January 19, 2023

Mr. Chad Reese
Assistant Director for Activism
Institute for Justice
901 N Glebe Rd., Suite 900
Arlington, VA 22203

Re: Evaluation of the Roseau Lake Rehabilitation Study and the hydrologic and hydraulic modeling used in the study

Dear Mr. Reese:

This letter report summarizes the review of the results presented in Roseau Lake Rehabilitation Study Final Engineer's Report, June 2019 and the modeling used in the development of the report. Included in the review is a comparison of the impacts for the recommended alternative vs existing conditions. Note, at the time the Final Engineers report was written, Alternative 2A' was the recommended alternative, and it is my understanding that since the report was written Alternative 1 has become the preferred alternative. Included in the review is the proposed construction costs.

The draft operations plan dated October 2021 was also reviewed.

The report is broken down by topic.

Hydrologic Model

Review of the HEC-HMS model provided by HDR was undertaken to assess the consistency and appropriateness of parameter selection. It appears that the model was well constructed and uses appropriately selected parameters for the area.

Hydraulic Model

Review of the HEC-RAS model provided by HDR was also conducted to evaluate the model for consistency and appropriate parameter selection. The review indicated that the placement of cross-sections used in model appears to be generally appropriate. However, when ran, the model gives conveyance ratio warnings and error messages indicative that the cross-sections may be spaced too far apart in several reaches, which could lead to possible inaccuracies in the model results and possible model flow instability in some reaches.

Model flow instabilities were observed when reviewing the stage-flow hydrographs for some storage areas and storage area connections. Figure 1 shows two of such storage areas. As seen in Figure 1, the discharges indicated by the flow hydrographs for the S_Spillover and SouthCell storage areas fluctuate rapidly for a period of over 10 days. For example, in the case of the S_Spillover storage area the flow fluctuates from about 3160 cfs to about minus 480 cfs and then back to about 3100 cfs over the period of two hours which is not expected to be representative of real conditions during a flood The fluctuations are similarly evident in Figure 2 which shows the storage area connections S Embankment 1 and NW Embankment 2. It is not possible to estimate the impact the model instability may be having on overall model output.

The review also indicates that the selection of model parameters is reasonable. However, during the review it was noted that input parameters for one of the storage areas appears to be incorrect. The SE_Spillover2 elevation-storage volume input data appears to have been copied from the SE_Spillover storage data, and not changed to the correct area-storage curve. Figures 3 and 4 show the two areas and Table 1 shows the elevation-storage table for the two sub-basins used in the modeling. Table 2 summarizes the surface area of the Roseau River storage areas at the peak of the 100-yr 10-day flood. As seen in Figures 3 and 4, from the plan view, the storage areas SE_Spillover and SE_Spillover2 have widely differing surface areas, whereas the respective input storage volumes in the model are the same for both. This discrepancy needs clarification. Not having the topographic survey information makes the precise determination of the impact of this apparent discrepancy not possible as part of this review. None-the-less as is visually evident from Figures 3 and 4, and also noted in Tables 1 and 2, the impact of this discrepancy could be quite significant and lead to model results that do not accurately represent present or proposed conditions.

As presently modeled, the surface areas of the SE Spillover and SE Spillover2 storage areas each contribute nominally 13% of the overall combined surface area of the 19 storage areas during the 100-year 10-day flood event. In combination, they account for over 25 percent for the surface area of the 19 storage areas. It visually appears that the surface area of the SE Spillover2 storage area is actually less than 5 percent of the SE Spillover area. Even assuming the SE Spillover2 area to be 10%

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817 19th AVENUE NORTH, SOUTH ST. PAUL, MN 55075
952-292-8486, RICKVOIGT @VOIGTCONSULTANTS.COM

that of the SE Spillover sub-basin, if this is the case, there would be a reduction of the surface area of these two combined storage areas to approximately 15% of the overall storage area, and a corresponding reduction of the total surface area of all 19 storage areas by approximately 10 percent. Given the size of the differences, the impacts of this discrepancy could be quite significant.

