RAPID CITY REGIONAL AIRPORT

KLJ
ENGINEERING, REIMAGINED

BNP ASSOCIATES, INC.

ALLIIANCE

2017 TERMINAL STUDY

Rapid City Regional Airport

September 2017

RAPID CITY REGIONAL AIRPORT
2017 TERMINAL STUDY
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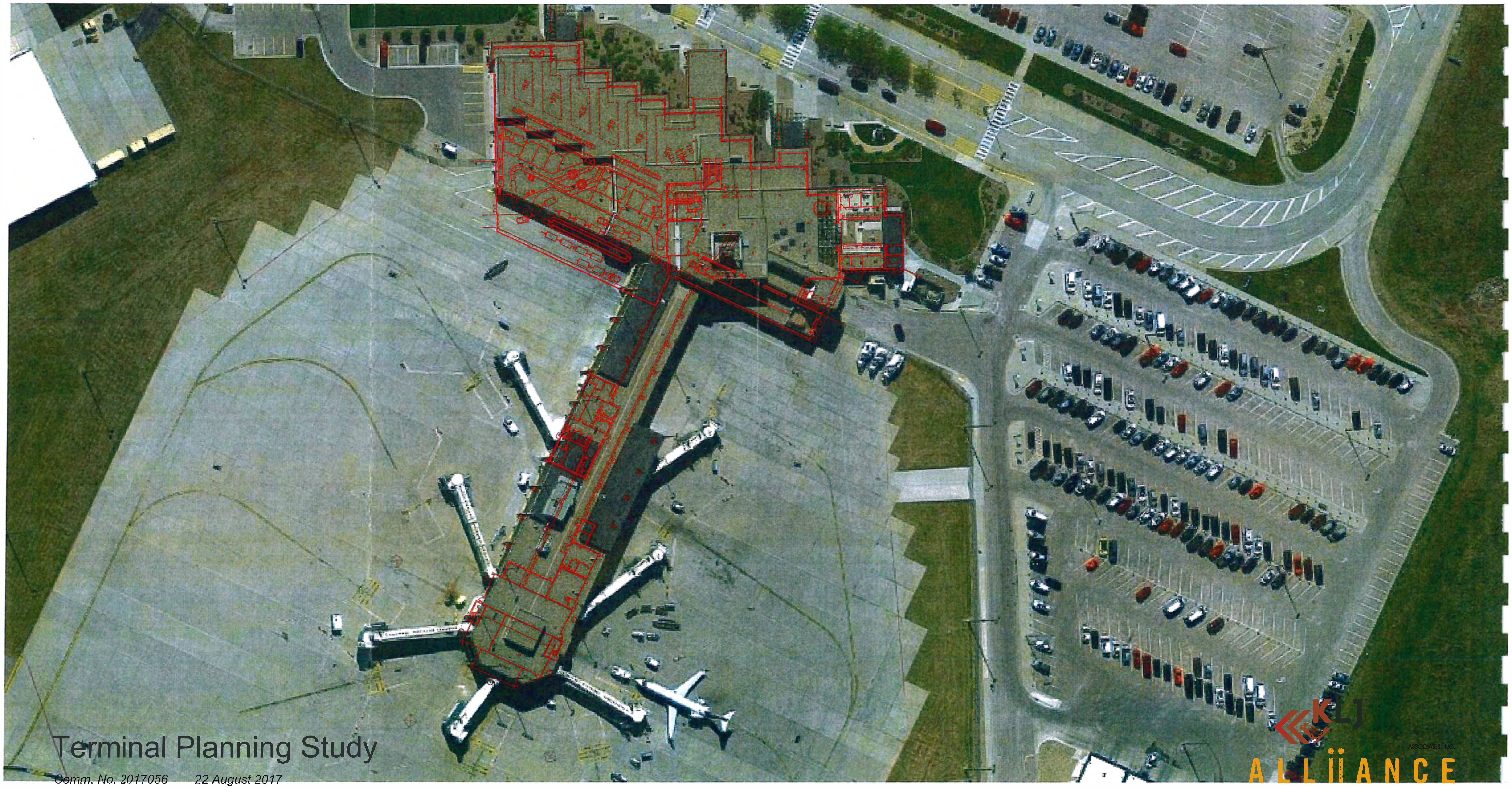
Rapid City Regional Airport



Terminal Planning Study

Comm. No. 2017056 22 August 2017

Alliiance was retained by KLJ, the Prime Consultant, to provide conceptual architectural and system planning studies to improve terminal functionality and efficiency. Together with BNP Associates, Faithful & Gould, and Convergint Technologies, Alliiance led two primary planning studies for Rapid City Regional Airport (RAP) focusing on:

1. Outbound passenger processing functions associated with ticketing, baggage security and make-up areas, and airline ticket offices
2. Interior vertical circulation improvements focused on escalator replacement and orientation to improve passenger sightlines and wayfinding

From our initial review several different potential projects were identified for planning and cost estimates. There is no clear understanding of when these projects might be carried out, and the order does not necessarily suggest an order of execution.

A) Outbound Baggage Handling System and Screening
B) Terminal Expansion and Remodel – Outbound Passenger Processing
C) Vertical Circulation Improvements
  C.2) Vertical Roof Expansion Adjacent to Vertical Circulation
D) Replace Existing Bag Claim Device "B1"

As a starting point, the team reviewed the 2008 Master Plan to understand planning recommendations related to the anticipated list of projects as well as passenger enplanement forecasts. KLJ and Alliiance participated in an on-site kick-off meeting to tour the existing site and building envelope as well as to hold discussions with the Airport and their tenants regarding potential constraints, expansion opportunities, and funding sources.

Existing Conditions

The terminal and concourse were constructed in 1987. There was a major remodeling and finishes upgrade in 2012 that also added a one-story terminal expansion for rental car facilities. The terminal building is a two-story structure with a partial lower level for utilities and storage, and a partial mechanical penthouse level. The roof rises in steps of varying heights, incorporating clerestory windows and creating a pyramidal ziggurat effect. The principal construction is concrete columns with precast floor and roof slabs, and an exterior of precast concrete panels, stucco, and aluminum windows. The terminal building includes departures and arrivals operations on the ground level. The second level includes administration offices, a restaurant, and restrooms, with the security checkpoint at the entrance to the concourse.

The terminal building has a structural grid shifted at an angle into a saw-tooth pattern. One column grid is oriented north-south, with the other at approximately 25 degrees from orthogonal with the first. Ticket counters and airline spaces are fit into the stepped pattern, resulting in a lack of flexibility, broken-up passenger sight-lines in the departures hall, and odd geometries where the spaces resolve into non-stepped areas at the rear. Ticket Lobby space available for queues and circulation is inadequate for current and projected needs.

Screening of checked baggage is handled by two manually fed Reveal CT-80 EDS machines and by Explosives Trace Detection (ETD) stations positioned behind the airline ticket counters. Screened bags are handled by the airlines through the spaces immediately behind the ticket counters, and loaded on tug carts through a narrow interior tug drive at the rear of the building. This configuration and the fact that one airline's bags may pass through another airlines office creates a security risk of introduction of an object into screened bags. The outbound baggage operation is inefficient at every stage due to the distributed screening and baggage makeup operations and the physical constraints of building size and geometry. There are numerous doors between the sterile and non-sterile areas, at each airline bay. This is likely to soon become a security concern given trends toward more restricted security access.

With the concourse at the upper level, vertical circulation is a critical component of the experience of departing and arriving passengers. The existing escalators, elevator, and stairs divide the departures and arrivals areas visually and physically. The up escalator is obvious to departing passengers, open in a two-story space. The down escalator does not present itself in an obvious or intuitive way for arriving passengers, requiring a hard-right turn and dropping through a narrow shaft. It is well oriented to sight-lines of baggage claim devices at ground level. The elevator is partially visible to arriving passengers, but not at all visible to departing passengers. It effectively blocks views between the two areas of the terminal, and interrupts views from the upper level to the distant hills. The stair is extremely non-intuitive, with a few steps up to a landing lounge, and the remainder of the stair enclosed by a wall behind the elevator.

The information desk is in a high traffic area adjacent to the bottom of the down escalator and next to the main exit vestibule.

The easternmost flat-plate baggage claim device is understood to be in need of replacement, requiring frequent maintenance. It has been resurfaced using truck bed-liner material.

Projects A and B – Outbound Passenger Processing

Initial concept sketches were developed to relocate the existing baggage Explosives Detection Systems (EDS) devices to "back-of-house" areas of the terminal from their existing locations behind the ticket counters. Options included a fully in-line system following the Master Plan alternatives for locating the baggage screening room under the concourse. Challenges with this location included extensive conveyance requirements as well as structural clearance issues along the conveyor routes. An additional terminal expansion to the east that displaced staff parking was also studied. Layouts were studied for a mini-in-line system in various configurations that required building expansion to the north. These options investigated alternative ticket counter configurations ranging from the existing staggered layout to a more traditional linear counter arrangement and their associated airline ticket offices. Self-service kiosks were included in the expanded passenger queue layouts along with proper lobby cross-circulation width. A layout that included no building expansion for the baggage make-up area was also studied for its ability to accommodate the requirements of the EDS screening functions. These concept sketches were then taken into further development by BNP and incorporated into architectural concept plans developed by Alliiance.

The various options were reviewed with the Airport and three were selected for further development. Option A included the building expansion to the east for a fully in-line screening matrix. Option B included two independent mini-in-line systems associated with the east and west ticket counter banks. The third configuration, Option C, while also a mini-in-line system, combined the conveyor lines post EDS with a consolidated OSR and ETD/baggage screening table area. All options expanded the existing make-up area an additional 30 feet to the north to incorporate a single baggage make-up carousel and associated tug maneuvering lanes. KLJ analyzed Gate 1 for any operational impacts due to this proposed building expansion onto the existing apron area and concluded no constraints would result from the expansion. Additional design features common to all three options included:

- Consolidated Airline Ticket Offices (ATOs) allowing flexible layouts
- Linear ticket counter layouts allowing flexible airline frontage and use over time
- Airside and landside staff restrooms
- Enhanced security with reduced Security Identification Display Area (SIDA) access points
- Accommodation of oversize/out-of-gauge (OGG) baggage
- Adaptable mechanical system keeping main distribution in place with option to "open up" overhead space with mechanical modifications if desired

Upon review of the three short-listed options, it was concluded that a fully in-line system would be inefficient for RAP based on the forecasted peak baggage requirements and expense associated with the system. Option C combining conveyor lines post-EDS was recommended by the Planning Team and chosen by the Airport Board as the Preferred Option. This was based on the layout's ability to offer the best combination of function, efficiency, and value while meeting the criteria and operational needs laid out by the Airport during the kick-off meeting. Additional advantages included:

- Lowest first cost
- Least TSA staffing requirements
- Greater ATO space
- Improved access at the Checked Bag Resolution Area (CBRA)
- Fewer conveyor merges resulting in fewer baggage jambs

It should be noted that although considered minor, this layout may increase the chance of "die-back" or baggage back-up due to fewer CBRA stations

Convergint developed planning-level plans for security equipment for the preferred option, and provided an estimate of their cost, as shown in the appendix. Biometric door security upgrades are possible to enhance security. Rough order of magnitude cost would be $3700 for the basic system, plus $1700 per upgraded door. These costs are not reflected in the project Cost Estimate.

The baggage handling and screening systems (Project A) are broken out separately in the cost estimate with the understanding that there could be financial participation by the Transportation Security Administration (TSA) for some or all of this work. BNP Associates has prepared a 10% Basis of Design Report that would serve as the preliminary alternative analysis for TSA review. The document is considered sensitive security information (SSI).

Project C – Vertical Circulation Improvements

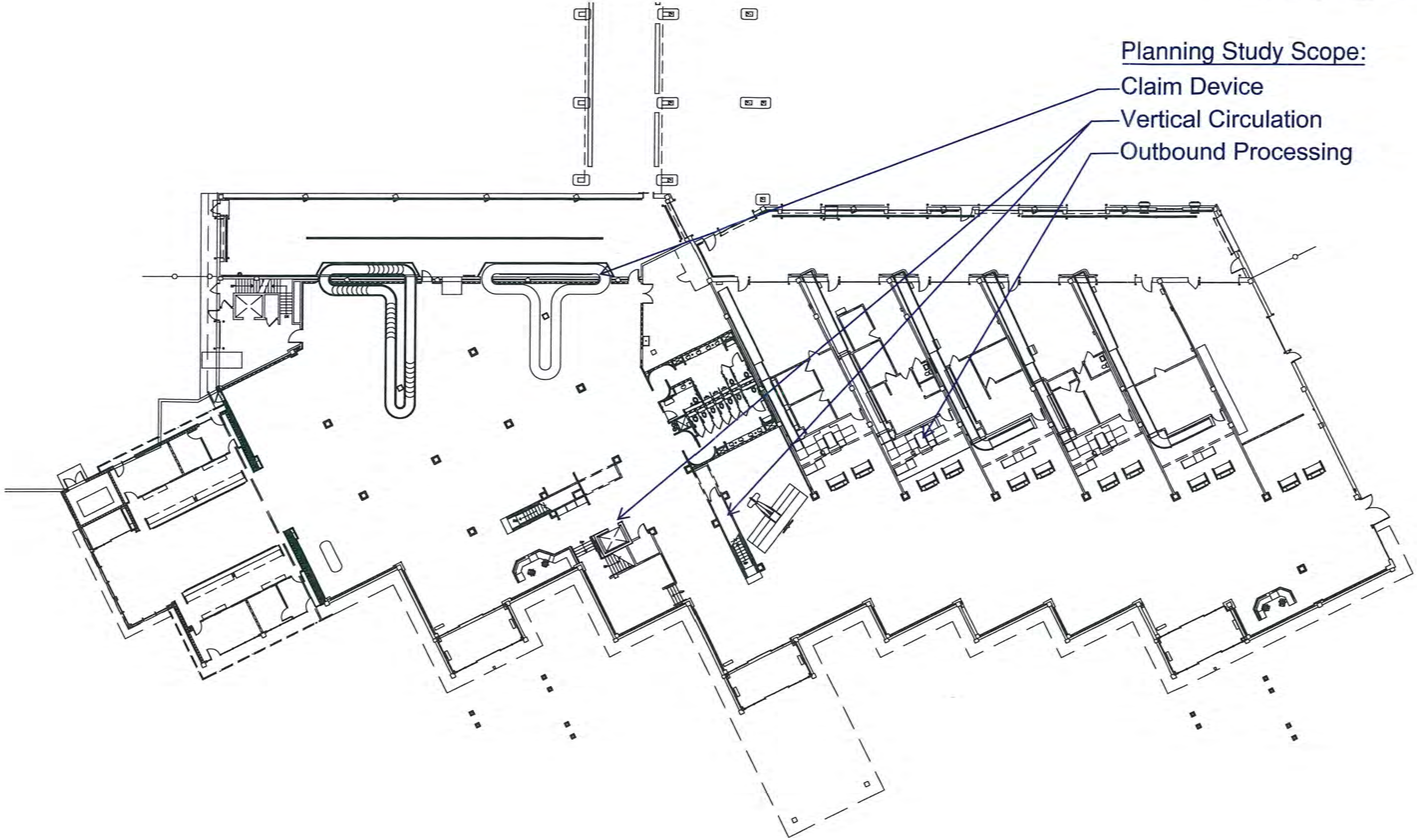
Because the existing elevator and escalators limit visibility and flow between the arrivals and departures areas of the terminal, additional vertical circulation layouts were studied. To provide intuitive wayfinding and alleviate these constraints the existing elevator is proposed to be removed and relocated. The existing up/down escalators would be co-located along with a more visible stair below the existing clerestory, and adjacent to the new elevator. These modifications would provide open sight lines with better visibility for passengers, especially those arriving from the concourse level. Removing the existing elevator and replacing it in a new location with a glass hoistway and remote mechanical room would enhance the view of the distant hills. Although a small portion of the raised area within the existing concessions space would be lost, the reallocated area to the vertical circulation core would provide for a more intuitive and visible circulation path. The existing ground level information counter would be shifted west, allowing more open circulation and avoiding congestion near the exit.

Project C.2 – Vertical Roof Expansion Adjacent to Vertical Circulation

With the relocation of the elevator and stairs there is an opportunity to "open up" the central circulation area by raising the existing roof bay half a level consistent with the building massing, further expanding sight lines and emphasizing the circulation area. This is an optional enhancement, not critical to the relocation of the elevator and escalators.

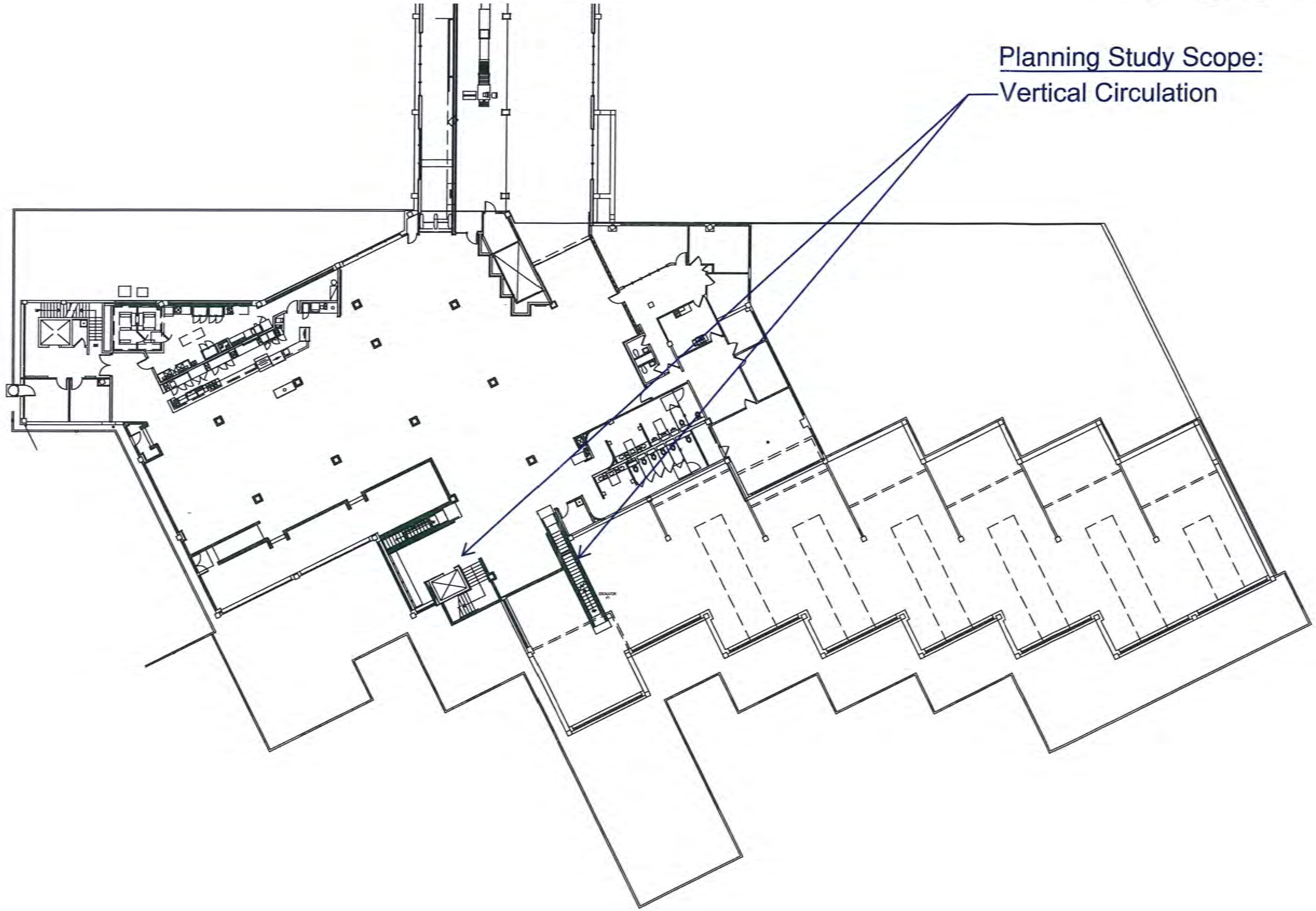
Project D – Replace Existing Bag Claim Device "B1"

The east existing flat plate bag claim device is worn, and may be more cost effective to replace rather than continue to repair. Its configuration is appropriate for demand, and it is assumed that it would be replaced in kind with a new flat plate device in the same location and configuration.



Existing Plan - Ground Floor

Comm. No. 2017056 *22 August 2017*

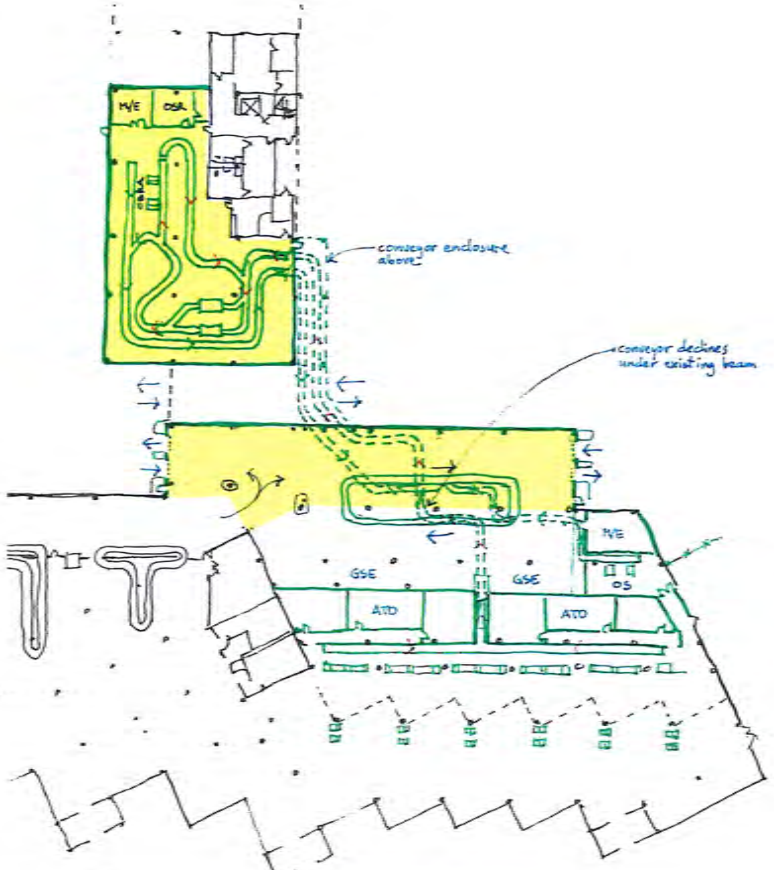


Existing Plan - Upper Level

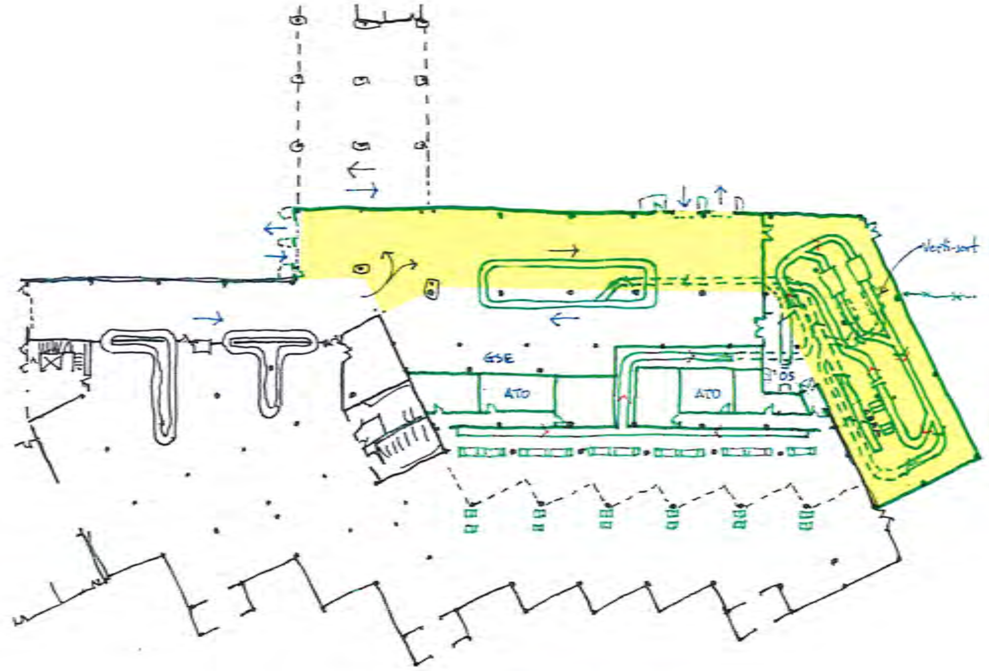
Comm. No. 2017056 22 August 2017

0 15' 30' 100'

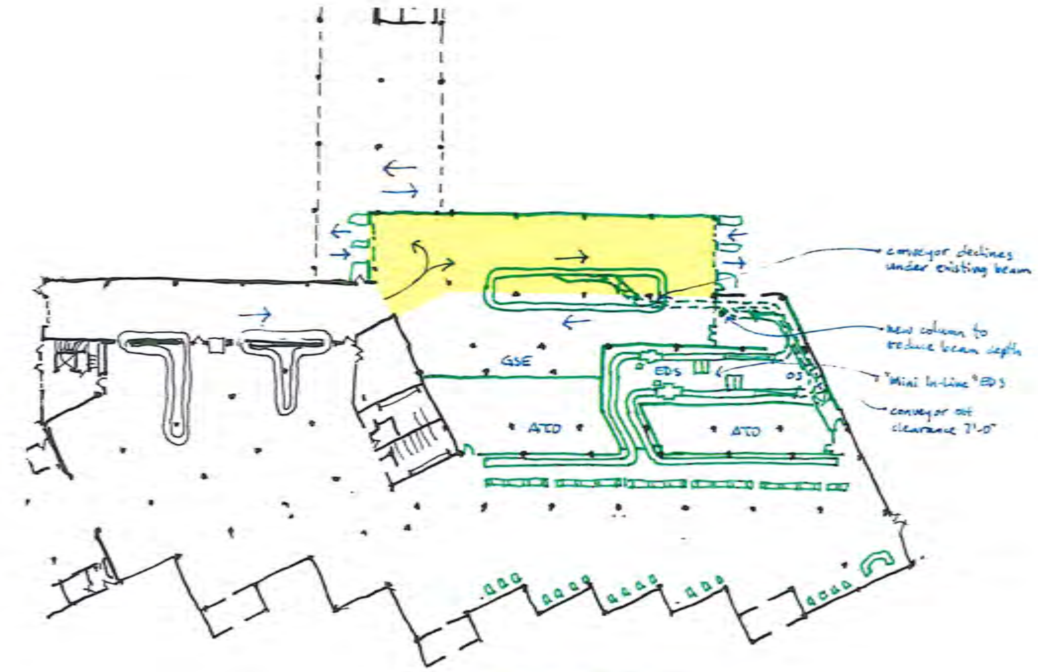
N



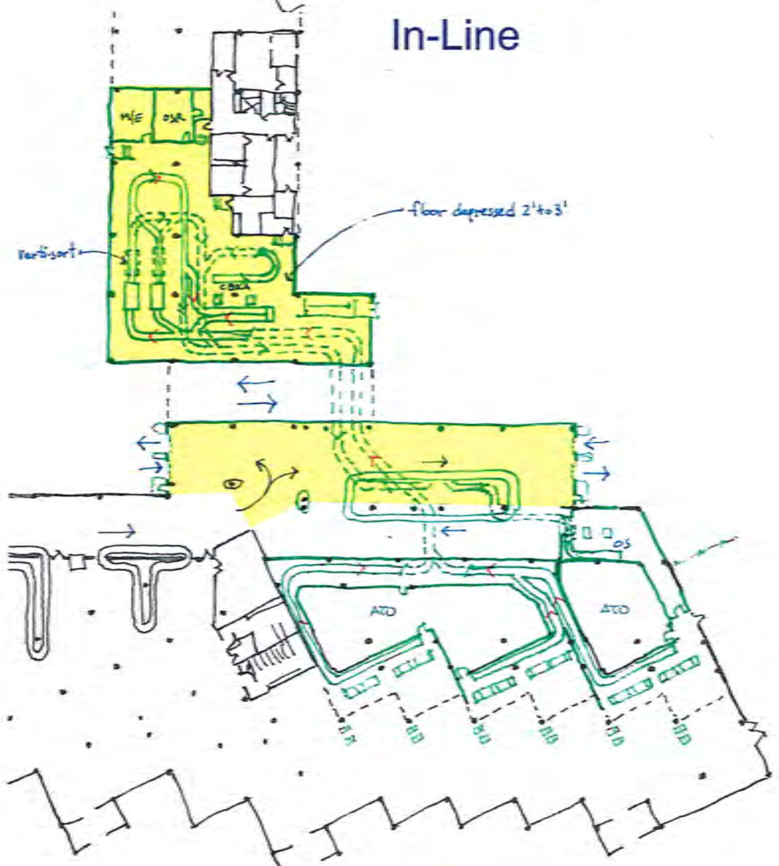
In-Line



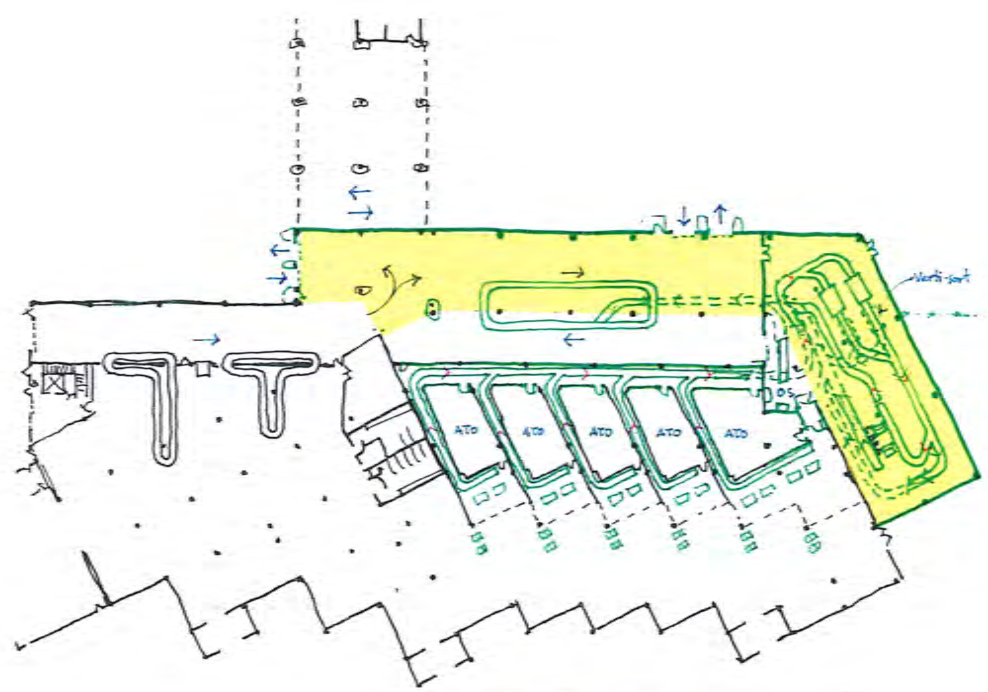
In-Line



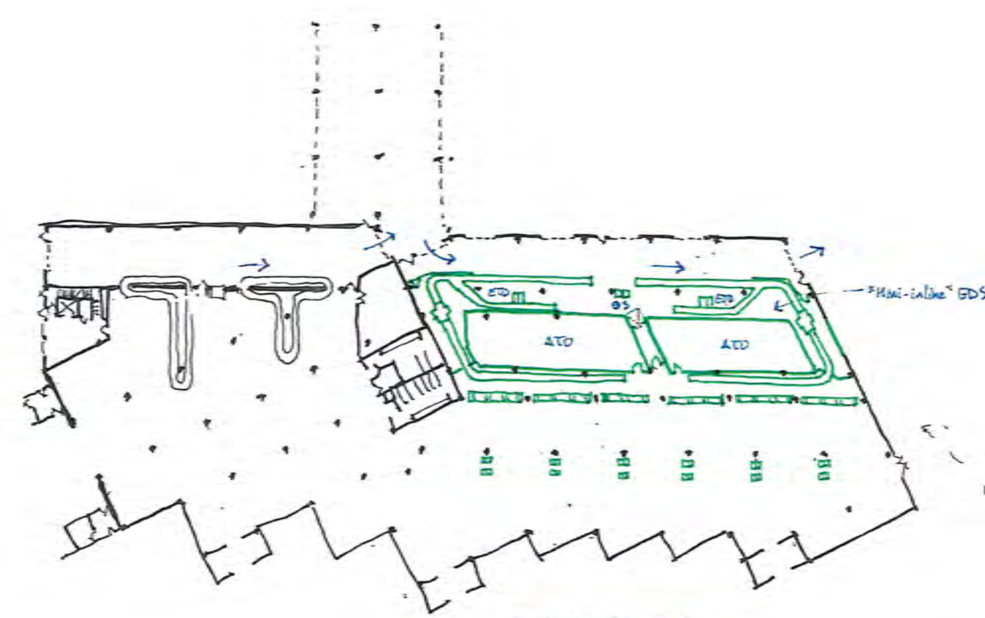
Mini-In-Line



In-Line



In-Line



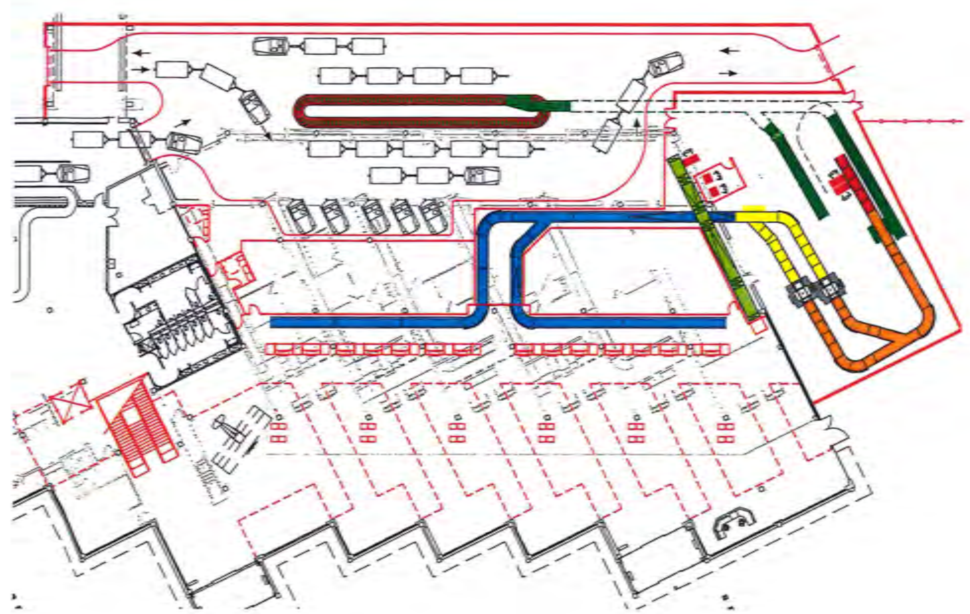
Mini-In-Line

Initial EDS Options

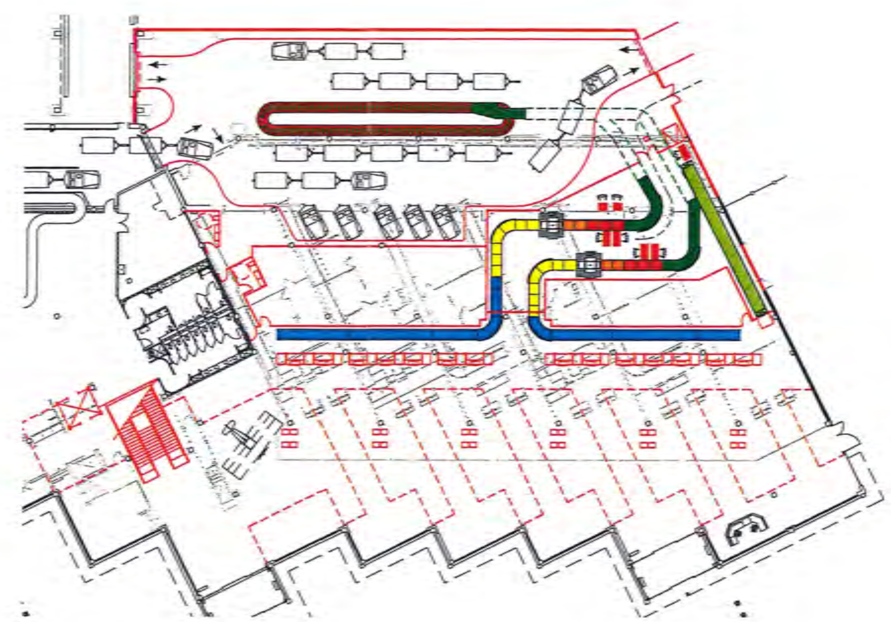
Comm. No. 2017056 *22 August 2017*

Not to Scale

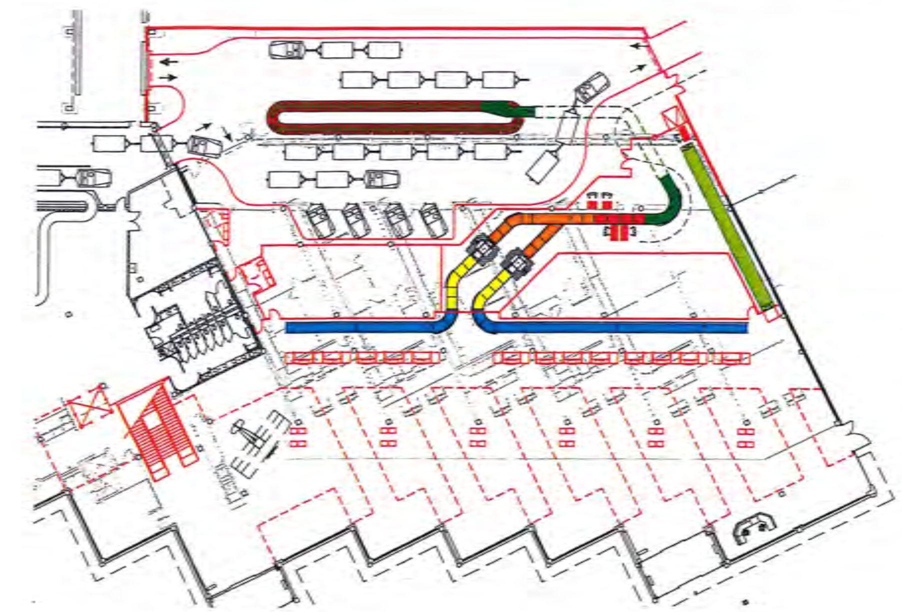
N



EDS Option 'A'
In-Line System CT-80DR



EDS Option 'B'
Mini-In-Line System CT-80DR



EDS Option 'C'
Mini-In-Line System CT-80DR

Design Features - All Options

- consolidated in-line baggage screening
- Baggage Makeup Area expansion
- Consolidated Airline Ticket Offices (ATOs) allowing flexible layouts
- linear ticket counter layout allowing flexible airline frontage
- staff restrooms airside and landside
- enhanced security with limited SIDA access
- address oversized/out-of-gauge bags

