False Creek Flats Analysis

Submitted to Greater Vancouver Gateway Council

by MainLine Management, Inc.

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Background

The False Creek Flats (FCF or the Flats) is a 308-acre industrial area located south east of downtown Vancouver. It has long been home to Port and city-serving activities, particularly rail in its central and eastern areas.

Canadian National Railway (CN) and BNSF Railway (BNSF) use the rail yards in the Flats to support the South Shore waterfront terminal operations that have a very limited amount of track on dock.

The Flats is also home to passenger rail services. Via Rail and Amtrak operate out of the Via rail yard, while the Rocky Mountaineer operates out of its own terminal on the south side of Terminal Ave.

Planning Process

Increased container volumes through Centerm and Vanterm, Vancouver Port Authority's (VPA) two international container facilities on the South Shore of Burrard Inlet, have contributed to an increase in rail traffic in and around Vancouver. This growth has increased the number of rail cars moving through and/or being stored near the terminals. However, a lack of rail yard trackage on the waterfront has forced the railways to look for alternative locations to accommodate the switching, staging, or storage of this traffic.

For CN, one such alternative is the nearby FCF. Rail operations in the Flats have increased in recent years in response to the growth in the trade of containers, grain and other goods through the Port of Vancouver.

While the demand on the existing rail infrastructure in the Flats has increased, many of the surrounding traditional warehousing and distribution operations have vacated the False Creek Flats area. This has left much of the land area underutilized and poised for redevelopment. Inherently, there is a conflict with increasing rail traffic and underutilized land near a major downtown area, such as the Flats. In an attempt to resolve these conflicts, the City of Vancouver has embarked on a planning initiative to map out a future for the area.

During the early stages of the work program it became evident that further information was required on the existing rail operations in the False Creek Flats, as well as some indication of how rail operations will change in the future.

The City of Vancouver requested the Gateway Council, Vancouver Port Authority (VPA) and the railways to provide more detailed information on current rail capacities and future demand for the rail yards in the Flats and on the south shore of Burrard Inlet. The City of Vancouver has also requested that the parties explore the implications of four rail footprint scenarios in the Flats.

To facilitate this request, MainLine Management (MLM) was engaged by the Gateway Council, VPA and the railways.

Methodology

To analyze FCF capacity utilization, MLM relied upon computer simulations of rail operations in the Lower Mainland that were created and performed in 2003 and 2004. These simulations were designed to analyze all aspects of capacity utilization, including on-dock capacity, support yard capacity, the routes connecting the yards and the rail car transfer operations that each railway utilized. A Base Case (existing operations) was created and validated by the railways, and then projected future traffic was added to analyze potential changes in the area. These changes included some minor additions to rail infrastructure and more complex changes to methods of operations. All results of the simulations were presented upon completion to VPA and railway personnel. There was general agreement to the conclusions and recommendations by the parties associated with the analyses based upon the assumptions that were made.

Overview of Operations and Infrastructure

Three major Class 1 railways provide service in Vancouver: Canadian National Railway (CN), Canadian Pacific Railway (CP) and BNSF Railway (BNSF). A brief description of CP's, CN's and BNSF's operation follows.

CP and CN have parallel lines that extend eastward from Vancouver and are on opposite sides of the Fraser River. The parallel lines have allowed the two railways to reach a commercial agreement to operate each line more or less in a single direction, with both railways using the CN line westward towards the Lower Mainland and both railways using the CP line to depart the Lower Mainland. The joint operation is in effect between Mission/Matsqui, BC and to near Kamloops.

Both railways operate west of Mission/Matsqui into major yards on separate sides of the Fraser River. CP's primary yard in Vancouver is at Port Coquitlam on the north side of the Fraser River, while CN's primary yard is named Thornton Yard and is south of the Fraser River in Surrey.

CP's route from Coquitlam Yard to the Port of Vancouver (VPA) runs from Coquitlam to downtown Vancouver along the south shore of Burrard Inlet. The route provides excellent direct access to the Port facilities and industries on the South Shore.

CN's route from Thornton Yard to the FCF and the Port is more complex. After the route leaves Thornton to the west, it joins with the BNSF route at the Fraser River Rail Bridge (FRB). CN operates on BNSF tracks from the FRB through New Westminster to Willingdon Jct. At Willingdon Jct., CN trains destined for North Vancouver leave the BNSF route and cross the Second Narrows Rail Bridge. Trains destined for the VPA South Shore continue on BNSF track to Still Creek.

At Still Creek, CN and BNSF trains enter the "Grandview Cut", which is a single-track section of railroad that ends in the FCF area at CN Jct. There are three yards in the FCF area; Main Yard,

Glen Yard and South Yard. Main Yard is CN's primary support yard for Port of Vancouver operations; they also use the largest portion of Glen Yard to support Port operations. South Yard is BNSF's main support yard for a rail barge operation that runs between the South Shore of Burrard Inlet and industries on Vancouver Island, as well as the Sunshine and Central Coast.

CN uses the FCF yards to stage and switch traffic going to or from the Port. This traffic includes international containers that are loaded or unloaded from ships at Vanterm or Centerm. Grain and manifest traffic going to/from the waterfront terminals also move through the FCF, along with manifest traffic destined for industries around Main Yard.

BNSF uses South Yard in the FCF area to stage and store cars for the Burrard Inlet barge operation. BNSF currently does not access Centerm, Vanterm or other Port of Vancouver waterfront terminals.

A single-track line called the Burrard Inlet Line (BI Line) connects the yards in the FCF area with the Port's waterfront terminals. All CN and BNSF movements that travel to or from the waterfront area currently must use this route. The BI Line crosses three CP tracks at grade just north of Powell Street and south of the waterfront area. This crossing is called the Heatley Diamond, and it plays an important role in the ability of CN and BNSF to move traffic to/from the Port. On the north side of the Heatley Diamond, CN has a yard called Waterfront Yard, which also is used by waterfront industries.

In addition to freight operations, there are multiple passenger operations in the FCF area as well. West Coast Express (WCE) operates commuter trains between Mission and Vancouver on the CP route in the morning and afternoons of weekdays. VIA operates a tri-weekly transcontinental train into and from the VIA station, which utilizes the BNSF route between the FRB and the FCF area. Amtrak operates a daily train to/from Seattle into the VIA station, also utilizing the BNSF FCF route. Finally, Rocky Mountaineer Tours runs a bi-weekly tourist train between their station in Main Yard and eastern BC/western Alberta.

General Yard Functions and Quantification of Yard Capacity

One objective of the analysis was to explain railway yard operations and capacity utilization. In this summary MLM has provided a brief overview of yard operations and how capacity utilization is quantified. The report covers these topics in much greater detail.

Yards have three primary functions associated with operations. Those functions are arriving or departing trains, staging or storing cars, and switching or marshaling cars. Each has an effect on the capacity utilization of a railway yard.

Each of the functions has an associated capacity. Arrival/Departure Capacity can be defined by the number of tracks in the arrival/departure portion of the yard and what percentage of them are available to be utilized for an arriving or departing train. Standing Capacity of a yard is better quantified through the measurement of how many cars can fit into a yard, rather than how many tracks are available. Switching/Marshaling Capacity is dependent on both the number of tracks available and the car spots within the tracks.

To determine Total Yard Capacity, the measurements of capacity must be combined. For each yard, the simplest method to combine the functional measurements of capacity is to assign a percentage of importance to each function within the yard and create a weighted-average using those percentages. Since yard utilization changes each time a train arrives or departs, or each time cars are switched around a yard, capacity utilization must be measured over time. Each yard in the FCF was analyzed in this manner and capacity utilization was graphed.

Sustainable Yard Capacity is more relevant than the theoretical yard capacity that can be calculated. Most yards cannot function efficiently at or near maximum capacity utilization. The primary reason for this is that at or near maximum capacity utilization, there is little or no room to perform the functions of a yard, such as marshaling, in a normal manner.

When a yard experiences a high percentage of utilization of its theoretical capacity, it doesn't mean the yard shuts down. It does mean, however, that operations that occur under normal conditions cannot occur unless unusual operational moves are performed.

From experience with yard operations, MLM has found that the need to operate yards in an extraordinary manner begins to occur when total capacity utilization exceeds 60% to 65% for sustained periods of time. The capacity level defined by this measure is generally termed "sustainable capacity", because it reflects the level of capacity utilization where efficient yard operations can be sustained.

Yard Capacity Utilization in the False Creek Flats

MLM was tasked with analyzing the capacity utilization of the three major yards in the FCF, and describing how operations within those yards affected the utilization of capacity. Additionally, MLM was tasked with identifying factors or influences that occurred around the FCF area or on the waterfront that impacted FCF yard capacity utilization.

After the initial report was completed, CN and CP announced a co-production agreement that could greatly modify the operations through the FCF yards. The co-production agreement changes the routing of traffic to the waterfront area; however it does not consider any reduction in yard capacity in the area. The agreement was designed to improve rail traffic flow by bypassing yards and eliminating some railway-to-railway handoffs. MLM has provided an addendum to the initial report to describe these changes and their potential effects on FCF operations. The effects of the modifications are also discussed briefly in this summary.

CN Main Yard

The analysis found that based upon Main Yard's current and projected operational responsibilities, the yard is appropriately sized. The capacity utilization graphs indicate even though the capacity consumed over the simulated day does not regularly exceed sustainable levels, the track usage for Main Yard shows that all tracks in the yard are used regularly throughout the day. During periods when a large transfer train arrives, up to 90% of tracks had

cars on them for approximately two hours. This is an indication that all available tracks were necessary for the operation to be accomplished.

With the new co-production agreement between CN and CP, MLM anticipates that transfers to/from Thornton will decrease. However, we believe that Main Yard will continue to be used to support local FCF rail served industries and will also see an increase in staging/storage of intermodal and manifest traffic. As identified in the addendum, there are capacity concerns regarding the CN and CP yards along the waterfront, and with the increase in traffic through these yards due to the co-production agreement, cars that traditionally have been staged or stored there will likely be relocated to FCF yards.

CN Glen Yard

The analysis revealed that while Glen Yard was used on a regular basis for the staging of grain and intermodal cars, it was not capacity constrained throughout the simulations. MLM believes that in the future, as intermodal volumes increase, this yard will be used more often for the staging of international container traffic for the waterfront terminals.

One issue that was a concern about Glen Yard is that many of the tracks are relatively short (compared to Main and South Yards) and the south end of the yard is on a grade. This reduces Glen Yard's ability to be used as a switching yard. Its position on the opposite side of the main line from Main and South Yards also reduces operational efficiency between Glen and Main Yard.

With the co-production agreement described in the addendum, MLM believes Glen Yard will also be used to stage/store international container and manifest traffic if and when necessary. When the traffic through Main Yard is reduced by the co-production operational patterns, we believe that that yard will be used first for staging/storage of rail traffic. However, if volumes increase to a level where Main Yard becomes congested, Glen Yard will likely handle the overflow.

BNSF South Yard

South Yard supports the barge operations on the South Shore of Burrard Inlet, and acts as a staging/storage facility for other Vancouver area rail traffic. Yard utilization is high because of limited capacity in other BNSF yards in the Vancouver area.

MLM does not see the CN - CP co-production agreement having a major effect on South Yard operations.

VIA Facility

Based upon the number of station tracks available at the VIA station and maintenance facility, the analysis revealed that the facility is adequately sized for current and projected operations.

Influences on Yard Capacity Utilization

Yards in the FCF area face network configuration issues that can and do affect the velocity with which cars move from the yards. Main Yard in particular is sensitive to these network complexities because it handles levels of traffic that require consistent car velocity. The four major network configuration issues that affect the velocity of car movements from Main Yard to the Waterfront are the Burrard Inlet line (BI Line), the Heatley Diamond, the connection to the CN Lead north of the diamond and the length of yard tracks at Waterfront Yard.

The BI Line is the single-track access for all trains moving between the FCF yards and the Waterfront. The speed of trains operating over the line is severely restricted due to grade crossing issues. Once trains enter the BI Line, they cannot be delayed for any significant time because of the grade crossing blockage issue. This means trains must be held in the yards until a clear route is established, affecting yard capacity utilization.

The Heatley Diamond is where the BI Line crosses three CP tracks just north of Powell Street and south of the waterfront. The CP tracks include the main line and two heavily used yard lead tracks. CN and BNSF must request permission from CP to cross the diamond for access to/from the waterfront, which can be done verbally or via an electronic system accessible to railway employees. CP traffic is generally given priority over CN or BNSF operations.

Beyond being the connection between the FCF and the waterfront, the CN track that extends north of the Heatley Diamond also serves as the main switching lead for Waterfront Yard, as the access route for Centerm and Vanterm, and as an industrial lead track for other waterfront industries east of Waterfront Yard. This section of track frequently experiences conflicts between competing switching moves, which can in turn impact train movements between the FCF and the waterfront.

The length of the Waterfront Yard tracks restricts the length of trains that can move between FCF and the waterfront. This restriction creates additional moves that have to operate between the two yards.

Passenger movements also have an effect on trains moving between FCF and the waterfront. WCE trains operating to/from Waterfront Station cross the Heatley Diamond and have priority over all freight movements. WCE also uses the BI Line to access the VIA facility where some maintenance is performed on the commuter equipment. VIA and Amtrak trains operate into the VIA facility in a variety of manners that affect switching and operations at Main and Glen Yards. All revenue passenger moves have priority over freight operations.

Potential Network Modifications

Analysis indicated that there are some potential modifications in and around the FCF/BI Line area that could improve rail operations, and thereby improve the capacity utilization in the FCF yards. One such improvement would be the construction of grade separations at Powell and Venables St. These grade separations would allow trains operating between FCF and the

waterfront to stop on the BI Line, which in turn would generate flexibility for operations at Waterfront and Main/Glen Yards.

Double-tracking the BI Line was also analyzed, and in conjunction with the grade separations, would also likely improve operations. However, the track alignment at the Heatley Diamond and north of the diamond would have to be studied to determine if an additional route could be created in that area to alleviate some of the conflicts that occur between Waterfront Yard, Centerm, Vanterm and other waterfront industrial traffic.

False Creek Flats Footprint Modifications

The City offered four footprint configurations that were studied in the analysis. These were the Status Quo footprint, the Reduced footprint, the Expanded footprint and the Reconfigured footprint. Each was analyzed to determine what the most likely outcome on rail traffic would be.

- **Status Quo Footprint**: Based upon the study's results, this option would be favorable for current operations and future operations that include a co-production agreement between CN and CP. The projected increase in intermodal traffic will likely have an effect on the utilization of the FCF yards, as they are natural locations for staging and storage of equipment.

- **Reduced Footprint**: The reduced footprint concept entails removal of BNSF's South Yard. The analysis found that the barge facility and South Yard are linked. If the barge facility can be relocated or its traffic can be moved through another existing facility, it is likely that South Yard will become available. However, MLM believes that CN may want to secure rights to that yard because it fits better operationally with Main Yard than Glen Yard does.

- **Expanded Footprint**: Under the expanded footprint scenario, South Yard remains in its current configuration, while Main Yard, Glen Yard and the VIA station are expanded. All these yards serve separate purposes, and the proposed expansion of all three may not improve overall operations.

  The VIA facility is the least likely to be expanded because the size of the existing facility should be sufficient for projected passenger operations. Glen Yard also is unlikely to be expanded because its configuration and grade issues do not make it a desirable yard for switching operations. The existing track will likely be used for staging of intermodal equipment.

  Main Yard is the yard most likely to require expansion with the projected growth of intermodal traffic through the South Shore intermodal terminals. MLM believes that CN may pursue an agreement with BNSF should South Yard become available for use because of the Main and South Yards' configurations and proximity. If that arrangement cannot be worked out, and additional trackage is necessary, then we believe CN may consider expanding Main Yard. There are industries that would need to be relocated under that concept, and Glen Yard is a location that may be considered if the land were available.

- **Reconfigured Footprint**: Under the reconfigured footprint proposal, South Yard is removed, while Main Yard is expanded. As with other concepts where South Yard is removed, MLM believes the BNSF barge operation would have to be relocated and CN will have to decline interest in the property before this occurs. The reconfiguration of Main Yard will also depend on relocating the industries that will be affected with the conceptual expansion.

Of the yards in the FCF area, MLM believes the one most likely to be made available for non-rail use would be Glen Yard. The location of the yard on the opposite side of the main line from South and Main Yards impacts the efficiency with which the yard can be served. The shorter track lengths and the grade issue on the south end of the yard also impact its utility.

As mentioned, if Main Yard is expanded, there are rail served industries that will have to be relocated. Glen Yard may serve this purpose, particularly if South and Main Yard are combined into a larger rail complex.

When the CN - CP co-production agreement is put into effect, MLM believes that the number of transfers from Thornton Yard to waterfront industrial traffic in Main and Glen Yards will be reduced. The role of these yards will shift from that of arrival/departure to staging and storing of railcars for waterfront industry. As described in Addendum 1, we believe that as volumes grow at the international container terminals, traffic that is staged/stored in the waterfront yards will be relocated to Glen/Main Yards.

It is MLM's opinion that over time, Main Yard will be included into the terms of the co-production agreement. When that occurs, Main Yard will be utilized for staging and storage of rail equipment because of the track lengths and switching accessibility. When it becomes congested, however, Glen Yard will serve as the overflow yard. Glen Yard is well suited to be used as a storage facility, so we see no reason why CN would pursue an expansion policy at Main Yard as long as Glen Yard is available.

The volumes that were provided as the estimated maximum throughput for an expanded Centerm and Vanterm would indicate that the staging/storage capacity of Main and Glen Yard should be sufficient to meet the long term operational needs of the railways serving the South Shore.

Conclusions

1. BNSF South Yard will remain unavailable for alternative uses unless the barge facility is relocated and trackage equivalent to South Yard's is relocated near the new BNSF facility.

2. An increased footprint will be most likely to occur at Main Yard under a growth scenario that doesn't involve a co-production agreement between CN and CP. MLM believes that if CN requires an expanded yard area, they will pursue South Yard prior to going through the steps of relocating the existing industry and constructing new trackage in its place.

3. The BI Line, Heatley Diamond and CN Lead connection will have to be addressed before any expansion or reconfiguration of FCF yards is likely to be undertaken by the railways.

This would likely only occur under a growth scenario that doesn't involve a co-production agreement between CN and CP.

4. If the BI Line restrictions, including conflicts at Heatley Diamond, can be acceptably mitigated, CN will be more likely to focus on utilizing the FCF route for their traffic than to rely on a CP co-production agreement.

5. A reconfiguration of South Yard with Main Yard makes more operational sense than a reconfiguration of Main Yard and Glen Yard.

6. MLM believes it is unlikely that the VIA facility or its footprint will require expansion.

7. Based upon the new co-production agreement between CN - CP that was reached following the completion of the main report, MLM believes there will still be a viable need for Glen and Main Yards. This will likely revolve around staging/storage of displaced rail equipment from the waterfront yards because of increased through traffic that will utilize the capacity of those yards.

8. The co-production agreement will also likely reduce the use of the BI Line. The line will continue to be required for originating, terminating and maintenance passenger movements and some freight movements, primarily barge operations and movements of staged/stored equipment to/from the waterfront.

9. As CN and CP refine the agreement's operations, it is MLM's opinion that there is potential for Glen Yard's usage to be phased out. MLM does not anticipate the availability of Glen Yard to occur in the near future, however. We believe CN and CP will want to test the commercial agreement under existing and future levels of traffic before making decisions on infrastructure requirements and long term usage.

False Creek Flats Analysis
Main Report

Chapter 1- Introduction

1.1 Background

The False Creek Flats (FCF) is a 308-acre industrial area located south east of downtown Vancouver. The area is bounded by Main Street to the west, Clark Street to the east, Great Northern Way to the south and Prior Street/Malkin Ave to the north. It has long been home to Port and city-serving activities, particularly rail in its central and eastern areas.

Canadian National Railway (CN) and BNSF Railway (BNSF) use the rail yards in the Flats to support the waterfront terminal operations that have a very limited amount of track on dock. Canadian Pacific Railway's (CP's) main support yard is located adjacent to the Waterfront Skytrain Station.

The Flats is also home to passenger rail services. Via Rail and Amtrak operate out of the Via rail yard, while the Rocky Mountaineer operates out of its own terminal on the south side of Terminal Ave.

1.2 Planning Process

Increased container volumes through Centerm and Vanterm, Vancouver Port Authority's (VPA) two international container facilities on the South Shore of Burrard Inlet, have contributed to an increase in rail traffic in and around Vancouver. This growth has increased the number of rail cars moving through and/or being stored near the terminals. However, a lack of rail yard trackage on the waterfront has forced the railways to look for alternative locations to accommodate the switching, staging, or storage of this traffic.

For CN, one such alternative is the nearby FCF. Rail operations in the Flats have increased in recent years in response to the growth in the trade of containers, grain and other goods through the Port of Vancouver.

While the demand on the existing rail infrastructure in the Flats has increased, many of the surrounding traditional warehousing and distribution operations have vacated the False Creek Flats area. This has left much of the land area underutilized and poised for redevelopment. Inherently, there is a conflict with increasing rail traffic and underutilized land near a major downtown area, such as the Flats. In an attempt to resolve these conflicts, the City of Vancouver has embarked on a planning initiative to map out a future for the area.

The most recent planning initiative began in the spring of 2005. The process brought together the key stakeholders in the area including community groups, businesses, landowners and the railways to map out a future for the area.

During the early stages of the work program it became evident that further information was required on the existing rail operations in the False Creek Flats, as well as some indication of how rail operations will change in the future.

The City of Vancouver requested the Gateway Council, VPA and the railways to provide more detailed information on current rail capacities and future demand for the rail yards in the Flats and on the South Shore of Burrard Inlet. The City of Vancouver has also requested that the parties explore the implications of four rail footprint scenarios in the Flats.

To facilitate this request, MainLine Management (MLM) was engaged by the Gateway Council, VPA and the railways.

1.3 Purpose of Report

MLM has structured the report to address three primary issues regarding the False Creek Flats area. The first purpose is to describe the rail infrastructure and operations that take place in the FCF and South Shore waterfront area near downtown Vancouver, BC. The intent is to provide a reader with a high level understanding of rail operations and infrastructure under current and future operations.

The second purpose is to describe and illustrate the effects of capacity utilization in general terms and then apply them to the FCF rail support yards. This discussion will also describe how the existing network and rail operations have an impact on that utilization. The goal is to help a reader understand the necessity of the size and configuration of the existing facilities, as well as how future operations will affect the capacity of the facilities.

Finally, the report addresses possible modifications to the FCF yards and surrounding infrastructure, and analyzes the effects those modifications may have on utilization of capacity in and around the yards. The intent here is to allow a reader to understand what changes will be necessary in the area as future growth occurs, and how those changes will affect capacity utilization and operations in the FCF and waterfront areas.

1.4 Methodology

To analyze FCF capacity utilization, MLM relied upon computer simulations of rail operations in the Lower Mainland that were created and performed in 2003 and 2004. These simulations were designed to analyze all aspects of capacity utilization, including on-dock capacity, support yard capacity, the routes connecting the yards and the transfer operations that each railway utilized. MLM's understanding of the Lower Mainland, the False Creek Flats and South Shore waterfront operations was developed in the process of creating these simulations.

All simulations were performed with the Rail Traffic Controller™ model (RTC™). The model performs complex mathematical calculations that represent trains moving throughout a defined network of track, switches, yards and terminals. The model considers track speed, train length and weight, motive power, signals, bridges, train priorities and other information as trains are dispatched across the network.

The model creates output that can be formatted and analyzed to understand what is occurring across the entire network as trains are dispatched to and from designated destinations. Based on

the technical capabilities of the model, yard capacities, train delay, train velocity, link occupancy and schedule adherence were all analyzed.

In Chapter 5 of this report, there is a more detailed description of the simulations used to create the capacity utilization graphs and analyses for both the Base case and the Future case simulations.