Given the concern of the community and the impacts that even a very small increase in water level may have on the residents, farm land and infrastructure in the area, this possible discrepancy should be reviewed, and if the input data is in error, the model should be corrected, and the modeling and evaluation of the model results redone. In addition, the reach conveyance ratios and cross-section extents should be evaluated to minimize errors associated with the model run results, and the results be provided in an updated report.

Results vs Criteria

Section 3 of the report lists the criteria and Section 9 provides the results of the analysis. Table 11 of the report compares the discharge between existing and Alternative 2A' at the Ross Gage for various flood scenarios. Figure 19 of the report makes a similar graphical comparison. A comparison of the 10-day flood events shows a minimal reduction in the peak discharge due to the proposed project., In the case of the Roseau River in the area, the discharges associated with a 10-day flood event is significantly higher than the 24-hr flood event for the same flood return interval. Given that the preferred alternative is now Alternative 1, the report should also be updated to provide a direct comparison between existing conditions and the preferred alternative.

One of the items listed in the Preliminary Engineer's Report dated October 2016 summary of additional project objectives:

- Reduce peak flows on the Roseau River by up to 25% for 2-year to 50-year flood frequency events

However, a review of the preferred alternative provided in the 2019 Final Engineers report in comparison to the existing conditions indicates minimal change to the discharges and water levels at Ross.

Following a flood event, it is naturally necessary to discharge the water retained during the flood back into the channel to be conveyed downstream. This is done at a lower rate generally within the river bank level. Has the impact of the increased duration of bank full or near bank full discharge on riverbank erosion been evaluated?

It was beyond the scope of this review to evaluate the specific impact to localized land areas. However, another item of possible concern is, will the extended release of lower discharges impact any low-lying properties for a sufficient period of time to render farming the properties impractical and require the purchase of easements over that land?

Cost Estimate

Review of the cost estimates indicates that in light of the COVID-19 pandemic and subsequent inflation as the economy rebounded since the report was written the estimated cost appears to be low and should be re-assessed. During the pandemic some construction costs increased significantly, and while much of the increase was for steel and components such as gates and pipe which will be a relatively small portion of the overall budget for this project, other items could significantly impact project cost. The underlying cost assumption that the necessary borrow for earthwork will be able to be obtained within a mile of the placement location may not be realistic and material transportation costs may be significantly more than anticipated. The report states; *"In order to make the project as economical as possible it was assumed that the potential sources of borrow would be located in close proximity to the project location. The combination of NRCS Soil Survey maps and soil information from the geotechnical investigation were used to determine locations likely of containing a suitable borrow source. The first criteria used in selecting potential borrow locations was that the site be located within the project footprint. This ensures that the site will be relatively close to the project and additional storage volume would be created. The second criteria used was the maximum hauling distance along any portion of the embankment would be 1 mile. In addition, attempts would be made to locate borrow sources completely on one landowners property."*

It is stated in the report that *"It should be noted the analysis of settlement of the embankments has not been completed at this stage in the project. Standard penetrations values for the on-site foundations soils (clay) correlate to soft to very soft conditions in all boreholes with the exception of BH 3. This indicates that settlement under the weight of the new embankments could be a concern".* I concur with that concern, and given the nature of the underlying soils, the impact of possible settlement created when fill is placed on the soil should be carefully reviewed to determine if additional fill will be needed and if active compaction of the underlying soils will be needed as part of construction. Both of the local obtainability and the potential need for additional material due to settlement could create significant increases to the budget.

Lastly, the budget uses a 25 % contingency of construction costs, which is reasonable. However, it appears that the contingency isn't applied to all construction costs, and the discrepancy in how the contingency cost is computed alone could increase the budget by $2.4 million, (actual contingency minus contingency provided in the budget in Table 21 of the report).

