Appendix G

Freight Rail Impacts

TECHNICAL MEMORANDUM

From: Dave McKenzie, PE, SEH

To: Gavin Poindexter, URS

Topic: Potential Impacts to Freight Railroads – Detailed Definition of Alternatives

Date: June 18, 2013

1.0 Introduction

The proposed Nicollet-Central transit Improvement alignment crosses existing freight railroad tracks at four locations. Three locations are currently grade separated and one is an at-grade crossing.

Table 1: Freight Railroad Crossings

CROSSING	RAILROAD	POSITION
Central @ 8th Street SE	*BNSF*	*Roadway over*
Central @ Broadway NE	*BNSF*	*Roadway over*
Central @ 14th Ave NE	*BNSF*	*Railroad over*[1]
Central @ Comubia Pkwy NE	*CP RR*	*At grade*

[1] Bridge #27236 and roadwork under the bridge is scheduled to be replaced in 2014 and the general vertical clearance will increase from 14'-7" to 16'-4".

2.0 Track Crossing Issues

There are two areas of consideration when addressing how modern streetcars and buses interact with freight railroads. The first is the potential impact to operations and the second is related to construction and engineering details.

Enhanced bus service equipment is similar to regular bus service except that the buses are 60 ft. articulated verses the 40 ft. buses currently used in the corridor. This should not provide any additional issues to the railroad crossings from a construction perspective.

2.1 Potential Impacts to Operations

Grade separations generally do not have major impacts to long-term operations of either freight rail or transit system.

An at-grade crossing has the potential for major disruptions of the streetcar or bus schedules. The freight train would have the priority and their schedules can be random.

The existing crossing near Columbia Pkwy has eight freight trains per day at speeds up to 30 miles per hours (mph) and train length that regularly exceed 6,000 feet. Because of the rail yard just southwest of the crossing, very few trains reach the 30 mph across the track; 10 mph is a more typical speed through at this location. As an example,

a 6,000-foot train going 10 mph would require almost 8 minutes to cross the crossing (6.8 minutes plus 1 minute for signal activation). It is not unusual at this crossing for traffic to be blocked for 10 or more minutes.

The proposed 7.5-minute peak frequency for the enhanced bus service or streetcar may be impacted at the Columbia Pkwy at-grade crossing if a freight train is crossing. The potential traffic queue may be up to two enhanced buses if a freight train occupies the crossing for more than 7.5 minutes. A grade-separated crossing is assumed for streetcar (see Section 2.2.3 below) due to the complexities of an at-grade crossing for two rail lines.

2.2 Potential Impacts during Construction

2.2.1 Grade Separation – Roadway Over (between 8th St. and Spring St. and Broadway Ave.)

Construction impact for bridges over railroad tracks is dependent on how much bridge updating needs to be done. In most instances, the railroad impact would be limited to the railroad providing flagging during construction work is going on to prevent objects or equipment from falling on the tracks or creating a safety issue. A standard flagging agreement would be needed.

2.2.2 Grade Separation – Railroad Over (between 14th Ave and 18th Ave)

There are less construction impacts for railroad bridges over the roadway are less but care also needs to be taken so the railroad bridge is not impacted. During design coordination with BNSF RR and MnDOT will be required to ensure proper clearances are provided. In addition, if any supports will need to be attached to the structure, it would likely require a permit from BNSF RR.

Vertical clearance is normally an issue. MnDOT's standard vertical clearance under a bridge is 16'4". With modern streetcar operating in mixed traffic such as proposed in concept in this planning study, additional analysis is needed to determine how to conform to applicable regulations. This consideration is applicable to the BNSF freight railroad bridge over Central Avenue at 14th Avenue NE, which is programmed for reconstruction in 2014. Generally, the existing vertical clearance will be increased from 14'-7" to 16'-4". Specifically, modern streetcar with an overhead contact system operating in mixed traffic requires sufficient clearances to also allow for a tractor-trailer to pass under the wires. A preliminary analysis of this condition is documented separately as *General Traffic Clearance Allowances due to Streetcar Overhead Wires, Appendix A*.

2.2.3 At-Grade Crossings (near Columbia Pkwy)

At grade crossing of streetcars and freight railroad tracks is possible but requires special trackwork and signal design considerations. Freight tracks use the rails part of the electric loop for track and crossing signals. To allow streetcar to operate within the freight track would require a sophisticated system to eliminate the interference between the two rail systems.

