

Roseau River HEC-1 Hydrologic Model

prepared for the:
ROSEAU RIVER WATERSHED DISTRICT
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and the:
U.S. ARMY CORPS OF ENGINEERS
St. Paul District

October 24, 2001

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Introduction

This hydrologic model of the Roseau River Basin was developed for the Roseau River Watershed District for planning purposes, including evaluation of proposed flood control strategies. The model covers the drainage area of the Roseau River to the point where it crosses the International Border and enters Canada near Caribou, Minnesota. The modeled basin includes 1,009 square miles of drainage area in Minnesota and 423 square miles of drainage area in Manitoba.

The Minnesota portion of the model was developed as part of the Roseau River Watershed District "Overall Plan" revision process as required by the 1998 Red River Basin Mediation Agreement. The Manitoba portion of the model was developed by a Section 22 Study under the U.S. Army Corps of Engineers. The modeling effort of both sides of the border was done concurrently in order to develop a seamless model. This report covers the entire model.

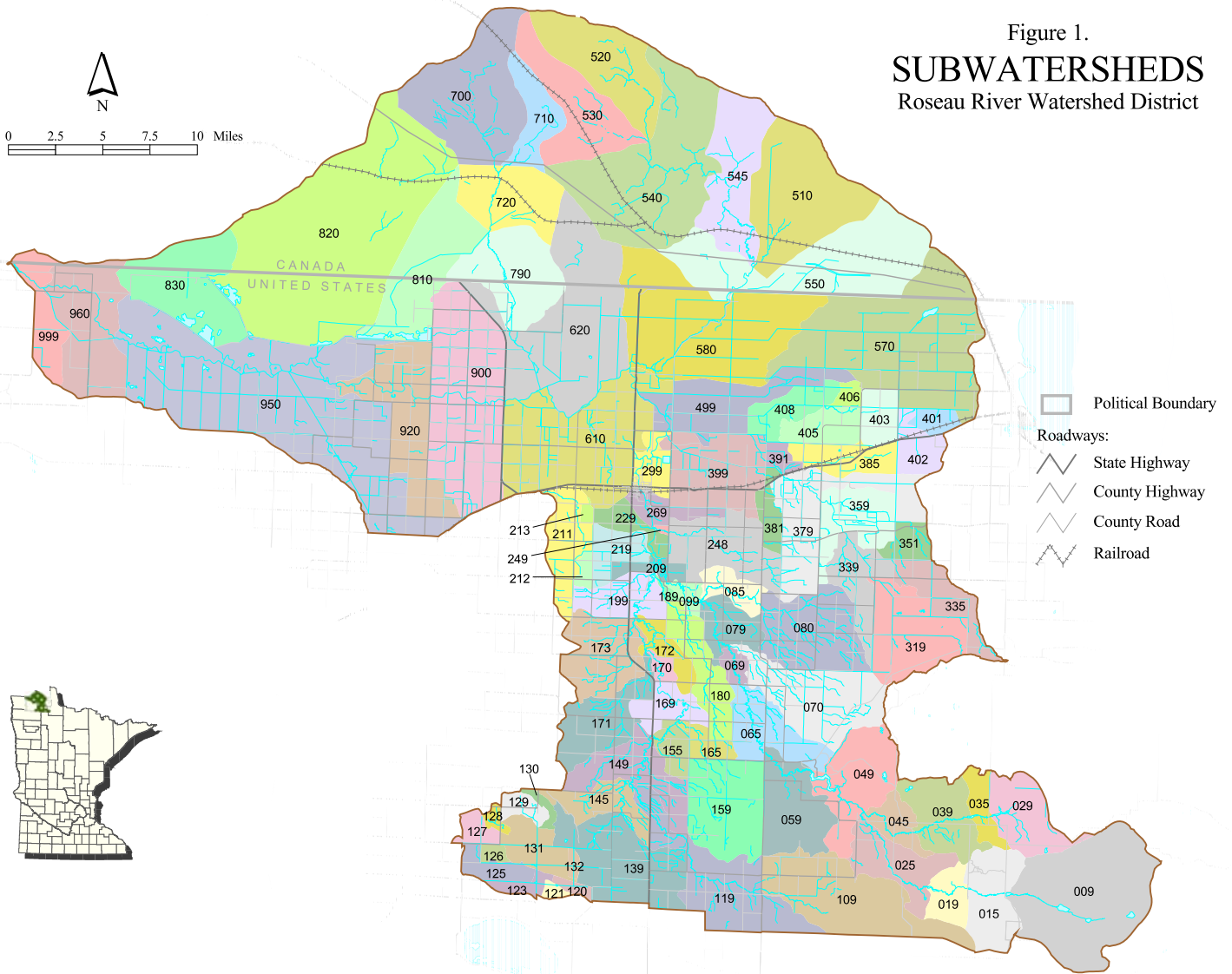
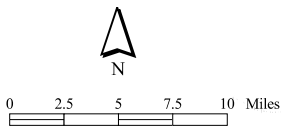
There are significant differences in the type and extent of data available in Manitoba and Minnesota. In general, the Manitoba data has been transformed to provide the necessary modeling parameters in a format consistent with the way data is presented in Minnesota.

Although the model is fully functional at this time, it is anticipated that refinements will continue to be made as the planning and implementation process evolves. Potential users should ensure that they have the latest, or most appropriate, version of the model.

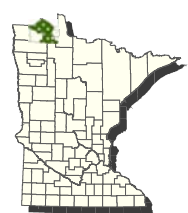
Watershed

The modeled watershed is the upper portion of the Roseau River Basin as outlined on the map shown in Figure 1. The Roseau River is a major tributary of the Red River of the North. It joins the Red River in Canada near Letellier, Manitoba about 91.5 miles downstream from the modeled area. The drainage area of the Roseau River at its mouth is 2,057 square miles. The modeled portion is 1,432.2 square miles. It consists primarily of cropland, grassland, woodland, and wetlands.

Figure 1.
SUBWATERSHEDS
 Roseau River Watershed District



- Political Boundary
- Roadways:
 - ≡ State Highway
 - ≡ County Highway
 - ≡ County Road
 - ≡ Railroad



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The Minnesota portion of the drainage area is within the geomorphic areas of the Agassiz Lacustrine Plain. Included are the Inter-Beach area, Beltrami Island area, and Agassiz Peatlands (Minnesota Soil Atlas Miscellaneous Report 173-1980). The Inter-Beach area consists of a linear network of beach ridges and low, poorly drained areas. About half the soils are sandy, 10% are organic, and the rest are loamy. The Beltrami Island area consists of a nearly level to slightly depressional lake plain. Most of the soils are loamy and poorly drained. This region also includes some shallow sands over loamy till, areas of clayey soils, and areas of organic soils. Agassiz Peatlands are a low, very poorly drained lake plain. About 75% consists of organic soils generally from 7 to 8 feet deep. The mineral soils are pre-dominantly sandy and poorly drained.

The Manitoba portion of the Roseau River Watershed tributary to Caribou, Minnesota has been subdivided into Lowland Till Plain, Sandilands Upland, Pine Creek Lowland, and Sprague Creek Lowland (Joint Studies for Co-ordinated Water Use and Control in the Roseau River Basin, International Roseau River Engineering Board Report to the International Joint Commission, September, 1975, Appendix A Water Resources).

Sandilands Upland consists primarily of thick sand deposits, overlain along the lower edges by till or lacustrine clays.

Pinecreek Lowlands are mainly peats and lacustrine clays.

Sprague Creek Lowland occupies the eastern portion of the watershed in Manitoba. It is a broad flat area with appreciable local relief developed on glacial till with extensive areas of peat, thick lacustrine clays, and isolated patches of sand.

The portion of the Lowland Till Plain that contributes to the Caribou drainage area is primarily the Menisino Swamp. The swamp is primarily sedge but areas of treed swamp occur at the higher elevations. This area drains into the Roseau River Wildlife Management Area in Minnesota.

Rainfall

Meteorological data used in this model for hypothetical rainstorm events is based on information developed by the National Weather Service as presented in (Technical Papers #40 and 49).

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These papers include maps showing expected amounts of point precipitation for storms with durations of 30 minutes to 10 days. The magnitude of storms range from 1 year to 100 years and also include an estimate of the Probable Maximum Precipitation (PMP).

Point Rainfall-Duration-Frequency curves were developed from the meteorological data. They are shown graphically in Figure 2. The curves are based on data at the City of Roseau, which is near the geographic center of the modeled watershed. The rainfall intensity tends to increase from northwest to southeast. Therefore, when analyzing individual sub-watershed strategies, it may be advisable to adjust the rainfall amounts.

Area reduction factors are applied by the hydrologic model to reduce the point precipitation to the amount which would be expected to fall over the entire 1,432 square mile watershed area. Smaller storm areas should be used where appropriate to evaluate strategies at a sub-basin level.

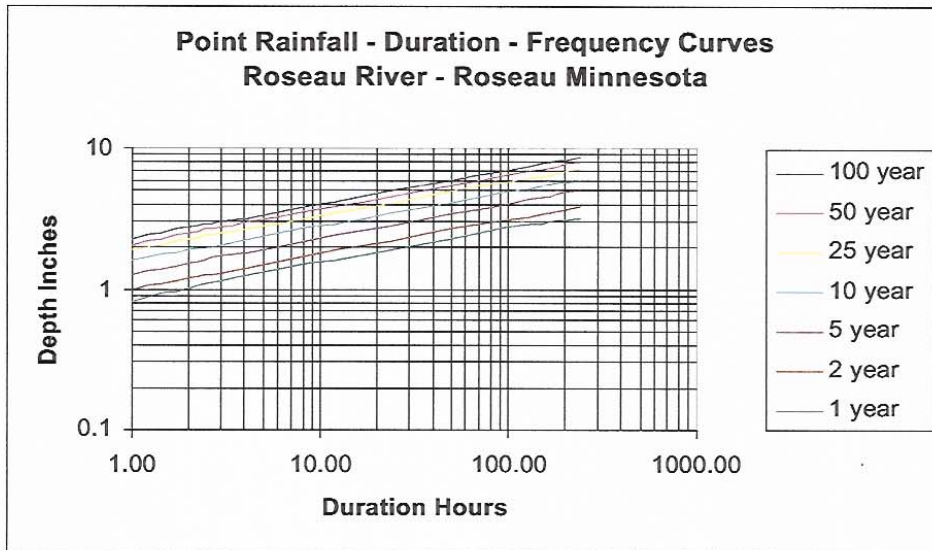
The hypothetical summer storm events that have been analyzed are of 10 days total duration. The precipitation pattern within the 10 days was determined by nesting the shorter duration amounts. In other words, the Maximum precipitation rate of the 6 hour storm is within the 1 day storm which is within the 10 day storm.

Summer Runoff (Rainfall Events)

The amount of runoff generated by rainfall was estimated using the Hydrologic Curve Number (CN) method developed by the Soil Conservation Service (SCS). The curve number takes into account the soil type, topography, land cover, and cultural practices of the watershed, and relates precipitation to runoff. The runoff curve numbers were adjusted for use with 10 day duration storms as recommended by the SCS National Engineering Handbook (NEH).

SCS curve numbers were developed using Geographic Information System (GIS) based analysis. So far as known, the best available GIS data has been used. The level of detail of the available data varies considerably.

Figure 2



Roseau River HEC-1 Hydrologic Model (October 24, 2001)

The required data layers to determine the curve numbers are land cover and hydrologic soil group. A composite map of the hydrologic soil groups is shown in Figure 3. A composite map of the land use data is shown in Figure 4 and a composite map of hydrologic curve numbers is shown in Figure 5.

The hydrologic soil groups are based on expected rates of infiltration. They are A, B, C, and D, varying from most to least permeable. For some soil types, two classes are given, depending on whether or not the soil has been drained. These were reclassified by processing the data within the GIS system using the assumption that all lands shown as agricultural had been drained.

The land cover data used for Minnesota was developed in the early 1990's by the International Coalition (TIC) and by the Minnesota Department of Natural Resources (MNDNR). The TIC data, which covers most of the basin, was developed from 1990 vintage aerial photography. The land cover for the forested, southeastern portion of the basin, was developed from satellite imagery from 1995-1996 by the Manitoba Remote Sensing Center. MNDNR further reclassified the forested area data set into fewer categories.

The land cover data used for the Manitoba portion was provided by Environment, Manitoba.

Most of the soils information in Minnesota was from the Minnesota Land Management Information System (MLMIS) 100 meter, generalized soil data. A detailed soil survey of Roseau County has been done by Natural Resource and Conservation Service (NRCS). However, only pre-release detailed soil survey data is currently available from NRCS. Some of the soil survey sheets have been digitized by JOR for the Watershed District. The digitized detailed soils information was used where available.

The GIS soils data for the Canadian portion of the basin was from data developed by the Canadian Department of Agriculture. They do not classify soils into hydrologic groups. The SCS Hydrologic Soils Group was developed based on infiltration rates for each soils class. This was done using criteria described in the United States Department of Agriculture, (Soil Survey Manual, Soil Survey Division Staff, Agriculture Handbook No. 18, Issued October 1993).

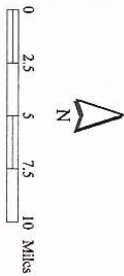
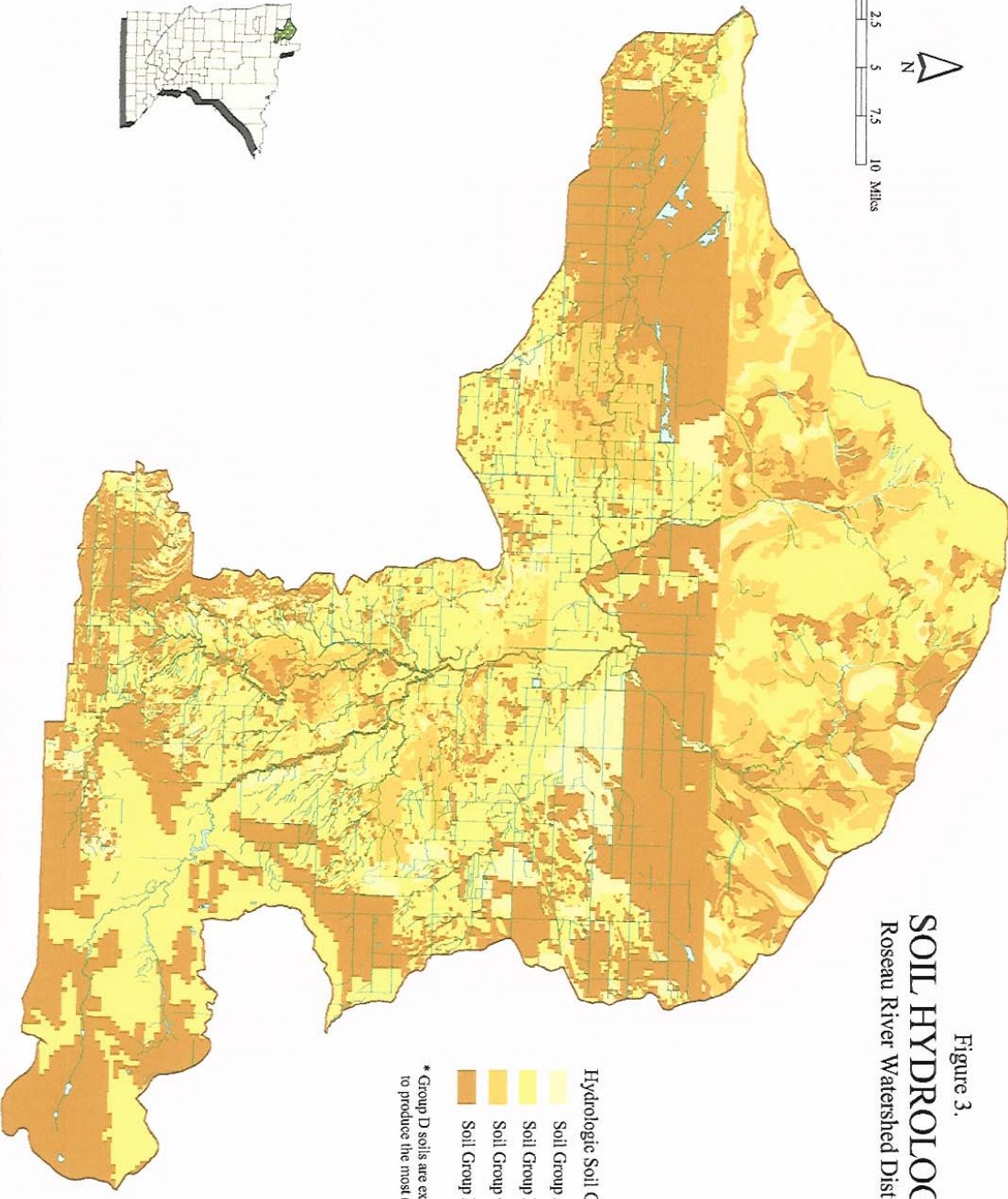


Figure 3.
SOIL HYDROLOGY
 Roseau River Watershed District



Hydrologic Soil Group *

- Soil Group A
- Soil Group B
- Soil Group C
- Soil Group D

*Group D soils are expected to produce the most runoff.



Source: Soils data was derived through compilation of data from Minnesota Land Management Information System (MLMIS), from the Natural Resource and Conservation Service (NRCS), and the Canadian Department of Agriculture.

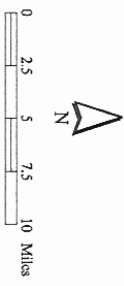
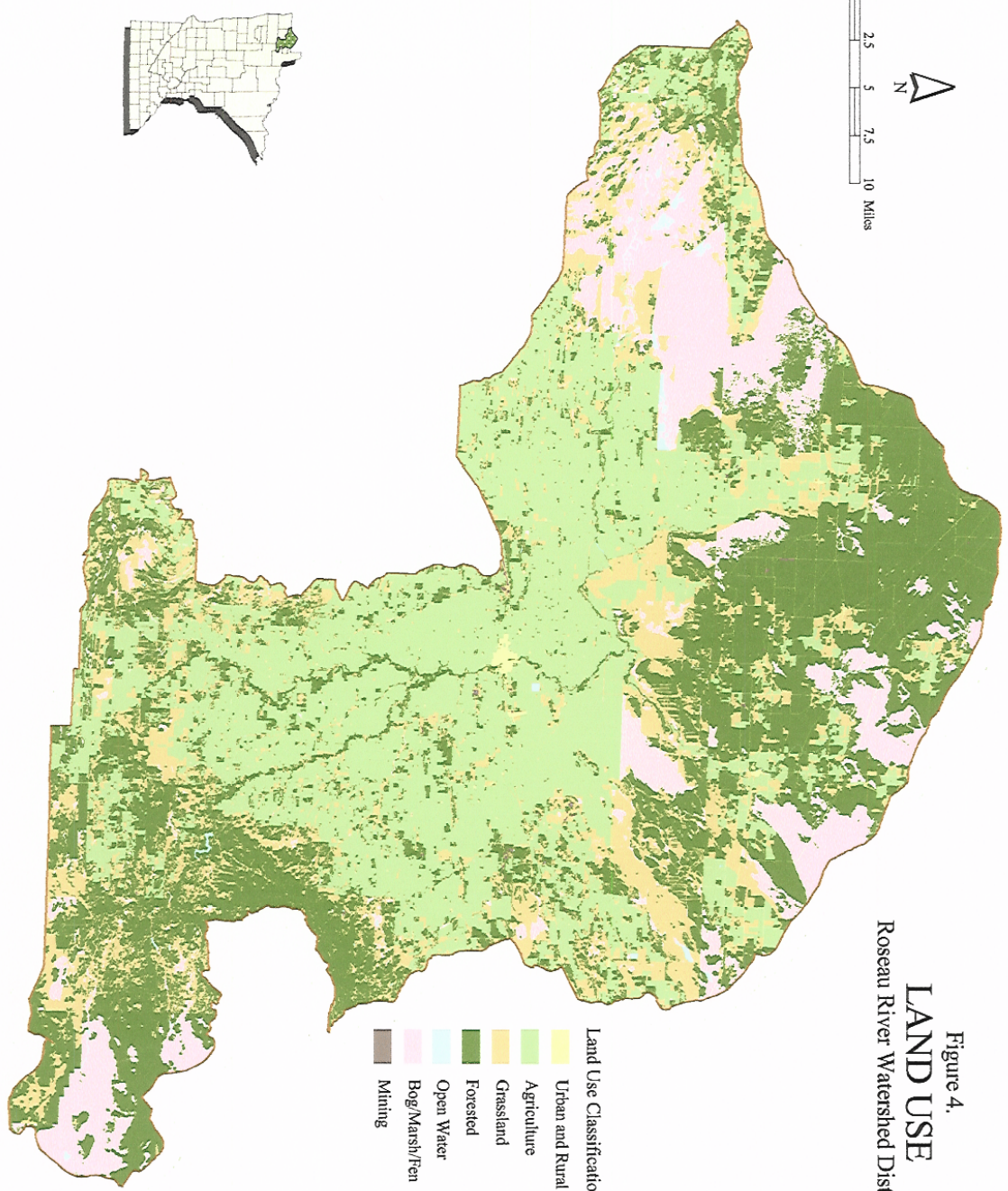


Figure 4.
LAND USE
Roseau River Watershed District



- Land Use Classification
- Urban and Rural Development
 - Agriculture
 - Grassland
 - Forested
 - Open Water
 - Bog/Marsh/Fen
 - Mining

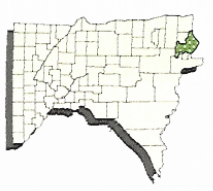
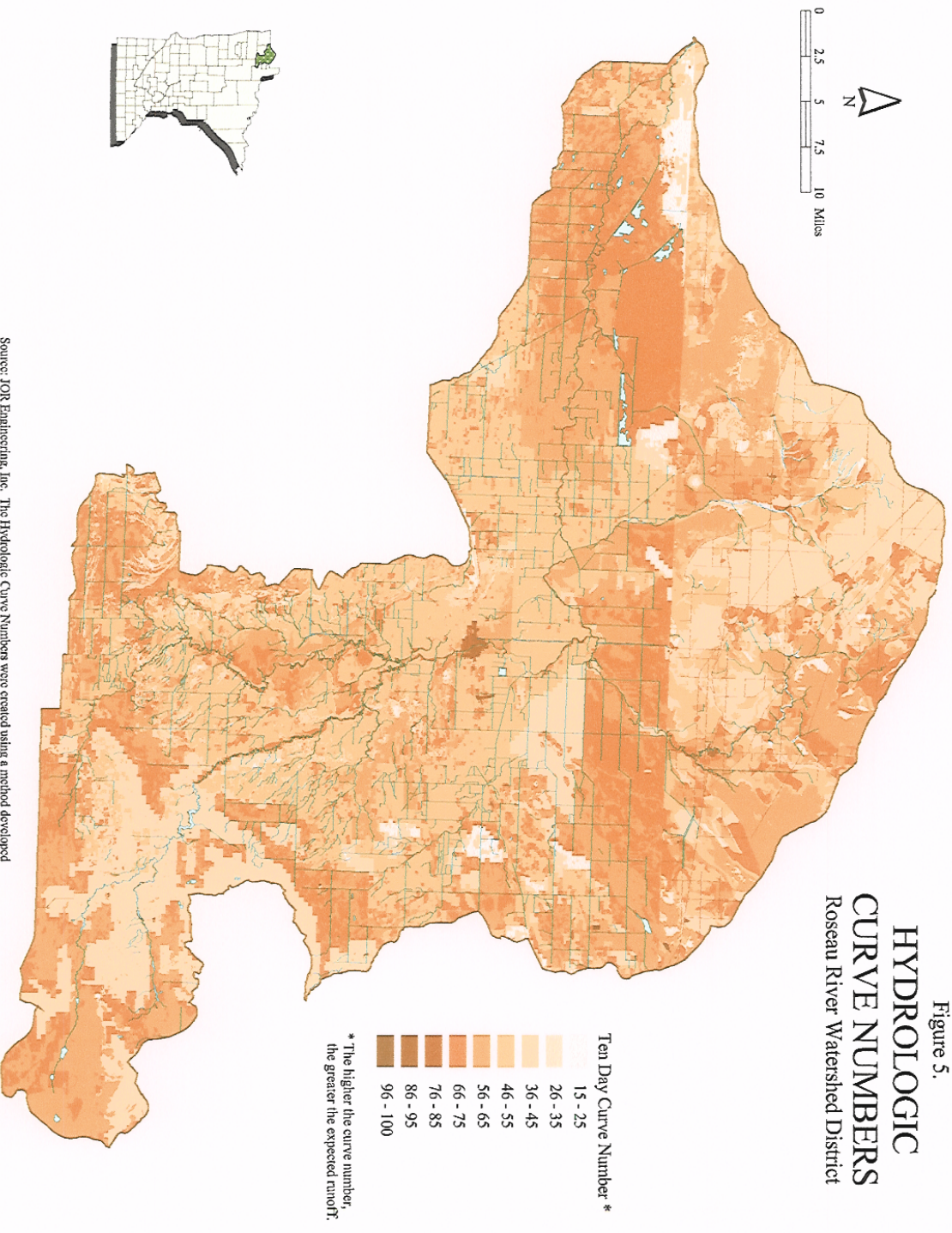


Figure 5.
**HYDROLOGIC
 CURVE NUMBERS**
 Roseau River Watershed District



Source: JOR Engineering, Inc. The Hydrologic Curve Numbers were created using a method developed by the Soil Conservation Service. The data used to create this dataset was a land-use file (MNDNR, TIC, and Environment), Manitocha, as well as a soils base (MLMIS and NRCS).

