7A and C5B and Gate C7 are unavailable and position C5A is the only available contact position for Gate C5.

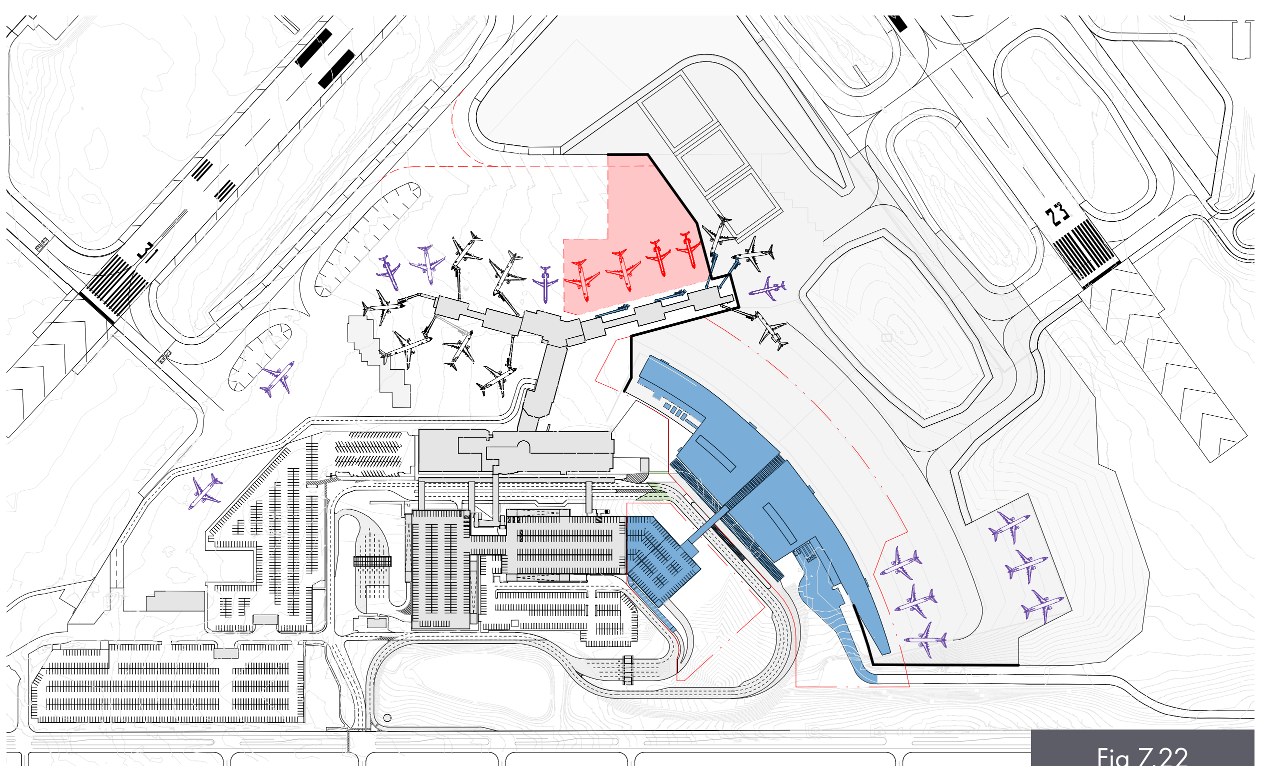


Fig 7.22

7.2.16 Phase 22 (Airside)

When Apron Package D is complete, Gates C5, C6 and C7 will all serve parking positions on the new elevated pavement. These positions can only be accessed from Taxiway Bravo and Papa, and the aircraft cannot circulate between the taxilane on the existing pavement and the new Package D apron pavement. Positions C6A, C7B, C7A and C5B are located on the elevated pavement, and those aircraft will temporarily deice at the gate. The residual deicing fluid will be directed to the new deice pad area for collection. **Figure 7.22** displays Gates C1, C3 and associated parking positions as temporarily closed while the site is cleared for Apron Package E. The aircraft parking at Concourse A accesses the runway system only through Taxiway Delta.

N 0 625' 1250'

7.2.23 Phase 23 (Airside)

Figure 7.23 exhibits the construction of Apron Package E. This pavement will connect the new deice pads to the existing apron pavement to the south so when completed, aircraft can navigate between new and existing apron pavements. During construction, Gates C1 and C3 are temporarily closed. Apron Packet E requires small retaining walls near the concourse and adjacent to RON position A1A.

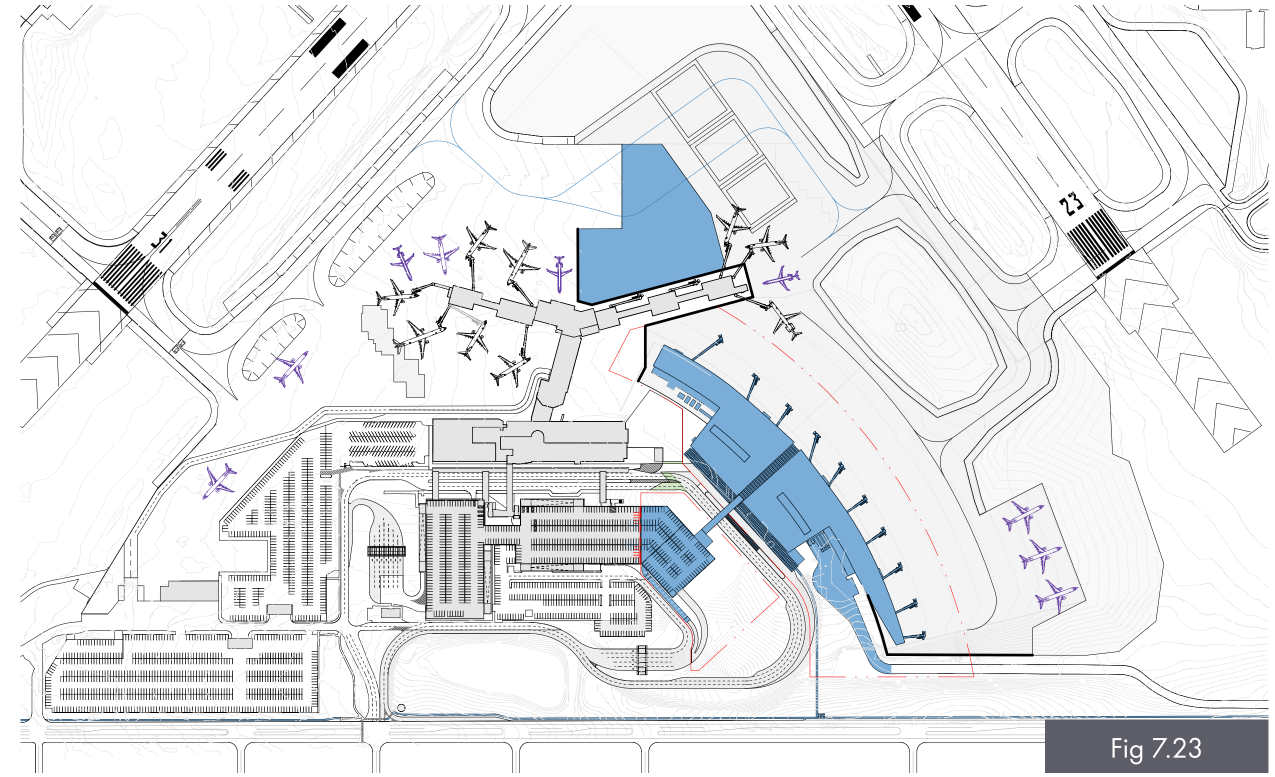


Fig 7.23

7.2.24 Phase 24 (Landside)

The garage completion represents a project milestone. The new garage will open 476 stalls for public use, greatly relieving the parking demand and improve the level of service for the existing terminal. The new garage aligns with each level of the north existing garage and the parking drives will flow directly between the two. Modifications, as identified in **Figure 7.24**, are necessary for the existing garage to allow passage between the two structures, including curb / sidewalk removal, guardrail demolition and parking re-striping.

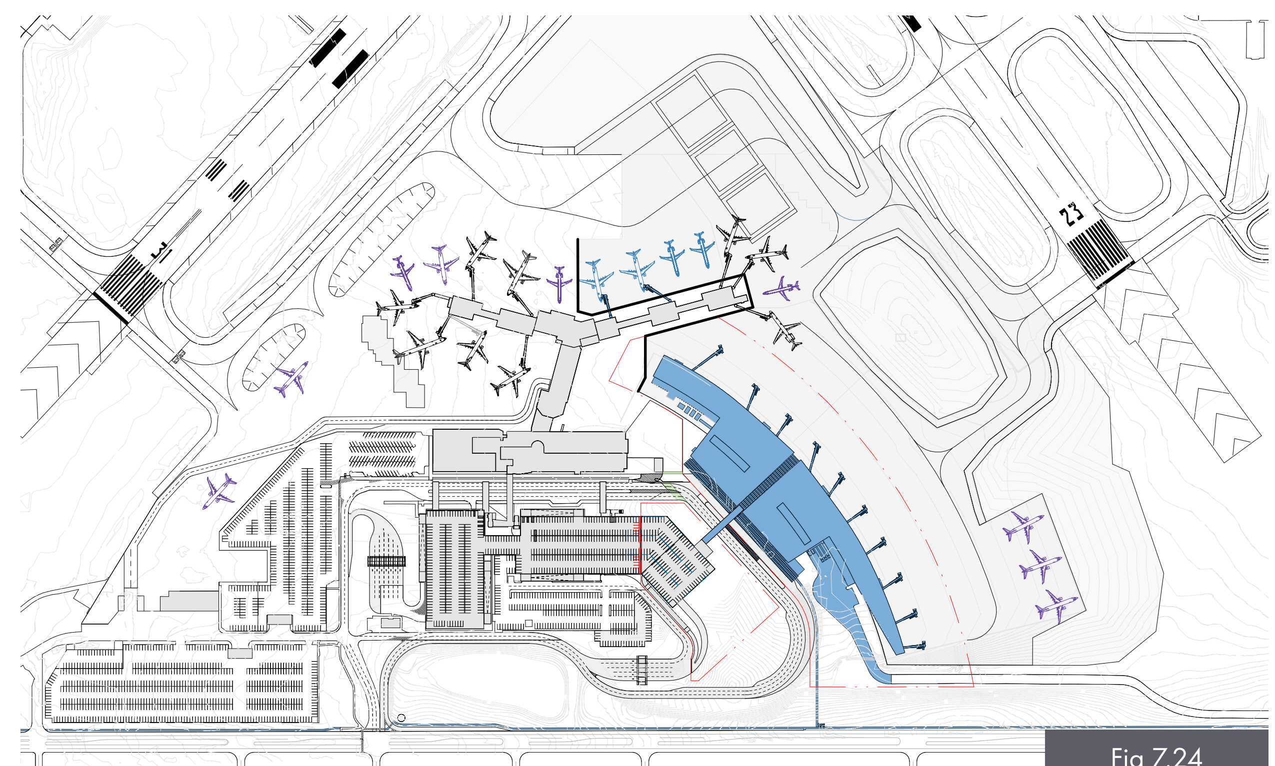


Fig 7.24

0 625' 1250' N

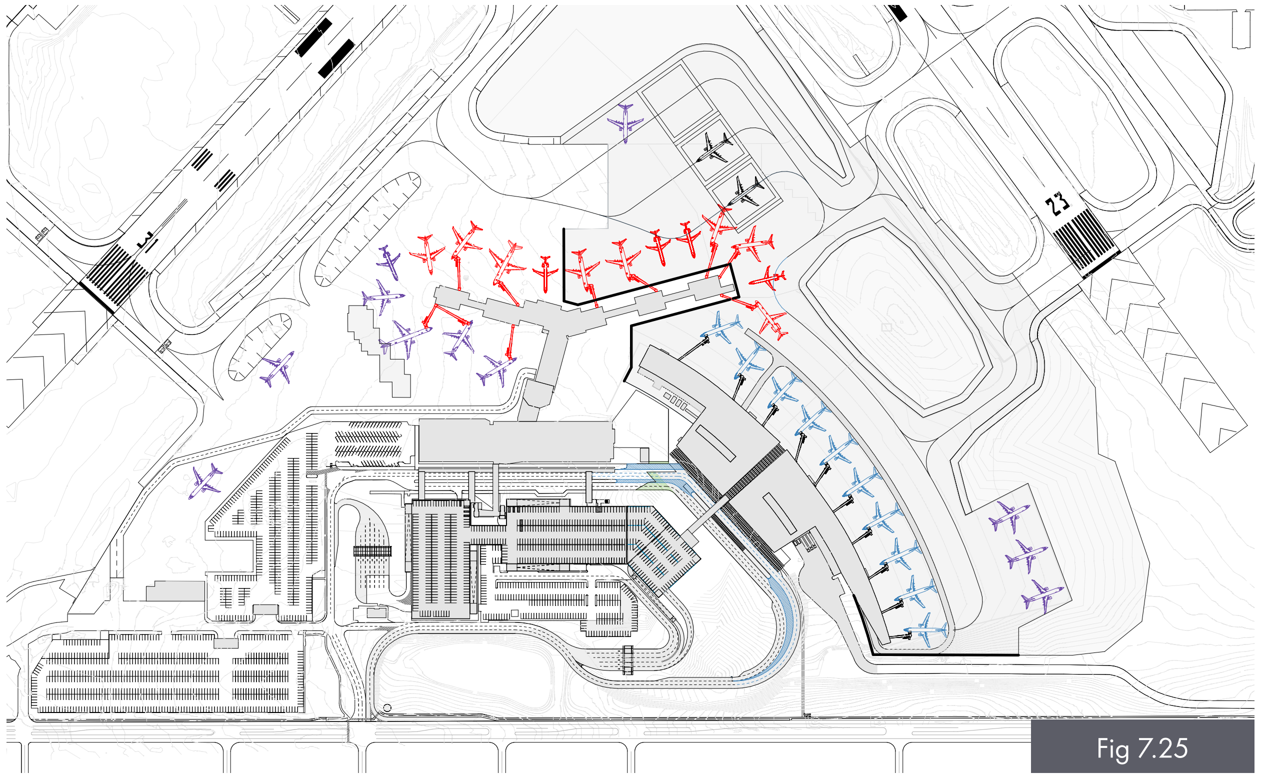


Fig 7.25

7.2.25 Phase 25 (Airside / Landside) - Opening Day (MAP 3.0)

The terminal will open, as represented in **Figure 7.25**, with 10 contact gate positions available. The new building is constructed as one phase for the 14-gate scenario. The existing terminal will be permanently closed to passenger traffic the same day the new terminal opens. Most parking positions at the existing terminal will be removed, with a few remaining on the south side of C as temporary RON positions. All aircraft will now use the new deice-pads and will no-longer deice at the gate.

