# SITING REPORT

## PROPOSED NEW AIRPORT TRAFFIC CONTROL TOWER at the BLUE GRASS AIRPORT

## LEXINGTON, KENTUCKY

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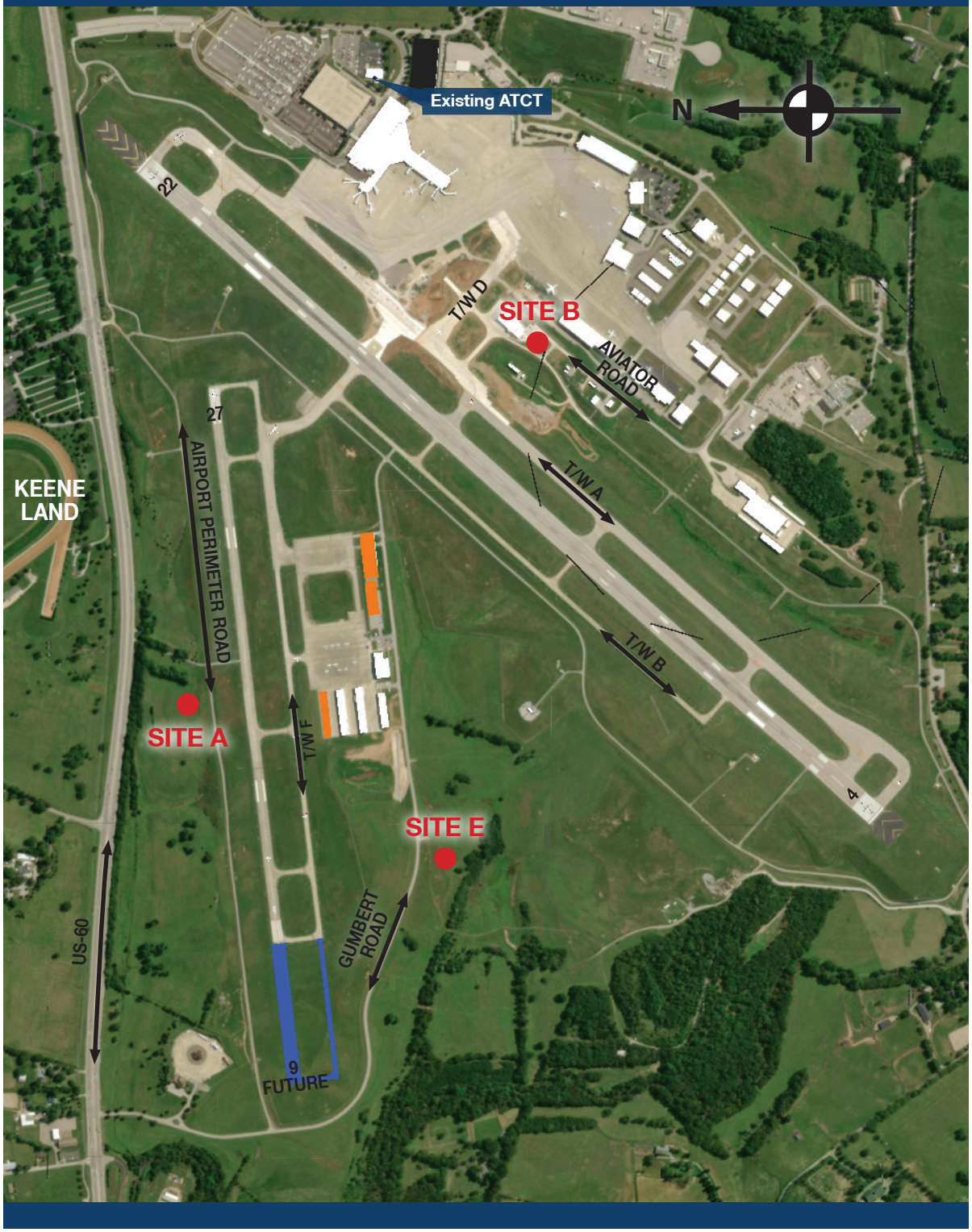
CTBXaviation
in association with CHA and POND


## AIR TRAFFIC CONTROL TOWER (ATCT) FEASIBILITY STUDY (PHASE 1)

September 9, 2022

# LEX AIRFIELD OVERVIEW



# 1. BACKGROUND INFORMATION

## 1.1 PURPOSE OF THIS REPORT

Blue Grass Airport (LEX) is a public airport in Fayette County, Kentucky, United States, 6 miles west of downtown Lexington. LEX is located among world-renowned horse farms and situated directly across from Keeneland Race Course and is the primary airport serving central and eastern Kentucky. Scenic highway US-60 runs along the northwest side of LEX, adjacent to Runway 9-27. The airport has significant demand for additional hangars and businesses with limited options for locations.

Blue Grass Airport has two hard surface runways, an instrument landing system on one runway (4-22), an airport traffic control tower (ATCT), taxiway system, airlines terminal, aircraft aprons and many hangars. The existing ATCT was constructed in 1970 and has a cab floor of 67 feet (AGL). Multiple structures have been erected in the ATCT's line-of-sight (LOS) since that time, including the passenger terminal, two-story parking garage, an aircraft rescue and firefighting

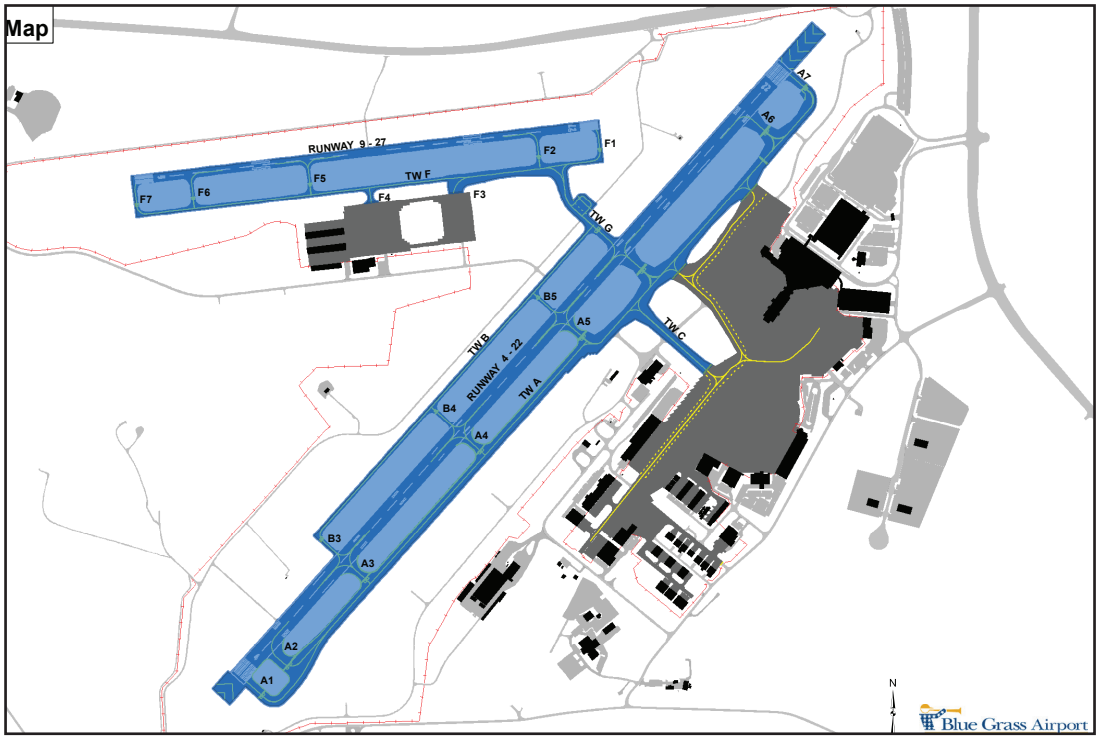



*Figure 1-1: LEX Movement Area*

(ARFF) facility and various hangars. There are also future development plans to expand the terminal area. The Runway 4 threshold has shifted to the southwest, moving the threshold much further from the ATCT. Additionally, Runway 9-27 has been constructed, along with a significant westside general aviation complex.