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Antecedent Moisture Condition II (normal) was assumed to exist prior to all hypothetical storm events. This is generally considered applicable for moisture conditions when storms would occur in Minnesota. The Minnesota Hydrology Guide (MHG), Table 3-1, provides a table for conversion to AMC III for pre-storm conditions which could be used to assume wetter conditions prior to the storm event.

Spring Runoff (Snowmelt Events)

Spring snowmelt runoff events are also modeled. The amount of 10 day runoff was based on a map in Figure 1-12 of the MHG which displays expected 10 day runoff amounts for 100 year recurrence events. The estimates were developed from records which include both rainfall and snowmelt runoff estimates. Since most major floods occur in the spring as a result of a combination of rainfall and snowmelt, this data reasonably represents the spring runoff condition. However, in a strict statistical sense, this flood could occur at any time during the year. Factors are also given to estimate runoff amounts for the 50, 25, and 10 year recurrence events. The amount of runoff estimated for each 10 day runoff event in the Roseau area is listed in Table 1. This amount of runoff was used over the entire modeled basin; however, the runoff amount tends to increase from west to east. For individual project assessment, area specific runoff data should be used.

Table 1
Runoff Estimated for 10-day Event

Year	Runoff (Inches)
10	4.03
25	4.88
50	5.49
100	6.1

The 10 day runoff amounts were distributed in time using the SCS procedure described in (NEH, Chapter 21.10) with the following equation:

$$Q_{(\max\ 24\ \text{hour})} = .3 * Q_{(10\ \text{Day})}$$

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This relation means that 30% of the runoff, for the 10 day period, occurs within a 24 hour period. We consider this distribution representative of a typical snowmelt with rainfall event in Northwestern Minnesota. The runoff was distributed equally over the watershed area. Total runoff is simulated in the model by using a SCS curve number of 100 which represents an impervious condition and inputting the runoff amount as precipitation. The assumption that runoff is equally distributed implies that soil infiltration rates are equal. This tends to be true due to the frozen condition of the soil. However, as actual spring flow data is collected, the model can be calibrated to reflect observed differences in spring infiltration rates due to soil type, land cover, or other factors.

Hydrograph Development

For the purpose of hydrograph development at a sub-basin level, the watershed was divided into 97 sub-watersheds. The subwatersheds were shown on the map in Figure 1. Runoff within each sub-watershed is determined, as discussed above, by the SCS curve number method. The curve number determined for each sub-watershed is shown in Table 2. The weighted average 24 hour curve number for the entire drainage area was determined to be 72. This converts to a 10 day curve number of 55 (SCS NEH-4, Table 21.2)

The Clark Unit Hydrograph Method was used in the model to transform runoff excess to outflow from each sub-watershed. This method requires determination of two runoff parameters related to time of concentration and storage. The time of concentration was calculated for each sub-watershed. Time of concentration is the travel time required for runoff to flow from the most hydrologically distant point of the sub-watershed to the outlet. The storage coefficients were preliminarily estimated using regional curves developed by the Red Lake Watershed District, Charles Anderson, P.E.. This uses the relationship: $R=K*T_c$ where R is the storage parameter, K is a drainage/slope coefficient, and T_c is the time of concentration. The Clark Method utilizes time-area curve of the basin for runoff transformation. Synthetic time-area curves were used based on the sub-watershed shape (ie., fan, rectangular, or diamond shape) as presented in the October 6-9, 1981 workshop on Hydrologic Analysis of Floods, US Army Corps of Engineers in Madison Wisconsin. Sub-watershed hydrologic parameters used in the model are summarized in Table 2.

Table 2
Subwatershed Parameters

Name	Code	DA (Sq Mi)	24-Hour CN	10-Day CN	Tc (Hours)	R (Hours)
Roseau River Flowage	RNF9	40.81	75	58	35.53	115.89
Dam 3	RNF15	13.69	68	50	25.65	71.82
Dam 4	RNF19	5.80	73	56	14.88	41.66
RR to Hanson Creek	RNF25	12.52	62	43	18.80	52.64
Dam 1	RNF29	12.73	75	58	34.28	111.82
Dam 2	RNF35	4.90	65	46	22.66	73.92
Winner Dam	RNF39	13.36	65	46	40.79	133.06
Hanson Creek to RR	RNF45	5.59	57	38	16.96	47.49
Hayes Lake	RNF49	18.29	64	45	60.89	170.49
Beaver	RNF59	15.71	66	47	43.26	90.85
Pencer East	RNF65	12.79	67	49	15.54	17.40
RR to Severson Creek	RNF69	2.29	72	54	7.24	10.14
Severson Creek	RNF70	22.25	68	50	17.30	24.22
RR to Bear Creek	RNF79	7.52	70	52	13.14	18.40
Comstocks	RNF80	20.66	72	55	16.80	19.75
Bear Creek	RNF85	5.27	72	54	11.08	12.10
Gage 2	RNF99	2.18	74	57	3.96	3.71
North Branch		216.09	69	51		
Skime	RNF109	28.21	72	55	67.63	220.61
SB to Mickinock Creek	RNF119	24.20	73	56	25.87	72.44
Palmville Sub RNF3	RNF120	1.27	76	60	7.06	19.77
Palmville Sub RNF4b	RNF121	0.95	78	63	9.62	26.94
Palmville Sub RNF4a	RNF123	2.32	78	62	6.98	19.54
Palmville Sub RNF5	RNF125	4.44	72	54	15.40	43.18
Palmville Sub RNF6	RNF126	1.25	74	57	11.52	24.19
Palmville Sub RNF7	RNF127	2.93	67	48	16.27	22.78
Palmville Sub RNF8	RNF128	1.22	66	47	6.25	13.13

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Name	Code	DA (Sq Mi)	24-Hour CN	10-Day CN	Tc (Hours)	R (Hours)
Palmville Sub RNF9	RNF129	2.90	66	47	7.84	16.46
Palmville Sub RNF10	RNF130	1.29	64	45	5.11	16.67
Palmville wildlife pool	RNF131	7.65	78	62	13.89	45.30
Palmville flood pool	RNF132	0.89	78	62	7.85	25.61
Oseland	RNF139	23.74	73	56	21.3	44.73
Mickinock Creek	RNF145	8.37	72	54	18.97	26.56
Wannaska	RNF149	14.00	72	54	19.28	26.99
SB to Paulson Creek	RNF155	4.45	71	53	6.05	5.67
Gage 43	RNF159	20.07	72	55	20.56	38.86
Paulson Creek	RNF165	3.47	71	53	10.25	14.35
Pencer West	RNF169	6.56	77	61	14.79	20.71
SB to Unamed Creek 1	RNF170	1.65	77	61	6.34	8.88
Unamed Creek 1	RNF171	13.67	72	54	19.15	26.81
SB to Unamed Creek 2	RNF172	5.04	76	60	16.23	22.72
Unamed Creek 2	RNF173	16.03	71	53	16.17	22.64
Gage 3	RNF180	11.52	72	54	18.81	26.33
Sueker Creek	RNF189	0.69	72	55	7.44	6.97
Gage 1	RNF199	9.25	74	57	11.09	15.53
South Branch		218.03	73	55		
Gage 50	RNF209	3.24	72	55	8.83	12.36
Stafford 1	RNF211	11.25	70	52	16.80	15.75
Stafford 2	RNF212	1.45	71	53	2.49	2.34
Stafford 3	RNF213	0.70	66	47	5.56	5.22
County Ditch 8	RNF219	6.26	71	53	17.92	25.09
RR to Cow Creek	RNF229	4.83	71	53	12.04	16.86
Gage 44	RNF248	16.90	72	55	15.15	21.21
Cow Creek	RNF249	0.31	75	58	1.76	2.46
Center Street	RNF269	5.07	76	60	10.04	14.56
Roseau River at Center Street		484.13	71	53		
Gage 15	RNF299	5.51	76	60	9.18	12.85

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Name	Code	DA (Sq Mi)	24-Hour CN	10-Day CN	Tc (Hours)	R (Hours)
County Road 2	RNF319	19.38	74	57	17.12	23.73
Upper Summer Road	RNF335	10.04	69	51	19.28	26.99
Summer Road	RNF339	10.50	67	49	17.20	24.08
Upper SE Hwy11	RNF351	4.32	72	55	12.99	18.19
Gage 12	RNF359	12.44	68	50	13.97	20.15
MN Highway 11	RNF379	20.97	72	54	37.80	79.38
Hay Creek Det 1	RNF381	4.14	72	54	20.23	28.32
Norland CD 18	RNF385	8.39	72	55	29.83	83.52
Hay Creek Pool 1	RNF391	2.21	72	55	3.60	5.04
Lower Hay Creek	RNF399	19.76	71	53	24.80	43.40
Hay Creek		112.15	71	53		
Norland sub RNF20	RNF401	2.85	74	57	6.27	13.17
Norland sub RNF30	RNF402	6.43	72	54	39.75	111.30
Norland sub RNF40	RNF403	5.66	67	49	13.51	18.91
Norland sub RNF60	RNF405	7.08	72	55	11.04	15.46
Norland sub RNF65	RNF406	1.71	65	46	5.00	8.19
Norland sub RNF70	RNF408	7.65	67	48	12.55	26.36
MN Highway 310	RNF499	19.26	67	49	18.59	45.29
Roseau River @ MN 310		652.43	71	53		
Mud Creek near Sprague, MB	RNF510	32.18	75	59	71.13	149.38
East Fork Sprague Creek	RNF520	22.42	68	51	43.20	90.72
West Fork Sprague Creek	RNF530	20.42	64	45	48.32	101.47
Sprague Creek at Vassar Road	RNF540	47.64	69	51	43.35	91.04
Sprague Creek near Sprague, MB	RNF545	21.93	74	57	35.70	74.97
Sprague Creek at USGS gage	RNF550	39.01	72	55	52.83	49.56
Lat 2 JD 61	RNF570	54.33	76	60	39.24	82.40
Lower Sprague Creek	RNF580	47.32	78	62	29.00	60.90
Sprague Creek		285.25	73	56		
South Roseau Lake	RNF610	40.91	71	53	10.48	9.82
North Roseau Lake	RNF620	46.20	72	55	40.11	56.15

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Name	Code	DA (Sq Mi)	24-Hour CN	10-Day CN	Tc (Hours)	R (Hours)
West Pine Creek	RNF700	33.76	62	43	56.23	52.74
East Pine Creek	RNF710	9.55	60	41	20.36	19.08
Pine Creek to Diversion	RNF720	16.68	67	49	7.58	10.61
Pine Creek at Gage 19	RNF790	20.29	73	56	17.76	24.86
Pine Creek		80.28	66	47		
Roseau River at Ross		1105.07	71	54		
RRWMA Pool 1	RNF810	24.88	75	58	13.30	18.62
RRWMA Pool 2	RNF820	89.71	75	58	51.00	107.10
RRWMA Pool 3	RNF830	23.73	70	52	12.50	17.50
Lins Bridge	RNF900	41.99	72	54	14.73	13.82
RR to Big Swamp	RNF920	24.09	75	59	32.83	45.96
Big Swamp	RNF950	88.82	78	63	32.48	68.21
Caribou	RNF960	24.04	71	53	24.04	47.32
Roseau River to Int'l Border	RNF999	9.56	70	52	13.78	19.29
Roseau River at Int'l Border		1431.89	72	55		

Reach Routing

The channel reaches were modeled using the Muskingin-Cunge Channel routing method. For this method, we used an eight point cross section, Mannings n value, for channel and overbank flow, reach length, and slope.

The channel cross section, reach length, and slope were derived from USGS 7.5 minute topographic maps. Cross section data from the stream gaging program the District operates were also used.

Calibration

Preliminary manual calibration of the model was done based on a rainfall event occurring in May of 1996 and then checked against the rainfall event occurring in October of 2000. The results after calibration are shown in Figures 6-13. The gage on Sprague Creek was not in operation for the 1996 flood.

The May 1996 event, according to the NWS at Grand Forks, was a wide spread fairly evenly distributed rainfall. This event occurred while the river was still receding from the spring runoff. Rainfall was distributed based on hourly precipitation at Thief Lake. Rainfall totals were 4.5 inches on basins above Malung and 3.75 inches on basins below Malung. This was determined by gaging at Thief Lake and Section 32, T163NR39W. Antecedent moisture condition III was assumed because of the recent spring runoff.

The November 2000 event occurred late in October and early November. Total precipitation of 6.51 inches measured at Roseau was distributed across the basin. Hourly precipitation from Thief Lake was not available for this storm. Ten day curve numbers were used. This event was only used for checking because of the freezing and thawing which occurred during the event.

The initial runs of these floods produced higher peaks and shorter durations than the gaged data. Preliminary calibration was done by adjusting the Clark storage coefficient. The need is apparent for further adjustment of input parameters including time routing parameters. However, better precipitation and additional flow data is needed. As more gage data becomes available, further adjustment will be made by the Watershed District. Users of the model should verify that they have the latest calibrated version.

Roseau River HEC-1 Hydrologic Model (October 24, 2001)

Stream gaging performed by the Watershed District in May 1996 near Malung shows a peak flow of 7,435 cfs and a peak flow of 8,190 at Roseau.

Results and Conclusions

The model can be used to evaluate the relative change to the flood hydrograph with and without projects which are being considered in the basin. The ability to evaluate relative difference (as opposed to predicting absolute values) is the strength of the hydrologic modeling process.

Tables 3 and 4 show a summary of preliminary calibrated model predicted peak flows at various points in the basin. These predicted peak flows are considered reasonable. However, care should be taken in using model predicted peak flows for project design purposes. Modeling is only one of the methods normally used for project design.

Figure 6

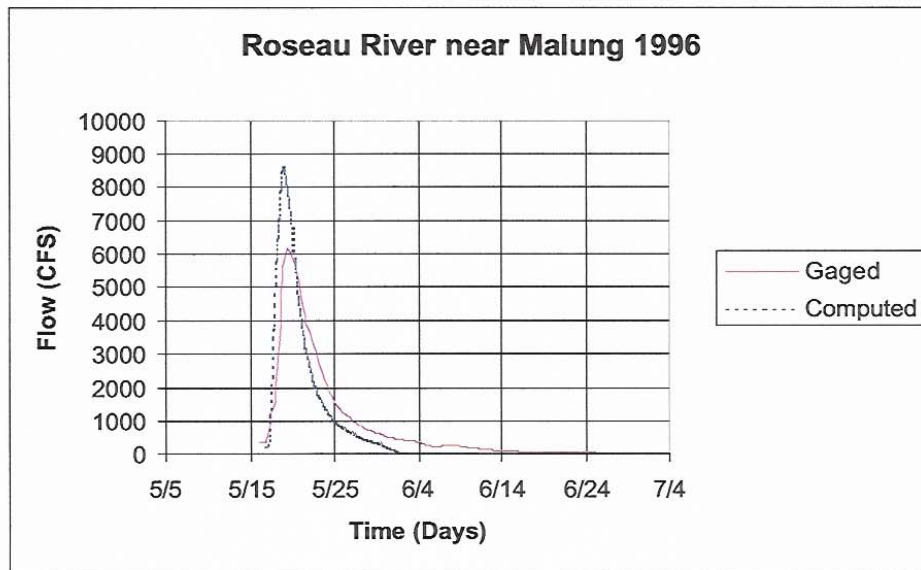


Figure 7

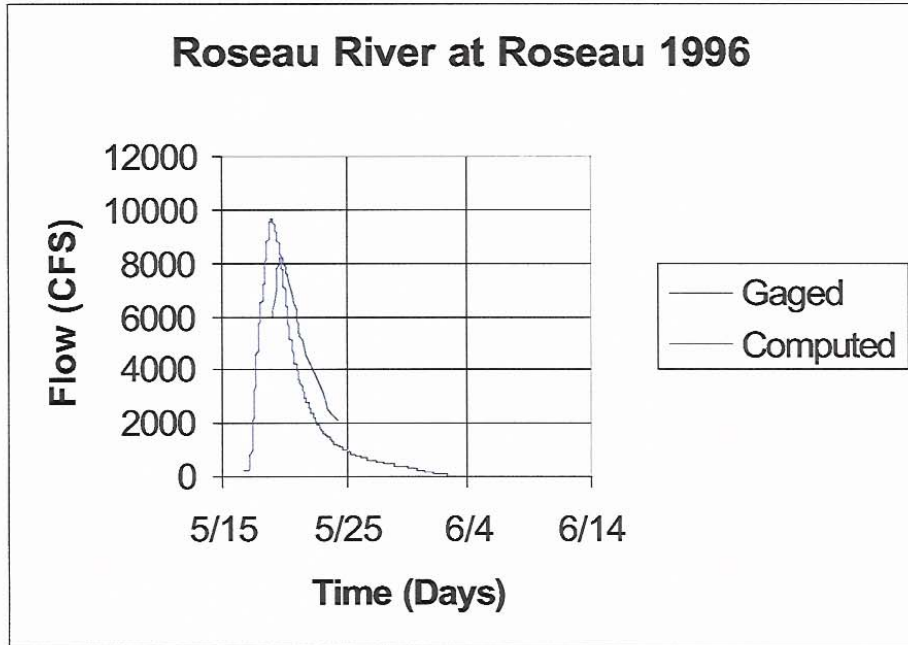


Figure 8

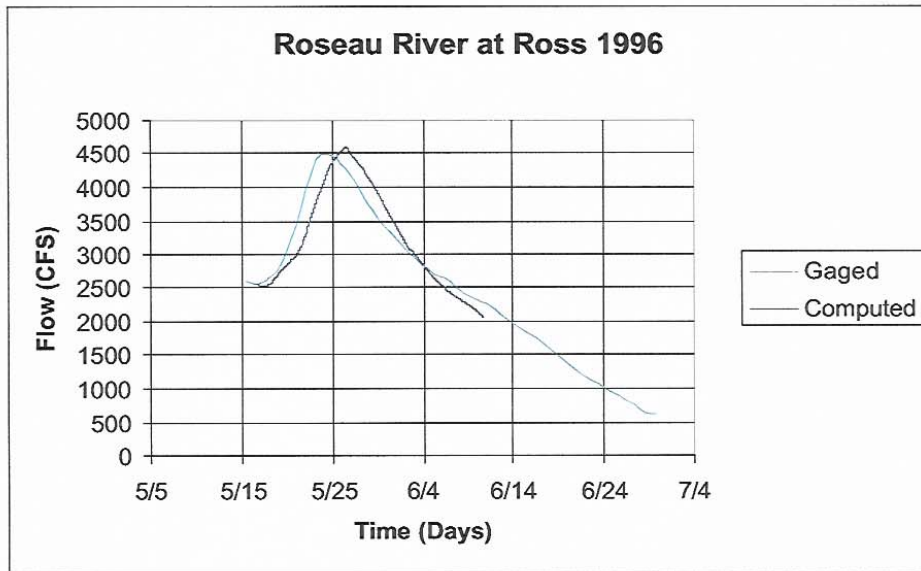


Figure 10

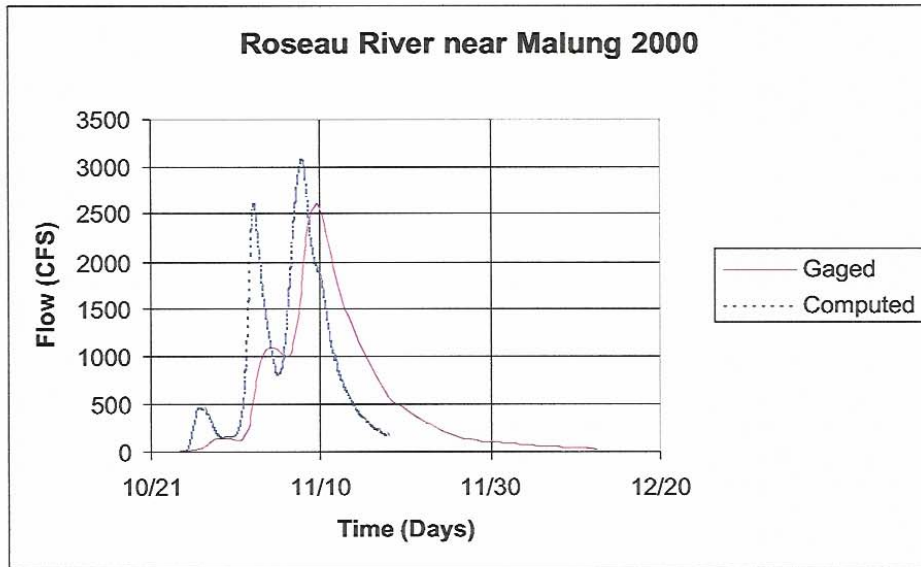


Figure 11

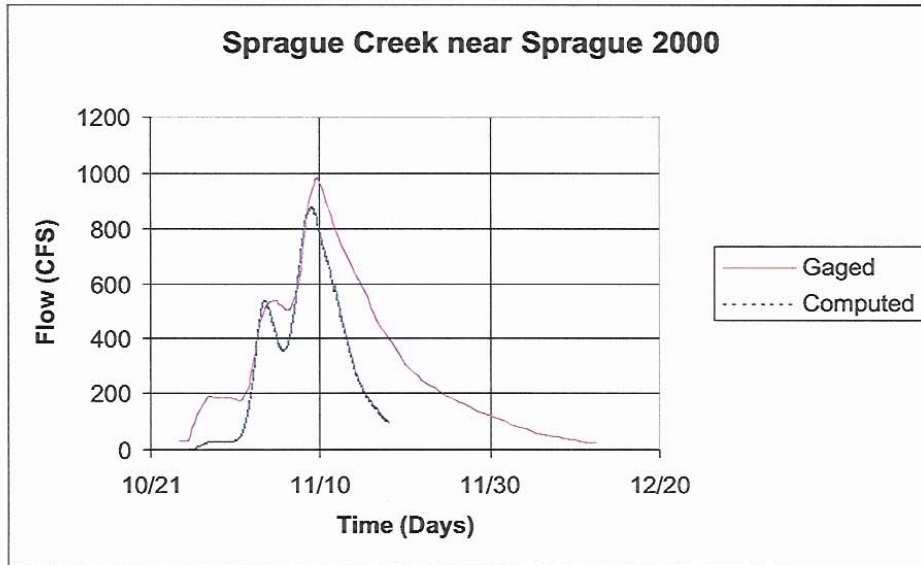


Figure 12

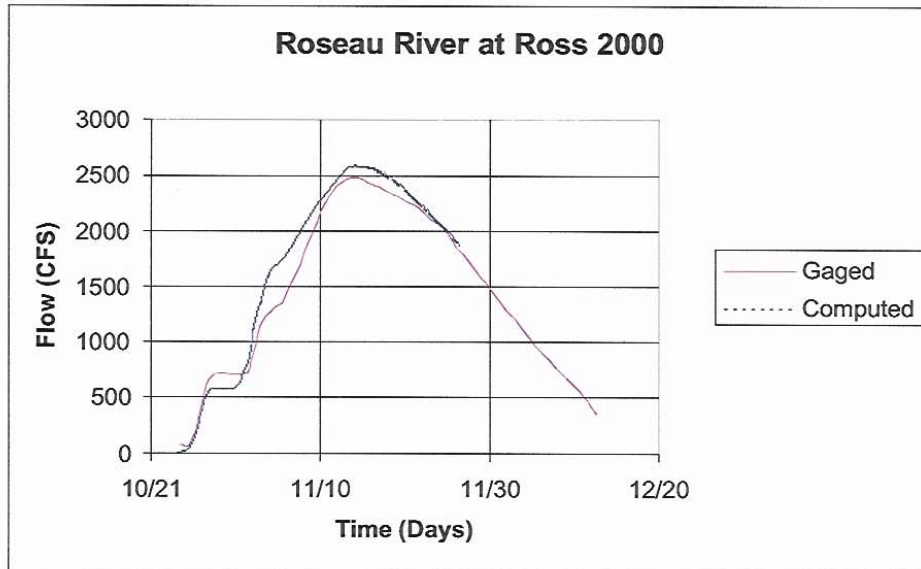
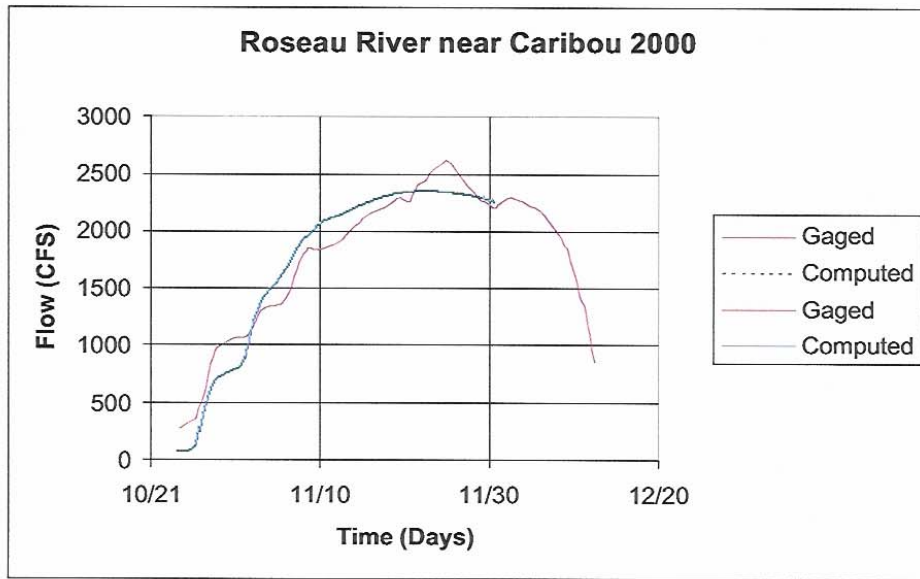