1.5 Report Layout

The report is divided into nine chapters. Following this introductory chapter, there are sections on Overview of Operations and Infrastructure, General Yard Functions, Yard Capacity and the Utilization of Capacity, Yard Capacity Utilization in the False Creek Flats, Influences on Yard Capacity Utilization, Potential Network Modifications, False Creek Flats Footprint Modifications and Conclusions.

The report is structured in this manner to assist a reader in developing a basic knowledge of railroad operations and capacity utilization and apply that information to the specifics of the False Creek Flats. From there, the report attempts to provide an understanding of how modifications may improve utilization or operations.

The main report focuses on the FCF yards and surrounding area. Additional appendices include a glossary of terms (Appendix 1) and two examples of how capacity utilization affects simple railway operations (Appendix 2).

Also attached to the report are schematics for all yards in the FCF and waterfront areas, which show their configuration and approximate track lengths. Finally, there are exhibits attached that detail track utilization over a 24-hour period for both the Base and Future simulations for each yard in the FCF/waterfront area. This track utilization depicts the type and amount of traffic that used the tracks in the simulations, and was the data that was used to calculate the capacity utilization graphs that are included in Chapter 6 of the report.

Chapter 2 – Overview of Operations and Infrastructure

Three major Class 1 railways provide service in Vancouver: Canadian National Railway (CN), Canadian Pacific Railway (CP) and BNSF Railway (BNSF). In addition, one short line carrier, Southern Railway of British Columbia (SRY) serves areas around Vancouver. A brief description of CP's, CN's and BNSF's operation follows.

CP and CN have parallel lines that extend eastward from Vancouver and are on opposite sides of the Fraser River. The parallel lines have allowed the two railways to reach a commercial agreement to operate each line more or less in a single direction, with both railways using the CN line westward towards the Lower Mainland and both railways using the CP line to depart the Lower Mainland. The joint operation is in effect between Mission/Matsqui, BC and to near Kamloops, BC.

Both railways operate between Mission/Matsqui into major yards on separate sides of the Fraser River. CP's primary yard in Vancouver is at Port Coquitlam on the north side of the Fraser River, approximately 23 miles west of Mission. CN's primary yard is named Thornton Yard, and it is south of the Fraser River approximately 25 miles west of Matsqui, in Surrey. These yards are the main processing facilities for each railway in the Vancouver area. Each yard is responsible for marshaling merchandise traffic (also described as manifest traffic; i.e., boxcars, tank cars, lumber cars etc.) as well as staging and inspecting unit train traffic. Additionally, each yard has a large domestic intermodal facility adjacent to the freight yard that handles locally generated intermodal business.

CP's route from Coquitlam Yard to the Port of Vancouver (VPA) runs from Coquitlam to downtown Vancouver along the South Shore of the Burrard Inlet. It is primarily a double-track route. CP's support yards for Port operations are located along this route, with L Yard located near the east-end of the Port and N Yard located at the west-end of the Port. CP does not operate through the FCF area when on this route.

CN's route from Thornton Yard to the FCF and the Port is more complex. After the route leaves Thornton to the west, it joins with the BNSF route at the Fraser River Bridge (FRB). CN operates on BNSF from the FRB through New Westminster to Willingdon Jct., approximately 10 miles. At Willingdon Jct., CN trains destined for North Vancouver leave the BNSF route and cross the Second Narrows Bridge. Trains destined for the VPA industries continue on BNSF track approximately 3 miles to Still Creek. The route between the FRB and Still Creek is double-track.

At Still Creek, CN and BNSF trains enter the "Grandview Cut", which is a mile and a half long single-track section of railroad that ends in the FCF area at CN Jct. There are three yards in the FCF area; Main Yard, Glen Yard and South Yard. Main Yard is CN's primary support yard for VPA operations; they also use the largest portion of Glen Yard to support Port operations. South Yard is BNSF's main support yard for a rail barge operation that runs between the South Shore of Burrard Inlet and industries along the coast of British Columbia and on the islands in the Strait of Georgia. BNSF owns Glen Yard, but leases out most of it to CN. BNSF does use some of the tracks in Glen Yard, mostly for storage purposes.

CN uses the FCF yards to stage and switch traffic going to or from the Port industrial area. This traffic includes international containers that are loaded or unloaded from ships at Vanterm or Centerm, which are the two VPA international container facilities on the South Shore. Grain moving to Agricore - United Grain (referred to as UGG) or Pacific Grain also moves through the FCF to the waterfront. Merchandise traffic going to multiple industries and import/export sheds also moves through the FCF, along with merchandise traffic destined for industries around Main Yard and the VIA facility.

BNSF's main operations occur at New Westminster or in Thornton Yard. Trains arriving from the U.S. are either directed into Thornton Yard for interchange to CN and CP, or terminate at BNSF's New or Old Yards at New Westminster. Much of the traffic that goes to New Westminster is interchange traffic for the SRY or for local industries.

BNSF uses South Yard in the FCF area to stage and store cars for the barge operation. Switch engines move cars from South Yard to the waterfront to be loaded onto barges, and takes cars from the barges back to South Yard. BNSF currently does not access Centerm, Vanterm or other VPA industries along the waterfront.

A single-track line called the Burrard Inlet Line (BI Line) connects the yards in the FCF area with the Port industrial area. All CN and BNSF movements that move to or from the waterfront area currently must use this route. The BI Line crosses three CP tracks at grade just south of the waterfront area. This crossing is called the Heatley Diamond, and it plays an important role in the ability of CN and BNSF to move traffic to/from the Port. On the north side of the Heatley Diamond, CN has a yard called Waterfront Yard, which also is used for support of waterfront industries.

In addition to freight operations in the Vancouver area, there are multiple passenger operations as well. West Coast Express (WCE) operates commuter trains between Mission and Vancouver on the CP route in the morning and afternoons of weekdays. VIA operates a tri-weekly transcontinental train into and from the VIA station, which utilizes the BNSF route between the FRB and the FCF area. Amtrak operates a daily train to/from Seattle into the VIA station, also utilizing the BNSF FCF route. Finally, Rocky Mountaineer Tours runs a bi-weekly tourist train between their station in Main Yard and eastern BC/western Alberta. It also operates via the BNSF route between the FRB and Main Yard.

A more detailed description of the infrastructure and freight and passenger operations in the FCF area is provided in a later section of the report and in the provided schematics.

Chapter 3: General Yard Functions

The following three chapters describe general yard functions, how yard capacity is quantified, and how the FCF yards operate and what their current and projected future capacity utilization is estimated as. MLM believes the background information on general yard operations and capacity quantification is necessary to understand the FCF yards.

Yards have three primary functions associated with operations. Those functions are arriving or departing trains, staging or storing cars, and switching or marshaling cars. A brief description is provided below of the common configuration of a yard area for each function, along with descriptions of normal operations associated with the function.

3.1 Arrival Departure Function

The first type of function is the arrival and/or departure (A/D) process. A yard designated as an A/D yard can be a separate set of tracks designated only for receiving or departing trains, or long tracks in a multiple function yard that are appropriately sized to allow trains to arrive or depart from them. The basic responsibilities of an A/D yard (or the A/D portion of a yard) are exactly what the name implies. The yard serves as the primary location to receive a train and prepare that train for marshaling, or to build a train from a group of cars that have already been switched.

When a facility has a separate A/D Yard, the configuration of the yard is usually a number of long tracks that provide direct access to a lead track used for marshaling. If the yard is also used for the departure function, then it will also have access to the pullout end of the marshaling area of the facility. The yard will also have direct access to the main line(s). A/D yards are usually designed based upon the maximum length of and the number of projected trains moving to or from the facility the yard is associated with.

The A/D portion of a multiple function yard is usually the longer tracks within the yard. In multiple function yards, all tracks tend to be connected by lead tracks on both ends of the yards, so movements can be made from either end of the yard. This allows trains that have arrived on the long track to be marshaled into adjacent, shorter tracks, or outbound trains to be built in the long tracks from cars already in the shorter tracks without conflicting with other switching activities at the marshaling end of the yard.

It is generally assumed that a standard train arrival into a yard involves a locomotive(s) pulling a string of cars into a clear track that has switches at both ends leading to other tracks. Once the entire train is in the track, the locomotives uncouple from the cars and leave the track, normally to be used in other operations. A train cannot make a normal arrival if there are cars already on a track, as the locomotive(s) will be blocked between the cars on the track and the cars being pulled in. Likewise, a train cannot pull into a stub-ended track in what would be considered a standard fashion; again, the locomotive(s) will be blocked from leaving by the train it pulled in.

The standard departure procedure from a yard is to attach locomotives to one end of the train, and pull the train from the yard. This applies as long as the route the train is taking is accessible

to the locomotives. If getting to the route requires a series of additional moves, such as backing around a “wye” track, it would not be considered a standard departure.

In yards that are not as long as the length of trains being run into or from them, a train can be "doubled" into or out of the yard. Doubling a train into a yard can be done in one of two fashions. First, if there is sufficient room on both ends of the yard, a train will normally pull the entire train through a yard track and cut off the rear portion in that track. The locomotives will then back the head portion of the train into a second track. The locomotives will then uncouple from the cars and leave the track. This method of doubling a train into a yard works well if there are long tracks on both ends of the yard that the train can use when it is placing the cars into the multiple tracks.

When there isn't sufficient room at both ends of a yard, a train being doubled in will pull the head end of the train into a track and uncouple the rear portion of the train just clear of the yard entrance. Once the head end is in the track, the locomotives uncouple from that portion of the train and run back through a clear yard track to the rear portion. That section is then pulled into the yard on a second track. There must be another clear track in the yard for this operation to be considered "normal", because if there is not, the engines are once again trapped.

Doubling a train together for departure is less complicated. Once the engines are attached to the cars in one track, they are pulled out of the yard until they clear the entrance to the yard. The train then backs up to couple into the second track. Once the train is together, it can leave the facility.

The multiple yards within the FCF and waterfront areas utilize all of the methods described above to arrive and depart trains. The methods necessary to arrive or depart trains at specific FCF/waterfront yards are examined as part of the capacity utilization portion of this report. How those operations affect the capacity utilization of the yard is included in those discussions.

3.2 Staging/Storage Function

A second specific type of yard function is staging/storage. A yard responsible for staging/storage is usually found at locations where the preponderance of rail business requires holding cars for long periods of time (days, or in some cases, weeks or months), such as international container, plastics or grain operations. Track design in these types of yards frequently consists of multiple, moderate length tracks, with an emphasis on the ability to hold a certain number of cars of similar type in each track. The number and length of tracks in a staging/storage facility is generally designed around how many cars require storage.

Long tracks with limited access are not the most efficient staging/storage tracks, as there are times when cars from the middle of the track are required rather than those immediately available at one end or the other. Long tracks require switch engines gathering cars to make long pull moves to get middle cars, which can affect other operations around a staging/storage facility.

Staging/storage yards exist because rail car flows are not uniform, or at times, even predictable. VPA experiences the non-uniform flow phenomena daily in their international container operations. Following is a description of why one type of non-uniform flow exists.

When rail cars loaded with export container traffic arrive at a container facility, the cars are unloaded so the containers are available to be loaded onto a ship. Ideally, there would be the same number of import containers at the facility to load into that equipment, creating a balanced flow between the export and import rail equipment. The reality is that this balance rarely occurs.

What happens in actual operations is that when a ship is unloading, there is a surge in demand for empty rail equipment to handle the volume of import containers coming from the ship that are destined to inland locations. When no ship is unloading, there is generally a lesser volume of import traffic that requires loading onto trains. Consequently, there is a fluctuation in demand for import rail equipment depending on whether a ship is unloading or not.

At the same time, however, the normal flow of export rail traffic is relatively consistent on a daily basis. Export traffic does not rely on ship arrivals; it is based more upon the gathering of export containers from various locations and the scheduled rail movements to the Port.

The fluctuating import situation coupled with a more "steady-state" export situation creates an imbalance in rail cars arriving and departing the Port area. Most Port international container facilities do not have the capability to hold large volumes of rail cars; therefore, the unused cars must be moved to some other location.

As the description above implies, international container rail cars must be staged/stored when export traffic exceeds the demand for import traffic. The excess cars must be moved to a yard and held until such time that they are needed for import demand, or the cars must be sent to a location that requires empty cars. Since the Port yards have minimal capacity for storage, the cars are taken and staged/stored by the railway until they are needed.

Conversely, when import demand exceeds export supply, staged empty railcars will be used to augment the cars generated from the daily unloading of the export traffic. The railway will then pull the cars that have been stored in their yards and bring them back to the Port, where they will be loaded with import traffic.

The flow of export grain cars often experience similar staging/storage demands as a result of matching up particular types and grades of grain with specific ship calls.

A staging/storage yard allows a railway to hold cars to account for the ebb and flow of demand. The closer the yard that is responsible for staging/storage is to the Port's operations, the easier it is for the railway to match car supply with demand. Staging/storage yards that are close to customer facilities also provide the ability for railways to provide timely switching of those facilities. Railway service loses efficiency when staging/storage yards are located at great distance from the locations they serve.

3.3 Switching/Marshaling Function

A final yard function to consider is the marshaling function (also referred to as "car classification"). The marshaling function is usually limited to a specific area of a railway facility. Any available track can be used for marshaling purposes, although usually an area of a yard is designated because of track configuration. The area designated can be a separate yard or it can be a group of tracks located together in a multiple function yard.

In a standard marshaling area, the yard will have multiple, shorter tracks connected by a track designated as a "switching lead". Each track will be assigned a destination; for example, all cars for one destination are switched to track 1, all cars for a second destination are switched to track 2, etc. A railway gathers cars for a specific destination in this manner, so those cars can be put on a train going to that destination. Cars that have been grouped together for a destination are called a block of cars. It is necessary to block cars because every train does not go to every destination.

More tracks available in a marshaling yard allow for more destination blocks of cars to be made. If track lengths in the marshaling area vary due to the geometry of the yard, the longer tracks will be used for blocks that have a large number of cars and the shorter tracks will be used for blocks with lesser volumes.

When marshaling cars, the usual procedure is to pull a long string of cars out onto the switching lead track. The cars are then propelled, either by gravity (as in a "hump" yard) or by an engine shoving the cars down the lead towards the marshaling tracks. Switches are operated along the lead to route the cars into the correct track(s) where the blocks of cars are being gathered. With the exception of automated hump yards, a railway employee on the ground is responsible for operating the switches along the switching lead as the cars are being marshaled into each track.

Another function of switching is to consolidate cars in a yard so the available tracks are used in an efficient manner. To illustrate this point, consider that facilities such as Centerm and Vanterm have track lengths that will only hold a specific number of feet of railcars in each track. At the same time, yard tracks in Main Yard or N Yard do not necessarily match those lengths. Therefore, when cuts of cars are pulled from yard tracks based on the size of the tracks they are destined for, the yard tracks may not end up being efficiently utilized.

As an example, consider a situation where only 2,000 feet of cars are required from a track holding 2,200 feet of traffic. In that case, the leftover 200 feet of traffic now sits in a track that could be used for a train that is 2,200 feet in length. Since this is not an efficient use of a track of that length, when a switch engine is switching the tracks in the yard, the 200 feet of cars in the long track may be moved into another track that is sized more appropriately for short cuts of cars. Or, the cars may be consolidated with other similar small cuts of cars in another partially utilized track, filling that track up while freeing up longer tracks.

Chapter 4: Yard Capacity and Utilization of Capacity

Yard capacity can be defined as a measurement of the ability of a railway yard to perform functions associated with railway yard operations. The term yard capacity is usually not associated with specific yard functions, but rather with the overall concept of all operations that occur within a yard.

MLM believes yard capacity must be measured in conjunction with the yard functions consistently required for any yard, such as arrival/departure, storage or marshaling cars. Yard configuration, networks surrounding the yard, operational constraints and other traffic operating in and around the yard all have an impact on yard capacity.

4.1 Calculation of Yard Capacity or Capacity Utilization

Each of the yards in the FCF/waterfront area is responsible to perform many, if not all of the functions that were described in the previous chapter. MLM believes that with these multiple responsibilities, multiple calculations of capacity utilization are necessary to determine the true capacity of the yards. MLM believes that yard capacity is a mathematical function of the rail operations that have been described above.

4.1.1 Arrival Departure Capacity

As previously described, a standard train arrival or departure requires a track (or tracks) in a yard. Therefore, the ability to receive and depart trains is directly proportional to the number of tracks in the A/D portion of the yard.

Using that criterion, the A/D function can be quantified by calculating the percentage of clear tracks in the yard at any given time. The measurement is independent from the number of cars in any given track. For example, if a 10-track yard has three tracks that have 10 cars sitting on them, the yard has utilized 30% of its A/D capacity. The utilization of A/D capacity would be the same if only one car was in each of the three tracks, because there would still be only seven clear tracks to arrive a train on.

4.1.2 Standing Capacity

The storage function of a yard is better quantified through the measurement of how many cars can fit into a yard, rather than how many tracks are available. The measurement of how many cars can fit into a yard is often called the Standing Capacity (SC) of a yard. This is the number of cars that all tracks in the yard could hold if each track were filled. For example, with the 10-track yard example from above, if all the tracks could hold 30 cars, the standing capacity of the yard would be 300 cars. Standing capacity is the most common measure of yard capacity; however, MLM believes it only accounts for a portion of a yard's ability to perform work.

A method to measure the SC that has been utilized in a yard is to compare the number of cars in the yard against the total possible cars the yard can hold. Again referring to the example above, if there are 30 cars in a yard capable of holding 300 cars, then 10% of the standing capacity of

that yard is being utilized. Note that the standing capacity of a yard is different from the A/D capacity.

A/D and SC utilization tend to move in similar directions as cars are added or removed from a yard, but they do not parallel each other. Consider that in the yard described above, a group of 15 cars added to one clear track changes the A/D utilization by 10%, but it only changes the SC utilization by 5%. If those cars were added to a track that already had 10 cars on it, the A/D percentage would not change at all while the SC percentage would increase 5%. Therefore, both how an operation is performed as well as what volume of cars is associated with that operation must be considered to understand the utilization of capacity within a yard.

4.1.3 Switching/Marshaling Capacity

The previous description of marshaling operations shows that the ability to perform this operation is dependent on both the number of tracks available and the car spots within the tracks. Using the previous yard example, if five of the tracks are full with cars, there are still five tracks available for creating blocks in. If two of the remaining five tracks are half-filled with cars, five blocks could still be made, as long as two of the blocks required less than half of a track. In other words, a block can be made in a track in addition to cars that are already on that track as long as the combined number of cars does not exceed that track's length.

4.1.4 Total Yard Capacity

As the above description indicates, a yard has two measurements of capacity. To determine the total capacity of a yard, the measurements must be combined. How they are combined is based upon the yards' operational responsibilities.

The simplest method to combine the functional measurements of capacity is to assign a percentage of importance to each function and create a weighted-average using those percentages. The yard's daily responsibilities factor into the assignment of the percentage of importance for each function. For example, in the case of the pure A/D yard described earlier (a yard not considered a portion of a multiple function yard), the A/D capacity might be weighted at 90% and the standing capacity would be weighted at 10%. For a storage facility, the standing capacity might be weighted at 80%, and the A/D capacity would be weighted at 20%.

A multiple function yard is likely to be required to perform different operations at different times during the day. When this occurs, the weighting percentages assigned to each capacity measurement might change. This tends to overcomplicate the process; in those cases where a yard's responsibilities change over a 24 hour period, applying a 50/50% share of utilization by function is normally sufficient.

As an example of how A/D and SC utilization are combined to determine total utilization, assume the 10-track yard above has three tracks holding 10 cars. If the weighting of the measurements of capacity were 25% A/D capacity and 75% standing capacity, the yard as described would have 15% of its total capacity consumed. This calculation is derived from (3 tracks used/10 total tracks) x (25% weight) + (30 cars in yard/300 total cars) x (75% weight). If

the A/D and SC utilization percentages were changed to 50/50%, then the yard would have a total capacity utilization of 20% [(3/10) x 50% + (30/300) x 50%].

It must be noted in the analysis of utilization that it is constantly changing over the course of a day. Every time a train arrives, departs, is marshaled or is built, the utilization percentages change. When tracks are consolidated for more efficient yard operations, utilization percentages change. Consequently, yard capacity utilization must be addressed over time.

The measurements described above need to be performed repeatedly over a day to quantify yard capacity utilization. By doing this, the fluctuating utilization percentage can be graphed. This has been done for each yard in the FCF area, and is presented in a later chapter of this report.

Graphing utilization percentages allows an observer to identify time periods where a high percentage of the yard's capacity is being utilized. This then allows an observer to determine the cause of those spikes in utilization. For planning purposes, it is not in the best interest of a yard to schedule additional moves into the facility during periods of high capacity utilization. Likewise, during periods of low utilization, the yard could be performing additional work that may relieve other congestion points in the network.

For the purpose of this study, reviewing the utilization of capacity in the FCF yard areas allows an observer to understand the usage of the various yards, and the roles those yards play in the Lower Mainland railway network. The graphs also convey a sense of whether the configuration of the yards is adequate for the work currently being performed, or the work that is planned on being performed.

As tracks are being marshaled, capacity utilization figures rapidly change as cars are shuttled between tracks. For purposes of this study, capacity consumption was analyzed every 15 minutes, which captures all of the major changes over the course of the day. However, since the consumption graphs were based on simulated train data, each individual switch move was not captured. Therefore small, frequent fluctuations are not shown in the results.

MLM assigned the weighting percentages to the various support yards in the Greater Vancouver area based upon our understanding of the function of each respective yard. These percentages were designed to reflect the multiple function use of the FCF/waterfront yards, which handle arriving and departing “transfers”, and have responsibility for holding or marshaling cars over the course of the day. Following are the percentages assigned for each yard relative to how total capacity utilization was calculated.

- **CN Main Yard**: 50% A/D and 50% standing
- **CN Glen Yard**: 25% A/D and 75% standing
- **BNSF South Yard**: 25% A/D and 75% standing

These percentages are not hard and fast numbers, and can certainly be debated for each yard that was analyzed. MLM chose them, however, based upon our experience with yard operations and discussions with primary operating contacts from the owner railways.

A description of each yard's primary responsibilities is included in a later chapter of this report. Graphs of 24 hours of each FCF yard's capacity utilization are also included based upon the Base and Future simulations.

4.2 Sustainable Yard Capacity

Up to this point, the theoretical capacity of a yard has been discussed based upon a method to calculate a percentage of the yard's maximum capacity that is utilized during operations. This section addresses sustainable levels of yard capacity utilization and how excessive consumption of capacity affects the efficiency of operations.

Most yards, except those purely devoted to staging/storage, cannot function efficiently at or near maximum capacity utilization. The primary reason for this is that at or near maximum capacity utilization, there is little or no room to perform the functions of a yard, such as marshaling, in a normal manner. A good analogy to this effect is an automobile parking lot; when the lot is mostly empty, it is easy to find a space near where an individual driver wants to park, saving time and effort to get to a store. When the lot is mostly full, however, the driver may have to hunt for a spot and accept any location that becomes available, which adds time to the function of parking the car and may expose the driver to additional effort to get to the store. Rail yards are not particularly different.

When a yard experiences a high percentage of utilization of its standing (or "theoretical") capacity, it doesn't mean the yard shuts down. It does mean, however, that operations that occur under normal conditions cannot occur unless unusual operational moves are performed. Unusual moves cost time, affect other operations, and can lead to additional cost to accomplish the same amount of work that occurs under normal operations.

It is extremely difficult to explain how high capacity utilization percentages affect other operations. Instead, MLM has included examples of two common yard operations performed under "normal" and "high" utilization percentages in Appendix 2. These detailed examples clearly show how yard operations must be modified as a yard "fills up", and also provides insight into the effects on working time, ease of operations, and impact on environment.

