Budinger & Associates
Proudly serving the Inland Northwest for over 40 years

Geotechnical Engineering
Environmental Engineering
Construction Materials Testing
Subsurface Exploration
Special Inspection

Anna Drumheller
Blue Fern Development
18300 Redmond Way Suite 120
Redmond, WA 98052

March 24, 2022

Project: G22186

Project: True Property, Victory Heights, Spokane County, WA
Subject: Results of Geohazard Evaluation

Ms. Drumheller,

At your request, we conducted geologic research and reconnaissance of the subject property. We understand a preliminary geohazard assessment is required by Spokane County prior to development.

INTRODUCTION

Project

A residential development consisting of 1,003 lots is planned for an approximately 177-acre site. Current plans indicate the development will include 220 townhome lots, 317 compact lots, 446 houses, and 22 new roadways. The proposed maximum and minimum lot sizes are 0.47 and 0.05 acres, respectively.

We previously completed a Preliminary Subsurface Characterization Report on March 30, 2022. We observed and logged the excavation of 16 test pits on the site to characterize the subsurface conditions. The site has been expanded to the south and west to include additional property since our previous report. The location is illustrated in the *Vicinity Map* and *Site Plan*.

Scope

The scope of services included:

- Review of readily available geologic and soil information;
- Field reconnaissance of the property;
- Evaluation of pertinent geologic and hydrologic conditions at the site based on visual observations;
- Development of professional opinions relating to potential geologic hazards as defined by the Critical Areas Ordinance (CAO); and,
- Preparation of a letter report documenting our conclusions.

Laboratory analysis was not included in this scope of services. Additional geotechnical evaluation to support the construction of structures or the safety factors associated with existing fill, cut, or native slopes was not performed. Such an evaluation would require additional subsurface exploration and geotechnical engineering analysis of information associated with the proposed design of infrastructure and houses such as loads, levels, and geometry that is not included in the scope of these services.

This report addresses only conclusions as to the potential geohazards associated with the slopes and erodible soils associated with development. The conclusions are based on visual observations of the ground surface conditions and our review of the published data. Soil or other geotechnical parameters associated with foundation design, wall design, structural fill, bearing capacity, or seismic criteria are not addressed in this report.

ENCOUNTERED CONDITIONS

Physical Setting and USDA Soil Mapping

The physical setting remains as described in our previous report.

The Natural Resource Conservation Service (NRCS) lists the native soils associated with the site as described in *Table 1* below.

Table 1. NRCS Soil Units

Soil Unit	Soil Name	Slopes	K Factor, Whole Soil
2053	Speigle-Rock outcrop complex	15 to 30 percent slopes	0.15
2080	Gibbs ashy silt loam	0 to 8 percent slopes	0.49
3044	Cheney ashy silt loam	0 to 8 percent slopes	0.37
3045	Rockly-Deno complex	0 to 15 percent slopes	0.1
3113	Stutler-Springdale complex	3 to 15 percent slopes	0.49
3114	Rockly-Fourmound complex	0 to 15 percent slopes	0.1
3115	Northstar-Rock outcrop complex	3 to 15 percent slopes	0.37
3120	Marble loamy sand	0 to 8 percent slopes	0.05
3122	Marble loamy sand	15 to 30 percent slopes	0.05
3126	Rock outcrop-Northstar complex	15 to 30 percent slopes	0.37

Field Reconnaissance

We visited the site on January 24, 2023, to observe surface conditions. The observed surface conditions appeared to match those described in our previous March 16, 2022, visit. The site was snow covered at the time of our visit.

The site was expanded to the west and south as previously described in *project considerations*.

An additional 15.3 acres, south of Thorpe Road, was added at the northwest corner of the site. The topography consisted of an approximately 20 to 40 percent, north-facing slope that transitioned down to approximately 10 percent. Basalt outcrops were observed on the north-facing slope. The relief was 146 feet from a high point of 2,230 feet at the southeast corner to a low point of 2,084 feet at the northeast corner. Three existing single-family residences and gravel driveways were observed.

Approximately 30.7 acres was added to the south edge of the site, south of 41st Avenue. The topography consisted of a relatively level ground surface with a basalt outcrop rising approximately 40 feet above the surrounding plain. The relief was approximately 40 feet from a high point of 2,310 feet at the southeast edge of the basalt outcrop to a low point of 2,270 feet at the northeast corner of the southern addition. Three existing single-family residences, several outbuildings, driveways, and farm fields were observed.

The surface water conditions appeared consistent with our previous report. However, we observed a spring northwest of the shallow pond in proposed "Tract E" that was not observed in our previous site visit. The spring was characterized by wet, spongy ground with visible, flowing water extending approximately 130 feet from the source before disappearing below the ground surface.

GEOLOGIC HAZARDS

The Spokane County CAO (2018) requires evaluation of geologically hazardous areas, principally erosion, landslide, and seismic hazards (Section 11.20.030 Table A, and 11.20.070 d.2). The purpose of the ordinance is to discourage development in geologically hazardous areas unless proponents demonstrate that such areas can be developed consistent to acceptable standards for public health and safety.