Figure 13



Roseau River HEC-1 Hydrologic Model (October 24, 2001)

Table 3
Summary of Synthetic Summer Flood Flows

Location	Stream Gage ID	Model Id	Drainage Area	5 yr (cfs)	10 yr (cfs)	25 yr (cfs)	50 yr (cfs)	100 yr (cfs)
North Branch near Malung	2	adh99	216.09	408	1,137	1,303	1,746	2,134
South Fork at Wannaska	36	adh149	125.63	445	935	1,350	1,742	2,084
South Fork near Malung	1	adh199	218.03	952	1,918	2,746	3,503	4,119
Roseau River near Malung	50	adh209	437.36	1,334	3,084	3,963	5,100	6,076
Roseau River at Roseau	30	adh269	484.13	1,583	2,811	4,663	6,005	7,111
Hay Creek at Summer Road	11	adh339	45.43	200	331	620	814	981
Hay Creek at MN Hwy 11	13	adh379	83.16	338	736	1,053	1,345	1,603
Hay Creek at Mouth		adh399	112.15	443	1,005	1,295	1,600	1,909
Roseau River at CR 28	15	rc401m	601.79	1,903	3,505	5,057	5,915	6,737
Roseau River at MN Hwy 310	16	rc499m	652.43	2,026	3,450	4,455	5,692	6,646
Sprague Creek at USGS Gage	57	adh550	183.60	456	877	1,262	1,545	1,832
Sprague Creek		rc580m	285.25	857	1,300	1,699	2,067	2,324
Pine Creek at Diversion	606	adh720	59.99	91	246	400	555	703
Pine Creek Diversion	606	rtv720		91	0	340	444	543
Pine Creek at CR 118	19	adh790	80.28	140	196	462	636	793
Roseau River at Ross	20	rsv699	1,105.07	1,646	2,586	2,600	3,235	3,833
Overflow to Two Rivers	40	rtv920		0	0	206	350	487
Roseau River near Caribou		adh960	1,422.33	0	0	2,379	2,643	2,895
Roseau River at Int'l Border		adh999	1,432.89	0	0	2,379	2,643	2,895

Roseau River HEC-1 Hydrologic Model (October 24, 2001)

Table 4
Summary of Synthetic Spring Flood Flows

Location	Stream Gage ID	Model Id	Drainage Area	10 yr (cfs)	25 yr (cfs)	50 yr (cfs)	100 yr (cfs)
North Branch near Malung	2	adh99	216.09	2,861	3,479	3,922	4,367
South Fork at Wannaska	36	adh149	125.63	1,990	2,414	2,718	3,024
South Fork near Malung	1	adh199	218.03	3,774	4,475	4,961	5,460
Roseau River near Malung	50	adh209	437.36	6,637	7,934	8,798	9,670
Roseau River at Roseau	30	adh269	484.13	7,559	9,053	9,859	10,504
Hay Creek at Summer Road	11	adh339	45.43	823	995	1,112	1,232
Hay Creek at MN Hwy 11	13	adh379	83.16	1,518	1,811	2,022	2,239
Hay Creek at Mouth		adh399	112.15	1,883	2,270	2,548	2,834
Roseau River at CR 28	15	rc401m	601.79	7,247	8,932	10,606	11,954
Roseau River at MN Hwy 310	16	rc499m	652.43	7,490	9,136	10,817	12,222
Sprague Creek at USGS Gage	57	adh550	183.60	2,190	2,659	2,984	3,281
Sprague Creek		rc580m	285.25	2,580	3,122	3,733	4,273
Pine Creek at Diversion	606	adh720	59.99	929	1,117	1,250	1,389
Pine Creek Diversion	606	rtv720		693	791	850	850
Pine Creek at CR 118	19	adh790	80.28	647	787	924	1,114
Roseau River at Ross	20	rsv699	1,105.07	5,150	7,021	8,203	9,333
Overflow to Two Rivers	40	rtv920		929	1,408	1,767	2,125
Roseau River near Caribou		adh960	1,422.33	3,240	3,584	3,876	4,167
Roseau River at Int'l Border		adh999	1,432.89	3,239	3,583	3,875	4,167

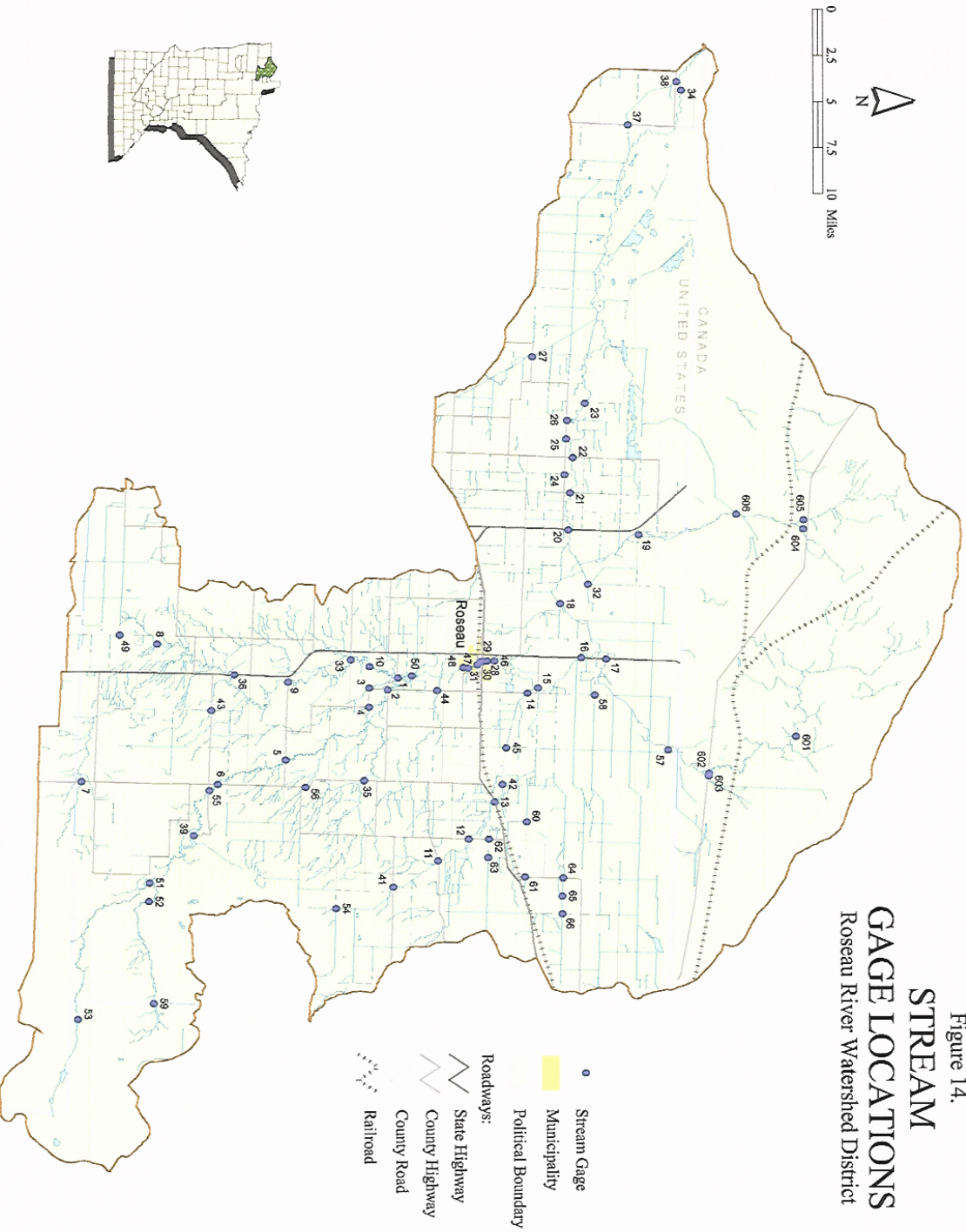
Future Model Improvements

The model has had limited calibration to actual storm events due to the limited extent of actual gaging data available, particularly in Manitoba. We have established a network of stream gaging sites within the watershed. The location of these sites are shown in Figure 14. We recommend that as additional data from these sites becomes available, further calibration of the model should be performed.

The modeling capabilities of the program are somewhat limited in their ability to model the sloped storage that occurs in the Old Roseau Lake Bed and the Big Swamp areas. Within the current model, this is done by an approximation of level pool storage. Ideally, these areas would be analyzed using a dynamic routing model such as NET.

As the planning process evolves, it is anticipated that the model will need to be further refined to analyze specific flood damage reduction strategies in specific areas.

Figure 14.
**STREAM
 GAGE LOCATIONS**
 Roseau River Watershed District



Roseau River HEC-1 Hydrologic Model (October 24, 2001)

References

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- Joint Studies for Co-ordinated Water Use and Control in the Roseau River Basin, International Roseau River Engineering Board Report to the International Joint Commission, September, 1975, Appendix A Water Resources
- National Weather Service, Technical Papers #40 and 49
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- United States Department of Agriculture, Soil Survey Manual, Soil Survey Division Staff, Agriculture Handbook No. 18, Issued October 1993
- The Minnesota Hydrology Guide (MHG)
- Red Lake Watershed District, Charles Anderson, P.E.
- Hydrologic Analysis of Floods, Workshop - U.S. Army Corps of Engineers, October 6-9, 1981 Madison, Wisconsin
- USGS 7.5 Minute Topographic Maps

APPENDIX A

Basin Schematic

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE	(V) ROUTING	(--->) DIVERSION OR PUMP FLOW
NO.	(.) CONNECTOR	(<---) RETURN OF DIVERTED OR PUMPED FLOW
7	RNF9	
	V	
	V	
27	RSV9	
	V	
	V	
35	RCH9	
	.	
	.	
42	.	RNF15
	.	.
	.	.
49	ADH15.....	
	V	
	V	
52	RCH15	
	.	
	.	
59	.	RNF19
	.	.
	.	.
66	ADH19.....	
	V	
	V	
69	RCH19a	
	V	
	V	
76	RC19b	
	.	
	.	
83	.	RNF25
	.	.
	.	.
90	ADH25.....	
	.	
	.	
94	.	RNF29
	V	
	V	
101	.	RSV29
	V	
	V	
109	.	RCH29
	.	
	.	
116	.	RNF35
	.	.
	.	.
123	.	ADH35.....
	V	
	V	
126	.	RCH35
	.	
	.	
133	.	RNF39
	.	.
	.	.
140	.	ADH39.....
	V	
	V	
143	.	RSV39
	V	
	V	
151	.	RCH39
	.	
	.	
158	.	RNF45
	.	.
	.	.
165	.	ADH45.....
	.	
	.	
169	ADH46.....	
	V	
	V	
172	RCH46	
	.	

179	.	RNF49	.
	.		.
186	ADH49.....		.
	V		
	V		
189	RSV49		
	V		
	V		
200	RCH49		
	.		
207	.	RNF59	.
	.		.
214	ADH59.....		.
	V		
	V		
217	RCH59		
	.		
224	.	RNF65	.
	.		.
231	ADH65.....		.
	V		
	V		
234	RCH65		
	.		
241	.	RNF69	.
	.		.
248	ADH69.....		.
	.		.
251	.	RNF070	.
	.		.
258	ADH70.....		.
	V		
	V		
261	RCH070		
	.		
268	.	RNF079	.
	.		.
275	ADH79.....		.
	.		.
278	.	RNF80	.
	.	V	
	.	V	
285	.	RCH80	.
	.		.
292	.		RNF85
	.		.
299	.	ADH85.....	.
	.		.
303	ADH86.....		.
	V		
	V		
306	RCH86		
	.		
313	.	RNF99	.
	.		.
320	ADH99.....		.
	V		
	V		
323	RCH99		
	.		
330	.	RNF109	.
	.	V	
	.	V	
337	.	RCH109	.
	.	V	

344	.	V						
	.	RCH110						
351	.		RNF119					
358	.	ADH119					
362	.		RNF120					
	.		V					
370	.		V	RCH120				
	.							
376	.			RNF121				
	.			V				
383	.			V	RCH121			
	.							
389	.					RNF123		
	.							
396	.			ADH123			
	.			V				
399	.			V	RCH123			
	.							
405	.			ADH124			
	.							
408	.			RNF125				
	.			V				
415	.			V	RCH125			
	.							
421	.					RNF126		
	.					V		
428	.					V	RCH126	
	.							
434	.							RNF127
	.							V
441	.							V
	.							RCH127
	.							
447	.							
	.							RNF128
	.							V
454	.							V
	.							RCH128
	.							
460	.							
	.							RNF129
	.							
467	.							
	.							RNF130
	.							
474	.			ADH130			
	.							
477	.							
	.							RNF131
	.							
484	.			ADH131			
	.							
487	.							
	.							RNF132
	.							
494	.			ADH132			
	.			V				
	.			V				
497	.			RCH132				
	.			V				
	.			V				
503	.			RCH133				
	.							

509	.	.	.	RNF139

516	.	.	ADH139.....	.
	.	.	V	.
	.	.	V	.
519	.	.	RCH139	.

525	.	.	.	RNF145

532	.	.	ADH145.....	.

536	.	ADH146.....	.	.
	.	V	.	.
	.	V	.	.
539	.	RCH146	.	.

546	.	.	RNF149	.

553	.	ADH149.....	.	.
	.	V	.	.
	.	V	.	.
556	.	RCH149	.	.

563	.	.	RNF155	.

570	.	ADH155.....	.	.

573	.	.	RNF159	.
	.	.	V	.
	.	.	V	.
580	.	.	RCH159	.
	.	.	V	.
	.	.	V	.
586	.	.	RCH160	.

592	.	.	.	RNF165

599	.	.	ADH165.....	.

603	.	ADH166.....	.	.
	.	V	.	.
	.	V	.	.
606	.	RCH166	.	.

613	.	.	RNF169	.

620	.	ADH169.....	.	.
	.	V	.	.
	.	V	.	.
623	.	RCH169	.	.

630	.	.	RNF170	.

637	.	ADH170.....	.	.

641	.	.	RNF171	.

648	.	ADH171.....	.	.
	.	V	.	.
	.	V	.	.
651	.	RCH171	.	.

658	.	.	RNF172	.

665	.	ADH172.....	.
	.	.	.
669	.	.	RNF173
	.	.	.
676	.	ADH173.....	.
	.	V	.
	.	V	.
679	.	RCH173	.
	.	.	.
686	.	.	RNF199
	.	.	.
693	.	ADH198.....	.
	.	.	.
696	.	.	RNF180
	.	.	V
	.	.	V
703	.	.	RCH180
	.	.	.
710	.	.	RNF189
	.	.	.
717	.	.	ADH189.....
	.	.	.
721	.	ADH199.....	.
	.	V	.
	.	V	.
724	.	RCH199	.
	.	.	.
731	ADH200.....	.	.
	.	V	.
	.	V	.
734	RCH200	.	.
	.	.	.
741	.	RNF209	.
	.	.	.
748	ADH209.....	.	.
	.	V	.
	.	V	.
751	RCH209	.	.
	.	.	.
758	.	RNF211	.
	.	.	.
765	.	.	RNF212
	.	.	.
772	.	.	RNF213
	.	.	.
779	.	ADH211.....	.
	.	V	.
	.	V	.
782	.	RCH211	.
	.	.	.
790	.	.	RNF219
	.	.	.
797	.	ADH220.....	.
	.	.	.
801	ADH221.....	.	.
	.	V	.
	.	V	.
804	RCH221	.	.
	.	.	.
811	.	RNF229	.
	.	.	.
818	ADH229.....	.	.
	.	.	.

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822      .      RNF248
      .      V
      .      V
829      .      RCH248
      .      .
      .      .
836      .      .      RNF249
      .      .
      .      .
843      .      ADH249.....
      .      .
      .      .
847      ADH260.....
      .      V
      .      V
850      RCH260
      .      .
      .      .
857      .      RNF269
      .      .
      .      .
864      ADH269.....
      .      V
      .      V
867      RCH269
      .      .
      .      .
874      .      RNF299
      .      .
      .      .
881      ADH299.....
      .      .
      .      .
884      .      RNF319
      .      V
      .      V
891      .      RCH319
      .      .
      .      .
898      .      .      RNF335
      .      .
      .      .
907      .      .      .----->  OUT335
905      .      .      DVT335
      .      .      V
      .      .      V
910      .      .      RCH335
      .      .
      .      .
917      .      ADH336.....
      .      V
      .      V
920      .      RCH336
      .      .
      .      .
927      .      .      RNF339
      .      .
      .      .
934      .      ADH339.....
      .      V
      .      V
937      .      RCH339
      .      .
      .      .
944      .      .      RNF351
      .      .
      .      .
953      .      .      .-----<  OUT335
951      .      .      RTV335
      .      .      V
      .      .      V
954      .      .      RCH350
      .      .
      .      .
959      .      .      ADH351.....
      .      .
      .      .
964      .      .      .----->  OUT351
962      .      .      DVT351
      .      .      V
      .      .      V
967      .      .      RCH351
      .      .
      .      .

```

```
974 . . . . . ADH352.....
    . . . . . V
    . . . . . V
977 . . . . . RCH352
    . . . . .
    . . . . .
984 . . . . . RNF359
    . . . . .
    . . . . .
991 . . . . . ADH359.....
    . . . . . V
    . . . . . V
994 . . . . . RCH359
    . . . . .
    . . . . .
1003 . . . . . .<----- OUT351
1001 . . . . . RTV351
    . . . . . V
    . . . . . V
1004 . . . . . RCH352
    . . . . .
    . . . . .
1009 . . . . . ADH360.....
    . . . . . V
    . . . . . V
1012 . . . . . RCH360
    . . . . .
    . . . . .
1019 . . . . . RNF379
    . . . . .
    . . . . .
1026 . . . . . ADH379.....
    . . . . . V
    . . . . . V
1029 . . . . . RCH379
    . . . . .
    . . . . .
1036 . . . . . RNF381
    . . . . .
    . . . . .
1043 . . . . . ADH381.....
    . . . . . V
    . . . . . V
1046 . . . . . RCH381
    . . . . .
    . . . . .
1053 . . . . . RNF385
    . . . . . V
    . . . . . V
1061 . . . . . RCH385
    . . . . .
    . . . . .
1068 . . . . . RNF391
    . . . . .
    . . . . .
1075 . . . . . ADH391.....
    . . . . . V
    . . . . . V
1078 . . . . . RCH391
    . . . . .
    . . . . .
1087 . . . . . .-----> OUT391
1085 . . . . . DVT391
    . . . . . V
    . . . . . V
1090 . . . . . RCH392
    . . . . .
    . . . . .
1097 . . . . . ADH395.....
    . . . . . V
    . . . . . V
1100 . . . . . RCH395
    . . . . .
    . . . . .
1107 . . . . . RNF399
    . . . . .
    . . . . .
1114 . . . . . ADH399.....
    . . . . .
    . . . . .
1118 . . . . . ADH400.....
    . . . . .
    . . . . .
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1124 . . .<----- OUT391
1122 . . RTV391
. . V
. . V
1125 . . RC391b
. . .
1130 ADH401.....
. . V
. . V
1134 RC401m
. . .
1140 . . RNF401
. . V
. . V
1148 . . RCH401
. . .
1155 . . . RNF402
. . .
1163 . . ADH402.....
. . .
1168 . . .-----> OUT402
1166 . . DVT402
. . V
. . V
1171 . . RCH402
. . .
1178 . . . RNF403
. . .
1186 . . ADH403.....
. . V
. . V
1189 . . RCH403
. . .
1196 . . . RNF405
. . .
1204 . . ADH405.....
. . .
1208 . . . RNF406
. . .
1216 . . ADH406.....
. . .
1220 . . . RNF408
. . .
1228 . . ADH408.....
. . .
1233 . . .-----> OUT410
1231 . . DVT408
. . V
. . V
1236 . . RCH420
. . .
1243 ADH421.....
. . V
. . V
1246 RCH421
. . .
1255 . . .<----- OUT410
1253 . . RTV430
. . V
. . V
1256 . . RCH430
. . .
1261 ADH430.....
. . .
1264 . . RNF499
. . .

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1271 ADH499.....
      V
      V
1275 RC499m
      .
1280      RNF520
      .
1287      RNF530
      .
1294      ADH530.....
      V
1297      RCH530
      .
1304      RNF540
      .
1311      ADH540.....
      V
1314      RCH540
      .
1321      RNF545
      .
1328      ADH545.....
      .
1332      RNF510
      .
1339      ADH546.....
      V
1342      RCH546
      .
1349      RNF550
      .
1356      ADH550.....
      V
1360      RCH550
      .
1367      RNF570
      .
1376      .<----- OUT402
1374      RTV402
      V
1377      RCH571
      .
1382      ADH574.....
      V
1385      RCH574
      .
1392      ADH575.....
      V
1395      RCH575
      .
1402      RNF580
      .
1409      ADH580.....
      V
1413      RC580m
      .
1417 ADH456.....

```

```

V
V
1421 RCH456
.
1428 . RNF610
.
1435 . RNF620
.
1442 ADH620.....
.
1446 . RNF700
. V
. V
1453 . RCH700
.
1460 . RNF710
. V
. V
1467 . RCH710
.
1474 . ADH710.....
. V
. V
1478 . RCH711
.
1485 . RNF720
.
1492 . ADH720.....
.
1498 . -----> OUT720
1496 . DVT720
. V
. V
1501 . RCH720
.
1508 . RNF790
.
1515 . ADH790.....
.
1519 ADH699.....
. V
. V
1522 RSV699
. V
. V
1532 RCH699
.
1539 . RNF900
.
1546 ADH900.....
. V
. V
1549 RCH900
.
1556 . RNF920
.
1563 ADH920.....
. V
. V
1566 RCH920
.
1573 . RNF810
.
1582 . <----- OUT720
1580 . RIV720
. V
.