Preferred Option = Modified Option 'C'

Advantages:

- lowest first cost
- least TSA staffing
- greater ATO space
- improved access at CBRA
- fewer conveyor merges mean fewer jambs

Disadvantages:

- minor increased chance of die-back with fewer CBRA stations
- angled walls in east ATO

Ground Floor East - EDS Options

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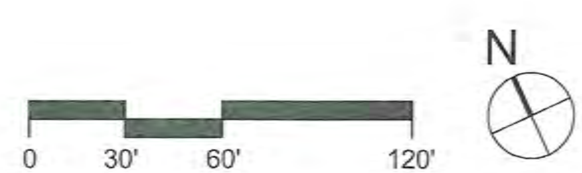
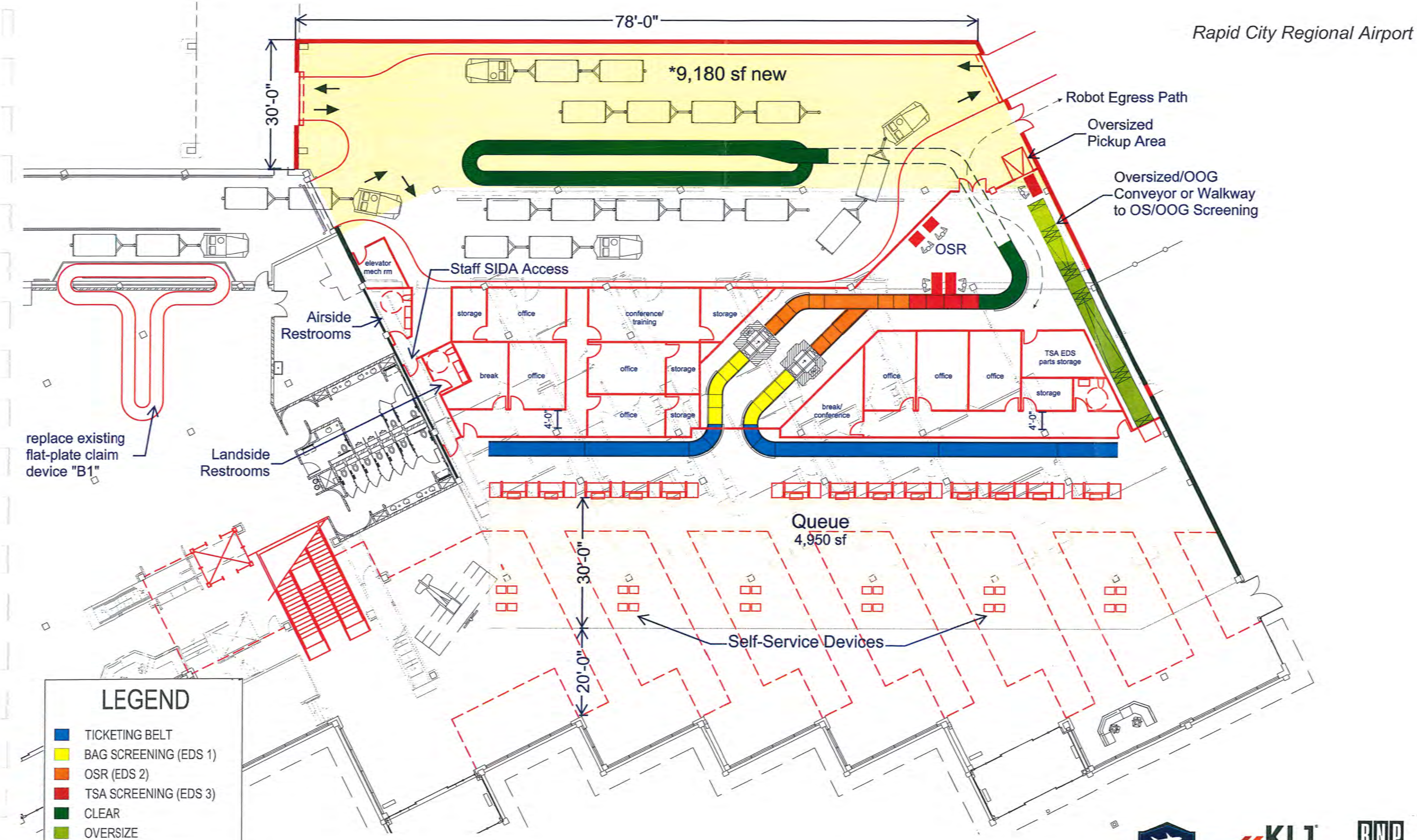




LEGEND

- TICKETING BELT
- BAG SCREENING (EDS 1)
- OSR (EDS 2)
- TSA SCREENING (EDS 3)
- CLEAR
- OVERSIZE

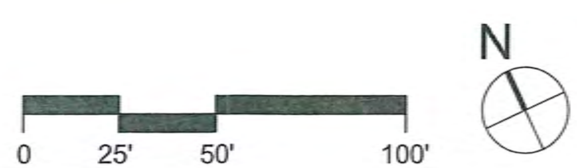
Ground Floor East - Preferred Option

Comm. No. 2017056 *22 August 2017* Mini-in-Line System CT-80DR

RAPID CITY REGIONAL AIRPORT KLJ BNP ASSOCIATES, INC. ALLIIANCE

Site Plan - Preferred Option

Comm. No. 2017056   *22 August 2017*

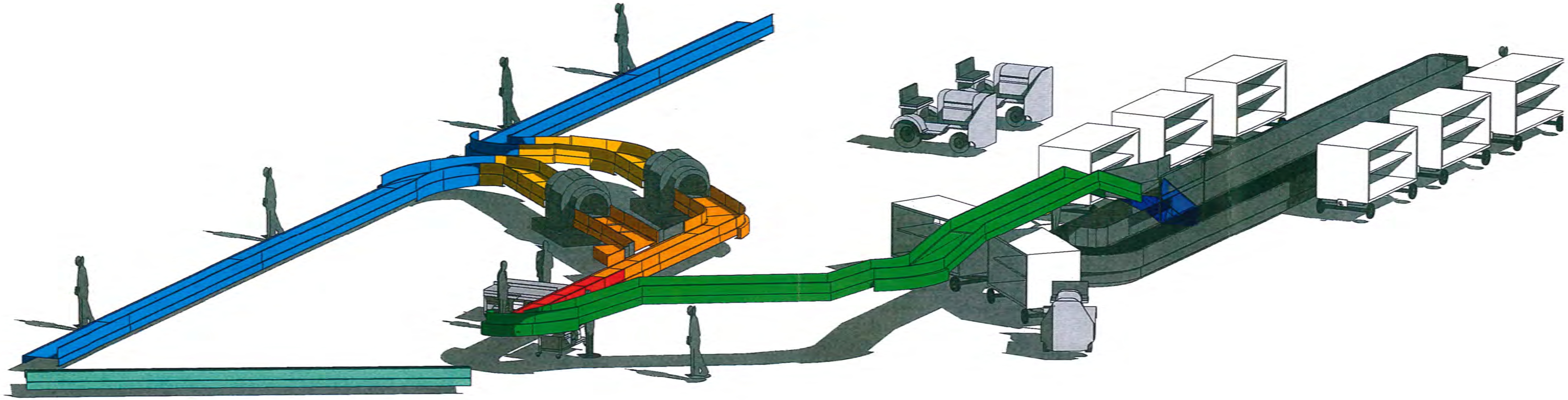


RAPID CITY REGIONAL AIRPORT

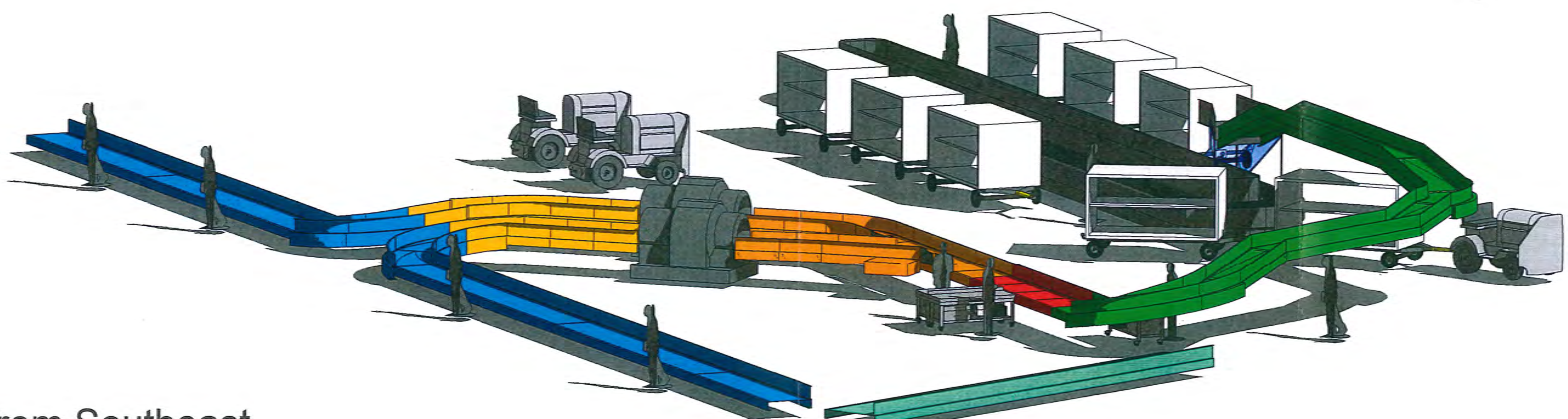
KLJ

BNP ASSOCIATES, INC.

ALLIIANCE



View from Northeast

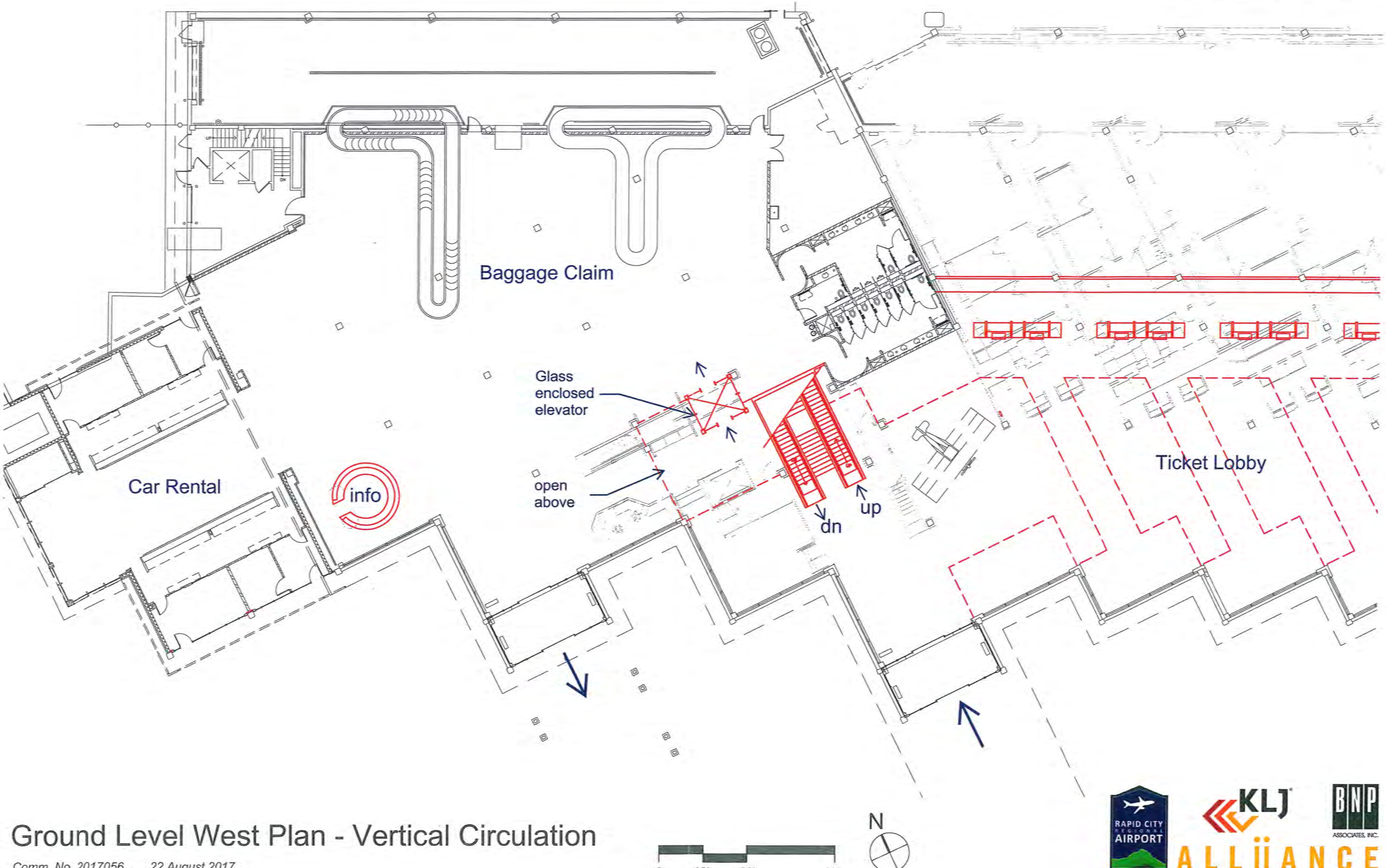


View from Southeast

3D BHS Views - Preferred Option

Comm. No. 2017056 22 August 2017

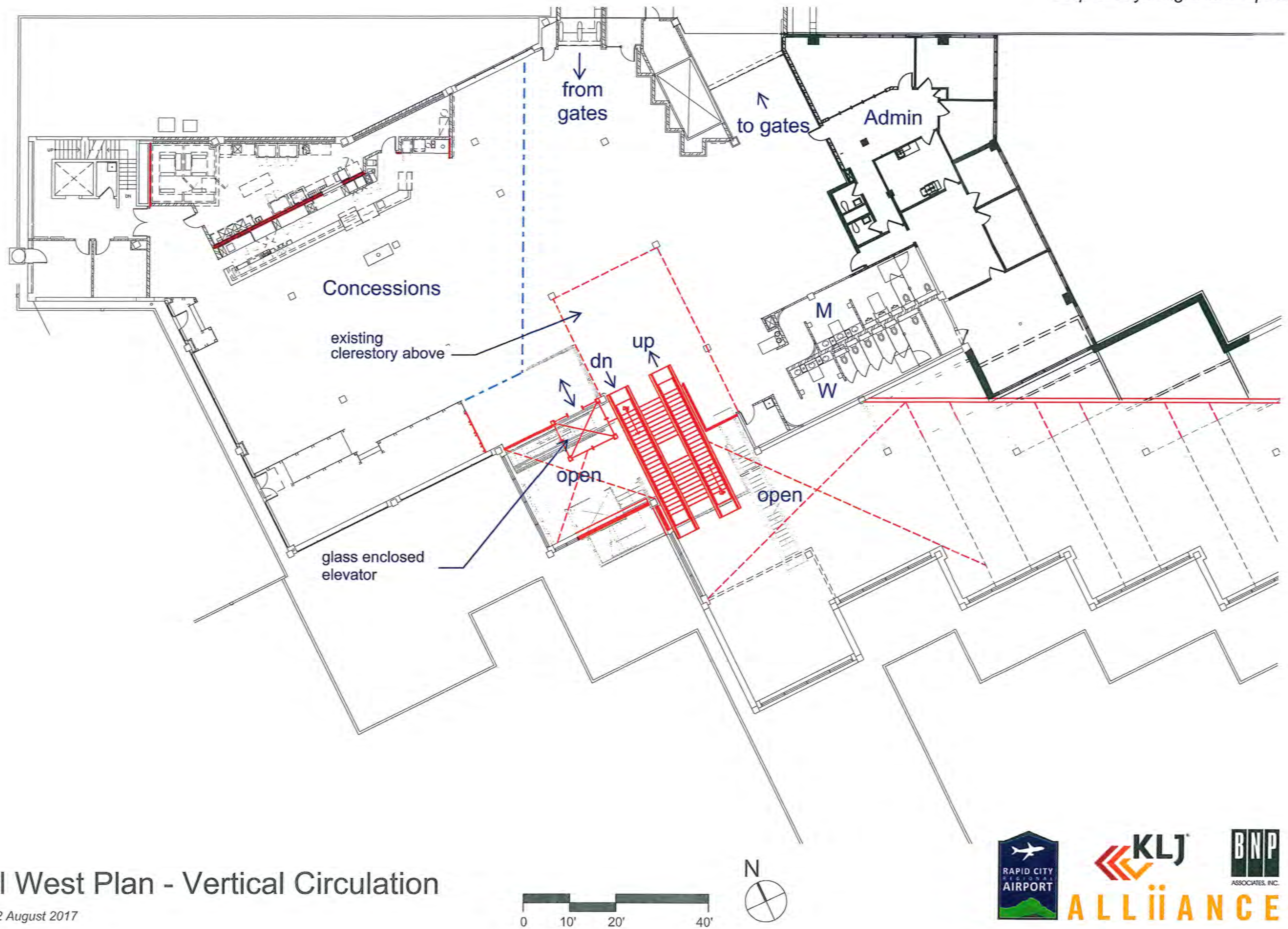
RAPID CITY REGIONAL AIRPORT KLJ BNP ASSOCIATES, INC. ALLIANCE



Ground Level West Plan - Vertical Circulation

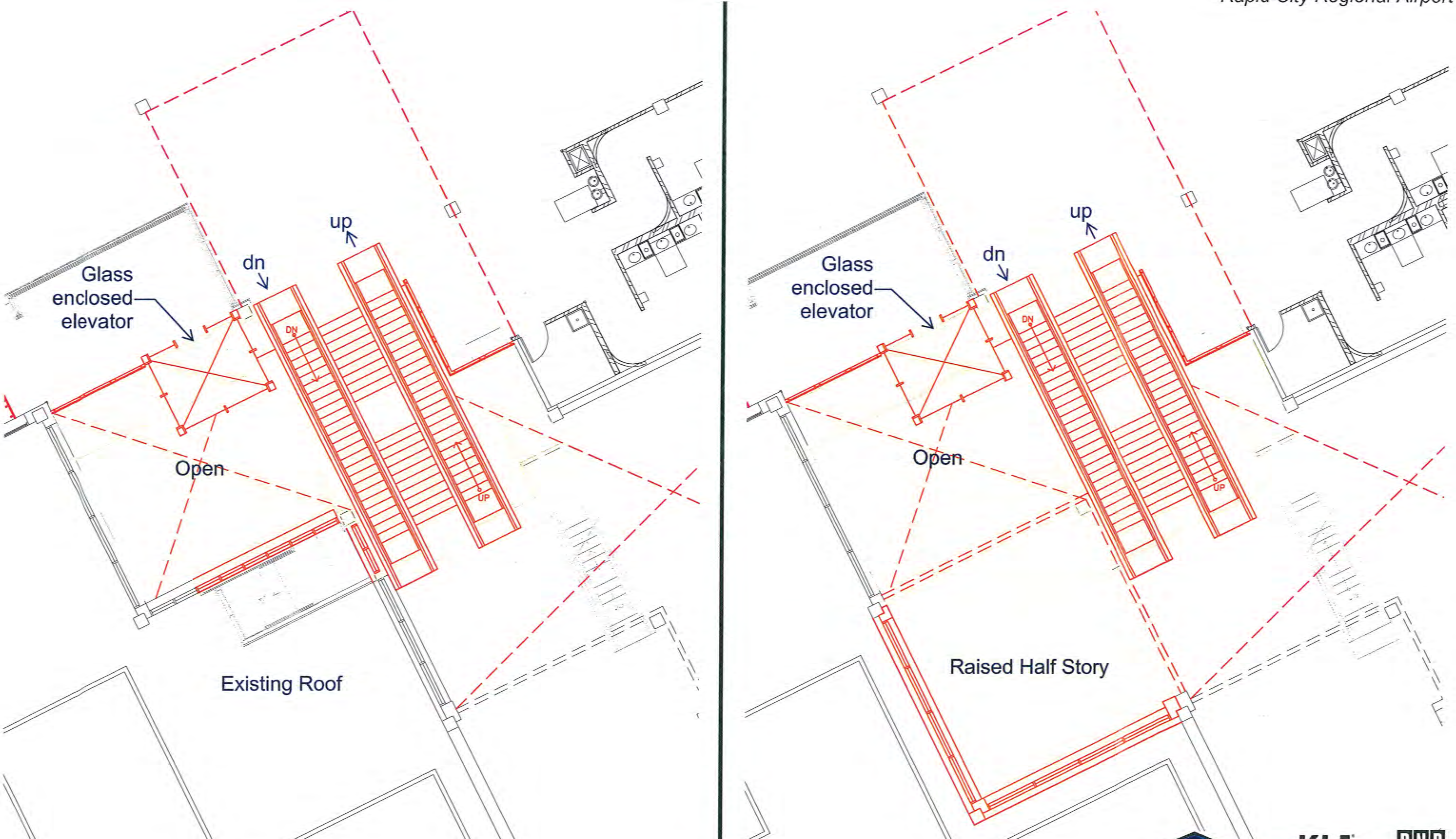
Comm. No. 2017056 *22 August 2017*

RAPID CITY REGIONAL AIRPORT KLJ BNP ASSOCIATES, INC. ALLIANCE



Upper Level West Plan - Vertical Circulation

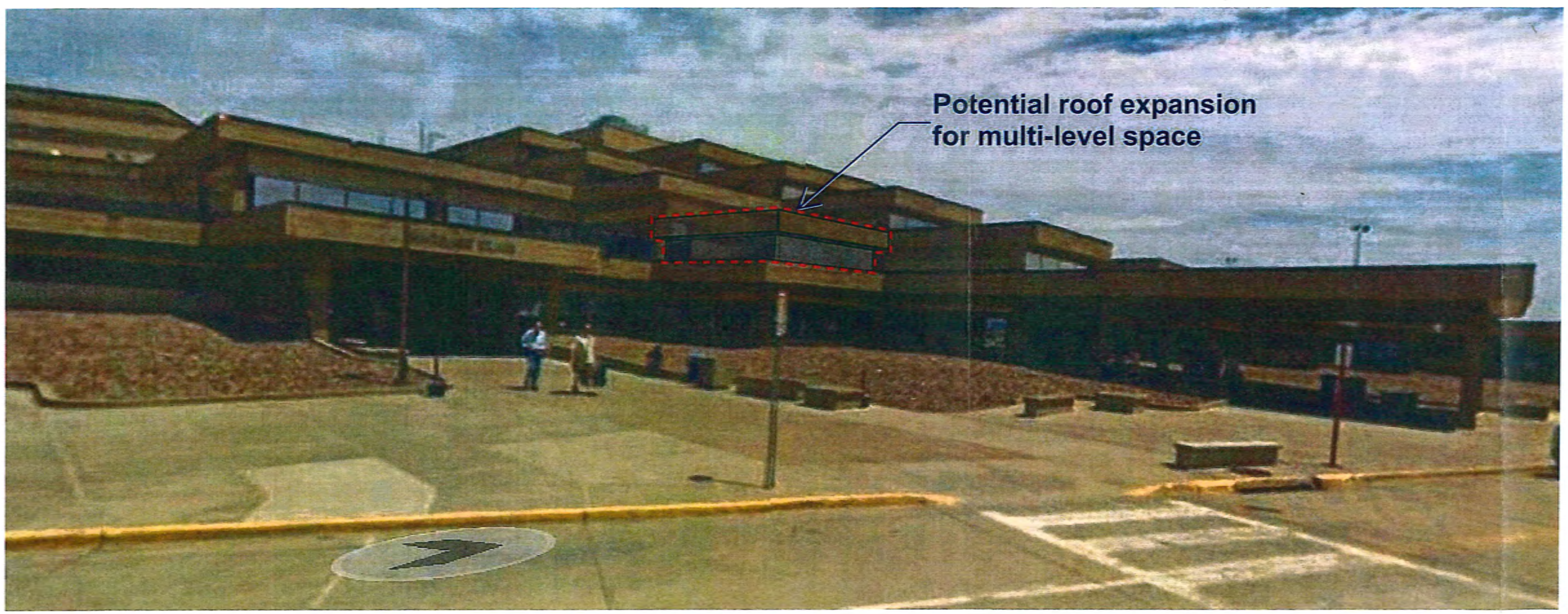
Comm. No. 2017056 *22 August 2017*



Upper Level Roof Options

Comm. No. 2017056 *22 August 2017*

Existing

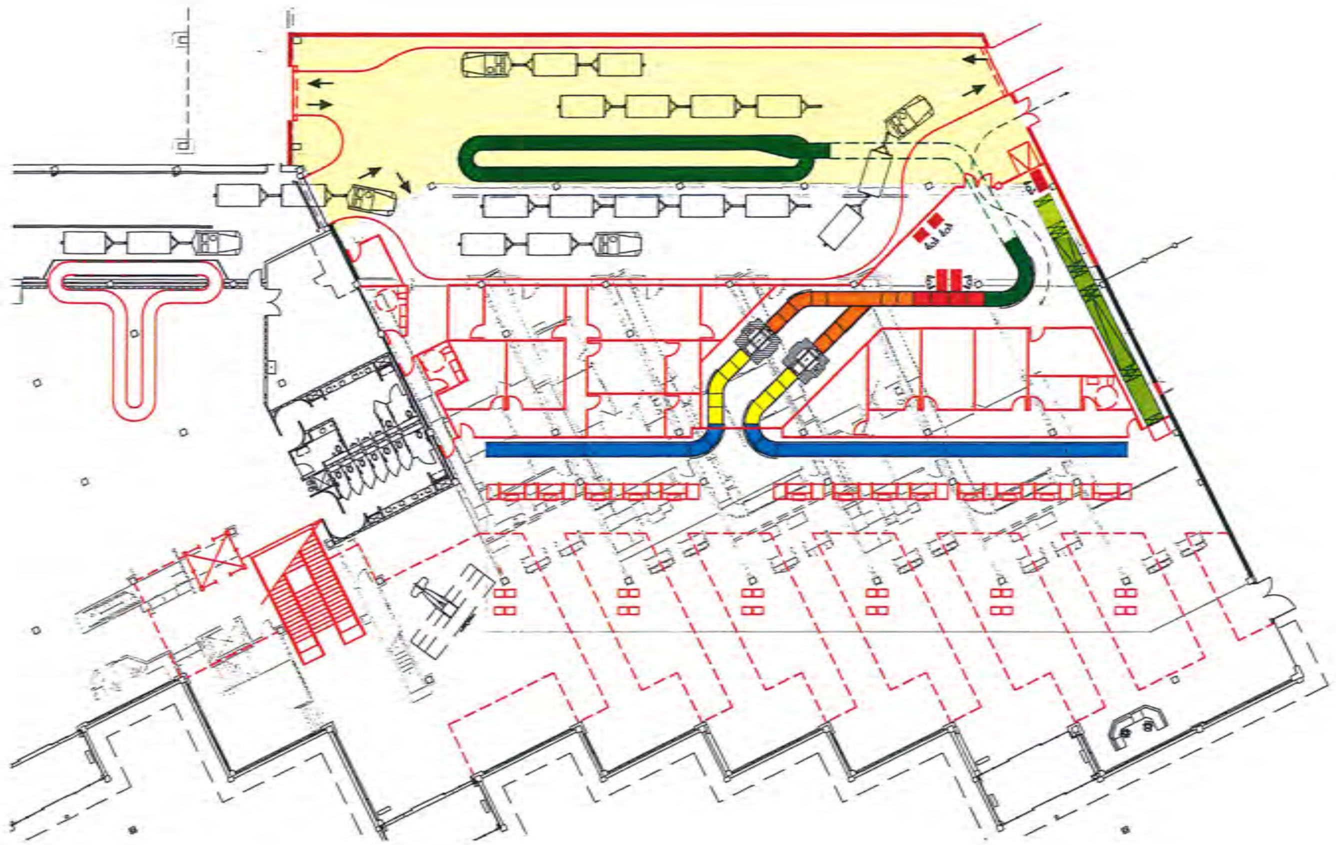


Proposed

RAPID CITY REGIONAL AIRPORT KLJ BNP ASSOCIATES, INC. ALLIIANCE

Exterior Massing Sketch

Comm. No. 2017056 *22 August 2017*



Preferred Option Plan 0 30' 60' 120' N

Outbound Processing:

A. Baggage Handling System	**$3,611,081**
B. East Terminal Expansion & Remodel	**$3,700,926**
SUBTOTAL	**$7,312,007**

Other:

C. Vertical Circulation	
C.1 Reconfigure	**$1,073,633**
C.2 Raise Roof (Alternate)	**$177,910**
SUBTOTAL	**$1,251,543**
D. Replace Claim Device B1	**$299,230**
TOTAL	**$8,862,780**

complete Concept Estimate document attached as separate document

Appendix

Rapid City Regional Airport

Preferred Option - Renderings

22 August 2017

Re-Aligned Ticketing Lobby

Comm. No. 2017056   22 August 2017

RAPID CITY REGIONAL AIRPORT

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Proposed Vertical Circulation

Comm. No. 2017056 *22 August 2017*

RAPID CITY REGIONAL AIRPORT KLJ BNP ASSOCIATES, INC. ALLIANCE

First Floor Entry

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Second Floor Looking at Proposed Vertical Circulation

Comm. No. 2017056 22 August 2017

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RAPID CITY REGIONAL AIRPORT (RAP)
Terminal – Optimization Project

Baggage Handling System – Pre - Design Stage

Preliminary Alternative Analysis/Preferred Alternate TSA Submittal

June 14, 2017

CONTENTS

DOCUMENT REVISION/SUBMITTAL HISTORY

Version	Description of Version	Date Completed
1	Preliminary Alternative Analysis Report	06-23-2017

ACRONYMS AND ABBREVIATIONS

ACRONYM	DEFINITION
ADPM	Average-Day Peak-Month
AOA	Airport Operations Area
BHS	Baggage Handling System
BIT	Baggage Inspection Table
BNP	BNP Associates, Inc., the Baggage Handling System Consultant/Engineer
BPM	Bags Per Minute
BPH	Bags Per Hour
BRP	Baggage Removal Point (removal queue conveyors in the CBRA)
CB	Clear Bag Subsystem
CBIS	Checked Baggage Inspection System
CBRA	Checked Baggage Resolution Area
CT	Computed Tomography
DBU	Date of Beneficial Use
FIP	Flights in Process
FPM	Feet per Minute
FTE	Full Time Equivalent
HMI	Human Machine Interface
IATA	International Airline Transportation Association
ML	Main Line Subsystem
MU	Make-up Unit Subsystem
O&M	Operations and Maintenance
OG	Out-of-Gauge Subsystem
OOG	Out-of-Gauge
OSR	On-Screen Resolution
PAX	Passenger
PGDS	Planning Guidelines and Design Standards – TSA's guidelines for planning, and designing CBIS
RAP	Rapid City Regional Airport

ACRONYM	DEFINITION
SSI	Sensitive Security Information
STD	Standard Time of Departure
TC	Ticket Counter Subsystem
TRT	Threat Resolution Tools
TSA	Transportation Security Administration
TSO	Transportation Security Officer

1. Introduction

BNP Associates, Inc. has been retained by Alliiance.US to provide baggage handling system consultancy services as part of the Terminal Optimization Project for Rapid City Regional Airport (RAP).

The Rapid City Regional Airport (RAP) design was proposed as an effort to remove all "stand-alone" EDS machines from behind the ticketing area and provide a centralized CBIS that meets the TSA's Planning Guidelines and Design Standards (PGDS, version 5.0).

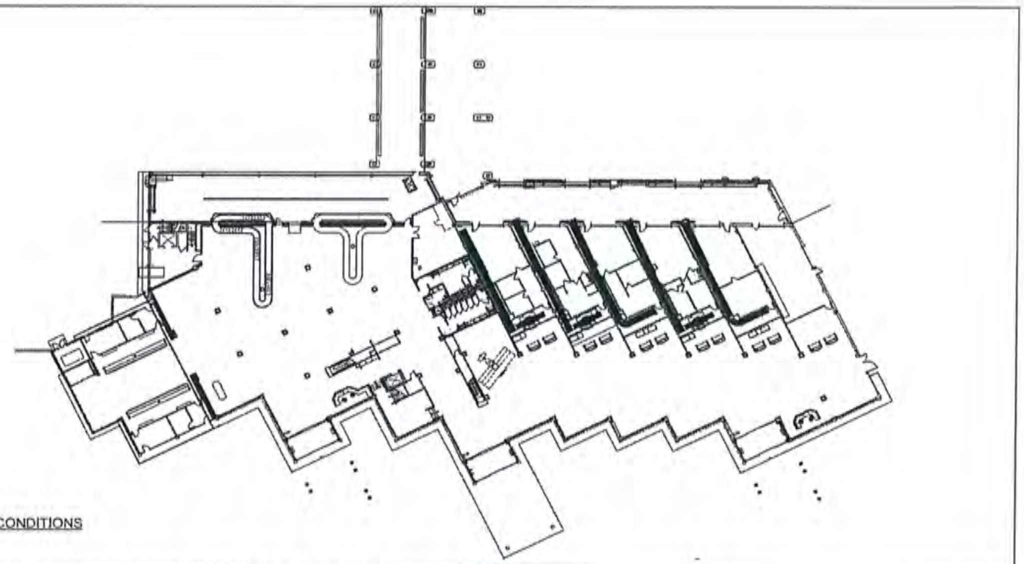
Utilizing the flight schedules as provided to the integrated local design team (ILDT) by the airport, the resulting data has been summarized within the following sections of this Report document to form the BDR. The preliminary alternatives and basic descriptions that have been explored have been included in this Preliminary Alternative/Preferred Report document section 6.1 through 6.3. The ILDT Preferred Alternate can be found in section 8.1.

The intent of this document is to describe the various BHS design options, each of their respective costs, and the analysis that reflects the airports needs for the present and future.

2. Existing Conditions

The existing RAP Terminal departures check-in area comprises of five – (5) individual ticket counter subsystems which transport checked bags to an associated run out pier for make-up by flight. Three – (3) of the conveyor lines have Reveal-80DR stand-alone screening machines that are 8-11 years old.

If the bag can be cleared at Level 1 then it is manually loaded onto a take away conveyor downstream of the EDS device to the associated outbound make-up area. If the bag is not able to be cleared at Level 1 then it is stopped on a downstream of the EDS device to allow for the Level 2 image to be reviewed. If the bag can be cleared by the Level 2 operator, then the bag will be manually loaded onto the take away belt and transported to the outbound make-up area. If the bag is not able to be cleared, then it is manually removed from the EDS device output conveyor and transferred to the ETD table within that zone for screening per TSA protocol. The layout of the existing screening system is illustrated below:



EXISTING CONDITIONS

RAPID CITY REGIONAL AIRPORT (RAP)
EXISTING BAGGAGE INSPECTION SYSTEM
Comm. No. 2017056 01.03.2017
Scale: 1/32" = 1'-0"

ENLARGED - EXISTING CONDITIONS

RAPID CITY REGIONAL AIRPORT (RAP)
ENLARGED EXISTING BAGGAGE INSPECTION SYSTEM
Comm. No. 2017056 01.03.2017
Scale: 5/64" = 1'-0"

3. Analysis Summary Results

The following table presents the results of the baggage system analysis:

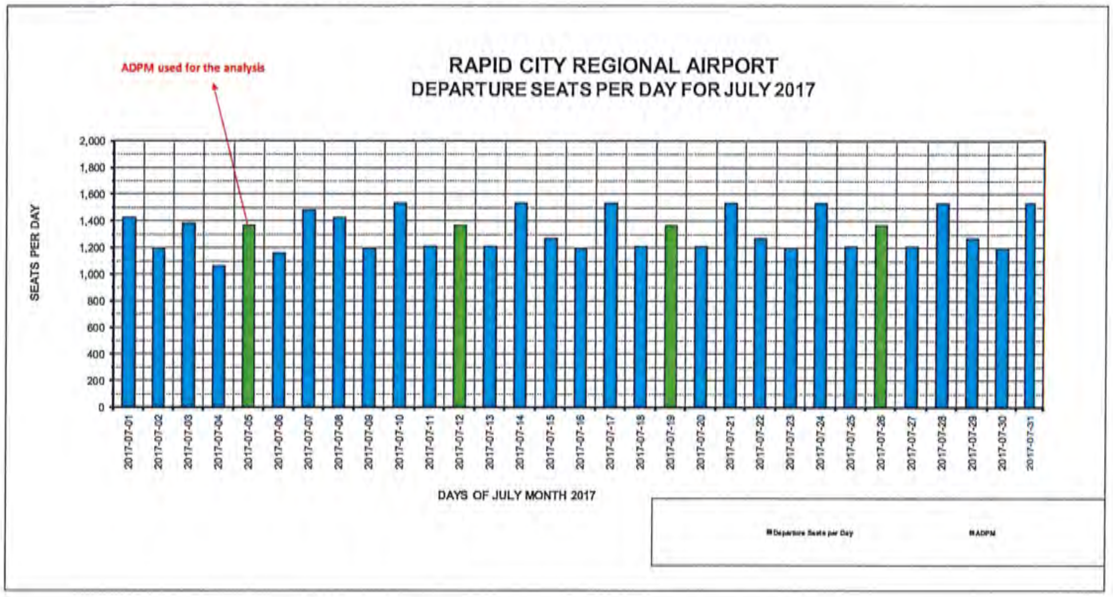
Design Requirements				
Type	**2017**	**2023**	**2028**	**2033**
Screening Bag Rate (BPM) *(excludes TSA Surge Factor)*	**1.7**	**1.8**	**2.0**	**2.2**
Level 1 EDS (Units) – 189 BPH *(excludes redundant)*	**1.0**	**1.0**	**1.0**	**1.0**
Presentation (Carts/Containers)	**8**	**9**	**10**	**11**
Claim Frontage (Feet)	**132**	**146**	**160**	**175**

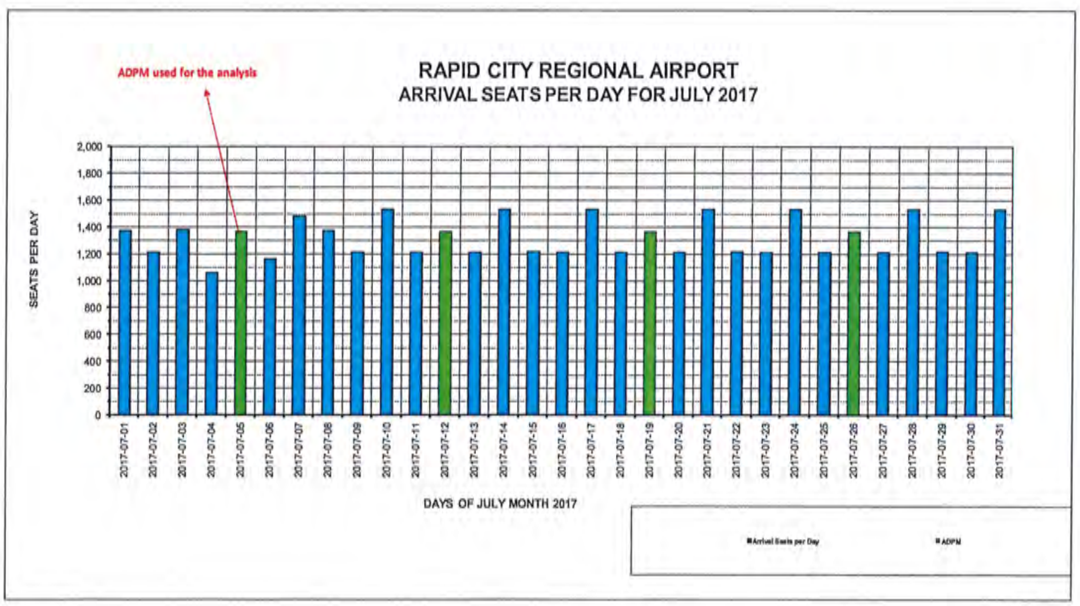
4. Planning Premises

The flight schedule used for the analysis is based on July 2017 flight schedule, provided to BNP by RAP. (reference Appendix A).

