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June 21, 2013

Mr. Andy Loos/Mr. Dave Tomson
SRM Development
520 6th Street South
Kirkland, WA 98033

Subject: Google Trail Crossing
Re: Traffic Control Considerations

Dear Andy & Dave;

We have looked at ideas regarding safe and efficient at-grade crossing considerations of the railroad right-of-way/future trail for the proposed Google crossing roadway connection between the existing campus and the proposed Phase 2 campus.

The proposed crossing location of the trail will be at the south end of the existing campus and provide connection of Phase 2 to 6th St S; at the existing south Google driveway. The distance from the railroad tracks to 6th St S is approximately 570 feet. The distance could store approximately 23 vehicles.

From the traffic study for Phase 2 currently in SEPA submittal, there are currently 98 vehicles entering the south driveway in the AM peak (for Phase 1), and with Phase 2, it is estimated there would be 199 vehicles entering total. Hence, about 100 vehicles during the AM peak will cross the trail westbound to the Phase 2 garage. In addition, approximately 20 vehicles from Phase 2 in the AM peak would cross the trail eastbound. The estimated daily vehicular volume across the trail is about 840 vehicles/day. The peaks will be in the AM and PM street peak hours, with volumes around 100 vehicles/hour in the peak direction.

For trail use, the interim trail design will be gravel, thus it is expected that the usage will be relatively low. With the ultimate completion of the trail, usage is expected to be much higher with a multitude of non-motorized user types. The *King County Regional Trail Inventory and Implementation Guidelines July 2004* suggests that about 75% of the users will be bicycle. Our preliminary estimate of bike and pedestrian traffic for a long range forecast is 600 bikes (500 peak direction) and 100 pedestrians (50/50 split direction) which we believe is a very overly conservative estimate. We obtained 2030 forecasts on the Burke-Gilman Trail from a recent UW study, as well as peak bicycle trail use information from PSRC. Both would suggest the trail usage estimates used herein are overly conservative. Weekday daily volume activity for bikes is estimated to follow similar patterns as office peaks, with the busiest times in the AM and PM commute

peaks. Pedestrian activity for the average weekday is estimated to be low in the morning and increase throughout the day.

Weekend trail use could be similar or even higher than weekday use, however, the vehicle trips at Google are estimated to be significantly less to non-existent.

For long range consideration, 2030 horizon era, it is estimated that the trail use will be significantly higher than the number of vehicles using the road crossing.

Trails crossing streets have typically had stop signs facing trail users, without consideration of relative volumes of traffic. More recently, trails with higher volumes of traffic than the streets they cross have reversed the right-of-way, turning the stop signs towards the route with the least traffic, even if that is a street used by motor vehicles. This reversal of right-of-way is being implemented on the King County section of the Trail in Lake Forest park as part of a larger trail upgrade project.

In regards to assignment of right of way, the *King County Regional Trails System Development Guidelines DRAFT February 2009* notes that best engineering practices should be used to assign appropriate right-of-way at intersections. These practices include volume, speed, and road classification to identify the safest method. Volume, speed, and road classification should not be the only criteria to consider. The comfort and convenience of the trail user, and the unique behavioral characteristics of the trial user and motorist alike, must also be considered. Regarding behavior, it must be recognized that some trail users may have:

1. Very low delay tolerance
2. A strong desire to maintain momentum
3. Little traffic knowledge (particularly children); and
4. Sometimes a “regulations don’t apply to me” mentality.

Assigning incorrect priority or being overly restrictive in an attempt to protect the trail user, however can lead to confusion and unsafe practices by both trail users and motorists, increasing conflict potential.

The *AASHTO 1999 Guide for the Development of Bicycle Facilities* recommends that a regulatory traffic control device be installed at all path-roadway intersections. There are three options:

- Traffic Signals -- Traffic signals for path-roadway intersections are appropriate under certain circumstances. The MUTCD lists 11 warrants for traffic signals, and although path crossings are not addressed, bicycle traffic on the path may be functionally classified as vehicular traffic and the warrants applied accordingly.