Based on this ordinance, geohazard areas in Spokane County exhibit at least one of the following characteristics:

a. *A slope of 30 percent or greater;*
b. *Soils identified by Natural Resource Conservation Service (NRCS) as posing a severe potential for erosion (see Section 11.20.090L Appendix L);*
c. *Hydraulic factors such as existing on-site surface and groundwater or changes in hydraulic factors, caused by proposals that create a severe potential for erosion or landslide hazard;*
d. *Areas that historically have been prone to land sliding or with one of the following geologic formations: alluvium, landslide deposits, Latah Formation;*
e. *Areas of uncompacted fill;*
f. *Areas that are unstable as a result of rapid stream or stream bank erosion;*
g. *Seismic hazards include the following areas identified on the Liquefaction Susceptibility Map of Spokane County, Washington (source: Washington State Department of Natural Resources, Sept. 2004):*
    i. *For public buildings and public assembly buildings and uses those areas classified as having a liquefaction susceptibility of moderate; and*
    ii. *For all buildings and public assembly uses those areas classified as having liquefaction susceptibilities of "moderate to high", "high", or "peat deposit."*
h. *Seismic hazards include the following areas identified on the Site Class Map of Spokane County, Washington (source: Washington State Department of Natural Resources, Sept. 2004):*
i. *For public buildings and public assembly buildings and uses those areas classified as having a site class of "D"; and*
ii. *For all buildings and public assembly uses those areas classified as having a site class of "D to E", "E", or "F."*

Review of readily available information and our previous report, and recent site observations indicated components "a", "b", "c", "d", and "e" of the CAO, as described above, were observed on site. Other components of the CAO were not observed. Geohazards are further addressed in the following sections of the report.

DISCUSSION

Geologic hazards identified on the site, as defined by the CAO are slopes greater than 30 percent, soils identified by the NRCS as posing a severe potential for erosion, hydraulic factors such as existing on-site surface water, areas mapped as alluvium or Latah Formation, and areas of uncompacted fill. Due to these conditions, the viability of the project should be determined by a thorough geotechnical evaluation of slope stability and design to mitigate hazards. The extent of these hazards are delineated in *Figures 2-2*, to *2-6* utilizing Geographic Information System data obtained from the Washington State Department of Natural Resources and Spokane County.

Slopes greater than 30 percent were observed as cut slopes in borrow pits, rock outcrops, and the north-facing slope near the center of the site. Basalt outcrops were observed on the north-facing slope; signs of slope instability such as scarps or cracks were not observed. Slopes greater than 30 percent are illustrated in *Figure 2-2*.

We used the modified version of Universal Soil Loss Equation (USLE) outlined in Section 11.20.090 L Appendix L in the CAO to determine whether soils pose a severe potential for erosion. "*The index is a product of K times the average slope of the map unit (K*average slope). Slight has an index of less than or equal to 3.0 (less than 5 tons/acre/yr.), moderate has an index of 3.0 to 4.0 (5 to 8 tons/acre/yr.), and severe has and index greater than 4.0 (greater than 8 tons/acre/yr.)." Table 2* lists slopes that pose severe

potential for erosion based on the equation outlined above. The potential for erosion, based on parameters in *Table 2*, is illustrated in *Figure 2-3*.

Table 2. Modified USLE Index Parameters

K Factor, Whole Soil	Severe Potential for Erosion
0.05	Greater than 80 percent slopes
0.1	Greater than 40 percent slopes
0.15	Greater than 26.7 percent slopes
0.37	Greater than 10.8 percent slopes
0.49	Greater than 8.2 percent slopes

Two springs were observed on the north-facing hillside. Signs of streambank erosion were not observed. Shallow surface pools were observed on the southern half of the site. Springs and shallow pools should be considered in civil engineering design to provide adequate drainage. Observed hydraulic features are illustrated in *Figure 2-4*.

Latah Formation (*Ml*) is mapped by the Washington Department of Natural Resources (WSDNR) in the northeastern portion of the site. The *Ml* unit was observed outcropping in a railroad cut just east of the site. With the exception of the railroad cut, *Ml* outcrops were not observed on the site and was mapped on a relatively shallow, north-sloping bench. A geologic map of the site illustrating the location of the *Ml* unit is illustrated in *Figure 2-5*.

Quaternary alluvium (*Qal*) was mapped by Spokane County and illustrated in the web-based viewer in the northwest corner of the site. Although alluvium is mapped on the site by Spokane County, WSDNR did not include the *Qal* unit on published geologic maps and we encountered coarse-grained, well consolidated soils on gentle slopes in our subsurface explorations.

Undocumented fill was observed in previous subsurface explorations and during surface reconnaissance. Existing houses were observed on the western and southern ends of the site. Two abandoned homes were observed on the center and northern areas of the site. Undocumented and uncompacted fill should be anticipated surrounding the buildings, especially following demolition. Three borrow pits were observed on the south side of Thorpe Road and may contain undocumented fill. Two possible fill wedges were observed in the northern quarter of the property. LIDAR and the locations of suspected undocumented fill are illustrated in *Figure 2-6*.

While geologic hazard conditions are present within the proposed development, we conclude the project is feasible because these conditions can be managed through proper design, construction, and verification. Special considerations will need to be addressed by civil and structural engineers with respect to designing utilities, roads, and buildings on and directly adjacent to highly erodible soils, steep slopes, and hydraulic features.

Typical construction Best Management Practices and preservation of natural drainages are anticipated to be adequate to address soil erosion issues. Dust abatement will likely be necessary during grading activities and dry periods.

