INVITATION TO BID #2019-06
Engineering Services for 232nd Drive at MP 0.3 ("RFP")
RESPONSE TO CLARIFYING QUESTIONS
March 21, 2019

Note that these are questions submitted by interested firms to the above referenced solicitation. The below answers are for clarification purposes only and in no way alter or amend the RFP as published.

1. *Can you please send the preliminary geotechnical report for the 232nd Drive at MP 0.3 project?*
   Answer: Yes, the preliminary geotechnical report is attached below.

End of Clarifying Questions #1

LANDSLIDE TECHNOLOGY
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April 25, 2017 2587

Daryn Thorpe
Clackamas County Department of Transportation
902 Abernethy Road
Oregon City, OR 97045

Geotechnical Site Visit
SE 232nd Drive Slide
Damascus, Oregon

Dear Mr. Thorpe:

This letter summarizes observations made during a visit to a section of SE 232nd Drive near Damascus, Oregon that has been experiencing roadway distress related to slope instability over the past several years. Included in this report are conceptual level options to mitigate the roadway distress and our recommendations. Our work was performed under our existing on-call contract with Clackamas County under Purchase Order Number 864546.

Background and Site Description

At your request, a senior engineering geologist (Mr. Brent Black) met with you and Kevin Hutchison on March 23, 2017 to observe a portion of SE 232nd Drive between SE Weatherly Lane and SE Royer Road. The approximate location of the site is shown in Figure 1. It is our understanding that Clackamas County has observed pavement distress and cracks in the northbound lane in this section of road over the past several years, and a pavement overlay was placed as recently as five years ago. A review of Google Maps Street View indicates that pavement cracks were present in roughly the same locations in October 2007. However, the County indicates that the cracks have become more pronounced and started to expand laterally in early March of this year.

SE 232nd Drive is a two-way road that traverses a hillside in a northeast-southwest direction (see Figure 1). The northbound lane is 11 feet wide between the centerline and fogline. The pavement typically extends less than one foot beyond the fogline to the east (or outboard) side of the road. The road shoulder is typically five feet wide, and there is a guardrail along the outboard shoulder of the road. The area downslope of the roadway is densely vegetated with blackberry bushes and small to medium deciduous trees.

Published geologic maps of the area indicate the site is underlain by Pliocene-age basalt from the Boring Lavas and Miocene-Pliocene-age siltstone and sandstone of the Troutdale Formation. This

portion of SE 232nd Drive crosses onto and traverses a previously mapped, large landslide complex (see Figure 2).

Site Observations

On March 23, 2017 pavement distress and signs of embankment slumping on the outboard side (northbound lane) of the roadway were observed and documented (see Photo Exhibit 1). Three sets of arcuate cracks in the pavement and slumping of the outboard edge of the roadway were observed over approximately 60 feet of northbound lane. Vertical displacement up to 1½-inches was observed in the pavement cracks (see Photo Exhibit 2). The maximum horizontal displacement observed in the pavement cracks was approximately 1-inch. The cracks extend up to nine feet into the northbound travel-lane from the fogline (roughly two feet from the centerline) as shown on Photo Exhibit 3. During our site visit, the cracks extended to the outboard fogline on the north end of the slump feature and stopped approximately two feet from the fogline on the south end. No cracks were observed extending into the shoulder or through the embankment. Evidence of a previous pavement overlay, approximately 85 feet in length, was observed on the northbound lane where the recent pavement cracks are located.

The outboard slope of the road embankment and the natural slope below the road embankment are moderately steep to steep (24° to 40° inclination from horizontal), as shown on Photo Exhibit 4A. Noyer Creek runs along the toe of the natural slope below the road embankment (see Photo Exhibit 4B). The creek is approximately 130 feet (horizontal distance) and 87 feet (vertical distance) from the edge of the road shoulder. A major seep was observed flowing from the slope, approximately 40 feet (horizontal distance and vertical distance) from the slope below the road (see Photo Exhibit 4B). This seep may be associated with the contact between embankment fill and native Troutdale material.