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1583      .      .      V
          .      .      RC720a
          .      .      .
1588      .      ADH810.....
          .      V
          .      V
1591      .      RSV810
          .      .
          .      .
1598      .      .      RNF820
          .      .      .
          .      .      .
1605      .      ADH820.....
          .      V
          .      V
1608      .      RSV820
          .      .
          .      .
1617      .      .----->  OUT820
1615      .      DVT820
          .      V
          .      V
1620      .      RCH821
          .      V
          .      V
1627      .      RCH822
          .      .
          .      .
1634      ADH930.....
          .      V
          .      V
1637      RCH930
          .      .
          .      .
1644      .      RNF830
          .      .
          .      .
1653      .      .      .<-----  OUT820
1651      .      .      RTV820
          .      .
          .      .
1654      .      ADH830.....
          .      V
          .      V
1657      .      RSV830
          .      V
          .      V
1664      .      RCH831
          .      V
          .      V
1671      .      RCH832
          .      .
          .      .
1678      ADH940.....
          .      V
          .      V
1681      RCH940
          .      .
          .      .
1688      .      RNF950
          .      .
          .      .
1695      ADH950.....
          .      V
          .      V
1698      RSV950
          .      .
          .      .
1706      .----->  OUT920
1704      DVT950
          .      V
          .      V
1709      RCH950
          .      .
          .      .
1716      .      RNF960
          .      .
          .      .
1723      ADH960.....
          .      V
          .      V
1726      RCH960
          .
          .

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1733      .      RNF999
          .      .
          .      .
1740  ADH999.....
          .
          .
1746      .      .<----- OUT920
1744      .      RTV920
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Appendix B

HEC-1 Input Spring Runoff Events

ID Roseau River Watershed District
 ID Developed by JOR Engineering, Inc. Crookston, MN
 ID 10 Day Spring Event 10/23/01 Michael Bakken
 ID Calibrated to May 1996 Flood
 *DIAGRAM
 IT 60 1JAN94 0 600
 IO 0
 KK RNF9
 KM Local Drainage to Roseau River Flowage
 KO 0 0 0 0 22
 BA 40.81
 IN 144.
 KM 100 year
 PB 6.1
 KM 50 year
 PB 5.49
 KM 25 year
 PB 4.88
 KM 10 year
 PB 4.03
 PC 0. 0.00527 0.01059 0.01596 0.02139 0.02687 0.03241 0.03801 0.04368 0.04941
 PC0.0552 0.06108 0.06702 0.07304 0.07914 0.08532 0.09158 0.09793 0.10438 0.11092
 PC0.1175 0.12432 0.13119 0.13818 0.14529 0.15253 0.15991 0.16744 0.17513 0.183
 PC0.191 0.1993 0.20776 0.21645 0.22539 0.23460 0.24412 0.25397 0.2642 0.27485
 PC0.2859 0.29769 0.31004 0.32318 0.33728 0.35261 0.36957 0.38885 0.41184 0.44238
 PC0.5323 0.57169 0.59764 0.61852 0.63652 0.6526 0.66728 0.68088 0.69361 0.70562
 PC0.717 0.72792 0.73836 0.7484 0.75808 0.76744 0.77651 0.78532 0.79389 0.80224
 PC0.8103 0.81834 0.82612 0.83373 0.84119 0.8485 0.85568 0.86273 0.86965 0.87646
 PC0.8831 0.88975 0.89624 0.90264 0.90895 0.91517 0.92131 0.92737 0.93335 0.93925
 PC0.945 0.95084 0.95654 0.96217 0.96774 0.97325 0.97871 0.98411 0.98947 0.99474
 LS 0 100 0
 UC 35.53 115.89
 * fan
 UA 0 0.05 0.15 0.35 0.65 1
 KK RSV9
 KM Roseau River Flowage Impoundment
 KM Outlet and Storage curves developed by Dan Thul (MNDNR 1981)
 KO 0 0 0 0 22
 RS 1 STOR 240 0
 * rsv9stor
 SV 240 310 400 500 643 940 1092 1245 1550
 * rsv9flow
 SQ 0 52 155 288 435 800 1225 1913 3663
 * Rsv9elev
 SE 1230 1230.5 1231 1231.5 1232 1233 1233.5 1234 1235
 KK RCH9
 KM North Branch Downstream of Roseau River Flowage
 KO 0 0 0 0 22
 RD
 RC 0.125 0.035 0.125 11200 0.0004 0
 * rch9
 RX 0 700 750 756 780 786 900 2800
 RY 1230 1225 1224 1218 1218 1224 1225 1230
 KK RNF15
 KM local drainage to DNR dam 3 Non-functional
 KO 0 0 0 0 22
 BA 13.69
 LS 0 100 0
 UC 25.65 71.82
 * diamond
 UA 0 0.09 0.34 0.64 0.9 1
 KK ADH15
 KO 0 0 0 0 22
 HC 2
 KK RCH15
 KM North Branch Downstream of DNR dam 3
 KO 0 0 0 0 22
 RD
 RC 0.125 0.035 0.125 12800 0.0004 0

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* rch15
RX      0      820      1000      1006      1030      1036      1400      2500
RY 1225      1220      1219      1213      1213      1219      1220      1225
KK RNF19
KM      Local Drainage to DNR dam 4 Non-functional
KO      0          0          0          0          22
BA      5.8
LS      0          100          0
UC 14.88      41.66
* diamond
UA      0          0.09          0.34          0.64          0.9          1
KK ADH19
KO      0          0          0          0          22
HC      2
KKRCH19a
KM      North Branch downstream of DNR dam 4
KO      0          0          0          0          22
RD
RC 0.125      0.035      0.125      9400      0.0011          0
* rch19a
RX      0          510          690          696          720          726          990      1690
RY 1225      1220      1209      1203      1203      1209      1220      1225
KK RC19b
KM      North Branch downstream of DNR dam 4
KO      0          0          0          0          22
RD
RC 0.125      0.035      0.125      26000      0.0012          0
* rch19b
RX      0          200          280          286          318          324          390          450
RY 1210      1200      1195      1188.5      1188.5      1195      1200      1210
KK RNF25
KM      Local drainage to North Branch at Hanson Creek
KO      0          0          0          0          22
BA 12.52
LS      0          100          0
UC 18.8      52.64
* rectangle
UA      0          0.2          0.4          0.6          0.8          1
KK ADH25
KM      North Branch Upstream of Hanson Creek
KO      0          0          0          0          22
HC      2
KK RNF29
KM      DNR dam 1 on Hanson Creek
KO      0          0          0          0          22
BA 12.73
LS      0          100          0
UC 34.28      111.82
* fan
UA      0          0.05          0.15          0.35          0.65          1
KK RSV29
KM      DNR dam 1 on Hanson Creek
KM      Outlet and Storage curves developed by Dan Thul (MNDNR 1981)
KO      0          0          0          0          22
RS      1      STOR      320          0
* rsv29stor
SV 320      370      450      650      670      810      960      1360
* rsv29flow
SQ      0          57.5          166          319          558          934          1310      4235
* rsv29elev
SE 1219      1219.5      1220      1220.5      1221      1221.5      1222      1223
KK RCH29
KM      Hanson Creek downstream of DNR dam 1
KO      0          0          0          0          22
RD
RC 0.125      0.035      0.125      6000      0.0009          0
* rch29
RX      0          400          800          803          818          821          1100      1480
RY 1220      1215      1214      1211      1211      1214      1215      1220

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KK RNF35
 KM Non-functional DNR dam 2 on Hanson Creek
 KO 0 0 0 0 22
 BA 4.9
 LS 0 100 0
 UC 22.66 73.92
 * diamond
 UA 0 0.09 0.34 0.64 0.9 1
 KK ADH35
 KO 0 0 0 0 22
 HC 2
 KK RCH35
 KM Hanson Creek from DNR dam 2 to Winner Dam
 KO 0 0 0 0 22
 RD
 RC 0.125 0.035 0.125 17000 0.0006 0
 * rch35
 RX 0 110 310 316 336 342 600 1000
 RY 1210 1205 1204 1198 1198 1204 1205 1210
 KK RNF39
 KM Local drainage to Winner Dam
 KO 0 0 0 0 22
 BA 13.36
 LS 0 100 0
 UC 40.79 133.06
 * diamond
 UA 0 0.09 0.34 0.64 0.9 1
 KK ADH39
 KO 0 0 0 0 22
 HC 2
 KK RSV39
 KM Winner Dam impoundment on Hanson Creek
 KM Outlet and Storage curves developed by Dan Thul (MNDNR 1981)
 KO 0 0 0 0 22
 RS 1 STOR 5 0
 * rsv39stor
 SV 5 21 30 65 120 220 370 470 580
 * rsv39flow
 SQ 0 6 32 75 170 320 560 920 1500
 * rsv39elev
 SE1201.5 1202 1203 1204 1205 1206 1207 1207.5 1208
 KK RCH39
 KM Hanson Creek Winner dam to North Branch
 KO 0 0 0 0 22
 RD
 RC 0.125 0.035 0.125 20500 0.0013 0
 * rch39
 RX 0 700 990 996 1036 1042 1290 1680
 RY 1205 1200 1194 1182 1182 1194 1200 1205
 KK RNF45
 KM Local drainage to outlet of Hanson Creek
 KO 0 0 0 0 22
 BA 5.59
 LS 0 100 0
 UC 16.96 47.49
 * rectangle
 UA 0 0.2 0.4 0.6 0.8 1
 KK ADH45
 KM Hanson Creek outflow
 KO 0 0 0 0 22
 HC 2
 KK ADH46
 KO 0 0 0 0 22
 HC 2
 KK RCH46
 KM North Branch from Hanson Creek to Hayes Lake
 KO 0 0 0 0 22
 RD
 RC 0.125 0.035 0.125 11000 0.0007 0

* rch46										
RX	0	200	350	358	390	398	460	990		
RY	1190	1175	1169	1161	1161	1169	1175	1190		
KK RNF49										
KM Local drainage to Hayes Lake										
KO	0	0	0	0	22					
BA 18.29										
LS	0	100	0							
UC	60.89	170.49								
* diamond										
UA	0	0.09	0.34	0.64	0.9	1				
KK ADH49										
KO	0	0	0	0	22					
HC	2									
KK RSV49										
KM Hayes Lake Dam										
KM Outlet and Storage curves developed by Dan Thul (MNDNR 1981)										
KO	0	0	0	0	22					
RS	1	STOR	1640	0						
* rsv49stor										
SV	0	180	595	1290	1640	1680	1750	1840	2050	2270
SV	2510	2760	3000	3070	3180	3250				
* rsv49flow										
SQ	0	0	0	0	0	19	72	213	640	1235
SQ	2000	2950	4060	4610	5140	8150				
* rsv49elev										
SE	1150	1155	1160	1165	1167	1167.2	1167.5	1168	1169	1170
SE	1171	1172	1173	1173.4	1173.7	1174				
KK RCH49										
KM North Branch Hayes Lake to Beaver										
KO	0	0	0	0	22					
RD										
RC	0.125	0.035	0.125	28200	0.001	0				
* rch49										
RX	0	90	160	168	228	236	690	800		
RY	1150	1135	1130	1122	1122	1130	1135	1150		
KK RNF59										
KM Local Drainage to Beaver										
KO	0	0	0	0	22					
BA 15.71										
LS	0	100	0							
UC	43.26	90.85								
* fan										
UA	0	0.05	0.15	0.35	0.65	1				
KK ADH59										
KO	0	0	0	0	22					
HC	2									
KK RCH59										
KM North Branch to Pencer										
KO	0	0	0	0	22					
RD										
RC	0.125	0.035	0.125	38000	0.0009	0				
* rch59										
RX	0	110	1000	1008	1068	1072	1690	1770		
RY	1125	1120	1115	1107	1107	1115	1120	1125		
KK RNF65										
KM Local drainage to Pencer East										
KO	0	0	0	0	22					
BA 12.79										
LS	0	100	0							
UC	15.54	17.40								
* fan										
UA	0	0.05	0.15	0.35	0.65	1				
KK ADH65										
KO	0	0	0	0	22					
HC	2									
KK RCH65										
KM North Branch to Severson Creek										
KO	0	0	0	0	22					

RD								
RC	0.125	0.035	0.125	25509	0.0008		0	
* rch65								
RX	0	80	250	270	330	350	1580	1680
RY	1095	1090	1085	1075	1075	1085	1090	1095
KK RNF69								
KM	Local drainage to North Branch at Severson Creek							
KO	0	0	0	0	22			
BA	2.29							
LS	0	100	0					
UC	7.24	10.14						
* rectangle								
UA	0	0.2	0.4	0.6	0.8	1		
KK ADH69								
KO	0	0	0	0	22			
HC	2.							
KKRNF070								
KM	Severson Creek							
KO	0	0	0	0	22			
BA	22.25							
LS	0	100	0					
UC	17.3	24.22						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KK ADH70								
KO	0	0	0	0	22			
HC	2							
KKRCH070								
KM	North Branch to Bear Creek							
KO	0	0	0	0	22			
RD								
RC	0.125	0.035	0.125	29973	0.0008		0	
* rch70								
RX	0	80	250	270	330	350	1580	1680
RY	1085	1080	1075	1065	1065	1075	1080	1085
KKRNF079								
KM	Local drainage North Branch at Bear Creek							
KO	0	0	0	0	22			
BA	7.52							
LS	0	100	0					
UC	13.14	18.04						
* rectangle								
UA	0	0.2	0.4	0.6	0.8	1		
KK ADH79								
KO	0	0	0	0	22			
HC	2							
KK RNF80								
KM	Local Drainage Comstocks Bear Creek at Roseau CSAH 9							
KO	0	0	0	0	22			
BA	20.66							
LS	0	100	0					
UC	16.8	19.75						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KK RCH80								
KM	Bear Creek Comstock to North Branch							
KO	0	0	0	0	22			
RD								
RC	0.125	0.035	0.125	28200	0.0008		0	
* rch80								
RX	0	180	400	406	456	462	640	820
RY	1080	1075	1070	1064	1064	1070	1075	1080
KK RNF85								
KM	Local drainage Bear Creek at outlet							
KO	0	0	0	0	22			
BA	5.27							
LS	0	100	0					
UC	11.08	12.10						
* rectangle								

UA	0	0.2	0.4	0.6	0.8	1		
KK ADH85								
KM Bear Creek at North Branch								
KO	0	0	0	0	22			
HC	2							
KK ADH86								
KO	0	0	0	0	22			
HC	2							
KK RCH86								
KM North Branch from Bear Creek to Malung								
KO	0	0	0	0	22			
RD								
RC	0.125	0.035	0.125	20800	0.0006	0		
* rch86								
RX	0	260	350	354	411	415	490	710
RY	1070	1055	1054	1050	1050	1054	1055	1070
KK RNF99								
KM Local Drainage to Gage 2								
KO	0	0	0	0	22			
BA	2.18							
LS	0	100	0					
UC	3.96	3.71						
* diamond								
UA	0	0.09	0.34	0.64	0.9	1		
KK ADH99								
KO	0	0	0	0	22			
HC	2							
KK RCH99 CNAME G2								
KM North Branch gage 2 to South Branch								
KO	0	0	0	0	22			
RD								
RC	0.125	0.035	0.125	17800	0.0004	0		
* rch99								
RX	0	110	180	186	246	252	260	810
RY	1055	1050	1044	1038	1038	1044	1050	1055
KKRNF109								
KM Local drainage South Branch at Skime								
KO	0	0	0	0	22			
BA	28.21							
LS	0	100	0					
UC	67.63	220.61						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKRCH109								
KM South Branch Skime to Casperson								
KO	0	0	0	0	22			
RD								
RC	0.125	0.035	0.125	34800	0.0007	0		
* rch109								
RX	0	1400	1620	1624	1664	1668	2150	3220
RY	1175	1170	1165	1161	1161	1165	1170	1175
KKRCH110								
KM South Branch Casperson to Mickinock Creek								
KO	0	0	0	0	22			
RD								
RC	0.125	0.035	0.125	35000	0.0012	0		
* rch110								
RX	0	280	300	305	345	349	400	540
RY	1135	1130	1125	1120	1120	1125	1130	1135
KKRNF119								
KM Local drainage to South Branch at Mickinock Creek								
KO	0	0	0	0	22			
BA	24.2							
LS	0	100	0					
UC	25.87	72.44						
* rectangle								
UA	0	0.2	0.4	0.6	0.8	1		
KKADH119								
KM Combined flow South Branch upstream of Mickinock Creek								

KO	0	0	0	0	22			
HC	2							
KKRNF120								
KM	Palmville sub RNF3							
KM	Palmville sub refers to areas developed for the Palmville Flood Control P							
KO	0	0	0	0	22			
BA	1.27							
LS	0	100	0					
UC	7.06	19.77						
* fan								
UA	0	0.05	0.15	0.35	65	1		
KKRCH120								
KO	0	0	0	0	22			
RD								
RC	0.15	0.15	0.15	5500	0.0018	0		
* rch120								
RX	0	10	20	500	800	1300	1310	1320
RY	1170	1169	1168.5	1168	1168	1168.5	1169	1170
KKRNF121								
KM	Palmville sub RNF4b							
KO	0	0	0	0	22			
BA	0.95							
LS	0	100	0					
UC	9.62	26.94						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKRCH121								
KO	0	0	0	0	22			
RD								
RC	0.15	0.15	0.15	5500	0.0009	0		
* rch121								
RX	0	10	20	500	800	1300	1310	1320
RY	1172	1171	1170.5	1170	1170	1170.5	1171	1172
KKRNF123								
KM	Palmville sub RNF4a							
KO	0	0	0	0	22			
BA	2.32							
LS	0	100	0					
UC	6.98	19.54						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH123								
KO	0	0	0	0	22			
HC	2							
KKRCH123								
KO	0	0	0	0	22			
RD								
RC	0.15	0.15	0.15	2500	0.004	0		
* rch120								
RX	0	10	20	500	800	1300	1310	1320
RY	1170	1169	1168.5	1168	1168	1168.5	1169	1170
KKADH124								
KO	0	0	0	0	22			
HC	2							
KKRNF125								
KM	Palmville sub RNF5							
KO	0	0	0	0	22			
BA	4.44							
LS	0	100	0					
UC	15.4	43.18						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKRCH125								
KO	0	0	0	0	22			
RD								
RC	0.15	0.15	0.15	1500	0.0033	0		
* rch120								
RX	0	10	20	500	800	1300	1310	1320
RY	1170	1169	1168.5	1168	1168	1168.5	1169	1170

KKRNF126
 KM Palmville sub RNF6
 KO 0 0 0 22
 BA 1.25
 LS 0 100 0
 UC 11.52 24.19
 * fan
 UA 0 0.05 0.15 0.35 0.65 1
 KKRCH126
 KO 0 0 0 22
 RD
 RC 0.15 0.15 0.15 8000 0.0006 0
 * rch120
 RX 0 10 20 500 800 1300 1310 1320
 RY 1170 1169 1168.5 1168 1168 1168.5 1169 1170
 KKRNF127
 KM Palmville sub RNF7
 KO 0 0 0 22
 BA 2.93
 LS 0 100 0
 UC 16.27 22.78
 * diamond
 UA 0 0.09 0.34 0.64 0.9 1
 KKRCH127
 KO 0 0 0 22
 RD
 RC 0.15 0.15 0.15 9000 0.0006 0
 * rch120
 RX 0 10 20 500 800 1300 1310 1320
 RY 1170 1169 1168.5 1168 1168 1168.5 1169 1170
 KKRNF128
 KM Palmville sub RNF8
 KO 0 0 0 22
 BA 1.22
 LS 0 100 0
 UC 6.25 13.13
 * fan
 UA 0 0.05 0.15 0.35 0.65 1
 KKRCH128
 KO 0 0 0 22
 RD
 RC 0.15 0.15 0.15 6000 0.0008 0
 * rch120
 RX 0 10 20 500 800 1300 1310 1320
 RY 1170 1169 1168.5 1168 1168 1168.5 1169 1170
 KKRNF129
 KM Palmville sub RNF9
 KO 0 0 0 22
 BA 2.9
 LS 0 100 0
 UC 7.84 16.46
 * fan
 UA 0 0.05 0.15 0.35 0.65 1
 KKRNF130
 KM Palmville sub RNF10
 KO 0 0 0 22
 BA 1.29
 LS 0 100 0
 UC 5.11 16.67
 * fan
 UA 0 0.05 0.15 0.35 0.65 1
 KKADH130
 KO 0 0 0 22
 HC 7
 KKRNF131
 KM Palmville wildlife pool
 KO 0 0 0 22
 BA 7.65
 LS 0 100 0

UC	13.89	45.30						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH131								
KO	0	0	0	0	22			
HC	2							
KKRNF132								
KM Palmville Flood Pool								
KO	0	0	0	0	22			
BA	0.89							
LS	0	100	0					
UC	7.85	25.61						
* diamond								
UA	0	0.09	0.34	0.64	0.9	1		
KKADH132								
KO	0	0	0	0	22			
HC	2							
KKRCH132								
KO	0	0	0	0	22			
RD								
RC	0.15	0.05	0.15	10560	0.0005	0		
* rch132								
RX	0	4	6	16	24	34	1320	1325
RY	1153	1151	1149	1144	1144	1149	1150	1152
KKRCH133								
KO	0	0	0	0	22			
RD								
RC	0.15	0.05	0.15	9200	0.0016	0		
* rch133								
RX	0	4	6	22	30	46	1320	1325
RY	1148	1146	1144	1136	1136	1144	1144	1146
KKRNF139								
KM Local drainage to Oseland Gage								
KO	0	0	0	0	22			
BA	23.74							
LS	0	100	0					
UC	21.3	44.73						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH139								
KO	0	0	0	0	22			
HC	2							
KKRCH139								
KO	0	0	0	0	22			
RD								
RC	0.125	0.05	0.125	14800	0.0006	0		
* rch139								
RX	0	140	200	204	224	228	305	350
RY	1127	1120	1119	1115	1115	1119	1120	1127
KKRNF145								
KM Local drainage to Mickinock Creek at Outlet								
KO	0	0	0	0	22			
BA	8.37							
LS	0	100	0					
UC	18.97	26.56						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH145								
KM Mickinock Creek								
KO	0	0	0	0	22			
HC	2							
KKADH146								
KO	0	0	0	0	22			
HC	2							
KKRCH146								
KM South Branch Mickinock Creek to Wannaska								
KO	0	0	0	0	22			
RD								
RC	0.125	0.035	0.125	26600	0.0009	0		

* rch146								
RX	0	90	120	127	167	174	305	390
RY	1110	1105	1100	1093	1093	1100	1105	1110
KKRNF149								
KM Local drainage South Branch at Wannaska								
KO	0	0	0	0	22			
BA	14							
LS	0	100	0					
UC	19.28	26.99						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH149								
KO	0	0	0	0	22			
HC	2							
KKRCH149								
KM South Branch Wannaska to Paulson Creek								
KO	0	0	0	0	22			
RD								
RC	0.125	0.035	0.125	15200	0.0004	0		
* rch149								
RX	0	175	300	306	346	352	775	800
RY	1100	1095	1090	1084	1084	1090	1095	1100
KKRNF155								
KM Local drainage South Branch at Paulson Creek								
KO	0	0	0	0	22			
BA	4.45							
LS	0	100	0					
UC	6.05	5.67						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH155								
KO	0	0	0	0	22			
HC	2							
KKRNF159								
KM Local drainage gage 43 Roseau CD 21 at CSAH4								
KO	0	0	0	0	22			
BA	20.07							
LS	0	100	0					
UC	20.56	38.86						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKRCH159								
KO	0	0	0	0	22			
RD								
RC	0.125	0.05	0.125	8500	0.0005	0		
* rch159								
RX	0	7.5	15	30	38	53	1373	2700
RY	1125	1122.5	1120	1115	1115	1120	1122.5	1125
KKRCH160								
KO	0	0	0	0	22			
RD								
RC	0.125	0.05	0.125	4400	0.0036	0		
* rch160								
RX	0	150	180	185	195	200	300	400
RY	1115	1100	1095	1090	1090	1095	1100	1115
KKRNF165								
KM Local Drainage Paulson Creek at Outlet								
KO	0	0	0	0	22			
BA	3.47							
LS	0	100	0					
UC	10.25	14.35						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH165								
KM Combined outflow Paulson Creek								
KO	0	0	0	0	22			
HC	2							
KKADH166								
KO	0	0	0	0	22			

