GeoEngineers
8410 154th Avenue NE
Redmond, Washington 98052
425.861.6000

July 12, 2016

City of Burien
400 SW 152nd Street, Suite 300
Burien, Washington 98166-1957

Attention: Maiya Andrews, PE
Public Works Director

Subject: 2016 Eagle Landing Park Stairway Evaluation
Burien, Washington
File No. 3416-053-08

INTRODUCTION AND SCOPE

This letter report summarizes our site reconnaissance on March 23, 2016 to evaluate a west-facing slope located along the shoreline of the Puget Sound in Eagle Landing Park in Burien, Washington, and to re-assess the safety of a public staircase leading down the slope to the shoreline. We previously prepared a letter dated January 5, 2015 where we recommended the stairway be closed for public use due to landslide activity that had affected the landing located closest to the beach, causing it to tilt and become unstable. That landing was subsequently removed from the site in 2015. We visited the site at the request of Maiya Andrews with the City of Burien Public Works Department. Dan O'Brien of the City of Burien Public Works Department visited the site with us.

Since a period of over 1 year has passed since the closure, there has been a desire by some users to access the shoreline using the stairs, or to at least have partial access to the stairs for exercise. In addition, it is apparent to the City that a trail has been pioneered by members of the public, bypassing the warning signs and fencing that was put in place following the stair closure.

SCOPE OF WORK

Our scope of work was as follows:

1. Review our previous reports on Eagle Landing Park, particularly our January 2015 letter that focused on the stairway safety.
2. Conduct a site reconnaissance to:
    a. Observe and evaluate existing site conditions; and

b. Determine if the stairs can be safely used in whole or in part by the public to access the beach.

3. Prepare this short letter documenting our observations and opinions regarding the stability of the stairway with respect to slope movement that has occurred from the time that we provided our January 2105 letter.

BACKGROUND AND DOCUMENT REVIEW

GeoEngineers, Inc. (GeoEngineers) reviewed the following reports regarding landslide activity at Eagle Landing Park in Burien, Washington:

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Shannon & Wilson, Inc., 2003. Design Statement Regarding Branson Park Stairway.

Shannon & Wilson, Inc., 2003. Geotechnical Report Branson Park, Burien, Washington.

Gilles Consulting, 2013. Evaluation of Trees at Eagle Landing Park.

GeoEngineers, Inc., 2013. Letter Report, Eagle Landing Landslide Evaluation, Burien, Washington.

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SITE GEOLOGY

We reviewed a published geologic map of the area (Waldron 1962). The mapped geologic unit in the area is identified as advance outwash (Qsa) which Waldron (1962) describes as sand, and sand and pebble to cobble gravel with very fine sand and laminated silt. This unit was deposited by proglacial streams formed at the front of advancing glaciers in the Puget Sound. As described by Shannon & Wilson, these deposits are covered by colluvium. Colluvium is loose material that accumulates on slopes due to gravity; it is commonly attributed to root loosening, freeze-thaw action, animal burrowing or from landslide or other erosion processes that originate from higher elevations. Shannon & Wilson also documents interbedded hard clay, silt and sand exposures at the beach.

During our site reconnaissance, near surface soils were observed in slope exposures and in the scarp of the December 2012 and December 2014 landslides. We generally found that approximately the upper 2 to 3 feet of slope deposits are colluvium, and is composed of fine to medium sand with silt, gravel and occasional cobbles. Toward the base of the slope, we observed exposures of laminated silt and clay; likely part of interglacial deposits or laminated silt interbeds near the base of and within the glacial advance outwash mapped in the area.

SITE RECONNAISSANCE

We completed a site reconnaissance at Eagle Landing Park on March 23, 2016 to evaluate the slope conditions in the vicinity of the stairway and the foundations of the stairway landings, particularly near the

Photograph 1. View of Top of Stairway with Warning Signs

Photograph 2. Base of Landing 2

lower sections of the stairs (see Figure 2, Site Map). Galan McInelly and Craig Erdman of GeoEngineers were accompanied by Dan O'Brien from the City of Burien. This evaluation was conducted to evaluate changes in the slope indicative of landsliding, observe potential changes in the foundation support of the landings, and evaluate the risk to public safety along the stairs and slope.

