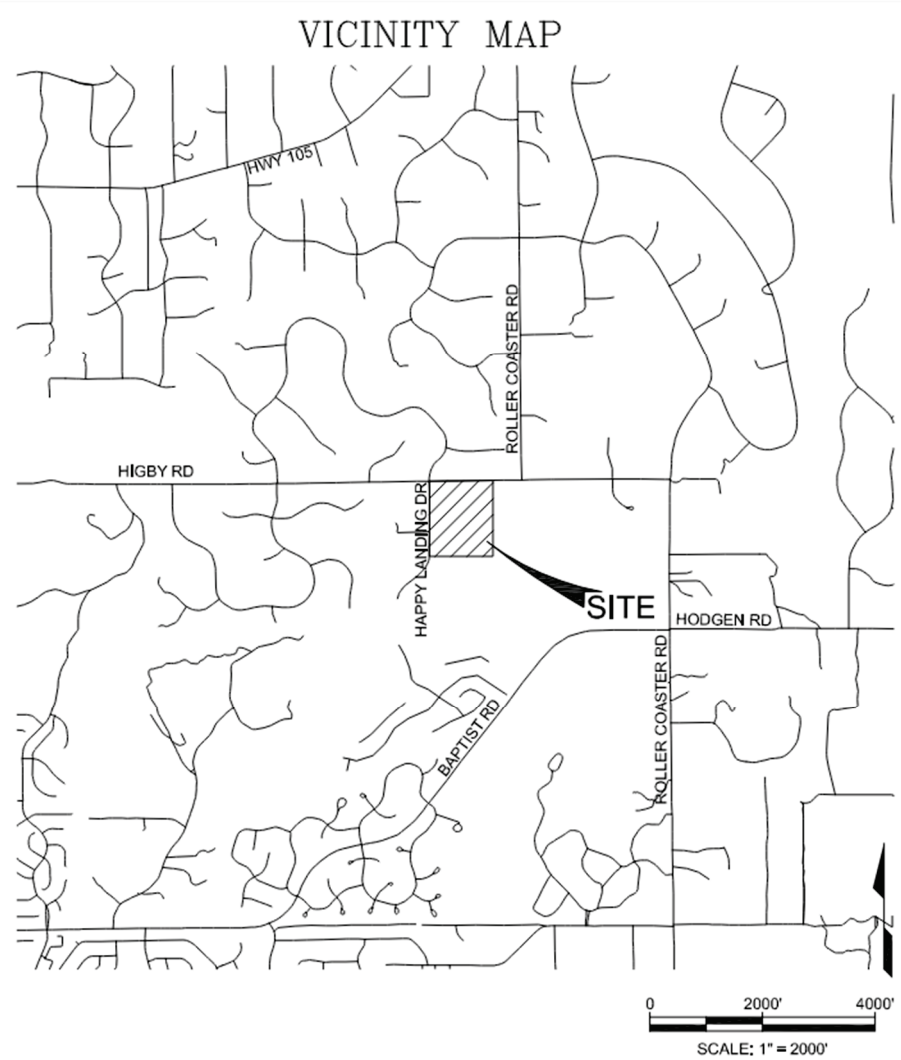
NOTE: This is reprint of pages 4 - 11 of 2N Engineering Drainage Report

A. INTRODUCTION

This Drainage Report presents the final drainage plan and design characteristics for the proposed development known as Aspen Willow Estates located approximately 3 miles southeast of the Town of Monument, Colorado. This report was prepared in accordance with the El Paso County Storm Drainage Criteria Manual and the Mile High Flood District.

Location

Aspen Willow Estates is a request to subdivide a 35-acre property into 3 – 5 acre lots and 1 – 20-acre lot. The development is in the southeast quarter of Section 20, Township 11 South, Range 66 West of the 6th Principal Meridian, El Paso County, State of Colorado. The project is bounded by Higby Road to the north, Happy Landing Drive to the west, and agricultural land to the south and east. See Vicinity Map below.



Description of Property

The property contains an existing house, barn, gravel driveway, and other buildings supporting a horse facility. The site is approximately 35 acres. The site is served by well and septic for water and sewer. The existing ground cover on the site is composed of native grasses with a stand of Ponderosa Pine trees on the west 7-8 acres. The site generally slopes from west to east ranging from 2 to 10 percent grade. The property will be subdivided into four lots and create a single private driveway to serve the lots with a hammerhead turnaround at the end. The soil types present onsite are presented on the table below as designated by the Natural Resources Conservation Service.