HC	2							
KKRCH166								
KM	South Branch Paulson Creek to Pencer West							
KO	0	0	0	0	22			
RD								
RC	0.125	0.035	0.125	29800	0.0004	0		
* rch166								
RX	0	160	500	520	580	600	650	700
RY	1090	1080	1080	1070	1070	1080	1085	1090
KKRNF169								
KM	Local Drainage to Pencer West							
KO	0	0	0	0	22			
BA	6.56							
LS	0	100	0					
UC	14.79	20.71						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH169								
KO	0	0	0	0	22			
HC	2							
KKRCH169								
KM	South Branch Pencer West to Unamed Creek 1							
KO	0	0	0	0	22			
RD								
RC	0.125	0.035	0.125	17000	0.0005	0		
* rch169								
RX	0	90	690	712	752	774	800	850
RY	1075	1070	1065	1054	1054	1065	1070	1075
KKRNF170								
KM	Local drairange South Branch at Unamed Creek 1							
KO	0	0	0	0	22			
BA	1.65							
LS	0	100	0					
UC	6.34	8.88						
* general								
UA	0	0.13	0.36	0.67	0.89	1		
KKADH170								
KM	South Branch upstream Unamed Creek 1							
KO	0	0	0	0	22			
HC	2							
KKRNF171								
KM	Local Drainage Unamed Creek 1							
KO	0	0	0	0	22			
BA	13.67							
LS	0	100	0					
UC	19.15	26.81						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH171								
KO	0	0	0	0	22			
HC	2							
KKRCH171								
KM	South Branch Unamed Creek 1 to Unamed Creek 2							
KO	0	0	0	0	22			
RD								
RC	0.125	0.035	0.125	34400	0.0005	0		
* rch171								
RX	0	90	690	712	752	774	800	850
RY	1070	1065	1060	1049	1049	1060	1065	1070
KKRNF172								
KM	Local drainage South Branch at Unamed Creek 2							
KO	0	0	0	0	22			
BA	5.04							
LS	0	100	0					
UC	16.23	22.72						
* diamond								
UA	0	0.09	0.34	0.64	0.9	1		
KKADH172								
KM	South Branch upstream Unamed Creek 2							

RC	0.125	0.05	0.125	8810	0.0005	0		
* rch335								
RX	0	800	1700	1708	1712	1720	1722	1724
RY	1110	1107	1105	1101	1101	1105	1106	1107
KKADH336								
KO	0	0	0	0	22			
HC 2								
KKRCH336								
KM Hay Creek branch RCD9 to Summer Road								
KO	0	0	0	0	22			
RD								
RC	0.125	0.05	0.125	7800	0.0017	0		
* rch336								
RX	0	1130	1270	1282	1300	1312	1400	1650
RY	1105	1100	1090	1084	1084	1090	1100	1105
KKRNF339								
KM Local Drainage Hay Creek at Summer Road								
KO	0	0	0	0	22			
BA 10.5								
LS	0	100	0					
UC	17.2	24.08						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH339								
KO	0	0	0	0	22			
HC 2								
KKRCH339								
KM Hay Creek Summer Road to Branch of RCD 9								
KO	0	0	0	0	22			
RD								
RC	0.125	0.05	0.125	4400	0.001	0		
* rch339								
RX	0	100	3550	3562	3580	3592	4000	4800
RY	1080	1078	1075	1069	1069	1075	1078	1080
KKRNF351								
KM Local drainage Upper Hwy 11								
KO	0	0	0	0	22			
BA 4.32								
LS	0	100	0					
UC	12.99	18.19						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKRTV335								
KM Split flow from Upper Summer Road North								
DROUT335								
KKRCH350								
RD								
RC	0.125	0.05	0.125	10560	0.0014	0		
* rch350								
RX	0	2	4	12	16	24	1320	2640
RY	1107	1106	1105	1101	1101	1105	1105.5	1107
KKADH351								
KO	0	0	0	0	22			
HC 2								
KKDVT351								
KM Split flow to Roseau County Road 11								
DTOUT351								
* din351								
DI	0.	100.	200.	400.	600.	800.	1000.	2000.
* dout351								
DQ	0.	50.	100.	200.	300.	400.	500.	1000.
KKRCH351								
KM Branch RCD 9 to Hay Creek								
KO	0	0	0	0	22			
RD								
RC	0.125	0.05	0.125	16600	0.0007	0		
* rch351								
RX	0	750	1320	1328	1332	1340	1342	1344
RY	1090	1089	1088	1084	1084	1088	1090	1092

KKADH352								
KO	0	0	0	0	22			
HC	2							
KKRCH352								
KM	Hay Creek branch of RCD9 to Gage 12							
KO	0	0	0	0	22			
RD								
RC	0.125	0.05	0.125	7400	0.0014	0		
* rch352								
RX	0	100	3550	3562	3580	3592	4000	4800
RY	1075	1073	1070	1064	1064	1070	1073	1075
KKRNF359								
KM	Local drainage Hay Creek at Gage 12							
KO	0	0	0	0	22			
BA	12.44							
LS	0	100	0					
UC	13.97	20.15						
* diamond								
UA	0	0.09	0.34	0.64	0.9	1		
KKADH359								
KO	0	0	0	0	22			
HC	2							
KKRCH359								
KM	Hay Creek Gage 12 to Branch RCD 9							
KO	0	0	0	0	22			
RD								
RC	0.125	0.05	0.125	9220	0.0009	0		
* rch359								
RX	0	250	550	562	580	592	700	1000
RY	1070	1068	1065	1059	1059	1065	1068	1070
KKRTV351								
KM	Upper Hwy 11 split flow							
DROUT351								
KKRCH352								
RD								
RC	0.125	0.05	0.125	37920	0.0007	0		
* rch352								
RX	0	2	4	12	16	24	500	1000
RY	1076	1075	1074	1070	1070	1074	1074	1075
KKADH360								
KO	0	0	0	0	22			
HC	2							
KKRCH360								
KM	Hay Creek Branch RCD9 to MN HWY 11							
KO	0	0	0	0	22			
RD								
RC	0.125	0.05	0.125	4980	0.0009	0		
* rch360								
RX	0	250	550	562	580	592	700	1000
RY	1060	1058	1055	1049	1049	1055	1058	1060
KKRNF379								
KM	Local Drainage MN Hwy 11							
KO	0	0	0	0	22			
BA	20.97							
LS	0	100	0					
UC	37.8	79.38						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH379								
KO	0	0	0	0	22			
HC	2							
KKRCH379								
KM	Hay Creek MN Hwy 11 to Hay Creek Proj Det 1							
KO	0	0	0	0	22			
RD								
RC	0.125	0.035	0.125	5680	0.0004	0		
* rch379								
RX	0	1000	2300	2312	2328	2340	4000	5000
RY	1060	1058	1058	1050	1050	1058	1058	1060

KKRNF381
 KM Hay Creek Proj Det 1
 KO 0 0 0 0 22
 BA 4.14
 LS 0 100 0
 UC 20.23 28.32
 * fan
 UA 0 0.05 0.15 0.35 0.65 1
 KKADH381
 KO 0 0 0 0 22
 HC 2
 KKRCH381
 KM Hay Creek Det 1 to Roseau County Ditch 18
 KO 0 0 0 0 22
 RD
 RC 0.125 0.035 0.125 10820 0.0004 0
 * rch381
 RX 0 1000 2300 2312 2328 2340 4000 5000
 RY 1055 1053 1053 1045 1045 1053 1053 1055
 KKRNF385
 KM Norland sub RNF50 Roseau County Ditch 18 Sec 4/5 T162N R38W
 KO 0 0 0 0 22
 BA 8.39
 LS 0 100 0
 UC 29.83 83.52
 * rnf385
 UA 0 0.1 0.24 0.46 0.65 0.75 0.83 0.89 0.94 0.98
 UA 1
 KKRCH385
 KM RCD 18 to Hay Creek
 KO 0 0 0 0 22
 RD
 RC 0.08 0.05 0.08 17690 0.001 0
 * rch385
 RX 0 5 10 45 53 57 100 250
 RY1067.4 1067.4 1067.4 1056.14 1056.14 1064.7 1064.7 1064.7
 KKRNF391
 KM Hay Creek Project Pool #1
 KO 0 0 0 0 22
 BA 2.21
 LS 0 100 0
 UC 3.6 5.04
 * fan
 UA 0 0.05 0.15 0.35 0.65 1
 KKADH391
 KO 0 0 0 0 22
 HC 2
 KKRCH391 CNAME 391
 KM RCD 18 Pool#1 to NW Sec 2 T162N R39W
 KO 0 0 0 0 22
 RD
 RC 0.08 0.05 0.08 5280 0.0003 0
 * rch391
 RX 0 5 10 24 30 44 5000 5250
 RY 1053 1052 1049 1042 1042 1049 1049.5 1050
 KKDVT391
 KM Split flow RCD 18
 DTOUT391
 * in391
 DI 0. 300. 600. 900. 1200. 2100.
 * out391
 DQ 0. 200. 400. 600. 800. 1400.
 KKRCH392
 KM RCD 18 NW Sec 2 T162N R39W
 KO 0 0 0 0 22
 RD
 RC 0.08 0.05 0.08 8300 0.0003 0
 * rch392
 RX 0 5 10 24 30 44 5000 5250

RKADH395	1052	1051	1048	1041	1041	1048	1048.5	1049		
KO	0	0	0	0	22					
HC	2									
KKRCH395										
KM	Hay Creek RCD 18 to Outlet									
KO	0	0	0	0	22					
RD										
RC	0.125	0.04	0.125	12900	0.0004	0				
* rch395										
RX	0	1000	2300	2312	2328	2340	4000	5000		
RY	1050	1048	1048	1040	1040	1048	1048	1050		
KKRNF399										
KM	Local drainage to Lower Hay Creek									
KO	0	0	0	0	22					
BA	19.76									
LS	0	100	0							
UC	24.8	43.40								
* fan										
UA	0	0.05	0.15	0.35	0.65	1				
KKADH399										
KM	Hay Creek at Outlet									
KO	0	0	0	0	22					
HC	2									
KKADH400										
KM	Roseau River at Gage 15 Sec 6/31 T162-163N R39W County Road 28									
KO	0	0	0	0	22					
HC	2.									
KKRTV391										
KM	Overflow RCD 18									
DROUT391										
KKRC391b										
RD										
RC	0.08	0.05	0.08	17000	0.0006	0				
* rc391b										
RX	0	2	4	14	18	28	1300	2600		
RY	1057	1056	1055	1050	1050	1055	1055.5	1057		
KKADH401										
KM	Roseau River at Sout side Sec 31 T163N R39W at lateral JD61									
KO	0	0	0	0	22					
HC	2									
KKRC401m										
KM	Roseau River Gage 15 to Lat 3 Judicial 61									
KO	0	0	0	0	22					
RS	1	FLOW	0	0						
* stor401m										
SV	0	90	632	1328	2606	6187	10916	15479	22242	29460
* flow401m										
SQ	0	500	1000	2000	3000	5000	6000	7000	8000	13000
KKRNF401										
KM	Norland sub RNF20 Sec 28/29 T163N R37W									
KO	0	0	0	0	22					
BA	2.85									
LS	0	100	0							
UC	6.27	13.17								
* rnf401										
UA	0	0	0.01	0.03	0.09	0.19	0.29	0.51	0.78	0.95
UA	1									
KKRCH401										
KM	Lat 3 JD61									
KO	0	0	0	0	22					
RD										
RC	0.08	0.05	0.08	5120	0.006	0				
* rch401										
RX	0	5	10	19	27	36	143	243		
RY1079.1	1079	1078	1075	1075	1078	1079	1079.1			
KKRNF402										
KM	Norland Sub RNF30									
KO	0	0	0	0	22					

BA	6.43									
LS	0	100	0							
UC	39.75	111.30								
* rnf402										
UA	0	0.19	0.33	0.56	0.79	0.87	0.92	0.93	0.95	0.99
UA	1									
KKADH402										
KO	0	0	0	0	22					
HC	2									
KKDVT402										
KM 50-50 split west and north										
DTOUT402										
* in402										
DI	0.	10.	20.	30.	40.	50.	100.	200.	500.	1000.
* out402										
DQ	0.	5.	10.	15.	20.	25.	50.	100.	250.	500.
KKRCH402										
KM Lat 3 JD61										
KO	0	0	0	0	22					
RD										
RC	0.08	0.05	0.08	10320	0.006	0				
* rch402										
RX	0	5	10	22	30	42	47	252		
RY1075.1	1075	1074	1070	1070	1074	1075	1075.1			
KKRNF403										
KM Norland Sub RNF40										
KO	0	0	0	0	22					
BA	5.66									
LS	0	100	0							
UC	13.51	18.91								
* rnf40										
UA	0	0.1	0.29	0.5	0.62	0.74	0.8	0.86	0.91	0.95
UA	1									
KKADH403										
KO	0	0	0	0	22					
HC	2									
KKRCH403										
KM Lat 3 JD 61										
KO	0	0	0	0	22					
RD										
RC	0.08	0.05	0.08	9650	0.006	0				
* rch403										
RX	0	5	10	22	30	42	47	252		
RY1070.1	1070	1069	1065	1065	1069	1070	1070.1			
KKRNF405										
KM Norland sub RNF60										
KO	0	0	0	0	22					
BA	7.08									
LS	0	100	0							
UC	11.04	15.46								
* rnf405										
UA	0	0.08	0.18	0.31	0.51	0.65	0.82	0.9	0.97	0.99
UA	1									
KKADH405										
KM Sec 21/22 T163N R38W										
KO	0	0	0	0	22					
HC	2									
KKRNF406										
KM Norland sub RNF65										
KO	0	0	0	0	22					
BA	1.71									
LS	0	100	0							
UC	5	8.19								
* rnf406										
UA	0	0.13	0.25	0.34	0.45	0.57	0.7	0.8	0.89	0.97
UA	1									
KKADH406										
KM Sec 21/22 T163N R38W										
KO	0	0	0	0	22					

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HC      2
KKRNF408
KM      Norland Pool area RNF70
KO      0      0      0      0      22
BA      7.65
LS      0      100      0
UC      12.55  26.36
* rnf408
UA      0      0.02      0.08      0.15      0.26      0.41      0.61      0.75      0.87      0.93
UA      1
KKADH408
KO      0      0      0      0      22
HC      2
KKDVT408
KM Split Norland flows into BR 5 Lat 3 and Lat 3 flows
DTOUT410
* in410
DI      0.      35.      99.      239.      443.      696.      1065.      1515.      2032.
* out410
DQ      0.      11.      33.      80.      148.      232.      355.      505.      677.
KKRCH420
KM      Lat 3 JD 61
KO      0      0      0      0      22
RD
RC      0.125      0.05      0.125      24200      0.0006      0
* rch420
RX      0      6      8      18      24      34      1320      2325
RY      1054      1051      1050      1045      1045      1050      1051      1054
KKADH421
KO      0      0      0      0      22
HC      2
KKRCH421
KM      Roseau River Lat 3 JD 61 to Hwy 310
KO      0      0      0      0      22
RD
RC      .125      .035      .125      11400      .00031
* rch421
RX      14054      19204      20000      20039      20069      20104      20313      22937
RY      1040      1035.1      1037.2      1022.2      1021.7      1038.6      1036.3      1040
KKRTV430
KM      Br 5 Lat 3 JD61
DROUT410
KKRCH430
RD
RC      0.125      0.05      0.125      44000      0.0004      0
* out410
RX      0      6      8      18      24      34      1320      1325
RY      1054      1051      1050      1045      1045      1050      1050      1054
KKADH430
KO      0      0      0      0      22
HC      2
KKRNF499
KM      Local drainage Roseau River at MN Hwy 310
KO      0      0      0      0      22
BA      19.26
LS      0      100      0
UC      18.59      45.29
* fan
UA      0      0.05      0.15      0.35      0.65      1
KKADH499
KM      Roseau River at MN Hwy 310
KO      0      0      0      0      22
HC      2
KKRC499m
KM      Storage upstream Hwy 310
RS      1      FLOW      0
* stor499m
SV      0      100      250      500      5000      9000      13000      16000      22000
* flow499m

```

SQ 0 1000 2000 3000 4000 5000 7500 10000 15000

KKRNF520

KM East Fork of Sprague Creek

KO 0 0 0 0 22

BA 22.42

LS 0 100 0

UC 43.2 90.72

* fan

UA 0 0.05 0.15 0.35 0.65 1

KKRNF530

KM West Fork of Sprague Creek

KO 0 0 0 0 22

BA 20.42

LS 0 100 0

UC 48.32 101.47

* fan

UA 0 0.05 0.15 0.35 0.65 1

KKADH530

KO 0 0 0 0 22

HC 2

KKRCH530

KM Sprague Creek forks to Vasser Road

KO 0 0 0 0 22

RD

RC 0.125 0.04 0.125 40765 0.0006 0

* rch530

RX 0 10 510 516 534 540 1040 1050

RY 1080 1075 1073 1067 1067 1073 1075 1080

KKRNF540

KM Local drainage to Sprague Creek at Vassar Road

KO 0 0 0 0 22

BA 47.64

LS 0 100 0

UC 43.35 91.04

* fan

UA 0 0.05 0.15 0.35 0.65 1

KKADH540

KO 0 0 0 0 22

HC 2

KKRCH540

KM Sprague Creek Vassar Road to Mud Creek

KO 0 0 0 0 22

RD

RC 0.125 0.04 0.125 56058 0.0005 0

* rch540

RX 0 10 510 516 534 540 1040 1050

RY 1075 1070 1068 1062 1062 1068 1070 1075

KKRNF545

KM Local drainage Sprague Creek at Sprague Manitoba

KO 0 0 0 0 22

BA 21.93

LS 0 100 0

UC 35.7 74.97

* fan

UA 0 0.05 0.15 0.35 0.65 1

KKADH545

KM Sprague Creek at Sprague

KO 0 0 0 0 22

HC 2

KKRNF510

KM Local Drainage to Mud Creek

KO 0 0 0 0 22

BA 32.18

LS 0 100 0

UC 71.13 149.38

* fan

UA 0 0.05 0.15 0.35 0.65 1

KKADH546

KO 0 0 0 0 22

HC	2							
KKRCH546								
KM	Sprague Creek Sprague to USGS Gage							
KO	0	0	0	0	22			
RD								
RC	0.125	0.04	0.125	17973	0.0009	0		
* rch546								
RX	0	10	510	516	534	540	1040	1050
RY	1065	1062	1057	1051	1051	1057	1060	1065
KKRNF550								
KM	Local drainage Sprague Creek at USGS Gage							
KO	0	0	0	0	22			
BA	39.01							
LS	0	100	0					
UC	52.83	49.56						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH550								
KM	Sprague Creek at USGS gaging station							
KO	0	0	0	0	22			
HC	2							
KKRCH550								
KM	Sprague Creek USGS Gage to Lat 2 JD 61							
KO	0	0	0	0	22			
RD								
RC	0.125	0.04	0.125	32800	0.0006	0		
* rch550								
RX	0	50	1850	1856	1874	1880	3500	5250
RY	1050	1047	1045	1039	1039	1045	1047	1050
KKRNF570								
KM	Local Drainage to Upper Lat 2 JD 61							
KO	0	0	0	0	22			
BA	54.33							
LS	0	100	0					
UC	39.24	82.40						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKRTV402								
KM	Split flow out of RNF402							
DROUT402								
KKRCH571								
RD								
RC	0.08	0.05	0.08	10420	0.0006	0		
* rch571								
RX	0	2	4	10	24	30	1300	2600
RY	1081	1080	1079	1076	1076	1079	1079.5	1080
KKADH574								
KO	0	0	0	0	22			
HC	2							
KKRCH574								
KM	Lat 2 JD 61							
KO	0	0	0	0	22			
RD								
RC	0.125	0.05	0.125	31460	0.0005	0		
* rch574								
RX	0	1	5	9	17	21	2621	5280
RY	1044	1043	1042	1038	1038	1042	1043	1044
KKADH575								
KO	0	0	0	0	22			
HC	2							
KKRCH575								
KM	Sprague Creek Br2 JD 61 to Outlet							
KO	0	0	0	0	22			
RD								
RC	0.125	0.04	0.125	9000	0.0005	0		
* rch575								
RX	0	15	1515	1521	1541	1547	2547	2555
RY	1036	1033	1032	1026	1026	1032	1033	1035
KKRNF580								

KM Local drainage to Sprague Creek at Outlet
 KO 0 0 0 0 22
 BA 47.32
 LS 0 100 0
 UC 29 60.90
 * rectangle
 UA 0 0.2 0.4 0.6 0.8 1
 KKADH580
 KM Sprague Creek at Outlet
 KO 0 0 0 0 22
 HC 2
 KKRC580m
 RS 1 FLOW 0
 * stor580m
 SV 0 500 6500 15000 18000 21000
 * flow580m
 SQ 0 1000 2000 3000 4000 5000
 KKADH456
 KM Combined flows Roseau River and Sprague Creek
 KO 0 0 0 0 22
 HC 2
 KKRCH456
 KM Roseau Rive Sprague Creek to Roseau Lake Bed
 KO 0 0 0 0 22
 RD
 RC 0.125 0.035 0.125 27200 0.0002 0
 * rch456
 RX 0 9240 10560 10585 10638 10663 11983 15943
 RY1038.5 1034.25 1034 1021.5 1021.5 1034 1034.25 1038.5
 KKRNF610
 KM South Roseau Lake Bottom
 KO 0 0 0 0 22
 BA 40.91
 LS 0 100 0
 UC 10.48 9.83
 * rectangle
 UA 0 0.2 0.4 0.6 0.8 1
 KKRNF620
 KM North Roseau Lake Bottom
 KO 0 0 0 0 22
 BA 46.2
 LS 0 100 0
 UC 40.11 56.15
 * fan
 UA 0 0.05 0.15 0.35 0.65 1
 KKADH620
 KM Roseau River at Lake Bed
 KO 0 0 0 0 22
 HC 3
 KKRNF700
 KM Local Drainage West Pine Creek
 KO 0 0 0 0 22
 BA 33.76
 LS 0 100 0
 UC 56.23 52.74
 * fan
 UA 0 0.05 0.15 0.35 0.65 1
 KKRCH700
 KM West Pine Creek Manitoba Hwy 12 to East Pine Creek
 KO 0 0 0 0 22
 RD
 RC 0.125 0.05 0.125 1672 0.0014 0
 * rch700
 RX 0 750 1500 1510 1518 1528 2278 3000
 RY 1100 1095 1090 1086 1086 1090 1091 1095
 KKRNF710
 KM Local drainage East Pine Creek
 KO 0 0 0 0 22
 BA 9.55

LS	0	100	0					
UC	20.36	19.08						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKRCH710								
KM East Pine Creek Manitoba Hwy 12 to West Pine Creek								
KO	0	0	0	0	22			
RD								
RC	0.125	0.05	0.125	2048	0.0014	0		
* rch710								
RX	0	750	1500	1510	1516	1526	2276	3000
RY	1095	1091	1090	1086	1086	1090	1095	1100
KKADH710								
KM Pine Creek near Hwy 12								
KO	0	0	0	0	22			
HC	2							
KKRCH711								
KM East and West Pine Creek to Diversion								
KO	0	0	0	0	22			
RD								
RC	0.125	0.05	0.125	19288	0.0014			
* rch711								
RX	0	750	3000	3010	3016	3026	5250	6000
RY	1095	1090	1085	1081	1081	1085	1090	1095
KKRNF720								
KM Local drainage Pine Creek at Diversion								
KO	0	0	0	0	22			
BA	16.68							
LS	0	100	0					
UC	7.58	10.61						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH720								
KM Pine Creek Upstream of Diversion								
KO	0	0	0	0	22			
HC	2.							
KKDVT720								
KM Pine Creek Diversion								
DTOUT720								
* in720								
DI	0.	220.	300.	500.	1000.	1250.	1500.	2000.
* out720								
DQ	0.	220.	273.	407.	740.	850.	850.	850.
KKRCH720								
KM Pine Creek Diversion to Roseau County Road 118								
KO	0	0	0	0	22			
RD								
RC	0.125	0.04	0.125	37815	0.001	0		
* rch720								
RX	0	600	1180	1184	1192	1196	1700	2410
RY	1050	1047	1045	10417	1041	1045	1047	1050
KKRNF790								
KM Local Drainage at RCR 118								
KO	0	0	0	0	22			
BA	20.29							
LS	0	100	0					
UC	17.76	24.86						
* rectangle								
UA	0	0.2	0.4	0.6	0.8	1		
KKADH790								
KM Pine Creek at Lake Bottom								
KO	0	0	0	0	22			
HC	2							
KKADH699								
KO	0	0	0	0	22			
HC	2							
KKRSV699								
KM Roseau Lake Bottom								
KO	0	0	0	0	22			

RS	1	FLOW	0	0						
* stor699										
SV	0	900	2300	4900	6000	10100	14250	23000	34000	51900
SV	68500	88900	105900	118250	141000	168800				
* flow699										
SQ	0	250	732	954	1136	1372	1638	1924	2222	2574
SQ	3084	3868	4494	5200	7500	10000				
* elev699										
SE1	1017.1	1024.8	1026	1027	1028	1029	1030	1031	1032	1033
SE	1034	1035	1035.5	1036	1037	1038				
KKRCH699										
KM Roseau River Ross to Lins Bridge										
KO	0	0	0	0	22					
RD										
RC	0.125	0.035	0.125	24390	0.0005	0				
* rch699										
RX	0	9	3200	3232	3299	3331	5271	5280		
RY	1035	1032	1030	1014	1014	1030	1032	1035		
KKRNF900										
KM Local drainage at Lins Bridge										
KO	0	0	0	0	22					
BA 41.99										
LS	0	100	0							
UC	14.73	13.82								
* rectangle										
UA	0	0.2	0.4	0.6	0.8	1				
KKADH900										
KO	0	0	0	0	22					
HC 2										
KKRCH900										
KM Roseau River Lins Bridge to Big Swamp										
KO	0	0	0	0	22					
RD										
RC	0.125	0.035	0.125	24390	0.0004	0				
* rch900										
RX	0	25	35	67	134	166	2806	5280		
RY	1035	1030	1028	1012	1012	1028	1030	1032		
KKRNF920										
KM Local drainage upstream of Big Swamp										
KO	0	0	0	0	22					
BA 24.09										
LS	0	100	0							
UC	32.83	45.96								
* rectangle										
UA	0	0.2	0.4	0.6	0.8	1				
KKADH920										
KO	0	0	0	0	22					
HC 2										
KKRCH920										
KM Roseau River to Roseau River Wildlife Management Pool 2 Outlet										
KO	0	0	0	0	22					
RD										
RC	0.125	0.035	0.125	13000	0.0004	0				
* rch920										
RX	0	2640	5280	5296	5363	5380	8020	10659		
RY	1025	1024.5	1024	1018	1018	1024	1024.5	1025		
KKRNF810 RRWMA Pool 1										
KM Local Drainage to RRWMA Pool 1										
KO	0	0	0	0	22					
BA 24.88										
LS	0	100	0							
UC	13.3	18.62								
* rectangle										
UA	0	0.2	0.4	0.6	0.8	1				
KKRTV720										
KM Pine Creek Diversion										
DROUT720										
KKRC720a										
RD										

RC	0.05	0.05	0.05	41517	0.0001	0				
* rc720a										
RX	0	10	28	42	52	66	84	94		
RY	1068	1063	1063	1056	1056	1063	1063	1068		
KKADH810										
KO	0	0	0	0	22					
HC 2										
KKRSV810										
KM RRWMA Pool 1										
KO	0	0	0	0	22					
RS	1	STOR	2415	0						
* stor810										
SV	2415	2477	3968	4899	4215	4575	5115	5475	6415	6735
* flow810										
SQ	0	8.4	33	235	460	820	1390	1960	3035	4735
* elev810										
SE	1035	1035.2	1035.5	1035.8	1036	1036.2	1036.5	1036.7	1037	1037.4
KKRNF820										
KM Local drainage RRWMA Pool 2										
KO	0	0	0	0	22					
BA 89.71										
LS	0	100	0							
UC	51	107.10								
* fan										
UA	0	0.05	0.15	0.35	0.65	1				
KKADH820										
KO	0	0	0	0	22					
HC 2										
KKRSV820										
KM RRWMA Pool 2										
KO	0	0	0	0	22					
RS	1	STOR	4450	0						
* stor820										
SV	4450	5400	6800	8400	9500	10800	12800	14300	16540	19550
* flow810										
SQ	0	8.4	33	235	460	820	1390	1960	3035	4735
* elev820										
SE	1029	1029.2	1029.5	1029.8	1030	1030.2	1030.5	1030.7	1031	1031.4
KKDVT820										
KM Main outlet Roseau River, Emergency Spillway and Secondary Outlet										
DTOUT820										
* in820										
DI	0.	8.4	33.	235.	460.	820.	1390.	1960.	3035.	4735.
* out820										
DQ	0.	0.	0.	170.	370.	700.	1225.	1645.	2345.	3325.
KKRCH821										
KM Roseau County Ditch 17										
KO	0	0	0	0	22					
RD										
RC	0.125	0.035	0.125	3900	0.0001	0				
* rch821										
RX	0	1050	2100	2108	2116	2124	2128	2134		
RY	1025	1022	1020	1016	1016	1020	1022	1025		
KKRCH822										
KM Old Roseau River Channel										
KO	0	0	0	0	22					
RD										
RC	0.125	0.035	0.125	8800	0.0001	0				
* rch822										
RX	0	500	1400	1408	1548	1556	2500	4000		
RY	1024	1022	1020	1016	1016	1020	1022	1024		
KKADH930										
KO	0	0	0	0	22					
HC 2										
KKRCH930										
KM Roseau River Pool 2 outlet to Pool 3 outlet										
KO	0	0	0	0	22					
RD										
RC	0.125	0.035	0.125	15200	0.0004	0				

* rch930									
RX	0	2640	5280	5296	5363	5380	8020	10659	
RY	1020	1019.5	1019	1013	1013	1019	1019.5	1020	
KKRNF830									
KM Local drainage RRWMA Pool 3									
KO	0	0	0	0	22				
BA	23.73								
LS	0	100	0						
UC	12.5	17.5							
* fan									
UA	0	0.05	0.15	0.35	0.65	1			
KKRTV820									
KM Pool 2 outflow to Pool3									
DROUT820									
KKADH830									
KO	0	0	0	0	22				
HC	2								
KKRSV830									
KM RRWMA Pool 3									
KO	0	0	0	0	22				
RS	1	STOR	2700	0					
* stor830									
SV	2700	3400	4500	5800	6750	7750	9700	12900	16650
* flow830									
SQ	0	8.4	33	185	355	620	1040	1925	2980
* elev830									
SE	1024	1024.2	1024.5	1024.8	1025	1025.2	1025.5	1026	1026.5
KKRCH831									
KM Outlet Channel Pool3									
KO	0	0	0	0	22				
RD									
RC	0.125	0.05	0.125	2920	0.0001	0			
* rch831									
RX	0	700	1400	1410	1420	1430	2100	3000	
RY	1023	1022	1021	1016	1016	1021	1022	1023	
KKRCH832									
KM Old Roseau River Channel									
KO	0	0	0	0	22				
RD									
RC	0.125	0.05	0.125	1150	0.0001	0			
* rch832									
RX	0	700	1400	1412	1512	1514	2100	3000	
RY	1023	1022	1021	1015	1015	1021	1022	1023	
KKADH940									
KO	0	0	0	0	22				
HC	2								
KKRCH940									
KM Roseau River pool 3 to end of Big Swamp									
KO	0	0	0	0	22				
RD									
RC	0.125	0.035	0.125	34000	0.0004	0			
* rch940									
RX	0	2640	5280	5296	5363	5380	8020	10659	
RY	1019	1018.5	1018	1012	1012	1018	1018.5	1019	
KKRNF950									
KM Local drainage Big Swamp									
KO	0	0	0	0	22				
BA	88.82								
LS	0	100	0						
UC	32.48	68.21							
* rectangle									
UA	0	0.2	0.4	0.6	0.8	1			
KKADH950									
KO	0	0	0	0	22				
HC	2								
KKRSV950									
KM Big Swamp Storage									
KO	0	0	0	0	22				
RS	1	STOR	0	0					

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* stor950
SV 0 2000 6000 13000 21000 29000 37000 45000 53000 153000
* flow950
SQ 0 700 1300 1900 2300 2600 2900 3200 3500 6500
KKDVT950
KM Flow transfer to Two Rivers
DTOUT920
* in920
DI 0. 2000. 3513. 3699. 4403. 6310.
* out920
DQ 0. 0. 533. 619. 1083. 2133.
KKRCH950
KM Roseau River Big Swamp to USGS Gaging Station
KO 0 0 0 0 22
RD
RC 0.125 0.035 0.125 32900 0.0002 0
* rch950
RX 0 1600 2200 2220 2275 2295 2900 3250
RY 1020 1018 1015 1005 1005 1015 1018 1020
KKRNF960
KM Local drainage to USGS Gage near Caribou
KO 0 0 0 0 22
BA 24.04
LS 0 100 0
UC 24.04 47.32
* rectangle
UA 0 0.2 0.4 0.6 0.8 1
KKADH960
KO 0 0 0 0 22
HC 2
KKRCH960
KM Roseau River Caribou to International Border
KO 0 0 0 0 22
RD
RC 0.125 0.035 0.125 12200 .0003 0
* rch960
RX 0 1600 2200 2220 2275 2295 2900 3250
RY 1015 1013 1010 1000 1000 1010 1013 1015
KKRNF999
KM Local Drainage Roseau River at Border
KO 0 0 0 0 22
BA 9.56
LS 0 100 0
UC 13.78 19.29
* rectangle
UA 0 0.2 0.4 0.6 0.8 1
KKADH999
KM Roseau River at International Border
KO 0 0 0 0 22
HC 2
KKRTV920
KM Diverted flow to Two Rivers
DROUT920
ZZ

