TETRA TECH

MEMO

To:	Jason Rice, P.E., Territorial-Landworks, Inc.
Cc:	Alan McCormick
From:	Jeremy Dierking, P.E.
Date:	April 1, 2019
Subject:	Review of Geotechnical Report – Hillview Crossing Project, Missoula, Montana

Tetra Tech has been retained to provide third-party review of the geotechnical report for the above referenced project. The following documents were provided to Tetra Tech for review:

- Updated Geotechnical Evaluation Report, dated December 3, 2015 by SK Geotechnical
- Preliminary Site Plan and Typical Cross Sections, dated April 19, 2018 (attached for reference)
- Memo No. 4, dated March 11, 2019 to the City Council from Mary McCrea, Development Services

Tetra Tech performed a general review of the above documents with respect to the project's current preliminary mass grading, utilities, and roadway design. General comments on the report are as follows:

In general, the geotechnical report appears to be appropriate for the scope of project site development. Slope stability analyses were performed on the maximum cut and fill slope cross-sections, which indicated acceptable factors of safety for both static and seismic conditions. Detailed geotechnical recommendations for site grading, including; topsoil stripping, embankment construction with keyed benches and toe keyways with geogrid reinforcement, fill material and compaction, cut slopes, seepage, utility installation, pavement sections, and drainage. Detailed recommendations for earthwork observation, quality assurance/quality control inspection and testing, and subgrade preparation and stabilization were also provided in the report. In our opinion, the report satisfactorily addresses the key geotechnical issues identified for the project scope at the time of report preparation.

Current preliminary site grading plans do not appear to have not substantially changed since preparation of the report in 2015. Notable exceptions include; 1) an approximately 270-foot long retaining wall with a max height of approximately 7.5 feet, and 2) a stormwater detention tank near the toe of the slope below the mass site grading area.

Tetra Tech understands the City of Missoula's concern is that the geotechnical report does not address the following primary items related to the current preliminary grading plans and should be updated to include; 1) geotechnical evaluation and recommendations for the proposed retaining wall, 2) geotechnical evaluation and recommendations for the proposed stormwater detention tank, and 3) geotechnical evaluation and recommendations for topsoil stockpile staging locations. In our opinion, the geotechnical report can be updated to satisfactorily address the above items and general comments on these items are provided below.

The preliminary retaining wall and stormwater detention tank layout appears to be feasible based on the subsurface conditions presented in the 2015 report. The proposed retaining wall will be located in the native cut slope and is

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anticipated to perform as desired provided it is designed to meet standard retaining wall design factors of safety for global stability, overturning, and sliding, and includes appropriate drainage behind the wall.

The proposed stormwater detention tank will be mostly below grade and the net difference between the weight of the existing soil in place and the maximum weight of the tank is anticipated to be low enough that the slope factor of safety would not decrease below acceptable values. The proposed configuration and weight of the tank should be evaluated with respect to the slope to verify the factor of safety as part of the final geotechnical report.

Topsoil stockpile staging should be located in designated areas deemed appropriate by the geotechnical engineer. The slope stability analyses in the report included boundary loads of 1,000 pounds per square foot (psf) to represent future residential structure loads and indicated acceptable factors of safety. A topsoil stockpile with a height of 8 ft or less would not exceed the 1,000 psf load modeled in the stability analyses. In our opinion, topsoil stockpiles located on the benches excavated in native soils at the end of the roadways would be acceptable. Based on discussions with the project team, stormwater runoff during construction will be properly administered by the project Stormwater Pollution Prevention Plan (SWPPP), included installation of temporary lined swales to provide drainage and prevent infiltration into fill slopes.

The geotechnical report states that cut and fill slopes can be constructed at maximum slopes of 2.5H:1V but also states that 3H:1V slopes are generally considered the practical maximum for maintenance operations, erosion control, and safety. It is Tetra Tech's opinion that 2.5H:1V slopes can be designed and maintained with appropriate landscaping and erosion control to provide long term performance.

Tetra Tech understands there has been some discussion on widening the streets, which may shift the lower downhill lots to the north (downslope), resulting in footing elevations bearing within the new fill slopes, which is a concern for long term foundation settlement. This concern can be mitigated by various alternatives, including; 1) extending footing walls down through the fill and bear footings on native soils, or 2) bearing footings on helical piers or similar structural foundation elements extending through the fill and into the native soils.