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	B	0.1	0.3%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	B	34.9	99.7%
Totals for Area of Interest			**35.0**	**100.0%**

Group B soils have a moderate infiltration rate when thoroughly wet and a moderate rate of water transmission. Please see Appendix B for additional soils information from NRCS.

Proposed Development

The proposed development will include 4 lots, 3- 5 acre lots and 1-20 acre lot. The guidance from Mile High Flood District and El Paso County Criteria suggest an impervious value of 20% which would lead to approximately 7 acres of land that would be distributed in the proposed development. This value is conservative for a 5-acre lot and would assume 1 acre (20% of 5 acres) of impervious surface on each of the 3-5 acre lots. After completing many plot and drainage plans on lots throughout Douglas, Elbert and El Paso Counties, we would expect an actual impervious value of 9% or less. Further discussion is contained in the proposed basins below.

B. DRAINAGE BASINS

Overall Basin Description

The proposed development is outside of any mapped flood area according to FEMA FIRM for El Paso County, Colorado Panel 0285, Map Number 08041C0285G with the effective date of December 07, 2018. The property is upstream of an unnamed tributary of West Cherry Creek. See map below.

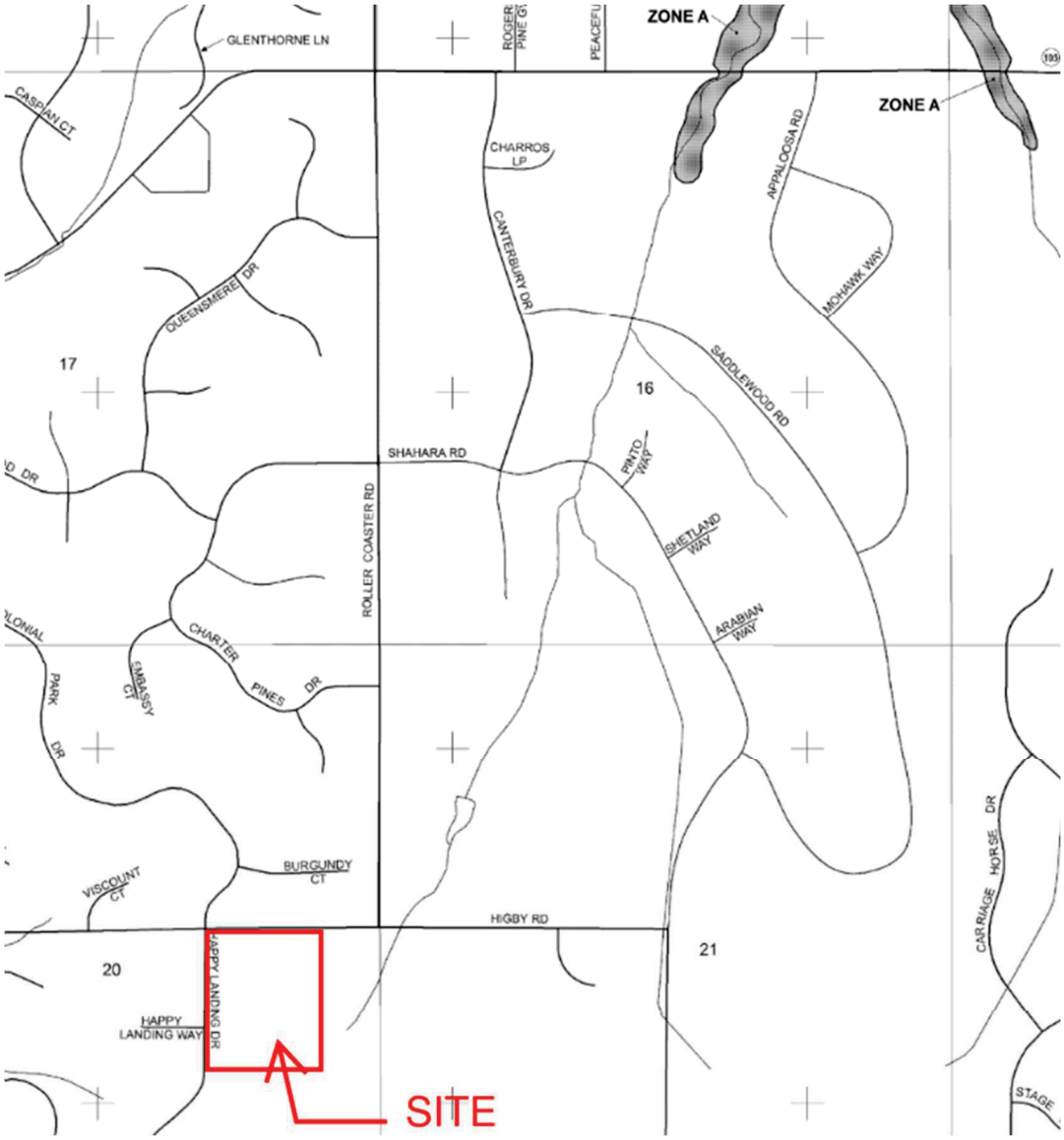


Figure 1- Portion of Map No. 08041C0285G

All drainage on site will flow from the west to the east. The nearest Zone A floodplain is almost 2 miles northeast of the site.

Descriptions of the two existing drainage basins are as follows:

EXISTING BASINS

Basin EX-1

Basin EX-1 is the north end of the site along Higby Road and adjacent to Happy Landing Drive. Basin EX-1 drains from the west to east side of the site. The existing impervious value used for this basin is 2% impervious per MHFD and El Paso County Drainage

Criteria. In reality the basin is partially developed in the existing condition so the value of 2% represents the "historic" condition rather than a true "existing" condition. A summary of the basin characteristics is shown in the following table.

Basin Area (ac)	Existing Impervious	Ex. 2 Year Peak Flow	Ex. 100 Year Peak Flow
12.4	2%	0.66	16.74

Basin EX-2

Basin EX-2 contains the south portion of the site and extends offsite to the south of the property another 750 feet. This basin is 42.8 acres with an existing imperviousness of 2.0%. The basin consists of native grasses. The basin flows towards the east of the property. A summary of the basin characteristics and resulting flow rates is shown below.

Basin Area (ac)	Existing Impervious	Ex. 2 Year Peak Flow	Ex. 100 Year Peak Flow
42.8	2%	2.17	55.12

The Existing Drainage Basin Map can be found in Appendix C.