```

Appendix C

HEC-1 Input Summer Rainfall Events

ID Roseau River Watershed District
 ID Developed by JOR Engineering, Inc. Crookston, MN
 ID 10 Day Summer Event 10/23/01 Michael Bakken
 ID Calibrated to May 1996 Flood
 *DIAGRAM
 IT 60 1JUN96 0 600
 IO 0
 JD 1432
 PH 1 2.25 2.71 3.00 3.55 4.23 5.00
 PH 5.85 7.00 7.99 8.70
 PH 2 2.09 2.50 2.76 3.25 3.85 4.59
 PH 5.40 6.49 7.40 8.00
 PH 4 1.89 2.24 2.49 2.93 3.45 4.10
 PH 4.85 5.79 6.55 7.10
 PH 10 1.59 1.88 2.09 2.48 2.92 3.45
 PH 4.08 4.90 5.55 6.00
 PH 20 1.28 1.52 1.70 2.00 2.39 2.82
 PH 3.35 4.00 4.59 5.00
 PH 50 0.99 1.19 1.31 1.58 1.86 2.20
 PH 2.61 3.09 3.52 3.83
 PH 99 0.82 1.01 1.16 1.37 1.61 1.91
 PH 2.27 2.69 3.02 3.17
 KK RNF9
 KM Local Drainage to Roseau River Flowage
 KO 0 0 0 0 22
 BA 40.81
 LS 0 58 0
 UC 35.53 115.89
 * fan
 UA 0 0.05 0.15 0.35 0.65 1
 KK RSV9
 KM Roseau River Flowage Impoundment
 KM Outlet and Storage curves developed by Dan Thul (MNDNR 1981)
 KO 0 0 0 0 22
 RS 1 STOR 240 0
 * rsv9stor
 SV 240 310 400 500 643 940 1092 1245 1550
 * rsv9flow
 SQ 0 52 155 288 435 800 1225 1913 3663
 * Rsv9elev
 SE 1230 1230.5 1231 1231.5 1232 1233 1233.5 1234 1235
 KK RCH9
 KM North Branch Downstream of Roseau River Flowage
 KO 0 0 0 0 22
 RD
 RC 0.125 0.035 0.125 11200 0.0004 0
 * rch9
 RX 0 700 750 756 780 786 900 2800
 RY 1230 1225 1224 1218 1218 1224 1225 1230
 KK RNF15
 KM local drainage to DNR dam 3 Non-functional
 KO 0 0 0 0 22
 BA 13.69
 LS 0 50 0
 UC 25.65 71.82
 * diamond
 UA 0 0.09 0.34 0.64 0.9 1
 KK ADH15
 KO 0 0 0 0 22
 HC 2
 KK RCH15
 KM North Branch Downstream of DNR dam 3
 KO 0 0 0 0 22

RRSumCal.DAT

RD								
RC	0.125	0.035	0.125	12800	0.0004		0	
* rch15								
RX	0	820	1000	1006	1030	1036	1400	2500
RY	1225	1220	1219	1213	1213	1219	1220	1225
KK	RNF19							
KM	Local Drainage to DNR dam 4 Non-functional							
KO	0	0	0	0	22			
BA	5.8							
LS	0	56	0					
UC	14.88	41.66						
* diamond								
UA	0	0.09	0.34	0.64	0.9	1		
KK	ADH19							
KO	0	0	0	0	22			
HC	2							
KKRCH19a								
KM	North Branch downstream of DNR dam 4							
KO	0	0	0	0	22			
RD								
RC	0.125	0.035	0.125	9400	0.0011		0	
* rch19a								
RX	0	510	690	696	720	726	990	1690
RY	1225	1220	1209	1203	1203	1209	1220	1225
KK	RC19b							
KM	North Branch downstream of DNR dam 4							
KO	0	0	0	0	22			
RD								
RC	0.125	0.035	0.125	26000	0.0012		0	
* rch19b								
RX	0	200	280	286	318	324	390	450
RY	1210	1200	1195	1188.5	1188.5	1195	1200	1210
KK	RNF25							
KM	Local drainage to North Branch at Hanson Creek							
KO	0	0	0	0	22			
BA	12.52							
LS	0	43	0					
UC	18.8	52.64						
* rectangle								
UA	0	0.2	0.4	0.6	0.8	1		
KK	ADH25							
KM	North Branch Upstream of Hanson Creek							
KO	0	0	0	0	22			
HC	2							
KK	RNF29							
KM	DNR dam 1 on Hanson Creek							
KO	0	0	0	0	22			
BA	12.73							
LS	0	58	0					
UC	34.28	111.82						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KK	RSV29							
KM	DNR dam 1 on Hanson Creek							
KM	Outlet and Storage curves developed by Dan Thul (MNDNR 1981)							
KO	0	0	0	0	22			
RS	1	STOR	320	0				
* rsv29stor								
SV	320	370	450	650	670	810	960	1360
* rsv29flow								
SQ	0	57.5	166	319	558	934	1310	4235
* rsv29elev								
SE	1219	1219.5	1220	1220.5	1221	1221.5	1222	1223

RRSumCal.DAT

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KK RCH29
KM Hanson Creek downstream of DNR dam 1
KO 0 0 0 0 22
RD
RC 0.125 0.035 0.125 6000 0.0009 0
* rch29
RX 0 400 800 803 818 821 1100 1480
RY 1220 1215 1214 1211 1211 1214 1215 1220
KK RNF35
KM Non-functional DNR dam 2 on Hanson Creek
KO 0 0 0 0 22
BA 4.9
LS 0 46 0
UC 22.66 73.92
* diamond
UA 0 0.09 0.34 0.64 0.9 1
KK ADH35
KO 0 0 0 0 22
HC 2
KK RCH35
KM Hanson Creek from DNR dam 2 to Winner Dam
KO 0 0 0 0 22
RD
RC 0.125 0.035 0.125 17000 0.0006 0
* rch35
RX 0 110 310 316 336 342 600 1000
RY 1210 1205 1204 1198 1198 1204 1205 1210
KK RNF39
KM Local drainage to Winner Dam
KO 0 0 0 0 22
BA 13.36
LS 0 46 0
UC 40.79 133.06
* diamond
UA 0 0.09 0.34 0.64 0.9 1
KK ADH39
KO 0 0 0 0 22
HC 2
KK RSV39
KM Winner Dam impoundment on Hanson Creek
KM Outlet and Storage curves developed by Dan Thul (MNDNR 1981)
KO 0 0 0 0 22
RS 1 STOR 5 0
* rsv39stor
SV 5 21 30 65 120 220 370 470 580
* rsv39flow
SQ 0 6 32 75 170 320 560 920 1500
* rsv39elev
SE1201.5 1202 1203 1204 1205 1206 1207 1207.5 1208
KK RCH39
KM Hanson Creek Winner dam to North Branch
KO 0 0 0 0 22
RD
RC 0.125 0.035 0.125 20500 0.0013 0
* rch39
RX 0 700 990 996 1036 1042 1290 1680
RY 1205 1200 1194 1182 1182 1194 1200 1205
KK RNF45
KM Local drainage to outlet of Hanson Creek
KO 0 0 0 0 22
BA 5.59
LS 0 38 0
UC 16.96 47.49

```

* rectangle

UA 0 0.2 0.4 0.6 0.8 1

KK ADH45

KM Hanson Creek outflow

KO 0 0 0 0 22

HC 2

KK ADH46

KO 0 0 0 0 22

HC 2

KK RCH46

KM North Branch from Hanson Creek to Hayes Lake

KO 0 0 0 0 22

RD

RC 0.125 0.035 0.125 11000 0.0007 0

* rch46

RX 0 200 350 358 390 398 460 990

RY 1190 1175 1169 1161 1161 1169 1175 1190

KK RNF49

KM Local drainage to Hayes Lake

KO 0 0 0 0 22

BA 18.29

LS 0 45 0

UC 60.89 170.49

* diamond

UA 0 0.09 0.34 0.64 0.9 1

KK ADH49

KO 0 0 0 0 22

HC 2

KK RSV49

KM Hayes Lake Dam

KM Outlet and Storage curves developed by Dan Thul (MNDNR 1981)

KO 0 0 0 0 22

RS 1 STOR 1640 0

* rsv49stor

SV 0 180 595 1290 1640 1680 1750 1840 2050 2270

SV 2510 2760 3000 3070 3180 3250

* rsv49flow

SQ 0 0 0 0 0 19 72 213 640 1235

SQ 2000 2950 4060 4610 5140 8150

* rsv49elev

SE 1150 1155 1160 1165 1167 1167.2 1167.5 1168 1169 1170

SE 1171 1172 1173 1173.4 1173.7 1174

KK RCH49

KM North Branch Hayes Lake to Beaver

KO 0 0 0 0 22

RD

RC 0.125 0.035 0.125 28200 0.001 0

* rch49

RX 0 90 160 168 228 236 690 800

RY 1150 1135 1130 1122 1122 1130 1135 1150

KK RNF59

KM Local Drainage to Beaver

KO 0 0 0 0 22

BA 15.71

LS 0 47 0

UC 43.26 90.85

* fan

UA 0 0.05 0.15 0.35 0.65 1

KK ADH59

KO 0 0 0 0 22

HC 2

KK RCH59

KM North Branch to Pencer

```

RRSumCal.DAT
KO      0      0      0      0
RD
RC 0.125  0.035  0.125  38000  0.0009  0
* rch59
RX      0      110     1000     1008     1068     1072     1690     1770
RY 1125    1120     1115     1107     1107     1115     1120     1125
KK RNF65
KM      Local drainage to Pencer East
KO      0      0      0      0      22
BA 12.79
LS      0      49      0
UC 15.54  17.40
* fan
UA      0      0.05     0.15     0.35     0.65     1
KK ADH65
KO      0      0      0      0      22
HC      2
KK RCH65
KM      North Branch to Severson Creek
KO      0      0      0      0      22
RD
RC 0.125  0.035  0.125  25509  0.0008  0
* rch65
RX      0      80      250      270      330      350      1580     1680
RY 1095    1090     1085     1075     1075     1085     1090     1095
KK RNF69
KM      Local drainage to North Branch at Severson Creek
KO      0      0      0      0      22
BA 2.29
LS      0      54      0
UC 7.24   10.14
* rectangle
UA      0      0.2      0.4      0.6      0.8      1
KK ADH69
KO      0      0      0      0      22
HC      2
KKRNF070
KM      Severson Creek
KO      0      0      0      0      22
BA 22.25
LS      0      50      0
UC 17.3   24.22
* fan
UA      0      0.05     0.15     0.35     0.65     1
KK ADH70
KO      0      0      0      0      22
HC      2
KKRCH070
KM      North Branch to Bear Creek
KO      0      0      0      0      22
RD
RC 0.125  0.035  0.125  29973  0.0008  0
* rch70
RX      0      80      250      270      330      350      1580     1680
RY 1085    1080     1075     1065     1065     1075     1080     1085
KKRNF079
KM      Local drainage North Branch at Bear Creek
KO      0      0      0      0      22
BA 7.52
LS      0      52      0
UC 13.14  18.04
* rectangle
UA      0      0.2      0.4      0.6      0.8      1

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KK ADH79								
KO	0	0	0	0	22			
HC	2							
KK RNF80								
KM	Local Drainage Comstocks Bear Creek at Roseau CSAH 9							
KO	0	0	0	0	22			
BA	20.66							
LS	0	55	0					
UC	16.8	19.75						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KK RCH80								
KM	Bear Creek Comstock to North Branch							
KO	0	0	0	0	22			
RD								
RC	0.125	0.035	0.125	28200	0.0008	0		
* rch80								
RX	0	180	400	406	456	462	640	820
RY	1080	1075	1070	1064	1064	1070	1075	1080
KK RNF85								
KM	Local drainage Bear Creek at outlet							
KO	0	0	0	0	22			
BA	5.27							
LS	0	54	0					
UC	11.08	12.10						
* rectangle								
UA	0	0.2	0.4	0.6	0.8	1		
KK ADH85								
KM	Bear Creek at North Branch							
KO	0	0	0	0	22			
HC	2							
KK ADH86								
KO	0	0	0	0	22			
HC	2							
KK RCH86								
KM	North Branch from Bear Creek to Malung							
KO	0	0	0	0	22			
RD								
RC	0.125	0.035	0.125	20800	0.0006	0		
* rch86								
RX	0	260	350	354	411	415	490	710
RY	1070	1055	1054	1050	1050	1054	1055	1070
KK RNF99								
KM	Local Drainage to Gage 2							
KO	0	0	0	0	22			
BA	2.18							
LS	0	57	0					
UC	3.96	3.71						
* diamond								
UA	0	0.09	0.34	0.64	0.9	1		
KK ADH99								
KO	0	0	0	0	22			
HC	2							
KK RCH99	CNAME	G2						
KM	North Branch gage 2 to South Branch							
KO	0	0	0	0	22			
RD								
RC	0.125	0.035	0.125	17800	0.0004	0		
* rch99								
RX	0	110	180	186	246	252	260	810
RY	1055	1050	1044	1038	1038	1044	1050	1055
KKRNF109								
KM	Local drainage South Branch at Skime							

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RRSumCal.DAT
KO      0      0      0      0      22
BA 28.21
LS      0      55      0
UC 67.63 220.61
* fan
UA      0      0.05  0.15  0.35  0.65  1
KKRCH109
KM      South Branch Skime to Casperson
KO      0      0      0      0      22
RD
RC 0.125  0.035  0.125  34800  0.0007  0
* rch109
RX      0      1400  1620  1624  1664  1668  2150  3220
RY 1175  1170  1165  1161  1161  1165  1170  1175
KKRCH110
KM      South Branch Casperson to Mickinock Creek
KO      0      0      0      0      22
RD
RC 0.125  0.035  0.125  35000  0.0012  0
* rch110
RX      0      280   300   305   345   349   400   540
RY 1135  1130  1125  1120  1120  1125  1130  1135
KKRNF119
KM      Local drainage to South Branch at Mickinock Creek
KO      0      0      0      0      22
BA 24.2
LS      0      56      0
UC 25.87 72.44
* rectangle
UA      0      0.2   0.4   0.6   0.8   1
KKADH119
KM      Combined flow South Branch upstream of Mickinock Creek
KO      0      0      0      0      22
HC      2
KKRNF120
KM      Palmville sub RNF3
KM      Palmville sub refers to areas developed for the Palmville Flood Control P
KO      0      0      0      0      22
BA 1.27
LS      0      60      0
UC 7.06  19.77
* fan
UA      0      0.05  0.15  0.35  65    1
KKRCH120
KO      0      0      0      0      22
RD
RC 0.15  0.15  0.15  5500  0.0018  0
* rch120
RX      0      10     20    500   800   1300  1310  1320
RY 1170  1169  1168.5  1168  1168  1168.5  1169  1170
KKRNF121
KM      Palmville sub RNF4b
KO      0      0      0      0      22
BA 0.95
LS      0      63      0
UC 9.62  26.94
* fan
UA      0      0.05  0.15  0.35  0.65  1
KKRCH121
KO      0      0      0      0      22
RD
RC 0.15  0.15  0.15  5500  0.0009  0
* rch121

