1201 North Bowser Road
Richardson, Texas 75081
(214) 346-6368

Cumulative Impacts on Small Footprint Developments Memorandum

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SUBJECT:	NCTCOG iSWM Program Task Order 3 – Task 2		

1 INTRODUCTION

This memorandum summarizes the results of Task 2 of Task Order 3 of the Integrated Stormwater Management (iSWM) support services contract. The objective of this task was to research cumulative impacts on drainage systems from increases in impervious area on small footprint developments less than 10,000 square feet. The objectives of this task were accomplished using the City of Fort Worth's 2D hydrology and hydraulics (H&H) model for the Linwood watershed. The Linwood XPSWMM model extent is shown in **Figure 1**.

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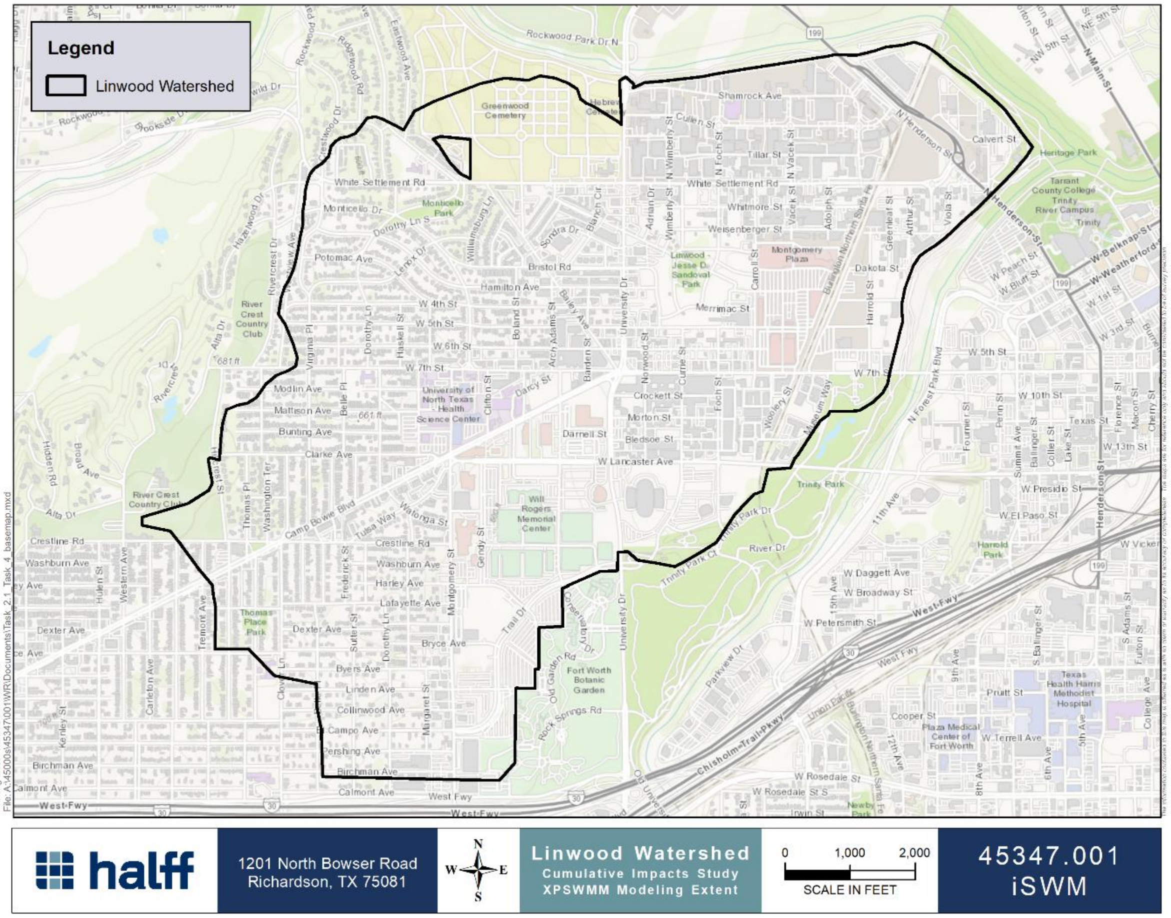

Figure 1. Linwood Watershed XPSWMM Model Extent

2 METHODOLOGY

The goal of the hydrologic analysis was to increase impervious area percentage across the Linwood watershed and to measure the impacts to runoff volumes. The City of Fort Worth's 2022 Cumulative Impacts Analysis study divided the Linwood watershed into 216 subcatchments, each with an assigned pervious curve number and percent impervious value. The subcatchment impervious percent values were based on a weighted average of the existing percent impervious value for each parcel within that subcatchment. This information also came from the 2022 Cumulative Impacts Study.

Parcels of interest for this study included "A-5," "A-10," and "B." Each of these was chosen because they represent developments with footprints less than 10,000 square feet. Please see **Table 1** below for details on each of these zoning classifications

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Table 1: City of Fort Worth Zoning Classifications of Interest

Zoning Classifications	Description
A-5	One-family detached dwellings (min. lot size 5,000 sq. ft.), churches, schools, parks, etc.
A-10	One-family detached dwellings (min. lot size 10,000 sq. ft.), churches, schools, parks, etc.
B	One-family and two-family detached and attached (min. lot size 5,000 sq. ft. for two attached dwellings on a single lot; and 7,500 sq. ft. min. lot size for two detached on a single lot); plus all "A-5" and "AR" uses

Five different impervious area scenarios were modelled, including the existing conditions model of the Lindwood watershed. Impervious area percentages were increased on all type A-10, A-5, and B parcels within the Linwood watershed for scenarios 2-5. These percentages were increased according to **Table 2**, but impervious area was not increased above 90% for any given parcel. Lastly, subcatchment impervious percent values in the XPSWMM model were adjusted based on changes to the parcels.