PROPOSED BASINS

Impervious areas and Detention

The proposed development will create a driveway with a hammerhead turnaround to serve the 3- 5 Acre lots while the remaining 20 Acre lot will be served by the existing entrance. There is no overlot grading planned for the lots, rather the existing terrain will remain with the home construction and grading isolated to the house location. The driveway will maintain existing ground elevations as much as possible to accommodate any drainage improvements. With the lots not being initially disturbed or over-lot graded, drainage patterns are not being changed. Rather, existing drainage paths are being maintained and the stormwater mitigated to accommodate the construction of the roadway. Stormwater in this condition cannot be routed to a central location or locations to accommodate typical detention or water quality measures usually undertaken on urban developments.

The benefit of rural acreage lots is that drainage from impervious surfaces does not flow in directly connected impervious surfaces. Runoff from impervious surfaces is dispersed across landscaping, absorbed by soils and velocity decreased due to the native vegetation. This minimizes the risk of local flooding generated by the lots while treating stormwater through natural infiltration in grass swales.

To determine a more accurate runoff from the developed lots an assumed typical 5-acre lot was broken out into its impervious areas for roof, driveway, paved surfaces as well as a portion of the gravel private access road. Applying El Paso County's impervious values for these surfaces to determine a composite impervious value for the developed condition of the lot. The resulting composite impervious value for the developed condition is 8.56% which will be rounded to 9% for the purposes of this drainage report. Please see the table below.

Composite Impervious Per El Paso County Drainage Criteria — Typical 5 AC lot

Land Area	Area (SqFt)	Area (AC)	% Impervious	Composite
Native	203,926	4.68	2	1.86
Gravel	10,700	0.25	80	0.64
Roof	3,000	0.07	90	1.24
Total:		5		8.56

Detention for this site, if required, should be handled on an individual lot basis to accommodate the development that occurs on the lot.

Suggested alternatives to detention would be to encourage rain gardens, permeable pavements, improved grass lined swales and even rain barrels to reduce the immediate impact of storm runoff.

Basin PR-1

Basin PR-1 contains the same area as EX-1. PR-2 will include a portion of the developed road, part of the 20-acre lot which includes an existing gravel drive and rooftops, and one of the 5 acre lots with a composite impervious value of 12.5%. The basin flows from east to west. A summary of the basin characteristics and resulting flow rates is shown below.

