Leigh | Fisher

Port of Seattle

TECHNICAL MEMORANDUM No.7 FINAL

FACILITIES IMPLEMENTATION AND FINANCIAL FEASIBILITY

Seattle-Tacoma International Airport

Prepared for

Port of Seattle
Seattle, Washington

May 2018

Sustainable Airport Master Plan
Seattle-Tacoma International Airport

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Introduction and Summary

The key results of the SAMP include a vision for long-term Airport development and a set of Near-Term Projects that is consistent with the Long-Term Vision, is compatible with the existing airfield, and is affordable.

1.1 Background

This *Technical Memorandum No. 7 – Facilities Implementation and Financial Feasibility* (TM-7) is the seventh in a series of memorandums which document the analyses, results, conclusions, and recommendations resulting from the Sustainable Airport Master Plan (SAMP) for Seattle-Tacoma International Airport (Airport). *Technical Memorandum No. 6 – Alternatives* (TM-6) determined an optimal layout of facilities required to satisfy the unconstrained 20-year forecast demand (Long-Term Vision). Airside modeling conducted to test the ability of the Long-Term Vision facilities to accommodate 20-year forecast demand is documented in TM-6. Airside modeling determined that, even with all Long-Term Vision improvements, airfield/airspace constraints resulted in severe congestion and aircraft delays as activity approached 15-year forecast demand (forecast to occur in 2029). Given these existing constraints, all improvements depicted in the Long-Term Vision that are not included in the Near-Term Projects will be subject to further study discussed in section 5 of this TM-7. The Long-Term Vision was refined as part of implementation planning and is illustrated in Figure 6-1 and further described in Section 6 of this TM-7.

1.2 Purpose

The purposes of this TM-7 are to:

- Determine a set of Near-Term Projects (NTP) resulting from the SAMP, which fit within the Long-Term Vision for Airport development as broadly defined in *Technical Memorandum No. 6 Alternatives* and illustrated on Figure 6-1.
- Summarize the results of the simulation analyses that confirmed the improvements included in the NTP can meet demand in the year that they would become operational.
- Confirm that the NTP is financially feasible.
- Recommend key follow-on actions, all related to the airfield/airspace system, which should be initiated as soon as practical.
- Document refinements to the Long-Term Vision resulting from implementation plan alternatives analysis.
- Document project phasing alternatives that were considered in determining the NTP.

1.3 Approach

The approach to conducting implementation planning and developing the NTP was significantly influenced by the physical constraints unique to the Airport and a recent, sustained increase in activity—among North American large hubs, the Airport experienced the highest growth (21.9%) in aircraft movements and the second highest growth (52.6%) in passenger traffic in the last 10 years. High passenger and cargo demand have strained existing facilities, leaving very few opportunities to relocate functions to underutilized areas and generating a pressing need to provide additional capacity in all key functional areas. The high utilization of the majority of existing facilities coupled with physical constraints results in difficult construction sequencing and long sequences of enabling projects, both of which increase program costs and delay the delivery of needed capacity. These factors drove the need to explore alternative project sequencing that could deliver capacity sooner and/or delay expensive enabling projects.

The implementation planning approach included the following guiding principles:

- Sequence projects to add gate and hardstand (designated aircraft parking) capacity for passenger operations as soon as possible.
- Program construction of a second terminal and landside access to align with construction of gates that can be readily connected to the Second Terminal.
- Sequence projects to add warehouse and hardstand capacity for cargo operations as soon as possible.
- Minimize impacts to existing cargo and aircraft maintenance facilities until additional capacity can be constructed.
- Minimize throwaway costs, by avoiding, where possible, building new facilities that will be impacted by subsequent construction.

1.4 Summary

This TM-7 documents the analysis and conclusions of the SAMP implementation planning and financial feasibility assessment. The SAMP Long-Term Vision identifies facility improvements required to satisfy unconstrained demand over the 20-year planning horizon. The implementation plan process began by establishing a baseline implementation plan to deliver needed capacity through a sequence of projects that concludes with the full build-out of the Long-Term Vision. Once the baseline plan was established, development and evaluation of alternative project sequencing then focused on Near-Term Projects to deliver capacity in response to dramatic growth in passenger and cargo activity. These alternatives were developed and evaluated within the context of the physical and financial constraints which were clarified early in implementation planning process. Alternative project sequencing and gate expansion options explored through the implementation planning process are documented in Appendix A.

Recent, sustained increased demand has strained existing facilities. High utilization of the majority of existing facilities and physical constraints limits opportunities for expansion or redevelopment of on-airfield facilities and often triggers the need to relocate existing functions in order to provide additional capacity to accommodate increased demand. The planning team established the guiding principles listed in Section 1.3 *Approach* in response to these constraints and used them to identify a financially feasible package of projects to accommodate near-term demand.

The Near-Term Projects (NTP) detailed in Section 2 *Near-Term Projects* and illustrated in Figure 2-1, include all enabling and capacity improvement projects required to accommodate forecast demand in 2027. The year 2027 corresponds to when substantial gate, hardstand and terminal capacity become operational. In addition to 19 new narrowbody equivalent gates connected to a second terminal, the NTP includes taxiway modifications to increase operational efficiency and the creation of new hardstands to boost capacity for passenger and cargo operations. These improvements were modeled using Total Airspace and Airport Modeler (TAAM) to confirm that they can accommodate forecast 2027 activity. TAAM modeling of the Near-Term Projects is detailed in Section 3 *Airfield Operational Feasibility*.

In addition to modeling the improvements to confirm they can accommodate forecast activity in 2027, the Port also conducted a financial feasibility assessment of the capital program costs to verify that the Port can feasibly finance these Near-Term Projects and other anticipate airport expenses through the year 2027. The analysis projected expenses and considered future airport debt and revenue to assess the Port's financial capabilities and future competitiveness with other airports in terms of Cost Per Enplanement (CPE). The analysis is documented in Section 4 *Financial Feasibility* and concluded that the Near-Term Projects are financially feasible.

As documented in Section 2.5 of *Technical Memorandum No. 6 Alternatives*, airfield modeling determined that, with all improvements included in the Long-Term Vision and no other changes to how the airfield/airspace is operated, the airfield/airspace as currently configured has insufficient capacity to meet the unconstrained 20-year forecast demand at an acceptable level of delay. The improvements included in the NTP fit within the Long-Term Vision and are stand-alone projects that are needed to satisfy near-term demand. While the Long-Term Vision includes airfield projects that improve the effectiveness of the airfield system, a comprehensive airfield/airspace study is needed to develop and assess alternatives to meet the unconstrained 20-year forecast demand. Given the existing airfield/airspace constraints, all improvements depicted in the Long-Term Vision that are not included in the Near-Term Projects will be subject to further study discussed in Section 5 *Key Actions Following Completion of the SAMP*. The Long-Term Vision was refined as part of implementation planning and is illustrated in Figure 6-1 and further described in Section 6 *Long-Term Vision*.

Near-Term Projects

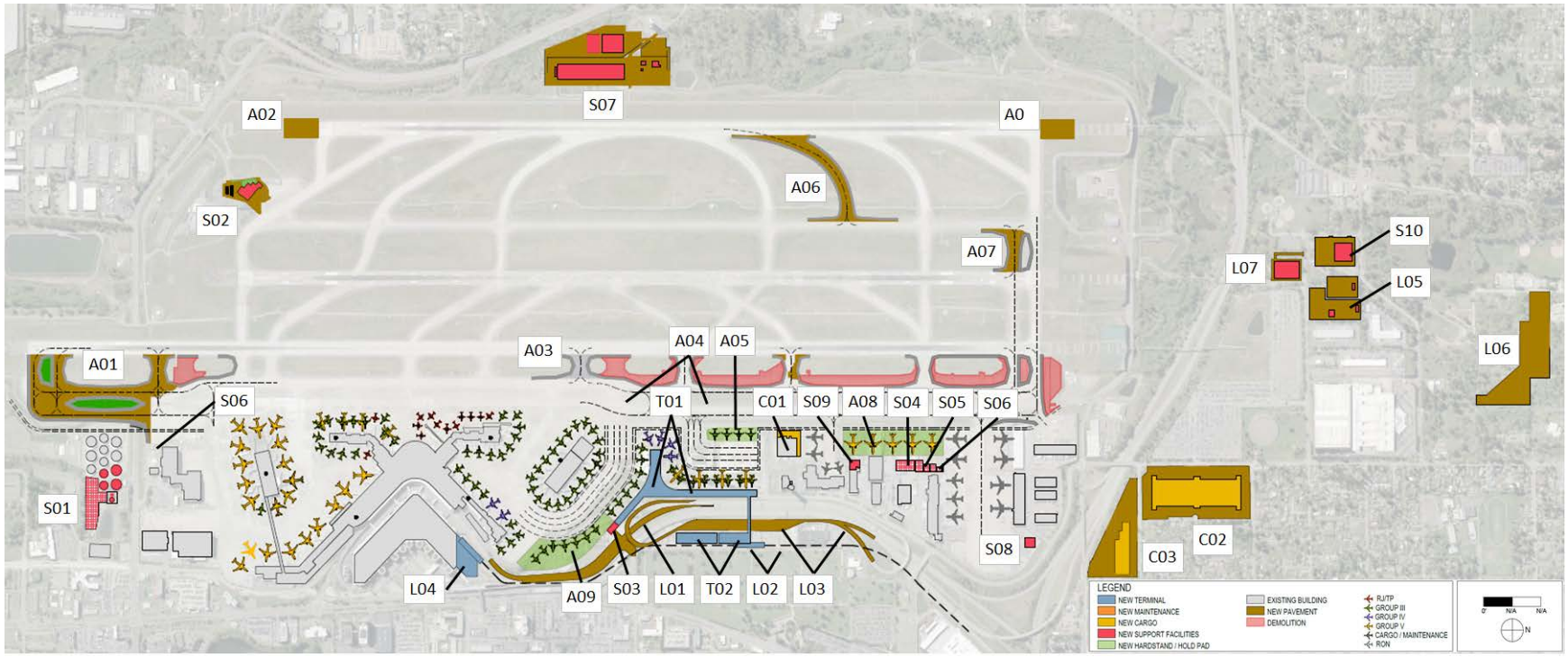
The Near-Term Projects (NTP) includes enabling and capacity projects, including a new north terminal and 19 new narrow-body gates, which will permit the Airport to accommodate approximately 56 million annual passengers.

