



4 Alternatives Analysis

4.1 INTRODUCTION

After identifying the facility requirements in the previous chapter—which determined the capacity and needs of various facilities required to accommodate the projected demand—this chapter focuses on identifying, developing, and evaluating alternative solutions to accommodate these needs at Felts Field.

Alternatives for each of the following elements were developed:

- Airside infrastructure (e.g., runways and taxiways) to accommodate the forecast demand levels
- General aviation aircraft storage hangars to support the anticipated growth of based fixed- and rotarywinged aircraft
- Airport support facilities
- Landside and ground access

4.1.1 Methodology

Figure 4-1 presents the following steps that were taken for this analysis:

- 1. Established the constraints and opportunities at the airport to identify the potential location of alternatives development
- 2. Developed alternatives for each element stated above based on the facility requirements developed with the demand forecasts
- 3. Analyzed and evaluated the alternatives for each element based on a set of criteria to aid in selecting feasible options
- 4. Integrated the recommended options for each element to produce a preferred airport-wide development concept, which was then analyzed and evaluated to determine the feasibility of the merged alternatives

This process follows the FAA AC 150/5070-6B, "Change 2 Airport Master Plan" approach.

Since a master plan covers a 20-year period, the alternatives should function through various stages of the long-term plan. This study considered the following short-, medium- and long-term planning horizons over a 20-year period:

- Short term: 0–5 years, by 2022
- Medium term: 6–10 years, by 2027
- Long term: 11–20 years, by 2037







Source: WSP USA

As shown in Figure 4-1, the following elements were considered during alternatives development:

- Runways and taxiways
- General aviation (i.e., fixed- and rotary-winged aircraft) hangars, aprons, and support facilities
- Landside

Due to the constraints of the airport property, the alternatives were structured around the airfield alternatives as the first priority, and more precisely runway extensions, taking into consideration the ATCT line of sight since existing hangars would limit how far the runways could be extended. The general aviation hangars alternatives were developed based on the recommendations of the preferred runway alternative.

4.1.2 Opportunities

The potential opportunities for aviation development are at the following locations:

- Northeastern and southwest sides of the airport property
- Midfield area between Taxiways A and B
- Along E. Rutter Avenue, adjacent to the airfield ramp where some available space has airside access for additional hangars

4.1.3 Constraints

Before identifying and developing alternatives for each element, an airport-wide overview was completed to identify the existing constraints and opportunities at Felts Field. **Figure 4-2** summarizes the following constraints and opportunities:

- Extending the runway could create issues with the ATCT line of sight.
- The 200-foot inner buffer requirement from the 100-year floodplain of the Spokane River to protect endangered species reduces developable land (see Section 1.2, "Existing Airport Conditions").





- BNSF railway tracks are south of the airport along E. Rutter Avenue.
- Incompatible land uses (e.g., public roads and residential buildings) exist within the Runway Protection Zone (RPZ).
- Mountains north of the airport (i.e., Beacon Hill, Little Baldy) could infringe on Part 77 surfaces.

Figure 4-2. Constraints and Opportunities



Source: WSP USA

4.1.4 Alternatives Evaluation Process

The alternatives developed for each element were analyzed and evaluated based on the following five criteria:

- Meet Design Standards (meets critical aircraft needs)
- Aircraft Operations (minimize impacts on aircraft ground movements or flight procedures)
- Off-Airport Impacts
- Cost (relative ROM)
- Feasibility of Implementation

For the evaluation process, each criterion was tailored to fit each element and alternative.

4.1.5 Modification of Standards

Two MOSs at Felts Field are addressed:

 Per the FAA AC 150/5300-13A, the required separation for simultaneous runway operations is 700 feet. However, the existing separation between the two paved runways, Runway 4R-22L and Runway 4L-22R, is 500 feet. A MOS at Felts Field was approved in 1987 based on a determination of an acceptable level of safety of the 500-foot runway-to-runway separation, depending on daylight visual conditions and operations of the ATCT. Under these conditions, the MOS allows simultaneous offset takeoffs and landings on closely spaced parallel runways.

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• Taxilanes MOS exists since 2015 in the south-east hangar complex that reduces the Taxilane Object Free Area (TOFA) and limits aircraft wingspans, as depicted in **Figure 4-3**, that can access this area, in order to ensure and maintain an acceptable level of safety.



Figure 4-3. Taxilanes of a Modification of Standards

Source: T-O Engineers, Inc.



4.2 AIRFIELD ALTERNATIVES

Development of the airfield alternatives focused on maintaining operations safety and meeting FAA design standards, while providing general aviation fixed- and rotary-winged aircraft expansion opportunities. The following conclusions were reached in Chapter 3, "Facility Requirements":

- As stated previously, the existing runway-to-runway separation at Felts Field is 500 feet and the FAA standard is 700 feet. The orientation of the existing runways provides sufficient wind coverage.
- For the "primary" Runway 4L-22R, a 5,000-foot runway is required to accommodate Cessna Citation at 60% useful payload. However, to accommodate the future critical aircraft—Learjet 25/36s at 75% useful load, a 6,100-foot runway is required, as listed in Chapter 3, "Facility Requirements". Due to the mountains and river limitations, such runway extension cannot be feasibly accommodated at Felts Field. Therefore, all proposed runway alternatives will consider a 5,500-foot runway extension which could be accommodated based on the existing constraints, and accommodate the future critical aircraft Learjet 25/36s at 75% useful payload.
- For the "additional" Runway 4R-22L, the critical aircraft is not expected to change in the future. No runway extension is required. As stated previously, 4R-22L is necessary for the existing tenants at SFF to accommodate the smaller/slower aircraft and to segregate them from the high performance turboprops and jet traffic has been increasing at SFF for many years and the linkage with the contract tower.
- The taxiway system is sufficient for the current operations at Felts Field.
- Airfield navigational improvements are required to enhance safety. The four-box VASIs on both ends of Runway 4L-22R are recommended to be replaced with PAPIs.
- Felts Field does not control portions of the Runway 4L-22R RPZs. Per recommendations, Felts Field should strive toward obtaining fee-simple or aviation easements to control the RPZs as funding becomes available.