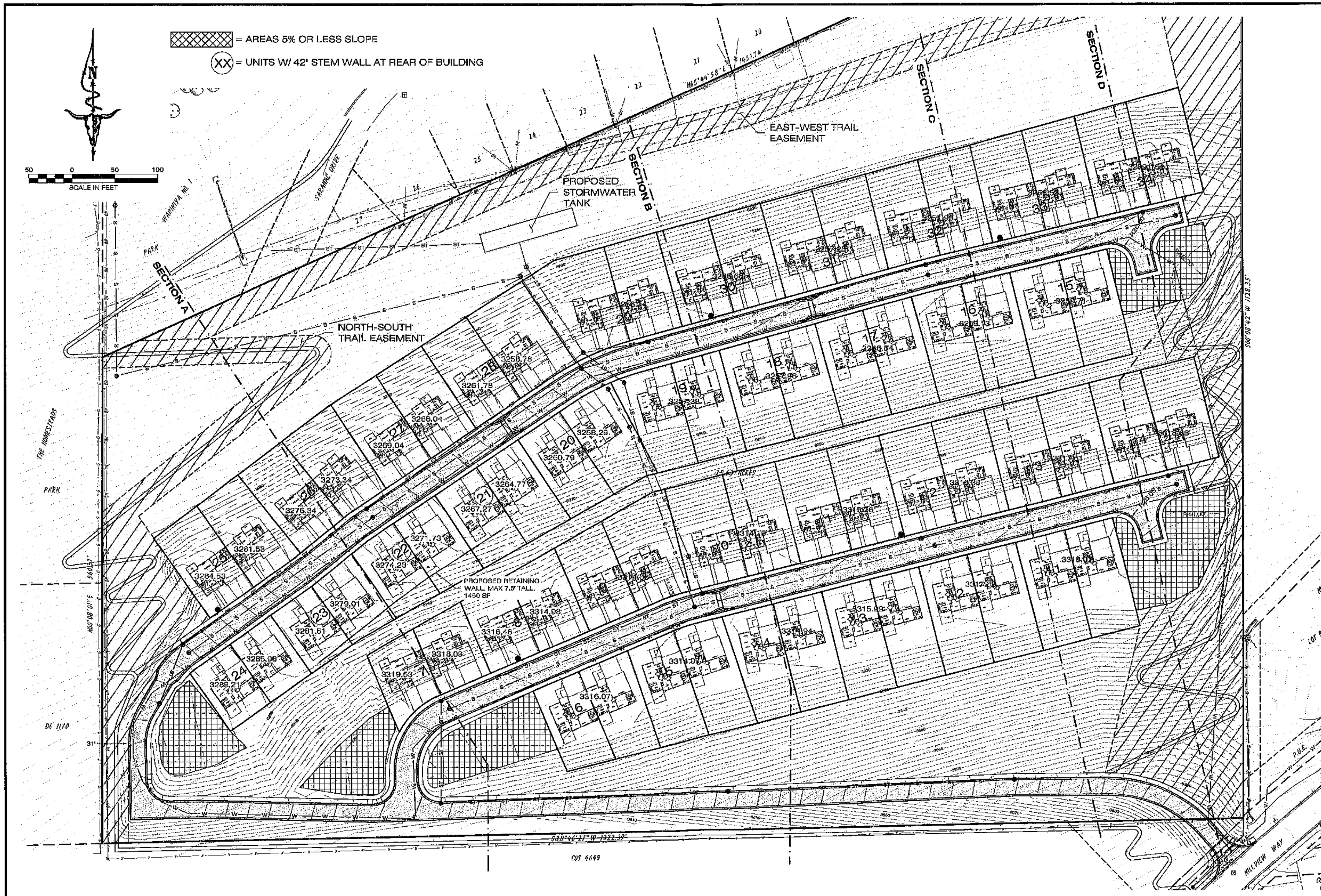
Foundations bearing adjacent to slopes are typically designed to include a minimum setback distance from the edge of slope. The setback distance is dependent on several factors, including; foundation depth, foundation width, soil type, and slope angle. In this case, a setback distance on the order of four times the foundation width is likely appropriate. It should be noted that foundation recommendations for buildings were not included in the geotechnical report and that the report recommends individual geotechnical reports for each individual residence.

