January 2, 2025
AVO 37449.004

Ms. Ramie Hammonds
Development Services Director/Building Official
City of Sanger
201 Bolivar Street
P.O. Box 1729
Sanger, Texas 76266

Re: **Lane Ranch Phase 5 – Drainage Study/Downstream Assessment – 1st Review**

Dear Ms. Hammonds,

Halff Associates, Inc. was requested by the City of Sanger to review the Drainage Study/Downstream Assessment in support of the Lane Ranch Phase 5, located east of Lake Ridge subdivision, north of McReynolds Rd. The subject tract is located within the City of Sanger. The drainage study was prepared by Cardinal Strategies and dated November 2024.

We have finished our review and offer comments as follows. Rules and Regulation citations have been provided in the markups. Please note that additional comments may be forthcoming after receipt of requested documents.

General Comments

1. Please address comments on attached markups and provide annotated responses on markups. Please note, not all comments are included in this letter since some comments are easier to show and explain on the markups.
2. Please note that according to review letter provided in June 2024, the Lane Ranch Addition Preliminary Plat is contingent upon acceptance of the preliminary downstream assessment. The study from the current submittal only addresses the drainage impact by Phase 5, not the entire Lane Ranch Addition. A preliminary drainage study for the entire Lane Ranch Addition in support of the preliminary plat is also needed. Please include drainage area maps and preliminary sizing of storm drain system, channels and any detention ponds.
3. Please note that comments on the preliminary plat was provided separately. Please address comments on both preliminary plat and preliminary drainage study to reconcile as necessary.
4. Please show and label 100-yr fully developed floodplain and floodplain easement for on plat and all preliminary plan sheets.
5. Please note that Oasis at Sanger is not part of the Preliminary Plat of Lane Ranch Addition. Please coordinate with Middleton & Associates, LLC. with regard to accurate naming conventions and relations to other developments. Clarification is needed in future submittal of both the plats/plans and drainage study.
6. Flood Study for storm events of 10-, 50-, 100-, and 500-year are required for FEMA regulated streams. Please prepare the flood study for LOMR when construction is completed.
7. Please note that the City of Sanger Code of Ordinance requires fully developed watershed conditions for facility design. (10.106(d)(2) Runoff Calculations). Similarly, the iSWM Hydrology Manual requires fully developed watershed conditions (with existing vs. proposed site conditions) for downstream assessment. The hydrologic analysis in this study is acceptable for comparing against FEMA flows. Please add the fully developed conditions analysis to the study for downstream assessment and for design of drainage facilities.
8. Floodplain Development Permit is required prior to any activity in FEMA SFHA.

Hydrology

1. The rainfall data in HMS model doesn't match city's Code of Ordinance. Please update.
2. The total drainage area from pre-developed condition to fully developed condition reduced by 140 acres. Please check your GIS data or HMS input.
3. There appears to be some warnings and convergence errors in HMS models. Please resolve the issues.

Hydraulics

1. Please add other storm events per general comment #6.
2. RS 4293 of Trib 2.1 shows the bank stations to be on one side of the reach. Please revise the geometry to fix the error. Similar comment applies to RS 6452.
3. RS 1766 doesn't appear to be perpendicular to the river reach. Please revise.
4. RS 2907 of Trib 2 is almost parallel to the reach. Please revise it to be perpendicular to the river.
5. Are the embankment data of the inline structures from LIDAR? Are these existing elevations or proposed pond grading? The alignment of the structure at RS 2580 doesn't look natural. Please explain/clarify.
6. The contour data to the RAS model are not accessible. Please provide the GIS data.
7. Inline Structure 1638 appears to be missing the U/S bounding cross-section. Please add.
8. Inline Structure 410 appears to be missing bounding cross-sections. Please add.
9. Bridge/Culvert at RS 392 of Trib 2.1 appear to be missing bounding cross-sections. Please provide 4 cross-sections per structure according to the HEC-RAS manual.
10. Bridge/Culvert at RS 393 of Trib 2 appears to be missing bounding cross-sections. RS 654 and 146 appear to be too far away from the structure. It is recommended that two cross-sections added.
11. In plans with FEMA Flows, please add ineffective flow areas to the right bank of RS 2849 and 2649.
12. Please show ineffective flow areas at RS 2455.
13. Does this study tie into the effective FEMA floodplain and flood study? What difference does it make if using normal depth as boundary condition for the 100-yr FEMA Flows? It would make sense to extend the Trib 2.1 model to the downstream side of the confluence with Trib 2 and apply the same boundary condition for Trib 2 and 2.1. The extended model also matches the HMS model better.
14. The profile shows big head loss at the inline structures. Please verify that the head losses are accurate and not caused by instability.

