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Simulating Recharge in a Wisconsin Watershed: the Effect of Sub Annual Precipitation Patterns

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SIMULATING RECHARGE IN A WISCONSIN WATERSHED: THE EFFECT OF SUB ANNUAL PRECIPITATION PATTERNS

by

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ABSTRACT

SIMULATING RECHARGE IN A WISCONSIN WATERSHED: THE EFFECT OF SUB ANNUAL PRECIPITATION PATTERNS

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Alice Egan

The University of Wisconsin-Milwaukee, 2014

Under the Supervision of Professor Shangping Xu

A watershed, the Prairie River in north-central Wisconsin was used to analyze why the same annual precipitation generates variable annual recharge rates. Global Climate Models (GCMs) with three greenhouse gas emission scenarios (B1, A1B and A2) for two time series 2047-2065 and 2082-2100 were used to examine the annual and monthly differences between the Prairie River watershed future projections and the Prairie River watershed historical record, 1954-2009. The USGS soil water balance (SWB) model was used to calculate recharge.

In the Prairie River watershed, there is a strong correlation (R^2=0.84) between growing season recharge and growing season precipitation, and there is a strong correlation (R^2=0.74) between non-growing season recharge and non-growing season precipitation. Using the linear regression equations from the two correlation plots, recharge for the watershed was calculated that shows that higher non-growing season precipitation and lower growing season precipitation generate higher annual recharge rates. Simulations of annual precipitation were generated using SDSM, a statistical

downscaling model. Using SWB, recharge rates were generated for the simulations. The correlations were similar to the non-simulated data with a correlation (R^2=0.75) between growing season recharge and growing season precipitation and a correlation (R^2=0.83) between non-growing season recharge and non-growing season precipitation. The linear regression equations for growing season recharge and precipitation and non-growing season recharge and precipitation showed similar equations to the non-simulated data.

For the future climate data, the student's t-test was applied to compare the annual and monthly means of precipitation, temperature, recharge and ET of the Prairie River watershed time series, 1954-2009 to the time series, 2047-2065 and 2082-2100 for the Global Climate Models using three greenhouse gas emission scenarios B1, A1B and A2. For all scenarios for both time series, the t-values predict significant increases in recharge in December and January although annual recharge is not predicted to change, significant increases in temperature in all months with the highest increases occurring in July, August, and September and significant annual increases in ET.

This is dedicated to my patient, kind and supportive husband,

to my four terrific children who cheered me up and on,

to my parents who always asked me about my research and

supported me completely,

to my thesis adviser, Shangping Xu who supported me

and guided me through my extended stay at UWM

and to everyone in the Geosciences Department.

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A1B	greenhouse gas emission scenario
A2	greenhouse gas emission scenario
AWC	available water content
B1	greenhouse gas emission scenario
DEM	Digital Elevation Model
CFGI	Continuous Frozen Ground Index
ET	evapotranspiration
GCM	Global Climate Model
IPCC	The Intergovernmental Panel on Climate Change
NCEP	National Centers for Environmental Prediction
NOAA	National Oceanic and Atmospheric Administration
NRCS	National Resources Conservation Service
R^2	coefficient of determination
SDSM	Statistical downscaling model
SWB	soil water balance method

1. INTRODUCTION

Groundwater recharge represents the amount of water that infiltrates into the saturated zone to replenish the underlying aquifer. The time it takes for the infiltrating water to reach the water table depends on the thickness of the vadose zone and the vertical hydraulic conductivity of the unsaturated soils (Freeze and Cherry, 1979). The water budget describes the water inputs or sources and outputs or sinks into a watershed with recharge calculated from the following equation (Westenbroek, 2012; Freeze and Cherry, 1979; Fetter, 2001):

Recharge = (precipitation + snowmelt + inflow) [sources] – (interception + outflow + Evapotranspiration) [sinks] – change in soil moisture

There is a multitude of ways to calculate recharge: water budgets, unsaturated zone methods, water table fluctuations, tracers, computer modeling, and stream flow methods (USGS, 2013). The selection of groundwater recharge estimation methods depends on budgets, time frames and the climatology of the region. One method, the chloride mass balance method is not valid in humid environments due to the low concentrations of chloride in the unsaturated zone (Scanlon, 2012).

For this study two methods were used to calculate recharge: SWB, a soil water balance computer model based on the Thornthwaite-Mather soil-water accounting method and PART, a USGS base flow separation program. The PART recharge values were used to calibrate the SWB model. Previous studies have used the SWB model to measure recharge in counties that fit the grid format required by SWB. This study used SWB to measure recharge using a watershed. Boundary conditions were necessary to fit the watershed into the grid. Using a watershed in SWB allows for calibration to base flow. This is the first time the SWB model has been calibrated to a base flow separation program.

Recharge can vary spatially and temporally. Precipitation is one of the most important driving forces of recharge. The main goals of this study include: 1) to calibrate the SWB model to PART-extracted stream base flow, 2) to analyze simulated recharge focusing on precipitation patterns and their effect on recharge, and 3) to examine the potential effects of future climate change on groundwater recharge in a northern Wisconsin watershed.

2. SETTING

Study Area

The Prairie River watershed is located in north-central Wisconsin and spans Lincoln, Langlade and Oneida counties (Figure 1). The drainage area is 184 square miles. It is part of the Upper Wisconsin River watershed and the Mississippi River watershed.

Figure 1. Location of the Prairie River watershed.

The topography of the area is hummocky with glacial till deposited during the Wisconsin glaciation approximately 11,000 years ago. The area is a characterized by moraines. Elevations range from a high of 588 feet to a low of 396 feet.

The watershed has a gaging station with historical daily discharge data. The gaging station 05394500 is located at 45°14'09"N, 89°38'59"W eight miles upstream from the mouth of the watershed.

Climate and precipitation

Climate data was retrieved from the National Oceanic and Atmospheric Administration’s National Climatic Data center from 1953-2009 (9 years were omitted due to lack of data) for the Merrill Station, WI475364, Latitude: 45°10'14N, Longitude: 089°39'41W. This time series was used because it had the most complete consecutive data for daily precipitation and minimum and maximum temperatures. The average annual temperature and precipitation is 41.7° F and 31.7 inches, respectively. Sixty percent of the precipitation falls during the growing season which starts the middle of May and ends late September/early October (NOAA, 2006) with a growing season length of approximately 140 days.

Bedrock Geology

The Prairie river watershed is underlain by lower Proterozoic basalts and rhyolites interspersed with metasedimentary rock and meta-gabbros and diorites. This area is called the northern highlands and is part of the Canadian Shield that contains the oldest rocks in North America. Throughout its history, it underwent uplift, folding, erosion and scouring and deposition by continental ice sheets.

The bedrock in the south Prairie River watershed is at a depth of 50 feet to five feet from the surface. The center of the Prairie river watershed has the bedrock at a depth of between 100 feet and 50 feet of the surface. The rest of the Prairie River watershed has the bedrock at greater than 100 feet from the surface.

Pleistocene sand and gravel make up the surficial deposits of the watershed. The soil makeup of the area includes a range of soil types A-D with sand having the highest percentage due to recent glaciation (Table 1). The watershed is approximately 70% forested and 25% agricultural (Table 1).

Soil Type	Area (%)	Vegetation Class	Area (%)
A	35	Broad leaved deciduous	28
B	25	Aspen	19
C	22	Grassland	9
D	16	Sugar Maples	7
		Mixed deciduous/conifers	7
		Agriculture	25
		Urban	0

Table 1. Soils and land use for the Prairie River watershed.

Hydrostratigraphy

At the surface of the Prairie River watershed is the sand and gravel aquifer which is the main source of water to wells. Depth to the water table ranges from 0 to 20 feet in the southwest and the northwest, greater than 50 feet in the center of the watershed and from 20 to 50 feet for the remainder of the watershed. Underlying the sand and gravel aquifer is the crystalline bedrock aquifer which holds water within cracks.

3. LITERATURE REVIEW

The effect of precipitation on recharge

Annual precipitation is not always the main determinant of the amount of annual recharge a watershed receives due its high intra-variability. Other factors influencing diffuse recharge include soil type, vegetation, temperature, solar radiation, vapor pressure deficit and CO_2 concentrations, but rainfall has been found to be the most vital (Allen et al., 2004; Serrat-Capdevila et al., 2007). Watersheds with the same soil and annual vegetation have higher annual recharge rates if they have winter dominated rainfall as opposed to summer dominated rainfall (Barron et al., 2012). In a New Mexico watershed, more intense summer storms or more frequent winter rainfall increased recharge (Vivoni, 2009). A study of the Spring Mountains in Nevada, showed that very intense, short summer storms which make up a third of the annual precipitation for the region account for only 10% of the annual recharge while the late snowmelt contributes to the majority of annual recharge (Winograd et al., 1998).

Rainfall intensity is an important factor in annual recharge. Increase in rainfall intensity can increase recharge as well as the percentage of precipitation that becomes recharge (Barron, 2012). The spatial variation in rainfall is another important factor as variations in soil permeability and root depth affect the amount of recharge. In a Kalahari catchment, 0.77% of the area contributes 7.2% of the recharge (Wanke, 2008).

Recharge depends on distribution of precipitation events such as the locality of the storm center and periods of wetness or dryness (Sheffer et al., 2010). For example, two watersheds with similar climatic and lithological characteristics, one in Israel and one in Texas have annual precipitation rates of 23 inches. For the Israeli watershed, 25% to 35% of precipitation recharges the underlying Israeli aquifer (Gvirtzman, 2002). For the Texas Edwards aquifer only 5% to 10% of precipitation becomes recharge (Abbott, 1975). The recharge difference is due to the temporal characteristic of the precipitation. The Israeli watershed received winter precipitation while the Texas watershed had an even annual distribution of precipitation (Sheffer et al., 2010). At Lake Grace in Western Australia, a semi-arid region 11.8 inches of annual precipitation produced a range of recharge between 0 and 2 inches. At times lower amounts of annual precipitation can generate more recharge. In 1968 the annual precipitation was 14.6 and the annual recharge rate of 4.3 inches. In 1963 annual precipitation was 22.7 inches but the annual recharge rate was 3.8 inches. It was hypothesized that the intensity of the rainfall in 1968 produced 23 days of recharge compared to 88 days of recharge in 1963 (Lewis, 1998).

A study of recharge in Dane County, Wisconsin using the SWB model showed a range of recharge rates for similar annual precipitation. For example, 32.5 inches of annual precipitation generated recharge from 7 inches up to 14 inches. The study did not determine the reason for the range but suggested possible factors involved including soil moisture, previous year’s snowmelt, rainfall strength and duration and ET (Hart et al., 2012).

Climate change

There have been many studies of the effect of climate change on the hydrology of watersheds using Global Climate Models (GCMs) (McCabe et al, 1997, Markstrom et al., 2011, Christiansen, 2011). GCMs are numerical models which include the Earth's atmosphere, oceans, land surface and cryosphere and their physical responses to increases in greenhouse gas concentrations (Markstrom et al., 2011). The Intergovernmental Panel on Climate Change (IPCC) generates climate data from the GCMs using different greenhouse gas emission scenarios. One GCM study looked at the Trout Lake Basin in north-central Wisconsin to analyze the effect of climate change using global climate models using three emission scenarios, B1, A1B and A2 (Markstrom et al., 2011). The Trout Lake Basin lies at a similar latitude as the Prairie River. An analysis of GCM projections with three emission scenarios showed that increases in temperature, ET and length of the growing season will occur during this century at the Trout Lake Basin. Less snowfall due to higher temperatures will result in a decrease in recharge pulses in April and May. More recharge is predicted to occur during the growing season and late fall (Markstrom et al., 2011).

According to a study of growing seasons, the Trout Lake basin will see an earlier spring and a longer fall depending on the emission scenario. For emission scenarios B1, A1B and A2 projections have predicted that spring will arrive 10, 17 and 20 days earlier, respectively and fall will last 11, 15 and 19 days longer, respectively (Christiansen et al., 2011).

4. OBJECTIVE

The main objectives of this study are 1) to analyze why similar annual precipitations generate remarkable variability in recharge rates by using SWB to calculate recharge rates for the years 1954-2009 and for SDSM annual precipitation simulations; 2) to estimate future recharge rates using SWB from the GCMs using three greenhouse gas emission scenarios B1, A1B and A2 for the years, 2047-2065 and 2082-2100 and to compare each future time series to the historical record to determine changes on an annual and monthly scale.

5. METHODS

SWB

SWB, the USGS soil water balance method is a computer model that calculates a daily groundwater recharge and ET rate. The computer program is available for download from http://wi.water.usgs.gov/Soil_Water_Balance/index.html. The model was used throughout the study. It was used to calculate recharge for the time series, 1953-2009, the SDSM simulations and the GCMs. The model works on a grid system. The recharge rate for each grid cell is calculated by determining the sources and sinks to each grid cell. The sources are 1) daily precipitation, 2) snowmelt that is permitted to accumulate or melt based on daily temperatures, and 3) inflow using a flow direction file. The sinks are 1) interception which is precipitation trapped by foliage from trees, 2) evapotranspiration (ET) a combination of water transpired by plants and evaporation from the land surface, and 3) surface runoff. Surface runoff is calculated using the United States Department of Agriculture, National Resources Conservation Service curve numbers that represent a precipitation-runoff relationship. Curve numbers are calculated based on soil type, land use, surface condition and antecedent runoff condition (Westenbroek et al., 2010). Curve numbers are increased or decreased depending on the soil moisture with higher curve numbers causing more runoff. Three antecedent runoff conditions I, II, III are dry, average and near saturation, respectively. For near saturated soils, antecedent runoff condition III, the curve numbers are increased causing more runoff. The SWB model accommodates for frozen ground using a continuous frozen ground index (CFGI) in units, degree-Celsius-days. The CFGI is calculated at a daily time step using daily air temperatures (Molnau et al., 1983). An upper and lower limit CFGI, 83 and 55, respectively is set in the control file that runs SWB. These values are suggested by the literature (Westenbroek et al., 2010). The ground is considered frozen when the daily calculated CFGI value is greater than the upper limit; the curve numbers are shifted to antecedent runoff condition III from antecedent runoff condition II causing runoff. A CFGI value above 83 should not generate recharge.

The model domain used for the Prairie River watershed was 1211 by 1002 with a cell size of 30 meters. Since watersheds are not grid-shaped, boundary conditions must be created to eliminate recharge outside of the watershed.

There are five inputs into the model: the climate data including minimum and maximum temperature and daily precipitation, land use (Figure 2), Digital Elevation Model (DEM) (Figure 3), soils (Figure 4) and the available water content (AWC) (Figure 5) which is created from the soils file. The available water content is the maximum amount of water capacity a soil can hold with units in inches per foot of thickness. A schematic of the process is described in Figure 6.

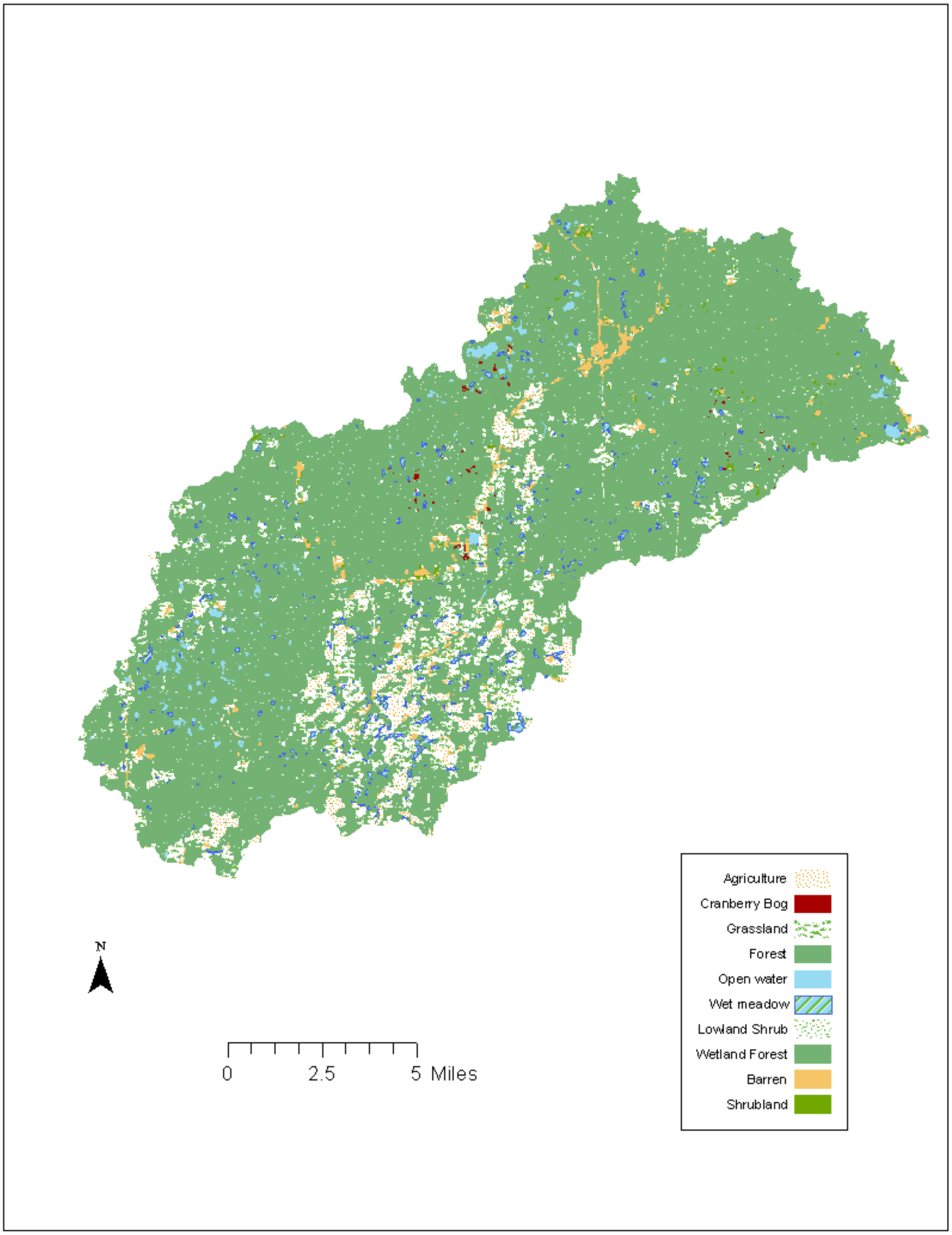

Figure 2. Land use of the Prairie River.

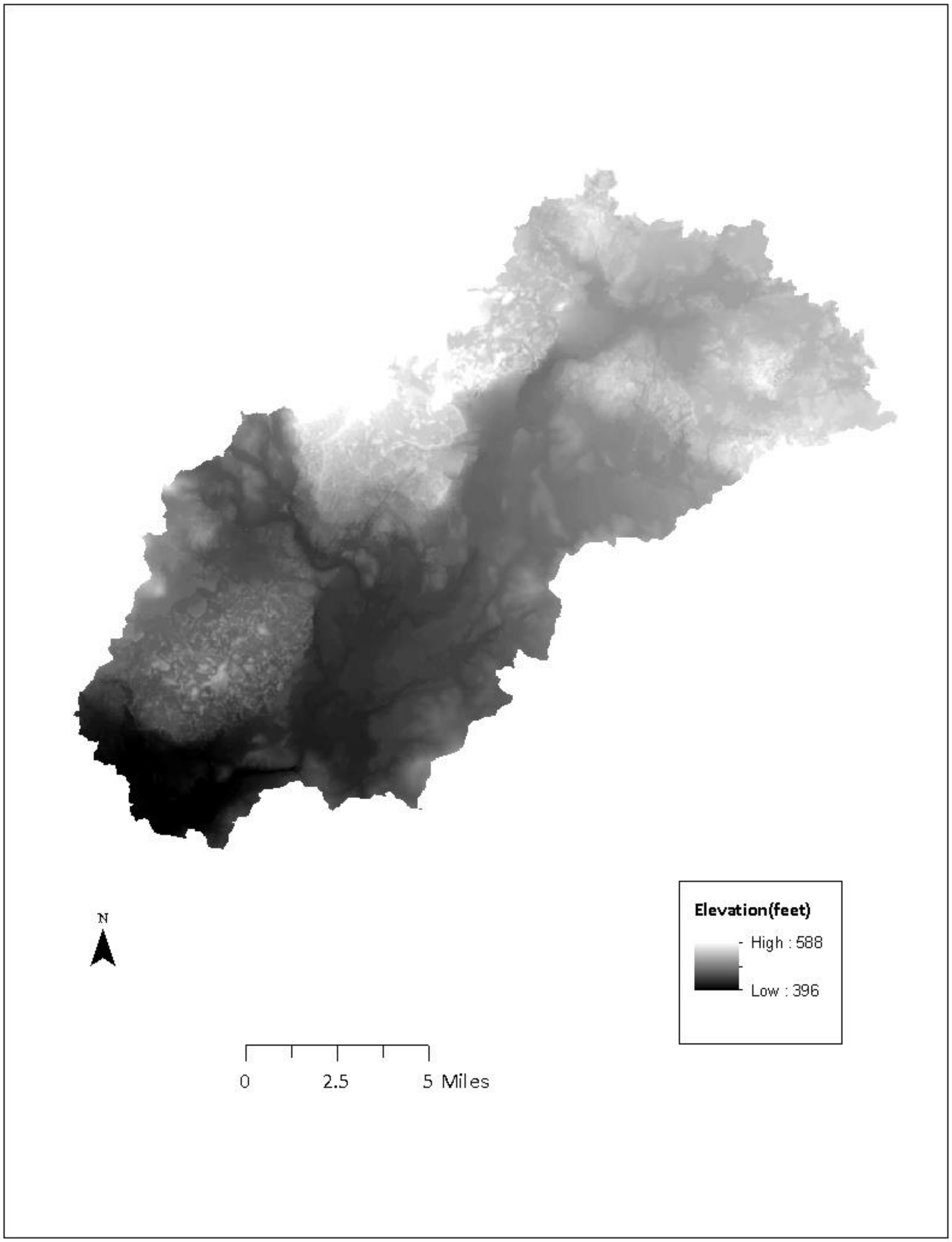

Figure 3. Digital Elevation Model of the Prairie River.

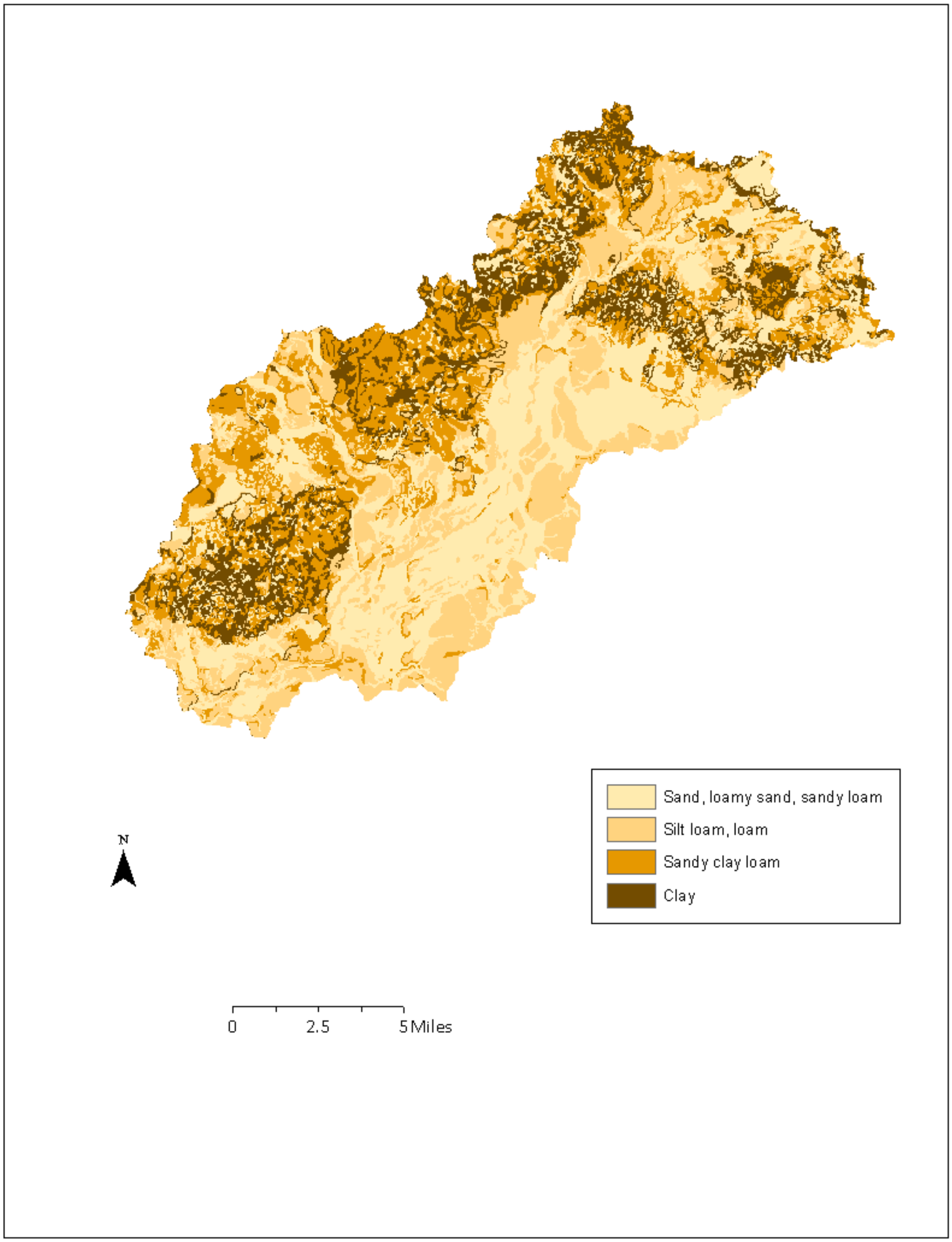

Figure 4. Soils of the Prairie River.

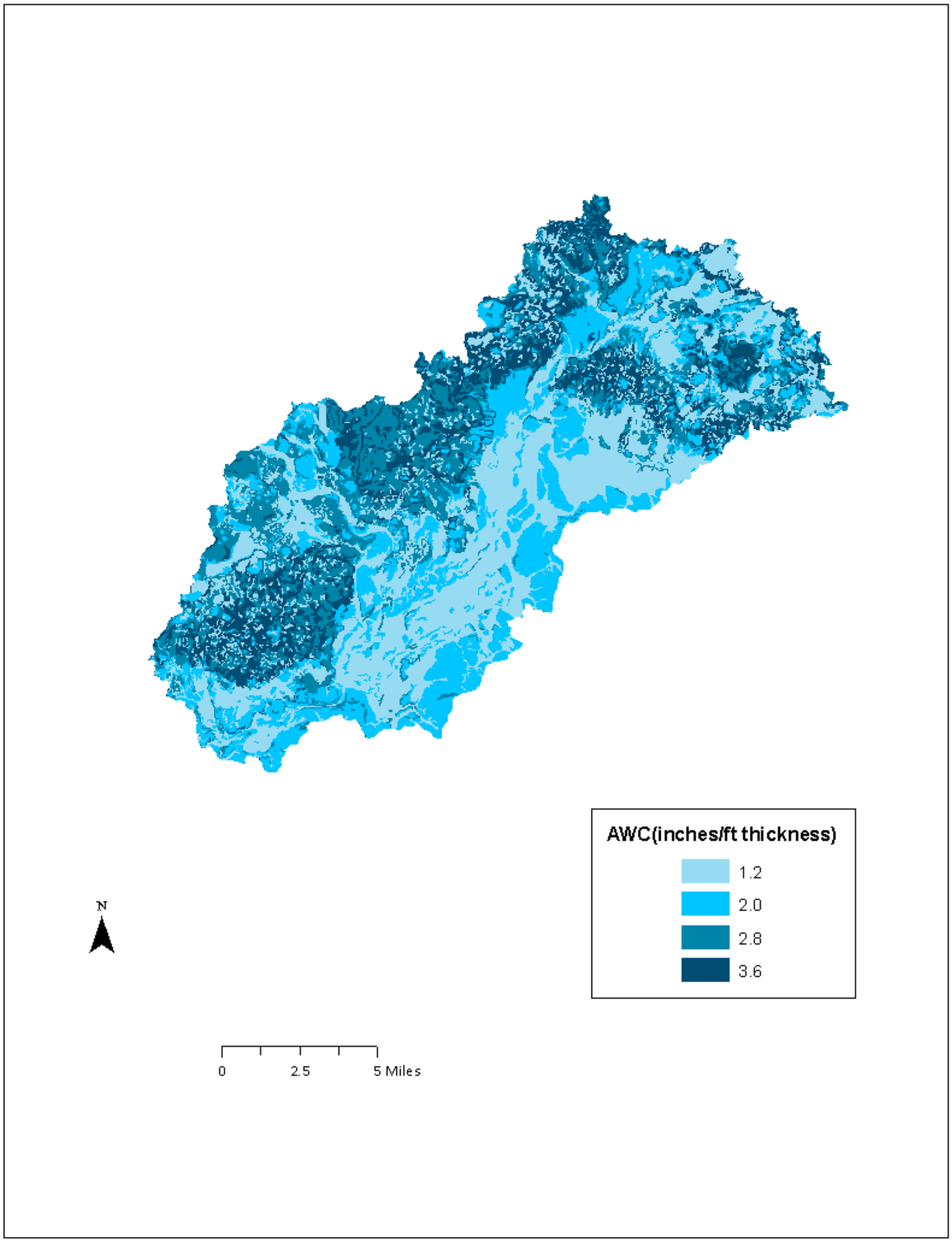

Figure 5. Available water content of the Prairie River.

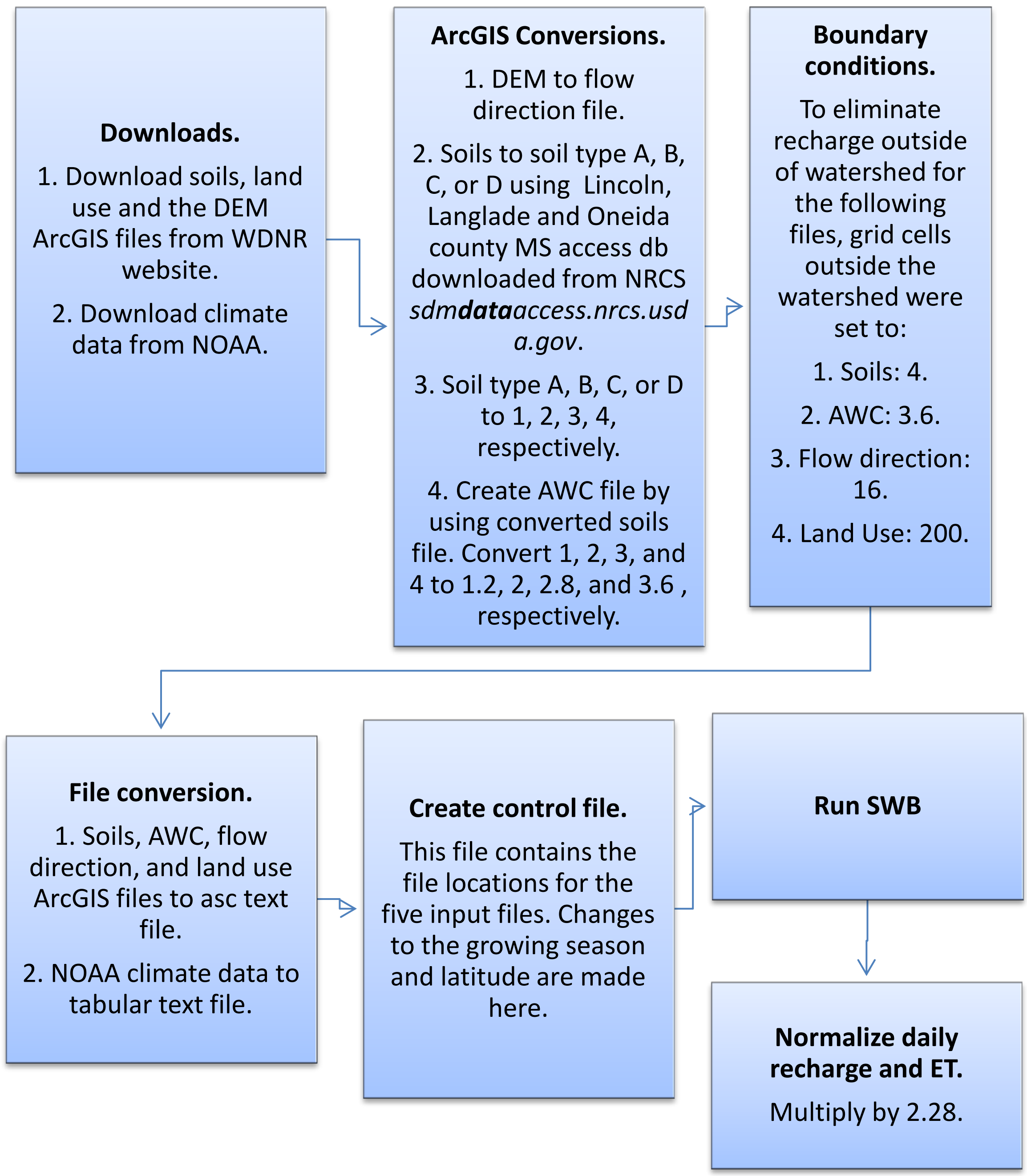

Figure 6. Schematic of the process to run SWB.

The first year of each time series, 1953, the first SDSM simulation, 2046 and 2081 was used to initialize the SWB model. Each run of the model provides an initial snow cover and soil moisture content value that is input into the following year's run of the model. One of the limitations of the SWB model is the use of the grid system. SWB calculates daily recharge and ET using the entire grid. To calculate recharge and ET for the watershed only, the values were normalized. To accomplish this, daily recharge and ET were multiplied by 2.8. This number was calculated by dividing the total number of grid cells by the total number of watershed cells.

Calibration of SWB to PART

Using a watershed in SWB allows for direct calibration to base flow. Stream flow data recorded at the Prairie River gaging station for the time period 1954-2009 were used to extract base flow values using the USGS computer program PART which gives an annual and monthly recharge rate. The monthly base flow was lagged by two months to account for the amount of time recharge from the aquifer becomes stream flow. To calibrate the SWB model to PART, the land use look up table, an SWB standard input table with curve numbers, maximum recharge and interception for all soil types (A-D) was modified by increasing the maximum recharge values by 35% to maximize the R^2 value for the plot of SWB annual recharge and PART annual recharge (Figure 7). The modified land use look up table was used in all subsequent runs of the SWB model. The intercept for the linear regression line was zeroed because when there is zero annual recharge for SWB there is zero annual recharge for PART. The most important factor for the calibration was the slope. When the slope became one, the mean annual recharge for SWB and PART were the same for 1954-2009.

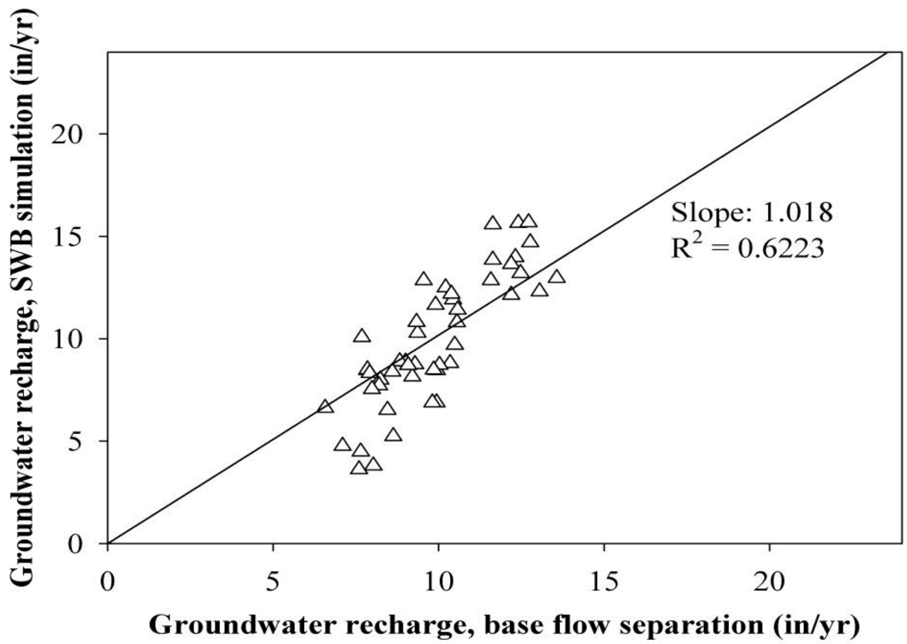

Figure 7. Calibration of SWB to PART.

The SDSM Model

The time series, 1954-2009 with 9 years omitted due to lack of data represents only 47 years of data to analyze similar annual precipitation with variable recharge rates. For further analysis, 1,000 files with similar annual precipitation but variable daily precipitation were generated using SDSM, a statistical downscaling model SDSM 4.2.9 (http://co-public.lboro.ac.uk/cocwd/SDSM/sdsmmain.html) Annual temperature and initial snow cover were kept constant for the 1,000 simulations to eliminate these variables' effects on variable recharge rates. For all simulations, the annual temperature was set to 42°F using the year 1990 temperature data from the Merrill station. It was set to 42°F because it is the mean temperature of the watershed. Initial snow cover was set to 0.9 inches, the mean initial snow cover for the watershed. This is a limitation of the study.