**LEX Runway Data Table**

| Runway | Existing | Ultimate |
|---|---|---|
| 4-22 | 7003' x 150' | 7003' x 150' |
| 9-27 | 5000' x 100' | 6000' x 100' |

*Note: For the purposes of this Siting Report, the Future runway length applied to the LOS and Eye Height calculations is the Ultimate Length.*

Runway usage for 4-22 averages 70% traffic for Runway End 22 and 30% for Runway End 4. Runway usage for 9-27 averages 60% traffic usage for Runway End 27 and 40% for Runway End 9 according to an interview with the Air Traffic Manager. Runways 22 and 27 generally use a right hand traffic pattern, while Runways 4 and 9 use left hand patterns. Runway 4-22 handles all of the airline operations and some of the larger general aviation jet aircraft. Runway 9-27 serves all other general aviation traffic.

Therefore, the purpose of this report is to identify three (3) viable locations and heights of an ATCT that can virtually satisfy the FAA criteria of a Safety Risk Management Document (SRMD) and could allow hangars to be constructed within the desired area without obstructing the controllers' line-of-sight. This process will generally follow the guidelines set forth in FAA Order 6480.4 C (working draft), Chapter 8, Alternate Siting Process, as well as the objectives of the new FAA VISTA (Virtual Immersion Siting Tower Assessment) Process. However, it will not provide a complete SRMD at this time.

This report will address:

- Impacts to instrument approaches with vertical guidance (Terminal Instrument Procedures – TERPS)
- Impacts to FAR Part 77
- Impacts to communications, navigation, surveillance equipment & rotating beacon
- Visibility Performance
- Operational Requirements
- Rough Order of Magnitude (ROM) construction cost of the ATCT structure and ATC equipment relative to recently constructed projects.

The technical source data for this study includes the Airport Layout Plan (ALP) dated August 2, 2013 ground contour mapping, aerial photography, an interactive 3D computer simulation, the FAA Visibility Tool, current instrument approach plates, site visits, and preliminary control cab design data. The proposed eye height, critical lines-of-sight, and site feasibility were examined through the use of these documents and tools.

## 1.2 SUMMARY OF KICKOFF MEETING/ATTENDEES

A kickoff meeting for the Blue Grass Airport (LEX) ATCT Siting Process took place on June 17, 2022 in the Board Room at LEX.

The list of attendees included:

- Mark J. Day, *Director or Development and Facilities, LEX*
- Paul Puckli, *VP of Market Development - Aviation, CHA Consulting*
- Hadwin Brown, *Air Traffic Manager, LEX*
- Bill Wilson, *FAA Sector Service Center (SSC) Manager*
- David Woods, *Principal, POND*
- Brian Lally, *President, CTBXaviation*
- Mike Lally, *Siting Analyst, CTBXaviation*

Mark Day, Paul Puckli, David Woods, Brian Lally, and Michael Lally met in the airport conference room to discuss criteria and objectives. Mark described planned terminal building improvements and possibly moving the parking garage. The LEX Air Traffic Manager (ATM) and Sector Service Center (SSC) spent about 45 minutes with the study participants describing existing situations and Air Traffic Control (ATC) equipment. After, several potential tower sites were discussed and evaluated for the best potentials. Six (6) sites, A, B, B2, C, D, and E, were decided upon to be looked at in the field. Each of these sites was visited and critiqued. After the site visits were complete, the participants reconvened in the conference room to identify the three (3) sites with the best potential for further study. Sites A, B, and E were selected to be the subjects of this siting report. The participants visited the controllers in the existing tower for data gathering and comments on existing operational issues and acceptable proposed site locations. Sites A, B, and E remained the best options. The controllers did mention certain undesirable operational issues with the existing tower. These were the tower cab elevation could be higher to more effectively see the entire airfield (cab floor 67’ AGL); the approach end of Runway 4 is a long way off, depth perception to small aircraft in particular could be better; looking west to the approach end of Runway 9 is sometimes difficult at sunset. Reference Appendix D for more detailed notes.

# 2. SITING CRITERIA

## 2.1 THE ATCT SITING PROCESS

The initial evaluation of LEX for the siting of an ATCT took into consideration the entire airfield for the study. That exercise resulted in six (6) initial candidate sites based upon factors having the highest potential for the successful siting and construction of an ATCT *(Figure 3-1)*. Through the process of elimination for the most desirable locations, three (3) sites were selected for final consideration.

The following is a summary of considerations used in this siting analysis:

- ***Analyze Airport Planning Standards*** **-** Identify building restriction lines, object free zones, runway visibility zone, aircraft parking aprons, buildings, aircraft movement areas, location of utilities, airfield lighting vault extensions, rotating beacon, and off airport development.

- ***Terminal Instrument Procedures (TERPS) Analysis*** **-** Evaluate ATCTs at each respective site for possible impacts to the approaches, circling minimums and missed approach segments (Appendix A).

- ***FAR Part 77 Surfaces*** **-** Each proposed site and structure was evaluated relative to its potential penetration of the Airport's Part 77 imaginary surfaces (Appendix A).

- ***Impacts to Communications, Navigation and Surveillance*** **-** A detailed preliminary assessment of the possibility of these impacts is presented in Appendix A. A summary of the conclusions follows here.

  Line-of-Sight and blockage issues for the on-field communications (RTR) and surveillance (ASR) facilities are expected to be minimal, since each of the three candidate sites is outside recommended 'keep clear' distances.

  Math modeling of the Instrument Landing System (ILS) reflection effects of a new ATCT at each candidate location has been completed. The predicted error levels for the Localizers at each end of Runway 4-22 are essentially negligible for sites A and E, while error levels for Site B are 28-35% for the new ATCT by itself, and up to 41% with reflections from the existing ATCT

(during construction)added. Measured Localizer error levels for the existing ATCT and other airport conditions are not available. However, these could be allowed up to 70-75% of allowed standards without the total for the existing conditions plus a new Site B ATCT exceeding 80% of allowed standards.

- ***Impact from Rotating Beacon*** **-** The existing airport rotating beacon is next to the existing tower and may be relocated as recommended in the master plan update. The standard beam angle of the beacon is between 2 and 3 degrees upward from the horizontal and should not shine into the control cab which would deter airport traffic control. The beacon should be located in order to avoid that possibility or have an approved shield installed on the side facing towards the ATCT.

- ***Visibility Performance Analysis*** **-** A minimum vertical LOS and angular intersection of 48-minutes (0.80 degrees) is used to determine controller eye height. The farthest distant points (Key Point) on the airfield as measured from the control cab typically represent a "worst case" situation for the purpose of ATCT siting and viewing perspective. However, when there is a significant difference in the elevations of runway ends with respect to an ATCT ground elevation, the furthest distance may not control the required eye. The gradient of the surfaces of taxiways and runways along the LOS is also considered in the cab eye height calculation. Two human factors performance metrics, Object Discrimination Analysis and LOS Angle of Incidence, are applied to assess the impact of the proposed ATCT height on the Air Traffic Control Specialist (ATCS) distance perception. The FAA ATCT Visibility Analysis Tool (ATCTVAT) was used to assess the human factors performance metrics. The three (3) shortlisted candidate sites both passed the Visibility Performance Analysis. ATCTVAT results are presented in Appendix C.

- ***Operational Requirements*** **-** The site plot must provide sufficient area to accommodate the tower shaft and base building, emergency generator, exterior hardware, personnel parking, and any planned future improvements as prescribed by facility requirements.

  Maximum visibility of airborne traffic patterns and airfield movement surfaces must be available to all ATCS's positions. A clear, unobstructed and direct view of all active runways, taxiways and landing areas must be available. The airport traffic pattern and inbound traffic direction are also a visibility consideration.