This section describes the potential airfield alternatives for extending Runway 4L-22R and provides a preliminary qualitative evaluation of each alternative. The hangar alternatives were then develop based on the preferred runway alternative.

4.2.1 Runway-to-Runway Separation of 700 Feet

As explained in the previous section, there is a MOS at Felts Field approving a 500-foot runway-to-runway separation, depending on daylight visual conditions and when the ATCT is operating. To address this MOS, two options were developed to attempt the standard 700-foot runway-to-runway separation, per FAA AC 150/5300-13A.



OPTION 1 – SHIFT RUNWAY NORTH

This option would involve moving Runway 4L-22R 700 feet north of Runway 4R-22L (**Figure 4-4**). Relocating Runway 4L-22R would cause the following changes:

- N. Waterworks Street would infringe on Runway 4L/22R Runway Object Free Area and Runway Safety Area, which are clear today.
- Runway 22R RPZ (in addition to 200-foot shoreline setback) would reduce the available northside land (potential hangar area).
- This option could result in the relocation of the ILS equipment, if possible.
- Moving the runway to the north would increase the possibility of mountains infringing the flight procedures clearances.



Figure 4-4.Runway-Runway 700-foot Separation: Option 1 – Shift Runway North





OPTION 2 – SHIFT RUNWAY SOUTH

This option would involves moving Runway 4R-22L 700 feet south of Runway 4L-22R (Figure 4-5). Relocating Runway 4R-22L would cause the following changes:

- Moving the runway south would eliminate parallel Taxiway A and shifting this taxiway south would affect the new fuel facility, at least nine existing hangars and the six new hangars under construction.
- Additional incompatible on-airport land uses would have to be relocated outside the RPZs, including the historic former National Guard headquarters and hangar. Insufficient space exists on airport property to relocate these existing hangars and tenants, let alone to meet the demand for additional hangars.
- Moving the runway south 200 feet would also worsen the existing ATC tower-line-of-sight constraints. Infield hangars would need to be relocated to not obstruct the line-of-sight of the current tower if the runway was shifted south.



Figure 4-5. Runway-Runway 700-foot Separation: Option2 – Shift Runway South

Source: WSP USA

RUNWAY MODIFICATION TO STANDARDS EVALUATION

To comply with the FAA design standards of a 700-foot runway-to-runway separation, the two options would result in additional safety standards' noncompliance (objects in the Runway Object Free Area, Runway Safety Area and/or incompatible land uses in the RPZs), and to implement either of these options would have significant relocation costs, both Airport Improvement Program eligible and noneligible (private hangars, etc.), and reduce developable space to meet existing and future demand for hangars. For these reasons, it is recommended that the FAA maintain the existing runway separation MOS.



4.2.2 Runway 4L-22R Extension

In order to accommodate the critical aircraft, the facility requirements concluded that Runway 4L-22R would need to be extended to 5,500 feet. The runway could be extended toward either the northeast or the southwest (Figure 4-6). Three runway alternatives were generated along the existing centerline of this runway.







RUNWAY ALTERNATIVE 1: 1,000-FOOT EXTENSION SOUTHWEST

Runway Alternative 1 proposes extending the runway 1,000 feet to the southwest end of the runway. The total length of the runway would be 5,500 feet. As seen in **Figure 4-7**, two public roads, significant existing commercial development, and some low-income housing exist near the airport on the southwest, which would increase the RPZ impacts with a runway extension.





Source: WSP USA

Pros:

- Aircraft departing from Runway 4L-22R would have the full 5,500 feet available.
- There would be a clear line of sight from the current ATCT to the new Runway 4L threshold.

Cons:

- The relocated Runway Safety Area would cause N. Waterworks Street to be relocated to meet FAA standards and provide the required access to the Spokane Upriver Dam and Facility.
- RPZ-incompatible land uses would include approximately 24 acres, consisting of two public roads, additional commercial development, and low-income housing areas.
- Significant expense would be required to relocate nonairport-related existing conditions.



RUNWAY ALTERNATIVE 2: 1,000-FOOT EXTENSION NORTHEAST

Runway Alternative 2 proposes a 1,000-foot extension to the northeast (Figure 4-8). The total length of the runway would be 5,500 feet. However, FAA Flight Procedures confirmed that the extended runway would cause an increase in approach minimums to Runway 22R due to the mountainous region at the northern part of the airport. The line of sight from the current ATCT to the extended runway threshold would not be blocked by the existing hangars.





Source: WSP USA

Pros:

- Aircraft departing from either direction of the extended Runway 4L-22R would have the full 5,500 feet available.
- The line of sight would be clear from the current ATCT to the new Runway 22R threshold.

Cons:

- Approximately 10 acres of RPZ—including public road, public ballfield, and residential properties would be affected, which is almost twice that of the existing RPZ-incompatible land (including approximately 5.60 acres).
- Runway 22R approach minimums would increase.



RUNWAY ALTERNATIVE 3: 1,000-FOOT EXTENSION NORTHEAST WITH DISPLACED THRESHOLD

Runway Alternative 3 proposes a 1,000-foot extension to the northeast (**Figure 4-9**). The total length of the runway would be 5,500 feet. To avoid increasing the approach minimums due to the mountains, Runway Alternative 3 would include a displaced threshold of 422 feet. The displacement would allow for a longer departing runway length without affecting the current IFR approach minimums.



Source: WSP USA

The off-airport RPZ impacts for Runway Alternative 3 would be similar to Felts Field existing conditions, with incompatible land totaling approximately 6.5 acres. The line of sight of the current ATCT to the extended threshold would not be blocked by the existing hangars.

Pros:

- Aircraft departing from extended Runway 22R would have the full 5,500 feet available.
- The amount of RPZ-incompatible land uses would be similar to existing conditions; however, it would include N. Park Road, fewer residential houses, and the existing baseball field, summing up to approximately 6.5 acres.
- The proposed displaced threshold would preserve existing IFR approach minimums, based on the preliminary FAA Flight Procedures evaluation conducted in December 2019.
- The line of sight would be clear from the current ATCT to the new Runway 22R threshold.





