Chapter 4 – Demand-Capacity & Facility Requirements Analyses

Chapter 4 – Airport Facility Requirements

Introduction

The evaluation of airport facility requirements uses the results of the inventory and forecasts contained in Chapters Two and Three, as well as established planning criteria, to determine the future facility needs for Bremerton National Airport through the current twenty year planning period. **Airside** facilities include runways, taxiways, navigational aids and lighting systems. **Landside** facilities include hangars, fixed base operator (FBO) facilities, aircraft parking apron, aircraft fueling, surface access and automobile parking, utilities, and other related items. All airfield items are evaluated based on established standards from the Federal Aviation Administration (FAA).

The facility requirements evaluation is used to identify the adequacy or inadequacy of existing airport facilities and identify what new facilities may be needed during the planning period based on forecast demand. Potential options and preliminary costs for providing these facilities will be evaluated in the Airport Development Alternatives (Chapter Five), to determine the most cost effective and efficient means for meeting projected facility needs.

Organization of Materials

This chapter evaluates facility requirements from two perspectives: (1) conformance of existing facilities with Federal Aviation Administration (FAA) airport design and airspace planning standards; and (2) new demand based facility needs that reflect the updated aviation activity forecasts presented in Chapter Three.

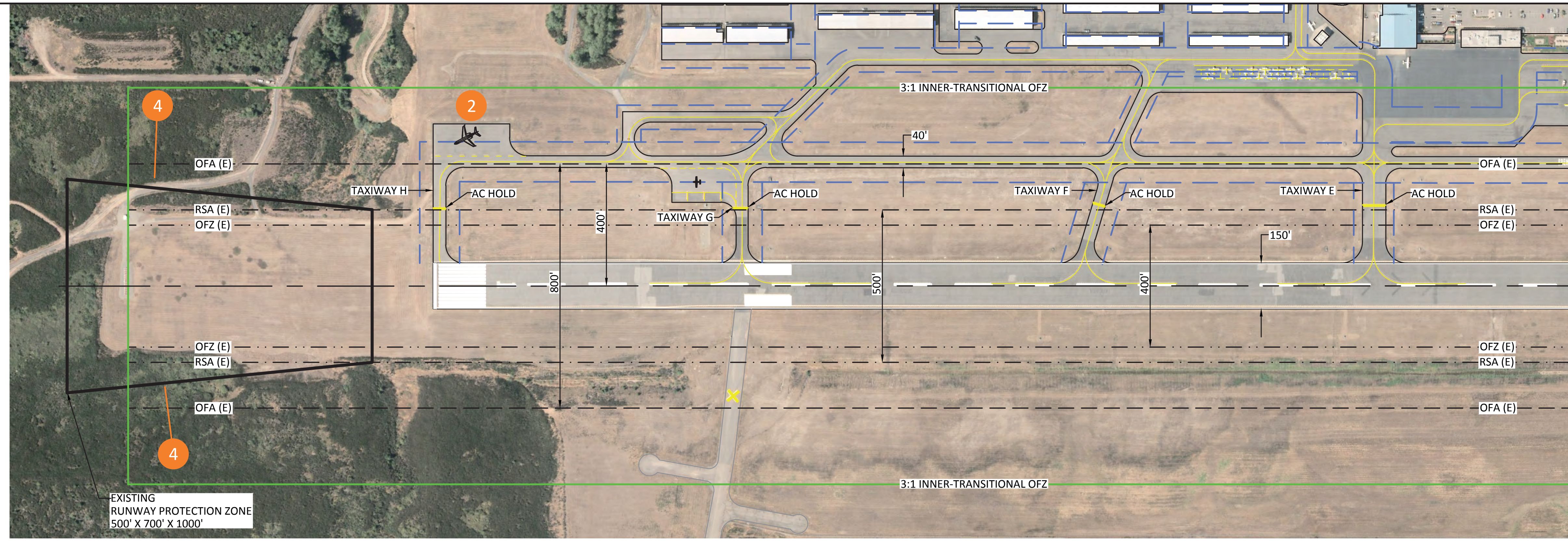
The evaluation of current and future conformance with FAA airport design standards and airspace planning criteria will be reflected on the updated FAA approved Airport Layout Plan. The evaluation of demand driven items will reflect in gross numbers, new facility needs such as runway length requirements, hangar spaces and aircraft parking positions based on forecast demand and the needs of the design aircraft. Items such as lighting and navigational aids are evaluated based on the type of airport activity, airport classification and capabilities.

The updated inventory of existing facilities presented in Chapter Two, is used to evaluate conformance with FAA standards. **Figures 4-1, 4-2, and 4-3** illustrate the location of the non-conforming items identified for the airport design standards described in this chapter. **Figure 4-1** depicts the runway-taxiway system and the runway protection zones at each runway end. **Figure 4-2** depicts the north section of the west landside area. **Figure 4-3** depicts the south section of the west landside area.

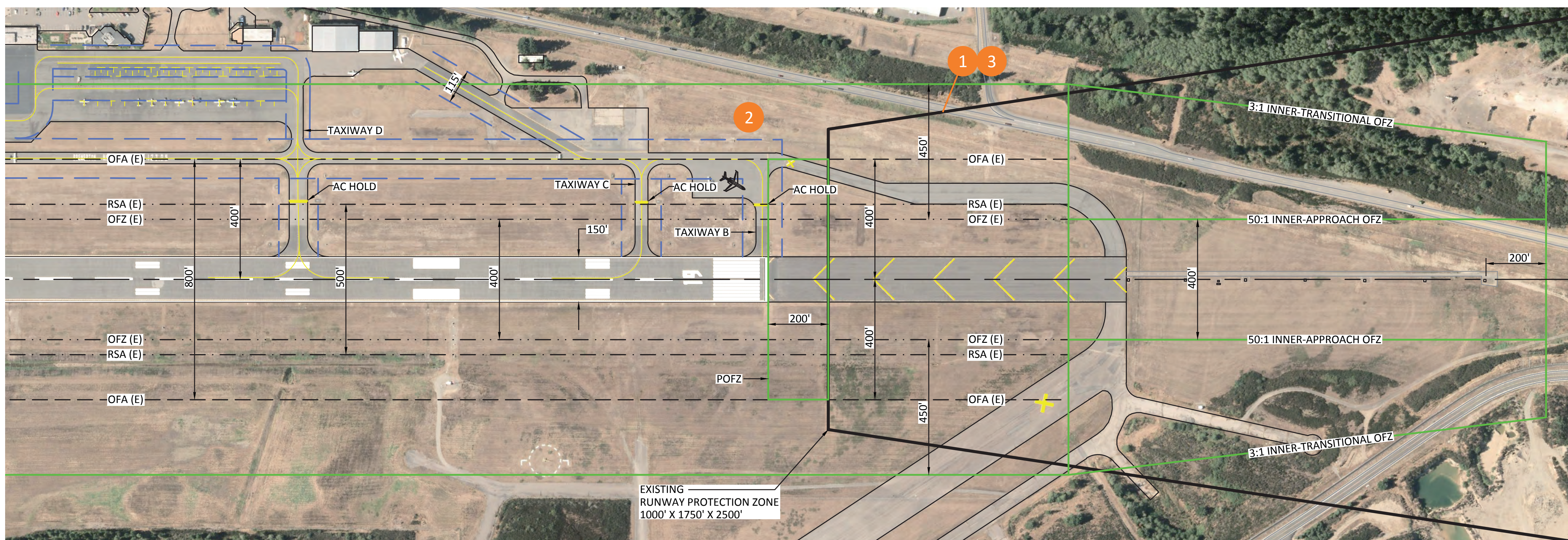
The most common nonstandard items identified in this evaluation are aircraft (wingtip) obstruction clearances for taxilanes located in hangar areas and in the terminal apron area. Although the clearances vary, most aircraft movements occur without incident. However, as facilities are updated or replaced (aircraft parking or hangars), new facilities should be designed to conform to appropriate design standards. The runway and west parallel taxiway meet, or exceed all applicable FAA design standards. Detailed definitions of the standards and their application at the Airport are provided throughout the chapter. The reader is encouraged to consult the Glossary of Aviation Terms provided previously to clarify technical information.

1 RPZ - ROAD
2 TAXIWAY OFA (AC HOLD)
3 RUNWAY APPROACH SURFACE PENETRATION IDENTIFIED (11 FEET) ON 2006 INNER APPROACH SURFACE DRAWING.
4 RUNWAY OFA (TERRAIN, VEGETATION) (TO BE VERIFIED)

TAXILANE/TAXIWAY OBJECT FREE AREA



Note: Runway numbers have been changed (repainted 02-20) to reflect curent magnetic heading 020-200 degrees.



BREMERTON NATIONAL AIRPORT | AIRPORT MASTER PLAN

PORT OF Bremerton Washington

AIRFIELD CONFORMANCE | **FIG. 4-1**

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BREMERTON NATIONAL AIRPORT | AIRPORT MASTER PLAN

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WEST LANDSIDE (NORTH AREA) CONFORMANCE | **FIG. 4-2**

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BREMERTON NATIONAL AIRPORT | AIRPORT MASTER PLAN

WEST LANDSIDE (SOUTH AREA) CONFORMANCE | FIG. 4-3

2004 Airport Master Plan Overview

The 2004[1] Bremerton National Airport Master Plan provided recommendations for airport facility improvements for a twenty-year planning period that extended to 2022. As noted in the Inventory Chapter, the south runway and parallel taxiway extension coupled with the elimination of the Runway 20 displaced threshold (runway shift), various lighting and drainage upgrades, the first phase of the SKIA connector road, and continued hangar development in the west landside area represent significant facility upgrades that were key elements in the previous planning for the airport.

The projects summarized in **Table 4-1** were included in the twenty year capital improvement program (CIP) for the 2004 Airport Master Plan. The projects that have been completed are noted in the table. The previously recommended improvements which have not been implemented will be revalidated, modified or eliminated based on the updated assessment of facility needs, current FAA guidelines and the elements of the Airport Master Plan preferred development alternative. Note: The runway was renumbered 2/20 in 2013 based on a change in magnetic declination.

TABLE 4-1: 2004 AIRPORT MASTER PLAN RECOMMENDED PROJECTS AND CURRENT STATUS

COMPLETED? YES/NO	PROJECTS
	Short Term (2004-2008)
Yes	Construct Runway 2-20/Taxiway A Shift
Yes	Add REILS and PAPI to Runway 1
Yes	Establish ROW for East Side Access
No	Environmental – Apron and Taxiway F Drainage *(taxiway design project to be completed in 2013)*
Yes	Upgrade PAPI-2 to PAPI-4 on Runway 20
No	Expand Aircraft Parking Apron (West Side) *(tiedown located opposite aircraft fueling area and T-hangars)*
No	Realign Taxiway F/Remove Old Pavement *(taxiway design project to be completed in 2013)*
Yes	Update Airport Layout Plan Drawings
Yes	Runway 2-20 Drainage Improvements
No	Pavement Removal
Yes	Equipment Replacement
	Intermediate Term (2009-2013)
Yes*	Environmental – Road and Hangar Development *(*environmental completed for SKIA connector road, but not for proposed east side hangar development)*
Yes	Construct Public Road (Phase 1) to East Side
No	Extend Utilities to East Side Hangar Area

1 Final Airport Master Plan Adopted in July 2004; the defined master plan planning period is 2002-2022.

No	Extend Taxiway B to East Side
No	Hangar Site Preparation *(east side)*
No	Hangar Construction *(east side)*
No	Construct Airport Perimeter Road to East Side
Yes	Rehabilitation (Overlay) Runway 02-20
No	Expand Aircraft Parking Apron (West Side)
No	Hangar Site Preparation
No	Hangar Construction *(east side)*
No	Upgrade MALSR on Runway 20
No	Add LAAS for GPS Approaches
Yes	Update Airport Master Plan
No	Pavement Removal
No	Airfield Pavement Rehabilitation
No	Equipment Replacement
	Long Term (2014-2023)
No	Complete East Side Access Road (Phase 2)
No	Expand General Aviation Terminal Building
No	Terminal Parking Expansion Vehicles
No	Remove Old Airfield Pavements
No	Grade West Side for Parallel Runway/Taxiway
No	Extend Taxiways D and F to East Side
No	Construct Parallel Taxiway on East Side
No	Hangar Site Preparation
No	Hangar Construction
No	Expand Aircraft Parking Apron
No	Update Airport Master Plan
No	Airfield Pavement Rehabilitation
No	Equipment Replacement

In addition to the master plan recommended items noted above, several other projects have been completed since 2004 including construction of several corporate and smaller storage hangars and the installation of the ADS-B transmitter.

FUTURE PARALLEL RUNWAY

The 2004 Airport Master Plan recommended adding a second runway to accommodate future flight training activity. The current Airport Layout Plan (last revised in 2006) depicts a future 2,400-foot parallel runway 700 feet west of Runway 02/20. Planning for the runway was based on small aircraft and its length would limit use to primarily small single engine aircraft. It appears that the second runway was added as a placeholder and other facilities on the east side of Runway 02/20 (taxiways, hangars, etc.) were planned to be compatible. Although a site grading project for the second runway was included in the 2014-2023 period of master plan's 20-year CIP, no projects were included for actual runway construction in the CIP.

Based on the updated aviation activity forecasts presented in Chapter Three, air traffic demand projected over the next twenty years is expected to remain below the current capacity provided by Runway 02/20. Normally, planning for a second runway is initiated when projected demand is expected to reach 60 percent of annual capacity, which is not anticipated in the current twenty-year planning period (see Airfield Capacity section at the end of this chapter). Based on an updated demand-capacity analysis, a second runway will not be required during the current planning period. However, the previous master plan recommendation should be discussed to determine if benefits other than additional capacity justify continuing to include a future second runway in long-term planning.

It is important to note that FAA funding for second runways is limited to airports with significant capacity needs or the need for noise abatement (when new runways are used to redirect aircraft arrival and departure routes away from noise sensitive areas). Neither of these scenarios appear to be consistent with future planning requirements at Bremerton National Airport. The ability to locally fund the initial construction cost and the life cycle costs for a new runway is an important element in the discussion.

Another practical consideration for maintaining a second runway in long term planning is the impact on near term planning and development of landside facilities (hangars, aircraft parking, etc.). As previously planned, the second runway and its protected areas require approximately 50 acres of prime developable land and the lateral clearances for the second runway pushes future landside facilities further east into rising terrain.

Design Aircraft

As indicated in Chapter Three (Aviation Activity Forecast), the current and future design aircraft identified for Bremerton National Airport is medium size business jet, included in **Aircraft Approach Category B** and **Airplane Design Group II (Airport Reference Code - ARC: B-II)**. The design aircraft represents the most demanding aircraft using the airport on a regular basis that meets the FAA's substantial use threshold (minimum of 500 annual itinerant operations). A variety of medium business jets and larger multi-engine turboprops are included in ARC B-II, including two of the three locally-based business jets (Cessna Citation VII and Dassualt Falcon 50); the third jet (Cessna Citation X) is included in ARC C-II. **Figure 3-6** (see Chapter 3, Page 29) depicts common aircraft for each ARC.