SDSM generates local present day daily maximum and minimum temperatures and precipitation simulations using large scale atmospheric forces called National Center for Environmental Predictions (NCEP) predictor variables and the statistics of the observed weather at the designated location, in this case the Merrill NOAA station. The present day is for the time period, 1961-1990, and the predictor variables are the means for this time period. SDSM also can generate future climate scenarios using GCMs. For the purposes of this study, the present day predictor variables were used to generate precipitation simulations for that time period. From these simulations, the precipitation data for the year 1990 was extracted from the output file and used in SWB. The reason for this is the use of the 1990 temperature data. A schematic of the process is described in Figure 8.

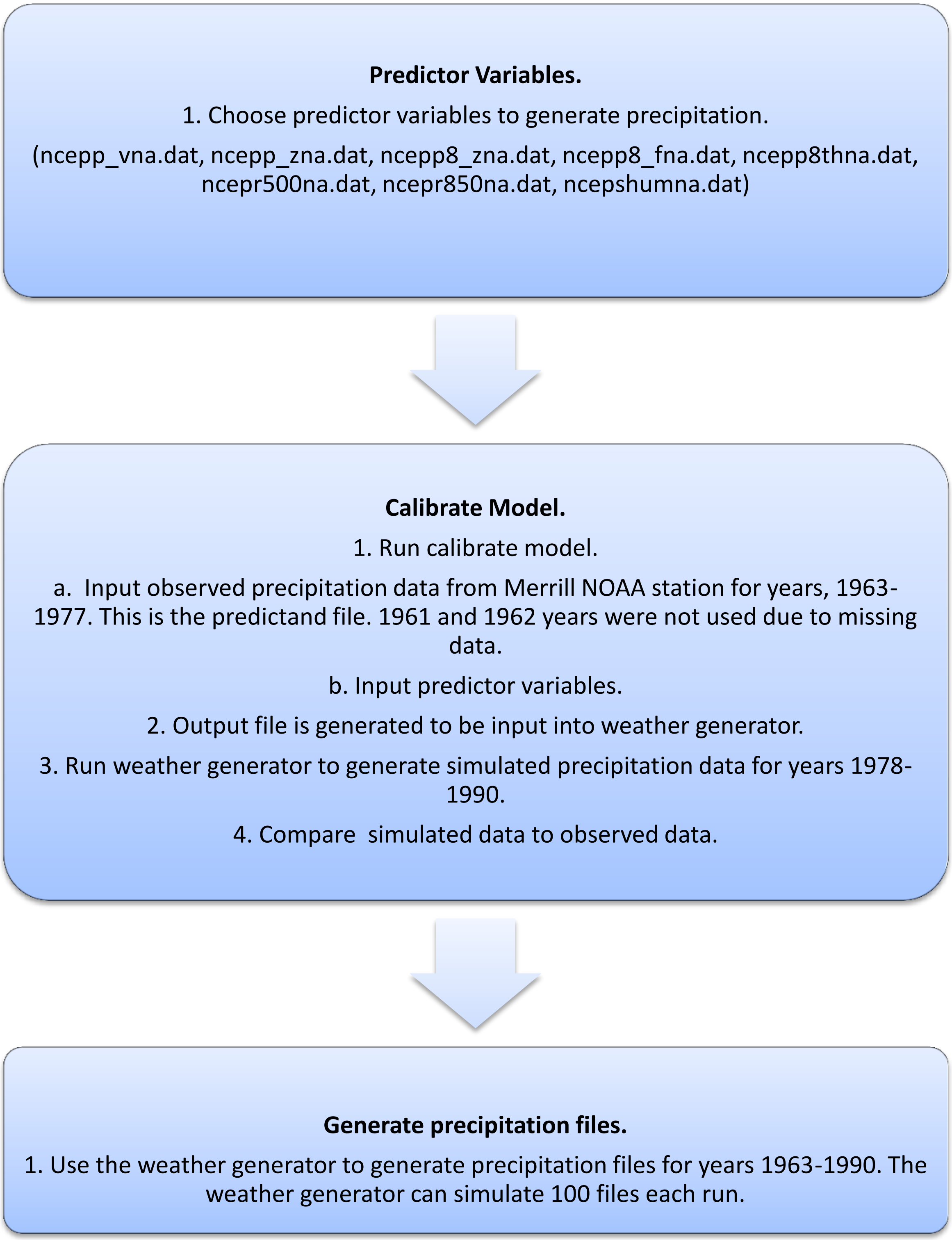

Figure 8. Schematic of the process to run SDSM.

Global Climate Models with three emission scenarios

Downscaled global climate simulations (Table 2) of three greenhouse gas emission scenarios, B1, A1B and A2 (Table 3) were provided by the University of Wisconsin-Madison. The simulations are for the time periods, 2046-2065 and 2081-2100, respectively. The first year of each series, 2046 and 2081 was used to initialize the SWB model. The other input files, land use, flow direction, soils and AWC were kept the same. A limitation of this study is the assumption that land use remains unchanged at the end of the 21st century.

GCM, vintage	Description
cccma-cgcm3.1, 2005	Canadian Centre for Climate Modelling and Analysis
cccma-cgcm3.1.t63,2005	Canadian Centre for Climate Modelling and Analysis
cnrm-cm3, 2004	Météo-France/Centre National de Recherches Météorologiques, France
csiro-mk3.0, 2001	Commonwealth Scientific and Industrial Research Organisation (CSIRO) Atmospheric Research, Australia
csiro-mk3.5, 2006	Commonwealth Scientific and Industrial Research Organisation (CSIRO) Atmospheric Research, Australia
gfdl-cm2.0, 2005	U.S. Department of Commerce/NOAA/Geophysical Fluid Dynamics Laboratory (GFDL), USA
giss-aom, 2004	National Aeronautics and Space Administration (NASA)/Goddard Institute for Space Studies (GISS), USA
giss-model.e.r, 2004	National Aeronautics and Space Administration (NASA)/Goddard Institute for Space Studies (GISS), USA
iap-fgoals1.0.g, 2004	LASG, Institute of Atmospheric Physics, Chinese Academy of Sciences
miroc3.2(hires), 2004	Center for Climate System Research (University of Tokyo), Japan
miub-echo g, 2001	Meteorological Institute University of Bonn, Germany
mpi-echam5, 2005	Max Planck Institute, Germany
mri-cgcm2.3.2a, 2003	Meteorological Research Institute, Japan

Table 2. Description of Global Climate Models**.**

Emission Scenario	Description
B1 (low)	Population peaking middle of the 21st century but global economies more ecologically prudent
A1B (medium)	Fast economic development using multiple energy sources and population peaking in the middle of the 21st century.
A2 (high)	High population growth and regional economic growth and slow technological changes

Table 3. Description of greenhouse gas emission scenarios.

6. RESULTS AND DISCUSSION

SWB results for the time series, 1954-2009

The SWB mean annual recharge rate for the Prairie River is 9.9 inches with a standard deviation of 3.2 inches for the time series, 1954-2009. The mean ET is 17.1 inches with a standard deviation of 1.7 inches. The mean initial snow cover is 1.17 inches with a standard deviation of 0.84 inches. The annual water budget for the Prairie River watershed is:

31.7 inches precipitation = 9.9 inches recharge + 17.1 inches ET + 4.7 inches runoff.

Variable recharge rates with same annual precipitation using the time series, 1954-2009

There is a strong correlation (R^2=0.78) between annual recharge and annual precipitation (Figure 9).

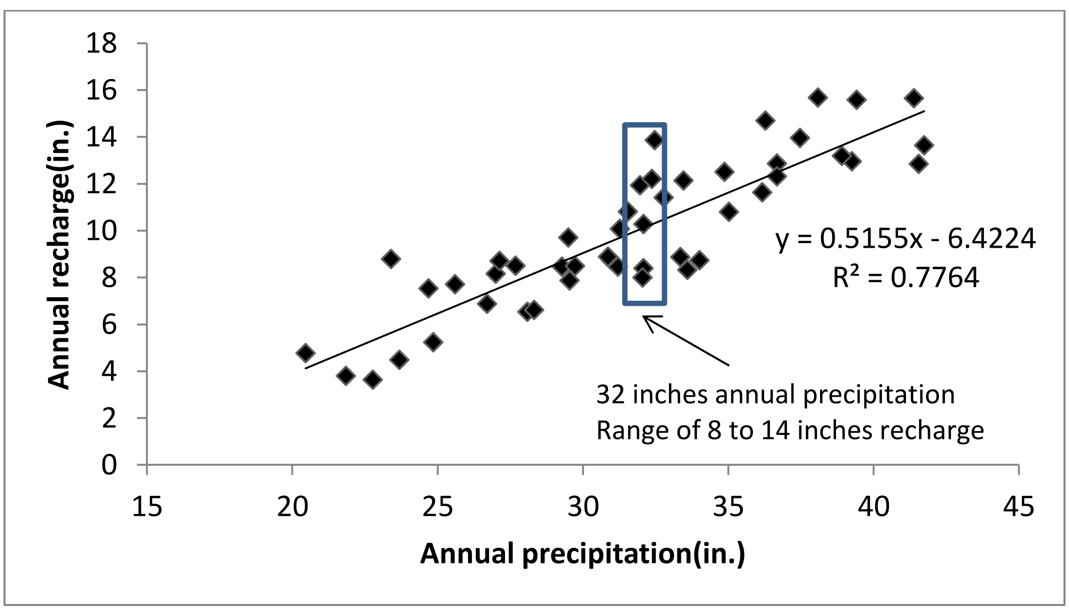

Figure 9. Annual recharge plotted against annual precipitation. 32 inches of annual precipitation generate a range of recharge rates from 8 to 14 inches.

Figure 9 shows the variability in recharge rates with similar annual precipitation. Thirty-two inches of annual precipitation generate a range of annual recharge rates from 8 to 14 inches. For two years that had similar annual precipitation rates but very different recharge rates, two plots were generated that show daily precipitation, minimum and maximum temperatures and recharge rates (Figures 10 and 11). Two plots were generated that show the daily recharge and continuous frozen ground index (CFGI) (Figures 12 and 13).

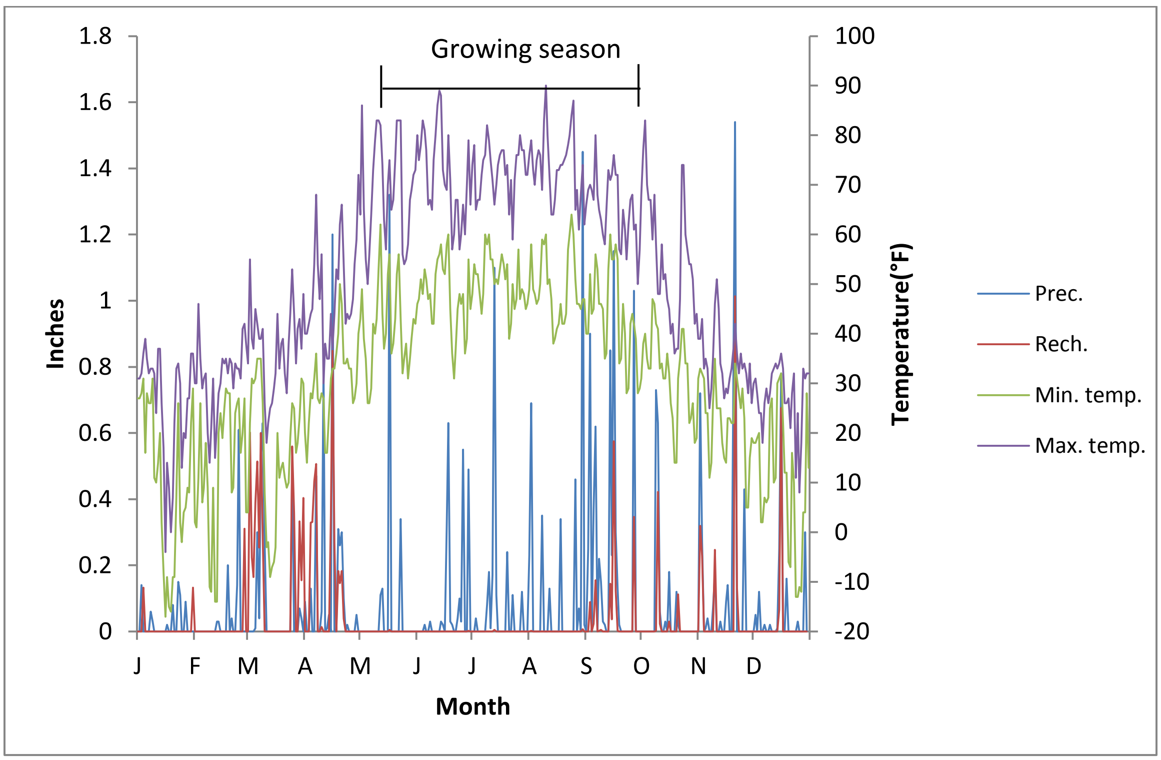

Figure 10. Plot of 32.5 inches of annual precipitation and 13.86 inches of recharge for the year 1992.

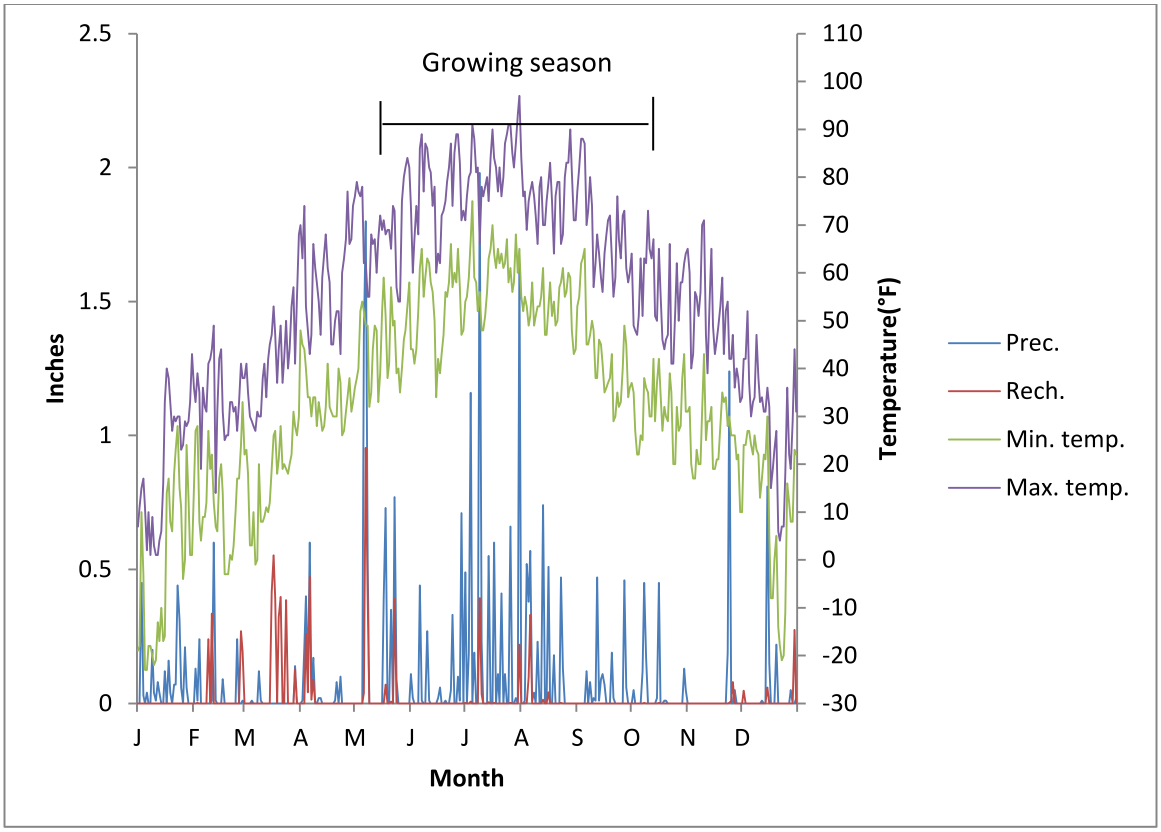

Figure 11. Plot of 32.1 inches of precipitation and 7.99 inches of recharge for the year 1999.

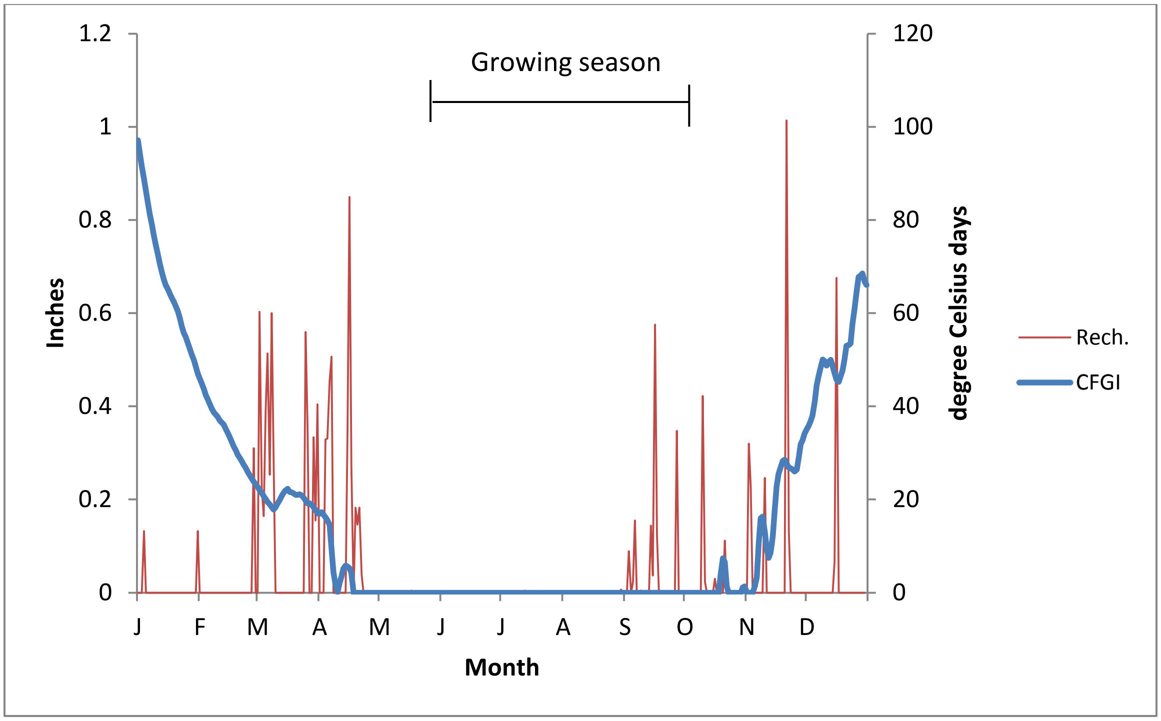

Figure 12. Recharge and CFGI for the year 1992.

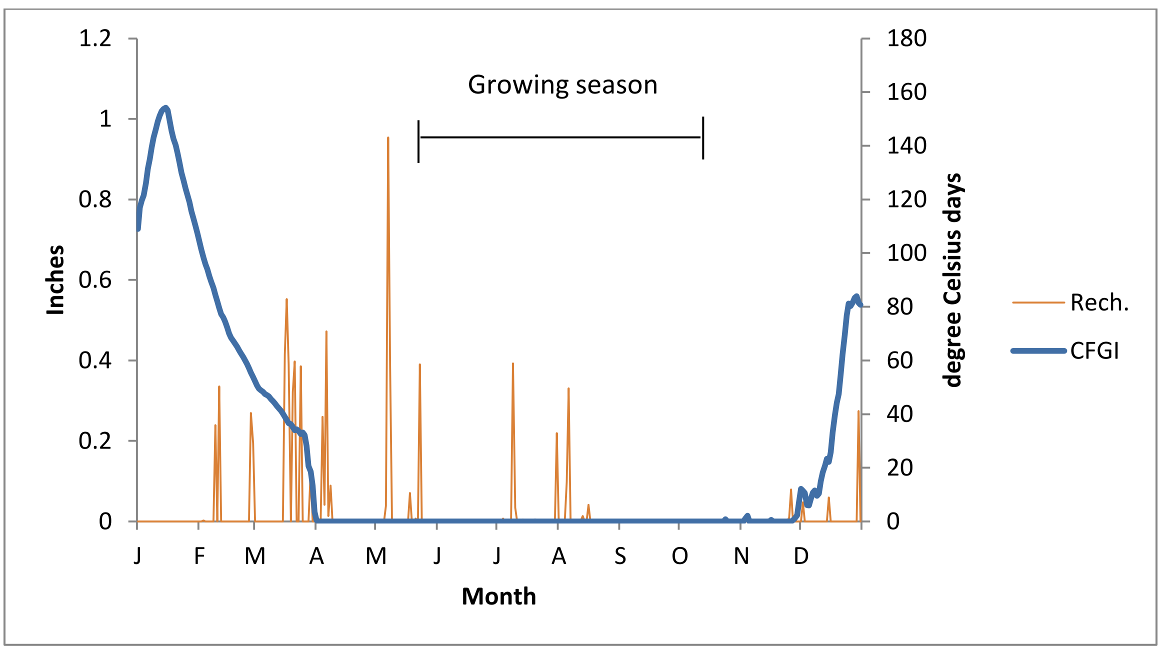

Figure 13. Recharge and CFGI for the year 1999.

The annual recharge rates were 13.9 and 8.0 inches for 1992 and 1999, respectively. Figures 10 and 11 show recharge generated in the spring months and high peaks of precipitation in the summer months generating very little recharge. The initial snow cover was 3.6 and 0.7 inches for 1992 and 1999, respectively. The mean annual temperature was 40.9°F and 43.6°F for 1992 and 1999, respectively. The 1992 and 1999 growing seasons had 16 inches and 22 inches of precipitation, respectively. In 1992 mean annual ET was 14.7 inches with 11.2 inches in the growing season and 3.4 inches in the non-growing season. In 1999 mean annual ET was 19.8 inches with 15.4 inches in the growing season and 4.4 inches in the non-growing season. Figures 12 and 13 show that recharge occurs when the CFGI is below 83 which can occur in the winter months. As a result of more precipitation occurring in the growing season and a higher annual ET of 5 inches, less initial snow cover and higher annual temperature, 1999 had 6 inches less recharge than 1992.

In the Prairie River watershed, there are two recharge seasons: the growing season which starts middle May and ends early October and the non-growing season which starts early October and concludes the middle of May. Evapotranspiration (ET) mainly occurs in the growing season. Table 4 shows the means for precipitation, recharge and ET in the growing and non-growing seasons.

Season	Prec. (in.)	Std. dev.	Rech. (in.)	Std. dev.	ET (in.)	Std. dev.
Growing	19	4.3	2.4	1.7	13.40	0.92
Non-growing	12.6	2.8	7.5	2.4	3.73	0.59

Table 4. Means and standard deviations for precipitation, recharge and ET for the growing and non-growing seasons.

The growing season has 50% more precipitation than the non-growing season but 3 times less recharge. Table 4 shows that ET uses 70% of the growing season precipitation and 30% of the non-growing season precipitation. ET occurs in the non-growing season as the result of conifers. Conifers constitute 15% of the watershed.

If growing season recharge is plotted against growing season precipitation and non-growing season recharge is plotted against non-growing season precipitation, strong correlations are found, R^2=0.84 and R^2=0.74, respectively (Figures 14 and 15).

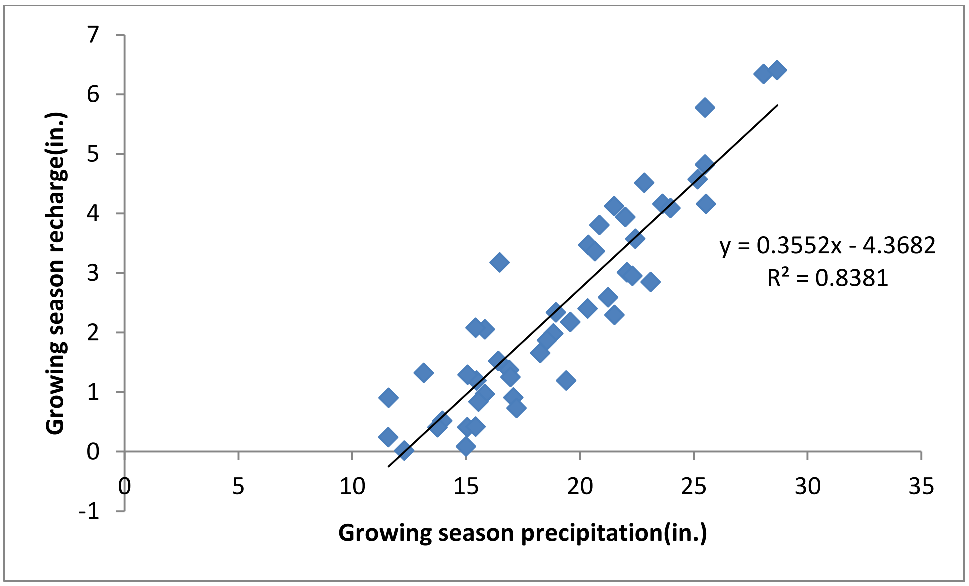

Figure 14. Growing season recharge plotted against growing season precipitation.

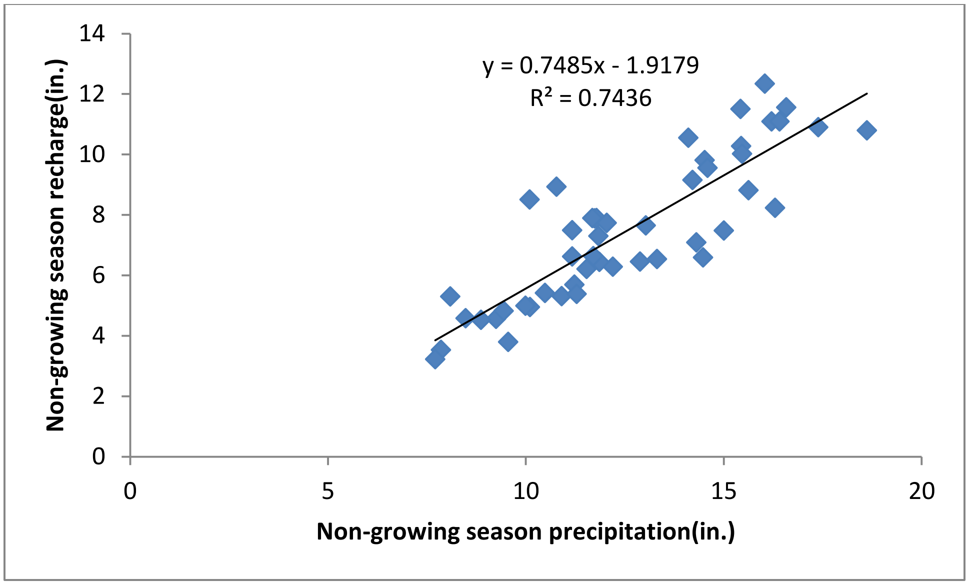

Figure 15. Non-growing season recharge plotted against non-growing season precipitation.

Due to these correlations, this part of the study will focus on these relationships and their effects on similar annual precipitation generating variable recharge rates. From these two plots, the regression line equations are used to calculate the annual recharge rate for the Prairie River.

The equation for annual recharge for the Prairie River is:

$$R = (0.35GP - 4.3682) + (0.75NP - 1.9179) \quad [1]$$

where R is recharge, GP is growing season precipitation, and NP is non-growing season precipitation.

Using this equation, recharge can be calculated for any combination of growing season and non-growing season precipitation (Table 5). The range of inches of precipitation for the growing season and non-growing season for the Prairie River are 12 to 29 inches and 8 to 19 inches, respectively.

Growing season prec. (in.)	Non-growing season prec. (in.)	Growing season rech. (in.)	Non-growing season rech. (in.)	Total rech. (in.)
12	20	0.00	13.08	13.08
13	19	0.18	12.33	12.51
14	18	0.53	11.58	12.11
15	17	0.88	10.83	11.71
16	16	1.23	10.08	11.31
17	15	1.58	9.33	10.91
18	14	1.93	8.58	10.51
19	13	2.28	7.83	10.11
20	12	2.63	7.08	9.71
21	11	2.98	6.33	9.31
22	10	3.33	5.58	8.91
23	9	3.68	4.83	8.51
24	8	4.03	4.08	8.11
25	7	4.38	3.33	7.71
26	6	4.73	2.58	7.31
27	5	5.08	1.83	6.91
28	4	5.43	1.08	6.51
29	3	5.78	0.33	6.11

Table 5. Growing season and non-growing season precipitation and recharge and total recharge for 32 inches of annual precipitation.

Table 5 shows that, for 32 inches of annual precipitation, increasing the non-growing season precipitation generates higher non-growing season recharge rates and higher annual recharge rates. Higher growing season precipitation generates higher growing season recharge rates but lower annual recharge rates. Therefore, variable recharge rates for the same annual precipitation are the result of variable timing of precipitation between the growing and the non-growing season. Table 6 shows the data from 1954-2009 for different years with 32 inches annual precipitation and shows the same pattern as in Table 5.

Growing season prec. (in.)	Non-growing season prec. (in.)	Growing season rech. (in.)	Non growing season rech. (in.)	Ann rech. (in.)
22.07	9.99	3.006175	4.985184	7.991359
17.08	15.01	0.908472	7.480058	8.38853
20.35	11.74	2.399005	7.884077	10.283083
16.96	14.59	1.250861	9.557218	10.808079
15.56	16.41	0.837712	11.088838	11.92655
18.26	14.11	1.65488	10.547863	12.202743
16.43	16.04	1.52249	12.339699	13.862189

Table 6. 32 inches of annual precipitation for time series, 1954-2009.

There exists variability between growing season recharge and growing season precipitation and between non-growing season recharge and non-growing season precipitation. These relationships were analyzed to see if other factors explain the variability. Annual temperature, annual ET and initial snow cover were analyzed producing no significant results. Temperatures in the growing and non-growing season and ET in the growing and non-growing season were not analyzed. To further analyze variable recharge rates with similar annual precipitation simulations were performed using SDSM.

Simulations using SDSM

SDSM was used to generate 1,000 unique simulations of annual precipitation to further analyze why similar annual precipitations generate variable annual recharge rates while keeping temperature and initial snow cover constant. Annual temperature was set to 42°F; initial snow cover was 0.9 inches. Plots were generated of growing season recharge plotted against growing season precipitation and non-growing season recharge plotted against non-growing season precipitation (Figures 16 and 17).

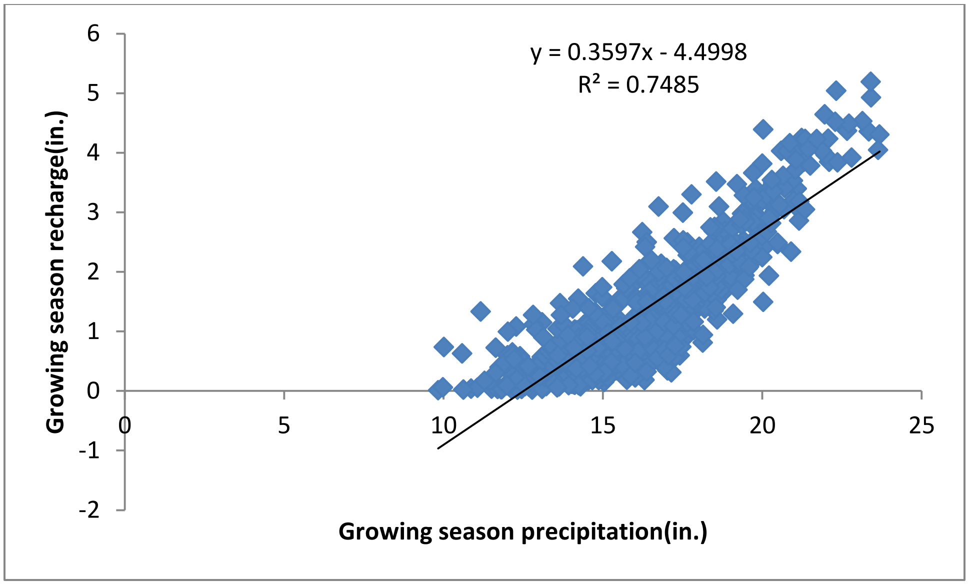

Figure 16. Plot of 1,000 SDSM simulations of annual precipitation with growing season recharge plotted against growing season precipitation with adjusted R^2.

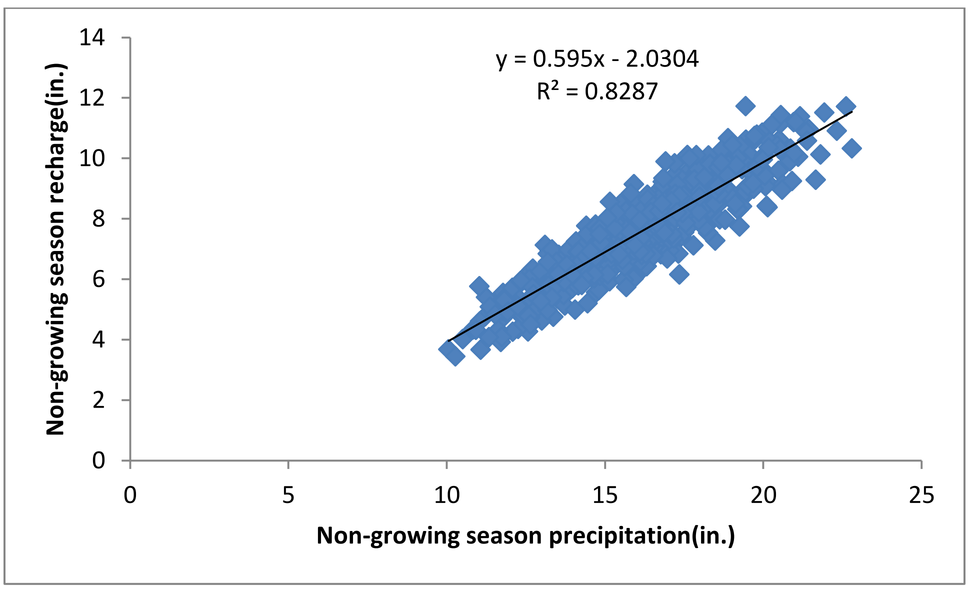

Figure 17. Plot of 1,000 SDSM simulations of annual precipitation with non-growing season recharge plotted against non-growing season precipitation with adjusted R^2.

The correlations, R^2=0.75 and R^2=0.83 are for growing season recharge and growing season precipitation and non-growing season recharge and non-growing season precipitation, respectively. The equation for annual recharge for the Prairie River using the simulations is:

$$R = (0.36GP - 4.5) + (0.60NP - 2.0) \quad [2]$$

where R is recharge, GP is growing season precipitation, and NP is non-growing season precipitation. The linear regression equation for the growing season is very similar to the linear regression equation for the non-simulated data. The slope of the linear regression equation for the non-growing season is 20% lower than the non-simulated data. The reason for this discrepancy could be small effects of temperature and initial snow cover on the non-simulated data.

Student t-tests to compare monthly and annual means of the historical record, 1954-2009 to two time series, 2047-2065 and 2082-2100.

Tables were generated to show the monthly and annual means for the historical record, 1954-2009 and for the SWB projections for the three emission scenarios for the two time series, 2047-2065 and 2082-2100 (Tables 7-14). To analyze the differences of the monthly and annual means between the historical record, 1954-2009 and the SWB projections from 2047-2065 and 2082-2100, student t-tests were used to determine if there will be significant($p<0.05$) annual and monthly changes by the middle and the end of the 21st century in the Prairie River watershed (Tables 30 and 31). These values are useful to analyze overall changes to the watershed in the middle and the 21st century. Stream flow is fed by groundwater. Any changes to groundwater changes stream flow that can affect watersheds downstream. This analysis could be used for a comparison to other watersheds in Wisconsin. The amount of growing and non-growing season precipitation are vital to the amount of recharge occurring in the watershed. For this part of the study, these factors were not analyzed due to the uncertainties of changes in the length of the growing season by the middle and the end of the 21st century. As mentioned in the literature review, an analysis using GCMs of the Trout Lake Basin showed an increase in the length of the growing season by the end of the 21st century.

	Historic 1954-2009 (in.)	Std. dev. (in.)	B1 (2047-2065) (in.)	Std. dev. (in.)	A1B (2047-2065) (in.)	Std.dev. (in.)	A2 (2047-2065) (in.)	Std. dev. (in.)
Jan.	1.01	0.77	1.12	0.15	1.31	0.16	1.23	0.23
Feb.	0.94	0.65	0.99	0.20	1.04	0.22	1.02	0.12
Mar.	1.79	1.06	2.00	0.23	2.06	0.28	2.15	0.29
Apr.	2.74	1.21	2.97	0.33	3.06	0.27	2.92	0.43
May	3.39	1.26	3.80	0.47	3.98	0.33	3.62	0.53
June	3.89	1.91	3.93	0.42	4.01	0.42	3.97	0.43
July	3.70	1.83	3.81	0.47	3.65	0.39	3.74	0.33
Aug.	4.04	2.00	4.16	0.51	4.19	0.44	4.23	0.58
Sept.	3.96	2.07	4.08	0.39	4.25	0.44	4.37	0.55
Oct.	2.77	1.39	2.90	0.32	2.99	0.39	2.83	0.41
Nov.	2.17	1.35	2.06	0.34	2.12	0.20	2.17	0.48
Dec.	1.28	0.70	1.36	0.25	1.50	0.19	1.48	0.26
Ann.	31.67	5.38	33.18	1.83	34.17	1.17	33.72	1.30

Table 7. Table of monthly and annual means for precipitation for the historical record, 1954-2009 and the three emission scenarios for the time series, 2047-2065. Ann., annual.