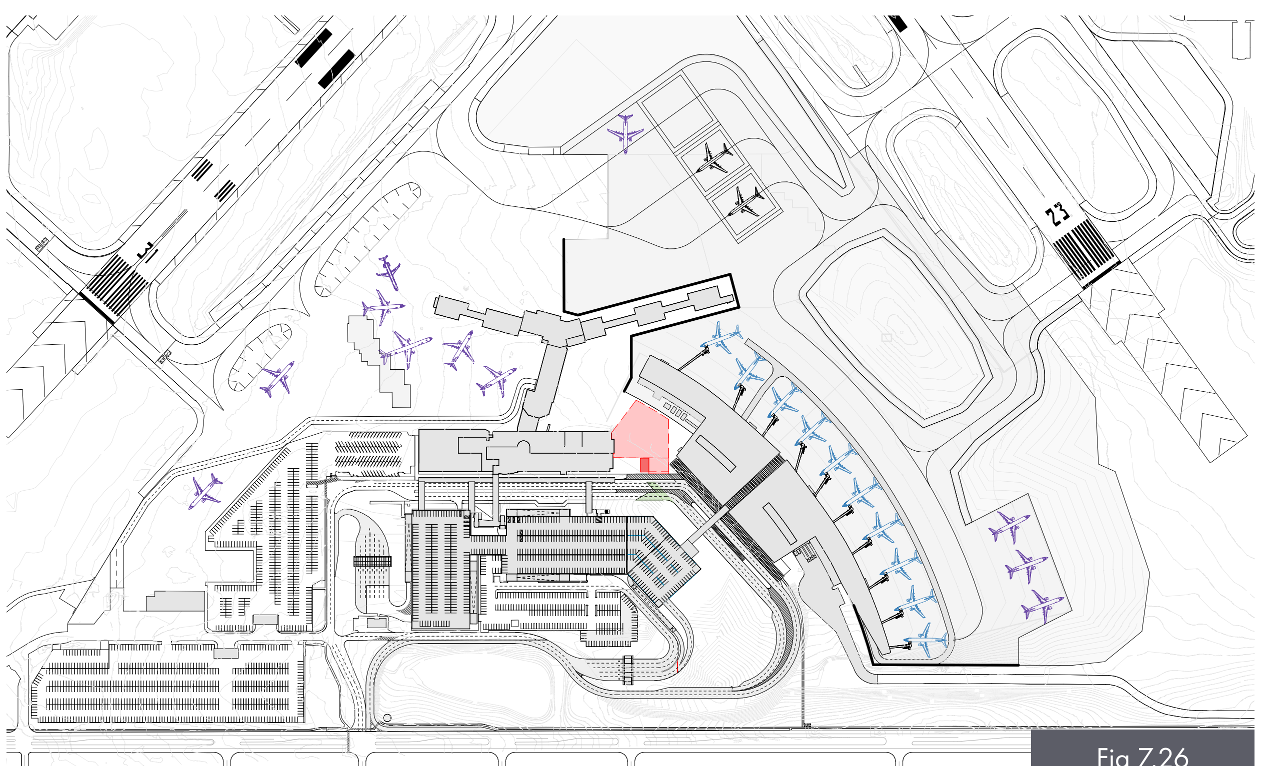


Fig 7.26

7.2.26 Phase 26 (Landside)

The new loading dock at the basement level of the terminal will open with the rest of the building on opening day, eliminating the need for the loading dock near the existing processor. This will remove all service/delivery traffic from the roadway loop because the new loading dock is directly connected to the northeast service road. The existing loading dock can be demolished, as represented by **Figure 7.26**, which will clear a site for the new Ground Transportation Facility (GTF.)

N 0 625' 1250'

7.2.27 Phase 27 (Airside)

The existing concourses will be demolished as separate packages to add contact gate positions at the new terminal as soon as possible. **Figure 7.27**shows the demolition of Concourse C occurring prior to Concourse A and the "Stem" where today's security checkpoint is located.

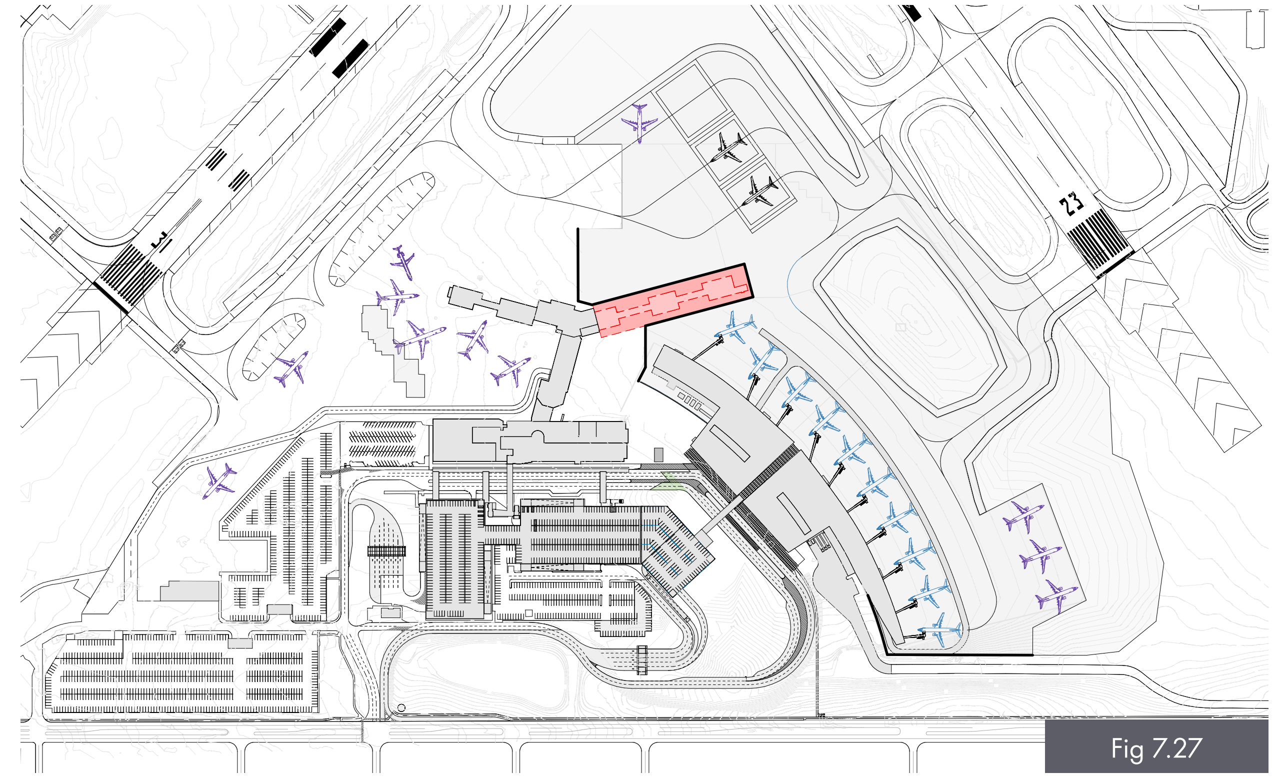


Fig 7.27

7.2.28 Phase 28 (Landside)

After the existing loading dock is removed, construction may begin on the new Ground Transportation Facility (GTF), displayed in **Figure 7.28**. This addition will provide a pick-up/drop-off area for TNC's and the rental car shuttle outside of the new terminal's baggage claim. An overhead canopy will protect passengers from the elements and allow pedestrians to access the terminal without crossing the street. This will also help reduce vehicular congestion on the curb front.

The surface lot between the existing processor and Economy Lot 1 will be demolished to prepare the site for the final roadway loop. Striping in Economy Lot 1 will be modified for vehicle circulation purposes.

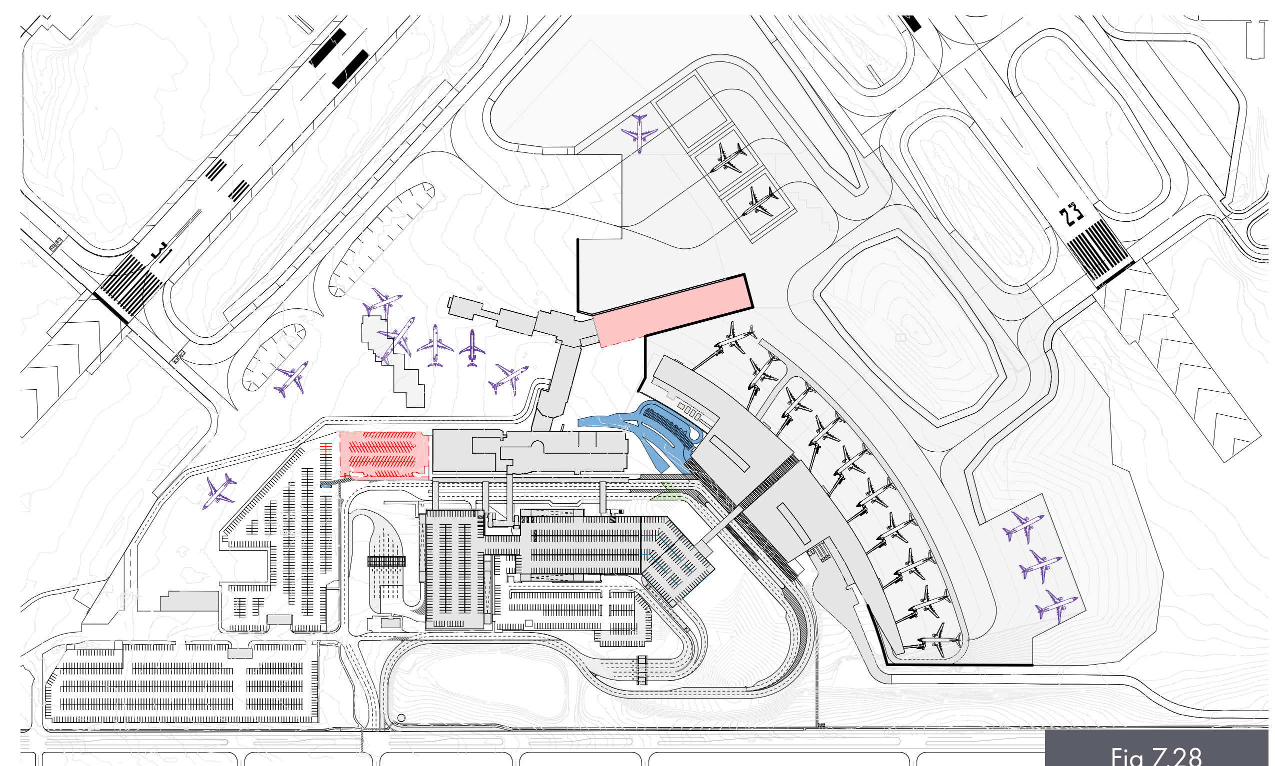


Fig 7.28

0 625' 1250' N

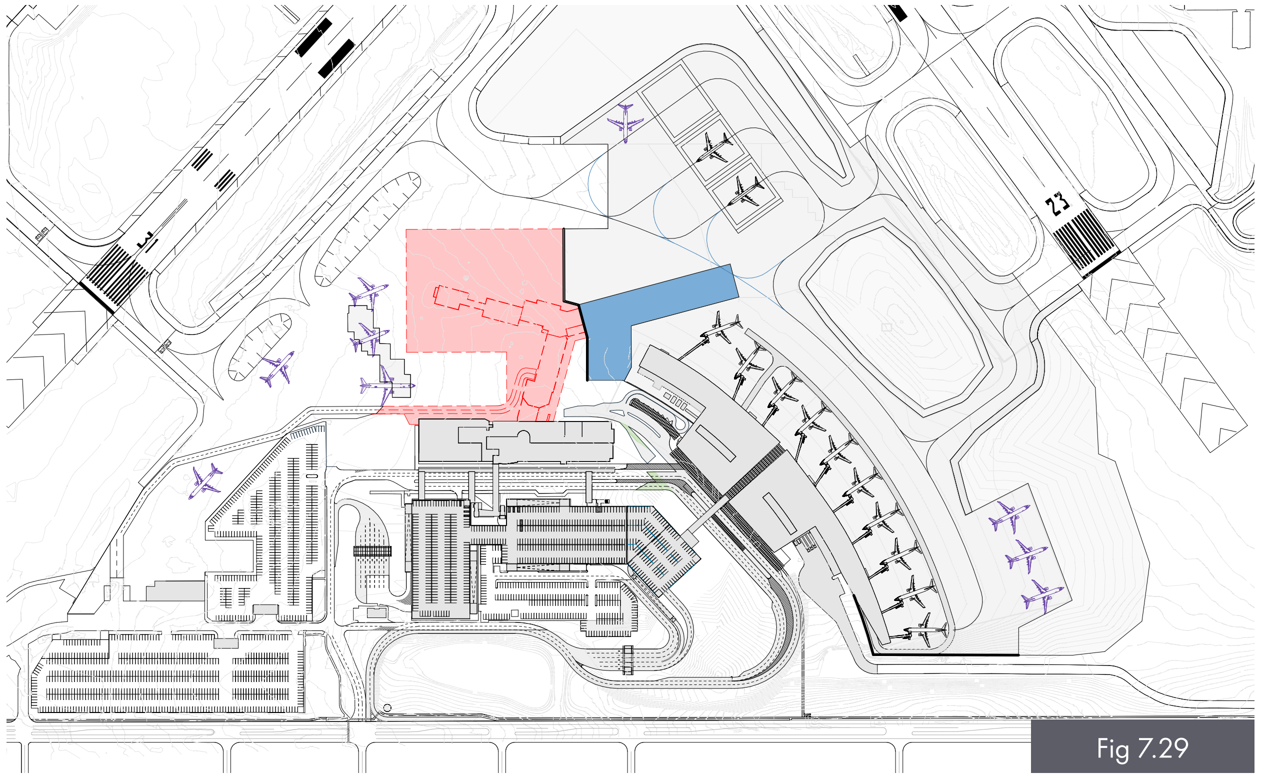


Fig 7.29

7.2.29 Phase 29 (Airside)

Once Concourse C is demolished, Apron Package F can be constructed, demonstrated by **Figure 7.29**. When completed, three additional contact gates will be added to the south end of the concourse. During Apron Package F construction, the concourse demolition crew can move ahead to Concourse A, the Stem, and surrounding apron pavement. The extents of the apron pavement demolition will modify the available RON parking south of Concourse A from 7 positions to 5. The East Quadrant will have 9 total RON positions during this phase.