Tetra Tech understands the City was concerned about the expiration date stated in SK's report. If Tetra Tech is retained to complete an updated geotechnical investigation and report, a report expiration date will not be included, provided the subsurface conditions and project details are not substantially different than those detailed and SK's previous investigation and report.

This memo is intended solely to provide a general review and comment on the project geotechnical report and is not intended to change or supplement the geotechnical report in any respect. SK Geotechnical is the current Geotechnical Engineer of Record.

Prepared by:

Jeremy Dierking, P.E.
Project Geotechnical Engineer



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P.O. Box 3851
Missoula, MT 59806

REVISIONS	DATE

DESIGNED:
DRAFTED: JW
CHECKED:
DATE: 4/19/2018

LOCATION: CITY OF MISSOULA, 12N, 19W, S6, MISSOULA COUNTY, MONTANA

PREPARED FOR: HILLVIEW CROSSING, LLC.

PROJECT NAME: HILLVIEW CROSSING - MISSOULA

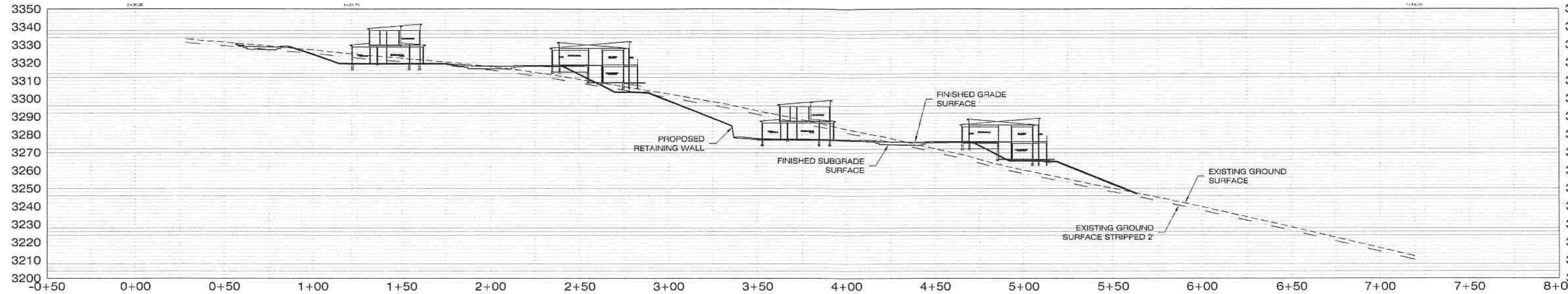
SHEET TITLE: SITE PLAN

PROJECT NO.: 14-3592

SHEET: 1 OF 1

PRELIMINARY

Alignment: SECTION A
Vert Exaggeration: 1:1



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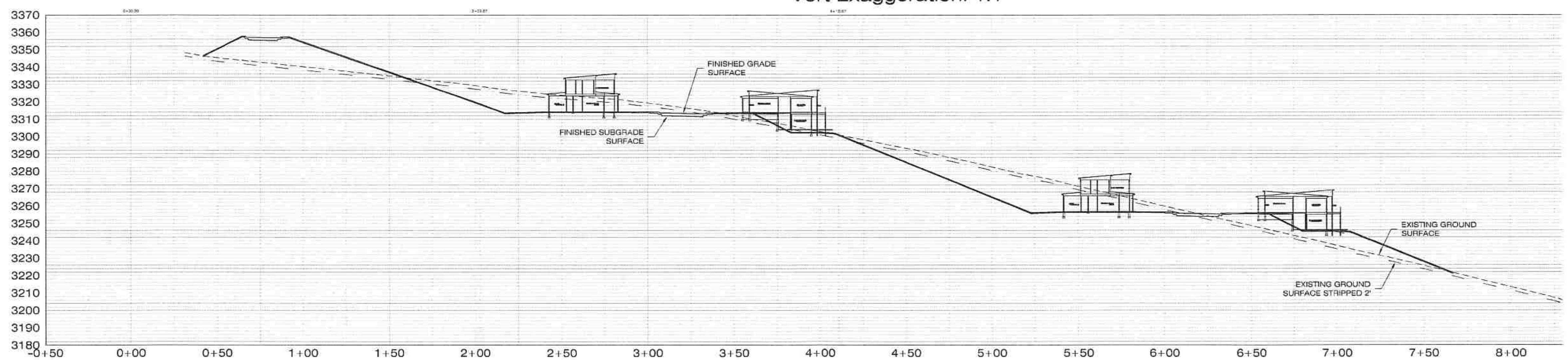
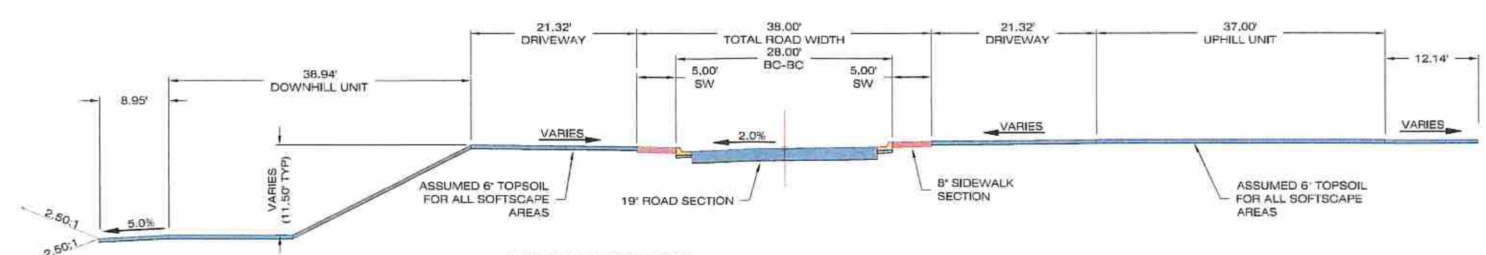
Vert Exaggeration: 1:1





GRADING ASSUMPTIONS:
- EACH DOWNHILL LOT WILL PRODUCE ~50 CY OF MATERIAL FOR BUILDING DIG-OUT
- NO FINISHED GRADE SLOPES OVER 2.5:1 OTHER THAN ON THE SOUTH SIDE OF ENTRY ROAD AND BENCHES WHERE BUILDINGS WILL BE BUILT
- ASSUMED 8.25' REVEAL FROM FINISHED FLOOR TO FG
- PER GEOTECH REPORT THERE WILL BE AN AVERAGE 2' OF TOPSOIL STRIPPING ACROSS THE SITE
- FINISHED FLOOR ELEVATIONS WERE SET ASSUMING MAX DRIVEWAY SLOPE OF 8% AND MIN OF 1%
- ELEVATION DIFFERENCE BETWEEN FINISHED FLOOR AND BASEMENT FLOOR IS 9.85'
- DOWNHILL LOTS WERE GRADED WITH THE ASSUMPTION OF A 2.5' REVEAL FROM BASEMENT EL TO FINISHED GRADE