We recommend retaining qualified professionals to complete erosion and sediment control plans, civil engineering and stormwater design, and geotechnical exploration and analysis.

LIMITATIONS

The conclusions presented herein represent our professional opinions based on the limited scope of work performed to date. This report is intended for the sole use of our client for the purposes stated herein and should not be used by other parties for other purposes without contacting us to provide specific evaluation and recommendations. Specific geotechnical evaluation and design for construction is beyond the scope of this report.

The client should expect these services to have been completed in a manner consistent with the level of skill and care ordinarily exercised by members of the profession currently practicing in this area with similar budget and time constraints on projects of similar size and scope. No express or implied warranties are offered or made.

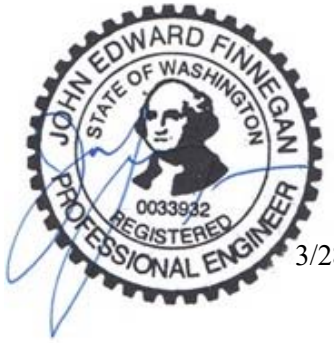
Be aware that geohazard evaluation reports do not substitute for geotechnical engineering evaluations to design earthwork, slopes, walls, roads, utilities, stormwater facilities, structures, and earthwork.

Please contact us if you have questions or concerns regarding the information presented herein.

Prepared by:
BUDINGER & ASSOCIATES, INC.

Jack Pappas, LG
Geologist

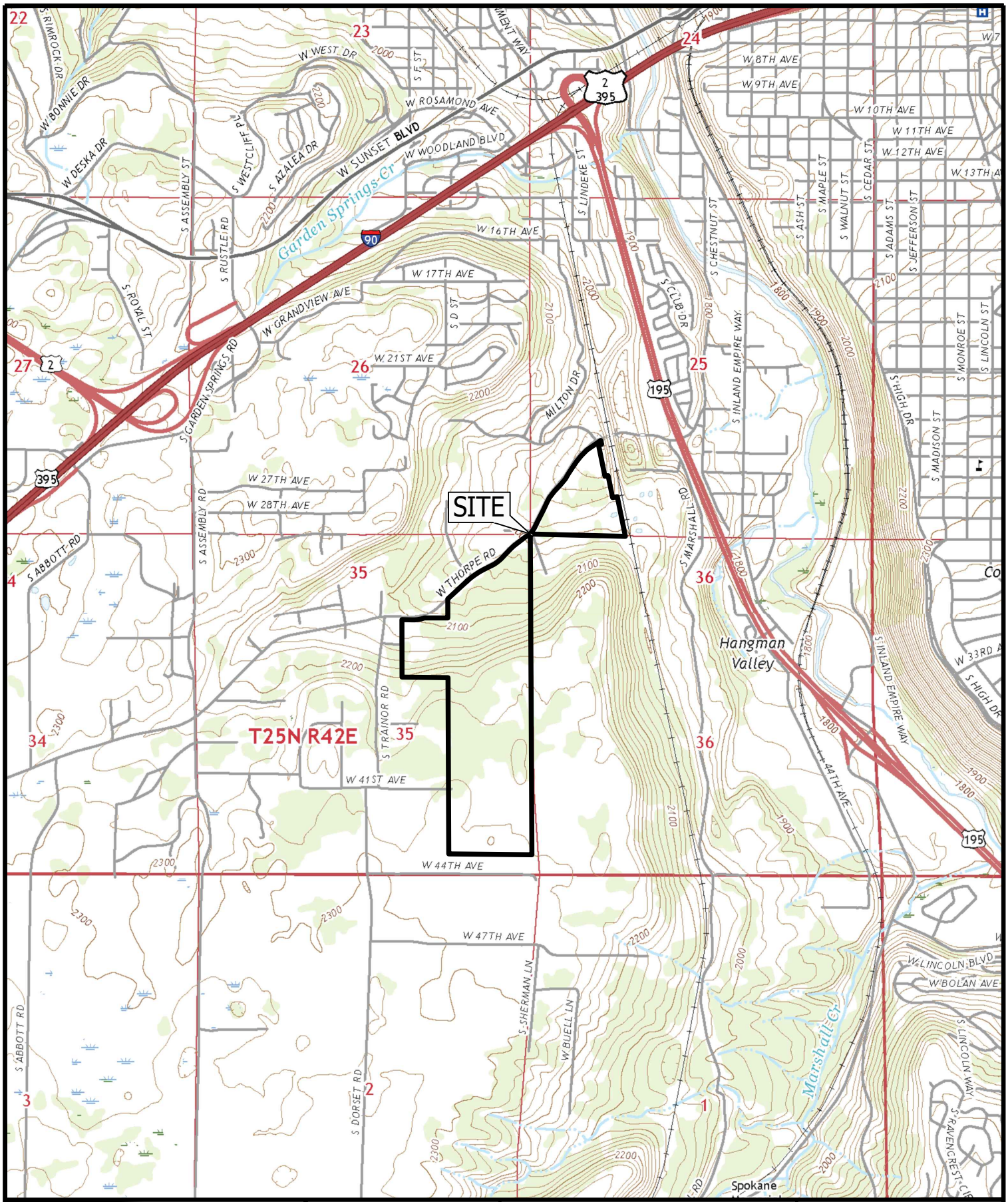
John Finnegan, PE, LEG, LHG
Geotechnical Engineer