From experience with yard operations, MLM has found that the need to operate yards in an extraordinary manner begins to occur when total capacity utilization exceeds **60% to 65%** for sustained periods of time. This number is not an absolute percentage; it can vary from yard to yard depending on the configuration of the tracks, number of switching leads, the connections to the main line and the work required by the railway within the yard. The capacity level defined by this measure is generally termed "sustainable capacity", because it reflects the level of capacity utilization where efficient yard operations can be sustained.

One consequence of sustainable capacity is that a yard experiencing 50% utilization is actually operating at approximately 80 to 85% of its sustainable capacity. Therefore, even though a yard looks to have relatively few cars in it, with nearly half the trackage in the yard being clear, the yard does not have a great deal of available capacity if it is expected to continue to operate at an efficient level.

As each of the FCF yards are analyzed below, their capacity utilization is compared to the concept of sustainable capacity. When events that exceed sustainable levels occur, analysis is provided to explain what occurred and the impact those events had on other traffic or yard operations.

Chapter 5 - Yard Capacity Utilization in the False Creek Flats

It is very difficult to describe a yard's capacity and how operations around the yard affect that capacity without having an understanding of what functions the yard is responsible for performing. In this section, each yard in the FCF area is examined. For those yards, a brief description is provided of the yards' various responsibilities, along with a short description of how the functions are accomplished within that specific yard. The way that work is performed is frequently based upon the configuration of the yard, and has an impact on yard capacity utilization.

Following the description of each yard's responsibilities, the analysis includes a discussion of the yards' capacity utilization for both the Base operating levels and the projected Future levels. Graphs of the utilization percentages, based upon the simulations that have been performed, are included for each yard to visually represent how the utilization percentages change over time.

The configuration of the network around and between the yards also has an impact on capacity utilization. Following the descriptions of operations and utilization for each yard, the report addresses the configuration issues in the FCF/waterfront area that have an impact on yard operations and capacity utilization.

As mentioned previously, simulations of yard operations were performed on all yards in the FCF/waterfront area to determine capacity issues associated with current volumes and projected growth of VPA traffic. To populate the simulations, the Base operations were created through discussions with the railways and data provided by CN and CP. After the Base simulation was completed, CN and CP were provided the opportunity to review the simulation and request changes that more closely represented what actually occurred in daily operations. The study did not proceed until both railways had reviewed and approved the Base simulation conditions and operations. BNSF provided data and descriptions of their operations; however, they did not participate in the review of the simulations.

For the Future simulations, growth was included into the model per projections by the Port, the railways and by waterfront industrial customers. The initial simulations utilized the Base operating plan and infrastructure configuration in an attempt to handle the projected growth volumes. Unfortunately, it quickly became apparent that the network was not capable of handling Future volumes under the assumptions made for market share and international container terminal utilization.

A co-production plan was created that featured the sharing of trackage around the waterfront once it was determined that the Base operating plan was not able to meet Future demand. Co-production is a term that refers to a commercial agreement between railways that involves sharing trackage. Since each railway owns or operates on independently owned trackage, both railways must agree upon any co-production operation. This usually involves a "trade-off" between the two railways. The first railway benefits operating on a second railway's track at one location while the second railway benefits operating on the first railway's track at another location.

The single directional running between Kamloops and Mission/Matsqui Jct. is an example of co-production. Both railways benefit with the single directional operation by eliminating most of the train meets each would face if they operated their railways as separate entities.

The co-production plan utilized in the Future simulations was jointly developed with the railways for the purpose of the simulation; both railways made it clear that the concept was for study purposes only. CN and CP remain competitors in the Vancouver area and it would be unreasonable to assume that they will agree to co-production operations without considering each competitive advantage/disadvantage from a business perspective.

The Future capacity utilization graphs provided in this section were created utilizing the co-production operating plan that was simulated. All assumptions used in the study were developed by the study committee and approved by all parties involved prior to being incorporated into the simulation. While those assumptions yielded the results displayed below, it should be noted that a change in the assumptions would likely result in different utilization of the yards.

5.1.1 CN Main Yard (Schematic 1) - Base Operations

Main Yard is the primary support yard for CN international container traffic destined to Centerm and Vanterm, and is also the primary yard for industrial traffic serving CN's waterfront and FCF merchandise industries. CN runs transfer trains carrying FCF/waterfront traffic from Thornton Yard to Main Yard. Traffic returning from the waterfront or FCF industries is built into transfers at Main Yard, which then take the cars back to Thornton Yard. Once back at Thornton, the traffic is entrained on eastbound international container, merchandise or unit trains.

During periods when volumes are heavy, there are three daily transfers between Main Yard and Thornton Yard in both directions. When business volumes are less, there may only be two transfers run between the yards.

Switch engines shuttle the traffic delivered by the transfers from Main Yard to the waterfront via the BI Line for spotting at the international container terminals or the merchandise facilities. International container and merchandise traffic arriving from Thornton is switched at Main Yard to separate it for individual destinations on the waterfront, as well as to size the cuts of cars so that they fit into Waterfront Yard's tracks. Traffic from the waterfront is shuttled back to Main Yard, where it is switched and entrained into the eastbound transfers.

Switch engine shuttle trains run between Main Yard and the waterfront 10 to 16 times per day, delivering traffic to Waterfront Yard or bringing traffic back from the waterfront. The number of shuttles depends on the volume of traffic being moved. The reason so many shuttles run back and forth is because of the limited track lengths at the FCF and waterfront yards, which is explored in more detail in the next section.

When the switch engines at Main Yard are switching traffic to or from the Thornton transfers, they may use either the connection towards the VIA station or the route towards CN Jct. as a switching lead. Length of the cuts of traffic being switched and other traffic in the area will determine which lead is used for marshaling.

Transfers from Thornton arrive via the line from Still Creek and CN Jct. (the Grandview Cut). The longest track in Main Yard is 2,700 feet in length; CN transfers are operated up to 6,000 feet in length. The discrepancy between the train length and the track length creates the requirement that most transfers must be doubled into Main Yard when they arrive.

When a transfer arrives, the rear portion of the train is left on the lead towards CN Jct. Main Yard does not have enough track length on the west-end for an entire train to pull through the yard to make a double. Instead, there is only enough track length to allow the engines to uncouple from the train and run back through a track to pull the rest of the train into the yard. If the portion of the train that could not be pulled into the yard extends beyond CN Jct., it blocks the main line.

Transfers departing to Thornton are built in a similar manner. Multiple tracks are doubled together towards Still Creek when a transfer is being assembled. Once it is together, a simplified "air test" is performed and the train departs for Thornton. Trains over 4,500 feet in length will block the main line towards Still Creek as they are being built.

The shuttles that move traffic from Main Yard to Waterfront Yard are built from the east-end of Main Yard by switch engines. When they are ready to depart, they may pull out of the yard and proceed to the north end of Glen Yard, near Parker St. This is the last location that a train on the Burrard Inlet line can stop without blocking at grade public crossings. Once a train from Main Yard departs this location, it cannot stop for an extended time period until it reaches Waterfront Yard.

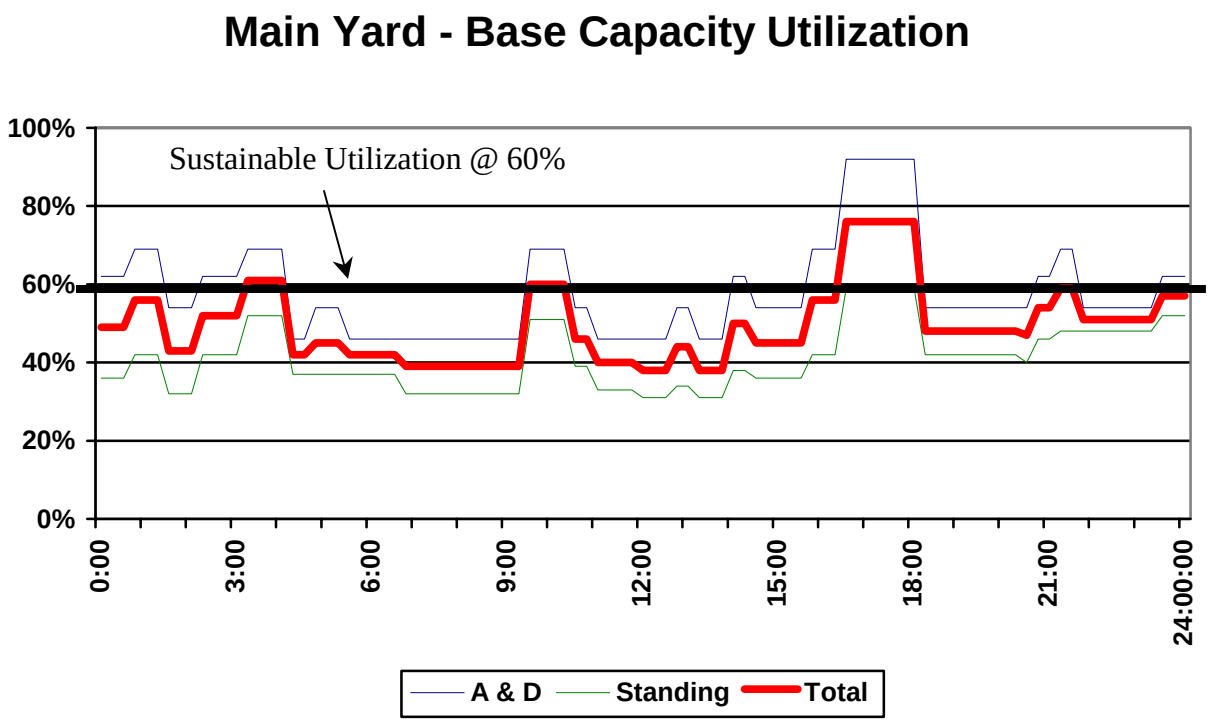
Shuttles arriving at Main Yard from the waterfront pull their train into a yard track. Once the entire train is in the track, the locomotives cut off from the train and use the stub track at the west-end of the yard to move to a different track to run back through the yard. If there is a shuttle destined for the Waterfront that is ready to depart, the engines will couple onto that train and pull it to the north. Again, the train may have to stop at Parker St. if the route is not clear to Waterfront Yard.

Main Yard also plays a role in passenger traffic within the FCF area. When a VIA train arrives from the east, the train pulls into one of Main Yard's tracks. The train then backs out of the yard, around the connection towards the VIA station and into a platform track at the station. This leaves the train facing the correct direction for the next departure.

The Rocky Mountaineer Tours (RMT) train also uses Main Yard for arrival and departure to/from their station, which is located on the northeast side of Main Yard. When the train arrives, it pulls to the west-end of the yard. The train then backs up onto the RMT station track that extends from the northernmost yard track to the RMT station. The train stays at the station until it is ready to depart.

When the train leaves the station, it again pulls to the west-end of the yard. The train then backs through the yard and onto the connection towards the VIA station. Once the train has backed clear of the main track towards CN Jct., it then departs to the east.

5.1.2 Main Yard Base Capacity Utilization



Even though the capacity consumed over the simulated day does not regularly exceed sustainable levels, the track usage chart for Main Yard (Exhibit 8) clearly shows that all tracks in the yard are used regularly throughout the day. During periods when a large transfer arrives (such as at 1600), up to 90% of tracks had cars on them for approximately two hours (A/D line in the graph). This is an indication that all available tracks were necessary for the operation to be accomplished.

As the Base utilization graph indicates, Main Yard does not experience exceptionally high percentages of capacity utilization for sustained periods. The only period when total utilized capacity exceeded 60% for more than a few minutes was when a transfer arrived from Thornton with a train, but did not leave until later that day. The traffic that was brought by the transfer, combined with international container and merchandise traffic already in the yard, briefly filled the yard.

The three major increases in capacity utilization during the 24 hours studied in the Base simulation were good examples of what can happen to a yard when other operations occur that impact the yard. The three spikes represented the times when a transfer from Thornton arrived at Main Yard, delivered cars to the yard, then picked up cars and departed. The width of the sudden increases in capacity utilization percentage represented the time the transfers were in the yard.

The two transfers that arrive at 0330 and 0930 were only in the yard for approximately one hour prior to their departure back to Thornton. Upon arrival, these two trains immediately set out their

inbound cars and picked up their outbound cars. There were no other operations occurring around the yard to delay these operations.

The transfer that arrives at 1600, however, does not depart until after 1800. This reflects the effect of VIA and Amtrak operations on Main Yard.

In the simulation, a VIA train departed the station at 1700 and an Amtrak train left at 1800. While neither of these trains needed to use tracks in Main Yard to depart, they both needed to use the main line between the VIA station, CN Jct., and Still Creek. The transfer was scheduled to be a 6,000-foot train that could depart as soon as it picked up its cars. However, the transfer was not built until the second passenger train departed because the 6,000-foot transfer extended onto the main track east of CN Jct., which was needed by the passenger trains. The transfer was delayed approximately one hour and was built and departed as soon as the passenger trains had cleared the area.

5.1.3 CN Main Yard - Future Operations

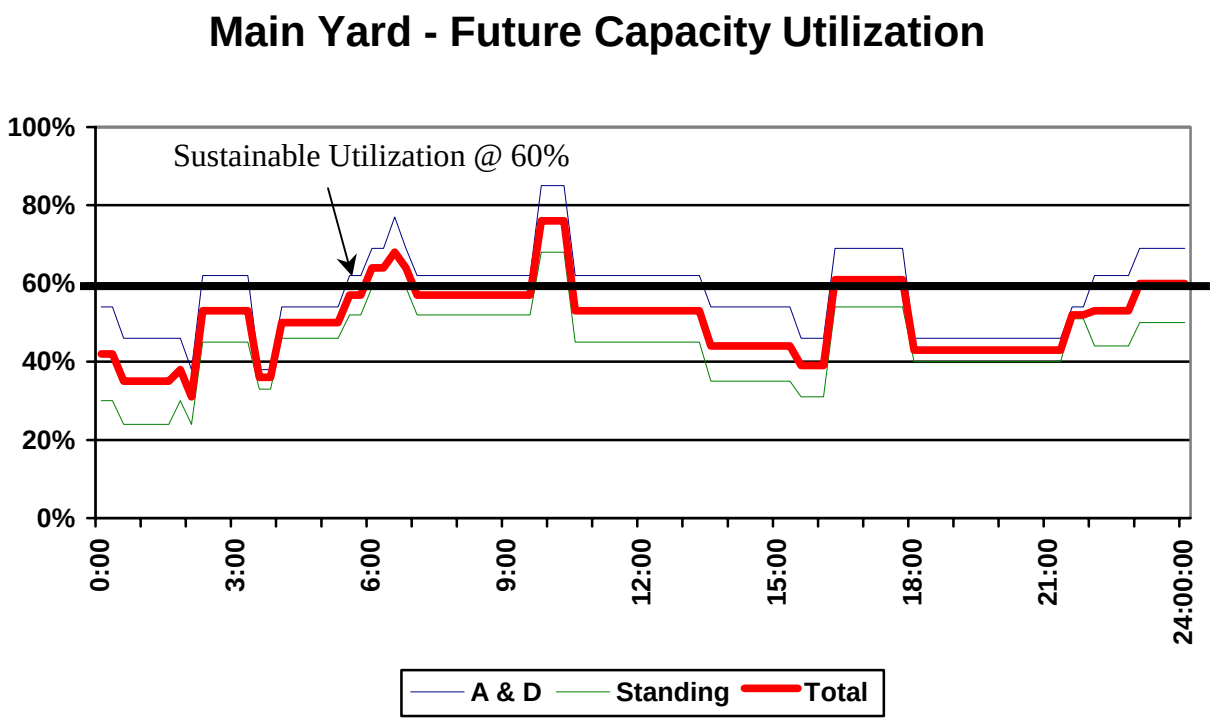
Future operations at Main Yard were projected to be very similar to existing operations from a yard utilization standpoint. Transfers would continue to run between Thornton and Main Yard to deliver and pull traffic from the facility, and switch engines would continue to operate between Main Yard and Waterfront Yard moving waterfront traffic to/from the international container terminals and waterfront industries. In the Future simulation, the mix of traffic was expected to change, however.

In the Base Operation, all CN international container traffic for Centerm and Vanterm operated via Main Yard. In the Future simulation, the co-production operation that was created had CN Vanterm international container traffic moved to and from Waterfront Yard via the CP route, rather than via Main Yard. Some merchandise traffic also utilized the projected co-production agreements.

The route to/from Main Yard was still used by grain in the Future Case. More grain was brought to Main Yard in the Thornton transfers in the Future simulation than in the Base simulation as CN believed that there would be less unit grain trains serving UGG and Pacific from the FCF yard side of the operation. Much of this grain was set out or transferred to Glen Yard for storage, then moved to the Waterfront.

There were no changes in VIA or RMT operations between the Base and the Future simulations. An additional Amtrak round trip was added, although the train did not enter Main Yard in the simulation.

5.1.4 Main Yard Future Capacity Utilization



Even with the co-production operating plan that removed all Vanterm international container and some merchandise traffic from Main Yard, the track usage chart for Main Yard in the Future simulation indicated that up to 85% of the tracks were used at a single time during the day. Similar to the Base simulation, this usage suggests that the yard is appropriately sized for projected co-production operations.

In the Future Case, the yard also did not exceed sustainable capacity for long periods of time. The largest increases in capacity utilization again occurred when transfers arrived. The transfer that arrived near the scheduled passenger operations was again delayed by those operations.

Daytime capacity consumption appeared to slightly increase in the Future simulation, particularly between 0600 and 1500. This occurred because of the shift in the market share assumption that was used in the Future simulation. While CN's total market-share of all South Shore international container traffic in the Base operation was approximately 30%, in the Future simulation it was increased to 50% for both Centerm and Vanterm. Coupled with the projected growth at the two container facilities, the Centerm volumes in the Future simulation slightly exceeded the combined volumes in the Base simulation. This additional traffic, along with some additional grain moving through Main Yard, created the increased capacity utilization indicated in the Future graph. As previously discussed, CN's Vanterm traffic was routed to/from the waterfront via CP as part of the conceptual co-production operations.

There were fewer shuttles between Main and Waterfront Yards in the Future analysis than in the Base analysis as well (reflected in the graph as smoother lines). The reason there were less shuttles is that with the new configuration at Centerm, longer international container cuts could

be moved from Main Yard to Centerm. Under the new configuration, it was assumed cars could be pulled into Centerm rather than having to be shoved into the facility as was the case in the Base simulation.

Shuttles from Main Yard to Centerm generally pulled 3,500 feet of Centerm traffic in the Future simulation, as compared to 1,500 feet in the Base simulations. 3,500 feet is approximately the distance between the end of the expanded Centerm tracks and the clearance point of the east-end of Waterfront Yard. Since shuttles could pull the traffic into the ramp tracks rather than use a Waterfront Yard track to run around the cars, longer cuts could be handled without blocking the yard or the critical links nears Heatley Diamond. This operation is described in more detail in the next section.

Shuttles returning from Centerm to Main Yard continued to be operated at 2,000 feet because of the track length restriction at Main Yard.

The infrastructure that allowed pulling cars into Centerm was approved by the Rail Stakeholders Committee for the Future simulations. As the expansion plans for Centerm were developed, however, that infrastructure was removed from the design. The current expanded Centerm facility does not have the capability to have cars pulled into it under actual operations.

5.2.1 CN Glen Yard (Schematic 2) - Base Operations

Under the Base operating conditions, Glen Yard was used to hold loaded and empty grain cars and to store some empty international container equipment. In that simulation, grain was moved from Thornton via unit trains, which set out into Glen Yard. A switch engine then shuttled the cars in multiple cuts to/from Waterfront Yard. The grain shuttle moves were in addition to the movements from Main Yard, which increased the traffic using the BI Line by up to six moves per night when a grain train was spotted to an elevator. The engines returned from the Waterfront with empties from UGG or Pacific grain, which were then held in Glen Yard until an empty unit train could be assembled.

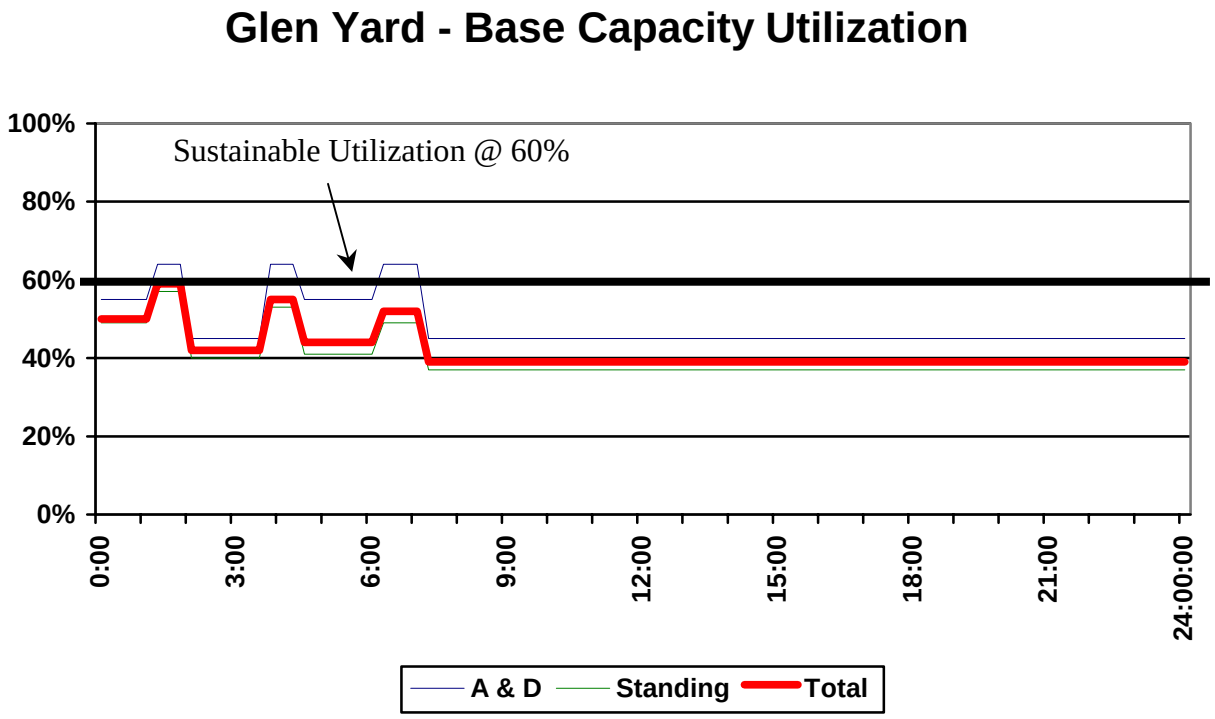
Glen Yard is also used to hold excess international container cars as Main Yard does not have the capacity during heavy traffic days to hold these cars. The international container cars are left in Glen Yard in addition to the grain loads or empties.

The south end of the long tracks along the eastside of Glen Yard is on the grade between Still Creek and FCF. Glen Yard is not a good yard to switch cars in because of the grade at the south end of the yard. The grade will accelerate the cars being switched, making the cars difficult to control when they couple into other cars. Safety is a major concern of the railways, so every precaution is taken when cars are switched at Glen Yard, including use of hand brakes. However, there is a chance of a car running away when it is cut loose on the grade, which can lead to a very dangerous situation for highway traffic on the cross streets or rail traffic at or near Heatley Diamond.

Additionally, the main line between CN Jct. and the VIA connection must be used to switch cars from the south end of Glen Yard. There is no lead track at that end of the yard that can be used for switching purposes.

Glen Yard is also not a good yard to switch from the north end because of the road crossings that would be blocked for extended periods during switching operations. The yard is best suited for storage and staging of unit or international container equipment. For these reasons, few cars that require extensive switching are handled in Glen yard.