- ***Rough Order of Magnitude (ROM) Cost Estimate*** - Opinion of Construction Cost (not based on any design at this time) is provided for site comparison purposes and are not recommended for setting construction budgets. It generally represents FY 2020 construction costs related to the ATCT building, Minimum Equipment List (MEL) electronics, and site work within 100 feet of structure. ROM construction-only costs are TBD on the Site Comparison Chart. SRMD, environmental assessment (EA), design, and other professional fees may be an additional 25% of the construction costs. FAA will require a Reimbursable Agreement for NAS Telecommunications, FDIO, STARS and NAVAIDs equipment and can range up to $800k.

## 2.2 INTERACTIVE 3D COMPUTER SIMULATION

CTBXaviation provided a 3D Interactive Computer Simulation of the airport and inner approaches that allowed real time analysis of various ATCT height and location scenarios from a controller's eyes to the airfield movement and non-movement areas. Simulation screenshots from the three (3) candidate sites are presented in Appendix B.

# 3. INITIAL SITES CONSIDERED

## 3.1 CANDIDATE SITES

The six (6) potential sites identified in Figure 3-1 were originally considered for the kickoff meeting held in June 2022.

The siting considerations listed in paragraph 2.1 were uniformly factored when evaluating the candidate sites. Candidate Sites are labeled A, B, B2, C, D and E. The observations made of these sites are summarized here.

The Airport Traffic Control Tower siting analysis was carried out to identify new potential ATCT sites at Blue Grass Airport (LEX) that are capable of supporting a new control tower.

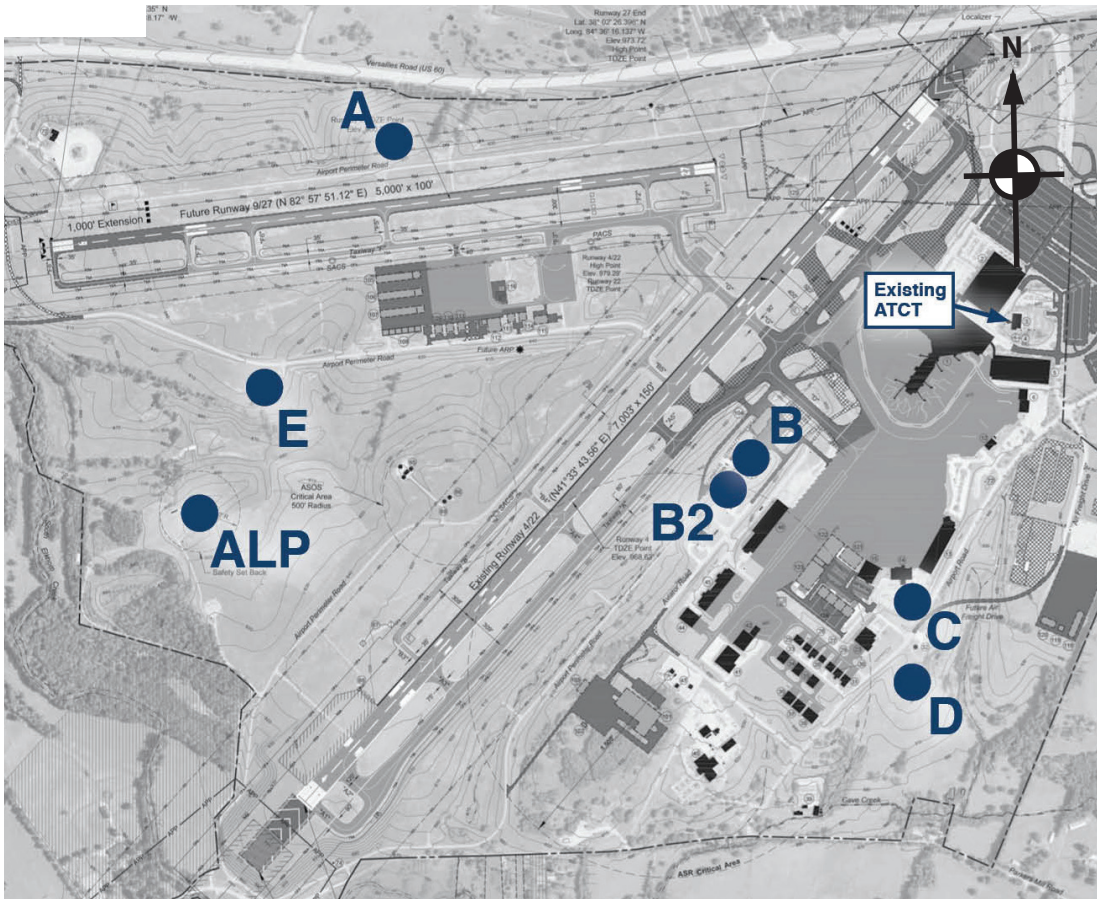



*Figure 3-1: Sites originally considered for Siting Report*

Six (6) sites were identified for evaluation based on available space, access, unencumbered line-of-sight, clean view of all critical operations areas, access to utilities and infrastructure, compatibility with the latest Airport Layout Plan (ALP), and cost.

**A - Northwest:** Located in an undeveloped treed area on the northwest side of the airport, Site A sits 200 feet west of the adjacent Airport Perimeter Road. Site A is 500 feet from Runway 9-27 centerline and sits 100 feet outside the Runway OFA. The eye height is 82 feet AGL. It is 3300 feet from the airfield lighting vault. Ground elevation is 945 feet MSL. This site has the potential to be considered further.

**B - ARFF Area:** Located on the east side of the airport inside of the Airport Operational Area (AOA) and 2250 feet southwest of the existing ATCT, this site is located at the south end of the existing Airport Rescue and Firefighting (ARFF) Building. Site B is 740 feet from Runway 4-22 centerline and 325 feet outside of the Runway OFA. The minimum eye height is 86 feet AGL, but a proposed eye height of 155 feet AGL is needed in order to have clear LOS over all existing and future hangars. It is 70 feet from the airfield lighting vault. Ground elevation is 935 feet MSL. This site has the potential to be considered further.

**B2 - ARFF Area South:** Located 125 feet south of Site B, Site B2 sits just inside the ASR Critical Area. This site is adjacent to the ARFF as well, but on the site of a fuel farm to be abandoned. Site B2 is 770 feet from Runway 4-22 centerline. Like Site B, the minimum eye height is 86 feet AGL, but a proposed eye height of 155 feet AGL is needed in order to have clear LOS over all existing and future hangars. It is 100 feet from the airfield lighting vault. Ground elevation is 935 feet MSL.

**C - FBO Parking Lot:** Located 2250 feet south of the existing ATCT and adjacent to the FBO Terminal, Site C is 2400 feet from Runway 4-22 centerline and 2000 feet outside the Runway OFA. The minimum eye height is 71 feet AGL. It is 1700 feet from the airfield lighting vault. Ground elevation is 970 feet MSL.

**D - LLWAS Area:** Located in an undeveloped area on the southeast side of the airport, Site D sits 200 feet south of the Wind Shear Tower. Site D is 2750 feet from Runway 4-22 centerline and 2300 feet outside the Runway OFA. The minimum eye height is 95 feet AGL. It is 2100 feet from the airfield lighting vault. Ground elevation is 940 feet MSL.

**E - Revised ALP Site:** Located on undeveloped land near the WestLEX area of the airport, Site E is an alternate for the site which is currently shown on the ALP. This site is 1100 feet southwest of the ALP site and was used as an alternate because it is closer to Runway End 22 and sits 10 feet higher, therefore a shorter tower height is needed. Site E is located adjacent to Airport Perimeter Road and existing utilities versus the ALP site being remote to access and utilities. This site is 2250 feet from Runway 4-22 centerline and 1140 feet from Runway 9-27 centerline. It is 725 feet outside the Runway OFA. The minimum eye height is 129 feet AGL, which has no obstructions to LOS from existing or known future buildings on the ALP. It is 3425 feet from the airfield lighting vault. Ground elevation is 920 feet MSL. Site E has the potential to be considered further.