Warrants from the MUTCD combined with sound engineering judgment should be considered when determining the type of traffic control device to be installed.

- Stop Signs -- Stop signs should be placed as close to the intended stopping point as possible, and should be supplemented with a stop bar, either for the road or the path. <u>Four-way stops at path-roadway intersections are not recommended because of frequent confusion about or disregard for right of way rules.</u>

- Yield Signs – These may be acceptable at some locations, such as low-volume, low-speed neighborhood streets. Sign type, size and location should be in accordance with the MUTCD. Care should be taken to ensure that shared use path signs are located so that motorists are not confused by them, and that roadway signs are placed so that bicyclists are not confused by them.

Signal warrants were evaluated for Warrant 3, the Peak Hour Warrant, and were found not to be met. Nor does the intersection meet the pedestrian peak hour warrant. Both attached.

A queue analysis was conducted for the AM peak hour condition with a signal at the trail crossing and with a stop sign. The signal operation assumed a typical 3-section signal head (red/yellow/green) for both roadway approaches, and a pedestrian hand/man signal for the trail approaches. The test assumed vehicle detection for the roadway with a 60-second signal cycle and 15 seconds assigned to the road and 45 seconds assigned to the trail. The signal would revert green (hand symbol) to the trail all times when no vehicles are detected from the road approach. It is estimated there would be a queue (95th percentile) of approximately 6 vehicles for the westbound approach. With a stop sign scenario (for only the road approaches) the westbound 95th percentile queue is estimated to be 5 vehicles for the AM peak hour. Screen prints of each are attaced.

A level of service estimate for the AM peak hour predicts an average delay of 43 seconds/vehicle (LOS D) with signal for the westbound approach, and an average delay of 23 seconds/vehicle (LO S C) with stop sign for westbound approach.

It should be noted that with a signal trail users are likely to cross the intersection against any “hand” symbol when no cars are present.

The typical design speed of a bicycle on a paved surface is about 20 mph, 15 mph on gravel. The assumed design speed of the roadway connection is 15 mph, the assumed posted speed is 10 mph. Vehicles crossing the trail will be required to stop (by either stop sign, or gate, or traffic signal) and the crossing will be an elongated speed hump (speed table) thus the vehicle speed across the trail is anticipated to be less than 5 mph. At this speed, it is assumed no serious injury accidents would occur.

The recommended design of the crossing whether it includes a signal or stop signs for the road approaches is to have a speed table for the road approach, "tabling"; ie., raising the level of the road to the higher level of the trail (typically a 6" height). In essence, this creates a "speed hump" for motorized traffic. Different pavement textures through the intersection could be used to help define the intersection area, however careful consideration should be made for bikes, scooters, in-line skates, etc. The trail as it runs through the intersection would be level throughout. In lieu of any alternate paving patterns, the intersection area could be marked with an appropriate crosswalk detail, possibly long white painted crosswalk bars ("piano bars") the full width of the trail for the road crossing.

An important concern to also consider is that all four approaches should have adequate sight distance for viewing conflicting motorized and non-motorized vehicles.

Finally, appropriate signage and placement, that meets the MUTCD and AASHTO guidelines design, adds predictability and easier interpretation of expected conditions and regulations on the trail. The disadvantage of restrictive signage as the primary control of the trail approach at intersections is that they are difficult to enforce in the trail environment.

We recognize that Google may wish to construct traffic control features that provide extra enforcement and enhancement to the crossing which if acceptable to the City is acceptable to us. However, our recommendation is that the road approaches be controlled by stop signs along with other appropriate signage and speed table for the initial construction. We would suggest that a target value of number of bikes per hour (to be determined) be identified and at which time that target value is met, then the crossing be supplemented with signal and crossing gate features.