2.1 Overview

The Near-Term Projects (NTP), illustrated on Figure 2-1, includes enabling and capacity improvement projects to satisfy facility requirements for forecast Airport activity through the year 2027 (approximately 56 million annual passengers). The Year 2027 corresponds to when substantial gate, hardstand and terminal capacity estimated to become operational. Airfield projects include taxiway modifications to increase operational efficiency and the creation of new hardstands to boost capacity for passenger and cargo operations. These improvements, along with added gate capacity, were modeled using Total Airspace and Airport Modeler (TAAM) to confirm that they can accommodate forecast 2027 activity. The TAAM modeling effort is documented in Section 3 *Airfield Operational Feasibility*. Figures 2-2, 2-3 and 2-4 illustrate the dimensions used to locate planned improvements and demonstrate compliance with separation requirements per AC 150/5300-13A- Airport Design.

Appendix A details alternative project sequencing and gate expansion options explored through the implementation planning process. The primary driver for the sequence of development included in Alternative 1 - *Baseline* and the exploration of other alternatives through the implementation planning process was the need to increase passenger and cargo facilities capacity as soon as possible. To that end, the planning team used the established guiding principles listed in Section 1.3 *Approach* to determine that Phase 1 of Alternative 2 - *Baseline with SASA deferred and Concourse B reconstruction removed* was the best package and sequence of projects to effectively accomplish this goal. The NTP also includes a number of landside improvements to provide access to the North Terminal; connectivity between the Rental Car Facility, Second Terminal and Main Terminal; expand employee parking; and expand ground transportation holding lots. Airport/airline support facility projects in the NTP primarily replace facilities displaced by passenger and cargo facility development, with the exception of projects S01 Fuel Farm Expansion (a capacity project) and S09 Centralized Receiving and Distribution Center (a security and operational efficiency project). Major project linkages and capacity drivers are discussed in more detail in Section 2.2. All projects included in the NTP are listed and described in Section 2.3 *Project Descriptions & Schedules*.

Figure 2-1
Near-Term Projects
Seattle-Tacoma International Airport



Airside

A01 Taxiway A/B Extension
A02 Runway 16R-34L Blast Pads
A03 Taxiway L Relocation *(Pre-SAMP project)*
A04 Taxiway B 500' Separation & RIM Mitigation
A05 North Hold Pad
A06 Runway 34L Highspeed Exit
A07 Taxiway D Extension
A08 Hardstand *(north)*
A09 Hardstand *(central)*
A10 Taxiway Fillets *(not shown)*
A11 Taxiway Q HS/RIM *(Pre-SAMP project)* *(not shown)*

Terminal

T01 North Gates
T02 Second Terminal & Parking

Cargo

C01 Cargo 4 South Redevelopment
C02 Off-site Cargo *Ph 1 (L-Shape)*
C03 Off-site Cargo *Ph 2 (L-Shape)*

Landside

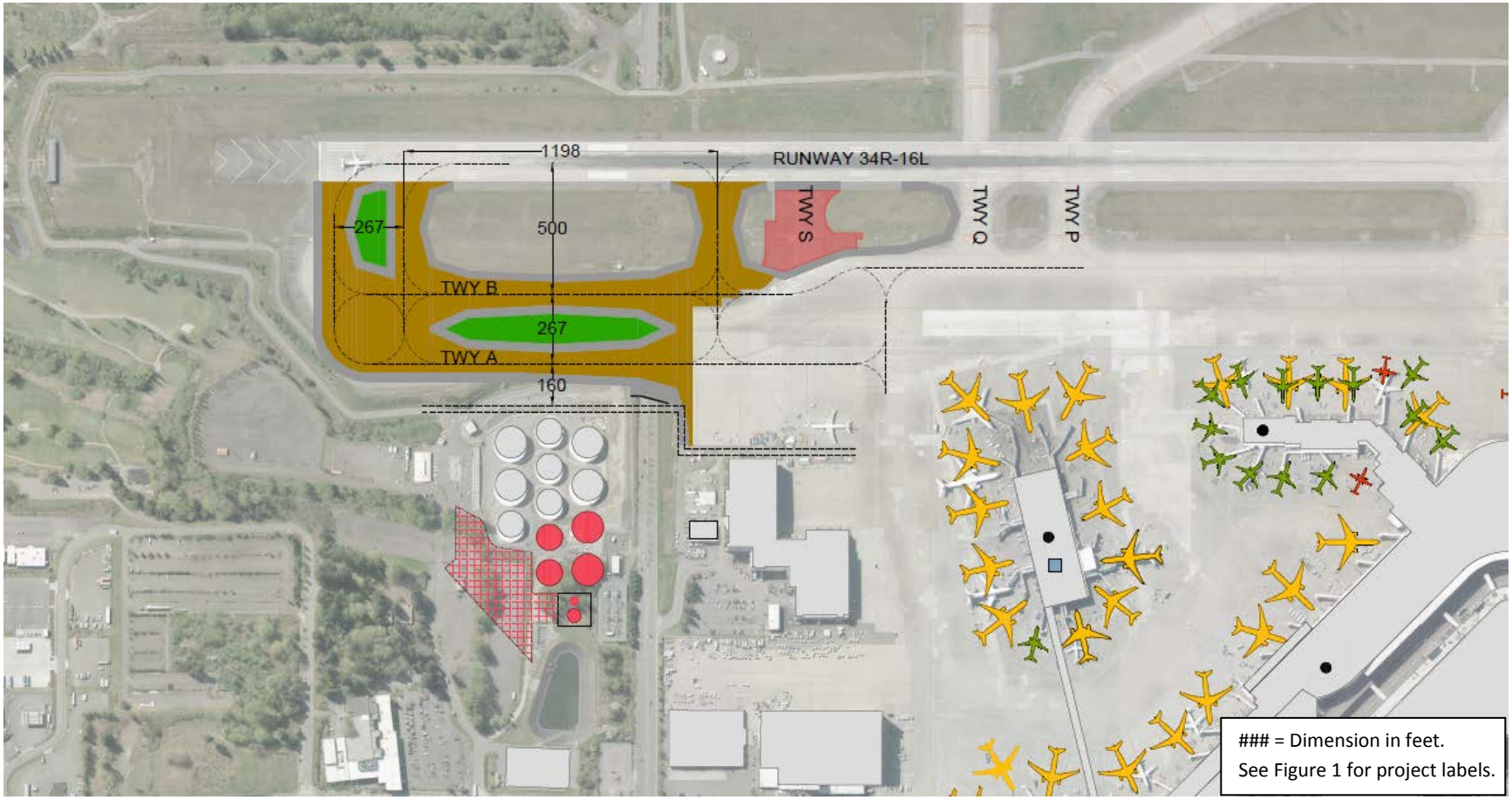
L01 NAE Relocation *(southbound lanes)*
L02 Elevated Busway & Stations
L03 Second Terminal Roads/Curbside
L04 Main Terminal North GT Lot
L05 North GT Holding Lot
L06 Employee Parking Surface Lot
L07 Employee Parking Structure

Airport/Airline Support

S01 Fuel Farm Expansion
S02 Primary ARFF
S03 Secondary ARFF
S04 Fuel Rack Relocation
S05 Triculator
S06 Consolidated De-icing Tanks
S07 Westside Maintenance Campus
S08 Airline Support *(north)*
S09 Airline Support *(west)*
S10 Centralized Rec. & Dist. Center

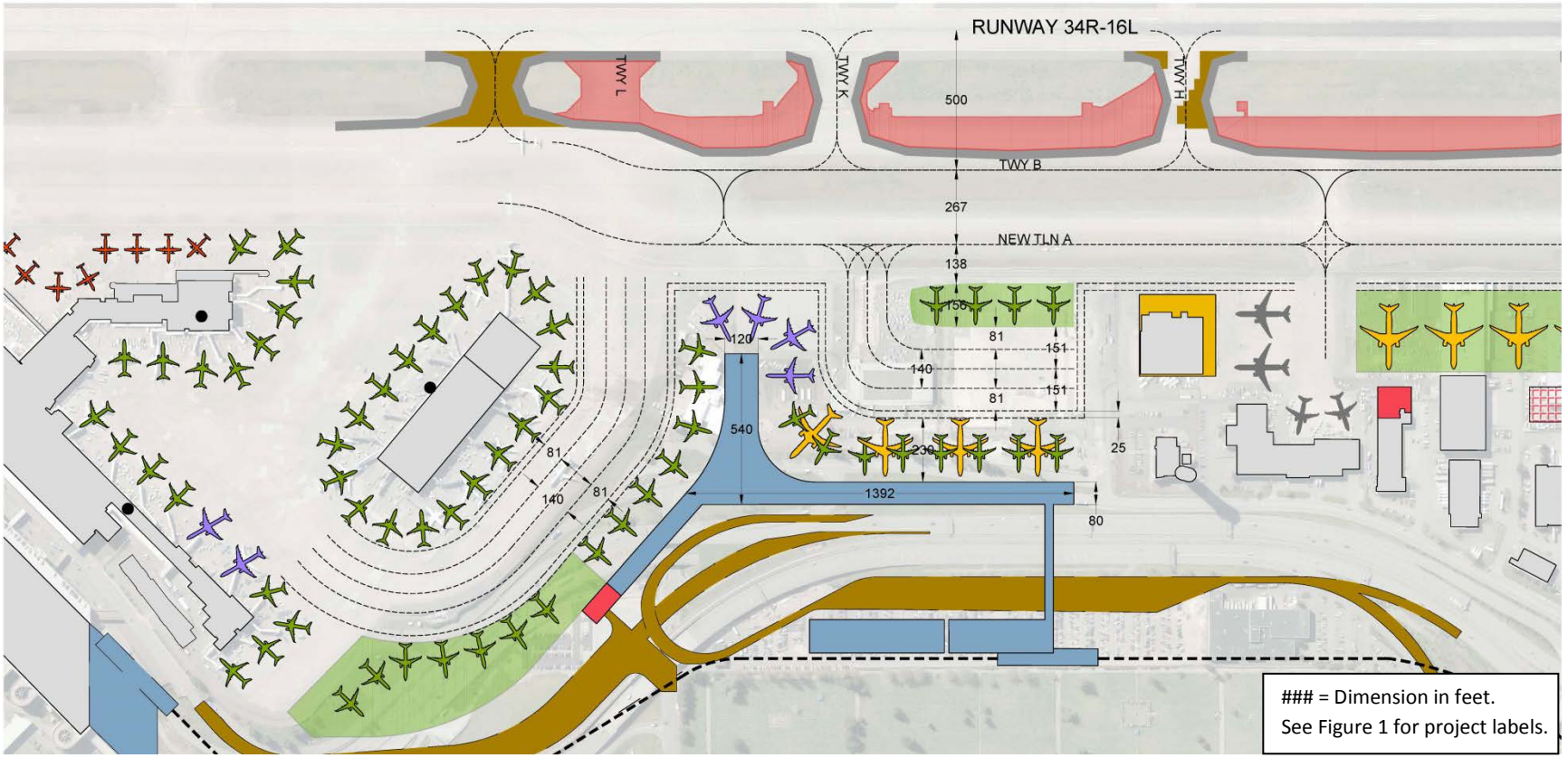
Source: Port of Seattle, 2017.