An existing cantilever soldier-pile wall with timber lagging was observed on the outboard edge of the roadway seven feet from the southern limits of the recent cracks in the pavement (see Photo Exhibit 5). The County was not sure when this approximately 32-foot long wall was constructed. The maximum exposed height of the wall is approximately 7½ feet. It is unclear how deep the soldier piles extend below the ground surface. The section of road that the soldier-pile road supports shows no signs of distress. A 2-inch steel pipe was observed attached to the underside of the wooden offset blocks on the guardrail that runs along the section of the road (see Photo Exhibit 6). A sign attached to the steel pipe indicated that it is a private waterline. It is unclear where this waterline originates or ends.

Conclusions and Conceptual Mitigation Options

The site is near the toe of a very large landslide complex. Given that a previous pavement overlay was also needed in this area, and the fact that a soldier-pile wall was constructed, suggests that this segment of SE 232nd Drive has experienced slope stability issues in the past. The on-going pavement distress and roadway embankment instability is likely due to a combination of localized factors such as loose and poor quality embankment fill, poor drainage, and creeping slopes. In addition, the roadway was constructed on a large existing landslide complex. During periods of

heavy rainfall and extended precipitation, both the localized conditions mentioned above and the larger landslide complex are destabilized by elevated groundwater levels. Groundwater pressures increase, decreasing both local and global stability, which leads to increased slope creep and landslide movement. Over this time period, OR 224 just south of the project area was closed due to several landslides impacting the highway between SE Tong Road and SE 232nd Drive. These slides are also likely associated with the recent heavy rainfall and reactivation of larger landslide complexes.

Following the field visit, Clackamas County asked for guidance regarding whether they should close the road due to a concern of a rapid failure of the roadway embankment. We provided the County an email on March 24, 2017 indicating that the failing roadway embankment on SE 232nd Drive appears to have a relatively low to moderately low risk of failing rapidly. This is based on our recent observations, experience with past landslides in this area, and evidence of past pavement distress and subsequent shoulder slumping at this site. We recommended that the County continue to monitor the extent and displacement of the ground cracks on a daily basis. If the displacement of the cracks (vertically and horizontally) accelerate, or it is evident that the cracks begin to extend across the shoulder down the slope of the embankment, the County may need to close the road. In addition, we recommended the County determine the owner of 2-inch waterline and make arrangements to shut the water off if it appears that the embankment section may fail.

As previously stated, we feel that the on-going pavement distress and roadway embankment instability is due to both localized factors and global instability associated with the adjacent large landslide. It would likely be cost prohibitive for the County to stabilize the larger landslide complex. Given this, mitigation for local stability must be flexible to accommodate global movements. For this reason, structural solutions (e.g. a soldier-pile wall) were not considered. The following mitigation options could be considered to reduce the hazards to the traveling public and extend the service life of the roadway. The time required to implement mitigation measures will depend on the time required to assemble and let a construction contract as well as available funding.

Option 1 – Pavement Overlay, Monitor, and Remove the Existing Above Ground Waterline. This option consists of applying another pavement overlay and monitoring the slide activity on a regular basis via visual observations (i.e. pavement distress and shoulder slumping/sloughing) during the rainy season. This option will do nothing to improve stability of the roadway embankment or reinforce the pavement. This option would only improve the pavement surface so northbound vehicles would be less likely to swerve into the southbound (downhill) traveling lane to avoid the distress in the northbound lane. Based on past performance of overlays in this area, the useful life of the road surface would likely be less than five years, and may need mitigation within a year. In addition, there is a potential that the roadway embankment could fail to the point where it represents a hazard to the traveling public and/or necessitate the closure of the road. If this option is selected by the County, we recommend that the 2-inch water attached to the underside of the guardrail along the section of the road be removed. Deformation of the guardrail due to increased landslide

movement or impact from a vehicle could rupture the waterline and increase the amount of water that could negatively impact the slide.

Option 2 – Reinforced Embankment "Deep Patch" Roadway Segment with Improved Drainage. A deep patch approach has been used successfully on other County roads experiencing instability within the travel-lane and along the outboard shoulder. The deep patch concept involves reconstructing the roadway subgrade in the distressed area with geogrid-reinforced fill. The face of the reinforced fill is typically wrapped with geogrid and erosion control fabric to prevent near-surface sloughing. The deep patch concept improves the stability of the upper section of the road. It does not treat deep-seated, global slope instability, but typically allows the reinforced section to bridge creep movement for a longer period than conventional pavement sections. This bridging effect extends the pavement life. The useful life of a deep patch is difficult to quantify without detailed history of slope movement rates, but typically varies from 5 to 15 years. The addition of measures to control surface and shallow subsurface water could increase the stability of the roadway embankment and prolong the service life of the deep patch. We recommend cutoff trench backfilled with drain rock be installed on the inboard side of the roadway to intercept perched groundwater and reduce the amount of water that infiltrates into the roadway embankment. We also recommend that the 2-inch water attached to the underside of the guardrail along the section of the road be removed.