## 3.2 SITES ELIMINATED

Sites B2, C, and D were eliminated from further study for the following reasons:

Site B2 was eliminated due to it being inside the ASR Critical Area. Site B was created as a more suitable location, while remaining in the same area adjacent to the ARFF.

Site C was eliminated due to being too close to the FBO Building and construction would be difficult. It is also considered much too far from Runway End 9 and LOS would be obstructed due to multiple buildings, including WestLEX.

Site D was eliminated for the same reasons as Site C. Site D is too far from Runway End 9 and LOS would be obstructed due to multiple buildings, including WestLEX.

**Summary of Candidate Sites**

| Site No. | Proposed Controller Eye Height (AGL) | Ground Elevation (MSL) | Distance to Keypoint | Key Point / Elevation (MSL) | ATCTVAT Pass/Fail Detection |
|---|---|---|---|---|---|
| A | 82’ | 945’ | 3822’ | 22 / 973’ | P |
| B | 155’ | 935’ | 5472’ | 9F / 944’ | P |
| E | 129’ | 920’ | 5384’ | 22 / 973’ | P |

*Note: For the purposes of this Siting Report, the Future runway length applied to the LOS and Eye Height calculations is the Ultimate Length.*

# 4. PREFERRED SITES

The remaining sites for further consideration, Sites A, B and E were fully evaluated. Refer to Figure 3-1 on Page 12 for their airfield locations.

## 4.1 SITE A

### 4.1.1 Description

Site A is located on the northwest side of the airport in an undeveloped treed area. The site sits 200 feet west of the adjacent Airport Perimeter Road and 2650 feet north of the ASOS. The setback to Runway 9-27 exceeds the minimum required 400 foot Object Free Area as noted on the ALP for Blue Grass Airport. This site is set 500 feet offset to the Runway 9-27 (visual approach runway) centerline. Site A is 3300 feet from the airfield lighting vault.


*Figure 4-1: Site A Location*

The existing ground is flat at an elevation of 945 feet MSL. The site is at the top of a hill that is approximately 15 feet below the airfield elevation. The ATCT cab was evaluated at an eye level of 1027 feet MSL (82 feet AGL). The overall height estimated to the tops of the antennas and lightning rods is estimated for airspace determinations (35' above cab floor) at 1057 feet MSL (112 feet AGL).

The distance to the furthest point on the airfield is 3822 feet to the end of Runway 22. The ATCS will mostly have southeasterly views of the airfield. Lines of sight to all runways, taxiways and terminal area apron will be unobstructed from this site and height. Site A has no impact on existing helicopter patterns.

Site A is adjacent to scenic corridor US-60 and in direct LOS of the grandstand at Keeneland Racecourse. An aesthetic design theme and planting of a screening tree line may alleviate possible concerns from Keeneland. Site A is also 2400 feet east of the airport's ARFF Training Center that produces occasional light smoke.

### 4.1.2 Site Reference Data

(Lat. 38° 2' 28.00"N; Long. 84° 36' 44.00"W; Eye 82' AGL)

### 4.1.3 Siting Criteria

4.1.3.1 Criteria 1 – Visual Performance

The LOS Angle of Incidence was measured from the proposed eye height of 82 feet AGL (1057 feet MSL) relative to the ground elevation (945 feet MSL) at Site A, which is also the minimum eye height for this location and elevation. The LOS to the furthest movement area of the airport from Site A is to the end of Runway 22 and will be visible from this height. The distance to Runway End 22 is 3822 feet from Site A. A proposed eye height of 82 feet AGL satisfies the FAA Angle of Incidence criteria and, as evidenced by the computer simulation, is high enough to see over any existing and future obstacles.

The 82 feet AGL eye height also provides room for functional spaces in the building below the cab. This height was entered into the FAA Visibility Tool which received a Passing result (see Appendix C).

The FAA uses the average distance from the cab floor to the ATCS eye as 5 feet. When the 5 feet is subtracted from the eye height at Site A, a cab floor height of 82 feet AGL (1057 feet MSL) is the result.

**Object Discrimination Analysis** is the metric that determines how well an object the size of a Dodge Caravan or a Cessna 152 can be identified from the proposed site and height. Site A at the 1057 foot MSL eye height produced Passing results (see Appendix C).

4.1.3.2 Criteria 2 – TERPS

An evaluation of the United States Standard for Terminal Instrument Procedures (TERPS) should be conducted at a later date by the FAA Eastern Service Area Flight Procedures Office (FPO). The preliminary advance analysis conducted for this report (Appendix A) found that there is no adverse impact to any of the instrument approach procedures.

4.1.3.3 Criteria 3 – Part 77

The ATCT at Site A will be approximately 500 feet from the centerline of visual approach Runway 9-27 and will penetrate the existing 7:1 surface of this runway by 62 feet (Appendix A). An ATCT is typically lighted with red FAA L-810 obstruction lighting in accordance with FAA Advisory Circular (AC) 70/7460-1K to allow such a penetration (see Appendix A).

4.1.3.4 Communications, Navigations and Surveillance

ATC or NAVAIDS signals can be affected by the construction of tall structures on airports. Signals can sometimes be affected by significant undulations in the airfield terrain. A NASWATCH determination should be conducted by FAA for each ATCT site proposed.

The Localizers and Glide Slope Antennas, RTR, and ASR are considered a safe distance from Site A. The predicted error levels for Localizers LEX and GNJ are essentially negligible for Site A. Preliminary findings are documented in Appendix A.

## 4.1.4 Other Factors

4.1.4.1 Panoramic Screen Shots of Computer Simulation

Digital still image files were taken during the computer siting simulation. They depict a sequential panoramic, 360 degree view from inside the

control cab at Site A at the 1057 foot MSL (82 foot AGL) eye height. It should be noted that the existing and future development areas are depicted in the simulation. The panoramic computer screen shots are presented in Appendix B.

4.1.4.2 Rotating Beacon and Weather Sensor

An FAA staffed ATCT typically does not locate a rotating beacon on top of a control tower. The rotating beacon is now located within 150 feet of the existing tower. It is about 4650 feet from Site A at an estimated height of 1060' MSL. Its beam, at a minimum upward angle of 2 degrees, would cross Site A at an elevation 265' above the proposed eye height indicating that it would not shine directly into the controllers' eyes. However, the site of the rotating beacon may be relocated as recommended in the on-going airport master plan update.

Automated Surface Observation System (ASOS) location criteria maintains that the sensors should be clear of all structures over 20 feet tall within 500 feet. Located on LEX, in the vicinity of the RTR and 2650 feet northeast of Site A, the ASOS is owned and maintained by the National Weather Service. There will be no weather sensor impacts from an ATCT at Site A.

4.1.4.3 Airfield Lighting and Landing Aids Monitoring: Site A is 3300 feet from the airfield lighting vault which is within the capabilities of remote control via UHF modem from the ATCT to the vault. The ASOS and LLWAS are both monitored from the existing tower via over-the-air UHF modems. These signals may be redirected to the new ATCT site. The ASR, RTR, and Airfield Lighting Control System (ALCS) are currently connected to the existing tower via fiberoptic cables which will need to be reconnected unless FAA chooses an over the air alternative.

### 4.1.5 Summary for Site A

Site A was evaluated at an ATCS eye height of 1057 feet MSL (82 feet AGL). The site is at the top of a hill that is approximately 15 below the airfield elevation. This site is considered to be suitable with no obstructed views to all existing and future runways, taxiways, WestLEX area and existing terminal area apron.

Site A is located in an undeveloped treed area on the northwest side of the airport and sits 200 feet west of the adjacent Airport Perimeter Road. It is 2460 feet northwest of the terminal building and it is set 500 feet offset to the Runway 9-27 centerline. The OFA of Runway 9-27 is 400 feet from the runway centerline. Since Site A is outside the AOA in a relatively public area, a six (6) foot high chain link fence with a motorized gate and access control is required around the site building and parking lot to satisfy some FAA security requirements.