Figure 2-2
Near-Term Projects – Dimensions for Improvements South of the Existing Terminal Complex
Seattle-Tacoma International Airport



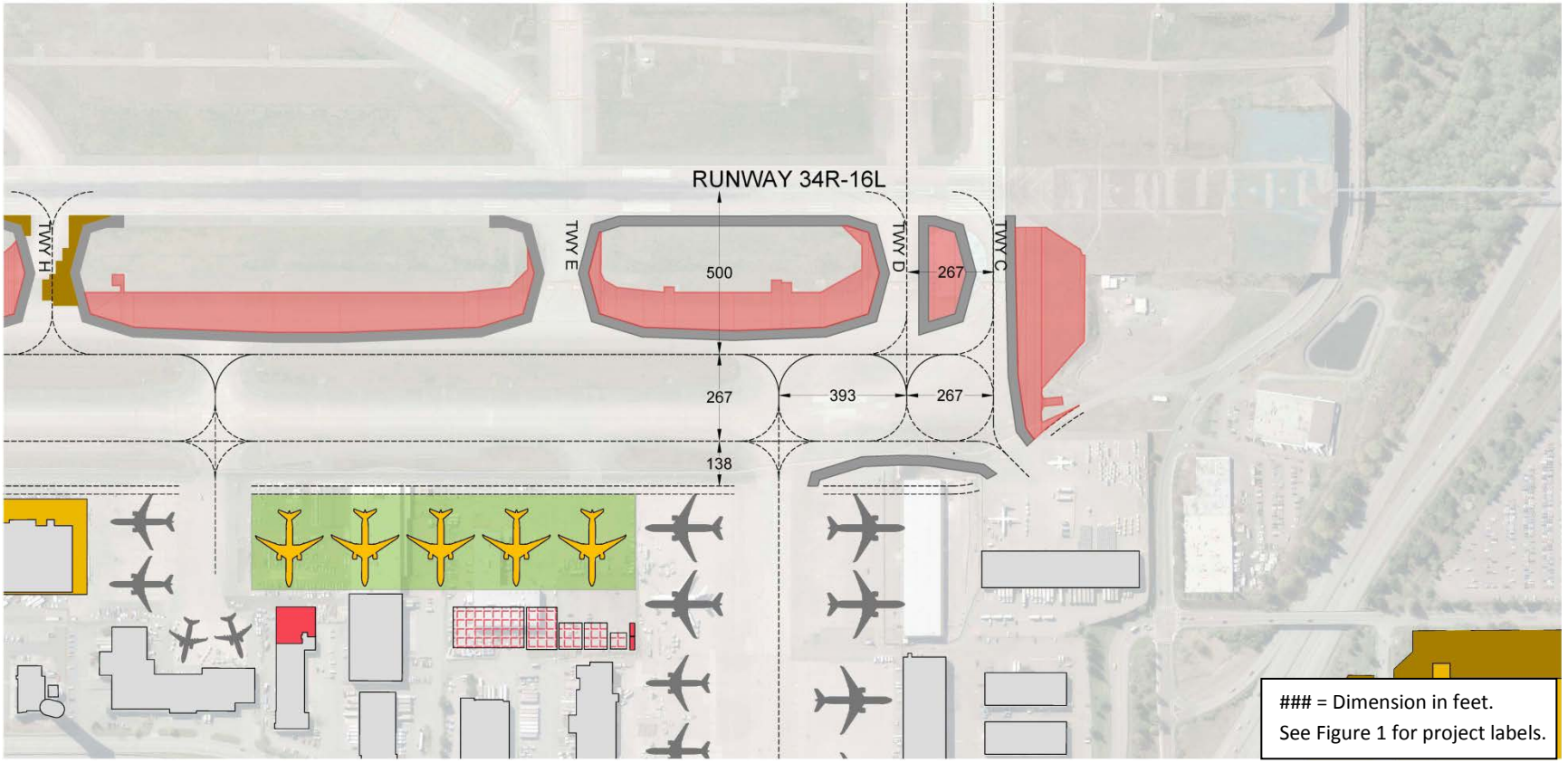
Source: Port of Seattle, 2017.

Figure 2-3
Near-Term Projects – Dimensions for Improvements in the area of the Existing Terminal Complex
Seattle-Tacoma International Airport



Source: Port of Seattle, 2017.

Figure 2-4
Near-Term Projects – Dimensions for Improvements North of the Existing Terminal Complex
Seattle-Tacoma International Airport



Source: Port of Seattle, 2017.

2.2 Major Project Linkages and Capacity Drivers

As described in Section 1.4 *Summary*, a primary purpose of conducting implementation planning is to determine a logical sequence of projects required to increase facility capacity and improve level of service in response to increased demand. Given the physical constraints surrounding the current airfield and high utilization of existing facilities, expansion or redevelopment of on-airfield facilities often triggers the need to relocate existing functions in order to provide additional capacity to accommodate increased demand. The subsections below describe enabling projects required to construct major NTP passenger and cargo capacity improvement projects.

2.2.1 Passenger Gates & Terminal

The schedule of projects in Figure 2-5 illustrates construction periods and includes the major capacity projects and enabling projects associated with providing additional passenger gates and terminal facilities. A number of enabling projects are required in order to clear an area for construction of gates hardstand for passenger operations. The critical path linkages between these enabling projects and the T01 North Gates and A09 Hardstand *(central)* projects are shown in red in Figure 2-5.

Figure 2-5
Schedule for Major Projects Associated With New North Gates and Second Terminal
Seattle-Tacoma International Airport

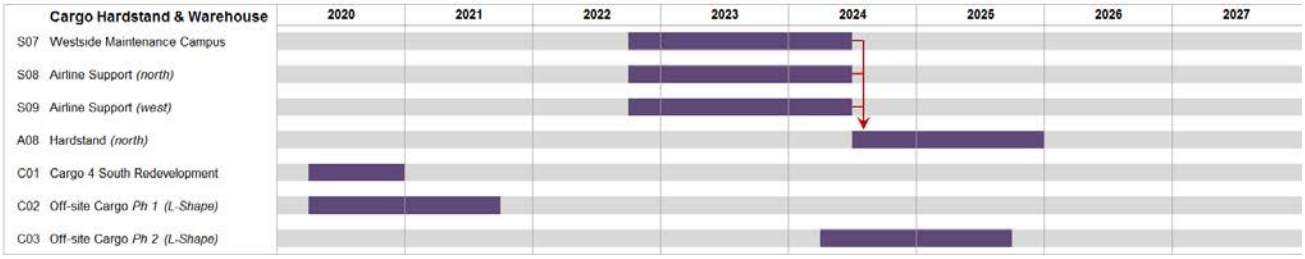
Source: Port of Seattle, 2017.

2.2.2 Cargo Warehouse & Freighter Hardstand

The schedule of projects in Figure 2-6 illustrates construction periods and includes the major capacity projects and enabling projects associated with providing cargo warehouse and freighter hardstands. Construction of hardstands for passenger operations, as a first phase of T01 North Gates construction, eliminates the Swissport cargo warehouse and two freighter parking positions in the Cargo 6 area. Reconstruction of the C01 Cargo 4 South building could potentially offset the loss of warehouse capacity at Cargo 6 and construction of new hardstand to the north (A08) would result in a net gain of hardstand capacity in the near-term. While not physically located on the airfield, new cargo warehouses and truck terminals constructed on the L-Shape property (C02 & C03) will be ideally situated to leverage this additional freighter hardstand capacity. Construction of the A08 Hardstand *(north)* requires removal of the Port Aviation Maintenance Facility (AMF) and the United Airlines

maintenance building. Replacement facilities for the AMF will be constructed in the S07 West-side Maintenance Campus. The United Airlines maintenance building includes shops for aircraft and Ground Service Equipment (GSE) maintenance and the Swissport building also includes GSE maintenance facilities. The NTP identifies two areas where these airline support functions can be accommodated (S08 & S09). Figure 2-6 identifies the construction of replacement Port maintenance facilities and the airline support facilities as critical path enabling projects for construction of the A08 Hardstand *(north)*.

Figure 2-6
Schedule for Major Projects Associated With Cargo Warehouse and Freighter Hardstand
Seattle-Tacoma International Airport



Source: Port of Seattle, 2017.

2.3 Project Descriptions & Schedules

2.3.1 Major Airside Projects

Major airside projects are described below and construction schedules are shown on Figure 2-7.