Bremerton National Airport also accommodates regular Approach Category C or D aircraft activity (Airplane Design Groups I and II), although activity is projected to remain below the required 500 annual operations during the current planning period. However, historic activity, the current mix of locally-based business jets, and forecast growth in jet activity suggest that this segment of business aviation activity has the potential to increase beyond current projections. Based on these factors, it would be prudent to protect the runway's ability to accommodate this activity in the future by establishing long-term development reserves based on ARC C-II/D-II design standards.

The 2004 Airport Master Plan identified B-II as the existing Airport Reference Code (ARC) for Runway 02/20, but forecast sufficient large military fixed wing transport activity to justify a future upgrade to ARC C-III However, as described in Chapter Three, airport management indicates that upgrades in facilities at Joint-Base Lewis McChord eliminated the need to operate large military transport aircraft at Bremerton National Airport on a regular basis and the projected levels of military transport activity have not occurred. As a result, the previous recommendation (future ARC C-III) is no longer supported by updated aviation activity forecasts and is not valid for use in the master plan. However, the existing ½-mile instrument approach visibility minimums for Runway 02/20 require the same dimensional standards for several runway protected areas (runway safety area, object free area, obstacle free zone, etc.) for ARC C/D-II and C-III. As a result, maintaining development reserves based on ARC C/D-II preserves most of the clearances previously defined by future ARC C-III.

Airport Design Standards

Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5300-13A, Airport Design, serves as the primary reference in planning airfield facilities. Federal Air Regulation (FAR) Part 77.25, Objects Affecting Navigable Airspace, defines airport imaginary surfaces which are established to protect the airspace immediately surrounding a runway. The airspace and ground areas surrounding a runway should be free of obstructions (i.e., structures, parked aircraft, trees, etc.) to the greatest extent possible to provide a safe operating environment for aircraft. FAA Order 8260.3B - United States Standard for Terminal Instrument Procedures (TERPS) defines protected airspace surfaces associated with instrument approaches and departures.

A comparison of existing conditions for Runway 02/20 and the B-II and C/D-II design standards are summarized in **Table 4-2**. A summary of Bremerton National Airport's current conformance with these various standards is presented in **Table 4-3**. Detailed narrative descriptions of design standards are presented in the following sections of the chapter.

TABLE 4-2: AIRPORT DESIGN STANDARDS SUMMARY (DIMENSIONS IN FEET)

FAA STANDARD	RUNWAY 02/20 *EXISTING CONDITIONS*[1]	AIRPLANE DESIGN GROUP II[2] *A&B AIRCRAFT APPROACH VISIBILITY < ¾ MILE*	AIRPLANE DESIGN GROUP II[2] *C&D AIRCRAFT APPROACH VISIBILITY < ¾ MILE*
Runway Length	6,000	5,310/6,740 [7]	5,310/6,740 [7]
Runway Width	150	100	100
Runway Shoulder Width	10	10	10
Runway Safety Area • Width • Beyond Rwy End • Prior to Landing Threshold)	 500 1,000 600	 300 600 600	 500 600 1,000
Obstacle Free Zone • Width • Beyond Rwy End • Prior to Landing Threshold)	 400 200 200	 400 200 200	 400 200 200
Object Free Area • Width • Beyond Rwy End • Prior to Landing Threshold	 800 1,000 600	 800 1,000 600	 800 1,000 600
Primary Surface Width	1,000	1,000	1,000
Primary Surface Length (Beyond Rwy End)	200	200	200
Runway Protection Zone Length	2,500 (Rwy 19) 1,000 (Rwy 01)	2,500 (Rwy 19) 1,000/1,700 (Rwy 01) [10]	2,500 (Rwy 19) 1,000/1,700 (Rwy 01) [10]
Runway Protection Zone Inner Width	1,000 (Rwy 19) 500 (Rwy 01)	1,000 (Rwy 19) 500 (Rwy 01)	1,000 (Rwy 19) 500 (Rwy 01)
Runway Protection Zone Outer Width	1,750 (Rwy 19) 700 (Rwy 01)	1,750 (Rwy 19) 700/1,510 (Rwy 01) [10]	1,750 (Rwy 19) 700/1,510 (Rwy 01) [10]
Runway Centerline to: Parallel Taxiway/Taxilane Centerline Aircraft Parking Line (APL) Building Restriction Line (BRL)	 400 559 [3] 790 [4]	 300 556 [8] 626/745 [9]	 400 556 [8] 626/745 [9]
Taxiway Width	40	35	35
Taxiway Shoulder Width	10	10	10
Taxiway Safety Area Width	79	79	79
Taxiway Object Free Area Width	131	131	131
Taxiway Centerline to Fixed/Movable Object	65.5 Except for AC Hold Areas[5]	65.5	65.5
Taxilane OFA Width (ADG I/II)	< 79 [6] / 115	79/115	79/115
Taxilane CL to Fixed/Movable Object (ADG I/II)	< 39.5 [6] / 57.5	39.5/57.5	39.5/57.5

Table 4-2 Notes:

1. Airfield dimensions as depicted on 2006 Airport Layout Plan (ALP).
2. Based on Other than Utility precision instrument runway (Per FAR Part 77). Runway Protection Zone dimensions based on approach visibility minimums lower than ¾-mile for all aircraft (Rwy 19) and not lower than 1-mile (Rwy 01 Existing)/as low as ¾-mile (Rwy 01 Future) (Per AC 150/5300-13A) based on 2006 ALP.
3. Nearest aircraft parking (Main Apron) is located approximately 575 feet west of runway centerline.
4. No existing BRL depicted on the 2006 ALP drawing. The nearest structure on the west side of the runway (U.S. Navy/CAP building) is approximately 710 feet from runway centerline. All other structures located at least 780 feet from runway centerline.
5. Parallel taxiway centerline to adjacent aircraft hold areas at runway ends (portion of holding aircraft may be located within Taxiway OFA).
6. Apron and hangar taxilane clearances with hangars and parked aircraft vary (See figure 4-2 and 4-3)..
7. Per FAA Runway Length Model: Runway lengths required to accommodate 75 percent of large airplanes (60,000 pounds or less) at 60 and 90 percent useful load at Bremerton National Airport. 75.3 degrees F, 3-foot change in runway centerline elevation.
8. Distance required to accommodate an 8-foot aircraft tail height without penetrating the 7:1 Transitional Surface extending from a 1,000-foot wide Primary Surface (precision instrument approach). This distance also clears the existing parallel taxiway OFA and the runway OFA. Setbacks for larger aircraft types (i.e., large business jets, etc.) would be based on tail height clearance of Transitional Surface slope. For example, a Gulfstream 650 (25.7-foot tail height) would require a 680-foot parking separation from the runway centerline, which is approximately 100 feet in front of the Avian Flight Center and Terminal buildings.
9. Distances required to accommodate 18-foot and 35-foot structures (typical T-Hangar and large conventional hangar roof heights) without penetrating the 7:1 Transitional Surface extending from a 1,000-foot wide Primary Surface (precision instrument approach) when ground elevation is the same for the runway and building. Setbacks for larger hangars or for hangars constructed in areas with terrain elevated above runway elevation would depend on roof elevation and actual clearance of Transitional Surface slope.
10. Existing Runway 02 RPZ based on approach visibilities of 1 mile/ Future Runway 02 RPZ based on approach visibilities not lower than 3/4-mile per 2006 ALP drawing,

All of the locally-based business jets and the majority of transient business jets operating at the Airport are classified as “large” general aviation airplanes based on their maximum takeoff weights above 12,500 pounds. The use of standards consistent with “large aircraft” and “other than utility” runways, as defined in FAR Part 77, is appropriate for Runway 02/20.

TABLE 4-3: BREMERTON NATIONAL AIRPORT CURRENT CONFORMANCE WITH FAA DESIGN STANDARDS

ITEM	AIRPLANE DESIGN GROUP II *A&B AIRCRAFT* *APPROACH VISIBILITY < ¾ MILE*	AIRPLANE DESIGN GROUP II *C&D AIRCRAFT* *APPROACH VISIBILITY < ¾ MILE*
Runway Safety Area	Yes	Yes[4]
Runway Object Free Area	Yes	Yes[4]
Runway Obstacle Free Zone	Yes	Yes
Taxiway Safety Area	Partial[1]	Partial[1]
Taxiway Object Free Area	Yes	Yes
Taxilane Object Free Area	No[2]	No[2]

Building Restriction Lines	Yes (west)	Yes (west)
	Yes (east)	Yes (east)
Aircraft Parking Lines	Yes	Yes
Runway Protection Zones	No[3]	No[3]
Runway - Parallel Taxiway Separation	Yes (E)	Yes
Runway Width	Yes (E)	Yes (E)
Runway Length	Yes	Yes
Taxiway Width	Yes (E)	Yes (E)

Table 4-3 Notes:

(E) Indicates facility dimension currently exceeds standard

1. Parallel Taxiway OFA is free of obstructions except where aircraft located in holding areas at both ends of the runway may partially penetrate OFA. The amount of penetration depends on size of aircraft.
2. Several existing taxilanes within aircraft parking aprons and hangar areas have less than 79 feet of unobstructed OFA; parked vehicles located in taxilanes adjacent to hangar rows create obstructions in taxilane OFA.
3. State Highway 3 is located within the existing Runway 20 RPZ. Portion of Runway 20 RPZ extends beyond airport property (Avigation Easements acquired). ARC C/D-II RSA for existing 6,000-foot runway can be accommodated within existing airport property, although some grading and compaction would be required.
4. ARC C/D-II OFA and RSA for existing 6,000-foot runway can be accommodated within existing airport property.

Airport Planning & Design Standards Note:

The following FAA standards are recommended for use in evaluating Runway 02/20 and its taxiway system:

Runway 02/20 (Existing/Future) *– Airport Reference Code (ARC) B-II. Runway design standards for aircraft approach category A & B runways with* ***lower than 3/4-statute mile*** *approach visibility minimums.*

*Existing and Future Runway Protection Zone (RPZ) for Runway 20 based on l****ower than 3/4-mile approach visibility minimums****. Existing RPZ for Runway 02 based on* ***not lower than 1-mile approach visibility****. Future RPZ for Runway 02 based on approach visibility standard* ***not lower than 3/4-mile****.*

FAR Part 77 airspace planning criteria based on "other than utility runways" with precision instrument approach (Rwy 19) and nonprecision instrument approach (Rwy 01) with visibility minimums as low as 3/4-statute mile.

Runway 02/20 (Reserve) *– Airport Reference Code (ARC) C/D-II. Runway design standards for aircraft approach category C & D runways with* ***lower than 3/4-statute mile*** *approach visibility minimums. No change in future RPZs for Runway 02 and 19. No change in FAR Part 77 airspace planning criteria.*

All references to the "standards" are based on these assumptions, unless otherwise noted (Per FAA Advisory Circular 150/5300-13A and FAR Part 77.25)

RUNWAY SAFETY AREA (RSA)

The FAA defines runway safety area (RSA) as “A defined surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway.” Runway safety areas are most commonly used by aircraft that inadvertently leave the runway environment during landing or takeoff.

By FAA design standard, the runway safety area “shall be:

(1) cleared and graded and have no potentially hazardous ruts, humps, depressions, or other surface variations;

(2) drained by grading or storm sewers to prevent water accumulation;

(3) capable, under dry conditions, of supporting snow removal equipment, aircraft rescue and firefighting equipment, and the occasional passage of aircraft without causing structural damage to the aircraft; and

(4) free of objects, except for objects that need to be located in the runway safety area because of their function. Objects higher than 3 inches above grade should be constructed on low impact resistant supports (frangible mounted structures) of the lowest practical height with the frangible point no higher than 3 inches. Other objects such as manholes, should be constructed at grade. In no case should their height exceed 3 inches.”

The recommended transverse grade for the RSA located along the sides of a runway ranges between 1½ and 5 percent from runway shoulder edges. The recommended longitudinal grade for the first 200 feet of RSA beyond the runway end is 0 to 3 percent. The remainder of the RSA must remain below the runway approach surface slope. The maximum negative grade is 5 percent. Limits on longitudinal grade changes are plus or minus 2 percent per 100 feet within the RSA.

The B-II RSA for Runway 02/20 appears to meet required geometric footprint and surface gradient standards and is free of physical obstructions, except for items with locations required by function (runway edge and threshold lights, information/directional signs, runway end identifier lights and precision approach path indicators, etc.). These items are mounted on frangible (break away) supports (per FAA standard). The RSA extending beyond the north end of the runway includes the former displaced threshold/paved overrun (150 feet wide) for its full length.

The 2006 Airport Layout Plan depicts an ultimate RSA for Runway 02/20 (500 feet wide and 1,000 feet beyond each runway end) which is consistent with the C/D-ARC II reserve noted above. Based on review of recent aerial photography, it appears that the outer edges of the C/D-II reserve RSA near the south end of the runway may require clearing and grading to its full width (250 feet from runway centerline) if development was pursued.

Airport management inspects runway and exit taxiway pavement edges to ensure that grass, dirt or gravel build ups do not exceed 3 inches and the RSA is cleared of brush or other debris and periodically graded and/or compacted to maintain FAA standards, as needed.

Any future runway extensions will require corresponding RSA improvements based on the applicable design standard. A summary of the RSA requirements based on the existing/future B-II ARC and the reserve C/D-II ARC is presented below:

Existing/Future Standard	***Reserve***
ARC B-II - 1/2-mile Approach Visibility Minimums	***ARC C/D-II - 1/2-mile Approach Visibility Minimums***
Runway Safety Area (RSA) 300 feet wide and extends 600 feet beyond each departure end of runway.	500 feet wide and extends 1,000 feet beyond each departure end of runway.
The RSA appears to be free of built items except those with locations fixed by function on break-away mounts. The RSA surface appears to meet gradient and compaction standards. Periodic maintenance and clearing is required. The RSA extending beyond the north end of the runway includes a 150-foot wide paved overrun. The center section of the RSA at the south end of the runway coincides with the localizer clear area, which prohibits terrain and physical items that could interfere with navigational aid electronic signal.	The RSA reserve can be accommodated within existing airport property. The same surface gradient and condition standards apply.

RUNWAY OBJECT FREE AREA (OFA)

Runway object free areas are two dimensional surfaces intended to be clear of ground objects that protrude above the runway safety area edge elevation. Obstructions within the object free area may interfere with aircraft flight in the immediate vicinity of the runway. The FAA defines the object free area clearing standard:

"The object free area clearing standard requires clearing the object free area of above ground objects protruding above the runway safety area edge elevation. Except where precluded by other clearing standards, it is acceptable to place objects that need to be located in the object free area for air navigation or aircraft ground maneuvering purposes and to taxi and hold aircraft in the object free area. Objects non-essential for air navigation or aircraft ground maneuvering purposes are not to be placed in the object free area. This includes parked airplanes and agricultural operations."