The Engineer shall revise the hydrologic study and/or plans in accordance with the above comments and/or provide a written response that addresses each comment. If you have any questions or need additional information, please do not hesitate to call me at (214) 937-3921.

Sincerely,
HALFF
TBPELS Firm No. 312

Yangbin Tong, PE, CFM
Project Manager

Attachments:

- Flood Study markups

2.0 Hydrologic Analysis

A hydrologic analysis was performed for Ranger Branch Tributary 2.1 to determine existing and fully developed peak discharges in the stream. This evaluation provides a comparison of pre-project and post-project peak discharges leaving the site to determine the hydrologic impact of the development.

An existing and fully developed SCS Unit Hydrograph model was created for the pre-project and post-project analysis using HEC-HMS version 4.10. The following sections will provide more detail for both the pre-project and post-project analysis.

2.1 Pre-Project

The Cardinal Strategies Lane Ranch Ph 1 Pre-Project Existing Conditions hydrologic model was used as the basis for this Pre-Project analysis.

The watershed for Ranger Branch Tributary 2.1 was delineated using 1-foot contours generated from 2020 TNRIS LiDAR DEM data and survey data. The subbasins for Tributary 2.1 were subdivided for added detail around the Ph 5 project site. All other subbasin delineations remained the same as in the Ph 1 Pre-Project Existing Conditions analysis. The pre-project watershed is shown below in Figure 3.

The basin is comprised of C and D type soils provided by the NRCS. A soils map is provided in Figure 4. The iSWM Curve Number and time of concentration methods were used to estimate losses and lag time, in accordance with the 2020 iSWM Hydrology Technical Manual.

The time of concentration was calculated for the longest flow using TNRIS 1-foot contours and the equations used for calculating sheet, shallow, and channel flow per iSWM hydrology standards. Only the Tributary 2.1 subbasins had their times of concentration updated to reflect the new subbasin delineations. All other subbasin times of concentration remained the same as in the Ph 1 Pre-Project Existing Conditions analysis. The calculations for the longest flow path can be found in Appendix B. The time of concentration for each basin is provided in Table 1.

Current aerial imagery was used to assign the iSWM land use values. The project site was assigned an open space good land use to reflect pre-project conditions. The calculations can be found in Appendix B. The curve number for each basin is shown below in Table 1. The land use can be seen in Figure 4.

A combination of the Muskingum-Cunge, Lag Time, and Modified Puls routing methods were used to model the 18 routing reaches. There are twelve (12) routing reaches for Tributary 2, two (2) for Tributary 2.1, and four (4) for Tributary 2.2, with ten (10) of them being Muskingum-Cunge reaches, 1 being Lag Time, and seven (7) being Modified Puls reaches. TNRIS 1' contours were used to develop eight-point cross

This is acceptable for floodplain modeling and mapping. However, for downstream assessment, fully developed watershed condition is required per iSWM and City of Sanger's Code of Ordinance.

sections for each Muskingum-Cunge reach. The Lag Time used in reach R003C was calculated by dividing the reach length by 8 ft/s (standard assumed velocity for pipe flow) to get 4.0 minutes. The pre-project hydrologic parameters can be found below in Table 1.

Table 1 – Pre-Project Hydrologic Parameters

HMS Element	Area (ac)	Lag Time (min.)	Curve Number
A001	76.3	14.5	79.4
A002	102.0	13.2	85.9
A003	41.6	15.4	85.1
A004	111.4	18.3	80.2
A005	132.1	17.9	82.3
A006	28.2	9.0	89.3
A007	29.8	13.3	83.7
A008	47.3	16.1	82.3
A009	10.0	6.0	89.7
B001	40.7	7.5	86.0
B002	98.7	12.5	80.6
B003	80.9	17.4	78.9
B004	95.5	19.0	78.7
B005	15.3	9.0	80.2
C001	22.0	9.1	82.7
C002	26.8	8.8	82.0
C003	27.2	17.14	89.0

2.2 Post-Project Ph 5

The Pre-Project hydrologic model was used as the starting point for this analysis. The focus areas being updated are Phase 5 as shown on the Lane Ranch site plan in Appendix A. The delineation of subbasins B001 and B002 were updated to reflect the proposed Ph 5 development.