	Historic 1954-2009 (in.)	Std. dev. (in.)	B1 (2082-2100) (in.)	Std. dev. (in.)	A1B (2082-2100) (in.)	Std.dev. (in.)	A2 (2082-2100) (in.)	Std. dev. (in.)
Jan.	1.01	0.77	1.19	0.25	1.30	0.16	1.29	0.23
Feb.	0.94	0.65	0.94	0.17	1.06	0.12	1.15	0.12
Mar.	1.79	1.06	2.08	0.23	2.17	0.22	2.29	0.29
Apr.	2.74	1.21	2.86	0.31	3.31	0.35	3.33	0.43
May	3.39	1.26	3.85	0.37	4.11	0.36	4.33	0.53
June	3.89	1.91	4.15	0.36	4.15	0.48	4.13	0.43
July	3.70	1.83	3.86	0.43	4.00	0.48	3.89	0.33
Aug.	4.04	2.00	4.22	0.38	4.46	0.58	4.40	0.58
Sept.	3.96	2.07	4.22	0.53	4.47	0.52	4.41	0.55
Oct.	2.77	1.39	3.05	0.40	3.17	0.42	3.04	0.41
Nov.	2.17	1.35	2.16	0.24	2.24	0.24	2.31	0.48
Dec.	1.28	0.70	1.58	0.25	1.51	0.17	1.49	0.26
Ann.	31.67	5.38	34.14	1.01	35.93	1.84	36.06	1.36

Table 8. Table of monthly and annual means for precipitation for the historical record, 1954-2009 and the three emission scenarios for the time series, 2082-2100. Ann., annual.

	Historic 1954-2009 (°F)	Std. dev. (°F)	B1 (2047-2065) (°F)	Std. dev. (°F)	A1B (2047-2065) (°F)	Std.dev. (°F)	A2 (2047-2065) (°F)	Std. dev. (°F)
Jan.	11.66	5.90	17.31	2.07	19.28	1.85	18.46	2.10
Feb.	16.00	5.66	19.89	1.61	22.27	1.64	20.85	2.33
Mar.	27.08	3.83	30.59	1.48	32.28	1.32	31.54	1.97
Apr.	42.26	3.15	45.53	0.86	46.88	0.99	46.27	1.69
May	54.17	3.76	58.26	1.02	59.21	0.98	58.88	1.35
June	63.93	2.90	66.73	0.95	67.93	1.05	67.43	1.49
July	68.05	2.60	71.11	0.59	72.54	1.11	72.20	0.86
Aug.	65.53	2.52	69.05	0.70	70.31	0.91	70.66	1.18
Sept.	56.74	2.81	60.67	0.78	61.85	1.02	61.34	1.21
Oct.	45.19	3.41	49.81	0.74	50.78	1.02	50.25	1.38
Nov.	31.22	3.98	35.22	0.97	36.72	1.07	36.74	1.50
Dec.	17.41	5.47	22.39	1.24	24.38	1.42	24.32	1.17
Ann.	41.72	0.46	45.67	0.58	47.15	0.76	46.70	0.89

Table 9. Table of monthly and annual means for temperature for the historical record, 1954-2009 and the three emission scenarios for the time series, 2047-2065. Ann., annual.

	Historic 1954-2009 (°F)	Std. dev. (°F)	B1 (2082-2100) (°F)	Std. dev. (°F)	A1B (2082-2100) (°F)	Std. dev. (°F)	A2 (2082-2100) (°F)	Std. dev. (°F)
Jan.	11.66	5.90	18.01	1.46	20.45	1.51	20.35	1.89
Feb.	16.00	5.66	20.51	1.17	22.89	1.03	22.62	2.23
Mar.	27.08	3.83	30.71	1.43	32.56	1.00	32.57	1.98
Apr.	42.26	3.15	45.26	1.14	47.03	0.87	47.35	1.95
May	54.17	3.76	57.67	1.00	59.00	0.87	59.63	1.33
June	63.93	2.90	65.60	0.84	67.22	0.66	67.67	1.53
July	68.05	2.60	69.97	0.57	71.66	0.75	72.38	1.28
Aug.	65.53	2.52	67.95	0.85	69.72	0.59	70.86	1.34
Sept.	56.74	2.81	59.89	0.74	61.58	0.84	61.90	1.15
Oct.	45.19	3.41	49.36	0.94	50.93	1.08	51.28	1.24
Nov.	31.22	3.98	35.25	1.16	36.90	1.12	38.06	1.83
Dec.	17.41	5.47	22.78	1.17	25.27	1.07	25.87	1.56
Ann.	41.72	0.46	47.38	0.40	49.71	0.47	51.11	1.12

Table 10**.** Table of monthly and annual means for temperature for the historical record, 1954-2009 and the three emission scenarios for the time series, 2082-2100.

	Historic 1954-2009 (in.)	Std. dev. (in.)	B1 (2047-2065) (in.)	Std. dev. (in.)	A1B (2047-2065) (in.)	Std.dev. (in.)	A2 (2047-2065) (in.)	Std. dev. (in.)
Jan.	0.14	0.23	0.50	0.17	0.72	0.14	0.64	0.17
Feb.	0.72	0.91	0.82	0.21	0.96	0.18	0.89	0.20
Mar.	2.34	1.15	2.21	0.30	2.12	0.24	2.21	0.31
Apr.	2.20	1.33	1.81	0.31	1.73	0.21	1.71	0.35
May	0.70	0.64	0.82	0.22	0.88	0.16	0.78	0.21
June	0.48	0.77	0.38	0.16	0.37	0.13	0.37	0.14
July	0.21	0.50	0.22	0.12	0.17	0.06	0.18	0.09
Aug.	0.30	0.64	0.29	0.10	0.31	0.12	0.31	0.13
Sept.	0.67	0.91	0.58	0.17	0.60	0.20	0.67	0.23
Oct.	0.85	0.73	0.76	0.23	0.78	0.24	0.71	0.25
Nov.	0.86	0.81	0.80	0.20	0.89	0.14	0.95	0.28
Dec.	0.42	0.54	0.60	0.18	0.71	0.09	0.76	0.18
Ann.	9.90	0.76	9.81	0.90	10.23	0.69	10.19	0.77

Table 11. Table of monthly and annual means for recharge for the historical record, 1954-2009 and the three emission scenarios for the time series, 2047-2065. Ann., annual.

	Historic 1954-2009 (in.)	Std. dev. (in.)	B1 (2082-2100) (in.)	Std. dev. (in.)	A1B (2082-2100) (in.)	Std.dev. (in.)	A2 (2082-2100) (in.)	Std. dev. (in.)
Jan.	0.14	0.23	0.69	0.16	0.82	0.13	0.85	0.17
Feb.	0.72	0.91	0.89	0.18	0.95	0.18	0.98	0.23
Mar.	2.34	1.15	2.04	0.25	1.96	0.12	2.02	0.35
Apr.	2.20	1.33	1.58	0.27	1.63	0.25	1.55	0.26
May	0.70	0.64	0.79	0.22	0.86	0.19	0.86	0.22
June	0.48	0.77	0.38	0.14	0.40	0.14	0.38	0.14
July	0.21	0.50	0.21	0.09	0.23	0.10	0.20	0.10
Aug.	0.30	0.64	0.30	0.12	0.36	0.15	0.30	0.13
Sept.	0.67	0.91	0.61	0.23	0.69	0.20	0.64	0.25
Oct.	0.85	0.73	0.76	0.25	0.81	0.26	0.73	0.24
Nov.	0.86	0.81	0.94	0.16	0.95	0.17	0.94	0.30
Dec.	0.42	0.54	0.73	0.17	0.82	0.16	0.79	0.21
Ann.	9.90	0.76	9.91	0.56	10.47	0.92	10.24	0.59

Table 12. Table of monthly and annual means for recharge for the historical record, 1954-2009 and the three emission scenarios for the time series, 2082-2100.

	Historic 1954-2009 (in.)	Std. dev. (in.)	B1 (2047-2065) (in.)	Std. dev. (in.)	A1B (2047-2065) (in.)	Std. dev. (in.)	A2 (2047-2065) (in.)	Std. dev. (in.)
Jan.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Feb.	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Mar.	0.01	0.06	0.07	0.04	0.10	0.05	0.07	0.05
Apr.	0.98	0.35	1.27	0.10	1.41	0.10	1.32	0.19
May	2.73	0.40	3.09	0.10	3.16	0.11	3.07	0.12
June	3.53	0.52	3.65	0.13	3.76	0.17	3.63	0.18
July	3.41	0.64	3.56	0.20	3.56	0.15	3.57	0.15
Aug.	3.00	0.73	3.03	0.17	3.02	0.16	3.03	0.19
Sept.	2.10	0.47	2.23	0.11	2.29	0.14	2.29	0.16
Oct.	1.15	0.32	1.36	0.06	1.39	0.06	1.39	0.10
Nov.	0.23	0.18	0.36	0.05	0.40	0.04	0.39	0.08
Dec.	0.00	0.02	0.02	0.01	0.03	0.01	0.03	0.02
Ann.	17.13	1.67	18.63	0.48	19.12	0.41	18.80	0.62

Table 13. Table of monthly and annual means for ET for the historical record, 1954-2009 and the three emission scenarios for the time series, 2047-2065.

Month	Historic 1954-2009 (in.)	Std. dev. (in.)	B1 (2082-2100) (in.)	Std. dev. (in.)	A1B (2082-2100) (in.)	Std. dev. (in.)	A2 (2082-2100) (in.)	Std. dev. (in.)
Jan.	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00
Feb.	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
Mar.	0.01	0.06	0.11	0.04	0.20	0.04	0.22	0.10
Apr.	0.98	0.35	1.43	0.11	1.62	0.09	1.73	0.20
May	2.73	0.40	3.19	0.12	3.36	0.11	3.50	0.15
June	3.53	0.52	3.73	0.11	3.87	0.15	3.96	0.19
July	3.41	0.64	3.69	0.20	3.72	0.21	3.78	0.24
Aug.	3.00	0.73	3.09	0.18	3.21	0.22	3.17	0.29
Sept.	2.10	0.47	2.31	0.10	2.44	0.14	2.43	0.14
Oct.	1.15	0.32	1.45	0.08	1.54	0.13	1.56	0.12
Nov.	0.23	0.18	0.41	0.07	0.47	0.05	0.55	0.09
Dec.	0.00	0.02	0.03	0.01	0.06	0.02	0.08	0.03
Ann.	17.13	1.67	19.45	0.48	20.50	0.65	21.01	0.82

Table 14. Table of monthly and annual means for ET for the historical record, 1954-2009 and the three emission scenarios for the time series, 2082-2100.

For precipitation, the t-values show no changes are predicted to occur for the time series, 2047-2065 (Table 30). For the time series, 2082-2100 precipitation is predicted to increase in April and May and in March, April and May for the A1B and A2 scenarios, respectively (Table 31). For annual precipitation, the A2 and A1B scenario predict significant increases in 2082-2100 (Table 31).

For recharge for all scenarios and both time series, significant increases are predicted to occur in January with the highest increases and December (Tables 30 and 31). The 2082-2100 time series shows larger increases compared to the time series, 2047-2065 (Tables 30 and 31). Significant decreases in April are predicted to occur for the A2 and B1 scenarios for the time series, 2082-2100 (Table 31). Although these increases are predicted to occur, annual recharge is not predicted to change. The reason for this is the offsetting gains and losses in monthly recharge in spring and fall months which cumulatively become significant. These results suggest a change in the timing of stream flow which is dependent on groundwater. The stream flow will be higher in the early spring months and lower in the summer and winter months affecting water budgets on the watershed and on downstream rivers and lakes.

For temperature for all scenarios and both time series, all months are predicted to significantly increase (Tables 30 and 31). The greatest increases will occur in July, August and September. The time series, 2082-2100 has the greater increases than 2047-2065 due to an increase of temperatures through the 21st century due to the effect of ever increasing greenhouse gas emissions through the century (Tables 30 and 31). The A2 scenario which is the greatest greenhouse gas emission scenario shows the greatest increases while the B1 scenario which is the lowest greenhouse gas emission scenario shows the smallest increases. Overall, the annual temperature is predicted to increase for all scenarios for both time series (Tables 30 and 31).

For ET, the time series 2047-2065 shows the greatest predicted increases in April and December for the A2 scenario and March and April for the A1B scenario and March and May for the B1 scenario (Table 30). The time series 2082-2100 shows the greatest increases in March and December for the A2 and A1B scenarios and March and April for the B1 scenario (Table 31). Plants and trees will require more water due to increased temperatures. Again the A2 scenario predicts the greatest increases while the B1 scenario exhibits the smallest increases. For annual ET, all scenarios for both time series predict significant increases (Tables 30 and 31). Table 14 shows that the highest predicted increase in annual ET is 4 inches at the end of the 21st century for the A2 scenario. Table 8 shows that the highest predicted increase in annual precipitation is approximately 5 inches at the end of the 21st century for the A2 scenario. The predicted monthly increases in precipitation for this scenario will provide for the ET increases (Tables 8 and 14). The mass balance equation for the watershed may not change in the future. This is beneficial to the agriculture of the watershed that constitutes 25% of the land use.

7. CONCLUSIONS

This study shows that the SWB model can be used for a watershed. Previous studies using the SWB model have been used to measure recharge for areas that are rectangular shaped such as counties that fit into the grid system required by SWB. This may indeed be the first time a watershed was used and calibrated to base flow using PART, a base flow separation program. SWB is a robust model that provides a daily recharge and ET rate and also an initial snow cover and soil moisture content. It requires five inputs that are easily acquired online.

In this study it was shown that the main driver of recharge is precipitation, and the timing of precipitation remains the most important factor affecting recharge. In the Prairie River watershed, the majority (75%) of recharge occurs during the non-growing season that spans early October to the middle of May when only 40% of the watershed's annual precipitation occurs. To study the variable recharge rates with similar annual precipitation, focus was placed on the non-growing season because of the higher recharge rate.

There are strong correlations, R^2=.84 and R^2=.74 for growing season recharge and precipitation and non-growing season recharge and precipitation, respectively. The two linear regression equations were used to calculate growing season and non-growing season recharge rates. It was shown that with increasing non-growing season precipitation and decreasing growing season precipitation, annual recharge increased. The SDSM annual precipitation simulations gave similar results although the slope from the non-growing season linear regression equation from the simulations was lower. There still exists variability between growing season recharge and growing season precipitation and non-growing season recharge and non-growing season precipitation. Annual temperature, annual ET and initial snow cover were analyzed, but there were no significant results. Further studies could look at the growing and non-growing season temperatures and the growing and non-growing season ET and their effects on variable recharge rates. A similar analysis could be done using other watersheds to compare the results to the Prairie River watershed.

This study also looked at the effect of climate change on precipitation, recharge, temperature and ET in the Prairie River watershed using GCMs with three emission scenarios. The A2 scenario which is the highest greenhouse gas emission scenario predicts the greatest increases with the B1 scenario which is the lowest emission scenario predicts the lowest increases. The most significant changes predicted are increasing temperatures in all months. Annual ET is predicted to increase for all scenarios. The timing of recharge is predicted to change. Increases are predicted in January and December although annual recharge is not predicted to change due to insignificant but cumulative decreases in recharge in spring and fall months. Because of the predicted changes in the recharge pulses, stream flow will also change with increases in early spring and decreases in summer and winter months. Since the Prairie River watershed is 25% agricultural, increasing temperatures will require higher water demands for the crops that will be met with the increasing predicted precipitation. This analysis could be used on other watersheds in north central Wisconsin to compare results. Further studies could also analyze changes in the growing and non-growing season precipitation, recharge, ET and temperature because the length of the growing season is predicted to increase.

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APPENDIX A

SAMPLE CONTROL FILE TO RUN SWB

Table 15. Sample control file to run the SWB model.

```
#       SWB    Model  annotated     control       file

#

#       This   test   case   covers a      grid   centered      in     central
        Wisconsin     at     the
#       Prairie       River  watershed.     Atmospheric    data   for    this

#       case   is     derived       from   the    climate       station       at
        Merrill.
#

#

#-------------------------------------------------------------------------


#       MODEL  DOMAIN DEFINITION

#

#       Definition    of     the    model  domain.       Units  of     meters are
        assumed.
#       All    subsequent    input  grids  must   match  the    specified     model
        domain exactly.
#

#       Lower  LH     Corner Upper  RH     Corner Grid

#       |_________________________|       |_________________________|       Cell

#       NX     NY     X0     Y0     X1     Y1     Size

GRID    1211   1002   544440.7      527793.5      580770.7      557853.5      30

#******************************************************************


#       LENGTH UNITS

#

#       Must   specify       whether       grid   coordinate    are    given  in
        METERS or     FEET.
#       This   affects       conversion    of     values from   inches to     acre-
ft.
GRID_LENGTH_UNITS     METERS

#******************************************************************


#       OUTPUT CONTROL

#       If     running       SWB    in     batch  "mode,"       it     may    be
        desirable     to     turn   off    "the"""
#       daily  mass   balance       summary       that   is     normally
        printed       to     the    screen.
#       Screen output and    DISLIN mesages       may    be     supressed     by
        uncommenting
```

```
#      the    directives   below.

#      TURN   OFF    SCREEN OUTPUT?

SUPPRESS_SCREEN_OUTPUT

#      TURN   OFF    INTEGRATED   OUTPUT (i.e.  use    external     SWBREAD
       program       after  run    completion)
#SUPPRESS_INTEGRATED_OUTPUT

#      TURN   OFF    SUPPLEMENTAL MASS   BALANCE      /      DAILY  REPORT FILES?

#SUPPRESS_DAILY_FILES

#      TURN   OFF    DISLIN MESSAGES

#SUPPRESS_DISLIN_MESSAGES

#******************************************************************


#      GROWING       SEASON

#

#      Define 1)     beginning     and    2)     ending Julian day    of
       growing       season;
#      and    3)     flag   indicating    whether      or     not    the
       problem       is     in     the
#      Northern      hemisphere    (possible     values:       TRUE   /      FALSE)

#

#      The    growing       season defines       only   the    timespan      within
       which
#      interception  terms  will   be     calculated.

#

GROWING_SEASON      133    268    TRUE

#******************************************************************


#      If     you    have   access to     a      terminal      program       such
       as     "rxvt"""",""" 
#      the    SWB    model  can    provide       screen output with   color  coding
       for    positive
#      and    negative      values.       (possible     values:       TRUE   /
       FALSE)
#

#      rxvt   is     a      package       that   may    be     installed     as
       an     option along  with
#      the    Cygwin Un*x   emulation     package       (www.cygwin.com).

#

ANSI_COLORS   FALSE

#******************************************************************
```

```
#       In      order   to      conserve        disk    "space,"        real    values are
        converted       "to"""
#       integer         "values,"       and     the     resulting       data    stream is
        compressed      "using"""
#       a       simple run-length       encoding        (RLE)   scheme.         A       larger
        value   for     the
#       RLE     multiplier      preserves       more    of      the     real    data    value
        and     lowers the
#       amount of       data    compression     that    takes   place. "However,"       a
        value   "for"""
#       the     RLE_MULTIPLIER          that    is      too     large   may     result in
        an      INTEGER         OVERFLOW
#       "error,"        in      which   the     converted       data    value   exceeds
        the     storage         "capacity"""
#       for     the     integer         data    structure.      In      this    "case,"
        the     "RLE_MULTIPLIER"""
#       must    be      lowered         in      order   that    the     maximum
        integer         value   to      be      stored
#       stays   within the      limitations     of      the     data    type.   For     a
        4-byte "integer,"""
#       the     converted       real    value   must    stay    inside the      range   from

#       "-2,147,483,647"        and     "2,147,483,647.00"      A       real    value   of
        "22,000,"       with    "a"""
#       RLE_MULTIPLIER          value   of      "100,000"       will    result in       an
        INTEGER         "OVERFLOW"""
#       condition;      the     resulting       integer         value   of
        "2,200,000,000"""
#       exceeds         the     maximum         that    can     be      represented     by
        a       4-byte integer.
#

RLE_MULTIPLIER          10000

#*******************************************************************

#       PRECIPITATION

#

#       Choose option for       precipitation input. Options            are:

#       1)      PRECIPITATION SINGLE_STATION

#       2)      PRECIPITATION ARC_GRID          file_prefix

#       3)      PRECIPITATION SURFER file_prefix

#

#       If      precipitation is        input   using   "grids,"        the     model
        assumes         that    "a"""
#       separate        grid    file    exists for      each    day     of      simulation.
        The     naming
#       convention      for     the     precipitation files  is:

#

#       prefix_yyyy_mm_dd.suffix

#
```

```
#       For   "example,"   a     series of    grids  for   the   first  few
        days  of    1990   would "be"""
#       names "precip_1990_01_01.asc""""," "precip_1990_01_02.asc""""," 
        "etc."""

#

PRECIPITATION SINGLE_STATION

#PRECIPITATION      ARC_GRID     precip\precip

#*****************************************************************


#       TEMPERATURE

#

#       Choose option for   temperature  input. Options      are:

#       1)     TEMPERATURE  SINGLE_STATION

#       2)     TEMPERATURE  ARC_GRID     TMAXprefix   TMINprefix

#       3)     TEMPERATURE  SURFER TMAXprefix   TMINprefix

#

#       If     temperature  is    input  using  "grids,"     the   model
        assumes       that  "a"""
#       separate      grid  file  exists for   each   day   of    simulation.
        The    naming
#       convention    for   the   temperature  files  is:

#

#       TMAXprefix_yyyy_mm_dd.suffix      TMINprefix_yyyy_mm_dd.suffix

#

#       For   "example,"   a     series of    grids  for   the   first  few
        days  of    1990   would "be"""
#       names "tmin_1990_01_01.asc""""," "tmin_1990_01_02.asc""""," "etc."""

#

TEMPERATURE  SINGLE_STATION

#TEMPERATURE ARC_GRID     precip\tmax  precip\tmin

#*****************************************************************


#       OUTPUT GRID  FILENAME     SUFFIX

#

#       Set    the    output grid   filename     suffix with  the
        OUTPUT_GRID_SUFFIX
#       option.       This  applies      only   to    annual and   monthly
        output grids.
#       Daily  grids  have  the   filename     pattern      "filename.###,"
        where  "###"""
```

```
#	is	the	Julian day	of	the	simulation
#
OUTPUT_GRID_SUFFIX  asc
#*****************************************************************

#	INITIAL	ABSTRACTION	METHOD
#
#	The	method for	calculating	the	initial	abstraction	within
	the
#	SCS	curve	number runoff procedure	may	be	specified	in
	two	ways:
#
#	1)	TR-55: Ia	is	assumed	equal	to	0.2	*	S
#	2)	Hawkins	(2002):	Ia	is	assumed	equal	to
	0.05	*	S
#
#	If	the	Hawkins	method is	"used,"	curve	numbers
	are	"adjusted"""
#	as	per	Equation	9	of	Hawkins	(2002).	Net
	effect should be	to
#	increase	runoff for	smaller	precip events.	This	method
	has	been
#	suggested	to	be	more	appropriate	to	long-term
	simulation	model	applications.
#
#INITIAL_ABSTRACTION_METHOD	TR55
INITIAL_ABSTRACTION_METHOD HAWKINS
#*****************************************************************

#	INITIAL	CONTINUOUS	FROZEN GROUND INDEX
#
#	assume that	ground is	initially	"frozen,"	"frozen"""""	>=
	"83"""
#
INITIAL_FROZEN_GROUND_INDEX	CONSTANT	100
#*****************************************************************

#	FROZEN GROUND THRESHOLD	CFGI	VALUE
#
#	Use	this	option to	set	a	different	value	defining
	the	boundary
#	between	"unfrozen"""""	and	"frozen"""""	ground.
	Literature	value	is	"83."""
```

```
#      For    "example,"    for    a      CFGI   <      "83,"  the    ground is
       considered    "unfrozen;"""
#      with   a      CFGI   >=     "83,"  the    ground is     considered
       "frozen."""
#

#      When   frozen ground conditions    "exist,"      the    curve  numbers
       are    "uniformly"""
#      assumed       to     reflect       antecedant    runoff condition     III
       (i.e.  increased
#      proportion    of     runoff for    a      given  amount of
       precipitation).
#

#      The    default       "value,"      if     no     other  value  is
       "specified," is     "9999."""
#

#      NOTE!  BY     DEFAULT       the    FROZEN GROUND INDEX  is     OFF    -9999

#

UPPER_LIMIT_CFGI    83

LOWER_LIMIT_CFGI    55

#*********************************************************************


#      NOTE   on     GRID   SPECIFICATION:

#      The    format for    the    following     input  grid   specifications
       is:
#      DIRECTIVE     OPTION FILENAME

#      where  the    "directive"""""     is     a      key    word   that
       identifies    the    intended      use    "for"""
#      the    model  input  "grid,"      "option""""" is     either ARC_GRID
       or     "SURFER,"     "depending"""
#      on     the    format of     the    input  grid   "file,"       and
       "filename"""""      is     the    "local"""
#      directory     name   plus   file   name   of     the    input  grid

#      (e.g.  input\soil_group.asc)

#      The    local  directory     specification may    be     omitted       if
       the    program       executable
#      and    the    input  grid   files  share  the    same   directory     name

#*********************************************************************


#      FLOW   DIRECTION

#

#      The    user   must   use    the    ARCINFO       "flowdirection"""""
       command       to     generate      "this"""
#      grid   from   a      DEM.   The    number within each   cell   indicates
       the    direction     to
#      which  surface       runoff is     routed from   that   cell.
```

```
#	1	in	a	cell	indicates	that	runoff from	this	cell
	will	be	routed to	the
#	cell	to	the	right

#	4	in	a	cell	indicates	that	runoff from	this	cell
	will	be	routed to
#	the	cell	below

#	16	in	a	cell	indicates	that	runoff from	this	cell
	will	be	routed to
#	the	cell	to	the	"left,"	etc	"..."""

#

#	32	64	128

#	16	center 1

#	8	4	2

#

#	A	number other	than	the	eight	listed above	designates	a
	closed depression.
#

FLOW_DIRECTION	ARC_GRID	input\flow_direction_merrill.asc

#*******************************************************************


#	SOIL	GROUP

#

#	SCS	Curve	Number Hydrologic	Soil	Groups:	The	Soil
	Conservation Service	(SCS)
#	has	categorized	every	soil	within the	United States into	one
	of	four
#	hydrologic	soil	groups based	on	its	infiltration	capacity
	(A	-	D)
#	(input to	the	model	as	1	-	4).

#	"A"""""	soils	have	a	high	minimum	infiltration
	capacity	and	subsequently a	"low"""
#	overland	flow	potential	while	"D"""""	soils	have	a
	very	low	"infiltration"""
#	capacity	and	subsequently a	high	overland	flow
	potential.	The	user	must
#	use	the	SCS	soil	surveys	to	look	up	the	soil
	group	for	all	soils	within
#	the	model	"area,"	and	use	ARCINFO	or	ArcView
	to	assign and	generate	"an"""
#	input	grid.	If	the	user	does	not	have	access to	the
	SCS	soil	survey or
#	a	soil	has	not	been	previously	assigned	to	a
	"group,"	infiltration data	"can"""
#	be	used	to	assign the	soil	to	a	hydrologic	soil
	group:
#

#	Soil	Group	A:	>	0.76	cm/h
```

```
#       Soil    Group  B:     0.38    -      0.76   cm/h

#       Soil    Group  C:     0.13    -      0.38   cm/h

#       Soil    Group  D:     <       0.13   cm/h

#

SOIL_GROUP    ARC_GRID      input\soils_Merrill.asc

#*******************************************************************

#       LAND    USE/COVER     CLASSIFICATION

#

#       The     model  uses   land    use    "information,"      together
        "with"""
#       the     soil   available      water  capacity     "information,"      to
        calculate      "surface"""
#       runoff and     assign a       maximum       soil   moisture     holding
        capacity       for    each
#       grid    cell.  THIS   VERSION       OF     THE    MODEL  CAN    HANDLE ANY
        ARBITRARY      LAND   USE
#       CLASSIFICATION        "METHOD,"     AS     LONG   AS     THE    ACCOMPANYING
        LAND    USE    LOOKUP "TABLE"""
#       CONTAINS       CURVE  "NUMBER,"     "INTERCEPTION,"     AND    ROOTING
        DEPTH   DATA   FOR    "EACH"""
#       LAND    USE    TYPE   CONTAINED     IN     THE    GRID.

#

LAND_USE      ARC_GRID      input\land_cover_merrill.asc

#*******************************************************************

#       SPECIFY        OPEN   WATER  LAND   USE

#

#       This    option forces the    cells  of     the    given  land   use    to
        be      treated
#       as      open   water  cells. In     these  "cells,"      recharge      is
        *NOT*   "calculated,"""
#       nor     is     flow   routing       or     soil-moisture accounting
        performed.     Water  is
#       either allowed        to     leave  these  cells  as     actual "ET,"  or
        assumed        to     "leave"""
#       the     grid   flow   out    of     grid   via    surface       water
        features.
#

OPEN_WATER_LAND_USE 200

#*******************************************************************

#

#       Land    Use    LOOKUP table:
```

```
#
#       The first line of this file must begin with:
#       NUM_LANDUSE_TYPES ##
#       where ## is the number of land use types contained
        in the table.
#
#       The remainder of the file is a tab-delimited text
        file having one line
#       for each land use specified within the land use grid.
#       Data items must be specified as follows for each
        line (separated by a tab):
#       Column Number Description
#       ------------- -----------
#       1 Land use code Integer value corresponding to the
        integer values
#       contained in the land use ARC ASCII grid.
#
#       2 Land use description Not used by model; for use
        by user to document
#       the description of the land use corresponding to
#       the integer land use code.
#
#       3 Assumed impervious area Not used by model; for
        use by user to document
#       assumed impervious area associated
#       with the land use code.
#
#       4-7* SCS base curve numbers SCS base curve numbers
        for hydrologic soil
#       groups "A-D," respectively. The curve "numbers"""
#       are those associated with antecedent runoff
#       condition II. A curve number must
#       be specified for each soil type.
#
#       8-11* Maximum infiltration rates Maximum infiltration rates
        (inches/day)
#       for each soil type.
#
#       "12,13" Interception storage values Interception storage
        values for "growing"""
```

```
#      season and    non-growing   season.
#
#      14-17* Depth  of     root   zone   Root   zone   "depth,"      in
       "FEET,"       for    each   soil   group  "A-D."""
#
#      "18,19"       Reference     Not    used   by     model; for    use    by
       users  "in"""
#      documenting   the    sources       of     information
#      placed into   the    table
#
#      *      Column numbering     will   obviously     change if     more   than
       4      soil   types  are    used.
#
LAND_USE_LOOKUP_TABLE
       std_input\LU_lookup_WISCLAND_w_forested_hillslope_125.txt
#*****************************************************************

#      BASE   SOIL   WATER  CAPACITY
#
#      The    model  uses   soil   "information,"      together      with   land
       cover  "information,"""
#      to     calculate     surface       runoff and    assign a      maximum
       soil   moisture      holding
#      capacity      to     each   grid   cell.  Soil   "classifications,"  which
       include       "the"""
#      requisite     available     water  capacity      or     textural
       "information,"       are    "typically"""
#      available     through       the    state  soil   conservation  service.
#
#      Each   soil   type   or     soil   series within the    model  area   must
       be     assigned      a
#      soil   available     water  capacity.     If     available     water
       capacity      data   are    not
#      "available," the     user   can    use    soil   texture       to     assign
       a      value  (see   "table"""
#      below  from   Thornthwaite).       ARCINFO       or     ArcView       is
       used   to
#      code   and    generate      the    ascii  input  file.
#
#      SOIL   TEXTURE       AVAILABLE     WATER  CAPACITY      (in    /      ft)
#      sand   1.2
#      loamy  sand   1.4
#      sandy  loam   1.6
```

```
#	fine	sandy	loam	1.8
#	very	fine	sandy	loam	2
#	loam	2.2
#	silt	loam	2.4
#	silt	2.55
#	sandy	clay	loam	2.7
#	silty	clay	loam	2.85
#	clay	loam	3
#	sandy	clay	3.2
#	silty	clay	3.4
#	clay	3.6
#
WATER_CAPACITY	ARC_GRID	input\soils_awc_Merrill.asc
#*******************************************************************

#	ADJUSTED	WATER	CAPACITY
#
#	The	model	will	calculate	the	total	available	water
	capacity	from
#	the	base	soil	water	capacity	grid	and	the	land	use
	"grid,"	using	"the"""
#	rooting	depth	functions	as	specified	in	the	land
	use	lookup	table.
#
#	"Alternatively,"	the	adjusted	water	capacity	may	be
	calculated	"external"""
#	to	the	model	and	read	in	as	an	ASCII	grid.	If
	this	is	"done,"	"internal"""
#	calculation	of	the	rooting	depth	and	resulting
	adjusted	water	capacity	is
#	disabled	in	the	model.
#
#ADJUSTED_WATER_CAPACITY	ARC_GRID	input\MAX_SM_STORAGE.grd
#*******************************************************************

#	SOIL	MOISTURE	ACCOUNTING	METHOD
#
#	The	model	currently	only	contains	one	soil-moisture
	accounting
```

```
#	calculation	option:		Thornthwaite-Mather "(1948,"	"1957)."""

#

#	The	Thornthwaite-Mather soil	moisture	retention	tables are
	included
#	in	the	standard	table	"soil-moisture-retention-
extended.grd"""""""
#

#	If	the	DRIPPS_COMPATIBLE	option is	"TRUE,"	then	the
	"Thornthwaite-Mather"""
#	tables are	"ignored,"	and	the	polynomials	developed	by
	Wes	"Dripps"""
#	(based on	the	same	tables)	are	used	instead.

#

SM	T-M	std_input\soil-moisture-retention-extended.grd

#*********************************************************************


#	INITIAL	SOIL	MOISTURE

#

#	If	"CONSTANT,"	initial	soil	moisture	is	specified
	as	a	PERCENTAGE	"saturation"""
#	of	the	available	water	capacity.

#

#	If	an	ASCII	GRID	"FILE,"	initial	soil	moisture
	is	specified	in	INCHES of	"water."""
#

#INITIAL_SOIL_MOISTURE	CONSTANT	100

INITIAL_SOIL_MOISTURE	ARC_GRID	output\future\final_pct_sm_1954.asc

#*********************************************************************


#	INITIAL	SNOW	COVER

#

#	Initial	snow	cover	is	specified	as	an	equivalent
	moisture	value.
#	This	may	be	specified	as	a	single constant	value

#	or	as	an	ASCII	grid	file.

#

#INITIAL_SNOW_COVER CONSTANT	0

INITIAL_SNOW_COVER	ARC_GRID	output\future\final_snow_cover_1954.asc

#*********************************************************************
```

```
#	SOLUTION	METHOD

#

#	Two	solution	methods	are	available	for	the
	routing	of	surface	water
#	through	the	model	domain.	The	"ITERATIVE"""""	method
	closely	"resembles"""
#	Wes	Dripps'	original	solution	"method,"	wherein
	water	is	iteratively	"moved"""
#	across	the	entire	grid	until	all	water	has	either	infiltrated
	or
#	left	the	grid	via	surface	flow.

#

#	The	"DOWNHILL"""""	method	was	developed	by	Vic
	"Kelson,"	and	"involves"""
#	a	pre-simulation	step	whereby	the	model	grid	cells
	are	sorted	in	an
#	upstream	to	downstream	fashion.	"Thereafter,"	runoff	is
	calculated	"once"""
#	for	the	entire	model	"domain,"	proceeding	from	the
	upstream	cells	to	"the"""
#	downstream	cells.	The	DOWNHILL	option	is	preferred.

#

#RUNOFF	C-N	ITERATIVE

RUNOFF	C-N	DOWNHILL

#RUNOFF	C-N	NO_ROUTING

#*****************************************************************************


#	ITERATIVE	METHOD	TOLERANCE

#

#	The	iterative	method	sometimes	fails	to	converge	for
	exceedingly
#	small	solution	tolerances	(i.e.	<	1.00E-06	change	in
	calculated
#	runoff	in	a	cell	from	one	iteration	to	the	next).
	This	option	is
#	offered	as	a	way	to	force	convergence.	The
	default	value	is	1E-12.
#

#ITERATIVE_METHOD_TOLERANCE	1.00E-04

#*****************************************************************************


#	EVAPOTRANSPIRATION	METHOD

#

#	The	model	implements	several	different	methods	for
	estimating	"ET,"""
```

```
#	including:
#	1)	Thornthwaite-Mather (program	option:	"T-M"""""
	latitude	")"""
#	2)	Jensen-Haise (program	option:	"J-H"""""	latitude
	albedo a_s	b_s	")"""
#	3)	Blaney-Criddle	(program	option:	"B-C"""""
	latitude	")"""
#	4)	Turc	(program	option:	"TURC"""""	latitude	albedo
	a_s	b_s	")"""
#	5)	Hargreaves	(program	option:	"HARGREAVES"""""
	southerly	lat	northerly	"lat)"""

#ET	HARGREAVES	42.89	43.24

#ET	TURC	43	0.23	0.25	0.75

#ET	J-H	45	0.23	0.25	0.5

ET	T-M	45

#**********************************************************************


#	PLOTTING	CUSTOMIZATION

#

#	This	version	of	the	SWB	model	allows very	limited
	assignment	of
#	DISLIN plotting	parameters	for	the	generation	of
	images.
#	See	http://www.mps.mpg.de/dislin/	for	more	information	about
	this
#	package.

#

#	If	no	customizations	are	"specified,"	default	values
	will	be	"used."""
#

DISLIN_PARAMETERS	RECHARGE

SET_Z_AXIS_RANGE	DAILY	0	1.5	0.1

SET_Z_AXIS_RANGE	MONTHLY	0	7	1

SET_Z_AXIS_RANGE	ANNUAL 0	20	2

Z_AXIS_TITLE "RECHARGE,"	IN	INCHES

#

DISLIN_PARAMETERS	ACT_ET

SET_Z_AXIS_RANGE	DAILY	0	0.8	0.05

SET_Z_AXIS_RANGE	MONTHLY	0	10	0.5

SET_Z_AXIS_RANGE	ANNUAL 0	40	5
```

```
#SET_DEVICE   PDF

#SET_FONT     Helvetica-Bold

#

DISLIN_PARAMETERS   POT_ET

SET_Z_AXIS_RANGE    DAILY  0     0.8    0.05

SET_Z_AXIS_RANGE    MONTHLY      0      10     0.5

SET_Z_AXIS_RANGE    ANNUAL 0     45     5

#SET_DEVICE   WMF

#SET_FONT     Courier       New    Italic

#DISLIN_PARAMETERS  RUNOFF_OUTSIDE

#SET_Z_AXIS_RANGE   DAILY  0     5      0.5

#SET_Z_AXIS_RANGE   MONTHLY      0      12     0.5

#SET_Z_AXIS_RANGE   ANNUAL 0     25     5

#DISLIN_PARAMETERS  SNOWCOVER

#SET_Z_AXIS_RANGE   DAILY  0     12     0.5

DISLIN_PARAMETERS   SM_APWL

SET_Z_AXIS_RANGE    DAILY  -20   0      2

SET_COLOR_TABLE     RRAIN

#********************************************************************

#      OUTPUT OPTIONS

#      The    SWB    code   can    generate     image  and    ARCGIS/Surfer output
       at     the
#      "daily,"      "monthly,"    or     annual timescale.    This   section
       allows the    user   "to"""
#      specify       exactly       what   output should be     generated     for
       each   of     24
#      internal      variables     at     each   of     the    three  timescales.

#      Format for    specifying    output options       is:

#      OUTPUT_OPTIONS      variable_name daily_option  monthly_option
       "annual_option"""","""

#      where  the    possible      values for    each   option are:

#      "NONE,"       GRAPH  (or    "PLOT),"      "GRID,"       or     "BOTH"""

OUTPUT_OPTIONS      RECHARGE      NONE   NONE   BOTH

OUTPUT_OPTIONS      SM_APWL       NONE   NONE   NONE
```

```
OUTPUT_OPTIONS      SNOWCOVER     NONE    NONE    NONE
OUTPUT_OPTIONS      INTERCEPTION NONE     NONE    PLOT
OUTPUT_OPTIONS      RUNOFF_OUTSIDE        NONE    NONE    PLOT
OUTPUT_OPTIONS      ACT_ET NONE   NONE    NONE
OUTPUT_OPTIONS      POT_ET NONE   NONE    PLOT
#*****************************************************************

#       OUTPUT GRID   FILE   FORMAT
#
#       Next   line   specifies    output grid   format:      ARC_GRID     or
        SURFER
#
OUTPUT_FORMAT ARC_GRID
#*****************************************************************

#       BEGIN  SOLUTION
#
#       The    time   series file   contains     daily  values with   the
        following     space  or
#       tab-delimited fields:
#
#       1)     Month
#       2)     Day
#       3)     Year
#       4)     Mean   Air    Temperature   (F)
#       5)     Precipitation (in)
#       6)     Mean   Relative     Humidity     (%)
#       7)     Maximum      Air    Temperature  TMAX   (F)
#       8)     Minimum      Air    Temperature  (F)
#       9)     Mean   Wind   Velocity     (m/sec)
#       10)Minimum    Relative     Humidity     (%)
#       11)    Percent      of     Possible     Sunshine     (%)
#
#       Any    fields without      data   should be    filled in     with   a
        "-99999""""""""
```

```
SOLVE  climate\Merrill_climate_1952_2009\Merrill_1955.txt
#
EOJ
#
```

APPENDIX B

CALIBRATION OF SWB TO PART

Table 16. Monthly PART base flow data.