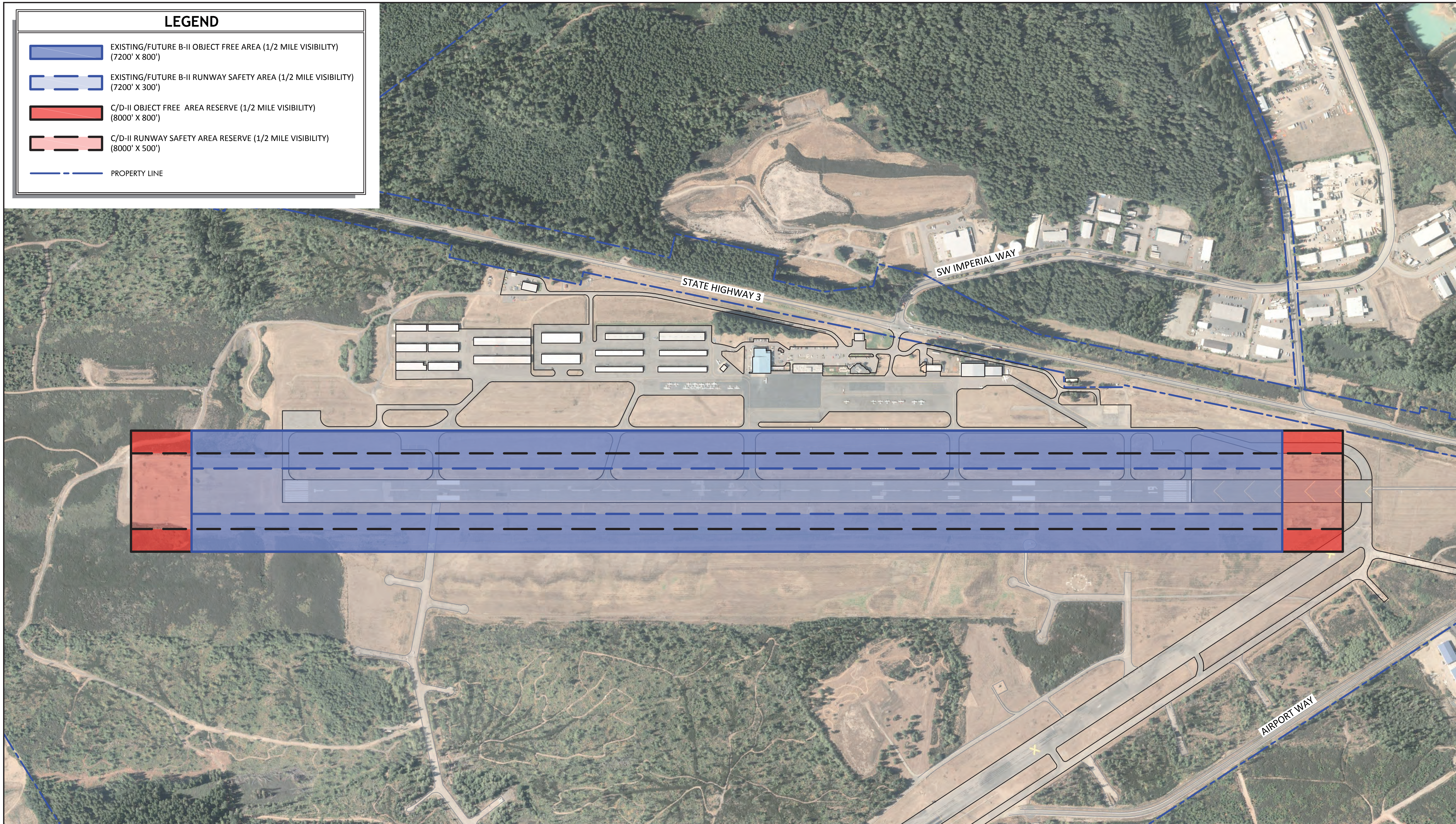
Based on review of recent aerial photography, it appears that the outer edges of the B-II runway object free area (OFA) near the south end of the runway may require clearing/grading to its full width (400 feet from runway centerline, 800 feet overall). The Inner Portion of Runway 1 Approach Surface Drawing (sheet 8 of 12), updated in 2006 following the south runway extension, identifies small areas of elevated terrain within the boundaries of the OFA beyond the RSA. Both the terrain elevation and height of vegetation within the OFA require site verification to determine if future improvements are needed. The remainder of the B-II OFA appears to be free of physical obstructions (excluding navigational aids, lighting, airfield signs, etc.) and meets FAA dimensional standards. Airport management periodically inspects the object free area and removes any protruding objects and clears vegetation.

The 2006 Airport Layout Plan depicts an ultimate OFA for Runway 02/20 (800 feet wide and 1,000 feet beyond each runway end) which is consistent with the C/D-ARC II reserve noted above. The ultimate OFA is depicted as being located entirely within airport property, however, the northwest corner of the OFA is located on the airport property line with a small section extending over the airport perimeter fence on the east side of Highway 3.

As with the RSA noted earlier, any future runway extensions will require corresponding object free area improvements based on the applicable design standard. A summary of the OFA requirements based on the existing/future B-II ARC and the reserve C/D-II ARC is presented below:

Existing/Future Standard	***Reserve***
ARC B-II - 1/2-mile Approach Visibility Minimums	***ARC C/D-II - 1/2-mile Approach Visibility Minimums***
Runway Object Free Area (OFA) 800 feet wide and extends 600 feet beyond each departure end of runway.	800 feet wide and extends 1,000 feet beyond each departure end of runway.
The south end of the OFA may require clearing and minor grading to meet obstruction clearing standards (to be verified). The remainder of the OFA appears to meet FAA standards. The center section of the OFA at the south end of the runway coincides with the localizer clear area, which prohibits terrain and physical items that could interfere with navigational aid electronic signal.	The OFA reserve can be accommodated within existing airport property, although its unobstructed length may be limited at the NW corner by an existing fence. The same surface gradient and obstruction clearance standards apply.

Figure 4-4 depicts the footprints of the runway object free area and runway safety area that are associated with both the current ARC B-II and reserve C/D-II based on the existing ½-mile approach visibility minimums.



BREMERTON NATIONAL AIRPORT | AIRPORT MASTER PLAN

PORT OF Bremerton Washington

RUNWAY 02/20 RUNWAY SAFETY AREA & OBJECT FREE AREA CLEARANCES | FIG. 4-4

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OBSTACLE FREE ZONE (OFZ)

The obstacle free zones (OFZ) are planes of clear airspace extending upward above runway elevation that are intended to protect close-in obstructions that may create hazards for aircraft. The FAA defines the following clearing standard for the OFZ:

"The obstacle free zone clearing standard precludes taxiing and parked airplanes and object penetrations, except for frangible visual NAVAIDs [navigational aids] *that need to located in the obstacle free zone because of their function."*

<u>The FAA defines the Runway Obstacle Free Zone as</u>:

"The runway OFZ [obstacle free zone] *is a defined volume of airspace centered above the runway centerline. The runway OFZ is the airspace above a surface whose elevation at any point is the same as the elevation of the nearest point on the runway centerline. The runway OFZ extends 200 feet beyond each end of the runway."*

The FAA recommended runway OFZ width for Runway 02/20 is 400 feet, based on its ability to serve large airplanes. Based on a recent visual inspection conducted during the master plan inventory, no penetrations to the existing runway OFZ were observed, other than the runway lights, precision approach path indicator units, runway end identifier lights, directional signage, and distance remaining signs which have locations fixed by function. All items currently located within the runway OFZ meet the FAA frangibility (break away) standard. Aircraft hold lines are located 250 feet from runway centerline on each of the exit taxiways connecting to the runway, which keeps holding aircraft entirely outside the runway OFZ; the aircraft holding areas located adjacent to Taxiways Bravo and Hotel are located outside the runway OFZ.

Based on current instrument approach capabilities, approach visibility minimums and approach lighting for Runway 20, one additional OFZ is defined for the runway (**Inner-transitional OFZ)** and two additional OFZs are defined for the Runway 20 end only (**Inner-approach OFZ** and **Precision OFZ**). They are summarized below:

<u>The FAA defines the Inner-transitional Obstacle Free Zone as:</u>

"The inner-transitional OFZ [obstacle free zone] *is a defined volume of airspace along the sides of the runway OFZ and the inner-approach OFZ. It applies only to runways with lower than ¾-statute mile approach visibility minimums.*

(1) *For runways serving large airplanes, separate inner-transitional OFZ* [obstacle free zone] *criteria apply for Category (CAT) I and CAT II/III runways.*[2]

(a) *For CAT I runways, the inner transitional OFZ* [obstacle free zone] *begins at the edges of the runway OFZ and inner-approach OFZ, then rises vertically for a height "H", and then slopes 6 (horizontal) to 1 (vertical) out to a height of 150 feet above the established airport elevation."*[3]

<u>The FAA defines the Inner-approach Obstacle Free Zone as:</u>

"The inner-approach OFZ [obstacle free zone] *is a defined volume of airspace centered on the approach area. It applies only to runways with an approach lighting system. The inner-approach OFZ begins 200 feet from the runway threshold at the same elevation as the runway threshold and extends 200 feet beyond the last light unit in the approach lighting system. Its width is the same as the runway OFZ and rises at a slope of 50 (horizontal) to 1 (vertical) from its beginning."*<u>The FAA defines the Precision Obstacle Free Zone as</u>:

"The Precision OFZ [obstacle free zone] *is defined as a volume of airspace above an area beginning at the runway threshold, at the threshold elevation, and centered on the extended runway centerline, 200 feet long by 800 feet wide."*

"The surface is in effect only when all of the following operational conditions are met:

(1) *Vertically guided approach*

(2) *Reported ceiling below 250 feet and/or visibility less than 3/4 –statute mile (or RVR* [runway visual range] *below 4,000 feet).*[4]

(3) *An aircraft on final approach within two (2) miles of the runway threshold.*

When the Precision OFZ [obstacle free zone] *is in effect, the wing of an aircraft holding on a taxiway waiting for runway clearance may penetrate the Precision OFZ; however, neither the fuselage nor the tail may infringe on the Precision OFZ."*

The existing aircraft holding area adjacent to Taxiway Alpha and Bravo is entirely clear of the Precision OFZ on Runway 20. The Inner Approach and Inner-Transitional OFZs appear to be free of obstructions, although portions of the sloped surfaces extend beyond airport property. The combined OFZ surfaces

[2] Runway Categories (I, II, III) refer the level of precision available, with Category I being the most typical for general aviation and smaller commercial runways; Categories II and III are more sophisticated and require special aircraft equipment and/or crew training.

[3] (1) In U.S. customary units, $H_{feet} = 61 - 0.094\ (S_{feet}) - 0.003\ (E_{feet})$. S is equal to the most demanding wingspan of the airplanes using the runway and E is equal to the runway threshold elevation above sea level.

[4] RVR: Runway Visual Range. A measurement (in feet) of visibility along the runway with transmissometer installed on the side of a runway.

define similar protected surfaces as the FAR Part 77 airspace surfaces for Runway 2/20. A summary of the runway obstacle free zones for current/future approach capabilities is presented below:

Existing/Future Standard	***Reserve***
ARC B-II - 1/2-mile Approach Visibility Minimums	***ARC C/D-II - 1/2-mile Approach Visibility Minimums***
Runway OFZ: 400 feet wide and extends 200 feet beyond each runway end.	Same dimensions and clearing standards
Inner Approach OFZ (Rwy 19 only): 400 feet wide, extending 200 feet beyond last approach light fixture at a slope of 50:1 **Inner Transitional OFZ**: Extends outward from edges of Runway OFZ at a slope of 6 to 1 to an elevation 150 feet above airport elevation **Precision OFZ** (Rwy 19 only): 800 feet wide and 200 feet long, beginning at runway threshold The OFAs for Runway 2/20 appear to be free of obstructions	Same dimensions, slope configurations, and clearing standards

TAXIWAY SAFETY AREA

Taxiway safety areas serve a similar function as runway safety areas and use the same design criteria for surface condition (see description of runway safety area provided earlier in this chapter), with varying dimensions based on airplane design group. The taxiway safety area standards are not affected potential changes in design aircraft (B-II to C/D-II (reserve)) discussed earlier.

It is noted that safety area standards do not apply to *taxilanes* typically located within hangar developments or aircraft parking aprons. Taxilanes provide aircraft access within a parking or hangar area; taxiways provide aircraft access between points on the airfield and serve runways (e.g. parallel taxiways and exit taxiways).

The main taxiways on the airfield (west parallel taxiway and exit taxiways) are designed to accommodate the same design aircraft as the runway (Airplane Design Group II). The sections of Taxiways Foxtrot, Golf and Hotel, west of Taxiway A, that provide access to adjacent hangar areas are designed to accommodate small airplanes (Airplane Design Group I).

The ADG II standard taxiway safety area dimension is 79 feet, centered on the taxiway, extending 39.5 feet each side of centerline. The ADG I taxiway safety area standard is 49 feet (24.5 feet from taxiway centerline). Items within the safety area that have locations fixed by function (taxiway reflectors, edge lights, signs, etc.) must be mounted on frangible (break away) mounts. Based on a recent visual inspection conducted during the master plan inventory, all existing taxiways appear to meet the surface condition and obstruction clearing standards required for taxiway safety areas.

As with runway safety areas, the ground surface located immediately adjacent to the taxiways periodically requires maintenance or improvement to adequately support the weight of an aircraft or an airport vehicle. Grading and/or soil compaction within taxiway safety areas should be completed as needed, and grass, brush or other debris should be regularly cleared to maintain FAA standards. Taxiway pavement edges should be periodically inspected to ensure that grass, dirt or gravel build ups do not exceed 3 inches.

TAXIWAY/TAXILANE OBJECT FREE AREA

Taxiway and taxilane object free areas (OFA) are intended to provide unobstructed taxi routes (adequate wingtip clearance) for aircraft. The outer edge of the OFA defines the recommended standard distance from taxiway or taxilane centerline to a fixed or moveable object. The FAA clearing standard prohibits service vehicle roads, parked aircraft, and above ground objects (hangars, other built items, etc.), except for objects with locations that are fixed by function (navigational aids, airfield signs, etc.). The applicable design standard (ADG I or ADG II) is determined by the largest size of aircraft that may be accommodated in aircraft parking areas or hangars served by that taxiway/taxilane. The taxiway/taxilane OFA standards are not affected potential changes in approach visibility minimums discussed earlier.