4.1 Capacity Planning Schedule

Below are the charts depicting the Average Day Peak Month (Wednesday, July 5th 2017) Flight Schedule used for the analysis:





4.2 Load factor

The peak hour load factor is the percentage of seats on a flight occupied:

90 percent peak hour load factor for all the flights was provided to BNP.

4.3 Average Number of Bags per Passenger

The average number of checked bags per boarded passenger at RAP is as follows:

Bags per Passenger (BPP)	
Domestic	**0.6**

4.4 Peak Hour Traffic Distribution

The peak hour passenger traffic distribution provided to BNP is:

Distribution	DOM
Originating	100%
Transfer	-
TOTAL	**100%**

4.5 Oversize and OOG Bags

The total Oversize and OOG baggage is subtracted from the total originating baggage rate to represent the screened baggage rate.

Oversize & OOG Bags	
	Standard Schedule
Oversize Baggage	**2%**
Out of Gauge Baggage	**4%**

4.6 Surge Factor

A surge factor was applied per the TSA Planning Guidelines and Design Standards for Checked Baggage Inspection Systems (PGDS for CBIS), Version 5.0, dated July 16, 2015:

Section 6.1.1: Equipment requirements should not be based on average baggage flows, but rather on surged flows obtained by multiplying the average baggage flow by a zone-specific surge factor* (for each 10-minute bin). The use of a surge factor is recommended to capture the intrinsic variance of baggage demand and ensure that equipment requirements are not undersized. For mini in-line systems the application of a surge factor may not be required. The following formula is used to calculate the surge factor:

$$SF = \frac{x + 2\sqrt{x}}{x}$$

where SF is the surge factor and x is the 10-minute baggage flow.

As the proposed CBIS system is a Mini-Inline, Surge factor is not applied to the baggage demand for this analysis.

4.7 Growth Factor

The growth factor, for the design years of 2023, 2028 and 2033 has been calculated from the FAA Terminal Area Forecast (TAF) Report.

Following is the formula to calculate Growth Factor:

Total Enplanements for Flight Schedule Year 2017 = 283,830

Total Enplanements for Design Year 2033 = 377,834

Growth Factor, Flight Schedule Year (2017) to Design Year (2033)

= Enplanements for Design Year / Enplanements for Flight Schedule Year

= 377,834/283,830

= 1.33

Annual Growth Rate = (Growth Factor ^ (1/Number of years)) – 1

= (1.33 ^ (1/16)) – 1

= 0.0180

= 1.80%

FAA Terminal Area Forecast (TAF) Data

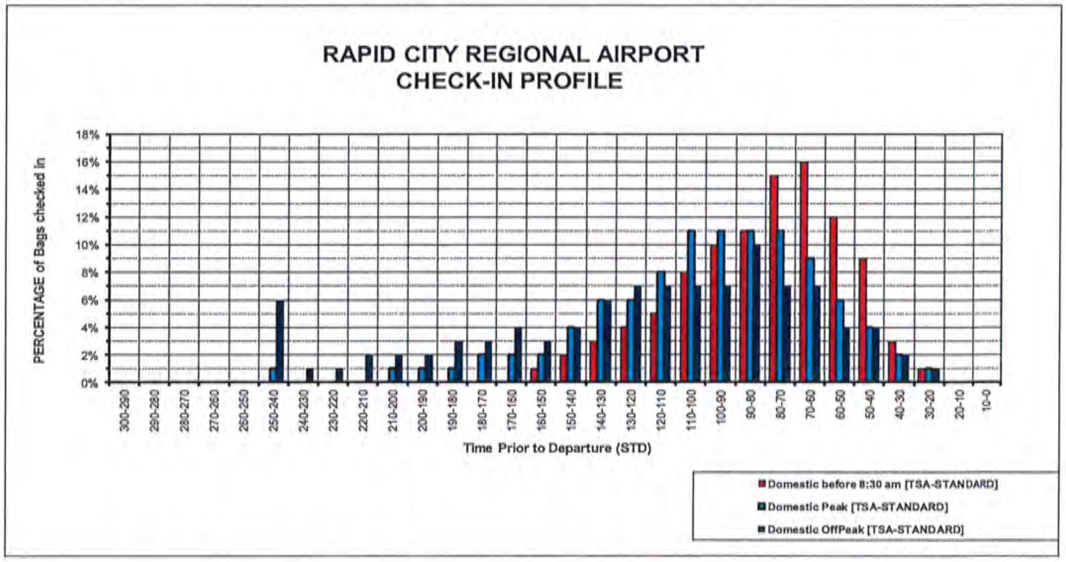
Year	Total Enplanements	2017 Flight Schedule	
		Growth	Annual Rate
2017	**283,830**	**1.00**	
2018	288,218	1.02	1.55%
2019	293,068	1.03	1.61%
2020	298,285	1.05	1.67%
2021	303,775	1.07	1.71%
2022	309,457	1.09	1.74%

Year	Total Enplanements	2017 Flight Schedule	
		Growth	Annual Rate
2023	**315,280**	**1.11**	**1.77%**
2024	321,177	1.13	1.78%
2025	327,131	1.15	1.79%
2026	333,183	1.17	1.80%
2027	339,323	1.20	1.80%
2028	**345,556**	**1.22**	**1.80%**
2029	351,884	1.24	1.81%
2030	358,288	1.26	1.81%
2031	364,752	1.29	1.81%
2032	371,270	1.31	1.81%
2033	**377,834**	**1.33**	**1.80%**

4.8 Check-in Profile

The passenger profile distribution specifies the percentages of passengers that arrive at the airport a specific number of minutes before their flights. The earliness distributions are used to determine the flow of departing passengers at the airport.

Airport specific arrival curve information should be applied if possible; this analysis is based on TSA default distributions from PGDS Version 5.0.



Time Prior to STD (min)	PGDS PROFILE		
	Domestic Before 8:30 AM	Domestic Peak After 8:30 AM Before 5:00 PM	Domestic Off-Peak
250-240		1.0%	6.0%
240-230		0.0%	1.0%
230-220		0.0%	1.0%
220-210		0.0%	2.0%
210-200		1.0%	2.0%
200-190		1.0%	2.0%
190-180		1.0%	3.0%
180-170		2.0%	3.0%
170-160		2.0%	4.0%
160-150	1.0%	2.0%	3.0%
150-140	2.0%	4.0%	4.0%
140-130	3.0%	6.0%	6.0%
130-120	4.0%	6.0%	7.0%

Time Prior to STD (min)	PGDS PROFILE		
	Domestic Before 8:30 AM	Domestic Peak After 8:30 AM Before 5:00 PM	Domestic Off-Peak
120-110	5.0%	8.0%	7.0%
110-100	8.0%	11.0%	7.0%
100-90	10.0%	11.0%	7.0%
90-80	11.0%	11.0%	10.0%
80-70	15.0%	11.0%	7.0%
70-60	16.0%	9.0%	7.0%
60-50	12.0%	6.0%	4.0%
50-40	9.0%	4.0%	4.0%
40-30	3.0%	2.0%	2.0%
30-20	1.0%	1.0%	1.0%
20-10			
10-0			
	100.00%	**100.00%**	**100.00%**

4.9 Security Screening Parameters

The following security screening parameters are provided per the TSA Planning Guidelines and Design Standards for Checked Baggage Inspection Systems (PGDS for CBIS).

SECURITY SCREENING PARAMETERS			
Type	**Screening Rate (bags/min)**	**Screening Rate (bags/hour)**	**Alarm Rate (%)**
Level 1: CT-80DR Mini-Inline	3.15 BPM	189 BPH	-

(Per PGDS - assumes remote OSR with four (4) queues before BRP and 1 OSR and 2 ETD Operators per machine)

4.10 Aircraft Capacities

The number of seats varies between the same aircraft types due to the seating configuration and capacity preferences of the different airlines. The number of seats per aircraft type provide to BNP is as follows:

Seats	Carts	Type
50	1	NB
70	2	NB
76	2	NB
149	3	NB
156	3	NB

4.11 BHS Make-up Times

BHS Make-up Times	
BHS Make-up Open Time before STD	**BHS Make-up Close Time before STD**
120 min.	20 min.

4.12 Claim Utilization

The percentage of passengers that have checked baggage at the up-line stations as provided to BNP is as follows:

Claim Type	Utilization (%)
Domestic	70%

Three factors largely determine claim frontage parameters – (1) percentage of passengers per flight that will be claiming bags (2) passenger presentation area expressed in terms of linear feet of claim device and (3) utilization time of the claim device by any flight.

Passengers that claim bags include terminating passengers and those passengers that are required to recheck bags.

The **passenger presentation** length is determined based on the number of simultaneous passengers at claim. Narrow body domestic flights tend to have more passengers arriving at claim simultaneously because the deplaning process is quicker and there is no immigration process. BNP has established a series of standards, which indicate the claim frontage that should be provided for each aircraft type (i.e., percentage of passengers per type of flight).

Seats	Percentage at Claim
NB (<200 seats)	67%

Based on the above as well as a standard area allocation of 2 feet per passenger, the Claim Device size can be determined based on the following generic formula:

Claim Size = (Aircraft Seats) x (Load Factor) x (% Terminating) x (% pax @ Claim) x (Claim Utilization) x (Frontage/Pax)

The Claim Device Utilization time is determined by the unload time of bags to claim plus an allowance of ten minutes to account for passenger baggage mis-matches.

The **utilization time** is determined as follows:

$$\text{Utilization Time} = \left[\frac{[(\text{Aircraft Seats}) \times (\text{Load Factor}) \times (\%\text{Terminating}) \times (\text{BPP})]}{(\text{offload rate})} \right] + 10 \text{ minutes}$$

For Example:

At 1208 Hour: flight to MSP (50 seats) needs 42 Linear Frontage for 20 minutes.

Claim Size = 50 x 90% x 100% x 67% x 70% x 2 Feet = 42 Feet

Utilization Time = (50 x 90% x 100% x 0.6 / 12) + 10 minutes

= (2.25) + 10

= 12.25 minutes

= 20 minutes (roundup)

12 bags/min offload rate for Claims

5. System Analysis Results

Screened Bag Rate (Bags/min) / EDS Requirement				
Type	2017	2023	2028	2033
Screening Bag Rate (BPM)*	**1.7**	**1.8**	**2.0**	**2.2**
Level 1 EDS Unit (189 BPH) *(excludes redundant) - Calculated*	0.5	0.6	0.6	0.7

Level 1 EDS Unit (189 BPH) *(excludes redundant) – Roundup*	**1.0**	**1.0**	**1.0**	**1.0**

* *Screening Bag Rate does not include TSA Surge Factor.*

Make-up Presentation Requirements					
Type	**2017 Make-up (carts)**	**2017 Outbound FIP (flights)**	**2023 Make-up (carts)**	**2028 Make-up (carts)**	**2033 Make-up (carts)**
Combined	**8**	**5**	**9**	**10**	**11**

Claim Frontage Requirements					
Type	**2017 Claim Frontage (feet)**	**2017 Inbound FIP (flights)**	**2023 Claim Frontage (feet)**	**2028 Claim Frontage (feet)**	**2033 Claim Frontage (feet)**
Combined	**132**	**2**	**146**	**160**	**175**

6. Design Options

6.1 Option A

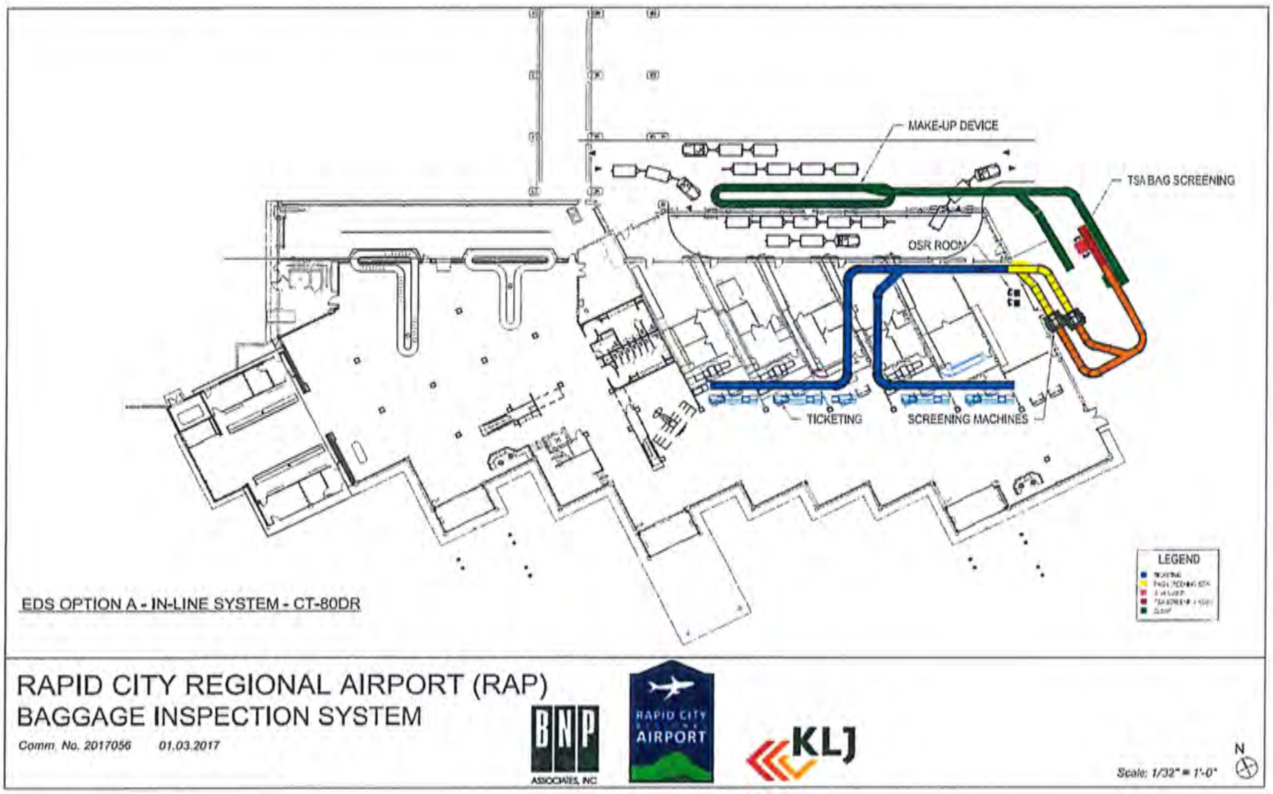
All bags will be checked in and input onto one – (1) of the two – (2) ticket counter conveyors for transport after they have merged into one conveyor into the screening area. Bags are transported to one of the two inline EDS devices for screening. If the bag can be cleared at Level 1 then it is transported downstream of the EDS device and into the associated outbound bag room make-up area. If the bag is not able to be cleared at Level 1 then the 45 seconds' review time will be provided on the downstream conveyors to allow for the Level 2 image to be reviewed. If the bag can be cleared by the Level 2 operator, then the bag will be diverted to the outbound make-up area. If the bag is not able to be cleared, then it is transported into the CBRA room for manual inspection by the TSO.

Pros-

- Make-up device that provides minimum 9 cart position presentation at make-up (2023 requirement).
- Decrease in the number of TSO personnel required

Cons-

- Requires major expansion of the existing terminal facility to both the east to accommodate the CBIS, and to the north for the Make-up area.
- Reduction in ATO available space.
- Most expensive option



6.2 Option B

This concept provides new check-in counters and two new ticketing lines that feed into separate screening machines with individual manual screening stations. Having separate mini-in-line systems will still allow for redundancy in the case of a line failure (bags manually moved to the operating mainline). After the bags are screened they will continue on separate lines to merge onto one clear line that feeds the new flat plate make-up device.

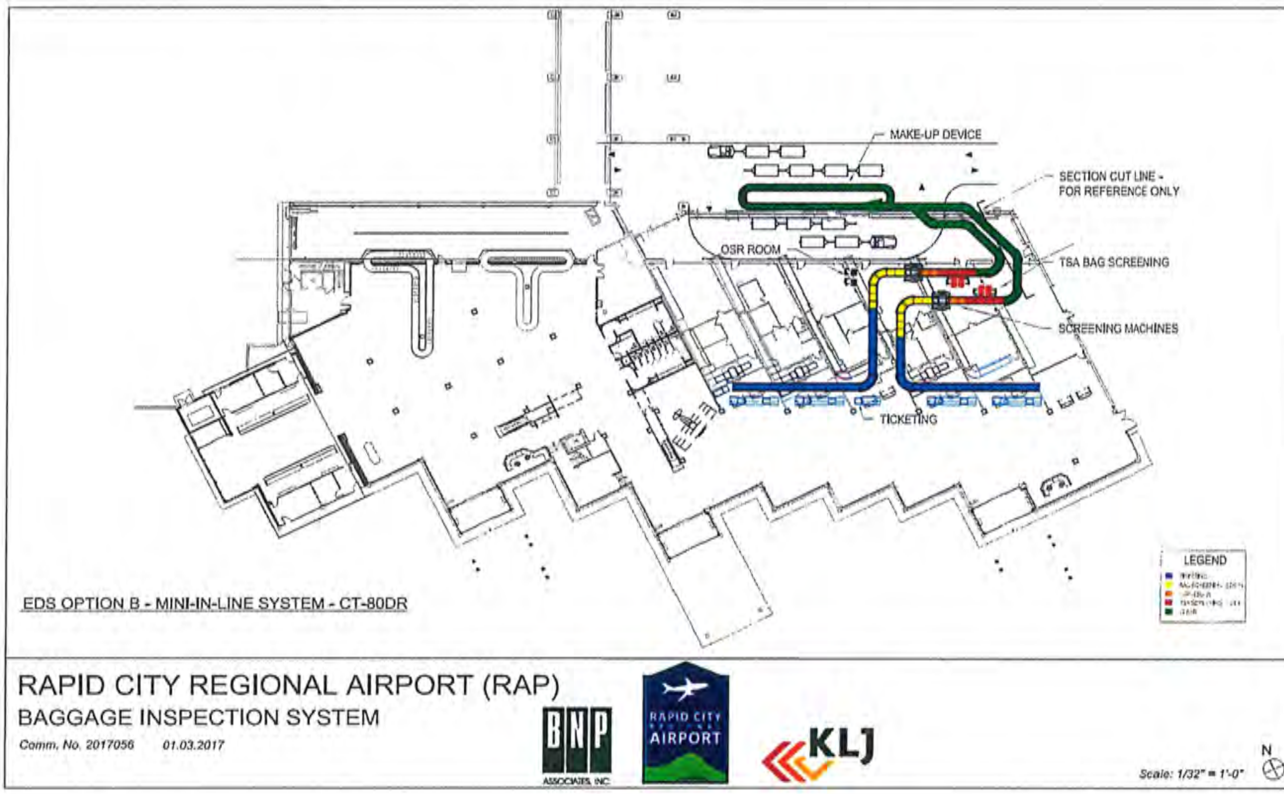
Pros-

- Separate mini-in-line screening system allows for a manual redundancy operation in case of failure.
- 9 cart presentation (2023 requirements).

- No expansion of existing facility to the east

Cons-

- Reduced ATO space.
- Expansion of building or addition of a canopy in north for protection of the make-up.
- Reduction in passenger ticketing queue area compared to Option C, unacceptable to RAP and User Airlines



6.3 Option C

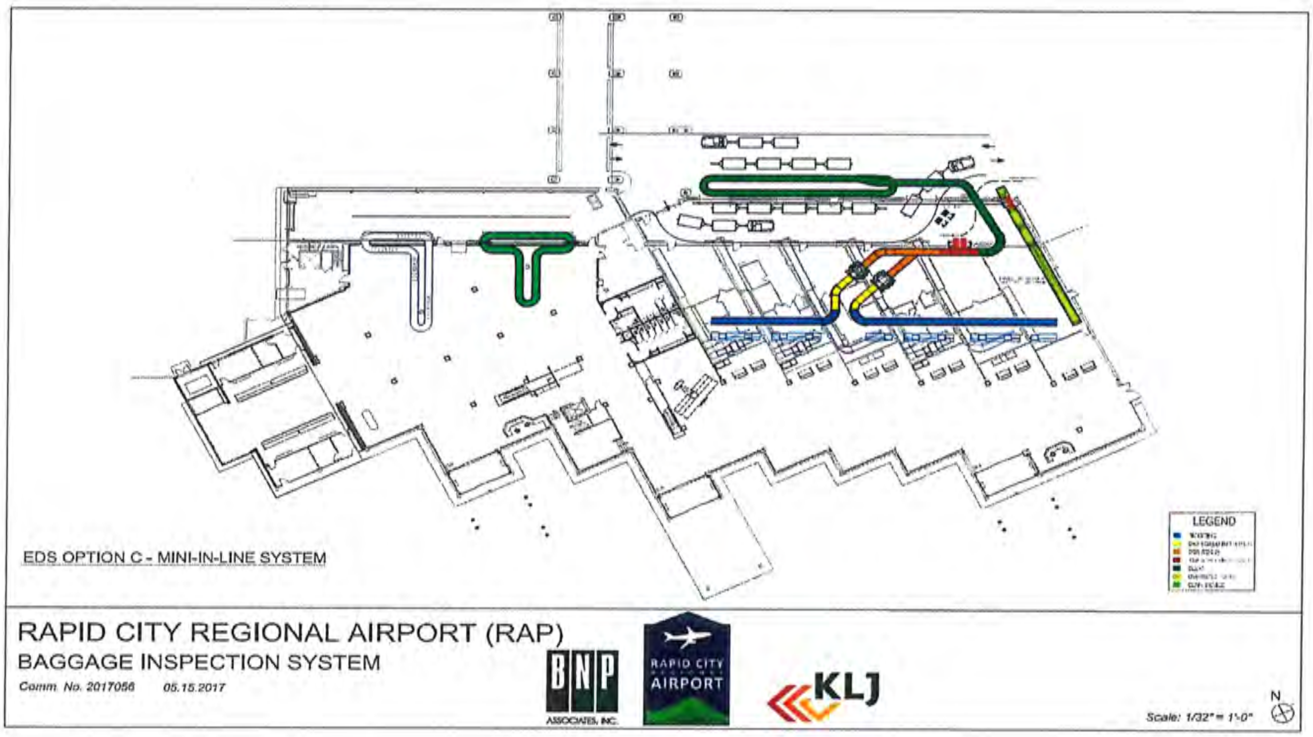
This mini in-line system will provide new ticket counters and two new ticketing lines that feed into two separate EDS screening machines. The ED lines merge to become one – (1) line with manual ETD screening stations for suspect bag protocol screening by TSA agents. After screening all clear bags will be transported to the flat plate makeup device for manual sortation by flight. This system will also have an oversized line that begins at the check-in counter and ends at a manual screening station near the sort piers.

Pros-

- Two separate mini-in-line systems that provide a total redundancy in case of failure.
- 9 cart presentation (2023 requirements).
- No expansion of existing building to the east needed.
- Cheapest solution
- Maximum ATO space provided
- Reduction in TSO's
- Passenger ticketing queue area increased as requested by RAP and User Airlines

Cons-

- Expansion of building or addition of a canopy in north for protection of the make-up.



7. **Design Options Cost Analysis**

The following are the ROM cost estimates for the three – (3) options. The turnkey estimates are for the BHS only and do not include facility work. Included in the cost is:

- Mechanical, electrical and control equipment
- Engineering drawings including PE stamping

- Mechanical, electrical and control installation
- All Testing including TSA mandated ISAT
- Demolition of existing systems
- BHS Contractor project management
- Insurance, bonds and shipping

- Not included - taxes and escalation

Option A – **$3,600,000.00**

Option B – **$2,550,000.00**

Option C - **$2,300,000.00**

8. Preferred Alternative

8.1 Preferred Alternative

The preferred option as agreed to by the RAP ILDT and the Rapid City Airports Board of Directors is Option C as it is the most cost effective solution, provides maximum ATO and passenger ticketing area and system redundancy from ticketing.

Rapid City Regional Airport

3D OVERALL - NORTHWEST VIEW

KLJ BNP ALLIANCE

9. Quantitate Assessment Matrix

	Option A	Option B	Option C
Screening Capacity	4	4	4
Future Capacity	4	4	4
Customer Service	4	4	4
Operations			
Performance	4	4	4
Utilization of EDS	4	4	4
Maintainability	4	4	4
Impact of Construction on Operations	1	2	3
BHS Design			
Impact on Existing Facilities	3	2	3
Expandability	4	3	3
Constructability	4	4	4
Higher throughput EDS capable	1	1	1
Re-insert Subsystem	1	1	1
Redundancy	4	2	2
Single point of failure	4	3	3
OOG Capability	1	1	1
PGDS Version 5 Compliant	4	4	4
CBRA Functionality	4	4	4
Ergonomics "TSA lift policy"	4	4	4
Total Assessment Score	59	55	57

Points Key:
1 = Lowest/Poor/Not Possible
2 = Average/Moderate
3 = Slight above Average/ Moderate
4 = Highest/Best

10. BHS Design Criteria

10.1 System Performance

The following are the performance criteria that guided the design and selection of the preferred concept.

- Equipment life of at least 15 years and an operating duty cycle of 18 hours per day, 365 days per year. (This provision is a design objective, not a warranty.)
- System constructed in accordance with all codes, standards, and local laws and regulations applicable to the design and installation of this type of equipment that are generally accepted as good practice throughout the industry (e.g., National Fire Protection Association, Underwriters Laboratory, OSHA, SAE publications, National Electrical Code, American National Standards). Design of all parts and sub-assemblies in accordance with good commercial practice for this type of system.
- System that can be easily and economically enhanced to meet requirements over the next 15 years. Easily removable conveyors have been specified to ensure EDSs can be removed and replaced with higher-throughput devices, if required.
- In-Line EDS security screening for all originating checked baggage based on current TSA protocols.
- All subsystems available no less than 99.5 percent of the time, as calculated monthly. Maximum allowable downtime in a single operating day of no more than 15 minutes on one subsystem. Cumulative daily downtime for all subsystems shall not exceed 20 minutes.
- No more than one PLC failure per month (applies also to any other control equipment with a slave/master pair). Maximum downtime for such a failure of 10 minutes per year.
- Minimum tracking accuracy of 99.5 percent, calculated monthly, for total bags delivered into the system. Tracking accuracy is defined as the percentage of successfully tracked bags from an encoding position (such as an ISD) to the final output device. It is a measure of the system's ability to identify and control the location of baggage. Bags that are proven to have lost tracking within the security screening device will not be counted against the 99.5 percent tracking figure.
- Bag jam rates and related best practices are to comply with PGDS v5.0 requirements.
- Safe and efficient workspaces and entry/exit points for maintenance and TSA staff.
- Conveyor speeds that ensure bag-in-system time is maintained below the PGDS requirement.

- Sufficient Level 2 OSR travel time (minimum 45 seconds from the exit of the device to the final decision point) to allow for 45 seconds of decision time for the OSR operator.
- Flexible design to allow for future upgrades to security technology.
- Appropriate number of queuing conveyors upstream of the EDSs to absorb surges in baggage demand throughout the day.
- Multiple flow paths to permit continued operations despite equipment failure or demand surges.
- Tracking on conveyors using shaft encoders and strategically located photoelectric sensors for verification.
- Direct interface between the BHS and security screening devices that transmits each bag's security status (Cleared or Suspect) and routes it based on this status.

10.2 Typical BHS Specifications

10.2.1 Building

Typical clearances for building elements (as required by conveyor components and baggage):

Overhead	36 inches from top of belt
Lateral	1 foot along walls and 6 inches along columns
Underneath	As required for maintenance

10.2.2 Work Aisles

Typical clearances for building elements (as required by conveyor components and baggage):

Work aisle width	3 feet
Work aisle clear height	7 feet 6 inches

10.2.3 Conveyors (General)

Maximum standard conveyor length	(5-foot drive)	60 feet
Maximum standard conveyor length	(mini drive)	15 feet
Minimum standard conveyor length	(queue belt)	3 feet 6 inches
Nominal incline/decline (non-tracking)	15 degrees	
Maximum incline/decline (non-tracking)	18 degrees	
Nominal incline/decline (tracking)	12 degrees	
Maximum incline/decline (tracking)	12 degrees	

10.2.4 Power Turns and Spirals

Power turn inside radius (standard)	4 feet
Spiral drop (maximum)	1 foot per 45 degrees
Spiral drop (tracking)	6 inches per 45 degrees

10.2.5 Noise Levels

Design, fabricate, and install the BHS to limit combined equipment and controlled ambient noise levels to the following allowable maximums in A-weighted filter measurements:

BHS Allowable Noise Levels	
Noise Level	**Location**
45 dB (A)	In adjacent or nearby office areas (measured at the center of room at a height of 5 feet above the floor)
65 dB (A)	In public areas, TSA areas, or ceilings above public areas and offices (measured at several positions normally occupied by passengers, public, and staff)
75 dB (A)	In bag room and other non-public or unoccupied areas

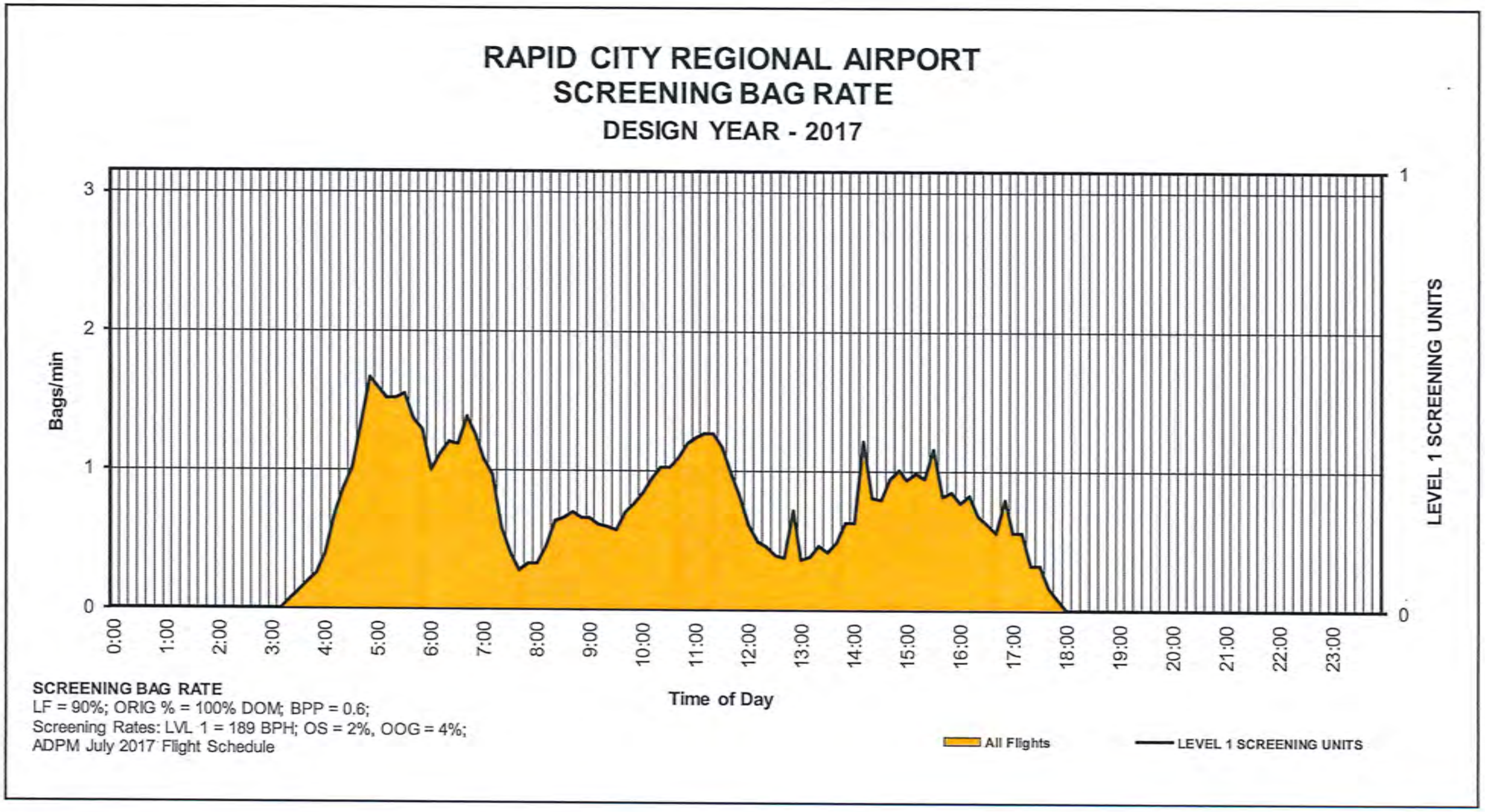
10.2.6 Baggage Size

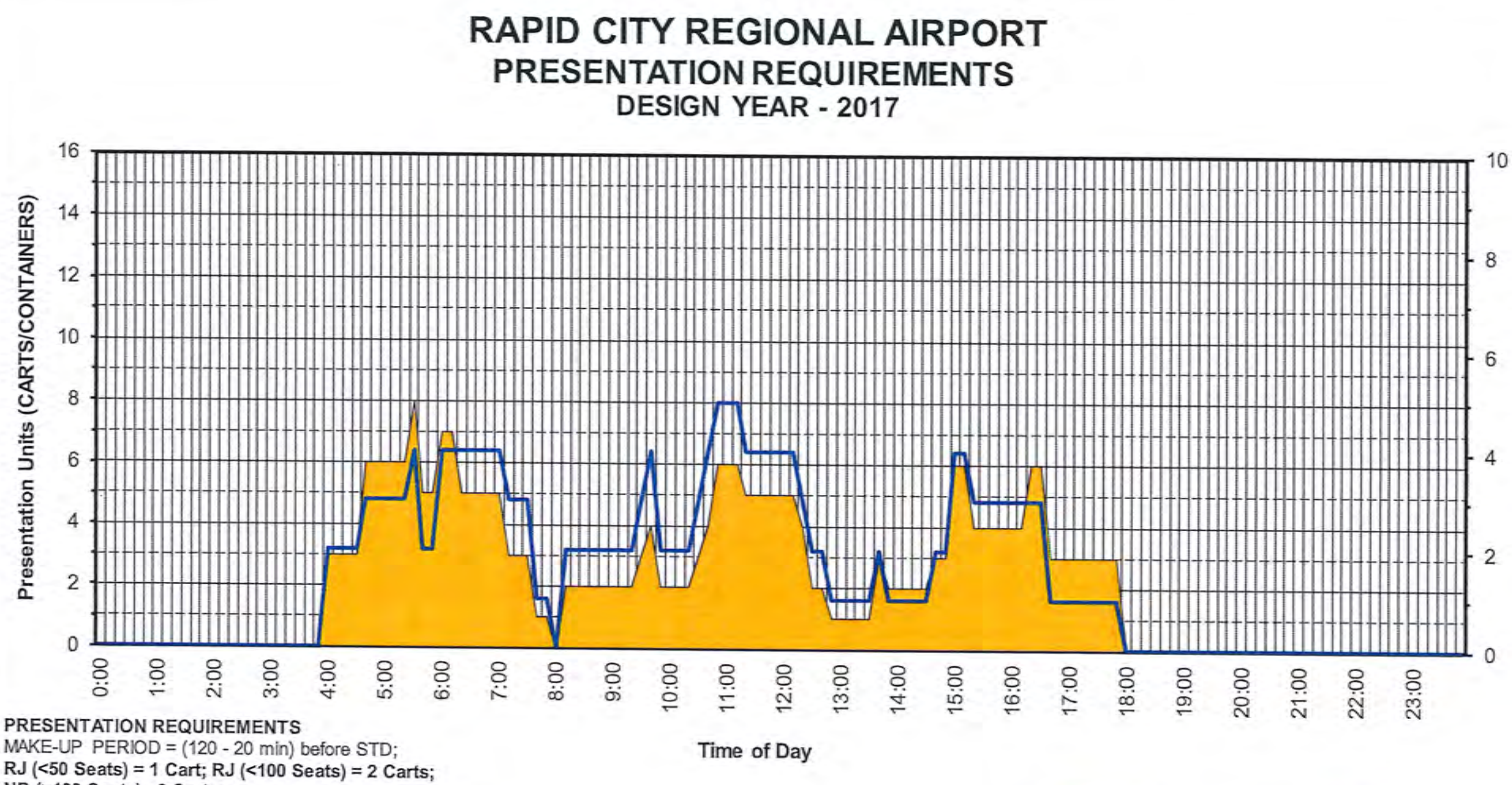
The BHS shall be designed to convey standard airline baggage tubs and to process baggage having the following characteristics:

Standard Baggage Sizes (inches)			
Conveyor Type	**Length**	**Width**	**Height**
Standard conveyor maximum[1]	54	33	34
Standard conveyor minimum[2, 3]	12	12	3

Notes:
1. Items that are greater than the maximum size are not entered into the BHS and are screened at the oversized baggage screening area.
2. Items this size should be transported in an airline tub.
3. Items greater than the EDS maximum but less than the standard conveyor maximum is dimensioned at the ticket counter and routed on the oversize subsystem.