As we approached the crest of the slope where the stairway begins, we observed the warning signage placed by the City along with the fencing that had been placed to limit access to the stairs. However, an unauthorized trail was present along the north side of the stairway that followed along the stairway for the first two landings. In addition to the vertical fencing at the top of the head of the stairs, trail users were also restricted from using the upper part of the stairs by fencing that had been placed over the stairs. However, once this fencing ended, the remainder of the stairs could be accessed by park users that had climbed over the railing.

We observed no indication of significant slope movement adjacent to the stairs along the upper approximate three-quarters of the stairway and landings. Where exposed, the length of pipe piles supporting the foundations we observed at the landings was typically less than about 1 foot in height. This is consistent with the observations in December 2014, where erosion and creep had exposed up to about 6 inches (or more based on photograph 2 of our January 2015 letter) below portions of the landings. There was not any readily noticeable ground cracking or separation of the ground from the concrete landings foundation concrete until the landing located directly upslope from the now demolished and removed lowest landing. This landing is located next to the head of the landslide that affected the lowest landing.

Photograph 3. Landing 5.

Photograph 4. Landing 9, located adjacent the 2014 Landslide

DISCUSSION AND CONCLUSIONS

General

Based on our review of available information and our site reconnaissance, it is our opinion that portions of the stairway have presently not been affected by slope movement associated with the 2014 landslide. The landings below Landing 10 were removed by the City in 2015. However, it is likely that movement of the landslide will continue and should be anticipated in the future, with possible additional impacts to the stairway. In addition, slope movement can result in the tilting and toppling of trees that could impact the users of the stairway.

Based on a map and other information in an email from Dan O'Brien to Galan McInelly, dated June 20, 2016, we understand that two leaning trees were located close to the stairway. One tree is a conifer leaning very slightly downhill and did not appear to be a risk to the stairway or users (see Figure 2). A second tree is a deciduous tree that leans downslope and is about 20 feet upslope of the landslide near Landing 9. If this tree fell, it is likely that it could impact Landing 9 and potentially impact users on the stairs.

In the last 1-½ years, the landslide adjacent to the stairways has regressed upslope about 45 to 50 feet. Therefore, it is reasonable to anticipate that within the next year or two, assuming the rate of regression upslope is the similar, both trees could topple from landslide activity. While it appears unlikely the conifer tree would fall on stairway users, it is likely that it would remove lateral support of Landing 7. This would leave stairway users at risk if the structure were to remain in place and was not blocked adequately from public use.

To reduce risk to trail users, we recommend that the landings and stairways from Landing 6 downslope be demolished and removed from the slope. Landing 6 should have railings installed that reduce the ability of users to jump over them.

We recommend that the City further discourage pioneering of trails down the slope to reduce the potential for slips, trips and falls on improperly formed trails. This could be accomplished by fencing, signage, increased railing heights or other means.

LIMITATIONS

We have prepared this report for the City of Burien and their authorized agents and regulatory agencies for evaluation of a landslide concerns at Eagle Landing Park in Burien, Washington.

Our services were provided to assist in the evaluation of the landslides that occurred in 2012 and 2014 and the potential for future slope movements that could affect the public. Our recommendations are general in nature and are intended to provide guidance to further understand and manage the potential risk for continued failure of the slope and potential impacts to the property. Qualified engineering geology, engineering and construction practices can help mitigate these risks if implemented in a timely manner.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of engineering geology in this area at the time this report was prepared. The conclusions, recommendations, and opinions presented in this report are based on our

professional knowledge, judgment and experience. No warranty or other conditions, express or implied, should be understood.

REFERENCES

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Sincerely,
GeoEngineers, Inc.