The trackwork would require a railroad diamond to allow the tracks to cross. These are special fabricated units that are unique to each installation. Adding to the complexity is that these railroad diamonds would be in the roadway; as a result, maintenance of the diamonds would likely require specialized agreements and procedures.

Enhanced bus service would not require any special construction features at an at-grade crossing.

The only existing at grade crossing is near Columbia Pkwy NE. The Canadian Pacific Railroad (CP RR) operates about eight freight trains per day over the crossing with no scheduled time, and they would take priority over the traffic on Central Avenue. For purposes of the Nicollet-Central Alternatives Analysis, it is assumed that grade separation of streetcar and the CP track would be required to avoid impacts on either system's operations. This assumption is reflected in the capital cost estimate for the 9.2-mile modern streetcar alternative.

3. Summary of Findings

Based on the preceding high-level analysis, following is a preliminary assessment of potential impacts of the Enhanced Bus and Modern Streetcar alternatives on freight railroads currently operating within the Nicollet-Central corridor:

- Enhanced Bus: Implementation of enhanced bus service will not differ significantly from bus service today. Therefore, there are no anticipated changes or impacts to freight railroads associated with this alternative. However, buses would continue to encounter significant delays when freight trains are crossing the at-grade crossing near Columbia Pkwy.

- Modern Streetcar alternatives: In the case of both the BNSF railroad overpass at Central Avenue and 14th Avenue NE and the CP at-grade freight crossing at Central Avenue near Columbia Parkway, there are feasible engineering solutions to address the operating requirements associated with each of the two locations. Several options are proposed for the BNSF overpass and a grade-separated crossing is assumed at the existing at-grade crossing near Columbia Pkwy. Therefore, there are no anticipated impacts to freight operations associated with the modern streetcar alternatives. The impact of addressing the operational requirements of freight and streetcar are reflected in the capital cost estimates, identified and documented under separate cover.

Appendix A: General Traffic Clearance Allowances due to Streetcar Overhead Wires

TECHNICAL MEMORANDUM

From: Mark Dorn, PE

To: April Manlapaz

Topic: General Traffic Clearance Allowances due to Streetcar Overhead Wires

Date: June 17, 2013

Existing/Proposed Conditions

The railroad overcrossing of Central Avenue, just north of NE 14th Avenue, currently has a vertical clearance of 14'-7". In 2014, MnDOT is planning to reconstruct the railroad bridge and Central Avenue which will increase the clearance to approximately 16'-4".

Proposed Design

The streetcar alternative for the Nicollet-Central Corridor is proposed to run under the railroad bridge. Typically, a modern streetcar is powered by an overhead wire known as an overhead contact system (OCS). Recently, some new streetcar systems are being implemented using a hybrid vehicle that can run for limited distances under battery power and without overhead wires. Assuming the Nicollet-Central streetcar has a traditional "wired" streetcar technology, the proposed OCS wire will need to run under the Central Avenue railroad bridge structure. The wire will more than likely need to be attached to the underside of the bridge structure using a 9" to 10" deep bracket. This will leave a total clearance from the OCS wire to the driving surface of approximately 15'-7".

Consideration

Typically, the OCS wire for a streetcar is designed to be a minimum of 18' over a roadway surface that is used by general traffic. The controlling document, NESC Table 232-1 -- Vertical clearances of wires conductors and cables above ground, roadway, rail or water surfaces, requires: "Trolley and electrified railroad contact conductors and associated span and messenger wires – 0 to 750V to ground above roads, streets, and other areas subject to truck traffic is 18.0 ft."

Several exceptions are allowed to the dimensions shown in the table, and the two exceptions pertaining to the Nicollet-Central alignment are:

Exception (1) states: Where subways, tunnels, or bridges require it, less clearance above ground or rails than required by Table 232-1 may be used locally. The trolley and electrified contact conductor should be graded very gradually from the regular construction down to the reduced elevation.

Exception (5) states: In communities where 16 ft has been established for trolley and electrified railroad contact conductors 0 to 750V to ground, or 18 ft has been established for trolley and electrified railroad contact conductors exceeding 750V, or where local conditions make it impractical to obtain the clearance given in the table, these reduced clearances may be used if carefully maintained.