5.2.2 Glen Yard Base Capacity Utilization



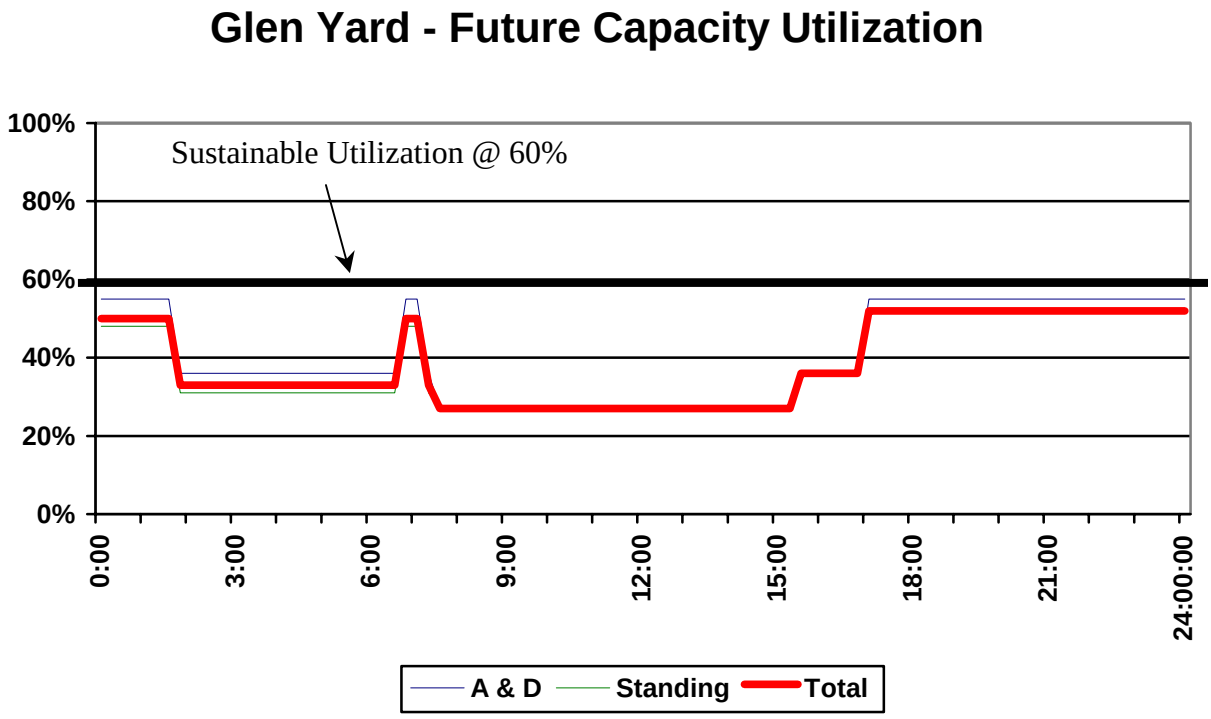
In the Base simulation, the daily utilization graph indicated that when a grain train was in Glen Yard, 40% to 50% of the total capacity of the yard was consumed. Sudden increases approaching 60% utilization were noted when transfers bringing empties back from the Waterfront arrived, but those spikes receded to more average levels when the shuttles left with loads destined for the elevators. Under these operating conditions, Glen Yard is not capacity constrained.

5.2.3 CN's Glen Yard - Future Operations

Glen Yard was used in the same manner in the Future simulation as it was in the Base simulation. Its primary responsibility was to hold loaded or empty grain cars and international container equipment being staged for use at the Waterfront terminals. There was little switching done to traffic within Glen Yard, other than reorganizing tracks as cars were moved into or from the yard.

In the Future simulation, grain moved on the CN transfers rather than on unit trains to/from Glen Yard. The grain arrived at Main Yard on the transfer, and was then moved by switch engine from Main Yard to Glen Yard to be held until it was shuttled to the waterfront to be spotted to UGG or Pacific.

5.2.4 Glen Yard Future Capacity Utilization



In the Future simulation, capacity consumption within the yard was again predicated on when loads arrived from Thornton (or Main Yard) and/or empties arrived from the waterfront. The utilization of the yard clearly indicated that not all available tracks were used, as the A/D percentage never exceeded 60%.

MLM believes that with the higher percentage of international container traffic that was projected in the Future simulation, CN will have a need for additional international container car storage tracks to handle the imbalance between import and export traffic. Glen Yard is a likely location for the storage of this equipment, because of its proximity to the waterfront international container terminals. For the purpose of this analysis, some international container equipment was added into Glen Yard to determine its effect on consumption of capacity. Even with this additional traffic, the yard remained well below sustainable levels of capacity utilization.

Both the Base and Future Glen Yard graphs clearly show that CN does not currently, nor are they projected to, perform any significant marshaling of cars in Glen Yard. If this type of operation were included in either the Base or Future simulations, the graphs would reflect the change in track utilization over the analysis period. The long, flat stretches of capacity utilization

percentages indicate that once cars are placed in a track, they remain there. Only shuttles bringing cars in or taking cars out of the yard affect capacity utilization.

It appears that Glen Yard is ideal for assuming some of Main Yard's operations, based upon the low capacity utilization percentages. However, CN has chosen not to utilize the yard for marshaling work because of the south end grade and configuration issues, and north end at-grade crossing conflicts. This continues to reinforce that Glen Yard is best utilized for storage of rail cars, rather than switching or marshaling work.

5.3.1 BNSF South Yard (Schematic 3) - Current Operations

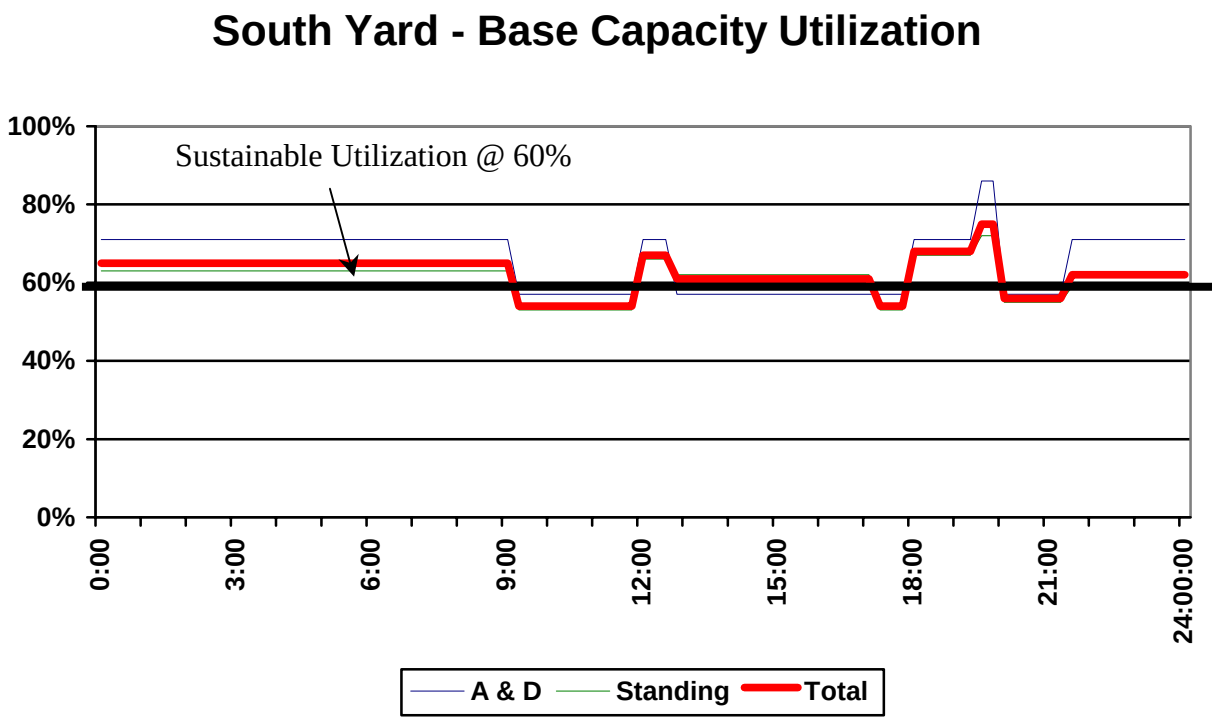
BNSF's South Yard primarily supports the barge operations at Burrard Inlet. BNSF stores cars in South Yard that are switched and transferred to the barge when ordered by customers that utilize the barge for rail access. A transfer operates between New Westminster and South Yard once a day to supply cars to the yard and to take cars from the yard that arrived via the barge.

BNSF does not have a great deal of capacity at New or Old Yards at New Westminster. South Yard acts as a storage yard for BNSF traffic that cannot be stored elsewhere.

Traffic to/from the barge that is interchanged with CN is also switched and delivered from South Yard. BNSF delivers this traffic to Main Yard, and pulls CN traffic destined for the barge back to South Yard. BNSF operates two barge loading/unloading cycles per day when traffic levels are heavy; this is reduced when levels do not require the second operation.

There are some small industries around South Yard that BNSF also switches with the engines that serve the yard. This traffic also moves on the transfer to New Westminster to be entrained for movement to the south.

5.3.2 South Yard Base Capacity Utilization

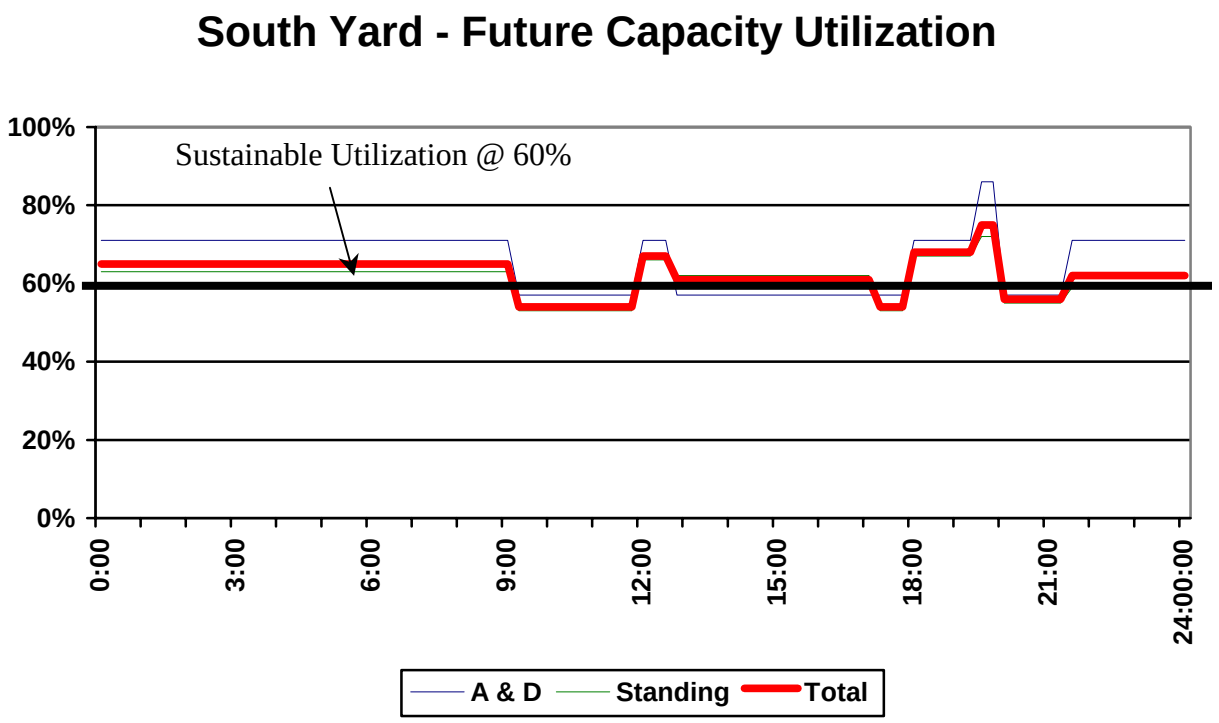


South Yard operated at a high level of capacity consumption as indicated in the Base simulation utilization graphs. MLM was told that approximately 120 cars are stored in the yard on a regular basis. This equates to 60% of the roughly 200-car capacity of the yard. At times, all six tracks in the yard have cars stored on them. Since the yard is switched from the east-end, this does not affect the operational capabilities of the yard, as long as the engines can move cars between tracks to pick up those destined for industries or BNSF's barge operation.

5.3.3 BNSF South Yard - Future Operations

The operations at South Yard did not change in the Future simulation. It is unclear whether in the future the barge facility will remain at Burrard Inlet; should this facility be relocated, operations at South Yard may possibly be modified. It is possible that South Yard would continue to be used as a storage facility under a relocated barge scenario because of the limited capacity at other BNSF facilities. Both these scenarios are explored in more detail in a future chapter of this report.

5.3.4 South Yard Future Capacity Utilization



Future use of South Yard is not clearly defined. The disposition of the barge facility will have an influence, although other BNSF traffic in the Lower Mainland will also be a factor in its usage. For purposes of this study, no changes in utilization or operations were included from the Base operations.

5.4.1 VIA Facility (Schematic 4) - Base Operations

Two types of passenger trains operate into or from the VIA station in the FCF area. The first type of train is the Amtrak train from Seattle. The train utilizes the main track between Still Creek and the VIA facility to arrive and depart from the facility. The train does not enter Main Yard prior to arriving at the VIA station.

When Amtrak arrives, it uses the platform track on the south side of the station. The train is capable of being controlled from either end (push-pull operation), so when the train arrives, the engineer just changes ends and the train is now pointing in the direction in which it will depart. No regular maintenance is done on the Amtrak train in Vancouver during the time it is in the station tracks other than cleaning the train.

As mentioned above, an arriving or departing Amtrak train utilizes the route between Still Creek, CN Jct. and the VIA station that is adjacent to the west-side of Glen Yard. The route bisects operations between Main Yard and Glen Yard, Main Yard and Thornton Yard, and Main Yard and the Waterfront. There is little that can be done about this cross over operation because of the locations of Main Yard, the BI Line, and the VIA station.

The other passenger train that operates into or from the station is a VIA train. As previously mentioned, upon arrival at Vancouver the train pulls into Main Yard, and then backs into the station so it is facing its subsequent departure direction.

VIA is serviced while it is in the platform tracks. When the train is ready to depart, it pulls directly from the station and utilizes the same route that Amtrak uses to depart east.

5.4.2 VIA Facility - Future Operations

The only change that was projected into the future for the VIA facility was an increase in Amtrak operations. The simulation included two daily round trips to Vancouver, which was a step towards the long-term plan of three daily Seattle – Vancouver trains. Only two trains were included in this simulation because of the time period that the simulation represented. The trains continued to be handled in the manner they were handled in the Base simulation.

VIA was simulated in the Base Case as a train that runs three days a week. There was some discussion as to whether this train would become a daily train, but no personnel that were spoken with during the simulation study could confirm it. The Future simulation left the VIA train and schedule the same as it was in the Base Case.

Even with the projected increase in Amtrak traffic, MLM believes there is enough station track capacity to handle the additional trains without expanding the facility. The projected Amtrak schedules that were provided did not have two trains in the station at the same time. There appears to be six usable station tracks, so there should not be a capacity issue even if VIA does increase its service schedules.

Chapter 6: Influences on Yard Capacity Utilization

One critical factor in maintaining a sustainable level of yard capacity is the velocity of cars moving through the yard. If cars that enter the yard can be moved out of the yard quickly, the yard has more utilizable capacity than if the cars remain stationary for long periods of time. As the capacity graphs clearly showed, yards can sustain high levels of capacity utilization for short periods when cars are removed from the yards soon after other cars arrive. When the outlet moves become delayed, however, yard efficiency quickly declines and capacity becomes an issue.

Yards in the FCF area face network configuration issues that can and do affect the velocity with which cars move from the yards. Main Yard in particular is sensitive to these network complexities because it handles levels of traffic that require consistent car velocity. The configuration issues also affect Glen Yard and South Yard, however as the graphs indicate, their levels of capacity utilization are not as critical as Main Yard's levels.

The four major network configuration issues that affect the velocity of car movements from Main Yard to the Waterfront are the BI line, the Heatley Diamond, the connection to the CN Lead north of the diamond and the length of yard tracks at Waterfront Yard. Each is described in this section, along with their impact on capacity utilization in the FCF area.

6.1 The Burrard Inlet Line

The Burrard Inlet line is the connection between CN Jct. and the Heatley Diamond, which is the rail crossing of CP's east-west waterfront tracks. As mentioned previously, both CN and BNSF use this section of track to access waterfront terminals and industries. During peak traffic periods, CN can use this line upwards of 15 times per day; BNSF usually only uses it four times per day. MLM also understands that the line is used by WCE trains to access the VIA facility for maintenance.

The line is a single-track route that winds its way through a narrow corridor, crossing streets at-grade between FCF and the diamond. Glen Yard's north switching lead connects into the BI Line just north of the yard, near Parker Street. Main Yard's connection to the Waterfront joins the BI Line near the middle of and to the west of Glen Yard's trackage under the Terminal Way overpass. The route is 1.4 miles in length between Main Yard's east-end and the crossing diamond, and 0.6 miles in length between Glen Yard's north end and the diamond.

The route crosses six streets at-grade between the north end of Glen Yard and the waterfront. Venables St. and Powell St. are the two largest streets that are crossed, both of which are major east-west routes. The other four crossings are all well used roadways or streets, although they are not major public thoroughfares.

In part because of these crossings, trains face restrictions on the line that do not exist for most rail routes in or around yards. One such restriction is that trains must avoid long delays when operating up or down the BI Line. This restriction means the line must be clear the entire way between Waterfront Yard and the train's origin before a train is allowed to access the route north

of Parker St. This restriction includes having a clear route across Heatley Diamond. If a clear route from Main Yard to Waterfront Yard is not available, the shuttle will not be allowed to leave from Waterfront Yard or from Parker St.

Another BI Line restriction is that trains using the line move at a maximum authorized speed of 8 mph. This is due to a combination of the grade crossings on the corridor and the diamond on the west-end of the route. Trains operate at this slow speed because they must be able to stop short of obstructions along the route, including highway traffic and/or the absolute signal that protects Heatley Diamond. At this speed, it takes approximately 12 minutes from the time a train pulls out of Main Yard until it arrives at Waterfront Yard, or vice versa. Once the train has left Parker St., it takes approximately 7 minutes for the rear of the train to clear Heatley Diamond.

6.2 Heatley Diamond

The second impediment to movements between the Waterfront and Main/Glen Yards is the Heatley Diamond. The Diamond is where the three CP tracks (the main line, the L4 Lead and the Country Lead) cross the BI Line at-grade, just to the north of Powell St.

At the diamond, CP's three tracks are parallel to each other. The Country and L4 Leads both serve as running routes between L Yard and N Yard, as well as serving as industrial leads for some of the waterfront industries that CP serves. WCE trains and transfers that run between Coquitlam and N Yard utilize the main line. The configuration of the tracks in parallel allows the railway to make multiple simultaneous east-west movements along the waterfront throughout the day. A movement on any CP track across the diamond blocks CN/BNSF's BI Line movements.

The distances between CP's primary waterfront yards and the diamonds are not great. There is approximately 3,000 feet of room between the west-end of L Yard and the diamond and there is approximately 4,000 feet of room between the east-end of N Yard and the diamond. These relatively short distances mean that trains pulling cars out of L Yard tracks will occasionally foul the diamond for CN/BNSF movements. Similarly, when CP is doubling a long transfer into or out of N Yard, these movements can block Heatley for an extended period of time.

As mentioned previously, WCE trains also must cross the diamond getting to or from Waterfront Station. These trains run every 30 minutes in the morning and afternoon during the commute period. CP has indicated that dispatchers are reluctant to allow conflicting freight movements across the diamond between commuter trains for fear of some delay occurring that will affect the commuter schedule. This effectively blocks most CN/BNSF movements for 2 1/2 hours in the morning and evening. There are occasions where a CN/BNSF train can cross between commuter trains, however conditions must be right to allow this and MLM was told it did not happen frequently.

CN, with multiple movements each day, is particularly vulnerable at Heatley because CP controls the dispatching of movements over the diamond. CN must request permission from CP to use the route prior to beginning any movement on the BI Line to or from the Waterfront. The train crew or the CN Yardmaster can make the request to CP for this movement, either verbally

over the radio or via a device accessible to the train crew. The position of CP or WCE movements in the area determines whether CN will be granted access immediately or whether they will have to wait until other traffic has cleared.

As mentioned previously, a move from Main Yard to Waterfront Yard takes between 7 and 12 minutes. The CP RTC train dispatcher must keep the signals lined for the CN move for that entire time so the move will not have to stop once it reaches the diamond. During that time, no CP movements can be authorized through Heatley.

6.3 Connection to CN Lead North of Heatley Diamond

The final impediment to movements between FCF and the Waterfront is the short section of track just north of the Heatley Diamond. This section of single-track connects Waterfront Yard, the CN Lead, the lead to Centerm and the BI Line. CN operates over this link when crossing Heatley Diamond, when using the CN Lead, when switching Waterfront Yard and when moving Centerm traffic to/from CP. The link is also used when CN is pulling its own cars from or spotting cars to Centerm and Vanterm. BNSF uses the link each time it moves to the waterfront to switch the barge facility or interchange cars to CP.

The CN Lead is the track between Waterfront Yard and Pacific Grain that runs parallel to but north of the CP tracks. The westernmost portion of the Lead is the connection from Waterfront Yard and the BI Line.

The principle bottleneck that was identified in previous analyses of the waterfront area was the conflict between the multiple movements that require this section of single-track. The distance between Vanterm and the Waterfront Yard is so short that service to the Vanterm facility (or any other along the CN Lead) conflicts with all Waterfront switching moves. This includes pulling or spotting of both CN and CP Centerm traffic.

The conflicts resulted in long blockages of the single-track segment; as soon as one movement was completed, a second movement took its place on the segment. No movements from the BI Line could be made at the same time that these other movements were occurring, so frequently, lesser priority BI Line shuttles experienced delays.

6.4 Yard Track Length

The length of tracks in Waterfront, Glen and to some extent Main Yard compounds the BI Line operational issues. CN limits traffic moving to the Waterfront to 1,200 to 1,500 feet for most movements because Waterfront Yard's tracks are short (between 1,300 and 1,600 feet). CN does not have the ability to easily double a train into Waterfront Yard because of the CP trackage at the west-end of the yard and the Heatley Diamond/BI Line issues at the east-end. With these restrictions, CN cannot pull through the yard and out the west-end with cars to double over, and it can't leave the rear portion of the train on the Heatley Diamond or the BI Line because it would block CP, WCE and/or surface street traffic. Therefore, movements to the Waterfront must fit on an available track so they can clear the connections on the east or west-end of the yard upon arrival.

The one exception to this is grain. Grain movements can be operated at 2,000 feet, because they are usually immediately shoved into the elevators upon their arrival at Waterfront Yard and do not need to fit into a single-track. CN has approximately 2,100 feet between the east and west-end of the yard (if lead tracks are included), so a 2,000-foot cut of grain will fit without requiring use of the CP trackage at the west-end of Waterfront Yard.

Movements to Main Yard from Waterfront Yard are limited to 2,000 feet. The allowable length of these shuttles reflects the somewhat longer tracks available at Main Yard.

The effect of the track length restrictions is that more movements have to be made each day because of the length of trains being operated. Additional shuttle movements result in the opportunity for additional conflicts that will delay other movements within the originating yard. With only a limited number of time periods when all operational restrictions line up to allow a CN/BNSF move on the BI Line, additional yard moves reduce the odds that CN will be able to make the move without negatively affecting yard capacity utilization.

6.5 Network Impact on Yard Capacity Utilization

The impact that these four impediments have on CN operations at Main Yard is significant. If CN desires to operate a train from Main Yard to Waterfront Yard, all operational restrictions must be favorable before the movement can occur. First, Waterfront Yard must have a track for the switch engine to arrive into. Second, the available Waterfront Yard track must be of sufficient length to receive the transfer. Third, CP must provide a route for CN to move over Heatley Diamond without delay, and fourth, there must be no conflicting switching or pulling/spotting moves at the east-end of Waterfront Yard. If any one of these four components is not available, the move from Main Yard cannot take place without additional delay.