Year	Month										
	1	2	3	4	5	6	7	8	9	10	11	12
1953	0.51	0.45	1.36	2.45	1.06	0.75	0.72	0.7	0.45	0.5	0.51	0.55
1954	0.44	0.45	0.58	1.53	1.5	0.86	0.7	0.53	0.68	0.8	0.67	0.53
1955	0.47	0.44	0.73	2.29	0.73	0.87	0.48	0.63	0.51	0.69	0.72	0.52
1956	0.44	0.39	0.42	1.59	0.87	0.61	0.79	0.6	0.42	0.45	0.61	0.5
1957	0.42	0.37	0.78	1.18	0.84	0.6	0.47	0.4	0.62	0.5	0.79	0.6
1958	0.44	0.38	0.65	1.55	0.77	0.63	1	0.42	0.6	0.8	0.74	0.5
1959	0.42	0.37	0.45	1.3	1.06	0.46	0.57	1.15	2.01	2.3	1.16	0.75
1960	0.96	0.61	0.53	2.07	3.28	1.19	0.85	0.95	0.98	0.84	1.14	0.82
1961	0.53	0.49	1.05	2.08	1.8	0.76	0.64	0.6	0.69	0.98	1.18	0.78
1962	0.56	0.46	0.7	2.3	1.42	0.84	0.55	0.81	1.09	0.88	0.73	0.66
1963	0.51	0.46	0.65	1.06	1.24	0.56	0.45	0.51	0.65	0.58	0.55	0.49
1964	0.43	0.42	0.53	1.35	1.54	0.5	0.51	0.48	0.95	0.73	0.87	0.5
1965	0.46	0.41	0.52	3.33	2.05	0.92	0.53	0.49	0.74	0.97	0.88	0.85
1966	0.63	0.5	1.47	1.79	1.12	0.75	0.49	0.55	0.46	0.57	0.53	0.5
1967	0.51	0.47	0.62	2.89	1.02	0.93	0.67	0.58	0.54	0.79	0.7	0.53
1968	0.5	0.44	0.8	1.67	1.55	2.02	1.43	0.81	1.21	1.01	0.83	0.75
1969	0.81	0.75	0.81	2.55	1.32	0.93	0.81	0.57	0.51	0.74	0.65	0.51
1970	0.52	0.44	0.52	1.25	1.43	0.73	0.46	0.43	0.59	0.74	1.17	0.9
1971	0.62	0.52	0.67	2.51	1.02	0.78	0.54	0.54	0.58	0.88	0.76	0.68
1972	0.53	0.46	0.65	3.12	1.29	0.48	0.5	0.95	0.83	1.43	1.26	0.77
1973	0.92	0.62	2.11	1.98	2.26	1.02	0.61	0.63	0.82	0.73	0.74	0.65
1974	0.54	0.45	0.72	1.41	0.92	0.83	0.5	0.59	0.62	0.63	0.84	0.52
1975	0.55	0.5	0.63	2.3	1.36	0.84	0.52	0.5	0.77	0.61	0.87	0.77
1976	0.65	0.62	1.33	3.47	1.17	0.58	0.47	0.49	0.46	0.51	0.47	0.5
1977	0.49	0.41	0.67	1.49	0.61	0.51	0.49	0.47	0.92	0.95	1.02	0.57
1978	0.5	0.4	0.55	1.48	0.98	0.81	1.24	0.85	1.01	0.89	0.64	0.56
1979	0.55	0.47	1.17	2.94	1.76	1.1	0.76	0.67	0.56	0.84	1.05	0.74
1980	0.61	0.52	0.65	1.79	0.84	0.74	0.61	0.72	1.32	0.91	0.8	0.5
1981	0.42	0.61	0.93	1.83	1.29	0.99	0.72	0.63	0.53	0.83	0.62	0.54
1982	0.49	0.41	0.55	2.49	1.41	0.58	0.65	0.51	0.97	1.3	1.38	1
1983	0.81	0.67	1.53	1.54	1.52	1.02	0.65	0.58	0.71	1.13	1.09	0.94
1984	0.67	0.81	0.73	1.68	1.44	0.8	0.63	0.56	0.63	0.9	1.06	0.79
1985	0.64	0.53	1.03	2.22	1.26	0.72	0.54	0.69	1.09	2.15	1.43	0.89
1986	0.85	0.7	1.1	2.15	0.83	0.71	1.07	0.79	1.21	2.13	0.95	0.85
1987	0.67	0.59	0.88	1.08	0.71	0.62	0.61	0.51	0.46	0.65	0.85	0.71
1988	0.51	0.44	0.76	1.49	0.71	0.4	0.46	0.44	0.53	0.56	0.98	0.62
1989	0.5	0.39	0.64	1.66	0.88	0.7	0.4	0.41	0.37	0.42	0.47	0.39
1990	0.4	0.36	0.68	0.56	1.12	0.82	0.6	0.81	1.21	1.12	0.84	0.75

1991	0.56	0.48	1.01	2.22	1.38	1.11	0.76	0.65	0.6	0.73	1.22	1.11
1992	0.8	0.6	1.29	2.62	1.06	0.6	0.64	0.54	0.84	0.93	1.01	1
1993	0.62	0.49	0.7	2.14	1.83	1.78	0.91	0.73	1	0.95	0.83	0.7
1994	0.64	0.56	0.79	1.43	1.11	0.66	0.66	0.56	1.02	1.09	0.81	0.71
1995	0.54	0.47	0.97	0.99	1.21	0.62	0.52	1.16	0.8	1.31	1.01	0.69
1996	0.67	0.6	0.73	3.37	1.67	0.99	0.74	0.69	0.61	0.79	0.9	0.72
1997	0.66	0.61	0.68	2.08	1.15	0.76	0.85	0.75	0.78	1.03	0.72	0.57
1998	0.46	0.66	1.01	1.36	0.67	0.71	0.49	0.45	0.46	0.58	0.66	0.51
1999	0.46	0.49	0.66	0.95	1.04	0.68	0.92	0.82	0.52	0.61	0.58	0.49
2000	0.46	0.51	1.02	0.8	0.64	0.83	0.74	0.56	0.74	0.59	0.64	0.53
2001	0.45	0.38	0.52	2.39	1.02	0.8	0.51	0.47	0.57	0.62	0.68	0.82
2002	0.48	0.45	0.61	2.71	2.01	0.86	0.57	0.71	0.73	1.37	0.8	0.54
2003	0.38	0.35	0.83	1.52	1.6	0.89	0.56	0.54	0.52	0.62	0.66	0.52
2004	0.41	0.41	0.93	2.32	1.19	1.19	0.61	0.54	0.52	0.65	0.87	0.65
2005	0.58	0.52	0.65	2.05	0.85	0.65	0.46	0.45	0.42	0.59	0.59	0.6
2006	0.49	0.4	0.71	1.57	1	0.5	0.4	0.46	0.44	0.58	0.52	0.55
2007	0.56	0.39	0.8	1.03	0.64	0.5	0.43	0.38	0.38	0.68	0.44	0.44
2008	0.46	0.39	0.44	2.41	1.15	0.77	0.44	0.38	0.36	0.43	0.43	0.4
2009	0.42	0.36	0.66	0.99	0.92	0.56	0.36	0.39	0.34	0.53	0.52	0.38

Table 17. Annual PART recharge and Annual SWB recharge increasing infiltration by 35%.

Years	2 month lag	Increase infil. by 35%
	PART	SWB
1953	9.94	6.887
1954	9.29	8.751
1955	9	8.877
1956	7.65	4.49
1957	7.6	3.626
1958	8.45	6.53
1961	11.58	12.858
1964	8.83	8.9
1965	12.41	15.654
1966	9.21	8.156
1967	10.21	12.506
1970	9.36	10.285
1971	9.95	8.465
1974	8.63	5.241
1975	10.44	11.923
1976	10.35	8.806
1977	8.6	8.401

1978	10.03	8.726
1979	12.72	15.687
1980	9.91	11.657
1981	9.81	6.885
1982	12.32	13.977
1983	12.19	12.145
1984	10.39	12.199
1985	13.57	12.97
1986	13.05	12.313
1987	8.03	3.813
1988	7.84	8.457
1989	7.1	4.766
1990	9.55	12.858
1991	12.19	13.651
1992	11.64	13.851
1993	12.77	14.704
1994	9.85	8.494
1995	10.55	10.806
1996	12.48	13.201
1997	10.49	9.71
1998	7.85	8.503
1999	8.24	7.996
2000	7.92	8.328
2001	9.33	10.812
2002	11.64	15.59
2003	9.08	8.717
2004	10.57	11.417
2005	8.2	7.717
2006	7.68	10.077
2007	6.57	6.624
2008	7.99	7.541

APPENDIX C

SWB OUTPUT FOR TIME SERIES, 1954-2009

Table 18. SWB annual output for time series 1954-2009.

Year	Ann prec. (in.)	Ann rech. (in.)	Ann temp (°F)	Initial snow cover (in.)	Total ET(in.)	Non-growing prec. (in.)	Non growing rech.(in.)	Growing season prec.(in.)	Growing season rech.(in.)
1954	30.97	8.74	42.90	0.79	17.17	10.11	4.94	20.86	3.80
1955	33.35	8.87	42.73	0.68	19.78	10.91	5.30	22.44	3.57
1956	23.69	4.49	42.22	1.25	16.61	7.86	3.52	15.83	0.97
1957	22.77	3.63	42.42	1.42	16.01	7.71	3.22	15.06	0.41
1958	28.09	6.54	42.31	0.96	18.82	9.25	4.55	18.84	1.98
1961	36.68	12.86	42.22	0.10	18.61	15.44	10.27	21.24	2.59
1964	30.87	8.89	43.71	0.69	16.87	10.49	5.42	20.38	3.47
1965	41.39	15.66	41.91	1.29	19.33	16.21	11.08	25.18	4.57
1966	27.00	8.16	42.08	1.25	15.97	13.03	7.64	13.97	0.52
1967	34.88	12.51	41.49	1.18	17.75	14.21	9.15	20.67	3.36
1970	32.09	10.28	42.62	1.90	17.70	11.74	7.88	20.35	2.40
1971	31.21	8.45	41.97	1.35	16.90	14.31	7.08	16.90	1.37
1974	24.86	5.24	41.32	0.94	15.63	9.44	4.82	15.42	0.42
1975	31.97	11.93	42.02	1.85	16.32	16.41	11.09	15.56	0.84
1976	23.40	8.79	38.62	0.35	12.99	11.79	7.89	11.61	0.90
1977	32.09	8.39	41.05	0.51	16.62	15.01	7.48	17.08	0.91
1978	34.02	8.73	39.09	1.19	19.35	8.48	4.57	25.54	4.16
1979	38.09	15.68	38.78	2.63	17.36	16.58	11.55	21.51	4.12
1980	36.17	11.64	40.32	0.14	18.28	8.09	5.30	28.08	6.34
1981	26.70	6.88	41.58	0.47	15.86	11.23	5.69	15.47	1.19
1982	37.47	13.96	39.55	1.08	17.40	15.47	10.02	22.00	3.94
1983	33.47	12.14	42.22	1.75	16.13	14.52	9.81	18.95	2.34
1984	32.37	12.20	41.64	2.13	16.99	14.11	10.55	18.26	1.65
1985	39.26	12.97	39.77	0.39	18.36	15.63	8.81	23.63	4.16
1986	36.68	12.31	41.53	2.76	19.07	11.17	7.49	25.51	4.82
1987	21.85	3.81	44.61	0.46	14.84	9.56	3.79	12.29	0.01
1988	29.28	8.46	41.40	0.98	16.63	12.05	7.73	17.23	0.73
1989	20.46	4.76	39.19	1.32	14.30	8.87	4.52	11.59	0.24
1990	41.56	12.85	42.67	1.00	19.87	12.89	6.45	28.67	6.40
1991	41.74	13.64	41.82	1.18	19.96	18.62	10.79	23.12	2.85
1992	32.47	13.86	40.86	3.57	14.69	16.04	12.34	16.43	1.52
1993	36.28	14.70	39.98	2.00	17.17	10.78	8.92	25.50	5.77
1994	29.73	8.49	41.47	0.27	17.39	11.17	6.62	18.56	1.87
1995	35.03	10.79	41.20	0.19	17.01	12.20	6.28	22.83	4.51
1996	38.92	13.20	38.81	2.43	18.99	17.39	10.90	21.53	2.30
1997	29.50	9.70	40.97	3.52	17.93	10.10	8.50	19.40	1.19

1998	27.69	8.50	46.06	0.05	16.01	11.86	6.44	15.83	2.05
1999	32.06	7.99	43.60	0.70	19.78	9.99	4.99	22.07	3.01
2000	33.60	8.32	42.18	0.71	19.54	11.29	5.38	22.31	2.95
2001	31.55	10.81	43.63	1.91	17.46	14.59	9.56	16.96	1.25
2002	39.42	15.59	43.10	0.47	18.72	15.43	11.50	23.99	4.09
2003	27.14	8.71	41.62	0.11	14.42	11.71	6.63	15.43	2.08
2004	32.78	11.41	41.13	0.45	15.29	16.30	8.23	16.48	3.18
2005	25.60	7.71	43.22	1.48	15.75	11.84	7.30	13.76	0.41
2006	31.27	10.07	44.27	0.60	16.98	11.68	7.89	19.59	2.18
2007	28.32	6.62	43.78	0.70	17.21	13.32	6.53	15.00	0.09
2008	24.69	7.53	40.40	1.65	14.58	11.54	6.21	13.15	1.32
2009	29.55	7.87	40.71	1.64	15.99	14.48	6.59	15.07	1.29

APPENDIX D

SWB OUTPUTFOR SDSM SIMULATION DATA AND SIM FILE TO RUN SDSM WEATHER GENERATOR

Table 19. SWB output for SDSM Simulations of 28 inches of annual precipitation.

Simulated Run	Ann. prec.(in.)	Ann. rech.(in.)	Non-growing prec.(in.)	Non-growing rech.(in.)	Growing prec.(in.)	Growing rech.(in.)
1	28.46	7.98	18.63	7.98	9.83	0.01
2	28.22	8.28	17.35	8.24	10.87	0.04
3	28.42	7.20	16.61	7.17	11.81	0.03
4	28.26	6.97	14.32	6.78	13.94	0.19
5	28.12	5.61	13.49	5.35	14.63	0.25
6	28.14	7.12	15.05	6.56	13.09	0.57
7	28.27	7.20	15.99	6.12	12.28	1.08
8	28.14	7.09	15.21	6.94	12.93	0.16
9	28.43	5.96	10.83	4.33	17.60	1.63
10	28.34	6.96	13.95	6.49	14.39	0.47
11	28.04	6.46	14.27	6.32	13.77	0.15
12	28.35	5.08	11.64	4.03	16.71	1.06
13	28.48	6.85	13.45	6.58	15.03	0.27
14	28.16	6.53	11.25	5.40	16.91	1.13
15	28.08	5.41	12.53	4.48	15.55	0.93
16	28.38	6.39	13.85	5.77	14.53	0.62
17	28.16	5.80	11.22	4.77	16.94	1.03
18	28.36	6.97	15.31	6.71	13.05	0.27
19	28.4	5.91	12.39	4.75	16.01	1.16
20	28.25	6.34	11.75	4.70	16.50	1.65
21	28.45	6.09	13.72	5.78	14.73	0.31
22	28.14	6.29	13.61	6.00	14.53	0.29
23	28.14	6.40	12.68	5.17	15.46	1.23
24	28.08	5.80	14.72	5.56	13.36	0.24
25	28.02	7.19	14.72	7.04	13.30	0.15
26	28.22	6.52	14.76	6.28	13.46	0.24
27	28.2	7.53	13.26	6.93	14.94	0.60
28	28.16	5.20	11.90	4.86	16.26	0.34
29	28.13	6.27	13.41	5.93	14.72	0.33
30	28.02	6.15	12.78	5.16	15.24	0.99
31	28.38	6.56	12.74	6.03	15.64	0.53
32	28.25	5.88	12.75	5.26	15.50	0.62
33	28.46	7.32	16.06	6.74	12.40	0.58
34	28.21	6.17	13.49	5.74	14.72	0.43
35	28.06	6.06	12.97	5.12	15.09	0.94
36	28.16	6.29	14.04	6.19	14.12	0.10
37	28.42	6.59	11.69	5.25	16.73	1.34

38	28.43	6.30	13.49	5.38	14.94	0.92
39	28.1	6.21	15.95	6.18	12.15	0.03
40	28.5	6.58	15.24	6.35	13.26	0.24
41	28	8.04	17.41	7.42	10.59	0.63
42	28.26	5.43	11.73	4.15	16.53	1.28
43	28.32	6.58	15.53	6.56	12.79	0.02
44	28.19	6.80	15.74	6.77	12.45	0.03
45	28.5	8.01	18.48	7.28	10.02	0.73
46	28.44	6.77	14.42	6.66	14.02	0.12
47	28.41	6.42	13.65	5.74	14.76	0.68
48	28.13	6.96	14.10	6.42	14.03	0.54
49	28.27	6.26	13.54	5.99	14.73	0.28
50	28.22	7.32	14.99	7.24	13.23	0.08
51	28.48	7.39	16.78	7.36	11.70	0.03
52	28.15	6.63	14.74	5.89	13.41	0.74
53	28.48	7.70	13.11	7.13	15.37	0.58
54	28.08	7.34	15.68	6.79	12.40	0.54
55	28.45	6.13	12.39	5.22	16.06	0.91
56	28.13	6.61	15.26	6.38	12.87	0.23
57	28.09	7.61	13.68	6.50	14.41	1.11
58	28.11	8.14	18.12	8.08	9.99	0.06
59	28.31	6.34	14.22	6.16	14.09	0.18
60	28.14	6.77	13.44	6.09	14.70	0.68
61	28.24	7.40	15.14	6.25	13.10	1.15
62	28.32	5.34	13.73	5.12	14.59	0.22
63	28.48	7.07	16.32	6.43	12.16	0.64
64	28.03	7.07	15.94	6.90	12.09	0.17
65	28.1	7.39	15.84	7.10	12.26	0.29
66	28.24	8.41	15.57	8.22	12.67	0.20
67	28.21	8.46	16.53	8.38	11.68	0.08
68	28.39	6.59	14.22	6.25	14.17	0.34
69	28.34	6.73	12.12	5.28	16.22	1.46
70	28.42	7.13	13.27	6.53	15.15	0.60
71	28.04	6.62	15.06	6.51	12.98	0.11
72	28.42	5.82	14.81	5.63	13.61	0.19
73	28.12	6.33	15.94	6.07	12.18	0.26
74	28.5	7.35	15.55	7.20	12.95	0.14
75	28.39	7.16	14.60	6.74	13.79	0.42
76	28.07	6.84	15.36	6.67	12.71	0.17
77	28.41	7.08	14.66	6.90	13.75	0.19
78	28.07	8.90	16.06	8.30	12.01	0.59

79	28.25	6.72	11.78	5.54	16.47	1.18
80	28.32	7.78	11.04	5.76	17.28	2.02
81	28.43	6.55	13.91	5.64	14.52	0.91
82	28.06	5.79	12.57	4.27	15.49	1.52
83	28.42	6.15	13.32	5.75	15.10	0.40
84	28.31	6.68	14.12	6.42	14.19	0.26
85	28.22	6.66	15.01	6.45	13.21	0.21
86	28.18	7.86	16.67	7.82	11.51	0.03
87	28.43	6.30	12.20	5.44	16.23	0.86
88	28.13	6.08	13.37	4.76	14.76	1.32
89	28.21	6.14	12.26	4.35	15.95	1.79
90	28.21	6.88	13.09	5.60	15.12	1.28
91	28.08	5.64	10.87	4.37	17.21	1.27
92	28.05	6.17	11.83	5.00	16.22	1.17
93	28.32	6.31	11.75	4.95	16.57	1.36
94	28.41	7.01	16.09	6.99	12.32	0.02
95	28.21	5.46	10.06	3.67	18.15	1.79
96	28.22	8.28	17.35	8.24	10.87	0.04
97	28.42	7.20	16.61	7.17	11.81	0.03
98	28.26	6.97	14.32	6.78	13.94	0.19
99	28.12	5.61	13.49	5.35	14.63	0.25
100	28.14	7.12	15.05	6.56	13.09	0.57
101	28.27	7.20	15.99	6.12	12.28	1.08
102	28.14	7.09	15.21	6.94	12.93	0.16
103	28.43	5.96	10.83	4.33	17.60	1.63
104	28.34	6.96	13.95	6.49	14.39	0.47
105	28.04	6.46	14.27	6.32	13.77	0.15
106	28.35	5.08	11.64	4.03	16.71	1.06
107	28.48	6.85	13.45	6.58	15.03	0.27
108	28.16	6.53	11.25	5.40	16.91	1.13
109	28.08	5.41	12.53	4.48	15.55	0.93
110	28.38	6.39	13.85	5.77	14.53	0.62
111	28.16	5.80	11.22	4.77	16.94	1.03
112	28.36	6.97	15.31	6.71	13.05	0.27
113	28.4	5.91	12.39	4.75	16.01	1.16
114	28.25	6.34	11.75	4.70	16.50	1.65
115	28.45	6.09	13.72	5.78	14.73	0.31
116	28.14	6.29	13.61	6.00	14.53	0.29
117	28.14	6.40	12.68	5.17	15.46	1.23
118	28.08	5.80	14.72	5.56	13.36	0.24
119	28.02	7.19	14.72	7.04	13.30	0.15

120	28.22	6.52	14.76	6.28	13.46	0.24
121	28.2	7.53	13.26	6.93	14.94	0.60
122	28.16	5.20	11.90	4.86	16.26	0.34
123	28.13	6.27	13.41	5.93	14.72	0.33
124	28.02	6.15	12.78	5.16	15.24	0.99
125	28.38	6.56	12.74	6.03	15.64	0.53
126	28.25	5.88	12.75	5.26	15.50	0.62
127	28.46	7.32	16.06	6.74	12.40	0.58
128	28.21	6.17	13.49	5.74	14.72	0.43
129	28.06	6.06	12.97	5.12	15.09	0.94
130	28.16	6.29	14.04	6.19	14.12	0.10
131	28.42	6.59	11.69	5.25	16.73	1.34
132	28.43	6.30	13.49	5.38	14.94	0.92
133	28.1	6.21	15.95	6.18	12.15	0.03
134	28.5	6.58	15.24	6.35	13.26	0.24
135	28	8.04	17.41	7.42	10.59	0.63
136	28.26	5.43	11.73	4.15	16.53	1.28
137	28.32	6.58	15.53	6.56	12.79	0.02
138	28.19	6.80	15.74	6.77	12.45	0.03
139	28.5	8.01	18.48	7.28	10.02	0.73
140	28.44	6.77	14.42	6.66	14.02	0.12
141	28.41	6.42	13.65	5.74	14.76	0.68
142	28.13	6.96	14.10	6.42	14.03	0.54
143	28.27	6.26	13.54	5.99	14.73	0.28
144	28.22	7.32	14.99	7.24	13.23	0.08
145	28.48	7.39	16.78	7.36	11.70	0.03
146	28.15	6.63	14.74	5.89	13.41	0.74
147	28.48	7.70	13.11	7.13	15.37	0.58
148	28.08	7.34	15.68	6.79	12.40	0.54
149	28.45	6.13	12.39	5.22	16.06	0.91
150	28.13	6.61	15.26	6.38	12.87	0.23
151	28.09	7.61	13.68	6.50	14.41	1.11
152	28.11	8.14	18.12	8.08	9.99	0.06
153	28.31	6.34	14.22	6.16	14.09	0.18
154	28.14	6.77	13.44	6.09	14.70	0.68
155	28.24	7.40	15.14	6.25	13.10	1.15
156	28.32	5.34	13.73	5.12	14.59	0.22
157	28.48	7.07	16.32	6.43	12.16	0.64
158	28.03	7.07	15.94	6.90	12.09	0.17
159	28.1	7.39	15.84	7.10	12.26	0.29
160	28.24	8.41	15.57	8.22	12.67	0.20

161	28.21	8.46	16.53	8.38	11.68	0.08
162	28.39	6.59	14.22	6.25	14.17	0.34
163	28.34	6.73	12.12	5.28	16.22	1.46
164	28.42	7.13	13.27	6.53	15.15	0.60
165	28.04	6.62	15.06	6.51	12.98	0.11
166	28.42	5.82	14.81	5.63	13.61	0.19
167	28.12	6.33	15.94	6.07	12.18	0.26
168	28.5	7.35	15.55	7.20	12.95	0.14
169	28.39	7.16	14.60	6.74	13.79	0.42
170	28.07	6.84	15.36	6.67	12.71	0.17
171	28.41	7.08	14.66	6.90	13.75	0.19
172	28.07	8.90	16.06	8.30	12.01	0.59
173	28.25	6.72	11.78	5.54	16.47	1.18
174	28.32	7.78	11.04	5.76	17.28	2.02
175	28.43	6.55	13.91	5.64	14.52	0.91
176	28.06	5.79	12.57	4.27	15.49	1.52
177	28.42	6.15	13.32	5.75	15.10	0.40
178	28.31	6.68	14.12	6.42	14.19	0.26
179	28.22	6.66	15.01	6.45	13.21	0.21
180	28.18	7.86	16.67	7.82	11.51	0.03
181	28.43	6.30	12.20	5.44	16.23	0.86
182	28.13	6.08	13.37	4.76	14.76	1.32
183	28.21	6.14	12.26	4.35	15.95	1.79
184	28.21	6.88	13.09	5.60	15.12	1.28
185	28.08	5.64	10.87	4.37	17.21	1.27
186	28.05	6.17	11.83	5.00	16.22	1.17
187	28.32	6.31	11.75	4.95	16.57	1.36
188	28.41	7.01	16.09	6.99	12.32	0.02
189	28.06	6.99	14.57	6.83	13.49	0.16
190	28.06	7.59	16.51	7.50	11.55	0.09
191	28.2	6.44	13.76	5.92	14.44	0.51
192	28.15	7.62	16.39	7.22	11.76	0.39
193	28.22	6.80	16.39	6.77	11.83	0.03
194	28.39	5.88	12.57	5.23	15.82	0.65
195	28.44	7.08	14.06	4.99	14.38	2.09
196	28.34	5.99	13.01	4.62	15.33	1.37
197	28.04	6.33	11.89	5.32	16.15	1.02
198	28.23	6.31	14.66	6.03	13.57	0.28
199	28.03	4.82	12.09	4.25	15.94	0.57
200	28.2	5.30	11.63	4.32	16.57	0.98

Table 20. SWB output for SDSM Simulations of 30 inches of annual precipitation.

Simulated Run	Ann. prec. (in.)	Ann. Rech. (in.)	Non-growing prec.(in.)	Non-growing rech.(in.)	Growing prec.(in.)	Growing rech.(in.)
1	30.13	8.72	18.67	8.55	11.46	0.16
2	30.29	7.30	10.92	4.32	19.37	2.97
3	30.24	8.45	16.00	7.76	14.24	0.68
4	30.47	7.84	16.34	7.66	14.13	0.18
5	30.3	7.38	13.38	6.34	16.92	1.04
6	30.02	6.95	12.53	5.03	17.49	1.93
7	30.16	6.39	14.16	5.80	16.00	0.59
8	30.08	7.13	11.37	5.08	18.71	2.05
9	30.4	7.33	13.66	6.41	16.74	0.92
10	30.36	7.25	16.41	6.77	13.95	0.48
11	30.08	6.88	12.67	6.29	17.41	0.59
12	30.13	8.60	13.78	6.79	16.35	1.81
13	30.01	8.89	18.94	8.84	11.07	0.05
14	30.3	7.44	11.82	5.30	18.48	2.14
15	30.48	6.95	14.28	6.29	16.20	0.66
16	29.97	9.29	18.80	7.96	11.17	1.33
17	30.47	9.44	17.55	8.42	12.92	1.02
18	30.02	6.48	13.97	5.70	16.05	0.79
19	30.23	6.07	14.45	5.20	15.78	0.87
20	30.07	7.49	16.51	7.42	13.56	0.07
21	30.23	7.67	10.51	4.02	19.72	3.66
22	30.43	8.10	16.80	8.03	13.63	0.08
23	30.41	8.05	16.48	7.75	13.93	0.30
24	30.39	8.22	15.61	7.36	14.78	0.87
25	30.21	7.72	15.04	6.86	15.17	0.87
26	30.52	7.39	16.03	6.91	14.49	0.48
27	30.06	7.03	13.90	6.73	16.16	0.31
28	30.43	6.59	11.74	4.09	18.69	2.50
29	30.13	6.61	12.69	5.24	17.44	1.37
30	30.42	8.68	15.85	8.01	14.57	0.67
31	30.34	7.91	12.69	6.19	17.65	1.72
32	30.39	8.34	16.71	7.49	13.68	0.85
33	30.36	6.98	15.32	6.83	15.04	0.15
34	30.17	7.43	17.35	6.16	12.82	1.27
35	30.18	8.84	15.77	8.06	14.41	0.78
36	30.08	7.01	16.29	6.43	13.79	0.59
37	30.15	6.50	13.12	6.16	17.03	0.34
38	30.53	7.74	15.69	7.18	14.84	0.56

39	30.39	8.11	15.69	7.60	14.70	0.51
40	30.29	7.71	16.08	6.97	14.21	0.74
41	30.32	7.93	16.24	7.81	14.08	0.11
42	30.14	6.90	14.85	6.11	15.29	0.79
43	30.31	6.96	12.42	4.80	17.89	2.16
44	30.29	6.50	12.49	4.91	17.80	1.59
45	30.23	8.76	15.09	7.59	15.14	1.17
46	30.52	7.76	15.29	7.49	15.23	0.26
47	30.02	7.47	13.23	5.67	16.79	1.80
48	30.25	7.79	12.72	6.34	17.53	1.45
49	30.3	7.21	14.32	5.98	15.98	1.23
50	30.01	8.74	19.38	8.72	10.63	0.02
51	30.11	8.13	12.08	5.71	18.03	2.42
52	30.25	7.95	15.00	6.76	15.25	1.19
53	30.29	6.78	11.54	4.83	18.75	1.95
54	30.32	6.77	11.34	4.07	18.98	2.70
55	30.26	7.57	16.10	6.96	14.16	0.62
56	30.31	8.28	13.54	6.80	16.77	1.48
57	30.21	7.96	17.18	7.47	13.03	0.50
58	30.33	8.20	15.80	7.72	14.53	0.47
59	30.46	9.19	17.22	8.98	13.24	0.20
60	30.34	8.51	14.77	7.51	15.57	1.00
61	30.05	7.88	13.20	6.84	16.85	1.04
62	30.16	7.84	15.08	7.59	15.08	0.25
63	30.21	8.89	18.92	8.72	11.29	0.17
64	30.16	8.00	18.26	7.53	11.90	0.47
65	30.23	8.17	12.39	5.96	17.84	2.21
66	30.39	8.98	16.22	8.35	14.17	0.63
67	30.36	8.63	17.67	8.56	12.69	0.07
68	30.35	7.30	17.05	6.95	13.30	0.35
69	30.37	8.26	16.00	7.57	14.37	0.69
70	30.14	9.96	18.50	9.24	11.64	0.72
71	30	6.72	11.95	4.93	18.05	1.79
72	30.43	8.11	14.57	7.22	15.86	0.89
73	30.22	6.88	14.80	6.53	15.42	0.35
74	30.23	8.26	15.98	7.81	14.25	0.45
75	30.35	7.60	12.47	6.06	17.88	1.54
76	30.17	6.85	15.30	6.67	14.87	0.18
77	30.1	7.41	15.46	6.78	14.64	0.63
78	30.33	7.14	15.58	6.58	14.75	0.56
79	30.27	8.33	15.88	7.65	14.39	0.68

80	30.41	7.93	15.91	7.05	14.50	0.88
81	30.35	7.79	14.03	6.35	16.32	1.44
82	30.33	9.92	18.03	9.72	12.30	0.19
83	30.04	8.89	15.81	7.34	14.23	1.55
84	30.12	6.89	15.91	6.01	14.21	0.88
85	30.07	6.95	12.62	6.01	17.45	0.93
86	30.21	6.99	15.15	5.93	15.06	1.06
87	30.34	7.40	13.93	6.58	16.41	0.82
88	30.26	7.68	15.71	6.55	14.55	1.13
89	30.16	8.32	16.16	7.91	14.00	0.40
90	30.07	7.16	14.00	6.85	16.07	0.31
91	30.29	7.98	12.90	6.09	17.39	1.88
92	30.32	7.06	13.75	6.58	16.57	0.49
93	30	5.60	11.71	3.92	18.29	1.68
94	30.19	9.63	18.12	9.52	12.07	0.11
95	30.21	7.24	13.53	6.34	16.68	0.90
96	30.01	8.05	16.56	7.72	13.45	0.33
97	30.25	7.68	12.61	5.32	17.64	2.36
98	30.17	7.17	16.77	6.82	13.40	0.35
99	30.51	6.55	11.06	4.61	19.45	1.94
100	30.39	10.60	17.55	9.48	12.84	1.12
101	30.47	7.70	15.86	7.33	14.61	0.38
102	30.08	6.83	10.28	3.44	19.80	3.39
103	30.01	6.09	13.69	5.48	16.32	0.61
104	30.09	6.89	17.32	6.85	12.77	0.05
105	30.1	6.46	13.79	6.27	16.31	0.19
106	29.97	7.79	16.57	7.64	13.40	0.15
107	30.22	9.47	18.57	9.16	11.65	0.30
108	30.4	6.99	11.49	4.89	18.91	2.10
109	30.35	7.90	15.58	7.51	14.77	0.39
110	30.28	6.66	13.17	5.30	17.11	1.36
111	30.39	6.93	11.92	5.47	18.47	1.47
112	30.23	6.71	12.84	5.37	17.39	1.34
113	30.43	8.53	16.15	8.23	14.28	0.29
114	30.18	6.38	12.95	5.62	17.23	0.76
115	30.29	7.30	10.92	4.32	19.37	2.97
116	30.24	8.45	16.00	7.76	14.24	0.68
117	30.47	7.84	16.34	7.66	14.13	0.18
118	30.3	7.38	13.38	6.34	16.92	1.04
119	30.02	6.95	12.53	5.03	17.49	1.93
120	30.16	6.39	14.16	5.80	16.00	0.59

121	30.08	7.13	11.37	5.08	18.71	2.05
122	30.4	7.33	13.66	6.41	16.74	0.92
123	30.36	7.25	16.41	6.77	13.95	0.48
124	30.08	6.88	12.67	6.29	17.41	0.59
125	30.13	8.60	13.78	6.79	16.35	1.81
126	30.01	8.89	18.94	8.84	11.07	0.05
127	30.3	7.44	11.82	5.30	18.48	2.14
128	30.48	6.95	14.28	6.29	16.20	0.66
129	29.97	9.29	18.80	7.96	11.17	1.33
130	30.47	9.44	17.55	8.42	12.92	1.02
131	30.02	6.48	13.97	5.70	16.05	0.79
132	30.23	6.07	14.45	5.20	15.78	0.87
133	30.07	7.49	16.51	7.42	13.56	0.07
134	30.23	7.67	10.51	4.02	19.72	3.66
135	30.43	8.10	16.80	8.03	13.63	0.08
136	30.41	8.05	16.48	7.75	13.93	0.30
137	30.39	8.22	15.61	7.36	14.78	0.87
138	30.21	7.72	15.04	6.86	15.17	0.87
139	30.52	7.39	16.03	6.91	14.49	0.48
140	30.06	7.03	13.90	6.73	16.16	0.31
141	30.43	6.59	11.74	4.09	18.69	2.50
142	30.13	6.61	12.69	5.24	17.44	1.37
143	30.42	8.68	15.85	8.01	14.57	0.67
144	30.34	7.91	12.69	6.19	17.65	1.72
145	30.39	8.34	16.71	7.49	13.68	0.85
146	30.36	6.98	15.32	6.83	15.04	0.15
147	30.17	7.43	17.35	6.16	12.82	1.27
148	30.18	8.84	15.77	8.06	14.41	0.78
149	30.08	7.01	16.29	6.43	13.79	0.59
150	30.15	6.50	13.12	6.16	17.03	0.34
151	30.53	7.74	15.69	7.18	14.84	0.56
152	30.39	8.11	15.69	7.60	14.70	0.51
153	30.29	7.71	16.08	6.97	14.21	0.74
154	30.32	7.93	16.24	7.81	14.08	0.11
155	30.14	6.90	14.85	6.11	15.29	0.79
156	30.31	6.96	12.42	4.80	17.89	2.16
157	30.29	6.50	12.49	4.91	17.80	1.59
158	30.23	8.76	15.09	7.59	15.14	1.17
159	30.52	7.76	15.29	7.49	15.23	0.26
160	30.02	7.47	13.23	5.67	16.79	1.80
161	30.25	7.79	12.72	6.34	17.53	1.45

162	30.3	7.21	14.32	5.98	15.98	1.23
163	30.01	8.74	19.38	8.72	10.63	0.02
164	30.11	8.13	12.08	5.71	18.03	2.42
165	30.25	7.95	15.00	6.76	15.25	1.19
166	30.29	6.78	11.54	4.83	18.75	1.95
167	30.32	6.77	11.34	4.07	18.98	2.70
168	30.26	7.57	16.10	6.96	14.16	0.62
169	30.31	8.28	13.54	6.80	16.77	1.48
170	30.21	7.96	17.18	7.47	13.03	0.50
171	30.33	8.20	15.80	7.72	14.53	0.47
172	30.46	9.19	17.22	8.98	13.24	0.20
173	30.34	8.51	14.77	7.51	15.57	1.00
174	30.05	7.88	13.20	6.84	16.85	1.04
175	30.16	7.84	15.08	7.59	15.08	0.25
176	30.21	8.89	18.92	8.72	11.29	0.17
177	30.16	8.00	18.26	7.53	11.90	0.47
178	30.23	8.17	12.39	5.96	17.84	2.21
179	30.39	8.98	16.22	8.35	14.17	0.63
180	30.36	8.63	17.67	8.56	12.69	0.07
181	30.35	7.30	17.05	6.95	13.30	0.35
182	30.37	8.26	16.00	7.57	14.37	0.69
183	30.14	9.96	18.50	9.24	11.64	0.72
184	30	6.72	11.95	4.93	18.05	1.79
185	30.43	8.11	14.57	7.22	15.86	0.89
186	30.22	6.88	14.80	6.53	15.42	0.35
187	30.23	8.26	15.98	7.81	14.25	0.45
188	30.35	7.60	12.47	6.06	17.88	1.54
189	30.17	6.85	15.30	6.67	14.87	0.18
190	30.1	7.41	15.46	6.78	14.64	0.63
191	30.33	7.14	15.58	6.58	14.75	0.56
192	30.27	8.33	15.88	7.65	14.39	0.68
193	30.41	7.93	15.91	7.05	14.50	0.88
194	30.35	7.79	14.03	6.35	16.32	1.44
195	30.33	9.92	18.03	9.72	12.30	0.19
196	30.04	8.89	15.81	7.34	14.23	1.55
197	30.12	6.89	15.91	6.01	14.21	0.88
198	30.07	6.95	12.62	6.01	17.45	0.93
199	30.21	6.99	15.15	5.93	15.06	1.06
200	30.34	7.40	13.93	6.58	16.41	0.82

Table 21. SWB output for SDSM simulations of 32 inches of annual precipitation.