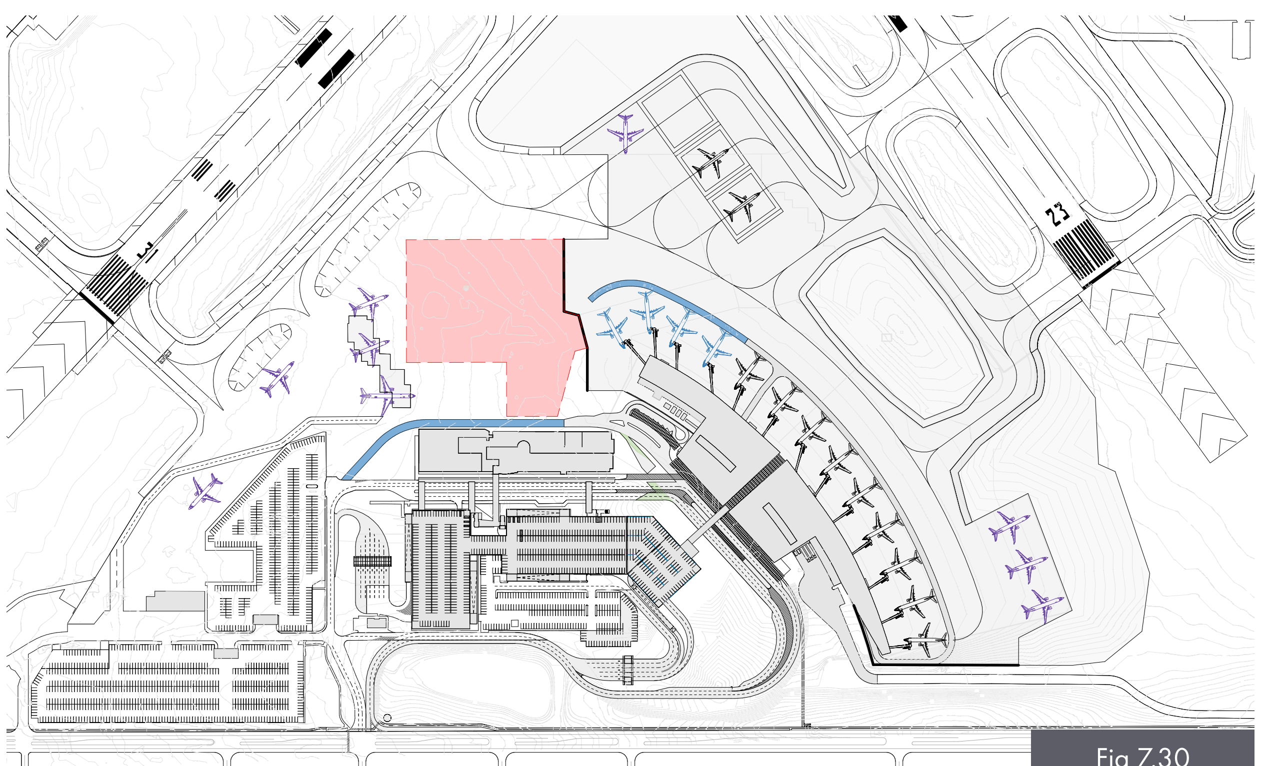


Fig 7.30

7.2.30 Phase 30 (Landside)

Demolition of the Stem should begin at its connection to the processor, so the site for the final roadway loop can be cleared sooner, as shown in **Figure 7.30**. Once the site is available, the passenger vehicle lanes will extend from the GTF, around the west side of the existing terminal processor and reconnect to the roadway loop near the exit plaza. The final roadway was configured to allow the potential deferral of the landside processor demolition until funding becomes available. Once completed, private vehicles will continue straight onto the final roadway loop but commercial vehicles will continue to turn left onto the existing commercial vehicle lanes.

N 0 625' 1250'

7.2.31 Phase 31 (Airside)

When the Stem and Concourse A are fully demolished, Apron Package G, the final apron package, depicted in **Figure 7.31** will resume. This will replace the pavement surrounding Concourse A and provide a parking position for the last contact gate for the new terminal.

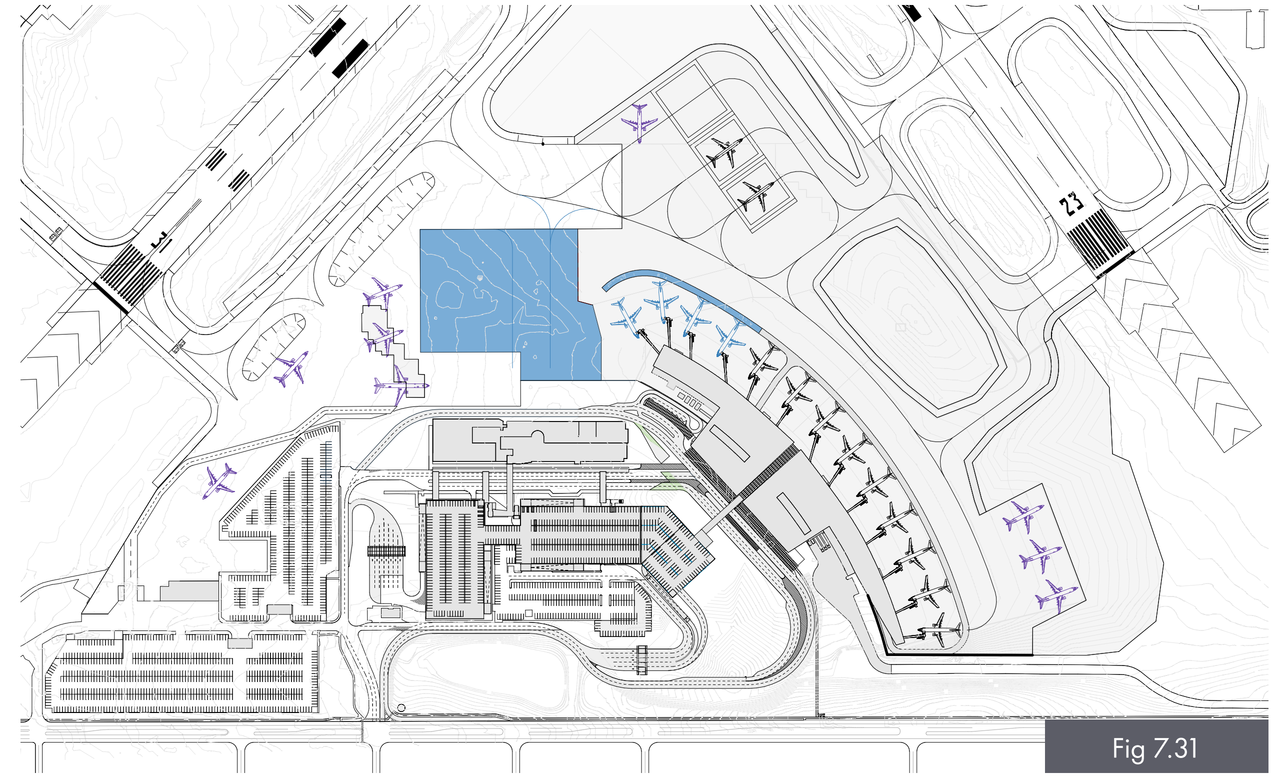


Fig 7.31

7.2.32 Phase 32 (Airside)

Following the completion of Apron Package G, the vehicle service road (VSR) will be connected to the existing south VSR as well as provide an entry route to the south side of the inbound baggage drop-off area on Level 1 of the new terminal. The last contact gate will be added during this phase, completing the airside phasing. The RON parking positions will be reorganized to their final parking configurations perpendicular to Runway 13/31, ensuring aircraft tails do not violate the Part 77 restrictions. The final airside configuration accommodates 14 contact gate positions, 9 RON positions and 3 deice pads, as demonstrated by **Figure 7.32**.

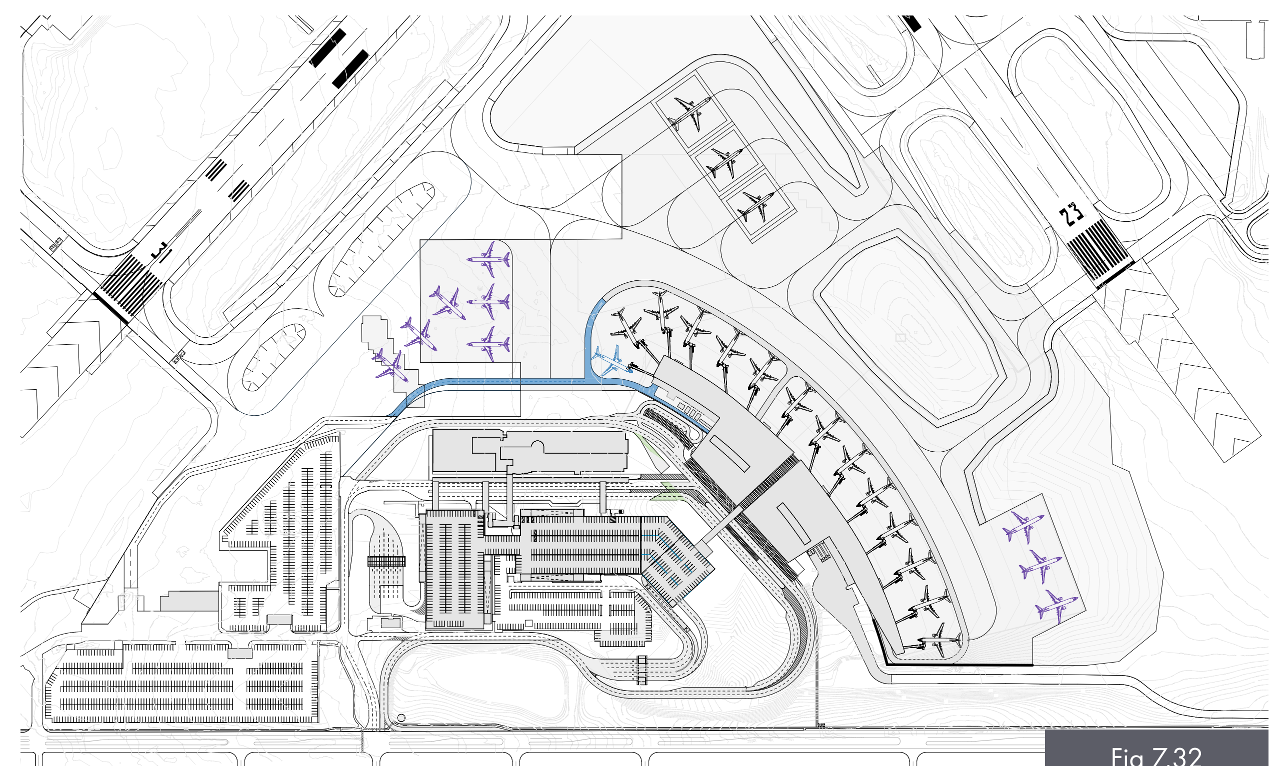


Fig 7.32

0 625' 1250' N

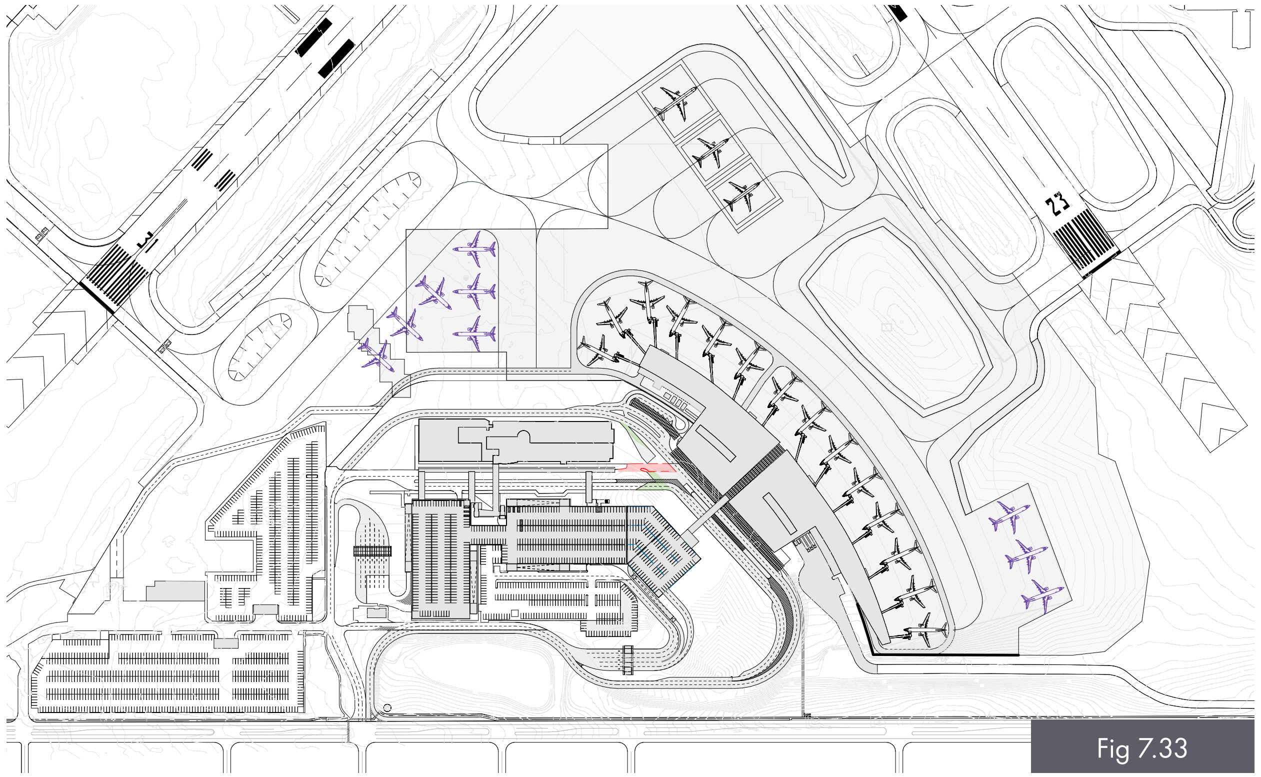


Fig 7.33

7.2.33 Phase 33 (Landside)

To connect the commercial vehicle lanes to the final roadway loop, portions of the existing terminal curb front and roadway need to be demolished, as shown in **Figure 7.33**. This will clear the way for the connection between the commercial lanes and the passenger vehicle lanes that bypass the landside processor.

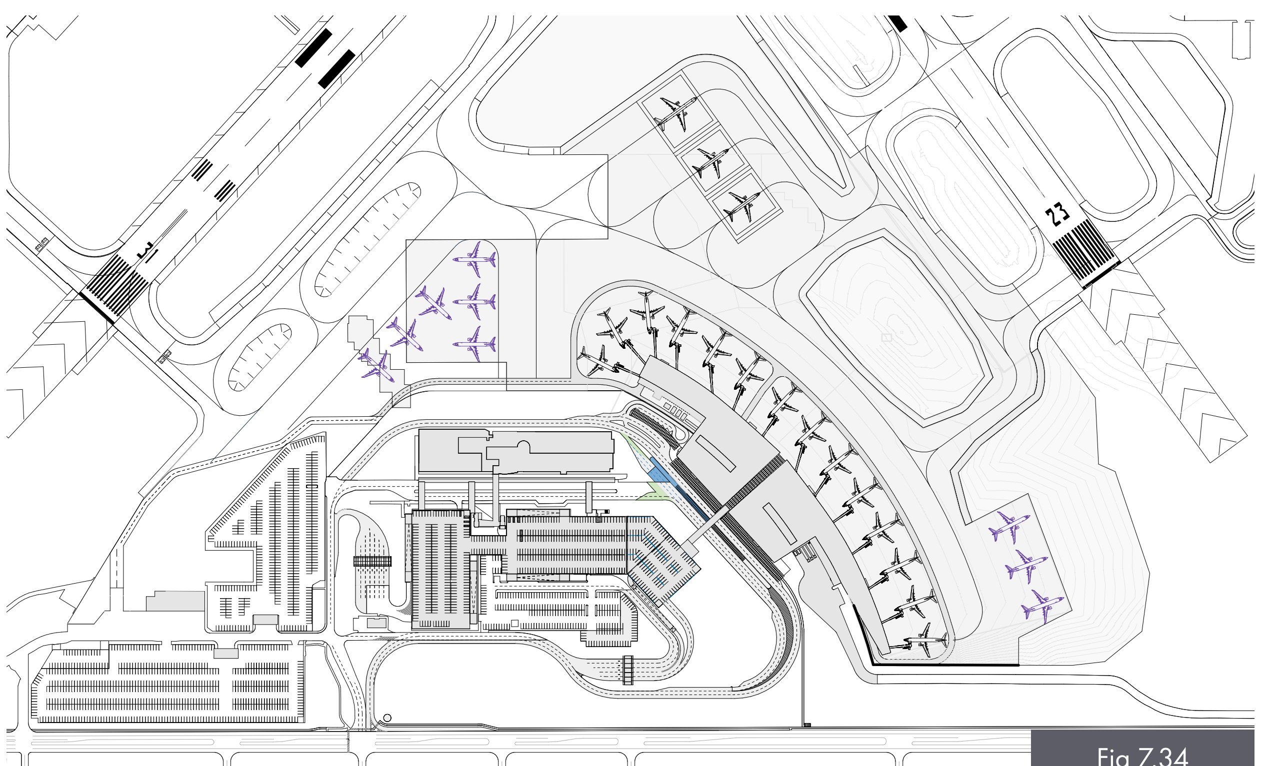


Fig 7.34

7.2.34 Phase 34 (Landside)

Figure 7.34 shows the construction of the commercial vehicle lane connection, commercial curb and canopy extensions that will extend to meet the final roadway loop. The connection between the commercial lanes and the passenger vehicle lanes is temporary and will be lengthened for an easier merge after the existing terminal processor is demolished.