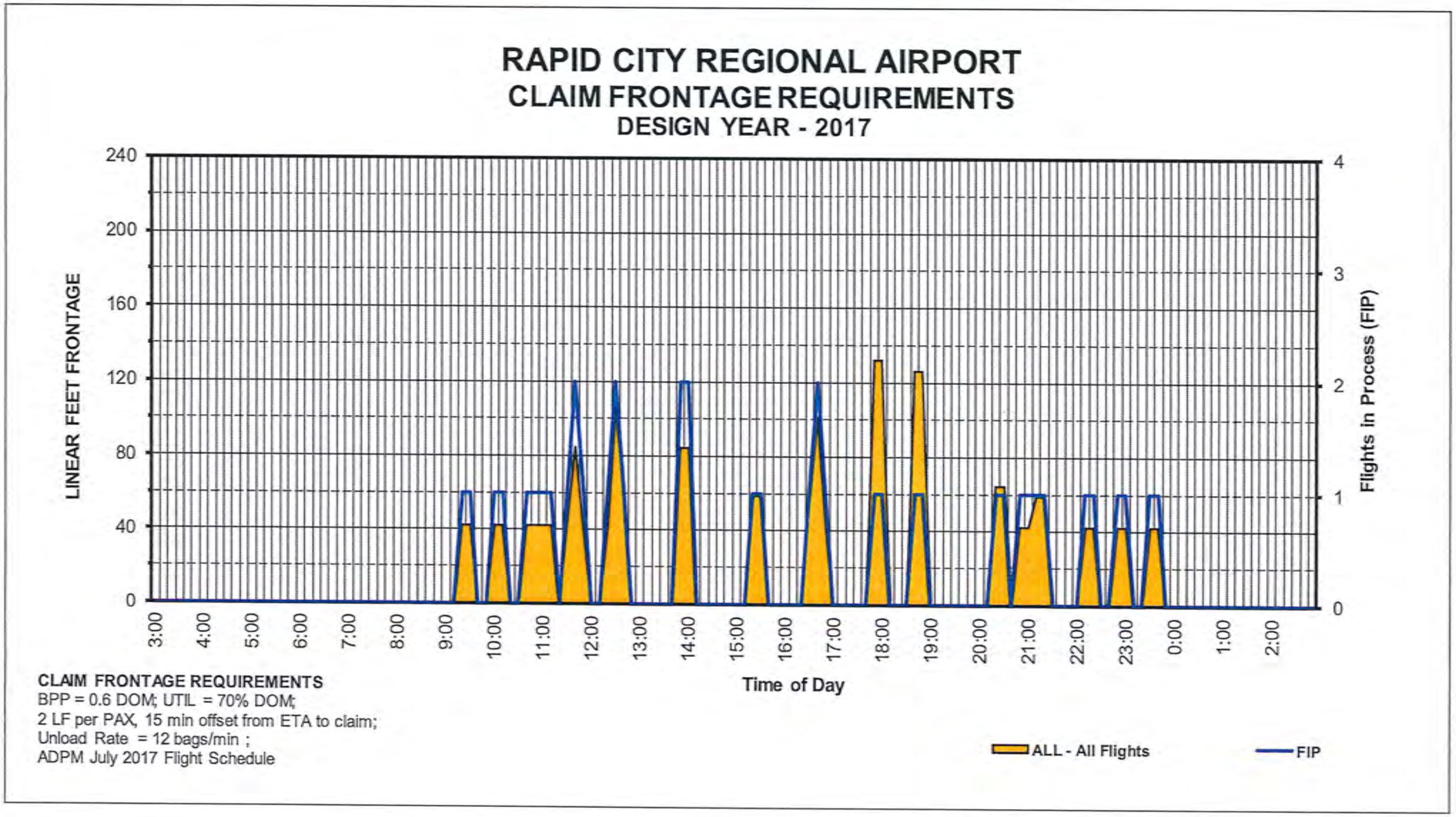
Appendix A – Analysis Charts

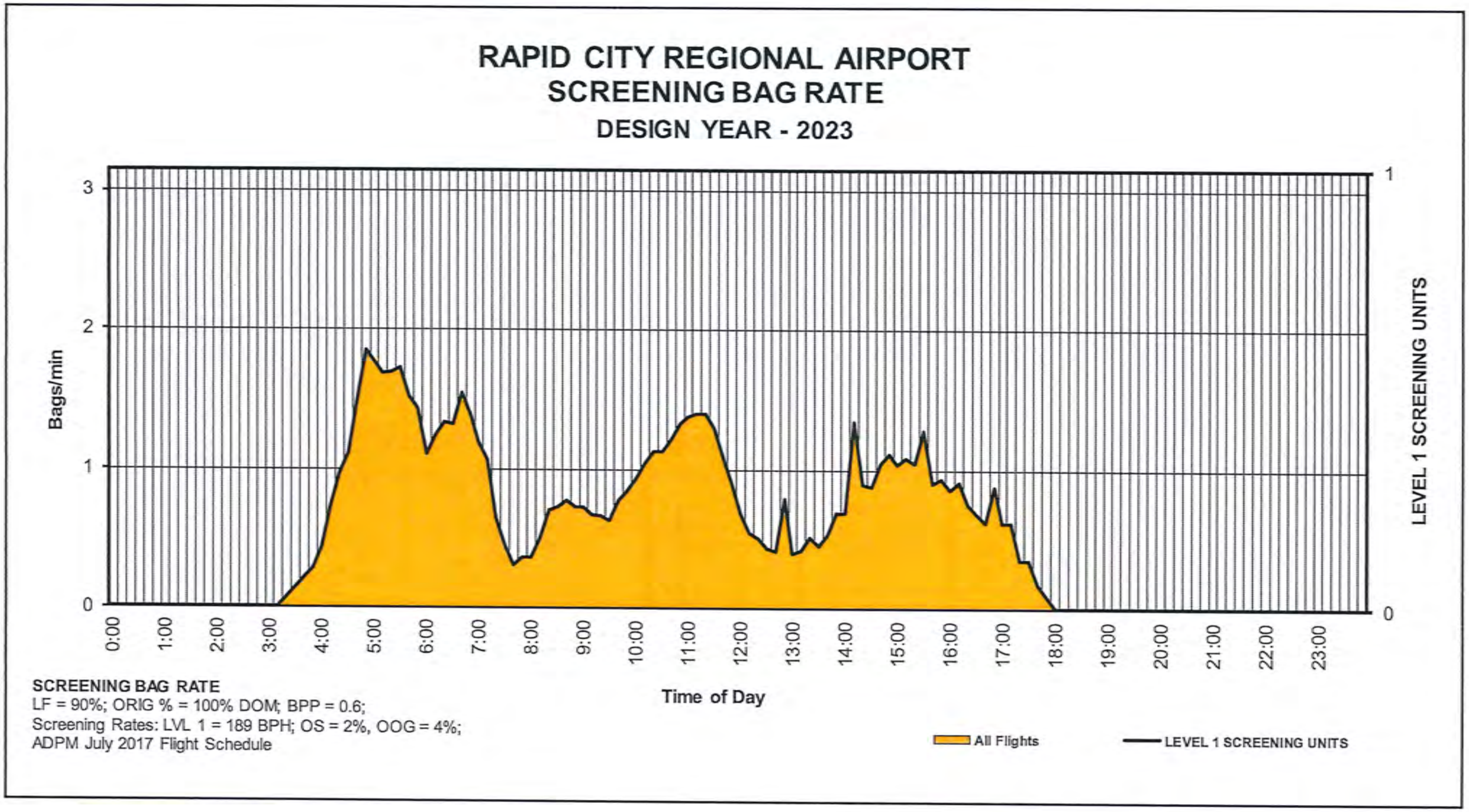




PRESENTATION REQUIREMENTS
MAKE-UP PERIOD = (120 - 20 min) before STD;
RJ (<50 Seats) = 1 Cart; RJ (<100 Seats) = 2 Carts;
NB (>100 Seats)= 3 Carts;
ADPM July 2017 Flight Schedule

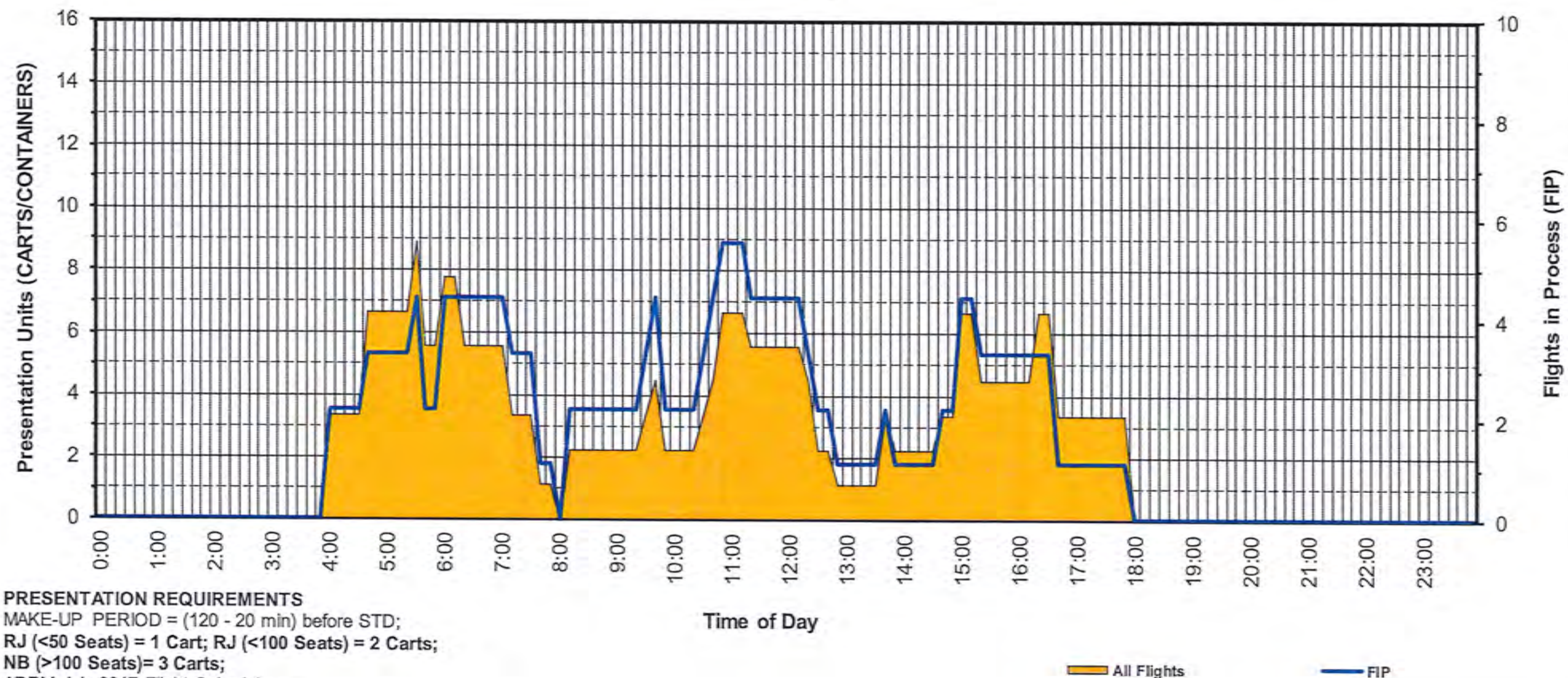
SENSITIVE SECURITY INFORMATION




RAPID CITY REGIONAL AIRPORT
SCREENING BAG RATE
DESIGN YEAR - 2023
Bags/min
3
2
1
0
LEVEL 1 SCREENING UNITS
1
0
0:00
1:00
2:00
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
Time of Day
SCREENING BAG RATE
LF = 90%; ORIG % = 100% DOM; BPP = 0.6;
Screening Rates: LVL 1 = 189 BPH; OS = 2%, OOG = 4%;
ADPM July 2017 Flight Schedule
All Flights
LEVEL 1 SCREENING UNITS

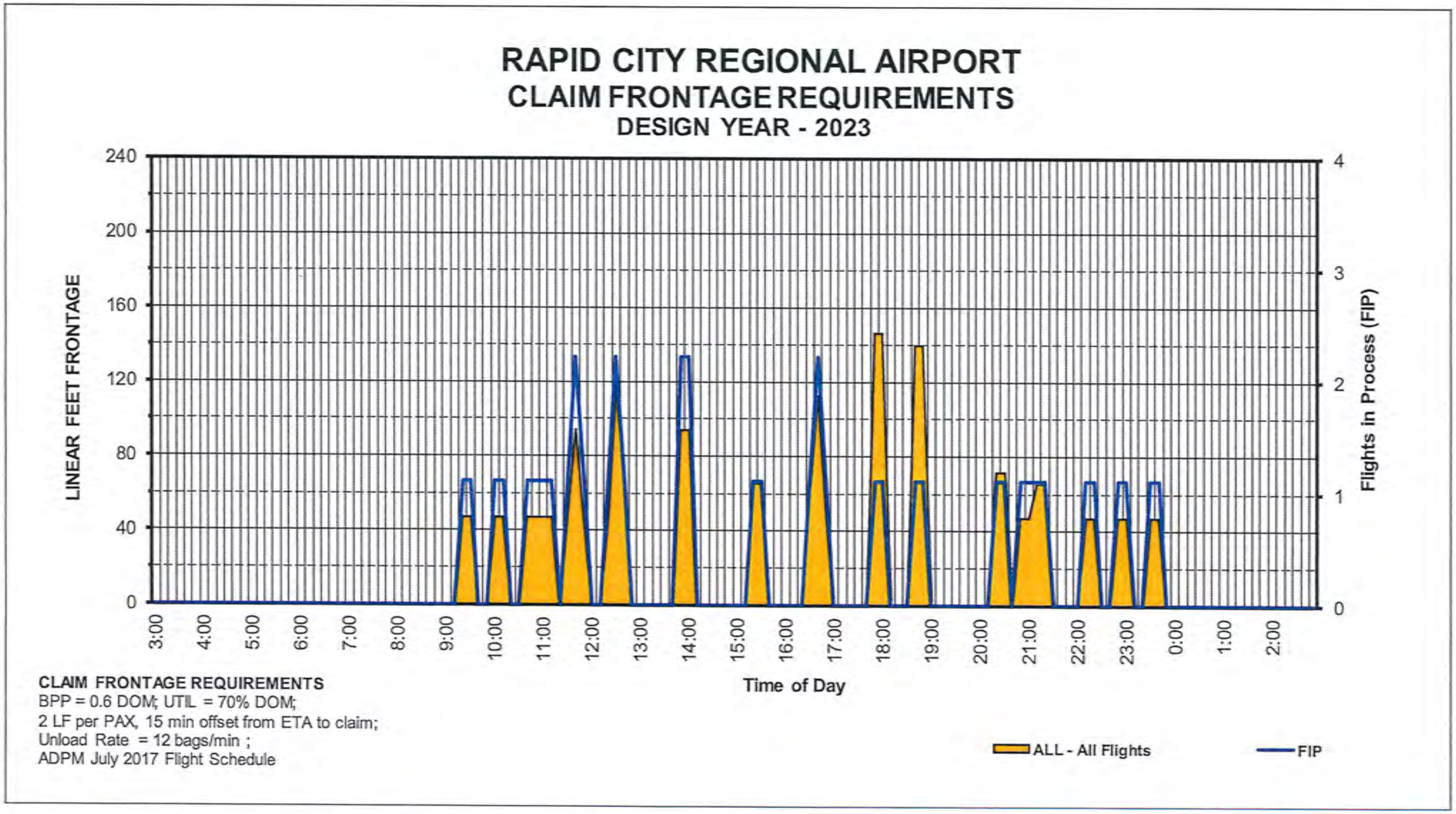
SENSITIVE SECURITY INFORMATION

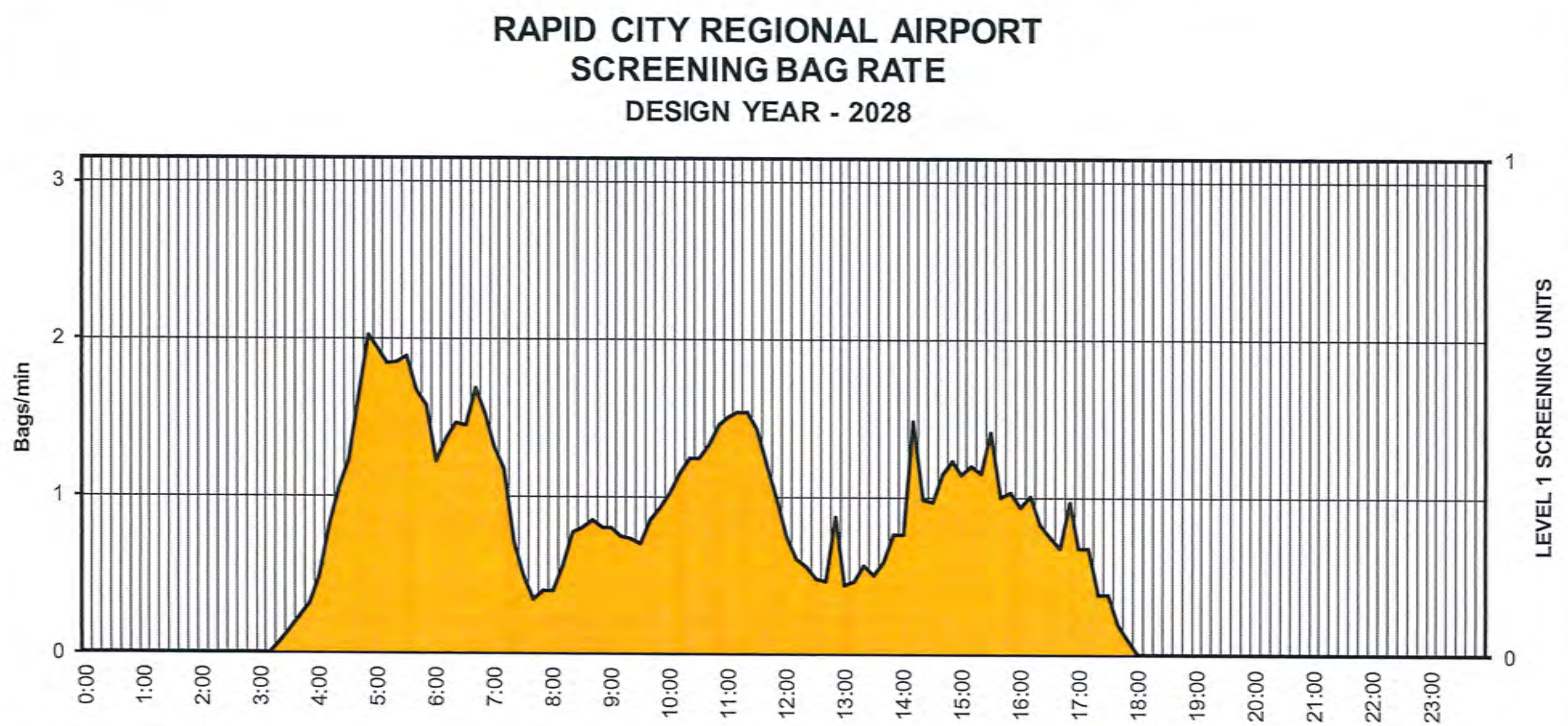
RAPID CITY REGIONAL AIRPORT
PRESENTATION REQUIREMENTS
DESIGN YEAR - 2023



PRESENTATION REQUIREMENTS
MAKE-UP PERIOD = (120 - 20 min) before STD;
RJ (<50 Seats) = 1 Cart; RJ (<100 Seats) = 2 Carts;
NB (>100 Seats)= 3 Carts;
ADPM July 2017 Flight Schedule

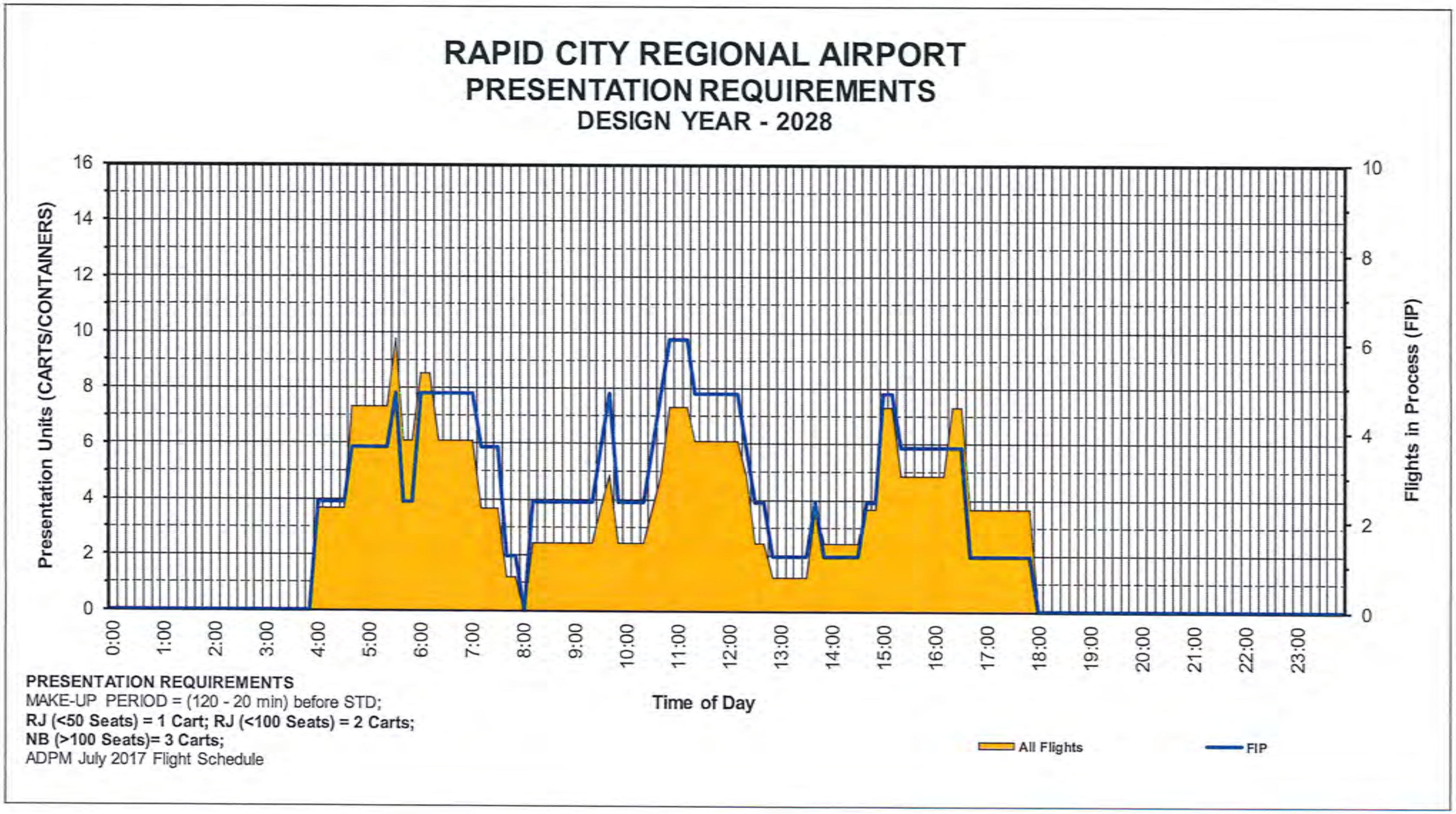
SENSITIVE SECURITY INFORMATION



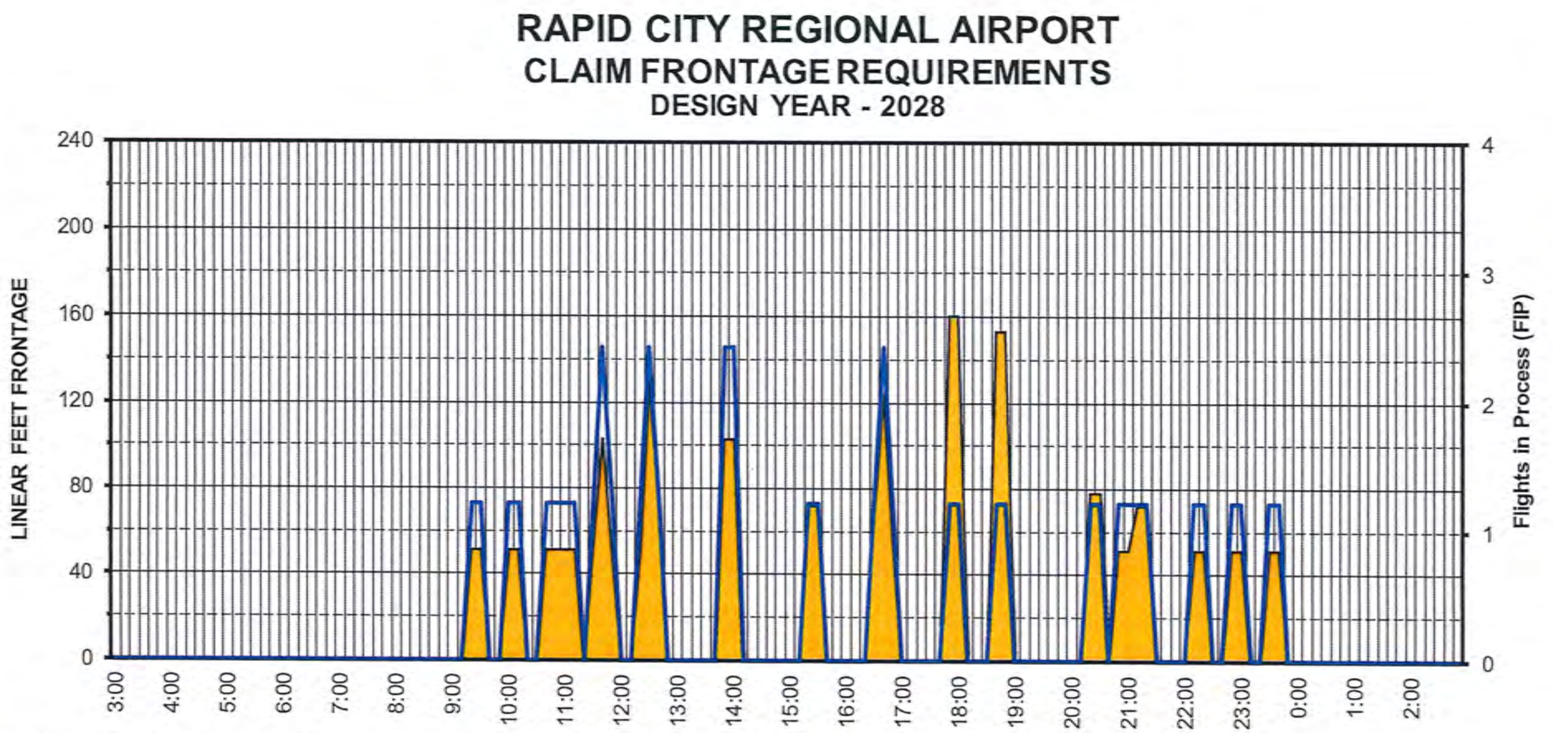


SCREENING BAG RATE
LF = 90%; ORIG % = 100% DOM; BPP = 0.6;
Screening Rates: LVL 1 = 189 BPH; OS = 2%, OOG = 4%;
ADPM July 2017 Flight Schedule

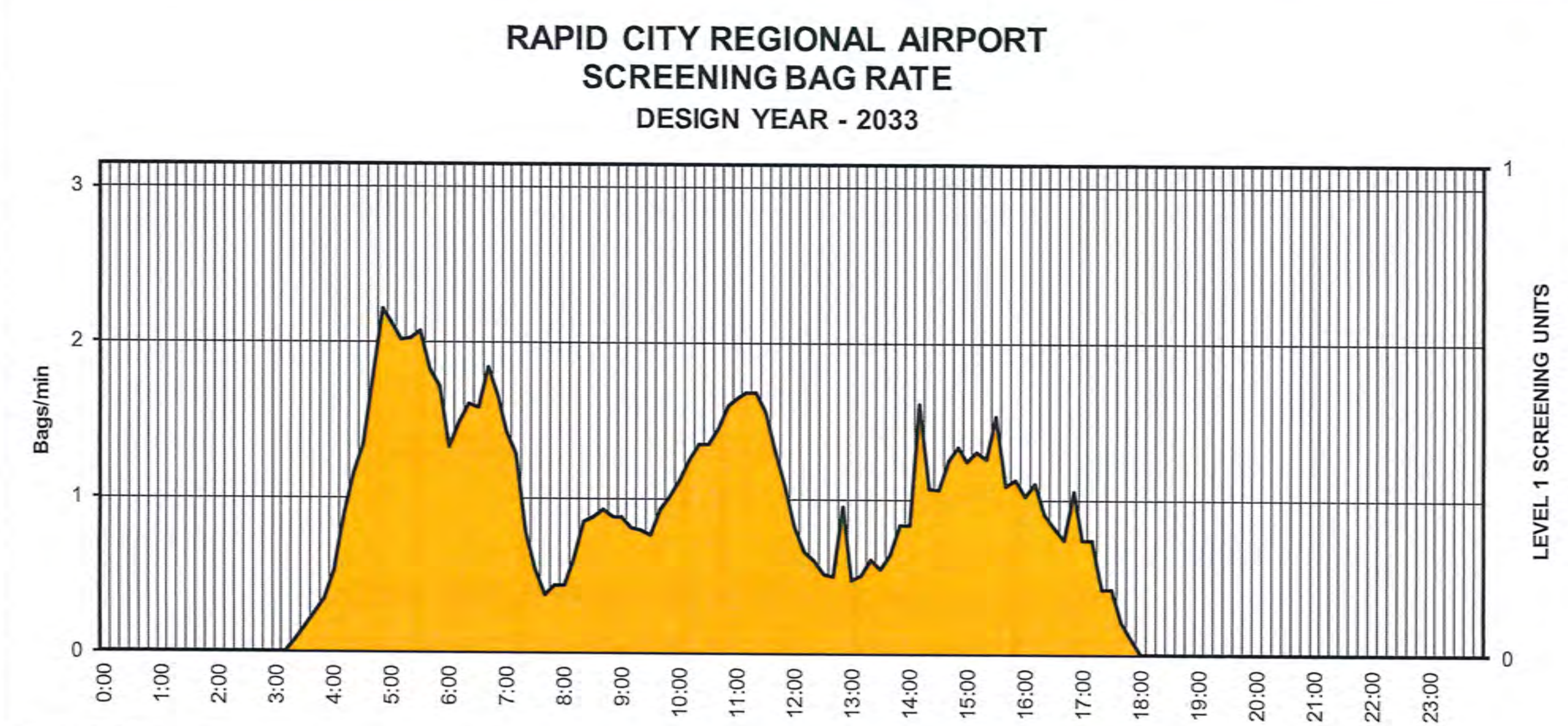
SENSITIVE SECURITY INFORMATION



SENSITIVE SECURITY INFORMATION

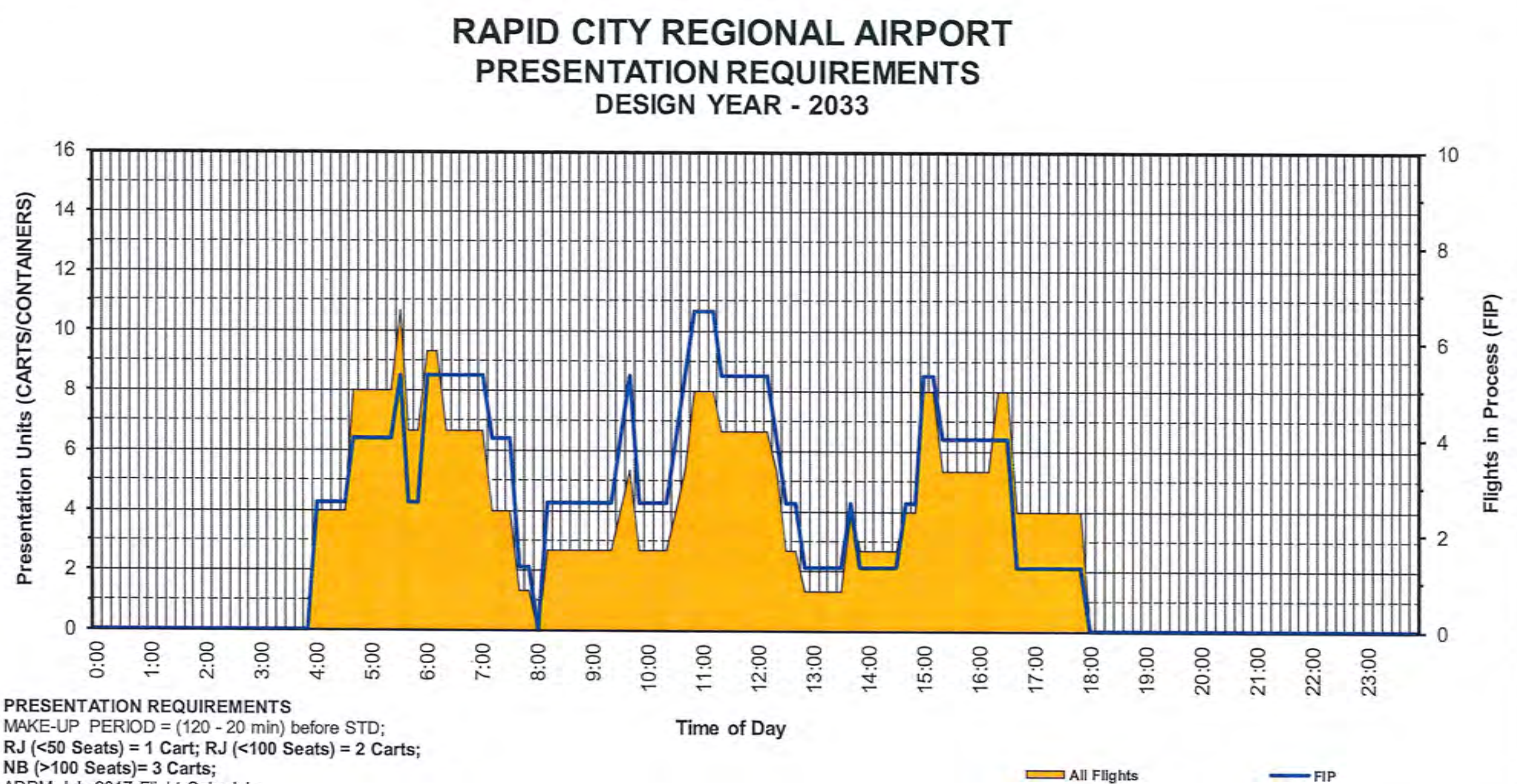


CLAIM FRONTAGE REQUIREMENTS
BPP = 0.6 DOM; UTIL = 70% DOM;
2 LF per PAX, 15 min offset from ETA to claim;
Unload Rate = 12 bags/min ;
ADPM July 2017 Flight Schedule

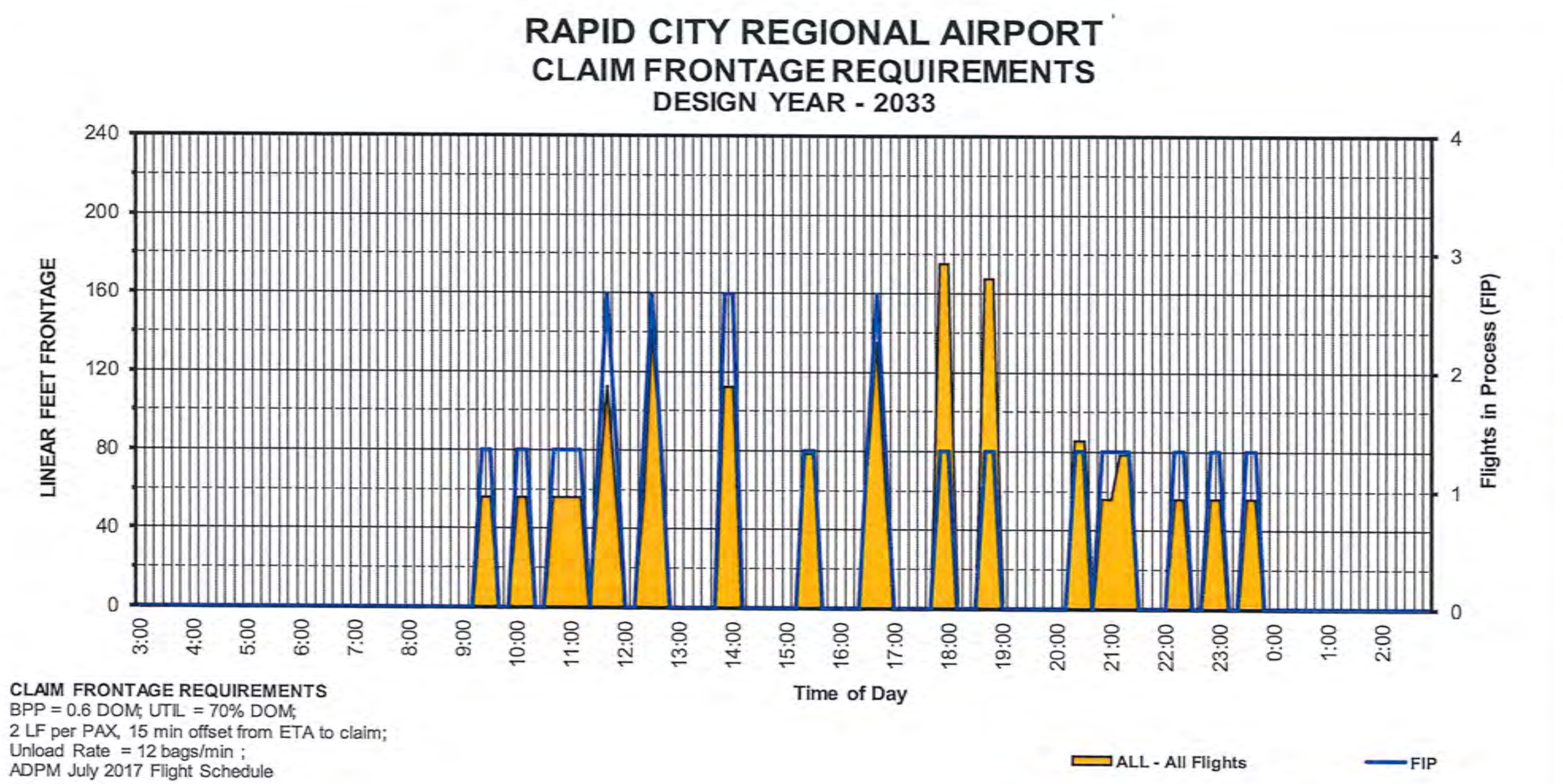


SCREENING BAG RATE
LF = 90%; ORIG % = 100% DOM; BPP = 0.6;
Screening Rates: LVL 1 = 189 BPH; OS = 2%, OOG = 4%;
ADPM July 2017 Flight Schedule

SENSITIVE SECURITY INFORMATION



PRESENTATION REQUIREMENTS
MAKE-UP PERIOD = (120 - 20 min) before STD;
RJ (<50 Seats) = 1 Cart; RJ (<100 Seats) = 2 Carts;
NB (>100 Seats)= 3 Carts;
ADPM July 2017 Flight Schedule


RAPID CITY REGIONAL AIRPORT
CLAIM FRONTAGE REQUIREMENTS
DESIGN YEAR - 2033
LINEAR FEET FRONTAGE
240
200
160
120
80
40
0
Flights in Process (FIP)
4
3
2
1
0
3:00
4:00
5:00
6:00
7:00
8:00
9:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
0:00
1:00
2:00
Time of Day
CLAIM FRONTAGE REQUIREMENTS
BPP = 0.6 DOM; UTIL = 70% DOM;
2 LF per PAX, 15 min offset from ETA to claim;
Unload Rate = 12 bags/min ;
ADPM July 2017 Flight Schedule
ALL - All Flights
FIP

Appendix B – Flight Schedule

ADPM Wednesday, July 05th 2017 - Flight Schedule provided to BNP

ADPM - Departure Flight Schedule					
Airline	**Depart Flight #**	**Destination**	**Type**	**Depart Time**	**Seats**
All the Flights	5238	DEN	DOM	6:00	50
All the Flights	3300	DFW	DOM	6:00	76
All the Flights	494	MSP	DOM	6:45	149
All the Flights	4545	DEN	DOM	7:30	70
All the Flights	4495	MSP	DOM	8:00	50
All the Flights	4210	ORD	DOM	8:00	50
All the Flights	4516	SLC	DOM	8:25	50
All the Flights	4576	MSP	DOM	10:11	50
All the Flights	5630	DEN	DOM	10:15	50
All the Flights	4705	DEN	DOM	11:33	50
All the Flights	4584	MSP	DOM	11:48	50
All the Flights	4729	SLC	DOM	12:35	50
All the Flights	3501	ORD	DOM	12:44	50
All the Flights	3370	DFW	DOM	12:53	76
All the Flights	4135	ORD	DOM	13:15	50
All the Flights	4536	MSP	DOM	14:15	50
All the Flights	4469	DEN	DOM	15:45	70
All the Flights	4026	ORD	DOM	16:47	50
All the Flights	4472	MSP	DOM	17:05	50
All the Flights	4508	DEN	DOM	17:09	70
All the Flights	161	AZA	DOM	18:24	156

ADPM - Arrival Flight Schedule					
Airline	Arrival Flight #	Origin	Type	Arrival Time	AC Type
All the Flights	5310	DEN	DOM	9:13	50
All the Flights	4576	MSP	DOM	9:45	50
All the Flights	4161	ORD	DOM	10:28	50
All the Flights	4674	DEN	DOM	10:53	50
All the Flights	4744	SLC	DOM	11:23	50
All the Flights	3501	ORD	DOM	11:30	50
All the Flights	4699	MSP	DOM	12:08	50
All the Flights	3370	DFW	DOM	12:20	76
All the Flights	3762	ORD	DOM	13:38	50
All the Flights	4536	MSP	DOM	13:42	50
All the Flights	4508	DEN	DOM	15:08	70
All the Flights	4565	DEN	DOM	16:18	70
All the Flights	4472	MSP	DOM	16:33	50
All the Flights	160	AZA	DOM	17:44	156
All the Flights	705	MSP	DOM	18:31	149
All the Flights	3772	DFW	DOM	20:14	76
All the Flights	3870	ORD	DOM	20:43	50
All the Flights	4481	DEN	DOM	20:58	70
All the Flights	4690	SLC	DOM	21:58	50
All the Flights	4494	MSP	DOM	22:40	50
All the Flights	5491	DEN	DOM	23:24	50

2201 East 54th Street North, Sioux Falls, SD
phone 605-271-7000 fax 605-271-7001
bob.peplinski@convergint.com

Alliance
400 Clifton Avenue
Minneapolis, MN 55403-3127

May 01, 2017

Reference: Rapid City Regional Airport Consulting - Security Study

Mr. Peterson,

Convergint Technologies has reviewed Design Options A, B, C and Upper Level West Plans as presented by Alliance. Studying the current facility layout, the existing security solution design, and considering the protection of people, process and property; we offer the following observations and recommendations.

