

The Preserve at White's Creek
Hydrologic Impacts of Proposed Development
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OVERVIEW

This report provides an assessment and a comparison of existing and proposed storm drainage conditions that could be expected as a result of the implementation of the proposed development plan known as The Preserve at White's Creek. The proposed development plan was presented by the Knox County Planning Commission and prepared by W. Scott Williams and Associates, revised 11/21/2022.

A drainage report has not been provided to support this development plan. The assessment provided in this report makes assumptions related to proposed drainage schemes. The potential impacts to White's Creek, which is the downstream receiving tributary will be discussed.

Hydrologic and hydraulic evaluations provided in this report are based on evaluation methodologies provided in the Knox County, Tennessee Stormwater Management Manual, January 2008.

EXISTING CONDITIONS

The development known as The Preserve at White's Creek is proposed on a northwest facing slope of undeveloped land above White's Creek east of Beverly Road and north of Greenway Drive in Knox County, Tennessee. The trapezoidal shaped parcel is 84.56 acres in size, with its southeastern boundary extending along a ridge line and its northwest boundary defined by White's Creek.

Hydrologically and from a development potential perspective, the parcel can be divided into three segments. The southeastern portion is steep along a ridge line. Slopes of 30% to 50% are typical in this area. The northwest portion is flat and is flood prone and is documented in the county's FEMA floodplain and Flood Insurance Study. The middle portion is higher than the floodplain, but below the steep slopes that extend up to the ridge line.

All runoff from the property is tributary to White's Creek, which drains toward the southwest, flowing into First Creek, which drains into the Tennessee River. The eastern end of the parcel drains to White's Creek as distributed flow at a location approximately 2,000 feet upstream of the Beverly Road Bridge and the western end of the property drains to the Creek as distributed flow closer to the Beverly Road Bridge.

The property is wooded and soil types vary across the site according to the USGS Web-Soil Survey. Area floodplain soils are typically classified as Steadman silt-loam with Stafford silt-loam adjacent to the floodplain. Further up is Apison-Montvalo complex and up towards the ridge line is Nonoburg channery silt loam characterized by rocky, severely eroded ground cover. The soil survey classifies soil types according to hydrologic soil group. Classifications range from type A to type D soils with type A soils having a high infiltration rate, such as sand and

gravel. Type B soils exhibit a moderate infiltration rate and type C soils have a slow infiltration rate, often with a subsurface layer that impedes downward movement. Type D soils have a very slow infiltration rate. At this site, the floodplain area and proposed development sites are Type C soils and the upslope areas approaching the ridge are Type D soils.

White's Creek

White's Creek is a FEMA regulated drainage. The regulatory floodplain and floodway are illustrated on the effective Flood Insurance Rate Map (FIRM), dated 5/2/2007. These floodplain and floodway lines appear to be appropriately shown on the proposed development plan.

The drainage is 6.5 square miles at its mouth and 5.39 square miles at the railroad bridge below Greenway Drive. The Flood Insurance Study for Knox County, Tennessee indicates that the 10-, 50-, 100-, and 500-year flood flowrates are 1075, 1614, 1900, and 2503 cfs at the bridge, respectively.

The flood profiles for White's Creek in the vicinity of Beverly Road and the proposed development are shown in the Flood Insurance Study for Knox County, Tennessee. Plate 205P in Volume 4 of the Study shows that all of the (10-, 50-, 100-, and 500-year) flood profiles overtop the Beverly Road Bridge. This Bridge, without guard rails, poses an existing hazard in a highly populated, well traveled setting.

Approximately 700 feet downstream of Beverly Road Bridge is the Norfolk Southern Railway Bridge. All flood profiles shown are higher than the bridge low chord. Approximately 450 feet further downstream is the Greenway Drive Bridge. All flood profiles shown are higher than this bridge's low chord, also. The low chord is the lowest part of the bridge, closest to the water surface. Freeboard is the dimension between the water surface and low chord. When freeboard goes to zero and water laps on the bottom of the bridge, debris is trapped and the capacity of the bridge to pass flow is further diminished. These downstream limited capacity bridges can and often do become blocked with logs and debris resulting in tailwater conditions that can back up to Beverly Road resulting in flooding even higher and more frequent than the FEMA modeling predicts.

PROPOSED DEVELOPMENT

The footprint for the proposed development is the middle section of the property. The regulatory floodplain and floodway will not be disturbed. This floodplain/floodway area that will not be disturbed is 27.33 acres. The 31.64 acre steep ridge area will be designated as open space. This leaves approximately 25.59 acres to be developed accommodating the roads and residential lots.

The proposed development is for 196 dwelling units (du) coming off of a single access point at Beverly Road approximately 150 feet south of the Beverly Road Bridge over White's Creek. The effective density of the entire development is 7.67 du/acre. The lower section, closest to Beverly Road propose 75 attached town homes at a density of approximately 12 du/acre. Further east, the proposal calls for a second parallel road. The two streets will serve a proposed 121 single family lots at a density of approximately 6 du/acre.