We assumed that a 5-foot deep section of roadway would be removed and replaced with geogrid-reinforced base rock. For estimating purposes, we assumed that the entire length of the roadway would be treated starting from the northern end of the solider-pile wall and extend the deep patch to the north, roughly 25 past the slump area, for approximately 100 feet of treated roadway. We estimate approximately 150 feet of a 2-foot wide by 10-foot deep cutoff trench to help control shallow groundwater. The estimated cost for the deep patch and drain is approximately $150,000.

Recommendations

We recommend that Clackamas County pursue Option 2. This concept to reinforce the upper road embankment and help control surface runoff and shallow groundwater is a concept that requires further evaluation and engineering to implement. Option 2 would need subsurface explorations that could likely be investigated using test pits to assist with final design. In the interim, if the County feels that pavement distress and roadway shoulder has deteriorated to a point that they present a relative hazard to the traveling public, the northbound travel-lane could temporarily be replaced with gravel and monitored on a regular basis to allow continued use.

We trust that this letter is sufficient for your current needs. If you have questions regarding the information presented above, please call Brent Black at 503-452-1200.

Truly yours,

LANDSLIDE TECHNOLOGY

Brent A. Black, C.E.G
Senior Associate Geologist

Limitations in the Use and Interpretation of this Geotechnical Report

Our professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties, either expressed or implied.

The geotechnical report was prepared for the use of the Owner in the design of the subject facility and should be made available to potential contractors and/or the Contractor for information on factual data only. This report should not be used for contractual purposes as a warranty of interpreted subsurface conditions such as those indicated by the interpretive boring and test pit logs, cross-sections, or discussion of subsurface conditions contained herein.

The analyses, conclusions and recommendations contained in the report are based on site conditions as they presently exist and assume that the exploratory borings, test pits, and/or probes are representative of the subsurface conditions of the site. If, during construction, subsurface conditions are found which are significantly different from those observed in the exploratory borings and test pits, or assumed to exist in the excavations, we should be advised at once so that we can review these conditions and reconsider our recommendations where necessary. If there is a substantial lapse of time between the submission of this report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, this report should be reviewed to determine the applicability of the conclusions and recommendations considering the changed conditions and time lapse.