Major Taxiways

The major taxiways (parallel taxiway and exits) at Bremerton National Airport are designed to meet or exceed ADG II standards. The ADG II taxiway OFA width dimension is 131 feet. All existing built items or parked aircraft located along the taxiways have a minimum setback of 65.5 feet, which corresponds to the outer edge of the taxiway OFA. However, the aircraft holding areas located adjacent to Taxiway Alpha have limited space to accommodate aircraft beyond the taxiway OFA (65.5 feet from centerline). Options for addressing taxiway OFA clearance will be included in the alternatives analysis. The aircraft hold area located on the runway side of Taxiway Alpha near the Runway 20 threshold at Taxiway Bravo is identified to be removed on the 2006 Airport Layout Plan. As with the taxiway safety area, any items within the taxiway OFA that have locations fixed by function, must be frangible (break away mount) to meet the FAA clearing standard.

Taxilanes

The Airport has taxilanes that are used by small airplanes (ADG I) and larger aircraft (ADG II). These include taxilanes within the main apron area and in the various aircraft hangar areas on the airport. The taxilanes located adjacent to T-hangars and smaller conventional hangars are typically intended for use by ADG I aircraft. Taxilanes providing access to small airplane tiedowns also accommodate ADG I aircraft. Taxilanes located adjacent to larger hangars (door openings of 50 feet and larger) typically accommodate both ADG I and ADG II aircraft. The ADG I taxilane OFA standard dimension is 79 feet wide, extending 39.5 feet from centerline. The ADG II taxilanes OFA standard dimension is 115 feet wide, extending 57.5 feet from centerline.

West Hangar Area Taxilanes

The clearances provided on these taxilanes (measured as the opening between hangar rows) vary from approximately 70 to 90 feet and are generally less than the corresponding ADG I taxilane OFA standard of 79 feet. **Figures 4-2** and **4-3** presented earlier in the chapter illustrate the existing and standard taxilane OFA clearances.

Since the type of aircraft located within a particular hangar can change over time, the appropriate method for determining taxilane clearance standards is based on the largest aircraft that can be physically accommodated within the hangar. ADG II standards are applied to taxilanes serving larger hangars (door openings 50 feet and larger) and ADG I standards are applied to taxilanes serving small individual hangars or T-hangars.

The FAA allows a modification to standards for Taxilane OFA clearance based the following formula: 1.2 x airplane wingspan plus 20 feet. Using this formula, a taxilane with a 60-foot wide clearance could accommodate airplanes with wingspans up to 33 feet (33.3' x 1.2 + 20' = 60'). For comparison, a Cessna 172 and 182 both have wingspans of 36 feet; a Cessna 150 has a wingspan of 33.3 feet.

While relocation of most hangars is not considered highly feasible, any new hangars (and the associated taxilanes) planned should meet the applicable ADG I or II taxilane object free area clearance standard. A modification to FAA standards should be noted for these hangars, with the recommended disposition (reconfiguration) to be addressed when the hangars reach the end of their useful lives.

Apron Taxilanes

Taxilanes on the main apron provide access to aircraft parking, circulation within the apron and serve hangars, the airport administration building, Avian Flight Center, and the airport restaurant located along the back edge of the apron. The main apron has two direct taxilane connections to the parallel taxiway at its north and south ends (aligned with Taxiways Delta and Echo). North and south access taxilanes extend from the ends of the apron providing access to adjacent landside facilities. The north taxilane connects the row of corporate hangars to the main apron and parallel taxiway between Taxiways Charlie and Delta. The south taxilane provides access to the aircraft fueling area, the southern tiedown area, and the south hangar area. The south access taxilane connects to the parallel taxiway via the western sections of Taxiway Foxtrot and Hotel.

It appears that taxilanes adjacent to small airplane tiedowns are designed to provide 79 feet of clearance between adjacent tiedown anchors (39.5 feet from taxilane centerline to tiedown anchor). While this dimension is consistent with the ADG I taxilane OFA standard, the actual use of the tiedowns results in the front portion of a parked aircraft extending 3 to 6 feet into the adjacent taxilane, in effect creating an opening approximately 68 to 70 feet wide. **Figure 4-2** and **4-3** presented earlier in the chapter illustrates the nonstandard taxilane clearances created by parked aircraft (visible in the aerial photo). The OFA clearance on the western-most taxilane on the main apron appears to be limited by landscaping. Changes to existing aircraft parking configurations will be addressed in the alternatives analysis that can be implemented when the apron areas are rehabilitated, reconfigured, or expanded. All new aircraft parking aprons should be designed to provide standard taxilane OFA clearances to the adjacent parked aircraft, rather than tiedown anchors. Another issue related to taxilane OFA clearance in the south hangar area is the practice of parking vehicles on the taxilanes adjacent to hangar rows. Vehicle parking on hangar taxilanes is not consistent with FAA standards and creates a potential hazard for taxiing aircraft. Options for providing additional vehicle parking in the hangar area will be examined in the alternatives.

The section of the main apron located directly in front of the fixed base operator (FBO) (Avian Flight Center) is not marked with taxilanes or defined aircraft parking positions. Transient aircraft are directed during business hours by FBO staff to the desired parking position on the apron. Business aircraft are typically directed to park in a row facing the FBO building, which allows unassisted movement in and out of the parking area, passenger loading, and fueling. The perimeter of the FBO apron has a defined taxilane that provides access to the FBO apron and also routes other taxiing aircraft (to north tiedown area, fuel area, hangars) clear of the transient parking area in front of the FBO. The perimeter taxilane is designed to accommodate ADG II aircraft.

The south aircraft tiedown area is located near the south end of main apron, opposite the aircraft fueling area. The apron is configured with one double-sided row of tiedowns that are accessed directly from adjacent taxilanes. The west-facing tiedowns directly abut the south access taxilane that connects the main apron, fueling area, and south hangar area. Portions of parked aircraft in the west-facing tiedowns penetrate the adjacent taxilane OFA. A similar situation exists for the row of west facing tiedowns and the stub access taxilane used to access the tiedowns. Changes in apron and taxilane configuration will be addressed in the alternatives analysis.

BUILDING RESTRICTION LINE (BRL)

A building restriction line (BRL) identifies the minimum setback required to accommodate a typical building height, such as a T-hangar or large conventional hangar, based on the ability to remain clear of all runway and taxiway clearances on the ground, and the protected airspace surrounding a runway. Taller buildings are located progressively farther from a runway in order to remain beneath the 7:1 Transitional Surface slopes that extend laterally from both sides of a runway. By using this standard, adequate clearance for the runway inner-transitional obstacle free zone (6:1 slope), described earlier can also be met.

The 2006 Airport Layout Plan and Airfield Facilities Drawing do not depict existing or future BRLs for Runway 02/20 (included in drawing legends only). However, as noted earlier, it appears that a common building setback of 750 to 780 feet has been observed for all recently constructed buildings on the west side of the runway. The only building located closer to the runway (approximately 710 feet) is the small Civil Air Patrol/U.S. Navy building located at the north end of west landside area. No existing structures were identified as obstructions to any FAR Part 77 airspace surface on the 2006 Airspace Plan or associated drawings. Please see the FAR Part 77 Airspace section later in the chapter for a description of the transitional surface and the other protected airspace surfaces.

A 750-foot BRL can accommodate structures with roof heights up to 35.7 feet above runway elevation (at the BRL) without penetrating the runway transitional surface associated with the existing precision instrument approach. At 780 feet from runway centerline, a structure height 40 feet above runway elevation can be accommodated. Taller structures require increased setback distances from the runway in order to avoid penetrating the runway transitional surface.

There are no existing structures on the west side of the runway, except for housings used for the instrument landing system glideslope and weather observation station. The nearest planned structures (hangars) on the west side of Runway 02/20 depicted on the 2006 Airport Layout Plan are located approximately 1,180 feet from runway centerline on slightly elevated terrain.

All new construction on or in the immediate vicinity of the Airport should routinely involve FAA review for airspace compatibility. FAA Form 7460-1, Notice of Proposed Construction or Alternation, should be prepared and submitted to FAA at least 60 to 90 days prior to planned construction. The 7460 form should be submitted by the Port for any projects located on the Airport and submitted by the applicant for any projects located off airport property (coordinated with City of Bremerton and Kitsap County, if outside Bremerton city limits). The FAA reviews all proposed development to determine if the proposed action would create any obstructions to FAR Part 77 airspace surfaces. In general, the FAA will object to proposals that result in a penetration to any FAR Part 77 airspace surfaces on the basis of safety.

A summary of the BRL requirements based on the existing/future B-II ARC and the reserve C/D-II ARC is presented below:

Existing/Future Standard	***Reserve***
ARC B-II - 1/2-mile Approach Visibility Minimums	***ARC C/D-II - 1/2-mile Approach Visibility Minimums***
Building Restriction Line (BRL) 1,000-foot wide primary surface used to define building setback distances. BRL locations can be adjusted to accommodate different building heights. As a general planning rule, no structures permitted within the primary surface or penetrating the 7:1 transitional surface. The existing 750-foot building setback observed on the west side of the runway allows structures up to 35.7 feet above runway elevation. This distance also minimizes the potential for ILS signal reflection on metal sided hangars located closer to the runway. Structures with lower roof heights could be accommodated with reduced setbacks if desired by the Airport, however any proposed development should meet all FAA technical requirements for ground based electronic navigational aid performance and air safety. No existing structures penetrate airspace surface associated with Runway 02/20.	Same dimensions and clearing standards

RUNWAY PROTECTION ZONES (RPZ)

The FAA provides the following definition for runway protection zones:

"The RPZ's [runway protection zone] *function is to enhance the protection of people and property on the ground. This is best achieved through airport owner control over RPZs. Control is preferably exercised through the acquisition of sufficient property interest in the RPZ and includes clearing RPZ areas (and maintaining them clear) of incompatible objects and activities. The RPZ is trapezoidal in shape and centered about the extended runway centerline. The RPZ's begins 200 feet beyond the end of the area useable for takeoff or landing." The central portion and controlled activity area are the two components of the RPZ. The central portion of the RPZ extends from the beginning to the end of the RPZ, centered on the* [extended] *runway centerline and is equal to the width of the runway OFA.*

The FAA also distinguishes between approach and departure RPZs. However, in most cases, the approach RPZ provides the more stringent requirements and is typically larger than departure RPZs for runways with lower approach visibility minimums.

Runway protection zones (RPZ) with buildings, roadways, or other items do not fully comply with FAA standards. It is recognized that realigning major surface roads located within the RPZs may not always be feasible. As noted earlier, the FAA recommends that airport sponsors control the RPZs through ownership whenever possible, although avigation easements[5] are commonly used when outright purchase is not feasible.

The 2006 Airport Layout Plan depicts existing and future RPZs for both runway ends based on existing and future approach capabilities. For Runway 20, the existing and future RPZ is consistent with approach visibility minimums lower than 3/4-mile. The RPZ dimensions are 2,500 feet long, 1,000 feet wide on the inner end, and 1,750 feet wide on the outer end, totaling 78.9 acres. Areas in the outer portion of the Runway 20 RPZ extend beyond airport property. The current Airport Property Map indicates that avigation easements were acquired for these areas through prior FAA-funded projects.

The existing Runway 1 RPZ is consistent with approach visibility minimums not lower than 1-mile. The RPZ dimensions are 1,000 feet (length), 500 feet (inner end), and 700 feet (outer end), totaling 13.8 acres. The future Runway 02 RPZ is consistent with a reduction in approach visibility minimums to not lower than 3/4-mile. The future RPZ dimensions are: 1,700 feet long, 1,000 feet wide (inner end), and 1,510 feet (outer end), totaling 49 acres. The existing and future RPZ dimensions noted above would be unchanged except for the existing RPZ for Runway 1. Both the existing and future RPZs identified for Runway 1 are located entirely on airport property.

Note: FAA Guidance of RPZs and Roads (Fall 2012)

In October 2012, the FAA released new guidance regarding runway protection zones and roads. In short, the policy directs airport sponsors to evaluate any planned changes to existing RPZs that introduce or increase the presence of roads in RPZs. Existing roads within RPZs are also to be evaluated during master planning to determine if feasible alternatives exist for realignment of roads outside RPZs or for changes to the RPZs themselves. Any proposed changes in the length or configuration of Runway 02/20 that changes the location of existing RPZs evaluated in this study are subject to review by FAA headquarters in Washington D.C.

A summary of the BRL requirements based on the existing/future B-II ARC and the reserve C/D-II ARC is presented below:

[5] An avigation easement (*avigation* = *aviation* + *navigation*) involves the purchase of airspace rights over a particular defined ground area. The easement normally limits the maximum height of any natural or built items (to coincide with the runway approach surface slope) and may include provisions restricting the type of activities permitted. Compensation is negotiated between the airport owner and property owner.

Existing/Future Standard	*Reserve*
ARC B-II - 1/2-mile Approach Visibility Minimums	***ARC C/D-II - 1/2-mile Approach Visibility Minimums***
Runway Protection Zone (RPZ) RPZ dimensions determined by runway category and approach visibility minimums. Runway 20: Not lower than ¾-mile visibility minimums Runway 02: Not lower than 1-mile approach visibility minimums (current) and not lower than ¾-mile approach visibility minimums (future) The majority of existing and future RPZs are located on airport property. The Port has acquired avigation easements for the outer end of the Runway 20 RPZ located off airport property.	Runway 20: Same dimensions and clearing standards Runway 02: Upgrade to ARC C/D-II would require increase in RPZ dimension for "not lower than 1-mile" although the dimension required for "not lower than ¾-mile" for ARC B-II or C/D-II is the same

AIRCRAFT PARKING LINE

The aircraft parking line (APL) represents the minimum setback required for locating aircraft parking in order to clear the adjacent runway-taxiway system. The location of the APL is generally determined by the more demanding of runway airspace clearance and taxiway obstruction clearance.

The nearest aircraft tiedowns on the west side of Runway 02/20 are located approximately 575 feet from runway centerline. The west facing row of tiedowns located near the aircraft fueling area is approximately 600 feet from runway centerline. At 575 feet from runway centerline, an aircraft tail height of approximately 10.7 feet can be accommodated without penetrating the runway transitional surface, assuming the same elevation between the runway and apron. Tail heights of 10 feet and lower are typical of most small aircraft. Larger aircraft (business jets, turboprops, etc.) have tail heights typically ranging from 12 to 26 feet and require increased setback distances to avoid penetrating the transitional surface. Please see the FAR Part 77 Airspace section later in the chapter for a description of the transitional surface. This distance is also beyond the west edge of the Taxiway A object free area (OFA), which is 465.5 feet from runway centerline.

The updated Airport Layout Plan will depict recommended aircraft parking setbacks based on the preferred alternative for all existing and future aircraft parking areas on the Airport based on applicable FAA standards. A summary of the APL requirements based on the existing/future B-II ARC and the reserve C/D-II ARC is presented below:

Existing/Future Standard	***Reserve***
ARC B-II - 1/2-mile Approach Visibility Minimums	***ARC C/D-II - 1/2-mile Approach Visibility Minimums***
Aircraft Parking Line (APL) 1,000-foot wide runway primary surface and Taxiway A OFA used to define aircraft parking setback distances. As a general planning rule, no parked aircraft permitted within the primary surface or penetrating the 7:1 transitional surface. The existing 575-foot aircraft parking setback observed on the west side of the runway allows aircraft tail heights up to 10.7 feet above runway elevation.	Same dimensions and clearing standards; no change in existing runway-to-parallel taxiway separation is required.