Very Truly Yours,

Bill

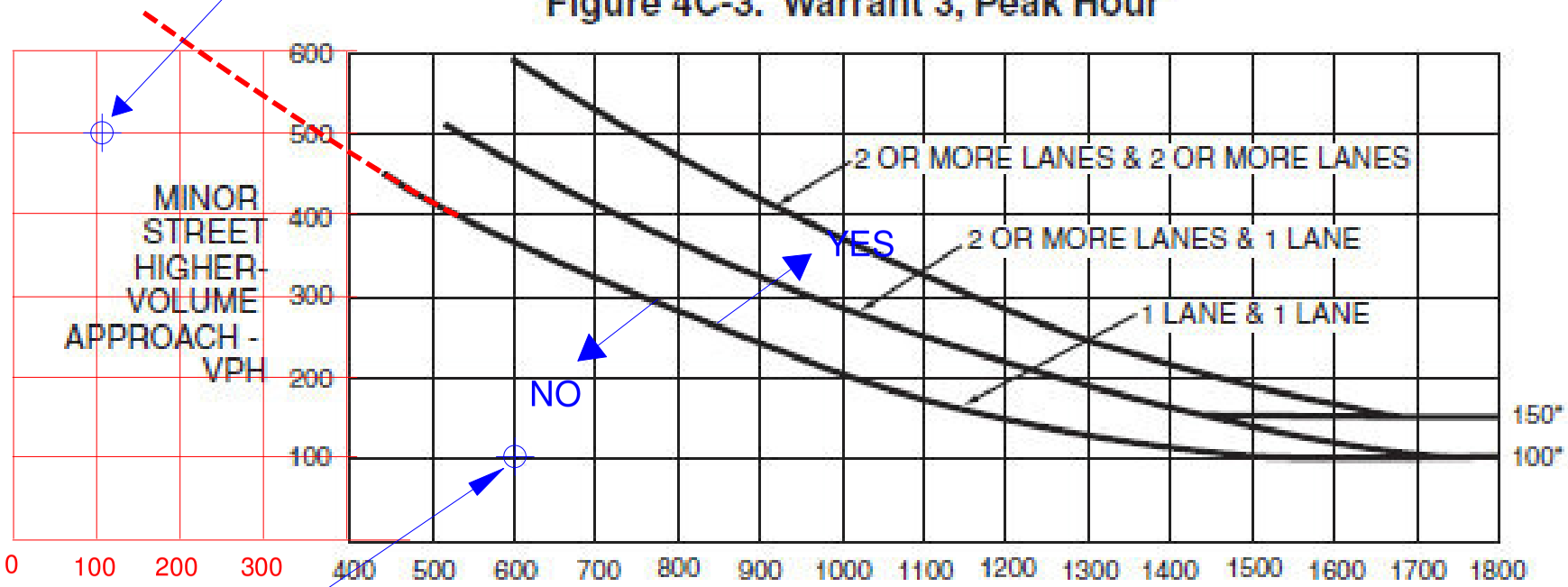
William E. Popp, Jr.
William Popp Associates

Attachments:

1. Signal Warrant 3 – Peak Hour Warrant (vehicles and bike equivalents)
2. Signal Warrant 4 – Pedestrian Peak Hour Warrant
3. Stop Sign simulation screen print (to show trail crossing)
4. Signal simulation screen print (to show trail crossing)

