Tacoma Link Expansion

Geotechnical Site Investigation Plan for Preliminary Engineering Studies

Prepared for:
Sound Transit

Prepared by:
CH2M HILL

October 2015
This Proposal Has Been Prepared by a Professional Engineer
Contents

Contents ........................................................................................................................................ iii
  General.......................................................................................................................................... 1
  Purpose and Scope of the Geotechnical Site Investigation Program ........................................ 1
  Location of Geotechnical Activity ................................................................................................. 2
  Description of Geotechnical Explorations .................................................................................. 2
    Soil Drilling and Sampling ........................................................................................................ 2
    Downhole Seismic Testing ........................................................................................................ 3
  Exploration Support Activities ...................................................................................................... 3
  Environmental Protection ............................................................................................................. 4
    Drilling and Sampling .............................................................................................................. 4
    Downhole Seismic Testing ........................................................................................................ 5
  Schedule ......................................................................................................................................... 5
  Concluding Remarks .................................................................................................................... 5

Appendices
  A  Proposed Geotechnical Boring Locations
  B  Summary of Geotechnical Site Investigation Program
  C  Proposed Traffic Control Plans

Tables
  1  Approximate Location of Proposed Explorations

Exhibits
  1  Drilling Location with Utilities Marking
  2  Drill Rig and Support Truck (side by side)
  3  Drill Rig and Support Truck (back to back)
  4  Completed Monitoring Well Monument
  5  Seismic Geophysical Survey Equipment – Set up
  6  Seismic Geophysical Survey Equipment – Lowering Device into Installed Casing
General

The Tacoma Link Expansion Project (henceforth referred to as the “Project”) is part of the proposed Sound Transit 2 Package that is currently being considered by Sound Transit. The proposed expansion of the existing Tacoma Link system includes a 2.4-mile, double-track alignment that would continue north from the existing Theater District Station along Stadium Way to the intersection of North 1st Street and Division Avenue, then from the intersection of North 1st Street and Division Avenue to Martin Luther King Way and South 19th Street. The Project also includes the expansion of the existing Sound Transit’s Operation and Maintenance Facility (OMF) on East 25th Street in the City of Tacoma.

As part of its Preliminary Engineering studies, Sound Transit plans to conduct a geotechnical site investigation along the proposed alignment of the Project and also at the expansion of the OMF. This document provides a preliminary overview of the proposed exploration plans, in terms of exploration locations and types. It is our understanding that the scope of this proposed geotechnical site investigation relative to program implementation, communication protocols, and other requirements will be reviewed and approved by Sound Transit and the City of Tacoma.

Purpose and Scope of the Geotechnical Site Investigation Program

The purpose of the geotechnical site investigation program is to assess general subsurface soil and groundwater conditions along the proposed alignment of the Project and also in the vicinity of the OMF. Information from the geotechnical site investigation program is required for the preliminary design and/or evaluation of the following project components:

- Site geology and geologic hazards
- Subsurface profiles
- Preliminary design soil properties
- Seismicity, seismic hazards, and seismic design parameters
- Slope stability
- Foundation type and performance
- Subgrade modulus for design of at-grade tracks
- Stormwater and LID facility evaluations
- Soil resistivity assessment, and
- Construction considerations

The scope of work will involve drilling and sampling of the subsurface at multiple locations along the proposed alignment of the Project and in the vicinity of the existing OMF. In addition, downhole seismic testing will also be conducted in one of the test borings at the OMF site. The general plans for these explorations are summarized in the Appendices of this document.
The proposed work will require coordination with and approvals from the City of Tacoma and private property owner(s). These approvals will include, but not necessarily be limited to:

- Right-of-entry permits for private properties
- Street-use permits
- Traffic control plans to provide safety to the public.

**Location of Geotechnical Activity**

The proposed locations of the geotechnical borings along the proposed alignment of the Project and at the OMF site are shown in Appendix A. Appendix B provides a preliminary summary of exploration plans. As shown in Appendix A, the proposed geotechnical explorations will occur both on public and private rights-of-way. It is noted that the actual drilling locations could change by up to 50 feet depending on conflicts with buried and overhead utilities, recommendations from the City of Tacoma, or agreements with private property owner(s).

All proposed geotechnical borings are located in urbanized areas, allowing use of local streets for access to each exploration site. Site clearing and preparation will not be needed for these locations. It is also anticipated that restricted work hours or night-time work will be required for some locations.