When these limitations create delays to a CN movement, the switch engine shuttle may remain in Main Yard. This takes up a track and negatively affects the velocity of cars being moved by that shuttle. The longer the traffic must remain in the yard, the more likely that it will conflict with other moves that are planned to occur, such as receiving a transfer from Thornton, switching FCF industries or switching other yard tracks for marshaling or efficiency purposes.

Some CN shuttles are allowed to pull north to Parker St. until given permission to operate to the Waterfront. There are two leads between Parker St. and Main Yard, so a shuttle from Waterfront Yard can move past a waiting train at that location. However, if a passenger move is scheduled to operate within a short period, the CN train cannot advance to this location to wait. At that location, a CN train draped back towards Main Yard blocks the connecting track between CN Jct. and the VIA station tracks.

Another impact on capacity utilization is since the length of Main Yard tracks and Waterfront tracks do not match, 1,500 feet of traffic from Main Yard may leave a small cut of "left over" traffic in the track the shuttle is made up from. At some point, that creates additional work within the yard because the left over traffic must be consolidated with other traffic in the yard. Since the alternative is to leave the extra traffic in the tracks, which would prevent an arriving shuttle

from using the track, the additional switching is a necessary operation to maximize the efficiency of the yard. The additional movements that must be performed to build the shuttles increase the utilization percentage of the yard, and create additional opportunities for conflicts with other yard moves.

6.6 Other Considerations for False Creek Flats Capacity Utilization - Transfer Length

Beyond movements between Main Yard and Waterfront Yard, there are two other issues that must be considered relative to the velocity of freight trains moving into or from the FCF area. The first of these issues is the length of CN transfers to or from Thornton.

As described in the yard schematics attached to this report, Main Yard has track lengths between 1,600 and 2,700 feet. Many of the transfers that arrive and or depart during peak traffic periods are approximately 6,000 feet in length. This means that the trains must double or triple into the yard upon their arrival, or double or triple tracks together prior to departure.

Main Yard's configuration features a short stub track at the west-end of the yard. The stub track is long enough to take locomotives off an arriving train and allow them to run through another track in the yard, but it is not long enough to pull a long train through the yard to double back into the yard. This means that when the trains are being doubled into the yard, the rear portion of the train must remain on the lead east of the yard. If the cut of cars is long enough, the train extends back onto the main line towards Still Creek. There is approximately 1,800 feet of room from the east-end of the yard to the main line.

Based upon this configuration, when a train exceeds 4,500 feet (1,800 plus 2,700 feet) it will block the main line east of CN Jct. until at least one track is doubled into the yard. If a shorter track than the longest track in the yard is used for the first section of the train, the blockage will occur with a shorter train.

The same also applies to departing transfers. If a transfer exceeds 4,500 feet in length (and is using the longest track in the yard), the head end of the train will block the main line to Thornton east of CN Jct. after being doubled together. Even though CN does a minimal air inspection test on many of their transfer moves, the train is likely to block the main line for 15 to 20 minutes before departing.

6.7 Other Considerations - Passenger Effects on Capacity Utilization

Another issue that has an impact on FCF capacity utilization is passenger moves in the area. This includes passenger trains from Eastern Canada and the U.S., and commuter trains operating between Mission and Vancouver.

Passenger movements are priority movements, and most freight operations will be worked around them. Train dispatchers are reluctant to allow freight movements in the same corridor when a passenger train is in the vicinity or is due to depart. It is not uncommon for conflicting freight operations to be stopped 30 minutes prior to an arrival or departure of a passenger train.

This is done so that if something happens to the freight train, it will be less likely that the passenger train will be affected.

Amtrak has discussed plans to increase service to at least three daily roundtrips from Seattle. The proposed passenger growth will have an effect on the capacity utilization of the yards in the FCF area. As more Amtrak trains operate, there will be additional passenger operating windows when freight operations will be halted. As discussed previously, these additional passenger movements will all bisect yard to yard freight movements in the FCF/waterfront area.

With increased bisecting passenger traffic, CN's long transfers will have an increased chance to be delayed because they will not be able to occupy the main line towards Still Creek until after the passenger train has passed. Similarly, shuttles to the Waterfront will remain in the yard rather than advancing to Parker St. until the additional passenger trains clear the area, also causing a build up of cars in the yard tracks.

Similarly, West Coast Express service has the potential to affect FCF yard utilization. It has been indicated that at some time in the future, WCE will likely request to expand their service to/from Vancouver, either with additional morning/afternoon trips or reverse trips during mid-day and/or in the evening. Additional passenger movements will create additional blocks of time when freight operations will be prohibited from crossing at Heatley Diamond to/from the BI Line. The more passenger windows created during the day, the less opportunities FCF traffic will have to get across CP's tracks. This may further impact FCF rail yard capacity as the shuttles will have fewer opportunities to align all four necessary operational constraints prior to moving between the yards.

Chapter 7: Potential Network Modifications

This section of the report analyzes potential modifications that could be made to the network to try to alleviate some of the yard capacity utilization issues discussed above.

7.1 BI Line Double-Track

One concept that has been discussed to improve capacity between FCF and the Waterfront is to double-track the BI Line. This would likely begin at Parker St., where the dual lead to Main Yard joins into a single-track, and continue to Heatley Diamond.

The first possible alternative would be to have only the existing diamonds at Heatley as the CN crossing. The second alternative would be adding additional diamonds across the CP tracks, creating two routes all the way to Waterfront Yard. Each option is briefly analyzed.

With a single-track crossing at the diamond, there is little to be gained from double-track alone. Only one train could operate across the CP tracks at a time, and without highway grade separations, a second train could not be held on the BI Line until the first train passed.

With a second set of diamonds at Heatley, the value of a second track without highway grade separations is still limited. Without the ability to stop on the BI Line, each meeting of two trains on that section would have to be timed from both Main and Waterfront Yards. While it can be done, there is a likelihood that a small delay to one train or the other would throw off the meet, which would negate the entire advantage or cause highway congestion on the major road crossings.

7.2 Grade Separation of the BI Line

The second improvement that has been considered is to grade separate the major crossings on the BI Line and "close" the remaining smaller crossings or modify the ordinance that concerns blocking of railway crossings. MLM believes this improvement must be considered under either a single-track or double-track configuration.

Under a single-track configuration, MLM believes this improvement will have a small positive effect on yard capacity utilization. The ability to leave a northbound train waiting on the BI Line near Heatley or a southbound train just north of Parker St. would allow the origin yards to send the train without having all four previously discussed operating criteria in place before the shuttle departed. Since CN controls the switching/pulling/spotting north of the diamonds and the yard track availability, the only criteria that would be out of their control is crossing CP's tracks. If a train could wait at Heatley without blocking highway traffic, less time would be required to get a train across the diamonds than is currently needed from Main/Glen Yard.

MLM believes that double-track in conjunction with separation of the at-grade crossings would further improve the access between FCF and the Waterfront. Under either the single or second diamond configuration, CN would be able to meet trains on the BI Line. Even if the meets were not perfect, the first train would have a location to stop while waiting for a second train.

If Main Yard capacity utilization were high in a given time period, under a grade separated BI Line configuration CN would have the ability to put together a switch engine shuttle and move it out of the yard to the BI Line. The ability to move a train out of the yard would create an open track for other yard movements or switching work. If the BI Line were double-track in conjunction with the grade separation, there would be a second route that a southbound move could utilize while the northbound move was stopped (or vice versa).

An additional benefit of grade separations would be that longer trains from Centerm could be run to Main Yard. Currently, the length of the tracks receiving the train at Main Yard limits the train length; a train cannot double into the yard because of the possibility that access to VIA or a grade crossing will be blocked. With a grade separated configuration on the BI Line, the rear of the train could be left north of the access to the passenger station while the first portion of the train was being pulled into the yard.

This point could have a substantial impact on operations and capacity utilization with the expansion that is currently being done at Centerm. CN engines pulling the Centerm ramp tracks would be able to handle 3,500-foot cuts of cars instead of the 2,000-foot existing limit. This would allow CN to pull cars from Centerm more quickly and with fewer shuttles than the current restrictions allow.

With a grade separated BI Line, shuttles moving from Main Yard to Waterfront also could be increased in length. The grade separations would create the ability to leave a portion of a train on the BI Line while the head end was being pulled into Waterfront Yard. This type of operation would still require that CN access the diamonds multiple times, but some of the moves would be light engine, which can move across the CP trackage in under a minute once a signal to proceed is displayed.

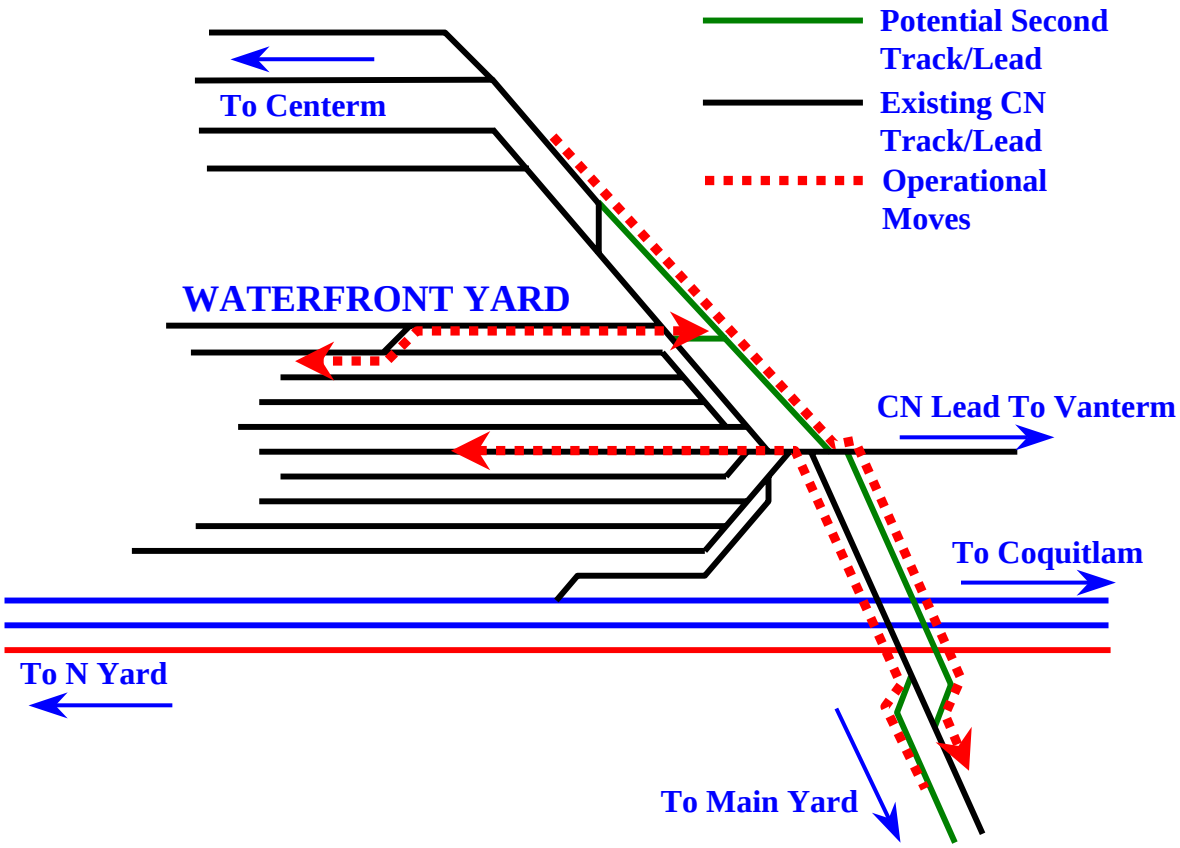
The ability to move longer shuttle trains to Waterfront Yard would enhance Main Yard's utilization. Rather than a single-track or a part of a track being pulled to Waterfront Yard, two full tracks could be pulled in a single move. This would more quickly free up trackage for other Main Yard operations, or reduce switching to size the shuttle trains.

7.3 Additional Route between Heatley Diamond and Centerm

The concept of a second route between Main Yard and Waterfront Yard would need to be designed to allow efficient movements north of Heatley. While there is little that can be done to eliminate the cross over moves associated with pulling and spotting Vanterm or other CN Lead industries, a second lead to Centerm could facilitate simultaneous moves between the BI Line, Waterfront Yard and Centerm.

Schematic 8 is a representation of a possible configuration that would allow these simultaneous moves.

Schematic 8



The configuration is designed to allow a move of CN traffic from Centerm to Main Yard to be made simultaneously with a move from Main Yard to Waterfront Yard. The configuration would also allow a pull or spot of CP Centerm traffic to/from N Yard to occur simultaneously with a move to/from Main Yard (see Appendix 3 for more details on the requirements for this type of move).

MLM is unable to propose any configuration that could be designed at ground level that would allow simultaneous moves on the BI Line with moves from Waterfront Yard to the CN Lead. The cross over nature of these two routes guarantees that without railway at-grade separation, they will always conflict with each other. However, two routes between Waterfront Yard and Main Yard may reduce the time the north-south movements require, which in turn could create some additional time for the east-west CN Lead movements.

It is unclear to MLM whether a configuration such as that shown in the schematic above would be possible due to the truck routes into Centerm and the Port area. The new track suggested in the schematic would likely cut into the existing truck entrance to Centerm. If that road could be relocated, the configuration may be possible.

7.4 Infrastructure to Minimize Passenger Conflicts

Due to the cross over nature of the routes between Still Creek and the VIA station and the routes between Main Yard, Glen Yard and the Waterfront, MLM is unaware of any at-grade improvement that can be done to correct the conflict between yard shuttles and arriving/departing passenger trains. The only configuration that would allow these conflicts to be resolved would be a railway grade separation project, commonly called a fly-over. MLM is not certain there is enough room between the leads to the various facilities to allow a fly-over to be constructed. A detailed engineering study would have to be done to ascertain if this type of improvement would be possible.

If the BI Line were highway grade separated and double-track was constructed, it would be possible to turn arriving VIA and Rocky Mountaineer trains using the BI Line north of Parker St. rather than using a track in Main Yard. The leg of the wye at the east-end of the station tracks could be used, rather than the connection between Main Yard and VIA. VIA trains would pull down the BI Line towards Heatley, then back around the Parker St. wye to enter the station. These trains would leave using the direct route to CN Jct. as they do currently.

Arriving Rocky Mountaineer trains could also pull down the BI Line, and then shove around the connection towards Main Yard. The RMT station track currently extends to the southeast and connects into the CN Lead track, although it doesn't appear to be used at that end. With the previously described configuration change, the RMT train could use that connection to back into the station. Departing RMT trains would have to continue to shove back into Main Yard, and then pull forward via the switching lead to leave the FCF area.

An extended switching lead between CN Jct. and Still Creek would allow a longer CN transfer to arrive or depart during periods when passenger trains are expected. The second lead would need to extend approximately 2,000 feet to the east of CN Jct. on the south side of the existing main track. This lead would allow a 6,000-foot train to utilize the south lead track while Amtrak or VIA continued to use the main track to get to or from the VIA station.

Chapter 8: False Creek Flats Footprint Modifications

This chapter of the report will address the City of Vancouver's conceptual potential changes in footprints at the FCF yards. The four options include no change to the existing footprint, reducing the existing footprint, expanding the footprint or reconfiguring the footprint. Each will be briefly analyzed regarding the effects they could potentially have on FCF rail operations.

8.1 Status Quo Footprint

Under the status quo footprint option, no yard trackage would be added or subtracted from the three FCF yards. Based upon the simulation studies, this option would be favorable for current operations and future operations that include a co-production agreement between CN and CP.

This conclusion is based upon the utilization graphs developed in the Base and Future simulations. In both, all of Main Yard's tracks were utilized throughout the day. Even though Glen Yard had some unused trackage, MLM believes it is possible that this trackage would be used for storage of international container equipment needed to balance import surge demand and export flows. This could potentially include CP empty international container traffic if an expanded co-production agreement on the waterfront were reached between the two railways. South Yard is already well utilized by BNSF, and would likely continue to be used in that manner if the barge operation were not relocated.

As was noted in the utilization analysis, Main and South Yards appear to be appropriately sized for current and projected traffic volumes. Glen Yard is currently under utilized, however with increased international container operations, storage of international container equipment may change that status. MLM does not believe that CN will relocate any of Main Yard's activities to Glen Yard because of the grade and grade crossing issues.

If the BI Line was double-tracked and grade separated, it is possible that CN could utilize Glen Yard for some switching. The switching would likely be done from the north end of the yard. Glen Yard's main body of tracks is shorter than Main Yard's, so it is unlikely that without expansion that CN would relocate all of their operations to Glen.

8.2 Reduced Footprint

The reduced footprint concept entails removal of BNSF’s South Yard. As has been discussed previously, this yard is used by BNSF to switch and store traffic moving to/from the Burrard Inlet barge facility, along with switching some rail served industries in the area. Interchange traffic to/from CN also is switched and stored at this yard.

MLM believes three things will have to occur for BNSF to agree to abandon South Yard. First, the barge facility will have to be relocated from Burrard Inlet. Second, comparable trackage to South Yard’s will have to be constructed or provided for to support the relocated facility. And finally, a fair price will have to be offered to BNSF for both the Burrard barge facility acreage and the South Yard acreage.

MLM has discussed the operational issues with local BNSF operating personnel. The barge facility on Burrard Inlet is licensed to handle dangerous goods in railcars. Any new facility would have to have that same ability. The new facility will also need to be convenient to BNSF operations, which is the case of the South Yard operation. The BNSF switch crew serving the barge facility currently starts their shift at South Yard. There is also an engine facility near the yard where locomotives can be safely stored over night. Both these criteria would likely need to be addressed prior to BNSF agreeing to relocation.

MLM also discussed the possibility of relocating the traffic stored in South Yard to BNSF's New or Old Yards in New Westminster. MLM was told that current interchange traffic levels with the SRY consume virtually all of New and Old Yard capacity. This means there would be little or no room to relocate South Yard traffic into New Westminster, further hampering the concept of closing the facility unless an acceptable replacement was found.

A reduced footprint also does not address the potential for growth of CN traffic. With the expanded Centerm and Vanterm facilities, CN international container traffic through FCF could grow to levels significantly higher than current volumes, particularly if no co-production agreement is reached between CN and CP. There is also still the potential that an increase in traffic could operate through Main Yard with or without a co-production agreement because MLM believes CN would try to handle as much traffic as possible on its own railway.

With higher levels of international container traffic to/from Centerm and Vanterm, there is also likelihood that additional storage for empty international container rail equipment will be necessary. MLM believes that Glen Yard alone does not have the capacity to meet this additional storage demand. If that is the case, CN may look to South Yard if there is the potential that the property may become available.

If the BNSF barge operation can be relocated along with a new yard for serving it, South Yard becomes an ideal location for additional international container equipment storage. The longer tracks would mean less switching of cars into or from the facility, which would be necessary with storage at Glen Yard. The 13,000 feet of capacity within South Yard would also address a significant portion of the increase in storage track that will potentially be needed to meet the expanded Centerm and/or Vanterm demand.

Based upon this analysis, MLM doesn't envision that South Yard will be readily available for removal. We believe that if BNSF were relocated, CN may express interest in the yard in its current configuration, even if international container levels are not yet near projected long-term levels. With the dynamic nature of carriers serving various Ports and utilizing different rail carriers, CN may want to protect its potential interests.

8.3 Expanded Footprint

Under the expanded footprint scenario, South Yard remains in its current configuration, while Main Yard, Glen Yard and the VIA station are expanded. All these yards serve separate purposes, and the proposed expansion of all three may not improve overall operations.

The VIA yard is the least likely to require expansion. The station currently has six tracks that can be used for passenger arrivals and departures, with only two trains per day currently operating into the facility. Even with an increase in Amtrak service, the tentative schedules indicate that there will not be two Amtrak trains in the station at the same time. With a single VIA train remaining, it does not appear to be likely that expansion of the facility will be needed to serve all potential inter-city passenger trains.

Glen Yard is the next least likely yard to require expansion. As mentioned previously, the south end of Glen Yard is on a grade, and therefore it is not a good yard to switch traffic in. It can be used for storage of traffic; however, the track lengths are such that multiple tracks are necessary for storage of longer cuts of cars. Using short tracks for storage requires multiple double over moves to put cars away or to take cars out, which uses crew hours and switch lead occupancy time. MLM is not convinced that CN would utilize additional tracks within Glen Yard to a level to justify that expense, particularly if there were other storage/switching options to consider.

Main Yard is a yard that MLM believes CN would support for expansion if traffic levels increased to a point where Main Yard capacity was a daily concern. The proposal, however, shows expansion occurring in an area that currently contains active rail-served industry. This industry would likely have to be relocated prior to using the area for additional yard tracks. This would require a location adjacent to a rail served property, and would likely remain in the FCF area.

The proposed expansion appears to limit the new tracks to an area that is approximately 1,800 feet in length. It is unclear how many tracks could be added into this area, however, any expansion would be useful for providing additional tracks that could be used for building or switching waterfront shuttles and/or Thornton transfers. The location of the proposed expansion is good in the sense that tracks in that area could be switched from the southernmost yard lead towards Still Creek, which, in conjunction with an extended switching lead discussed previously, could be used even when passenger trains were operating.

South Yard is left in place in this proposed configuration. Again, assuming that BNSF could be relocated, MLM believes CN would likely express interest in keeping an option on the property to protect potential future growth.

The expansion of Main Yard in conjunction with the use of Glen Yard and South Yard should improve the utilization percentages over those that were seen in the Future operating scenario. The additional trackage would allow storage traffic to be separated from traffic requiring switching, which should also improve operational conflicts.

Under a scenario where no co-production agreement is reached between CN and CP, MLM believes that the BI Line, Heatley Diamond and the CN Lead will limit the FCF - waterfront throughput before FCF yard capacity does. If those three restrictions are corrected in some manner, however, then the additional traffic that CN will likely run through the corridor will put an increased demand on FCF yard capacity. Under that scenario, expansion of the yards may be necessary.

8.4 Reconfigured Footprint

Under the reconfigured footprint proposal, South Yard is removed, while Main Yard is expanded. As with other concepts where South Yard is removed, MLM believes BNSF will have to be relocated and CN will have to decline interest in the property before this occurs. The reconfiguration of Main Yard will also depend on relocating the industries that will be affected with the conceptual expansion.

MLM believes CN will not be as interested in a combination of an expanded Main Yard with the existing Glen Yard as they would be with a Main/South Yard combination. This is partially because of the grade/switching issues associated with Glen Yard, but, in MLM's opinion, would be more about operational compatibility. With the main line separating Main and Glen Yards, the ability to use those yards in combination with each other will not be as great as using a combination of Main and South Yards.

Part of the reason a Main/Glen combination will not be as usable has been previously mentioned; Amtrak and VIA trains operating to or from the VIA station will bisect operations. Another reason, however, is the requirement to use the main line to get between the two yards. Each time the main line is accessed east of CN Jct. to get between Main and Glen Yards, the RTC dispatcher has to be contacted for permission and to report that the train is clear of the main. Each time the main is accessed near Parker St., the CN Yardmaster at Lind Creek must be contacted for permission. Waiting for approval of movements between the two yards will reduce the efficient operations between the yards.

MLM believes that a more operationally viable alternative for a reconfigured area is to expand South Yard in conjunction with Main Yard, and to remove Glen Yard or to relocate the Main Yard industries onto that property. South Yard does not have the switching and storage issues that are associated with Glen Yard and the lead tracks between Main and South Yards converge near CN Jct. With an extended lead track toward Still Creek, both yards could be switched without accessing the main line. This would remove the passenger operations effect on freight movements between yards, and would eliminate the necessity of contacting a controlling operator each time a move was made between yards.

If industry between Main and South Yards could be relocated (potentially to the Glen Yard property), the two yards could then be configured into a CN facility that combines the switching and storage functions in a single yard. Any potential configuration design of the facility would need to be created once the parameters were established to understand what the most efficient design and use of the tracks would be.