Alternative Selection

As concerns alternative selection, the report states; *"Alternative 2A' is the recommended alternative because it is the least cost option that is compatible with the stated project goals and provides for operational flexibility to benefit surrounding landowners."* However, I am unaware of documentation supporting the switch in the preferred alternative from Alternative 2A' to Alternative 1.

Draft Operations Plan

Based on review of the Draft Operations Plan (October 2021) I have some concern as to whether or not the plan can be implemented as intended under some flood conditions. While often similar, every flood presents its own challenges due to differences beyond human control.

1. Are there any flood scenarios where staff may be tied up on higher priority issues that could prevent them from being able to operate control structures? This could include nearby floods that are not directly related to the Roseau River or the project.

2. Will it be possible for personnel to safely access all control structures as planned under all flood scenarios?

3. Is there the possibility of debris clogging one or more control structures impacting the structures performance or the ability to operate the structure in a timely manner?

A possible mitigation to Items 1 and 2 may be through the installation of automatically, or remote operated gates/control structures with a backup power source.

Please let me know if you have any questions regarding this review.

Sincerely,

Richard L. Voigt, Jr., P.E.
MN 18526

Disclaimer: The information contained in this report and the resultant summary of information is based on public documents available from the Roseau River Watershed District (RRWD), the Minnesota DNR (MNDNR) and the Environmental Quality Board (EQB) and were provided to the author by the Institute for Justice (IJ). Specifically, the documents reviewed were; the Final Engineers Report for the Roseau Lake Rehabilitation Project, June 2019, the Draft Operations Plan for the Roseau Lake Rehabilitation Project, October 2021. In addition, the HEC-HMS and HEC-RAS models used in the development of the Final Engineers Report, were provided to the IJ by the RRWD and were used in this review. Should information in those or subsequent reports and models be updated, the summary and questions raised within this document may change.

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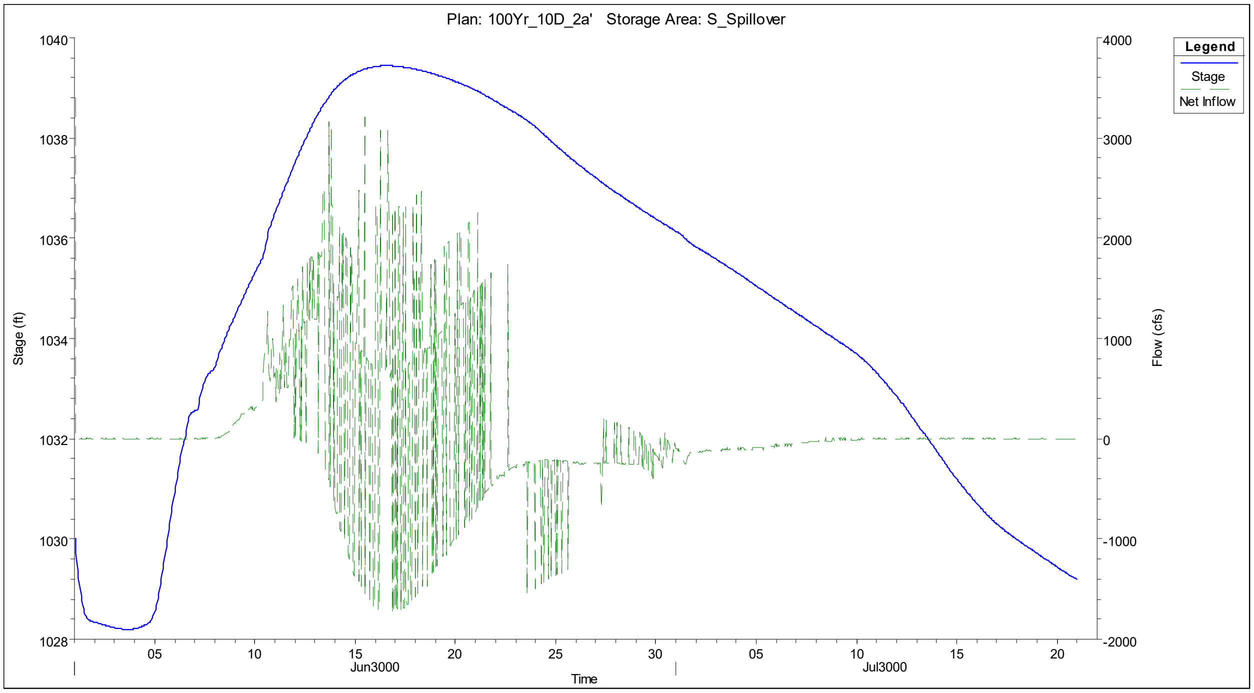
Figure 1. Storage Area Stage Hydrographs