N 0 625' 1250'

7.2.35 Phase 35 (Landside)

When funding is available, the existing landside processor, curb front, canopies and bridge to garage will be demolished. This demolition is represented by **Figure 7.35**.

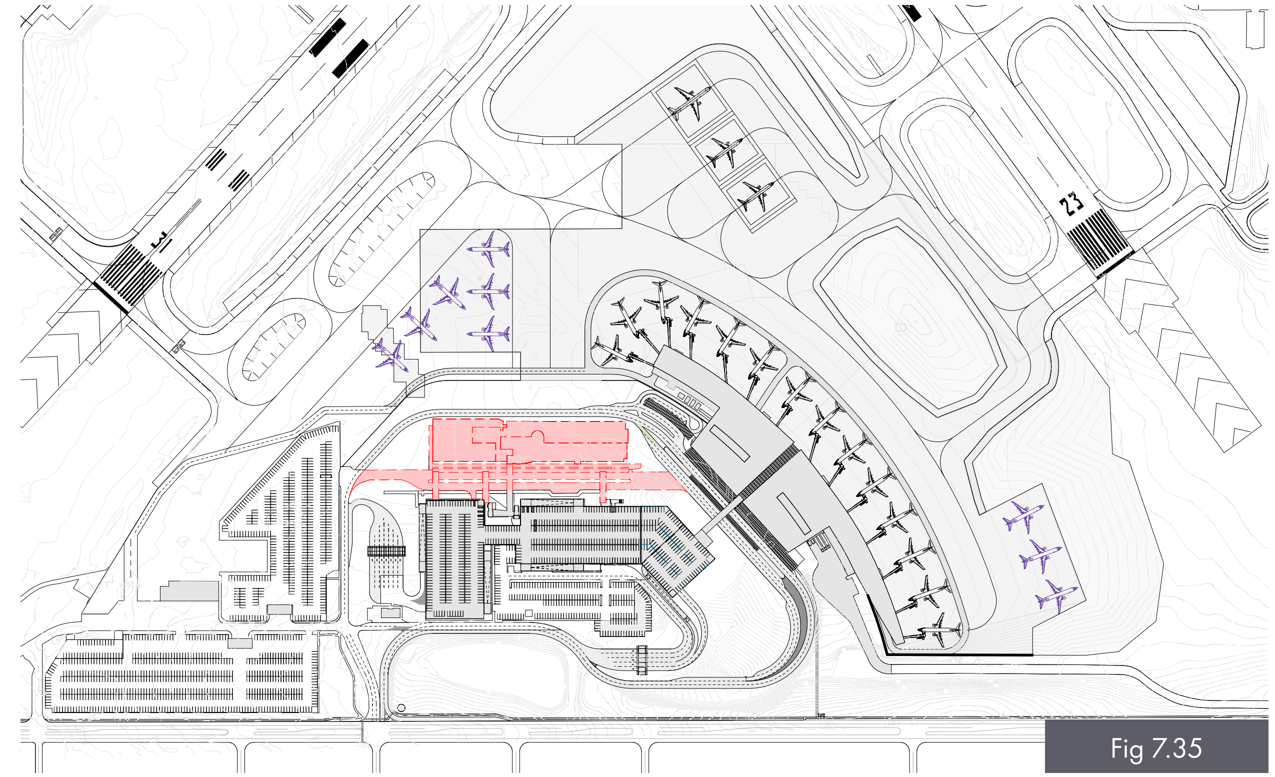


Fig 7.35

7.2.36 Phase 36 (Landside)

After the existing processor is demolished, the commercial curb lanes will be extended on the east side of the passenger lanes to create as safer, longer merge for commercial vehicles, as represented by **Figure 7.36**. Additionally, the sidewalk on the west side of the existing garages will be linked back to the new garage vertical circulation tower which connects to the pedestrian bridge.

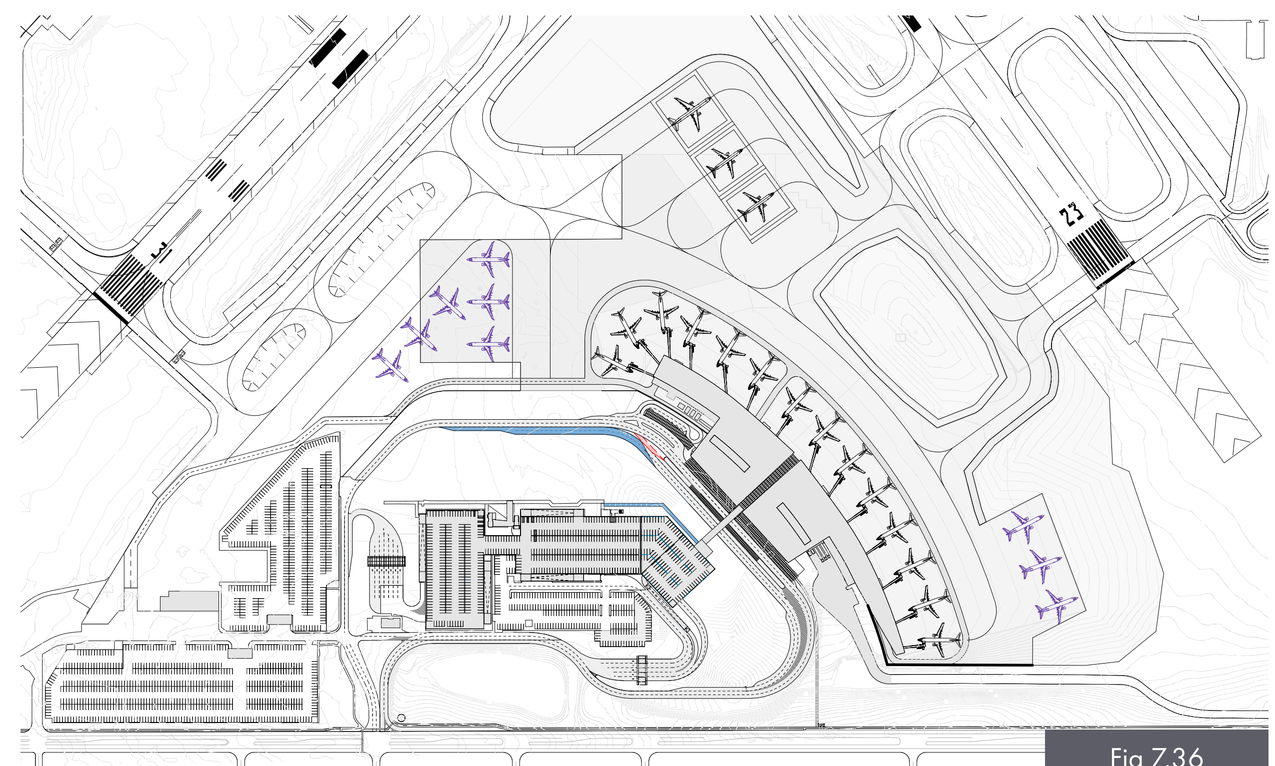


Fig 7.36

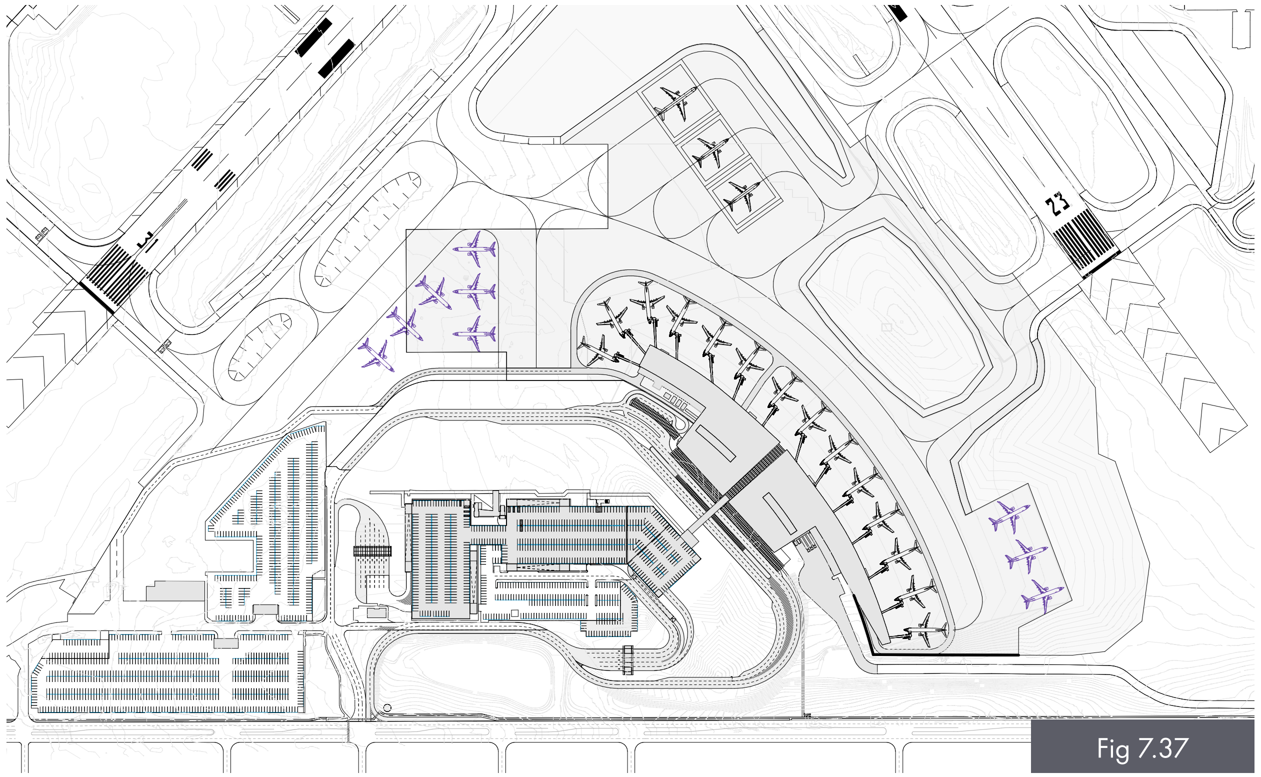


Fig 7.37

7.2.37 MAP 3 Phasing Complete

Figure 7.37 demonstrates the completed phasing for the MAP 3.0 airport improvement project.

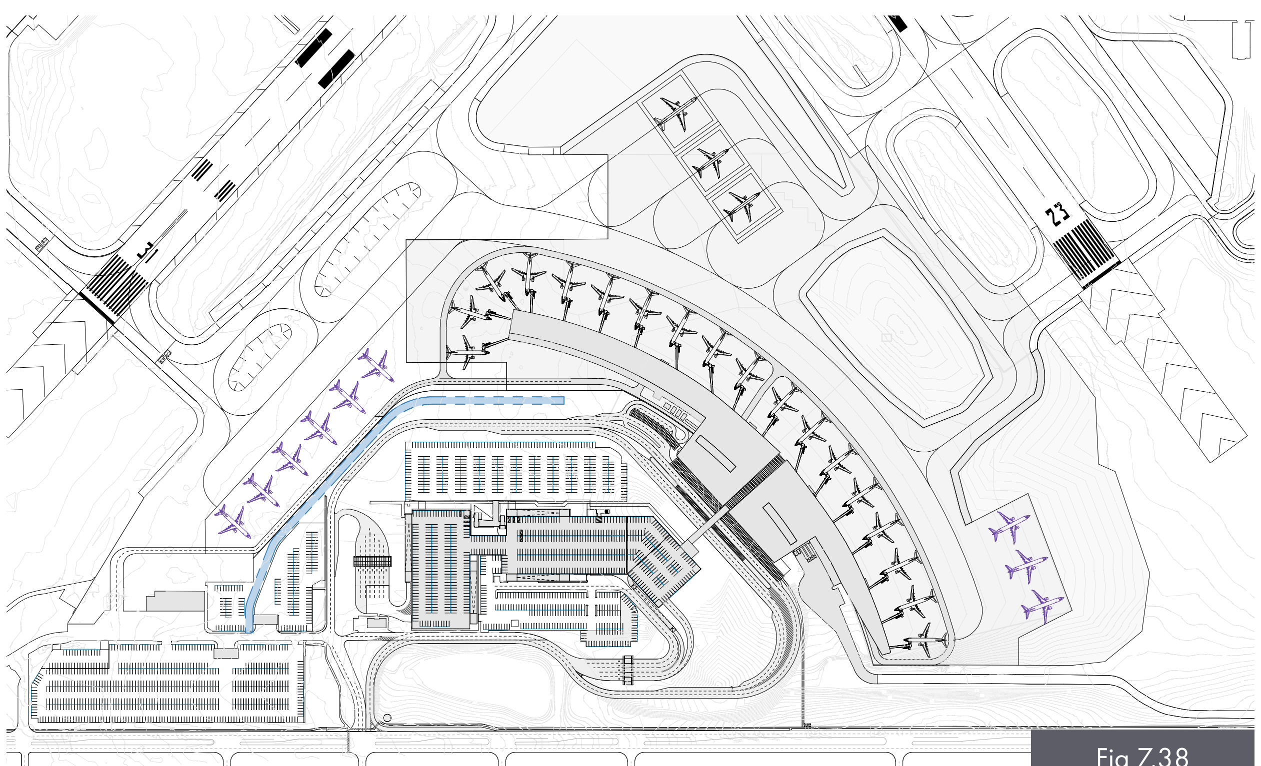


Fig 7.38

7.2.38 MAP 4 18-Gate Expansion

Figure 7.38 represents the ultimate 18-gate expansion. The concourse will be extended from the south end of the building to accommodate the future additional 4 gates. The new contact gate positions will push the RON positions further south, potentially taking up part of Economy Lot 1. This will ensure that at least 9 RON positions can be maintained into the future.

When parking demand exceeds the number of spaces in the new north garage, a new surface lot and/or garage can be constructed in place of the existing landside terminal processor, demolished in Phase 35.

The blue dashed line in **Figure 7.38** represents a right-of-way maintained for future autonomous busses.