3/28/2023

Attachments:

- **Figure 1: Vicinity Map**
- **Figure 2-1: Site Plan**
- **Figure 2-2: Slopes Greater than 30 Percent**
- **Figure 2-3: Erosion Potential**
- **Figure 2-4: Hydraulic Features**
- **Figure 2-5: Geologic Map**
- **Figure 2-6: LIDAR and Uncompacted Fill**
- **Appendix: *Important Information about This Geotechnical-Engineering Report***



N

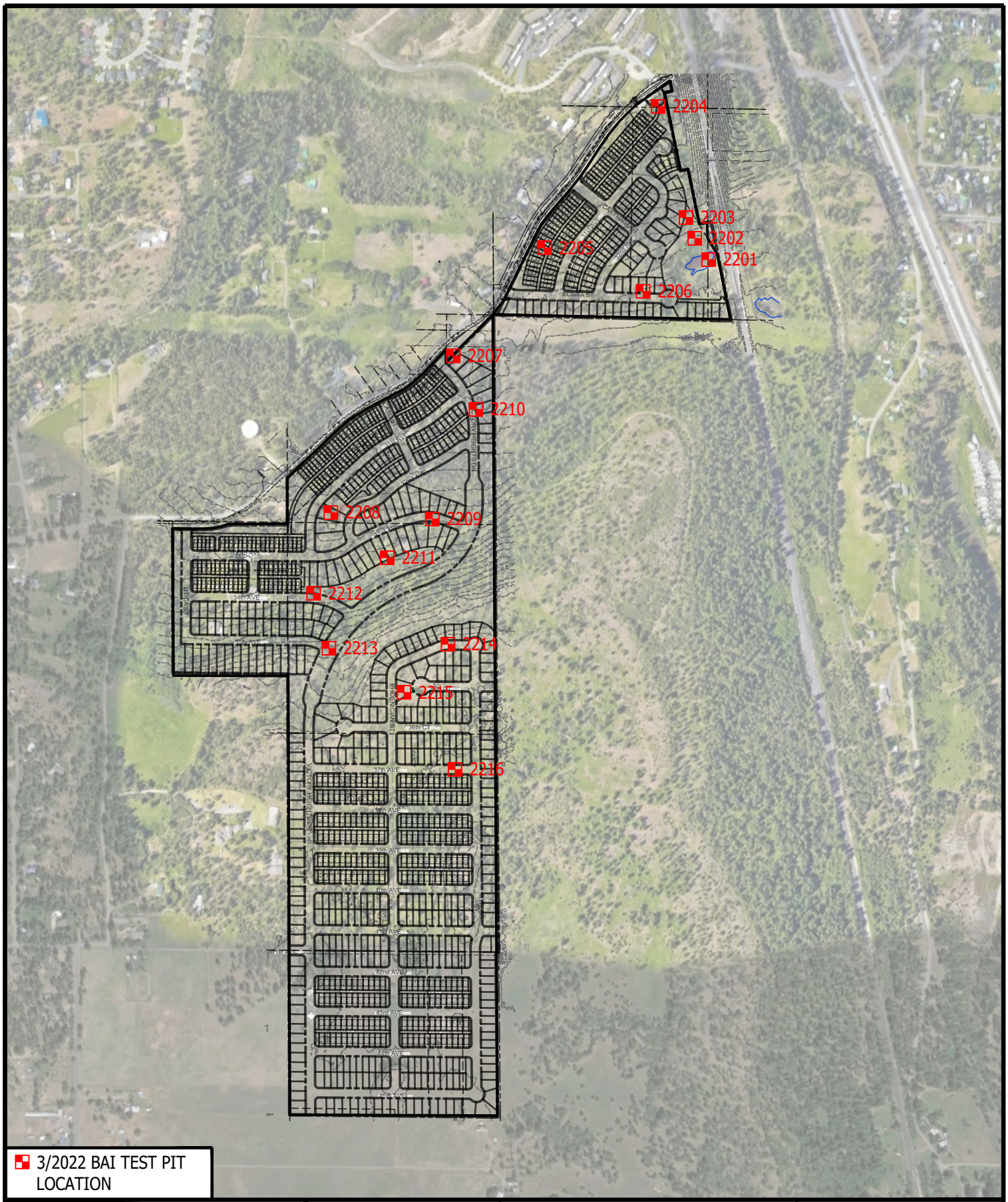
SCALE: 1"=2000'