if we switch the major and minor street assumptions

Figure 4C-3. Warrant 3, Peak Hour



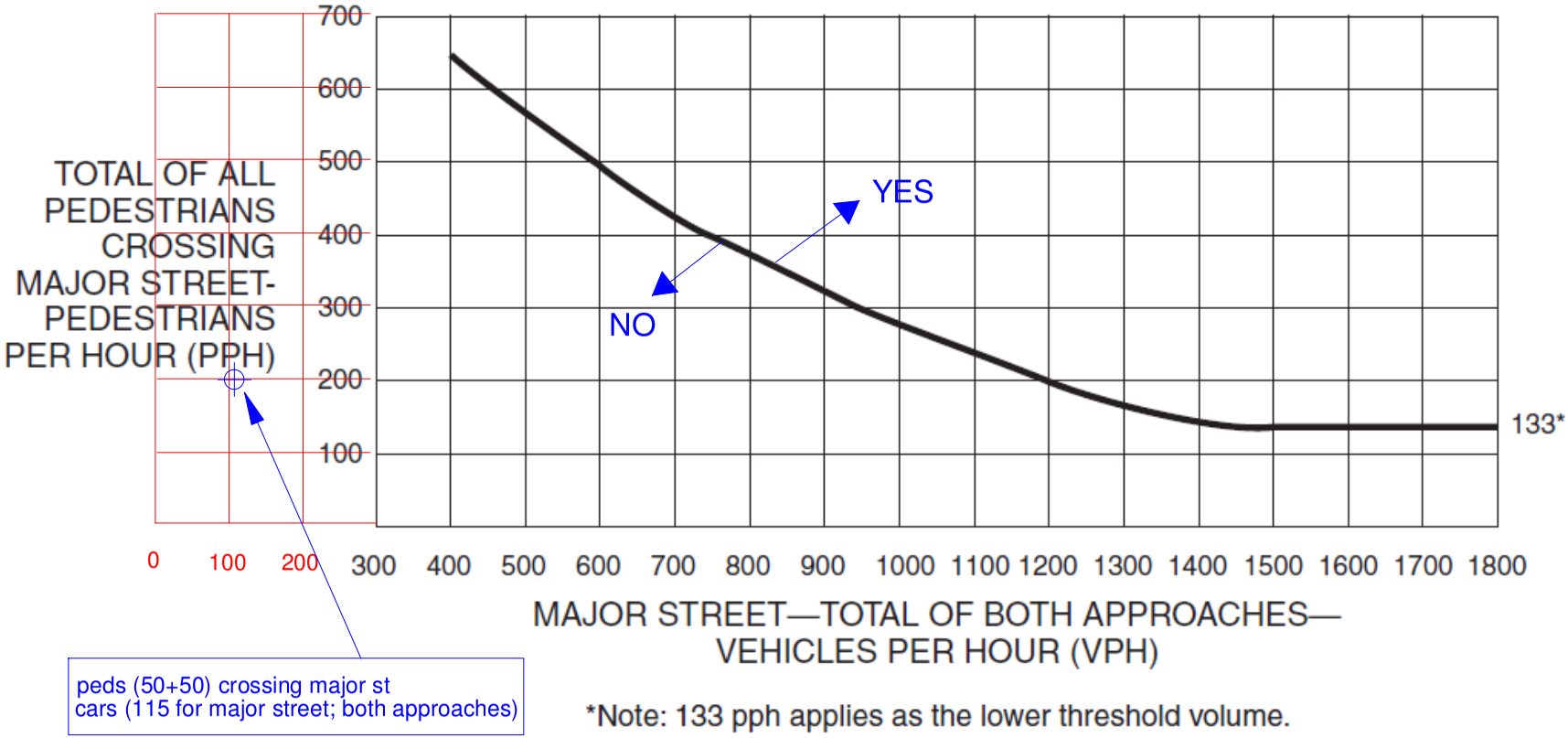
bikes (500+100) major st
cars (100 for minor street; peak approach)

MAJOR STREET—TOTAL OF BOTH APPROACHES—
VEHICLES PER HOUR (VPH)