Ground Floor East – EDS Option 'A'

1. Access Control

    a. Three (3) existing access control doors used by the public leading into the Self-Service Devices are not impacted by Option 'A' and could remain as-is
    b. Add access control functionality to the door leading into the East ATO area. This would be accomplished by relocating the card reader from door T158. Locking hardware and other door hardware would be determined with the release of a door hardware schedule
    c. Add two (2) door contacts to the conveyor baggage doors
    d. Add one (1) door contact to the OS/OOG conveyor door
    e. Add access control functionality to the door leading into the West ATO area. This would be accomplished by relocating the card reader from door T138. Locking hardware and other door hardware would be determined with the release of a door hardware schedule
    f. Add access control functionality to the two (2) doors leading into the Landside Restroom area (Staff SIDA Access and South Vestibule Door). This would be accomplished by relocating the card readers from doors T133 & T136. Locking hardware and other door hardware would be determined with the release of a door hardware schedule
    g. Add access control functionality to the double door leading into the OSR area. This would be accomplished by relocating the card reader from door T165. Locking hardware and other door hardware would be determined with the release of a door hardware schedule
    h. Relocate the existing Access Control Panel head-end

2. Video Surveillance

    a. The physical location of the Video Surveillance Headend will need to be relocated
    b. Existing Cameras
        i. Camera 01 remains as-is
        ii. Camera 02 would remain in-place. Re-aiming and focusing would be required to achieve the desired view.
        iii. Cameras 03, 04, 05, 06, 07, 08, 09, 10, and 11 would be repurposed (removed from current locations, re-installed, re-aimed and focused to achieve desired views)
    c. Camera Additions:
        i. Add two (2) cameras to the escalator viewing up and down travel
        ii. Add one (1) camera to view the West ATO Door
        iii. Add one (1) camera to view the East ATO Door
        iv. Add one (1) camera to view the Staff SIDA access door
        v. Add one (1) camera to view the OS/OOG conveyor
        vi. Add one (1) camera to view baggage travelling from ticketing area into OSR
        vii. Add three (3) cameras view OSR, Bag Screening and Clear areas
        viii. Add two (2) cameras to view the cargo loading conveyor

<u>Ground Floor East – EDS Option 'B'</u>

1. Access Control

    a. Three (3) existing access control doors used by the public leading into the Self-Service Devices are not impacted by Option 'B' and could remain as-is
    b. Add access control functionality to the door leading into the East ATO area. This would be accomplished by relocating the card reader from door T158. Locking hardware and other door hardware would be determined with the release of a door hardware schedule
    c. Add two (2) door contacts to the conveyor baggage doors
    d. Add one (1) door contact to the OS/OOG conveyor door
    e. Add access control functionality to the door leading into the West ATO area. This would be accomplished by relocating the card reader from door T138. Locking hardware and other door hardware would be determined with the release of a door hardware schedule
    f. Add access control functionality to the two (2) doors leading into the Landside Restroom area (Staff SIDA Access and South Vestibule Door). This would be accomplished by relocating the card readers from doors T133 & T136. Locking hardware and other door hardware would be determined with the release of a door hardware schedule
    g. Add access control functionality to the double door leading into the OSR area. This would be accomplished by relocating the card reader from door T165. Locking hardware and other door hardware would be determined with the release of a door hardware schedule
    h. Relocate the existing Access Control Panel head-end

2. Video Surveillance
    a. The physical location of the Video Surveillance Headend will need to be relocated
    b. Existing Cameras
        i. Camera 01 remains as-is
        ii. Camera 02 would remain in-place. Re-aiming and focusing would be required to achieve the desired view.
        iii. Cameras 03, 04, 05, 06, 07, 08, 09, 10, and 11 would be repurposed (removed from current locations, re-installed, re-aimed and focused to achieve desired views)
    c. Camera Additions:
        i. Add two (2) cameras to the escalator viewing up and down travel
        ii. Add one (1) camera to view the West ATO Door
        iii. Add one (1) camera to view the East ATO Door
        iv. Add one (1) camera to view the Staff SIDA access door
        v. Add one (1) camera to view the OS/OOG conveyor
        vi. Add four (4) cameras view OSR, Bag Screening and Clear areas
        vii. Add two (2) cameras to view the cargo loading conveyor

Ground Floor East – EDS Option 'C'

1. Access Control
    a. Three (3) existing access control doors used by the public leading into the Self-Service Devices are not impacted by Option 'C' and could remain as-is
    b. Add access control functionality to the door leading into the East ATO area. This would be accomplished by relocating the card reader from door T158. Locking hardware and other door hardware would be determined with the release of a door hardware schedule
    c. Add two (2) door contacts to the conveyor baggage doors
    d. Add one (1) door contact to the OS/OOG conveyor door
    e. Add access control functionality to the door leading into the West ATO area. This would be accomplished by relocating the card reader from door T138. Locking hardware and other door hardware would be determined with the release of a door hardware schedule
    f. Add access control functionality to the two (2) doors leading into the Landside Restroom area (Staff SIDA Access and South Vestibule Door). This would be accomplished by relocating the card readers from doors T133 & T136. Locking hardware and other door hardware would be determined with the release of a door hardware schedule
    g. Add access control functionality to the double door leading into the OSR area. This would be accomplished by relocating the card reader from door T165. Locking hardware and other door hardware would be determined with the release of a door hardware schedule
    h. Relocate the existing Access Control Panel head-end

1. Video Surveillance

    a. The physical location of the Video Surveillance Headend will need to be relocated
    b. Existing Cameras
        i. Camera 01 remains as-is
        ii. Camera 02 would remain in-place. Re-aiming and focusing would be required to achieve the desired view.
        iii. Cameras 03, 04, 05, 06, 07, 08, 09, 10, and 11 would be repurposed (removed from current locations, re-installed, re-aimed and focused to achieve desired views)
    c. Camera Additions:
        i. Add two (2) cameras to the escalator viewing up and down travel
        ii. Add one (1) camera to view the West ATO Door
        iii. Add one (1) camera to view the East ATO Door
        iv. Add one (1) camera to view the Staff SIDA access door
        v. Add one (1) camera to view the OS/OOG conveyor
        vi. Add three (3) cameras view OSR, Bag Screening and Clear areas
        vii. Add two (2) cameras to view the cargo loading conveyor

Upper Level West Plan

1. Access Control
    a. Add access control functionality to the double door leading into the Admin Area. This would be accomplished by relocating the card reader from door 1215. Locking hardware and other door hardware would be determined with the release of a door hardware schedule
    b. Staff Offices
        i. Add access control functionality to six (6) new staff offices. This would be accomplished by relocating the card reader from doors T163, T164, T222, T223, T226 and T227. Locking hardware and other door hardware would be determined with the release of a door hardware schedule
    c. The card reader into the Access Control headend remains as-is
    d. Relocate the existing door release button to the new receptionist desk in the Amin Area
    e. The Access Control Headend remains as-is

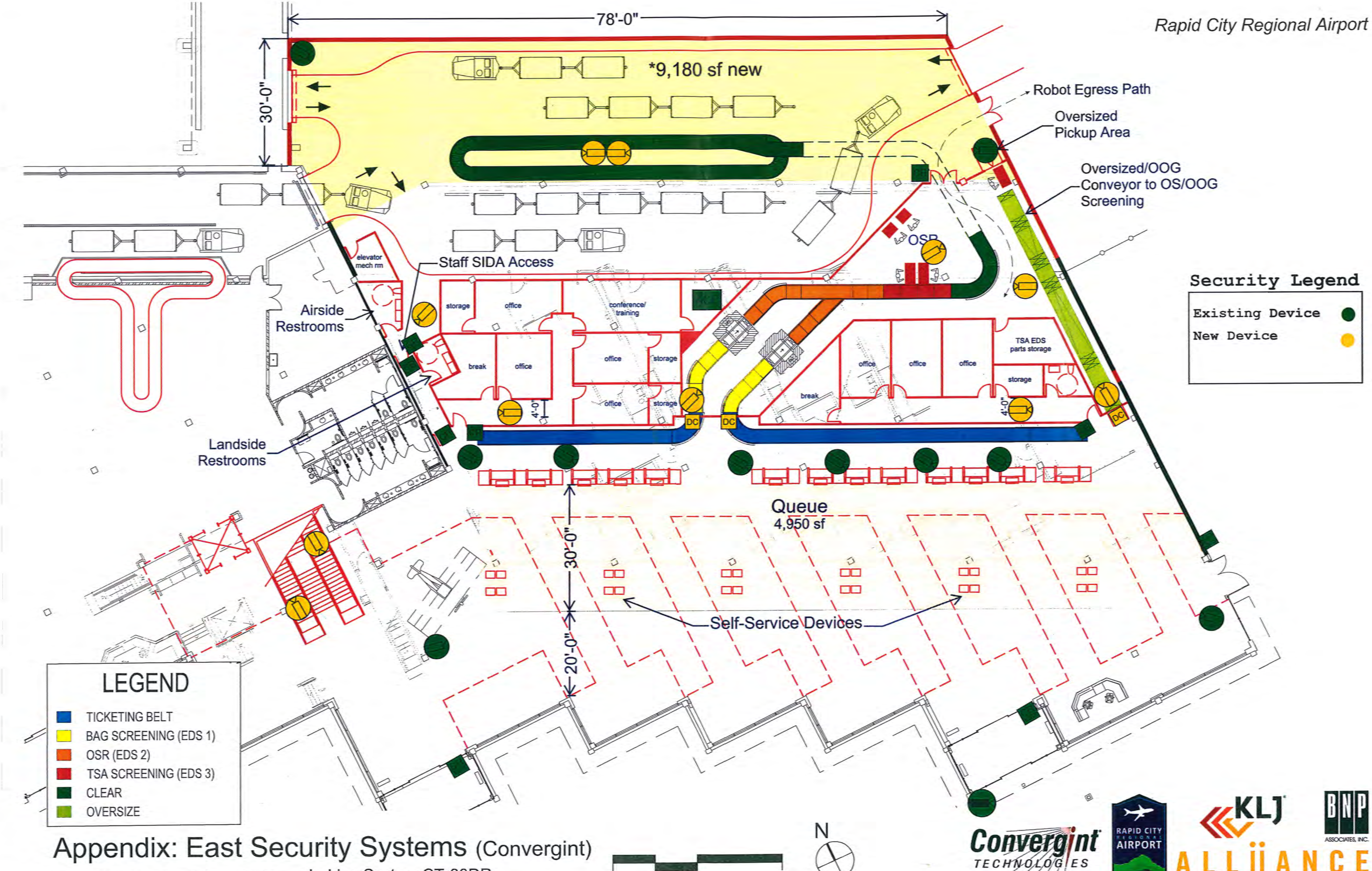
2. **Video Surveillance**

    a. The physical location of the Video Surveillance Headend is not impacted
    b. Existing Cameras
        i. Camera 22 would be repurposed (removed from current location, re-installed, re-aimed and focused to achieve desired views)
        ii. Camera 25 would be repurposed (removed from current location, re-installed, re-aimed and focused to achieve desired views)

c. Camera Additions:
    i. No camera additions are required

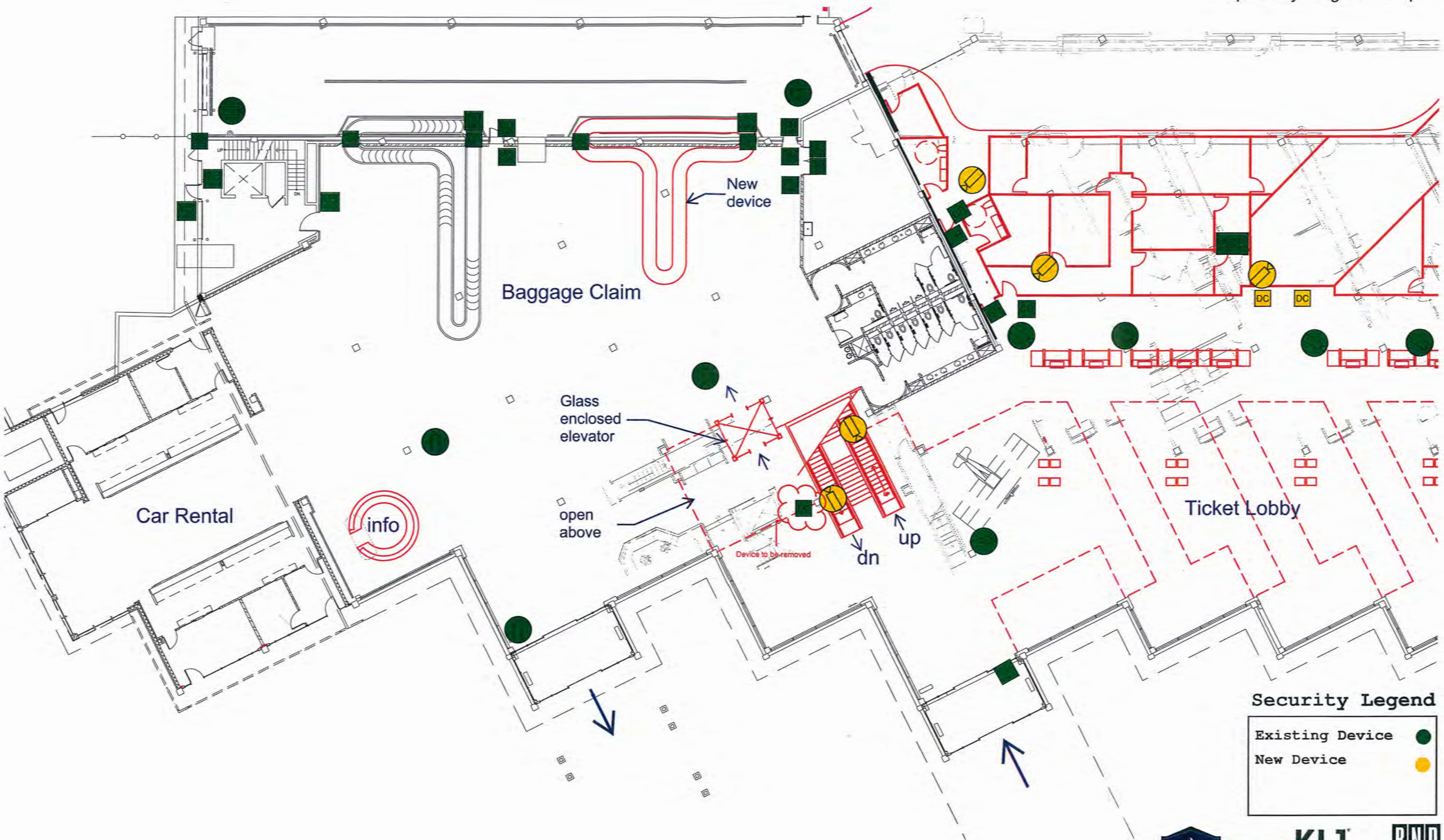
Best Regards,

Robert F. Peplinski
General Manager
Convergint Technologies, Inc.



Appendix: East Security Systems (Convergint)

Comm. No. 2017056 *22 August 2017* In-Line System CT-80DR



Appendix: West Security Systems (Convergint)

Comm. No. 2017056   22 August 2017

Convergint Technologies · Rapid City Regional Airport · KLJ · BNP Associates, Inc. · ALLIANCE

Alliiance Architects

Rapid City Airport - "A,B,C,D"

Class 4: Concept Estimate

Rapid City, South Dakota

June 7, 2017

FAITHFUL GOULD

Rapid City Airport - "A,B,C,D"

Rapid City, South Dakota

Alliiance Architects

Class 4: Concept Estimate

June 7, 2017

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Faithful+Gould		
VERIFICATION		
F+G Job #	Initial	Date
Arithmetical	PS	06/07/17
Technical	NM	06/07/17
Format & Presentation	CC	06/07/17
Authorized for Issue	RA	06/07/17

FAITHFUL GOULD

Contents

1.0 EXECUTIVE SUMMARY

The total project cost for the scope of this project:	$8,684,871	TOTAL
The gross floor area is calculated by squarefoot at:	62,625	SF
This equates to an overall cost per squarefoot of:	$138.68	PER SF

2.0 ESTIMATE REVISION HISTORY

Version	Rev.	Date
Conceptual Design Estimate (Draft)	0	6/5/17
Conceptual Design Estimate	1	6/6/17
Conceptual Design Estimate	2	6/7/17

3.0 PURPOSE OF THE ESTIMATE

Alliiance Architects has retained Faithful+Gould for the purpose of preparing this Opinion of Probable Cost for work in the Rapid City, South Dakota area.

Alliiance Architects acknowledges that the design of the work for which this statement of probable cost is prepared is incomplete and this Opinion of Probable Cost is not derived from full construction documents for which actual pricing may be obtained.

4.0 PROJECT DESCRIPTION

In brief, the project comprises of an expansion and remodel of the Rapid City Regional Airport, which includes work to the baggage handling system, structure, and interiors in Rapid City, South Dakota.

5.0 SCHEDULE OF AREAS

A schedule of areas has been measured by Faithful+Gould from the floor plans received from Alliiance Architects as listed in the Reference Information section of this report.

Description	GFA
Airport Remodel and Expansion excluding Upper Admin offices	62,625

6.0 BASIS OF ESTIMATE

This estimate is based upon the design information detailed in the Reference Information section. The estimate does not incorporate design and engineering changes occurring subsequent to this information.

The estimate is based on the measurement of quantities from the documents, where possible. For the remainder, parametric measurements were used in conjunction with references from other projects estimated by Faithful+Gould.

7.0 BASIS OF PRICING

This estimate reflects the fair market value for the construction of this project and should not be construed as a prediction of low bid. The unit costs include labor, material, and equipment costs plus subcontractors overhead and profit costs.

Procurement Method

Pricing assumes a procurement process with competitive bidding for every portion of the construction work.

This means a minimum of 5 competitive bids for all general contractors and at least 3 competitive bids from all subcontractors and materials/equipment suppliers.

If fewer bids are solicited or received, it is anticipated that prices will be higher.

Wage Rates

This estimate is priced on the basis of Union Prevailing Wage rates.

Duration

The anticipated duration of construction for this project is assumed as follows:

Start:	6/1/18	Midpoint:	11/30/18	Complete:	6/1/19

Phasing

Phasing and unproductive time Allowance **5.00%**

Access and Security

The estimate anticipates no constraints on site access or security.

8.0 ESCALATION

	Period	Escalation this period	Compound Escalation
	2016 Q4	0.00%	0.00%
	2017 Q1	0.00%	0.00%
Estimate	2017 Q2	0.00%	0.00%
	2017 Q3	0.92%	0.92%
	2017 Q4	0.92%	1.84%
	2018 Q1	0.92%	2.78%
	2018 Q2	0.92%	3.72%
	2018 Q3	0.92%	4.67%
Construction Midpoint	2018 Q4	0.92%	5.63%
	2019 Q1	0.92%	6.60%
	2019 Q2	0.92%	7.58%
	2019 Q3	0.92%	8.56%
	2019 Q4	0.92%	9.56%

9.0 MARK-UPS

Contractors Markup

General Conditions, Overhead & Profit **15.00%**

Allowances and Escalation

Design Development Allowance **15.00%**

Escalation (to midpoint of construction) **5.63%**

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.

This estimate includes a 15% design development allowance on construction costs. The allowance is a budgeting tool used to compensate for the lack of detail and definition during preliminary phases of design, as well as assumptions and allowances made with reference to quantities and pricing. This percentage is provided to cover scope which is not yet defined within the provided documents or narratives. These are monies which are expected to be absorbed into the line item detail as the design evolves.

AACE Cost Estimating Classification System

Estimate Class	MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES	END USAGE	METHODOLOGY	DESIGN DEVELOPMENT / ESTIMATING CONTINGENCY		EXPECTED ACCURACY RANGE
	(Expressed as % of complete definition)	(Typical purpose of estimate)	(Typical purpose of estimate)	(Typical estimating method)	(Typical allowance)	(Typical variation in low and high ranges)
Class 5	0% to 2%	Functional area, or concept screening	Program or Rough order of Magnitude (RoM)	SF or m2 factoring, parametric models, judgment, or analogy	20% +	L: -20% to -30% H: +30% to +50%
Class 4	1% to 15%	Schematic design or concept study	Concept or Feasibility	Parametric models, assembly driven models	15% to 20%	L: -10% to -20% H: +20% to +30%
Class 3	10% to 40%	Design development, budget authorization, feasibility	Schematic Design	Semi-detailed unit costs with assembly level line items	10% to 15%	L: -5% to -15% H: +10% to +20%
Class 2	30% to 75%	Control or bid/tender, semi-detailed	Design Development	Detailed unit cost with forced detailed take-off	5% to 10%	L: -5% to -10% H: +5% to +15%
Class 1	65% to 100%	Check estimate or pre bid/tender, change order	Construction Documents	Detailed unit cost with detailed take-off	0% to 5%	L: -3% to -5% H: +3% to +10%

The cost estimator makes the determination of the estimate class based upon the maturity level of project definition (design % complete). While the determination of the estimate class is somewhat subjective, the design input data, completeness and quality of the design deliverables serve to make the determination more objective. The cost estimator will make the final determination based on the actual detail provided, which may vary from the AACE Cost Estimating Classification System listed above.

Faithful+Gould recommends the Owner add a 5-10% construction contingency to this estimate to anticipate change orders which occur after the project is under construction. The construction contingency is not part of the construction bid amount, however it should be accounted for when establishing the overall construction budget.

10.0 STATEMENT OF PROBABLE COST OF CONSTRUCTION

Faithful+Gould has many years experience providing cost consulting services in the construction industry. Historically, the deviation between our construction estimates and the corresponding bid amounts is minimal. However, Faithful+Gould has no control over the method of determining prices adopted by any individual general contractor, subcontractor or supplier. Faithful+Gould 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.

Faithful+Gould 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 construction industry. This staff is available to discuss its content with any interested party.

11.0 RECOMMENDATIONS FOR COST CONTROL

Faithful+Gould recommends that the Owner, Architect and Engineers carefully review this entire document to ensure that it reflects their design intent. Requests for modifications of any apparent errors or omissions to this document should be made to Faithful+Gould within ten (10) working days of receipt of this estimate. Failing same, it will be deemed that the content have been concurred with and accepted.

If this estimate does not correspond to the Owner's budgetary objectives, Faithful+Gould strongly suggests that evaluation of design alternatives/options and/or project procurement options should be made before proceeding further. Faithful+Gould is not responsible for design revision costs in the event that the estimate is in excess of the established budget.

12.0 PROJECT SCOPE CLARIFICATIONS

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

Foundations
Assumptions: Sizes of foundations

Superstructure
Assumptions: Size of concrete columns and beams

Exterior Enclosure
Assumptions: Assumed construction of exterior wall to match existing.

Electrical
Assumptions: Assumes that there is capacity for the additional loads for power distribution and feeders assumed at 100lf. Voice/Data assumes that there is capacity for the additional devices and all runs are CAT 6 cabling in conduit. Fire Alarm is assumed to be existing and minor adjustments for the new scope of work. Access Control & CCTV per documents provided.

Site work
Assumptions: Tarmac concrete is 2" thick and will be removed 10' from new construction then replaced.

13.0 REFERENCE INFORMATION

Use of Information Provided

Faithful+Gould used the following documents and information to prepare the estimate:

Drawings

Set	Rev.	Date	Description	Provided by
		5/9/17	1987 Construction Docs	Alliiance Architects
		5/9/17	2012 Construction Docs	Alliiance Architects
		5/9/17	Recommended option Security Drawings	Alliiance Architects
		5/9/17	Recommended option drawings	Alliiance Architects
		5/9/17	Security Study Drawings	Alliiance Architects

Specifications and Project Manuals

Set	Rev.	Date	Description	Provided by
		5/9/17	Cost Est Narrative	Alliiance Architects

14.0 ADDITIONAL INFORMATION/FURTHER ACTION

Not Applicable

15.0 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, unless otherwise noted

Work beyond the boundaries of the property

Feasibility and financing costs

Owner administrative fees

Testing fees

Land acquisition and real estate fees

Professional design and consulting fees

Owner's field inspection costs

Owner furnished items and Owner move-in costs

Off-site work

Items marked on plans as N.I.C.

Furniture and Equipment beyond that listed in the narrative

LEED design allowance

Pre-construction fees

Project management costs

Moving costs

Credit for recycling

FF&E

Artwork

Technology/IT Equipment

16.0 VERIFICATION

Disclaimer

This document and its contents have been prepared and are intended solely for Alliiance Architects' information and use in relation to project budgeting and not for any individual member of the Alliiance Architects.

Alliiance Architects acknowledges that the design of the work for which this statement of probable costs is prepared is incomplete and this opinion of probable costs is not derived from full construction documents for which actual pricing may be obtained. The statement of probable cost is not based upon specific contractor or subcontractor bids, rather the market value of the improvements planned at the time the document was prepared. Specific market forces (including, but not limited to, the ultimate design requirements, code requirements, commodity pricing, and labor availability) may cause the actual bids received to be higher or lower than the probable costs identified herein, potentially by a wide margin. Faithful+Gould expressly disclaims any liability and Alliiance Architects releases Faithful+Gould under any and all theories of recovery, whether based in contract or in tort, if the actual costs in the future differ from the statement of probable costs contained herein.

Faithful+Gould assumes no responsibility to any party other than Alliiance Architects, including, but not limited to individual members of Alliiance Architects, with respect to or arising out of or in connection with this document and/or its contents and there are no third-party beneficiaries created through issuance of this document and/or its contents.

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Authorization
Approved for Issue Peter Schneider - Estimator
Project Manager Richard Anderson - Technical Director June 7, 2017

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June 7, 2017

FAITHFUL GOULD

Rapid City Airport - "A,B,C,D"

Rapid City, South Dakota

Class 4: Concept Estimate GFA 62,625

MAIN SUMMARY

SYSTEM DESCRIPTION			*TOTAL*
A10	FOUNDATIONS		$108,076
A20	BASEMENT CONSTRUCTION		$0
B10	SUPERSTRUCTURE		$173,698
B20	EXTERIOR CLOSURE		$232,051
B30	ROOFING		$57,410
C10	INTERIOR CONSTRUCTION		$303,326
C20	STAIRCASES		$25,000
C30	INTERIOR FINISHES		$368,618
D10	CONVEYING SYSTEMS		$3,020,388
D20	PLUMBING		$79,346
D30	HVAC		$385,550
D40	FIRE PROTECTION		$78,312
D50	ELECTRICAL		$700,453
E10	EQUIPMENT		$0
E20	FURNISHINGS		$0
F10	SPECIAL CONSTRUCTION		$0
F20	SELECTIVE BUILDING DEMOLITION		$260,317
G	SITE PREP/DEVELOPMENT		$128,355
TOTAL DIRECT COST (Trade Costs)			***$5,920,900***
MARKUPS			
	General Conditions, Overhead & Profit	15.00%	$888,135
SUBTOTAL CONSTRUCTION			***$6,809,035***
ALLOWANCES/ESCALATION			
	Design Development Allowance	15.00%	$470,425
	Phasing and unproductive time Allowance	5.00%	$180,330
	Escalation (to midpoint of construction)	5.63%	$1,225,081
TOTAL CONSTRUCTION COST			***$8,684,871***
ALTERNATES			
Alternate C.2: Replace existing roof structure south of elevator			***$177,910***

FAITHFUL GOULD

17.0 OPINION OF PROBABLE COSTS

MASTER SUMMARY

#	System Description	A) Outbound BHS and Screening	B) Terminal Expansion	C) Elevator Replacement	C.2) Replace Existing Roof	D) Replace Bag Claim Device	Total
	Areas	16,086 sf	58,261 sf	4,364 sf	1,952 sf	1,845 sf	
1	Foundations	$0	$108,076	$0	$0	$0	**$108,076**
2	Basement	$0	$0	$0	$0	$0	**$0**
3	Superstructure	$0	$173,698	$0	$62,395	$0	**$236,093**
4	Exterior Closure	$0	$212,427	$19,624	$18,740	$0	**$250,791**
5	Roofing	$0	$57,410	$0	$19,520	$0	**$76,930**
6	Interior Construction	$0	$289,590	$13,736	$5,000	$0	**$308,326**
7	Staircases	$0	$0	$25,000	$0	$0	**$25,000**
8	Interior Finishes	$0	$348,260	$20,358	$0	$0	**$368,618**
9	Conveying	$2,300,000	$0	$516,388	$0	$204,000	**$3,020,388**
10	Plumbing	$0	$79,346	$0	$0	$0	**$79,346**
11	Mechanical	$0	$353,550	$32,000	$0	$0	**$385,550**
12	Fire Protection	$0	$72,456	$5,856	$0	$0	**$78,312**
13	Electrical	$161,850	$511,153	$27,450	$0	$0	**$700,453**
14	Equipment	$0	$0	$0	$0	$0	**$0**
15	Furnishings	$0	$0	$0	$0	$0	**$0**
16	Special Construction	$0	$0	$0	$0	$0	**$0**
17	Selective Building Demolition	$0	$188,781	$71,536	$15,944	$0	**$276,261**
18	Site Prep/Development	$0	$128,355	$0	$0	$0	**$128,355**
TOTAL DIRECT COST (Trade Costs)		**$2,461,850**	**$2,523,102**	**$731,948**	**$121,599**	**$204,000**	**$6,042,499**
19	*$/sf*	*$153*	*$43*	*$168*	*$62*	*$111*	
20	**Markups**	$369,278	$378,465	$109,792	$18,240	$30,600	**$906,375**
21	**Contingencies/Escalation**	$779,953	$799,359	$231,893	$38,072	$64,630	**$1,913,907**
TOTAL CONSTRUCTION COST		**$3,611,081**	**$3,700,926**	**$1,073,633**	**$177,910**	**$299,230**	**$8,862,781**
22	*$/sf*	*$224*	*$64*	*$246*	*$91*	*$162*	

June 7, 2017

Rapid City Airport - "A,B,C,D"
Rapid City, South Dakota

Class 4: Concept Estimate

GFA 16,086

		OUTBOUND BHS - CONSTRUCTION COST SUMMARY				
SYSTEM DESCRIPTION			***SUB-TOTAL***	***TOTAL***	***$/SF***	***%***
D10	**CONVEYING**					
	D1090 Other Conveying Systems		$2,300,000			
	D10 - CONVEYING TOTAL			**$2,300,000**	$142.98	63.7%
D50	**ELECTRICAL**					
	D5010 Electrical Service & Distribution		$14,000			
	D5020 Lighting & Branch Wiring		$104,300			
	D5030 Communications & Security Systems		$29,550			
	D5090 Other Electrical Systems		$14,000			
	D50 - ELECTRICAL TOTAL			**$161,850**	$10.06	4.5%
TOTAL DIRECT COST (Trade Costs)				***$2,461,850***	$153.04	68.2%
MARKUPS						
	General Conditions, Overhead & Profit	15.00%	$369,278	**$369,278**	$22.96	10.2%
SUBTOTAL CONSTRUCTION				***$2,831,128***	$176.00	78.4%
ALLOWANCES/ESCALATION						
	Design Development Allowance	15.00%	$424,669			
	Phasing and unproductive time Allowance	5.00%	$162,790			
	Escalation (to midpoint of construction)	5.63%	$192,494	**$779,953**	$48.49	21.6%
TOTAL PROJECT COST				***$3,611,081***	$224.49	100.0%

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OUTBOUND BHS DETAIL DESCRIPTION		QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
D10	CONVEYING						
D1090	OTHER CONVEYING SYSTEMS						
	RAP Quote	1	ls	2,300,000.00	$2,300,000		
	SUBTOTAL					$2,300,000	
	TOTAL - CONVEYING SYSTEMS						$2,300,000
D50	ELECTRICAL						
D5010	ELECTRICAL SERVICE & DISTRIBUTION						
	200A Feeder MCP & Pull Box; assumes 100lf each	2	ea	4,000.00	$8,000		
	200A Circuit Breaker	2	allow	3,000.00	$6,000		
	SUBTOTAL					$14,000	
D5020	LIGHTING & BRANCH WIRING						
	Lighting, Lighting Control and Branch Wiring	9,180	sf	10.00	$91,800		
	OSR Workstations	5	ea	2,500.00	$12,500		
	SUBTOTAL					$104,300	
D5030	COMMUNICATIONS & SECURITY						
	OSR Workstations	5	ea	3,000.00	$15,000		
	CTX Data Drop; assumes CAT 6	2	ea	1,000.00	$2,000		
	EDS Data Drop; assumes CAT 6	2	ea	1,000.00	$2,000		
	CCTV Rough-In	11	ea	850.00	$9,350		
	Card Reader Rough-In	0	ea	1,500.00			
	Door Contact Rough-In	0	ea	1,500.00			
	Fire Alarm Adjustments/Programming	1	allow	1,200.00	$1,200		
	SUBTOTAL					$29,550	
D5090	OTHER ELECTRICAL SYSTEMS						
	CTX Disconnect/Connection	2	ea	4,000.00	$8,000		
	EDS Disconnect/Connection	2	ea	3,000.00	$6,000		
	SUBTOTAL					$14,000	
	TOTAL - ELECTRICAL						$161,850
	TOTAL DIRECT COST (Trade Costs)						$2,461,850

TERMINAL - CONSTRUCTION COST SUMMARY

SYSTEM DESCRIPTION			SUB-TOTAL	TOTAL	$/SF	%
A10	**FOUNDATIONS**					
	A1010	Standard Foundations	$68,068			
	A1030	Lowest Floor Construction	$40,008			
	A10 - FOUNDATIONS TOTAL			**$108,076**	$1.86	2.9%
B10	**SUPERSTRUCTURE**					
	B1020	Roof Construction	$173,698			
	B10 - SUPERSTRUCTURE TOTAL			**$173,698**	$2.98	4.7%
B20	**EXTERIOR CLOSURE**					
	B2010	Exterior Walls	$197,851			
	B2030	Exterior Doors	$14,576			
	B20 - EXTERIOR CLOSURE TOTAL			**$212,427**	$3.65	5.7%
B30	**ROOFING**					
	B3010	Roof Coverings	$57,410			
	B30 - ROOFING TOTAL			**$57,410**	$0.99	1.6%
C10	**INTERIOR CONSTRUCTION**					
	C1010	Partitions	$79,080			
	C1020	Interior Doors	$49,766			
	C1030	Specialties/Millwork	$160,744			
	C10 - INTERIOR CONSTRUCTION TOTAL			**$289,590**	$4.97	7.8%
C30	**INTERIOR FINISHES**					
	C3010	Wall Finishes	$98,065			
	C3020	Floor Finishes	$83,165			
	C3030	Ceiling Finishes	$167,030			
	C30 - INTERIOR FINISHES TOTAL			**$348,260**	$5.98	9.4%
D20	**PLUMBING**					
	D2010	Plumbing Fixtures	$18,346			
	D2020	Domestic Water Distribution	$12,000			
	D2030	Sanitary Waste	$20,000			
	D2040	Rain Water Drainage	$11,000			
	D2090	Other Plumbing Systems	$18,000			
	D20 - PLUMBING TOTAL			**$79,346**	$1.36	2.1%

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TERMINAL - CONSTRUCTION COST SUMMARY

