CIVIL DESIGN INC
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February 17, 2014

ENGINEERING REVIEW OF FREIGHT REROUTE PROPOSED BY TRANSYSTEMS

Civil Design, Inc. (CDI) has been retained by the Twin Cities and Western Railroad (TC&W) to provide technical assistance in its discussions with the Metropolitan Council (Met Council) for freight rail issues relating to the Southwest LRT. CDI first became involved in this project with the review of a plan dated December 2010 entitled "MN&S Freight Rail Study". Since that time, we have reviewed any number of plans, many that have similar looks and designs, most with the intent of rerouting the freight railroad through St. Louis Park on the MN&S line owned by the Canadian Pacific. The most current plan is a derivation of the October 2012 DEIS plan and was prepared by Transystems with a date of January 23, 2014. It is therefore appropriate to refer to the comments in Appendix A of the TC&W "Response to the Southwest Transitway Draft Environmental Impact Statement". Transystems was retained by the Met Council to provide an independent review of the freight relocation. CDI received the Transystems plan on January 24, 2014.

In our response to the Draft Environmental Impact Statement (DEIS), we submitted an Engineering Review (Appendix A) of the plan proposed with the DEIS and pointed out many deficiencies in the proposed plan. It must be understood that any relocation proposal, once accepted by the railroad, would be permanent and unaltered, likely for the rest of eternity. Consideration of any design must take into account changes occurring in the industry relating to train operations and size. For example, 20 years ago, most trains were limited to under 100 cars in length. Today the class 1 railroads are specifying designs for trains in excess of 120 cars in length.

In the NATIONAL RAIL PLAN, published by the US Department of Transportation, Federal Railroad Administration on September 2010, the opening statement in the Introduction states:

> "The United States and world economies are experiencing an increased demand for rail. Expanding US passenger and freight mobility will require a networked railroad system that is able to modernize and increase capacity"

The plan further suggests that freight rail will ship 2.8 Billion more tons of freight in the next 25 years and 4 Billion more tons of freight in the next 40 years. The FRA's highest priority continues to be the safety of the Nation's railroads, its users and its employees. There are two main goals of the National Rail Plan.

1. Support the current freight rail market share and growth.
2. Develop strategies to attract 50 percent of all shipments 500 miles or greater to intermodal rail.

The plan states "The performance and costs of our freight transportation systems are important ingredients in the comparative advantage of the United States when competing with other economies. Although speed and reliability are important measures of our freight system's performance, other

measures, such as safety security, fuel efficiency, and external costs such as GHG emissions, are also important public concerns."

The plan offered by Transystems is contrary to all of the goals stated in the National Rail Plan. This plan is neither efficient, safe nor cost effective when compared to the TC&W's current route.

When meeting with Transystems about their proposal, we were told that their proposed alignment is perfectly fine since there were many locations where trains were traversing similar alignments. Transystems has provided a couple of situations where they feel the alignments are similar. Although there may be some similarities, they are not the same. These alignments have been in place since the 1900's or before, when long trains consisted of 20 cars. Certainly no railroad would accept such an alignment today if there were any other choice. In fact, the Canadian National standard for horizontal curves in a mainline track is that the curve be not greater than 30 minutes. The Canadian Pacific does not have a written standard but would not allow a five degree in a mainline track given a choice and stated in a discussion that "their preferred option is the status quo". In other words, they would prefer that the TC&W not be routed onto the MN&S. Compliance with AREMA simply refers to the specifications for rail construction and does not really address the overall safety or operations of the railroad. These parameters are railroad specific and vary between railroad companies.

The current Kenilworth alignment is significantly better than the proposed Transystems alignment. If the TC&W accepts an alignment other than its current alignment, it should be as good or better. It would not be fair to the current and future customers of the TC&W to introduce a problematic alignment to replace a trouble free alignment, nor would it be good practice from a safety perspective. The proposed alignment by Transystems is certainly not close to an equivalent route through the Kenilworth alignment. Considering that Transystems is purported to be an expert in railroad design, had they performed an analysis of power requirements, maintenance and safety, they would have easily proved this.