0 1000 2000

SECTIONS 25 & 35
T 25 N R 42 E
USGS 2020

Budinger & Associates

VICINITY MAP	FIGURE 1
TRUE PROPERTY, VICTORY HEIGHTS SPOKANE, WASHINGTON	PROJECT NUMBER G22186
	DATE: 3/2023



N

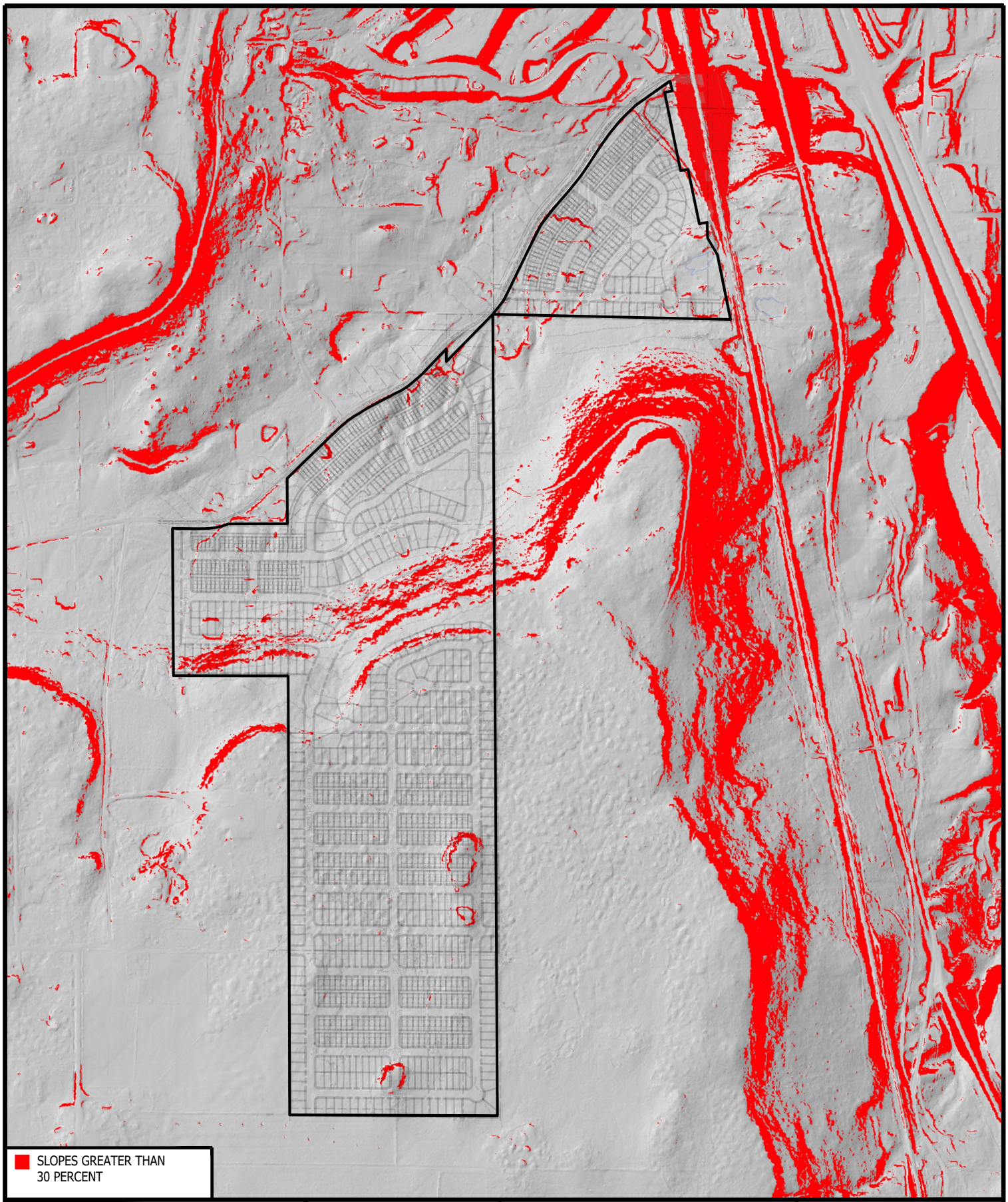
SCALE: 1"=800'

0 400 800

PLANS PROVIDED BY: WCE, 12/12/2022

Budinger & Associates

SITE PLAN	FIGURE 2-1
TRUE PROPERTY, VICTORY HEIGHTS SPOKANE, WASHINGTON	PROJECT NUMBER G22186
	DATE: 3/2023



N

SCALE: 1"=800'