Cons:

- While Runway Alternative 3 would have 5,500 feet of pavement, a displaced threshold would be necessary to avoid the mountains based on Terminal Instruments Procedures (TERPS) criteria. The landing distances would be reduced by 422 feet, making 5,078 feet available for landing distance.
- It is the policy of the FAA Northwest Mountain Region not to construct new pavement that would need to be displaced, and therefore, the displaced threshold may not be considered eligible for FAA AIP funding.
- The approach RPZ of Runway 22R would reduce the available land for hangar development in the north area by approximately 5 acres and would affect the existing ballfield and part of N. Park Road.
- N. Park Road would need to be relocated or a favorable FAA RPZ determination.

EVALUATION

As shown in **Table 4-1**, Runway Alternative 1 would have more off-airport impacts than the other concepts, and its RPZ would affect a large portion of incompatible land uses (26 acres), including significant commercial development, low-income housing, and two public roads. The cost of acquiring the RPZ-incompatible land uses and relocating them would be significantly costlier than Alternatives 2 and 3.

CRITERIA	RUNWAY ALTERNATIVE 1 (1,000-FOOT EXTENSION SOUTHWEST)	RUNWAY ALTERNATIVE 2 (1,000-FOOT EXTENSION NORTHEAST)	RUNWAY ALTERNATIVE 3 (1,000-FOOT EXTENSION NORTHEAST WITH DISPLACED THRESHOLD)
Facility Requirements	Meets 90% of Requirement	Meets 90% of Requirement	Meets 90% of Requirement
Aircraft Operations	No major impacts	Runway 22R IFR minimums would increase	Runway 22R with Displaced Threshold, shorter landing distance available for Runway 22R.
Off-Airport Impacts	RPZ would affect approximately 24 acres of development and low- income housing Impacts	RPZ would affect approximately 10 acres of development, public road, and ballfield - Section 4(f)*	RPZ impacts approx. 5 acres of development, public road and ballfield Section 4(f)*
Relative ROM Costs	Road and residential relocations, 24 acres of land acquisition	10 acres of land acquisition, residential relocations and possible N. Park Road relocation	5 acres of land acquisition, residential relocations and possible road relocation
Implementation/Feasibilit Y	Reconnect public access to Waterworks, low- income housing relocation	No major issues	FAA Northwest Mountain Region may not fund displaced pavement
Preferred Alternative			\checkmark

Table 4-1. Runway Alternatives Evaluation

* Section 4(f) of the Department of Transportation Act of 1966 (49 USC § 303 and 23 USC § 138; USDOT Act) applies to publicly or privately owned historic properties determined eligible for or listed on the National Register of Historic Places; and publicly owned parks, recreation areas, and wildlife and waterfowl refuges (collectively, Section 4(f) properties). The requirements of Section 4(f) apply to the Federal Highway Administration and other agencies of the U.S. Department of Transportation.



Runway Alternative 2 would affect the Runway 22R FAA Flight Procedures and would cause an increase to the IFR approach minimums due to the mountains. In addition, the resulting location of the RPZ would affect residential areas. The amount of the RPZ off-airport land use impacts would be significantly less than Runway Alternative 1.

Unlike Runway Alternatives 1 and 2, Runway Alternative 3 would have the lowest RPZ land use impacts and would be similar to that of the current runway length, except for the impact to the ballfield and a small portion of a second public road. The impact to the road would involve relocation for a favorable FAA RPZ determination. The cost and environmental impacts would be lower than Runway Alternatives 1 and 2. **Table 4-1** summarizes the runway alternative evaluation criteria and recommends Runway Alternative 3 to provide Felts Field with the runway length needs for the next 20 years.

4.2.3 Taxiway Alternatives

This section provides the analysis of potential parallel taxiways for Runway 4L-22R. Based on the forecast, aviation activity and based aircraft will increase in the next 20 years, and additional hangars will be required, as identified in Chapter 3, "Facility Requirements." One potential opportunity for business jet hangars would be on the northside, along the river (see the next section for more information). Therefore, a full, parallel taxiway for Runway 4L-22R was considered to segregate the northern complex operations (jet aircraft operations).

Two options exist:

- North of Runway 4L-22R
- South of Runway 4L-22R, between the two paved runways

As an RDC C-II with ³/₄-mile visibility, Runway 4L-22R requires a 300-foot separation with a parallel taxiway. Runway 4R-22L currently has an RDC B-I small with a visual approach, which requires a 150-foot separation with a parallel taxiway.

NORTH FULL, PARALLEL TAXIWAY OPTION

To provide a full, parallel taxiway for Runway 4L-22R, the taxiway would be offset 300 feet to the north. However, the taxiway would also need to address the following issues (**Figure 4-10**):

- Offset localizer would need to be relocated and may not be feasible.
- Existing road(s) outside the airport fence would conflict with the taxiway Object Free Area (OFA) and would need to be relocated.
- Glide slope antenna and shelter would need to be relocated outside the taxiway OFA.



Figure 4-10. North Full, Parallel Taxiway Option



Source: WSP USA

To avoid relocating the offset localizer, a partial north taxiway was explored, but deemed of limited use for jet traffic. Due to these constraints, aircraft taxiing on this portion of pavement would be within the localizer critical area and could interfere with aircraft arrivals. Thus, this option is not recommended.

SOUTH FULL, PARALLEL TAXIWAY OPTION

Although the separation between the two paved runways is 500 feet, a full, parallel taxiway could exist between them and could meet the existing RDC and visibility approach of both runways. This parallel taxiway would be 300 feet south of Runway 4L-22R, and 200 feet from Runway 4R-22L, which would exceed the 150-foot minimum separation required for a full, parallel taxiway from this type of runway (**Figure 4-11**). However, if Runway 4L-22R is ever upgraded to <¾ mile visibility, then the runway-to-taxiway separation would need to increase to 400 feet and would no longer meet the minimum separation requirements. Thus, a full parallel taxiway in this location is not recommended.