Transystems is also proposing CTC (Centralized Traffic Control) signaling of the proposed alignment. Since the route proposed by Transystems requires the TC&W to enter track owned by the Canadian Pacific (CP) and also the BNSF, the TC&W trains must wait for access rights from the controlling railroad before entering their track. In theory, this is a good idea from a train management perspective. However, the proposed alignment would require access rights from both railroads at the same time before entering. In all likelihood, the TC&W trains will be waiting a long time for this to occur since the controlling railroads will be serving themselves first with the TC&W receiving only secondary consideration. The CP and BNSF tracks are seeing more and more traffic that will create additional congestion on these lines leading to increased delays, increased operating costs and problematic issues with crew management. It would be conceivable that the TC&W train could sit and idle, waiting for access and have the crew's hours of service expire (end of their allowable on duty time) before receiving access. Thus when access is granted, the train would not be able to proceed without changing the crew, causing additional delays and expense to the TC&W.

The TC&W, while being a shortline railroad, interchanges with three Class 1 Railroads in St. Paul: BNSF, Canadian Pacific and Union Pacific. In order for TC&W's customers to participate in the North American freight rail marketplace, the mainline track structure and the customer's facilities must comply with the Class 1 Railroad's standards, of which they currently comply. The proposed alignment by Transystems does not comply with any of the three Class 1 railroad's mainline standards for new construction.

The train sizes on the TC&W are typically dictated by the originating carrier, or the Class 1 railroad that provides the cars and locomotives for TC&W customers, since the equipment is owned by the Class 1 railroad. Once the train reaches the TC&W track, TC&W and its customers are then ultimately responsible for the safety of the train and the timeliness of its return. Thus, any delay of the train on TC&W track either due to operations or track condition, is ultimately an economic hardship for TC&W customers. Class 1 railroads will impose penalties on the customer and the TC&W for delay in delivery of trains. For this reason, the TC&W must carefully consider all implications that change operations, timing, safety and the total cost of operating trains on their line.

An analysis of the Transystems plan concludes that the alignment is basically the same as that proposed in the DEIS with some minor modifications. As pointed out in our analysis of the original DEIS, the 2003 AREMA "Practical Guide to Railway Engineering" points out many hazards associated with extreme curvature, reverse curvature and undulating grade. This publication summarizes as follows:

> "…. reversing curves should be avoided at all costs. With reverse curves, there are two dynamic components acting on a single car or rail vehicle causing a yawing effect, which is of concern. . . . The net effect is a couple about the center of the car. This compares to a car on a single curve where the forces at either end of the car are acting in the same direction and thus counter-acting one another. This couple effect greatly increases the likelihood of the train buckling and thus a derailment."

The proposed plan includes three reversing curves in a distance of about 5,000 feet. This exact situation was addressed in Appendix A of the Draft DEIS. A train of 120 cars will measure approximately 7700 feet thus placing three reverse curves through the train. In fact, the lead locomotive will be just entering the existing Bass Lake Alignment when the end of the 17,000 ton train is at 28th Street. Although compensated grades in this plan are better than those proposed in the DEIS alignment, the proposed profile includes seven changes in grade in a length of 16,183 feet (3.06 miles). The maximum compensated grade for west bound trains is 0.98% and the maximum compensated grade for east bound trains is 0.67%.

Curves, especially sharp curves, are a maintenance problem for all railroads. Rail life is severely impacted on any curve over two degrees and the useful life is shortened based on tonnage and speed. Excessive effective grade will cause an increase of wheel burns to the rail, which will lead to an increase in web/head fracture or broken rail. The low rail is flattened particularly when the rail is traversed at slow speeds and underbalance imposes more car weight over the low rail. The high rail is abraded as the truck attacks the high rail as it is steered around the curve. AREMA indicates that wheel tread will generally guide the rail vehicle on curves up to three degrees before flange/rail contact begins to

regularly occur (thus significant curve wear of rail head begins). The proposed curves are five degrees so there would be substantial rail head wear expected.

Super-elevation (inside rail is lower than the outside rail) is required to keep cars balanced and the speed of the train will create a centrifugal force that will try to keep the cars on a straight line. By introducing super-elevation, the force on the track is more balanced between the rails. However in sharp curves, the amount of super-elevation required to counteract the centrifugal force becomes more substantial. Although the compensated grade for the proposed curves is under 1%, the sharp curves will require some super-elevation to avoid excessive wear on rails.