0 400 800

LIDAR PROVIDED BY:
WADNR, 2015

Budinger
& Associates

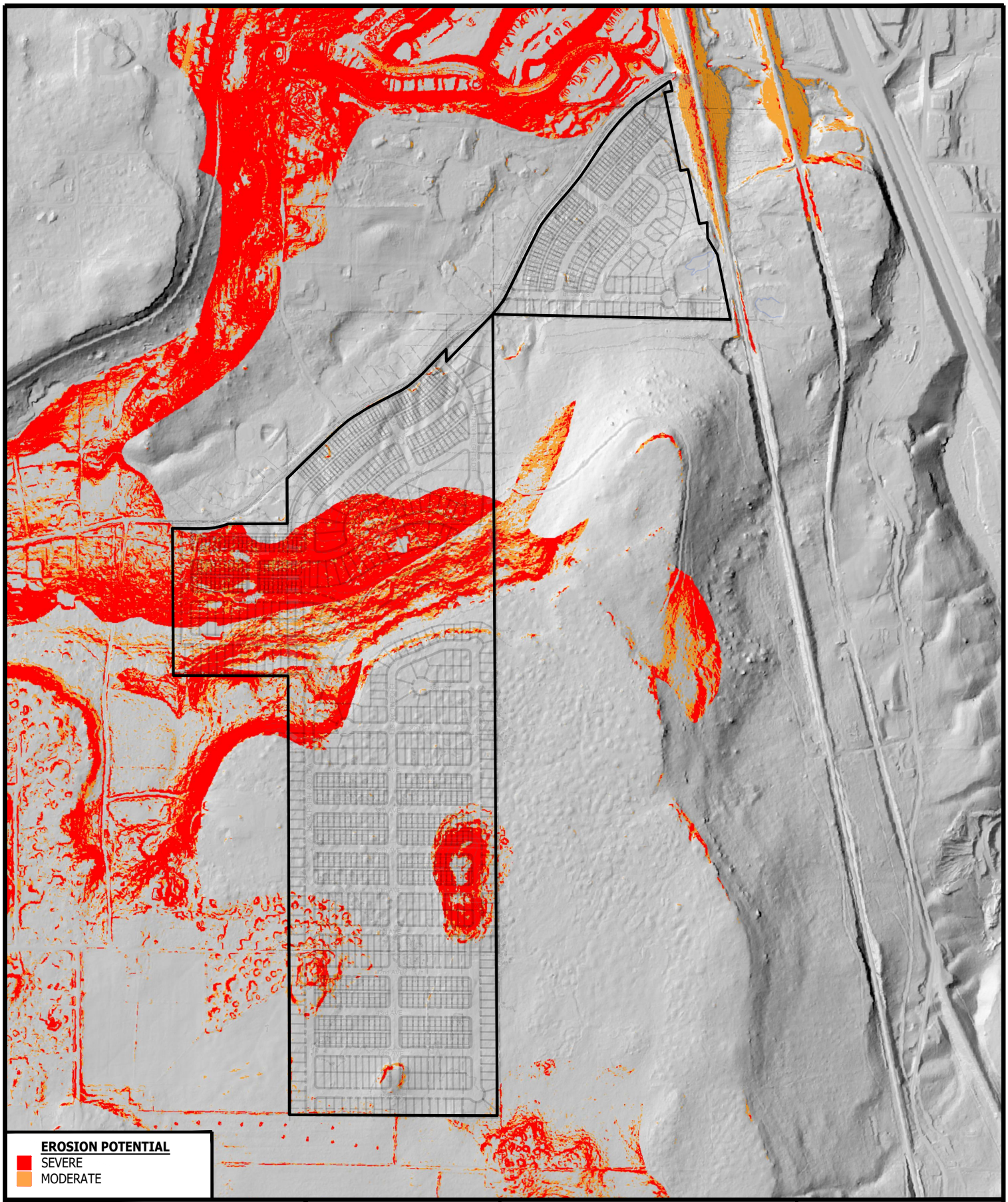
SLOPES GREATER THAN 30%

TRUE PROPERTY, VICTORY HEIGHTS
SPOKANE, WASHINGTON

FIGURE 2-2

PROJECT NUMBER G22186

DATE: 3/2023



N

SCALE: 1"=800'

