

April 4, 2018

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Attn: Drew Balsick

Re: Detention Ponds
Flying Horse North, Filing No. 1
El Paso County, Colorado

Dear Mr. Balsick:

The detention ponds to be constructed within the Flying Horse North Subdivision, Filing No. 1 are located in Tracts B, E, F, I, and P as shown on the Flying Horse North Filing No. 1 Drainage Improvement Plans prepared by Classic Consulting Engineers & Surveyors, dated November 21, 2017. Figure 1 shows the locations of the proposed detention facilities. The proposed subdivision is located north of Holmes Road in Black Forest, El Paso County, Colorado. Entech Engineering, Inc. prepared a Soil, Geology, Geologic Hazard, and Wastewater Study for this property, dated November 20, 2017, Job No. 171606 with reported findings and development recommendations. This letter provides recommendations for constructing the detention ponds based on our previous investigations, laboratory testing, and requirements specified in the El Paso County Engineering Criteria Manual and the El Paso County Drainage Criteria Manual. This letter should be used in conjunction with future County submittals for this development.

Five ponds are proposed on five separate tracts within this filing of the proposed subdivision. The pond designations; locations; test borings, test pits, or profile holes drilled or excavated within the vicinity of the proposed ponds; and jurisdictional entities are tabled below.

Name of Facility	Tract Designation	Soil Sampling	Jurisdictional Entity
Detention Facility No. 1	Tract B	TP-1	El Paso County
Detention Facility No. 12	Tract E	TB-5, TP-9	El Paso County
Detention Facility No. 4	Tract F	TP-4, PH-13	El Paso County
Detention Facility No. 8	Tract I	TB-3, TP-6	El Paso County
Irrigation Reservoir	Tract P	TP-10, PH-10	Colorado DWR

The soils in the vicinity of the individual County jurisdictional ponds are described below. Notably, the irrigation reservoir proposed within Tract P will require a large earthen embankment dam which is a State jurisdictional structure. The irrigation reservoir dam design is currently under review by the Colorado Division of Water Resources - Office of the State Engineer (SEO) - Dam Safety Branch and will not be addressed in this letter. The irrigation reservoir dam will be approved by the SEO Dam Safety Branch prior to construction.

SP-17-012

Detention Facility No. 1

Soils recovered in the vicinity of Detention Facility No. 1 (Tract B) consisted of clayey sand overlying slightly silty sand with underlying highly weathered sandstone. Groundwater was not encountered in the test pit. The maximum height of the pond embankment will be approximately 8 feet on the west side of the pond and cut into the native soils approximately 8 feet on the east side of the pond based on the grading plans.

Laboratory testing on a sample of the slightly silty sand obtained from Test Pit No. 1 at a depth of 3 feet determined the soil to contain 5.9 percent of the materials passing a No. 200 sieve (SM-SW).

Detention Facility No. 12

Soils recovered in the vicinity of Detention Facility No. 12 (Tract E) consisted of areas of sandy clay and highly weathered silty sandstone overlying clayey sandstone. The sandstone was encountered at 4 and 13 feet below the existing ground surface in the test pit and test boring, respectively. Groundwater was not encountered in the test pit or test boring. The maximum height of the pond embankment will be approximately 4 feet on the north side of the pond and cut into the native soils approximately 2 to 4 feet on the south side of the pond based on the grading plans.

Laboratory testing on a sample of the silty sand obtained from Test Boring No. 5 at a depth of 2 to 3 feet determined the soil to contain 22.3 percent of the materials passing a No. 200 sieve (SM), a Liquid Limit of 22 and a Plastic Index of 3. Laboratory testing on a sample of the silty sand obtained from Test Pit No. 9 at a depth of 6 feet determined the soil to contain 16.8 percent of the materials passing a No. 200 sieve (SM).

Detention Facility No. 4

Soils recovered in the vicinity of Detention Facility No. 4 (Tract F) consisted of silty sand overlying areas of thin sandy clay lenses with underlying silty sandstone. The sandstone was encountered at 1 and 5 feet below the existing ground surface in the profile hole and test pit, respectively. Groundwater was not encountered in the profile hole of test pit. The maximum height of the pond embankment will be approximately 4 to 6 feet on the south side of the pond and cut into the native soils approximately 10 to 14 feet on the north side of the pond based on the grading plans.