This site has clear views of the airfield with the furthest point being 3822 feet to the end of Runway 22. Views of the airfield will be mostly to the southeast. Site A is also 2400 feet east of the airport's ARFF Training Center that produces occasional light smoke that won't cause a LOS issue for controllers. Site A is also adjacent to scenic corridor US-60 and in direct LOS of the grandstand at Keeneland Race Course. Mitigation of visual impacts should be applied.

There are no known adverse impacts to TERPS, FAR Part 77, Communications, Navigation, or Surveillance facilities to be caused by Site A.

**Site A Pros and Cons**

| | |
|---|---|
| **PROS** | - Good Access<br>- Shortest Tower / Lowest Cost<br>- Views of primary operation areas good<br>- Available land for TRACON and parking, etc. is good |
| **CONS** | - Impact to Keenland Racetrack<br>- US Route 60 is a "Scenic Corridor"<br>- Sunrise glare – can be mitigated<br>- Distance to end of Runway 4 is approx. 5,000' |

**Other Notes:**

- The impact to Keenland is described as the view from the grandstand.
  - It was noted that the TVV camera locations are in shelters that are painted black
  - Pond offered to add panoramic photos from a couple of location in the grandstands

## 4.2 SITE B

### 4.2.1 Description

Site B is located on the east side of the airport inside of the Airport Operational Area (AOA) and 2250 feet southwest of the existing ATCT. This site is located at the south end of the existing Airport Rescue and Firefighting (ARFF) Building. The setback to Runway 4-22 exceeds the minimum required 400 foot Object Free Area as noted on the ALP for LEX. Site B is 740 feet from Runway 4-22 (primary/precision instrument runway) centerline and 340 feet from Taxiway A centerline. It is 70 feet from the airfield lighting vault and just outside of the ASR Critical Area at 1530 feet, center to center.

The existing ground is flat at an elevation of 935 feet MSL. The ATCT cab was evaluated at a minimum eye height of 86 feet AGL. At this height, Taxiway F was obstructed by hangars located in the WestLEX area *(Buildings 112 & 105 on the ALP)*. In order for ATCS to have a clear LOS over that obstruction, an eye level of 1090 feet MSL (155 feet AGL) is necessary. The overall height estimated to the tops of the antennas and lightning rods is estimated for airspace determinations (35' above cab floor) at 1120 feet MSL (185 feet AGL).


*Figure 4-2: Site B Location*

The distance to the furthest point on the airfield is 5472 feet to the future end of Runway 9 (1000 ft. extension). The ATCS will mostly have northwesterly views of the airfield. Lines of sight to all runways, taxiways and terminal area apron will be unobstructed from this site and height. Like the existing ATCT, Site B is on the east side of the airport, so controllers will use the same situational awareness that is currently in practice.

### 4.2.2 Site Reference Data

(Lat. 38° 2'3.48"N; Long. 84° 36'13.04"W; Eye 155' AGL)

### 4.2.3 Siting Criteria

4.2.3.1 Criteria 1 – Visual Performance

The minimum ATCTVAT eye height for Site B is 86 feet AGL (1021 feet MSL). At this height existing WestLEX hangars obstruct the LOS of Taxiway F and a portion of Runway 9-27 *(Figure 4-3a)*.

In order to alleviate the hangar obstructions to the line-of-sight for Site B, the Angle of Incidence was measured from the proposed eye height of 155 feet AGL (1090 feet MSL) relative to the ground elevation (935 feet MSL). The LOS to the furthest movement area of the airport from Site B is to the end of Runway 9 and will be visible from this height *(Figure 4-4b)*. The distance to Runway End 9 is 5472 feet from Site B. A proposed eye height of 155 feet AGL satisfies the FAA Angle of Incidence criteria and, as evidenced by the computer simulation, is high enough to see over the proposed large bulk hangar and museum. However, the ALP also shows a future T-Hangar to be constructed closely adjacent to Taxiway A. This development will likely increase the eye height to 175' AGL in order to clearly see a Cessna 172 traversing Taxiway A or otherwise the LOS will be almost totally blocked by the T-hangar (see Figure 4-3a and 4-3b). The decision as to whether or not this is a hazard should be left up to an FAA Safety Management Specialist. In some cases, seeing any portion of an aircraft is acceptable.

Both 155' and 175' agl eye heights will provide room for functional spaces in the building below the cab. These heights were entered into the FAA Visibility Tool which received a Passing result (see Appendix C).