**Description of Geotechnical Explorations**

Procedures that will be used for the geotechnical site investigation are described in the following subsections. These procedures include soil drilling, soil sampling, and downhole geophysical testing. This work will involve the use of either a truck-mounted exploration equipment at most locations; however, track-mounted rigs or skid rigs will be required in some locations due to access and site conditions.

**Soil Drilling and Sampling**

The primary exploration method will be drilling and sampling of soil borings. Currently 15 geotechnical borings are planned; however, this number could change during the site investigation program depending on the geologic conditions. Table 1 lists the number of explorations within the different properties in each segment of the work. In most locations, the exploration work will be carried out within street rights-of-way. An effort was made to avoid closure of traffic lanes to the extent possible when selecting exploration locations.

<table>
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<th>Boring ID</th>
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<tr>
<td>At-grade Track Design</td>
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<td>OMF Design</td>
<td>OMF-1 through OMF-3</td>
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<td></td>
<td>OMF-4 through OMF-6</td>
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</table>
Each geotechnical boring will be drilled from 20 feet to as much as 100 feet below the ground surface, depending on location. From start to finish, each geotechnical boring requires approximately 1 to 3 days to complete, depending on the exploration depth. The area needed to conduct the drilling activity is about two truck lengths, situated either side-by-side or back-to-back or about 600 square feet. The drill rig and support truck generally park on the shoulder of a roadway, in a parking lot, or a vacant site wherever possible.

The drilling equipment involves either a truck-mounted to track-mounted drill system. The drill system is used to advance the boring to the necessary depth by rotating an auger or drill tool into the soil. Either mud rotary or hollow-stem auger drilling methods will be used for drilling the boreholes. The boreholes will range from 4 to 8 inches in diameter. Figures 1 through 4 show photographs of a typical site before, during, and after drilling and sampling.

Soil sampling will generally occur at either 2.5-foot or 5-foot depth intervals using either a steel split-spoon sampler or a steel thin-walled sampler. In both cases, the sampler is lowered to the sampling depth inside the augers and then either driven into the soil using a rig-mounted hammer (split-spoon sampler) or pushed (thin-walled sampler) into the soil.

Groundwater monitoring wells will be installed in about a half of the proposed borings (i.e., two to three wells at the OMF site and three to five wells along the proposed alignment). The monitoring wells are used to record changes in groundwater elevation with time. Each well will involve grouting a polyvinyl chloride pipe into the drilled borehole. A flush-mounted, locking valve cover is installed at the top of the piezometer to prevent access by the public. The design of the piezometer is such that surface groundwater cannot access the monitoring system. Well development and pump test water will also be conducted at each well location.

**Downhole Seismic Testing**

In addition to drilling and sampling, downhole seismic geophysical testing will be conducted to characterize dynamic soil properties. The downhole seismic geophysical test will be conducted in one of the geotechnical borings at the OMF site during the soil drilling and sampling program. The equipment for the downhole seismic test is relative small (see Figures 5 and 6). This test will requires striking a steel beam located at the ground surface with a hammer to create seismic waves.

**Exploration Support Activities**

The exploration work described above will require other support activities. These activities will include:

- **Utility Locates**: Utility locates will be carried out for all locations involving drilling and sampling. A utility location service company will provide these services under contract to the Consultant for the project. The utility location service company will provide utility potholing and vacuum excavation at locations identified by the Consultant or at locations agreed to after discussions with Sound Transit and the City of Tacoma.

- **Traffic Control**: Traffic control services including barrier trucks, barricades, cones and barrels, lights, and signage will be required in some locations. A company specializing in traffic control
will provide these services under contract to the Consultant. Traffic control plans will be prepared by the Consultant in accordance with City of Tacoma’s requirements. The proposed traffic control plans for track borings TB-1 through TB-6, OMF borings from OMF-1 through OMF-3, and substation boring SB-1 are provided in Appendix C (per Traffic Control Handbook, City of Tacoma, 2009). Substation boring SB-2 and OMF borings from OMF-4 through OMF-6 are not located on City’s street and therefore do not need traffic control.

- **Surveying Services**: The location of explorations will be surveyed following completion of the explorations. Surveying services will be provided by the Consultant.

**Environmental Protection**

Best management practices (BMPs) will be implemented throughout the geotechnical site investigation program to prevent erosion, sedimentation, and leaching of contaminants, if any, from the explorations into surface waters, wetlands, and drainage systems. These BMPs will follow the recommendations of state and local agencies.