Figure 7.39 & 7.40 - Retaining Wall Options

Figure 7.39 - Baseline Option Wall

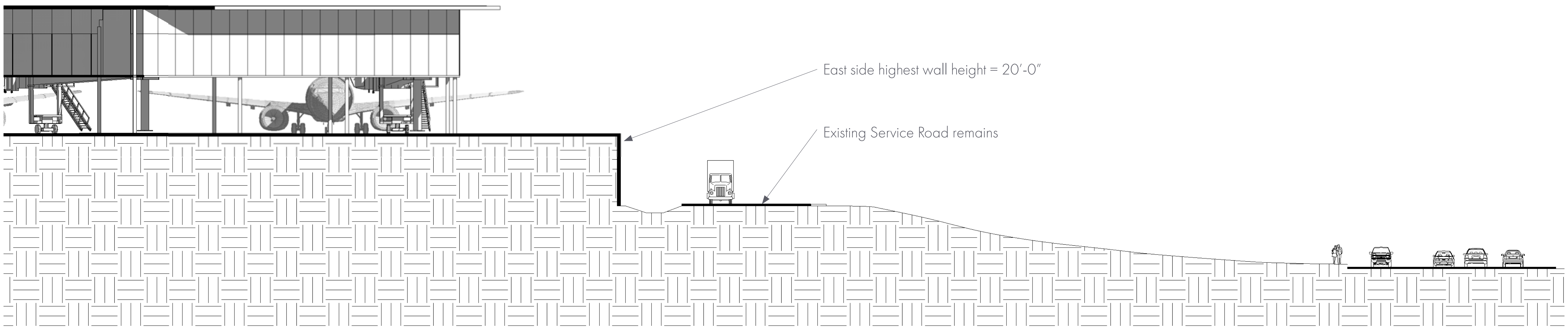


Figure 7.40 - Alternate Option Wall

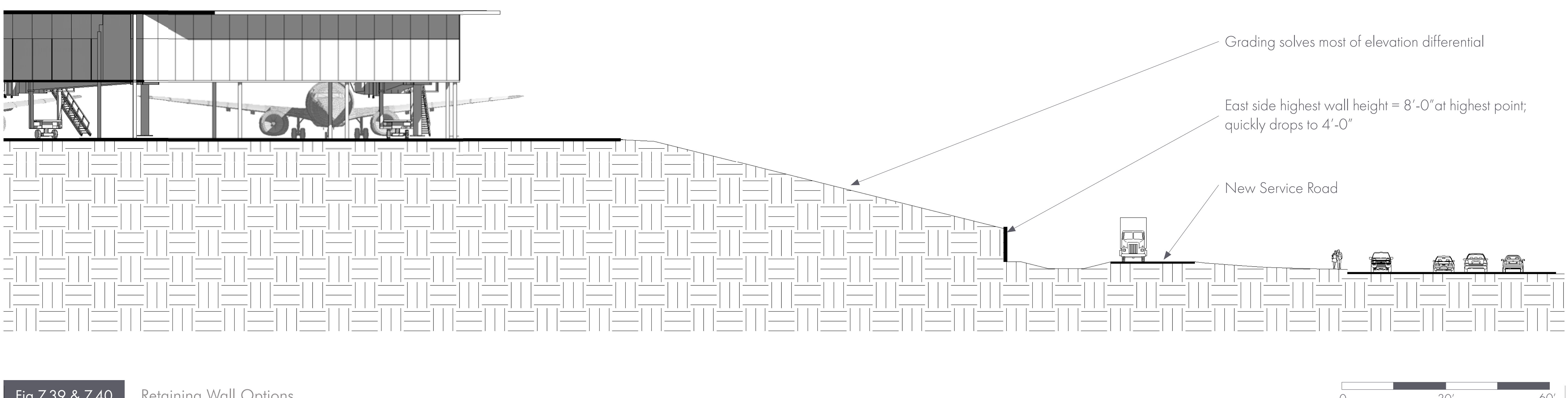


Fig 7.39 & 7.40 Retaining Wall Options

Chapter 8 Program Cost Estimates

8.0 Program Cost Estimates

This chapter summarizes the Rough Order of Magnitude (ROM) costs for the Des Moines International Airport – New Terminal Program. ROM estimates were prepared along the planning and programming process for decision making and to inform the Financial Analysis (Chapter 9). The preferred alternative plans are located in Chapter 5 and the full ROM cost estimate is included in Appendix C.

8.1 Basis of Estimate

This estimate is based upon the programming level design information for each of the facilities included in the scope of this program. The estimate does not incorporate design and engineering changes occurring subsequent to this information.

The cost estimates prepared for the New Terminal program at DSM are not definitive. These estimates were prepared from programming and planning level design and engineering information which due to the early stage of requirements planning did not all details and information from which deeper assessments of quantities and commodities could be identified. The estimates are based on the measurement of areas and or quantities from the documents, where possible. For the remainder of the scope, parametric measurements were used in conjunction with references from other projects estimated by the project team cost estimator, Faithful+Gould, and or historical information related to scope and cost routinely incorporated.

8.2 Basis of Pricing

This estimate reflects the fair market value for the construction of the individual projects within the overall scope of DSM program and should not be construed nor considered as a prediction of low bid. The unit costs include labor, material, and equipment costs plus subcontractors overhead and profit costs. To the extent possible, the estimators have endeavored to assess the identified design scope to the lowest singular commodity or assembly of materials for which costs could be assigned and or assembled. The depth to which the assessments and determinations of commodities and materials were made was dependent on the planning and programming information provided during this stage of planning.

The costs reflected in this estimate either in summary or in the Detail levels are benchmarked at and to only January 30, 2018 so this estimate reflects 2018 US dollars. Escalation has not been included.

8.2.1 Procurement Method

Pricing assumes a procurement process with competitive and open bidding processes for every portion of the construction work within the scope of the program. The fees included in the estimate(s) also consider the Construction Managers At Risk (CMAR) firms are qualified through a best-cost competitive solicitation process in order to return the best value of the program to DSM.

This means a minimum of at least 3 competitive and responsible bids from all subcontractors for divisional work and a minimum of 3 written quotations for materials/equipment suppliers.
If fewer bids are solicited or received, it is anticipated and reasonably expected that prices and costs will be higher.

8.2.2 Wage Rates

This estimate is priced on the basis of Union Prevailing Wage rates in the Des Moines, IA region.

8.2.3 Phasing

Phased construction will not be overly constrained by airport operational constraints and the contractor and design team will develop a detailed phasing approach to minimize disruption to airport and tenant operations; the construction team will have reasonable access to the work area as defined in the preliminary phasing approach (Chapter 7) and detailed phasing approach developed by the future Design Team.

8.2.4 Access and Security

The estimate anticipates that site access will be primarily from the Landside and that security requirements will be typical for this scale of project at an active airport facility. Construction access will be primarily from the north via McKinley Ave and then along the airport service road just west of Fleur Drive. All terminal, airside and most landside related work will have this access which is completely independent of passenger traffic. Landside work such as the new exit plaza and parking structure will be landside accessible but a dedicated pathway to minimize passenger disruption will be developed by the future design team and contractor.

8.2.5 Escalation

Escalation has not been included in this estimate.

8.3 Mark-Up and Contingency Assumptions

The following markups and margins have been added to the Direct Cost of Work.

Construction Manager at Risk (CMAR) fees are applied to the unit costs as shown in the following **Table 8.1**:

Table 8.1 - Construction Manager at Risk (CMAR) Fees

CATEGORY	PERCENTAGE
CMAR's General Conditions / General Requirements	11.50%
CMAR's Construction Contingency	5.00%
CMAR's Home Office Overhead / Administrative Costs	2.50%
CMAR's Bonds & Insurance	2.25%
CMAR's Fee	4.50%
Total CMAR Fees & Markups	**25.75%**

Owner's Allowances, Contingencies & Soft Costs

The routine and customary costs associated with an Owners administration and execution of a development program or construction project are typically referred to as Soft Costs and will be appended to a construction cost estimate to include the Owners monetary obligation. The projected cost including Soft Costs is termed Program Cost. **Table 8.2** summarizes the soft costs and contingencies for the overall project.

Table 8.2 - Owner's Soft Costs & Contingencies

CATEGORY	PERCENTAGE
Architecture / Engineering Fees	8.00%
Program Management Fees	3.50%
Testing	1.00%
Inspection	1.50%
QA / QC Services	1.00%
Insurance	2.00%
Bonds	2.00%
Administrative Fees	1.25%
Commissioning	1.50%
Public Art	0.50%
Total Soft Costs	**22.25%**
Owner Controlled Contingency	20.00%

Subcontractors' mark-ups have been included in each line item unit price. This covers the cost of field overhead, home office overhead, and subcontractors profit. Subcontractor's mark-ups typically range from 15% to 25% of the unit price, depending on trade requirements and market conditions.

8.4 Statement of Probable Cost of Construction

The ROM estimates are based upon 2018 US Dollars. The consultant team has many years of experience providing cost consulting services in the aviation construction industry. Historically, the deviation between construction estimates and the corresponding bid amounts is minimal, however, the consultant team has no control over the method of determining prices adopted by any individual general contractor, subcontractor or supplier. The consultant team cannot control the cost of labor and materials, the bidding environment or other market conditions, and it is not possible to provide any guarantee that proposals, bids, or actual construction costs will not deviate from this or subsequent cost estimates.

The consultant team has prepared this estimate in accordance with widely accepted principles and practices to reflect the fair market value of the project. This estimate is made on the basis of the experience, qualifications, and the best judgment of professional consultants who have gained an expertise in the aviation construction industry.

8.5 Project Scope Clarifications

The individual project estimates have been formatted and detailed and reflect the depth and breadth of the planning information developed and available for the programming level activities. Where necessary, within the estimate(s) details are annotated with specific clarifications and or assumptions made by the estimators in efforts to provide comprehensive scopes and costs for each project.

The following assumptions have been made in regards to this project:

8.5.1 Foundations

Foundations will be drilled piers with pier caps and grade beams. On grade floors will be typical slab-on-grade construction.

8.5.2 Basement Construction

The project includes a partial basement (Level 0). For purposes of pricing, this is assumed to be a cast-in-place structure.

8.5.3 Superstructure

For purposes of pricing, the superstructure will be structural steel with cast-in-place concrete floor slabs on metal deck.

8.5.4 Exterior Enclosure

Exterior enclosure is assumed to be a combination of metal panels and concrete masonry (CMU) for the first floor and curtain wall and metal panel for the second and higher floors. It is assumed that there will be limited areas of higher value exterior finishes. Public landside entrances are assumed to include vestibules.

8.5.5 Roofing

Roofing costs are based on large areas of metal roofing, complex geometry, clerestory windows and skylights. Low slope areas will have single-ply roofing. All areas will be insulated to meet current energy codes and will have integral gutters or roof drains.

8.5.6 Interior Construction

Interior partitions are considered metal framing with drywall, with large areas of interior glass walls.

8.5.7 Stairs

Stairs are considered metal pan with concrete infill at non-public areas.

8.5.8 Interior Finishes

Passenger circulation and gathering areas are assumed to have terrazzo flooring (or similar material), holdrooms are to have carpet. Other typical finishes in public areas include: glass partitions and guardrails, and other wall finishes of durable materials, and high-end ceilings. Back-of-house areas are assumed to include areas with carpet tile (or similar) flooring, painted gypsum board walls and acoustical ceilings, and other areas with sealed concrete floors, painted CMU walls and painted exposed-structure ceilings. Concession have been estimated as shell construction. Future Tenants will provide interior design and construction of these spaces under separate leases, agreements and permits.

8.5.9 Converying Systems

This includes elevators and escalators. The costs for these systems are represented parametrically based on similar programs (dollars per square foot).

8.5.10 Plumbing

The costs for this division are represented parametrically based on similar programs (dollars per square foot).

8.5.11 HVAC

The costs for this division are represented parametrically based on similar programs (dollars per square foot).

8.5.12 Fire Protection

The costs for this division are represented parametrically based on similar programs (dollars per square foot).

8.5.13 Electrical

The costs for this division are represented parametrically based on similar programs (dollars per square foot).

8.5.14 Services

This includes fire alarm, telephone/data networks and systems and equipment, access control, CCTV, EVIDS, and paging, public address and master clock systems. The costs for these systems are represented parametrically based on similar programs (dollars per square foot).

8.5.15 Equipment

This includes Baggage Handling Systems. The costs for these systems are represented parametrically based on similar programs (dollars per square foot).

8.5.16 Furnishings

This includes ticket and gate counters and other fixed furnishings and holdroom seating and other moveable furnishings. The costs for this division are represented parametrically based on similar programs (dollars per square foot).

8.5.17 Demolition

This is costs for the phased demolition of the existing buildings. The costs for this division are represented parametrically based on similar programs (dollars per square foot).

8.5.18 Airside Sitework

Sitework costs include demolition of apron paving and related utilities, earthwork, site utilities, lighting and communications, new apron paving and new passenger boarding bridges.

8.5.19 Landside Improvements

Landside improvements include the new parking structure, new exit and entry plaza's, temporary roadways and related work, demolition of existing roadways, sidewalks and utilities, earthwork and new utilities, roadways, sidewalks, fences, walls, barriers, lighting and landscaping.

8.6 Exclusions

This estimate specifically excludes the following items:
- Any non-competitive bid or restrictive contract conditions
- Unforeseen or unknown conditions
- Hazardous waste removal costs including asbestos abatement, contaminated soil, etc.. and related work, otherwise noted
- Any cost associated with the relocation of the employee parking lot or future long-term parking lot at existing terminal demolition location
- Any work related to Phase 2 (MAP 4.0) that adds the 4 additional gates to total 18 gates
- Feasibility and financing costs
- Owner administrative fees
- Testing fees – Geotechnical and materials
- Land acquisition and real estate fees
- Professional design and consulting fees
- Owners' field inspection costs
- Owner furnished items and owner move-in costs
- Furniture and Equipment beyond costs included in the estimate
- Pre-construction fees
- Project management costs
- Moving or relocation costs
- Credit for recycling
- Artwork
- Technology/IT Equipment unless specifically indicated in the estimate(s)

8.7 Cost Summary

The individual project estimates have been formatted and detailed and reflect the depth and breadth of the planning information developed and available for the programming level activities. Where necessary, within the estimate(s) details are annotated with specific clarifications and or assumptions made by the estimators in efforts to provide comprehensive scopes and costs for each project.

Table 8.3 summarizes the cost estimate for the New Terminal program. The cost estimate is broken into four major components:

- New Terminal
  - o New terminal building, demolition of existing terminal and concourses
- Landside
  - o Roadways/site improvements, site utilities, demo of existing roadways, new parking garage, new entry plaza and exit plaza, parking improvements, pedestrian bridge to terminal
- Airside
  - o New and demolition apron pavement, site grading, airside utilities/lighting/signage, glycol systems
- Misc/Enabling
  - o Temporary work including loading dock and DSM Admin staff relocation to the existing ARFF building.

Table 8.3 - Program Cost Estimate Summary

CATEGORY	COST TO OWNER (INCL. CMAR FEES)	CONTINGENCY (20%)	SOFT COST (22.25%)	TOTAL
New Terminal (incl. Demo)	$185,263,744	$37,052,749	$49,465,420	$271,781,913
Landside	$62,300,559	$12,460,112	$16,634,249	$91,394,920
Airside	$46,768,701	$9,353,740	$12,487,243	$68,609,684
Misc / Enabling Projects	$138,718	$27,744	$37,038	$203,500
TOTAL PROGRAM COST	**$294,471,722**	**$58,894,345**	**$78,623,950**	**$431,990,017**

Chapter 9

Financial Analysis

9.0 Financial Analysis

This chapter summarizes the financial plan for the New Terminal Planning & Programming Study. To ensure the viability of the proposed new Terminal, it is necessary to determine its affordability. This chapter presents a summary of the financial framework governing the airport, the current financial standing of the Airport, funding sources identified for capital projects, and a financial affordability analysis of the proposed project, including analysis of current debt levels, project costs, and the effect of future debt issuances on key financial metrics.