*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

ATTACHMENT 1

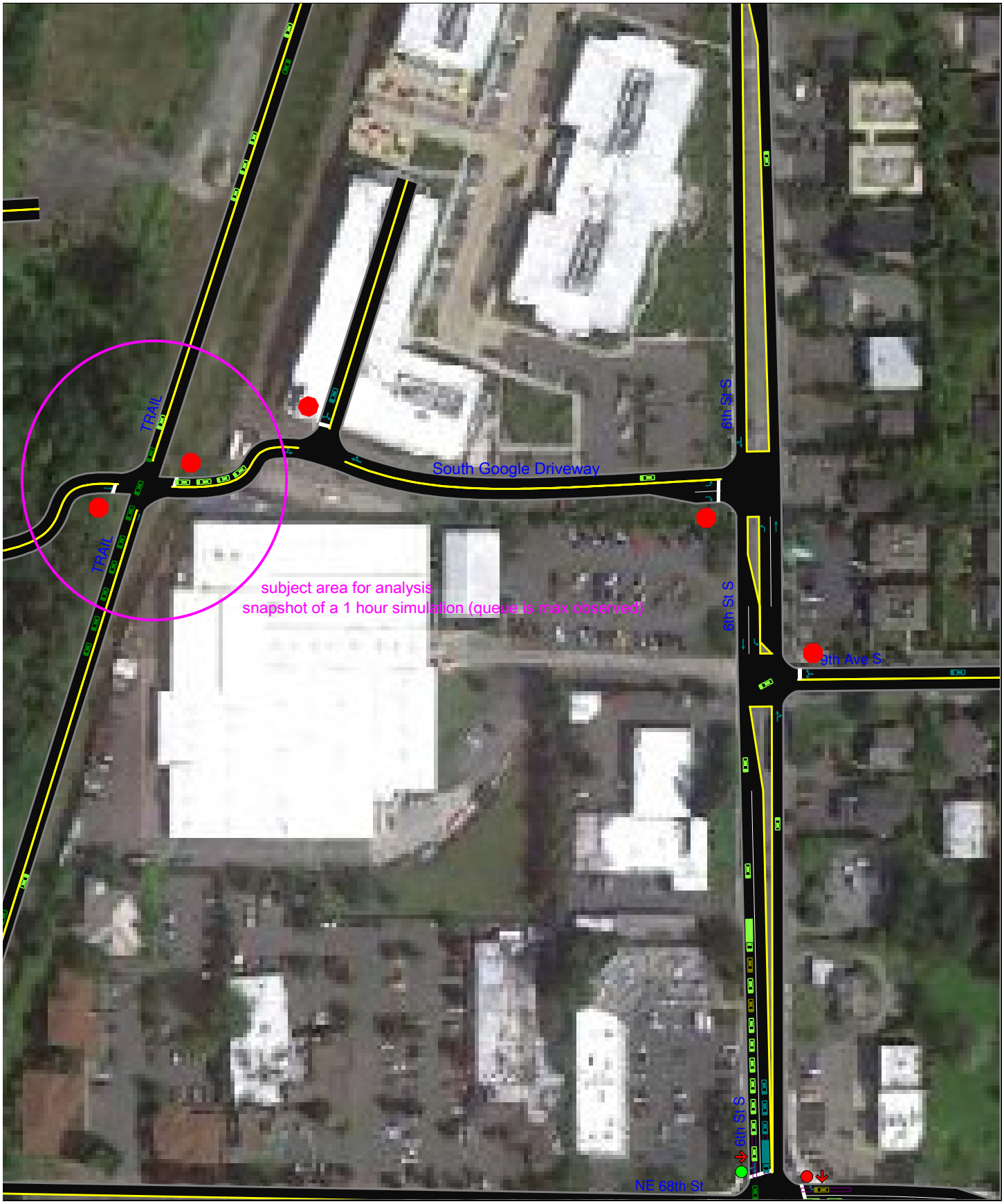
Figure 4C-7. Warrant 4, Pedestrian Peak Hour



*Note: 133 pph applies as the lower threshold volume.