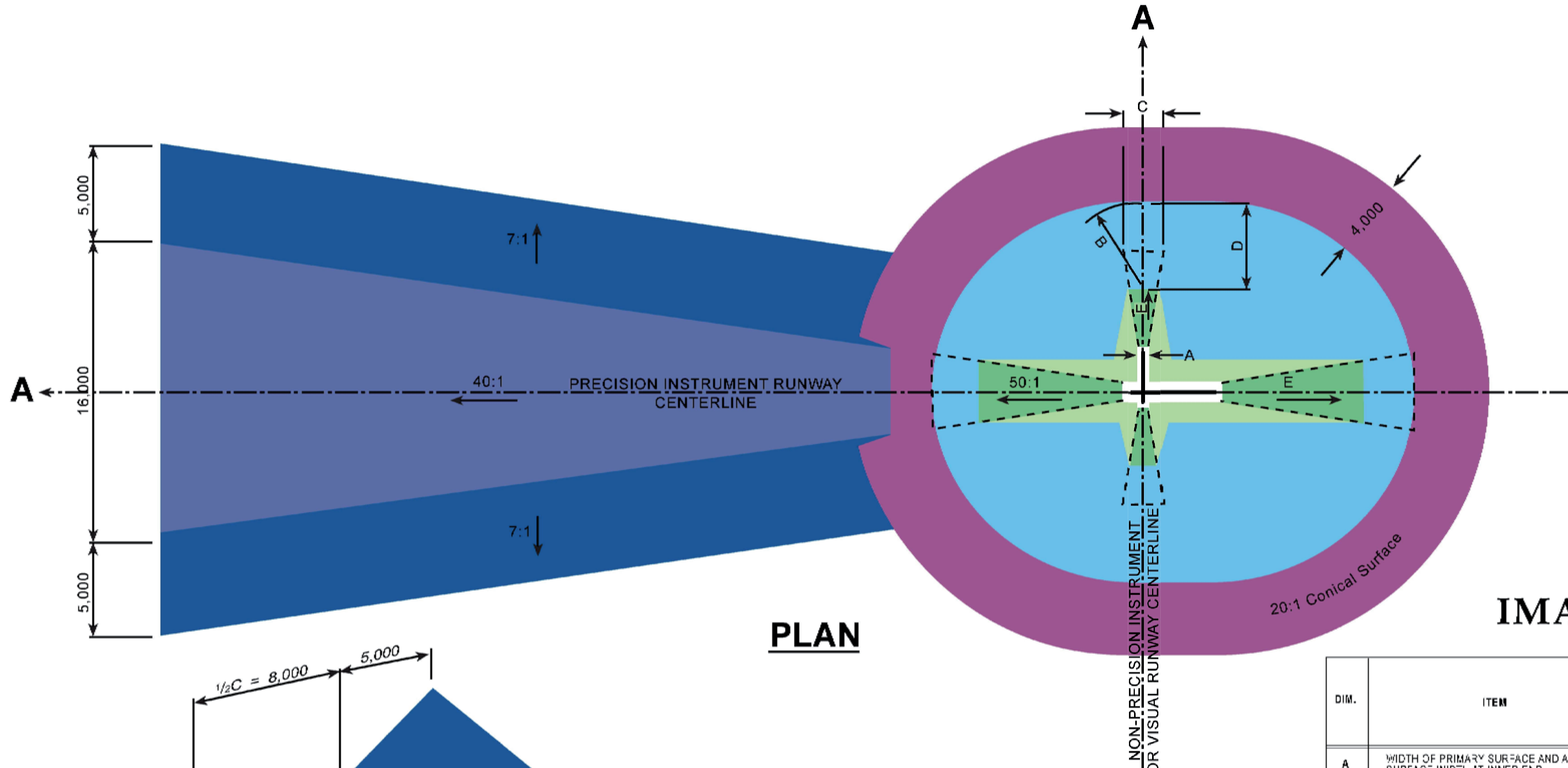
RUNWAY - PARALLEL TAXIWAY SEPARATION

Runway 02/20 has a full-length west parallel taxiway (Taxiway A) with a runway separation of 400 feet. The separation exceeds the B-II dimensional standard for runways with lower than ¾-mile approach visibility minimums and meets the standard for C-II (reserve) with the same visibility minimums. A summary of the parallel taxiway separation standards based on the existing/future B-II ARC and the reserve C/D-II ARC is presented below:

Existing/Future Standard	***Reserve***
ARC B-II - 1/2-mile Approach Visibility Minimums	***ARC C/D-II - 1/2-mile Approach Visibility Minimums***
Runway-Parallel Taxiway Separation B-II: 300 feet	C/D-II (reserve): 400 feet

FAR Part 77 Surfaces

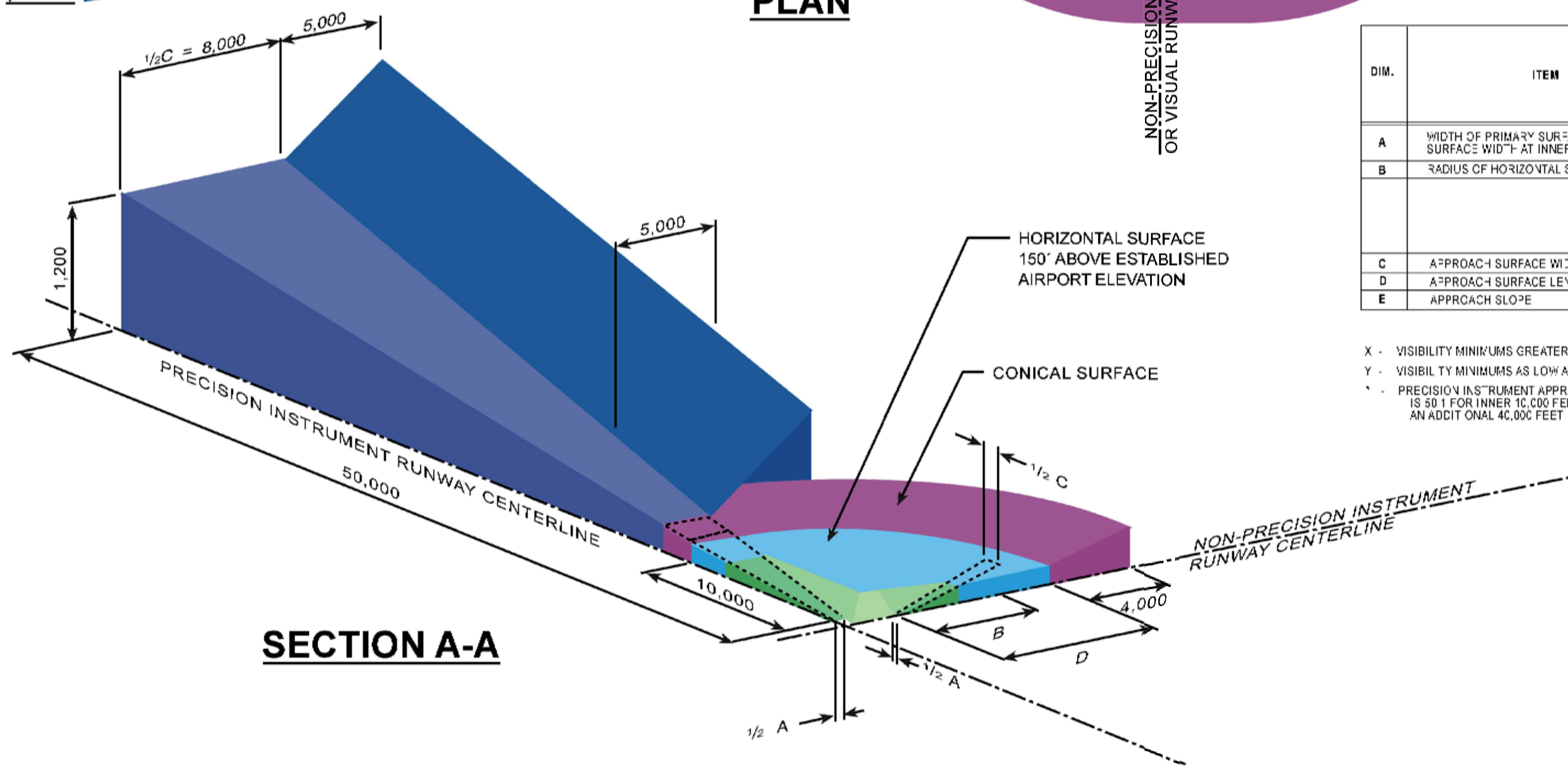
Airspace planning for U.S. airports is defined by Federal Air Regulations (FAR) Part 77 – Objects Affecting Navigable Airspace. FAR Part 77 defines imaginary surfaces (airspace) to be protected surrounding airports. **Figures 4-5 and 4-6** on the following pages illustrate plan and isometric views of generic Part 77 surfaces. **Table 4-4** summarizes the airspace surface dimensions for Bremerton National Airport based on current and future approach/visibility options.



CIVIL AIRPORT IMAGINARY SURFACES

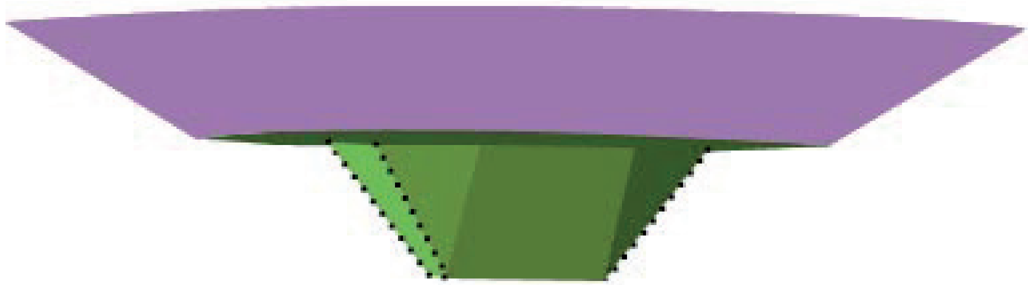
DIM.	ITEM	DIMENSIONAL STANDARDS (FEET)					
		VISUAL RUNWAY		NON-PRECISION INSTRUMENT RUNWAY			PRECISION INSTRUMENT RUNWAY
		UTILITY	LARGER THAN UTILITY	UTILITY	LARGER THAN UTILITY X	LARGER THAN UTILITY Y	
A	WIDTH OF PRIMARY SURFACE AND APPROACH SURFACE WIDTH AT INNER END	250	500	500	500	1,000	1,000
B	RADIUS OF HORIZONTAL SURFACE	5,000	5,000	5,000	10,000	10,000	10,000
		VISUAL APPROACH		NON-PRECISION INSTRUMENT APPROACH			PRECISION INSTRUMENT APPROACH
		UTILITY	LARGER THAN UTILITY	UTILITY	LARGER THAN UTILITY X	LARGER THAN UTILITY Y	
C	APPROACH SURFACE WIDTH AT END	1,250	1,500	2,000	3,500	4,000	16,000
D	APPROACH SURFACE LENGTH	5,000	5,000	5,000	10,000	10,000	*
E	APPROACH SLOPE	20:1	20:1	20:1	34:1	34:1	*

X - VISIBILITY MINIMUMS GREATER THAN 3/4 MILE
Y - VISIBILITY MINIMUMS AS LOW AS 3/4 MILE
* - PRECISION INSTRUMENT APPROACH SLOPE IS 50:1 FOR INNER 10,000 FEET AND 40:1 FOR AN ADDITIONAL 40,000 FEET

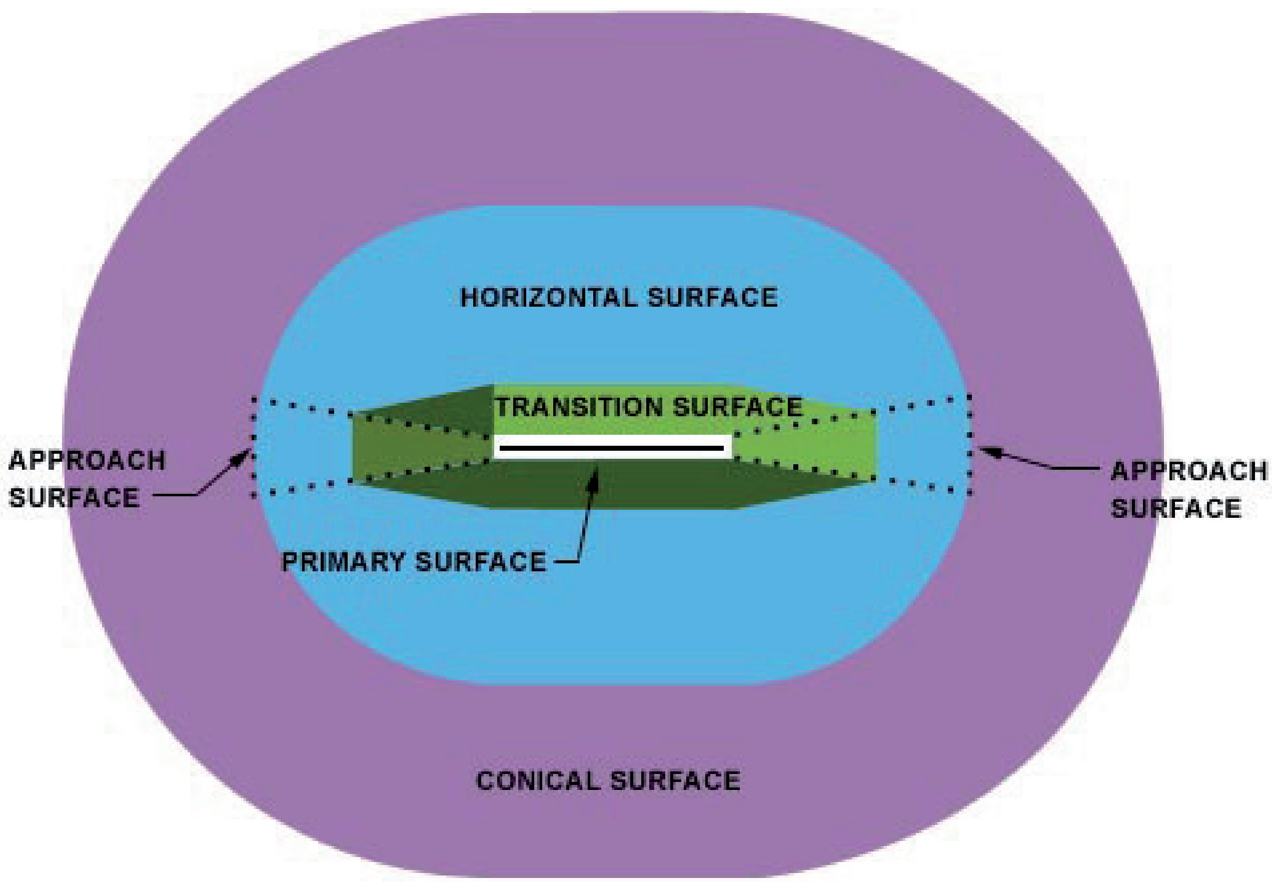


SECTION A-A

HEIGHT HAZARD AIRSPACE SURFACES



PROTECTED AIRSPACE



OVERHEAD VIEW

TABLE 4-4: FAR PART 77 AIRSPACE SURFACES

ITEM	**RUNWAY 02/20** *Other than Utility (Precision)* *(Standard Based on Ultimate Airspace Configuration, as depicted on 2006 Airspace Plan)*
Width of Primary Surface	1,000 feet
Transitional Surface	7:1 Slope to 150 feet above runway
Horizontal Surface Elevation/Radius	150 feet above airport elevation/10,000 feet
Conical Surface	20:1 for 4,000 feet
Approach Surface Length	Rwy 19: 50,000 feet Rwy 01: 10,000 feet
Approach Surface Slope	Rwy 19: 50:1 - Inner 10,000 feet Rwy 19: 40:1- Outer 40,000 feet Rwy 01: 34:1
Approach Surface Width at End	Rwy 19: 16,000 feet Rwy 01: 4,000 feet

The 2006 Airspace Plan depicts “ultimate” airspace surfaces based on “other than utility” precision instrument approach for Runway 20 and nonprecision instrument approach (visibility as low as ¾ mile) for Runway 02. The ultimate airspace surfaces also depict a future “utility” visual runway, the parallel general aviation runway recommended in the last master plan. Utility visual runways have 5,000-foot long approach surfaces with a slope of 20:1 and a 250-foot wide primary surface.