9.1 Financial Framework

9.1.1 Airport Governance

The Des Moines International Airport is operated by the Des Moines Airport Authority under direction of the Authority Board. The Authority was created on February 14, 2011 by a city ordinance passed by the City of Des Moines, pursuant to the provisions of the Iowa Aviation Authority Act under Iowa Code Chapter 330A. The Authority is a corporate municipality and is not subject to federal, state, or local income, sales, or property taxes. Under Chapter 330A, the Authority is tasked with operating the Airport as a financially self-sustaining enterprise and is authorized to borrow money, issue bonds, acquire or construct improvements to the Airport, impose and collect rentals, fees, and charges for services and facilities provided by the Airport.

The Des Moines International Airport, was previously operated by the City, but was transferred to the Authority on November 1, 2011 through a Real Estate Lease and Asset Transfer Agreement.

The Authority receives no local tax money. As an Authority, operating expenses are funded through user fees and charges. Capital improvements are funded through internally generated funds, FAA Airport Improvement Program (AIP) entitlement and discretionary grants, Transportation Security Administration (TSA) grants, passenger facility charges (PFCs), bond proceeds, and other funds.

9.1.2 Bond Resolutions

The Authority has previously issued debt to fund Airport projects under a Master Resolution dated December 20, 2010 and a Supplementary Resolution dated February 7, 2012. Additional Senior or Subordinate Bonds may be issued from time to time as provided in, and subject to the limitations set forth in the Master Resolution.
Under the Resolution, the Authority has covenanted that while any borrowings remain outstanding it will set fees, rates, and charges at the Airport so that Net Revenues are not less than 125% of Debt Service Requirements for that year. While Passenger Facility Charges (PFCs) and Customer Facility Charges (CFCs) are not included in the definition of Revenues, the Airport has the ability to pledge portions of these collections as such, along with other Transferred Amounts in order to meet coverage requirements.

The Airport has approximately $38m of outstanding debt with annual debt service payments of $3.7m per year through 2028, then $2.4m per year through 2035.

9.1.3 Airline Agreements

The Federal Aviation Administration (the "FAA") Authorization Act of 1994 requires Airport fees to be "reasonable" and provides a mechanism by which the Secretary of Transportation can review rates and charges complaints brought by air carriers. However, the 1994 Act provisions do not apply to fees imposed pursuant to a written agreement with air carriers using Airport facilities; this is the case at Des Moines.

The scheduled air carriers operate at the Airport under a Signatory Airline Use Agreement. The agreement provides funding for the ongoing maintenance, operations, debt service, and capital improvements of the airport through various rates and charges. Under the signatory agreements, the signatory airlines pay terminal rent, landing, and apron area fees during the course of the year at rates calculated as part of the budget process.

The existing agreement was effective on January 1, 2014 and contains no revenue sharing or reconciliation provisions. This has allowed the Authority to begin to build the cash reserves that will be necessary for future capital programs. On December 31, 2017, there were six signatory passenger airlines and two signatory cargo airlines, including American Airlines, United Airlines, Delta Air Lines, Southwest, Frontier, Allegiant, United Parcel Service, and Federal Express.

9.1.4 Passenger Facility Charges

The FAA's Aviation Safety and Capacity Expansion Act of 1990 provides approval to collect PFCs. In 1993, the FAA issued a Record of Decision authorizing the Airport to impose and use PFCs on enplaning passengers for the purpose of generating resources for airport projects that increase capacity, increase safety and security, or mitigate noise impact. PFC funds are restricted for such designated capital projects and any debt incurred to finance the construction of these projects.

The Airport initially received PFC approval at a level of $3.00 per passenger for specific projects, but since the initial approval, has received authorization for numerous other projects and in 2001 the collection level was raised to $4.50 per passenger.

9.1.5 Customer Facility Charges

Pursuant to Section 4.08 of the Concession Agreements with rental car companies, the Board of Directors approved the imposing of a CFC on each car rented at the airport commencing on September 1, 2008. The CFC is $3.75 per day, per transaction. The Authority is authorized to collect this fee pursuant to Iowa Code and for the purpose specified by the Authority Board.

9.1.6 Other Relevant Documents and Laws

- Concession agreements, leases, contracts, and permits with various tenants, users, and providers of services at the Airport.
- Federal statutory and constitutional provisions, including the Aviation and Transportation Security Act, the Anti-Head Tax Act of 1973, the Airport and Airways Improvement Act of 1982, and the Interstate Commerce Clause
- Various policies adopted by the Authority.
- Generally accepted accounting principles.
- Various policies adopted by the Authority.

9.2 Key Financial Metrics

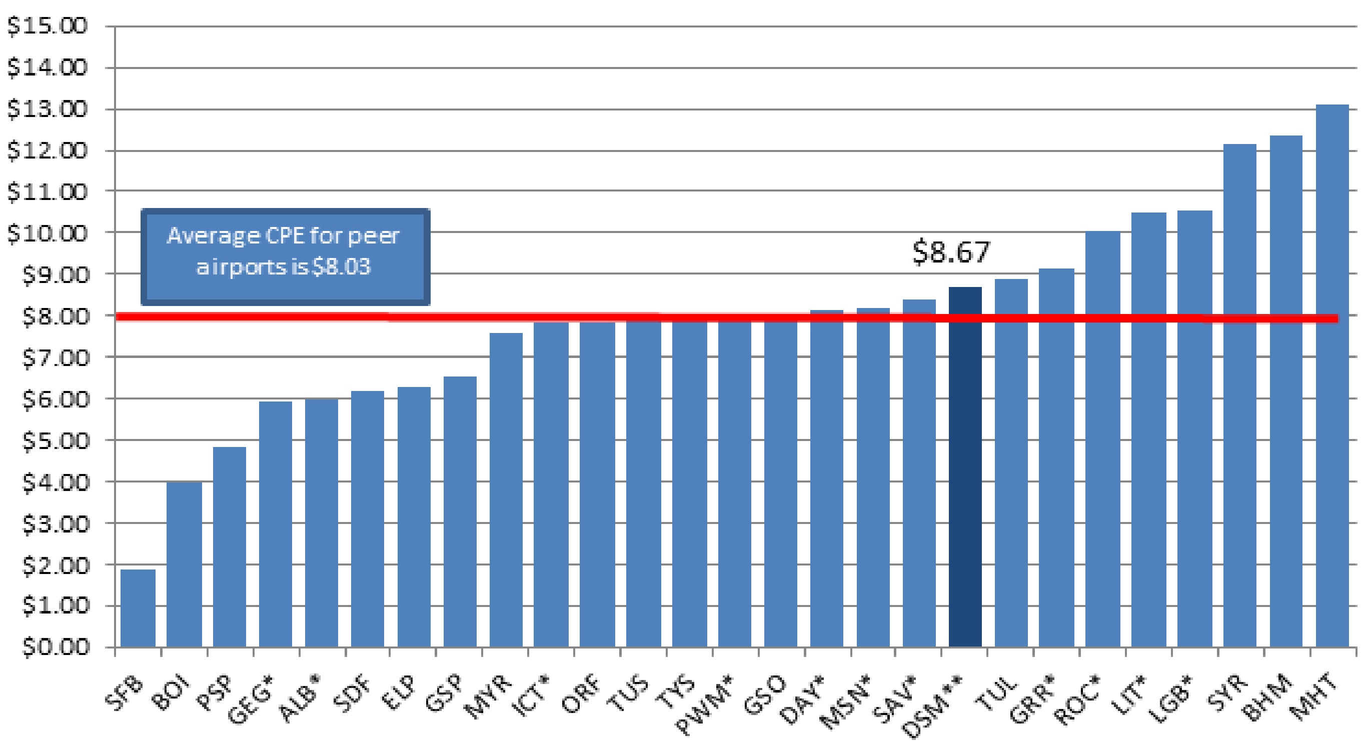
9.2.1 Cost per Enplanement

Cost per Enplaned Passenger (CPE) is the average passenger airline payment per enplaned passenger at a given airport. It is calculated as:

$$\frac{\text{Total airport charges paid by passenger airlines (landing fees, terminal rents, apron fees)}}{\text{Total airport enplanements}}$$

For Des Moines, airline payments in 2018 are estimated to be approximately $11.5m, and with 1.33m enplanements, CPE is projected to be $8.67. The table below illustrates how the CPE at Des Moines compares to a sample of other small hub airports that range in size from 700,000 to 1.4m enplanements.

Figure 9.1 Cost Per Enplanement



Source: FAA CATS Form 127 Data
Note: * indicates that 2016 is the most recent data available
** DSM is 2018 projection

CPE is not a perfect measure as it does not consider the stage an airport is at in terms of facility lifecycle, plus it does not capture any facilities funded by airlines. A lower CPE indicates an airport may be more cost efficient, but could also be an indication of underinvestment or deferred maintenance, or may have less than optimal operating conditions. The CPE may be compared to average fare revenues generated in a market (e.g., the NY market may have a higher CPE, but also can support a higher CPE because of higher fare revenues).

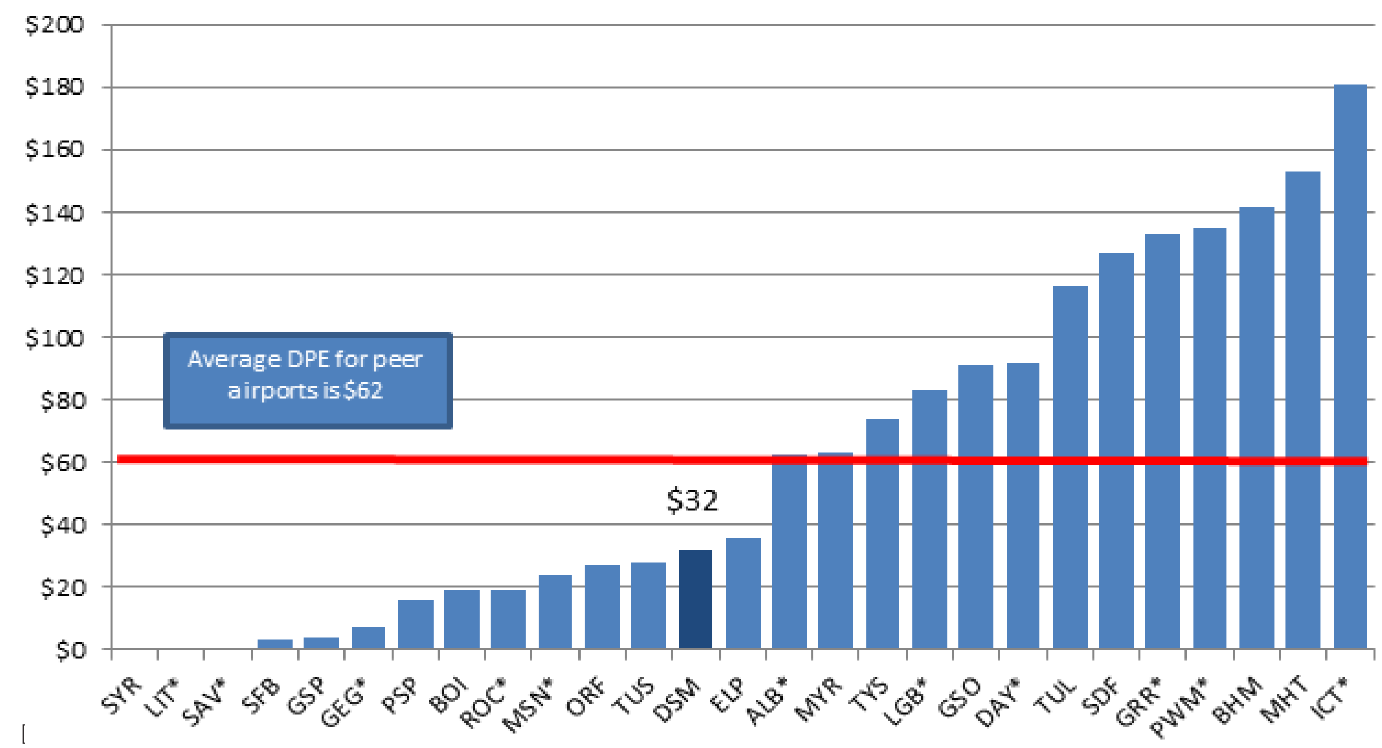
9.2.2 Debt per Enplanement

Debt per Enplaned Passenger (DPE) is the average debt per enplaned passenger at a given airport. Again, DPE is not a perfect measure for similar reasons as CPE, with airports that have recently completed large capital projects likely having higher levels of debt, and those about to commence significant projects likely to be lower. DPE is calculated as:

$$\frac{\text{Total outstanding debt (senior lien, junior lien, PFC, CFC)}}{\text{Total airport enplanements}}$$

For Des Moines, with just under $40m in outstanding debt and 1.33m enplanements, DPE is projected to be $32. Several other airports in the sample have zero outstanding debt. Airports serving Syracuse (SYR) and Little Rock (LIT) are currently evaluating or undertaking major terminal enhancements, and Savannah (SAV) paid off their existing bonds at the end of 2016.

Figure 9.2 Debt Per Enplanement



9.2.3 Debt Service Coverage

Debt Service Coverage (DSC, or coverage) is a measure of how much Net Revenue is available to meet annual debt service requirements. Coverage is calculated as:

(Revenues – Cash Expenses [Excludes Depreciation])
Debt Service

For Des Moines, with projected 2018 Revenues of approximately $36.4m, expenses of $22.5m, and debt service of $3.6m, coverage is estimated to be around 3.86x.

The higher the coverage ratio is the better. The minimum level can vary based on the type of airline agreement, reserve accounts, and other bond holder protections. The Airport will likely need to maintain coverage of 1.5x or greater through the terminal development program given the risk profile of the Airport. **Figures 9.3 and 9.4** compare the DSC and DCOH metrics at Des Moines with other airports analyzed by Fitch Ratings.

Figure 9.3 Debt Service Coverage

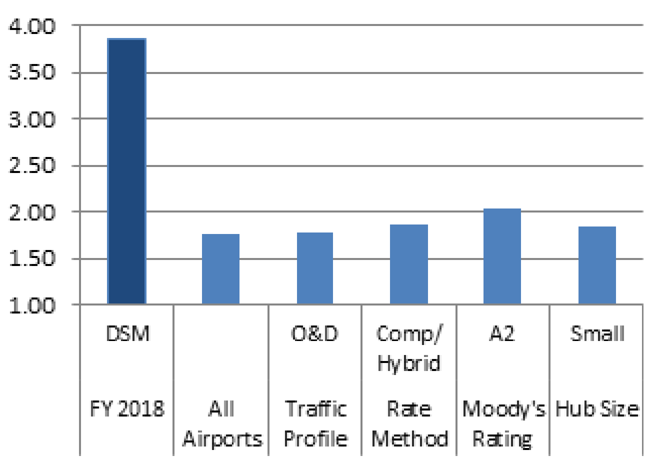
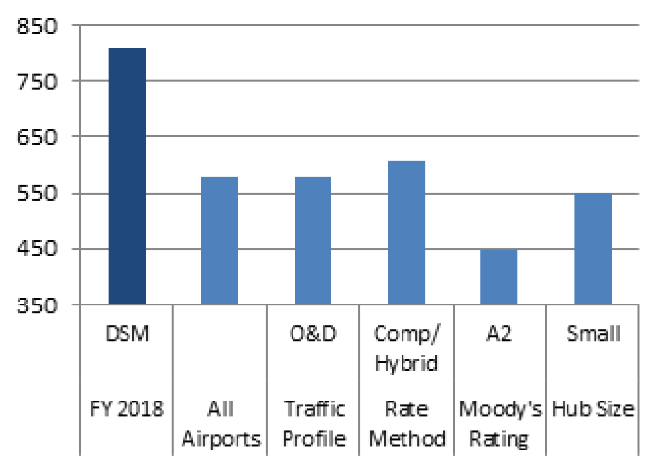


Figure 9.4 Days Cash on Hand



Source: FitchRatings - Rating Criteria for Airports. Airports, 2017

9.2.4 Days Cash on Hand

Days Cash on Hand (DCOH, or Days Cash) is a liquidity measure that calculates the amount of cash available to cover operating expenses and other financial requirements. DCOH is calculated as:

Unrestricted Cash and Investments
Average Daily O&M Expenses

The Airport has built up sizable reserves in anticipation of the terminal project, with more than $50m unrestricted cash projected to be on hand in 2018. With 2018 expenses estimated at $22.5m, DCOH is approximately 810 days or 2.2 years.