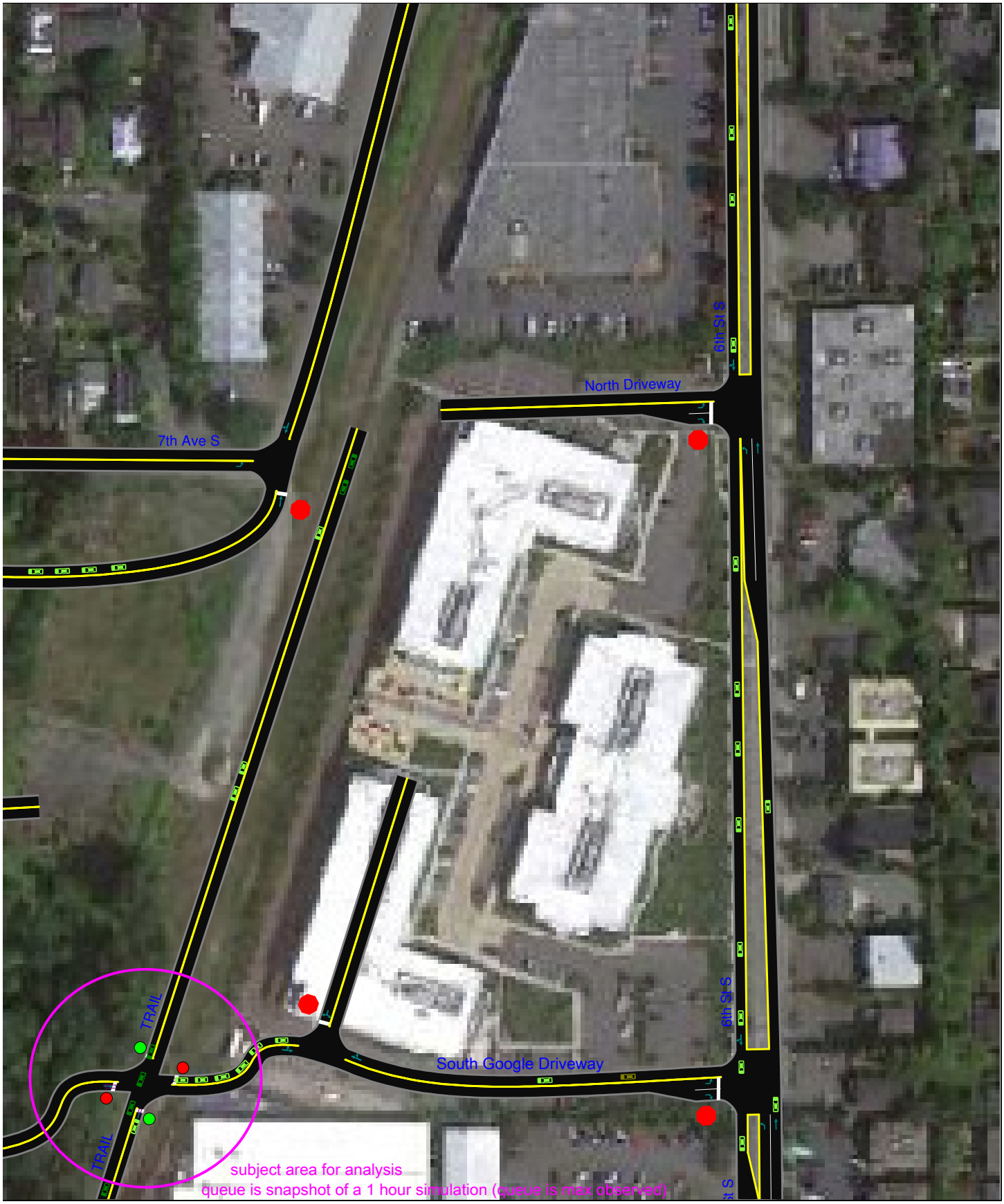
ATTACHMENT 2

6/21/2013

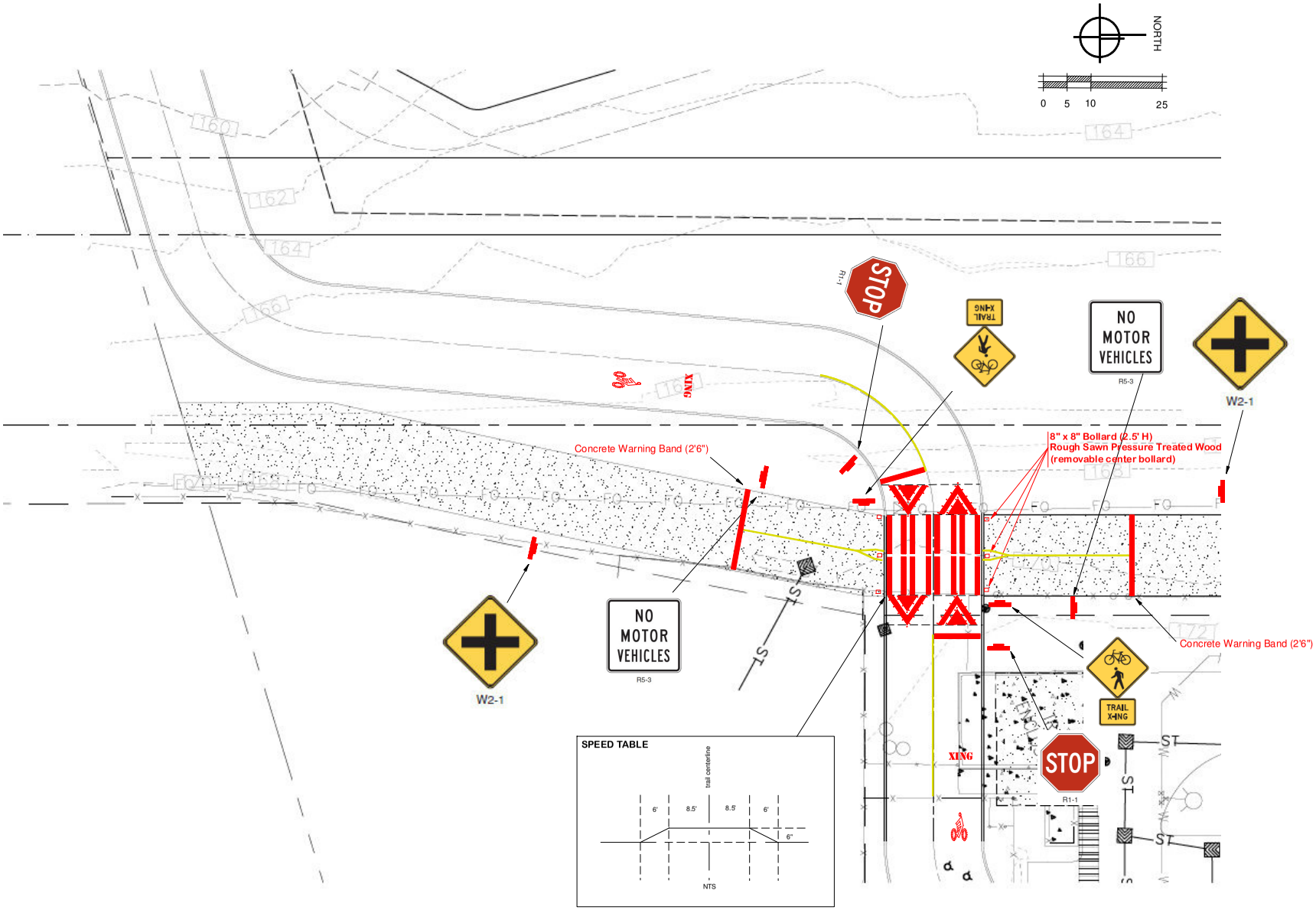


with stop sign control for road

6/21/2013



with signal control for road


NORTH
0 5 10 25
STOP
R1-1
TRAIL X-ING
NO MOTOR VEHICLES
R5-3
W2-1
Concrete Warning Band (2'6")
8" x 8" Bollard (2.5' H)
Rough Sawn Pressure Treated Wood
(removable center bollard)
Concrete Warning Band (2'6")
NO MOTOR VEHICLES
R5-3
W2-1
TRAIL X-ING
STOP
R1-1
XING
SPEED TABLE
trail centerline
6'
8.5'
8.5'
6'
6"
NTS