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								RRSumCal.DAT	
RX	0	10	20	500	800	1300	1310	1320	
RY	1172	1171	1170.5	1170	1170	1170.5	1171	1172	
KKRNF123									
KM	Palmville sub RNF4a								
KO	0	0	0	0	22				
BA	2.32								
LS	0	62	0						
UC	6.98	19.54							
* fan									
UA	0	0.05	0.15	0.35	0.65	1			
KKADH123									
KO	0	0	0	0	22				
HC	2								
KKRCH123									
KO	0	0	0	0	22				
RD									
RC	0.15	0.15	0.15	2500	0.004	0			
* rch120									
RX	0	10	20	500	800	1300	1310	1320	
RY	1170	1169	1168.5	1168	1168	1168.5	1169	1170	
KKADH124									
KO	0	0	0	0	22				
HC	2								
KKRNF125									
KM	Palmville sub RNF5								
KO	0	0	0	0	22				
BA	4.44								
LS	0	54	0						
UC	15.4	43.18							
* fan									
UA	0	0.05	0.15	0.35	0.65	1			
KKRCH125									
KO	0	0	0	0	22				
RD									
RC	0.15	0.15	0.15	1500	0.0033	0			
* rch120									
RX	0	10	20	500	800	1300	1310	1320	
RY	1170	1169	1168.5	1168	1168	1168.5	1169	1170	
KKRNF126									
KM	Palmville sub RNF6								
KO	0	0	0	0	22				
BA	1.25								
LS	0	57	0						
UC	11.52	24.19							
* fan									
UA	0	0.05	0.15	0.35	0.65	1			
KKRCH126									
KO	0	0	0	0	22				
RD									
RC	0.15	0.15	0.15	8000	0.0006	0			
* rch120									
RX	0	10	20	500	800	1300	1310	1320	
RY	1170	1169	1168.5	1168	1168	1168.5	1169	1170	
KKRNF127									
KM	Palmville sub RNF7								
KO	0	0	0	0	22				
BA	2.93								
LS	0	48	0						
UC	16.27	22.78							
* diamond									
UA	0	0.09	0.34	0.64	0.9	1			
KKRCH127									
KO	0	0	0	0	22				

RRSumCal.DAT

RD								
RC	0.15	0.15	0.15	9000	0.0006	0		
* rch120								
RX	0	10	20	500	800	1300	1310	1320
RY	1170	1169	1168.5	1168	1168	1168.5	1169	1170
KKRNF128								
KM	Palmville	sub	RNF8					
KO	0	0	0	0	22			
BA	1.22							
LS	0	47	0					
UC	6.25	13.13						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKRCH128								
KO	0	0	0	0	22			
RD								
RC	0.15	0.15	0.15	6000	0.0008	0		
* rch120								
RX	0	10	20	500	800	1300	1310	1320
RY	1170	1169	1168.5	1168	1168	1168.5	1169	1170
KKRNF129								
KM	Palmville	sub	RNF9					
KO	0	0	0	0	22			
BA	2.9							
LS	0	47	0					
UC	7.84	16.46						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKRNF130								
KM	Palmville	sub	RNF10					
KO	0	0	0	0	22			
BA	1.29							
LS	0	45	0					
UC	5.11	16.67						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH130								
KO	0	0	0	0	22			
HC	7							
KKRNF131								
KM	Palmville	wildlife	pool					
KO	0	0	0	0	22			
BA	7.65							
LS	0	62	0					
UC	13.89	45.30						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH131								
KO	0	0	0	0	22			
HC	2							
KKRNF132								
KM	Palmville	Flood	Pool					
KO	0	0	0	0	22			
BA	0.89							
LS	0	62	0					
UC	7.85	25.61						
* diamond								
UA	0	0.09	0.34	0.64	0.9	1		
KKADH132								
KO	0	0	0	0	22			
HC	2							
KKRCH132								
KO	0	0	0	0	22			

RRSumCal.DAT

RD								
RC	0.15	0.05	0.15	10560	0.0005	0		
* rch132								
RX	0	4	6	16	24	34	1320	1325
RY	1153	1151	1149	1144	1144	1149	1150	1152
KKRCH133								
KO	0	0	0	0	22			
RD								
RC	0.15	0.05	0.15	9200	0.0016	0		
* rch133								
RX	0	4	6	22	30	46	1320	1325
RY	1148	1146	1144	1136	1136	1144	1144	1146
KKRNF139								
KM	Local drainage to Oseland Gage							
KO	0	0	0	0	22			
BA	23.74							
LS	0	56	0					
UC	21.3	44.73						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH139								
KO	0	0	0	0	22			
HC	2							
KKRCH139								
KO	0	0	0	0	22			
RD								
RC	0.125	0.05	0.125	14800	0.0006	0		
* rch139								
RX	0	140	200	204	224	228	305	350
RY	1127	1120	1119	1115	1115	1119	1120	1127
KKRNF145								
KM	Local drainage to Mickinock Creek at Outlet							
KO	0	0	0	0	22			
BA	8.37							
LS	0	54	0					
UC	18.97	26.56						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH145								
KM	Mickinock Creek							
KO	0	0	0	0	22			
HC	2							
KKADH146								
KO	0	0	0	0	22			
HC	2							
KKRCH146								
KM	South Branch Mickinock Creek to Wannaska							
KO	0	0	0	0	22			
RD								
RC	0.125	0.035	0.125	26600	0.0009	0		
* rch146								
RX	0	90	120	127	167	174	305	390
RY	1110	1105	1100	1093	1093	1100	1105	1110
KKRNF149								
KM	Local drainage South Branch at Wannaska							
KO	0	0	0	0	22			
BA	14							
LS	0	54	0					
UC	19.28	26.99						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH149								
KO	0	0	0	0	22			

HC	2							
KKRCH149								
KM	South Branch Wannaska to Paulson Creek							
KO	0	0	0	0	22			
RD								
RC	0.125	0.035	0.125	15200	0.0004	0		
* rch149								
RX	0	175	300	306	346	352	775	800
RY	1100	1095	1090	1084	1084	1090	1095	1100
KKRNF155								
KM	Local drainage South Branch at Paulson Creek							
KO	0	0	0	0	22			
BA	4.45							
LS	0	53	0					
UC	6.05	5.67						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH155								
KO	0	0	0	0	22			
HC	2							
KKRNF159								
KM	Local drainage gage 43 Roseau CD 21 at CSAH4							
KO	0	0	0	0	22			
BA	20.07							
LS	0	55	0					
UC	20.56	38.86						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKRCH159								
KO	0	0	0	0	22			
RD								
RC	0.125	0.05	0.125	8500	0.0005	0		
* rch159								
RX	0	7.5	15	30	38	53	1373	2700
RY	1125	1122.5	1120	1115	1115	1120	1122.5	1125
KKRCH160								
KO	0	0	0	0	22			
RD								
RC	0.125	0.05	0.125	4400	0.0036	0		
* rch160								
RX	0	150	180	185	195	200	300	400
RY	1115	1100	1095	1090	1090	1095	1100	1115
KKRNF165								
KM	Local Drainage Paulson Creek at Outlet							
KO	0	0	0	0	22			
BA	3.47							
LS	0	53	0					
UC	10.25	14.35						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH165								
KM	Combined outflow Paulson Creek							
KO	0	0	0	0	22			
HC	2							
KKADH166								
KO	0	0	0	0	22			
HC	2							
KKRCH166								
KM	South Branch Paulson Creek to Pencer West							
KO	0	0	0	0	22			
RD								
RC	0.125	0.035	0.125	29800	0.0004	0		
* rch166								

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RRSumCal.DAT
RX      0      160      500      520      580      600      650      700
RY 1090    1080    1080    1070    1070    1080    1085    1090
KKRNF169
KM      Local Drainage to Pencer West
KO      0          0          0          0          22
BA 6.56
LS      0          61          0
UC 14.79    20.71
* fan
UA      0      0.05      0.15      0.35      0.65      1
KKADH169
KO      0          0          0          0          22
HC      2
KKRCH169
KM      South Branch Pencer West to Unamed Creek 1
KO      0          0          0          0          22
RD
RC 0.125    0.035    0.125    17000    0.0005      0
* rch169
RX      0          90          690          712          752          774          800          850
RY 1075    1070    1065    1054    1054    1065    1070    1075
KKRNF170
KM      Local draiange South Branch at Unamed Creek 1
KO      0          0          0          0          22
BA 1.65
LS      0          61          0
UC 6.34     8.88
* general
UA      0      0.13      0.36      0.67      0.89      1
KKADH170
KM      South Branch upstream Unamed Creek 1
KO      0          0          0          0          22
HC      2
KKRNF171
KM      Local Drainage Unamed Creek 1
KO      0          0          0          0          22
BA 13.67
LS      0          54          0
UC 19.15    26.81
* fan
UA      0      0.05      0.15      0.35      0.65      1
KKADH171
KO      0          0          0          0          22
HC      2
KKRCH171
KM      South Branch Unamed Creek 1 to Unamed Creek 2
KO      0          0          0          0          22
RD
RC 0.125    0.035    0.125    34400    0.0005      0
* rch171
RX      0          90          690          712          752          774          800          850
RY 1070    1065    1060    1049    1049    1060    1065    1070
KKRNF172
KM      Local drainage South Branch at Unamed Creek 2
KO      0          0          0          0          22
BA 5.04
LS      0          60          0
UC 16.23    22.72
* diamond
UA      0      0.09      0.34      0.64      0.9        1
KKADH172
KM      South Branch upstream Unamed Creek 2
KO      0          0          0          0          22

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HC	2							
KKRNF173								
KM	Local drainage Unamed Creek 2							
KO	0	0	0	0	22			
BA	16.03							
LS	0	53	0					
UC	16.17	22.64						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH173								
KO	0	0	0	0	22			
HC	2							
KKRCH173								
KM	South Branch Unamed Creek 2 to Gage 1							
KO	0	0	0	0	22			
RD								
RC	0.125	0.035	0.125	27000	0.0005	0		
* rch173								
RX	0	90	690	712	752	774	800	850
RY	1065	1060	1055	1044	1044	1055	1060	1065
KKRNF199								
KM	Local drainage to Gage 1							
KO	0	0	0	0	22			
BA	9.25							
LS	0	57	0					
UC	11.09	15.53						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH198								
KO	0	0	0	0	22			
HC	2							
KKRNF180								
KM	Local drainage gage 3 Sec 18/19 T161N R39W							
KO	0	0	0	0	22			
BA	11.52							
LS	0	54	0					
UC	18.81	26.33						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKRCH180								
KM	Sucker Creek Gage 1 to Outlet							
KO	0	0	0	0	22			
RD								
RC	0.125	0.05	0.125	9000	0.0023	0		
* rch180								
RX	0	90	100	125	130	155	180	240
RY	1060	1050	1044	1041	1041	1044	1050	1060
KKRNF189								
KM	Local drainage outlet Sucker Creek							
KO	0	0	0	0	22			
BA	0.69							
LS	0	55	0					
UC	7.44	6.97						
* rectangle								
UA	0	0.2	0.4	0.6	0.8	1		
KKADH189								
KM	Sucker Creek Outflow							
KO	0	0	0	0	22			
HC	2							
KKADH199								
KO	0	0	0	0	22			
HC	2							
KKRCH199								

KM	South Branch to North Branch								
KO	0	0	0	0	22				
RD									
RC	0.125	0.035	0.125	6000	0.0005	0			
* rch199									
RX	0	90	100	106	146	152	290	1200	
RY	1055	1040	1039	1033	1033	1039	1050	1055	
KKADH200									
KO	0	0	0	0	22				
HC	2								
KKRCH200									
KM	Roseau River to USGS Gage near Malung								
KO	0	0	0	0	22				
RD									
RC	0.125	0.035	0.125	2400	0.0003	0			
* rch200									
RX	0	400	435	443	493	501	600	1600	
RY	1055	1045	1040	1034	1034	1040	1050	1055	
KKRNF209									
KM	Local drainage to USGS Gage near Malung Gage 50								
KO	0	0	0	0	22				
BA	3.24								
LS	0	55	0						
UC	8.83	12.36							
* fan									
UA	0	0.05	0.15	0.35	0.65	1			
KKADH209									
KO	0	0	0	0	22				
HC	2								
KKRCH209									
KM	Roseau River gage 50 to CD 8								
KO	0	0	0	0	22				
RD									
RC	0.125	0.035	0.125	1000	0.0003	0			
* rch200									
RX	0	400	435	443	493	501	600	1600	
RY	1055	1045	1040	1034	1034	1040	1050	1055	
KKRNF211									
KM	Local Drainage to Stafford area 1								
KO	0	0	0	0	22				
BA	11.25								
LS	0	52	0						
UC	16.8	15.75							
* fan									
UA	0	0.05	0.15	0.35	0.65	1			
KKRNF212									
KM	Local drainage to Stafford area 2								
KO	0	0	0	0	22				
BA	1.45								
LS	0	53	0						
UC	2.49	2.34							
* fan									
UA	0	0.05	0.15	0.35	0.65	1			
KKRNF213									
KM	Local drainage to Stafford area 3								
KO	0	0	0	0	22				
BA	0.7								
LS	0	47	0						
UC	5.56	5.22							
* fan									
UA	0	0.05	0.15	0.35	0.65	1			
KKADH211									
KO	0	0	0	0	22				

HC	3								
KKRCH211									
KM	Roseau County Ditch 8 Stafford project to Outlet								
KO	0	0	0	0	22				
RD									
RS	1	FLOW	0	0					
RC	0.05	0.05	0.125	17120	0.0005	0			
* rch211									
RX	0	10	16	31	37	52	1372	2640	
RY	1058.2	1058	1056	1051	1051	1056	1056.2	1058.2	
KKRNF219									
KM	Local Drainage Outlet RCD 8								
KO	0	0	0	0	22				
BA	6.26								
LS	0	53	0						
UC	17.92	25.09							
* fan									
UA	0	0.05	0.15	0.35	0.65	1			
KKADH220									
KM	Roseau County ditch 8 outflow								
KO	0	0	0	0	22				
HC	2								
KKADH221									
KO	0	0	0	0	22				
HC	2								
KKRCH221									
KM	Roseau River RCD 8 to Cow Creek								
KO	0	0	0	0	22				
RD									
RC	0.125	0.035	0.125	8800	0.0003	0			
* rch221									
RX	0	3600	3800	3812	3862	3874	4024	7624	
RY	1055	1050	1035	1029	1029	1035	1050	1055	
KKRNF229									
KM	Local drainage Roseau River at Cow Creek								
KO	0	0	0	0	22				
BA	4.83								
LS	0	53	0						
UC	12.04	16.86							
* fan									
UA	0	0.05	0.15	0.35	0.65	1			
KKADH229									
KM	Roseau River upstream Cow Creek								
KO	0	0	0	0	22				
HC	2								
KKRNF248									
KM	Local drainage Cow Creek Gage 44 Sec 31/32 T162N R39W								
KO	0	0	0	0	22				
BA	16.9								
LS	0	55	0						
UC	15.15	21.21							
* fan									
UA	0	0.05	0.15	0.35	0.65	1			
KKRCH248									
KM	Cow Creek Gage 44 to Outlet								
KO	0	0	0	0	22				
RD									
RC	0.125	0.05	0.125	4800	0.0023	0			
* rch248									
RX	0	170	190	194	204	208	290	380	
RY	1050	1045	1044	1040	1040	1044	1045	1050	
KKRNF249									
KM	Local drainage outlet Cow Creek								

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RRSumCal.DAT
KO      0      0      0      0      22
BA 0.31
LS      0      58      0
UC 1.76      2.46
* rectangle
UA      0      0.2      0.4      0.6      0.8      1
KKADH249
KM      Cow Creek Outflow
KO      0      0      0      0      22
HC      2
KKADH260
KO      0      0      0      0      22
HC      2
KKRCH260
KM      Roseau River Cow Creek to Center Street
KO      0      0      0      0      22
RD
RC 0.125      0.035      0.125      11800      0.0003      0
* rch221
RX      0      3600      3800      3812      3862      3874      4024      7624
RY 1055      1050      1035      1029      1029      1035      1050      1055
KKRNF269
KM      Local drainage Roseau River at Center Street
KO      0      0      0      0      22
BA 5.07
LS      0      60      0
UC 10.04      14.56
* fan
UA      0      0.05      0.15      0.35      0.65      1
KKADH269
KO      0      0      0      0      22
HC      2
KKRCH269
KM      Roseau River Center Street to Gage 15
KO      0      0      0      0      22
RD
RC 0.125      0.035      0.125      23500      0.0003      0
* rch269
RX 11097      13712      20000      20035      20106      20131      20219      23721
RY1043.9      1038.4      1041.3      1024.7      1024.7      1036.8      1035.1      1043.6
KKRNF299
KM      Local drainage Roseau River Gage 15
KO      0      0      0      0      22
BA 5.51
LS      0      60      0
UC 9.18      12.85
* diamond
UA      0      0.09      0.34      0.64      0.9      1
KKADH299
KO      0      0      0      0      22
HC      2
KKRNF319
KM      Local Drainage Hay Creek at County Road 2 Sec 1/12 T161N R37W
KO      0      0      0      0      22
BA 19.38
LS      0      57      0
UC 17.12      23.73
* fan
UA      0      0.05      0.15      0.35      0.65      1
KKRCH319
KM      Hay Creek County Road 2 to Branch CD 9
KO      0      0      0      0      22
RD

```

```

RRSumCal.DAT
RC 0.125 0.05 0.125 7200 0.0017 0
* rch319
RX 0 1130 1270 1282 1300 1312 1400 1650
RY 1110 1105 1095 1089 1089 1095 1105 1110
KKRNF335
KM Upper Summer Road RCD 9 drainage
KO 0 0 0 0 22
BA 10.04
LS 0 51 0
UC 19.28 26.99
* fan
UA 0 0.05 0.15 0.35 0.65 1
KKDVT335
KM Split flow west to Summer Road
DTOUT335 0 0
* din335
DI 0 50 100 200 300 500 750 1000
* dout335
DQ 0 33 67 133 200 333 500 670
KKRCH335
KM Branch of RCD 9 west to Hay Creek
KO 0 0 0 0 22
RD
RC 0.125 0.05 0.125 8810 0.0005 0
* rch335
RX 0 800 1700 1708 1712 1720 1722 1724
RY 1110 1107 1105 1101 1101 1105 1106 1107
KKADH336
KO 0 0 0 0 22
HC 2
KKRCH336
KM Hay Creek branch RCD9 to Summer Road
KO 0 0 0 0 22
RD
RC 0.125 0.05 0.125 7800 0.0017 0
* rch336
RX 0 1130 1270 1282 1300 1312 1400 1650
RY 1105 1100 1090 1084 1084 1090 1100 1105
KKRNF339
KM Local Drainage Hay Creek at Summer Road
KO 0 0 0 0 22
BA 10.5
LS 0 49 0
UC 17.2 24.08
* fan
UA 0 0.05 0.15 0.35 0.65 1
KKADH339
KO 0 0 0 0 22
HC 2
KKRCH339
KM Hay Creek Summer Road to Branch of RCD 9
KO 0 0 0 0 22
RD
RC 0.125 0.05 0.125 4400 0.001 0
* rch339
RX 0 100 3550 3562 3580 3592 4000 4800
RY 1080 1078 1075 1069 1069 1075 1078 1080
KKRNF351
KM Local drainage Upper Hwy 11
KO 0 0 0 0 22
BA 4.32
LS 0 55 0
UC 12.99 18.19

```

```

* fan
UA 0 0.05 0.15 0.35 0.65 1
KKRTV335
KM Split flow from Upper Summer Road North
DROUT335
KKRCH350
RD
RC 0.125 0.05 0.125 10560 0.0014 0
* rch350
RX 0 2 4 12 16 24 1320 2640
RY 1107 1106 1105 1101 1101 1105 1105.5 1107
KKADH351
KO 0 0 0 0 22
HC 2
KKDVT351
KM Split flow to Roseau County Road 11
DTOUT351
* din351
DI 0. 100. 200. 400. 600. 800. 1000. 2000.
* dout351
DQ 0. 50. 100. 200. 300. 400. 500. 1000.
KKRCH351
KM Branch RCD 9 to Hay Creek
KO 0 0 0 0 22
RD
RC 0.125 0.05 0.125 16600 0.0007 0
* rch351
RX 0 750 1320 1328 1332 1340 1342 1344
RY 1090 1089 1088 1084 1084 1088 1090 1092
KKADH352
KO 0 0 0 0 22
HC 2
KKRCH352
KM Hay Creek branch of RCD9 to Gage 12
KO 0 0 0 0 22
RD
RC 0.125 0.05 0.125 7400 0.0014 0
* rch352
RX 0 100 3550 3562 3580 3592 4000 4800
RY 1075 1073 1070 1064 1064 1070 1073 1075
KKRNF359
KM Local drainage Hay Creek at Gage 12
KO 0 0 0 0 22
BA 12.44
LS 0 50 0
UC 13.97 20.15
* diamond
UA 0 0.09 0.34 0.64 0.9 1
KKADH359
KO 0 0 0 0 22
HC 2
KKRCH359
KM Hay Creek Gage 12 to Branch RCD 9
KO 0 0 0 0 22
RD
RC 0.125 0.05 0.125 9220 0.0009 0
* rch359
RX 0 250 550 562 580 592 700 1000
RY 1070 1068 1065 1059 1059 1065 1068 1070
KKRTV351
KM Upper Hwy 11 split flow
DROUT351
KKRCH352

```

RRSumCal.DAT

RD										
RC	0.125	0.05	0.125	37920	0.0007	0				
* rch352										
RX	0	2	4	12	16	24	500	1000		
RY	1076	1075	1074	1070	1070	1074	1074	1075		
KKADH360										
KO	0	0	0	0	22					
HC	2									
KKRCH360										
KM	Hay	Creek	Branch	RCD9	to	MN	HWY	11		
KO	0	0	0	0	0	22				
RD										
RC	0.125	0.05	0.125	4980	0.0009	0				
* rch360										
RX	0	250	550	562	580	592	700	1000		
RY	1060	1058	1055	1049	1049	1055	1058	1060		
KKRNF379										
KM	Local	Drainage	MN	Hwy	11					
KO	0	0	0	0	22					
BA	20.97									
LS	0	54	0							
UC	37.8	79.38								
* fan										
UA	0	0.05	0.15	0.35	0.65	1				
KKADH379										
KO	0	0	0	0	22					
HC	2									
KKRCH379										
KM	Hay	Creek	MN	Hwy	11	to	Hay	Creek	Proj	Det 1
KO	0	0	0	0	0	22				
RD										
RC	0.125	0.035	0.125	5680	0.0004	0				
* rch379										
RX	0	1000	2300	2312	2328	2340	4000	5000		
RY	1060	1058	1058	1050	1050	1058	1058	1060		
KKRNF381										
KM	Hay	Creek	Proj	Det	1					
KO	0	0	0	0	22					
BA	4.14									
LS	0	54	0							
UC	20.23	28.32								
* fan										
UA	0	0.05	0.15	0.35	0.65	1				
KKADH381										
KO	0	0	0	0	22					
HC	2									
KKRCH381										
KM	Hay	Creek	Det	1	to	Roseau	County	Ditch	18	
KO	0	0	0	0	22					
RD										
RC	0.125	0.035	0.125	10820	0.0004	0				
* rch381										
RX	0	1000	2300	2312	2328	2340	4000	5000		
RY	1055	1053	1053	1045	1045	1053	1053	1055		
KKRNF385										
KM	Norland	sub	RNF50	Roseau	County	Ditch	18	Sec	4/5	T162N R38W
KO	0	0	0	0	22					
BA	8.39									
LS	0	55	0							
UC	29.83	83.52								
* rnf385										
UA	0	0.1	0.24	0.46	0.65	0.75	0.83	0.89	0.94	0.98
UA	1									

KKRCH385
 KM RCD 18 to Hay Creek
 KO 0 0 0 0 22
 RD
 RC 0.08 0.05 0.08 17690 0.001 0
 * rch385
 RX 0 5 10 45 53 57 100 250
 RY1067.4 1067.4 1067.4 1056.14 1056.14 1064.7 1064.7 1064.7
 KKRNF391
 KM Hay Creek Project Pool #1
 KO 0 0 0 0 22
 BA 2.21
 LS 0 55 0
 UC 3.6 5.04
 * fan
 UA 0 0.05 0.15 0.35 0.65 1
 KKADH391
 KO 0 0 0 0 22
 HC 2
 KKRCH391 CNAME 391
 KM RCD 18 Pool#1 to NW Sec 2 T162N R39W
 KO 0 0 0 0 22
 RD
 RC 0.08 0.05 0.08 5280 0.0003 0
 * rch391
 RX 0 5 10 24 30 44 5000 5250
 RY 1053 1052 1049 1042 1042 1049 1049.5 1050
 KKDVT391
 KM Split flow RCD 18
 DTOUT391
 * in391
 DI 0. 300. 600. 900. 1200. 2100.
 * out391
 DQ 0. 200. 400. 600. 800. 1400.
 KKRCH392
 KM RCD 18 NW Sec 2 T162N R39W
 KO 0 0 0 0 22
 RD
 RC 0.08 0.05 0.08 8300 0.0003 0
 * rch392
 RX 0 5 10 24 30 44 5000 5250
 RY 1052 1051 1048 1041 1041 1048 1048.5 1049
 KKADH395
 KO 0 0 0 0 22
 HC 2
 KKRCH395
 KM Hay Creek RCD 18 to Outlet
 KO 0 0 0 0 22
 RD
 RC 0.125 0.04 0.125 12900 0.0004 0
 * rch395
 RX 0 1000 2300 2312 2328 2340 4000 5000
 RY 1050 1048 1048 1040 1040 1048 1048 1050
 KKRNF399
 KM Local drainage to Lower Hay Creek
 KO 0 0 0 0 22
 BA 19.76
 LS 0 53 0
 UC 24.8 43.40
 * fan
 UA 0 0.05 0.15 0.35 0.65 1
 KKADH399
 KM Hay Creek at Outlet

KO	0	0	0	0	22					
HC	2									
KKADH400										
KM Roseau River at Gage 15 Sec 6/31 T162-163N R39W County Road 28										
KO	0	0	0	0	22					
HC	2									
KKRTV391										
KM Overflow RCD 18										
DROUT391										
KKRC391b										
RD										
RC	0.08	0.05	0.08	17000	0.0006	0				
* rc391b										
RX	0	2	4	14	18	28	1300	2600		
RY	1057	1056	1055	1050	1050	1055	1055.5	1057		
KKADH401										
KM Roseau River at Sout side Sec 31 T163N R39W at lateral JD61										
KO	0	0	0	0	22					
HC	2									
KKRC401m										
KM Roseau River Gage 15 to Lat 3 Judicial 61										
KO	0	0	0	0	22					
RS	1	FLOW	0	0						
* stor401m										
SV	0	90	632	1328	2606	6187	10916	15479	22242	29460
* flow401m										
SQ	0	500	1000	2000	3000	5000	6000	7000	8000	13000
KKRNF401										
KM Norland sub RNF20 Sec 28/29 T163N R37W										
KO	0	0	0	0	22					
BA	2.85									
LS	0	57	0							
UC	6.27	13.17								
* rnf401										
UA	0	0	0.01	0.03	0.09	0.19	0.29	0.51	0.78	0.95
UA	1									
KKRCH401										
KM Lat 3 JD61										
KO	0	0	0	0	22					
RD										
RC	0.08	0.05	0.08	5120	0.006	0				
* rch401										
RX	0	5	10	19	27	36	143	243		
RY1079.1	1079	1078	1075	1075	1078	1079	1079.1			
KKRNF402										
KM Norland Sub RNF30										
KO	0	0	0	0	22					
BA	6.43									
LS	0	54	0							
UC	39.75	111.30								
* rnf402										
UA	0	0.19	0.33	0.56	0.79	0.87	0.92	0.93	0.95	0.99
UA	1									
KKADH402										
KO	0	0	0	0	22					
HC	2									
KKDVT402										
KM 50-50 split west and north										
DTOUT402										
* in402										
DI	0.	10.	20.	30.	40.	50.	100.	200.	500.	1000.
* out402										
DQ	0.	5.	10.	15.	20.	25.	50.	100.	250.	500.

RRSumCal.DAT

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KKRCH402
KM   Lat 3 JD61
KO   0      0      0      0      22
RD
RC  0.08   0.05   0.08  10320  0.006   0
* rch402
RX   0      5      10      22      30      42      47      252
RY1075.1  1075   1074   1070   1070   1074   1075   1075.1
KKRNF403
KM   Norland Sub RNF40
KO   0      0      0      0      22
BA  5.66
LS   0      49      0
UC  13.51  18.91
* rnf40
UA   0      0.1    0.29   0.5    0.62   0.74   0.8    0.86   0.91   0.95
UA   1
KKADH403
KO   0      0      0      0      22
HC   2
KKRCH403
KM   Lat 3 JD 61
KO   0      0      0      0      22
RD
RC  0.08   0.05   0.08   9650  0.006   0
* rch403
RX   0      5      10      22      30      42      47      252
RY1070.1  1070   1069   1065   1065   1069   1070   1070.1
KKRNF405
KM   Norland sub RNF60
KO   0      0      0      0      22
BA  7.08
LS   0      55      0
UC  11.04  15.46
* rnf405
UA   0      0.08   0.18   0.31   0.51   0.65   0.82   0.9    0.97   0.99
UA   1
KKADH405
KM   Sec 21/22 T163N R38W
KO   0      0      0      0      22
HC   2
KKRNF406
KM   Norland sub RNF65
KO   0      0      0      0      22
BA  1.71
LS   0      46      0
UC   5      8.19
* rnf406
UA   0      0.13   0.25   0.34   0.45   0.57   0.7    0.8    0.89   0.97
UA   1
KKADH406
KM   Sec 21/22 T163N R38W
KO   0      0      0      0      22
HC   2
KKRNF408
KM   Norland Pool area RNF70
KO   0      0      0      0      22
BA  7.65
LS   0      48      0
UC  12.55  26.36
* rnf408
UA   0      0.02   0.08   0.15   0.26   0.41   0.61   0.75   0.87   0.93
UA   1