To maintain this super-elevation is very costly. Failure to do so creates a hazardous condition where cars could overturn on the outside of the curve. Additionally, having a sharp curve on a bridge introduces safety issues related to public and railroad safety. Because of the safety concern, the FRA (Federal Railroad Administration) requirements for surface and alignment in a curve are much more stringent. For reference see FRA 213.55 and FRA 213.63.

Analysis of the vertical curves at the changes in grade reveals three problem areas. At Station 194+53.90, there is a sag vertical curve with a rate of change in grade per station of 0.32, more than three times the maximum allowed by BNSF standards, which is 0.10 for vertical curves in a sag. Rapid changes in grade can lead to decoupling or damage to couplers. At Station 217+83.53 there is a 200' crest vertical curve just west of the bridge over Minnetonka Blvd with a rate of change in grade per station of 0.40 which is twice the allowable rate of change per station of 0.20 for crest vertical curves. At Station 260+83.09 there is a sag vertical curve where the new alignment begins to parallel the current BNSF with a rate of change in grade equal to 0.40. This is four times the allowable rate of change of 0.10.

Looking at the south turnout profile, there are concerns with the rate of change of curves similar to that indicated above. At Station 105+66.11 there is a 200' crest vertical curve on the top of a bridge where the rate of change in grade per station is 0.15 with an allowable rate of 0.10. This particular curve applies also to the north bound grade as well. At Station 160+16.16 there is an 800' crest vertical curve on the top of the bridge where the rate of change per station is 1.06 which is more than five times the allowable rate of 0.20.

The typical section indicated along the MN&S indicates a retaining wall along the west side of the railroad at about 17' from the railroad centerline with a relatively steep grade along the east side where the typical section shows up to 115' of right of way from the centerline of track. Since this section is through a heavy residential area, access to the track except by highrail equipment will be difficult. Recommended practice would dictate that the retaining wall on the west be placed at or very near the edge of the right of way and extending the east side of the grade to allow for a maintenance road.

The typical section shown on sheets 2 and 4 of the proposed plan indicate a barrier at 20 feet from centerline of the Proposed TC&W Track 2 South Wye Segment. If the other deficiencies in the Transystems plan were somehow overcome, and this option were somehow implemented, then we

would recommend that this barrier be extended to 26 feet and reduce the proposed distance between the potential SWLRT Track 2 and the south right of way to 20 feet. This allows more room for maintenance of the freight track.

The proposal from Transystems includes a substantial length of track on bridges. There are several components related to track on bridges that are cause for concern. First, the cost to maintain track on bridges is quite substantial, and track on curved bridges is worse yet. Second, the long term maintenance of the structures themselves is an extreme burden. Third, the ability of the railroad to work on the bridge should there be a derailment or a problem with a train is hindered due to the access on these very long structures. In fact, the distance between the electrical substation and the Sam's Club is about 85 feet, making any type of access except by railed equipment virtually impossible. The TC&W currently has no cranes or equipment to address these issues.

TC&W has worked long and hard, collaboratively with the Met Council engineers to find an acceptable re-route. After considerable working and re-working, an alternate re-route was developed that would function at a physics, engineering and safety level (the high berm option) to the general satisfaction of the TC&W. With this alternative (the high berm option) for a re-route and the option of co-location of freight and the SWLRT, there are two alternatives which could work for freight (high berm relocation or collocation).

The proposed alignment by Transystems is by no means an improvement in the operating conditions for the TC&W over its current alignment. In fact, the operating conditions proposed by the Transystems alignment would be detrimental in every respect to current and future operating conditions for the TC&W. If the TC&W were to accept the Transystems alignment, the TC&W will become less efficient, increase operational expenses by delays in their deliveries, increase maintenance expenses, increase costs to its customers, decrease safety and ultimately threaten the long term viability of the entire transportation system on which it operates. We have addressed specific issues with the alignments that are safety and operational hazards and good reasons for avoiding the proposed Transystems alignment. The alignment proposed by Transystems would impose unreasonable restrictions on the TC&W. CDI would therefore recommend that the TC&W reject this proposed alignment in lieu of its current alignment or other acceptable alternatives.

Respectfully,

Carey Bretsch, PE
President