SYSTEM DESCRIPTION				SUB-TOTAL	TOTAL	$/SF	%
D30	**MECHANICAL**						
	D3040	Distribution Systems		$231,250			
	D3050	Terminal & Package Units		$70,900			
	D3060	Controls & Instrumentation		$25,000			
	D3070	Systems Testing & Balancing		$26,400			
	D30 - MECHANICAL TOTAL				**$353,550**	$6.07	9.6%
D40	**FIRE PROTECTION**						
	D4010	Fire Protection		$72,456			
	D40 - FIRE PROTECTION TOTAL				**$72,456**	$1.24	2.0%
D50	**ELECTRICAL**						
	D5010	Electrical Service & Distribution		$1,000			
	D5020	Lighting & Branch Wiring		$379,100			
	D5030	Communications & Security Systems		$126,553			
	D5090	Other Electrical Systems		$4,500			
	D50 - ELECTRICAL TOTAL				**$511,153**	$8.77	13.8%
F20	**SELECTIVE BUILDING DEMOLITION**						
	F2010	Building Elements Demolition		$188,781			
	F20 - SELECTIVE BUILDING DEMOLITION TOTAL				**$188,781**	$3.24	5.1%
G10	**SITE PREPARATION**						
	G1020	Site Demolition and Relocations		$67,752			
	G1030	Site Earthwork		$35,462			
	G10 - SITE PREPARATION TOTAL				**$103,214**	$1.77	2.8%
G20	**SITE IMPROVEMENT**						
	G2040	Site Development		$25,141			
	G20 - SITE IMPROVEMENT TOTAL				**$25,141**	$0.43	0.7%
TOTAL DIRECT COST (Trade Costs)					***$2,523,102***	$43.31	68.2%
MARKUPS							
	General Conditions, Overhead & Profit		15.00%	$378,465	**$378,465**	$6.50	10.2%
SUBTOTAL CONSTRUCTION					***$2,901,567***	$49.80	78.4%
ALLOWANCES/ESCALATION							
	Design Development Allowance		15.00%	$435,235			
	Phasing and unproductive time Allowance		5.00%	$166,840			
	Escalation (to midpoint of construction)		5.63%	$197,284	**$799,359**	$13.72	21.6%
TOTAL PROJECT COST					***$3,700,926***	$63.52	100.0%

TERMINAL DETAIL DESCRIPTION		QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
A10	FOUNDATIONS						
A1010	STANDARD FOUNDATIONS						
	Terminal Expansion & Remodel						
	3'x2' Strip footing, assumed	77	cy	321.00	$24,717		
	1'6" foundation wall, assumed	77	cy	563.00	$43,351		
	SUBTOTAL					$68,068	
A1030	SLAB ON GRADE						
	Terminal Expansion & Remodel						
	6" Slab on grade assumed	4,296	sf	6.00	$25,776		
	Raised concrete curb	1,779	sf	8.00	$14,232		
	SUBTOTAL					$40,008	
	TOTAL - FOUNDATIONS						$108,076
B10	SUPERSTRUCTURE						
B1020	ROOF CONSTRUCTION						
	Terminal Expansion & Remodel						
	Precast roof	5,741	sf	16.00	$91,856		
	Structural tie-in allowance	1	allow	60,000.00	$60,000		
	Structural steel for wood ceiling section extension	3	tons	8,036.00	$21,842		
	SUBTOTAL					$173,698	
	TOTAL - SUPERSTRUCTURE						$173,698
B20	EXTERIOR CLOSURE						
B2010	EXTERIOR WALLS						
	Terminal Expansion & Remodel						
	Exterior wall, 8" CMU, CMU veneer, stucco, rigid insulation, moisture barrier	4,509	sf	39.00	$175,851		
	Exterior tie in allowance, 217 lf	1	allow	22,000.00	$22,000		
	SUBTOTAL					$197,851	

TERMINAL DETAIL DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
B2030 EXTERIOR DOORS						
Terminal Expansion & Remodel						
Exterior door, 6'x8' assumed HM door	1	ea	1,848.00	$1,848		
Exterior door, OH coiling door, 12'x12' assumed	2	ea	6,364.00	$12,728		
SUBTOTAL					$14,576	
TOTAL - EXTERIOR CLOSURE						*$212,427*
B30 ROOFING						
B3010 ROOF COVERINGS						
Terminal Expansion & Remodel						
EPDM roofing over precast, R30 rigid insulation	5,741	sf	10.00	$57,410		
SUBTOTAL					$57,410	
TOTAL - ROOFING						*$57,410*
C10 INTERIOR CONSTRUCTION						
C1010 PARTITIONS						
Terminal Expansion & Remodel						
3 5/8" metal stud partitions, gyp both sides	13,180	sf	6.00	$79,080		
SUBTOTAL					$79,080	
C1020 INTERIOR DOORS						
Terminal Expansion & Remodel						
High-speed roll-up OH door, 10' x 12'	1	ea	5,304.00	$5,304		
High-speed roll-up OH door, 12' x 12'	1	ea	6,364.00	$6,364		
High-speed roll-up OH door, 11' x 12'	1	ea	5,834.00	$5,834		
3' x 7' Flush wood door, HM frame	22	ea	1,125.00	$24,750		
3' x 7' HM door and frame	3	ea	1,246.00	$3,738		
6' x 7' HM door and frame	2	ea	1,888.00	$3,776		
SUBTOTAL					$49,766	

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TERMINAL DETAIL DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
C1030 FITTINGS						
Terminal Expansion & Remodel						
Crash protection at columns	4	ea	603.00	$2,412		
New Information desk, stone, solid surface counte	1	allow	30,000.00	$30,000		
Ticket counter, ADA, limestone and granite fronts	13	ea	9,643.00	$125,359		
ADA Grab bar set	3	ea	281.00	$843		
Soap dispenser	3	ea	96.00	$288		
Toilet paper holder	3	ea	44.00	$132		
Mirror 2' x 3'	3	ea	169.00	$507		
Sanitary napkin disposal	3	ea	321.00	$963		
Paper towel dispenser	3	ea	80.00	$240		
SUBTOTAL					$160,744	
TOTAL - INTERIOR CONSTRUCTION						***$289,590***
C30 INTERIOR FINISHES						
C3010 WALL FINISHES						
Terminal Expansion & Remodel						
Paint, gypsum board	11,636	sf	1.00	$11,636		
Paint, CMU wall	2,882	sf	1.50	$4,323		
Vinyl wall covering	2,808	sf	5.00	$14,040		
Aluminum protective wainscot	1,203	sf	10.00	$12,030		
"Tectum" acoustical panels	2,755	sf	16.00	$44,080		
Ceramic wall tile	854	sf	14.00	$11,956		
SUBTOTAL					$98,065	
C3020 FLOOR FINISHES						
Terminal Expansion & Remodel						
Resilient flooring	3,158	sf	10.00	$31,580		
Carpet tile	872	sy	36.00	$31,392		
Sealed concrete	8,953	sf	1.00	$8,953		
Rubber floor base, assumed	1,760	lf	4.00	$7,040		
Ceramic tile flooring	240	sf	12.00	$2,880		
Ceramic tile base	110	lf	12.00	$1,320		
SUBTOTAL					$83,165	

TERMINAL DETAIL DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
C3030 CEILING FINISHES						
Terminal Expansion & Remodel						
Stained linear wood panels, M.E.	624	sf	48.00	$29,952		
Gypsum board soffit at Wood ceiling	1,170	sf	20.00	$23,400		
Acoustical metal paint at wood ceiling	624	sf	6.00	$3,744		
2 x 2 ACT	6,314	sf	4.00	$25,256		
Soffit at perimeter	2,079	sf	20.00	$41,580		
Paint, gyp board soffit	3,249	sf	2.00	$6,498		
Suspended gyp ceiling	3,660	sf	10.00	$36,600		
SUBTOTAL					$167,030	
TOTAL - INTERIOR FINISHES						***$348,260***
D20 PLUMBING						
D2010 PLUMBING FIXTURES						
Terminal Expansion & Remodel						
Trench drains	1	allow	10,000.00	$10,000		
Water closet w/flush valve	3	ea	1,200.00	$3,600		
Lavatory w/faucet	3	ea	1,042.00	$3,126		
Floor drain	3	ea	540.00	$1,620		
SUBTOTAL					$18,346	
D2020 DOMESTIC WATER DISTRIBUTION						
Terminal Expansion & Remodel						
Domestic water piping w/insulation	1	allow	12,000.00	$12,000		
SUBTOTAL					$12,000	
D2030 SANITARY WASTE						
Terminal Expansion & Remodel						
Sanitary waste & vent piping	1	allow	20,000.00	$20,000		
SUBTOTAL					$20,000	
D2040 RAIN WATER DRAINAGE						
Terminal Expansion & Remodel						
Storm drainage system	1	allow	11,000.00	$11,000		
SUBTOTAL					$11,000	

TERMINAL DETAIL DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
D2090 OTHER PLUMBING SYSTEMS						
Terminal Expansion & Remodel						
Tie-in new piping to existing	1	allow	3,000.00	$3,000		
Floor cut/patch	1	allow	15,000.00	$15,000		
SUBTOTAL					$18,000	
TOTAL - PLUMBING						***$79,346***
D30 MECHANICAL						
D3040 DISTRIBUTION SYSTEMS						
Terminal Expansion & Remodel						
Demolition	1	ls	4,000.00	$4,000		
Gas piping	200	lf	40.00	$8,000		
Tie-in to existing gas piping	1	ls	1,000.00	$1,000		
Ductwork	18,000	lbs	9.00	$162,000		
Duct insulation	12,500	sf	4.50	$56,250		
SUBTOTAL					$231,250	
D3050 TERMINAL & PACKAGE UNITS						
Terminal Expansion & Remodel						
RTU; assumed 15-ton capacity	1	ea	33,600.00	$33,600		
Crane/rig/hoist	1	ls	1,600.00	$1,600		
New grilles, registers, & diffusers	210	ea	170.00	$35,700		
SUBTOTAL					$70,900	
D3060 CONTROLS & INSTRUMENTATION						
Terminal Expansion & Remodel						
Temperature control; incl. tie-in to existing BAS	1	ls	25,000.00	$25,000		
SUBTOTAL					$25,000	
D3070 SYSTEMS TESTING & BALANCING						
Terminal Expansion & Remodel						
Testing, balancing, & commissioning	1	ls	26,400.00	$26,400		
SUBTOTAL					$26,400	
TOTAL - HVAC						***$353,550***

TERMINAL DETAIL DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
D40 FIRE PROTECTION						
D4010 SPRINKLERS						
Fire protection in addition	5,741	sf	4.00	$22,964		
Fire protection in remodeled areas	24,746	sf	2.00	$49,492		
SUBTOTAL					$72,456	
TOTAL - FIRE PROTECTION						$72,456
D50 ELECTRICAL						
D5010 ELECTRICAL SERVICE & DISTRIBUTION						
Terminal Expansion & Remodel						
Circuit/Panel Re-Work	1	allow	1,000.00	$1,000		
SUBTOTAL					$1,000	
D5020 LIGHTING & BRANCH WIRING						
Terminal Expansion & Remodel						
Office Lighting	7	ea	4,000.00	$28,000		
Storage Lighting	6	ea	1,500.00	$9,000		
Conference/Training Room Lighting	1	ea	6,500.00	$6,500		
Restroom Lighting	3	ea	3,000.00	$9,000		
Break Room Lighting	2	ea	2,500.00	$5,000		
Self Service Device Lighting	24	ea	4,500.00	$108,000		
Ticketing Lighting	13	ea	1,500.00	$19,500		
Corridor Lighting	14	ea	1,000.00	$14,000		
Information Booth General Power	1	ea	3,500.00	$3,500		
Office General Power	7	ea	1,500.00	$10,500		
Storage General Power	6	ea	350.00	$2,100		
Conference/Training Room General Power	1	ea	3,000.00	$3,000		
Restroom General Power	3	ea	500.00	$1,500		
Break Room General Power	2	ea	2,500.00	$5,000		
Self Service Device General Power	24	ea	3,000.00	$72,000		
Ticketing Floor Raceway	160	lf	500.00	$80,000		
Corridor General Power	5	ea	500.00	$2,500		
SUBTOTAL					$379,100	

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TERMINAL DETAIL *DESCRIPTION*	*QTY*	*UNIT*	*UNIT COST*	*EST'D COST*	*SUB TOTAL*	*TOTAL COST*
D5030 COMMUNICATIONS & SECURITY						
Terminal Expansion & Remodel						
Office Voice/Data	12	ea	1,200.00	$14,400		
Conference/Training Room Voice/Data	2	ea	3,500.00	$7,000		
Break Room Voice/Data	2	ea	750.00	$1,500		
Self Service Device Voice/Data	40	ea	750.00	$30,000		
Ticketing Voice/Data	21	ea	750.00	$15,750		
Corridor Voice/Data	1	ea	500.00	$500		
CCTV Rough-In	0	ea	850.00			
Card Reader Rough-In	0	ea	1,500.00			
Door Contact Rough-In	8	ea	1,500.00	$12,000		
Fire Alarm Adjustments/Programming	1	allow	3,000.00	$3,000		
Security quote - Convergint	1	ls	42,403.43	$42,403		
SUBTOTAL					$126,553	
D5090 OTHER ELECTRICAL SYSTEMS						
Terminal Expansion & Remodel						
HVAC Adjustments	1	allow	1,500.00	$1,500		
Replace Existing Bag Claim Device						
Bag Claim Power Adjustment	1	allow	3,000.00	$3,000		
SUBTOTAL					$4,500	
TOTAL - ELECTRICAL						*$511,153*

TERMINAL DETAIL DESCRIPTION	QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
F20 SELECTIVE BUILDING DEMOLITION						
F2010 BUILDING ELEMENTS DEMOLITION						
Terminal Expansion & Remodel						
Temporary partitions, includes removal	2,924	sf	5.00	$14,620		
Shoring allowance	1	allow	2,500.00	$2,500		
Daily cleanup allowance	1	allow	6,000.00	$6,000		
Demo floor finish	39,548	sf	1.00	$39,548		
Demo ACT tiles	6,848	sf	1.00	$6,848		
Demo wood ceiling panels	2,491	sf	1.50	$3,737		
Demo OH coiling doors	6	ea	482.00	$2,892		
Demo soffit, approximately 10' tall	10,292	sf	4.00	$41,168		
Demo partition wall, CMU wall assumed, finishes included	22,714	sf	2.00	$45,428		
Demo exterior wall, 8" concrete block, CMU veneer, stucco,	6,135	sf	4.00	$24,540		
Demo existing information desk, patch floor as required	1	allow	1,500.00	$1,500		
SUBTOTAL					$188,781	
TOTAL - SELECTIVE BUILDING DEMOLITION						**$188,781**
G10 SITE PREPARATION						
G1020 SITE DEMOLITION AND RELOCATION						
Terminal Expansion & Remodel						
Sawcut tarmac for new addition	409	lf	40.00	$16,360		
Remove tarmac concrete, assumes 2' thick	6,424	sf	8.00	$51,392		
SUBTOTAL					$67,752	
G1030 SITE EARTHWORK						
Terminal Expansion & Remodel						
Excavation for Strip footing	155	cy	26.00	$4,030		
Infill under SOG	239	cy	24.00	$5,736		
MSC grading	6,424	sf	4.00	$25,696		
SUBTOTAL					$35,462	
TOTAL - SITE PREPARATION						**$103,214**

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TERMINAL DETAIL *DESCRIPTION*	*QTY*	*UNIT*	*UNIT COST*	*EST'D COST*	*SUB TOTAL*	*TOTAL COST*
G20 SITE IMPROVEMENT						
G2040 SITE DEVELOPMENT						
Terminal Expansion & Remodel						
Tarmac concrete, assumes 2' thick	208	sy	121.00	$25,141		
SUBTOTAL					$25,141	
TOTAL - SITE IMPROVEMENT						*$25,141*

TOTAL DIRECT COST (Trade Costs)	*$2,523,102*

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ELEVATOR REPLACEMENT - CONSTRUCTION COST SUMMARY						
SYSTEM DESCRIPTION			SUB-TOTAL	TOTAL	$/SF	%
B20	**EXTERIOR CLOSURE**					
	B2020	Windows	$19,624			
	B20 - EXTERIOR CLOSURE TOTAL			**$19,624**	$4.50	1.8%
C10	**INTERIOR CONSTRUCTION**					
	C1010	Partitions	$3,132			
	C1030	Specialties/Millwork	$10,604			
	C10 - INTERIOR CONSTRUCTION TOTAL			**$13,736**	$3.15	1.3%
C20	**STAIRCASES**					
	C2010	Stair Construction	$25,000			
	C20 - STAIRCASES TOTAL			**$25,000**	$5.73	2.3%
C30	**INTERIOR FINISHES**					
	C3010	Wall Finishes	$522			
	C3020	Floor Finishes	$19,836			
	C30 - INTERIOR FINISHES TOTAL			**$20,358**	$4.66	1.9%
D10	**CONVEYING**					
	D1010	Elevator	$160,334			
	D1020	Escalators and Moving Walkways	$356,054			
	D10 - CONVEYING TOTAL			**$516,388**	$118.33	48.1%
D30	**MECHANICAL**					
	D3040	Distribution Systems	$23,800			
	D3050	Terminal & Package Units	$3,400			
	D3070	Systems Testing & Balancing	$4,800			
	D30 - MECHANICAL TOTAL			**$32,000**	$7.33	3.0%
D40	**FIRE PROTECTION**					
	D4010	Fire Protection	$5,856			
	D40 - FIRE PROTECTION TOTAL			**$5,856**	$1.34	0.5%
D50	**ELECTRICAL**					
	D5010	Electrical Service & Distribution	$8,500			
	D5020	Lighting & Branch Wiring	$15,700			
	D5030	Communications & Security Systems	$750			
	D5090	Other Electrical Systems	$2,500			
	D50 - ELECTRICAL TOTAL			**$27,450**	$6.29	2.6%

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ELEVATOR REPLACEMENT - CONSTRUCTION COST SUMMARY						
SYSTEM DESCRIPTION		*SUB-TOTAL*	*TOTAL*	*$/SF*	*%*
F20 SELECTIVE BUILDING DEMOLITION					
F2010 Building Elements Demolition		$71,536			
F2020 Hazardous Components Abatement		$0			
F20 - SELECTIVE BUILDING DEMOLITION TOTAL			**$71,536**	$16.39	6.7%
TOTAL DIRECT COST (Trade Costs)			***$731,948***	$167.72	68.2%
MARKUPS					
General Conditions, Overhead & Profit	15.00%	$109,792	**$109,792**	$25.16	10.2%
SUBTOTAL CONSTRUCTION			***$841,740***	$192.88	78.4%
ALLOWANCES/ESCALATION					
Design Development Allowance	15.00%	$126,261			
Phasing and unproductive time Allowance	5.00%	$48,400			
Escalation (to midpoint of construction)	5.63%	$57,232	**$231,893**	$53.14	21.6%
TOTAL PROJECT COST			***$1,073,633***	$246.02	100.0%

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ELEVATOR REPLACEMENT DETAIL DESCRIPTION		QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
B20	EXTERIOR CLOSURE						
B2020	EXTERIOR WINDOWS						
	Clearstory windows, 5' assumed	446	sf	44.00	$19,624		
	SUBTOTAL					$19,624	
	TOTAL - EXTERIOR CLOSURE						$19,624
C10	INTERIOR CONSTRUCTION						
C1010	PARTITIONS						
	3 5/8" metal stud partitions, gyp one side	522	sf	6.00	$3,132		
	SUBTOTAL					$3,132	
C1030	FITTINGS						
	1/4" glass aluminum post guardrail	44	lf	241.00	$10,604		
	SUBTOTAL					$10,604	
	TOTAL - INTERIOR CONSTRUCTION						$13,736
C20	STAIRCASES						
C2010	STAIR CONSTRUCTION						
	Stair riser, concrete filled metal pan stair, vinyl finish assumed, includes railing	1	allow	25,000.00	$25,000		
	SUBTOTAL					$25,000	
C2020	STAIR FINISHES						
	Included above		INC				
	SUBTOTAL					$0	
	TOTAL - STAIRCASES						$25,000

Class 4: Concept Estimate

GFA 4,364

ELEVATOR REPLACEMENT DETAIL DESCRIPTION		QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
C30	INTERIOR FINISHES						
C3010	WALL FINISHES						
	Paint, gypsum board	522	sf	1.00	$522		
	SUBTOTAL					$522	
C3020	FLOOR FINISHES						
	Carpet tile	544	sy	36.00	$19,584		
	Rubber floor base, assumed	63	lf	4.00	$252		
	SUBTOTAL					$19,836	
	TOTAL - INTERIOR FINISHES						$20,358
D10	CONVEYING						
D1010	ELEVATORS & LIFTS						
	Enclosed glass elevator cab	1	ea	35,000.00	$35,000		
	Enclosed glass elevator stop	2	stops	40,000.00	$80,000		
	Glass elevator shaft	1	allow	25,000.00	$25,000		
	Elevator pit	1	ea	12,054.00	$12,054		
	Trenching for hydraulic lines	115	lf	72.00	$8,280		
	SUBTOTAL					$160,334	
D1020	ESCALATORS & MOVING WALKWAYS						
	Escalator, 14' rise, assumes glass	2	ea	172,000.00	$344,000		
	Escalator pit	2	ea	6,027.00	$12,054		
	SUBTOTAL					$356,054	
	TOTAL - CONVEYING SYSTEMS						$516,388
D30	MECHANICAL						
D3040	DISTRIBUTION SYSTEMS						
	Demolition	1	ls	4,000.00	$4,000		
	Ductwork	1,600	lbs	9.00	$14,400		
	Duct insulation	1,200	sf	4.50	$5,400		
	SUBTOTAL					$23,800	

Rapid City Airport - "A,B,C,D"
Rapid City, South Dakota

Class 4: Concept Estimate

GFA 4,364

ELEVATOR REPLACEMENT DETAIL DESCRIPTION		QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
D3050	**TERMINAL & PACKAGE UNITS**						
	New grilles, registers, & diffusers	20	ea	170.00	$3,400		
	SUBTOTAL					$3,400	
D3070	**SYSTEMS TESTING & BALANCING**						
	Testing, balancing, & commissioning	1	ls	4,800.00	$4,800		
	SUBTOTAL					$4,800	
	TOTAL - HVAC						*$32,000*
D40	*FIRE PROTECTION*						
D4010	**SPRINKLERS**						
	Fire protection in remodeled areas	2,928	sf	2.00	$5,856		
	SUBTOTAL					$5,856	
	TOTAL - FIRE PROTECTION						*$5,856*
D50	*ELECTRICAL*						
D5010	**ELECTRICAL SERVICE & DISTRIBUTION**						
	Elevator; 100A, 3P, 100A NEMA 1 Fused Disconnect	1	ea	3,000.00	$3,000		
	Escalator; 60A, 3P, 60A NEMA 1 Fused Disconnect	1	ea	2,000.00	$2,000		
	Electrical Demo	1	allow	2,500.00	$2,500		
	Circuit/Panel Re-Work	1	allow	1,000.00	$1,000		
	SUBTOTAL					$8,500	
D5020	**LIGHTING & BRANCH WIRING**						
	Elevator Mech Room Lighting	1	ea	400.00	$400		
	Elevator Mech Room General Power	1	ea	300.00	$300		
	Elevator/Escalator Lighting Allowance	1	ls	15,000.00	$15,000		
	SUBTOTAL					$15,700	
D5030	**COMMUNICATIONS & SECURITY**						
	Elevator Mech Room Voice/Data	1	ea	450.00	$450		
	Fire Alarm Adjustments/Programming	1	allow	300.00	$300		
	SUBTOTAL					$750	

ELEVATOR REPLACEMENT DETAIL DESCRIPTION		QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
D5090	OTHER ELECTRICAL SYSTEMS						
	Cooling Unit Connection	1	ea	2,500.00	$2,500		
	SUBTOTAL					$2,500	
	TOTAL - ELECTRICAL						$27,450
F20	SELECTIVE BUILDING DEMOLITION						
F2010	BUILDING ELEMENTS DEMOLITION						
	Temporary stairs allowance	1	allow	7,500.00	$7,500		
	Temporary partitions, includes removal	2,636	sf	4.00	$10,544		
	Shoring allowance	1	allow	10,000.00	$10,000		
	Daily cleanup allowance	1	allow	6,000.00	$6,000		
	Demo floor finish	9,105	sf	1.00	$9,105		
	Demo partition wall, CMU wall assumed, finishes incl	3,508	sf	2.00	$7,016		
	Demo exterior wall for new clerestory, stucco, CMU, CMU veneer	805	sf	4.00	$3,218		
	Demo suspended concrete floor for new stairwell/ ele	3,190	sf	2.00	$6,380		
	Demo stairs	1	ea	2,531.00	$2,531		
	Demo escalator and pit, fill in pit	2	ea	2,813.00	$5,626		
	Demo existing elevator and pit, fill in pit	1	ea	3,616.00	$3,616		
	SUBTOTAL					$71,536	
	TOTAL - SELECTIVE BUILDING DEMOLITION						$71,536

TOTAL DIRECT COST (Trade Costs)	$731,948

FAITHFUL GOULD

Rapid City Airport - "A,B,C,D"
Rapid City, South Dakota

Class 4: Concept Estimate

GFA 1,845

REPLACE BAG CLAIM DEVICE - CONSTRUCTION COST SUMMARY						
SYSTEM DESCRIPTION			*SUB-TOTAL*	*TOTAL*	*$/SF*	*%*
D10	**CONVEYING**					
	D1090 Other Conveying Systems		$204,000			
	D10 - CONVEYING TOTAL			**$204,000**	$110.57	68.2%
TOTAL DIRECT COST (Trade Costs)				***$204,000***	$110.57	68.2%
MARKUPS						
	General Conditions, Overhead & Profit	15.00%	$30,600	**$30,600**	$16.59	10.2%
SUBTOTAL CONSTRUCTION				***$234,600***	$127.15	78.4%
ALLOWANCES/ESCALATION						
	Design Development Allowance	15.00%	$35,190			
	Phasing and unproductive time Allowance	5.00%	$13,490			
	Escalation (to midpoint of construction)	5.63%	$15,951	**$64,630**	$35.03	21.6%
TOTAL PROJECT COST				***$299,230***	$162.18	100.0%

FAITHFUL GOULD

Rapid City Airport - "A,B,C,D"
Rapid City, South Dakota

Class 4: Concept Estimate

GFA 1,845

REPLACE BAG CLAIM DEVICE DETAIL DESCRIPTION		QTY	UNIT	UNIT COST	EST'D COST	SUB TOTAL	TOTAL COST
D10	CONVEYING						
D1090	OTHER CONVEYING SYSTEMS						
	Flat Plate Claim Device	1	ls	200,000.00	$200,000		
	Circuit/Panel Re-Work	1	allow	1,000.00	$1,000		
	Bag Claim Power Adjustment	1	allow	3,000.00	$3,000		
	SUBTOTAL					$204,000	
	TOTAL - CONVEYING SYSTEMS						$204,000

TOTAL DIRECT COST (Trade Costs)	$204,000

FAITHFUL GOULD

Class 4: Concept Estimate

ALTERNATES	Qty	Unit	Rate	Alt Total	Base Total	Add/Deduct
Alternate C.2: Replace existing roof structure south of elevator						
Concrete column, 2'x2' assumed	4	cy	$ 964.00	$ 3,431.84		
Cast in place concrete beams	15	cy	$ 522.00	$ 7,730.82		
Precast roof	1,952	sf	$ 16.00	$ 31,232.00		
Structural tie-in allowance	1	allow	$ 20,000.00	$ 20,000.00		
Exterior tie in allowance, 51 lf	1	allow	$ 6,000.00	$ 6,000.00		
EPDM roofing over precast, R30 rigid insulation	1,952	sf	$ 10.00	$ 19,520.00		
Clearstory windows, 5' assumed	245	sf	$ 52.00	$ 12,740.00		
Demo roof, precast structure, EPDM membrane, rigid insulation, assumed	1,952	sf	$ 5.00	$ 9,760.00		
Demo exterior window at raised half story	181	sf	$ 12.00	$ 2,166.00		
Demo skylight	1	ea	$ 4,018.00	$ 4,018.00		
Retrofit and repair allowance	1	allow	$ 5,000.00	$ 5,000.00		
SUBTOTAL				$ 121,598.66	$ -	
GC's and Markup	15.00%			$ 18,239.80	$ -	
Design Development Allowance	15.00%			$ 20,975.77	$ -	
Phasing and unproductive time Allowance	5.00%			$ 8,040.71	$ -	
Escalation	5.63%			$ 9,055.16	$ -	
NET CHANGE: Add/(Deduct)				$ 177,910.10	$ -	$ 177,910.10

Convergint TECHNOLOGIES
Making a Daily Difference

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bob.peplinski@convergint.com

August 17, 2017

Alliiance
Rapid City Regional Airport
4550 Terminal Road, Rapid City, South Dakota 55403-3127

Reference: Rapid City Regional Airport Physical Access Control

Convergint Technologies submits the following Rough Order of Magnitude (ROM) as a consideration to enhance the access control credential method from card only or card + PIN by adding a third factor - Biometric Technology.

Improving physical security is an ongoing challenge for controlled facilities. One of the functions of the Physical Access Control System (PACS) application is to verify the identity of the cardholder presenting the card. The PACS application may perform one or more authentication mechanisms to establish confidence in the identity of the card holder. The authentication of an identity is based upon the verification of one, two, or three of these factors:

1. "Something You Have"
    a. For example, possession of the access control card
2. "Something You Know"
    a. For example, knowledge of the PIN
3. "Something You Are"
    a. For example, presentation of live fingerprints, irises or face by a cardholder

RAP has the discretion of determining access to different types of areas by identifying the Security Level for the area and establishing the number of Authentication Factors Required to gain access into the area.

EXAMPLE

Area of Use	Area Description	Security Level	# of Authentication Factors Required
Administration	Server Rooms, Administrative Files, Records	Limited	2
Tarmac	Direct access to aircraft	Exclusion	3
General Storage	Janitorial supplies, consumable storage	Controlled	1

ROM Biometric Technology Implementation Expense

1. Biometric enrollment equipment and software
    a. $3,700.00
2. Equip and upgrade and existing door of PACS with biometric credentialing technology
    a. $1,700.00/door
3. Equip a new door of PACS with biometric credentialing technology
    a. $4,000.00/door

Summary

1. Biometrics circumvents issues like undocumented access, ID Swapping, PIN Sharing, Credential Replacements and more.
2. Accurate Identification
    a. Biological characteristics offer a unique and ac curate method of identification
3. Accountability
    a. Biometric credentialing means a person can be directly connected to a specific action or event. Biometrics creates a clear, definable audit trail of transactions to activities.
4. Security
    a. Adding a third authentication factor enhances physical security. Biometric characteristics cannot be lost, stolen, shared or exchanged therefore you won't have to deal with the problem of sharing, duplication or fraud.

WASTEWATER TREATMENT FEASIBILITY REPORT

Rapid City Regional Airport (RAP)

Pennington County, SD

September 2017

Contents

List of Tables

List of Figures

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List of Abbreviations

ARFF	Aircraft Rescue and Fire Fighting
BOD	Biochemical Oxygen Demand
CBOD	Carbonaceous Biochemical Oxygen Demand
FAA	Federal Aviation Administration
ft	Foot
gpd	Gallons Per Day
gpm	Gallons Per Minute
HDPE	High Density Polyethylene
PVC	Polyvinyl Chloride
SD DENR	South Dakota Department of Environment and Natural Resources
SRE	Snow Removal Equipment

TSS	Total Suspended Solids
UV	Ultraviolet

1. INTRODUCTION

1.1 Project Location and Background

The existing Rapid City Regional Airport in Rapid City, SD has experienced a significant increase in use through the years. Consequently, a review of the wastewater treatment facilities is warranted. The airfield site is primarily located in Sections 8, 17, 20 and 21 Township 44 North, Range 103 West.

The existing wastewater treatment facility includes a single, 1.1-acre circular native clay lined lagoon located along the west side of the airport. All wastewater from the airport gravity flows into this lagoon from the collection system. The lagoon includes an emergency outlet pipe and structure. Any effluent discharged from the lagoon would enter a natural drainage that flows south into Rapid Creek. However, discharge has not been known to occur and there is currently no existing discharge permit in place for the facility. Based on the current wastewater flows from the airport, the existing lagoon does not appear to have sufficient volume to accommodate full retention and subsequent evaporation. Therefore, it appears the existing lagoon is likely leaking.

The existing wastewater lagoon location is depicted on **Figure 1**.

1.2 Physical Site Characteristics

The terrain at the airport consists primarily of sloping native prairie. There are natural drainage channels located on each side of the airport that flow south into Rapid Creek. Based on the USDA's Web Soil Survey, the soils have been classified as mostly Lohmiller silty clay and Zigweid-Nihill complex.

1.3 Wastewater Scope of Work

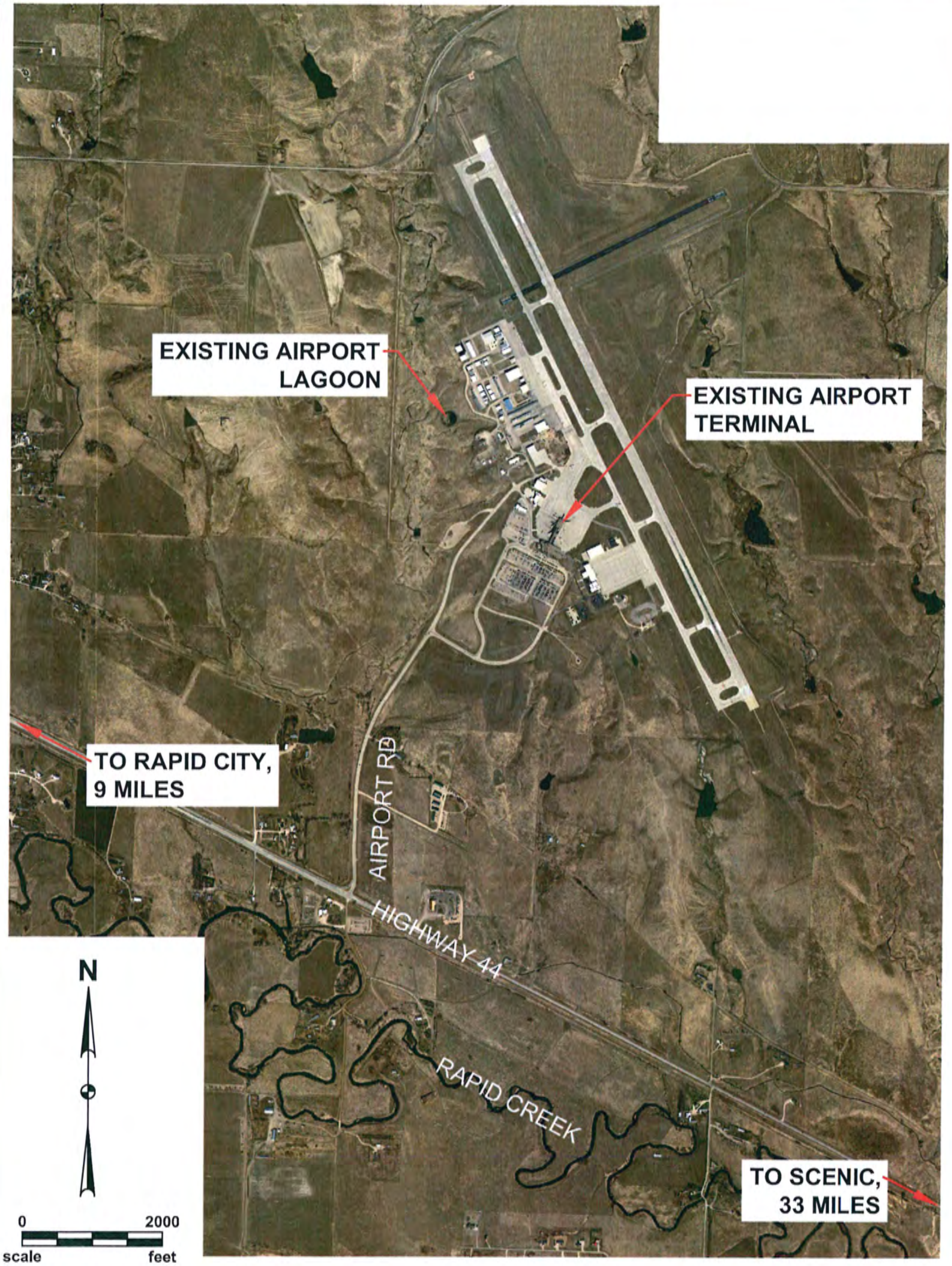
This report focuses on the identification and assessment of alternatives to accommodate treatment of wastewater from the airport facility. The primary focus is on options for replacement of the existing wastewater lagoon with a new on-site wastewater treatment system or the routing of wastewater to the City of Rapid City wastewater system.

Six possible alternatives for accommodation of wastewater are presented and analyzed. The advantages, disadvantages, feasibility of each alternative and recommendations are also included in the report.

2. DESIGN CRITERIA

2.1 Regulatory Agency and Design Requirements

The wastewater facilities must be designed in compliance with the South Dakota Department of Environment and Natural Resources (SD DENR) standards. In addition, as the primary funding and regulatory agency for aviation facilities, Federal Aviation Administration (FAA) regulations related to potential wildlife attraction from open lagoon systems need consideration.



VICINITY MAP
FIGURE 1

Jun 08, 2017 - 4:22pm - P:\Airport\SD\RapidCity\Projects\10516108\CADD\Misc\Report\Figure 1 - Vicinity Map.dwg (11x17 Border (Exhibit))

Discussions have been held with the SD DENR regarding the possibility of a new discharge permit and effluent limits for a new discharging wastewater treatment system. A summary of the requirements is included below.

- A new discharge permit would be required from the SD DENR if treated wastewater is discharged to the natural drainage flowing south to Rapid Creek.
- The discharge permit process with the SD DENR would likely take a minimum of 6 months and would require a 30 day public comment period.
- The County and downstream landowners would also need to be contacted regarding discharge through the natural drainage. The County would have authority to approve or deny the discharge of flow into the drainage.
- The discharge permit would be considered an "Industrial Permit".
- An Industrial Permit would have an annual fee of $600.
- A licensed operator and monthly effluent sampling and testing would be required for a discharging system.
- Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) effluent limits for an Industrial Permit are anticipated to be 10 mg/L.
- Rapid Creek is considered a "Warm Water Permanent Fishery" and a 30 day average Ammonia limit of 1 mg/L would apply to the effluent.
- Ammonia limits may become even more stringent within the next 2 to 5 years.
- Disinfection would be required if the system discharges effluent between May and September.