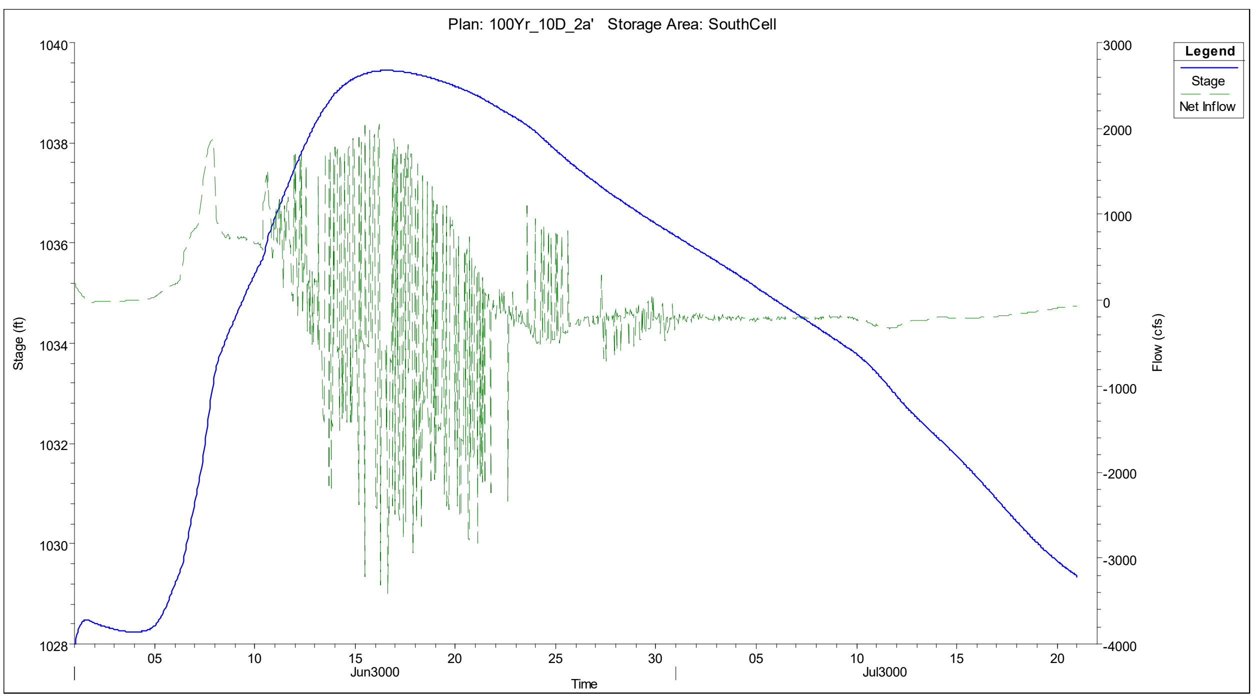


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