Laboratory testing on a sample of the silty sandstone obtained from Profile Hole No. 13 at a depth of 5 feet determined the soil to contain 20.0 percent of the materials passing a No. 200 sieve (SM).

Detention Facility No. 8

Soils recovered in the vicinity of Detention Facility No. 8 (Tract D) consisted silty clayey sand and highly weathered silty sandstone overlying clayey sandstone and silty sandstone. The sandstone was encountered at 5 and 9 feet below the existing ground surface in the test pit and test boring, respectively. Groundwater was not encountered in the test pit or test boring. The maximum height of the pond embankment will be approximately 6 to 8 feet on the south side of the pond and cut into the native soils approximately 8 to 10 feet on the north side of the pond based on the grading plans.

Laboratory testing on a sample of the silty sand obtained from Test Boring No. 3 at a depth of 2 to 3 feet determined the soil to contain 84.8 percent of the materials passing a No. 200 sieve (CL), a Liquid Limit of 32 and a Plastic Index of 13. Laboratory testing on a sample of the silty sandstone obtained from Test Boring No. 3 at a depth of 10 feet determined the soil to contain 23.8 percent of the materials passing a No. 200 sieve (SM), a Liquid Limit of no value and non-plastic. Laboratory testing on a sample of the silty sand obtained from Test Pit No. 6 at a depth of 4 feet determined the soil to contain 16.7 percent of the materials passing a No. 200 sieve (SM).

Embankment Construction

Detention Facility Nos. 1, 4, 8, and 12 design parameters and geometry shall conform to the requirements specified in the El Paso County Engineering Criteria Manual and the El Paso County Drainage Criteria Manual. Native sand and sandstone were relatively similar in structure and will likely be exposed based on our soil investigations at each detention facility site, with a soil bearing capacity of 2,400 psf anticipated for the well compacted native sands, and 3,500 psf for the undisturbed sandstone. It is likely that the site soils will be thoroughly mixed during pond construction. The soils on Tract B may require mixing with soils from another Tract or within the subdivision to increase the fines content of the soil prior to fill placement. The pond embankment foundations shall be fully exposed and observed by personnel of Entech prior to placing any embankment fill. Mitigation requirements, if any, shall be completed prior to constructing each detention facility. The subgrade of each embankment area shall be scarified, moisture conditioned, and compacted prior to fill placement. Groundwater is not expected at the proposed excavated depths. All fill placed in the embankments should be approved prior to placement.

Pond embankment soils consisting of site soils from each Tract, and soils likely requiring mixing on Tract B, should be placed in lifts to exceed 6 inches following compaction and compacted to at least 95 percent of the maximum Dry Density determined by Modified Proctor (ASTM D-1557). Clay materials should be placed in compacted lifts less than 6 inches thick compacted to at least 95 percent of maximum Standard Proctor (ASTM D 698) Dry Density. Pond embankment fill deeper than 10 feet should be moisture conditioned as above and compacted to 98 percent of Standard Proctor Dry Density (ASTM D 698) for cohesive materials or 98 percent of maximum Modified Proctor Dry Density (ASTM D 1557) for granular materials. The soil materials should be placed at a moisture content conducive to adequate compaction, usually within ± 2 percent of optimum moisture content for cohesionless soil and 0 to 3 percent of optimum moisture

content for cohesive soil. Fill placement and compaction should be observed and tested by Entech during construction to verify that adequate moisture and density has been achieved.

Based on the suggested compaction efforts for the pond embankment soils and the expected foundation soils exposed at each facility site, it is likely that embankment settlement will be less than 3 percent of the embankment height. The soils used to construct the pond embankments should perform adequately for the proposed 3:1 and 4:1 slopes. Routine pond maintenance and maintaining shallow rooting vegetation on the embankment faces will be very important to prevent damage to the embankment due to wind and surficial runoff erosion. Seepage through the embankment should be minimal due to the limited detention time.

We trust this letter has provided you with the information required to construct the proposed detention ponds. If you have any questions or need additional information, please do not hesitate to contact us.

Respectfully Submitted,

ENTECH ENGINEERING, INC


Stan C. Culp, P.E.
Senior Engineer



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Entech Job No. 171606
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Reviewed By:


Joseph C. Goode, Jr., P.E.
President