2.2 Wastewater Flows

Wastewater flow rates for the airport have been estimated based on the projected uses at the airport, including the following:

- Enplanements (Terminal Building)
- Deplanements (Terminal Building)
- FBO/General Aviation Operations
- Airport Support Staff (ARFF and SRE)
- Corporate Hangars
- Government Hangars
- Miscellaneous Office Buildings
- Rental Vehicle Car Wash

The wastewater volumes generated by the different users are primarily based on the actual metered water usage for the Rapid City Regional Airport and are summarized as follows:

- Enplanements and Deplanements: 4.7 gallons/person/day (used 5 gallons/day to remain conservative)
- General Aviation Operations : 13.1 gallons/person/day
- Airport Support Staff (ARFF and SRE): 455 gallons/day
- Corporate Hangars: 46 gallons/day/hangar
- Government Hangars: 194 gallons/day/hangar

- Car Wash: 26.7 gallons/wash

Wastewater flow estimates have been projected out for approximately 20 years (2038). In addition, a 30% contingency factor has been applied to the overall estimated design flow to account for uncertainties with the projected enplanements and deplanements.

Average Daily Flows:

An estimated design year (2038) Average Daily Flow of 24,500 gallons per day (gpd) has been established based on the flow summary spreadsheet included in **Appendix A**.

Peak Hourly Flows:

A peaking factor has been selected to calculate the Peak Hourly Flow. A peaking factor graph is included in **Appendix A**. Based on a daily population at the airport of roughly 2,100 to 2,200 individuals, a peaking factor of 3.6 has been selected and the corresponding Peak Hourly Flow is calculated as follows:

Peak Hourly Flow = Average Daily Flow x 3.6 = 24,500 gpd x (1 day/1,440 mins) x 3.6

= 61 gallons per minute (gpm)

3. WASTEWATER ALTERNATIVES

3.1 Identification of Alternatives

Six alternatives for accommodation of wastewater from the airport facility have been considered. These alternatives include the following:

- Alternative No. 1 - Regional Collection System and Connection to Rapid City System
- Alternative No. 2 - Facultative Lagoon with Bird Wire
- Alternative No. 3 - Aerated Lagoon with Cover System and Ammonia Treatment
- Alternative No. 4 - Airport Collection System with Connection to Rapid City System
- Alternative No. 5 - Mechanical Treatment Plant
- Alternative No. 6 - Total Retention Lagoon

The assessments of each of these alternatives are discussed in further detail in the subsequent sections of the report.

3.2 Alternative No. 1 - Regional Collection System and Connection to Rapid City System

This alternative would include installation of a regional collection system for the airport property and adjacent land areas with connection to the existing Rapid City collection system. All wastewater would be carried to the existing Water Reclamation Facility located southwest of the airport. Due to existing City sewer locations and ground elevations between the airport and the Water Reclamation Facility, a gravity main option would not be possible for the entire distance. The Airport Sanitary Sewer Master Plan prepared in 2015 has identified a possible concept for extending sewer service to the airport. The 2015 Master Plan is in included in **Appendix B**.

Figure 2 (from the 2015 Master Plan) depicts the city sewer extension to the airport. A gravity main serving the airport would likely follow the existing entrance roadway south and connect to a new gravity trunk main along Highway 44. The Highway 44 main would flow to the east to a new lift station. The sewage would then be pumped via a force main back to the west to the existing gravity sewer main southeast of Anderson Road and Highway 44, which eventually discharges to the Water Reclamation Facility. This regional system would also provide sewer service to the land areas west and east of the airport

According to the 2015 Master Plan, approximately 1.3 miles of 15-inch to 18-inch sewer main would be installed from the existing airport wastewater lagoon site to the new Highway 44 main. From there, an additional 1.9 miles of 24-inch to 30-inch trunk sewer would be installed along Highway 44 to the new lift station. Approximately 4.5 miles of force main would be installed to carry wastewater from the lift station to the west for connection into the existing wastewater collection system. Manholes would be required at horizontal direction changes, at vertical grade changes and at a maximum spacing of 400 to 500 feet along straight runs of gravity main. The 2015 Master Plan includes cost estimates for the airport's financial responsibility for the overall project.

Gravity Main Design Criteria:

SD DENR design criteria for gravity mains is summarized below in **Table 1**. Only gravity collection main would be installed on Airport property under Alternative No. 1. The lift station and force main would be offsite.

Table 1: Gravity Collection Main Design Criteria

Parameter	Value
Min. Gravity Collection Main Diameter	8-inches
Max. Spacing Between Manholes for 15" and Smaller Mains	400 ft
Max. Spacing Between Manholes for Mains 18" and Larger Mains	500 ft

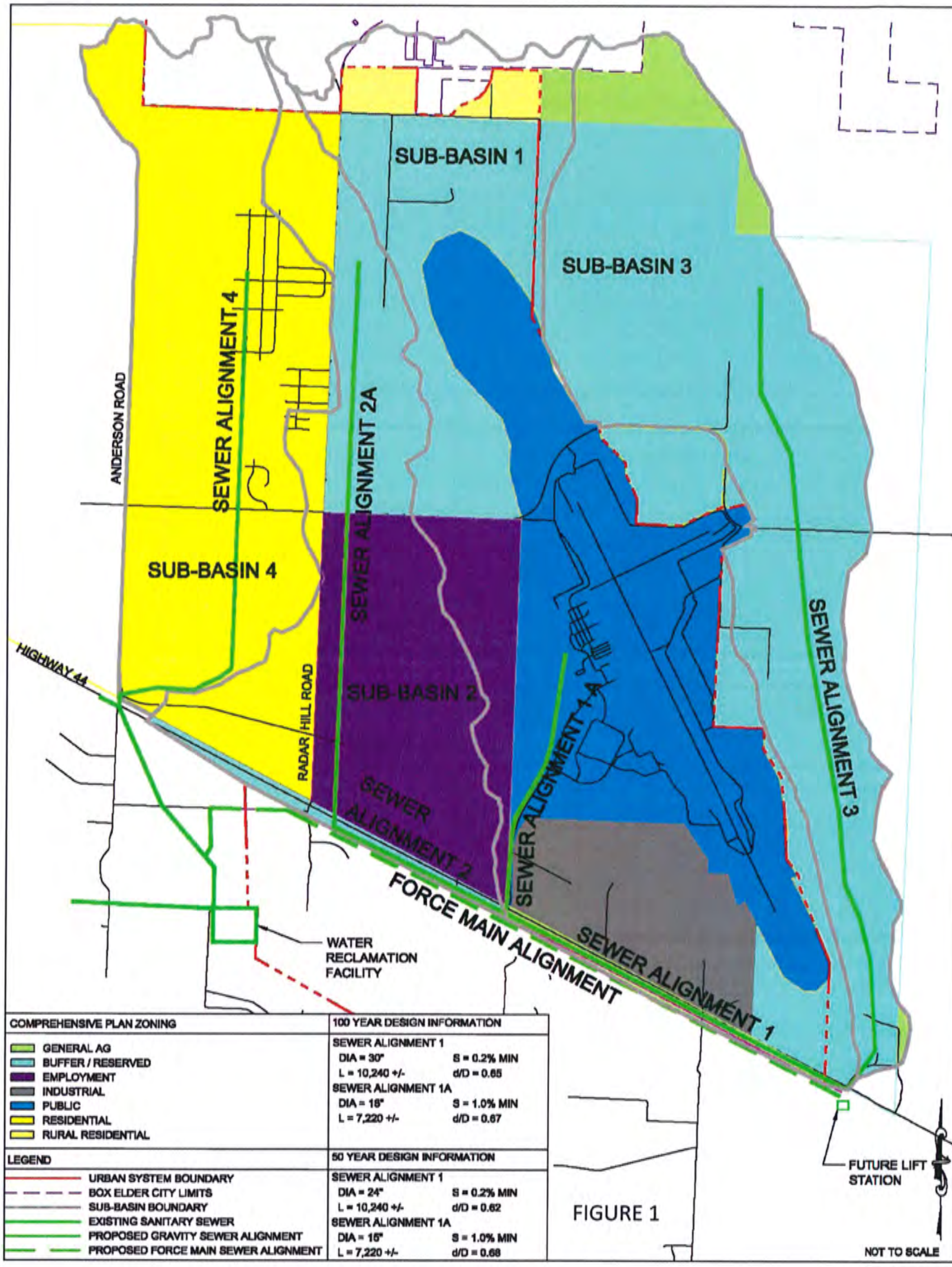
Alternative No. 1 Advantages and Disadvantages:

Advantages:

- Would utilize existing Rapid City wastewater treatment facility (high level of treatment)
- The gravity collection main would provide sewer connection availability for future growth
- No waterfowl attractant potential at the airport
- Low operation and maintenance complexity and cost
- A licensed wastewater operator would not be required for the airport
- No wastewater discharge permit or monthly testing required
- Reliable system

Disadvantages:

- Most expensive alternative considered due to significant length of gravity collection main and force main and a new lift station
- May require easements on private property (potential for project delays)
- Requires construction of the Highway 44 trunk main, lift station and force main discussed in the 2015 Airport Sanitary Sewer Master Plan (potential for project delays)



ALTERNATIVE NO. 1 - REGIONAL COLLECTION SYSTEM AND CONNECTION TO RAPID CITY SYSTEM FIGURE 2

KLJ

Jun 08, 2017 - 4:23pm - P:\Airport\SD\RapidCity\Projects\10516108\CADD\Misc\Report\Figure 2 - City's Airport Master Plan.dwg (11x17 Border (Exhibit))

3.3 Alternative No. 2 - Facultative Lagoon with Bird Wire

Alternative No. 2 would include a new facultative wastewater treatment lagoon system located on airport property near the existing lagoon. The lagoon system would be open to the atmosphere and would take advantage of wind and sunlight to provide treatment of effluent that would be discharged to the existing west side drainage that carries flows south to Rapid Creek. In South Dakota, facultative lagoons are typically sized with a significant amount of storage capacity and discharge is limited to early spring and late fall. Avoiding discharge from May to September eliminates the need for disinfection of effluent.

Due to the open water surface associated with facultative lagoons, they tend to attract waterfowl. The presence of waterfowl at airports is a significant concern for public safety due to the risks associated with bird and aircraft incursions, known as "bird strike". The FAA restricts open water sources on airports and within 2 to 5 miles of airports. A waterfowl deterrent system would be required for any type of new lagoon on the airport property. One potential option would include a "bird wire" system. This type of system basically consists of small diameter stainless steel cables installed in a grid pattern above the open water of the ponds. The grid deters birds from flying through the wires to access the water.

The SD DENR has indicated that an Industrial Permit would be required for discharge to Rapid Creek. Included in the permit would be effluent limitations for BOD, TSS, and Ammonia. These limits may be as low as 10 mg/l for BOD and TSS, and 1 mg/l for Ammonia. Consistent treatment with a facultative lagoon system to these levels indicated by the SD DENR would be very difficult. A more typical treatment level for facultative lagoons would be 30 mg/L for both BOD and TSS. Ammonia limits of 1 mg/L may be possible with a facultative lagoon during the warm summer months, but would not be achievable during the cooler months due to a slow-down in the nitrification process under cool conditions. Total storage of wastewater from October through May, with discharge only between May and September, could be a strategy for meeting Ammonia limits. However, meeting the 10 mg/L requirement for BOD and TSS would likely still prove difficult and disinfection would be required for discharge during the warmer months.

In summary, it appears that a facultative system will likely not be capable of meeting the effluent quality required by the SD DENR and this alternative will not be considered further at this time.

3.4 Alternative No. 3 - Aerated Lagoon with Cover System and Ammonia Treatment

Alternative No. 3 would include an aerated lagoon system constructed near the existing lagoon with discharge of treated effluent to the natural drainage that flows south into Rapid Creek. The existing lagoon would be abandoned. Treatment for more stringent limits on Ammonia have historically been difficult with lagoon systems. In addition, consistently meeting BOD and TSS limits of 10 mg/L for the effluent may also be challenging for a typical aerated lagoon system. There are newer technologies being implemented to address the more stringent treatment levels being required. LEMNA Environmental Technologies has been contacted to discuss alternatives for meeting the limits that the SD DENR has preliminarily indicated may be required. One feasible option identified consists of a two-cell aerated lagoon with an Ammonia and BOD polishing reactor downstream of the lagoon. The lagoon would consist of an excavated cell and earthen dikes lined with reinforced polypropylene or high density polyethylene (HDPE). An HDPE baffle curtain would be installed to separate the lagoon into two separate cells. The first cell would be more robustly aerated and mixed with a blower system and diffusers and would be utilized to remove the majority of the BOD and Ammonia. The second cell would have much lesser aeration and would function primarily as a settling basin. The entire water surface within the lagoon cells would be covered with HDPE material with integral rigid insulation panels. The intent of a cover system would be to maintain heat within the cells for improved Ammonia removal and to completely eliminate access to the lagoon cells by waterfowl. The cover would also block sunlight and eliminate algae growth, which would result in lower TSS levels. The cover would allow precipitation and gas to pass through at openings between the panels. This type of cover floats on the water surface and is anchored around the perimeter of the lagoon cells with cables.

The Ammonia and BOD polishing reactor would be located downstream of the settling cell. The reactor would consist of a concrete basin, which would contain fixed film media modules. Aeration diffusers would also be installed in the basin below the media. The media and aeration supports nitrification bacteria which facilitate Ammonia removal.

The system considered in this report would be a continuously discharging system (year-round), and thus disinfection would be required between May and September. Disinfection would be the last step in the treatment process prior to discharge to the natural drainage. Disinfection options could include Ultraviolet (UV) light or chlorination. A UV system has been assumed for this report. The disinfection system could be housed in a common building with the aeration system blowers. Two blowers would be necessary for redundancy and would supply all of the air necessary for the diffusers in the lagoon cells and the polishing reactor. The aeration system would need to operate full time (24 hours/day, 7 days/week). The blowers would feed air out to manifold piping, and the manifold piping would branch into laterals that carry air to individual diffusers spaced throughout the system.

A licensed operator would be required for operation of the system and a discharge permit would need to be obtained from the SD DENR. It is anticipated that a discharge permit could take at least 6 months to be approved by the State once the system design has been approved according to discussions with the SD DENR. The system considered has not been implemented in South Dakota. However, the SD DENR has indicated they are currently in the process of reviewing other types of new technologies that employ Ammonia removal capability and they are willing to consider this alternative.

The natural drainage flows through several private properties along its route to Rapid Creek. The County and private landowners would also need to be contacted regarding the discharge of treated effluent into the drainage. This has the potential to generate opposition from private landowners.

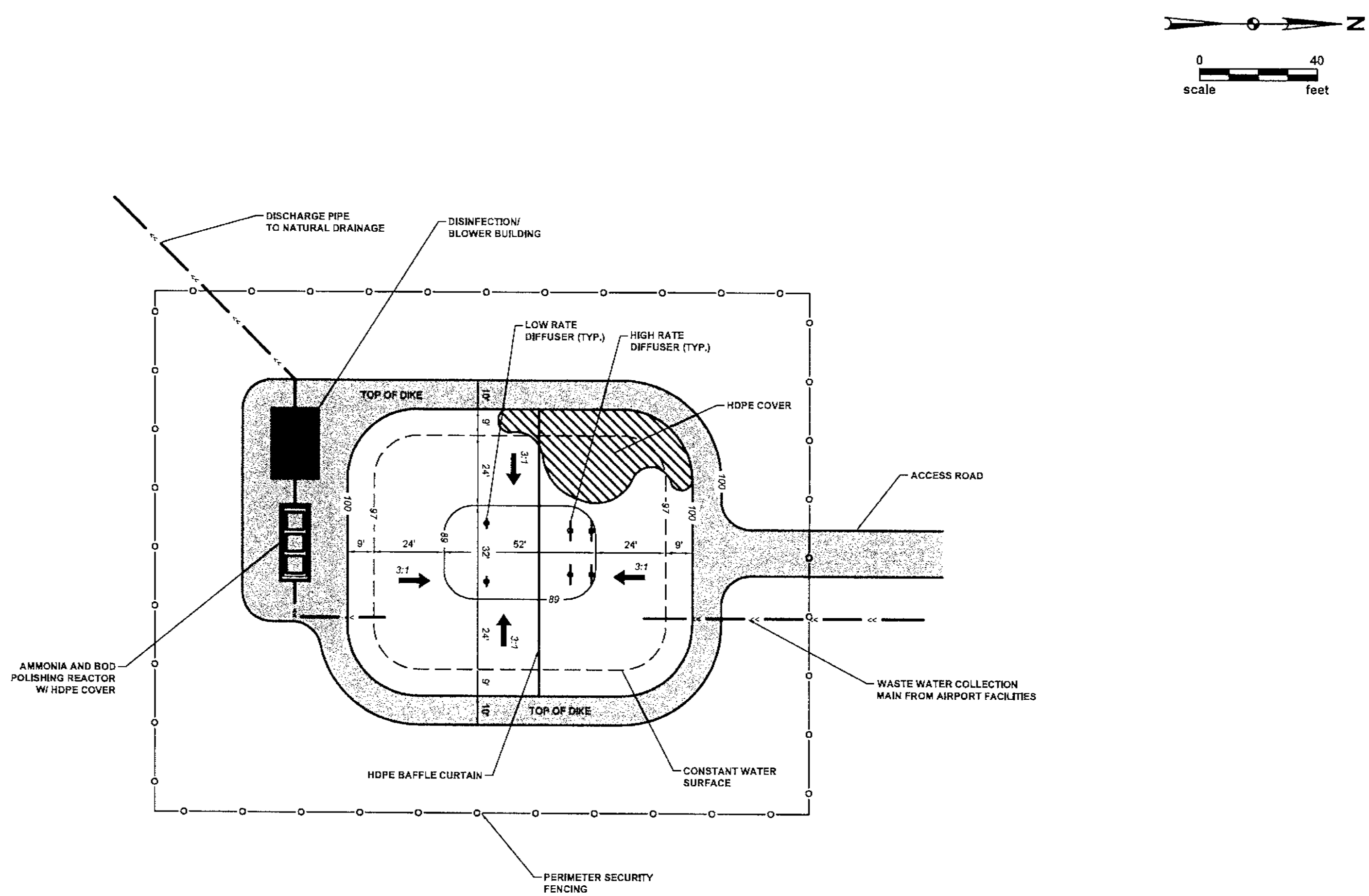
A security fence would be required for installation around the perimeter of the facility, which would also reduce access for wildlife.

The conceptual layout of the lagoon and polishing reactor system is shown in **Figure 3**. Preliminary information for the aerated lagoon cover, baffle curtain, aeration system and polishing reactor components is included in **Appendix C**.

Aerated Lagoon Design Criteria:
Design criteria for the aerated lagoon system is summarized below in **Table 2**.

Table 2: Aerated Lagoon System Design Criteria

Parameter	Value
Average Daily Flow Rate	24,500 gpd
Total Detention Time	11 to 12 days
Lagoon Water Depth	8 feet
Lagoon Freeboard	3 feet
Overall Approx. Lagoon Water Surface Dimensions	100 feet x 80 feet
Blower Horsepower	7.5 HP
Assumed Influent CBOD Concentration	250 mg/L
Assumed Influent TSS Concentration	250 mg/L
Assumed Influent Ammonia Concentration	25 mg/L
BOD Effluent Limit	10 mg/L
TSS Effluent Limit	10 mg/L
Ammonia Effluent Limit	1 mg/L
Max. Lagoon Cell Seepage	1/16-inch/day



ALTERNATIVE NO. 3 - AERATED LAGOON W/ COVER SYSTEM AND AMMONIA TREATMENT
FIGURE 3

Alternative No. 3 Advantages and Disadvantages:

Advantages:

- Potentially the lowest cost alternative considered
- The cover system would eliminate access for waterfowl and would improve Ammonia removal capability
- No impact to City of Rapid City wastewater collection or treatment systems
- Improved treatment efficiency compared to facultative lagoon
- Lower potential for odors compared to facultative lagoon
- Smaller footprint than facultative lagoon

Disadvantages:

- Significant power cost to operate blowers for aeration and the polishing reactor (roughly $6,500/year)
- Newer technology for the State of South Dakota, would require additional coordination, documentation, and discussions with the SD DENR to obtain approval
- A licensed operator would be required
- Discharge of effluent to surface water would require a permit from the SD DENR
- Private landowners along the drainage route may contest discharge of treated wastewater
- Increased long term maintenance associated with the cover, aeration, disinfection and polishing reactor systems
- Monthly discharge sampling and testing would be required when effluent discharge is occurring

3.5 Alternative No. 4 - Airport Collection System with Connection to Rapid City System

Alternative No. 4 would be similar to Alternative No. 1, but would only construct the facilities necessary to accommodate wastewater strictly from the airport. Facilities would include a new 8-inch gravity collection main installed along the airport access road to carry wastewater to the south, a new lift station near the intersection of the airport access road and Highway 44 and a new force main to carry wastewater from the lift station to the west and into the existing Rapid City collection system. **Figure 4** depicts a conceptual layout of the gravity main, the lift station location and force main route. Ultimately all wastewater would be carried to the existing Water Reclamation Facility for treatment.

For purposes of this report, it has been assumed that a submersible lift station would be installed. However, other lift station configurations could also be considered in greater detail during the design phase for the project. Similarly, there are several variations of submersible stations that could be evaluated to best meet the needs of the project.

Preliminary Lift Station Layout:

The storage volume of a wet well would be sized based on the Average Daily Flow of 24,500 gpd (17 gpm) and a maximum fill time of 30 minutes between pumping cycles. The total depth of the wet well needs to accommodate both the storage volume required and the depth necessary to accept flows from the gravity collection system. Duplex submersible pumps are required to provide system redundancy. A buried concrete valve vault could be installed adjacent to the lift station to house plug valves for isolation of either of the two submersible pumps for maintenance and check valves on the pump discharge lines to prevent backflow into the wet well. Concrete surfacing would be placed around the lift station wet well and valve vault and the entire facility would be enclosed by chain link security fencing. A vehicle gate would be necessary to allow for truck access to the wet well for pump removal when necessary. A road or vehicle turnout would be included in the design to provide access to the lift station.

The electrical components of the system would need to meet Class I, Group D, Division 1 requirements. A dedicated generator and transfer switch may be desirable for the new lift station to ensure continuous operation in the event of power outages.

The lowest cost system would include installation of the pump controls on an exterior support adjacent to the wet well. A transducer or float system would control starting and stopping of pumps based on the water level in the wet well. The submersible pumps would automatically alternate between each pumping cycle.

Lift Station and Force Main Design Criteria:

SD DENR design criteria for lift stations and force mains is summarized below in **Table 3**.

Table 3: Lift Station and Force Main Design Criteria

Parameter	Value
Min. Number of Pumps	2
Min. Lift Station Pumping Rate	4 Times Average Design Flow
Max. Lift Station Wet Well Fill Time	30 minutes
Max. Flow Velocity in Force Mains	8 ft/sec
Min. Flow Velocity in Force Mains	2 ft/sec

Force Main and Pump Considerations:

Submersible pumps must be designed to accommodate raw wastewater and have the capability to pass a 3-inch sphere. Each of the duplex pumps would need to evacuate water from the wet well at a flow rate greater or equal to four times the average daily flow from the collection system (68 gpm). The sizing of the pumps would also be contingent upon the vertical elevation difference between the pumps and the daylight elevation of the force main piping and the head-loss that must be overcome in the force main.

The new force main would consist of ductile iron pipe inside the wet well and the valve vault. After leaving the valve vault, the force main would transition to PVC. The possible force main route depicted in **Figure 4** would follow Highway 44 and Dunn Road to a connection point with the existing collection system. It may be possible to install the force main within the existing roadway right-of-way to avoid the need for easements on private property. The total distance of this route is roughly 1.9 miles.

Flow velocity in the force main must be between 2 ft/s and 8 ft/s. The minimum size of force main is 4-inches for this application. Force main sizing and pump sizing go hand-in-hand. For preliminary calculations, a pumping rate of 200 gpm and a 6-inch force main have been assumed, which would result in a total dynamic head (TDH) of roughly 72 feet and 7 horsepower pumps. Preliminary pump and force main sizing calculations are included in **Appendix D**. Under this scenario, the velocity in a 6-inch force main would be 2.3 ft/s (within the allowable range) and the pumps would run for approximately 2.5 minutes per pumping cycle.

Due to the relatively long force main, the residence time for wastewater within the piping would also be relatively long. A 6-inch diameter force main with a length of 1.9 miles would have a total volume of 14,450 gallons. Each pumping cycle would move roughly 500 gallons of wastewater through the force main (200 gpm x 2.5 min/cycle) and the pump station would cycle approximately 49 times per day (24,500 gpd ÷ 500 gal/cycle). This would result in a wastewater residence time of 1.0 day and 0.6 days in the force main piping under the current average daily flow and design year (2038) average daily flow conditions respectively.

Due to the relatively long wastewater residence time within the force main, accumulation of hydrogen sulfide gas would be a concern. Hydrogen sulfide is highly corrosive to concrete and metal, is toxic when inhaled by humans and has a foul odor. Use of PVC for the new force main would eliminate concerns with corrosion of the new piping. However, it would still be necessary to implement measures for reduction of hydrogen sulfide to reduce the odors, potential exposure to maintenance staff and corrosiveness in the downstream collection system. One method successfully being utilized in other cities is the injection of ferrous chloride into the waste stream. With this approach, chemical metering pumps housed in a vault or small building near the lift station could be utilized to inject ferrous chloride directly into the lift station wet well. Ferrous chloride reacts with dissolved sulfides, which minimizes the formation of hydrogen sulfide gas. Bulk ferrous chloride is relatively low cost. Potential negatives with ferrous chloride include staining when working with the chemical, iron flakes within the bulk tanks that can plug metering pumps and additional solids loading at the treatment plant. Even with chemical treatment upstream, it would still be prudent to line the inside surfaces of the existing concrete manholes near the connection into the City collection system. Coal tar epoxy or another type of coating could be used for manhole lining to provide protection from hydrogen sulfide gas.

The impacts on the existing collection mains would be another important consideration with the lift station alternative. A careful assessment of the downstream capacities of both the mains and the treatment facility would need to be completed.

<u>Alternative No. 4 Advantages and Disadvantages:</u>

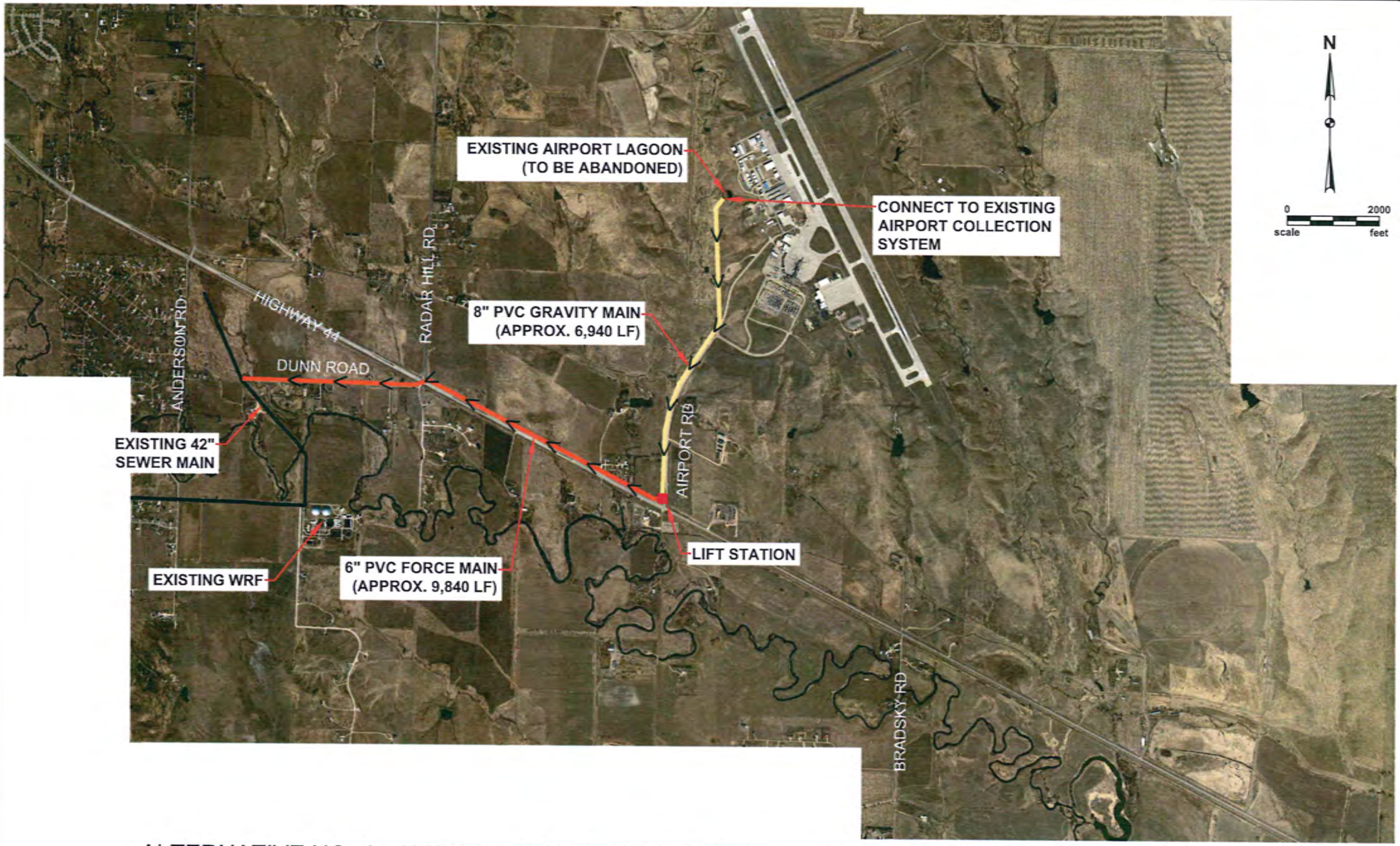
Advantages:

- Would utilize the existing Rapid City wastewater treatment facility (high level of treatment)
- No waterfowl attractant potential at the airport
- Low operation and maintenance complexity and cost
- A licensed wastewater operator would not be required for the airport
- Potential opportunities for shared use from other developments
- No wastewater discharge permit or monthly testing required

- Reliable system

Disadvantages:

- May require easements on private property (potential for project delays) if existing right-of-way cannot be utilized
- Long force main may introduce hydrogen sulfide issues



ALTERNATIVE NO. 4 - AIRPORT COLLECTION SYSTEM W/ CONNECTION TO RAPID CITY SYSTEM
FIGURE 4

Jun 08, 2017 - 4:25pm - P:\Airport\SD\RapidCity\Projects\10516106\CADD\Misc\Report\Figure 4 - Airport Collection System w Connection to Rapid City System.dwg (11x17 Border (Exhibit))

3.6 Alternative No. 5 - Mechanical Treatment Plant

Alternative No. 5 would consist of a mechanical package treatment plant. Mechanical plant options could potentially provide a higher level of wastewater treatment for BOD, TSS and Ammonia. However, a mechanical system would be significantly more complex to operate. A mechanical plant would still need to discharge to the natural drainage along the west side of the airport facility and would need to be enclosed or covered to eliminate the possibility of waterfowl attraction.

Due to the additional operational complexity and cost when compared to other alternatives, it has been assumed that a mechanical plant is not warranted and will not be considered further in the comparison of alternatives.

3.7 Alternative No. 6 - Total Retention Lagoon

Alternative No. 6 would consist of the construction of a new total retention lagoon facility. The existing lagoon would be abandoned. The new facility would need to be sized to retain all incoming wastewater and precipitation for subsequent evaporation. There would be no discharge from the facility to Rapid Creek or to the City's wastewater system. No mechanical aeration system would be required for this alternative. The new retention cells would be relatively shallow (2 to 4 foot water depth) and would operate as a facultative system.

Rapid City's climate is well suited for a total retention system due to relatively low average annual precipitation and high average annual evaporation. However, the design wastewater flows (design average daily flow = 24,500 gpd) for the airport would require a large surface area to allow for complete evaporation. The lagoon would be separated into several smaller cells to reduce wind action and erosion potential. The cells could likely be lined with native clays, but riprap along the inside banks may be necessary for erosion protection, which would add significant cost. A total pond water surface area of approximately 20 acres would be necessary based on preliminary lagoon calculations (see **Appendix D**). Placement of bird wire over an area this large could be difficult and costly and the FAA may have significant concerns with this large of a water surface adjacent to the airport. In addition, construction of lagoons with this much surface area would be costly.

<u>Alternative No. 6 Advantages and Disadvantages:</u>

Advantages:

- Discharge to Rapid Creek would be eliminated, making stringent BOD, TSS and Ammonia treatment and disinfection unnecessary
- There would be minimal operation and maintenance
- A discharge permit would not be necessary
- Discharge sampling and testing would not be required

Disadvantages:

- The very large surface area of the retention cells necessary for evaporation would tie up a large area of land (20 acres) and would be costly to construct
- The FAA would likely have significant concern with 20 acres of water surface area adjacent to the airport due to waterfowl attraction potential.

Due to the large surface area required and concerns with waterfowl attraction, Alternative No. 6 will not be considered further in this report.

4. COST COMPARISON OF ALTERNATIVES

4.1 Cost Estimates

As described in Section 3, only the following alternatives will be considered further:

- Alternative No. 1 - Regional Collection System and Connection to Rapid City System
- Alternative No. 3 - Aerated Lagoon with Cover System and Ammonia Treatment
- Alternative No. 4 - Airport Collection System with Connection to Rapid City System

The estimated initial capital costs for the four alternatives are summarized below in **Table 4.** Detailed cost estimates are included in **Appendix E.**

Table 4: Cost Estimate Summary

Alternative	Estimated Capital Cost
Alt No. 1 - Regional Collection System	$3,142,000 to $4,230,000 [1]
Alt No. 3 - Aerated Lagoon System	$895,000
Alt No. 4 - Airport Collection System	$1,794,000

[1] Alternative No. 1 cost estimate is from the 2015 Airport Sanitary Sewer Master Plan and represents the airport's cost share of the regional system.

The cost estimates do not include any ongoing operation and maintenance costs. Annual Operation and Maintenance (O&M) costs have been estimated for each alternative and are included in **Appendix E.** The annual O&M costs have been brought back to a present worth using an assumed 7% interest rate and a 20-year term. These costs were then added to the initial capital costs, allowing for a comparison of total "present worth" for the alternatives. These life cycle costs are presented below in **Table 5.**

Table 5: Life Cycle Cost Comparison

Alternative	Total Initial Cost	Annual O&M Cost	Present Worth of Annual O&M Cost (1)	Present Worth of Total Costs (2)
Alt No. 1 - Regional Collection System	$3,142,000 to $4,230,000	$16,740	$177,344	$3,319,344 to $4,407,344
Alt No. 3 - Aerated Lagoon System	$895,000	$41,660	$441,346	$1,336,346
Alt No. 4 - Airport Collection System	$1,794,000	$8,430	$89,307	$1,883,307

(1) Present Worth Costs for O&M are based on an annually compounded interest rate of 7.00% over a 20 year period.

(2) The total present worth is equal to the initial costs plus the present worth of annual O&M costs.

5. SUMMARY

Based on all considerations presented in this report, Alternative No. 3 (Aerated Lagoon with Cover System and Ammonia Treatment) is the preferred alternative only because it is the lowest cost alternative. The following items are necessary for this alternative to be carried forward:

- The new technology for Ammonia treatment with a lagoon system must be approved by the SD DENR
- A discharge permit will need to be obtained from the SD DENR
- The County and downstream landowners will need to be coordinated with regarding discharge of effluent to the natural drainage

If the above items can be achieved, the lagoon system presented under Alternative No. 3 is a viable option for addressing the airport's wastewater treatment. In the event, that any one of the items above present an obstacle, Alternative No. 4 would be the second preferred alternative. Alternative No. 4 has the following benefits.

- Low operation and maintenance cost and complexity
- A licensed wastewater operator would not be required for the airport
- No discharge permit or monthly effluent sampling required
- Would utilize the existing Rapid City wastewater treatment facility (high level of treatment)
- Reliable system

Appendix A
Wastewater Flow Calculations

RAPID CITY REGIONAL AIRPORT (RAP) ESTIMATED AVERAGE DAILY WASTEWATER FLOWS

Operations	Rapid City Airport Sewer Flow Per Unit [1]	2018 FAA TAF	2018 No. of Units Per Day	Sewer Flow Per Unit (Gal/Day)	Total Daily Sewer Flow (Gal)	2028 FAA TAF	2028 No. of Units Per Day	Sewer Flow Per Unit (Gal/Day)	Total Daily Sewer Flow (Gal)	2038 FAA TAF	2038 No. of Units Per Day	Sewer Flow Per Unit (Gal/Day)	Total Daily Sewer Flow (Gal)
Terminal Enplanement [2]	4.72 Gal/Passenger	275634	755	5	3776	318133	872	5	4358	366671	1005	5	5022.89
Terminal Deplanement [2]	4.72 **Gal/Passenger**	275634	755	5	3776	318133	872	5	4358	366671	1005	5	5022.89
FBO/General Aviation Operations	13.1 Gal/Operation	16153	44	13.1	580	20216	55	13.1	726	25738	71	13.1	924
Airport Support Staff(ARFF/SRE) [3]	455 Gal/**Day**				455				500				550
Corporate Hangars [4]	46 Gal/Day/Hangar		13	46	598		15	46	690		17	46	782
Government Hangars [4]	194 Gal/Day/Hangar		4	194	776		5	194	970		6	194	1164
Miscellaneous Office Buildings [5]					233				256				282
Rental Car Washes [6]	26.7 Gal/Wash		154	26.7	4112		169	26.7	4523		186	26.7	4975
Total Daily Flow					**14305**				**16381**				**18723**
Contingency (30%) [7]					-				-				**5617**
Revised Total Daily Flow					**14305**				**16381**				**24340**

[1] Sewer flows are based on actual metered water usage at Rapid City Regional Airport.

[2] An average flow of 5 gallons/day per passenger has been utilized for Terminal sewage flows to remain conservative.

[3] ARFF/SRE flows are based on actual metered usage at Rapid City Airport with a 10% growth factor included for 2028 and 2038.

[4] Flows for corporate/government hangars are from actual metered Rapid City Airport flows with a 10% growth factor included for 2028 and 2038.

[5] Flows for miscellaneous office buildings have been assumed with a 10% growth factor included for 2028 and 2038.

[6] Rental car wash flows are based on metered per vehicle usage from Rapid City Airport with a 10% growth factor included for 2028 and 2038.

[7] A contingency of 30% has been included for the design year flows to account for uncertainties with the projected number of enplanements and deplanements. This factor is based on the possible doubling of these uses from 755 to 1510 per day over the next 20 years.

Appendix B
2015 Airport Sanitary Sewer Master Plan

Airport Sanitary Sewer Master Plan

Purpose

On February 2, 2015 a request was made to investigate the cost of extending sanitary sewer to the Airport. It is presumed that a lift station will be required as identified in the Utility System Master Plan. This Airport master plan further documents the improvements required should the airport elect to get rid of their sewage lagoon and connect to City sewer. This document also provides the estimated cost to the airport of these improvements.

Design Criteria and Background Information

The City GIS orthogonal data was used to delineate the sub-basins and to establish preliminary vertical and horizontal alignments for the future sanitary sewer mains.