**Drilling and Sampling**

During the drilling and sampling process, a small pile of generally damp to wet soil will accumulate at the top of the boring around the auger. This pile of soil cuttings is kept to a minimum size by shoveling the soil into barrels as it approaches the ground surface. For unpaved, grassy areas, plastic sheeting will be placed on the ground to control cuttings and aid in site clean-up. To provide additional protection against fluids and sediment from the drilling process entering the stormwater drainage system or a nearby body of water, sandbags will be placed down gradient of the boring operation in a configuration that would prevent the bypass of unfiltered water. Drilling will not take place during heavy rainfall events. On-site personnel will monitor runoff to capture possible runoff of drilling fluids and sediment.

Material that is removed from the boring, including cuttings, water, and soil samples, will be either stored for later laboratory testing or placed in watertight drums for disposal. Drummed soil will be removed from the site at the end of each day and disposed of at an approved disposal facility. Sample bags and sample tubes with soil samples will be taken from the site and stored in a warehouse facility for later inspection or testing. Each soil boring will generate approximately one to two drums of waste, depending on the boring depth.

After the borings are completed, the holes will be backfilled with bentonite chips or a bentonite-cement mixture, in accordance with Washington State Department of Ecology standards. The holes will be sealed to prevent all potential cross contamination of groundwater aquifers. There would be no increase in impervious surfaces associated with this geotechnical activity. At the conclusion of each boring, holes drilled in pavement will be patched using concrete. Holes drilled in a grassy area are patched using the grass which is cut out prior to drilling. The site will be cleaned with shovels and a hand broom.
Explorations in proximity to bodies of water (i.e., less than 250 feet) will utilize special, environmental sampling agents (e.g., vegetable oil) instead of petroleum-based lubrication typically used in the boring process. Additionally, dry drilling methods will be employed, unless geologic conditions require the wet methods. Wet methods typically use water (possibly mixed with bentonite) as a drilling fluid.

**Downhole Seismic Testing**

Downhole seismic testing will be performed in the borehole described above. No special BMPs are required.

**Schedule**

The field exploration work described in this geotechnical site investigation program is scheduled for early November 2015 and should be completed either late November or early December of 2015. Work is expected to begin along the project alignment and then proceed to the OMF site. Specific dates for exploration will depend on a number of different factors, including completion of agency agreements, right-of-entry (ROE) permits, approval of traffic control plans, environmental access restrictions, etc.

Each exploration location will require between 1 and 3 days to complete the work. The actual duration for the exploration at specific locations will depend upon the type of exploration, the depth of the exploration, and the types of soil and groundwater conditions encountered.

A schedule will be prepared to identify the general time frame for explorations in different areas once this geotechnical site investigation plan has been discussed with the City of Tacoma and the property’s owner(s), environmental permits have been received, and project priorities are established. Periodic updates of this schedule will be provided to the City of Tacoma and the property’s owner(s), as better information is received on production rates.

**Concluding Remarks**

The exploration plan described above is provided to give the City of Tacoma a general understanding of the types of work planned. Accompanying drawings and table(s) in the Appendices identify specific locations that are being considered by Sound Transit for the explorations.

The information summarized in this document is intended to serve as a starting point for finalizing the geotechnical site investigation program in terms of the following:

- Locations of explorations
- Types of permits that will be required for the locations. These permits are likely to include right-of-entry, street occupancy permit, and permit for installation of groundwater monitoring well.
- Restrictions that will need to occur for these locations, such as lane closures, night-time work.
- Special environmental or safety requirements that will be required.

Sound Transit expects that it will be necessary to arrange specific discussions between Sound Transit technical representatives and the City of Tacoma’s representatives to identify requirements and
coordinate responses to these requirements. Once the protocol for communications is established, additional details for the exploration plan can be resolved.
EXHIBIT 1
Drilling Location with Utilities Marking

EXHIBIT 2
Drill Rig and Support Truck (side by side)
EXHIBIT 3
Drill Rig and Support Truck (back to back)

EXHIBIT 4
Completed Monitoring Well Monument
EXHIBIT 5
Seismic Geophysical Survey Equipment – Set up

EXHIBIT 6
Seismic Geophysical Survey Equipment – Lowering Device into Installed Casing
Appendix A

Proposed Geotechnical Boring Locations
FIGURE A-2
Proposed Geotechnical Boring Locations at the OMF Site
Tacoma Link Expansion Project – Preliminary Engineering Studies