Figure 4-11. South Full, Parallel Taxiway Option





PARTIAL, PARALLEL TAXIWAY OPTION

Figure 4-12 depicts the partial, parallel taxiway option. A taxiway to the north (1) would start from the end of the existing runway to the end of the runway extension. Just like the north full, parallel taxiway option, the partial, parallel taxiway option would offset the taxiway by 300 feet to the north of Runway 4L-22R which would connect potential hangar development at the northern section of the airport to the runway. The taxiway to the southside (2) would extend from the holding bay at the south side of Runway 4L-22R to the end of the runway extension. A portion of the taxiway is under the Runway 22L approach surface with a vertical clearance of approximately of 30 feet, which clears C-II aircraft tails. This option would not conflict with the runway design standards and is recommended.



Figure 4-12. Partial, Parallel Taxiway Option

Source: WSP USA

TAXIWAY RECOMMENDATION

In summary, the north full, parallel taxiway option would relocate ILS navigational equipment. The south full, parallel taxiway option (although meeting design standards) would not meet the minimum separation requirements in the future if Runway 4L-22R is ever upgraded to <¾ mile visibility, which would require the runway-to-taxiway separation to increase to 400 feet. In addition, a portion of the proposed south parallel taxiway (2) is within Runway 22L approach surface footprint. However, the vertical clearance at this location is 30 feet, which provides clearance for C-II aircraft. Therefore, the recommended taxiway system for the proposed runway extension would be the dual partial, parallel taxiway option (Table 4-2).



CRITERIA	NORTH FULL, PARALLEL TAXIWAY OPTION	SOUTH FULL, PARALLEL TAXIWAY OPTION	PARTIAL, PARALLEL TAXIWAY NORTH AND SOUTH OPTION
Design Standards	TOFA affected by existing roads	Meet Design Standard	Meets Design Standard
Aircraft Operations	Affects the critical area of the localizer	Operational	Operational
Roadway Impacts	Existing road would be relocated for TOFA	No Impact	No Impact
Relative ROM Costs	Relocation of existing road, localizer and glide slope antenna	No additional cost	No additional cost
Implementation/ Feasibility	Glide slope antenna and Offset localizer would need to be relocated	Currently feasible, but future upgrade of Runway 4R-22L to <¾ mile visibility is not feasible	Feasible
Preferred Alternative			\checkmark

Table 4-2. Taxiway Options Evaluation

4.3 AIRCRAFT STORAGE HANGAR ALTERNATIVES

The purpose of hangar alternatives is to accommodate the future based aircraft requirements – and especially the growing based jet aircraft. Chapter 3, "Facility Requirements" determined the following:

- The number of based single-engine aircraft is expected to decrease by 2037 (-10).
- The number of based jet aircraft is expected to significantly increase by 2037 (+32).
- The number of based helicopters is expected to increase by 2037 (+13).

This section describes the potential locations on airport property, potential alternatives for the future based jet aircraft, and the needs of helicopters.

The development of the business jet hangar alternatives is based on the following assumptions:

- Large-jet hangars (150 feet by 110 feet) would be designed for the Falcon 800.
- Medium-jet hangars (125 feet by 90 feet) would be designed for the Cessna Citation II.
- Small-jet hangars (70 feet by 60 feet) would be designed for the Honda Jet HA-420;
- Assumed jet fleet mix:
 - 8 large aircraft (design aircraft: Falcon 800)
 - 24 medium aircraft (design aircraft: Cessna Citation II)

Due to limited space available at Felts Field, the helicopter storage concepts are limited to multiple aircraft stored in single hangars versus individual hangars. The assumptions follow:

- Large helicopter hangars (240 feet by 120 feet) would be designed to accommodate multiple H135s (10).
- Small helicopter hangars (130 feet by 110 feet) would be designed to accommodate multiple H135s (6).





4.3.1 *Methodology*

Development of the alternatives was conducted using two criteria:

- The aircraft hangars would have to be accommodated within existing airport property, with the existing control tower. Adding cameras to mitigate hangar concept line-of-sight issues was dismissed as not preferable and not analyzed as part of the master plan.
- If hangar storage requirements could not be met, the remaining required hangars would be developed beyond existing airport property on potential adjacent parcels.

As depicted in Figure 4-13, three based aircraft jet hangar options were developed:

- BA1 would be on the north side of the airport, along the top of the river edge and existing and future Runway 4L-22R RPZ.
- BA2 would be in the midfield area between Taxiways A and B and the area along E. Rutter Avenue.
- BA3 would require acquiring off-airport lands, and become a development option if insufficient space exists on-airport to meet the demand for hangars. This area would be between the airport property boundary and N. Coleman Road on the northeast side of the existing hangar area.



Figure 4-13. Business Jet Storage Hangar Development Areas

Source: WSP USA

Due to the constraints of the airport, each location could not accommodate the entire projected demand for storage hangars. Thus, different scenarios were tested by combining alternatives of each location and described in this section.



4.3.2 ATCT Location

Currently, the ATCT is south of Taxiway A, in the historic district along E. Rutter Avenue, and next to the terminal building. Given the height and the location of the tower, any new hangar could obstruct the ATCT line of sight from the tower to the runway extension. Due to the lack of enough hangar development land within the existing airport property, the future hangar demand could not be met without acquiring off-airport lands. A mitigation solution could be the relocation of the ATCT, which would provide more available space to develop hangars in the midfield area, beyond what might be considered on the northside, near the river.

Therefore, the hangar alternatives were developed for two scenarios: one assuming the existing ATCT, and the other one assuming the relocation of the ATCT. An ATCT siting study was performed and documented in **Appendix D**. The study concluded a preferred site located in the midfield area, between Taxiway A and Taxiway B, north of the existing Airport Maintenance Building.

4.3.3 North Hangar Complex BA1

The North Hangar Complex BA1 is constrained by the river and the existing and future runway RPZ. Areas adjacent to the Spokane River are protected by City of Spokane environmental rules: all development must comply with a 200-foot shoreline setback (**Figure 4-14**). Therefore, this 200-foot clearance was considered during the alternative's development. However, some facilities are allowed within the shoreline buffer as long as they minimize adverse impacts on the shoreline ecological functions (Section 17E.060.720, "Shoreline Buffers"). Assuming a 15-foot-long parking, vehicle parking can occur beyond 165 feet of the shoreline, but requires a permit.