The higher the cash reserves the better, and borrowers and rating agencies typically wish to see a 1-year minimum of cash on hand. The affordability analysis to follow assumes the Authority spends all available cash down to a level that maintains ~400 days cash on hand.

9.3 Sources of Funds

In addition to the new terminal, the Authority has other significant projects included in its capital plan, including major airfield pavement work, development of the South Quadrant and ongoing projects at the existing terminal. The principal sources of funding for the new terminal and these additional projects are expected to be:

- Federal Grants
- Passenger Facility Charge Revenues
- Customer Facility Charges
- General Airport Revenue Bonds
- Airports Reserve Funds and Retained Surpluses

9.3.1 Federal AIP Grants

The Airport Improvement Program (AIP) is a federal program which has been established to provide grants to airport sponsors to aid with funding for the planning and development of public-use airports. DSM is designated as a "small hub," a class for which the AIP program will generally fund up to 90% of the project costs for eligible projects.

The FAA has established formulas for the allocation of AIP entitlement funding to airports based on passenger enplanements and cargo volumes. In addition to programmed annual entitlements, airports may receive discretionary AIP funding from the FAA. AIP entitlement and discretionary funds have provided an important source of capital funding for airports in general and specifically at DSM.

9.3.1.1 Entitlement Grants

Based upon the FAA formula for AIP entitlement grants and current traffic activity forecasts, the Authority expects to receive approximately $4.4m annually for use on eligible projects. It is assumed that the United States Congress will continue to authorize and fund the AIP program in substantially similar form throughout the projection period and therefore that the Authority will continue to receive these grants at levels commensurate with historical receipts. In the near-term, the Authority plans to use Entitlement grants to fund portions of key airfield projects, such as the reconstruction of Runway 13/31, the reconstruction of Runway 5/23, the intersection of the two runways, and final design of the new terminal. Starting in 2024, Entitlement grants will be used towards the construction of the new terminal apron.

9.3.1.2 Discretionary Grants

The FAA awards discretionary grants for projects based upon national priority to the aviation system. The FAA has acknowledged the importance of the terminal project to the Authority and has indicated that it intends to make discretionary grants available to fund the reconstruction of Runway 13/31, the reconstruction of Runway 5/23, the intersection of the two runways, taxiway Papa construction, and final design of the new terminal. However, there is no guarantee of future availability beyond existing FAA authorized amounts, and if discretionary funds do not materialize for projects as planned, the terminal project could encounter significant delays unless funding may be sought from alternative sources. Starting in 2024, Discretionary grants will be used towards the construction of the new terminal apron, glycol systems and airfield utilities.

9.3.2 Passenger Facility Charges

An airport must apply to the FAA for the authority to impose a PFC and can only use PFCs for approved projects. The Authority is currently applying PFC revenues to projects under two PFC applications. PFC #15 and #16 include approval for an Environmental Assessment for the new terminal, the reconstruction of Runway 13/31, the reconstruction of Runway 5/23, this terminal programming study, and others.

New applications will be required to seek approval for further eligible projects. PFCs are planned to be used for the 10% "local match" of AIP funded projects identified above, namely the intersection and terminal design. After 2024, PFCs are planned to be used to fund initial terminal site projects, such as demolition, utilities, and roadways, followed by construction of the terminal itself. In addition, PFC funds are planned to be used to pay for upgrades or enhancements of facilities in the existing terminal until the new facility is operational. PFCs will also be pledged towards debt service of Airport bonds.

For the "Base Case" funding scenario, no increase in the PFC level from the current $4.50 is anticipated. However, for an alternate scenario, and increase to $8.50 in 2022 is contemplated.

9.3.3 Customer Facility Charges

CFCs are planned to be used for the construction of the new ConRAC facility planned for 2020, as well as to fund the purchase of shuttle buses. After 2024, CFCs are planned to be used to partially fund terminal utilities, roadways and site work. In addition, some CFCs are pledged towards debt service of future Airport bonds. The Authority's base case does not contemplate an increase in the CFC from the current level of $3.75 per transaction day.

9.3.4 General Airport Revenue Bonds

General Airport Revenue Bonds (GARBs) are planned to be issued to fund significant portions of the terminal construction, as well as preliminary work on roads and utilities, design, and demolition. The bonds will be backed by Airport revenues, together with pledges from CFCs and PFCs. Two 30-year bonds are anticipated, one in 2024 and the other in 2027, both with an assumed interest rate of 6%, with issuance costs, reserves, and capitalized interest funded from proceeds. As airlines can only be charged for debt service costs on occupancy of the new facilities, the first issuance will be supported by PFCs and CFCs with the debt service from the second issuance flowing to the airline rates and charges.

9.3.5 Other Grants

The Authority has been investigating the ability to obtain additional grants towards capital projects at the Airport. Although no funds have been approved or specifically requested, the Authority believes there is a strong chance that these should become available as the project advances.

9.3.6 Authority Reserve Funds and Retained Surpluses

The Authority has more than $50m in reserves on hand, and anticipates continued annual surpluses going forward. These funds are available for the Authority's discretionary use and are not subject to approval by airlines. The Authority plans to use retained surpluses to fund work on the South Quadrant of the Airport and to prepare the site for General Aviation and cargo developments. Additional internal funds are planned for the ConRAC facility, the parking garage expansion, terminal demolition and site work, and terminal construction. Retained Surpluses are planned to fund ongoing projects or major maintenance at the existing terminal.

9.4 Capital Requirements

9.4.1 Capital Requirements by Funding Source

The chart below summarizes the Airport's planned capital projects by funding source through 2030 under the base case. Note, all values are shown in 2018 dollars, i.e. not adjusted for inflation.

Figure 9.5 Summary of Capital Requirements by Funding Source ($M)

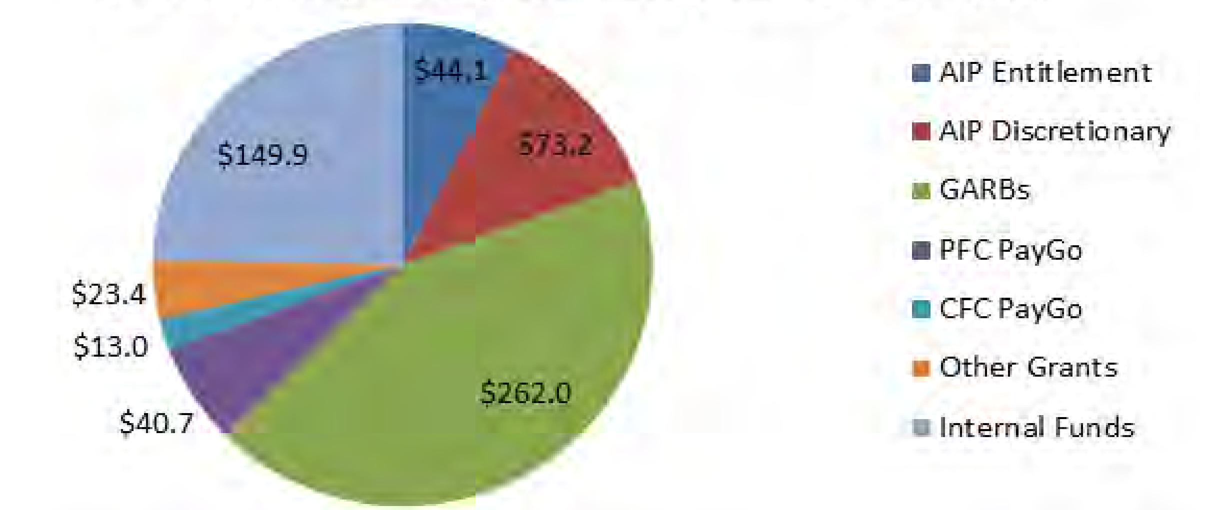


Figure 9.6 Funding Source By Year

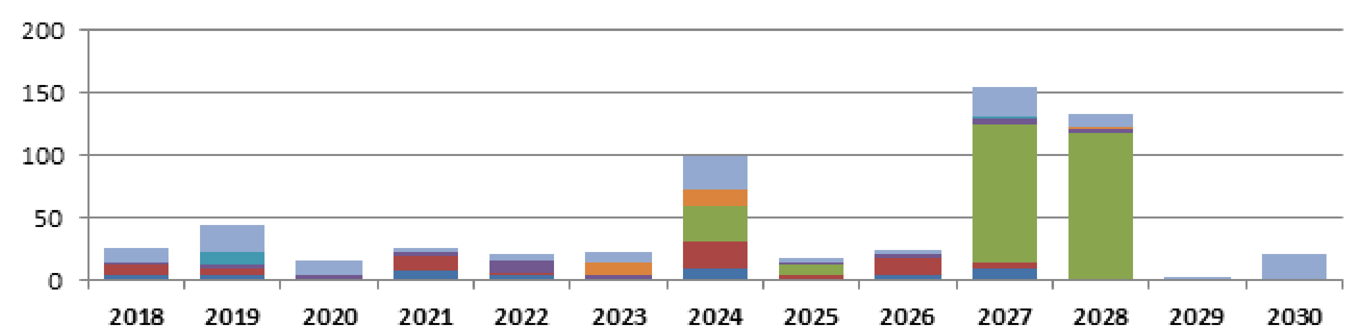
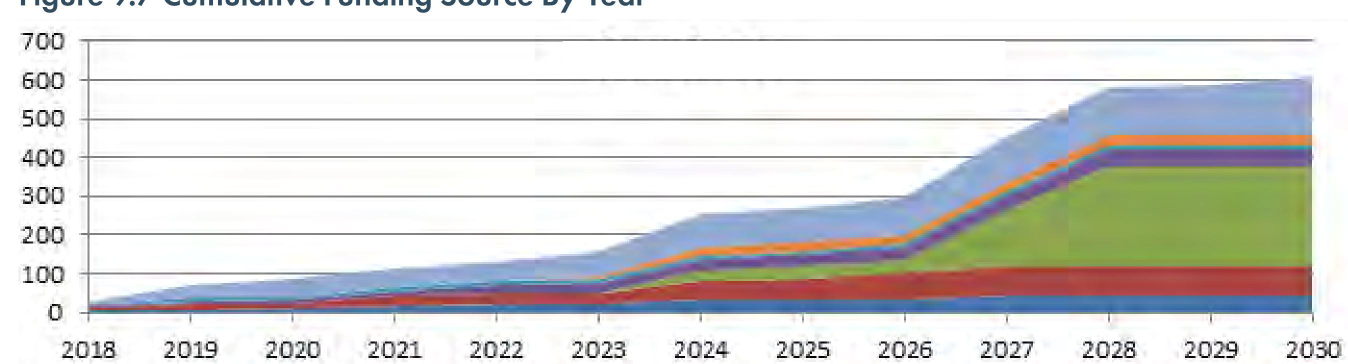


Figure 9.7 Cumulative Funding Source By Year



9.4.2 Capital Requirements by Project Type

Figures 9.8 & 9.9 below summarizes the Airport's planned capital projects by project type through 2030 under the base case. Note, all values are shown in 2018 dollars, i.e. not adjusted for inflation.

Figure 9.8 Summary of Capital Requirements by Project Type ($M)

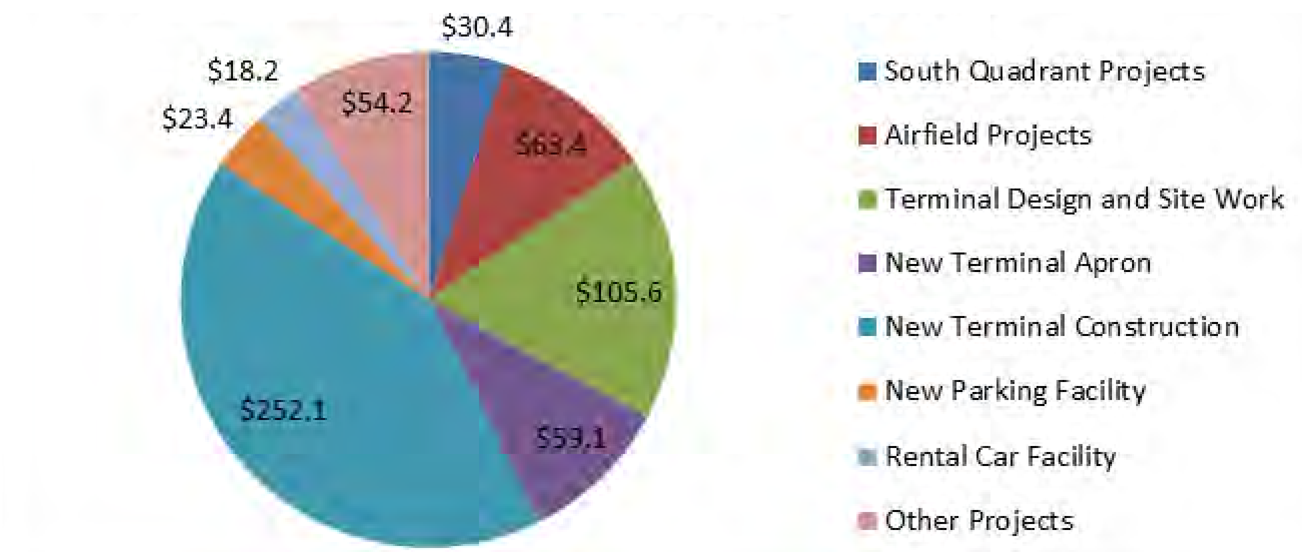


Figure 9.9 Project Type By Year

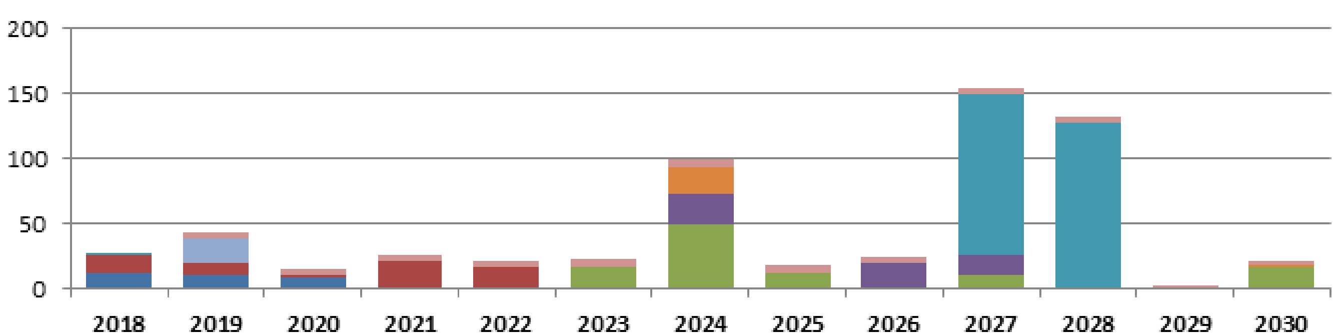
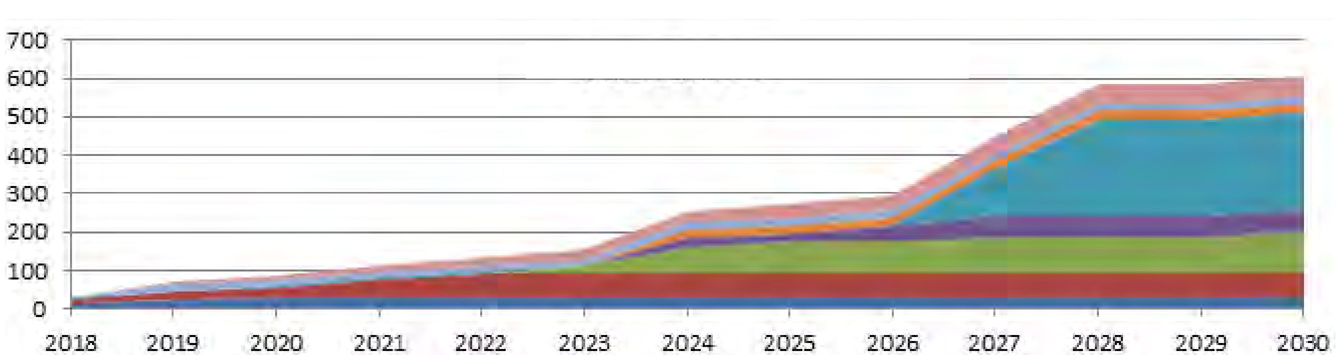


Figure 9.10 Cumulative Project Type By Year



9.5 Key Assumptions

To evaluate the affordability of the new Terminal Plan along with other capital projects, long range projections of revenues, expenses, activity levels, and cash flows were developed through 2030 when the terminal project is estimated to be complete.