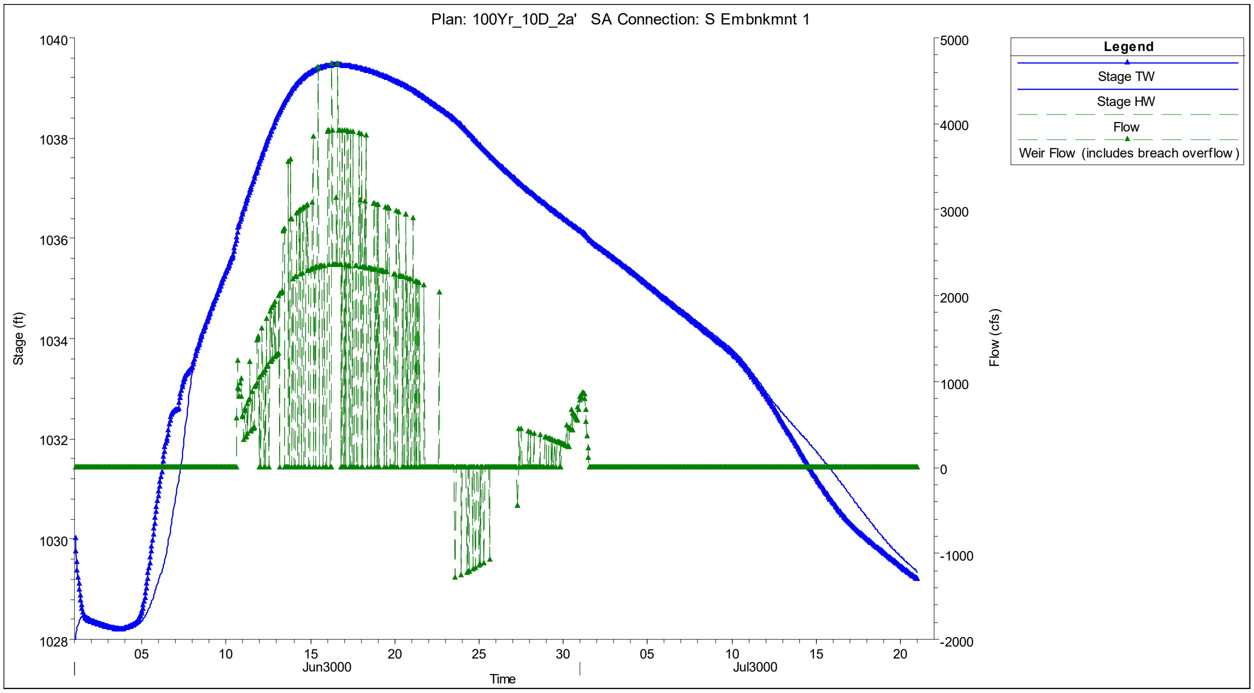
Figure 2. Storage Area Connection Stage Hydrographs



