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Technical Memorandum

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Project No.: 10111.32 / Boston South Station HSIPR Expansion Project

From: Tim Macaskill, VHB

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Re: Conceptual Design Memo

This memorandum summarizes the technical aspects of conceptual design undertaken for the track and track related elements of the Boston South Station HSIPR Expansion Project. The three primary areas evaluated during this conceptual design effort were track layout, platforms, and station layout. The conceptual designs developed reflect MBTA design standards, Amtrak design standards, industry practice and engineering judgment in the application of these guidance documents.

1. Track Layout

a. Overview

Tower 1 Interlocking is the primary restricting element in operating rail service at Boston South Station followed by the number of platform tracks which are also at capacity. The optimal number of tracks determined by the team (20 platform tracks) and presented in the Operations Analysis Report is primarily a function of Tower 1 throughput capacity. To a lesser extent it is also a function of space available to assemble platform tracks between today's South Station Track No. 13 and the Fort Point Channel.

The proposed increase in throughput capacity at Tower 1 requires both shifting more train switching movements out to Broadway and Cove Interlockings and away from Tower 1 as well as increasing operational flexibility at Tower 1 itself. The increase in operational flexibility at Tower 1 results from maximizing how many turnouts, crossovers and double slip switches fit within the interlocking. The ability to fit these elements of infrastructure within the interlocking is determined by the length of the interlocking. Both the length of the interlocking and the ability to lengthen existing platforms at South Station are limited by how far Tower 1 interlocking can be moved south and away from the platform ends. A high level view of the station and even more broadly at the southeast corner of the Shawmut Peninsula reveals that the length of Tower 1 interlocking is restricted by the split of the Worchester/Northeast Corridor (NEC) Tracks to the west and the Dorchester/Old Colony Tracks to the south. The ability to move this split point further from South Station is

realistically restricted by a number of large articles of infrastructure including the Interstate 93 elevated structure over the NEC tracks and a large portion of Boston's South End southwest of Interstate 90. The team elongated and shifted the Tower 1 interlocking as far south as was reasonably feasible while obeying the boundaries of the infrastructure noted above.

b. The Interlockings

Once the Tower 1 interlocking was shifted to the south, the team provided for additional parallel moves and operational flexibility through an iterative process, laying out multiple configurations of crossovers at Cove Interlocking and Broadway Interlocking, and by adding a new "Mountain" Interlocking with a portion of this new interlocking resting on the Fort Point Channel Bridge. These modifications at Cove, Broadway and Tower 1, and the new "Mountain" Interlocking are presented in Figure 1-3.

The team concurrently completed a parallel iterative process focused on redesigning the overall configuration of Tower 1 itself. The configuration proposed in this conceptual design process was chosen based on the reviews of operational experts, signals experts, and track layout/design experts. After several reviews and fine-tuning, this configuration was adopted as the optimal conceptual configuration to sustain 2030 forecast volumes of both intercity and commuter rail train operations and was coded into the model for operations analysis. Figure 1-4 provides a stick diagram of the proposed Tower 1 Interlocking configuration modeled.

Primary conceptual Tower 1 layout criteria included:

- Use of No. 8 turnouts / crossovers / slip switches
- Use of horizontal curves with mostly a maximum degree of curvature of 12°-00' (Only one curve was laid with a curvature of 12°-30')
- No spirals were used in the layout, and the layout was only plan-view in nature assuming a mostly flat profile
- Conventional turnouts and slip switches were used
- Diamond crossings would need custom designing

c. Construction Phasing

Construction phasing was not developed in this conceptual design level. However, an allotment was established for both the capital construction cost and preliminary engineering design cost that will be required to design/construct several phases of Tower 1, which will be necessary to maintain operations while building towards the proposed condition.

d. New Tracks – Proposed Layout

There are a total of 13 platform tracks at Boston's South Station today. Track 1 is nearest Atlantic Avenue, with the number increasing towards the east with Track 13 closest to the existing USPS Annex Building. Today's 13 tracks run roughly parallel to Atlantic Ave, while the Fort Point Channel and Dorchester Avenue run at an acute angle to Atlantic Avenue. Figure 1-2 shows the expanded station with 7 new tracks, for a total of 20 platform tracks. The 7 new tracks were laid parallel to Dorchester Avenue for two reasons. First, turning the tracks further to parallel the existing tracks (as opposed to paralleling Dorchester Avenue) would have resulted in substantially shortening the proposed tracks versus what was achieved in the recommended layout. This would have limited their value substantially,

with many of the new tracks being too short to serve the desired length of trains. Second, a critical service/freight elevator sits east of track No. 13. This freight elevator is used to provide service access to commercial vendors inside the existing South Station headhouse. Laying out the proposed tracks parallel to Atlantic Ave starting from a new Track 14 eastward would require the demolition of this important service access point. The proposed layout of track spacing is discussed below.

2. Platforms

Both proposed and existing platforms were considered by the team. From the years 2000 to 2006 Hines Interests LP worked with various agencies to establish a design for construction of an overbuild development (referred to here as the "Hines Development") that would be situated above the existing tracks. The Hines Development proposed over the existing station tracks, would shorten several of the existing platform tracks. By reconfiguring Tower 1 it was possible to accommodate mostly longer clear-track lengths and platforms than were agreed to during the previous Hines/Amtrak negotiations without affecting the Hines Development. Table 1 below compares the platform accommodation of passenger coaches and locomotives developed during Hines/Amtrak negotiations against platform accommodation of coaches and locomotives developed during this conceptual design process for elongated existing platforms at tracks 1 through 13. In general, the majority of the existing platforms will be lengthened considerably which will enable train dispatchers to make more use of Track No. 13 and will also help Amtrak's "Thanksgiving" Northeast Regional trains to be better accommodated at the platforms.