8.5 Other Considerations Regarding Modifications in the False Creek Flats

An issue that needs further exploration is the route and restrictions between Waterfront and Main Yards under an operating plan that does not involve co-production. MLM does not believe that increasing the capacity or reconfiguring the footprints of Main, Glen or South Yards accomplishes anything unless the capacity of the BI Line is addressed. Previous studies of this area concluded that when additional traffic was added through the corridor, the delays incurred

on the BI Line and at the Heatley Diamond or CN Lead limited throughput before yard capacity was exhausted. The biggest obstacle was the CP and CN east west traffic and/or switch moves.

The results of the studies that utilized an operating plan without co-production indicated that as Centerm and Vanterm expanded, so did CP's traffic to and from N Yard and CN's traffic on the CN Lead. As those volumes increased, blockages at the diamonds or on the CN Lead connection track north of Heatley became more frequent, and CN BI Line traffic saw fewer opportunities to cross CP's tracks.

This situation was aggravated with the increase in WCE traffic between Coquitlam and Vancouver. Per an agreement reached within the Rail Stakeholders Committee, one additional inbound and outbound train was added to the morning and afternoon rush periods. A mid-morning and mid-evening turn between Coquitlam and Vancouver was also added to the operations. These schedules were estimated during the study for simulation purposes only. Any expansion in actual operations would need to be negotiated with CP before any such service could begin.

As more commuter trains were introduced, the windows for CN movements decreased. With increased international container operations to the expanded terminals, the demand for movements increased while the available slots were reduced. MLM's conclusions under this scenario was that the FCF yards had enough capacity under those circumstances, because the BI Line limited traffic levels to where the utilization of the available yard capacity remained at or under sustainable levels.

Chapter 9: Conclusions

Based upon studies and analysis of rail operations in the FCF area, it is MLM's opinion that the following will be likely outcomes of the proposed modifications to the yards in the FCF area.

1. BNSF will not give up South Yard unless the barge facility is relocated and trackage equivalent to South Yard's is relocated near BNSF's new facility. Operations to the new facility will need to approximate the current operating cost to BNSF, or some form of compensation will be necessary to persuade the railway to make the change. CN may express interest in the yard for storage purposes, or may utilize the yard if no co-production agreement can be reached with CP.

2. An increased footprint will be most likely to occur at Main Yard under a growth scenario that doesn't involve a co-production agreement between CN and CP. If that increase in trackage is where the City has conceptually proposed it, then the active industries will need to be relocated to other railroad served property. It is MLM's opinion that if CN requires an expanded yard area, they will pursue South Yard prior to going through the steps of relocating the existing industry and constructing new trackage in its place.

3. The BI Line, Heatley Diamond and CN Lead connection will have to be addressed before any expansion or reconfiguration of FCF yards is likely to be undertaken by the railways. Without a better route to flow traffic between the FCF area and the waterfront, MLM believes that FCF yard capacity will not be the limiting factor. Clearly, however, it should be recognized that CN is the primary beneficiary of improvements to the FCF, the BI Line or the crossing conflict areas on the Waterfront. It is MLM's opinion that CP may not be agreeable to all improvements necessary to improve rail flow to/from FCF.

4. If the BI Line restrictions, including conflicts at Heatley Diamond, can be acceptably mitigated, CN will be more likely to focus on utilizing the FCF route for their traffic than to rely on a CP co-production agreement. It is under this criterion that expansion or reconfiguration of FCF yards appears to be most likely.

5. A reconfiguration of South Yard with Main Yard makes more operational sense than a reconfiguration of Main Yard and Glen Yard. South and Main Yards are on the same side of the main track, minimizing the need for contact with a control operator to move between yards. They can both be served off of parallel lead tracks, and both yards' operations can be enhanced by an extended lead east of CN Jct. Main and Glen Yards are separated by the main line, and with increased passenger service to the VIA facility, will be more difficult to operate efficiently.

6. MLM believes it is unlikely that the VIA facility or its footprint will require expansion.

False Creek Flats Analysis
Addendum 1

Addendum 1: CN - CP Co-production Agreement and its Impact on False Creek Flats

After the main body of the False Creek Flats report was completed, CN and CP announced that they had reached a co-production agreement that would materially change the operating patterns between Mission/Matsqui and the South and North Shores of Burrard Inlet. VPA asked MLM to comment on this agreement and how it was likely to affect operations through the FCF area. This addendum briefly describes the agreement and how the operations will be modified. It also relates MLM's opinions on how the agreement will impact the FCF area and rail yards.

The co-production agreement changes the routing of traffic to the waterfront area; however it does not consider any reduction in yard capacity in the area. The agreement was designed to improve rail traffic flow by bypassing yards and eliminating some railway-to-railway handoffs. MLM believes that even though traffic is routed differently to/from the waterfront under the agreement, waterfront and FCF yards will continue to experience equal or higher levels of utilization than are currently experienced due to the projected increase in rail volumes to/from the South Shore terminals.

A1-1: Summary of Terms of the CN - CP Agreement

Following is a summary of the CN - CP co-production agreement that has a potential impact on FCF rail operations and yard utilization. There are other operations affected by the agreement reached by the two railways, however, they have no bearing on the FCF area and are not included in these brief descriptions.

1. **CN will operate both railways' unit trains from Boston Bar to the North Shore terminals.** All CN and CP unit trains destined for the North Shore will be operated by CN crews utilizing the BNSF - CN Joint Section to Willingdon Jct. via the Fraser River Bridge (FRB). Trains leaving from the North Shore will operate with CN crews via reverse route to Matsqui Jct., and then enter CP's directional trackage at Mission. CP empty unit trains will be returned to CP crews at North Bend for furtherance east.

2. **CP will operate both railways' South Shore traffic from Boston Bar to the waterfront terminals**. All CN trains carrying traffic for the Vancouver terminals on the South Shore and Port Moodys' Pacific Coast Terminal (international container, grain, sulfur, and merchandise) will be manned by CP crews at Boston Bar and operated to South Shore yards/terminals via the CP route through Coquitlam. CN trains returning from the South Shore will operate via Coquitlam onto the CP directional trackage at Mission and be returned to a CN crew at North Bend.

3. **CP crews will perform all South Shore switching.** CP will take over all CN switching operations on the South Shore, including Centerm, Waterfront Yard and any CN industrial switch assignments. CP will be responsible for pulling and spotting all South Shore terminals, and sorting traffic to/from the appropriate railway. All yards on the waterfront (N, L and Waterfront Yard) will be available to CP to perform these switching operations.

4. **CP will be given access to Glen Yard for storage of international container equipment if necessary.** CN will work with BNSF to insure that CP has access to Glen Yard for the occasional staging of international container equipment. These trains are likely to use the BI Line to move between the waterfront and Glen Yard when they are operated.

A1-2: Implications of CN - CP Agreement for FCF Yards

Under the agreement, it is clear that there will be a reduced level of Thornton Yard to South Shore waterfront industrial traffic moving through Main Yard. With CP serving all South Shore industries, international container and merchandise traffic that currently is transferred to Main Yard prior to being spotted to the waterfront terminals or industries will now be brought in on the CP route through Coquitlam.

With CP handling all CN South Shore waterfront traffic, it is MLM's opinion that CN will not require three daily transfers between Thornton Yard and Main Yard. MLM anticipates there will be one daily local train operated between Main Yard and Thornton; that train will handle the local FCF merchandise traffic. Main Yard will continue to function as a support yard for CN's switchers that work the FCF industries. MLM believes it is possible that CN and BNSF will reach an agreement to allow only a single local train to serve both CN's Main Yard transfer requirements as well as BNSF's South Yard transfer requirements.

Glen Yard, whose primary responsibility in the past has been to stage/store grain loads and empties for the waterfront elevators, will also see a reduction in levels of this type of traffic as it will now also be handled via CP. MLM anticipates that most of the grain loads (and empties) will be staged in Waterfront Yard prior to spotting or after being pulled from the elevators.

South Yard is likely to be unaffected by the agreement. MLM believes that if the South Shore barge operation continues, South Yard will continue to be used as the support yard for that traffic.

Traffic over the Burrard Inlet Line will also be reduced. With the rerouting of South Shore terminal traffic via CP's Coquitlam route, the two daily barge operation switch assignments will become the largest regular user of the BI Line across the Heatley Diamond.

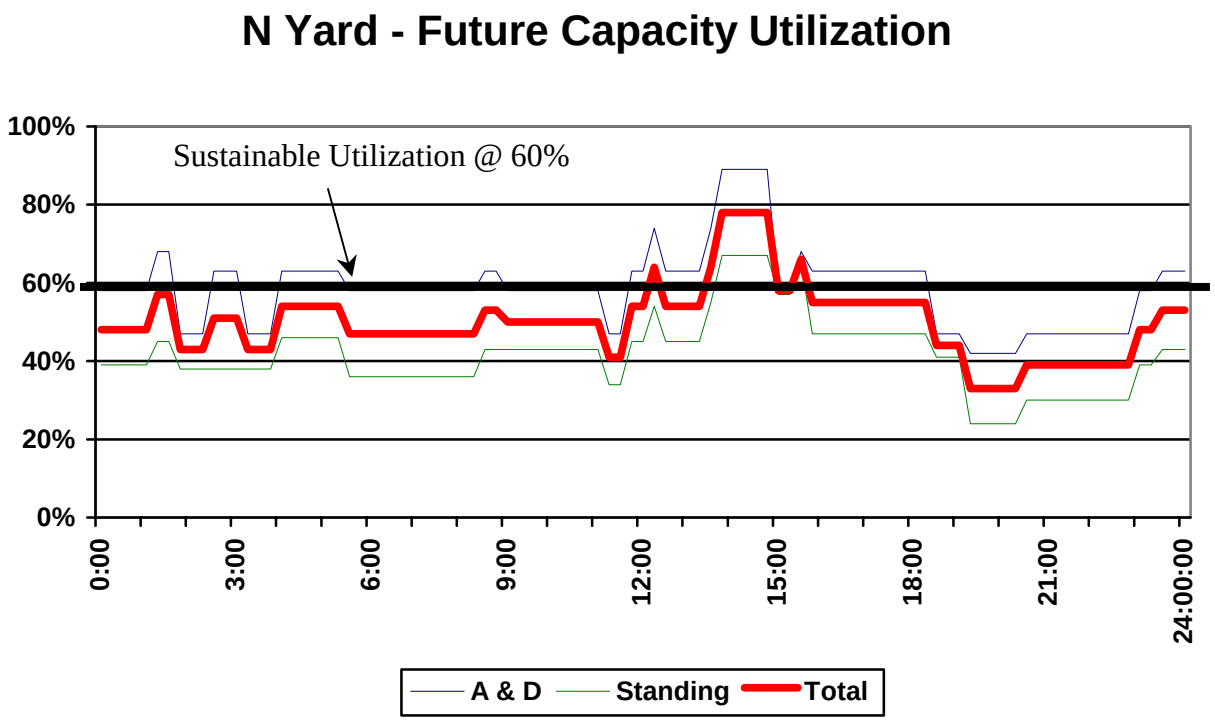
Amtrak, VIA and the Rocky Mountaineer Tours trains will continue to operate over the south end of the BI Line as they currently do. With reduced freight operations around Glen and Main Yards, the passenger trains will not have a sizeable impact on False Creek Flats or South Shore freight operations even if additional Amtrak or VIA service is established.

West Coast Express trains will continue to use the north end of the BI Line during weekends to access the VIA maintenance facility. These trains will move from the CP route onto the BI Line at Heatley and move south to access the facility.

While these changes appear to reduce the importance of the Main and Glen Yards, MLM believes that this agreement will actually just shift responsibility between FCF and South Shore waterfront yards. This shift in traffic would be a direct result of the level of co-production associated with the recent CN - CP agreement.

As part of the VPA Rail Stakeholders analysis that was completed in 2004, MLM analyzed the capacity utilization of the South Shore waterfront yards under existing and potential future operations. What was found in the analyses was that under the simulation's projected co-production agreement, N Yard's capacity consumption reached levels that would indicate there will be some congestion due to the amount of traffic that utilized the yard. This traffic included all CP Centerm traffic, both railways' Vanterm import traffic, and most of both railways' merchandise traffic destined to waterfront industries. With the expansion of Centerm and Vanterm and the projected associated growth of international container traffic through those two terminals, N Yard maintained utilization levels above 50% for a majority of the day. As discussed in the main report, 50% utilization is approaching the maximum level of utilization for sustainable efficient rail yard operations.

The following graph represented the projected future capacity utilization at N Yard utilizing the simulated co-production agreement.



This utilization graph accounted for the growth in international container traffic as projected by the international container terminals, and also included additional daily West Coast Express trains to/from Coquitlam. The types of traffic that were included in the co-production agreement were specified by the railways, as they requested that the minimum possible co-production be tested in the study.

The graph (and the supporting data) indicates that at minimum, 60% of all tracks were occupied throughout the day. During peak yard usage, 90% of the tracks were occupied. This level of utilization represents the maximum utilization that can occur if the yard is to maintain an efficient level of operations. It also indicates that N Yard is appropriately sized based upon the simulation's assumptions.

The CN - CP commercial agreement recently announced goes beyond the co-production that was simulated. Under the new agreement, all international container, merchandise and grain traffic will now be moved via the CP's line from Coquitlam. This exceeds what was simulated; in that study, CN's Centerm traffic and all CN's grain traffic was handled via Main/Glen Yards. Based upon the recent agreement, it will now operate through the waterfront yards.

It is MLM's opinion that under the actual co-production agreement, more rail traffic will move through N Yard than was estimated in the simulations. This means that N Yard's utilization percentages will likely increase, putting further strain on the existing infrastructure.

MLM believes this increased volume through N Yard will force a reorganization of other traffic along the waterfront. Cars that CP staged in N Yard, along with cars that CN staged in Waterfront Yard will now need to be relocated to create room for the additional international container and grain traffic. MLM believes that the logical location for this relocation will be the FCF yards.

During the early stages of the agreement, MLM believes Glen Yard will be used to stage relocated waterfront traffic. However, MLM would anticipate that over time, Main Yard will be used as the primary staging yard for this traffic. MLM believes this for two reasons; there are longer tracks available in Main Yard, and the yard is configured better for switching than is Glen Yard. The commercial agreement currently only applies to Glen Yard, however it is MLM's opinion that as operations are refined, further co-production trackage will be identified based on operational efficiency. We anticipate that traffic that must be relocated from the waterfront yards will be moved to Glen/Main Yards, and shuttled down to the waterfront on an as needed basis.

This traffic will create and maintain a high level of utilization of Main Yard's trackage. The BI Line, however, will still see a reduced number of transfers, as much of the staged traffic will stay in the FCF area until it is needed on the waterfront. It is difficult to assess at this time how many trains will operate over the BI Line, other than to say it will likely be less than currently operate. These shuttles would be in addition to the BNSF movements to and from the barge facility.

Additionally, CN anticipates that it may occasionally run a train moving empty containers from Thornton Yard to the waterfront terminals via the FCF Yards. These cars would also likely be staged at Glen/Main Yards until needed on the waterfront, and would also then use the BI Line for that access.

It is MLM's opinion that as waterfront traffic grows, Glen Yard will act as an overflow yard for Main Yard. If there is enough equipment that needs staging/storage in the FCF area, or if it is

known certain equipment will be staged for a lengthy period of time, then Glen Yard will be used to hold that traffic. Therefore, if an agreement is reached to allow CP access to Main Yard, MLM believes that Glen Yard may potentially be used less in the future than it is today.

For that reason, as CN and CP refine the agreement's operations, MLM believes that the use of Glen Yard may be phased out. Since this yard is leased from BNSF by CN, CN could save that cost if all traffic can be operated efficiently through Main Yard. Under that scenario, it would appear that Glen Yard would be a candidate for redevelopment, if terms can be reached with BNSF.

MLM does not anticipate the availability of Glen Yard to occur in the near future, however. We believe CN and CP will want to test the commercial agreement under existing and future levels of traffic before making decisions on infrastructure requirements and long term usage. MLM believes this process could take many years, because the traffic growth through Vanterm and Centerm that will test the operating volumes in the South Shore/FCF area will take multiple years to develop.

False Creek Flats Analysis
Appendices

Appendix 1 - Glossary of Terms

Air Test: A test of the air brake system on a train or string of cars to ensure that the braking system is working properly on all cars prior to movement from one location to another. Ensuring that the brakes apply and release on the rear car of the train or cut of cars is called a "Continuity Air Test".

Arrival/Departure: The arrival of a train or cut of cars at a destination location or the departure of a train or cut of cars from an origin location. Frequently the origin or destination location is a yard.

Block or Block of Cars: A group of cars having the same or similar destination attributes, e.g. a block of cars grouped for delivery to a specific location or industry.

Blocking: The switching process that groups cars together that have the same or similar destination attributes. Can be performed by flat yard switching or hump yard classification.

BNSF Glen Yard: BNSF Railway's support yard located on False Creek Flats. CN Railway leases a portion of the yard to support rail service to the Waterfront area.

BNSF New Westminster Yard(s): BNSF Railway's primary yards in the Greater Vancouver area, located just west (north) of the Fraser River Bridge. Composed of two yards – Old Yard and New Yard.

BNSF South Yard: BNSF Railway's support yard on the False Creek Flats, utilized to support BNSF Barge operations on the Waterfront, support local BNSF-served industry and for interchange of cars with CN Railway.

Capacity: A measurement of the ability of a section of railroad to accommodate traffic. Main lines and yards have a capacity. They are usually measured in different manners.

Classification: The process of switching cars in a yard into blocks for the purpose of segregating cars with common destination attributes together. Marshalling can be performed in a flat yard or a hump yard.

CN Main Yard: Canadian National Railway's primary support yard for Waterfront rail activities, located on the False Creek Flats.

CN Thornton Yard: Canadian National Railway's primary rail yard in the Greater Vancouver area, located just east of the Fraser River Bridge.

CN Waterfront Yard: Canadian National Railway's support yard located on the Vancouver Waterfront, adjacent to Centerm and Burrard Inlet.

Co-Production: An operating strategy between two or more railways in which assets such as tracks are used jointly to improve efficiency.

Couple: The process of joining cars together so the entire string of cars can be pulled as a unit.

CP L Yard: Canadian Pacific Railway's support yard located on the Waterfront, primarily for handling of grain and Vanterm intermodal cars.

CP N Yard: Canadian Pacific Railway's primary support yard located on the Waterfront. Used for the arrival and departure of transfers from Coquitlam, staging of cars for local industry, marshaling, and interchange with CN Railway for Centerm cars.

CP Coquitlam Yard: Canadian Pacific Railway's primary rail yard in the Greater Vancouver area, located on the north (east) side of the Fraser River opposite of CN Railway's Thornton Yard.

Critical Link: A rail infrastructure location on which multiple activities take place which compete with each other for use of the asset. An example is CN Railway's Waterfront Lead which provides access to Centerm, Vanterm, CN's Waterfront Yard and other industry directly served by CN on the Waterfront.

Cut: A smaller group of cars, generally separated from the main body of a train. A "cut of cars" refers to the smaller group.

Cut off: Uncouple cars.

Diamond: An intersection of two (or more) tracks at grade. At a diamond, a train on one route cannot access the other (crossing) routes.

Double Handling: The necessity of handling cars more times than normal service would require, often as the result of yard congestion. Double handling generally has a negative impact on rail operating efficiency.

Doubling: The process whereby a string of cars from one track are pulled out and shoved back to couple onto the cars on another track, normally in the process of making up a train. Conversely, doubling occurs when an arriving train is too large to fit into one available track, with the excess cars uncoupled and shoved back into a second (or more) available track.

Double over: The process of doubling cars into or out of multiple tracks.

Dynamic Model Simulation: The use of a technologically advanced computer planning tool to analyze the implications of changes in rail operations and/or infrastructure over a defined area.

Export: Traffic brought to a Port from Canadian or US sources that is to be loaded onto a ship and sent to another destination. "Export" containers arrive at VPA's terminals on a train and are unloaded from the railcars, then loaded onto a ship.

Hump Yard: Also known as a Classification or Marshalling Yard. A complex yard containing an elevation on the primary switching lead that allows cars to roll by gravity when uncoupled into classification tracks. Primary purpose is to create large number of car blocks in an efficient manner. The classification tracks are often referred to as the "bowl" and a Hump Yard will often also contain separate Arrival and Departure Yards adjacent to the Hump and the Bowl.

Import: Traffic that is unloaded from a ship at a Port and loaded onto railcars for distribution to Canadian or US destinations.

Infrastructure Configuration: The arrangement of tracks, yards, switches, signals and connections in a defined area within a major terminal rail complex. For example, the arrangement of rail infrastructure incorporating CP's, CN's and BNSF's facilities between the Second Narrows Bridge, CP's N Yard, CN's Waterfront Yard and CN Jct. on the False Creek Flats would be a defined area of infrastructure configuration for analysis purposes.

Intermodal: Traffic that transfers from one mode of transportation to another mode, such as containers from ships being loaded onto a rail car and then being moved by train.

Lead Track: A non-main line track primarily used to link together other tracks, for movement between different yards/facilities and for switching/marshalling purposes. A lead track often connects to the main line(s). An example of a lead track is CN Railway's Waterfront Lead, which connects to Waterfront Yard, Centerm, Vanterm, and other CN industry on the Waterfront and to BNSF's Burrard Inlet (BI) Line.

Main Line: A primary operating track for the movement of trains and engines between origins and destinations. Use of main lines is governed by occupancy authority granted in a variety of ways, or combination of ways, including signals, by a RTC/Train Dispatcher or other designated Control Operator.

Manifest Train: Also referred to as a **Merchandise** Train. A train made up of a variety of car types and commodities destined to multiple locations and customers. For example, a manifest train could include cars carrying various lumber products, industrial products, chemicals, metals and empty cars being returned for further loading.

Marshalling: Also referred to as switching, classification and shunting. The process of switching cars in a yard into blocks for the purpose of segregating cars with common destination attributes together. Marshalling can be performed in a flat yard or a hump yard.

Multi-Function Yard: A yard, primarily a flat yard, that by operating plan performs a variety of functions, including train arrivals and departures, marshalling and/or car staging and storage. An example of a multi-function yard is CP's N Yard on the Waterfront.

Pullout End of Yard: The end of a yard where cars/blocks are normally pulled from classification tracks for the purpose of doubling them together to make up a train. The pullout end of a yard normally refers to the end of a hump yard's bowl tracks opposite the elevated end

of the bowl tracks. The pullout end normally involves a lead track or series of lead tracks to access various bowl tracks.

Ramp Tracks: A series of tracks for intermodal rail car loading/unloading located within the confines of an international or domestic intermodal facility. Intermodal facilities within the Greater Vancouver area that contain ramp tracks include Centerm, Vanterm, Deltaport, VIT and VIF.

RTC: Also known as a Train Dispatcher on some railways. The railway personnel assigned with the responsibility for authorizing train and engine movements on main lines. Authority from an RTC/Train Dispatcher normally also has to be secured prior to entering main line tracks.

Spur: A track that branches off a track but does not connect back into other tracks or a lead track.

Staging/storage Yard: A yard that's primary function is to hold cars for sometimes lengthy periods of time, awaiting customer orders or further movement disposition. A staging/storage yard is often composed of fewer tracks with longer lengths and cars staged/stored often are of similar car types handling the same or similar commodities.

Standing Capacity: Similar to Theoretical Capacity**.** The total car capacity of a yard if every track is completely filled from one end of each track to the other.

Stub-end Track: A track that dead-ends on one end without connecting back into other tracks or a lead track.

Sustainable Capacity: The percentage of theoretical capacity for any rail infrastructure at which operations can be efficiently sustained within the designed operating plan. Sustainable capacity can vary from yard to yard depending on the design and operating responsibilities of the yard.

Switch: The configuration of track that allows a train moving on one track to diverge to a second track.