- A01 – Taxiway A/B Extension –Taxiway B is a full length Taxiway parallel to RWY 16L/34R and serves as a primary link to the runway and all gates. Taxiway A runs parallel to Taxiway B north of the terminal complex. This project would create a similar configuration south of the Cargo 7 hardstand by relocating Taxiway B south of Taxiway S to 500' runway/taxiway separation and provide a new parallel taxiway, Taxiway A. Taxiway A will be located 267' east of Taxiway B. The existing Taxiway B (Runway 16L-34R entry/exit taxiway) will also be split into two entry/exit taxiways, one at the runway threshold and a second 267' (centerline-to-centerline separation) north. All taxiways should be designed to Aircraft Design Group (ADG)-V / Taxiway Design Group (TDG)-6 standards aligning with the airports critical aircrafts. The taxiways should be equipped with in-pavement centerline lights and elevated taxiway edge lights. For Runway 16L-34R protection, the taxiway shall include hold position markings with in-pavement lights and elevated runway guard lights. Taxiway signage will be provided. To facilitate the taxiway work, the Runway 34R Glide Slope (GS) will need to relocated to the west side of Runway 16L-34R because it will be displaced by the Taxiway B construction. Relocation of the GS will require fill material to create a pad for the GS antenna and reflective plane that is at the runway elevation. Additional work that may also be required to facilitate the taxiway

construction is a new Vehicle Service Road (VSR) bridge over S 188 Street. The VSR will be placed outside of the proposed Taxiway A Object Free Area (OFA).

- A02 – Runway 16R-34L Blast Pads – A runway blast pad is a surface adjacent to a runway intended to provide erosion protection from aircraft jet blast. The existing blast pads on RWY 16R-34L will be expanded to standard 220'x400' blast pads. This project will require additional asphalt pavement and pavement markings.

- A03 – Taxiway L Relocation *(Pre-SAMP project)* –Taxiway L is a short east-west taxiway adjacent to the North Satellite. Taxiway L will shift approximately 400' to the south to resolve an issue with direct access between Runway 16L-34R and the North Satellite apron. The relocated Taxiway L will be designed to ADG-V / TDG-6 standards and will be equipped with in-pavement centerline lights and elevated taxiway edge lights. For Runway 16L-34R protection, the taxiway shall include hold position markings with in-pavement lights and elevated runway guard lights. Taxiway signage will be provided. Relocation of Taxiway L is anticipated to be completed during the 2018 construction season.

- A04 – Taxiway B 500' Separation & RIM Mitigation – To provide the standard 500' runway/taxiway separation, Taxiway B will be moved 100' to the east between Taxiway C (at the north end of the airfield) and the approximate location of the existing Taxiway L. Shifting Taxiway B will also result in Taxiway A being shifted east so that it is 267' (centerline-to-centerline separation) east of Taxiway B. Taxiway A will become a taxilane with 138' Taxiway Object Free Area (OFA) separation. Taxilanes can be either inside or outside of the movement area and the SAMP is not proposing to change the existing operational use of Taxiway A when it becomes the new Taxilane A. Taxiways C, D, E, H, and K between Taxiway B and Runway 16L-34R will need to be adjusted/extended to account for the shift in Taxiway B. Taxiways C and D will also be extended to Taxilane A and the expanse of pavement north of Taxiway C will be removed in an attempt to mitigate the existing RIM location. A phased approach to mitigating the RIM location by connecting Taxiways C and D perpendicularly to the existing Taxiway A and eliminating the expanse of pavement will be evaluated as part of ongoing planning and design activities with the intent to incrementally improve safety at this location. A phased approach appears feasible and may provide an opportunity to mitigate the RIM location earlier than shown in Figure 2-7. All taxiways should be designed to ADG-V / TDG-6 standards aligning with the airport's critical aircrafts. The taxiways should be equipped with in-pavement centerline lights and elevated taxiway edge lights. For Runway 16L-34R protection, all taxiway entrances/exits shall include hold position markings with in-pavement lights and elevated runway guard lights. Taxiway signage will be provided.

- A05 – North Hold Pad - In the northwest corner of the apron constructed as part of the T01 North Gates project is a hold pad capable of accommodating four ADG-III

aircraft. The hold pad would be used by aircraft waiting to take off or waiting for a gate, to reduce congestion on the taxiways and at the terminal.

- A06 – Runway 34L High-speed Exit – High-speed exits allow landing aircraft to exit the runway at relatively higher speeds, leading to less time on the runway. A new high-speed exit will be constructed for Runway 34L arrivals. The high-speed exit should be designed to ADG-V / TDG-6 standards aligning with the airport's critical aircrafts. The high-speed exit should be located between Taxiway J and Taxiway E, approximately 5,000' from the RWY 34L threshold. The high-speed exit should be equipped with in-pavement centerline lights and elevated taxiway edge lights. For Runway 16R-34L protection, the taxiway shall include a hold position marking with in-pavement lights. Taxiway signage will be provided. The Airport is currently updating from a Local-Area Augmentation System (LAAS) to a Ground Based Augmentation System (GBAS). As part of the update, a new location for the GBAS is being considered. If the GBAS utilizes the existing LAAS site, the GBAS will need to be relocated to facilitate construction of the high-speed exit.

- A07 – Taxiway D Extension – Taxiway D is currently a short taxiway between Runways 16C-34C and 16L-34R, and is used by aircraft waiting to take off from Runway 16C. This project will extend Taxiway D from Runway 16C-34C west to Taxiway T, which is a full-length taxiway between Runways 16C-34C and 16R-34L. Taxiway D should be designed to ADG-V / TDG-6 standards aligning with the airport's critical aircrafts. Taxiway D should be parallel to and located 267' (centerline-to-centerline separation) from Taxiway C. Taxiway D should be equipped with in-pavement centerline lights and elevated taxiway edge lights. For Runway 16C-34C protection, the taxiway shall include a hold position marking with in-pavement lights and elevated runway guard lights. Taxiway signage will be provided.

- A08 – Hardstand *(north)* – New hardstand (designated aircraft parking) is needed to accommodate increased cargo freighter demand. The hardstand will be constructed in the North Cargo area and located east of Taxiway A with all aircraft entering/exiting the hardstand via Taxiway A. The hardstand will be approximately 1,200' long with a depth of approximately 300' on the south and 500' on the north. The hardstand should be sufficient to accommodate approximately 5 ADG-V aircraft. This project requires the relocation of Airfield Maintenance Building (Project S07) and demolition of the United Airlines maintenance building.

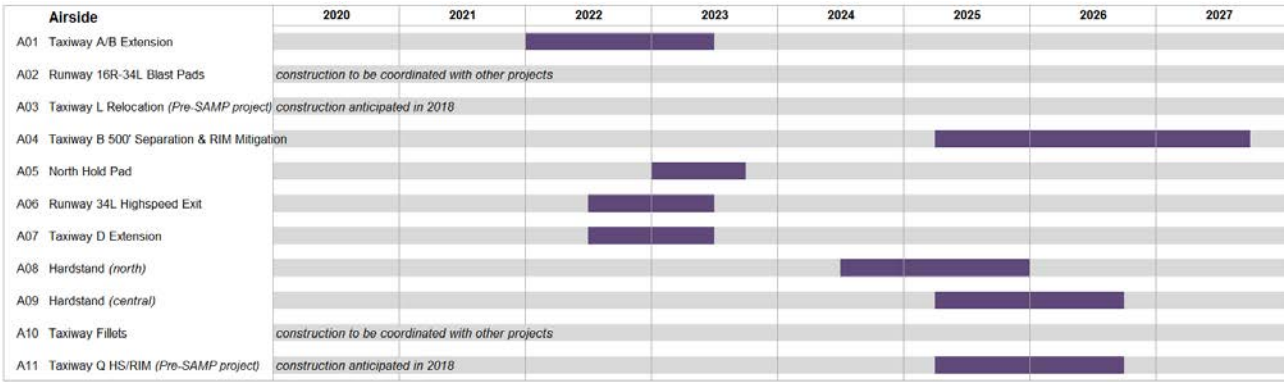
- A09 – Hardstand *(central)* – New hardstand is needed to accommodate increased demand for passenger hardstand operations and Remain Overnight parking of passenger aircraft (RON, used for aircraft parking at night so that they can be used for early-morning departures). Passengers will be bused to/from aircraft on the hardstand, primarily from the Concourse D hardstand holdroom and other holdrooms with bus access on the north side of the terminal complex. This project will create apron space for hardstand/RON operations north of Concourse D and East

of the North Satellite. The apron space should be sufficient to accommodate approximately 7 ADG-III aircraft. The depth and width of the apron varies. This project requires the relocation of the southbound lanes of the North Airport Expressway (Project L01). Following relocation of the roadway, fill will be required to increase the elevation in the area to provide a continuous expansion of the existing apron.

- A10 – Taxiway Fillets *[NOT SHOWN]* – Fillets are essentially rounded corners created with pavement and markings, and are used as part of taxiways to provide adequate distances between aircraft and the pavement edges. Fillets which currently do not meet TDG-6 standards will be improved when the fillet/area is in need of a reconstruction or impacted by a project. Adjustments to fillets will likely require adjustments to full strength pavement panels, shoulders, edge lighting, and signage.

- A11 – Taxiway Q Hot Spot/Runway Incursion Mitigation (HS/RIM) *(Pre-SAMP project) [NOT SHOWN]* – Adjustments will be made to the Taxiway Q centerline paint markings and in-pavement taxiway centerline lights to mitigate hot spots and runway incursions hazards. The Taxiway Q HS/RIM project is anticipated to be completed during the 2018 construction season.

Figure 2-7
Schedule for Major Airside Projects
Seattle-Tacoma International Airport



Source: Port of Seattle, 2017.

2.3.2 Major Terminal Projects

Major terminal projects are described below and construction schedules are shown on Figure 2-8.