Table 1: Comparison of platform accommodation – Amtrak/Hines negotiated vs. S. Station Expansion conceptual design of elongated existing platforms

Track Number	AMTRAK/HINES Negotiated Consists		S. Station Expansion: Conceptual Design Consists (Existing Platfoms)	
	Locomotives	Coaches	Locomotives	Coaches
1	1	7	1	14
2	1	7	1	11
3	1	9	1	11
4	1	9	1	12
5	2	9	2	11
6	2	9	2	12
7	2	11	2	12
	1	12		
8	1	12	1	14
	2	11		
9	3	12	3	11
10	1	12	1	12
	2	11		
11	1	8	1	11
12	1	7	1	11
13	1	6	1	11

In addition to lengthening most of the existing platforms considerably, the conceptual design adds seven new platform tracks. Table 2 below indicates the platform accommodation that would be provided for along the proposed seven new tracks.

Table 2: S. Station Expansion conceptual design – platform accommodation at proposed seven new tracks

ro o e Track Number	tatio a io o ce tua e i o i t	
	Locomoti e	oac e
14	1	11
15	1	10
16	1	10
17	1	8
18	1	8
19	1	11
20	1	13

Spacing of these proposed platform tracks was developed by using the existing platform track spacing and applying said spacing as a template. This was completed both for passenger flow, and for potential future overbuild column/footing placement. Below are a few technical parameters used to lay out the proposed conceptual platforms.

- Minimum platform end width (Southwest ends) of 8′
- Minimum offset from clear track point (Southwest ends) along track to end of platform of 20′ (This offset would be needed for signal requirements.)
- Offset from platform edge to track being served 5′-7″

As is discussed below, the future station will likely have a mid concourse. This concourse will require elevator and escalator access and, therefore, the existing platform widths were conceptually evaluated for the feasibility of elevator placement. Existing platforms are approximately 18′ wide (and varies), while typical elevators are approximately 6′ wide (outside to outside). This would allow approximately 6′ from the outside of the elevators to the platform edge on both sides of the elevators. This 6′ of clearance is wider than the minimum 36″ per ADA requirements but it would require a variance from MBTA Standard Drawing No. 1013, in which the minimum required distance from platform edge to a fixed obstruction is indicated to be 7′-6″.

3. Station Layout

A secondary headhouse will be required to accommodate the new 7 tracks and platforms. This is illustrated in Figure 1-2. This secondary headhouse is envisioned to be the signature architectural element of the station expansion. While the secondary headhouse would have pedestrian connections onto a newly rededicated Dorchester Avenue - allowing flow to Summer Street - it would also have a wide, covered and potentially fully enclosed pedestrian connection into the existing main headhouse. The secondary headhouse is envisioned primarily as a large glass canopy with a waiting area and train display board with minimal additional commercial space, the details of which will be determined at a later phase.

The secondary headhouse is conceptualized to be offset from the rear side of the existing 245 Summer Street building with a 15' emergency egress alley, which would result in narrowing today's alley down from its approximate 40'-50' existing width. Service deliveries for 245 Summer would continue to access the loading docks for this building off Dorchester Avenue, while three sides of the building would be accessible for fire suppression/fighting including Dorchester Avenue, Summer Street, and the pedestrian park area along the northwest side of the building. In the current concepts, 245 Summer Street is not envisioned as a component of the secondary headhouse.

To preserve the loading dock (and elevator) leading down into the basement of the existing South Station headhouse, the existing busway ramp would be extended along the southeastern side of the bus terminal in a northeasterly direction until reaching the new freight elevator. Freight shipments would be unloaded into an elevated loading dock, reaching the basement via the new elevator. It should be noted that the extension of the busway is included in the capital cost estimate of this project and eventual extension by any developer is not a prerequisite.

Pedestrian flow at, around, and inside of the expanded station was also accommodated. With the rededication of Dorchester Avenue, and with new platform tracks, there is a need to connect the tracks to one another with a mid concourse and to allow for easier pedestrian flow from Atlantic Avenue to the eastern side of the proposed station. To accommodate these needs in the most efficient and logical manner, the existing pedestrian concourse that today runs from Atlantic Ave southeasterly into the South Station Bus Terminal rotunda would be extended. Today, this pedestrian concourse travels one level above the train tracks, and one level beneath the busway. Extension of this concourse over and above the proposed tracks and then down to Dorchester Avenue would likely be the least expensive way of constructing a pedestrian connection from Atlantic Avenue to Dorchester Avenue, and would likely be the least expensive way of connecting the busway terminal to the proposed tracks and the tracks to one another at a secondary location. This mid concourse is shown in the conceptual schematics and has been included in the conceptual capital cost estimate. An emergency egress route at the far tail (southwest) ends of the existing and proposed tracks may need to be pursued in the future.

The conceptual design analysis evaluated how trains move and function through the various interlockings and how the trains interact at the station. This comprehensive conceptual analysis concluded by studying the platforms and how pedestrians move and interact in the area before boarding or after detraining.