Key assumptions used to develop the model include:

- Enplaned passenger growth of 2% throughout the projection period and 1-1.5% growth for landed weight
- Operating expenses to grow at 2.5% across all categories
- Interest earned on cash deposits assumed at 1% for 2018 and 2% thereafter
- Non-aeronautical revenues grow at 1-4% depending on type, with most ground leases at 1% and some concessions at 4% based on passenger and inflationary growth
- Rental car concessions revenue growth at 1%
- Rental car bus purchases estimated at $1.5m with annual operating expenses of $1.5m (in 2018 dollars)
- Parking revenues to grow at 2% per year with a one-time increase of $750k in 2021 once new parking spaces become available when rental car operations move to the new location
- The Airport has $50m cash reserves and retained surpluses on hand at the end of FY2017, plus a further $5m in PFCs and $7m in CFC funds
- Operating surpluses of approximately $8-11m (including PFC and CFC revenues) per year are projected for 2018-2022 prior to annual capital spending. These add to the retained surpluses available for the terminal project.
- The financial metrics calculations assume the future cost of capital projects is increased by 3% per year for construction cost inflation. Note that the pie charts showing capital requirements are shown in 2018 dollars and not inflated.

9.6 Financial Metrics - Base Case

Based upon the capital requirements, funding sources and project timeline shown in Section 9.4 and Key Assumptions in Section 9.5, the following metrics are derived from the financial model.

Table 9.1 Summary Metrics - Base Case

	2018	2024	2025	2026	2027	2028	2029	2030
Net Passenger Airline Payments ($m)	$11.60	$13.80	$14.40	$14.90	$15.40	$15.80	$37.70	$37.80
Enplaned Passengers (000s)	1,332	1,500	1,530	1,561	1,592	1,624	1,656	1,689
CPE	$8.67	$9.22	$9.39	$9.53	$9.70	$9.74	$22.74	$22.39
CPE ($2018 @ 2.5%)	$8.67	$7.95	$7.90	$7.82	$7.76	$7.61	$17.33	$16.65
Total Outstanding Debt ($m)	$38	$86	$83	$80	$454	$450	$447	$439
Debt Per Enplanement	$29	$57	$54	$51	$285	$277	$270	$260
Annual Debt Service ($m)	$3.70	$8.00	$8.00	$7.90	$7.90	$7.90	$34.90	$34.80
Debt Service Coverage	3.77x	2.75x	2.77x	2.86x	2.95x	2.90x	1.36x	1.38x
Available Cash ($m)	$51	$30	$38	$47	$31	$31	$40	$22
Days Cash on Hand	830	417	518	621	404	399	492	259

In 2029 and 2030, the CPE is projected to be well above $20 per passenger in real (inflated) terms, or $17.33 when discounted to 2018 dollars. This would likely place the Airport's CPE well above other small hub airports. At these projected airline cost levels, the profitability of certain routes served by airlines could be impacted leading to loss of service, plus the Airport might face challenges attracting new entrants to the market.

Under the base case, the levels of debt required to fund the project result in a debt per enplanement of $285 in 2027, which is well above the average for small hub airports. Even accounting for inflation, and that other airports may require new facilities over the next decade, DSM would likely be an outlier at this level.

Debt Service Coverage levels are projected to be 1.36x. While above the covenant requirement of 1.25x, this is below the likely requirement of 1.5x, which investors and rating agencies seek to protect from any negative events such as activity reductions, project cost overruns, unanticipated expenses, or other industry events.

With PFCs, CFCs, and Bonds fully utilized, Airport funds are the remaining source available to fund projects in 2030, which results in Days Cash on Hand falling to 259 days in 2030. This is below the 1 year minimum cushion investors would require.

The above metrics indicate that the planned capital program is not financially viable under the stated key assumptions.

9.7 Scenario 1 - Funding Gap

The Authority has been evaluating whether various state, local, or federal grants might be available for this project. Reductions to anticipated borrowings would reduce debt per enplanement and cost per enplanement as well as increase coverage levels. Scenario 1 evaluates what amount of grants will be required to fill the "funding gap", and reduce the CPE to a more manageable level of $15.00.

Scenario 1 shows that if $203.6m of grants were received, , in addition to a CPE of $15.00, total borrowings are projected to be less than $200m, debt per enplanement reaches a high of $123 in 2027, and annual debt service is only $15.5m per year, compared to $34.9m under the base case. Debt service coverage would be a healthy 2.23x, and the Authority is projected to maintain cash levels above 400 days. However, although the Authority continues to investigate and evaluate a wide range of grants and other available funding sources, it is unlikely that an amount in excess of $200m would be available for the project.

Figure 9 .11 Scenario 1 - Capital Requirements by Funding Source ($M)

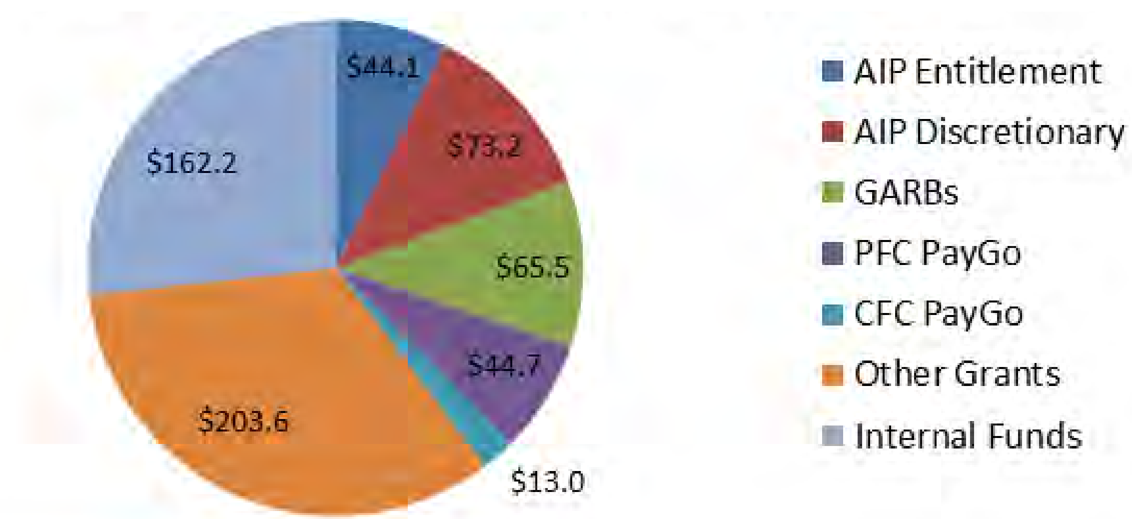


Table 9.2 - Summary Metrics - Scenario 1

	2018	2024	2025	2026	2027	2028	2029	2030
Net Passenger Airline Payments ($m)	$11.60	$13.80	$14.40	$14.90	$15.40	$15.80	$24.80	$25.00
Enplaned Passengers (000s)	1,332	1,500	1,530	1,561	1,592	1,624	1,656	1,689
CPE	$8.67	$9.22	$9.39	$9.53	$9.70	$9.74	$15.00	$14.81
CPE ($2018 @ 2.5%)	$8.67	$7.95	$7.90	$7.82	$7.76	$7.61	$11.43	$11.01
Total Outstanding Debt ($m)	$38	$75	$72	$69	$195	$192	$188	$184
Debt Per Enplanement	$29	$50	$47	$44	$123	$118	$114	$109
Annual Debt Service ($m)	$3.70	$7.10	$7.20	$7.10	$7.10	$7.10	$15.50	$15.50
Debt Service Coverage	3.77x	2.95x	2.97x	3.07x	3.17x	3.11x	2.23x	2.26x
Available Cash ($m)	$51	$46	$54	$63	$31	$32	$47	$35
Days Cash on Hand	830	646	742	839	405	404	578	421

9.8 Scenario 2 - PFC Increase and Further Value Engineering

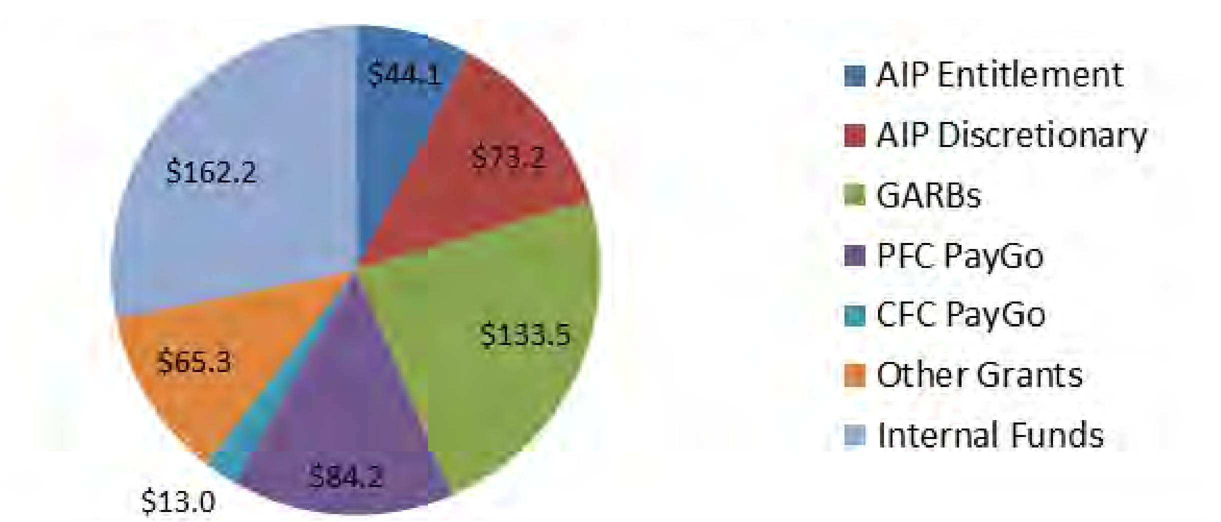
PFCs have been capped by the federal government at $4.50 since 2001, and since that time, their purchasing power has been significantly eroded by inflation. Of the largest 133 airports in the country, 129 now impose a PFC, and 123 impose it at the maximum $4.50 level. Through 2016, a total of $50.1b of PFCs have been collected by all airports since the program began in 1992, and a further $52.7b of future collections are already obligation for approved projects. This indicates that many airports have exhausted the ability to use PFCs as a funding source for near-term and even medium term projects.

Congress has been considering changes to PFC regulations for a number of years, but to date, no increase has been approved. Scenario 2 assumes that the PFC is increased to $8.50 in 2022, and that these funds can be utilized in the same manner as under existing regulations. This scenario allows the Authority to accumulate additional PFC funds prior to construction of the new terminal which minimizes required borrowings, plus it generates additional annual revenues to pledge against (and reduce) debt service obligations.

At this stage of the terminal planning exercise, the current project cost estimates include significant amounts for contingencies. As project requirements are reevaluated, refined, and updated, Scenario 2 assumes that the cost of the terminal building could be reduced by 12.5%.

As with Scenario 1, a target CPE of $15.00 is assumed, with grants again used to fill any funding gap.

Figure 9.12 Scenario 2 - Capital Requirements by Funding Source ($M)



AIP Entitlement and Discretionary grants are unchanged from the base case, but reliance on GARBs is reduced by almost 50%. The additional PFCs from 2022 allow for more PFC Paygo to be utilized to fund preliminary terminal related projects. Scenario 2 indicates that the funding gap to be plugged by grants reduces from $200m to around $65m.

As shown below, in addition to the $15.00 CPE, the Debt per Enplanement metric of $168 is more reasonable compared to the small hub airport sample, debt service coverage is adequate at 1.92x, and the Airport maintains cash levels above 400 days.

Table 9.3 - Summary Metrics - Scenario 2

	2018	2024	2025	2026	2027	2028	2029	2030
Net Passenger Airline Payments ($m)	$11.60	$13.80	$14.40	$14.90	$15.40	$15.80	$24.80	$24.90
Enplaned Passengers (000s)	1,332	1,500	1,530	1,561	1,592	1,624	1,656	1,689
CPE	$8.67	$9.22	$9.39	$9.53	$9.70	$9.74	$15.00	$14.76
CPE ($2018 @ 2.5%)	$8.67	$7.95	$7.90	$7.82	$7.76	$7.61	$11.43	$10.97
Total Outstanding Debt ($m)	$38	$75	$72	$69	$267	$264	$260	$255
Debt Per Enplanement	$29	$50	$47	$44	$168	$162	$157	$151
Annual Debt Service ($m)	$3.70	$7.10	$7.20	$7.10	$7.10	$7.10	$20.90	$20.90
Debt Service Coverage	3.77x	2.95x	2.97x	3.07x	3.17x	3.11x	1.92x	1.95x
Available Cash ($m)	$51	$46	$54	$63	$31	$32	$47	$35
Days Cash on Hand	830	646	742	839	405	404	579	425

9.9 Conclusion

The planning team has made significant efforts to reduce the size and cost of the program through reviews of project requirements, evaluation of numerous alternatives, and ongoing discussions with stakeholders. However, the Authority still needs to identify a combination of a further $200m in grants and new funding sources, or additional cost savings in order to maintain healthy financial metrics and enable the project to be feasible.

An increase in the PFC level is crucial to the affordability of the project and an immediate increase to the $4.50 cap could allow the Authority to accelerate the project from the current schedule. Given the congestion, capacity, operational, and ongoing maintenance issues the existing terminal faces, the Authority needs to identify a path forward to alleviate current and future problems, and further value engineering and construction costs discipline will be key to meeting the financial metrics that make the terminal plan viable.