0 400 800

LIDAR PROVIDED BY: WADNR, 2015

Budinger & Associates

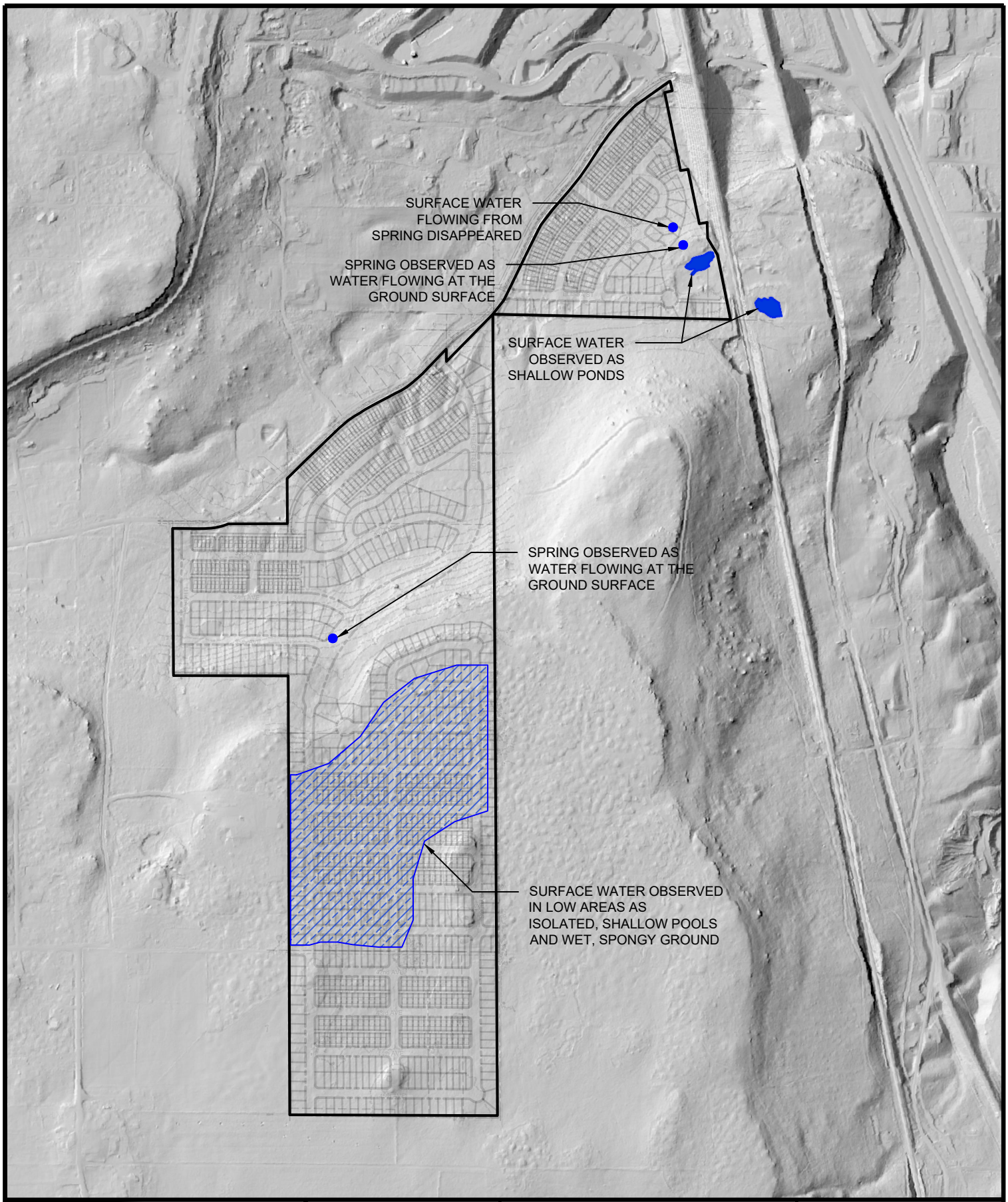
EROSION POTENTIAL

TRUE PROPERTY, VICTORY HEIGHTS
SPOKANE, WASHINGTON

FIGURE 2-3

PROJECT NUMBER G22186

DATE: 3/2023



N

SCALE: 1"=800'

0 400 800

LIDAR PROVIDED BY: WADNR, 2015

Budinger & Associates

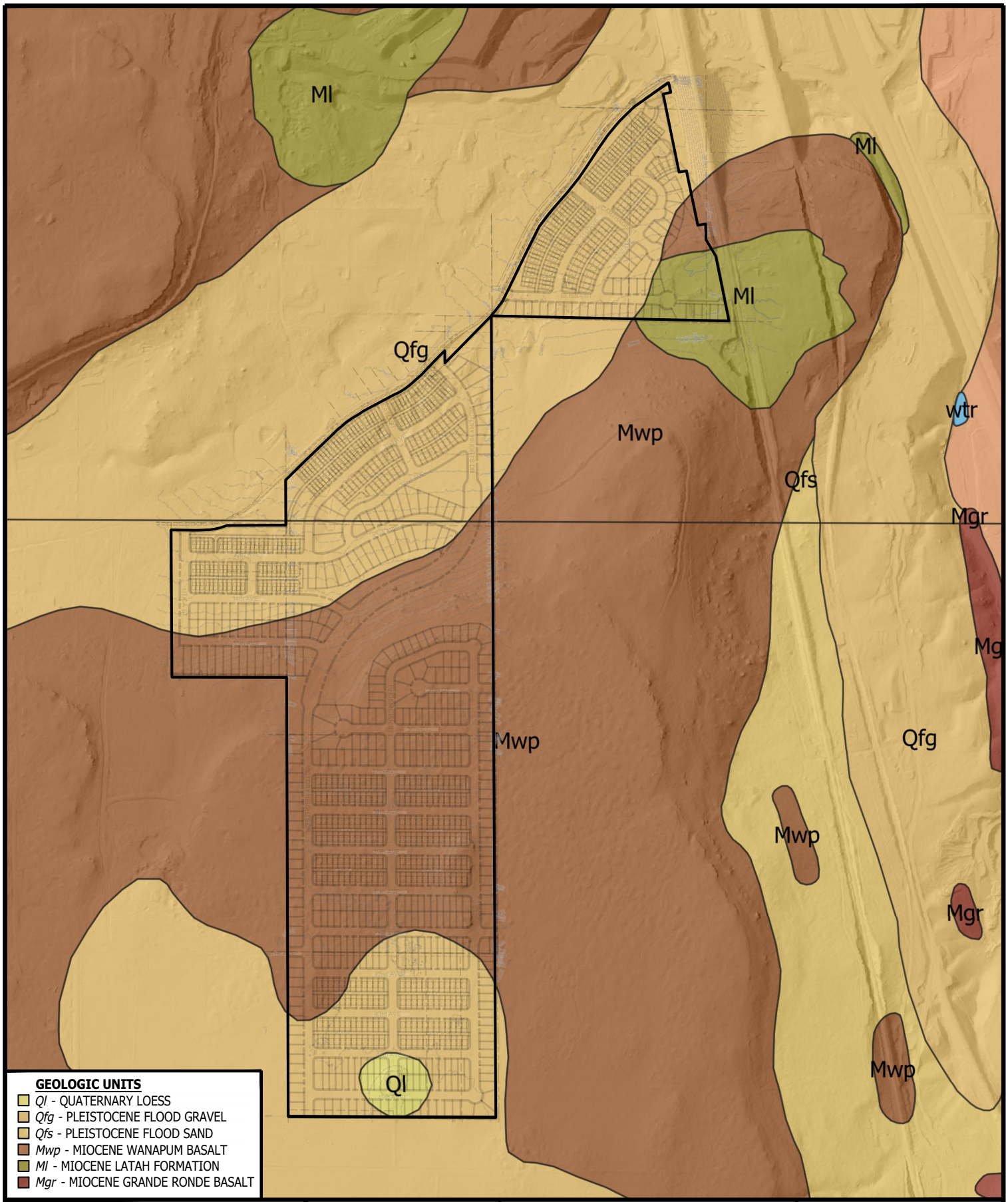
HYDRAULIC FEATURES

TRUE PROPERTY, VICTORY HEIGHTS
SPOKANE, WASHINGTON

FIGURE 2-4

PROJECT NUMBER G22186

DATE: 3/2023



N

SCALE: 1"=800'