State of Washington
Engineering Geologist
620
Licensed Geologist
Galan W. McInelly

Craig F. Erdman, LG, LEG
Senior Engineering Geologist

Galan W. McInelly, LG, LEG
Principal

CFE:GWM:cam

List of Figures
Figure 1. Vicinity Map
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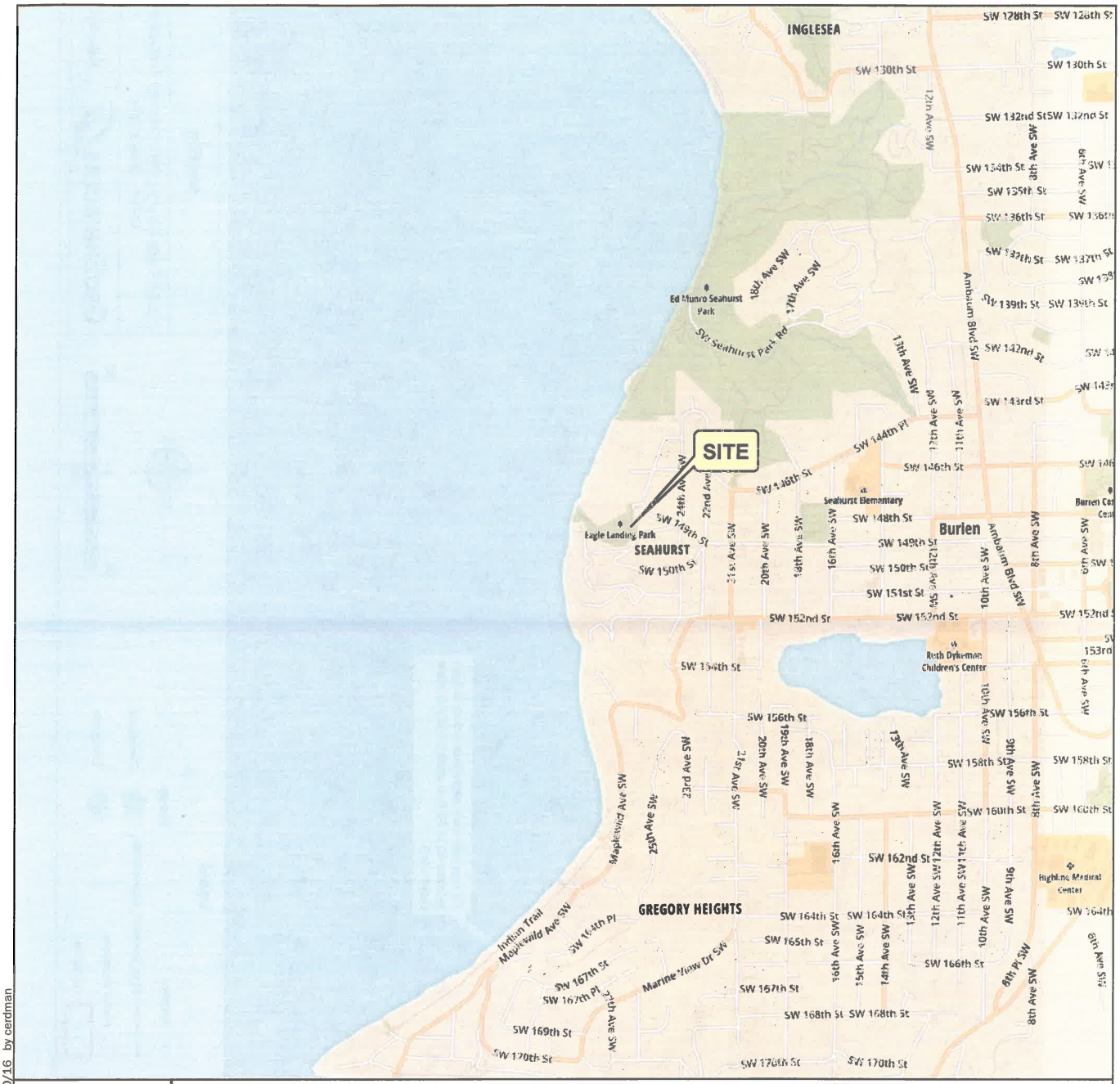

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Vicinity Map

2016 Eagle Landing Park Stairway Evaluation
Burien, Washington

GeoEngineers

Figure 1

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- Seepage
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Senior Engineering Geologist