Figure 4-14. River Shoreline Setback Area

Source: WSP USA



The airport land available for hangar development also depends on Runway 22R RPZ. Before the runway extension is constructed, eight large jet hangars could be developed within the constrained area. To avoid taxiing bottlenecks and considering the proposed runway extension, dual runway access taxilanes were included.

After the Runway 22R approach end 1,000-foot runway extension (Runway Alternative 3) is implemented and the RPZ shifts, two additional large jet hangars and two medium-jet hangars could be constructed. This would require the reorganization of the access taxilanes. The North Complex would consist of 12 hangars in this phase. These hangars would fall below the Transitional Surface (7:1) and Departure Surface (40:1). **Figure 4-15** depicts the layout of this completed concept.





Source: WSP USA

The north area has a basic road but requires upgrades and there are no existing utilities, which would be required to serve the new hangars.



4.3.4 South Hangar Complex BA2

The South Hangar Complex BA2 is in the midfield area, between Taxiway A and Taxiway B, and the area of hangars along E. Rutter Avenue, where there is some available space for additional hangars and redevelopment of old facilities. Moreover, three existing old hangars are planned to be demolished, and the airport maintenance facility is planned to be relocated out of the isolated airside area to an area with direct access to landside.

As explained earlier in this section, this potential hangar complex area was developed assuming the existing ATCT and assuming the relocation of the tower.

EXISTING HANGAR TAXILANE MODIFICATION OF STANDARDS

As explained in Section 4.1.5, "Modification of Standards," a MOS applies to the southeast hangar complex that allows reduced TOFA and limits aircraft wingspans that can access this area. In order to provide the FAA design standard for nonmovement taxilanes, many of the hangars (which are occupied today) would need to be removed or be relocated, such as every other hangar row. Due to lack of space and constrained airport property, there is no available land within the property to relocate these existing hangars and tenants. The space for new hangars for new tenants is already limited and acquiring off-airport lands is a possibility, but with significant expense, beyond what Felts Field can afford. Therefore, it is recommended to maintain the MOS. **Table 4-3** summarizes the MOS on the TOFA and the maximum wingspan allowed.

TAXILANE	EXISTING TAXILANE CENTERLINE TO FIXED OR MOVABLE OBJECT (FEET)	MAXIMUM WINGSPAN PERMITTED BY THE MOS (FEET)
Taxilane 1	37.00	45.00
Taxilane 2	32.6	37.66
Taxilane 3	29.37	32.28
Taxilane 5	28.85	31.42
Taxilane 6	38.32	47.20
Taxilane 7	38.00	46.67
Taxilane 8	38.00	46.67
Taxilane 9	31.08	35.13
Taxilane 10	35.06	41.76

Table 4-3. Hangar Taxilane Modification of Standards

Note:

FAA ADG-I Standards:

• Taxilane Centerline to Fixed or Movable Object: **39.5 feet**

Maximum Wingspan: 49 feet

SOUTHERN HANGAR COMPLEX WITH EXISTING ATCT

Figure 4-16 depicts the first scenario, where five future general aviation hangars and four medium-jet hangars would be located in the midfield area, and an additional two helicopter hangars (one small and one large) and three medium-jet hangars would be located among the hangars along E. Rutter Avenue. The small proposed hangars (shown in purple and currently under lease) could accommodate Very Light Jets

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(VLJ) and small turboprops. In total, for fixed-wing accommodation, 12 jets could be accommodated, and 16 helicopters could be accommodated with the proposed helicopter hangars.





Source: WSP USA

SOUTHERN HANGAR COMPLEX WITH RELOCATED ATCT

If the ATCT were relocated to the midfield area near the existing airport maintenance facility (see **Appendix D** for details), more space would be available for hangar development because the tower must be able to view the movement areas (runways and taxiways), which would allow hangars to be placed closer to the taxiways. This concept includes a combination of 6 future general aviation hangars, 13 medium-jet hangars, 5 small-jet hangars, and 2 helicopter hangars (one small and one large) that could be accommodated in the Southern Hangar Complex (**Figure 4-17**). In total, for fixed-wing accommodation, 24 jets could be accommodated. A total of 16 helicopters could be accommodated with the helicopter hangars.







Source: WSP USA

4.3.5 North Complex and South Complex Hangar Alternatives Summary

Table 4-4 shows the summary of the total hangars that could be accommodated in the North Complex and South Complex with the existing ATCT and with a relocated ATCT.

	NORTH COMPLEX HANGAR ALTERNATIVES	SOUTH COMPLEX HANGAR ALTERNATIVES WITH EXISTING ATCT	SOUTH COMPLEX HANGAR ALTERNATIVES WITH RELOCATED ATCT
Large Jet Hangars	10	0	0
Medium-Jet Hangars	2	7	13
Small-Jet Hangars	0	0	5
Total Jet Hangars	12	7	18
Total North plus South Complex Jet Hangars		19	30
Non-Jet Hangars*		5	6
Total Hangars		24	36

Table 4-4. North Complex and South Complex Hangar Alternatives Summa
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Note: *Non-jet hangars (future general aviation hangars) might accommodate smaller Very Light Jets and turboprop aircraft.

4.3.6 Off-Airport Land for Hangars Needs BA3

Unfortunately, the North Complex and the South Complex Hangar Alternatives would not provide enough space to accommodate the required aircraft storage hangars for both jets and helicopters with the existing ATCT. If the tower were relocated, more hangars could be accommodated, depending on the actual type of aircraft. In addition, justifying a new tower would be challenging, both for FAA approvals and funding requirements. Thus, if the tower could not be relocated, adjacent off-airport parcels were evaluated to





determine how much additional land would be required to meet the need of projected based aircraft and hangars. The area east of Felts Field's north gate near N. Dora Lane would be the logical location to explore potential hangar development. It should be noted this analysis is to determine how much space would be necessary if the tower could not be relocated. This analysis attempted to respect existing roadways and neighborhood blocks and to minimize impacts as far as practical.