Related to site drainage, it is noted that the proposed access road (Road A) is designed as a reverse crown road, dipping and draining toward the middle of the road. This non-standard roadway design will create a hazard if drainage becomes blocked. The design seems even more hazardous considering this is the one and only development access.

Three parcels along the northwestern row of residential lots are designated for runoff detention purposes. These are discussed below.

EXISTING AND PROPOSED HYDROLOGY

Section 1.1.1 of the Knox County Stormwater Management Manual begins, “When land is developed, the hydrology, or the natural cycle of water is disrupted and altered.” The Manual goes on to specify that land clearing removes the vegetation and generally the impervious surfaces of development increase runoff volumes and concentrate the flows into gutters, storm sewers and channels increasing peak flows by expediting the time of concentration of flows delivered to receiving waters.

Below is a comparison of conditions that could be expected at White’s Creek in the vicinity of the Beverly Road Bridge due to the proposed development parcel of 25.6 acres for both pre- and post-development conditions. The Knox County 100-year, 24-hour rainfall of 6.5 inches is used for this comparison. The SCS method is employed and the source (equation or table from Knox Co. Manual) is cited in the table. Numerous assumptions are employed related to proposed drainage design and flow patterns.

Table 1.

<u>Parameter</u>	<u>Existing Condition</u>	<u>Proposed Condition</u>	<u>Source</u>
Overland Flow Length	300 feet	50 feet	Devel. Plan
Overland Flow Time	18 minutes	1 minute	Eqn 3-4
Shallow Concentrated L	600 feet	1500 feet	Devel. Plan
Shallow Flow Time	3 minutes	6 minutes	Eqns 3-4,5,6
Creek Flow L	2770 feet	1500 feet	Flow Patterns
Creek Flow Time	9 minutes	5 minutes	Eqns 3-7,8
Total flow Time	30 minutes	12 minutes	Eqn 3-3
SCS CN	70	88	Table 3-12
Initial Abstraction	0.857 inches	0.273 inches	Eqn 3-13
Direct Runoff	3.2 inches	5.1 inches	Eqn 3-12
Unit Pk Q	500	800	Fig 3-6
Peak 100-yr Q	64 cfs	163 cfs	Eqn 3-16

The SCS method calculation shows a volume increase of direct runoff of 60% and more than doubling of the expected peak flow from the 100-year storm coming off the 25.59 acres of development. More frequent, common storms will also show more runoff volume and peak flow due to the proposed development.

Detention Storage

Detention Storage of excess runoff due to urbanization can mitigate the runoff impacts due to development. Typically, at these facilities, runoff is collected and metered out at historic rates. The development plan shows three lots identified as detention ponds. A cursory review indicates that with typical pond grading and maintenance access, these lots are not large enough to capture the excess runoff expected due to development. These proposed, smaller area ponds may be beneficial for water quality mitigation and for providing appropriate easements for drainage paths.

SUMMARY

The White's Creek drainage is an existing flood hazard at a number of locations, particularly at the Beverly Road Bridge crossing. In a previous study related to a different proposed development in this drainage basin, Dr. James L. Smoot, Hydrologist, then a University of Tennessee professor offered this opinion regarding development in the White's Creek drainage area. *"Any further development of property in the watershed which would result in increases in either runoff volume or runoff peak flows would likely have a negative impact on downstream properties."* (June 23, 2000).

The developer and the County jurisdiction are encouraged to show precaution in advancing a proposed development on this property. An extremely dense development, as currently proposed, will not allow for the inclusion of Best Management Practices (BMP's) that can serve to mitigate for increased runoff and downstream water quality. The development as proposed will exacerbate flooding locally and downstream, within the City of Knoxville.

A development plan that is limited to 50 to 60 residential units on this property is recommended. This density would allow for adequate open space to accommodate functional detention ponds and provide for overland drainage paths, which allow a disconnection of the impervious surface drainage paths. Disconnecting impervious drainage paths by including paths across lawns and wooded areas has been found to slow down and reduce runoff and enhance the water quality emanating from a developed area. It is recommended that this site be limited to a density of approximately 1 du/acre on the approximate 57 acres that is not within the regulatory floodplain. It is also recommended that all Best Management Practices be employed during and after construction. Erosion will lead to silt accumulations in downstream waterways and bridges and will exacerbate flooding.

A Drainage Report detailing the proposed drainage scheme would assist the community and developer in understanding and mitigating drainage and flooding impacts.

About the Author- Robert Christensen is a retired Civil Engineer. Mr. Christensen served as a project manager for URS Corporation, AECOM, and WSP specializing in Water Resources. Clients included developers, municipal jurisdictions, state DOT's, UP Railroad and mining enterprises.