0 400 800

GEOLOGIC MAP PROVIDED BY: WADNR, 2004
LIDAR PROVIDED BY: WADNR, 2015

Budinger & Associates

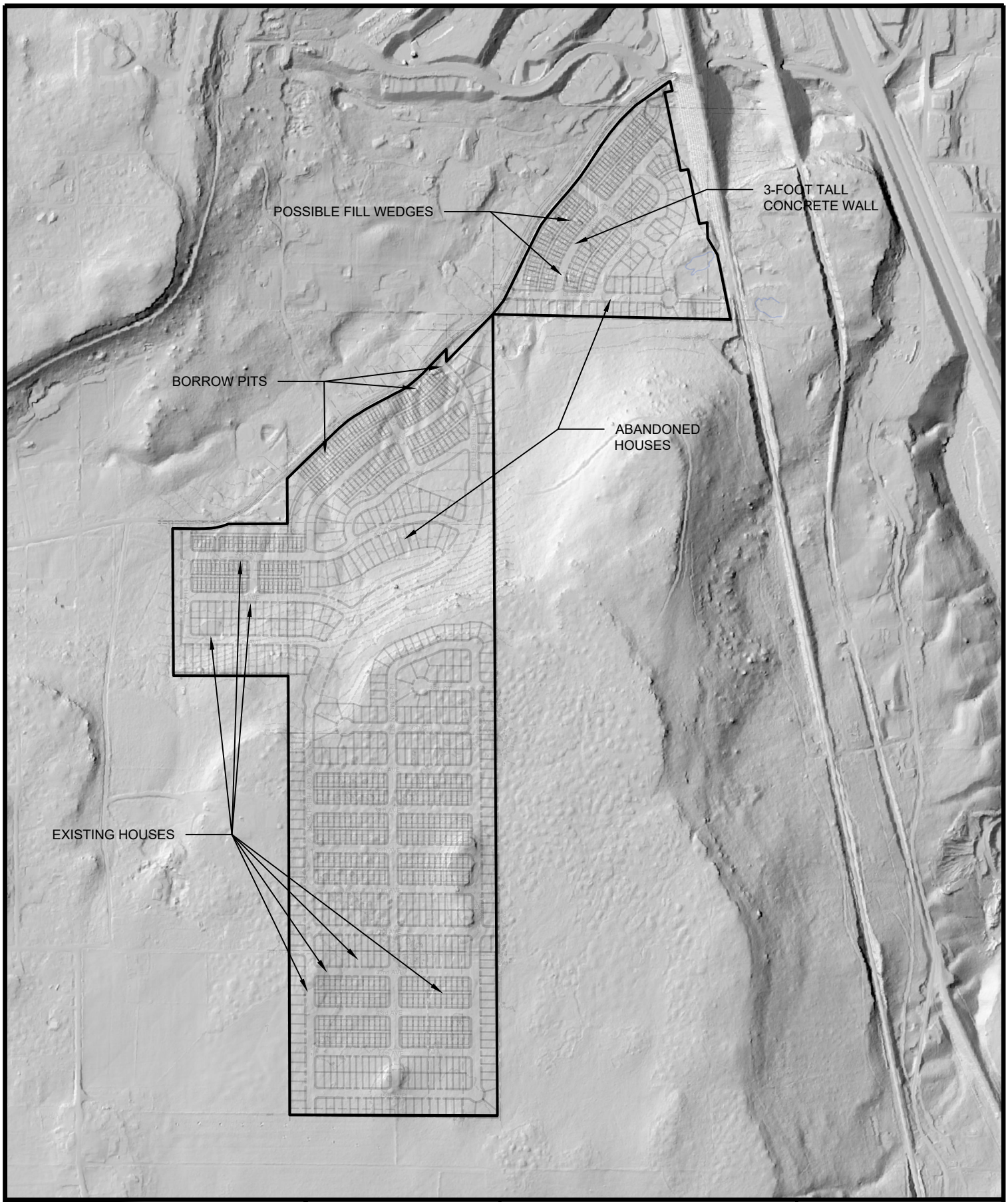
GEOLOGIC MAP

TRUE PROPERTY, VICTORY HEIGHTS
SPOKANE, WASHINGTON

FIGURE 2-5

PROJECT NUMBER G22186

DATE: 3/2023



N

SCALE: 1"=800'

0 400 800

LIDAR PROVIDED BY:
WADNR, 2015

Budinger
& Associates

LIDAR AND UNCOMPACTED FILL

TRUE PROPERTY, VICTORY HEIGHTS
SPOKANE, WASHINGTON

FIGURE 2-6

PROJECT NUMBER G22186

DATE: 3/2023

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly

problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.

GEOTECHNICAL BUSINESS COUNCIL
of the Geoprofessional Business Association

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@geoprofessional.org www.geoprofessional.org