To connect this area to the airport with airside access, a new taxiway would need to be constructed. To create this access, five existing hangars would be affected and would be replaced with the new hangars.

Three additional alternatives were developed on off-airport lands, which will need to be acquired and to minimize the impact to adjacent land acquisition:

- Off-Airport (Future Land Acquisition) Hangar Alternative 1 (Figure 4-18):
 - 4 new medium-jet hangars (plus 5 rebuilt existing hangars)
 - Requires approximately 5.5 acres of off-airport land
- Off-Airport (Future Land Acquisition) Hangar Alternative 2 (Figure 4-19):
 - 12 new medium-jet hangars (plus 5 rebuilt existing hangars)
 - Requires approximately 14.7 acres of off-airport land
- Off-Airport (Future Land Acquisition) Hangar Alternative 3 (Figure 4-20):
 - 2 small general aviation hangars and 14 new medium-jet hangars (plus 5 rebuilt existing hangars)
 - Requires approximately 14.7 acres of off-airport land

Figure 4-18. Off-Airport (Future Land Acquisition) Hangar Alternative 1













Source: WSP USA





4.3.7 Hangar Storage Alternatives Summary

Based on the evaluation of the overall hangar alternative areas, none of the areas could accommodate the required 32 jets and 13 helicopter-based aircraft within individual hangars. However, if the focus is on accommodating jets, then the helicopters could be located with a combination of ramp storage and/or consolidated in a larger hangar on existing airport property. Based on this assessment, six aircraft storage scenarios were developed using a combination of each area with the goal of accommodating at least 32 hangars for jets:

- North Hangar Complex: Depending on the phase of the runway extension, the available space for hangars would change. However, this area could accommodate 12 hangars.
- South Hangar Complex: The ATCT location would define the space available in the South Complex. With the existing ATCT location, the area could accommodate 12 hangars; if the tower were relocated, 24 hangars could be developed.
- With Land Acquisition: Hangar development in this area would depend on the runway extension and the ATCT location; therefore, three alternatives were prepared based on minimizing the impact to existing neighborhood blocks and streets, etc.:
 - Alternative 1 could accommodate 4 new jet hangars.
 - Alternative 2 could accommodate 12 new jet hangars.
 - Alternative 3 could accommodate 16 new jet hangars.

Based on these various components, six scenarios were developed and are presented in Figure 4-21.



Figure 4-21. Accommodating the Ultimate Need for Aircraft Storage Hangars Scenarios

Note: *General aviation hangars might accommodate smaller very light jets and turboprop aircraft.

Table 4-5 summarizes the number of hangars that can be added for each alternative and preferred runway extension scenario. The number of hangars that cannot meet the facility requirements is also identified.





	BEFORE RUNWAY EXTENSION		AFTER RUNWAY EXTENSION		WITH LAND ACQUISITION (OFF-AIRPORT)	
SCENARIO	TOTAL	MISSING	TOTAL	MISSING	TOTAL	MISSING
Scenario 1 (Existing ATCT)	20 Hangars	12 Hangars	24 Hangars	8 Hangars	28 Hangars	4 Hangars
Scenario 2 (Existing ATCT)	20 Hangars	12 Hangars	24 Hangars	8 Hangars	36 Hangars	+4 Hangars
Scenario 3 (Existing ATCT)	20 Hangars	12 Hangars	24 Hangars	8 Hangars	40 Hangars	+8 Hangars
Scenario 4 (ATCT relocated)	32 Hangars	0 Hangars	36 Hangars	+4 Hangars	Not Required	

Table 4-5.Business Jet Hangar Alternatives Summary

Note: Facility Requirements identified the need for an additional 32 jet hangars in 2037.

4.3.8 Hangar Storage Alternatives Scenarios Evaluation

Table 4-6 summarizes the evaluation criteria for assessing how to accommodate the 2037 based aircraft hangar needs. Scenario 1, which would not relocate the control tower, would not provide enough hangars before or after the runway extension and would need an additional 5.5 acres of land acquisition.

CRITERIA	SCENARIO 1 (EXISTING ATCT)	SCENARIO 2 (EXISTING ATCT)	SCENARIO 3 (EXISTING ATCT)	SCENARIO 4 (RELOCATED ATCT)
Design Standards	Does not meet the Facility Requirement	Meets the Facility Requirements	Meets the Facility Requirements	Meets the Facility Requirements
Aircraft Operations	Single taxilane for "off-airport" hangar access may cause aircraft flow conflicts	Single taxilane for "off-airport" hangar access may cause aircraft flow conflicts	Single taxilane for "off-airport" hangar access may cause aircraft flow conflicts	No major issues
Off-Airport Impacts	Requires 5.5 acres of off-airport land (residential relocations)	Requires 14.7 acres of off-airport land (residential relocations)	Requires 14.7 acres of off-airport land (residential relocations)	No significant U.S. Environmental Protection Agency issues
Relative ROM Costs	Smallest land acquisition and 5 existing hangar demo/relocation	Biggest land acquisition and 5 existing hangar demo/relocation	Biggest land acquisition and 5 existing hangar demo/relocation	New ATCT
Implementation/ Feasibility	No major issues	Potential issues	Potential issues	New ATCT funding
Preferred Alternative				✓

Table 4-6. Business Jet Hangar Alternatives Evaluation

Scenarios 2 and 3 would be quite similar before and after the runway extension. Both scenarios would not provide enough hangars before and after the runway extension; however, with about 14.7 acres of land acquisition, both scenarios would fulfill the required number of jet hangars. By acquiring the land indicated





in the figures, which are based on complete blocks/streets, there would be an excess of four hangars for Scenario 2 and eight hangars for Scenario 3. For the purpose of this study, it was assumed that full blocks/streets would be acquired for future airport development needs.

Scenario 4, with a relocated ATCT, would satisfy the hangars needed by 2037 with four excess hangars available with no land acquisition thus making this option the preferred scenario.