The Airspace Plan identified 47 items in the obstruction table (17 of these items are repeated on the extended approach surface drawing for Runway 20). The majority of obstructions were identified in the horizontal, transitional and conical surfaces, with a small number in the runway approach surfaces. The obstructions included 39 “tree/trees,” 5 “ground,” 2 “Rods” (for obstruction lights mounted on glide slope and a tower), and 1 “transmission towers.” Disposition for the obstructions includes tree trimming or removal (or adding an obstruction light on a pole), ground excavation, and aeronautical study for the electrical transmission towers.

It should be noted that the current obstructions to airspace surrounding Runway 02/20 has been factored into current instrument approach minimums, although mitigation is recommended whenever possible to improve obstruction clearance for aircraft in both instrument and visual flight conditions.

APPROACH SURFACES

Runway approach surfaces extend outward and upward from each end of the primary surface, along the extended runway centerline. As noted earlier, the dimensions and slope of approach surfaces are determined by the type of aircraft intended to use the runway and most demanding approach planned for the runway.

In accordance with FAA standards, threshold siting surfaces (TSS) were utilized for both runway ends to obtain required obstruction clearance within prescribed FAA limits based on approach type and visibility minimums. A 34:1 TSS was used on Runway 20 and a 20:1 TSS was used on Runway 20. The recommended obstruction dispositions (terrain excavation, etc.) are based on clearing the threshold siting surfaces. The use of the appropriate TSS for obstruction clearance provides an acceptable level of safety without necessarily requiring displacement or relocation of a runway threshold. The 20:1 TSS for Runway 02 is compatible with the current 1-mile instrument approach visibility minimums and the planned future reduction to ¾-mile.

The Inner Approach Surface drawings for Runway 20 and 01 identified a total of 15 additional items in their obstruction tables. With two notable exceptions (roads), the items and their dispositions were generally similar to the obstructions listed on the Airspace Plan. For Runway 20, Highway 3 (15-foot high vehicles traveling on the road) are identified as an obstruction (11 foot penetration). The recommended disposition was excavation. Future roads were also identified as potential obstructions. The Phase 1 of the SKIA connector road was identified with 23 to 39-foot penetrations to the TSS for Runway 20. The updated Airspace Plan will include elevation data from the actual road construction to determine the extent of obstruction, if any. A proposed airport service road that would extend beyond the north end of the runway to connect with the east side of the airfield was identified with a potential 11-foot penetration approximately 65 feet from the beginning of the Runway 20 approach surface and TSS. The alignment of the proposed airport service road will be reviewed in the alternatives analysis to determine if new FAA standards discouraging roads in runway protection zones (RPZ) are feasible.

PRIMARY SURFACE

The primary surface is a rectangular plane of airspace, which rests on the runway (at centerline elevation) and extends 200 feet beyond the runway end. The primary surface should be free of any penetrations, except items with locations fixed by function (i.e., PAPI, runway or taxiway edge lights, etc.). The primary surface end connects to the inner portion of the runway approach surface.

The 2006 Airspace Plan depicts a 1,000-foot wide primary surface for Runway 02/20 that is consistent with the runway category, existing approach capabilities and approach visibility minimums. The Airspace Plan identified 4 obstructions in the primary surface, including 3 to 6-foot ground penetrations on the east side of the runway, mid-runway-south (recommended to be excavated) and a 30-foot penetration on the glideslope antennae (no action required, equipped with obstruction light).

TRANSITIONAL SURFACE

The transitional surface is located at the outer edge of the primary surface, represented by a plane of airspace that rises perpendicularly at a slope of 7 to 1, until reaching an elevation 150 feet above runway elevation, where it connects to the runway horizontal surface. The transitional surface should be free of obstructions (i.e., parked aircraft, structures, trees, etc.).

The Airspace Plan identified 18 obstructions (17 trees, 1 ground) in the runway transitional surface. No building or other built item penetrations were identified in the runway transitional surfaces.

HORIZONTAL SURFACE

The horizontal surface is a flat plane of airspace located 150 feet above runway elevation with its boundaries defined by the radii (10,000 feet for other than utility instrument runways) that extend from each runway end. The outer points of the radii for each runway are connected to form an oval, which is defined as the horizontal surface.

The 2006 Airspace Plan depicts the horizontal surface elevation at 604 feet above mean sea level (MSL), based on a future published airport elevation of 454 feet (high point on future parallel runway). Areas of terrain/tree penetrations are identified east and northeast of the runway. The recommended disposition was to trim and/or place obstruction lights on poles, presumably to identify representative obstructions on high terrain, rather than individual trees. In the event that the previously recommended parallel runway is not maintained on the updated Airport Layout Plan, the elevation of the horizontal surface will be adjusted based on the high point on the airfield (currently 444 feet MSL at the Runway 02 end).

CONICAL SURFACE

The conical surface is an outer band of airspace, which abuts the horizontal surface. The conical surface begins at the elevation of the horizontal surface and extends outward 4,000 feet at a slope of 20:1. The 2006 Airspace Plan depicts the top elevation of the conical surface 804 feet MSL, 200 feet above the horizontal surface and 350 feet above airport elevation. Areas of terrain/tree penetrations are identified northwest and northeast of the runway (same recommended disposition as horizontal surface).

Airside Requirements

Airside facilities are those directly related to the arrival and departure and movement of aircraft:

- Runways
- Taxiways
- Airfield Instrumentation and Lighting

Runways

The adequacy of the existing runway system at Bremerton National Airport was analyzed from a number of perspectives including runway orientation, airfield capacity, runway length, and pavement strength.

RUNWAY ORIENTATION & WIND COVERAGE

The orientation of runways for takeoff and landing operations is primarily a function of wind velocity and direction, combined with the ability of aircraft to operate under adverse wind conditions. A runway's wind coverage is measured by an aircraft's ability to operate with a "direct" crosswind, which is defined as 90 degrees to the direction of travel. For runway planning purposes, the maximum direct crosswind for small aircraft is 12 miles per hour (10.5 knots); for larger general aviation aircraft, a 15-mile per hour (13 knot) direct crosswind is used. Aircraft are able to operate safely in progressively higher wind speeds as the crosswind angle decreases and the wind direction turns more closely to the direction of flight. In addition, some aircraft are designed to safely operate with higher crosswind components. Ideally, an aircraft will take off and land directly into the wind or with light crosswind. The FAA recommends that primary runways accommodate at least 95 percent of local wind conditions; when this level of coverage is not provided, the FAA recommends development of a secondary (crosswind) runway.

The wind rose depicted on the 2006 Airport Layout Plan (cover sheet), indicates that Runway 02/20 accommodates approximately 99.97 percent of local wind conditions for small aircraft and 100 percent of local wind conditions for larger aircraft. The wind rose reflects eleven years of wind data collected between 1992 and 2001.

RUNWAY LENGTH

Runway length requirements are based primarily upon airport elevation, mean maximum daily temperature of the hottest month, runway gradient, and the critical aircraft type expected to use the runway. For general aviation airport runways used by large aircraft (typically aircraft with maximum takeoff weights between 12,500 pounds and 60,000 pounds), the FAA recommends an evaluation based on the "family of aircraft" approach which captures the most common aircraft within a particular category. For Bremerton National Airport, the future design aircraft identified in the updated aviation activity forecasts is a medium size business jet (above 12,500 pounds), such as a Cessna Citation Excel. FAA Advisory Circular (AC) 150-5324-4B, Runway Length Requirements for Airport Design identifies a group of "airplanes that make up 75 percent of the fleet." **Table 4-5** summarizes representative aircraft within this "family of aircraft," which includes the design aircraft for Bremerton National Airport. Based on the FAA-recommended methodology, planning for Runway 02/20 should be consistent with the requirements of this segment of activity.

The potential to accommodate commercial air service with transport category aircraft in the future does exist based on general market conditions and periodic inquires fielded by airport management. However, the ability to accurately quantify this type of activity or predict a potential timeline is premature based on current information. Airline inquires directed to airport management have indicated a preferred runway length of approximately 7,000 feet at Bremerton National Airport to accommodate an MD80 class of aircraft, although shorter runway lengths may be adequate for some operations. The feasibility and operating limitations of increasing useable runway length to 7,000 feet will be briefly examined later in the master plan as a "place holder" for the Port in the event that demand materializes, creating the need to examine the options in greater detail.

TABLE 4-5: AIRPLANES THAT MAKE UP 75% OF THE FLEET (LARGE AIRPLANES LESS THAN 60,000 POUNDS)

- British Aerospace – Bae 124-700
- Beechcraft/Mitsubishi/Raytheon - Beechjet – 400A, Premier I
- Bombardier – Challenger 300
- Cessna – Citation I/II/III/V/VII, CJ-2, Bravo, Excel, Encore, Sovereign
- Dassault – Falcon 10, 20, 50
- Israel Aircraft Industries – Jet Commander 1121, 1123, 1124
- Learjet - 20 series, 30 series, 40, 45
- Raytheon Hawker – Hawker 400, 600
- Rockwell - Saberliner 75

It is noted that the 2004 Airport Master Plan recommended an ultimate runway length of 6,000 feet for an ADG III transport category design aircraft (military version of the DC-9, predecessor to the MD-80 series). However, the runway length analysis also indicated that use of the 75 percent of the large airplane fleet at either the 60 or 90 percent of useful load, was an appropriate methodology to reflect the requirements for current and forecast business jet traffic at the Airport.

A summary of FAA recommended runway lengths for planning based on the requirements of small aircraft and large general aviation aircraft in a variety of load configurations is presented in **Table 4-6**. The runway length requirements for a variety of business aircraft are summarized in **Table 4-7** for comparison to the output from the FAA model.

TABLE 4-6: FAA RECOMMENDED RUNWAY LENGTHS FOR PLANNING (FROM FAA COMPUTER MODEL)

Runway Length Parameters for Bremerton National Airport • Airport Elevation: 444 feet MSL • Mean Max Temperature in Hottest Month: 75.3 F • Maximum Difference in Runway Centerline Elevation: 3 Feet • Wet Runway • Existing Runway Length: 6,000’	
Small Airplanes with less than 10 seats	
75 percent of these airplanes	2,490 feet
95 percent of these airplanes	3,020 feet
100 percent of these airplanes	3,610 feet
Small airplanes with 10 or more seats	4,090 feet
Large Airplanes of 60,000 pounds or less	
75 percent of these airplanes at 60 percent useful load *(Consistent with Current/Future Design Aircraft)*	**5,310 feet**
75 percent of these airplanes at 90 percent useful load *(Consistent with C/D-II Aircraft that define long term development reserves)*	6,740 feet
100 percent of these airplanes at 60 percent useful load	5,500 feet
100 percent of these airplanes at 90 percent useful load	7,350 feet
Airplanes of more than 60,000 pounds	5,170 feet

Based on local conditions and the methodology outlined in **AC 150/5324-4B,** the existing runway length of 6,000 feet is adequate to accommodate 75 percent of large airplanes (60,000 pounds or less maximum gross takeoff weight) at 60 percent useful load under typical operating conditions.[6] Some aircraft may experience operational limits (payload or fuel) on warmer days during the summer months. Larger or more complex business jets may experience operational constraints more frequently either during warmer summer months or when the runway has a thin accumulation of snow or ice after a winter storm event.

The FAA indicates that the selection of the 60- or 90-percent of useful load curves is based on the haul lengths and service needs of critical design aircraft. Assuming a typical haul length of 500 miles or less, it appears that 60 percent of useful load profile for the 75 percent of the fleet is most consistent with current and forecast activity. Reasonable justification would be required to demonstrate to FAA that the typical operational requirements of the design aircraft family are consistent with the higher useful load assumptions. As noted earlier, the FAA establishes a “substantial use threshold” of 500 annual itinerant takeoffs and landings for the design aircraft or family of design aircraft. To pursue a runway extension

[6] Useful load is generally defined as passengers, cargo, and usable fuel.

based on the higher demand profile, the Port would need to document sufficient activity (either aircraft currently using the airport that are regularly constrained by current runway length or new aircraft unable to operate at the airport due to runway length) to meet the FAA substantial use threshold.

The runway length requirements summarized in **Table 4-7** suggest that the majority of medium business jets are able operate on the current 6,000-foot Runway 02/20 without significant operational limits in the most common local weather conditions. However, at higher temperatures, passenger and/or fuel load limitations may occur for aircraft in this category and for some multi-engine turboprop aircraft and larger business jets may be more limited by available runway length.