Simulated Run	Ann. prec.(in.)	Ann. rech.(in.)	Non-growing prec.(in.)	Non-growing rech.(in.)	Growing prec.(in.)	Growing rech.(in.)
1	32.35	7.78	16.16	6.80	16.19	0.99
2	32.35	9.24	17.01	8.26	15.34	0.98
3	32.44	8.83	13.43	6.54	19.01	2.29
4	32.18	7.77	13.12	5.58	19.06	2.19
5	32.30	7.93	18.20	7.76	14.10	0.17
6	32.01	10.30	16.66	8.89	15.35	1.42
7	32.52	9.74	15.77	8.19	16.75	1.55
8	32.42	9.13	16.42	8.41	16.00	0.72
9	32.17	6.93	12.76	4.95	19.41	1.99
10	32.06	8.06	14.27	5.95	17.79	2.11
11	32.32	9.82	19.75	9.74	12.57	0.08
12	32.02	10.24	15.84	8.28	16.18	1.95
13	32.21	9.79	17.64	8.74	14.57	1.05
14	32.37	9.20	19.23	8.30	13.14	0.89
15	32.21	10.60	15.83	8.11	16.38	2.50
16	32.24	8.86	13.64	6.37	18.60	2.49
17	32.53	7.54	12.64	4.73	19.89	2.81
18	32.07	8.85	16.33	7.92	15.74	0.93
19	32.13	7.71	16.19	7.21	15.94	0.50
20	32.47	9.06	17.31	8.84	15.16	0.22
21	32.37	8.93	17.08	8.42	15.29	0.52
22	32.20	9.65	13.33	6.98	18.87	2.67
23	32.19	8.85	16.12	7.30	16.07	1.55
24	32.07	7.24	14.09	5.82	17.98	1.42
25	32.37	8.34	17.60	7.82	14.77	0.51
26	32.25	10.13	20.08	9.53	12.17	0.60
27	32.29	9.96	17.70	9.34	14.59	0.62
28	32.16	9.11	18.98	8.88	13.18	0.23
29	32.41	7.49	16.97	6.68	15.44	0.81
30	32.30	7.99	12.59	4.78	19.71	3.22
31	32.27	8.50	16.53	6.78	15.74	1.72
32	32.12	8.09	17.50	7.55	14.62	0.54
33	32.41	8.24	16.13	7.85	16.28	0.39
34	32.12	8.76	17.88	8.66	14.24	0.10
35	32.14	9.87	17.95	8.86	14.19	1.01
36	32.05	7.68	14.78	7.11	17.27	0.58
37	32.46	9.64	18.89	9.51	13.57	0.13
38	32.19	9.41	16.89	8.78	15.30	0.63

39	32.48	9.67	20.49	9.58	11.99	0.09
40	32.02	9.15	18.11	8.68	13.91	0.47
41	32.38	7.77	15.06	6.54	17.32	1.23
42	32.16	7.20	15.59	5.98	16.57	1.22
43	32.19	11.37	19.97	10.84	12.22	0.53
44	32.37	8.85	15.43	7.03	16.94	1.82
45	32.28	9.12	15.45	6.99	16.83	2.13
46	32.22	7.58	12.65	4.50	19.57	3.08
47	32.17	9.57	14.66	6.58	17.51	2.99
48	32.43	8.83	15.68	5.74	16.75	3.09
49	32.52	9.39	18.27	8.50	14.25	0.89
50	32.20	8.98	17.67	8.00	14.53	0.98
51	32.35	9.12	14.41	7.76	17.94	1.36
52	32.09	9.91	15.56	7.71	16.53	2.19
53	32.44	9.90	17.66	8.27	14.78	1.64
54	32.15	10.18	19.22	9.77	12.93	0.41
55	32.49	8.05	17.65	7.74	14.84	0.31
56	32.24	8.47	14.39	7.45	17.85	1.02
57	32.45	9.95	17.15	8.57	15.30	1.38
58	32.10	7.98	13.62	6.63	18.48	1.35
59	31.98	8.20	14.66	6.81	17.32	1.39
60	32.26	8.59	16.64	8.16	15.62	0.43
61	32.31	9.93	18.73	9.43	13.58	0.49
62	32.18	7.32	14.04	6.51	18.14	0.81
63	32.24	8.47	13.73	6.21	18.51	2.26
64	32.44	9.49	13.85	6.97	18.59	2.52
65	32.25	9.83	17.11	8.55	15.14	1.28
66	32.48	9.03	15.48	7.30	17.00	1.72
67	32.36	8.12	14.57	6.43	17.79	1.69
68	32.24	7.12	15.93	6.94	16.31	0.18
69	32.30	7.67	17.17	7.35	15.13	0.32
70	32.52	8.54	14.35	6.66	18.17	1.87
71	32.18	9.18	19.45	9.03	12.73	0.15
72	32.45	9.94	17.28	9.15	15.17	0.79
73	32.27	8.15	17.73	7.98	14.54	0.17
74	32.49	7.27	13.90	6.07	18.59	1.20
75	32.50	7.94	15.14	6.73	17.36	1.21
76	32.50	11.21	18.89	10.67	13.61	0.54
77	32.28	8.41	11.93	4.91	20.35	3.49
78	32.16	8.15	16.73	7.81	15.43	0.34
79	32.07	9.85	18.49	8.80	13.58	1.04

80	32.05	9.61	17.10	8.65	14.95	0.96
81	32.51	9.23	14.70	7.81	17.81	1.42
82	32.14	9.00	17.84	8.92	14.30	0.08
83	32.38	9.20	16.04	7.30	16.34	1.90
84	32.16	9.37	20.14	8.37	12.02	0.99
85	32.33	9.48	15.82	7.86	16.51	1.62
86	32.42	10.99	16.18	8.33	16.24	2.66
87	32.09	9.07	15.49	7.47	16.60	1.59
88	32.16	8.59	15.66	6.40	16.50	2.19
89	32.43	8.44	19.33	8.41	13.10	0.03
90	32.13	9.04	16.21	7.95	15.92	1.09
91	32.21	7.32	16.12	6.59	16.09	0.74
92	32.11	9.76	16.01	8.31	16.10	1.46
93	32.13	8.61	15.63	7.90	16.50	0.71
94	32.38	10.45	18.72	8.98	13.66	1.47
95	32.04	8.37	15.16	6.83	16.88	1.54
96	32.02	7.99	13.62	6.25	18.40	1.73
97	32.37	7.32	14.85	6.46	17.52	0.86
98	32.04	9.82	14.38	7.33	17.66	2.49
99	31.95	9.61	16.83	9.22	15.12	0.39
100	32.22	9.38	13.44	6.54	18.78	2.84
101	32.39	8.79	15.69	7.27	16.70	1.52
102	32.02	8.97	17.79	8.19	14.23	0.78
103	32.30	9.92	17.28	8.77	15.02	1.15
104	32.46	10.46	18.69	10.27	13.77	0.19
105	32.17	9.47	16.75	8.77	15.42	0.70
106	32.15	8.51	14.88	6.94	17.27	1.57
107	32.08	8.70	16.65	8.26	15.43	0.44
108	32.07	8.79	17.50	7.99	14.57	0.80
109	32.41	8.21	16.17	7.73	16.24	0.47
110	32.08	8.06	14.93	6.19	17.15	1.87
111	32.18	9.21	18.02	8.76	14.16	0.45
112	32.32	9.44	13.11	5.98	19.21	3.47
113	32.17	9.78	18.11	8.40	14.06	1.38
114	32.25	7.59	15.87	6.76	16.38	0.83
115	32.41	9.56	14.27	7.22	18.14	2.34
116	32.05	7.55	12.96	6.25	19.09	1.29
117	32.27	7.90	17.04	7.30	15.23	0.60
118	32.41	8.57	15.19	6.53	17.22	2.04
119	32.50	9.72	18.38	8.69	14.12	1.03
120	32.46	8.97	14.46	7.02	18.00	1.95

121	32.35	9.15	12.36	5.89	19.99	3.25
122	32.44	9.45	16.84	7.93	15.60	1.52
123	32.03	9.01	16.33	7.94	15.70	1.07
124	32.06	8.77	15.84	7.84	16.22	0.92
125	32.24	8.03	14.48	6.40	17.76	1.63
126	32.13	8.31	14.79	6.72	17.34	1.59
127	32.19	8.65	14.38	6.45	17.81	2.21
128	32.14	8.05	15.87	7.42	16.27	0.63
129	32.16	7.53	13.20	5.43	18.96	2.10
130	32.13	9.41	18.32	8.31	13.81	1.10
131	32.37	9.03	15.85	7.94	16.52	1.09
132	32.35	7.78	16.16	6.80	16.19	0.99
133	32.35	9.24	17.01	8.26	15.34	0.98
134	32.44	8.83	13.43	6.54	19.01	2.29
135	32.18	7.77	13.12	5.58	19.06	2.19
136	32.30	7.93	18.20	7.76	14.10	0.17
137	32.01	10.30	16.66	8.89	15.35	1.42
138	32.52	9.74	15.77	8.19	16.75	1.55
139	32.42	9.13	16.42	8.41	16.00	0.72
140	32.17	6.93	12.76	4.95	19.41	1.99
141	32.06	8.06	14.27	5.95	17.79	2.11
142	32.32	9.82	19.75	9.74	12.57	0.08
143	32.02	10.24	15.84	8.28	16.18	1.95
144	32.21	9.79	17.64	8.74	14.57	1.05
145	32.37	9.20	19.23	8.30	13.14	0.89
146	32.21	10.60	15.83	8.11	16.38	2.50
147	32.24	8.86	13.64	6.37	18.60	2.49
148	32.53	7.54	12.64	4.73	19.89	2.81
149	32.07	8.85	16.33	7.92	15.74	0.93
150	32.13	7.71	16.19	7.21	15.94	0.50
151	32.47	9.06	17.31	8.84	15.16	0.22
152	32.37	8.93	17.08	8.42	15.29	0.52
153	32.20	9.65	13.33	6.98	18.87	2.67
154	32.19	8.85	16.12	7.30	16.07	1.55
155	32.07	7.24	14.09	5.82	17.98	1.42
156	32.37	8.34	17.60	7.82	14.77	0.51
157	32.25	10.13	20.08	9.53	12.17	0.60
158	32.29	9.96	17.70	9.34	14.59	0.62
159	32.16	9.11	18.98	8.88	13.18	0.23
160	32.41	7.49	16.97	6.68	15.44	0.81
161	32.30	7.99	12.59	4.78	19.71	3.22

162	32.27	8.50	16.53	6.78	15.74	1.72
163	32.12	8.09	17.50	7.55	14.62	0.54
164	32.41	8.24	16.13	7.85	16.28	0.39
165	32.12	8.76	17.88	8.66	14.24	0.10
166	32.14	9.87	17.95	8.86	14.19	1.01
167	32.05	7.68	14.78	7.11	17.27	0.58
168	32.46	9.64	18.89	9.51	13.57	0.13
169	32.19	9.41	16.89	8.78	15.30	0.63
170	32.48	9.67	20.49	9.58	11.99	0.09
171	32.02	9.15	18.11	8.68	13.91	0.47
172	32.38	7.77	15.06	6.54	17.32	1.23
173	32.16	7.20	15.59	5.98	16.57	1.22
174	32.19	11.37	19.97	10.84	12.22	0.53
175	32.37	8.85	15.43	7.03	16.94	1.82
176	32.28	9.12	15.45	6.99	16.83	2.13
177	32.22	7.58	12.65	4.50	19.57	3.08
178	32.17	9.57	14.66	6.58	17.51	2.99
179	32.43	8.83	15.68	5.74	16.75	3.09
180	32.52	9.39	18.27	8.50	14.25	0.89
181	32.20	8.98	17.67	8.00	14.53	0.98
182	32.35	9.12	14.41	7.76	17.94	1.36
183	32.09	9.91	15.56	7.71	16.53	2.19
184	32.44	9.90	17.66	8.27	14.78	1.64
185	32.15	10.18	19.22	9.77	12.93	0.41
186	32.49	8.05	17.65	7.74	14.84	0.31
187	32.24	8.47	14.39	7.45	17.85	1.02
188	32.45	9.95	17.15	8.57	15.30	1.38
189	32.10	7.98	13.62	6.63	18.48	1.35
190	31.98	8.20	14.66	6.81	17.32	1.39
191	32.26	8.59	16.64	8.16	15.62	0.43
192	32.31	9.93	18.73	9.43	13.58	0.49
193	32.18	7.32	14.04	6.51	18.14	0.81
194	32.24	8.47	13.73	6.21	18.51	2.26
195	32.44	9.49	13.85	6.97	18.59	2.52
196	32.25	9.83	17.11	8.55	15.14	1.28
197	32.48	9.03	15.48	7.30	17.00	1.72
198	32.36	8.12	14.57	6.43	17.79	1.69
199	32.24	7.12	15.93	6.94	16.31	0.18
200	32.30	7.67	17.17	7.35	15.13	0.32

Table 22. SWB output for SDSM simulations of 34 inches of annual precipitation.

Simulated Run	Ann. prec. (in.)	Ann. rech. (in.)	Non-growing prec.(in.)	Non-growing rech.(in.)	Growing prec.(in.)	Growing rech.(in.)
1	34.26	10.02	17.09	8.24	17.17	1.78
2	34.02	10.55	17.92	9.34	16.10	1.21
3	34.29	9.50	17.63	8.67	16.66	0.83
4	34.39	10.10	15.75	8.02	18.64	2.08
5	34.53	9.23	15.98	7.34	18.55	1.89
6	34.17	8.98	15.03	6.89	19.14	2.09
7	34.22	10.32	19.55	10.14	14.67	0.18
8	34.19	10.24	13.59	6.21	20.60	4.03
9	34.44	9.44	13.35	6.04	21.09	3.39
10	34.14	10.17	16.65	8.33	17.49	1.84
11	34.27	9.51	15.62	6.42	18.65	3.09
12	34.18	9.58	15.34	6.89	18.84	2.68
13	34.3	8.28	15.55	6.64	18.75	1.64
14	34.38	10.15	18.39	9.23	15.99	0.92
15	34.13	9.32	15.60	6.98	18.53	2.35
16	34.12	9.34	14.71	6.81	19.41	2.52
17	34.46	12.04	17.23	9.48	17.23	2.56
18	34.35	8.95	12.25	5.11	22.10	3.84
19	34.07	10.11	20.16	9.17	13.91	0.93
20	34.19	11.62	21.16	11.38	13.03	0.24
21	34.43	9.90	16.71	7.62	17.72	2.28
22	34.05	9.66	16.94	8.39	17.11	1.27
23	34.31	10.42	20.62	9.14	13.69	1.27
24	34.26	9.69	16.97	7.76	17.29	1.93
25	34.25	9.48	16.03	8.07	18.22	1.41
26	34.21	10.18	20.74	10.06	13.47	0.12
27	34.33	10.08	19.45	8.90	14.88	1.18
28	34.5	10.69	15.91	8.56	18.59	2.13
29	34.06	8.35	15.09	6.16	18.97	2.19
30	34.09	9.44	16.18	7.99	17.91	1.45
31	34.36	9.16	14.59	6.95	19.77	2.21
32	34.38	8.90	13.47	6.56	20.91	2.34
33	34.35	10.06	15.97	7.59	18.38	2.47
34	34.33	8.85	16.87	8.11	17.46	0.74
35	34.39	9.12	13.19	4.96	21.20	4.15
36	34.33	10.21	14.89	7.21	19.44	2.99
37	34.37	9.05	15.21	6.85	19.16	2.20
38	34.26	8.92	15.68	7.39	18.58	1.54

39	34.51	11.68	17.61	10.10	16.90	1.58
40	34.18	9.14	19.00	8.71	15.18	0.42
41	34.36	9.96	15.64	8.27	18.72	1.70
42	34.18	8.37	13.69	5.91	20.49	2.47
43	34.38	9.96	15.90	7.27	18.48	2.69
44	34.43	8.02	11.08	3.66	23.35	4.36
45	34.1	10.48	16.58	7.95	17.52	2.52
46	34.35	11.48	19.37	9.91	14.98	1.58
47	34.18	9.02	14.11	6.61	20.07	2.41
48	34.38	10.37	14.09	7.25	20.29	3.12
49	34.38	9.45	16.17	7.80	18.21	1.65
50	34.16	8.60	18.14	8.37	16.02	0.23
51	34.37	10.97	19.02	9.96	15.35	1.01
52	34.31	11.00	19.75	9.61	14.56	1.39
53	34.18	9.87	18.34	9.01	15.84	0.86
54	34.25	8.58	18.14	7.71	16.11	0.87
55	34.48	8.06	17.80	7.12	16.68	0.94
56	34.23	9.80	16.45	7.72	17.78	2.08
57	34.16	9.48	16.39	8.06	17.77	1.43
58	34.33	10.05	13.09	5.81	21.24	4.24
59	34.4	9.49	14.70	6.72	19.70	2.77
60	34.1	9.96	16.83	8.09	17.27	1.88
61	34.18	9.78	13.14	5.78	21.04	4.00
62	34.26	9.16	12.95	5.31	21.31	3.84
63	34.2	8.88	19.25	7.74	14.95	1.14
64	34.2	10.48	20.03	10.10	14.17	0.38
65	34.18	9.02	18.42	8.84	15.76	0.18
66	34.07	9.25	17.08	8.17	16.99	1.07
67	34.13	9.53	18.47	8.50	15.66	1.04
68	34.28	7.80	17.13	7.49	17.15	0.31
69	34.47	8.62	17.96	7.93	16.51	0.69
70	34.32	9.49	15.22	7.70	19.10	1.79
71	34.04	8.52	20.11	8.42	13.93	0.10
72	34.15	10.36	19.33	9.64	14.82	0.72
73	34.11	11.37	21.44	10.96	12.67	0.42
74	34.1	9.73	16.46	8.39	17.64	1.34
75	34.09	9.42	14.66	6.14	19.43	3.28
76	34.27	9.93	14.69	7.74	19.58	2.19
77	34.43	10.29	17.92	9.18	16.51	1.11
78	34.29	9.82	14.26	7.03	20.03	2.80
79	34.12	10.40	18.79	9.02	15.33	1.38

80	34.09	9.23	14.21	6.33	19.88	2.89
81	34.49	10.55	18.14	8.95	16.35	1.60
82	34.45	9.67	20.07	9.08	14.38	0.59
83	34.11	9.51	16.80	8.13	17.31	1.38
84	34.19	9.31	13.22	5.78	20.97	3.53
85	34.19	10.47	17.73	9.29	16.46	1.17
86	34.06	10.66	18.91	9.51	15.15	1.14
87	34.29	9.66	16.75	7.77	17.54	1.89
88	34.45	9.27	15.47	7.33	18.98	1.95
89	34.31	11.86	19.46	10.62	14.85	1.24
90	34.44	9.88	16.24	8.50	18.20	1.38
91	34.02	10.55	17.92	9.34	16.10	1.21
92	34.29	9.50	17.63	8.67	16.66	0.83
93	34.39	10.10	15.75	8.02	18.64	2.08
94	34.53	9.23	15.98	7.34	18.55	1.89
95	34.17	8.98	15.03	6.89	19.14	2.09
96	34.22	10.32	19.55	10.14	14.67	0.18
97	34.19	10.24	13.59	6.21	20.60	4.03
98	34.44	9.44	13.35	6.04	21.09	3.39
99	34.14	10.17	16.65	8.33	17.49	1.84
100	34.27	9.51	15.62	6.42	18.65	3.09
101	34.18	9.58	15.34	6.89	18.84	2.68
102	34.3	8.28	15.55	6.64	18.75	1.64
103	34.38	10.15	18.39	9.23	15.99	0.92
104	34.13	9.32	15.60	6.98	18.53	2.35
105	34.12	9.34	14.71	6.81	19.41	2.52
106	34.46	12.04	17.23	9.48	17.23	2.56
107	34.35	8.95	12.25	5.11	22.10	3.84
108	34.07	10.11	20.16	9.17	13.91	0.93
109	34.19	11.62	21.16	11.38	13.03	0.24
110	34.43	9.90	16.71	7.62	17.72	2.28
111	34.05	9.66	16.94	8.39	17.11	1.27
112	34.31	10.42	20.62	9.14	13.69	1.27
113	34.26	9.69	16.97	7.76	17.29	1.93
114	34.25	9.48	16.03	8.07	18.22	1.41
115	34.21	10.18	20.74	10.06	13.47	0.12
116	34.33	10.08	19.45	8.90	14.88	1.18
117	34.5	10.69	15.91	8.56	18.59	2.13
118	34.06	8.35	15.09	6.16	18.97	2.19
119	34.09	9.44	16.18	7.99	17.91	1.45
120	34.36	9.16	14.59	6.95	19.77	2.21

121	34.38	8.90	13.47	6.56	20.91	2.34
122	34.35	10.06	15.97	7.59	18.38	2.47
123	34.33	8.85	16.87	8.11	17.46	0.74
124	34.39	9.12	13.19	4.96	21.20	4.15
125	34.33	10.21	14.89	7.21	19.44	2.99
126	34.37	9.05	15.21	6.85	19.16	2.20
127	34.26	8.92	15.68	7.39	18.58	1.54
128	34.51	11.68	17.61	10.10	16.90	1.58
129	34.18	9.14	19.00	8.71	15.18	0.42
130	34.36	9.96	15.64	8.27	18.72	1.70
131	34.18	8.37	13.69	5.91	20.49	2.47
132	34.38	9.96	15.90	7.27	18.48	2.69
133	34.43	8.02	11.08	3.66	23.35	4.36
134	34.1	10.48	16.58	7.95	17.52	2.52
135	34.35	11.48	19.37	9.91	14.98	1.58
136	34.18	9.02	14.11	6.61	20.07	2.41
137	34.38	10.37	14.09	7.25	20.29	3.12
138	34.38	9.45	16.17	7.80	18.21	1.65
139	34.16	8.60	18.14	8.37	16.02	0.23
140	34.37	10.97	19.02	9.96	15.35	1.01
141	34.31	11.00	19.75	9.61	14.56	1.39
142	34.18	9.87	18.34	9.01	15.84	0.86
143	34.25	8.58	18.14	7.71	16.11	0.87
144	34.48	8.06	17.80	7.12	16.68	0.94
145	34.23	9.80	16.45	7.72	17.78	2.08
146	34.16	9.48	16.39	8.06	17.77	1.43
147	34.33	10.05	13.09	5.81	21.24	4.24
148	34.4	9.49	14.70	6.72	19.70	2.77
149	34.1	9.96	16.83	8.09	17.27	1.88
150	34.18	9.78	13.14	5.78	21.04	4.00
151	34.26	9.16	12.95	5.31	21.31	3.84
152	34.2	8.88	19.25	7.74	14.95	1.14
153	34.2	10.48	20.03	10.10	14.17	0.38
154	34.18	9.02	18.42	8.84	15.76	0.18
155	34.07	9.25	17.08	8.17	16.99	1.07
156	34.13	9.53	18.47	8.50	15.66	1.04
157	34.28	7.80	17.13	7.49	17.15	0.31
158	34.47	8.62	17.96	7.93	16.51	0.69
159	34.32	9.49	15.22	7.70	19.10	1.79
160	34.04	8.52	20.11	8.42	13.93	0.10
161	34.15	10.36	19.33	9.64	14.82	0.72

162	34.11	11.37	21.44	10.96	12.67	0.42
163	34.1	9.73	16.46	8.39	17.64	1.34
164	34.09	9.42	14.66	6.14	19.43	3.28
165	34.27	9.93	14.69	7.74	19.58	2.19
166	34.43	10.29	17.92	9.18	16.51	1.11
167	34.29	9.82	14.26	7.03	20.03	2.80
168	34.12	10.40	18.79	9.02	15.33	1.38
169	34.09	9.23	14.21	6.33	19.88	2.89
170	34.49	10.55	18.14	8.95	16.35	1.60
171	34.45	9.67	20.07	9.08	14.38	0.59
172	34.11	9.51	16.80	8.13	17.31	1.38
173	34.19	9.31	13.22	5.78	20.97	3.53
174	34.19	10.47	17.73	9.29	16.46	1.17
175	34.06	10.66	18.91	9.51	15.15	1.14
176	34.29	9.66	16.75	7.77	17.54	1.89
177	34.45	9.27	15.47	7.33	18.98	1.95
178	34.31	11.86	19.46	10.62	14.85	1.24
179	34.42	8.73	17.49	8.33	16.93	0.40
180	34.08	10.14	16.29	6.84	17.79	3.30
181	34.12	10.79	18.27	10.09	15.85	0.70
182	34.3	10.02	16.63	7.74	17.67	2.28
183	34.47	9.39	14.34	6.04	20.13	3.35
184	34.52	10.84	16.85	9.00	17.67	1.84
185	34.51	10.35	18.18	9.45	16.33	0.90
186	34.45	9.63	16.82	8.43	17.63	1.20
187	34.5	9.83	17.14	8.92	17.36	0.91
188	34.13	10.35	18.28	9.70	15.85	0.65
189	34.18	9.21	13.47	5.81	20.71	3.40
190	34.27	9.65	13.20	6.57	21.07	3.09
191	34.12	10.78	18.14	9.57	15.98	1.21
192	34.12	10.05	16.77	8.74	17.35	1.31
193	34.29	11.55	19.27	10.40	15.02	1.14
194	34.07	9.35	15.52	7.95	18.55	1.40
195	34.36	8.83	16.70	7.68	17.66	1.15
196	34.45	10.19	19.38	9.87	15.07	0.32
197	34.31	10.66	16.52	8.76	17.79	1.89
198	34.09	8.91	17.15	7.90	16.94	1.01
199	34.39	10.22	17.44	9.29	16.95	0.93
200	34.07	10.24	19.56	9.56	14.51	0.67

Table 23. SWB output for SDSM simulations of 36 inches of annual precipitation.

Simulated Run	Ann. prec. (in.)	Ann. rech. (in.)	Non-growing prec.(in.)	Non-growing rech.(in.)	Growing prec.(in.)	Growing rech.(in.)
1	36.42	11.62	22.33	10.90	14.09	0.72
2	36.46	11.64	19.75	10.64	16.71	1.00
3	36.42	11.17	18.80	9.63	17.62	1.53
4	36.27	12.37	17.20	9.83	19.07	2.54
5	36.38	10.53	21.10	10.05	15.28	0.48
6	36.1	10.47	17.28	8.08	18.82	2.40
7	36.1	11.65	16.71	8.68	19.39	2.98
8	36.03	11.29	20.86	10.32	15.17	0.97
9	36.02	10.01	18.16	8.85	17.86	1.16
10	36.2	10.32	15.80	7.31	20.40	3.01
11	36.19	11.77	22.62	11.71	13.57	0.06
12	36.06	11.69	20.51	10.61	15.55	1.08
13	36.46	10.99	19.70	8.99	16.76	2.00
14	36.17	12.63	17.61	9.11	18.56	3.51
15	36.26	10.74	20.60	8.96	15.66	1.79
16	36.11	11.27	16.85	9.11	19.26	2.16
17	36.38	11.12	17.48	8.86	18.90	2.26
18	36.14	10.81	17.07	8.08	19.07	2.73
19	36.35	12.60	20.20	10.56	16.15	2.04
20	36	10.21	19.89	9.54	16.11	0.66
21	36.41	11.18	21.37	10.87	15.04	0.31
22	36.44	10.23	19.52	9.07	16.92	1.15
23	35.98	10.16	16.61	7.73	19.37	2.43
24	36.45	10.37	17.20	8.01	19.25	2.35
25	36.43	9.60	16.88	7.54	19.55	2.06
26	36.42	12.29	16.39	7.90	20.03	4.39
27	36.06	10.22	16.06	7.98	20.00	2.25
28	36.03	10.26	12.35	5.96	23.68	4.30
29	36.44	11.70	15.65	7.67	20.79	4.02
30	36.15	11.76	16.34	8.79	19.81	2.96
31	36.22	10.94	19.00	9.85	17.22	1.09
32	35.99	9.76	13.33	5.39	22.66	4.37
33	36.06	11.13	16.05	7.94	20.01	3.19
34	36.32	11.07	15.33	7.87	20.99	3.20
35	36.07	10.61	17.56	7.86	18.51	2.75
36	36.19	11.91	14.84	7.68	21.35	4.23
37	36.29	11.04	17.28	9.13	19.01	1.91
38	36.23	10.81	16.56	8.45	19.67	2.36

39	36.1	11.54	14.14	6.90	21.96	4.64
40	36.13	12.08	20.84	9.91	15.29	2.17
41	36.51	12.02	16.51	8.20	20.00	3.81
42	36.24	10.20	16.11	6.92	20.13	3.28
43	36.27	10.55	20.05	9.42	16.22	1.13
44	36.19	12.07	19.19	10.01	17.00	2.06
45	36.32	11.02	21.81	10.13	14.51	0.90
46	36.31	11.45	19.84	9.78	16.47	1.67
47	36.35	10.70	14.28	6.47	22.07	4.23
48	36.03	11.27	18.98	9.81	17.05	1.46
49	36.52	11.37	17.94	9.62	18.58	1.75
50	36.14	11.08	15.92	9.14	20.22	1.93
51	36.27	12.68	16.92	9.89	19.35	2.79
52	36.42	9.58	21.66	9.29	14.76	0.28
53	36.05	10.97	13.73	5.93	22.32	5.04
54	36.15	11.33	18.32	9.81	17.83	1.53
55	36.15	9.96	16.15	7.36	20.00	2.60
56	36.11	10.11	15.42	7.06	20.69	3.05
57	36.14	9.45	16.11	7.96	20.03	1.49
58	36.46	11.64	19.75	10.64	16.71	1.00
59	36.42	11.17	18.80	9.63	17.62	1.53
60	36.27	12.37	17.20	9.83	19.07	2.54
61	36.38	10.53	21.10	10.05	15.28	0.48
62	36.1	10.47	17.28	8.08	18.82	2.40
63	36.1	11.65	16.71	8.68	19.39	2.98
64	36.03	11.29	20.86	10.32	15.17	0.97
65	36.02	10.01	18.16	8.85	17.86	1.16
66	36.2	10.32	15.80	7.31	20.40	3.01
67	36.19	11.77	22.62	11.71	13.57	0.06
68	36.06	11.69	20.51	10.61	15.55	1.08
69	36.46	10.99	19.70	8.99	16.76	2.00
70	36.17	12.63	17.61	9.11	18.56	3.51
71	36.26	10.74	20.60	8.96	15.66	1.79
72	36.11	11.27	16.85	9.11	19.26	2.16
73	36.38	11.12	17.48	8.86	18.90	2.26
74	36.14	10.81	17.07	8.08	19.07	2.73
75	36.35	12.60	20.20	10.56	16.15	2.04
76	36	10.21	19.89	9.54	16.11	0.66
77	36.41	11.18	21.37	10.87	15.04	0.31
78	36.44	10.23	19.52	9.07	16.92	1.15
79	35.98	10.16	16.61	7.73	19.37	2.43