It should be noted that a potential aircraft operational issue could exist regarding the access to the Scenario 4 hangar development complex. A single taxilane connecting these hangars to the airport movement area could cause an aircraft flow issue (an arriving aircraft using the taxilane could conflict with aircraft exiting the proposed hangar area). This conflict would increase as more hangars are built but would depend on the frequency of aircraft movements to and from this area.

4.4 LANDSIDE

This section focuses on the following current and future key issues with landside access:

- Airport access points
- Airside access
- On-Airport Roadway/Taxiway Intersection

4.4.1 Airport Access

There are two main points of access to the airport. The western access via N. Fancher Road (primary access) and eastern access via N. Park Road to E. Rutter Avenue (**Figure 4-22**). A new access point from ES Riverway Avenue (**Figure 4-23**) would provide access to the proposed north hangar area.



Figure 4-22. Airport Access



The rail line adjacent to E. Rutter Avenue has trains stopping for crew changes at least twice a day on each direction, which blocks the airport entrances. A westbound will block the rail crossing at N. Park Road and an eastbound train blocks the rail crossing at N. Fancher Road. A third railway intersection is at N. Vista Road, 0.5 mile from railway intersection on N. Park Road, and is available when the other intersections are blocked. One potential option is to install dynamic messaging signs on E. Trent Avenue, informing drivers that a train is blocking the road to access Felts Field and that N. Vista Road/N. Park Road are open. This issue should be discussed with BNSF and consider potentially relocating BNSF's crew change site elsewhere, not near Felts Field, to enhance safety at the airport for unimpeded access for emergency and fire trucks responses.

Fire Department Access to Felts Field. The Spokane Fire Department is west of the airport. The Spokane Fire Department has no direct access to Felts Field. The distance from the nearest firehouse to the airport is 2 miles via the rail crossing on N. Fancher Road, 3.5 miles via the rail crossing on N. Park Road, and 4 miles from the proposed northern hangar campus. The issue with traffic stops between the Spokane Fire Department and the airport—and trains stopping for crew changes that block airport access—occurs at least twice a day and has delayed emergency response recently. An aircraft crashed into Spokane River adjacent to Felts Field, and the rescue vehicles were delayed because of a parked train awaiting a crew change.

Creating a pathway that links the N. Waterworks Street to the cul-de-sac for the Spokane Fire Department would resolve this issue by allowing a direct and shorter path to the airport. This pathway, with a secured gate to enter the airport, would be accessible only to the Spokane Fire Department, and a future RPZ assessment would be conducted for this propose limited-access road and entrance.



Figure 4-23. Fire Department Access to Felts Field





4.4.2 Airside Access

MIDFIELD AREA ACCESS

This section covers the access to the midfield campus between Taxiway A and Taxiway B. The service road in the midfield campus would be relocated to fit with the proposed hangars in the midfield campus. **Figure 4-24** depicts the footprint of the midfield area.





Source: WSP USA

The service road in this area intersects with Taxilane A. The intersection would have increased aircraft and vehicle activities based on forecasts. A "Yield to Aircraft" sign is at this intersection notifies vehicles to yield to taxing aircrafts. The following potential methods would enhance safety in this intersection:

- Remove the taxiway to allow only road access; however, aircraft would be cut off from nearby Runway 22L and Runway 22R thresholds.
- Enhance intersection signage (flashing lights) or install a traffic light that is tripped by presence of aircraft.

Removing the taxiway would result in aircraft flow issues in the midfield area. Thus, the recommended method to enhance safety in the intersection would be to enhance intersection signage or install a traffic light that is tripped by presence of aircraft.



NORTHERN CAMPUS ACCESS

This section focuses on the access to proposed development to the north. There are two entrances to the northern campus: through the airfield (currently for airport maintenance vehicles only) and via ES Riverway Avenue (Figure 4-25).



Figure 4-25.

Source: WSP USA

The existing service road from the midfield campus to the northern section would be within the extended Runway 4L-22R Runway Object Free Area. Thus, the portion of the road would need to be relocated outside the Runway Object Free Area for the airport service vehicles or stop signs may need to be implemented.

Portions of public roads will be within the RPZ of the extended Runway 4L-22R. However, these portions are located at the extremities of the RPZ surface and will require an RPZ assessment for FAA.

A gate is used to access the airside from ES Riverway Avenue but is closed to the general public. The following two routes allow access to the gate from E. Rutter Avenue:

- N. Dora Road to E. Euclid Avenue to N. Coleman Road to E. Bridgeport Avenue to N. Park Avenue to ES Riverway Ave (1.26 miles)
- N. Park Road to ES Riverway Avenue (0.8 mile)

The recommended access route is the second option—N. Park Road to ES Riverway Avenue—because this route has less impact to the Runway 22R end RPZ.



4.5 SUPPORT FACILITIES

Aviation support facilities are required to operate and maintain the airport and were evaluated as a part of this alternatives analysis. This section focuses on the following facilities that could play a vital role in keeping the airfield operationally efficient:

- Airport Traffic Control Tower Siting Study
- Airport Maintenance Facility
- Compass Rose

4.5.1 Airport Traffic Control Tower Siting Study

As stated previously, existing Airport Traffic Control Tower (ATCT) is located on the southside of the airport and one hangar is currently a line-of-sight issue. The area between the control tower and Taxiway B is very limited for hangar development due to the tower line-of-sight limitations. Therefore, a tower siting study was funded by the airport to determine if and where a new tower could be located that would allow SFF to maximize existing land for hangar development and account for a future runway extension. **Appendix D** provides details of this study, but the conclusion is summarized in the following paragraphs.

The purpose of the study was to identify at least two viable locations and heights of an ATCT that can satisfy the FAA criteria of a Safety Risk Management Document (SRMD) and allow hangars to be constructed within the desired area without obstructing the controllers' line-of-sight. The analysis generally followed the guidelines set forth in FAA Order 6480.4B, Chapter 8, Alternate Siting Process.

It was determined that Site 2 is the preferred site and was evaluated at an eye height of 2,051 feet MSL (100 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, including the helipad located 340 feet south of Site 2. Site 2 allows for the proper scan of the runway with concurrent helicopter operations.