***NOTE: White structures are existing & Colored structures are proposed hangars***

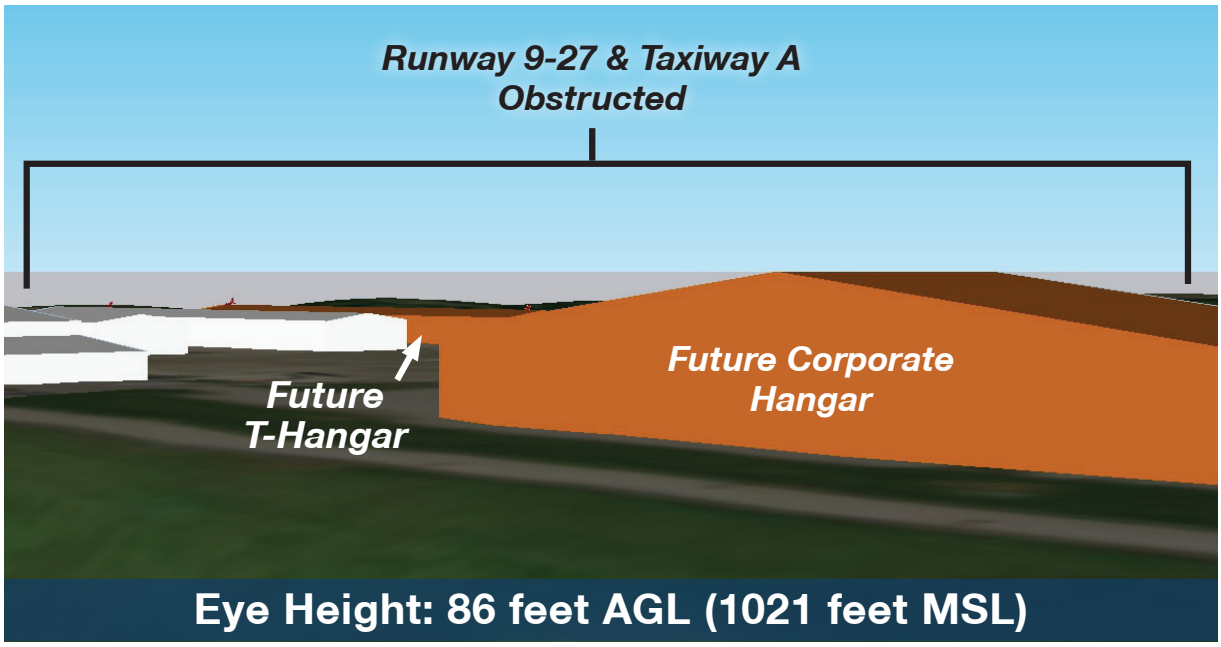



*Figure 4-3a: Site B LOS Obstruction*

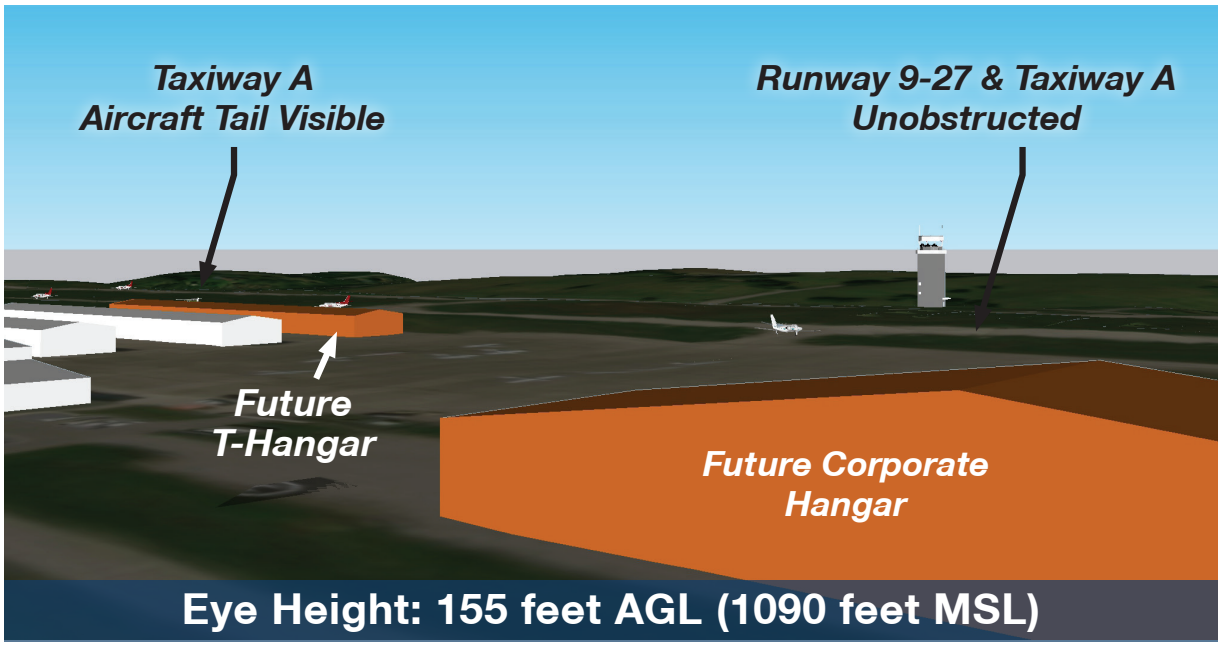



*Figure 4-3b: Site B LOS partial obstruction to Taxiway A small aircraft*

***NOTE: White structures are existing & Colored structures are proposed hangars***

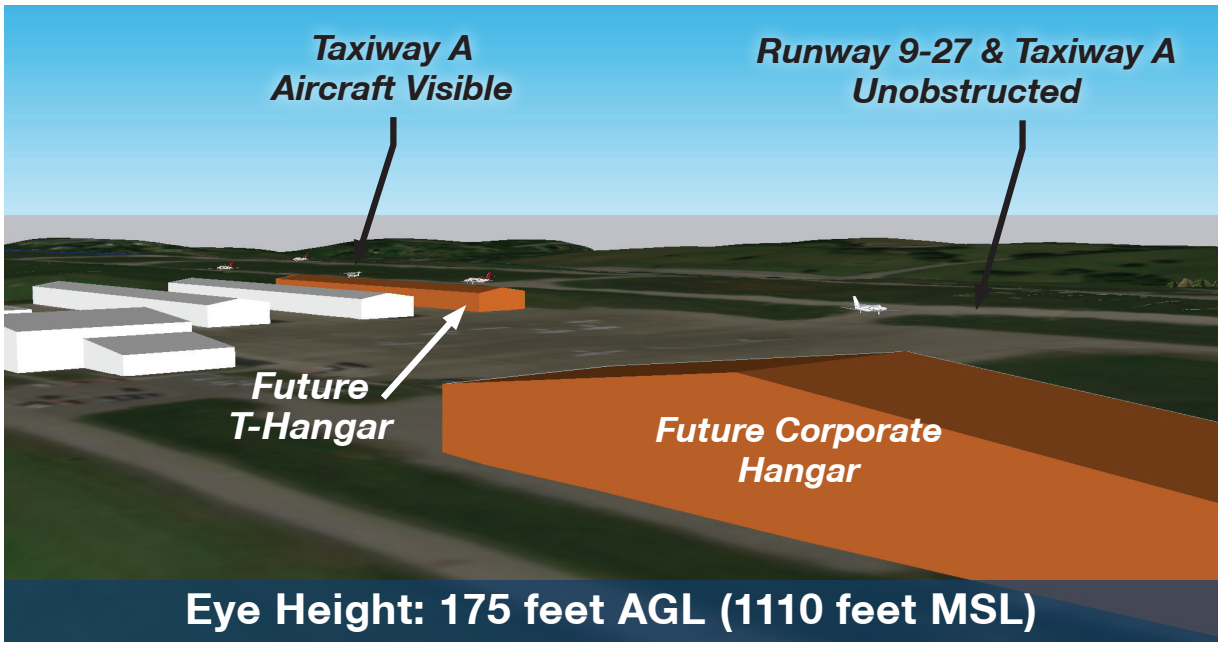



*Figure 4-3c: Site B LOS No Obstructions*

The FAA uses the average distance from the cab floor to the ATCS eye as 5 feet. When the 5 feet is subtracted from the eye height at Site B, a cab floor height of 150 feet AGL (1085 feet MSL) and an optional 170 feet AGL (1105 feet MSL) are the results.

**Object Discrimination Analysis** is the metric that determines how well an object the size of a Dodge Caravan or a Cessna 152 can be identified from the proposed site and height. Site B at the 1090 foot MSL eye height produced Passing results (see Appendix C).

4.2.3.2 Criteria 2 – TERPS

An evaluation of the United States Standard for Terminal Instrument Procedures (TERPS) should be conducted at a later date by the FAA Eastern Service Area Flight Procedures Office (FPO). The preliminary advance analysis conducted for this report (Appendix A) found that at an eye height of 155; agl with an estimated air terminal height of 1120', Site B becomes the new controlling obstacle for Cat A circling. It does not raise minimums but it is exactly at minimums. It cannot end up at 1121' after survey without raising circling minimums 20 feet. That would seem to create at least a 20' increase in minimums for that procedure if the eye height is determined to be 175' agl with an estimated air terminal height of 1140'.

4.2.3.3 Criteria 3 – Part 77

The ATCT at Site B will be approximately 500 feet from the centerline of precision instrument Runway 4-22 and, based on a 155' agl eye height, will penetrate the existing 7:1 surface of this runway by 118 feet (Appendix A). An ATCT is typically lighted with red FAA L-810 obstruction lighting in accordance with FAA Advisory Circular (AC) 70/7460-1K to allow such a penetration (see Appendix A).

4.2.3.4 Communications, Navigations and Surveillance

ATC or NAVAIDS signals can be affected by the construction of tall structures on airports. Signals can sometimes be affected by significant undulations in the airfield terrain. A NASWATCH determination should be conducted by FAA for each ATCT site proposed.

Site B can exist with respect to the Runway 4-22 localizers but in the final analysis will require some caution on orientation of the ATCT shaft. Some other preliminary observations include:

1. The site is close to the 1500' critical area circle for the ASR which in this case should not be a problem but may raise questions with the FAA.

2. The site is about 15 degrees off the north-end (LEX) localizer course line, and only about 7-8 degrees off the south-end (GNJ) localizer. These are both only 8-element arrays, so they likely have moderately to low performance against multipath. The predicted error levels for Site B are 45-55% for the new ATCT by itself, and up to about 60% with reflections from the existing ATCT added. That is relative to a threshold equal to 80% of allowed standards

3. Finally, the VOR approach is at right angles to the runway, so we can't introduce significant reflections toward the VOR, but want to keep LOC reflections over the runway. It may be difficult to meet this requirement, depending on how well these two localizers perform now (cumulative effects TBD).

In summary, Site B may be the least desirable with respect to facilities effects. However, the ILS effects from a Site B ATCT can likely be tolerated since their magnitude is roughly 44% (at the 155' eye ht) and up to 63% (at the 175' eye ht.) of acceptable tolerances (without considering existing flight inspection conditions). This site is also closer to the ASR, which may attract more FAA attention than Sites A or E but it is not expected to be a problem. Impacts were evaluated at the proposed 155' and optional 175' agl eye heights. More specific details about impacts may be found in Appendix A.