80	36.45	10.37	17.20	8.01	19.25	2.35
81	36.43	9.60	16.88	7.54	19.55	2.06
82	36.42	12.29	16.39	7.90	20.03	4.39
83	36.06	10.22	16.06	7.98	20.00	2.25
84	36.03	10.26	12.35	5.96	23.68	4.30
85	36.44	11.70	15.65	7.67	20.79	4.02
86	36.15	11.76	16.34	8.79	19.81	2.96
87	36.22	10.94	19.00	9.85	17.22	1.09
88	35.99	9.76	13.33	5.39	22.66	4.37
89	36.06	11.13	16.05	7.94	20.01	3.19
90	36.32	11.07	15.33	7.87	20.99	3.20
91	36.07	10.61	17.56	7.86	18.51	2.75
92	36.19	11.91	14.84	7.68	21.35	4.23
93	36.29	11.04	17.28	9.13	19.01	1.91
94	36.23	10.81	16.56	8.45	19.67	2.36
95	36.1	11.54	14.14	6.90	21.96	4.64
96	36.13	12.08	20.84	9.91	15.29	2.17
97	36.51	12.02	16.51	8.20	20.00	3.81
98	36.24	10.20	16.11	6.92	20.13	3.28
99	36.27	10.55	20.05	9.42	16.22	1.13
100	36.19	12.07	19.19	10.01	17.00	2.06
101	36.32	11.02	21.81	10.13	14.51	0.90
102	36.31	11.45	19.84	9.78	16.47	1.67
103	36.35	10.70	14.28	6.47	22.07	4.23
104	36.03	11.27	18.98	9.81	17.05	1.46
105	36.52	11.37	17.94	9.62	18.58	1.75
106	36.14	11.08	15.92	9.14	20.22	1.93
107	36.27	12.68	16.92	9.89	19.35	2.79
108	36.42	9.58	21.66	9.29	14.76	0.28
109	36.05	10.97	13.73	5.93	22.32	5.04
110	36.15	11.33	18.32	9.81	17.83	1.53
111	36.15	9.96	16.15	7.36	20.00	2.60
112	36.11	10.11	15.42	7.06	20.69	3.05
113	36.39	11.05	16.23	8.38	20.16	2.67
114	36.16	10.90	17.98	8.90	18.18	2.00
115	36.16	10.87	14.17	6.91	21.99	3.96
116	36.41	9.65	19.18	8.32	17.23	1.34
117	36.35	10.55	15.86	8.06	20.49	2.49
118	36.48	10.25	15.94	7.14	20.54	3.11
119	36.35	10.16	20.91	9.25	15.44	0.91
120	36.36	12.65	15.49	8.49	20.87	4.16

121	36.43	10.78	16.64	7.86	19.79	2.91
122	36.36	11.39	15.32	7.68	21.04	3.70
123	36.39	10.92	22.80	10.33	13.59	0.59
124	36.07	11.03	15.78	8.21	20.29	2.82
125	35.98	10.24	17.83	9.30	18.15	0.94
126	36.18	12.16	19.85	9.74	16.33	2.42
127	36.05	11.48	16.35	8.65	19.70	2.83
128	36.37	12.32	21.39	10.58	14.98	1.74
129	36.15	10.65	14.27	6.62	21.88	4.03
130	36.17	10.82	18.63	8.82	17.54	2.00
131	36.23	12.01	20.96	11.20	15.27	0.82
132	36.47	10.27	14.11	6.44	22.36	3.83
133	36.4	11.53	16.96	8.65	19.44	2.88
134	36.41	12.29	20.54	11.14	15.87	1.15
135	36.2	11.18	19.80	10.78	16.40	0.40
136	36.06	9.49	19.68	9.17	16.38	0.32
137	36.09	12.27	19.73	10.74	16.36	1.54
138	36.06	10.69	17.48	8.77	18.58	1.93
139	36.05	9.87	12.90	5.34	23.15	4.53
140	36.07	10.14	16.63	8.26	19.44	1.88
141	36.15	10.73	18.50	9.02	17.65	1.71
142	36.51	10.70	15.45	6.82	21.06	3.88
143	36.4	12.10	18.71	9.78	17.69	2.32
144	36.29	11.54	14.84	7.48	21.45	4.06
145	36.32	11.86	15.66	8.25	20.66	3.61
146	36.47	11.51	18.91	9.78	17.56	1.73
147	36.5	10.40	17.87	8.36	18.63	2.04
148	36.32	10.50	17.34	8.39	18.98	2.12
149	36.3	12.31	20.45	10.42	15.85	1.89
150	36.25	12.13	20.56	11.43	15.69	0.71
151	36.33	11.73	15.16	8.56	21.17	3.18
152	36.41	10.40	19.80	9.71	16.61	0.69
153	36.25	11.84	17.89	10.11	18.36	1.73
154	36.33	12.59	20.27	11.11	16.06	1.47
155	36.35	9.78	12.71	5.73	23.64	4.04
156	36.31	10.27	17.08	8.57	19.23	1.70
157	36.27	11.66	16.53	8.42	19.74	3.24
158	36.2	11.99	17.68	10.00	18.52	1.99
159	36.41	9.77	19.12	8.49	17.29	1.29
160	36.5	10.99	17.22	8.82	19.28	2.17
161	36.04	10.30	16.45	8.22	19.59	2.09

162	36.06	10.37	17.97	8.22	18.09	2.15
163	36.02	11.34	18.50	8.94	17.52	2.41
164	36.43	11.28	15.87	8.16	20.56	3.12
165	36.16	10.42	12.74	5.49	23.42	4.93
166	36.37	11.44	19.99	9.95	16.38	1.49
167	36.14	11.68	18.59	9.70	17.55	1.99
168	36.16	12.28	19.45	11.73	16.71	0.55
169	35.98	10.03	14.27	5.80	21.71	4.23
170	36.52	10.96	13.79	6.47	22.73	4.49
171	36.4	11.28	18.14	9.37	18.26	1.91
172	36.42	10.54	20.54	10.29	15.88	0.25
173	36.21	11.15	17.35	8.75	18.86	2.40
174	36.06	10.36	18.58	9.08	17.48	1.28
175	36.27	10.68	13.98	6.16	22.29	4.52
176	36.09	10.46	19.15	9.77	16.94	0.68
177	36.18	12.18	15.82	8.83	20.36	3.35
178	36.37	11.63	17.99	8.88	18.38	2.74
179	36.5	10.80	16.87	8.32	19.63	2.48
180	36.45	12.06	21.02	11.21	15.43	0.85
181	36.33	10.69	18.88	9.42	17.45	1.27
182	36.09	11.04	19.03	10.44	17.06	0.60
183	36.16	10.92	17.99	8.73	18.17	2.19
184	36.2	11.09	16.72	8.25	19.48	2.84
185	36.04	10.57	17.45	8.19	18.59	2.39
186	36.41	11.48	16.10	7.94	20.31	3.54
187	35.95	10.60	18.68	9.84	17.27	0.76
188	36.17	10.88	17.10	8.58	19.07	2.30
189	36.52	11.92	21.93	11.51	14.59	0.41
190	36.52	11.05	15.36	8.19	21.16	2.86
191	36.43	11.08	15.08	8.03	21.35	3.05
192	36.39	10.45	12.98	5.26	23.41	5.19
193	36.3	10.67	17.28	8.21	19.02	2.46
194	36.29	11.00	20.98	10.17	15.31	0.83
195	36.34	10.08	13.53	6.16	22.81	3.91
196	36.19	10.83	20.17	10.36	16.02	0.47
197	36.01	10.45	15.79	7.56	20.22	2.90
198	36.05	11.68	16.85	9.34	19.20	2.35
199	36.05	10.70	14.54	6.92	21.51	3.78
200	36.11	11.37	16.81	8.49	19.30	2.88

Table 24. SIM file to run weather generator in SDSM.

8 (Number of predictors)

12 (Months of data)

366 (Use of calendar years)

1/1/1963 (Beginning date of simulation)

10227 (Number of days in simulation)

#TRUE# (Conditional)

100 (How many ensembles generated for each run of the model)

12 (Variance inflation)

2 (Fourth root transformation of predictand)

1 (Bias correction)

PRCPMERRILL1963-1990.txt (Predictand file name)

ncepp_vna.dat (Predictors)

ncepp_zna.dat

ncepp8_fna.dat

ncepp8_zna.dat

ncepp8thna.dat

ncepr500na.dat

ncepr850na.dat

ncepshumna.dat

APPENDIX E

EMISSION SCENARIOS ANNUAL DATA

Table 25. SWB annual output for three emission scenarios.

Scenario	Year	Ann. prec.(in.)	Ann.rech.(in.)	Ann. ET(in.)	Min.temp.(°F)	Max. temp.(°F)
A1B	2047	33.55	10.14	18.86	34.81	56.26
A1B	2048	35.11	10.94	19.05	35.73	56.86
A1B	2049	35.10	10.90	19.28	35.53	56.63
A1B	2050	36.04	11.46	19.09	36.43	57.25
A1B	2051	34.27	10.47	19.04	36.13	57.82
A1B	2052	33.93	10.50	18.50	36.12	57.66
A1B	2053	36.60	11.61	19.72	36.44	57.39
A1B	2054	33.96	9.84	19.16	36.39	57.87
A1B	2055	32.97	9.43	19.01	36.55	57.86
A1B	2056	34.09	9.58	19.71	36.87	58.52
A1B	2057	35.78	10.66	19.99	36.72	57.86
A1B	2058	33.07	10.06	18.61	36.67	57.90
A1B	2059	33.10	9.58	19.15	36.89	58.49
A1B	2060	33.28	9.79	18.73	36.23	57.74
A1B	2061	34.45	10.47	18.61	36.80	57.91
A1B	2062	32.65	9.36	19.13	37.76	59.31
A1B	2063	34.61	10.26	19.69	37.69	59.15
A1B	2064	34.25	10.18	19.18	37.30	58.66
A1B	2065	32.37	9.17	18.86	37.76	59.30
A1B	2082	32.11	8.71	19.35	39.32	60.80
A1B	2083	34.96	10.07	19.71	39.36	60.28
A1B	2084	37.52	10.83	21.06	38.61	59.39
A1B	2085	36.43	10.75	20.78	38.69	59.84
A1B	2086	33.88	9.08	20.16	38.67	60.18
A1B	2087	34.62	10.03	20.06	39.19	60.30
A1B	2088	33.23	8.95	19.76	39.85	61.13
A1B	2089	35.83	10.26	20.68	38.97	59.94
A1B	2090	35.52	10.61	20.15	39.11	59.90
A1B	2091	34.14	10.17	19.65	39.82	60.95
A1B	2092	37.24	11.20	20.55	39.23	59.90
A1B	2093	37.39	11.49	20.84	39.30	59.93
A1B	2094	36.86	10.71	20.98	39.92	60.70
A1B	2095	35.23	10.25	20.11	39.87	61.32
A1B	2096	36.87	10.70	21.29	40.00	60.80
A1B	2097	36.02	10.51	20.58	39.58	60.49
A1B	2098	37.05	10.42	21.36	39.76	60.59
A1B	2099	39.55	12.36	21.70	39.86	60.64
A1B	2100	38.25	11.83	20.80	39.89	60.71
A2	2047	31.88	9.69	17.89	33.36	55.14
A2	2048	31.93	9.12	17.90	34.96	56.72
A2	2049	34.12	11.27	17.78	35.60	56.77
A2	2050	36.11	11.77	19.00	34.41	56.08
A2	2051	31.17	8.84	18.20	36.19	58.02
A2	2052	34.27	10.69	18.77	35.70	57.21
A2	2053	33.91	10.96	18.61	36.05	57.18

A2	2054	34.24	9.87	19.00	35.60	57.25
A2	2055	35.00	10.86	19.28	36.13	57.37
A2	2056	34.49	10.69	18.88	35.63	56.66
A2	2057	34.26	10.20	19.77	36.24	57.95
A2	2058	34.04	9.89	19.26	36.51	58.14
A2	2059	36.06	10.78	20.00	36.53	58.19
A2	2060	32.79	10.01	18.49	36.20	57.86
A2	2061	32.62	9.42	18.58	36.68	58.47
A2	2062	33.33	10.34	18.38	36.36	57.96
A2	2063	33.31	9.42	19.41	36.68	58.51
A2	2064	34.14	9.58	19.29	36.86	58.47
A2	2065	33.06	10.20	18.62	36.53	58.43
A2	2082	37.54	11.06	21.37	39.47	60.70
A2	2083	38.12	11.34	21.23	38.76	59.96
A2	2084	34.17	10.17	19.42	38.73	59.78
A2	2085	36.69	11.11	20.59	39.68	60.51
A2	2086	34.41	9.60	20.54	39.66	61.02
A2	2087	37.11	9.95	21.87	39.14	60.34
A2	2088	35.12	10.41	20.06	39.36	60.17
A2	2089	34.18	9.38	20.34	41.11	62.12
A2	2090	36.22	9.84	21.44	41.73	63.18
A2	2091	35.33	10.01	20.71	40.68	61.63
A2	2092	34.91	9.50	20.90	41.41	62.53
A2	2093	35.52	10.65	20.09	40.42	61.86
A2	2094	37.11	10.35	21.90	41.83	63.04
A2	2095	38.24	11.14	22.09	41.78	62.96
A2	2096	37.10	10.42	21.88	41.31	62.40
A2	2097	33.91	9.68	19.78	41.00	62.28
A2	2098	36.01	9.96	21.55	40.71	62.14
A2	2099	37.06	10.18	21.26	41.47	62.41
A2	2100	36.39	9.82	22.14	41.84	63.06
B1	2047	34.38	10.21	18.97	34.06	55.56
B1	2048	31.83	9.43	18.09	33.56	55.06
B1	2049	34.66	10.37	18.98	34.36	56.06
B1	2050	30.48	8.80	17.89	34.35	56.12
B1	2051	30.21	8.44	17.78	34.96	57.02
B1	2052	34.93	10.86	18.91	35.53	57.03
B1	2053	33.43	9.73	18.75	34.99	56.67
B1	2054	34.46	10.07	19.10	34.95	56.38
B1	2055	31.68	8.83	18.36	34.02	55.95
B1	2056	33.18	10.21	18.49	34.93	56.44
B1	2057	33.07	9.46	18.34	34.36	55.99
B1	2058	34.14	10.88	18.76	34.91	56.32
B1	2059	37.47	11.46	19.65	35.92	57.23
B1	2060	34.24	10.64	19.21	35.49	56.90
B1	2061	30.51	8.35	18.35	35.05	56.77
B1	2062	31.41	8.78	18.17	35.32	57.33
B1	2063	34.03	10.47	18.55	35.35	56.67

B1	2064	33.63	10.11	18.68	35.03	56.62
B1	2065	32.76	9.29	18.95	35.28	56.84
B1	2082	34.55	10.09	19.60	36.19	57.93
B1	2083	35.90	10.19	20.52	36.77	58.17
B1	2084	33.13	9.35	19.19	36.81	58.39
B1	2085	33.94	10.19	19.06	36.57	57.94
B1	2086	34.04	9.98	19.52	36.43	58.03
B1	2087	34.85	10.17	19.67	36.67	58.03
B1	2088	33.20	9.29	19.23	35.98	57.63
B1	2089	33.16	9.80	18.82	35.96	57.78
B1	2090	33.96	10.30	19.01	36.35	57.61
B1	2091	34.83	10.47	19.11	36.84	58.00
B1	2092	35.49	10.50	20.09	36.86	58.20
B1	2093	32.26	8.53	19.53	37.61	59.16
B1	2094	33.38	9.32	19.60	36.42	58.13
B1	2095	33.58	9.54	19.48	36.85	58.52
B1	2096	35.53	10.27	19.85	37.23	58.75
B1	2097	35.56	10.44	20.21	36.36	57.65
B1	2098	33.80	10.01	19.09	36.53	58.09
B1	2099	34.36	10.67	18.66	36.43	57.91
B1	2100	33.25	9.28	19.29	37.10	58.55

APPENDIX F

MONTHLY MEANS FOR HISTORIC AND EMISSION SCENARIOS

Table 26. SWB output of monthly precipitation means of historical record and three emission scenarios.

Scenario	Year	Jan. prec. (in.)	Feb. prec. (in.)	Mar. prec. (in.)	Apr. prec. (in.)	May prec. (in.)	Jun. prec. (in.)	Jul. prec. (in.)	Aug. prec. (in.)	Sep. prec. (in.)	Oct. prec. (in.)	Nov. prec. (in.)	Dec. prec. (in.)
Historic	1954	0.34	0.96	1.36	3.47	3.77	5.74	2.76	2.20	6.39	2.95	0.81	0.22
Historic	1955	0.45	1.13	2.34	2.35	3.55	5.48	4.61	6.86	1.94	3.27	0.56	0.81
Historic	1956	0.40	0.25	1.92	1.19	2.97	4.52	3.48	3.13	1.27	0.72	3.32	0.52
Historic	1957	0.19	0.45	0.59	1.80	3.44	2.29	3.03	3.27	3.03	1.50	2.74	0.44
Historic	1958	0.21	0.01	0.50	3.45	2.88	3.29	5.39	3.36	3.92	2.98	1.95	0.15
Historic	1961	0.18	1.87	3.46	1.83	2.73	3.76	6.68	3.73	4.26	4.01	2.80	1.37
Historic	1964	1.25	0.23	1.35	3.10	4.17	2.03	2.94	3.34	7.42	0.31	3.47	1.26
Historic	1965	0.56	2.47	2.25	3.86	4.52	4.11	6.55	3.06	6.94	0.97	3.72	2.38
Historic	1966	0.91	0.64	3.67	2.69	1.13	3.38	2.44	5.09	1.50	2.81	1.20	1.54
Historic	1967	3.35	0.93	1.09	4.35	2.31	8.36	2.12	3.93	3.92	3.60	0.14	0.78
Historic	1970	0.86	0.16	1.54	1.04	5.63	2.27	4.85	1.06	6.54	4.51	2.64	0.99
Historic	1971	2.12	2.43	0.94	0.81	3.77	1.26	4.41	2.87	4.49	3.48	1.78	2.85
Historic	1974	0.38	0.43	0.72	2.70	2.88	3.03	2.97	2.90	3.64	1.51	2.58	1.12
Historic	1975	1.69	0.74	1.21	4.38	1.95	4.90	1.70	3.66	3.26	3.23	3.54	1.71
Historic	1976	1.42	1.18	4.35	3.92	3.11	1.07	3.52	2.20	1.71	0.31	0.17	0.44
Historic	1977	0.57	1.06	3.47	3.54	1.26	3.55	3.62	3.58	5.07	1.82	3.10	1.45
Historic	1978	0.52	0.25	0.23	3.02	4.21	3.10	9.41	4.02	4.80	1.32	1.92	1.22
Historic	1979	1.01	1.65	3.93	1.15	4.64	7.01	4.15	5.13	0.56	5.11	3.08	0.67
Historic	1980	1.59	0.18	0.53	2.42	3.20	7.13	2.20	7.88	7.67	1.82	0.69	0.86
Historic	1981	0.05	2.30	0.34	4.33	2.72	4.08	2.33	4.11	2.23	2.74	0.55	0.92
Historic	1982	1.39	0.29	1.82	3.80	4.76	3.42	3.69	3.94	6.19	3.60	1.74	2.83
Historic	1983	1.49	1.18	1.05	1.98	4.54	1.86	2.58	4.76	5.21	3.51	4.16	1.15
Historic	1984	0.42	1.80	1.32	3.47	1.77	3.91	3.56	3.10	3.71	4.64	2.06	2.61
Historic	1985	0.34	1.26	2.56	2.18	2.92	4.27	2.10	6.48	7.86	3.04	4.67	1.58
Historic	1986	0.54	0.88	1.88	2.99	1.10	5.32	6.49	3.51	8.69	3.83	0.97	0.48
Historic	1987	0.45	0.05	1.03	1.28	2.84	1.70	3.41	2.74	1.60	2.04	3.07	1.64
Historic	1988	1.04	0.19	2.27	1.58	1.64	1.97	4.79	4.97	3.86	1.54	4.08	1.35
Historic	1989	0.66	0.97	2.26	1.35	3.00	2.33	2.55	2.22	1.19	1.93	1.46	0.54
Historic	1990	0.72	0.57	2.59	2.40	4.66	7.05	3.76	8.53	4.63	3.72	1.45	1.48
Historic	1991	0.38	0.99	3.22	4.46	4.23	4.01	5.68	4.60	4.04	2.27	6.41	1.45
Historic	1992	0.68	1.05	2.42	3.85	1.90	2.31	2.16	3.74	6.27	1.77	4.31	2.01
Historic	1993	1.55	0.11	0.41	3.65	4.77	8.17	3.43	3.59	5.53	2.05	2.38	0.64
Historic	1994	1.03	0.86	0.71	3.54	1.50	2.55	4.93	3.47	6.11	2.24	2.42	0.37
Historic	1995	0.59	0.35	1.62	1.90	4.30	1.18	3.05	12.47	1.83	4.33	1.86	1.55
Historic	1996	3.15	0.47	2.35	2.71	1.21	5.67	7.03	3.59	3.37	4.04	3.02	2.31
Historic	1997	2.60	0.22	2.00	0.58	3.19	3.32	4.17	3.95	4.65	3.86	0.48	0.48
Historic	1998	1.71	1.42	2.40	1.49	3.14	7.16	0.62	1.34	3.57	2.38	1.70	0.76

Historic	1999	2.43	1.34	0.28	1.74	6.03	2.15	8.39	3.79	1.71	1.46	1.48	1.26
Historic	2000	2.10	1.07	1.70	2.00	3.75	7.17	2.12	4.03	5.24	0.63	2.68	1.11
Historic	2001	0.88	1.34	0.76	4.78	4.39	2.77	2.13	4.34	3.33	2.54	2.40	1.89
Historic	2002	0.38	2.19	3.29	4.54	4.84	5.41	3.19	5.23	5.31	4.21	0.27	0.56
Historic	2003	0.27	1.07	2.19	4.16	5.05	3.18	1.88	2.44	2.88	0.98	2.03	1.01
Historic	2004	0.97	1.97	2.90	2.01	5.26	4.66	1.67	2.16	2.58	5.38	1.56	1.66
Historic	2005	1.41	1.23	0.74	1.70	2.32	3.63	2.08	1.88	3.85	2.91	2.87	0.98
Historic	2006	1.22	0.67	2.06	1.01	3.21	1.93	5.32	6.57	2.34	2.24	2.02	2.68
Historic	2007	0.79	0.71	2.18	1.99	2.96	3.90	2.93	3.34	1.87	5.63	0.26	1.76
Historic	2008	0.78	0.87	0.38	4.79	4.22	2.96	2.62	1.80	1.55	1.61	1.08	2.03
Historic	2009	0.44	0.79	1.59	4.20	4.52	2.19	2.12	5.76	0.45	5.46	0.63	1.40
A1B	2047	1.17	0.82	2.07	2.57	4.09	3.78	3.78	4.16	4.66	2.96	1.73	1.76
A1B	2048	1.32	1.36	1.78	3.51	3.52	4.05	3.91	4.58	4.56	3.03	2.03	1.44
A1B	2049	1.56	0.75	2.31	2.73	4.51	4.31	4.14	4.00	4.01	3.26	2.12	1.41
A1B	2050	1.36	1.17	2.06	2.80	4.23	4.82	3.43	3.44	4.89	3.78	2.46	1.61
A1B	2051	1.27	1.09	1.73	3.21	4.02	3.77	3.35	4.86	4.57	2.75	2.09	1.57
A1B	2052	1.28	1.23	2.67	3.12	3.75	3.41	3.70	3.68	4.29	3.39	2.04	1.36
A1B	2053	1.16	1.38	2.59	2.99	4.49	4.37	3.79	4.72	5.01	2.73	1.90	1.47
A1B	2054	1.70	0.97	1.54	3.27	3.67	3.40	3.72	5.06	3.92	2.97	2.44	1.32
A1B	2055	1.25	1.02	2.10	2.98	3.47	4.34	3.43	3.80	4.47	2.69	1.74	1.69
A1B	2056	1.12	1.26	1.75	2.88	3.94	4.22	3.96	4.72	3.81	2.50	2.28	1.65
A1B	2057	1.28	1.09	2.08	3.39	3.80	4.52	4.52	4.26	4.41	2.57	2.05	1.82
A1B	2058	1.17	1.12	2.10	2.81	4.53	3.80	3.08	4.29	3.64	3.00	2.02	1.53
A1B	2059	1.09	1.19	1.98	2.76	4.19	3.61	3.96	3.87	3.93	2.83	2.24	1.47
A1B	2060	1.44	1.10	1.99	2.76	3.82	3.71	3.52	4.18	4.50	2.71	2.17	1.40
A1B	2061	1.22	0.70	2.24	3.24	3.92	4.06	3.32	3.77	4.19	4.00	2.06	1.74
A1B	2062	1.26	0.93	1.83	3.17	3.59	4.71	3.07	3.83	3.56	3.03	2.11	1.58
A1B	2063	1.30	0.75	2.08	3.25	4.07	3.59	3.90	4.45	4.80	2.69	2.35	1.38
A1B	2064	1.60	1.15	2.01	3.22	4.33	3.99	3.69	3.87	3.93	2.92	2.34	1.18
A1B	2065	1.26	0.68	2.22	3.45	3.72	3.81	3.01	4.15	3.68	3.06	2.21	1.12
A1B	2082	1.10	0.96	2.03	3.06	4.52	4.05	3.84	3.57	3.74	2.10	1.88	1.26
A1B	2083	1.66	1.16	2.24	2.99	4.26	4.30	3.45	3.72	3.97	2.87	2.66	1.67
A1B	2084	1.32	0.94	1.86	3.03	4.53	4.92	4.13	4.94	4.53	3.73	2.15	1.45
A1B	2085	1.33	0.85	1.96	3.45	4.50	4.24	4.51	4.52	3.93	3.20	2.33	1.59
A1B	2086	1.39	1.18	1.97	2.79	4.10	3.20	4.57	4.22	4.39	2.72	2.16	1.19
A1B	2087	1.31	0.93	2.19	2.99	4.01	4.53	3.71	4.48	4.14	2.68	2.30	1.36
A1B	2088	1.24	1.12	1.91	3.25	4.20	3.64	3.03	3.90	4.19	3.10	1.93	1.73
A1B	2089	1.27	1.11	2.11	3.08	4.51	4.25	4.10	4.45	4.29	3.37	1.98	1.32
A1B	2090	1.41	1.09	2.29	3.45	3.71	4.19	3.57	4.48	4.59	2.98	2.07	1.69
A1B	2091	1.38	1.04	1.85	3.55	3.77	3.24	3.83	3.54	4.67	3.17	2.58	1.52
A1B	2092	1.01	1.00	2.24	4.06	3.55	3.76	4.31	4.68	5.14	3.59	2.47	1.44

A1B	2093	1.19	1.03	2.42	3.08	3.44	4.52	4.08	5.25	5.08	3.52	2.15	1.65
A1B	2094	1.51	1.12	2.09	3.21	3.80	4.27	4.90	4.60	3.80	3.39	2.65	1.51
A1B	2095	1.33	0.99	2.42	3.36	3.90	4.13	3.38	3.57	5.07	3.30	2.11	1.66
A1B	2096	1.18	1.03	2.69	3.65	4.40	4.38	4.17	4.74	3.65	3.58	2.08	1.31
A1B	2097	1.39	1.19	2.17	3.09	4.55	3.64	3.46	4.77	5.35	2.99	2.03	1.39
A1B	2098	1.09	0.92	2.11	3.07	4.45	4.08	4.38	5.37	4.73	2.83	2.48	1.56
A1B	2099	1.35	1.35	2.19	3.80	4.07	4.91	4.27	5.30	5.04	3.33	2.20	1.75
A1B	2100	1.15	1.23	2.46	3.86	3.83	4.63	4.23	4.56	4.70	3.75	2.28	1.56
A2	2047	1.01	0.96	1.53	2.21	3.38	3.42	3.81	4.82	4.69	2.70	1.93	1.41
A2	2048	1.67	1.10	1.78	2.38	3.20	3.76	4.21	3.94	3.80	3.16	1.51	1.42
A2	2049	1.14	1.02	2.18	2.39	3.99	4.11	3.05	4.43	4.16	2.79	3.11	1.77
A2	2050	1.18	1.02	2.35	3.10	4.61	4.46	3.49	4.73	5.19	2.87	1.64	1.47
A2	2051	0.96	0.95	1.82	2.86	3.39	3.85	3.57	3.82	3.52	2.67	2.13	1.64
A2	2052	1.35	1.15	1.90	3.17	3.31	3.38	4.31	4.51	4.28	2.73	2.60	1.59
A2	2053	1.07	1.32	2.04	3.16	3.83	3.77	3.90	4.34	4.74	2.55	1.97	1.22
A2	2054	1.32	0.97	2.09	2.48	3.74	3.60	3.68	4.88	4.73	3.48	1.87	1.38
A2	2055	1.29	1.05	2.03	2.91	3.19	4.87	3.49	4.79	4.73	3.21	1.92	1.52
A2	2056	1.31	0.91	2.03	3.53	4.38	4.09	3.68	4.03	4.13	2.72	1.67	2.01
A2	2057	1.06	0.86	2.71	3.05	3.73	4.18	4.21	3.94	5.57	2.20	1.74	1.02
A2	2058	1.53	0.99	2.58	3.12	3.49	3.12	4.02	4.54	4.88	2.24	2.44	1.09
A2	2059	1.40	1.23	2.51	2.24	3.94	4.32	4.11	3.42	4.50	3.69	3.26	1.45
A2	2060	0.77	0.92	2.14	2.72	2.83	4.32	3.77	4.42	4.29	3.34	1.77	1.49
A2	2061	1.11	1.13	2.21	3.10	2.80	3.66	3.51	4.95	3.33	2.61	2.30	1.90
A2	2062	1.66	0.91	2.03	3.69	3.67	3.84	3.33	3.41	4.03	3.01	2.43	1.32
A2	2063	1.09	1.00	2.25	2.93	3.05	4.44	3.70	4.70	4.04	2.43	2.42	1.25
A2	2064	1.23	0.97	2.37	2.90	4.60	4.01	3.58	3.87	4.26	2.44	2.08	1.83
A2	2065	1.12	1.01	2.24	3.55	3.59	4.23	3.60	2.89	4.26	2.83	2.37	1.37
A2	2082	1.34	0.95	2.58	3.06	4.93	4.48	4.03	4.90	4.29	2.68	2.89	1.41
A2	2083	1.42	1.35	2.96	2.75	5.10	4.00	4.48	4.66	4.72	3.19	1.84	1.64
A2	2084	1.13	1.22	2.42	3.55	3.79	3.59	3.18	4.32	4.77	2.91	1.90	1.39
A2	2085	1.24	1.21	1.95	3.31	4.22	3.95	4.08	4.82	4.91	3.41	2.70	0.88
A2	2086	1.05	0.88	2.48	3.49	3.93	3.78	4.70	3.83	3.54	2.88	2.20	1.63
A2	2087	1.38	0.88	2.26	3.64	4.70	4.55	4.66	5.18	4.39	2.64	1.59	1.25
A2	2088	1.25	0.74	2.28	2.73	4.04	4.14	3.55	4.50	4.49	2.56	3.30	1.55
A2	2089	1.44	1.31	2.33	3.26	4.35	2.64	3.95	4.18	4.35	2.66	2.17	1.54
A2	2090	1.03	1.12	1.40	3.68	3.90	4.35	3.91	4.73	4.36	2.94	3.41	1.40
A2	2091	0.93	1.05	2.20	3.51	3.83	3.90	3.64	3.93	4.68	3.44	2.23	1.97
A2	2092	1.65	1.33	2.38	3.15	3.55	4.09	3.61	4.93	4.02	2.27	2.55	1.37
A2	2093	1.40	1.53	2.38	3.62	3.23	4.42	3.42	3.75	4.65	3.36	2.14	1.61
A2	2094	1.43	1.21	2.49	3.78	4.96	4.65	4.68	3.53	4.05	2.95	1.74	1.63
A2	2095	1.33	1.19	2.43	3.31	5.29	3.79	4.00	5.26	3.49	3.74	2.54	1.87

A2	2096	1.35	1.15	2.74	3.90	4.35	4.10	4.44	3.87	4.48	3.48	1.75	1.50
A2	2097	1.41	1.46	2.08	2.92	4.43	4.56	3.39	2.89	3.62	2.93	2.59	1.63
A2	2098	0.91	0.54	1.95	3.19	4.59	4.33	3.49	4.74	5.15	3.00	2.88	1.23
A2	2099	1.36	1.49	2.00	3.55	4.42	4.61	3.11	5.10	4.99	3.12	1.73	1.57
A2	2100	1.44	1.23	2.21	2.87	4.58	4.54	3.59	4.41	4.84	3.70	1.75	1.24
B1	2047	0.99	1.04	1.92	2.80	4.31	4.47	4.04	4.35	4.11	2.78	2.51	1.06
B1	2048	0.90	0.86	1.93	2.66	4.06	3.87	4.07	3.91	4.09	2.58	1.75	1.14
B1	2049	1.23	0.94	2.21	2.86	2.97	4.19	4.60	3.68	4.72	3.11	2.13	2.02
B1	2050	1.01	0.78	1.86	2.61	4.02	3.21	3.11	4.00	4.25	2.59	1.88	1.14
B1	2051	0.97	0.89	1.78	2.27	4.08	3.28	3.60	3.45	3.46	3.17	2.11	1.13
B1	2052	1.29	1.08	2.44	2.97	2.92	4.22	3.74	4.61	4.48	3.46	2.21	1.52
B1	2053	1.24	0.74	1.49	3.39	4.46	4.07	3.61	4.22	3.57	3.01	1.96	1.68
B1	2054	0.90	1.43	2.24	3.37	3.80	4.12	3.88	4.66	3.81	3.30	1.77	1.18
B1	2055	1.18	0.73	1.84	2.94	3.79	3.29	4.01	3.15	4.46	2.96	2.08	1.25
B1	2056	1.07	1.03	2.09	3.19	3.35	4.39	3.71	3.77	4.32	2.93	2.10	1.22
B1	2057	0.99	0.93	1.97	3.49	3.87	4.36	4.12	3.61	3.53	2.61	2.07	1.53
B1	2058	1.34	1.05	1.90	2.95	3.87	3.90	4.01	4.13	4.41	3.26	1.98	1.35
B1	2059	1.44	1.01	2.22	2.93	4.45	3.73	4.97	4.66	4.32	2.94	3.09	1.71
B1	2060	1.16	1.20	2.06	2.93	4.15	3.85	3.47	5.09	4.05	2.72	2.17	1.41
B1	2061	1.19	1.05	1.96	2.80	3.46	3.76	3.31	4.23	3.81	2.19	1.53	1.22
B1	2062	1.15	0.98	2.35	2.98	3.08	3.29	3.79	3.98	3.53	2.63	2.08	1.57
B1	2063	1.06	1.43	1.77	3.15	3.43	4.02	3.26	4.95	4.45	3.22	2.14	1.16
B1	2064	1.10	0.93	1.81	3.50	3.96	4.13	3.20	4.40	4.47	2.97	1.93	1.24
B1	2065	1.11	0.79	2.19	2.55	4.13	4.59	3.99	4.20	3.70	2.57	1.63	1.33
B1	2082	0.78	0.69	1.60	2.91	3.86	3.91	4.28	4.35	4.55	4.11	2.23	1.29
B1	2083	1.62	1.06	2.28	2.42	3.98	4.44	4.60	4.27	4.65	2.60	2.49	1.49
B1	2084	1.22	0.81	2.38	3.14	4.06	4.13	3.75	3.28	4.04	2.98	1.98	1.36
B1	2085	1.20	0.68	1.92	3.00	3.82	4.09	3.56	4.19	4.68	3.01	2.08	1.71
B1	2086	0.96	1.12	2.24	2.97	3.50	3.99	4.22	4.28	3.86	3.28	2.18	1.43
B1	2087	0.96	0.89	2.22	3.03	4.22	3.80	4.39	4.61	4.50	2.86	1.88	1.50
B1	2088	1.54	0.89	1.80	2.55	3.50	3.55	4.13	4.14	4.10	3.17	1.88	1.94
B1	2089	1.58	0.98	2.49	2.49	3.65	3.76	3.56	4.26	3.79	3.03	2.02	1.55
B1	2090	1.07	0.91	1.77	3.08	4.11	4.55	3.61	3.47	3.99	3.53	1.80	2.07
B1	2091	1.17	1.31	2.31	2.50	3.15	4.23	3.35	4.19	5.14	3.44	2.46	1.57
B1	2092	0.96	1.04	1.89	2.59	4.46	4.37	4.06	4.65	5.18	2.65	2.14	1.50
B1	2093	0.96	0.88	2.03	2.61	3.75	3.83	4.01	4.11	3.34	2.75	2.67	1.34
B1	2094	1.21	0.78	2.10	3.26	3.38	4.16	3.99	4.26	3.79	2.94	2.17	1.35
B1	2095	1.24	0.79	2.16	3.45	3.61	3.97	3.54	4.33	3.72	3.11	2.42	1.23
B1	2096	1.31	0.87	2.20	2.95	4.24	4.59	3.43	4.18	4.79	2.92	2.01	2.03
B1	2097	0.82	0.89	2.21	2.47	3.71	4.82	4.30	5.10	4.49	3.21	2.00	1.53
B1	2098	1.39	1.19	1.95	3.21	3.57	3.77	4.13	4.16	4.04	2.70	2.21	1.47

B1	2099	1.41	0.93	1.84	2.76	4.57	4.09	3.43	4.10	3.53	3.34	2.47	1.89
B1	2100	1.15	1.18	2.04	3.05	3.94	4.80	3.01	4.24	3.92	2.26	1.92	1.73

Table 27. SWB output of monthly recharge means of historical record and three emission scenarios.