Basin Area (ac)	Existing Impervious	Ex. 2 Year Peak Flow	Ex. 100 Year Peak Flow	Proposed Impervious	Proposed 2 Year Peak Flow	Proposed 100 Year Peak Flow
12.4	2%	0.66	16.74	12.5%	2.47	20.07

Basin PR-2

Basin PR-2 is about half of the of the area of EX-2. PR-2 will have additional developed areas for the road and 2- 5 acre lots with a large portion of the undeveloped area on the 20-acre lot. Considering the gravel and rooftop for 2 lots as above, the basin has an impervious value of 4.1% flowing from west to east. A basin summary follows.

Basin Area (ac)	Proposed Impervious	Proposed 2 Year Peak Flow	Proposed 100 Year Peak Flow
24.1	14.7%	1.9	32.26

Basin OS-1
Basin OS-1 is the offsite area that is part of EX-2, reducing the basin area. OS-1 captures offsite flow from the south of the site. OS-1 crosses into PR-2 at design point 3 and has an imperviousness of 2%. A summary follows.

Basin Area (ac)	Proposed Impervious	Proposed 2 Year Peak Flow	Proposed 100 Year Peak Flow
18.80	2%	1.10	27.98

Routing Basin OS-1 through and combining basin PR-2 yields a combined flow at design point 2R as follows.

Basin Area (ac)	Proposed 100 Year Peak Flow
42.9	56.73

C. DESIGN CRITERIA

Hydrologic Criteria

The drainage analysis was performed using the Rational Method for basins under 90 acres. This method is consistent with the El Paso County and the Mile High Flood District criteria. El Paso County's rainfall frequency was used per "Section 2.1 – Rainfall Depths" as outlined in the El Paso County Drainage Criteria Manual.

Using the UD-Rational Spreadsheet as necessary, the peak runoff was calculated for the 2-year (minor) and 100-year (major) storm events for existing and developed conditions. Calculation Results can be found in the basin descriptions above and in Appendix B.

Culvert Design

The only infrastructure required for the subdivision is a single culvert for the driveway. The culvert will convey flows generated from proposed Basin 1 and is sized for the 100-year storm at 18.39 cfs. Culvert calculations are included in the appendix.

D. EROSION CONTROL

Erosion control measures required during construction will be shown on the Construction

Documents for this project. These measures, including (but not limited to) vehicle tracking control, silt fence, stabilized staging area, inlet protection, sediment control logs, diversion ditches, check dams, riprap, rock berms, sediment basins, seeding and mulching, and erosion control blanket, will act to stabilize disturbed areas and mitigate sediment transport during construction.

The individual homeowner is encouraged to implement steps to help prevent erosion and stormwater pollution. Limiting the use of impervious surfaces for walks/patios allows stormwater to soak into the ground instead of running downstream and causing erosion. Permeable pavers can be used to allow water to pass through them, rather than run off the surface. Redirecting downspouts away from hard surfaces and onto grass or shallow depressed planting beds can help reduce the amount of runoff. Planting native vegetation and minimizing the use of fertilizers and pesticides will help reduce the impact of stormwater on the environment.

E. PERMITTING

Construction sites that disturb one acre or greater or are part of a larger common plan of development are required to obtain a Construction Stormwater Discharge Permit issued by the Colorado Department of Public Health and Environment (CDPHE). Additional permit requirements such as a Grading Permit will be required by El Paso County.

F. CONCLUSION

This Drainage Report is prepared in conformance with the Drainage Criteria Manual of El Paso, Colorado, with supplemental data from the MHFD USDCM Volume 1. This report provides stormwater calculations regarding the historic drainage of the site and anticipated proposed storm peak flows based on published impervious values. El Paso County building department will determine if any stormwater mitigation based on the individual lot impervious values is required. Stormwater conveyance and peak flow attenuation for the proposed area to be developed will be in conformance with the applicable El Paso County criteria.

G. REFERENCES

El Paso County, Co Drainage Criteria Manual. El Paso County Colorado. October 31, 2018.

Federal Emergency Management Agency. *Flood Insurance Rate Map.* Panel 08041C0285G. El Paso County. December 7, 2018.

Urban Storm Drainage Criteria Manual. Mile High Flood District (MHFD); September 1969. Revised August 2018.

Web Soil Survey. United States Department of Agriculture, Natural Resources Conservation Service, September 2021.