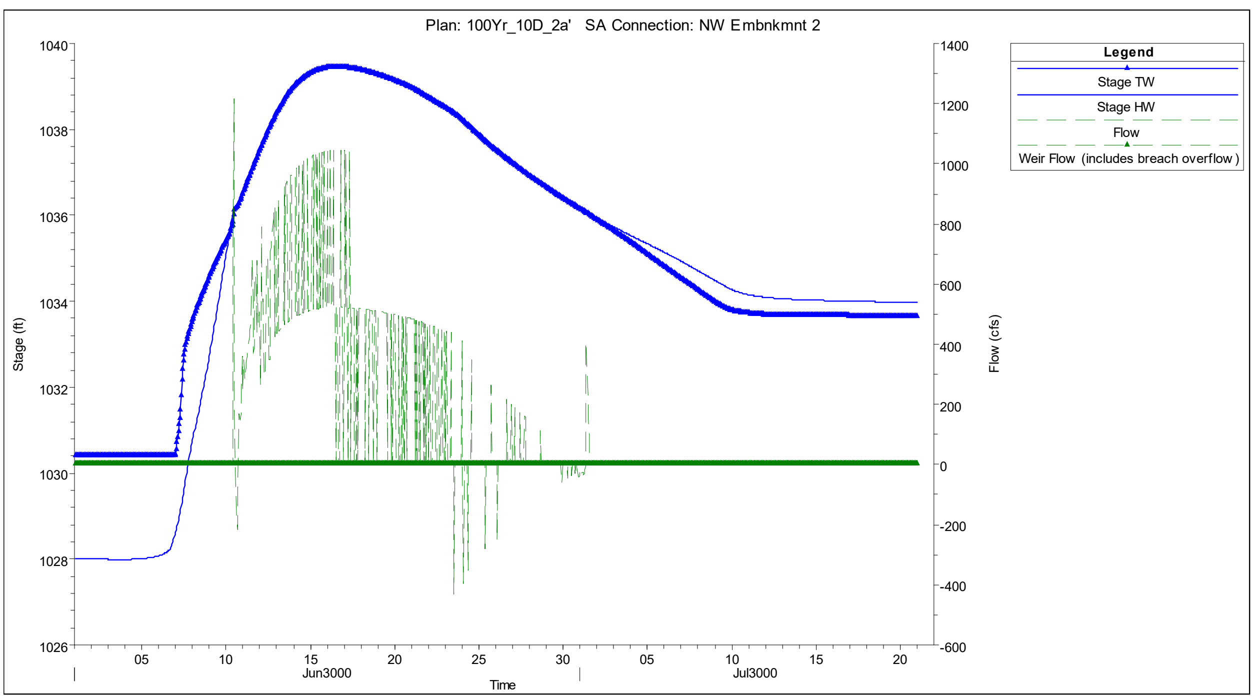


Figure 3. Plan View Storage Areas

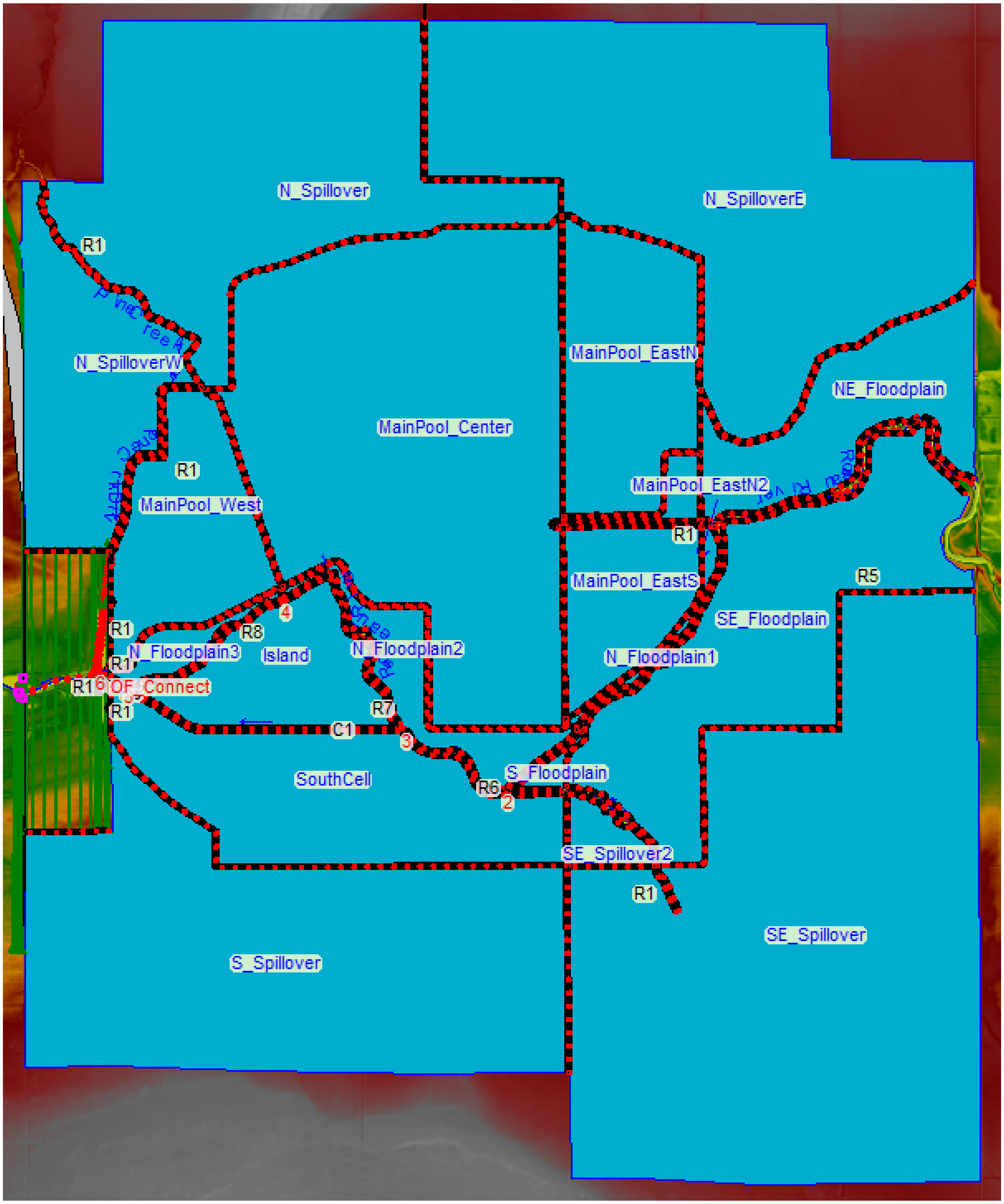


Figure 4, Plan View Southeast Storage Areas

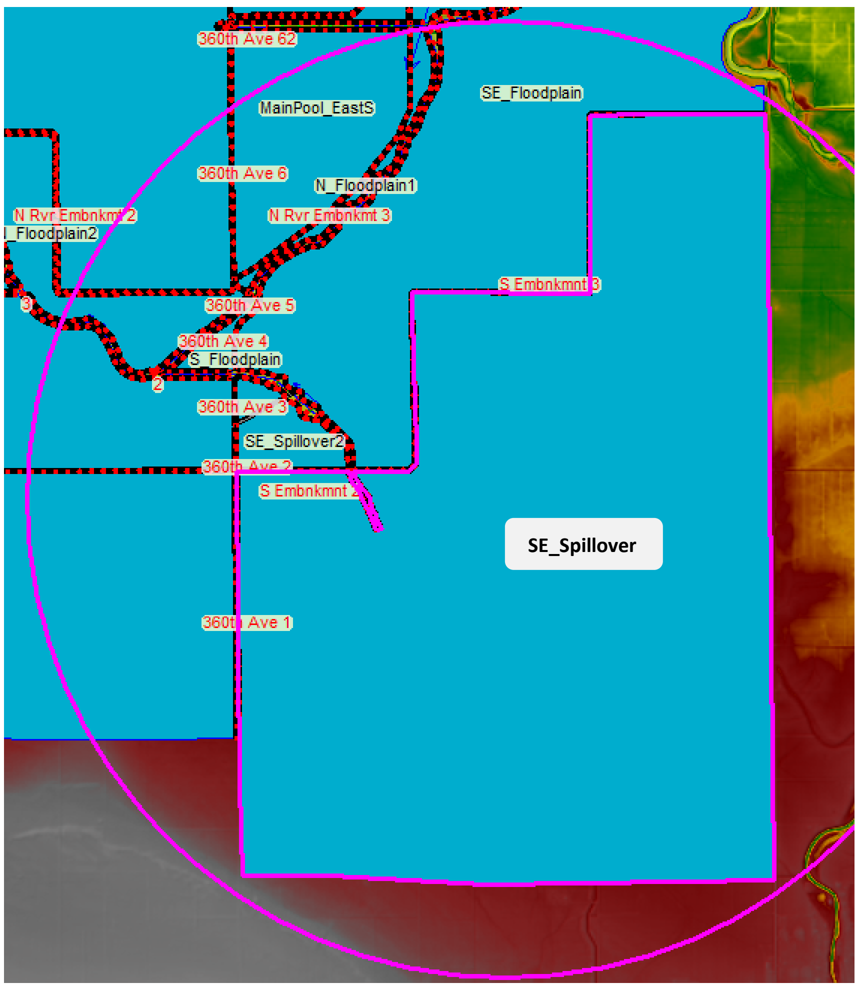


Table 1 Roseau Lake Southeast Storage Areas Volume versus Elevation in HEC RAS Model			
SE_Spillover		SE_Spillover2	
Elevation (ft)	Volume (ac-ft)	Elevation (ft)	Volume (ac-ft)
1025	0	1025	0
1032.53	0.01	1032.53	0.01
1032.65	0.04	1032.65	0.04
1032.71	0.09	1032.71	0.09
1032.77	0.19	1032.77	0.19
1032.88	0.56	1032.88	0.56
1032.97	1.22	1032.97	1.22
1033.07	2.35	1033.07	2.35
1033.17	4.09	1033.17	4.09
1033.28	6.24	1033.28	6.24
1033.36	8.57	1033.36	8.57
1033.5	14.11	1033.5	14.11
1033.64	22.93	1033.64	22.93
1033.75	32.67	1033.75	32.67