Scenario	Year	Jan. rech. (in.)	Feb. rech. (in.)	Mar. rech. (in.)	Apr. rech. (in.)	May rech. (in.)	Jun. rech. (in.)	Jul. rech. (in.)	Aug. rech. (in.)	Sep. rech. (in.)	Oct. rech. (in.)	Nov. rech. (in.)	Dec. rech. (in.)
Historic	1954	0.00	0.64	0.74	2.34	2.01	0.81	0.00	0.00	0.98	1.15	0.07	0.00
Historic	1955	0.00	0.00	3.08	1.75	0.17	1.62	0.01	1.76	0.00	0.45	0.02	0.00
Historic	1956	0.00	0.00	1.74	1.68	0.69	0.09	0.07	0.12	0.00	0.00	0.06	0.04
Historic	1957	0.00	0.20	1.27	0.94	0.38	0.00	0.00	0.01	0.02	0.00	0.49	0.31
Historic	1958	0.00	0.92	0.43	2.07	0.28	0.18	1.32	0.01	0.19	0.44	0.69	0.00
Historic	1961	0.09	0.86	3.88	1.26	0.86	0.11	1.01	0.05	0.56	1.83	2.25	0.09
Historic	1964	0.29	0.53	1.47	1.92	1.20	0.00	0.00	0.01	2.09	0.00	1.23	0.16
Historic	1965	0.19	0.22	1.54	5.95	0.54	0.80	0.69	0.13	2.41	0.00	1.01	2.16
Historic	1966	0.00	1.04	4.14	1.74	0.00	0.13	0.00	0.11	0.00	0.29	0.45	0.25
Historic	1967	0.25	0.00	4.78	2.72	0.56	1.84	0.01	0.07	0.88	1.21	0.00	0.18
Historic	1970	0.00	0.00	1.79	2.23	1.36	0.00	0.01	0.00	1.02	2.07	0.68	1.11
Historic	1971	0.00	0.64	1.58	2.94	0.88	0.00	0.12	0.03	0.34	0.97	0.67	0.29
Historic	1974	0.00	0.07	1.59	2.17	0.22	0.01	0.00	0.01	0.17	0.03	0.97	0.00
Historic	1975	0.00	0.00	2.34	4.93	0.29	0.10	0.00	0.08	0.36	0.97	1.94	0.91
Historic	1976	0.00	2.19	3.39	2.31	0.87	0.00	0.02	0.01	0.00	0.00	0.00	0.00
Historic	1977	0.00	0.00	2.47	2.04	0.00	0.00	0.01	0.03	0.87	0.81	1.28	0.88
Historic	1978	0.00	0.00	1.57	2.42	0.56	0.07	2.58	0.06	0.89	0.58	0.00	0.00
Historic	1979	0.00	0.00	3.90	3.34	1.57	2.10	0.01	0.45	0.00	1.46	2.29	0.57
Historic	1980	0.55	0.21	1.25	1.86	0.01	2.00	0.00	1.12	3.20	0.67	0.37	0.38
Historic	1981	0.41	1.39	0.86	2.27	1.12	0.01	0.00	0.05	0.01	0.75	0.00	0.00
Historic	1982	0.00	0.88	2.72	2.87	1.39	0.01	0.01	0.21	2.32	1.44	1.04	1.08
Historic	1983	0.00	3.01	1.78	1.62	1.25	0.01	0.00	0.02	1.05	1.31	2.09	0.00
Historic	1984	0.00	3.46	1.13	1.53	0.64	0.03	0.01	0.00	0.03	1.66	1.78	1.93
Historic	1985	0.00	1.41	2.51	1.04	0.02	0.06	0.05	0.81	3.22	1.73	2.11	0.00
Historic	1986	0.00	0.16	4.38	1.06	0.13	0.40	1.19	0.02	2.99	1.68	0.30	0.00
Historic	1987	0.00	0.00	1.58	0.36	0.01	0.00	0.00	0.00	0.00	0.04	1.28	0.53
Historic	1988	0.49	0.00	3.09	0.90	0.00	0.00	0.15	0.06	0.52	0.27	2.61	0.38
Historic	1989	0.00	0.00	3.96	0.58	0.08	0.08	0.00	0.00	0.00	0.00	0.07	0.00
Historic	1990	0.00	0.07	2.48	0.94	1.96	1.27	0.01	2.20	0.96	1.93	0.63	0.40
Historic	1991	0.00	1.26	3.14	2.89	0.79	0.69	0.10	0.73	0.13	0.73	2.98	0.19
Historic	1992	0.26	0.31	4.84	3.65	0.00	0.00	0.00	0.01	1.50	0.59	1.94	0.74
Historic	1993	0.00	0.45	2.82	2.61	1.21	3.32	0.01	0.00	1.24	0.73	0.90	1.40
Historic	1994	0.00	1.02	1.05	2.62	0.07	0.00	0.05	0.01	1.46	0.66	0.85	0.70
Historic	1995	0.13	0.54	1.68	1.51	1.33	0.00	0.00	3.18	0.00	1.73	0.69	0.00

Historic	1996	0.41	0.91	2.18	4.79	0.07	0.30	1.40	0.02	0.03	1.81	1.28	0.00
Historic	1997	0.41	0.73	2.95	2.63	0.30	0.07	0.01	0.08	0.73	1.16	0.27	0.35
Historic	1998	0.04	2.75	1.86	0.60	0.18	1.72	0.00	0.00	0.16	0.29	0.91	0.00
Historic	1999	0.00	1.04	2.59	0.88	1.85	0.00	0.66	0.49	0.00	0.00	0.09	0.38
Historic	2000	0.00	2.93	1.05	1.24	0.06	1.86	0.06	0.09	0.87	0.00	0.17	0.00
Historic	2001	0.21	0.00	1.86	4.99	0.56	0.00	0.00	0.54	0.15	0.19	0.95	1.34
Historic	2002	0.66	1.79	2.25	3.51	2.05	0.82	0.00	0.51	0.71	2.82	0.10	0.38
Historic	2003	0.17	0.41	1.58	3.77	1.67	0.39	0.00	0.00	0.01	0.00	0.32	0.38
Historic	2004	0.00	0.00	4.67	0.90	1.60	1.56	0.00	0.00	0.02	1.50	0.36	0.80
Historic	2005	0.00	2.17	1.84	0.47	0.26	0.03	0.00	0.00	0.12	0.65	1.82	0.35
Historic	2006	0.51	0.00	3.35	0.39	0.32	0.00	0.40	1.45	0.00	0.70	1.40	1.55
Historic	2007	0.81	0.24	2.40	1.36	0.01	0.07	0.00	0.01	0.00	1.73	0.00	0.00
Historic	2008	0.75	0.00	0.62	4.78	1.29	0.03	0.00	0.00	0.00	0.00	0.02	0.04
Historic	2009	0.00	0.21	2.22	2.39	0.96	0.24	0.00	0.10	0.00	1.69	0.06	0.02
A1B	2047	0.62	0.83	2.06	1.64	1.04	0.39	0.13	0.31	0.52	0.98	0.75	0.88
A1B	2048	0.85	0.77	2.21	2.13	0.90	0.37	0.18	0.47	0.67	0.90	0.83	0.65
A1B	2049	0.71	0.82	2.61	1.56	0.96	0.53	0.27	0.29	0.49	0.77	1.12	0.76
A1B	2050	0.69	0.98	2.24	1.57	0.87	0.55	0.16	0.27	0.90	1.25	1.24	0.74
A1B	2051	0.50	1.40	2.01	1.70	0.96	0.26	0.13	0.59	0.72	0.64	0.78	0.80
A1B	2052	0.56	1.23	2.64	1.66	0.86	0.30	0.16	0.13	0.59	0.86	0.83	0.69
A1B	2053	0.79	0.94	2.31	1.93	1.14	0.45	0.18	0.44	1.19	0.70	0.90	0.64
A1B	2054	0.69	0.68	1.90	2.11	0.71	0.13	0.26	0.37	0.55	0.74	0.98	0.72
A1B	2055	0.60	1.09	2.16	1.60	0.64	0.42	0.14	0.19	0.64	0.56	0.72	0.65
A1B	2056	0.52	0.90	2.13	1.55	0.67	0.47	0.21	0.43	0.52	0.63	0.84	0.72
A1B	2057	0.70	0.95	1.99	2.13	0.77	0.56	0.27	0.39	0.56	0.60	0.87	0.86
A1B	2058	0.71	1.09	2.24	1.54	1.23	0.35	0.11	0.17	0.43	0.79	0.86	0.54
A1B	2059	0.70	0.97	1.96	1.52	0.92	0.28	0.25	0.16	0.59	0.61	0.97	0.65
A1B	2060	0.72	1.07	2.15	1.46	0.91	0.21	0.16	0.34	0.65	0.71	0.68	0.73
A1B	2061	0.65	0.66	2.17	1.73	0.84	0.38	0.13	0.33	0.44	1.50	0.85	0.79
A1B	2062	1.06	1.00	1.76	1.66	0.59	0.55	0.12	0.19	0.30	0.58	0.78	0.77
A1B	2063	0.82	0.88	2.02	1.75	0.86	0.32	0.21	0.31	0.74	0.72	1.02	0.62
A1B	2064	0.86	1.08	2.15	1.64	0.99	0.27	0.16	0.26	0.43	0.70	0.95	0.68
A1B	2065	0.88	0.85	1.66	1.90	0.77	0.22	0.05	0.29	0.39	0.58	0.95	0.63
A1B	2082	0.76	0.83	1.91	1.27	1.24	0.50	0.15	0.22	0.44	0.30	0.58	0.54
A1B	2083	0.81	1.17	2.07	1.44	0.83	0.55	0.11	0.15	0.52	0.57	1.13	0.73
A1B	2084	0.82	0.67	1.98	1.49	1.02	0.57	0.27	0.48	0.57	1.12	1.05	0.80
A1B	2085	1.00	0.78	1.76	1.84	1.10	0.38	0.37	0.36	0.51	0.89	1.06	0.71
A1B	2086	0.89	0.89	1.80	1.35	0.72	0.16	0.25	0.29	0.70	0.44	0.95	0.63
A1B	2087	0.80	0.94	1.97	1.51	0.85	0.57	0.23	0.34	0.61	0.54	0.94	0.72
A1B	2088	0.68	0.97	1.83	1.46	0.75	0.30	0.04	0.16	0.46	0.77	0.62	0.91
A1B	2089	0.65	0.92	2.09	1.48	1.02	0.50	0.27	0.36	0.55	0.88	0.90	0.64

A1B	2090	0.73	1.15	2.12	1.80	0.83	0.30	0.13	0.29	0.68	0.70	0.93	0.96
A1B	2091	0.85	0.93	1.89	1.70	0.68	0.12	0.20	0.18	0.60	0.79	1.15	1.08
A1B	2092	0.55	0.80	2.11	2.04	0.58	0.28	0.26	0.37	0.91	1.33	1.14	0.82
A1B	2093	0.65	1.21	1.94	1.56	0.63	0.47	0.22	0.65	0.97	0.99	1.07	1.13
A1B	2094	0.95	1.15	1.85	1.54	0.78	0.36	0.37	0.43	0.54	0.67	1.15	0.91
A1B	2095	0.94	0.95	1.94	1.66	0.64	0.25	0.19	0.10	0.92	0.86	0.89	0.93
A1B	2096	0.90	0.91	2.04	2.12	0.85	0.48	0.14	0.41	0.39	0.81	0.98	0.67
A1B	2097	1.06	0.85	1.92	1.54	1.11	0.35	0.13	0.42	0.87	0.82	0.69	0.74
A1B	2098	0.82	0.77	1.83	1.29	1.09	0.36	0.41	0.58	0.88	0.62	1.04	0.74
A1B	2099	0.81	1.39	2.05	1.93	0.86	0.56	0.25	0.54	1.02	1.08	0.93	0.92
A1B	2100	0.84	0.86	2.17	1.99	0.70	0.57	0.31	0.47	0.89	1.15	0.93	0.96
A2	2047	0.44	0.73	1.89	1.71	0.59	0.28	0.23	0.45	0.83	0.96	0.79	0.80
A2	2048	0.76	0.77	2.39	1.27	0.63	0.31	0.27	0.37	0.46	0.74	0.73	0.42
A2	2049	0.84	1.13	1.99	1.48	1.03	0.49	0.25	0.43	0.49	0.60	1.48	1.07
A2	2050	0.54	0.96	2.34	2.13	1.17	0.78	0.09	0.48	1.07	0.76	0.76	0.69
A2	2051	0.76	0.64	1.90	1.46	0.77	0.24	0.10	0.29	0.33	0.62	0.92	0.82
A2	2052	0.39	1.05	2.52	1.67	0.66	0.25	0.35	0.41	0.65	0.64	1.27	0.82
A2	2053	0.65	1.22	2.28	1.97	0.90	0.34	0.15	0.42	0.80	0.65	0.80	0.79
A2	2054	0.78	0.66	1.86	1.45	0.95	0.24	0.06	0.35	0.87	1.03	0.87	0.75
A2	2055	0.83	0.81	1.58	2.42	0.82	0.51	0.29	0.23	0.69	0.98	0.83	0.87
A2	2056	0.88	0.51	2.09	2.35	1.08	0.49	0.08	0.20	0.63	0.68	0.66	1.04
A2	2057	0.47	0.87	2.85	1.41	0.77	0.49	0.26	0.22	1.12	0.45	0.72	0.58
A2	2058	0.87	1.00	2.42	1.42	0.66	0.14	0.21	0.29	0.97	0.38	1.00	0.54
A2	2059	0.72	1.11	2.29	1.31	0.49	0.42	0.18	0.13	0.58	1.17	1.73	0.64
A2	2060	0.59	0.58	2.41	1.47	0.60	0.28	0.27	0.22	0.81	1.07	0.79	0.92
A2	2061	0.32	1.17	2.12	1.64	0.44	0.30	0.13	0.48	0.41	0.47	0.87	1.06
A2	2062	0.74	0.87	2.25	2.21	0.81	0.29	0.12	0.16	0.45	0.91	0.99	0.54
A2	2063	0.49	1.01	1.87	1.89	0.60	0.47	0.12	0.52	0.49	0.38	0.98	0.59
A2	2064	0.55	0.91	2.35	1.51	1.06	0.37	0.16	0.18	0.60	0.42	0.79	0.69
A2	2065	0.53	0.90	2.62	1.73	0.87	0.38	0.09	0.08	0.42	0.63	1.15	0.78
A2	2082	0.95	0.92	2.12	1.55	1.12	0.46	0.29	0.44	0.59	0.51	1.24	0.88
A2	2083	0.71	1.03	2.97	1.28	1.17	0.33	0.37	0.37	1.00	0.59	0.60	0.91
A2	2084	0.80	1.10	2.25	1.89	0.83	0.19	0.09	0.20	0.80	0.79	0.76	0.47
A2	2085	0.74	0.97	2.04	1.51	0.79	0.32	0.34	0.32	1.18	1.08	1.40	0.42
A2	2086	0.76	0.86	1.98	1.71	0.57	0.32	0.35	0.31	0.36	0.59	0.87	0.93
A2	2087	0.68	0.64	2.18	1.89	1.09	0.50	0.17	0.40	0.71	0.71	0.51	0.47
A2	2088	0.85	0.64	2.12	1.34	0.85	0.29	0.23	0.47	0.60	0.42	1.49	1.13
A2	2089	0.88	1.03	2.13	1.33	0.62	0.10	0.11	0.23	0.54	0.71	0.90	0.79
A2	2090	0.66	1.00	1.22	1.42	0.85	0.37	0.30	0.41	0.63	0.73	1.36	0.88
A2	2091	0.73	0.76	1.98	1.81	0.56	0.30	0.09	0.17	0.43	1.00	1.05	1.12
A2	2092	1.36	0.97	1.77	1.63	0.51	0.33	0.13	0.38	0.58	0.27	0.91	0.66

A2	2093	0.65	1.04	2.37	2.06	0.52	0.43	0.11	0.22	0.51	1.01	1.00	0.75
A2	2094	0.97	1.15	1.98	1.57	1.14	0.72	0.22	0.19	0.44	0.55	0.64	0.77
A2	2095	0.84	1.16	1.99	1.50	1.13	0.41	0.11	0.50	0.39	1.04	0.98	1.09
A2	2096	0.94	1.16	2.21	1.66	0.87	0.34	0.28	0.14	0.56	0.84	0.62	0.81
A2	2097	0.91	1.46	1.82	1.34	0.91	0.57	0.17	0.03	0.25	0.51	0.95	0.75
A2	2098	0.70	0.54	1.60	1.31	0.90	0.37	0.19	0.40	1.00	0.85	1.23	0.85
A2	2099	1.07	0.99	1.77	1.60	1.03	0.53	0.10	0.34	0.96	0.61	0.60	0.57
A2	2100	0.94	1.26	1.89	0.95	0.79	0.43	0.13	0.18	0.64	1.09	0.70	0.82
B1	2047	0.41	0.92	2.29	1.51	1.00	0.63	0.36	0.34	0.59	0.74	1.01	0.42
B1	2048	0.41	0.62	2.31	1.84	0.99	0.43	0.20	0.26	0.68	0.61	0.62	0.46
B1	2049	0.25	0.65	2.81	1.60	0.47	0.36	0.38	0.28	0.69	0.84	0.92	1.13
B1	2050	0.31	0.79	1.86	2.07	0.78	0.24	0.06	0.19	0.63	0.59	0.55	0.72
B1	2051	0.58	0.77	1.89	1.15	1.10	0.14	0.18	0.14	0.45	0.75	0.67	0.61
B1	2052	0.78	0.92	2.33	1.50	0.44	0.39	0.26	0.37	0.73	1.32	0.96	0.85
B1	2053	0.52	0.83	1.74	1.96	1.02	0.43	0.21	0.29	0.43	0.80	0.85	0.65
B1	2054	0.39	1.34	2.23	1.96	0.68	0.43	0.20	0.35	0.57	0.87	0.67	0.38
B1	2055	0.33	0.65	2.42	1.76	0.71	0.10	0.26	0.12	0.57	0.65	0.73	0.54
B1	2056	0.75	0.69	2.36	1.95	0.69	0.48	0.17	0.23	0.63	0.79	0.91	0.57
B1	2057	0.33	0.75	2.12	2.03	1.08	0.56	0.29	0.16	0.43	0.41	0.74	0.56
B1	2058	0.49	0.74	2.43	1.97	0.91	0.30	0.25	0.30	0.71	1.15	0.91	0.71
B1	2059	0.73	0.88	2.31	1.44	1.10	0.33	0.59	0.45	0.86	0.87	1.30	0.61
B1	2060	0.89	1.09	2.12	1.94	0.94	0.37	0.11	0.41	0.49	0.64	1.01	0.63
B1	2061	0.56	0.90	1.86	2.09	0.60	0.28	0.14	0.23	0.46	0.32	0.46	0.44
B1	2062	0.51	0.56	2.65	1.60	0.50	0.16	0.22	0.22	0.17	0.72	0.70	0.76
B1	2063	0.42	1.21	1.90	2.12	0.78	0.36	0.12	0.43	0.75	0.95	0.93	0.51
B1	2064	0.45	0.68	1.93	2.42	0.89	0.49	0.05	0.35	0.79	0.84	0.74	0.48
B1	2065	0.42	0.64	2.54	1.42	0.97	0.72	0.22	0.37	0.40	0.56	0.56	0.47
B1	2082	0.56	0.53	1.68	1.66	0.71	0.32	0.39	0.35	0.63	1.45	0.98	0.84
B1	2083	0.94	1.01	2.36	0.95	0.73	0.41	0.28	0.34	0.66	0.56	1.07	0.88
B1	2084	0.78	0.76	2.40	1.50	0.85	0.35	0.18	0.13	0.51	0.64	0.76	0.49
B1	2085	0.56	0.77	2.15	1.65	1.08	0.27	0.12	0.30	0.70	0.89	0.93	0.78
B1	2086	0.80	0.79	1.93	1.96	0.57	0.37	0.20	0.22	0.46	0.75	1.04	0.90
B1	2087	0.60	0.73	2.01	1.74	1.08	0.24	0.36	0.56	0.79	0.60	0.79	0.68
B1	2088	0.90	0.86	1.77	1.55	0.63	0.16	0.18	0.36	0.64	0.94	0.66	0.65
B1	2089	0.53	1.00	2.70	1.52	0.71	0.32	0.19	0.42	0.39	0.61	0.95	0.46
B1	2090	0.55	1.09	1.62	1.95	1.06	0.47	0.12	0.14	0.38	0.92	0.89	1.08
B1	2091	0.48	1.29	2.04	1.42	0.54	0.34	0.11	0.20	1.01	1.07	1.23	0.74
B1	2092	0.65	0.96	2.04	1.13	1.01	0.62	0.17	0.43	1.18	0.66	0.85	0.78
B1	2093	0.57	0.93	1.93	1.27	0.50	0.33	0.11	0.19	0.38	0.49	1.03	0.79
B1	2094	0.57	0.76	2.16	1.78	0.70	0.32	0.20	0.21	0.40	0.68	1.00	0.55
B1	2095	0.64	1.00	1.91	1.74	0.86	0.17	0.25	0.25	0.39	0.64	1.05	0.65

B1	2096	0.93	0.81	2.07	1.65	0.72	0.47	0.20	0.30	0.83	0.68	0.77	0.83
B1	2097	0.67	0.83	2.11	1.48	0.58	0.61	0.33	0.48	0.71	1.00	1.02	0.62
B1	2098	0.84	0.75	2.08	1.97	0.67	0.37	0.35	0.24	0.54	0.68	0.98	0.55
B1	2099	0.94	0.87	1.93	1.42	1.32	0.45	0.17	0.19	0.36	0.86	1.16	0.99
B1	2100	0.58	1.23	1.92	1.64	0.69	0.64	0.07	0.30	0.57	0.36	0.61	0.65

Table 28. SWB output of monthly temperature means of historical record and three emission scenarios.

Scenario	Year	Jan. tmp. (°F)	Feb. tmp. (°F)	Mar. tmp. (°F)	Apr. tmp. (°F)	May tmp. (°F)	Jun. tmp. (°F)	Jul. tmp. (°F)	Aug. tmp. (°F)	Sep. tmp. (°F)	Oct. tmp. (°F)	Nov. tmp. (°F)	Dec. tmp. (°F)
Historic	1954	12.4	27.5	25.7	44.2	49.0	66.5	68.5	64.9	56.0	44.5	34.7	20.4
Historic	1955	12.3	14.3	22.7	48.5	57.6	63.2	73.1	70.9	59.0	48.6	27.0	13.6
Historic	1956	15.2	14.2	22.8	39.2	54.0	66.9	65.5	66.7	55.5	52.8	32.0	21.0
Historic	1957	7.5	18.4	28.8	44.4	54.0	64.1	70.8	66.3	56.0	46.0	31.4	20.0
Historic	1958	18.6	13.6	29.6	44.1	54.1	59.4	66.5	65.9	58.8	49.7	33.6	11.9
Historic	1961	14.0	22.7	30.0	39.2	50.8	64.0	67.7	67.3	57.4	47.1	29.4	15.8
Historic	1964	18.8	19.6	26.0	44.8	60.5	65.3	71.4	65.0	56.9	45.3	35.8	14.3
Historic	1965	10.9	12.7	21.8	39.6	59.9	63.4	67.1	65.3	53.8	48.1	32.4	25.8
Historic	1966	5.7	18.6	32.1	40.5	51.2	66.6	72.0	64.7	57.0	45.4	31.1	18.8
Historic	1967	16.4	9.9	27.8	43.3	50.1	65.3	66.8	64.2	57.1	45.6	29.3	20.0
Historic	1970	6.5	13.9	24.0	41.2	57.5	67.9	72.2	68.2	59.8	49.7	30.5	18.2
Historic	1971	6.1	15.8	23.4	42.2	52.0	67.9	64.7	64.2	59.8	53.7	33.0	19.5
Historic	1974	12.5	14.9	27.7	44.6	49.1	70.3	68.4	63.1	49.1	43.9	30.4	20.3
Historic	1975	12.4	13.2	22.3	38.4	60.1	64.8	70.3	65.9	52.5	48.2	36.6	17.6
Historic	1976	7.4	20.9	25.7	43.3	50.7	64.5	66.9	63.2	53.9	38.8	22.6	5.5
Historic	1977	-2.4	15.2	33.5	46.6	61.7	60.8	68.6	60.0	56.8	44.3	31.1	15.0
Historic	1978	7.5	7.7	24.0	40.0	55.1	61.2	65.0	65.3	58.9	42.6	28.9	10.8
Historic	1979	0.6	5.9	25.7	38.8	49.2	60.7	66.8	62.7	57.3	43.3	29.9	22.4
Historic	1980	12.6	12.9	22.6	43.5	55.9	61.1	67.7	64.7	53.5	40.3	32.5	15.8
Historic	1981	12.7	19.1	31.2	43.9	51.9	62.1	65.6	64.6	53.4	41.5	34.5	17.1
Historic	1982	1.3	11.0	24.8	37.1	58.7	56.3	67.4	61.9	53.2	46.0	30.6	24.2
Historic	1983	17.7	24.1	31.4	38.9	48.2	62.8	71.4	68.9	57.2	45.6	33.7	6.0
Historic	1984	10.0	25.4	21.5	45.4	49.8	64.6	65.3	67.3	53.9	48.4	30.1	17.7
Historic	1985	9.9	12.1	31.8	45.1	57.4	59.1	65.6	63.6	56.3	44.2	25.3	5.2
Historic	1986	12.2	12.5	28.1	46.9	57.1	62.6	68.7	61.8	56.5	43.9	26.0	20.3
Historic	1987	17.6	23.9	33.4	45.7	56.3	66.3	70.7	65.3	57.4	38.7	34.3	24.5
Historic	1988	6.9	8.7	27.9	41.9	57.9	66.2	70.8	69.6	57.0	39.3	33.6	16.0
Historic	1989	17.4	6.3	21.2	39.0	53.3	61.6	69.3	66.3	55.8	46.9	25.8	5.0
Historic	1990	20.9	15.9	30.3	44.4	50.5	63.1	66.6	65.5	58.7	43.2	35.1	16.4
Historic	1991	8.1	17.6	29.0	44.8	58.4	68.0	66.9	67.5	53.9	43.4	25.1	17.7
Historic	1992	18.1	22.0	26.6	39.1	55.1	59.9	61.8	61.6	54.5	43.5	28.7	18.9

Historic	1993	11.1	14.4	27.5	37.4	53.3	60.1	66.7	66.2	50.6	42.2	28.2	20.1
Historic	1994	1.5	9.9	28.8	40.3	54.0	65.6	65.8	62.9	59.9	47.8	35.3	23.8
Historic	1995	15.4	15.1	30.5	35.6	52.8	68.6	68.5	70.6	54.2	45.7	21.9	13.5
Historic	1996	8.1	12.3	19.8	36.9	50.7	63.1	64.0	65.8	57.2	45.3	24.7	17.0
Historic	1997	10.0	17.6	25.9	39.4	47.6	65.0	66.5	61.5	57.9	45.5	28.5	24.9
Historic	1998	18.3	30.0	29.2	46.4	60.7	63.0	68.6	68.2	61.6	47.7	35.6	22.8
Historic	1999	8.7	23.1	29.2	46.1	57.3	64.8	71.4	64.5	56.0	43.6	37.8	19.7
Historic	2000	11.5	21.2	36.6	41.3	55.9	61.6	66.8	66.4	56.7	48.5	31.0	7.9
Historic	2001	16.9	12.8	26.2	44.9	56.2	63.5	68.1	67.9	56.1	43.7	40.3	25.1
Historic	2002	21.7	23.7	22.1	41.0	49.5	65.9	72.6	66.8	60.1	40.6	29.7	22.3
Historic	2003	11.5	8.8	27.0	41.4	52.7	62.8	67.8	69.4	58.5	44.9	30.3	22.0
Historic	2004	7.1	16.8	30.3	42.0	50.9	60.9	65.8	60.5	61.4	45.7	34.0	17.6
Historic	2005	10.8	21.2	23.8	45.8	51.4	69.2	70.3	67.4	61.4	47.6	31.8	17.0
Historic	2006	24.9	14.0	29.2	47.6	55.2	64.5	72.0	66.4	54.5	41.1	34.8	25.0
Historic	2007	18.7	9.5	32.1	41.7	59.2	67.1	69.7	67.7	60.3	51.4	30.8	14.5
Historic	2008	13.5	10.1	21.7	41.8	51.1	63.6	68.6	66.4	60.1	45.2	31.3	10.4
Historic	2009	2.3	16.9	26.5	41.2	54.5	63.3	63.4	64.4	60.6	40.3	38.1	16.0
A1B	2047	15.4	20.0	31.1	46.5	56.9	65.9	70.9	69.4	59.8	49.0	35.3	24.7
A1B	2048	19.4	22.3	31.2	45.9	56.9	67.7	71.5	70.0	61.5	49.2	36.2	22.6
A1B	2049	18.7	20.0	32.9	45.0	59.1	66.1	70.5	69.1	59.7	49.6	35.7	24.6
A1B	2050	18.1	23.7	31.7	46.8	60.5	68.3	71.6	68.5	60.4	50.1	35.7	24.3
A1B	2051	17.0	22.8	31.1	47.0	58.3	68.1	73.5	70.9	62.3	51.0	36.8	23.6
A1B	2052	18.3	22.5	34.3	47.6	59.2	66.3	72.4	69.7	62.3	51.2	35.3	22.4
A1B	2053	20.6	20.9	30.9	46.7	59.5	68.7	71.7	68.9	62.3	49.8	36.6	24.0
A1B	2054	19.7	20.2	31.8	46.6	60.1	68.0	72.5	70.0	62.1	51.3	36.2	24.9
A1B	2055	17.6	22.5	33.8	46.7	58.6	67.0	72.2	69.8	62.4	50.8	37.2	25.4
A1B	2056	20.0	21.1	34.1	46.6	59.6	69.1	73.5	72.2	61.1	51.0	37.9	23.6
A1B	2057	19.6	23.8	31.2	47.5	59.6	67.8	72.1	70.6	61.5	49.6	36.8	23.4
A1B	2058	20.7	23.8	30.8	45.9	59.4	68.1	71.7	70.5	62.8	50.8	36.1	23.3
A1B	2059	20.9	23.7	33.7	46.2	60.1	68.4	73.3	71.0	62.6	51.2	36.4	21.3
A1B	2060	16.3	21.9	29.8	45.7	59.2	69.7	72.4	70.8	62.2	51.3	37.0	25.6
A1B	2061	19.0	20.0	33.0	47.9	59.8	67.9	72.6	71.0	61.5	50.2	36.2	25.0
A1B	2062	22.1	24.0	32.7	48.7	59.9	68.6	73.6	70.7	63.0	52.2	37.7	26.1
A1B	2063	20.1	23.3	33.3	46.9	60.1	69.0	73.0	70.4	63.1	52.4	39.1	26.6
A1B	2064	22.2	21.0	33.5	47.3	59.6	67.1	74.4	71.1	62.9	51.8	36.6	26.0
A1B	2065	20.7	25.5	32.5	49.1	58.9	68.8	74.7	71.1	61.9	52.1	38.9	26.0
A1B	2082	20.8	25.0	36.0	49.4	60.2	70.5	74.4	73.9	66.1	53.1	38.3	28.2
A1B	2083	20.6	25.7	34.5	49.2	63.0	69.8	75.2	73.5	64.6	52.6	39.3	26.1
A1B	2084	21.9	24.5	32.9	48.7	61.8	69.1	73.8	71.9	63.1	52.4	37.6	26.5
A1B	2085	22.1	22.7	33.5	48.8	61.0	69.3	73.3	72.2	64.0	53.2	39.7	26.3
A1B	2086	21.9	25.0	33.6	51.2	60.9	68.8	74.1	72.3	63.4	52.3	38.2	26.4

A1B	2087	22.8	23.7	33.4	48.8	61.4	70.9	74.9	71.8	63.9	53.9	38.8	28.9
A1B	2088	23.6	24.3	36.3	49.6	62.7	70.1	75.8	73.1	64.8	53.6	40.3	27.5
A1B	2089	21.7	24.8	34.7	48.3	62.0	68.6	72.7	72.4	65.1	53.3	38.2	27.1
A1B	2090	21.3	23.9	33.6	49.0	61.2	70.6	74.0	73.1	64.0	53.6	38.5	26.7
A1B	2091	23.5	25.4	34.1	50.7	61.7	69.6	75.2	73.4	64.0	54.8	39.4	29.1
A1B	2092	23.2	24.5	35.4	49.6	61.4	70.1	73.8	72.2	64.3	52.1	37.7	27.3
A1B	2093	19.8	24.0	35.3	50.8	62.5	70.6	74.7	72.9	63.5	53.1	38.6	27.2
A1B	2094	23.0	25.2	34.6	48.9	63.8	70.3	74.8	73.0	65.1	56.2	38.3	27.1
A1B	2095	24.1	26.3	35.2	50.2	62.1	70.8	75.2	73.2	65.4	53.3	38.8	27.8
A1B	2096	25.1	25.2	34.7	50.5	63.0	70.3	75.3	72.2	66.0	54.2	38.4	26.0
A1B	2097	24.8	22.5	33.9	49.4	62.4	69.4	74.3	73.0	64.5	54.3	40.3	28.0
A1B	2098	24.8	24.8	36.0	50.5	61.5	70.1	74.3	72.4	63.9	54.3	37.9	27.5
A1B	2099	21.7	26.5	34.3	48.8	61.0	69.7	74.4	72.8	64.0	55.3	41.9	30.0
A1B	2100	23.7	24.6	33.5	50.3	61.5	70.1	74.1	72.2	65.4	54.9	40.4	28.0
A2	2047	13.9	17.9	25.8	43.4	57.1	65.1	70.8	68.4	58.7	46.4	35.6	26.1
A2	2048	19.2	19.7	30.1	46.3	59.1	66.7	71.4	69.3	59.3	49.8	35.6	22.7
A2	2049	20.8	23.2	31.7	44.0	56.2	63.5	71.0	70.5	62.5	48.9	36.0	24.5
A2	2050	16.4	19.2	30.9	44.7	57.6	65.4	70.9	68.8	60.9	49.2	34.6	22.7
A2	2051	22.5	20.9	31.7	47.4	60.3	68.7	70.9	70.0	61.7	50.3	35.3	23.8
A2	2052	16.4	18.7	33.4	46.5	58.2	68.3	72.4	70.5	62.5	49.7	35.8	24.0
A2	2053	20.6	24.0	30.7	43.5	57.5	67.6	71.9	70.4	59.9	51.0	35.9	24.9
A2	2054	19.4	19.4	31.1	45.0	57.8	66.9	72.4	71.0	61.3	50.5	36.7	23.7
A2	2055	18.3	23.7	30.2	44.7	57.8	67.6	72.1	70.6	61.5	50.8	37.5	24.8
A2	2056	21.5	17.6	29.8	47.2	57.9	67.2	72.5	69.5	59.6	48.8	36.9	24.2
A2	2057	16.5	19.3	33.4	48.9	60.0	68.5	72.9	70.2	61.3	50.2	35.7	26.2
A2	2058	19.5	23.7	33.4	48.1	58.9	67.2	72.6	70.9	62.6	49.9	37.0	22.7
A2	2059	18.8	18.5	33.7	48.5	60.5	68.1	72.3	70.6	62.1	50.4	37.9	25.0
A2	2060	19.0	19.5	32.5	47.1	60.4	68.3	73.9	71.5	60.9	50.5	35.4	24.3
A2	2061	16.0	25.8	32.5	45.7	60.1	69.1	72.4	71.6	61.9	51.6	37.4	25.6
A2	2062	18.0	20.2	30.7	46.5	59.8	67.2	73.0	72.8	62.6	51.2	38.9	23.2
A2	2063	17.5	21.3	31.3	45.9	59.4	69.9	72.8	71.8	61.7	52.6	40.8	24.8
A2	2064	18.2	21.7	31.6	48.2	61.0	68.1	72.6	71.6	61.4	52.3	38.5	26.0
A2	2065	18.1	21.9	34.9	47.4	59.0	67.9	73.1	72.7	62.9	50.8	36.6	22.9
A2	2082	21.8	24.7	35.1	48.1	63.1	70.3	74.2	72.4	65.5	53.6	41.8	28.4
A2	2083	20.5	23.4	33.1	49.4	63.4	67.9	75.0	72.9	63.7	55.4	38.4	27.4
A2	2084	20.7	21.7	33.6	48.8	62.5	71.4	75.4	72.5	64.1	54.3	39.3	25.9
A2	2085	20.7	25.7	35.2	51.1	62.2	70.4	76.9	75.2	64.6	52.1	38.7	26.9
A2	2086	23.7	23.9	33.8	51.9	62.2	69.3	75.2	72.9	64.9	55.0	40.2	29.2
A2	2087	20.0	22.6	35.7	49.2	62.9	69.4	74.8	74.9	64.5	53.4	39.0	28.5
A2	2088	25.3	23.0	33.0	47.8	60.3	70.9	74.8	73.8	64.2	55.7	40.6	26.9
A2	2089	23.7	28.8	35.9	52.3	65.4	71.0	77.2	76.1	65.7	53.9	40.2	27.8

A2	2090	22.9	28.3	38.8	53.0	63.9	72.6	77.1	75.9	66.5	56.1	43.7	29.1
A2	2091	25.5	25.8	34.3	49.4	64.3	72.1	74.9	73.8	66.2	55.0	41.3	29.7
A2	2092	25.7	27.8	35.4	51.1	63.4	71.9	77.4	75.8	65.6	55.4	44.3	29.0
A2	2093	21.7	22.6	31.0	49.6	64.6	74.8	78.1	74.2	66.7	55.9	41.7	31.1
A2	2094	25.3	28.4	37.1	54.2	63.6	72.2	76.4	75.3	67.2	55.6	42.0	30.4
A2	2095	24.4	25.8	35.6	53.1	65.3	71.7	78.3	74.9	67.2	57.3	42.5	30.6
A2	2096	25.1	27.5	36.1	51.9	64.0	73.0	76.5	75.6	65.8	55.0	41.4	29.5
A2	2097	24.4	27.2	35.0	49.8	63.4	72.2	78.2	75.7	66.6	54.0	44.1	27.6
A2	2098	23.2	24.6	36.9	52.4	62.5	71.3	76.5	76.5	65.3	56.4	42.2	27.7
A2	2099	23.3	27.4	34.9	50.1	63.4	72.0	77.3	75.2	67.7	56.2	43.9	30.3
A2	2100	24.7	26.1	39.4	53.8	66.2	72.3	76.0	76.5	65.9	54.5	40.9	31.4
B1	2047	16.0	19.5	31.2	44.9	57.1	64.2	70.0	68.3	60.2	48.2	35.4	21.1
B1	2048	15.1	18.0	27.6	43.6	56.6	65.7	70.6	68.2	60.7	49.6	33.7	21.5
B1	2049	14.3	18.0	31.2	44.7	58.7	66.0	70.3	69.2	60.6	50.4	33.0	24.2
B1	2050	15.5	19.0	29.0	45.8	58.1	67.1	71.0	69.3	60.0	48.7	34.7	23.0
B1	2051	17.1	20.6	32.5	44.7	57.4	67.9	70.7	68.4	61.0	51.6	35.5	22.9
B1	2052	19.8	20.4	32.7	46.5	58.2	66.7	71.2	68.0	60.8	49.7	36.1	24.3
B1	2053	18.8	19.3	29.0	45.8	59.2	67.2	71.0	69.2	60.0	49.4	36.8	22.5
B1	2054	14.9	21.5	32.4	45.3	59.3	67.1	71.9	69.9	59.2	49.3	35.3	20.2
B1	2055	16.1	16.5	29.1	45.9	59.2	66.2	70.1	68.5	59.7	50.1	35.8	20.7
B1	2056	20.5	18.9	30.1	45.3	56.6	66.5	71.3	68.3	61.9	49.3	35.5	23.1
B1	2057	16.3	19.0	30.6	44.9	56.6	66.2	71.2	68.4	60.2	50.4	35.3	21.2
B1	2058	16.0	19.5	31.8	45.1	58.0	67.0	70.9	69.2	60.2	49.8	34.8	23.3
B1	2059	20.9	21.5	32.2	47.6	59.3	66.2	71.5	68.9	61.4	49.8	36.4	21.6
B1	2060	21.0	22.6	30.8	45.3	57.8	67.1	71.9	69.6	62.3	50.4	34.1	20.7
B1	2061	17.8	21.0	28.4	45.9	59.3	67.3	71.2	69.6	60.4	50.0	34.7	23.7
B1	2062	18.5	20.2	31.6	46.7	59.4	67.5	71.1	70.3	61.3	49.2	34.7	23.5
B1	2063	16.1	23.0	30.0	45.3	59.2	67.3	72.1	70.3	60.3	50.0	35.2	21.8
B1	2064	17.3	19.4	30.2	46.0	58.8	65.9	71.3	69.5	61.3	49.9	36.7	22.7
B1	2065	16.5	19.7	30.7	45.5	58.4	68.6	71.7	69.1	61.3	50.7	35.4	23.3
B1	2082	18.0	19.8	29.8	49.1	60.7	68.0	72.0	69.4	62.2	51.5	37.2	25.2
B1	2083	21.1	22.6	33.1	47.8	60.5	67.7	72.2	69.6	61.0	51.2	36.5	24.7
B1	2084	21.6	22.8	34.0	47.9	60.1	69.2	72.3	69.9	63.6	52.1	34.9	21.9
B1	2085	18.5	21.6	32.2	46.6	58.7	69.3	72.7	71.1	61.6	50.0	37.2	25.9
B1	2086	21.5	22.1	30.5	45.8	60.9	67.2	72.0	70.6	61.8	52.2	35.6	24.9
B1	2087	20.9	21.4	33.2	47.5	60.2	67.6	72.6	69.2	60.9	52.6	37.1	23.3
B1	2088	19.7	20.8	30.2	45.5	59.0	67.3	71.5	69.7	62.1	51.7	38.8	24.5
B1	2089	16.8	20.9	31.4	47.2	59.2	67.0	73.5	71.8	62.7	51.8	36.3	22.3
B1	2090	19.2	22.9	30.8	46.6	59.2	67.4	73.0	71.6	61.3	49.6	36.2	24.4
B1	2091	17.3	22.3	34.4	48.0	60.4	67.5	72.1	70.6	61.6	50.7	37.6	24.8
B1	2092	20.1	23.0	33.8	47.0	59.6	66.3	72.3	70.3	62.4	51.3	38.3	25.1

B1	2093	20.2	22.6	34.2	48.7	62.1	69.3	72.7	71.6	63.5	52.6	37.2	24.2
B1	2094	17.6	20.9	33.8	47.9	59.8	68.2	72.0	70.9	62.5	51.0	36.4	24.7
B1	2095	18.6	23.2	33.8	48.3	60.9	67.8	72.1	68.7	62.6	52.9	37.9	23.9
B1	2096	20.6	23.5	32.4	46.9	61.7	68.1	73.6	70.4	62.9	52.5	38.4	24.0
B1	2097	19.4	25.0	31.7	47.5	58.8	67.2	71.9	69.6	61.9	50.8	35.0	23.8
B1	2098	21.2	21.9	31.7	47.6	59.3	67.2	71.9	70.4	62.1	50.5	38.9	23.5
B1	2099	20.2	21.6	32.4	44.6	58.7	68.9	72.9	69.9	62.9	50.4	37.6	24.2
B1	2100	19.9	22.2	32.1	48.6	60.6	67.4	72.7	70.9	61.7	51.7	37.4	27.1

Table 29. SWB output of monthly ET means of historical record and three emission scenarios.