LEGEND
● OMF-1 PROPOSED BOREHOLE LOCATION AND BOREHOLE ID
Figure A-3
Proposed location of boring SB-1
(looking north)
Figure A-4
Proposed location of boring TB-1
(looking north)
Figure A-5
Proposed location of boring TB-2
(looking south)
Figure A-6
Proposed location of boring TB-3
(looking south)
Figure A-7
Proposed location of boring TB-4
(looking south)
Figure A-8
Proposed location of boring TB-5
(looking south)
Figure A-9
Proposed location of boring TB-6
(looking south)
Figure A-10
Proposed location of boring SB-2
(looking south)
Figure A-11
Proposed location of borings OMF-1 through OMF-3 (looking east)
Figure A-12
Proposed location of borings OMF-4 through OMF-6 (looking west)
Appendix B

Summary of Geotechnical Site Investigation Program
### Summary of Geotechnical Site Investigation Program

**Project Name:** Tacoma Link Extension  
**Work Sheet:** Geotechnical Site Investigation  
**Prepared By:** H. Pham  
**Last Modified:** 10/23/2015

<table>
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<th>Boring ID</th>
<th>Termination Depth (ft)</th>
<th>Sampling</th>
<th>Piezometer / Testing</th>
<th>Piezometer Type</th>
<th>Topo/C Control</th>
<th>Access Tyoe</th>
<th>Notes</th>
<th>Property Owner</th>
<th>Drilling Method</th>
<th>Coring Depth</th>
<th>Equipment Type</th>
<th>Loghole Description</th>
<th>Drilling Location Address</th>
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<td>TB-1</td>
<td>30</td>
<td>Yes</td>
<td>Monitoring Well</td>
<td>Yes</td>
<td>N E Street</td>
<td>Drill on asphalt pavement</td>
<td>City of Tacoma ROW</td>
<td>HAS</td>
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<td>Truck-Mounted Rig</td>
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<td>Yes</td>
<td>N 1st Street</td>
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<td>Main St. Way</td>
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<td>Monitoring Well</td>
<td>Yes</td>
<td>Main St. Way</td>
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<td>City of Tacoma ROW</td>
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<td>Drained</td>
<td>Truck-Mounted Rig</td>
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<td>TBD</td>
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<tr>
<td>SB-1</td>
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<td>No</td>
<td>Monitoring Well</td>
<td>Yes (sidewalk closed)</td>
<td>Stadium Way</td>
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<tr>
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<td>Yes (alley closed)</td>
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<td>OMT-1</td>
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<td>£ 25th Street</td>
<td>Drill on concrete pavement</td>
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<td>Drained</td>
<td>Truck-Mounted Rig</td>
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<td>Yes</td>
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<td>Drained</td>
<td>Truck-Mounted Rig</td>
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<td>OMT-3</td>
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<td>Yes</td>
<td>£ 25th Street</td>
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<td>City of Tacoma ROW</td>
<td>HAS + Mud Rotary</td>
<td>Drained</td>
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<tr>
<td>OMT-4</td>
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<td>No / Downhole Seismic</td>
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<td>OMT-6</td>
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<td>Skid Rig</td>
<td>TBD</td>
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</table>

**Note:** OMT will be used above groundwater level whereas Mud Rotary drilling will be used below groundwater level.
SHOULDER WORK WITH MINOR ENCROACHMENT

☐ APPROVED BY:
☐ APPROVED WITH CONDITIONS BY: ___________________________ DATE: ___________________________

START TRAFFIC CONTROL SET UP DATE: ________ OFF PEAK 9:00 AM WEEKDAYS

MUST BE OUT OF THE ROAD BY DATE: ________ OFF PEAK 3:30 PM WEEKDAYS

EVENING AND WEEKENDS ONLY
START TRAFFIC CONTROL SET UP DATE & TIME:

MUST BE OUT OF THE ROAD BY DATE & TIME:

NOTE 1. MAINTAIN LOCAL ACCESS AND PROTECTED WALKWAYS AT ALL TIMES. PROVIDE AND MAINTAIN BARRIERS, SIGNS, LIGHTS, ETC. AS PER "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" AT ALL TIMES. STREETS AND WALKWAYS SHALL BE KEPT CLEAR OF DEBRIS DROPPED OR TRASHED BY VEHICLES ENTERING OR EXITING THE WORK SITE. FAILURE TO COMPLY WILL RESULT IN A STOP WORK ORDER AND/ OR CIVIL CITATION.