Switch Engine: A train that is dedicated to switching cars in a yard or serving industries by pulling and spotting the cars for that industry. Switch engines can shuttle cars around an industrial area as well.

Switching: The process of separating cars into various yard tracks for the purpose of creating blocks, making up or breaking up trains, or accessing specific cars to meet customer service orders. Also referred to as marshalling or classifying.

Theoretical Capacity: The maximum rail car or train capacity a defined infrastructure configuration can accommodate. For yards, theoretical capacity is the same as standing capacity. For main lines and lead tracks, theoretical capacity denotes the maximum number of train and

engine movements that can occur over a defined period of time given the operating capabilities and restrictions of the segment.

Transfers: Trains that operate within the confines of a major terminal for the purpose of transferring cars from one yard or area to another. For example, CP and CN operate transfers between their respective primary yards at Coquitlam and Thornton to their Waterfront support yards.

Unit Train: A train comprised of rail cars all of one type, often transporting commodities all of one kind, or similar kinds. Examples include full-train loads of grain, coal, potash and sulphur. Full trains of intermodal rail cars are also classified as unit trains, though the individual containers/trailers contain a variety of commodities.

Utilization: The amount of capacity consumed on a piece of track or within a yard. If 50% of the capacity of a yard has been consumed, the yard is said to have 50% capacity utilization.

Velocity: A measurement of the time required to move a car or train through a yard. The higher the velocity of the car (or train), the less time that car (or train) remains in a yard. Higher velocities for cars usually equate to more available yard capacity.

Wye Track: A set of three intersecting tracks with switches at each connection that allows engines or cars to be "turned" in the opposite direction.

Yard: A series of tracks, normally parallel to each other and with connections on both ends to lead tracks. Yards are normally located in the vicinity of main lines and concentrations of large customers and can be used for classification, arrival/departure, switching, customer service and staging/storage or combinations thereof.

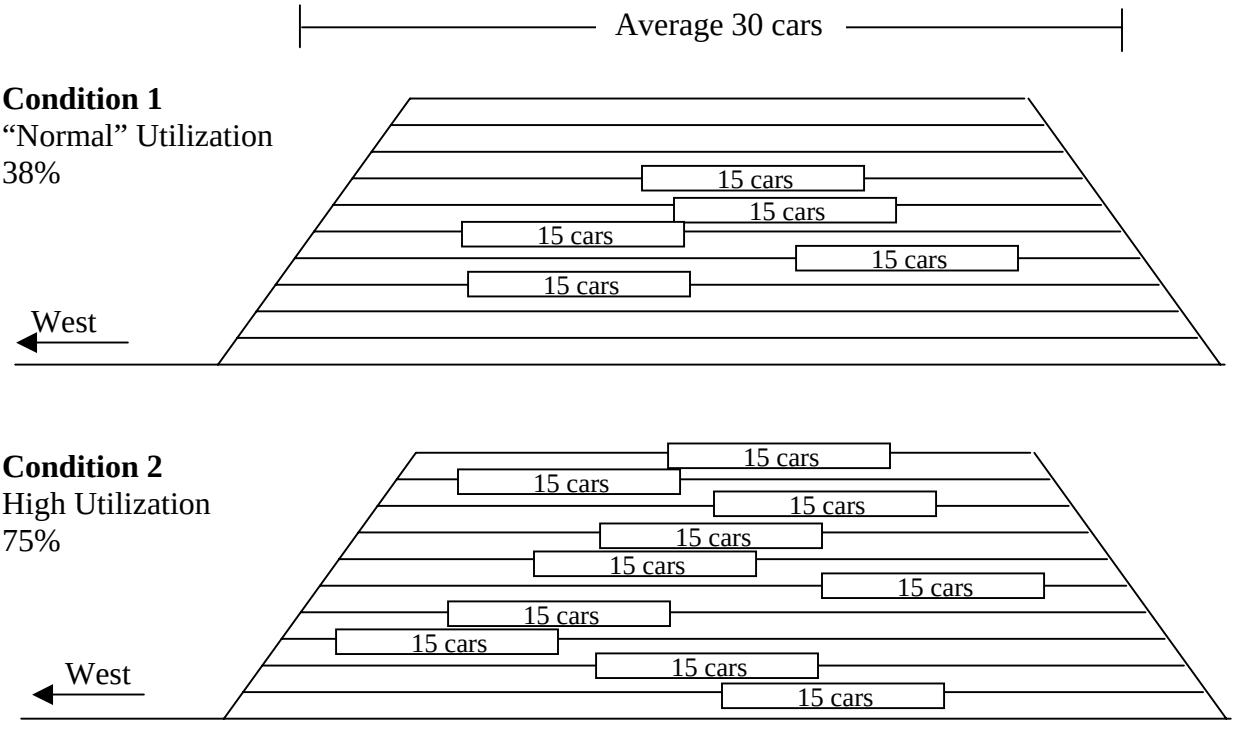
Appendix 2 – Effects of Yard Capacity Utilization on Operating Functions

Appendix 2 has been created to demonstrate how common yard operations are affected when a high level of capacity utilization is experienced in a yard. To illustrate the impact of capacity utilization, these examples examine what happens to yard operations during a period where operations occur under normal utilization versus a period where capacity utilization is very high. The examples also discuss how a yard can continue to function at a high level of capacity utilization, and what the effects are on other operations. The first example reflects the Arrival/Departure (A/D) process.

Appendix 2.1 - Yard Capacity Utilization Effects on the Arrival Process

For this example, assume the ten-track yard that was discussed in the main document (10 tracks, 30 cars per track) is operating under two conditions. Condition 1 is a "normal" condition, where five tracks have 15 cars on each of them (leaving five tracks clear), and Condition 2 is at a high level of capacity utilization, where there are 15 cars on all 10 tracks in the yard (Schematic 1). If the yard is assumed to have a 50/50 weighted percentage of A/D and standing capacity, the total percentage of capacity consumed in the normal condition is 38% (A/D = 50%, SC = 25%). Under Condition 2, the total capacity consumed is at 75% (A/D = 100%, SC = 50%). This is a very high utilization percentage for a yard if it is sustained for a long period of time.

Schematic 1



For this example, also assume the yard has a main line track running past it from east to west. If a 60-car westbound train needs to arrive into this yard in Condition 1 (normal operations), it

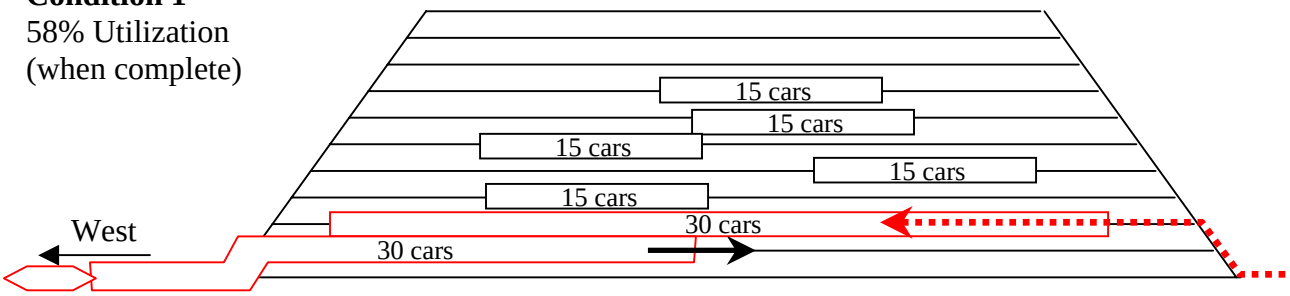
would pull through one clear track (Track 2), leave the rear portion of the train in that track and then shove the head portion into a second clear track (Track 1). Total utilization would increase from 38% to 58%.

A move of this nature would likely take 20 to 30 minutes. While the physical movement of the cars would not take this long, for safety reasons, a train crew employee would likely ride the easternmost car of the head end section of the train as it was shoved into the second clear track. This is done because the employee would be responsible for informing the locomotive engineer as to when the car he was riding on was close to the switch on the east-end of the yard track, so the car wouldn't be shoved out the other end of the track.

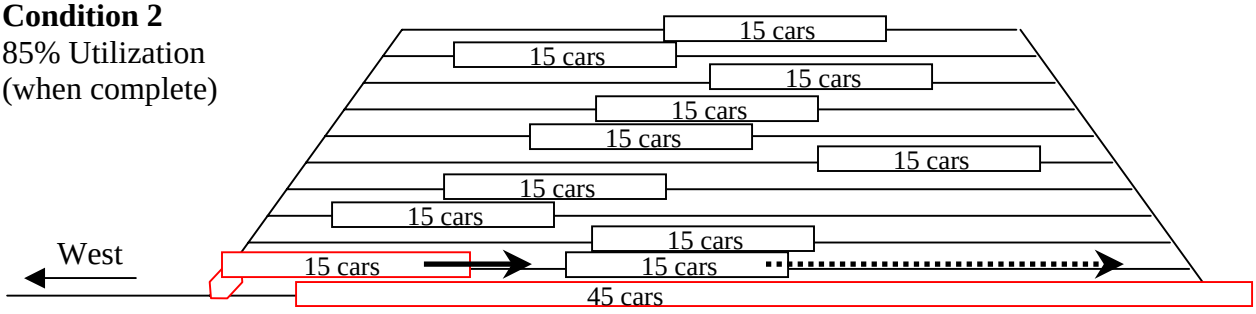
Conversely, under Condition 2 of this example, the train could still arrive into the yard; however, the operation would likely be done as follows. The train would pull down the main line until the first 15 cars are even with the west-end of the yard. A train crew employee would uncouple these cars from the balance of the train and take them west until they were west of the yard lead. The crew would then shove the cars back into a track (Track 1) on top of the 15 cars already in the track. The engines would then return to the main line, run back to the cars that remain and repeat the process three additional times (Tracks 2, 3, 4) until the train was put away. Schematic 2 represents the Condition 1 and 2 methods of a train arrival.

Schematic 2

Condition 1
58% Utilization
(when complete)



Condition 2
85% Utilization
(when complete)



An arrival process of this nature would likely take 1.5 to 2 hours because each cut of cars being moved into the yard tracks has to be ridden by the train crew employee to make sure they don't collide with the cars already in the tracks. Additionally, if the cars in the track are not sitting at the east-end of the track, the employee would have to couple the cars on the train to the cars in

the track, and then walk to the east-end of the string of cars. The employee would then have to ride all 30 cars east and inform the locomotive engineer when the cars were close to the switch. The employee would then have to walk back to the locomotives to make the next move.

As can be seen from the two operations, the impact to the main line is very different. In the normal scenario, it is blocked for a manageable 30 minutes. In the high capacity utilization scenario, it would likely be blocked for two hours.

As this example shows, there are ways to operate even when the utilization of the yard is very high (in this case, 100% A/D, 85% for total capacity utilized). But the efficiency of the operation suffers, and the conflicts with other operations that occur during the extraordinary operations affects not only the arriving train, but all other trains attempting to either pass or use this yard at the same time.

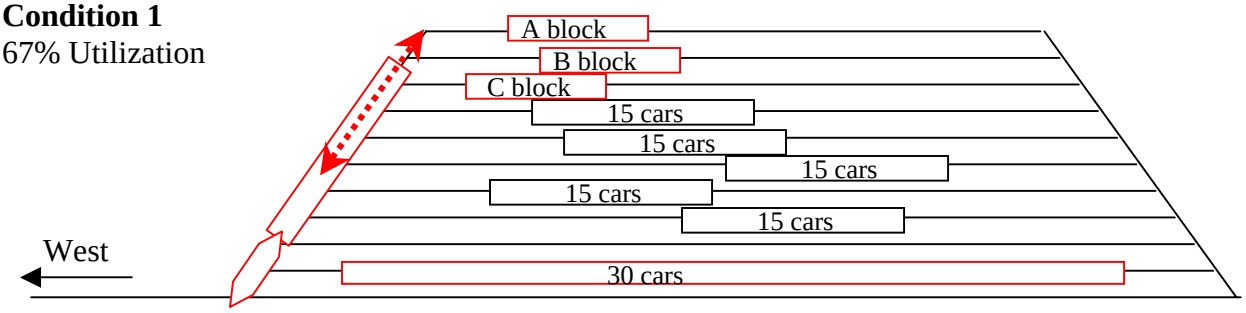
Appendix 2.2 Yard Capacity Utilization Effects on Switching

The second example reflects how high utilization percentages affect other yard operations such as switching. If the train that arrived in the preceding example needs to be marshaled, and it will be switched into three blocks of 20 cars each, the high level of capacity utilization again forces extraordinary moves. In the case of switching, this usually means "double-handling" cars that could be switched a single time under more normal operations, or making preparatory moves to create room where the work can be performed.

In the Condition 1 example, to complete the required switching, a switch engine would pull one of the two 30-car tracks to the west and begin marshalling the cars into three blocks of cars, one in each of the three clear tracks. When this was completed, the engine would go back, couple into the second 30-car track, and repeat the process. MLM estimates that the time this work would take would be approximately 1 hour.

Schematic 3

Condition 1
67% Utilization



The yard would be configured as shown in Schematic 3 as the first track was switched. At the completion of switching one of the two tracks, the total capacity utilization percentage would be 67% (A/D = 90%, standing = 45%). When both tracks have been switched, the utilization percentage reduces to 62% (A/D = 80%, standing = 45%). As this example demonstrates, a yard

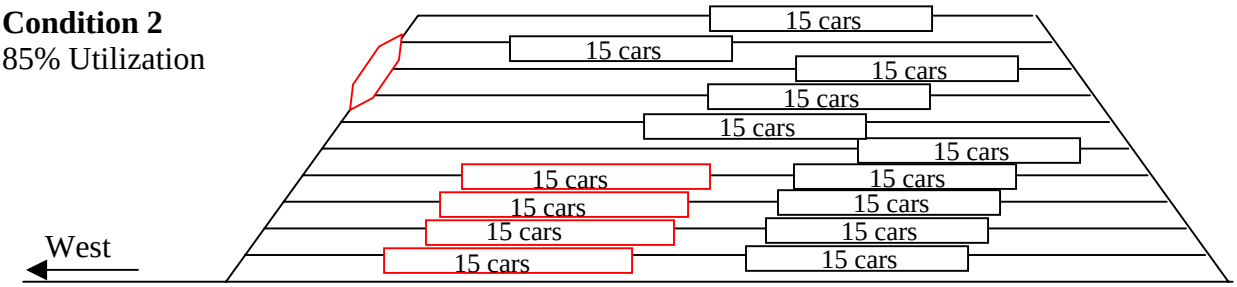
that was at normal utilization can change its capacity utilization quickly with the arrival of additional cars and some switching.

This example is convenient in the sense that there are three open tracks and a requirement for three blocks. However, if a fourth block was required, it could be built into the track the first 30 cars were pulled from. This is another benefit of a yard at normal utilization levels; switching work often creates some additional room that can be used during the switching process.

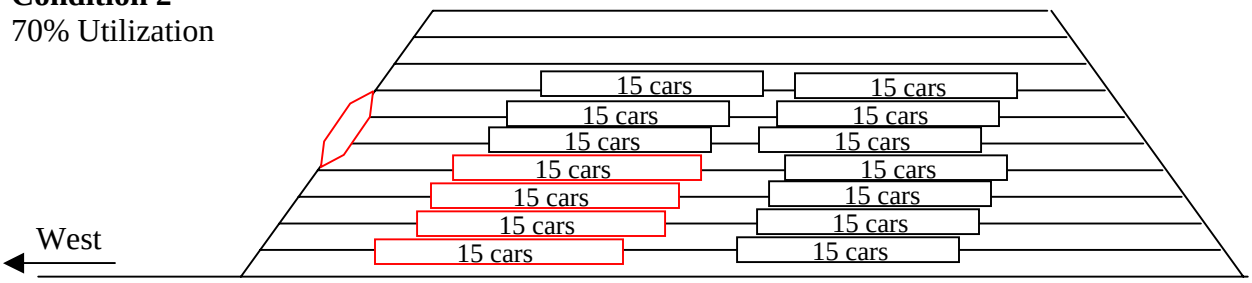
In the Condition 2 example, after the train arrives, four tracks will have 30 cars on them (Tracks 1, 2, 3 and 4) and the other six tracks will have 15 cars on them (Schematic 4, top). This equates to a total capacity utilization percentage of 85% (A/D = 100%, standing = 70%). To create room to allow marshalling of the cars, the first move the switch engine must make is to double three of the 15-car tracks into the three other tracks with 15 cars on them. This creates the empty tracks that the blocks can now be switched into (Schematic 4, bottom). While room for marshalling work is created, this preparatory switching requires three distinct moves that will take almost as much time as was taken to bring the train into the yard. It also leaves cars that were already separated on the same track, which may require additional switching at a later time.

Schematic 4

Condition 2
85% Utilization



Condition 2
70% Utilization



Once room is created, the switch engine can now couple to the cars that need to be switched, pull them west of the yard, and marshal them into the empty tracks. As mentioned previously, it is convenient that there are only three blocks necessary and there are three tracks available. If a fourth block was required, cars would have to be switched back into one of the tracks the cars were pulled from, leaving a portion of the track marshaled while the rest of the track was not switched.

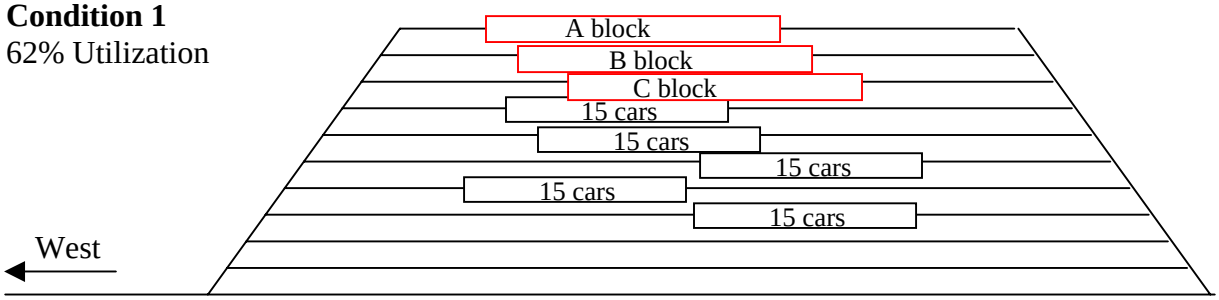
In addition to the extra preparatory moves required by the condition of the yard, the engine has to pick up from four tracks rather than the two tracks in this scenario to switch out all 60 cars. The cars being pulled out for switching also have to be uncoupled from the other 15 cars in the track, which were coupled together when the train arrived. MLM estimates that with the preparatory work and the marshalling process, the switching of these cars would take between 3 and 3.5 hours under the Condition 2 levels of capacity utilization.

The final result of the switching under the two conditions is displayed in Schematic 5. While both methods achieved the same result, the yard configuration in Condition 1 is less congested than that in the Condition 2 yard. The operations of arriving and switching a train in normal utilization levels involved approximately 1.5 hours, while that same work under high utilization levels took 4.5 to 5 hours. These hours equate to additional fuel and labor hours, which for a railway, equate to additional cost. Additionally, the extra time for performing the same work in Condition 2 is switching productivity time that could not be devoted to other service activities.

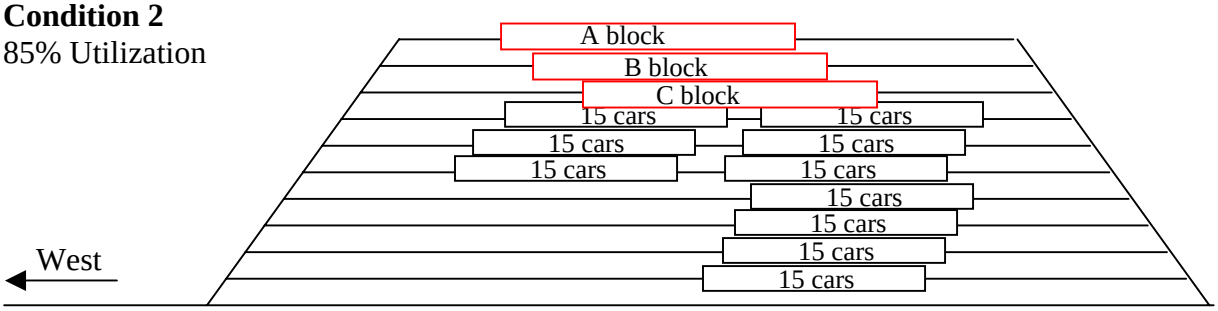
As an adjunct to the time and cost to the railway, there is also an environmental component to operations under the more congested scenario. The additional time required to switch or make additional moves equates to usage of additional fuel. It also equates to additional exhaust from the locomotive, which could have an impact on air quality in or around the yard area.

Schematic 5

Condition 1
62% Utilization



Condition 2
85% Utilization



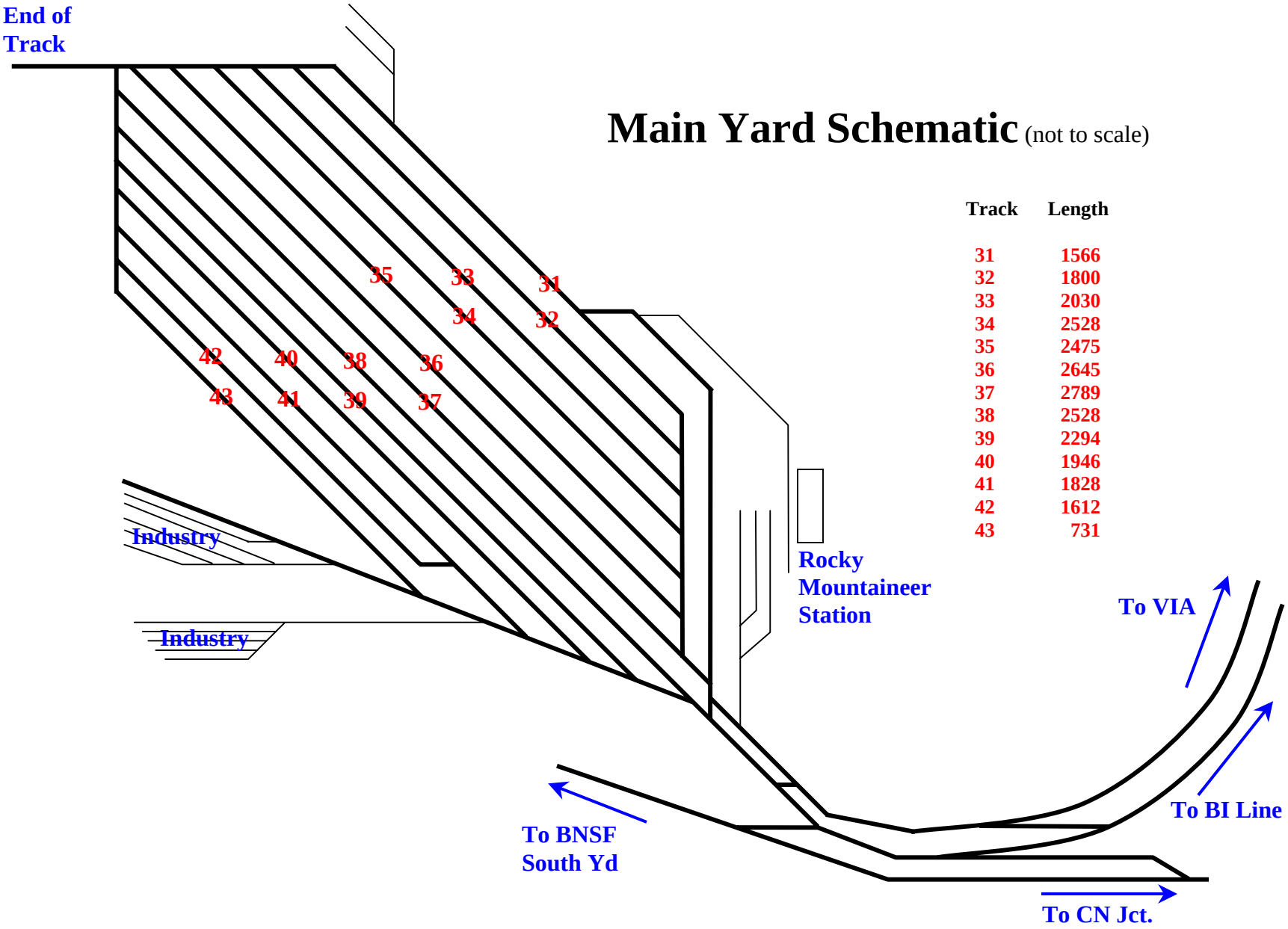
There are other effects of high levels of capacity utilization within a yard. In a yard where two engines work simultaneously, the extra moves that have to be made often conflict with the second engine's work. The more extra moves each engine has to make, the more opportunities exist for them to conflict with each other. This leads to further inefficiencies and potential service delays within the yard, which require additional time, effort and cost.