Table 2: Scenarios Modelled

Scenario Modelled	Impervious % Increase from Existing Conditions for Each Parcel
1	None
2	Added 15 to existing percentage
3	Added 30 to existing percentage
4	Added 45 to existing percentage
5	Each parcel set to 90%, unless existing greater than 90%

The impacts of the increase in impervious area were quantified by multiplying the acreage of each subcatchment by the total runoff depth in inches that was produced. The results are summarized below in **Table 3**

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Table 3: Analysis Results for Each Scenario

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
100-year Runoff (ac-ft)	1274	1292	1309	1324	1339
Total Impervious Area (ac)	1248	1324	1408	1475	1545
Total Percent Impervious %	65%	69%	73%	76%	80%

The effect of increasing the impervious area on runoff and flood inundation volume is shown in **Figure 2** below. The change in impervious area and change in runoff in this image are defined as the difference between existing conditions and each scenario. The change in flooding volume was calculated using global statistics generated by XPSWMM for each run representing the depth of flooding in each cell on the mesh.

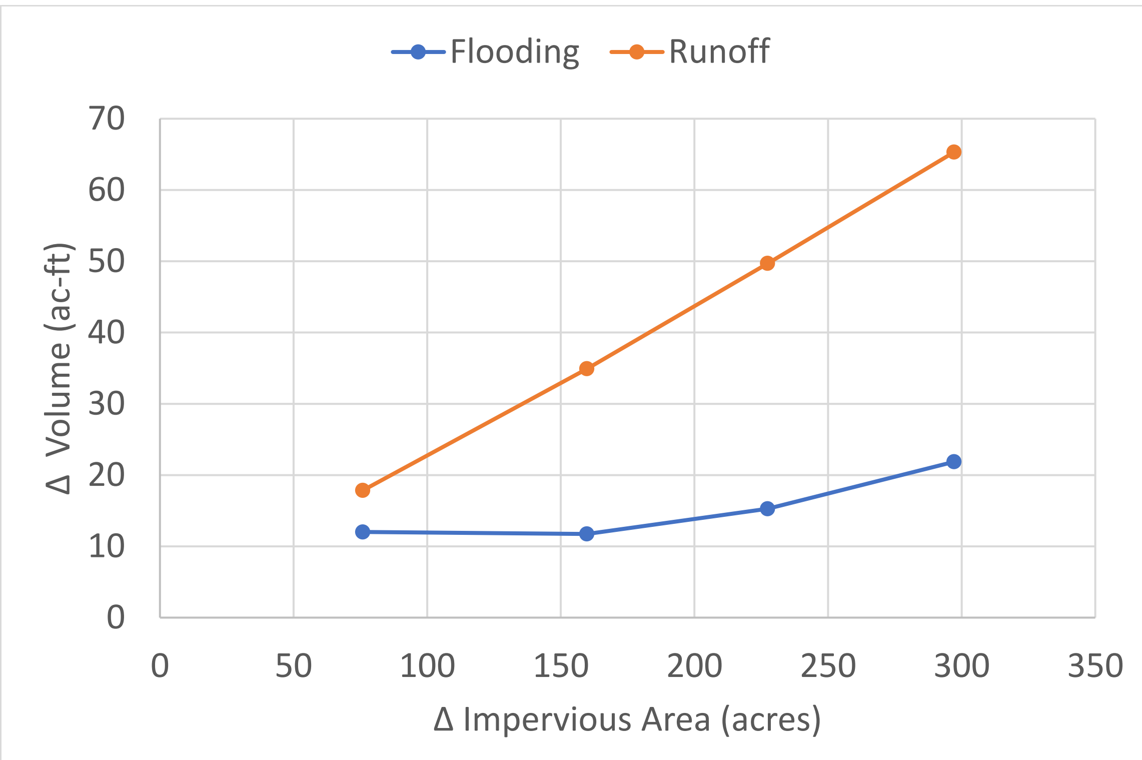

Figure 2: Change in Model Parameters

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3 FUTURE MITIGATION REQUIREMENTS

This study analyzed how much bioretention could be needed to offset the increased impervious area in each scenario. This assumes that every acre-foot of runoff generated could be offset by an acre-foot of storage available in a bioretention area on residential property. Residential area was considered to be type A-10, A-5, and B parcels – a total of 553 acres within the Linwood watershed. The iSWM Site Development Controls Technical Manual suggests that the maximum recommended ponding depth of a bioretention facility should be 6 inches with a drain time of 3 to 4 hours, so it was assumed that bioretention areas would have 6 inches of storage available.

The required percentage of the current of available residential area for each scenario was calculated, and the results are summarized in **Table 4.**

Table 4: Percent of Total Residential Area Needed to Offset Impacts for Each Scenario

	Scenario 2	Scenario 3	Scenario 4	Scenario 5
% of Residential Area Needed with 6 Inches of Bioretention Storage Available.	6%	13%	18%	24%

Because Scenario 5 assumes that each parcel is 90% impervious, this analysis indicates that increase in runoff in this scenario could not be adequately mitigated with bioretetion. Further analysis will be necessary to determine which other scenarios would be feasible.