The controlling document for trolley and electrified railroad contact conductors and associated span and messenger wires – 0 to 750V to ground above roads, streets, and other areas subject to oversize trucks traffic is the mechanical and electrical component per NESC Appendix A, Table A-1, which must be added to the height of the maximum allowable height of a vehicle (truck). The mechanical component NESC Appendix A, Table A-1 includes the clearances for rigid/non-rigid clearance and grounded, insulated/bare, ungrounded clearance.

In this case, the trolley and electrified railroad contact conductors and associated span and messenger wires are treated the same as an open supply conductor 0 to 750V. The mechanical component per NESC Appendix A, Table A-1 is 2 ft. The electrical component NESC Appendix A, Table A-1 is 0.5 ft. Therefore, the minimum clearance required by the NESC for trolley and electrified railroad contact conductors and associated span and messenger wires with the largest final sag condition - 0 to 750V to ground per NESC Rule 232A, above roads, streets, and other areas subject to oversize truck traffic is 2.5 ft above the height of the maximum allowable vehicle (truck).[1] In other words, with the support bracket holding the wire (say 9") and the required 2.5' of clearance from the OCS wire, the maximum height of a vehicle (truck) that could travel on Central Avenue under the railroad overcrossing will be between 13'-1" and 13'-6". Final clearances will need to be determined during final design and will need to account for the appropriate calculations for the sag of the wire due to expansion at the maximum temperature. The largest final sag condition of the trolley and electrified railroad contact conductors per NESC Rule 232A, calculations are performed for the conductor at 120^{o} F with no wind.

Potential Design Resolutions

There are several options to consider and should be decided when a potential streetcar project advances into design development:

- Restrictions for over-height vehicles – Depending on the final design configuration and the resultant clearances, it may be necessary to restrict vehicular traffic that is higher than 13.1 to 13.5 feet in this segment of Central Avenue (or in the specific streetcar lane).

- Dedicated streetcar-only lane – Removing general traffic from the streetcar lane may be a simple solution which allows for streetcars to pass under the railroad bridge and removes the potential conflict with the OCS wire by segregating general traffic operations from the streetcar infrastructure. Potential traffic capacity concerns and traffic signing/channelization treatments would need to be addressed during the early phases of project implementation.

- Dedicated streetcar-only (single-track) – If maintaining the same capacity for traffic (i.e. the same number of general traffic lanes), it is possible to provide for a single (exclusive) streetcar-only lane under the railroad bridge. This would create a single-track operation which could have some effect on the planned streetcar service by creating a potential operating constraint for streetcars traveling under the bridge. However, this might be mitigated by minimizing the length of the single-track segment, and modeling the streetcar operations to create a schedule so the streetcars traveling in opposite directions do not meet at this point. Figure X [TO BE PROVIDED SEPARATELY] shows the potential section for a single-track operation under the railroad bridge.

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[1] Per MnDOT, a permit is required for *any* vehicle over 13'-6" in height.

- Hybrid streetcar vehicle – Being able to operate a battery-powered (hybrid) vehicle for limited distances is feasible which would eliminate the need for OCS wires. A proposed streetcar could run on wireless operation between stops on either side of the railroad bridge, thereby removing the potential conflict with the OCS wires. However, this option would require that the entire streetcar fleet be composed of hybrid vehicles and add a significant capital cost. Another consideration is that this streetcar vehicle technology is new to the United States; at this time, there are none currently in operation, although there are two U.S. cities that that will use hybrid streetcars. They are Seattle First Hill (in construction) and Dallas Oak Cliff/Union Station (in design).

- Sectionalized OCS wires in vicinity of railroad overpass – It is feasible to create an isolated (sectionalized) segment of the OCS design which energizes the overhead wire only when a streetcar is present in the vicinity of the Central Avenue railroad overpass, and de-energizes the wire once the streetcar has passed under the bridge. This potential solution would significantly reduce the risk of a potential conflict between over-height vehicles contacting the OCS wire and could be used in combination with vehicle restrictions/permitting. To date, there has not been an application such as this for an OCS system. This option would have to be explored further in the early phases of design to determine if it is indeed a practical solution.