In some instances, yards can operate at levels of consumed capacity greater than 60% for short periods without a major negative effect on efficiency. An example of this occurring is when a train arrives and delivers cars, but then immediately picks up a train that is ready to depart. This circumstance was regularly observed in the FCF/WF yard operations. Consistent capacity consumption in excess of 70% to 80%, however, can rarely be sustained in multiple function yards without significantly affecting operating efficiency.

False Creek Flats Analysis
Yard Schematics

MainLine Management, Inc.

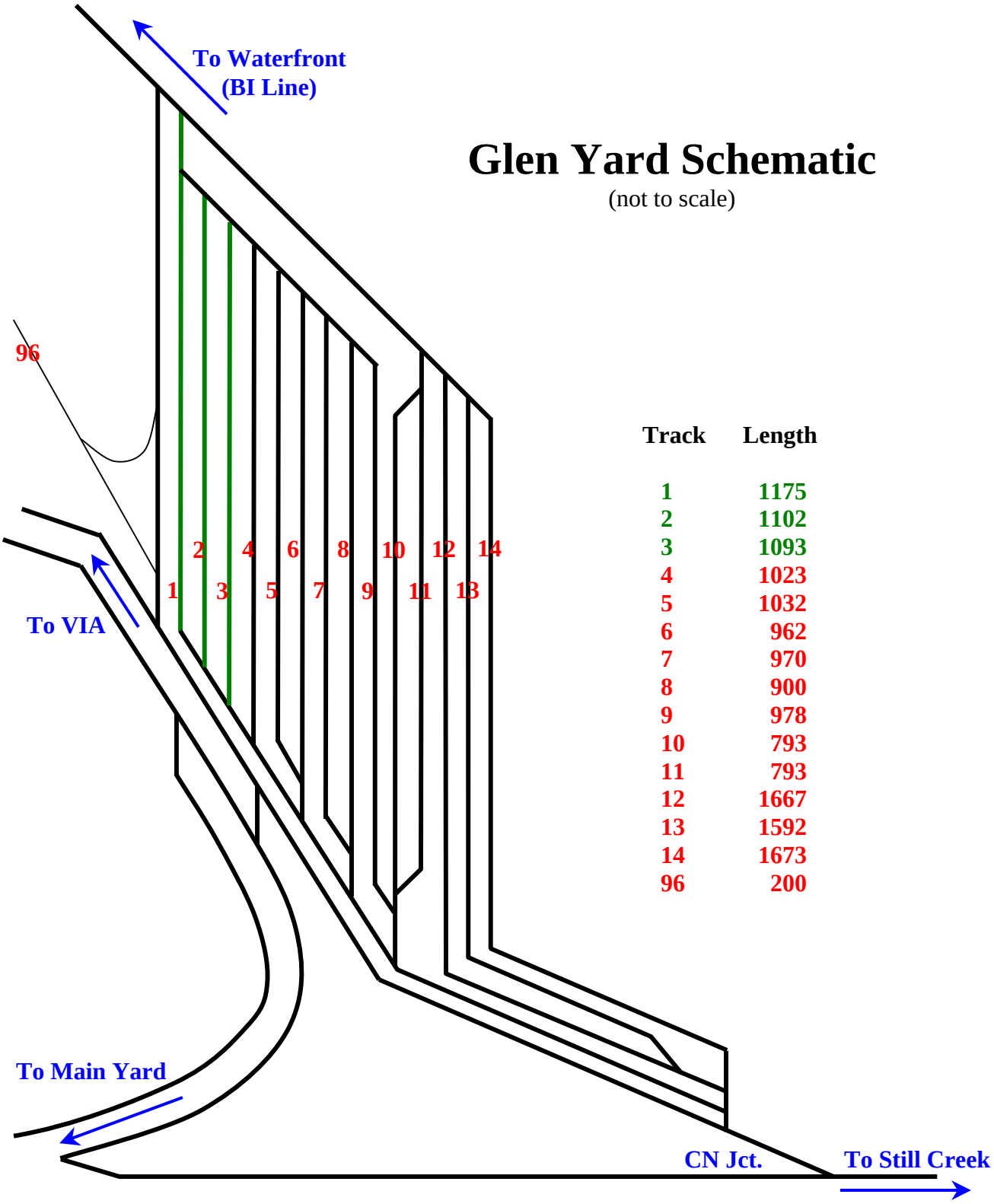
Main Yard Schematic (not to scale)



Track	Length
31	1566
32	1800
33	2030
34	2528
35	2475
36	2645
37	2789
38	2528
39	2294
40	1946
41	1828
42	1612
43	731

Glen Yard Schematic

(not to scale)



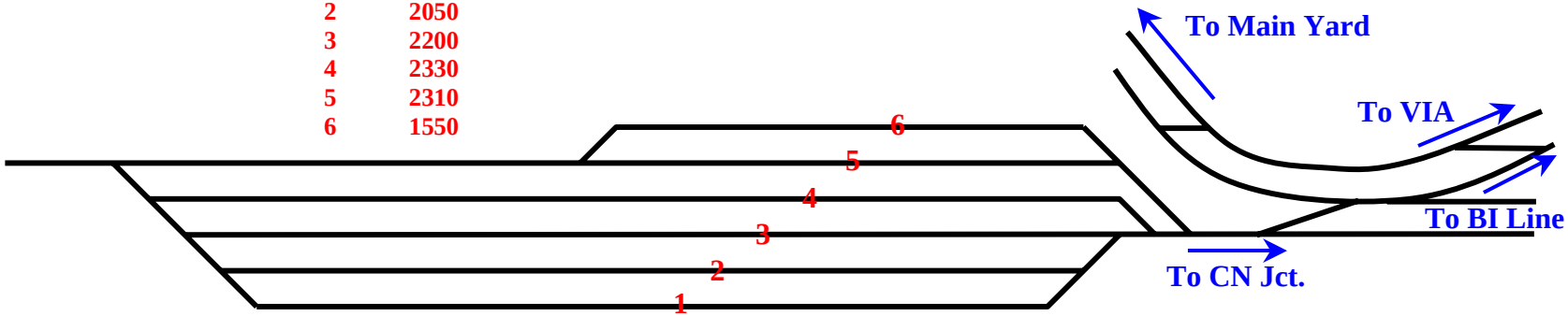
Track	Length
1	1175
2	1102
3	1093
4	1023
5	1032
6	962
7	970
8	900
9	978
10	793
11	793
12	1667
13	1592
14	1673
96	200

Schematic 2

South Yard Schematic

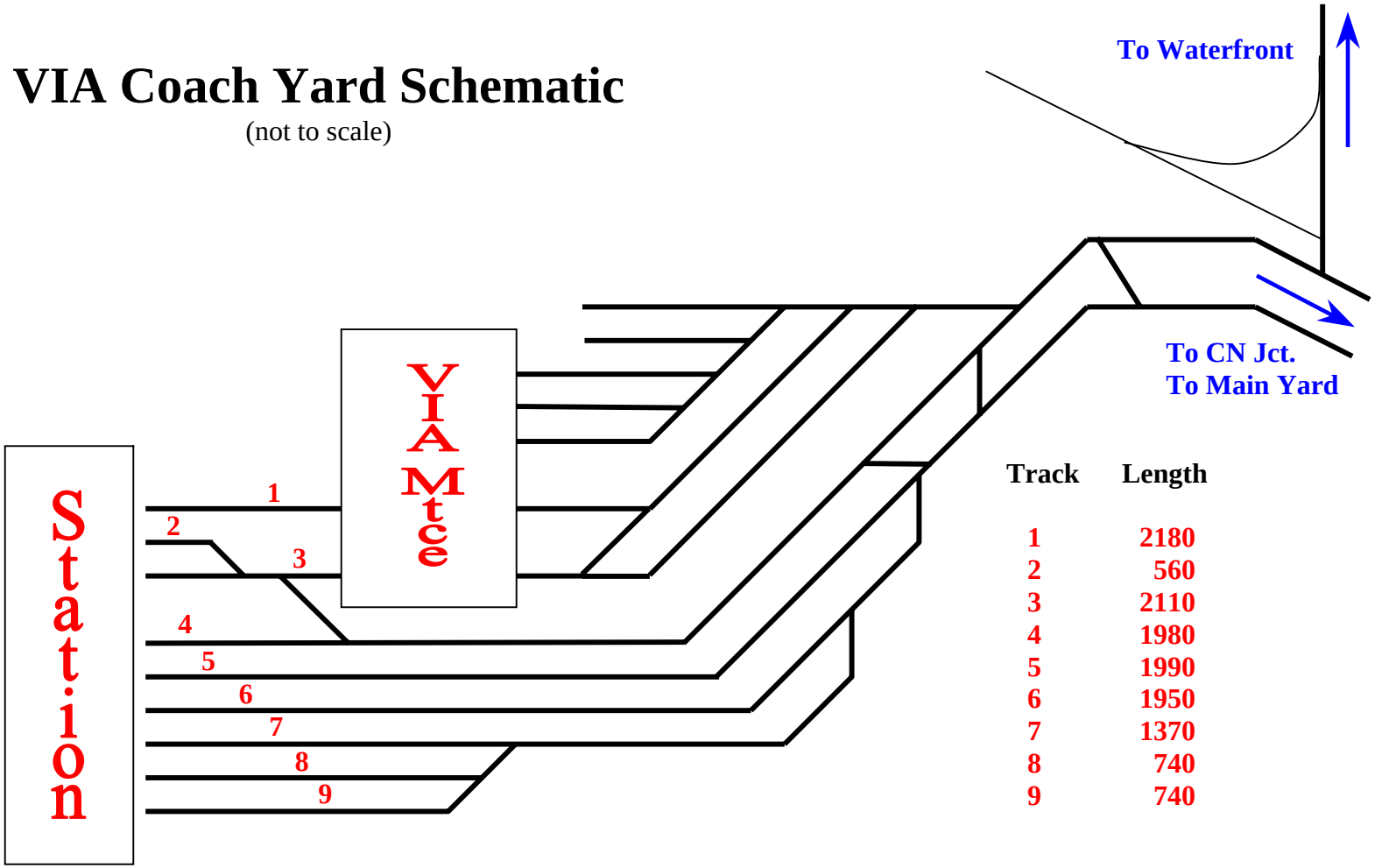
(not to scale)

Track	Length
1	1750
2	2050
3	2200
4	2330
5	2310
6	1550



VIA Coach Yard Schematic

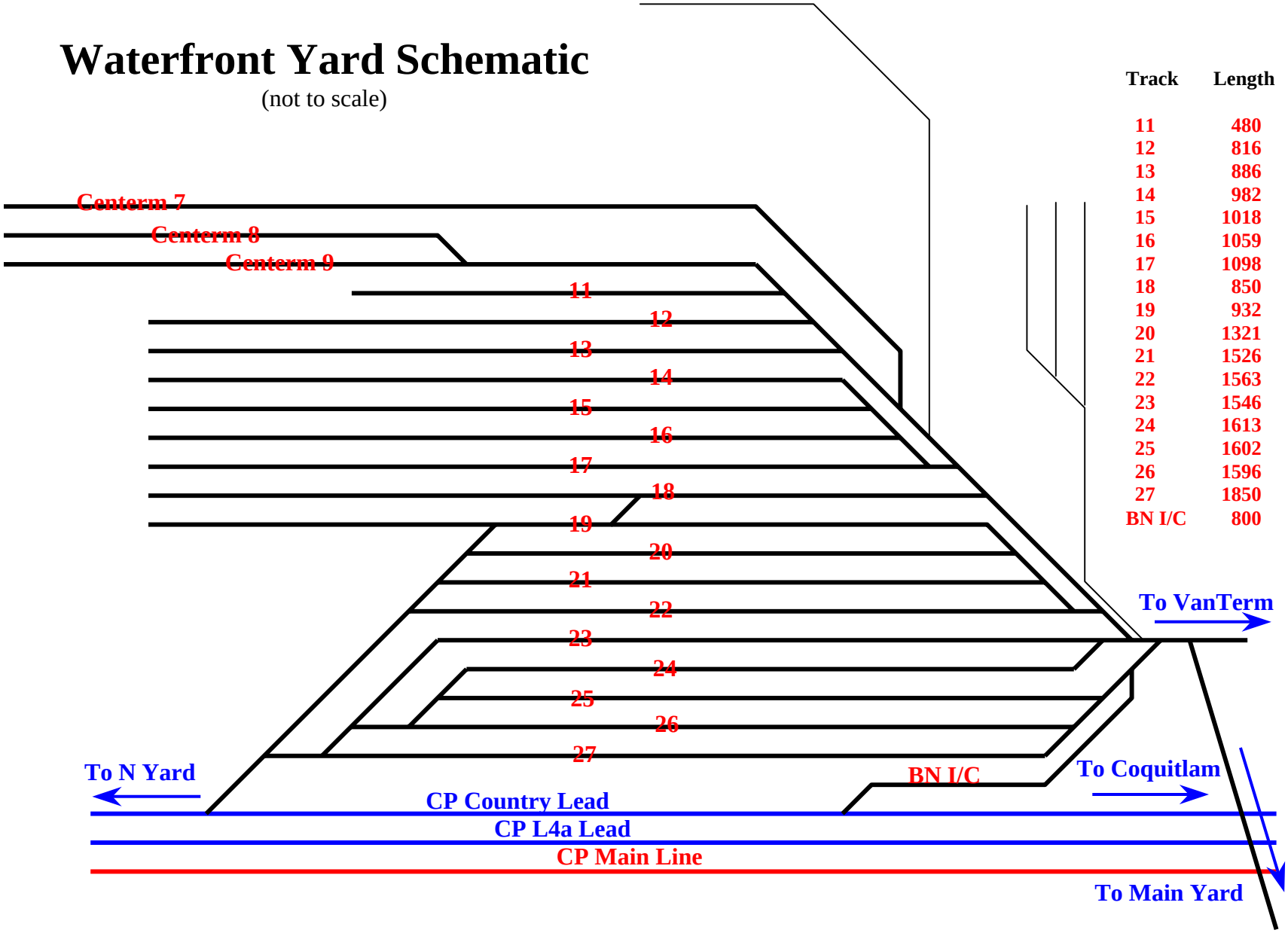
(not to scale)



Track	Length
1	2180
2	560
3	2110
4	1980
5	1990
6	1950
7	1370
8	740
9	740

Waterfront Yard Schematic

(not to scale)

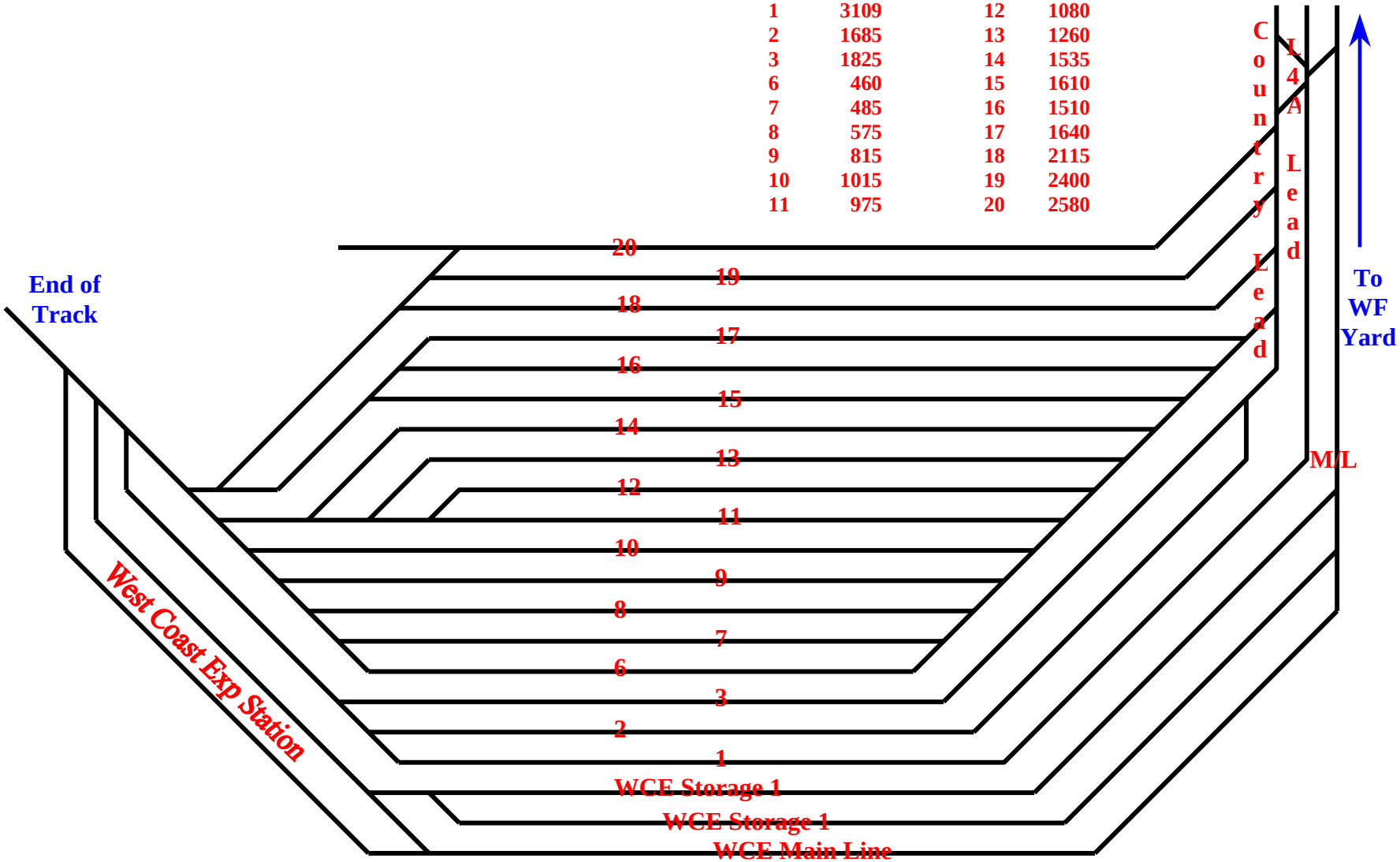


Track	Length
11	480
12	816
13	886
14	982
15	1018
16	1059
17	1098
18	850
19	932
20	1321
21	1526
22	1563
23	1546
24	1613
25	1602
26	1596
27	1850
BN I/C	800

N Yard Schematic

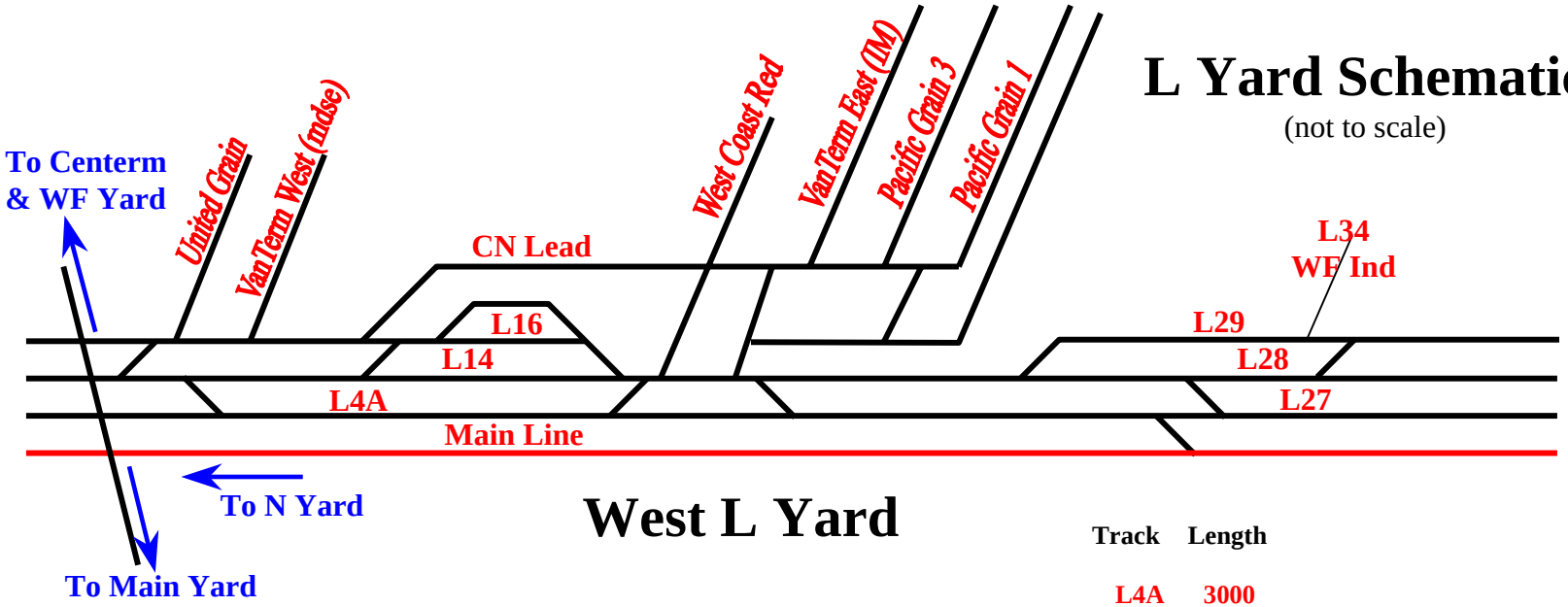
(not to scale)

Track	Length	Track	Length
1	3109	12	1080
2	1685	13	1260
3	1825	14	1535
6	460	15	1610
7	485	16	1510
8	575	17	1640
9	815	18	2115
10	1015	19	2400
11	975	20	2580



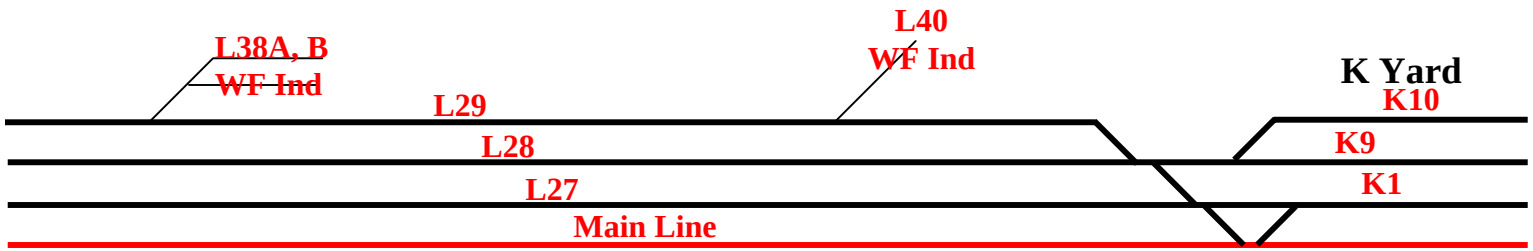
L Yard Schematic

(not to scale)



West L Yard

Track	Length
L4A	3000
L14	975
L16	650
L27	5600
L28	5380
L29	4300



East L Yard