TYPICAL LOT GRADING SCHEMATIC

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REVISIONS | DATE

DESIGNED: NL
DRAFTED: BD
CHECKED:
DATE: 08/14/2015

LOCATION: CITY OF MISSOULA 12N, 19W, S6 MISSOULA COUNTY, MONTANA

PREPARED FOR: DJ HOLDINGS

PROJECT NAME: HILLVIEW CROSSING - MISSOULA

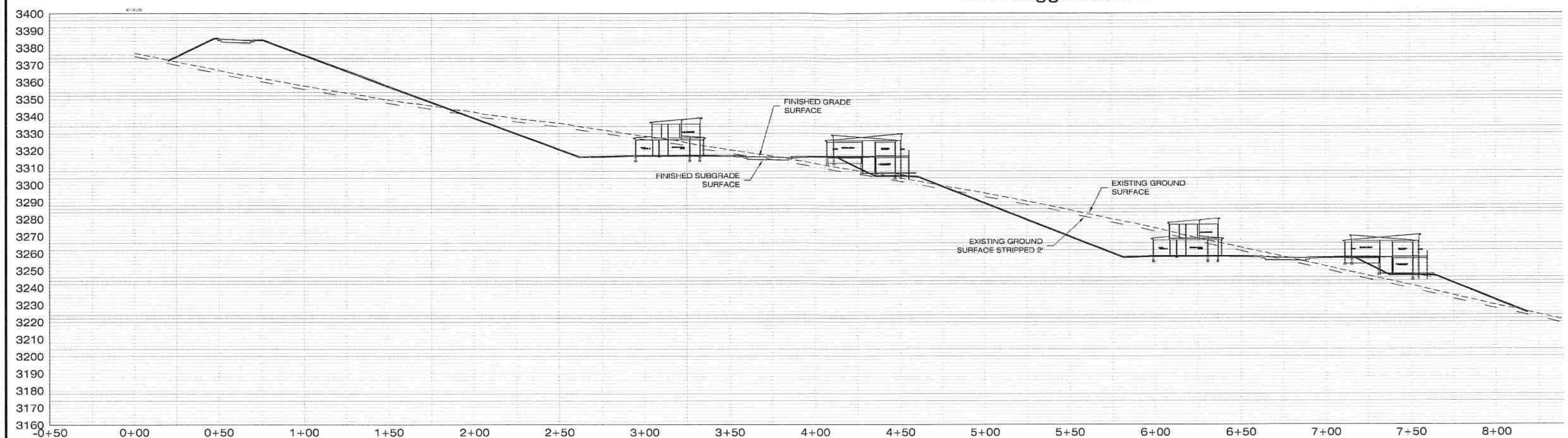
SHEET TITLE: TYPICAL CROSS SECTION

PROJECT NO. 14-3592

SHEET: 1 OF 1

PRELIMINARY

Alignment: SECTION C
Vert Exaggeration: 1:1



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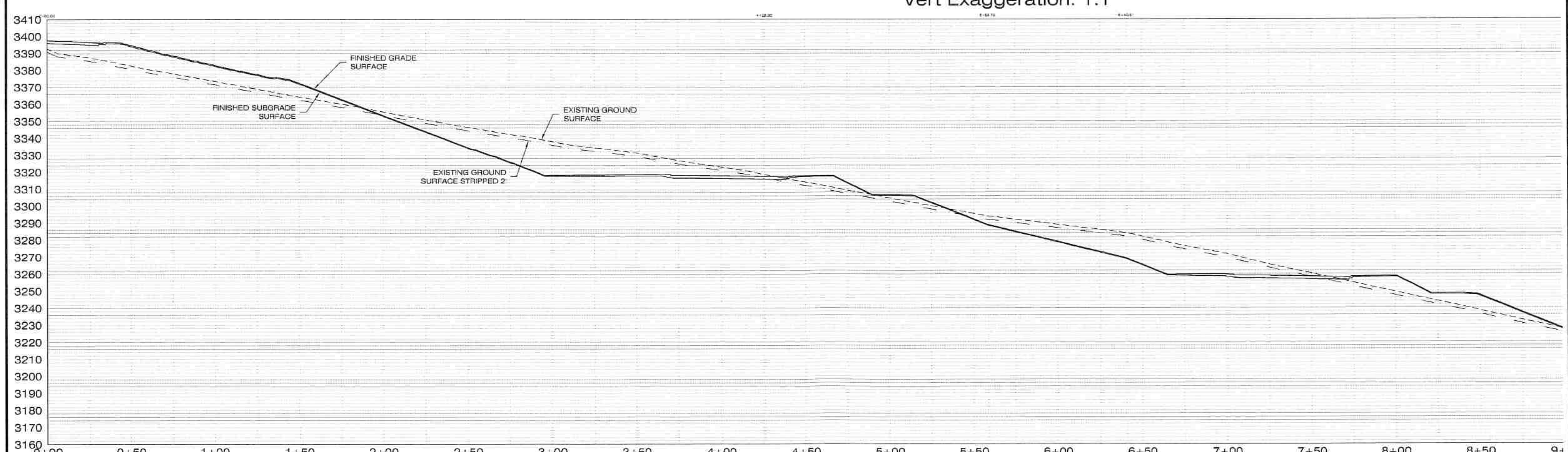
Vert Exaggeration: 1:1



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