1033.84	44.51	1033.84	44.51
1033.96	64.83	1033.96	64.83
1034.08	89.3	1034.08	89.3
1034.19	116	1034.19	116
1034.29	147.8	1034.29	147.8
1034.48	223.95	1034.48	223.95
1034.66	321.09	1034.66	321.09
1034.84	450.03	1034.84	450.03
1035.01	604.46	1035.01	604.46
1035.17	780.51	1035.17	780.51
1035.35	1002.13	1035.35	1002.13
1035.51	1247.84	1035.51	1247.84
1035.7	1553.5	1035.7	1553.5
1036.1	2305.46	1036.1	2305.46
1036.74	3641.51	1036.74	3641.51
1037.36	5107.07	1037.36	5107.07
1037.97	6675.44	1037.97	6675.44
1038.5	8199.9	1038.5	8199.9
1039.03	9936.89	1039.03	9936.89
1039.6	11959.36	1039.6	11959.36
1040.15	14082.21	1040.15	14082.21
1040.7	16403.74	1040.7	16403.74
1041	17649.75	1041	17649.75

Table 2 Roseau Lake Storage Areas - Maximum Surface Area During a 100-yr 10-day flood event as Presently Modeled			
Storage Area		W.S. Elev (ft)	SA Area (acres)
Island		1093.44	743.76
MainPool _Center		1039.45	4414.47
MainPool _EastN		1039.45	1218.76
MainPool _EastN2		1039.45	96.33
MainPool _EastS		1039.45	645.17
MainPool _West		1093.44	950.08
NE_Floodplain		1039.45	979.73
N_Floodplain1		1039.45	76.4
N_Floodplain2		1039.45	425.56
N_Floodplain3		1093.44	142.14
N_Spillover		1039.45	1545.41
N_SpilloverE		1039.45	1328.14
N_SpilloverW		1093.44	881.88
SE_Floodplain		1039.45	2149.33
SE_Spillover		1039.45	3548.53
SE_Spillover2		1093.44	3548.53
SouthCell		1093.44	1637.67
S_Floodplain		1039.45	45.14
S_Spillover		1093.44	2469.42
Total Surface Area			26846.45