Ph 5 is made up of a proposed multi-family apartment complex on the western portion and 1/8th single family residential on the eastern portion. These two developments constitute the hydrologic and hydraulic Post-Project Ph 5 condition. All other off-site subbasin curve numbers remained the same as in the Post-Project Ph 1 Existing Conditions analysis. The Post-Project Ph 5 watershed map can be seen in Figure 5 and the land use can be seen in Figure 6.

The zone of influence was established using the total area for the Ph 5 development, approx. 30.2 acres. For the Ph 5 development to constitute 10% of the watershed, the overall watershed would need to be approx. 302 acres. The total area of subbasins B001 – B006 is approx. 331.1 acres, exceeding the minimum size for the development to no longer have a significant impact upon the receiving stream, Ranger Branch Tributary

Please note that the Oasis at Sanger has submitted plat separately. It shouldn't be a part of Lane Ranch Phase 5. Please provide clarification.

The fully developed conditions of Lane Ranch Addition shall require larger zone of influence than what this study is showing. An drainage study of the overall project is needed to accompany the previously submitted plat.

2.1. The watershed was extended farther downstream to conceptually model the Fully Developed condition and to develop flows for the entire length of the hydraulic models. As a result, the flow comparison between Pre-Project and Post-Project Ph 5 will show subbasins A001 and B001 – B006 and their corresponding junctions.

The longest flow path within Ph 5 was updated to reflect the proposed site plan storm sewer routing. All other flowpaths remained the same as in Post-Project Ph 1 Existing Conditions analysis. The hydrologic calculations can be found in Appendix B. The time of concentration for each basin is provided in Table 2.

Modified-Puls routing reaches were updated using Post-Project Ph 5 reference flows to update the subreach calculations, which can be found in Appendix B. The post-project Ph 5 hydrologic parameters can be found below in Table 2.

Table 2 – Post-Project Ph 5 Hydrologic Parameters

HMS Element	Area (ac)	Lag Time (min.)	Curve Number
A001	76.3	14.5	79.4
A002	102.1	13.2	86.0
A003	50.6	12.0	89.2
A004	105.3	17.3	81.8
A005	132.1	17.9	82.3
A006	28.2	9.0	89.3
A007	29.8	13.3	83.7
A008	47.3	16.1	82.3
A009	10.0	6.0	89.7
B001	72.6	11.9	88.0
B002	66.8	12.5	81.1
B003	80.9	17.4	78.9
B004	95.5	19.0	78.7
B005	15.3	9.0	80.2
C001	19.0	8.8	83.5
C002	26.8	8.8	82.0
C003	27.2	17.14	89.0

2.3 Hydrologic Results

The result in peak discharge between the pre-project and post-project Ph 5 is shown below in Tables 3 – 8. The proposed single family and apartment developments in Ph 5 are demonstrated to create lower peak discharges downstream of the project site and through to the outfall of the watershed for all storm events except the 2-yr storm event. Due to lower storage occurring differently for each Modified Puls routing reach with the lower flows generated by the 2-yr storm event, the attenuation each reach offers differs to create a situation where increases were noted at junctions J002, J001,

Please provide additional information to explain the significant changes of peak flow, such as:
1. Provide comparisons of drainage area, time of concentration (or lag time in HMS), and curve number between FEMA and this study.
2. Provide the effective FEMA model for review.
3. Please clarify how the existing ponds on Tributary 2.1 was accounted for. The design engineer shall size drainage facilities by disregarding the detention effect of upstream detention. (**10.106(d)(2)**)

Table 9 – Comparison of FEMA Effective vs Existing Conditions Flows

Ranger Branch Tributary	HMS Element	FEMA Effective Flows (cfs)	HMS Element	CS Pre-Project Existing Flows (cfs)	Difference (cfs)	% Difference
2.1	CP-5	95.0	J006B	102.3	7.3	7.7%
	CP-6	535.0	---	---	---	---
	CP-7	972.0	J004B	835.3	-136.7	-14.1%
	CP-8	1842.0	J003B	1205.8	-636.2	-34.5%
	RB-2.1	1842.0	J002B	1151.0	-691.0	-37.5%

The decrease in peak discharge rates compared to the effective FEMA model is likely due to increased detail in the hydrologic model and incorporation of hydrologic routing to account for attenuation through existing ponds in Tributary 2.1.