Galan W. McInelly, LG, LEG
Principal

CFE:GWM:cam

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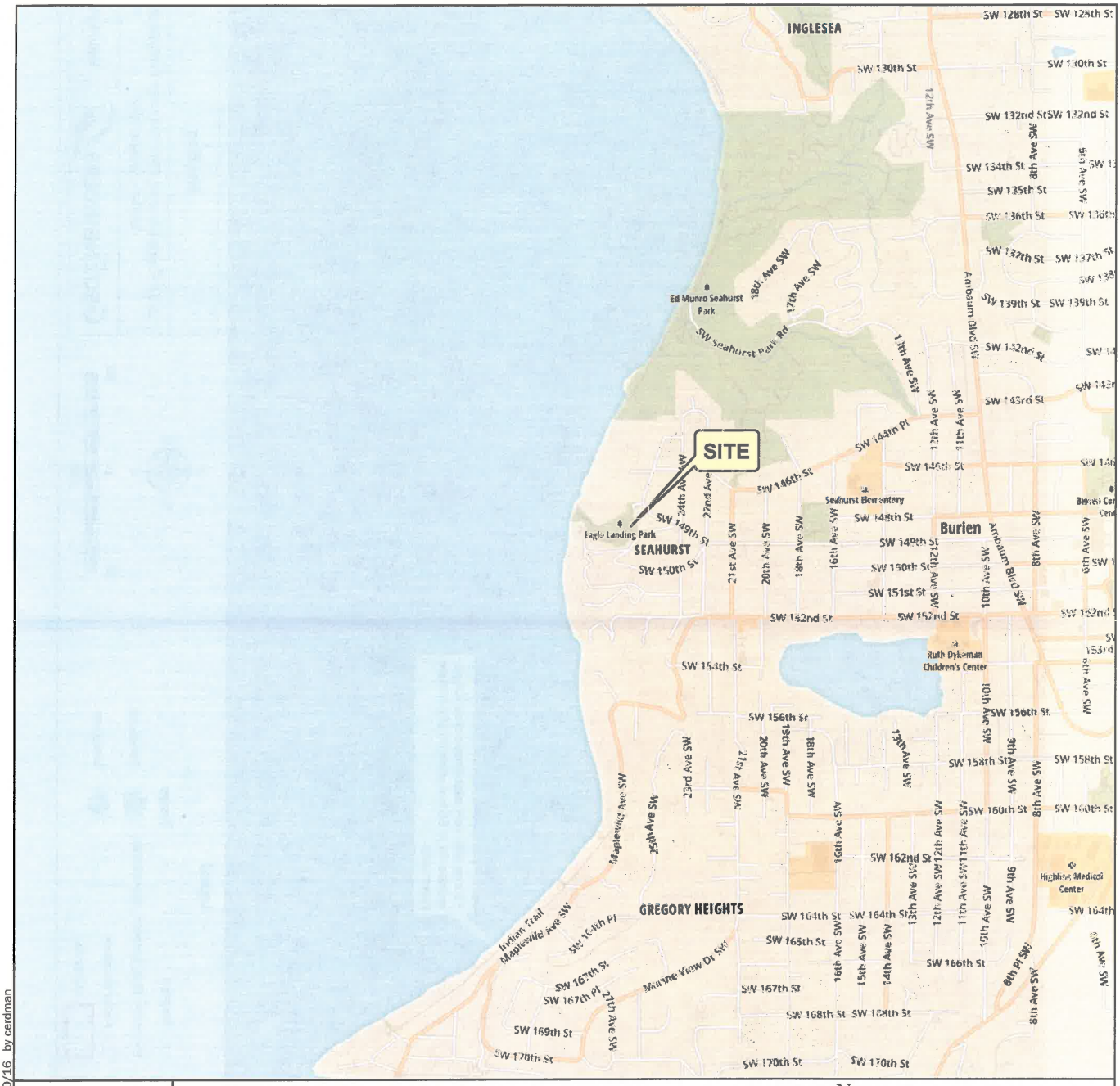

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Vicinity Map

2016 Eagle Landing Park Stairway Evaluation
Burien, Washington

GeoEngineers

Figure 1

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2016 Eagle Landing Park Stairway Evaluation
Burien, Washington

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Figure 2

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