## 4.2.4 Other Factors

4.2.4.1 Panoramic Screen Shots of Computer Simulation
Digital still image files were taken during the computer siting simulation. They depict a sequential panoramic, 360 degree view from inside the control cab at Site B at the1021 foot MSL (86 foot AGL) minimum eye height and at the 1090 foot MSL (155 foot AGL) proposed eye height. It should be noted that the existing and future development areas are depicted in the simulation. The panoramic computer screen shots are presented in Appendix B.

4.2.4.2 Rotating Beacon and Weather Sensor
An FAA staffed ATCT typically does not locate a rotating beacon on top of a control tower. The rotating beacon is now located within 150 feet of the existing tower. It is about 2030 feet from Site B at an estimated height of 1060' MSL. Its beam, at a minimum upward angle of 2 degrees, would cross Site B at an elevation 110' above the proposed 155' eye height indicating that it would not shine directly into the controllers' eyes. However, the site of the rotating beacon may be relocated as recommended in the on-going airport master plan update.

Automated Surface Observation System (ASOS) location criteria maintains that the sensors should be clear of all structures over 20 feet tall within 500 feet. Located on LEX, in the vicinity of the RTR and 2125 feet west of Site B, the ASOS is owned and maintained by the National Weather Service. There will be no weather sensor impacts from an ATCT at Site B.

4.2.4.3 Airfield Lighting and Landing Aids Monitoring: Site B is 70 feet from the airfield lighting vault which is within the capabilities of remote control via UHF modem from the ATCT to the vault. The ASOS and LLWAS are both monitored from the existing tower via over-the-air UHF modems. These signals may be redirected to the new ATCT site. The ASR, RTR, and Airfield Lighting Control System (ALCS) are currently connected to the existing tower via fiberoptic cables which will need to be reconnected unless FAA chooses an over the air alternative.

### 4.2.5 Summary for Site B

Site B was evaluated at an ATCS eye height of 1090 feet MSL (155 feet AGL). This site is considered to be suitable with no obstructed views to all existing and future runways, taxiways, future north side aircraft apron and existing terminal area apron. An optional eye height of 175' agl was also considered due to only having a LOS to a very minor portion (the tail) of a Cessna 172 showing above a proposed T-Hangar in the WestLEX area. This situation is noted in the event that, upon further risk management evaluation by an FAA siting team, it is determined to require a better view of small aircraft. Site B allows for the proper scan of the runway with concurrent helicopter operations.

Site B is located on the east side of the airport, 2250 feet northwest of the existing ATCT and inside of the Airport Operational Area (AOA). Therefore, Site B will not require any perimeter fencing or gate. This site is located at the south end of the existing Airport Rescue and Firefighting (ARFF) Building. Site B is 740 feet from Runway 4-22 centerline and 325 feet outside of the Runway OFA.

At the proposed eye height of 155 feet AGL, this site has clear views of the airfield *(Figure 4-5)* with the furthest point being 5472 feet to the future end of Runway 9. Views of the airfield will be mostly to the northwest. Like the existing ATCT, Site B is on the east side of the airport, so controllers will use the same situational awareness that is currently in practice.

There are no known adverse impacts to TERPS, FAR Part 77, Communications, Navigation, or Surveillance facilities to be caused by Site B. However, cumulative effects to either of the Runway 4-22 Localizers from a proposed Site B ATCT plus existing error levels (if/when known) must be evaluated.

**Site B Pros and Cons**

| | |
|---|---|
| **PROS** | - Centrally located<br>- Best Views looking northwest to primary operations<br>- Good access and utilities<br>- Located inside the Airport AOA<br>- Best view of Terminal Ramp areas (there is no Ramp Control) |
| **CONS** | - Close to ARFF Parking Lot<br>- Tallest Tower / Highest cost<br>- Visual impact for existing Tower during construction<br>- L-Nav for Runway 27 Approach may increase by 20'<br>- Distance to end of Runway 9 is in excess of 5,000'<br>- Has some impacts to localizer performance but lower than tolerable limits. |

**Other Notes:**

- Low ground elevation = tallest Tower
- Security concerned over parking lot size
  - FAA typically looks at max. shift size x 2, plus visitor spaces, plus Disability spaces
- Existing Fuel Farm impact
  - Tanks are in planning for relocation to the north
- FAA and Airport asked about the impact of a possible new T-Hangar Building
  - Reviewed placement
  - May impact Tower height and result in an increase of 20' of height to the circling pattern

## 4.3 SITE E

### 4.3.1 Description

Site E is centrally located between Runway 9-27 and Runway 4-22. It sits on undeveloped land near the WestLEX area of the airport and is 4250 feet east of the existing ATCT. The setback to Runway 4-22 exceeds the minimum required 400 foot Object Free Area as noted on the ALP for LEX. Site B is 2250 feet from Runway 4-22 (primary/precision instrument runway) centerline and 1140 feet from Runway 9-27 centerline. It is 3425 feet from the airfield lighting vault and 1575 feet northeast of the ASOS.

The existing ground is flat at an elevation of 920 feet MSL. The site is at the bottom of a hill that is approximately 30 feet below the airfield elevation. The ATCT cab was evaluated at an eye level of 1049 feet MSL (129 feet AGL). The overall height estimated to the tops of the antennas and lightning rods is estimated for airspace determinations (35' above cab floor) at 1079 feet MSL (159 feet AGL).


*Figure 4-4: Site E Location*

The distance to the furthest point on the airfield is 5384 feet to the end of Runway 22. The ATCS will mostly have northerly views of the airfield. Lines of sight to all runways, taxiways and terminal area apron will be unobstructed from this site and height. Site E has no impact on existing helicopter patterns.

Site E was used as an alternative to the site on the ALP. This site is much closer to existing access and utilities and will have somewhat better views of the airfield.

### 4.3.2 Site Reference Data

(Lat. 38° 2' 10.00" N; Long. 84° 36' 58.00" W; Eye 129' AGL)

### 4.3.3 Siting Criteria

4.3.3.1 Criteria 1 – Visual Performance

The LOS Angle of Incidence was measured from the proposed eye height of 129 feet AGL (1049 feet MSL) relative to the ground elevation (920 feet MSL) at Site E, which is also the minimum eye height for this location and elevation. The LOS to the furthest movement area of the airport from Site E is to the end of Runway 22 and will be visible from this height. The distance to Runway End 22 is 5384 feet from Site E. A proposed eye height of 129 feet AGL satisfies the FAA Angle of Incidence criteria and, as evidenced by the computer simulation, is high enough to see over any existing and future obstacles.

The 129 feet AGL eye height also provides room for functional spaces in the building below the cab. This height was entered into the FAA Visibility Tool which received a Passing result (see Appendix C).

The FAA uses the average distance from the cab floor to the ATCS eye as 5 feet. When the 5 feet is subtracted from the eye height at Site E, a cab floor height of 129 feet AGL (1049 feet MSL) is the result.

**Object Discrimination Analysis** is the metric that determines how well an object the size of a Dodge Caravan or a Cessna 152 can be identified from the proposed site and height. Site E at the 1049 foot MSL eye height produced Passing results (see Appendix C).

4.3.3.2 Criteria 2 – TERPS

An evaluation of the United States Standard for Terminal Instrument Procedures (TERPS) should be conducted at a later date by the FAA Eastern Service Area Flight Procedures Office (FPO). The preliminary advance analysis conducted for this report (Appendix A) found that there is no adverse impact to any of the instrument approach procedures.

4.3.3.3 Criteria 3 – Part 77

The ATCT at Site E will be approximately 1140 feet from the centerline of visual approach Runway 9-27 and will be under the existing 7:1 surface of this runway by 3 feet (Appendix A). An ATCT is considered fundamental airport development and is typically lighted with red FAA L-810 obstruction lighting in accordance with FAA Advisory Circular (AC) 70/7460-1K to allow such a penetration (see Appendix A).

4.2.3.4 Communications, Navigations and Surveillance

ATC or NAVAIDS signals can be affected by the construction of tall structures on airports. Signals can sometimes be affected by significant undulations in the airfield terrain. A NASWATCH determination should be conducted by FAA for each ATCT site proposed.