TABLE 4-7: TYPICAL BUSINESS AIRCRAFT RUNWAY REQUIREMENTS

AIRCRAFT	PASSENGERS (TYPICAL CONFIGURATION)	MAXIMUM TAKEOFF WEIGHT	RUNWAY LENGTH REQUIRED FOR TAKEOFF[1]	RUNWAY LENGTH REQUIRED FOR LANDING[2]
Cessna Citation CJ1+	4-6	10,700	3,530	2,660
Cessna Citation CJ2+	6-7	12,500	3,590	3,060
Cessna Citation CJ3	6-7	13,870	3,610	3,140
Cessna Citation CJ4	6-7	16,950	3,440	2,740
Cessna Citation Bravo	6-9	14,800	3,920	3,310
Cessna Citation Excel	7-8	20,000	3,750	3,260
Cessna Citation VII	7-8	22,450	4,950	3,000
Citation Sovereign	9-12	30,300	3,750	2,710
Cessna Citation X	8-12	36,100	5,340	3,530
Learjet 45	7-9	20,500	5,660(a)	3,060(a)
Challenger 300	8-15	37,500	6,440(a)	2,990(a)
Gulfstream 100 (Astra)	6-8	24,650	7,010(a)	3,360(a)
Gulfstream 200 (G-II)	8-10	35,450	7,900(a)	3,770(a)
Gulfstream 300 (G-III)	11-14	72,000	6,630(a)	3,670(a)

1. FAR Part 25 or 23 Balanced Field Length (Distance to 35 Feet Above the Runway); Sea Level, 77 degrees F; Zero Wind, Dry Level Runway, 15 degrees flaps, except otherwise noted.
2. Distance from 50 Feet Above the Runway; Flaps Land, Zero Wind.

(a) For general comparison only. Manufacturer runway length data based on sea level and standard day temperature (59 degrees F) at maximum takeoff/landing weight;

Source: Aircraft manufacturers operating data, flight planning guides.

Runway Width

Runway 02/20 is 150 feet wide which exceeds the 100-foot minimum width dimensional standard for current and forecast general aviation activity, runway approach capabilities and approach visibility minimums. However, as noted earlier, Runway 02/20 is capable of accommodating large military or commercial transport aircraft in a variety of missions critical to both national security and regional emergency response. This capability was preserved in the most recent runway extension/shift and rehabilitation completed in 2006.

Airfield Pavement

As noted in the Inventory Chapter, an updated airfield pavement maintenance and management study for Bremerton National Airport will be completed by WSDOT Aviation in 2013. The updated pavement plan, along with other engineering analyses will be the primary decision making tools for the ongoing maintenance and replacement of airfield pavements. Pavement rehabilitation for Taxiway Alpha and exit taxiways is planned for 2014. Some aircraft apron areas and hangar taxilanes will require rehabilitation or reconstruction during the current planning period. All airfield pavements will require ongoing maintenance. For planning purposes, rehabilitation of asphalt pavements is typically assumed on a 15- to 25-year cycle, depending on use and pavement design. Crack filling and fog/slurry seals should be performed on a regular basis for all asphalt sections to maximize the useful life of the pavement. A prioritized list of pavement rehabilitation or reconstruction projects will be provided in the updated capital improvement program.

Ideally, airfield pavements designed to accommodate all aircraft operating at an airport should have the same weight bearing capacity as the primary runway. Pavements accommodating small aircraft (hangar taxilanes, etc.) are normally designed based on 12,500 pound aircraft weight. In 2010, the pavement strength for Runway 02/20 was evaluated and determined to be 196,000 pounds for dual wheel aircraft landing gear configurations. Taxiway A was rated at 86,000 pounds for dual wheel aircraft and the exit taxiway ratings ranged from 103,000 to 201,000 pounds. The majority of dual wheel aircraft operating at the Airport have maximum operating weights of 100,000 pounds or less, with the majority of business jets weighing less than 75,000 pounds. The appropriate design parameters for the Taxiway A and exit taxiway rehabilitation will be determined in design. However, an asphalt overlay or combination surface grind and overlay may provide a marginal increase in current pavement strength for each section.

Taxiways

Taxiways are constructed primarily to facilitate aircraft movements to and from the runway system. Some taxiways are necessary simply to provide access between apron and runways, while other taxiways become necessary as activity increases and safer and more efficient use of the airfield is needed. The existing taxiway system at Bremerton National Airport provides aircraft access to the runway and all landside facilities.

PARALLEL TAXIWAY

The parallel taxiway (Alpha) serving Runway 02/20 provides efficient access to the runway from the west landside area. No major capacity or service related improvements are anticipated during the current 20-year planning period. The parallel taxiway has six 90-degree connecting exit taxiways and one angled exit taxiway (Foxtrot) that has previously been recommended for replacement with a 90-degree exit. Taxiway Alpha is 40 feet wide, which exceeds the minimum dimensional width standard for ADG II (35 feet). The exit taxiways vary in width, but all meet or exceed the ADG II width standard.

Recent FAA guidance on runway-taxiway connections suggests that direct, unbroken taxiway routes extending from aircraft parking aprons directly to a runway have the potential of creating hot spots for runway safety/incursion. Currently, Taxiways Delta and Echo are configured with direct access from each end of the main apron to the runway, after crossing Taxiway Alpha. A taxiway rehabilitation project is programmed for 2014 and the configuration of the exit taxiways will be examined for possible modification.

As noted earlier in the chapter, the parallel taxiway has aircraft holding areas located near each end of the runway that may require modification to meet the ADG II taxiway object free area (OFA) clearance. Large aircraft located in the hold areas may partially penetrate the parallel taxiway OFA, which by FAA standard should be clear of parked or holding aircraft.

TAXILANES

The future development of new hangars and aircraft parking on the east side of the airport will require additional taxilanes. Access taxiways and taxilanes serving small hangar development are 25 feet wide for ADG I aircraft and 35 feet wide for ADG II aircraft. As noted earlier in this chapter, several existing hangar taxilanes do not meet FAA taxilane object free area clearing standards. While it may not be feasible to relocate existing hangars, new hangars should be configured to meet FAA standards.

The taxilanes located within the main aircraft apron should be configured to provide the standard object free area clearances for the specific aircraft types. Light airplane tiedown rows and adjacent taxilanes are typically designed to accommodate (ADG) I aircraft; parking positions for larger, business class aircraft should be designed based on ADG II taxilane clearing standards. The taxilane centerline to the nearest fixed/moveable object (parked aircraft) of 39.5 and 57.5 feet, correspond to the object free area dimensions for ADG I and II.

Taxiway Echo currently provides primary taxiway access to the main apron for larger business and military aircraft. Taxiway Delta, located at the north end of the main apron provides access to the north tiedown apron. The option of adding a second ADG II taxilane connection between the main apron and Taxiway Alpha, near mid apron should be considered as a future option to improve ground movement for larger aircraft on the apron.

Airfield Instrumentation, Lighting and Marking

NAVIGATIONAL AIDS

Runway 02/20 currently supports a straight-in precision (ILS) instrument approach to Runway 20 and straight-in nonprecision approaches to Runway 02, including a back course ILS procedure.

Runway 02/20 is equipped with a Category I instrument landing system that includes a glide slope located near the Runway 20 end and a localizer located beyond the end of Runway 02. Both navigation aids have FAA-defined critical areas designed to protect the integrity of the electronic transmission signals. It is noted that all existing exit taxiways for Runway 02/20 are located on the west side of the runway. Future expansion of landside facilities on the east side of the airport will require additional taxiway access. New east side taxiways, particularly taxiways at the north end of the runway, will need to meet all FAA location and “ILS hold” requirements to protect the glide slope, which is located approximately 1,000 feet from the end of Runway 20. The FAA’s long range plan for maintaining conventional ground based navigation aids, particularly ILS equipment, remains unclear. However, it is possible that the next generation replacement for the ILS that provides comparable approach capabilities will be based entirely or largely on satellite navigation. However, until a clear replacement platform is identified by FAA, the airspace and protected ground areas associated with the ILS must continue to be protected.

The Port-owned nondirectional beacon (NDB) located on the east side of the airfield was recommended for relocation/removal in the previous master plan based on a need to accommodate future hangar and taxiway development. The decommissioning of the NDB is scheduled for July 2014.

Runways with Category I instrument landing systems (ILS) are often equipped with Runway Visual Range (RVR) instrumentation. Automated RVR systems provide pilots with distances (in feet) where runway markings are visible, compared to normal AWOS visibility measurements in increments of a mile. The RVR sensors are installed adjacent to the runway at one or more points in order to provide accurate, unbroken line of sight measurements along the entire length of the runway. The addition of RVR on Runway 02/20 may be considered to improve the operational capabilities of the current instrument approaches and weather reporting.

RUNWAY/TAXIWAY LIGHTING

As noted in the Inventory Chapter, the lighting systems associated with Runway 02/20 and the major taxiways are all in good operating condition. Normal replacement of lighting systems is usually assumed between 20 and 30 years, although installations in marine environments often have shorter useful lives. For planning purposes, the updated capital improvement program will include replacement for any existing lighting system that reaches 25 years old during the current planning period.

The previous master plan recommended installation of runway end identifier lights (REIL) on Runway 02 (done) and replacement of the 2-light precision approach path indicator (PAPI) on Runway 20 with a 4-light PAPI (done). The 2006 Airport Layout Plan (ALP) identifies a future runway protection zone (RPZ) for Runway 02 based on approach visibility minimums "not lower than ¾-mile." This normally requires installation of an approach lighting system (ALS), similar to the MALS-R on Runway 20. However, the ALP does not depict a future ALS and the capital improvement program does not include an ALS project for Runway 02. This recommendation will be evaluated in the alternatives analysis.

RUNWAY MARKINGS

Runway 02/20 has precision instrument markings on the Runway 20 end and non-precision markings on the Runway 02 end, consistent with existing instrument approach capabilities (threshold marking bars, runway end numbers and aiming point markings located approximately 1,000 feet from each end of the runway). The markings were applied during the runway shift and rehabilitation projects and will require periodic repainting as they wear. The runway exit taxiways have yellow aircraft hold line markings located 250 feet from runway centerline, which meets the runway obstacle free zone (OFZ) and runway safety area (RSA) clearing standard.

The runway designation numbers (02/20) will be changed to "02/20" in an upcoming project due to changes in magnetic declination.

AIRFIELD SIGNAGE

The lighted airfield signage (location, mandatory, directional, destination, and distance remaining signs) are internally illuminated and are in generally good condition.

AIRFIELD LIGHTING

The airfield lighting systems (airport beacon, wind cones) are in good condition and reportedly function normally.

On Field Weather Data

The airport has an Automated Weather Observation System (AWOS-3), which allows aircraft licensed under FAR Part 135 (air taxi/charter) and private aircraft operating under FAR Part 91 to operate in IFR conditions. The AWOS provides weather data to support airport operations in both visual and instrument conditions. Local pilots have indicated that a need exists to upgrade the existing AWOS unit to provide additional weather data. Options for adding sensors to the existing system or upgrading the entire system will be examined.

Landside Facilities

For general aviation airports, landside facilities are generally defined as those that serve aircraft, passenger needs and their related functions. At Bremerton National Airport, landside facilities include aircraft aprons, hangars, fixed base operator (FBO), and aircraft fueling facilities.

The airport currently has one full service FBO (Avian Flight Center) that provides a variety of services to local and transient aircraft and flight training. Currently, all aviation services are provided on the west side of the runway. Future development of landside facilities on the east side of the runway should include space to accommodate additional FBO and aircraft fueling facilities. The development of landside facilities on both sides of a runway often results in split operations for FBO and fueling services, which in turn, creates additional demand for hangar and aircraft parking space. To the extent feasible, it is preferable to minimize taxiing distances and reduce the frequency of runway crossings by providing adequate landside facilities, such as aircraft parking and hangars, capable of supporting each development area. However, local market conditions generally dictate the economic feasibility of serving physically separated landside facility areas with services such as fuel.

The 2006 Airport Layout Plan depicts a future airport service road extending from the north end of the west landside area to the east landside area. New FAA guidance on roads within runway protection zones (RPZ) is now being applied to on-airport service roadways in addition to public roadways. Current FAA airport design standards recommend routing airport service roads around the perimeter of RPZs when possible. Options for providing future on-airport service roads for airport maintenance, emergency and service vehicles will be included in the alternatives analysis.

As noted in the Inventory chapter, the west landside area of the Airport has reached a development limit based on capacity limitations of existing stormwater basins and readily developable sites. As a result, it is anticipated that most new hangar development and other support facilities will be located on the east side of Runway 02/20. In order to accommodate new east side development, extensions or upgrades will be required to existing surface access, utilities and stormwater systems.

The 2006 Airport Layout Plan does not depict a future FBO or aircraft parking apron on the east side of runway, although for long-term planning purposes, options for establishing development areas or reserves to accommodate business and general aviation aircraft should be considered.

AIRCRAFT PARKING AND TIEDOWN APRON

Aircraft aprons provide parking for locally based aircraft that are not stored in hangars and for transient aircraft visiting the airport and for specialized ground operations such as aircraft fueling or air cargo. At Bremerton National Airport, the main apron area accommodates parking for large and small fixed wing aircraft and helicopters. Additional small airplane parking is provided in the south tiedown area, near the Avian Flight Center and fueling area. The Airport's aircraft fueling island is located immediately south of the Avian Flight Center.

The main apron area currently has 48 small airplane tiedowns in two west-facing rows and the south tiedown area has 23 small airplane tiedowns in one dual-sided row. As noted earlier, the spacing of the taxilanes serving the tiedowns does not fully conform to FAA taxilane object free area standards. Options for reconfiguring the existing aircraft parking aprons to meet FAA taxilane design standards will be evaluated in the airport development alternatives. The current capacity of 71 small airplane tiedowns may change, depending on the need for reconfiguration to meet FAA design standards.

In order to address the uncertainty associated with predicting long term demand, aircraft apron reserve areas should be identified to preserve the Airport's ability to accommodate user needs. A development reserve area equal to 50 to 100 percent of the net twenty year parking demand (net demand above available capacity) will provide a conservative planning guideline to accommodate unanticipated demand, changes in existing apron configurations, and demand beyond the current planning period. The location and configuration of the development reserves will be addressed in the alternatives analysis.

Light Aircraft Parking Demand (Local and Itinerant)

For planning purposes, it is assumed that 85 percent of forecast based aircraft will be stored in hangars and 15 percent will use apron parking. Based on the projected increase over the twenty year planning period, **41 light aircraft tiedowns will be required for locally based aircraft by 2032**. These estimates may prove to be overly optimistic in gauging apron parking demand for based aircraft as additional hangar space is developed at the Airport. However, this approach will ensure that adequate apron is preserved for long term use.

FAA **Advisory Circular 150/5300-13** suggests a methodology by which itinerant parking requirements can be determined from knowledge of busy day operations. Future demand for itinerant parking spaces was estimated based on 40 percent of design day itinerant operations (40% of daily itinerant operations divided by two, to identify peak parking demand). The FAA planning criterion of 360 square yards per itinerant aircraft was applied to the number itinerant spaces to determine future itinerant ramp requirements. **By 2032, itinerant aircraft parking requirements are estimated to be 25 aircraft positions**. It is anticipated that the parking requirements would include space for small airplanes, business aircraft and helicopters (see below). Projected aircraft parking requirements are summarized in **Table 4-8**.

Corporate Aircraft Parking

The Airport accommodates regular itinerant business aircraft activity including turboprops and business jets in the apron area adjacent to the Avian Flight Center. As noted earlier, this section of apron is not marked with specific aircraft parking positions, but the apron appears to be large enough to accommodate projected demand for business aircraft parking. The alternatives analysis will evaluate aircraft parking configuration options for this section of apron that meet FAA design standards for taxilane clearance and provide efficient movement of aircraft.