Site 2 is located on the south side of the airport, 1,150 feet northeast of the existing ATCT and inside of the Airport Operational Area (AOA). Therefore, Site 2 will not require any perimeter fencing or gate. This site is located at the north end of the existing Airport Equipment Building. Site 2 is 1,100 feet from Runway 4L-22R centerline and 475 feet outside of the Runway OFA. It is 600 feet outside of the 4L-22R runway primary surface and 475 feet outside of the 4R-22L runway primary surface.

At the proposed eye height of 100 feet AGL, this site has clear views of the airfield with the furthest point being 4,022 feet to the end of Runway 4L. Views of the airfield will be mostly to the northwest. Currently, Beacon Hill creates some LOS concerns because controllers lose sight of aircraft coming from the north over the hill. ATCs usually have visual of aircraft once they are about 3 miles away. Like the existing ATCT, Site 2 is on the south side of the airport, so controllers will use the same situational awareness that is

vsp



currently in practice. Downwind to the main runway (4L-22R) will be in front of controller's positions, which is desirable in order for them to see aircraft traffic patterns and the airfield without distractions.

4.5.2 Airport Maintenance Facility

The existing airport maintenance facility (9,800 square feet) is in the midfield area between Taxiway A and Taxiway B (**Figure 4-26**). This facility is in an area that could be used for hangars; however, with such a shortage of space, relocation should be considered. In addition, because the existing facility does not have a street address, deliveries are difficult. By relocating the maintenance building to a location along a public road would allow airside and landside access.

Figure 4-26. Existing Airport Maintenance Location



Source: WSP USA Note: Numbers represent Airport Building designations.

Figure 4-27 depicts the three potential locations for the airport maintenance facility listed below:

- Site A in front of water tower
- Site B open space near the southeastern gate
- Site C North Hangar Complex







Figure 4-27. Potential Airport Maintenance Facility Locations

Source: WSP USA

Site A would have difficult public access due to the water tower complex and conflict with the potential helicopter hangar that was proposed, and Site B, although a good location, could conflict with existing tenant leases. Due to its location, Site C would provide direct landside and airside access and would also enable the facility to have improved deliveries. Therefore, it is the recommended that Site C be the location for the future airport maintenance facility due to the accessibility to the airfield and minimal impact to proposed hangar development.

4.5.3 Compass Rose

With the projected growth of based aircraft, the need to re-establish a proper compass rose is recommended. The airport compass rose would be used to calibrate an aircraft's magnetic compass. The compass rose would be drawn or painted on a paved area designated as a compass calibration pad. The design standard for the compass rose is based on FAA AC 150/5300-13A. The design aircraft for the compass rose are C-II business jets, such as Lear Jets.

The assumed diameter for compass rose is 60 feet based on the length of the design aircraft (51.2 feet).





The center of the compass rose should adhere to the following FAA design standards:

- 600 feet away from magnetic objects such as railroad tracks and high voltage (230KV 500KV) electrical transmission cables
- 300 feet away from buildings, fuel lines/underground pipes (when they contain magnetic materials), and other aircraft
- 150 feet away from steel or ferrous materials such as airfield signs and drain gates

COMPASS ROSE LOCATION ALTERNATIVES

Taking into consideration the safety areas of the runways and taxiways, seven compass rose location alternatives were developed (Figure 4-28):

- Alternative C1 would be located on Runway 4L's holding pad on/near Taxiway A.
- Alternative C2 would be located on Runway 4R's holding pad near Taxiway B.
- Alternative C3 would be located close to the fuel farm in the midfield area.
- Alternative C4 would be located on Runway 22L's holding pad of Taxiway B.
- Alternative C5 would be located on the holding pad for Runway 22R.
- Alternative C6 would be an area between Taxiway D and the turf strip, for the short term.
- Alternative C7 would be an area near the future taxiway located at the proposed hangar location, northward of Runway 4L-22R.

Figure 4-28. Compass Rose Alternatives







COMPASS ROSE LOCATION EVALUATION

The seven compass rose alternatives were analyzed and evaluated based on the FAA design standards. **Table 4-7** depicts the outcome of the evaluation of the alternatives.

Per the evaluation, Alternative C6 is the favorable option for existing conditions, and Alternative C7 is the favorable option for the ultimate upgrade of Runway 4L-22R to C-II.

Alternative C5 would be the next acceptable location but would incur operational constraints with existing and ultimate Runway 4L-22R when the compass rose is in use.

ALTERNATIVE	ISSUES	OUTCOME
C1	 Rail track within 600 feet from the center of the compass rose 	Not
	 Buildings within the 300 feet from the center of the compass rose 	Compatible
C2	 Parked aircraft within the 300 feet from the center of the compass rose 	Not
C2	 Rail track within 600 feet from the center of the compass rose 	Compatible
	• Two buildings and parked aircraft within 300 feet from center of the compass	Not
C3	rose	Compatible
	 Airfield signs possibly within 150 feet from center of compass rose 	
	 Likely within future hangar footprint 	
C4	 Would need paved area 	Not
01	 Might conflict with long-term development 	Compatible
	 A building within 300 feet from the center of the compass rose. 	
	 Access to Runway interrupted when compass in use 	Operational
C5	 Runway 4L-22R surfaces may not be clear of obstacles when compass in use 	Constraints
	 Airfield signs within 150 feet from center of the compass rose 	CONSTIANTS
	 Surface is unpaved 	
	 Runway 4R-22L crossings for access to compass rose 	Favorable
C6	 Ultimate Runway 4L-22R Runway Object Free Surface will be upgraded from 	(Existing
	B-II to C-II, which widens the ROFA over the proposed compass rose. Thus,	Runway 4L-
	usable until the primary runway has at least 500 annual operations by C-II	22R)
	aircraft and officially upgraded accordingly.	,
	- Conference d	Favorable
	 Surface is unpaved. 	(Ultimate
C7	• This is a long-term solution dependent upon the north hangar area being	Runway 4L-
	developed.	, _ 22R)

 Table 4-7.
 Compass Rose Alternative Evaluation