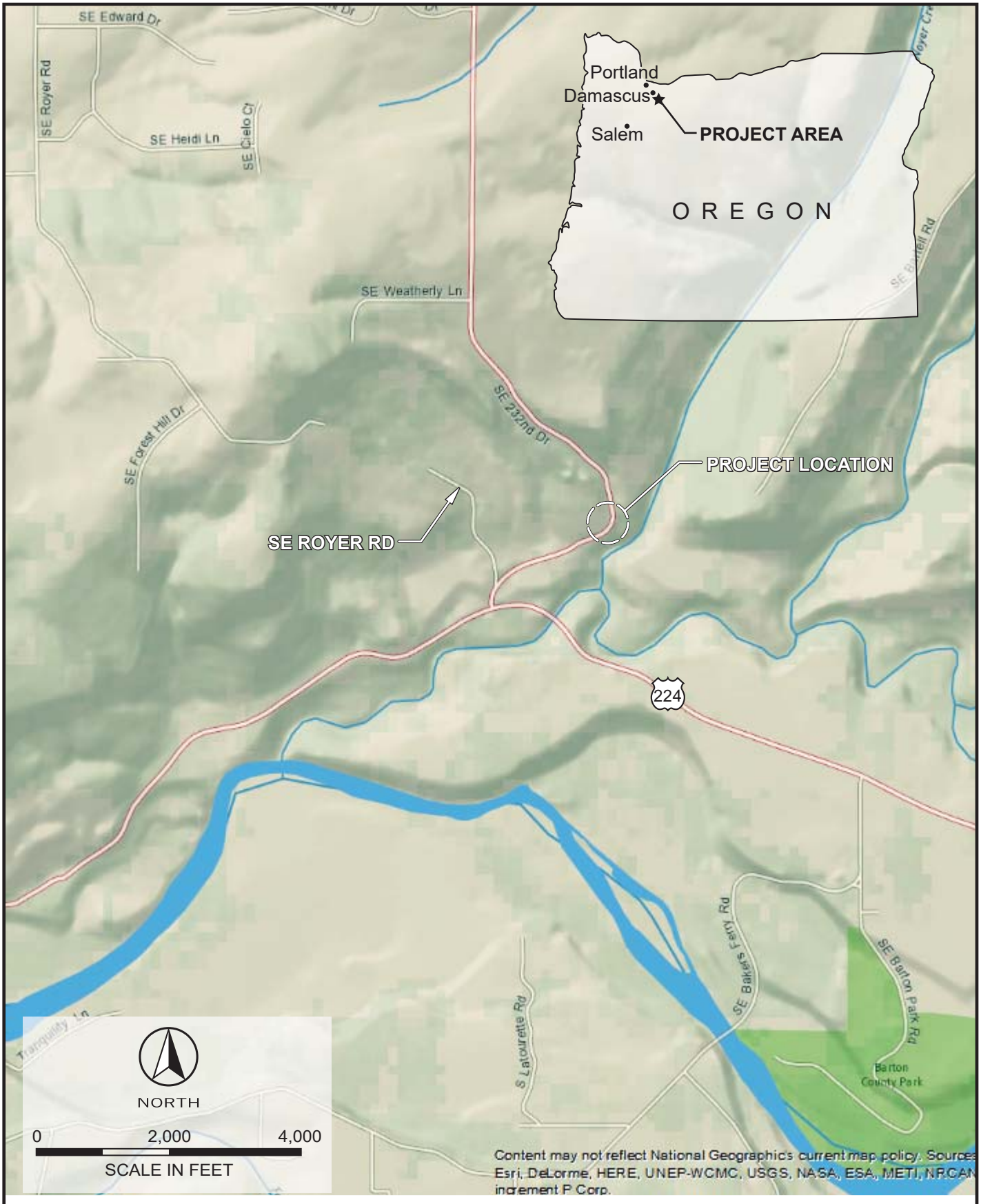
The Summary Boring Logs are our opinion of the subsurface conditions revealed by periodic sampling of the ground as the borings progressed. The soil descriptions and interfaces between strata are interpretive and actual changes may be gradual.

The boring logs and related information depict subsurface conditions only at these specific locations and at the particular time designated on the logs. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the soil conditions at these boring locations.

Groundwater levels often vary seasonally. Groundwater levels reported on the boring logs or in the body of the report are factual data only for the dates shown.

Unanticipated soil conditions are commonly encountered on construction sites and cannot be fully anticipated by merely taking soil samples, borings or test pits. Such unexpected conditions frequently require that additional expenditures be made to attain a properly constructed project. It is recommended that the Owner consider providing a contingency fund to accommodate such potential extra costs.

This firm cannot be responsible for any deviation from the intent of this report including, but not restricted to, any changes to the scheduled time of construction, the nature of the project or the specific construction methods or means indicated in this report; nor can our firm be responsible for any construction activity on sites other than the specific site referred to in this report.