Initially, it appears that four parking positions (drive-through) for transient corporate aircraft are adequate to accommodate current typical peak demand adjacent to the general aviation terminal/FBO. It is estimated that six business aircraft parking positions will be needed by 2032. In the event that additional FBO facilities are developed on the east side of the airport, a portion of the projected demand may need to be accommodated in different areas.

Air Cargo Aircraft

Bremerton National Airport accommodates daily small package express flights with Cessna Caravan single-engine turbine aircraft or a variety of multi-engine turboprops. 1 or 2 designated parking spaces with adequate space for aircraft loading/unloading and support vehicle access appears to be adequate for current and projected needs.

Helicopter Parking

Bremerton National Airport accommodates locally based and transient helicopters, including aircraft used in flight training. It appears that providing parking for 1 or 2 transient helicopters will be adequate for the foreseeable future. Longer term demand may require additional helicopter parking. Peninsula Helicopters also uses a portion of the main apron for aircraft parking during normal business hours.

Aircraft Fueling Apron

The existing aircraft fueling area can accommodate two small aircraft simultaneously at the fuel island. The covered fueling area appears to be adequate for current and projected use, although as noted earlier, the need to develop new hangars and related facilities on the east side of the runway may require a second fixed-point fueling area to serve the east flight line.

AIRCRAFT HANGARS

Bremerton National Airport accommodates a wide variety of hangars including commercial hangars and hangars used primarily for aircraft storage. It is estimated that 85 percent of the airport's 192 based aircraft are stored in hangars, with the remaining aircraft parked on aircraft apron. For planning purposes, it is assumed that existing hangar space is committed and all additional (forecast) demand would need to be met through new construction.

As indicated in the aviation activity forecasts, the number of based aircraft at Bremerton National Airport is projected to increase by 84 aircraft during the twenty year planning period. Based on a projected 85 percent hangar utilization level, additional long term demand for new hangar space is estimated to be 71 spaces (approximately 106,500 square feet). A planning standard of 1,500 square feet per based aircraft stored in hangars is used to project gross space requirements. The projected hangar requirements for aircraft storage at Bremerton National Airport are presented in **Table 4-8.**

In addition to aircraft storage, additional demand for business related and commercial hangar needs is anticipated. Specialized aviation service businesses such as engine & airframe repair, avionics, interior and paint shops generally prefer locations that provide convenient aircraft access. Highly successful aviation service businesses generally rely on both locally based aircraft and their ability to attract customers from outside the local area. While there is no specific formula to predict demand for general aviation service businesses at a particular airport, reserving several spaces for larger commercial hangars is recommended.

Individual aircraft owners needs vary and demand can be influenced by a wide range of factors beyond the control of an airport. In addition, the moderate forecast growth in based aircraft may be exceeded if conditions are favorable. For this reason, it is recommended that hangar development reserves be identified to address the uncertainty of hangar market conditions and demand factors. Conservative development reserves should be established to accommodate a combination of conventional hangars and T-hangars, roughly equal to 50 to 100 percent of the twenty year forecast (net) demand. The location and configuration of the development reserves will be addressed in the alternatives analysis.

TABLE 4-8: APRON AND HANGAR FACILITY REQUIREMENTS SUMMARY

ITEM	BASE YEAR (2012)	2017	2022	2027	2032
Based Aircraft Forecast	**192**	**209**	**230**	**252**	**276**
Aircraft Parking Apron ***(Note: capacities reflect current configuration of existing public use apron areas, actual capacity when reconfigured may be different.)***					
Small Aircraft Tiedowns (SE/ME)	71				
Large Aircraft Parking Positions	5-10				
Small Helicopter Parking Spaces	0*				
Air Cargo Aircraft Parking Spaces	0*				
Total Designated Parking Spaces Available	76-81*				
Total Apron Area *(includes taxilanes and unusable space required for hangars access)*	45,000 sy (estimated)				
Projected Needs (*Gross Demand*) [1]					
Small Airplane Itinerant Tiedowns (@ 360 SY each)		11 spaces / 3,960 sy	11 spaces / 3,960 sy	12 spaces / 4,320 sy	13 spaces / 4,680 sy
Locally Based Tiedowns (@ 300 SY each)		31 spaces / 9,300 sy	35 spaces / 10,200 sy	38 spaces / 11,400 sy	41 spaces / 12,300 sy
Business Aircraft Parking Positions (@ 625 SY each)		4 spaces / 2,500 sy	5 spaces / 3,125 sy	5 spaces / 3,125 sy	6 spaces / 3,750 sy
Small Helicopter Parking Positions (@ 380 SY each)		2 spaces / 760 sy	2 spaces / 760 sy	3 spaces / 1,140 sy	4 spaces / 1,520 sy
Air Cargo Parking Demand (@ 625 SY each)		1 space / 625 sy	1 space / 625 sy	2 spaces / 1,250 sy	2 spaces / 1,250 sy
Total Apron Needs		**49 spaces 17,145 SY**	**54 spaces 18,670 SY**	**60 spaces 21,235 SY**	**66 spaces 23,500 SY**
Aircraft Hangars *(Existing Facilities)*					
Existing Hangar Spaces	Approx. 151 spaces (AC storage)				
Projected Needs *(Net Increase in Demand)* [2]					
(New) Hangar Space Demand (@ 1,500 SF per space) *(Cumulative twenty year projected demand: 71 spaces / 106,500 SF)*		**+14 spaces / 21,000 sf**	**+18 spaces / 27,000 sf**	**+19 spaces / 28,500 sf**	**+20 spaces / 30,000 sf**

* These aircraft are accommodated on the main apron (open areas)

1. Aircraft parking demand levels identified for each forecast year represent forecast gross demand.
2. Hangar demand levels identified for each forecast year represent the net increase above current hangar capacity.

AIRCRAFT WASH DOWN FACILITIES

Wash down facilities are recommended to accommodate general aviation aircraft with a catch basin and hard piping to divert wash residue into a sewer or stormwater treatment system. Wash facilities are typically sized to accommodate one aircraft on a pad approximately 50 feet by 50 feet. The wash pad may be located adjacent to existing parking apron or hangars; close access to utility systems is a key siting factor.

SURFACE ACCESS AND VEHICLE PARKING

The primary surface access to the Airport is provided by State Highway 3. The Airport's west landside area is accessed by one direct connection to the highway and a frontage road that extends the entire length of the area.

Vehicle access to the east landside area is provided Airport Way, which connects to Highway 3 on the north end of the Airport. All existing developed landside areas on the Airport are served by internal access roads.

The future development of landside facilities on the east side of Runway 02/20 is expected to contribute to an increase in airport ground vehicle activity, including airport fuel trucks. To maintain a safe operating environment, only airport maintenance, emergency and snow removal vehicles should be permitted on the runway taxiway system. The recommended alignment for an airport service road depicted on the 2006 Airport Layout Plan will be reevaluated based on current FAA standards.

Vehicle Parking

The west landside area has several areas used for vehicle parking in the terminal area, adjacent to the road system and within individual lease areas. Some of the vehicle parking is paved, other areas are gravel surfaced. Expansion of dedicated vehicle parking areas adjacent to existing and future hangar developments should be considered to address vehicle parking on taxilanes.

AGRICULTURAL AIRCRAFT FACILITIES

There are currently no designated agricultural aircraft facilities at the Airport. There is no indication of current need to accommodate this type of use at the Airport.

AIR TRAFFIC CONTROL TOWER

Based on current and forecast air traffic levels, it does not appear that the Airport will reach activity levels needed to justify an Air Traffic Control Tower (ATCT). The FAA is currently evaluating options for closing several control towers at lower activity commercial service and general aviation airports. Historically, airports accommodating 75,000 to 100,000 annual operations were considered viable candidates for siting a control tower. However, recent cost-cutting efforts have focused on closing towers at airports with annual operations in this range, or higher.

Support Facilities

AVIATION FUEL STORAGE

The Port-owned aviation fuel storage and dispensing facilities appear to be adequate to accommodate current demand. However, as noted earlier, future landside development on the east side of the airport may drive the need to provide additional fueling facilities. For planning purposes, a development area capable of accommodating two 12,000-gallon aboveground fuel storage tanks and multiple aircraft fueling positions should be incorporated into all east landside development options.

The development of secondary containment areas for mobile fuel truck parking should also be considered. Most mobile fuel trucks in use today have single wall tank construction and do not provide the secondary containment of double wall aboveground bulk storage tanks. It is anticipated that federal or state regulations will eventually require secondary containment for single wall tank mobile fuel trucks when unattended, such as for overnight parking when the trucks are not in service or otherwise monitored. Locating secondary containment areas for airport fuel trucks in close proximity to the bulk fuel storage areas may be the most efficient use of land in the terminal area.

AIRPORT UTILITIES

The existing utilities on the airport appear to be adequate both in capacity and service within the developed areas of the airport. However, extensions of water, sanitary sewer, electrical, fiber optics and telephone service to serve future east landside developments will be required to support future expansion. All electrical power service in the vicinity of the airfield is required to be buried.

Another significant element in future master planning will be storm water detention and management. As noted earlier, the stormwater basins serving the west landside area are at or near capacity. In addition, airport management anticipates a potential requirement in the future to modify the existing stormwater detention pond and dam located near the south end of the runway to comply with fish passage requirements. The addition of large areas of impervious surfaces on the east side of the runway will also require upgrades in stormwater conveyance and storage. Stormwater system requirements will be evaluated as part of the alternatives analysis based on projected runoff levels for existing and future impervious surfaces.

Security

The Airport's existing perimeter fencing and controlled access gates appear to provide adequate security for current development. Expansion of landside facilities on the east side of the airfield will require modifications in fencing and gate access to accommodate future development.

Flood lighting should be provided in expanded aircraft parking and hangar areas and any other new development areas on the airport to maintain adequate security. The use of full or partial cutoff light fixtures is recommended for all exterior lighting on the airport to limit upward glare.

Facility Requirements Summary

The projected twenty year facility needs for Bremerton National Airport are summarized in **Table 4-9**. As noted in the table, maintaining existing pavements represents a significant, ongoing facility need. The updated forecasts of aviation activity anticipate moderate growth in activity that will result in similarly moderate airside and landside facility demands beyond existing capabilities. The existing airfield facilities have the ability to accommodate a significant increase in activity, with targeted facility improvements. For the most part, the need for new or expanded facilities, such as aircraft hangars, will be market driven, although there will be significant front end investments required in preparation, utility extensions, road extensions, and taxiway construction for new development on the east side of the airfield. The nonconforming items noted at the beginning of this chapter are relatively minor and can be addressed systematically during the current planning period to improve overall safety for all users.

TABLE 4-9: FACILITY REQUIREMENTS SUMMARY

ITEM	SHORT TERM	LONG TERM
Runway 02/20	Pavement Maintenance[1] Replace Runway Designation Numbers to "2" and "20"	Pavement Maintenance[1] Pavement Rehabilitation
Taxiways	Rehabilitate Taxiway A and Exit Taxiways Reconfigure Taxiway F to 90-degree Exit Potential Reconfiguration of Taxiways D and E to address FAA "hot spot" design considerations Access Taxiways to East Landside Area Taxilanes in New Hangar Areas Pavement Maintenance[1]	Pavement Maintenance[1] Taxiways/Taxilanes to New Hangar Areas Rehabilitate West Hangar Taxilanes Additional Taxilane Connection on Main Apron to Taxiway A (optional) East Parallel Taxiway (Reserve)
Aircraft Aprons	Reconfigure Main Apron and South Tiedown Apron (rehabilitate/reconstruct older sections) to meet FAA Design Standards Pavement Maintenance[1]	Pavement Maintenance[1] Apron Development Reserves (East Landside Area)

Hangars	West Landside Area: Infill Development East Landside Area: Define development Areas for T-hangars, Conventional Hangars, and Commercial Hangars	Hangar development reserves
Navigational Aids and Lighting	Evaluate Replacement/Upgrade of AWOS-3	Evaluate NDB Removal Runway Visual Range (RVR) (optional) Runway 02 Approach Lighting (optional) Replace Runway 20 MALS-R Replace HIRL and MITL(at end of useful life) Next Generation Precision Instrument Approach System
Fuel Storage	Establish East Landside Aviation Fuel Storage Reserve Identify Secondary Containment Area(s) for Fuel Truck Parking	Same
FBO	Identify East Landside FBO reserve(s)	Same
Utilities	Extend Service to New Development Areas Update Stormwater Management Plan Upgrade/Expand Stormwater Conveyance and Storage System Capacity	Same
Roadways & Vehicle Parking	Extend/Improve Roads to New Development Areas Add Vehicle Parking in Existing/Future Hangar Areas Construct New Internal Airport Service Road to Connect West and East Flightlines	Same
Security	Modify Perimeter Fencing and Automated Gates for new landside areas Flood Lighting	Same

Vegetation control, crackfill, sealcoat, slurry seal, localized patching, joint rehabilitation, etc., as required.

Airfield Capacity

Annual service volume (ASV) is a measure of estimated airport capacity and delay used for long-term planning. ASV, as defined in FAA Advisory Circular (AC) 150/5060-5, Airport Capacity and Delay, provides a reasonable estimate of an airport's operational capacity. The ratio between demand and capacity helps to define a timeline to address potential runway capacity constraints before they reach a critical point. If average delay becomes excessive (greater than 3 minutes per aircraft), significant congestion can occur on a regular basis, which significantly reduces the efficient movement of air traffic. ASV is calculated based on the runway and taxiway configuration, percent of VFR/IFR traffic, aircraft mix, lighting, instrumentation, the availability of terminal radar coverage and the level of air traffic control at an airport.

The 2004 Airport Master Plan did not analyze annual airfield capacity. However, for long-term planning purposes, the FAA estimates annual capacity (ASV) for a single runway with no air carrier traffic is approximately 230,000 operations; hourly capacity is estimated to be 98 operations during visual flight rules (VFR) conditions and 59 operations during instrument flight rules (IFR) conditions. Although these estimates assume optimal conditions (air traffic control, etc.), they provide a reasonable basis for approximating existing and future capacity:

Existing Capacity: 55,558 Annual Operations / 230,000 ASV = 24.2% (demand/capacity ratio)

Future Capacity: 90,503 Annual Operations/ 230,000 ASV = 39.4% (demand/capacity ratio)

Based on these ratios, the average delay per aircraft would be expected to remain below one minute through the planning period. The FAA recommends that airports proceed with planning to provide additional capacity when 60 percent of ASV is reached. As indicated in the updated aviation activity forecasts, peak hour activity is projected to remain well below the 60 percent threshold during the planning period.

In the event that the runway-taxiway system begins to experience periodic periods of congestion leading to increase delay, one or more existing 90-degree exit taxiways could be modified to provide high speed exit capabilities for aircraft to reduce runway occupancy time for landing aircraft. In addition, the location and configuration of aircraft holding areas can be examined to enhance aircraft ground movement.