NOTE 2. NO WORK SHALL BE SCHEDULED ON STREETS OR WALKWAYS WITHIN THE CITY OF INDIANAPOLIS BUSINESS DISTRICTS FROM THANKSGIVING DAY THROUGH NEW YEAR'S DAY.

NOTE 3. SIGN SPACING: URBAN LOW SPEED 25-30 MPH SIGNS MUST BE PLACED 100' APART. URBAN HIGH SPEED 35-40 MPH SIGNS MUST BE PLACED 300' APART.

MERGING TAPER LENGTHS FOR CONE PATTERN

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Offset cones 1 foot maximum.
RIGHT LANE CLOSURE

☐ APPROVED BY: ___________________________ DATE: ______________

☐ APPROVED WITH CONDITIONS BY: ___________________________ DATE: ______________

START TRAFFIC CONTROL SET UP DATE: ________ OFF PEAK 9:00 AM WEEKDAYS

MUST BE OUT OF THE ROAD BY DATE: ________ OFF PEAK 3:30 PM WEEKDAYS

EVENING AND WEEKENDS ONLY

START TRAFFIC CONTROL SET UP DATE & TIME: ____________________________

MUST BE OUT OF THE ROAD BY DATE & TIME: ____________________________

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(All minimums)

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Note 1: Maintain local access and protected walkways at all times. Provide and maintain barricades, signs, lights, etc. as per "Manual on Uniform Traffic Control Devices" at all times. Streets and walkways shall be kept clear of debris dropped or tracked by vehicles entering or exiting the work site. Failure to comply will result in a stop work order and/or citation.

Note 2: No work shall be scheduled on streets or walkways within the city of Iowa business districts from Thanksgiving Day through New Year’s Day.

Note 3: Sign spacing: urban low speed 25-30 MPH signs must be placed 100' apart. Urban high speed 35-40 MPH signs must be placed 300' apart.
SIDEBAND CLOSURE

☐ APPROVED BY: __________________________ DATE: __________________________

☐ APPROVED WITH CONDITIONS BY: __________________________ DATE: __________________________

START TRAFFIC CONTROL SET UP DATE: _______ OFF PEAK 9:00 AM WEEKDAYS

MUST BE OUT OF THE ROAD BY DATE: _______ OFF PEAK 3:30 PM WEEKDAYS

EVENING AND WEEKENDS ONLY

START TRAFFIC CONTROL SET UP DATE & TIME:

MUST BE OUT OF THE ROAD BY DATE & TIME:

MERGING TAPER LENGTHS
FOR CONE PATTERN
(All minimums)

<table>
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<tr>
<th>MPH</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
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<tbody>
<tr>
<td>8'</td>
<td>14</td>
<td>30</td>
<td>54</td>
<td>84</td>
<td>120</td>
<td>164</td>
<td>214</td>
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<tr>
<td>10'</td>
<td>17</td>
<td>38</td>
<td>67</td>
<td>105</td>
<td>150</td>
<td>204</td>
<td>267</td>
</tr>
<tr>
<td>12'</td>
<td>20</td>
<td>45</td>
<td>80</td>
<td>125</td>
<td>180</td>
<td>245</td>
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<tr>
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<td>94</td>
<td>146</td>
<td>210</td>
<td>286</td>
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<td>27</td>
<td>60</td>
<td>107</td>
<td>167</td>
<td>240</td>
<td>327</td>
<td>427</td>
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</tbody>
</table>

OFFSET CONES 1 FOOT MAXIMUM

NOTE 1: MAINTAIN LOCAL ACCESS AND PROTECTED WALKWAYS AT ALL TIMES. PROVIDE AND MAINTAIN BARRIERS, SIGNS, LIGHTS, ETC. AS PER "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES" AT ALL TIMES. STREETS AND WALKWAYS SHALL BE KEPT CLEAR OF DEBRIS DROPPED OR Tracker BY VEHICLES ENTERING OR EXITING THE WORK SITE. FAILURE TO COMPLY WILL RESULT IN A STOP WORK ORDER AN/or CITATION.

NOTE 2: NO WORK SHALL BE SCHEDULED ON STREETS OR WALKWAYS WITHIN THE CITY OF JACOBA BUSINESS DISTRICTS FROM THANKSGIVING DAY THROUGH NEW YEAR'S DAY.

NOTE 3: SIGN SPACING: URBAN LOW SPEED 25-30 MPH SIGNS MUST BE PLACED 120 FT APART. URBAN HIGH SPEED 35-40 MPH SIGNS MUST BE PLACED 390 FT APART.