2.4 Fully Developed

The Post-Project Ph 5 hydrologic model was used as the starting point for the Fully Developed hydrologic analysis. The Fully Developed condition reflects a proposed full build-out condition with off-site proposed land use for all phases of the Lane Ranch site plan. The delineations along Tributary 2.1 were updated to reflect proposed grading changes to increase the attenuation through Tributary 2.1. The watershed can be seen in Figure 7.

The land use of the remaining proposed Phases within the project area were updated to reflect 1/8th acre residential and commercial land use, reflecting the site plan provided in Appendix A. The off-site land use was updated following the Sanger Future Land Use Plan (April 2022) and the proposed plans for the New High School and Field House. These plans can be found in Appendix A. The curve number for each basin can be found below in Table 10. The Fully Developed land use can be found below in Figure 8.

The longest flowpaths in off-site basins were updated to reflect the future land use condition. The hydrologic calculations can be found in Appendix B. The time of concentration for each basin is provided in Table 10.

Due to the Fully Developed condition accounting for the completed build following approved plans for the new Sanger HS and Field House (22-049.00), the Sanger HS pond has been included in the Fully Developed basin model. The purpose of this is to include the proposed detention designed to detain 9.5 ac-ft of additional runoff generated by the proposed Sanger HS, Field House, and other off-site proposed development.

3.0 Hydraulic Analysis

A hydraulic model was developed for Ranger Branch Tributaries 2, 2.1, and 2.2. For this analysis, the focus will remain on results for Tributary 2.1 to establish the existing conditions and fully developed 100-year floodplains and to evaluate impacts of peak discharges in the stream. A hydraulic model was created using HEC-RAS version 6.5. The following sections will provide more detail for both the pre-project and post-project analysis.

Does this mean both the hydrologic and hydraulic analyses are incorporating the existing ponds for attenuation? Please clarify that flow attenuation by ponds are not double counted.

3.1 Pre-Project

The FEMA NFHL cross sections were used as the basis for this analysis. These cross sections were unlettered and extended from just downstream of McReynolds Rd to FM 455. There were no FEMA NFHL waterlines through the project site, so stream centerlines were drawn for all three tributaries. To better model the streams, several cross sections were added. Table 14 below shows the list of added cross sections. Additionally, inline structures 410, 1638, and 2580 were added to model the existing inline ponds along Tributary 2.1.

Aerial imagery was used to determine the Manning's roughness coefficients for the channel and overbanks of the model. The Manning's values used for overbanks ranged from 0.05 to 0.07 and the channel values ranged from 0.04 to 0.05.

The pre-project flows from Section 2.1 were used for the hydraulic model. The calculated water surface elevation from the FEMA NFHL cross sections at cross sections 146 and 103 were used as the downstream boundary condition for the 100-YR storm event for Tributaries 2 and 2.1. For all lesser storm events, the normal depth at the bottom of each reach was used for the downstream boundary condition. For Tributary 2.2, the calculated water surface elevation at cross section 2478 at each storm event was used for the downstream boundary condition for each corresponding storm event. The results are shown below in Tables 13 – 18 and 20 – 25.

Table 12 – Added Cross Sections by Tributary

Tributary 2.0	Tributary 2.1	Tributary 2.2
6124	6564	3627
6021	6452	3024
5933	6404	2649
5852	6310	2525
5629	1533	2455
4981	1458	1766
4729	1292	1596
4414	1213	489
4012	1106	---
3880	929	---
3205	766	---

Please clarify which flow was use for each condition. As the pre-project flow significantly reduced from FEMA effective flow, did this study choose the more conservative FEMA flow?

Does this study tie in to the effective FEMA floodplain and flood study? It would make sense to extend the model to confluence and apply same boundary condition for Trib 2 and 2.1