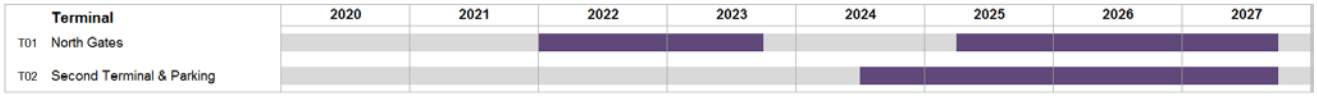
- T01 – North Gates – The North Gates project is a multi-level concourse connected to the Second Terminal via a pedestrian bridge and tunnel for baggage conveyance. In addition to gates, it includes an apron area for at gate aircraft parking, taxilanes, and a hold pad (A05 North Hold Pad). The multi-level concourse occupies an approximately 215,000 sf footprint and includes a ramp level for baggage/aircraft support functions; passenger concourse level with holdrooms, concessions, restrooms, etc.; and a mezzanine level with

office space and vertical circulation to the north terminal passenger walkway. The apron would accommodate up to 19 Aircraft Design Group (ADG)-III contact gates (sized for narrowbody aircraft such as the Boeing 737, but with the ability to be reconfigured for larger aircraft, and connected to the building) surrounded by dual ADG-III or a single ADG-V taxilane.

Construction of the North Gates and Apron requires the relocation of multiple facilities, including: the primary ARFF, fuel rack, the southbound lanes of the North Airport Expressway (NAE), Cargo 5 hardstand, Cargo 6 hardstand, deicing fluid storage, and the Swissport cargo building. The majority of facilities impacted by the North Gates will be relocated (Projects S02, S04, L01, S06, C02, and C03), with the exception of the Cargo 5 & 6 hardstands. Reconstruction/expansion of the Cargo 5 & 6 hardstands will be one of the initial phases for the North Gates project and will accommodate increased demand for hardstand operations and RON until the North Gates are activated and hardstand operations can be moved to contact gates.

- T02 – Second Terminal & Parking – A second terminal to the north is needed to support the planned North Gates. The Second Terminal will include facilities for passenger check-in; passenger and baggage screening; airline offices, baggage conveyance and claim; concessions; and restrooms. The Second Terminal and associated parking will be sized to support the new North Gates.

Figure 2-8
Schedule for Major Terminal Projects
Seattle-Tacoma International Airport



Source: Port of Seattle, 2017.

2.3.3 Major Cargo Projects

Major cargo projects are described below and construction schedules are shown on Figure 2-9.

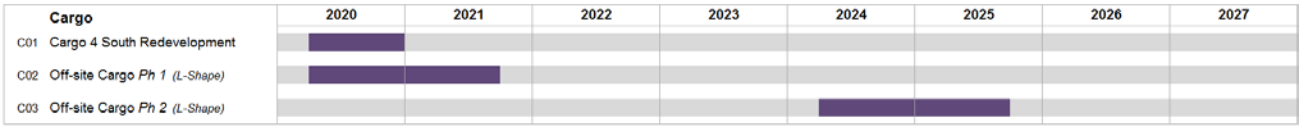
- C01 – Cargo 4 South Redevelopment – Additional cargo warehouse capacity is needed to accommodate growth in cargo activity. The Cargo 4 South site will be redeveloped to maximize warehouse capacity. New facilities will include a roughly 80,000 square foot building with warehouse and office space, truck terminals and parking for visitors and employees.

- C02 – Off-site Cargo Phase 1 *(L-Shape)* – Additional cargo warehouse capacity is needed to accommodate growth in cargo activity. New cargo facilities constructed on the Port owned L-Shape property in this first phase of development will include a roughly 330,000 square foot building with warehouse and office space, truck terminals and

parking for visitors and employees. While the L-Shape property is not located on the airfield and has no direct adjacency to freighter hardstands or secure warehouse access for cargo tugs, the close proximity of the L-Shape to the airfield provides the ability to transfer prescreened cargo pallets via trucks to/from the airfield. Cargo warehousing on the L-Shape will be used to build-up and breakdown cargo and will maximize the use of existing and planned freighter hardstand positions.

- C03 – Off-site Cargo Phase 2 *(L-Shape)* – Additional cargo warehouse capacity is needed to accommodate growth in cargo activity. New cargo facilities constructed on the Port owned L-Shape property in this second phase of development will include a roughly 90,000 square foot building with warehouse and office space, truck terminals and parking for visitors and employees. While the L-Shape property is not located on the airfield and has no direct adjacency to freighter hardstands or secure warehouse access for cargo tugs, the close proximity of the L-Shape to the airfield provides the ability to transfer prescreened cargo pallets via trucks to/from the airfield. Cargo warehousing on the L-Shape will be used to build-up and breakdown cargo and will maximize the use of existing and planned freighter hardstand positions.

Figure 2-9
Schedule for Major Cargo Projects
Seattle-Tacoma International Airport



Source: Port of Seattle, 2017.

2.3.4 Major Landside Projects

Major landside projects are described below and construction schedules are shown on Figure 2-10.

- L01 – North Airport Expressway (NAE) Relocation *(southbound lanes)* – Relocation of the southbound lanes of the NAE is required to clear the site for construction of A08 Hardstand *(central)* and T01 North Gates. The reconstructed southbound lanes will include the same number of lanes as exist today, and will result in the elimination of the cell phone waiting lot as well as Air Cargo Road and associated on/off ramps currently located south of Gate E125 and air traffic control tower. There are no suitable locations on Port property for relocation of the cell phone waiting lot which requires convenient and intuitive access to the freeway system. In the absence of a cell phone waiting lot, the Port will explore operational alternatives utilizing parking garages at the existing and future terminals.

- L02 – Elevated Busway & Stations – An elevated busway and stations are required to provide a landside connection for non-secure passengers accessing the Main Terminal,

Second Terminal, and Rental Car Facility (RCF). The Main Terminal busway station will be at the north end of the existing Main Parking garage and incorporated into the Main Terminal North Ground Transportation (GT) lot. The busway will extend north over the NAE and Light Rail to a Second Terminal station. The busway will extend north from the Second Terminal Station and ramp down to an at grade intersection at the S. 160th GT lot site where the existing RCF bus entrance will provide access to the RCF curb.

- L03 – Second Terminal Roads & Curbside – Landside improvements are required to provide ingress/egress to the Second Terminal and to connect the existing roadways system, providing access to/from the existing Main Terminal. Ingress is provided via a loop ramp from the southbound lanes of the NAE. Curbs for private and commercial vehicles are provided on a single level for arriving and departing passengers. Egress is provided via exit lanes/ramps connecting to the existing S. 160th St. Loop, westbound SR 518 on-ramp at S. 160th St., and the northbound lanes of the NAE.

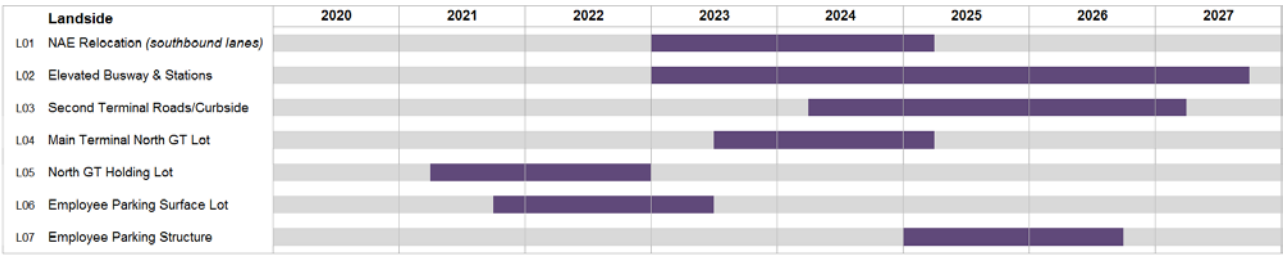
- L04 – Main Terminal North Ground Transportation (GT) Lot – Vertical expansion of the existing lot is required to accommodate increased bus demand including charter and cruise passenger buses. The expansion may include levels above for passenger circulation and office space with pedestrian bridge connection to the Main Terminal.

- L05 – North Ground Transportation (GT) Lot – A new GT lot is needed to accommodate increased demand and replace the S 160th St. GT lot displaced by the Elevated Busway. A new 180,000 square foot surface lot will be constructed on Port property north of SR 518.

- L06 – Employee Parking Surface Lot – A new surface parking lot is required to accommodate increased demand. A new 1,500 stall employee parking surface lot will be constructed on Port owned property north of SR 518.

- L07 – Employee Parking Structure – A new parking structure would provide additional capacity to accommodate increased demand and/or replace stalls displaced by potential cargo development on the existing North Employee Parking Lot (NEPL). A new parking structure of up to 2,000 stalls would be constructed on Port property adjacent to and west of NEPL.

Figure 2-10
Schedule for Major Landside Projects
Seattle-Tacoma International Airport



Source: Port of Seattle, 2017.

2.3.5 Major Airport/Airline Support Projects

Major airport/airline support projects are described below and construction schedules are shown on Figure 2-11.

- S01 – Fuel Farm Expansion – Expansion of the fuel farm includes additional settling tank capacity and construction of infrastructure to support the Ports biofuel initiative. The addition of four settling tanks adding approximately 10 million gallon storage capacity will require additional piping, expansion of the spill containment dike, and four above ground storage tanks. Infrastructure required to support the Ports Sustainable Aviation Biofuels (SAB) initiative includes a 500,000 gallon blending tank, 100,000 gallon neat SAB receipt tank, spill containment dike, fuel transfer pump, piping to transfer the fuel from the blending station to the existing/proposed settling tanks, and a truck fuel rack to support the delivery of SABs for blending. The infrastructure required for both projects will be located east of the existing fuel farm on the abandoned south end employee parking lot.

- S02 – Primary Air Rescue and Firefighting (ARFF) station – Relocation of the Primary ARFF station from its current location in the Cargo 6 area is required to clear the site for construction of T01 North Gates. The Primary ARFF will be relocated to the site of the existing secondary ARFF in the General Aviation Area. From this location, response times to the furthest runway can be achieved. The ARFF facility will be a multi-bay station that conforms to AC 150/5210-15A – Aircraft Rescue and Firefighting Station Building Design.

- S03 – Secondary ARFF – Relocation of the Primary ARFF station from its current location in the Cargo 6 area is required to clear the site for construction of T01 North Gates. With the relocation of the Primary ARFF station, a Secondary ARFF is needed to provide ambulatory response to the Terminals and Concourses; fuel spill and fire response to the concourse ramp areas, and back-up emergency response to the airfield. The secondary ARFF facility will be integrated with the North Gates at the southeast end of the concourse and will have both airside and landside access.