Scenario	Year	Jan. ET (in.)	Feb. ET (in.)	Mar. ET (in.)	Apr. ET (in.)	May ET (in.)	Jun. ET (in.)	Jul. ET (in.)	Aug. ET (in.)	Sep. ET (in.)	Oct. ET (in.)	Nov. ET (in.)	Dec. ET (in.)
Historic	1954	0.00	0.00	0.00	1.09	2.02	4.16	3.40	2.74	2.20	1.26	0.29	0.00
Historic	1955	0.00	0.00	0.00	1.41	2.65	3.89	4.09	4.33	2.03	1.31	0.06	0.00
Historic	1956	0.00	0.00	0.00	0.45	2.82	3.70	3.98	3.17	1.34	0.91	0.24	0.00
Historic	1957	0.00	0.00	0.00	1.32	2.62	3.28	3.20	2.49	1.88	1.00	0.23	0.00
Historic	1958	0.00	0.00	0.00	1.03	2.73	3.39	4.16	3.03	2.50	1.50	0.48	0.00
Historic	1961	0.00	0.00	0.00	0.58	2.44	3.39	3.86	4.11	2.64	1.50	0.09	0.00
Historic	1964	0.00	0.00	0.00	1.02	3.59	2.90	2.68	2.34	2.57	1.09	0.68	0.00
Historic	1965	0.00	0.00	0.00	0.55	3.69	3.67	3.76	3.67	2.22	1.53	0.23	0.00
Historic	1966	0.00	0.00	0.00	0.87	2.30	3.71	3.04	3.23	1.77	1.00	0.03	0.00
Historic	1967	0.00	0.00	0.00	1.30	2.29	4.33	3.65	2.60	2.21	1.23	0.12	0.00
Historic	1970	0.00	0.00	0.00	0.84	3.19	3.75	3.72	2.26	2.21	1.49	0.24	0.00
Historic	1971	0.00	0.00	0.00	1.03	2.44	3.21	2.47	3.01	2.36	2.10	0.29	0.00
Historic	1974	0.00	0.00	0.00	0.99	2.15	4.21	2.84	2.71	1.52	1.04	0.17	0.00
Historic	1975	0.00	0.00	0.00	0.73	3.11	3.76	3.15	1.84	1.89	1.23	0.62	0.00
Historic	1976	0.00	0.00	0.00	1.20	2.49	2.52	2.25	2.74	1.37	0.43	0.00	0.00
Historic	1977	0.00	0.00	0.00	1.61	2.80	2.65	3.41	2.07	2.50	1.15	0.43	0.00
Historic	1978	0.00	0.00	0.00	0.63	3.10	3.70	4.56	3.26	2.76	1.07	0.28	0.00
Historic	1979	0.00	0.00	0.00	0.84	2.41	3.81	3.69	3.44	2.09	0.97	0.11	0.00
Historic	1980	0.00	0.00	0.00	0.87	2.60	3.79	3.75	3.80	2.45	0.85	0.17	0.00
Historic	1981	0.00	0.00	0.00	1.18	2.49	3.35	3.07	2.49	1.86	0.98	0.43	0.00
Historic	1982	0.00	0.00	0.00	0.45	3.57	2.88	3.98	2.41	2.42	1.51	0.17	0.00
Historic	1983	0.00	0.00	0.02	0.71	2.18	3.43	2.73	3.10	2.38	1.29	0.27	0.00
Historic	1984	0.00	0.00	0.00	1.11	2.23	3.74	3.55	2.81	1.94	1.55	0.05	0.00
Historic	1985	0.00	0.00	0.00	1.37	3.16	3.09	3.50	3.33	2.56	1.21	0.14	0.00
Historic	1986	0.00	0.00	0.00	1.79	2.71	3.08	4.58	3.19	2.50	1.15	0.07	0.00
Historic	1987	0.00	0.00	0.00	1.51	2.75	3.09	3.06	2.28	1.42	0.46	0.28	0.00
Historic	1988	0.00	0.00	0.00	0.67	2.94	2.35	3.48	3.98	2.43	0.66	0.13	0.00
Historic	1989	0.00	0.00	0.00	0.69	2.67	3.56	2.95	2.31	1.28	0.77	0.06	0.00

Historic	1990	0.00	0.00	0.00	1.38	2.47	4.00	3.65	4.00	2.87	1.13	0.38	0.00
Historic	1991	0.00	0.00	0.00	1.13	3.40	4.13	3.81	4.14	2.25	1.08	0.02	0.00
Historic	1992	0.00	0.00	0.00	0.77	2.80	2.48	2.57	2.23	2.55	1.23	0.04	0.00
Historic	1993	0.00	0.00	0.00	0.70	2.84	3.94	3.99	2.77	1.83	1.10	0.00	0.00
Historic	1994	0.00	0.00	0.00	0.51	2.57	3.25	3.61	2.84	2.67	1.55	0.39	0.00
Historic	1995	0.00	0.00	0.00	0.24	2.71	3.25	2.85	4.52	2.11	1.32	0.02	0.00
Historic	1996	0.00	0.00	0.00	0.59	2.39	4.12	4.17	3.87	2.52	1.29	0.03	0.00
Historic	1997	0.00	0.00	0.00	0.71	2.19	4.13	3.89	2.73	2.75	1.36	0.16	0.00
Historic	1998	0.00	0.00	0.00	1.39	3.24	3.66	3.23	1.65	1.13	1.29	0.27	0.15
Historic	1999	0.00	0.00	0.00	1.51	3.16	3.00	5.07	3.95	1.82	0.89	0.37	0.00
Historic	2000	0.00	0.00	0.39	1.10	2.95	4.04	3.73	3.14	2.58	1.32	0.29	0.00
Historic	2001	0.00	0.00	0.00	1.30	3.12	3.62	2.47	3.30	1.97	0.94	0.68	0.07
Historic	2002	0.00	0.00	0.00	0.79	2.31	4.44	3.90	3.44	2.88	0.85	0.11	0.00
Historic	2003	0.00	0.00	0.00	0.67	2.62	3.69	2.82	2.40	1.36	0.81	0.06	0.00
Historic	2004	0.00	0.00	0.00	1.05	2.62	3.73	2.87	1.93	1.63	1.13	0.34	0.00
Historic	2005	0.00	0.00	0.00	1.17	2.42	4.26	2.46	2.22	1.60	1.35	0.26	0.00
Historic	2006	0.00	0.00	0.00	1.47	2.84	2.60	2.84	4.20	1.90	0.84	0.28	0.00
Historic	2007	0.00	0.00	0.00	0.93	2.99	3.28	3.71	2.57	1.78	1.78	0.18	0.00
Historic	2008	0.00	0.00	0.00	0.78	2.41	3.90	3.08	1.86	1.48	0.84	0.23	0.00
Historic	2009	0.00	0.00	0.00	0.85	2.86	3.40	2.26	3.44	1.87	0.77	0.54	0.00
A1B	2047	0.00	0.00	0.05	1.40	2.98	3.65	3.54	3.05	2.32	1.44	0.37	0.04
A1B	2048	0.00	0.00	0.07	1.37	2.95	3.68	3.69	3.15	2.42	1.34	0.37	0.02
A1B	2049	0.00	0.00	0.05	1.28	3.26	3.80	3.79	3.01	2.25	1.45	0.38	0.01
A1B	2050	0.00	0.00	0.06	1.44	3.36	3.95	3.59	2.63	2.20	1.43	0.40	0.02
A1B	2051	0.00	0.00	0.07	1.41	3.04	3.81	3.45	3.07	2.40	1.39	0.40	0.02
A1B	2052	0.00	0.00	0.17	1.55	3.09	3.31	3.41	2.95	2.25	1.39	0.35	0.02
A1B	2053	0.00	0.01	0.12	1.40	3.22	4.01	3.66	3.10	2.46	1.31	0.36	0.06
A1B	2054	0.00	0.00	0.07	1.41	3.25	3.51	3.49	3.24	2.44	1.34	0.37	0.04
A1B	2055	0.00	0.02	0.13	1.40	3.04	3.69	3.60	3.02	2.32	1.35	0.40	0.04
A1B	2056	0.00	0.01	0.17	1.36	3.21	4.00	3.70	3.19	2.25	1.32	0.44	0.05
A1B	2057	0.00	0.00	0.08	1.49	3.16	3.86	3.89	3.34	2.35	1.35	0.41	0.05
A1B	2058	0.00	0.00	0.11	1.27	3.23	3.70	3.33	3.07	2.11	1.41	0.34	0.04
A1B	2059	0.00	0.02	0.17	1.34	3.25	3.69	3.62	3.05	2.25	1.36	0.39	0.02
A1B	2060	0.00	0.00	0.01	1.20	3.17	3.76	3.44	2.97	2.30	1.45	0.41	0.03
A1B	2061	0.00	0.00	0.14	1.50	3.19	3.69	3.46	2.88	2.02	1.32	0.38	0.03
A1B	2062	0.00	0.01	0.11	1.55	3.17	3.96	3.47	2.85	2.16	1.39	0.44	0.04
A1B	2063	0.00	0.00	0.08	1.42	3.22	3.75	3.52	3.03	2.58	1.54	0.50	0.06
A1B	2064	0.00	0.00	0.14	1.44	3.21	3.83	3.69	2.84	2.19	1.44	0.36	0.02
A1B	2065	0.00	0.00	0.08	1.61	3.06	3.72	3.37	2.95	2.17	1.39	0.49	0.03
A1B	2082	0.01	0.03	0.23	1.62	3.19	3.95	3.58	2.95	2.10	1.25	0.38	0.06
A1B	2083	0.00	0.00	0.24	1.59	3.44	3.84	3.53	3.02	2.17	1.38	0.45	0.04

A1B	2084	0.00	0.01	0.18	1.57	3.37	4.02	3.90	3.40	2.51	1.61	0.42	0.05
A1B	2085	0.01	0.01	0.11	1.56	3.32	3.98	3.96	3.35	2.44	1.46	0.50	0.09
A1B	2086	0.02	0.01	0.21	1.74	3.18	3.59	3.85	3.25	2.38	1.45	0.43	0.05
A1B	2087	0.00	0.01	0.16	1.48	3.36	4.01	3.58	3.05	2.38	1.50	0.44	0.09
A1B	2088	0.00	0.00	0.26	1.60	3.46	3.81	3.32	2.97	2.33	1.44	0.51	0.05
A1B	2089	0.00	0.04	0.18	1.53	3.47	3.86	3.71	3.32	2.51	1.58	0.44	0.04
A1B	2090	0.01	0.00	0.12	1.58	3.29	3.81	3.50	3.28	2.43	1.63	0.45	0.04
A1B	2091	0.00	0.00	0.14	1.75	3.31	3.55	3.57	2.75	2.41	1.61	0.50	0.05
A1B	2092	0.01	0.01	0.23	1.67	3.34	3.75	3.76	3.32	2.49	1.48	0.42	0.06
A1B	2093	0.00	0.01	0.20	1.77	3.23	3.81	3.75	3.40	2.58	1.55	0.50	0.04
A1B	2094	0.00	0.00	0.17	1.53	3.54	3.77	4.04	3.32	2.39	1.74	0.44	0.04
A1B	2095	0.01	0.00	0.23	1.68	3.36	4.02	3.67	2.88	2.32	1.39	0.48	0.06
A1B	2096	0.01	0.02	0.24	1.69	3.51	4.07	3.85	3.37	2.47	1.59	0.42	0.06
A1B	2097	0.00	0.00	0.17	1.60	3.51	3.69	3.40	3.22	2.72	1.66	0.54	0.08
A1B	2098	0.02	0.02	0.25	1.71	3.38	3.92	3.85	3.48	2.59	1.64	0.42	0.08
A1B	2099	0.00	0.01	0.23	1.53	3.28	4.04	4.11	3.55	2.54	1.70	0.61	0.10
A1B	2100	0.01	0.02	0.20	1.67	3.29	3.95	3.74	3.14	2.50	1.69	0.53	0.07
A2	2047	0.00	0.00	0.01	0.98	2.92	3.31	3.55	3.09	2.38	1.20	0.38	0.08
A2	2048	0.00	0.00	0.01	1.30	3.04	3.28	3.61	2.91	2.02	1.39	0.31	0.04
A2	2049	0.00	0.00	0.09	1.10	2.88	3.54	3.29	2.97	2.21	1.28	0.37	0.05
A2	2050	0.00	0.00	0.05	1.19	3.11	3.73	3.64	3.11	2.43	1.40	0.31	0.02
A2	2051	0.00	0.00	0.09	1.45	3.09	3.57	3.48	2.92	2.07	1.24	0.28	0.01
A2	2052	0.00	0.00	0.10	1.43	2.95	3.56	3.58	3.10	2.36	1.34	0.32	0.05
A2	2053	0.00	0.00	0.03	1.08	3.01	3.70	3.65	2.94	2.35	1.48	0.36	0.02
A2	2054	0.00	0.00	0.09	1.13	2.98	3.50	3.60	3.28	2.41	1.58	0.40	0.02
A2	2055	0.00	0.00	0.03	1.17	2.94	3.70	3.68	3.29	2.50	1.53	0.43	0.01
A2	2056	0.00	0.00	0.00	1.37	3.10	3.81	3.60	3.09	2.21	1.29	0.40	0.01
A2	2057	0.00	0.00	0.06	1.63	3.22	3.78	3.90	2.85	2.55	1.41	0.34	0.03
A2	2058	0.00	0.00	0.12	1.58	3.08	3.48	3.50	3.12	2.53	1.37	0.46	0.01
A2	2059	0.00	0.00	0.10	1.60	3.27	3.93	3.79	2.96	2.41	1.41	0.51	0.04
A2	2060	0.00	0.00	0.03	1.34	3.04	3.54	3.59	2.97	2.20	1.41	0.37	0.01
A2	2061	0.00	0.00	0.17	1.20	3.14	3.56	3.25	3.27	2.13	1.39	0.44	0.03
A2	2062	0.00	0.00	0.01	1.32	3.23	3.58	3.55	2.80	2.08	1.35	0.44	0.03
A2	2063	0.00	0.00	0.07	1.25	2.99	3.89	3.54	3.27	2.27	1.51	0.59	0.05
A2	2064	0.00	0.00	0.06	1.47	3.33	3.86	3.41	3.13	2.17	1.39	0.46	0.01
A2	2065	0.00	0.00	0.19	1.49	3.05	3.75	3.69	2.55	2.13	1.39	0.33	0.05
A2	2082	0.00	0.00	0.15	1.52	3.63	4.18	3.81	3.36	2.46	1.58	0.60	0.07
A2	2083	0.00	0.00	0.12	1.64	3.59	3.66	3.96	3.50	2.49	1.74	0.47	0.06
A2	2084	0.00	0.00	0.13	1.52	3.35	3.70	3.35	2.84	2.46	1.54	0.46	0.07
A2	2085	0.00	0.01	0.23	1.76	3.43	3.89	3.78	3.21	2.42	1.39	0.41	0.05
A2	2086	0.00	0.00	0.17	1.86	3.33	3.81	4.03	3.05	2.23	1.47	0.49	0.10

A2	2087	0.00	0.00	0.26	1.60	3.51	3.99	4.28	3.61	2.61	1.49	0.44	0.08
A2	2088	0.00	0.00	0.13	1.39	3.21	4.10	3.56	3.02	2.40	1.64	0.57	0.04
A2	2089	0.00	0.03	0.26	1.90	3.78	3.58	3.60	2.92	2.34	1.43	0.42	0.09
A2	2090	0.00	0.03	0.43	1.90	3.45	4.02	3.63	3.27	2.42	1.54	0.68	0.06
A2	2091	0.00	0.00	0.17	1.57	3.60	3.78	3.64	3.09	2.49	1.66	0.60	0.10
A2	2092	0.00	0.03	0.34	1.69	3.35	3.90	3.65	3.29	2.43	1.46	0.68	0.07
A2	2093	0.00	0.00	0.07	1.51	3.42	3.98	3.62	2.61	2.62	1.64	0.53	0.09
A2	2094	0.01	0.02	0.36	2.05	3.48	4.14	4.21	3.27	2.25	1.43	0.55	0.12
A2	2095	0.00	0.00	0.20	1.94	3.77	3.93	3.90	3.46	2.43	1.75	0.58	0.13
A2	2096	0.00	0.00	0.22	1.92	3.58	4.21	3.99	3.28	2.47	1.57	0.58	0.06
A2	2097	0.00	0.00	0.16	1.62	3.40	4.15	3.63	2.55	2.09	1.38	0.70	0.11
A2	2098	0.00	0.00	0.19	1.88	3.48	4.21	3.64	3.38	2.42	1.70	0.58	0.06
A2	2099	0.00	0.00	0.22	1.60	3.45	4.03	3.60	3.31	2.66	1.65	0.63	0.12
A2	2100	0.00	0.01	0.36	2.02	3.74	4.04	3.89	3.28	2.50	1.66	0.51	0.14
B1	2047	0.00	0.00	0.10	1.25	3.01	3.63	3.71	3.21	2.33	1.31	0.40	0.01
B1	2048	0.00	0.00	0.00	1.05	2.98	3.56	3.57	3.04	2.21	1.35	0.30	0.01
B1	2049	0.00	0.00	0.09	1.19	3.07	3.58	3.89	3.06	2.34	1.46	0.28	0.03
B1	2050	0.00	0.00	0.02	1.25	3.13	3.49	3.21	2.94	2.22	1.28	0.35	0.01
B1	2051	0.00	0.00	0.05	1.23	2.99	3.60	3.33	2.74	2.03	1.40	0.39	0.02
B1	2052	0.00	0.00	0.13	1.42	3.01	3.60	3.41	3.13	2.42	1.38	0.39	0.02
B1	2053	0.00	0.00	0.06	1.24	3.22	3.87	3.47	3.03	2.09	1.29	0.46	0.03
B1	2054	0.00	0.00	0.10	1.28	3.17	3.80	3.73	3.17	2.12	1.37	0.36	0.01
B1	2055	0.00	0.00	0.01	1.31	3.26	3.47	3.53	2.77	2.15	1.44	0.39	0.02
B1	2056	0.00	0.00	0.08	1.26	2.92	3.75	3.70	2.89	2.26	1.31	0.33	0.00
B1	2057	0.00	0.00	0.10	1.19	2.95	3.70	3.81	2.78	2.09	1.37	0.34	0.01
B1	2058	0.00	0.00	0.15	1.25	3.08	3.61	3.61	3.12	2.22	1.37	0.34	0.01
B1	2059	0.00	0.00	0.13	1.50	3.19	3.62	3.88	3.30	2.23	1.35	0.40	0.04
B1	2060	0.00	0.00	0.08	1.25	3.06	3.76	3.55	3.26	2.49	1.46	0.29	0.01
B1	2061	0.01	0.00	0.06	1.24	3.18	3.69	3.29	3.08	2.19	1.29	0.29	0.03
B1	2062	0.00	0.00	0.04	1.44	3.12	3.39	3.39	3.02	2.19	1.23	0.31	0.04
B1	2063	0.00	0.00	0.04	1.21	3.08	3.57	3.40	3.21	2.26	1.41	0.37	0.01
B1	2064	0.00	0.01	0.08	1.31	3.17	3.67	3.44	2.87	2.27	1.41	0.41	0.04
B1	2065	0.00	0.00	0.05	1.24	3.06	3.91	3.68	3.00	2.30	1.34	0.36	0.01
B1	2082	0.00	0.00	0.01	1.48	3.26	3.66	3.65	3.18	2.31	1.57	0.45	0.02
B1	2083	0.00	0.00	0.12	1.52	3.31	3.80	4.19	3.29	2.39	1.49	0.39	0.02
B1	2084	0.00	0.00	0.17	1.51	3.22	3.87	3.67	2.71	2.28	1.46	0.28	0.02
B1	2085	0.00	0.00	0.11	1.35	3.03	3.80	3.62	3.04	2.30	1.37	0.41	0.04
B1	2086	0.00	0.00	0.08	1.28	3.30	3.54	3.80	3.23	2.41	1.53	0.34	0.01
B1	2087	0.00	0.00	0.15	1.48	3.19	3.71	3.89	3.02	2.24	1.52	0.45	0.02
B1	2088	0.00	0.00	0.06	1.26	3.14	3.59	3.56	3.26	2.27	1.50	0.53	0.06
B1	2089	0.00	0.02	0.11	1.40	3.00	3.61	3.55	3.11	2.23	1.44	0.35	0.01

B1	2090	0.00	0.01	0.09	1.36	3.13	3.82	3.63	2.93	2.26	1.37	0.37	0.04
B1	2091	0.00	0.00	0.20	1.53	3.06	3.61	3.38	3.02	2.31	1.51	0.46	0.02
B1	2092	0.00	0.00	0.10	1.46	3.28	3.75	3.93	3.25	2.43	1.40	0.45	0.04
B1	2093	0.00	0.00	0.11	1.52	3.30	3.70	3.55	3.25	2.26	1.39	0.41	0.01
B1	2094	0.00	0.00	0.15	1.50	3.08	3.70	3.75	3.23	2.35	1.44	0.36	0.04
B1	2095	0.01	0.01	0.16	1.57	3.27	3.66	3.55	2.92	2.27	1.59	0.46	0.01
B1	2096	0.00	0.00	0.07	1.37	3.45	3.90	3.71	2.84	2.48	1.51	0.49	0.03
B1	2097	0.00	0.00	0.11	1.46	3.04	3.91	3.99	3.42	2.52	1.43	0.30	0.03
B1	2098	0.00	0.01	0.10	1.48	3.06	3.62	3.64	3.00	2.35	1.30	0.47	0.05
B1	2099	0.00	0.00	0.07	1.14	3.18	3.85	3.49	2.97	2.16	1.34	0.45	0.01
B1	2100	0.00	0.00	0.10	1.54	3.32	3.84	3.58	3.01	2.12	1.33	0.42	0.04

APPENDIX G

T-VALUES COMPARING HISTORICAL RECORD TO GCMS FOR

THREE EMISSION SCENARIOS FOR TIME SERIES, 2047-2065 AND 2082-2100

Table 30. T-values comparing means of time series, 1954-2009 to three emission scenarios for time series, 2047-2065. Pink shading denotes a significant increase in the mean. Blue shading denotes a significant decrease in the mean. Statistical significance is p<.05

Scenario	A2			A1B			B1		
Variable	t-value	p-value	Stat. signif.	t-value	p-value	Stat. signif.	t-value	p-value	Stat. signif.
Annual prec.	1.64	0.11	No	2.00	0.05	No	1.20	0.24	No
Annual rech.	0.39	0.70	No	0.45	0.66	No	-0.13	0.90	No
Annual temp.	12.84	0.00	Yes	14.21	0.00	Yes	10.50	0.00	Yes
Annual ET	4.20	0.00	Yes	5.11	0.00	Yes	3.83	0.00	Yes
Jan. prec.	1.19	0.24	No	1.648	.104	No	0.63	0.53	No
Jan. rech.	8.71	0.00	Yes	10.427	.000	Yes	6.32	0.00	Yes
Jan. mean temp.	4.88	0.00	Yes	5.494	.000	Yes	4.05	0.00	Yes
Jan. ET	NA	NA	NA	2.305	.024	Yes	2.03	0.05	No
Feb. prec.	.539	.592	No	.632	.530	No	0.34	0.73	No
Feb. rech.	.791	.432	No	1.104	.274	No	0.47	0.64	No
Feb. mean temp.	3.603	.001	Yes	4.730	.000	Yes	2.93	0.00	Yes
Feb. ET	1.608	.113	No	4.395	.000	Yes	2.58	0.01	Yes
March prec.	1.453	.151	No	1.098	.276	No	0.87	0.39	No
March rech.	-.486	.629	No	-.813	.419	No	-0.47	0.64	No
Mar. mean temp.	4.813	.000	Yes	5.759	.000	Yes	3.86	0.00	Yes
March ET	3.921	.000	Yes	6.197	.000	Yes	4.43	0.00	Yes
April prec.	.625	.534	No	1.128	.264	No	0.80	0.43	No
April rech.	-1.584	.118	No	-1.548	.126	No	-1.27	0.21	No
April mean temp	5.241	.000	Yes	6.245	.000	Yes	4.44	0.00	Yes
April ET	4.015	.000	Yes	5.297	.000	Yes	3.56	0.00	Yes
May prec.	.747	.458	No	2.001	.050	No	1.36	0.18	No
May rech.	.546	.587	No	1.172	.246	No	0.82	0.42	No
May mean temp.	5.297	.000	Yes	5.732	.000	Yes	4.65	0.00	Yes
May ET	3.658	.001	Yes	4.631	.000	Yes	3.86	0.00	Yes
June prec.	.188	.851	No	.288	.774	No	0.11	0.91	No
June rech.	-.577	.566	No	-.601	.550	No	-0.54	0.59	No
June mean temp.	4.981	.000	Yes	5.829	.000	Yes	4.09	0.00	Yes
June ET	.876	.384	No	1.876	.065	No	0.98	0.33	No
July prec.	.088	.930	No	-.129	.898	No	0.27	0.79	No
July rech.	-.252	.802	No	-.321	.749	No	0.14	0.89	No
July mean temp.	6.779	.000	Yes	7.236	.000	Yes	5.05	0.00	Yes
July ET	1.121	.267	No	1.059	.293	No	1.00	0.32	No
Aug. prec.	.424	.673	No	.341	.734	No	0.27	0.79	No
Aug. rech.	.039	.969	No	.059	.953	No	-0.11	0.91	No
Aug. mean temp.	8.494	.000	Yes	8.039	.000	Yes	5.98	0.00	Yes
Aug. ET	.195	.846	No	.130	.897	No	0.20	0.84	No
Sept. prec.	.863	.391	No	.616	.540	No	0.26	0.80	No
Sept. rech.	-.023	.982	No	-.362	.719	No	-0.43	0.67	No
Sept. mean temp.	6.856	.000	Yes	7.704	.000	Yes	5.98	0.00	Yes
Sept. ET	1.669	.100	No	1.690	.096	No	1.20	0.23	No
Oct. prec.	.178	.859	No	.697	.488	No	0.40	0.69	No
Oct. rech.	-.795	.430	No	-.404	.687	No	-0.51	0.61	No
Oct. mean temp.	6.248	.000	Yes	6.996	.000	Yes	5.83	0.00	Yes
Oct. ET	3.166	.002	Yes	3.230	.002	Yes	2.81	0.01	Yes

Nov. prec.	-.016	.987	No	-.156	.877	No	-0.36	0.72	No
Nov. rech.	.473	.638	No	.145	.885	No	-0.33	0.74	No
Nov. mean temp.	5.859	.000	Yes	5.913	.000	Yes	4.31	0.00	Yes
Nov. ET	3.949	.000	Yes	4.113	.000	Yes	3.07	0.00	Yes
Dec. prec.	1.238	.220	No	1.366	.177	No	0.51	0.61	No
Dec. rech.	2.643	.010	Yes	2.308	.024	Yes	1.43	0.16	No
Dec. mean temp.	5.438	.000	Yes	5.468	.000	Yes	3.92	0.00	Yes
Dec. ET	4.129	.000	Yes	5.100	.000	Yes	2.57	0.01	Yes

Table 31. T-values comparing means of time series, 1954-2009 to three emission scenarios for time series, 2082-2100. Pink shading denotes a significant increase in the mean. Blue shading denotes a significant decrease in the mean. Statistical significance is p<.05.

Scenario	A2			A1B			B1		
Variable	t-value	p-value	Stat. signif.	t-value	p-value	Stat. signif.	t-value	p-value	Stat. signif.
Annual prec.	3.50	0.00	Yes	3.36	0.00	Yes	1.98	0.05	No
Annual rech.	0.46	0.65	No	0.77	0.44	No	0.02	0.99	No
Annual temp.	23.50	0.00	Yes	21.43	0.00	Yes	15.26	0.00	Yes
Annual ET	9.62	0.00	Yes	8.51	0.00	Yes	5.92	0.00	Yes
Jan. prec.	1.55	0.12	No	1.59	0.12	No	0.98	0.33	No
Jan. rech.	12.39	0.00	Yes	12.30	0.00	Yes	9.71	0.00	Yes
Jan. mean temp.	8.39	0.00	Yes	7.98	0.00	Yes	5.76	0.00	Yes
Jan. ET	2.56	0.01	Yes	6.53	0.00	Yes	1.96	0.05	No
Feb. prec.	1.34	0.18	No	0.81	0.42	No	-0.01	0.99	No
Feb. rech.	1.22	0.23	No	1.10	0.28	No	0.81	0.42	No
Feb. temp.	7.11	0.00	Yes	6.59	0.00	Yes	4.69	0.00	Yes
Feb. ET	4.29	0.00	Yes	6.91	0.00	Yes	4.31	0.00	Yes
March prec.	2.03	0.05	Yes	1.54	0.13	No	1.17	0.25	No
March rech.	-1.19	0.24	No	-1.43	0.16	No	-1.12	0.27	No
Mar. mean temp.	8.82	0.00	Yes	8.29	0.00	Yes	5.86	0.00	Yes
March ET	11.20	0.00	Yes	13.07	0.00	Yes	6.93	0.00	Yes
April prec.	2.08	0.04	Yes	1.99	0.05	Yes	0.44	0.66	No
April rech.	-2.13	0.04	Yes	-1.85	0.07	No	-2.02	0.05	Yes
April mean temp	11.11	0.00	Yes	9.98	0.00	Yes	6.80	0.00	Yes
April ET	8.82	0.00	Yes	7.94	0.00	Yes	5.53	0.00	Yes
May prec.	3.11	0.00	Yes	2.44	0.02	Yes	1.54	0.13	No
May rech.	1.02	0.31	No	1.04	0.30	No	0.59	0.56	No
May mean temp.	10.49	0.00	Yes	8.74	0.00	Yes	6.65	0.00	Yes
May ET	8.20	0.00	Yes	6.78	0.00	Yes	4.92	0.00	Yes
June prec.	0.55	0.58	No	0.60	0.55	No	0.60	0.55	No
June rech.	-0.52	0.61	No	-0.42	0.68	No	-0.53	0.60	No
June mean temp.	10.61	0.00	Yes	8.90	0.00	Yes	5.71	0.00	Yes
June ET	3.56	0.00	Yes	2.79	0.01	Yes	1.71	0.09	No
July prec.	0.44	0.66	No	0.69	0.49	No	0.38	0.71	No
July rech.	-0.09	0.93	No	0.15	0.88	No	0.01	1.00	No
July mean temp.	13.21	0.00	Yes	10.50	0.00	Yes	7.23	0.00	Yes
July ET	2.45	0.02	Yes	2.08	0.04	Yes	1.90	0.06	No
Aug. prec.	0.77	0.44	No	0.90	0.37	No	0.40	0.69	No
Aug. rech.	-0.03	0.98	No	0.35	0.73	No	-0.06	0.95	No
Aug. mean temp.	15.08	0.00	Yes	12.27	0.00	Yes	8.09	0.00	Yes

Aug. ET	1.01	0.32	No	1.24	0.22	No	0.52	0.60	No
Sept. prec.	0.94	0.35	No	1.07	0.29	No	0.53	0.59	No
Sept. rech.	-0.15	0.88	No	0.07	0.94	No	-0.30	0.76	No
Sept. mean temp.	13.39	0.00	Yes	11.75	0.00	Yes	8.28	0.00	Yes
Sept. ET	3.01	0.00	Yes	3.04	0.00	Yes	1.95	0.06	No
Oct. prec.	0.85	0.40	No	1.23	0.22	No	0.86	0.39	No
Oct. rech.	-0.68	0.50	No	-0.24	0.81	No	-0.50	0.62	No
Oct. mean temp.	12.17	0.00	Yes	10.64	0.00	Yes	7.83	0.00	Yes
Oct. ET	5.48	0.00	Yes	5.20	0.00	Yes	3.97	0.00	Yes
Nov. prec.	0.44	0.66	No	0.21	0.84	No	-0.04	0.97	No
Nov. rech.	0.39	0.70	No	0.47	0.64	No	0.38	0.71	No
Nov. mean temp.	10.65	0.00	Yes	8.34	0.00	Yes	6.29	0.00	Yes
Nov. ET	7.61	0.00	Yes	5.79	0.00	Yes	4.42	0.00	Yes
Dec. prec.	1.29	0.20	No	1.40	0.17	No	1.82	0.07	No
Dec. rech.	2.89	0.01	Yes	3.12	0.00	Yes	2.45	0.02	Yes
Dec. mean temp.	8.91	0.00	Yes	7.92	0.00	Yes	5.45	0.00	Yes
Dec. ET	11.57	0.00	Yes	9.09	0.00	Yes	4.00	0.00	Yes