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VICINITY MAP

232ND DRIVE SLIDE
DAMASCUS, OREGON

APR 2017

PROJ. 2587

FIG. 1

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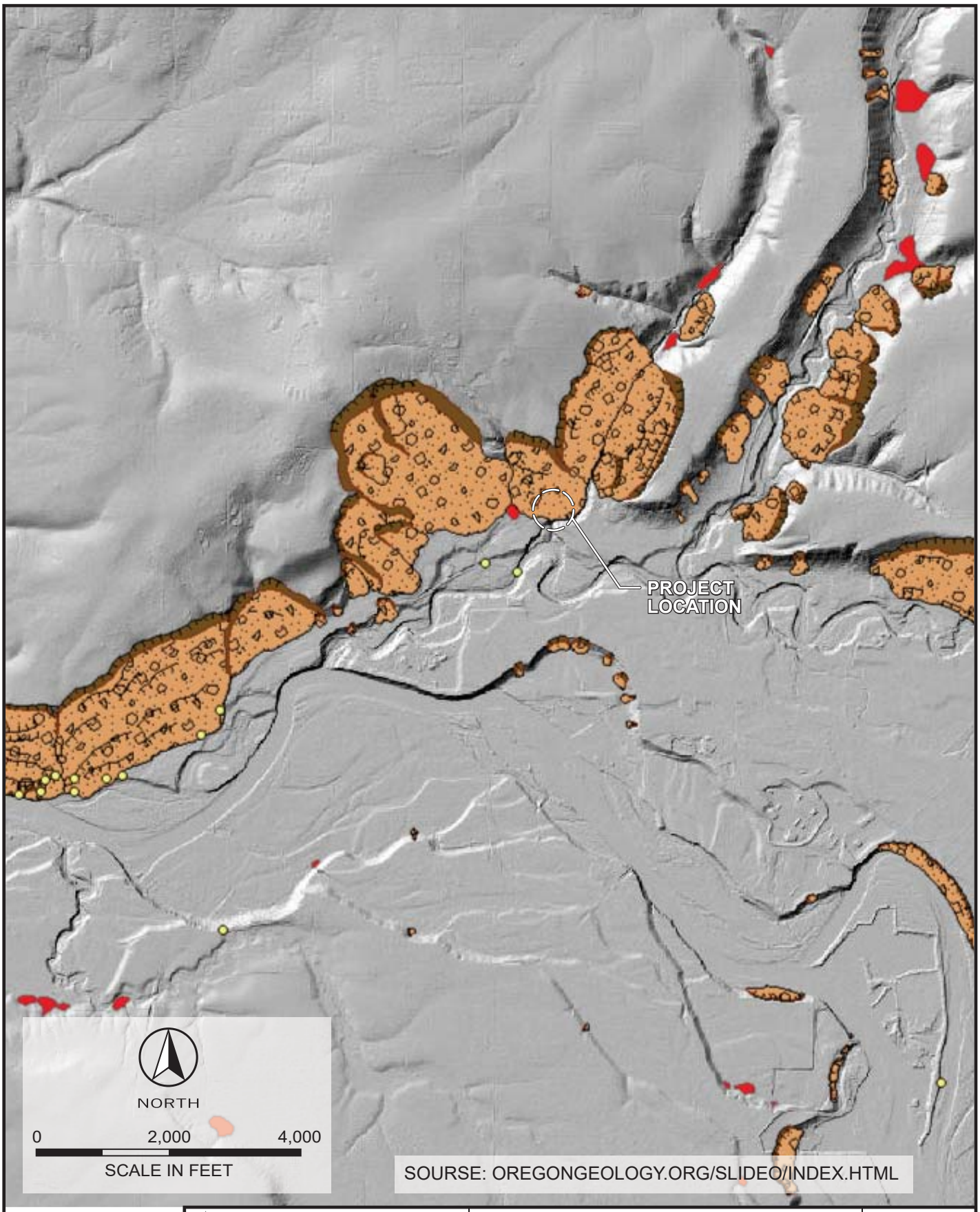

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DOGAMI LANDSLIDE MAP 2017

232ND DRIVE SLIDE
DAMASCUS, OREGON

APR 2017

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FIG. 2

A. View looking south at recent pavement distress and roadway embankment slumping on the northbound lane of SE 232nd Drive.

B. View looking north at recent pavement distress and roadway embankment slumping on the northbound lane of SE 232nd Drive.

A. View of recent cracks in pavement at the fogline on the north end of the northbound lane.

B. View of recent cracks in pavement on the northbound lane.

A. Up close view looking south at recent pavement distress and roadway embankment slumping on the northbound lane of SE 232nd Drive. Note distance to centerline

B. Up close view looking southwest at pavement cracks associated with roadway embankment slumping on the northbound lane of SE 232nd Drive.

A. View looking north at outboard shoulder of the roadway embankment and the natural slope. Note the creek at the toe of the slope on the right-hand side of the photo.

B. View looking down the road embankment (east). Note seep flowing from the slope just below the car body in the photo.

A. View looking south at the existing cantilever soldier-pile wall with timber lagging on the outboard edge of the roadway immediately south of the active slide area.

B. View looking south at the existing soldier-pile wall on the outboard edge of the roadway immediately south of the active slide area.

A. View looking northwest at the 2-inch waterline attached to the underside of the guardrail along the section of the road adjacent to the slide area and the solider-pile wall.

B. View looking southeast at the 2-inch waterline attached to the underside of the guardrail along the section of the road adjacent to the slide area and the solider-pile wall.