- S04 – Fuel Rack Relocation – Relocation of the fuel rack from its current location in the Cargo 6 area is required to clear the site for construction of T01 North Gates. The project will include extension of the fuel line to the future location in the North Cargo area east of the new A08 Hardstand *(north)*. The project will replace existing, displaced facilities and fuel truck parking.

- S05 – Triculator – The Triculator (or Triturator) is a waste grinding facility that requires water and sewer access to process the contents of ground service provider lavatory trucks. The Triculator is currently located east of the existing ARFF station and is an impediment to the A09 Hardstand *(central)* project. To facilitate the A09 Hardstand *(central)* project, the triculator will be relocated to the North Cargo area east of the new A08 Hardstand *(north)*.

- S06 – Consolidated De-icing Fluid Storage Tanks – In an effort to consolidate storage of aircraft deicing fluid and to clear a site for the construction of T01 North Gates, a set of deicing fluid tanks are proposed on both the north and south end of the airfield. The consolidated de-icing fluid storage tanks will be the common de-icing fluid racks from which all ground service providers can fill de-icing equipment with de-icing fluid. The southern set of tanks will replace and occupy the same location as the individual airline tanks that are currently located at Cargo 7. The northern set of tanks is to be located in the North Cargo area, east of the new A08 Hardstand *(north)* and will replace tanks that are displaced from the Cargo 6 area. Each site will have two tanks, one for Type I and the second for Type IV. Each set of tanks will also have a blending station.

- S07 – West-side Maintenance Campus – Relocation of the Port's Aviation Maintenance Facility (AMF) from its current location in the North Cargo area is required to clear the site for construction of the A08 Hardstand *(north) project*. The AMF will be located on the west side of the airport in the West-side Maintenance Campus and situated on a set of tiered platforms moving down the hill side. The new AMF will accommodate the relocation of current AMF facilities which includes a vehicle fuel rack, airfield deicer storage, and an approximate 135,000 square feet multi-bay building.

  The West-side Maintenance Campus will also accommodate relocation of the snow shed from the General Aviation area; relocation of the Port's Stormwater Lab and Wildlife Management Facility from Port property south of the airfield; and a new Consolidated Resource Recovery Facility (CRRF). The CRRF will be a fully enclosed building for consolidation of Airport waste materials to improve waste handling efficiency; enhance solid waste collection and storage capacity; and provide opportunities to optimize truck traffic. In addition, this facility will provide opportunities for environmental benefits through the sorting and recovery of compostable and non-compostable materials to enhance waste diversion from landfill. Materials will be processed to compact non-compostable waste and reduce the volume and weight of compostable materials through pulping and potentially anaerobic digestion or use of other waste-to-energy conversion technologies.

Due to the sites proximity to the Airport Surveillance Radar (ASR), and based on feedback from FAA Tech-Ops, the project assumes that no structure can be higher than the adjacent elevation of RWY 16R-34L. Today, the top platform closest to the runway sits approximately 20' below the runway elevation.

- S08 – Airline Support *(north)* & S09 – Airline Support *(west)* – To accommodate displaced Ground Service Equipment (GSE) maintenance and aircraft maintenance functions from the United Airlines maintenance building and Swissport cargo facility, and aircraft maintenance functions from the United Airlines maintenance building, two airline support buildings/expansions are planned. The first is a new building that would be located in the far northeast corner of the North Cargo area. The building will have an approximate 15,000 square feet footprint (S08 Airlines Support *(north)*). The second is an expansion of the existing AMB/AFCO III building to the west. The AMB/AFCO III building is currently being used for GSE maintenance functions. The proposed building expansion footprint is approximate 12,500 square feet (S09 Airlines Support *(west)*). Both buildings may be one or two stories depending on need/use.

- S10 – Centralized Receiving & Distribution Center (CRDC) – A new CRDC is needed to improve security and more efficiently screen and move supplies to concessionaires in the current and future passenger terminals. The new CRDC will be constructed on Port owned property north of SR 518 and will include a roughly 50,000 square foot building with warehouse and office space, truck terminals and parking for visitors and employees.

Figure 2-11
Schedule for Major Airport/Airline Support Projects
Seattle-Tacoma International Airport

Source: Port of Seattle, 2017.

Airfield Operational Feasibility

The airfield can support the Near-Term Projects at sustainable levels of annualized delay.

3.1 Background

Simulation modeling was performed to assess and confirm the ability of the airfield to support the proposed first phase of Airport development (i.e. the NTP).

3.2 Approach and Assumptions

As with all prior SAMP airfield simulation modeling, airfield simulation modeling related to the NTP was conducted using the Total Airspace and Airport Modeler (TAAM). With the exception of the facilities layout and flight schedule, the remaining modeling parameters were identical to the parameters used in prior simulations.

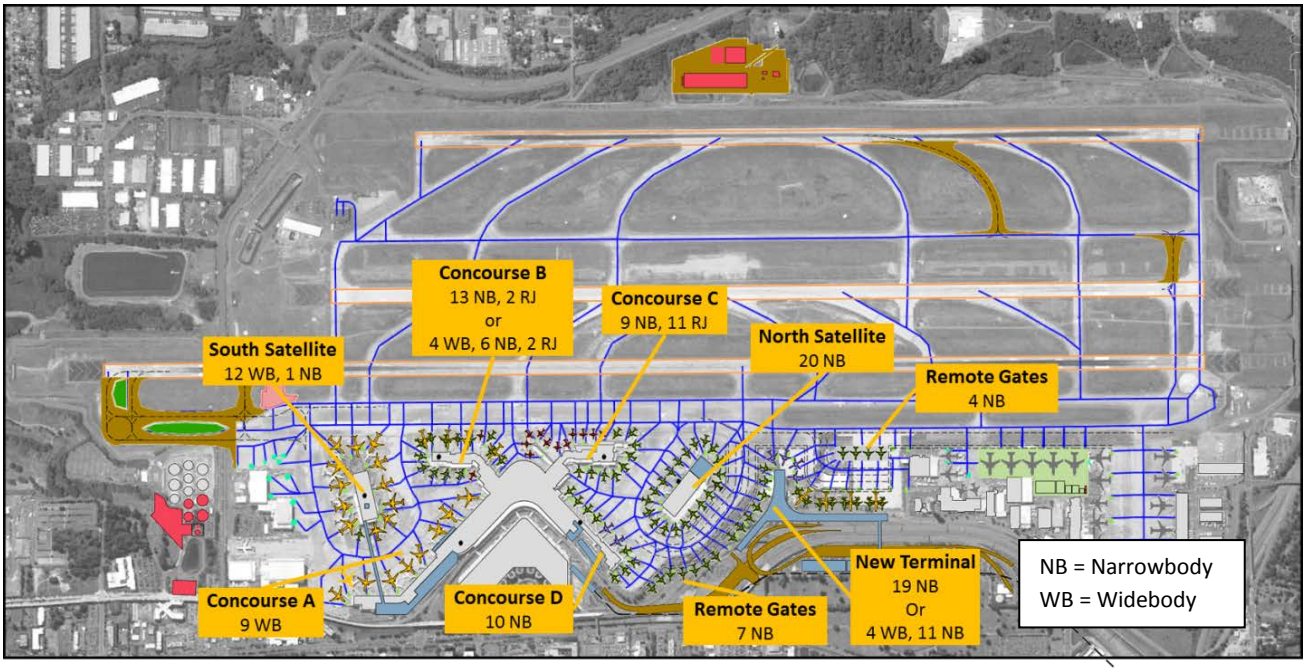
The facilities modeled are illustrated on Figure 3-1 and included NTP improvements to both the airfield and passenger terminal (please refer to Section 2.3 for descriptions of the improvements). Physical airfield improvements modeled included:

- A high-speed exit off Runway 34L between Taxiways E and J (A06 Runway 34L Highspeed Exit)
- An additional runway crossing at Taxiway D between Taxiway T and Runway 16C-34C (A07 Taxiway D Extension)
- Parallel Taxiways A and B located adjacent to the threshold of Runway 34R (A01 Taxiway A/B Extension)

Terminal improvements modeled included:

- A new International Arrivals Facility adjacent to Concourse A (IAF, *pre-SAMP project*)
- A newly renovated North Satellite (NorthSTAR, *pre-SAMP project*)
- 19 narrow-body aircraft gates (T01 North Gates)
- 7 hardstand positions located immediately north of Concourse D (A09 Hardstand *(central)*) and 4 hardstand positions located north and west of the new North Gates (A05 North Hold Pad)

Figure 3-1
Facilities Layout Modeled
Seattle-Tacoma International Airport



Source: Port of Seattle, 2017.

For the purposes of conducting modeling to test the ability of the airfield to support the NTP, a design day flight schedule (DDFS) representative of the year in which the NTP will be completed (2027) was developed. This flight schedule was (1) consistent with the other flight schedules used during the SAMP to assess facility requirements and for other TAAM modeling, and (2) contained activity estimated for 2027 (i.e., activity between PAL 2 (2024) and PAL 3 (2029)). Table 3-1 summarizes the activity contained in this 2027 flight schedule.

As with other SAMP simulations, simulations related to the NTP were conducted for five different weather and flow configurations and for two different airfield efficiency scenarios. The airfield efficiency scenarios simulate delays assuming that the future runway throughput would remain the same as today or with a moderate increase of 3-4 operations per hour (operations increase based on consultation with FAA staff). For more discussion on the simulated conditions and efficiency scenarios, please refer to Chapter 2 and Appendix G of *Technical Memorandum No. 6 – Alternatives*.

Table 3-1
Summary of Operations Included in 2027 Flight Schedule
Seattle-Tacoma International Airport

2027 Design Day Flight Schedule	Operation Type		
	Arrival	Departure	Total
Operations			
DDFS Operations	726	733	1459
Peak Hour Ops	68	63	108
Peak Hour Start	8:40 PM	10:36 AM	9:31 AM
Aircraft Type			
Wide Body	25	25	50
Narrow Body	448	456	904
Regional Jet	114	113	227
Turboprop	139	139	278
O/D Market Type			
Domestic	654	660	1314
International	27	28	55
Precleared	45	45	90

Source: LeighFisher, 2017.