```

RRSumCal.DAT

KKADH408
 KO 0 0 0 0 22
 HC 2
 KKDVT408
 KM Split Norland flows into BR 5 Lat 3 and Lat 3 flows
 DTOUT410
 * in410
 DI 0. 35. 99. 239. 443. 696. 1065. 1515. 2032.
 * out410
 DQ 0. 11. 33. 80. 148. 232. 355. 505. 677.
 KKRCH420
 KM Lat 3 JD 61
 KO 0 0 0 0 22
 RD
 RC 0.125 0.05 0.125 24200 0.0006 0
 * rch420
 RX 0 6 8 18 24 34 1320 2325
 RY 1054 1051 1050 1045 1045 1050 1051 1054
 KKADH421
 KO 0 0 0 0 22
 HC 2
 KKRCH421
 KM Roseau River Lat 3 JD 61 to Hwy 310
 KO 0 0 0 0 22
 RD
 RC .125 .035 .125 11400 .00031
 * rch421
 RX 14054 19204 20000 20039 20069 20104 20313 22937
 RY 1040 1035.1 1037.2 1022.2 1021.7 1038.6 1036.3 1040
 KKRTV430
 KM Br 5 Lat 3 JD61
 DROUT410
 KKRCH430
 RD
 RC 0.125 0.05 0.125 44000 0.0004 0
 * out410
 RX 0 6 8 18 24 34 1320 1325
 RY 1054 1051 1050 1045 1045 1050 1050 1054
 KKADH430
 KO 0 0 0 0 22
 HC 2
 KKRNF499
 KM Local drainage Roseau River at MN Hwy 310
 KO 0 0 0 0 22
 BA 19.26
 LS 0 49 0
 UC 18.59 45.29
 * fan
 UA 0 0.05 0.15 0.35 0.65 1
 KKADH499
 KM Roseau River at MN Hwy 310
 KO 0 0 0 0 22
 HC 2
 KKRC499m
 KM Storage upstream Hwy 310
 RS 1 FLOW 0
 * stor499m
 SV 0 100 250 500 5000 9000 13000 16000 22000
 * flow499m
 SQ 0 1000 2000 3000 4000 5000 7500 10000 15000
 KKRNF520
 KM East Fork of Sprague Creek
 KO 0 0 0 0 22

BA	22.42							
LS	0	51	0					
UC	43.2	90.72						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKRNF530								
KM West Fork of Sprague Creek								
KO	0	0	0	0	22			
BA	20.42							
LS	0	45	0					
UC	48.32	101.47						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH530								
KO	0	0	0	0	22			
HC	2							
KKRCH530								
KM Sprague Creek forks to Vasser Road								
KO	0	0	0	0	22			
RD								
RC	0.125	0.04	0.125	40765	0.0006	0		
* rch530								
RX	0	10	510	516	534	540	1040	1050
RY	1080	1075	1073	1067	1067	1073	1075	1080
KKRNF540								
KM Local drainage to Sprague Creek at Vassar Road								
KO	0	0	0	0	22			
BA	47.64							
LS	0	51	0					
UC	43.35	91.04						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH540								
KO	0	0	0	0	22			
HC	2							
KKRCH540								
KM Sprague Creek Vassar Road to Mud Creek								
KO	0	0	0	0	22			
RD								
RC	0.125	0.04	0.125	56058	0.0005	0		
* rch540								
RX	0	10	510	516	534	540	1040	1050
RY	1075	1070	1068	1062	1062	1068	1070	1075
KKRNF545								
KM Local drainage Sprague Creek at Sprague Manitoba								
KO	0	0	0	0	22			
BA	21.93							
LS	0	57	0					
UC	35.7	74.97						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		
KKADH545								
KM Sprague Creek at Sprague								
KO	0	0	0	0	22			
HC	2							
KKRNF510								
KM Local Drainage to Mud Creek								
KO	0	0	0	0	22			
BA	32.18							
LS	0	59	0					
UC	71.13	149.38						
* fan								
UA	0	0.05	0.15	0.35	0.65	1		

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KKADH546
KO 0 0 0 0 22
HC 2
KKRCH546
KM Sprague Creek Sprague to USGS Gage
KO 0 0 0 0 22
RD
RC 0.125 0.04 0.125 17973 0.0009 0
* rch546
RX 0 10 510 516 534 540 1040 1050
RY 1065 1062 1057 1051 1051 1057 1060 1065
KKRNF550
KM Local drainage Sprague Creek at USGS Gage
KO 0 0 0 0 22
BA 39.01
LS 0 55 0
UC 52.83 49.56
* fan
UA 0 0.05 0.15 0.35 0.65 1
KKADH550
KM Sprague Creek at USGS gaging station
KO 0 0 0 0 22
HC 2
KKRCH550
KM Sprague Creek USGS Gage to Lat 2 JD 61
KO 0 0 0 0 22
RD
RC 0.125 0.04 0.125 32800 0.0006 0
* rch550
RX 0 50 1850 1856 1874 1880 3500 5250
RY 1050 1047 1045 1039 1039 1045 1047 1050
KKRNF570
KM Local Drainage to Upper Lat 2 JD 61
KO 0 0 0 0 22
BA 54.33
LS 0 60 0
UC 39.24 82.40
* fan
UA 0 0.05 0.15 0.35 0.65 1
KKRTV402
KM Split flow out of RNF402
DROUT402
KKRCH571
RD
RC 0.08 0.05 0.08 10420 0.0006 0
* rch571
RX 0 2 4 10 24 30 1300 2600
RY 1081 1080 1079 1076 1076 1079 1079.5 1080
KKADH574
KO 0 0 0 0 22
HC 2
KKRCH574
KM Lat 2 JD 61
KO 0 0 0 0 22
RD
RC 0.125 0.05 0.125 31460 0.0005 0
* rch574
RX 0 1 5 9 17 21 2621 5280
RY 1044 1043 1042 1038 1038 1042 1043 1044
KKADH575
KO 0 0 0 0 22
HC 2
KKRCH575

```

KM	Sprague Creek Br2 JD 61 to Outlet								
KO	0	0	0	0	22				
RD									
RC	0.125	0.04	0.125	9000	0.0005	0			
*	rch575								
RX	0	15	1515	1521	1541	1547	2547	2555	
RY	1036	1033	1032	1026	1026	1032	1033	1035	
KKRNF580									
KM	Local drainage to Sprague Creek at Outlet								
KO	0	0	0	0	22				
BA	47.32								
LS	0	62	0						
UC	29	60.90							
*	rectangle								
UA	0	0.2	0.4	0.6	0.8	1			
KKADH580									
KM	Sprague Creek at Outlet								
KO	0	0	0	0	22				
HC	2								
KKRC580m									
RS	1	FLOW	0						
*	stor580m								
SV	0	500	6500	15000	18000	21000			
*	flow580m								
SQ	0	1000	2000	3000	4000	5000			
KKADH456									
KM	Combined flows Roseau River and Sprague Creek								
KO	0	0	0	0	22				
HC	2								
KKRCH456									
KM	Roseau Rive Sprague Creek to Roseau Lake Bed								
KO	0	0	0	0	22				
RD									
RC	0.125	0.035	0.125	27200	0.0002	0			
*	rch456								
RX	0	9240	10560	10585	10638	10663	11983	15943	
RY	1038.5	1034.25	1034	1021.5	1021.5	1034	1034.25	1038.5	
KKRNF610									
KM	South Roseau Lake Bottom								
KO	0	0	0	0	22				
BA	40.91								
LS	0	53	0						
UC	10.48	9.83							
*	rectangle								
UA	0	0.2	0.4	0.6	0.8	1			
KKRNF620									
KM	North Roseau Lake Bottom								
KO	0	0	0	0	22				
BA	46.2								
LS	0	55	0						
UC	40.11	56.15							
*	fan								
UA	0	0.05	0.15	0.35	0.65	1			
KKADH620									
KM	Roseau River at Lake Bed								
KO	0	0	0	0	22				
HC	3								
KKRNF700									
KM	Local Drainage West Pine Creek								
KO	0	0	0	0	22				
BA	33.76								
LS	0	43	0						
UC	56.23	52.74							

RRSumCal.DAT

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* fan
UA 0 0.05 0.15 0.35 0.65 1
KKRCH700
KM West Pine Creek Manitoba Hwy 12 to East Pine Creek
KO 0 0 0 0 22
RD
RC 0.125 0.05 0.125 1672 0.0014 0
* rch700
RX 0 750 1500 1510 1518 1528 2278 3000
RY 1100 1095 1090 1086 1086 1090 1091 1095
KKRNF710
KM Local drainage East Pine Creek
KO 0 0 0 0 22
BA 9.55
LS 0 41 0
UC 20.36 19.08
* fan
UA 0 0.05 0.15 0.35 0.65 1
KKRCH710
KM East Pine Creek Manitoba Hwy 12 to West Pine Creek
KO 0 0 0 0 22
RD
RC 0.125 0.05 0.125 2048 0.0014 0
* rch710
RX 0 750 1500 1510 1516 1526 2276 3000
RY 1095 1091 1090 1086 1086 1090 1095 1100
KKADH710
KM Pine Creek near Hwy 12
KO 0 0 0 0 22
HC 2
KKRCH711
KM East and West Pine Creek to Diversion
KO 0 0 0 0 22
RD
RC 0.125 0.05 0.125 19288 0.0014
* rch711
RX 0 750 3000 3010 3016 3026 5250 6000
RY 1095 1090 1085 1081 1081 1085 1090 1095
KKRNF720
KM Local drainage Pine Creek at Diversion
KO 0 0 0 0 22
BA 16.68
LS 0 49 0
UC 7.58 10.61
* fan
UA 0 0.05 0.15 0.35 0.65 1
KKADH720
KM Pine Creek Upstream of Diversion
KO 0 0 0 0 22
HC 2.
KKDVT720
KM Pine Creek Diversion
DTOUT720
* in720
DI 0. 220. 300. 500. 1000. 1250. 1500. 2000.
* out720
DQ 0. 220. 273. 407. 740. 850. 850. 850.
KKRCH720
KM Pine Creek Diversion to Roseau County Road 118
KO 0 0 0 0 22
RD
RC 0.125 0.04 0.125 37815 0.001 0
* rch720

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RRSumCal.DAT
RX      0      600    1180    1184    1192    1196    1700    2410
RY 1050    1047    1045    1041    1041    1045    1047    1050
KKRNF790
KM      Local Drainage at RCR 118
KO      0      0      0      0      22
BA 20.29
LS      0      56      0
UC 17.76    24.86
* rectangle
UA      0      0.2    0.4    0.6    0.8    1
KKADH790
KM      Pine Creek at Lake Bottom
KO      0      0      0      0      22
HC      2
KKADH699
KO      0      0      0      0      22
HC      2
KKRSV699
KM      Roseau Lake Bottom
KO      0      0      0      0      22
RS      1      FLOW    0      0
* stor699
SV      0      900    2300    4900    6000    10100    14250    23000    34000    51900
SV 68500    88900    105900    118250    141000    168800
* flow699
SQ      0      250    732    954    1136    1372    1638    1924    2222    2574
SQ 3084    3868    4494    5200    7500    10000
* elev699
SE1017.1    1024.8    1026    1027    1028    1029    1030    1031    1032    1033
SE 1034    1035    1035.5    1036    1037    1038
KKRCH699
KM      Roseau River Ross to Lins Bridge
KO      0      0      0      0      22
RD
RC 0.125    0.035    0.125    24390    0.0005    0
* rch699
RX      0      9      3200    3232    3299    3331    5271    5280
RY 1035    1032    1030    1014    1014    1030    1032    1035
KKRNF900
KM      Local drainage at Lins Bridge
KO      0      0      0      0      22
BA 41.99
LS      0      54      0
UC 14.73    13.82
* rectangle
UA      0      0.2    0.4    0.6    0.8    1
KKADH900
KO      0      0      0      0      22
HC      2
KKRCH900
KM      Roseau River Lins Bridge to Big Swamp
KO      0      0      0      0      22
RD
RC 0.125    0.035    0.125    24390    0.0004    0
* rch900
RX      0      25     35     67     134     166     2806     5280
RY 1035    1030    1028    1012    1012    1028    1030    1032
KKRNF920
KM      Local drainage upstream of Big Swamp
KO      0      0      0      0      22
BA 24.09
LS      0      59      0
UC 32.83    45.96

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RRSumCal.DAT

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* rectangle
UA 0 0.2 0.4 0.6 0.8 1
KKADH920
KO 0 0 0 0 22
HC 2
KKRCH920
KM Roseau River to Roseau River Wildlife Management Pool 2 Outlet
KO 0 0 0 0 22
RD
RC 0.125 0.035 0.125 13000 0.0004 0
* rch920
RX 0 2640 5280 5296 5363 5380 8020 10659
RY 1025 1024.5 1024 1018 1018 1024 1024.5 1025
KKRNF810 RRWMA Pool 1
KM Local Drainage to RRWMA Pool 1
KO 0 0 0 0 22
BA 24.88
LS 0 58 0
UC 13.3 18.62
* rectangle
UA 0 0.2 0.4 0.6 0.8 1
KKRTV720
KM Pine Creek Diversion
DROUT720
KKRC720a
RD
RC 0.05 0.05 0.05 41517 0.0001 0
* rc720a
RX 0 10 28 42 52 66 84 94
RY 1068 1063 1063 1056 1056 1063 1063 1068
KKADH810
KO 0 0 0 0 22
HC 2
KKRSV810
KM RRWMA Pool 1
KO 0 0 0 0 22
RS 1 STOR 2415 0
* stor810
SV 2415 2477 3968 4899 4215 4575 5115 5475 6415 6735
* flow810
SQ 0 8.4 33 235 460 820 1390 1960 3035 4735
* elev810
SE 1035 1035.2 1035.5 1035.8 1036 1036.2 1036.5 1036.7 1037 1037.4
KKRNF820
KM Local drainage RRWMA Pool 2
KO 0 0 0 0 22
BA 89.71
LS 0 58 0
UC 51 107.10
* fan
UA 0 0.05 0.15 0.35 0.65 1
KKADH820
KO 0 0 0 0 22
HC 2
KKRSV820
KM RRWMA Pool 2
KO 0 0 0 0 22
RS 1 STOR 4450 0
* stor820
SV 4450 5400 6800 8400 9500 10800 12800 14300 16540 19550
* flow810
SQ 0 8.4 33 235 460 820 1390 1960 3035 4735
* elev820

```


RRSumCal.DAT

	SE 1029	1029.2	1029.5	1029.8	1030	1030.2	1030.5	1030.7	1031	1031.4
KKDVT820										
KM Main outlet Roseau River, Emergency Spillway and Secondary Outlet										
DTOUT820										
* in820										
DI	0.	8.4	33.	235.	460.	820.	1390.	1960.	3035.	4735.
* out820										
DQ	0.	0.	0.	170.	370.	700.	1225.	1645.	2345.	3325.
KKRCH821										
KM Roseau County Ditch 17										
KO	0	0	0	0	22					
RD										
RC	0.125	0.035	0.125	3900	0.0001	0				
* rch821										
RX	0	1050	2100	2108	2116	2124	2128	2134		
RY	1025	1022	1020	1016	1016	1020	1022	1025		
KKRCH822										
KM Old Roseau River Channel										
KO	0	0	0	0	22					
RD										
RC	0.125	0.035	0.125	8800	0.0001	0				
* rch822										
RX	0	500	1400	1408	1548	1556	2500	4000		
RY	1024	1022	1020	1016	1016	1020	1022	1024		
KKADH930										
KO	0	0	0	0	22					
HC 2										
KKRCH930										
KM Roseau River Pool 2 outlet to Pool 3 outlet										
KO	0	0	0	0	22					
RD										
RC	0.125	0.035	0.125	15200	0.0004	0				
* rch930										
RX	0	2640	5280	5296	5363	5380	8020	10659		
RY	1020	1019.5	1019	1013	1013	1019	1019.5	1020		
KKRNF830										
KM Local drainage RRWMA Pool 3										
KO	0	0	0	0	22					
BA 23.73										
LS	0	52	0							
UC	12.5	17.5								
* fan										
UA	0	0.05	0.15	0.35	0.65	1				
KKRTV820										
KM Pool 2 outflow to Pool3										
DROUT820										
KKADH830										
KO	0	0	0	0	22					
HC 2										
KKRSV830										
KM RRWMA Pool 3										
KO	0	0	0	0	22					
RS	1	STOR	2700	0						
* stor830										
SV	2700	3400	4500	5800	6750	7750	9700	12900	16650	
* flow830										
SQ	0	8.4	33	185	355	620	1040	1925	2980	
* elev830										
SE	1024	1024.2	1024.5	1024.8	1025	1025.2	1025.5	1026	1026.5	
KKRCH831										
KM Outlet Channel Pool3										
KO	0	0	0	0	22					
RD										

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RRSumCal.DAT
RC 0.125 0.05 0.125 2920 0.0001 0
* rch831
RX 0 700 1400 1410 1420 1430 2100 3000
RY 1023 1022 1021 1016 1016 1021 1022 1023
KKRCH832
KM Old Roseau River Channel
KO 0 0 0 0 22
RD
RC 0.125 0.05 0.125 1150 0.0001 0
* rch832
RX 0 700 1400 1412 1512 1514 2100 3000
RY 1023 1022 1021 1015 1015 1021 1022 1023
KKADH940
KO 0 0 0 0 22
HC 2
KKRCH940
KM Roseau River pool 3 to end of Big Swamp
KO 0 0 0 0 22
RD
RC 0.125 0.035 0.125 34000 0.0004 0
* rch940
RX 0 2640 5280 5296 5363 5380 8020 10659
RY 1019 1018.5 1018 1012 1012 1018 1018.5 1019
KKRNF950
KM Local drainage Big Swamp
KO 0 0 0 0 22
BA 88.82
LS 0 63 0
UC 32.48 68.21
* rectangle
UA 0 0.2 0.4 0.6 0.8 1
KKADH950
KO 0 0 0 0 22
HC 2
KKRSV950
KM Big Swamp Storage
KO 0 0 0 0 22
RS 1 STOR 0 0
* stor950
SV 0 2000 6000 13000 21000 29000 37000 45000 53000 153000
* flow950
SQ 0 700 1300 1900 2300 2600 2900 3200 3500 6500
KKDVT950
KM Flow transfer to Two Rivers
DTOUT920
* in920
DI 0. 2000. 3513. 3699. 4403. 6310.
* out920
DQ 0. 0. 533. 619. 1083. 2133.
KKRCH950
KM Roseau River Big Swamp to USGS Gaging Station
KO 0 0 0 0 22
RD
RC 0.125 0.035 0.125 32900 0.0002 0
* rch950
RX 0 1600 2200 2220 2275 2295 2900 3250
RY 1020 1018 1015 1005 1005 1015 1018 1020
KKRNF960
KM Local drainage to USGS Gage near Caribou
KO 0 0 0 0 22
BA 24.04
LS 0 53 0
UC 24.04 47.32

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RRSumCal.DAT
* rectangle
UA      0      0.2      0.4      0.6      0.8      1
KKADH960
KO      0      0      0      0      22
HC      2
KKRCH960
KM      Roseau River Caribou to International Border
KO      0      0      0      0      22
RD
RC 0.125  0.035  0.125  12200  .0003      0
* rch960
RX      0      1600      2200      2220      2275      2295      2900      3250
RY 1015  1013  1010  1000  1000  1010  1013  1015
KKRNF999
KM      Local Drainage Roseau River at Border
KO      0      0      0      0      22
BA 9.56
LS      0      52      0
UC 13.78  19.29
* rectangle
UA      0      0.2      0.4      0.6      0.8      1
KKADH999
KM      Roseau River at International Border
KO      0      0      0      0      22
HC      2
KKRTV920
KM Diverted flow to Two Rivers
DROUT920
ZZ

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