The Comprehensive Plan (April 2014) was used to determine the land use for each sub-basin. The current Infrastructure Design Criteria Manual (IDCM) was used for sizing of the mains with some exceptions. The number of persons per household used in the calculations was 2.29, based on the Comprehensive Plan, rather than 2.65 as identified in the IDCM. The average annual growth rate for the Airport area was identified in the Utility System Master Plan as 2.2%. This number was used to extrapolate the anticipated residential population for the area for a 100 year design life and a 50 year design life. After 100 years, the overall population is expected to be approximately 17.1% of the full build-out population based on the maximum land use density identified in the Comprehensive Plan, and an average annual growth rate of 2.2%. The Comprehensive Plan identifies the population density for residential zoning to be 1-8 dwelling units (DU) per acre. The current density of the area zoned residential is approximately 0.16 DU per acre. After 100 years of growth at 2.2% annually, the density is estimated to be 1.2 dwelling unit per acre residential land uses. The Comprehensive Plan identifies Rural Residential land use density as 0.2 dwelling units per acre. General Agriculture areas were calculated based on a density of 0.2 dwelling units per acre. Employment and Industrial land use sewer flows were calculated at a rate of 3 gallons per minute per acre (gpm/ac), then reduced to 17.1% (expected developed rate at 100yrs), anticipating these land uses would follow the growth pattern of the residential growth in this area. The Buffer / Reserved area was calculated per the Public sewer flows of 2 gpm/ac, also reduced to 17.1% of full build-out. The Public area sewer flows were calculated on a current build-out of 23%, with a growth factor of 2.2%.

After 50 years, the overall population is expected to be 5.8% of the full build-out population based on the maximum land use density identified in the Comprehensive Plan. Adjustments were not made to the calculated residential flows because the changes did not affect the required pipe diameters.

Peaking factors of 1.2 for public/buffer, 1.7 for employment/industrial, and 1.8 for residential were used. Sewer sizing was based on sewers flowing at a maximum of 70% full for the 100 year and 50 year designs. Land uses are shown on Figure 1.

Sub-Basin 1

Sub-Basin 1 has been limited to the north by the urban system boundary, the Box Elder City limits, or the natural basin boundary for the purposes of estimating the basin area. The total basin area, excluding the unserviceable areas, is approximately 4100 acres. The acreage of each land use is summarized in the table below.

Sub-Basin 1 Land Use	Acreage	100 Yr Peak Design Flow (gpm)	50 Yr Peak Design Flow (gpm)
General Ag	285	16	16
Buffer / Reserved	1153	473	160
Employment	270	235	80
Industrial	537	468	159
Public	1733	4160	2783
Residential	16	5	2
Rural Residential	110	6	6
Total Acreage/Peak Flow	4100	5363	3203

The sewer main identified for this area would connect to the existing sewer system within the airport property at the current discharge location. This sewage is currently treated in a lagoon. It is also anticipated that the majority of the upper part of this basin will use the existing airport infrastructure and be collected at this point. The sewer will likely follow the existing roadway and connect to a future trunk sewer in Highway 44 and continue flowing to the east.

The trunk sewer in Highway 44 will discharge to a future lift station identified in the Utility System Master Plan. The sewage would be pumped via a force main to the existing gravity trunk sewer and eventually discharge to the Water Reclamation Facility.

Sub-Basin 2

Sub-Basin 2 is limited to the north by the urban system boundary sub-basins 4 and 1 on the east and west respectively, and Highway 44 to the south. The total basin area, excluding the unserviceable areas, is approximately 1732 acres. The acreage of each land use within the sub-basin is summarized in the table below.

Sub-Basin 2 Land Use	Acreage	100 Yr Peak Design Flow (gpm)	50 Yr Peak Design Flow (gpm)
Buffer / Reserved	471	193	66
Employment	820	715	242
Residential	441	152	62
Total Acreage/Peak Flow	1732	1060	370

The Sub-Basin 2 trunk sewer will be located approximately ¼ mile east of Radar Hill Road. It will flow to the future trunk sewer in Highway 44 and be pumped from the lift station to the existing trunk sewer.

Sub-Basin 3

Sub-Basin 3 is limited to the north by the urban system boundary and the natural basin boundary. The total basin area, excluding the unserviceable areas, is approximately 2115 acres. The acreage of each land use within the sub-basin is summarized in the table below.

Sub-Basin 3 Land Use	Acreage	100 Yr Peak Design Flow (gpm)	50 Yr Peak Design Flow (gpm)
Buffer / Reserved	2106	864	293
Residential	9	0	0
Total Acreage/Peak Flow	2115	864	293

The Sub-Basin 3 trunk sewer will be located east of the airport and will flow nearly directly to the lift station. This sewer main will not contribute to the trunk sewer on Highway 44, but will contribute flows to the lift station and force main.

Sub-Basin 4

Sub-Basin 4 is limited to the north by the urban system boundary and the natural basin boundary. The total basin area, excluding the unserviceable areas, is approximately 1704 acres. The acreage of each land use within the sub-basin is summarized in the table below.

Sub-Basin 4 Land Use	Acreage	100 Yr Peak Design Flow (gpm)
Buffer / Reserved	9	21
Residential	1695	1359
Total Acreage/Peak Flow	1709	1380

Sub-Basin 4 was initially identified in the Utility Master Plan to flow to a proposed lift station southeast of the Airport. After analyzing the contours, this area could flow by gravity to the existing sanitary sewer main located at the intersection of Highway 44 and Anderson Road and meet minimum criteria. This would require an 18" diameter sewer installed at a 0.12% slope with 3.5 feet of cover, based on City topographic information (not surveyed). There could potentially be some grading done to accommodate a steeper slope and/or to provide additional cover to the portion of the sewer main that will be very flat. Depending on how the 100 year population is determined, the 18" diameter sewer could require an exception because the d/D may exceed 0.70, and required cover may not be able to be met.

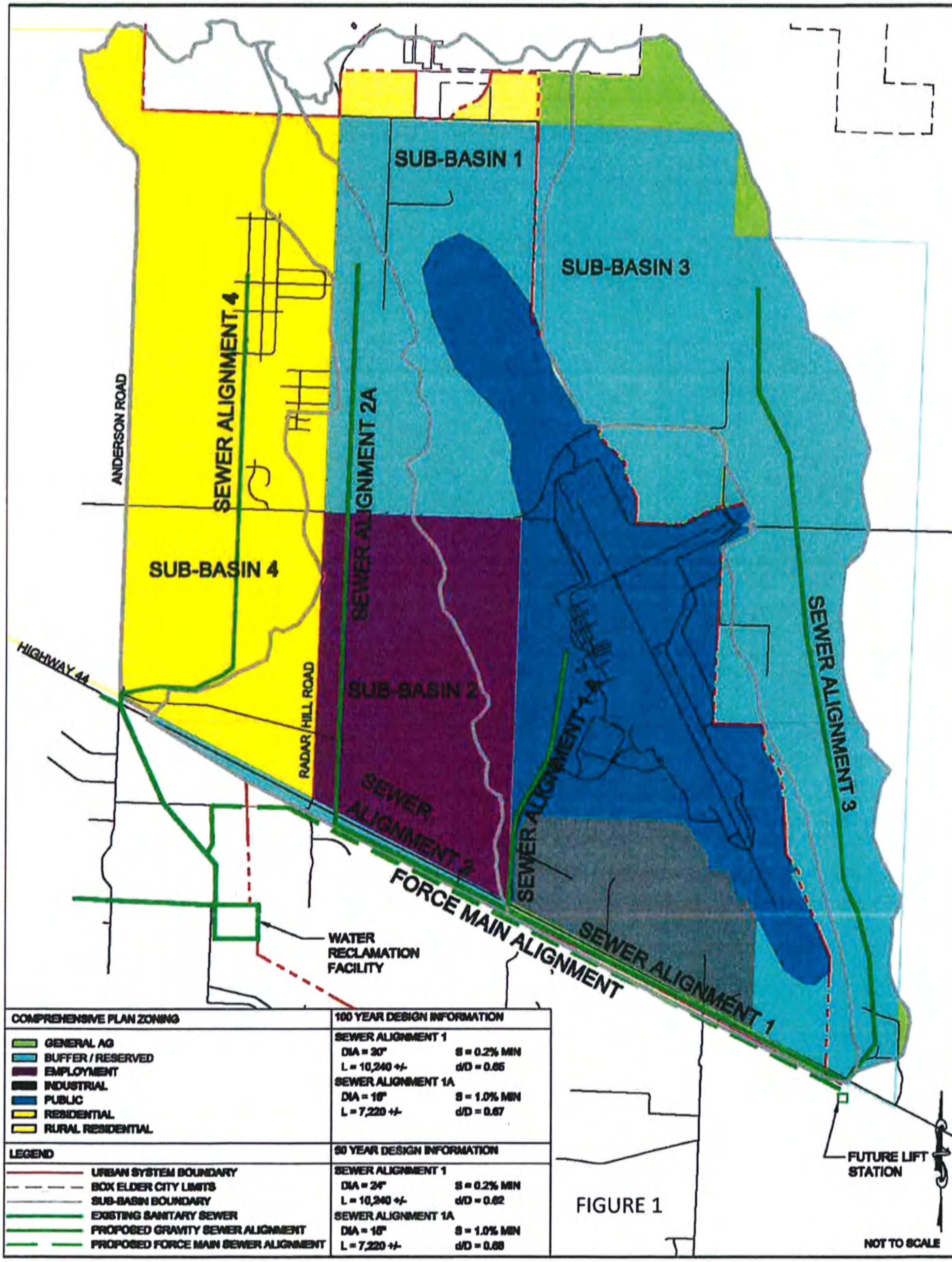

SUB-BASIN 1
SUB-BASIN 3
SUB-BASIN 4
SUB-BASIN 2
SEWER ALIGNMENT 4
SEWER ALIGNMENT 2A
SEWER ALIGNMENT 3
SEWER ALIGNMENT 1-A
SEWER ALIGNMENT 2
SEWER ALIGNMENT 1
FORCE MAIN ALIGNMENT
ANDERSON ROAD
RADAR HILL ROAD
HIGHWAY 44
WATER RECLAMATION FACILITY
FUTURE LIFT STATION
COMPREHENSIVE PLAN ZONING
GENERAL AG
BUFFER / RESERVED
EMPLOYMENT
INDUSTRIAL
PUBLIC
RESIDENTIAL
RURAL RESIDENTIAL
LEGEND
URBAN SYSTEM BOUNDARY
BOX ELDER CITY LIMITS
SUB-BASIN BOUNDARY
EXISTING SANITARY SEWER
PROPOSED GRAVITY SEWER ALIGNMENT
PROPOSED FORCE MAIN SEWER ALIGNMENT
100 YEAR DESIGN INFORMATION
SEWER ALIGNMENT 1
DIA = 30" S = 0.2% MIN
L = 10,240 +/- d/D = 0.65
SEWER ALIGNMENT 1A
DIA = 18" S = 1.0% MIN
L = 7,220 +/- d/D = 0.67
50 YEAR DESIGN INFORMATION
SEWER ALIGNMENT 1
DIA = 24" S = 0.2% MIN
L = 10,240 +/- d/D = 0.62
SEWER ALIGNMENT 1A
DIA = 18" S = 1.0% MIN
L = 7,220 +/- d/D = 0.68
NOT TO SCALE

FIGURE 1

Cost Estimates

The estimates are for the materials and installation of sanitary sewer main and a gravel access road. It is assumed all sewer will be constructed outside of the roadways. The costs include design fees, construction administration services and property acquisition.

Sewer Alignment 1 is approximately 10,240 feet in length. The 100 year design will require this sewer to be 30 inches in diameter. The 50 year design reduces the diameter to 24 inches. The cost estimates for both diameters have been included in the table below.

Sewer Alignment 1 30" Fiberglass Pipe, 100 yr capacity	$6,760,000
Sewer Alignment 1 24" PVC Pipe, 50 yr capacity	$3,810,000

Sewer Alignment 1A is approximately 7220 feet in length. The 100 year design will require this sewer to be 18 inches in diameter. The 50 year design reduces the diameter to 15 inches. The cost estimates for both diameters have been included in the table below.

Sewer Alignment 1A 18" PVC Pipe, 100 yr capacity	$1,695,000
Sewer Alignment 1A 15" PVC Pipe, 50 yr capacity	$1,355,000

The lift station and force main have been sized for a pumping rate of approximately 2000 gpm.

Lift Station	$3,000,000-$4,000,000
12" Force Main (20,000 LF)	$3,000,000

The total cost for the 50 year design and the 100 year design is noted in the table below.

100 Yr Design	$14,455,000 - $15,455,000
50 Yr Design	$11,165,000 - $12,165,000

Cost Allocation

The cost for sewer would be split on a front-footage basis and an oversize basis in accordance with the existing policy used to determine construction fees. An assumption that all front footage cost would be based on an 8" diameter sewer has been made for this project. All oversize costs would be split on a per acre basis to the entire basin.

Segment 1A is approximately 7220 feet in length. Approximately 2500 feet is adjacent to industrial property and employment property. The remaining 4720 is on the airport property, 100% allocated to the airport.

Airport Property Calculations	**100 YR Design**	
Segment 1A - Base Cost (4720LFx2)x$65	$	613,600.00
Segment 1A - Oversize (1733ACx$275/AC)	$	476,575.00
Segment 1 - Base Cost - No cost for airport	$	-
Segment 1 - Oversize (1733ACx$932/AC)	$	1,615,156.00
Force Main and Lift Station (1733ACx$880/AC)	$	1,525,040.00
Total	**$**	**4,230,371.00**

Airport Property Calculations	50 YR Design
Segment 1A - Base Cost (4720LFx2)x$65	$ 613,600.00
Segment 1A - Oversize (1733ACx$152/AC)	$ 263,416.00
Segment 1 - Base Cost - No cost for airport	$ -
Segment 1 - Oversize (1733ACx$427/AC)	$ 739,991.00
Force Main and Lift Station (1733ACx$880/AC)	$ 1,525,040.00
Total	**$ 3,142,047.00**

Appendix C
Aerated Lagoon Component Information

LEMTEC™ BIOLOGICAL TREATMENT PROCESS

LEMNA ENVIRONMENTAL TECHNOLOGIES

L•E•T

TREATING YOUR WATER RIGHT

PROPOSAL FOR: RAPID CITY, SD

PREPARED FOR: Nate Young, PE
KLJ Engineering
Great Falls, MT

PREPARED BY: TOM BIRKELAND
DIRECTOR OF SALES
LET

Proposal Number: 1592
Revision Number: 1
June 8, 2017

INTRODUCTION

Thank you for including Lemna in the planning of the Rapid City, SD Airport facility. Based on the information provided, we have developed a preliminary design and budget estimate for this project. The objective of our proposed system is to provide the best possible biological treatment solution capable of meeting or exceeding your requirements in the most efficient and cost effective way possible.

This proposal has been prepared for Mr. Nate Young, who is currently evaluating treatment alternatives, and is interested in products/technologies that can provide improvements to the existing facility, in order to accommodate projected flows as well as meet BOD, TSS and ammonia limits.

Lemna Environmental Technologies' proposed process design is based upon the following design parameters and site data.

DESIGN PARAMETERS

	Influent Summer	Influent Winter		Effluent Summer	Effluent Winter	
Flow	0.0245	0.0245	MGD			
$CBOD_5$	250	250	mg/L	10	10	mg/L
TSS	250	250	mg/L	10	10	mg/L
Ammonia	30	30	mg/L	1.0	1.0	mg/L

The proposed designs described below will achieve the basic requirements and provide a number of advantages to the end user which are unmatched by alternative technologies. The LemTec™ process is capable of achieving year-round effluent limits of10 mg/l BOD, 10 mg/l TSS and 1.0 mg/l NH3-N at a fraction of the cost of other traditional wastewater treatment systems. With a reduced footprint, a process that is extremely reliable, and simple to operate, the LemTec™ process is the highest performance lagoon-based package in the world and offers numerous advantages over other systems, including lower capital and operating costs, expandability and low maintenance.

DESIGN OVERVIEW

This proposed design utilizes one new lagoon to handle a total design flow of 24,500 gpd. The depth of the lagoon will be 8' for the purposes of this design. Following the treatment lagoon, the LemTec™ Polishing Reactor (LRR) will provide additional ammonia treatment.

For this design, the lagoon will be divided into two cells using Lemna's custom designed LemTec™ Reverse Miter Hydraulic Baffle, which will be installed to minimize short-circuiting between each cell. The first cell will be a complete mix cell. The complete mix zone of the LBTP process is an aerated, aggressively mixed cell that establishes an environment suitable for the rapid removal of BOD_5 by heterotrophic bacteria. The reduction of BOD_5 is calculated using state-of-the-art "mechanistic" models that relate to the growth of bacteria and removal of BOD_5 in relation to detention time and wastewater temperature. Similar models are currently used for the design of activated sludge plants.

In addition to BOD_5 removal, ammonia is also removed by heterotrophic bacteria present in the complete mix cell. Ammonia is utilized by the bacteria to support its nitrogen requirement for growth. Also, nitrifier growth will occur in the complete mix cell resulting in additional (and significant) ammonia reduction. Aeration and mixing will be provided by diffused aeration.

Following the complete mix cell, water will flow into a settling cell with a detention time of 8 days. Both the cells in the proposed design will be covered by Lemna's LemTec™ Modular Insulated Cover rated at R10. The LemTec™ Cover prevents algae growth by eliminating sunlight below the cover and improves clarification in two ways: 1) it prevents wind action on the water surface thereby establishing a quiescent zone for solids to settle, and 2) the insulation minimizes seasonal and diurnal temperature fluctuations, thereby reducing stirring by thermal currents. The LemTec™ Cover improves TSS removal, provides algae prevention and encourages nitrification by regulating temperatures within the treatment system. The cover also serves as wildlife mitigation in that it completely covers the liquid in the basin so that the lagoon system will not attract birds of water fowl.

Following the treatment lagoon, the LemTec™ Polishing Reactor will provide additional BOD and ammonia treatment. The LPR consists of submerged, attached-growth media modules used for maintaining an adequate population of bacteria. The LPR enhances the growth of nitrification bacteria to encourage conversion of ammonia to nitrates in an aerobic environment. Aeration is provided by rack-mounted coarse-bubble diffusers located under the media, which evenly distribute the air and shear coarse bubbles into very fine bubbles. The LPR produces BOD and TSS effluent levels less than 10 mg/l and NH_3-N as low as 1 mg/l. Typically housed in a concrete or metal structure near the effluent of the pond, the LPR is the final stage of the lagoon based LemTec Biological Treatment Process. The approximate size of the proposed LPR for this option is 8' x 24' x 10'.

The oxygen requirements for the system will be met (2) 7.5 HP blowers, of which 1 will be in continuous operation. A schematic of the proposed design is attached for your reference.

DESIGN SUMMARY

	Water Depth (ft)	Freeboard (ft)	Slope	Waterline Length (ft)	Waterline Width (ft)	Volume (MG)	Detention Time (days)
Basin # 1	8	2	3	100	80	0.3	11.1

	Mixing	Detention Time (days)	Winter Temp. (C)
Cell 1A	CM	3.0	9.6
Cell 1B	SC	8.1	8.5

A summary of the equipment supplied is provided in the table below:

EQUIPMENT SUMMARY

	Cover	Baffle		Blower		Cubes	Diffusers
	Sq. Ft.	**Qty.**	**Ft.**	**Qty.**	**HP**	**6'x6'x8'**	**Units**
Aeration Pond	8,000	1	84	2	7.5		
Complete Mix							4
Settling Cell							2
LPR	169					3	

DESIGN LAYOUT/DRAWINGS

Layout drawings are included.

LET PROJECT SUPPLY SCOPE

Engineering/Technical Services
- Lemna System Design Recommendations
- Lemna System Equipment Details

Lemna System Plans and Specifications
Lemna Design Calculations
Regulatory Technical Support

Equipment Supply
LemTec™ Insulated Cover (including integrated baffle)
LemTec™ Aeration System
LemTec™ LPR

Installation/Start-Up/Training
Equipment Installation Supervision (Lemna Equip.)
Process Start-Up/Training (Lemna Process)
Ongoing Technical Support

LET PROJECT PRICING

Equipment/Services	$142,095
Equipment Freight (estimate)	$ 6,405
Total Proposed Price	**$148,500**

By others: Civil Design, Electrical Design, Mechanical Design, Other Design Services (if required). Pond De-Sludging, Site Work/Improvements, Concrete Structures, Septic Tanks, Yard Piping (out of basin),Electrical Service to Site, Interconnect Wiring (Equipment to Equipment/ Remote Disconnect/MCCs/Control Panels).

Proposed pricing is based on available information and is valid for 60 days. Prices are in US funds and do not include any applicable taxes. All sales are subject to LET's standard terms and conditions. Proposed price subject to change based on changes in final design and final scope at time of bid or based on size changes at time of final survey. Typical equipment lead time is 6-12 weeks after approval of final submittals. Equipment lead time is subject to change based on size of project, complexity of design, customer requirements and shop-loading at time of order.

LIMITED WARRANTY

All LET supplied components are warranted against manufacturer's defects for a period of twelve months. This warranty does not cover wear or damage caused by improper installation, operation or maintenance. In the event of a manufacturer's defect, Lemna will repair or replace the damaged component. A process warranty based on the design parameters included as part of this proposal. This process warranty is contingent upon the full supply by LET of all equipment detailed in this proposal.

SITE CHARACTERISTICS:
WINTER AIR TEMPERATURE: −5.3 °C
ELEVATION: 3204 ft AMSL
ATMOSPHERIC PRESSURE: 13.1 psia

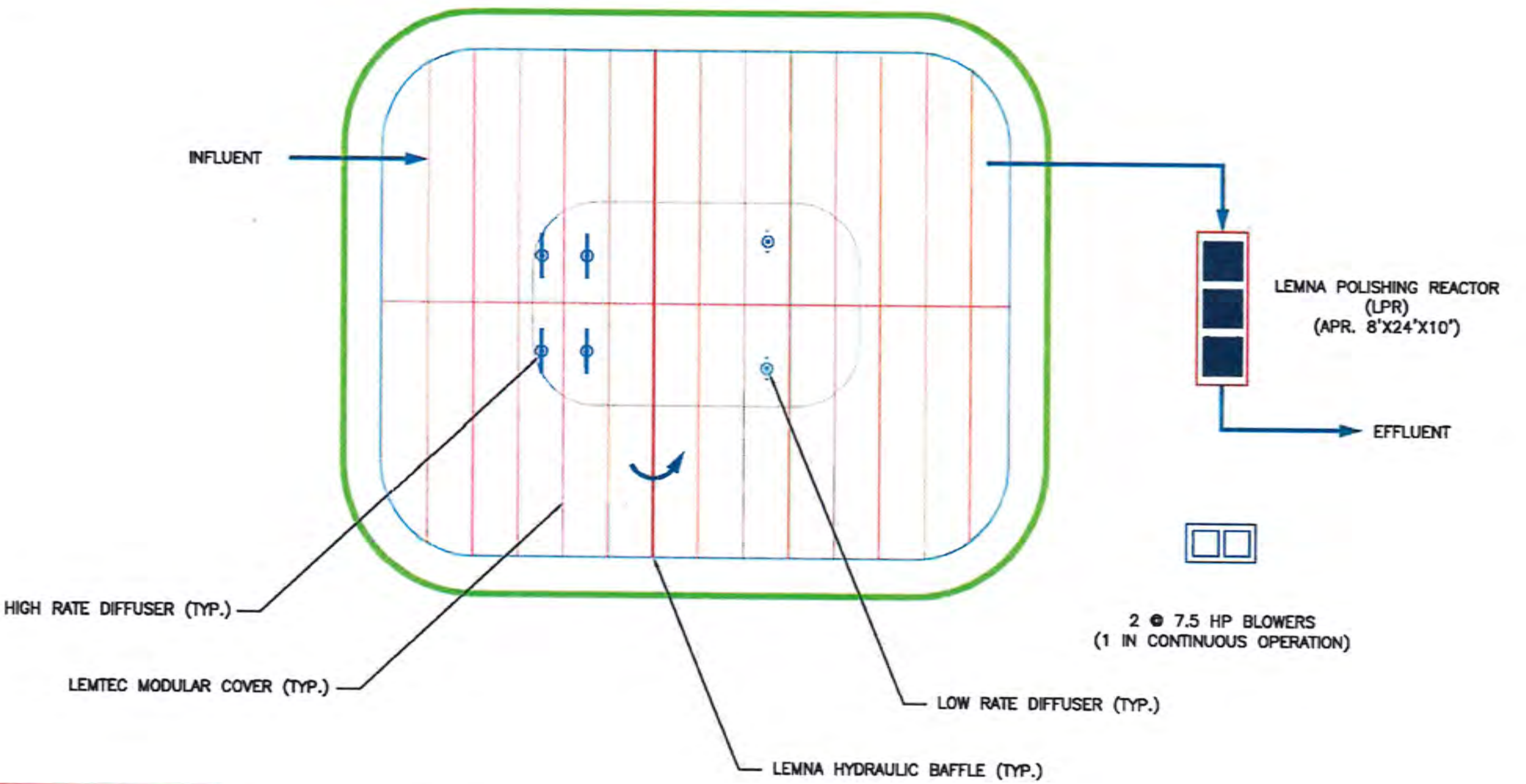
INFLUENT CHARACTERISTICS:
$CBOD_5$=250 mg/L
TSS=250 mg/L
NH_3=25 mg/L

EFFLUENT LIMITS:
$CBOD_5$=10 mg/L
TSS=10 mg/L
NH_3=1.0 mg/L

LEMTEC™ AERATION POND
0.18 ACRE
8' WATER DEPTH
11.1 DAYS D.T.

COMPLETE MIX CELL
3.0 DAYS D.T.

SETTLING CELL
8.1 DAYS D.T.



DESIGN FLOW: 24,000 GPD

NOTES: DESIGN BASED ON MINIMUM INFLUENT TEMPERATURE OF 10°C

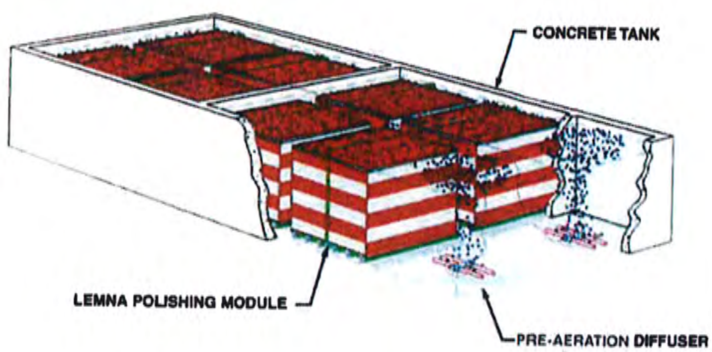
DRAWN BY:	DTE
APPROVED BY:	TD
SCALE:	NOT TO SCALE
DATE:	JUNE 2017
SHEET NO:	1 OF 1

LEMTEC™ BIOLOGICAL TREATMENT PROCESS
RAPID CITY REGIONAL AIRPORT

L•E•T

Lemna Polishing Reactor

- Effectively removes ammonia and polishes BOD.
- Submerged, attached growth process is reliable and consistent.
- Applications typically utilize concrete tanks



- Simple operation, requiring virtually no operational interface.
- No internal moving parts and efficiently aerated fixed film attached growth media.
- Can be sized to handle flows from 20,000 gpd to 2,000,000 gpd.

Appendix D
Preliminary Design Calculations

KLJ

PROJECT Rapid City Airport
SHEET NO. 1 OF 2
CALCULATED BY NLY DATE 6/6/17
CHECKED BY ______ DATE ______

Alternative No. 4

Determine Approximate Wet Well Size and Pumping Rate

- Avg. Daily Flow = 24,500 gpd
- Approx. 9,950 ft of force main
- Elev. Lift Station = 2999
- Elev. Ground @ Tie-In = 3024

Calculate Minimum Pumping Rate

$24{,}500 \text{ gpd} \times \frac{1 \text{ day}}{24 \text{ hr}} \times \frac{1 \text{ hr}}{60 \text{ min}} = 17.01 \text{ gpm} = 2.27 \text{ cfm}$

- Minimum Pumping Rate = 4.0 x Avg. Flow Rate

Minimum Pumping Rate = $4.0 \times 17.01 = 68.0$ gpm

Calculate Wet Well Size

- Assume Max Fill time of 30 min during average flow

$2.23 \text{ cfm} \times 30 \text{ min} = 66.9 \text{ cf}$

Calculate Ideal Pumping Rate

- Assume 5 min run time

$66.9 \text{ cf} \times \frac{7.48 \text{ gal}}{1 \text{ cf}} = 500 \text{ gallons} / 5 \text{ min} = 100 \text{ gpm}$

Using a 6' Diameter Lift Station will Provide for 2.4' of Storage
$(66.9 \text{ cf} / (\pi(3)^2) = 2.37')$

Min. Elev. in Lift Station (Point 1)

- Assume 8 foot to invert + 3 feet to upper water surface + 2.4' storage

Elev. = $2999 - 8 - 3 - 2.4 = 2985.6'$

Elevation of Tie-In (Point 2)

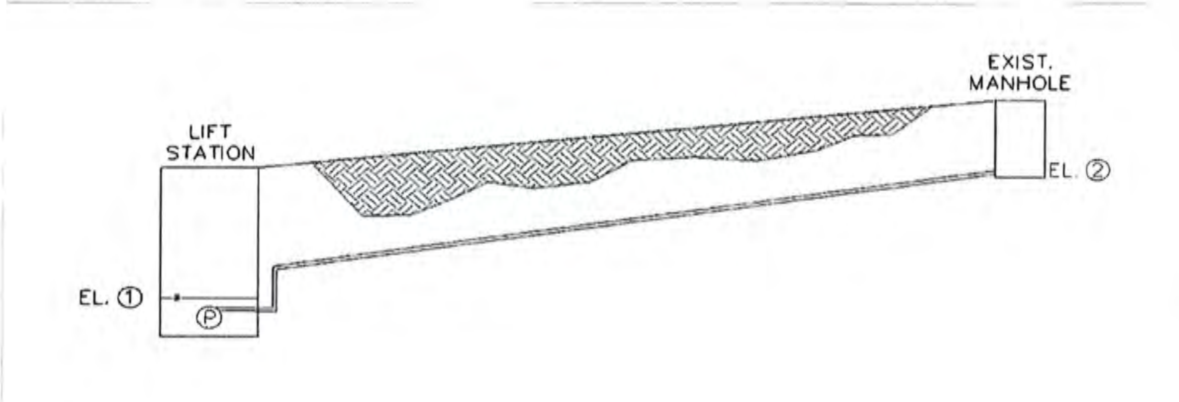
- Assume main is 10 feet deep

Elev. = $3024 - 10 = 3014'$

KLJ	Project:	Rapid City Airport	Project #:	10516108
	Calculated By:	NCY	Date:	6/6/2017
	Checked By:	JRS	Date:	

Lift Station - Force Main Analysis (Initial State) – Alternative No. 4

Calculate Total Dynamic Head



EL. 1 =	2985.60
EL. 2 =	3014.00

$$\frac{P_1}{\gamma} + \frac{V_1^2}{2g} + Z_1 + h_p = \frac{P_2}{\gamma} + \frac{V_2^2}{2g} + Z_2 + h_L$$

(Hazen-Williams Eq.)

$h_P = Z_2 - Z_1 + h_L$

$$h_L = \frac{(10.44)(L)(Q)^{1.85}}{(C)^{1.85}(D)^{4.8655}}$$

L =	9840 ft
Q =	200 gpm
C =	120 (pvc)
D =	6 "

h_L = 43.2535 ft

h_P = 71.65 ft

Calculate Pump Horsepower

$$P = \frac{(h_P)(Q)(SG)}{3956*(\text{Efficiency}\%)}$$

SG =	1.00
Eff. % =	50.00%

P = 7.25 Hp

Calculate Force Main Velocity

V = Q/A

A = 0.20 ft^2

Q = 200 gpm = 0.45 cfs

V = 2.27 ft/sec

Check Pump Run Time (>1 min)

Wet Well Volume, Vol= 66.9 ft3 = 500.41 gal

Pump Run Time = Vol/Q= 2.50 min

KLJ

PROJECT Rapid City Airport
SHEET NO. 1 OF 1
CALCULATED BY N. Young DATE 6/6/17
CHECKED BY ______ DATE ______

Alternative No. 6

Determine Approximate Size of Total Retention Lagoons:

- Avg. Design Flow = 24,500 gpd
- Wettest Year in Last 10 Precipitation Total = 25.3 inches
- Avg. Annual Evaporation = 42 inches
- Net Evaporation = 16.7 inches = 1.39 ft

Calculate Required Surface Area for Total Evaporation:

Total Annual Vol. of Wastewater = 24,500 gpd × 365 days/yr

= 8,942,500 gal/yr × $\frac{1\ ft^3}{7.48\ gal}$

= 1,195,521 ft^3/yr

Total Lagoon Surface Area Required = 1,195,521 ft^3/yr × $\frac{1\ yr}{1.39\ ft}$

= 860,087 ft^2 × $\frac{1\ acre}{43,560\ ft^2}$

= 19.74 acres

Appendix E
Preliminary Cost Estimates

RAPID CITY REGIONAL AIRPORT (RAP) WASTEWATER SYSTEM
ALTERNATIVE NO. 3 - AERATED LAGOON WITH COVER SYSTEM AND AMMONIA TREATMENT
COST ESTIMATE

	Description of Items	Qty	Units	Unit Cost	Total Cost
	Mobilization (20%)	1	LS	$126,100.00	$126,100.00
	Lagoon Earthwork	1	LS	$50,000.00	$50,000.00
	Gravel Surfacing for Lagoon Access Road and Dikes	120	CY	$35.00	$4,200.00
	Lagoon Flow Distribution Piping	1	LS	$25,000.00	$25,000.00
	Aeration Piping	1	LS	$25,000.00	$25,000.00
	Level Control Manhole	1	EA	$8,000.00	$8,000.00
	Outfall Structure	1	EA	$5,000.00	$5,000.00
	Polypropylene Pond Liner	13,000	SF	$1.00	$13,000.00
	Lagoon Covers, Baffle, Blowers, Aeration System and Polishing Reactor	1	LS	$165,000.00	$165,000.00
	Concrete Basin for Polishing Reactor	1	LS	$20,000.00	$20,000.00
	Electrical Work	1	LS	$50,000.00	$50,000.00
	UV Disinfection System	1	LS	$80,000.00	$80,000.00
	UV/Aeration Building	1	LS	$150,000.00	$150,000.00
	Lagoon Depth Gauge	1	EA	$1,500.00	$1,500.00
	Chain Link Fence	800	LF	$30.00	$24,000.00
	4 ft Personnel Gate	1	EA	$500.00	$500.00
	14 ft Vehicle Gate	1	EA	$1,600.00	$1,600.00
	Lagoon Site Signs	6	EA	$150.00	$900.00
	Seeding and Fertilizing	2,500	SY	$2.00	$5,000.00
	Erosion Control Blanket	600	SY	$3.00	$1,800.00
	TOTAL CONSTRUCTION ESTIMATE				**$756,600.00**
	CONTINGENCY (15%)				**$113,490.00**
	INFLATION (3%)				**$22,698.00**
	TOTAL ESTIMATED COST				**$892,788.00**

RAPID CITY REGIONAL AIRPORT (RAP) WASTEWATER SYSTEM
ALTERNATIVE NO. 4 - AIRPORT COLLECTION SYSTEM WITH CONNECTION TO RAPID CITY SYSTEM
COST ESTIMATE

	Description of Items	Qty	Units	Unit Cost	Total Cost
	Mobilization (20%)	1	LS	$253,440.00	$253,440.00
	Traffic Control	1	LS	$15,000.00	$15,000.00
	New Lift Station	1	LS	$250,000.00	$250,000.00
	New Lift Station Electrical	1	LS	$50,000.00	$50,000.00
	Emergency Generator	1	LS	$50,000.00	$50,000.00
	Hydrogen Sulfide Treatment System	1	LS	$40,000.00	$40,000.00
	20" Jack and Bore (6" PVC Carrier Pipe)	250	LF	$525.00	$131,250.00
	6" SDR 21 PVC Force Main	9,790	LF	$25.00	$244,750.00
	8" SDR 35 PVC Gravity Collection Main	7,000	LF	$50.00	$350,000.00
	48" Manhole	18	EA	$4,800.00	$86,400.00
	Connect Force Main to Existing Manhole	1	EA	$5,000.00	$5,000.00
	Type 2 Pipe Bedding	250	CY	$50.00	$12,500.00
	Buried Utility Crossing	20	EA	$500.00	$10,000.00
	1-1/2" Minus Crushed Base Course	40	CY	$35.00	$1,400.00
	3" Asphalt Surfacing	50	SY	$20.00	$1,000.00
	Seeding and Fertilizing	10	ACRE	$1,500.00	$15,000.00
	Chain Link Fence	110	LF	$30.00	$3,300.00
	14' Vehicle Gate	1	EA	$1,600.00	$1,600.00
	TOTAL CONSTRUCTION ESTIMATE				**$1,520,640.00**
	CONTINGENCY (15%)				**$228,096.00**
	INFLATION (3%)				**$45,619.20**
	TOTAL ESTIMATED COST				**$1,794,355.20**

RAPID CITY REGIONAL AIRPORT (RAP) WASTEWATER SYSTEM
ALTERNATIVE NO. 1 - REGIONAL COLLECTION SYSTEM AND CONNECTION TO RAPID CITY SYSTEM
OPERATION AND MAINTENANCE COST ESTIMATE

Description of Items	Estimated Annual Cost
Power - Lift Station	$2,000
Power - Ferrous Chloride System	$500
Operator Labor (2 hours/week @ $60 00/hour)	$6,240
Equipment and Materials	$5,000
Bulk Ferrous Chloride	$1,000
Miscellaneous	$2,000
Total	**$16,740**

RAPID CITY REGIONAL AIRPORT (RAP) WASTEWATER SYSTEM
ALTERNATIVE NO. 3 - AERATED LAGOON W/ COVER SYSTEM AND AMMONIA TREATMENT
OPERATION AND MAINTENANCE COST ESTIMATE

Description of Items	Estimated Annual Cost
Power - Blowers	$6,000
Power - UV Disinfection	$500
Operator Labor (8 hours/week @ $60.00/hour)	$24,960
Equipment and Materials	$4,000
Testing ($300/Month for 12 Months)	$3,600
Discharge Permit Fee	$600
Miscellaneous	$2,000
Total	**$41,660**

RAPID CITY REGIONAL AIRPORT (RAP) WASTEWATER SYSTEM
ALTERNATIVE NO. 4 - AIRPORT COLLECTION SYSTEM AND CONNECTION TO RAPID CITY SYSTEM
OPERATION AND MAINTENANCE COST ESTIMATE

Description of Items	Estimated Annual Cost
Power - Lift Station	$1,000
Power - Ferrous Chloride System	$250
Operator Labor (1.5 hours/week @ $60.00/hour)	$4,680
Equipment and Materials	$1,000
Bulk Ferrous Chloride	$500
Miscellaneous	$1,000
Total	**$8,430**