The Localizers and Glide Slope Antennas, RTR, and ASR are considered a safe distance from Site E. The predicted error levels for Localizers LEX and GNJ are essentially negligible for Site E. Preliminary findings are documented in Appendix A.

## 4.3.4 Other Factors

4.3.4.1 Panoramic Screen Shots of Computer Simulation

Digital still image files were taken during the computer siting simulation. They depict a sequential panoramic, 360 degree view from inside the control cab at Site E at the 1049 foot MSL (129 foot AGL) eye height. It should be noted that the existing and future development areas are depicted in the simulation. The panoramic computer screen shots are presented in Appendix B.

4.3.4.2 Rotating Beacon and Weather Sensor

An FAA staffed ATCT typically does not locate a rotating beacon on top of a control tower. The rotating beacon is now located within 150 feet of the existing tower. It is about 5575 feet from Site E at an estimated height of 1060'

MSL. Its beam, at a minimum upward angle of 2 degrees, would cross Site E at an elevation 276' above the proposed eye height indicating that it would not shine directly into the controllers' eyes. However, the site of the rotating beacon may be relocated as recommended in the on-going airport master plan update.

Automated Surface Observation System (ASOS) location criteria maintains that the sensors should be clear of all structures over 20 feet tall within 500 feet. Located on LEX, in the vicinity of the RTR and 1575 feet northeast of Site E, the ASOS is owned and maintained by the National Weather Service. There will be no weather sensor impacts from an ATCT at Site E.

4.3.4.3 Airfield Lighting and Landing Aids Monitoring: Site E is 3425 feet from the airfield lighting vault which is within the capabilities of remote control via UHF modem from the ATCT to the vault. The ASOS and LLWAS are both monitored from the existing tower via over-the-air UHF modems. These signals may be redirected to the new ATCT site. The ASR, RTR, and Airfield Lighting Control System (ALCS) are currently connected to the existing tower via fiberoptic cables which will need to be reconnected unless FAA chooses an over the air alternative.

4.3.4.4 ATC Operational Considerations: Site E could be a challenge to controllers in certain instances. While views of the airfield movement areas and approaches to Runways 22 and 27 are ideal, there could be a concern during approaches from the opposite direction. For example, when landing large aircraft using the ILS on Runway 4 while simultaneously running a VFR traffic pattern to Runway 9, assuming the local controller would typically sit facing towards the approach ends of Runway 22 and 27, would make the controller have to look behind a lot. Some of the things that would make that a challenge depend on how often would that situation exist? ATC would not likely run traffic to both runways at the same time because it would be difficult to do so, even for 15% of the time. With the approach ends behind the controllers, they would have to turn around and look behind (sometimes called "swivelhead"). Mitigating factors would involve how the controllers track traffic. Perhaps by creating situational awareness procedures supplemented with a traffic management board for the VFR runway and assistance from approach control for both runways? Most controllers would think this situation is viable but certainly not ideal. A lot would depend on how often the situation exists and the mitigating methods employed.

### 4.3.5 Summary for Site E

Site E was evaluated at an ATCS eye height of 1049 feet MSL (129 feet AGL). The site is at the bottom of a hill that is approximately 30 below the airfield elevation. This site is considered to be suitable with no obstructed views to all existing and future runways, taxiways, WestLEX area and existing terminal area apron.

Site E is centrally located between Runway 9-27 and Runway 4-22. It sits on undeveloped land near the WestLEX area of the airport, approximately 75 feet from adjacent Gumbert Road. It is 4250 feet east of the existing ATCT and it is set 1140 feet offset to the Runway 9-27 centerline. The OFA of Runway 9-27 is 400 feet from the runway centerline. Site E is set 2250 feet offset to the Runway 4-22 centerline. The OFA of Runway 4-22 is also 400 feet from the runway centerline. Since Site E is outside the AOA in a relatively public area, a six (6) foot high chain link fence with a motorized gate and access control is required around the site building and parking lot to satisfy some FAA security requirements.

This site has clear views of the airfield with the furthest point being 5384 feet to the end of Runway 22. Views of the airfield will be mostly to the northeast. Runway 4 is a left approach and Runway 22 is a right approach. Runway 27 is a right approach and Runway 9 is a left approach. Since Site E sits in between both runways, controllers will have to turn left, right and behind throughout the day in order to locate aircraft arriving and departing from the south and west. This can cause what is called “swivel head” for air traffic controllers but the LEX ATM said it should not be an issue.

There are no known adverse impacts to TERPS, FAR Part 77, Communications, Navigation, or Surveillance facilities to be caused by Site E.

**Site E Pros and Cons**

| | |
|---|---|
| **PROS** | - Good access and utilities<br>- Close to both Runways<br>- Good view of all movement areas |
| **CONS** | - Distance to end of Runway 22 is in excess of 5,000'<br>- Impact of "swivel head" on controller workload<br>- Lowest ground elevation which adds to the required height of structure |

**Other Notes:**

- Discussion related to the potential for "swivel head" operations
  - This is the situation where a controller will need to look to the right and then left over the respective shoulder to see approaching or departing aircraft on Runways 4 and 9.
  - Controller present indicated that while it could be an issue., if operation change, they could swap controller positions to help reduce that impact.
  - Two other controllers (at other airports) were asked about this condition. They provided their insight which had the same conclusion - while not an ideal situation, it has been workable at other airports with a similar situation.

# Blue Grass Airport ATCT
# SITE COMPARISON CHART

| | ITEM | SITE A | SITE B | SITE E |
|---|---|---|---|---|
| 1 | ATCT Orientation/Cab Direction | Primarily Southeast | Primarily Northwest | Primarily Northeast |
| 2 | Construction Cost Estimate | | | |
| 3 | Latitude/Longitude | 38° 2' 28.00" N<br>84° 36' 44.00" W | 38° 2' 3.48"N<br>84°36' 13.04"W | 38° 2' 10.00" N<br>84° 36' 58.00" W |
| 4 | Access to ATCT Site | Utilize Adjacent US-60 & Existing Perimeter Road | Utilize Existing Airport Road & Aviator Road | Utilize Adjacent US-60 & Existing Gumbert Road |
| 5 | Distance to and Elevation of Key Point | 3822 ft.<br>(appr. end Runway 22)<br>973 ft. MSL | 5472 ft.<br>(appr. end Runway 9 Future)<br>944 ft. MSL | 5384 ft.<br>(appr. end Runway 22)<br>973 ft. MSL |
| 6 | Ground Elevation | 945 ft. MSL | 935 ft. MSL | 920 ft. MSL |
| 7 | Controller (ATCS) Eye Height<br>(5' above cab floor) | 82 ft. AGL<br>1027 ft. MSL | 155 ft. AGL<br>1090 ft. MSL | 129 ft. AGL<br>1049 ft. MSL |
| 8 | ATCT Height<br>(cab floor +35 feet incl. antennas) | 112 ft. AGL<br>1057 ft. MSL | 185 ft. AGL<br>1120 ft. MSL | 159 ft. AGL<br>1079 ft. MSL |
| 9 | ATCT Potential Impacts to NAVAIDS | None | MDA incr 20 ft RNAV RW 27<br>LOC errors well under allowable | None |
| 10 | TERPS Impacts | None | None | None |
| 11 | Part 77 Impacts | | | |
| 13 | Object Discrimination:<br>Detection<br>Recognition<br>Identification | <br>PASS<br>PASS<br>PASS | <br>PASS<br>PASS<br>PASS | <br>PASS<br>PASS<br>PASS |
| 14 | LOS Angle of Incidence (degrees) | 0.81 | 1.52 | 0.81 |

*Note: The eye height at Site B is the result of the Line-of-Sight required to see over existing and future hangars. It is higher than the minimum requirement as exemplified by angle of incidence greater than 0.80 degrees. An optional eye height of 175 ft AGL was considered to provide a clearer LOS to small aircraft behind a future WestLEX T-Hangar (see narrative and appendices).*

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