3.3 Results and Conclusions

Table 3-2 summarizes the estimated average delays resulting from simulating the operation of the NTP assuming the 2027 flight schedule. Annualized weighting values were identified in consultation with FAA staff. When delay numbers for each model are weighted and totaled using the annualized weighting values shown, the average delay per operation is 22.0 minutes if there is no improvement in airfield efficiency and 16.6 minutes with medium improvement.

Table 3-2
Summary of Estimated 2027 Airfield Delay Associated with NTP
Seattle-Tacoma International Airport

Model	2027 No Improvement				2027 Medium Improvement			
	Arrival	Departure	Total	Weight	Arrival	Departure	Total	Weight
South VMC	11.7	12.3	12.0	0.3345	8.2	7.1	7.7	0.3345
South MMC	20.2	33.6	26.9	0.1099	19.4	17.5	18.5	0.1099
South IMC	21.2	54.8	37.8	0.2028	21.1	30.9	26.0	0.2028
North VMC	7.0	40.1	23.5	0.2496	7.7	35.6	21.7	0.2496
North IMC	110.9	107.7	109.4	0.0132	108.0	99.7	104.0	0.0132
Annualized				22.0				16.6

Source: LeighFisher, 2017.

Financial Feasibility

The Near-Term Projects are financially feasible.

4.1 Background and Objectives

This section summarizes the objectives, approach, results, and conclusions of an assessment conducted to determine the financial impacts and demonstrate the feasibility of the Near-Term Projects identified and described in Chapter 2 of this *Technical Memorandum No. 7*. The assessment was completed by Port of Seattle financial staff and incorporated existing forecasts of revenues, expenses, and planned capital improvements.

In order for the Near-Term Projects to be considered financially feasible, the financial forecast included in the assessment must demonstrate the Airport's ability to:

- Maintain debt service coverage consistent with bond covenants.
- Maintain debt levels within practical levels.
- Maintain cash reserves at levels consistent with current funding policy.
- Maintain a passenger airline cost per enplaned passenger (CPE) within a reasonable range of those projected at other large hub airports undergoing major capital programs.
- Maintain the capital capacity necessary for renewal and replacement of existing assets as well as ongoing maintenance costs.

4.2 Approach

The starting point for the assessment was the Port's financial forecast and funding plan for Sea-Tac Airport. This forecast includes assumptions relating to future revenues and operating and maintenance costs as well as future capital expenditures (excluding SAMP-related projects) and future operating and maintenance costs associated with new facilities. The funding plan for the existing capital program includes cash generated from airport operations, committed Airport Improvement Program and Transportation Security Administration grants and reasonable assumptions for future grants based on reviews with the FAA, Passenger Facility Charge (PFC) revenues continuing at the $4.50 level, Customer Facility Charge revenues to fund the debt service and operations of the consolidated rental car facility (in operation since 2012), and revenue bonds. Since most grants and PFCs in the coming years are committed to existing projects, the primary funding sources for SAMP projects will be cash from operations (net income) and new revenue bonds to be repaid from airport revenues.

Airline rates and charges were calculated consistent with the terms of the Signatory Lease and Operating Agreement (SLOA) that will go into effect June 1, 2018 (SLOA IV). The terms of SLOA IV are very similar to the prior agreement (SLOA III), with one notable change being the reduction of revenue sharing for 2018 and 2019 and the elimination of revenue sharing for 2020 and beyond. While the term of SLOA IV is for 2018 – 2022, the Port has assumed the terms of this agreement will continue throughout the forecast period. A continuing provision allows the Port to charge debt service coverage in the airline rate bases if needed to achieve total debt service coverage of 1.25x.

4.3 Results

The financial impacts of implementing the SAMP projects are reflected in Table 4-1 below.

Table 4-1
Financial Impacts of SAMP Near-Term Projects
Seattle-Tacoma International Airport

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2018-27 Total
Capital program ($M)											
Baseline	808	756	614	373	268	177	108	89	28	28	3,249
SAMP	--	1	56	158	487	720	810	1,017	855	361	4,465
Total	808	757	670	531	755	897	918	1,106	883	389	7,714
Key Measures											
CPE ($)	11.62	13.92	16.28	17.80	18.71	21.07	21.34	22.24	23.28	29.99	
D/S coverage	1.56	1.50	1.42	1.31	1.28	1.27	1.31	1.33	1.25	1.25	
Total Debt ($M)	2,703	3,229	3,747	4,121	4,731	5,381	6,215	7,108	7,811	7,827	
Debt/Enplanement ($)	110	130	149	163	186	209	236	267	286	280	
Cash ($M)	279	294	309	325	338	350	363	376	390	409	

Source: LeighFisher, 2017.

The baseline capital program includes all current projects and also includes an allowance for as yet undefined projects or budget changes to existing projects within the $3.25 billion. Based on a consultant's report on publicly available information on future CPE levels at the 30 large hub airports, it is the Port's judgment that by 2027 a number of large hub international gateway airports will have CPE in the $25 - $30 range, and some will likely be higher. Consequently, a projected CPE in this range will likely be competitive. Maintaining annual debt service coverage of at least 1.25x ensures the Port will meet its bond covenants. While less information is available about future debt levels at large hub airports, based on information obtained from the Port's bankers, it appears there will be multiple large hub airports with debt per enplaned passenger in the $250 - $300 range, and some above $300. Throughout the projection period, the Port is able to maintain a minimum cash balance equivalent to ten months of operating and maintenance costs (consistent with current target).

The financial projections include assumptions relating to future growth in non-aeronautical revenues as well as future operating and maintenance costs. Many factors can impact the actual costs the Port will incur and the actual revenues that the Port will generate. The costs of executing the capital program could also vary from current estimates. Clearly there are risks. Over a ten-year period, the Port will have opportunities to adjust course (change spending, alter fees) as conditions change in order to manage financial performance.

4.4 Conclusions

Based on the estimated costs of the Near-Term Projects, and the estimated timing of the expenditures, the assessment indicates that the Port's objectives can be met and that the plan is financially feasible.

The Port recognizes that undertaking this capital program will significantly increase airline costs at Sea-Tac, and significantly increase debt levels for the Port of Seattle. Information from peer airports suggest large hubs undertaking major expansions are increasing projected CPEs to levels that would have been considered "too high" a few years ago. Major expansions are very expensive, but the alternatives to expanding these large hubs are even more expensive to the cities and communities: foregoing airport expansion and suffering the economic consequences, or building or expanding another local airport.

In order to deliver the required capital improvements, and to potentially reduce the cost of construction, the Port will consider whether a public, private partnership (P3) of some kind could be advantageous to achieving the Port's objectives.

Another factor that could mitigate the cost impact of implementing the SAMP projects is if the project schedules are delayed, or if certain project elements are not deemed to be needed in the time frames currently planned. With each additional year that the project schedule is extended, Sea-Tac earns income from operations and PFCs that can be used to pay capital costs and therefore reduce the amount of revenue bonds needed to fund the program. Offsetting this, project delays can result in increased project costs due to cost escalation and increased project overhead, but on a net basis, there can still be savings.

Key Actions Following Completion of the SAMP

Increasing airfield/airspace operating efficiency is the most pressing long-range facility issue facing the Airport. Effective solutions will require a comprehensive process that should begin as soon as practical.

5.1 Introduction

In addition to actions directly related to environmental approvals, design, and construction of the NTP, the most significant actions following completion of the SAMP relate to the airfield/airspace system. As documented in Section 2.5 of *Technical Memorandum No. 6 Alternatives*, airfield modeling of the Long-Term Vision determined that with these improvements, and no other changes to how the airfield/airspace is operated, the airfield/airspace has insufficient capacity to meet the unconstrained 20-year forecast demand at a sustainable level of annualized delay. Airfield modeling of the NTP determined that with moderate efficiency gains over how the airfield/airspace is operated today (identified in consultation with FAA staff, see Section 3 – *Airfield Operational Feasibility*), the NTP improvements provide sufficient capacity to meet forecast demand in the year 2027 at a sustainable level of annualized delay. The improvements included in the NTP fit within the Long-Term Vision identified in the SAMP and are stand-alone projects that are needed to satisfy near-term demand. While the Long-Term Vision includes airfield projects that improve the effectiveness of the airfield system, a comprehensive airfield/airspace study is needed to develop and assess alternatives to meet the unconstrained 20-year forecast demand. Key findings and recommended actions are described in more detail below.

1. The airfield/airspace system, as it is currently configured and operated, has insufficient capacity to meet the unconstrained 20-year forecast demand at a sustainable level of annualized delay with all improvements in the SAMP Long-Term Vision. The primary constraint on the close-in airspace is the departure rate. The SAMP Long-Term Vision identifies several alternatives with the potential to improve the effectiveness of the airfield system. Such alternatives include, but are not limited to, end-around taxiways and modified runway use strategies. These requirements, constraints and alternatives for their resolution are discussed in *Technical Memorandum No. 5 Facility Requirements* and *Technical Memorandum No. 6 Alternatives.*

2. Design criteria issues are not unusual at U.S. airports; they occur for reasons such as the introduction of new aircraft, and are remedied either by physical changes or modifications to standards. Given the constraints to the airfield/airspace system, there are numerous airfield design criteria compliance issues that should be studied further in a comprehensive study of the airfield/airspace following the SAMP.

The significant design criteria compliance issues include those related to:

- Separation between Runway 16L-34R and Taxiway B (400 feet)
- Airfield intersection geometry
- Runway incursion and hot spot mitigation
- High-energy intersections
- Right-angle intersections
- Direct access to runway from apron
- Three-node concept

Design criteria compliance issues and alternatives for their resolution are discussed in *Technical Memorandum No. 5 Facility Requirements* and *Technical Memorandum No. 6 Alternatives*.

3. The most significant design criteria compliance issue is the non-standard centerline-to-centerline separation between Runway 16L-34R and Taxiway B of 400 feet. The standard separation based on current operations is 500 feet. The basis for this separation standard is low-visibility approaches to Runway 16L.*

   In a letter to the Airport Managing Director dated May 26, 2017 the FAA stated that the Port should initiate a study specifically designed to develop a plan to fully meet this separation standard in the long term. The facilities included in the Port's Long-Term Vision and NTP meet this standard by relocating both Taxiway A and Taxiway B in the areas of potential new construction north and south of the existing terminal complex. However, achieving 500 feet separation standard between Runway 16L-34R and Taxiway B in the area of the existing terminal complex would result in the loss of gates on the west side of both Concourse B and Concourse C.

5.2 Recommended Actions

The issues and potential solutions involving airfield/airspace system capacity and design criteria compliance are complex and involve benefit-cost tradeoffs. Therefore, additional study is required and should include a comprehensive systems and modeling approach and an inclusive stakeholder engagement process. The FAA and the Port should engage in this comprehensive study as soon as practical to assess the full range of issues and opportunities associated with reasonably improving airfield/airspace capacity and resolving design criteria compliance issues. The approach should be rigorous, analytical and involve airspace/airfield simulation modeling. The scope of the study should be limited to Sea-Tac airport and the close-in airspace and involve key stakeholders, including but not limited to: the Port, FAA, airlines, and the public. The Port and the FAA have committed to scoping the study in 2018.

*FAA advisory Circular 150/5300-13A *Airport Design* specifies that the separation required for an airplane design group V Taxiway B is 500 feet when airplanes in approach categories C, D, and E are conducting approaches with visibility minimums lower than ½ mile. The existing separation is 400 feet.

Long-Term Vision

Given existing airfield/airspace constraints, all improvements depicted in the Long-Term Vision that are not included in the NTP will be subject to further study.

6.1 Long-Term Vision

The vision for long-range development at the Airport is to provide facilities in all key functional areas (airfield, terminal, cargo, and airport/airline support facilities) to meet requirements for the unconstrained 20-year forecast of airport activity. The Long-Term Vision is the result of screening and analysis of a broad range of alternatives as documented in *Technical Memorandum No. 6 Alternatives* (TM-6). The alternatives analysis determined that the resulting Long-Term Vision is the most cost effective and operationally efficient layout of facilities to deliver balanced capacity to satisfy 20-year unconstrained demand within the conditions unique to Sea-Tac which constrain future Airport development.

Airside modeling conducted to test the ability of the Long-Term Vision facilities to accommodate 20-year forecast demand is documented in TM-6. Airside modeling determined that, even with all Long-Term Vision improvements, airfield/airspace constraints resulted in severe congestion and aircraft delays as activity approached 15-year forecast demand (forecast to occur in 2029). Given these existing constraints, all improvements included in the Long-Term Vision that are not included in the Near-Term Projects will be subject to further study discussed in section 5 of this TM-7. The Long-Term Vision is illustrated in Figure 6-1 and depicts all Near-Term Projects (shown in color) that would remain if development shown in grey were constructed. All Near-Term Projects included in the Long-Term Vision and described below are indicated by a project code and name. (e.g. A08 Hardstand *(north)*)

Given the physical constraints surrounding the current airfield and high utilization of existing facilities, expansion or redevelopment of on-airfield facilities often triggers the need to relocate existing functions in order to provide additional capacity to accommodate increased demand. The Long-Term Vision includes on-airfield facility expansion and redevelopment in the following areas:

- Modification of the airfield to improve safety and efficiency, including extension of Taxiway A/B in the southeast corner of the airfield (A01 Taxiway A/B Extension) and new end-around taxiways south and north of the airfield.
- Construction of aircraft hardstands to the south of the existing terminal in an area currently occupied by Alaska Airlines aircraft maintenance facilities to provide additional hold positions for passenger aircraft operations and remain overnight parking for passenger aircraft.

- Extension of Concourse D and gate expansion to the north of the existing terminal into an area currently occupied by cargo and airport/airline support facilities.

- Construction of new hardstands north of the future gate expansion, in an area currently occupied by the Port's Aviation Maintenance Facility (AMF) and United Airlines maintenance building (A08 Hardstand *(north)*). In the near-term, this hardstand provides additional cargo freighter parking positions and potential Remain Overnight parking for passenger aircraft (RON). With the development of additional cargo capacity in SASA, and reconfiguration/expansion of facilities in this area, this hardstand will eventually provide additional, flow-through hold positions for passenger aircraft operations.

- Construction of a new development "platform" in SASA by selectively excavating and filling the terrain. With the new platform, SASA would be capable of accommodating aircraft via a taxiway bridge to the existing airfield.

- Construction of new airline support facilities (e.g., ground support equipment and aircraft maintenance facilities) in SASA and the far north cargo area (S08 Airline Support *(north)* & S09 Airline Support *(west)*).

- Redevelopment of cargo facilities in the far north cargo area to maximize the efficiency of cargo operations in a limited footprint.

Facilities displaced by expansion and redevelopment of on-airfield facilities would be accommodated in three areas:

- SASA would accommodate relocated aircraft maintenance hangars and cargo facilities, as well as airline support facilities.

- The existing General Aviation (GA) area would accommodate relocated Primary Airport Rescue and Firefighting facility (S02 Primary ARFF).

- The future West-side Maintenance Campus would accommodate relocated airport support facilities, including the Port's Aviation Maintenance Facility (various shops/equipment storage), the Transportation Operations Center (bus maintenance), Distribution Center (parts warehouse), and the snow shed.

The plan also envisions improvements on Port property not contiguous to the airfield, including:

- Relocation of construction logistics facilities to vacant property south of S. 200th St.

- Expansion the existing Fuel Farm to the east (S01 Fuel Farm Expansion).

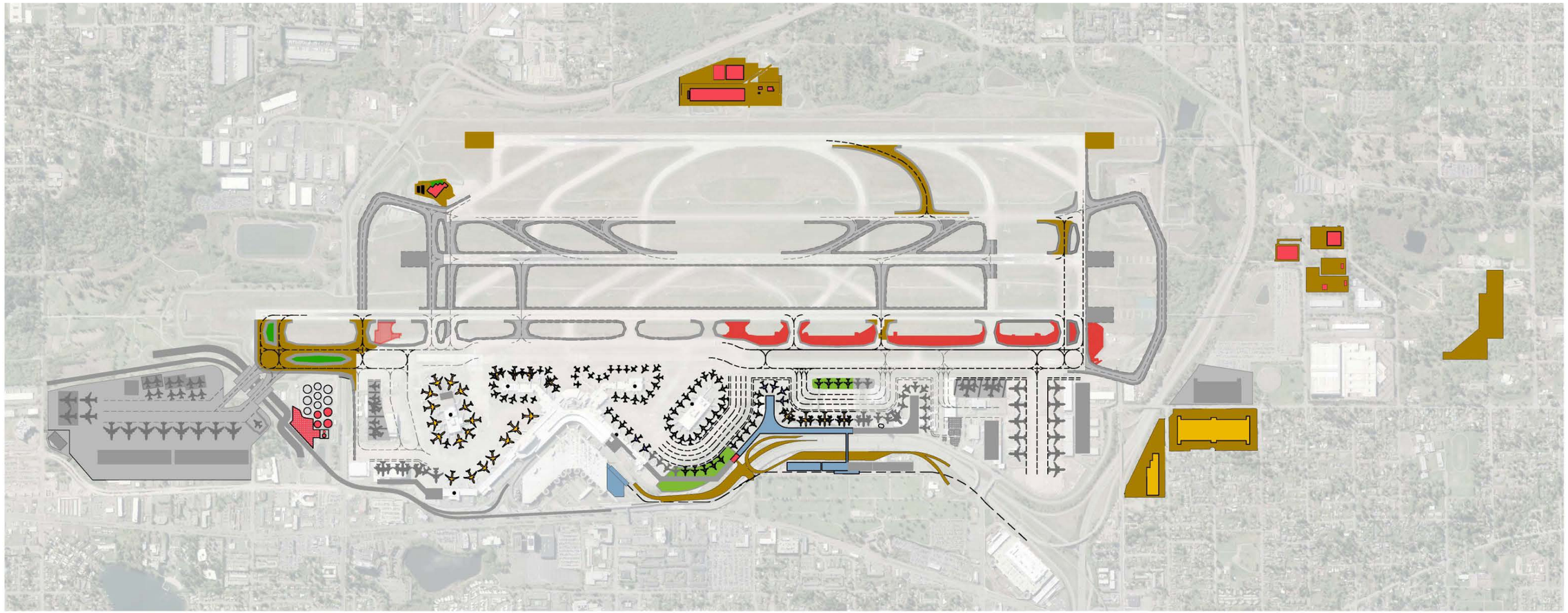
- Construction of a second terminal processor and associated passenger parking in an area currently occupied by the Doug Fox parking lot. In the near-term, the Second

Terminal and associated parking (T02 Second Terminal & Parking) would be sized to support gates constructed under the T01 North Gates project.

- Extensive roadway improvements to provide access to the Second Terminal and improve access to the Main Terminal (L01 North Airport Expressway Relocation & T03 Second Terminal Roads/Curbside).
- Construction of an elevated bus guideway to provide a landside connection between the Main Terminal, Second Terminal, and the Rental Car Facility (RCF) (L02 Elevated Busway & Stations).
- Expansion of the existing Main Terminal North Ground Transportation Lot (L04 Main Terminal North GT Lot).
- Relocation and expansion of employee parking to areas north of SR 518 (L06 Employee Parking Surface Lot & L07 Employee Parking Structure).
- Relocation and expansion of the existing S. 160th Street ground transportation holding lot to an area north of SR 518 (L05 North GT Holding Lot).
- Construction of a Centralized Receiving and Distribution Center (CRDC) in an area north of SR 518 (S10 Centralized Receiving and Distribution Center).
- Construction of cargo warehousing in an area north of SR 518 and adjacent to 24th Ave S (C02 & C03 Off-site Cargo *Ph1 & Ph2*).

The Long-Term Vision is illustrated in Figure 6-1 and depicts all Near-Term Projects (shown in color) that would remain if development shown in grey were constructed.

Figure 6-1
Vision for Comprehensive Long-range Airport Development
Seattle-Tacoma International Airport



Source: Port of Seattle and LeighFisher, 2016.