

Reference 1: Data requirements for WRENSS Simulations

To run a WRENSS simulation two files are required. The first is a “control” file containing information describing a watershed and the streamflow data and precipitation data to be used in the simulation (Table 1). The second is a unit file containing information for each harvest clock to be harvested in the watershed (Table 2).

Table 1 – Watershed data for WRENSS simulations (Control File)

Field name	Type	Size	Dec	Description
SCENARIO	C	100		Joint identifier to link this table with the harvested blocks in tbl_Units. This name must be the same as the one used for all of the harvested blocks in any given scenario, usually a watershed.
AREA_CUT	N	20	5	Total area of the scenario or watershed in km ² .
WS_STATION	C	100		The name or identifier of a stream gauging station in the Foothills Model Forest Area. Can be supplied at run time.
WS_YIELD	N	20	5	Supplied by link to WS_STATION at run time.
WS_STAT	C	6		Unless specified as Max or Min, defaults to Avg at run time.
WS_PERIOD	C	9		Supplied by link to WS_STATION at run time.
WS_REGION	C	100		The name of the type of analysis used in peak flow determinations, Instantaneous Max or Daily Max. Can be supplied at run time.
REGION	C	5		WRENSS regions CM or RM only. Can be supplied at run time.
WX_SOURCE	C	100		The name or identifier of a weather station in the Foothills Model Forest Area. Can be supplied at run time.
WX_STAT	C	6		Unless specified as Max or Min, defaults to Avg at run time.
WX_PERIOD	C	9		Supplied by link to WX_STATION at run time.
ANNUAL_PPT	N	20	5	Supplied by link to WX_STATION at run time.
BASE_YEAR	N	6	0	Default of 1-year prior to earliest year in the BLK_YRCUT field in tbl_Units is supplied by WrnsSdr at run time. Any year earlier than the first year cut can be supplied by the user.
START_YEAR	N	6	0	Default of 1-year prior to earliest year in the BLK_YRCUT field in tbl_Units is supplied by WrnsSdr at run time. Any year earlier than the first year cut can be supplied by the user.
END_YEAR	N	6	0	Default of 100-years after the START_YEAR is supplied by WrnsSdr at run time. This default of 100 years can be changed in the WrnsSdr Global Options form. Any year later than the first year cut can be supplied by the user.
RECORDNO	N	10	0	The user should not enter any information into this field. It is used internally within WrnsSdr.

Table 2 – Harvest data for WRENSS simulations (Unit file)

SCENARIO	Title of scenario being tested.
AREA CUT	Area of harvested unit in hectares
NUMBLOCKS	Number of blocks comprising the harvested unit. This field and the BLKSIZE field allow the grouping of several blocks of similar size, species, aspect and year of harvest into one area. The Total area of all of these similar blocks goes into AREACUT field, and either the number of blocks comprising that area go into this field or the average size of the individual block goes into the BLKSIZE field.
BLKSIZE	The size of individual blocks in hectares
BLK YRCUT	The year the block or group of blocks was cut in yyyy format.
BLK ELEV	The average elevation of the block or group of blocks in meters. Used in WRNSSDR-MF to adjust precipitation data from a different elevation to that the cut blocks being analyzed.
BLK ASPECT	The average aspect of the block as N, S, or EW. Aspect is used in conjunction with precipitation to estimate potential evapotranspiration. Maximum potential ET on south aspects and minimum on north aspects.
BLK REGEN	The species that the block is to be regenerated on a block. Lodgepole Pine, White Spruce or Deciduous are the only appropriate choices.
BUF SPECIES	The species of the surround stand, again LPP or WS or Deciduous are the only appropriate choices. Used to estimate species harvested on existing cut blocks.
BUF BA	The basal of the surrounding stand in m ² /ha. Used to estimate basal on existing cut blocks.
LUT BASEBA	The anticipated basal area of regeneration on the site at maturity, or the number of years in the rotation. Represents maximum basal area in ratio to adjust ET upwards or downwards.
LUT BAYEAR	The anticipated number of years to reach the basal area at maturity or the number of years in the rotation.
IN BAFUNCT	The name of the basal area growth function for regeneration in the unit. This is assigned during operation of WRNSSDR-MF.
BUF HT	The height of the surrounding stand in meters. Used to estimate redistribution effects of snow movement in cut blocks and surrounding stands.
LUT BASETH	The anticipated height of the regeneration on the site at maturity or at the end of the rotation.
LUT THYEAR	The anticipated number of years to reach the height of maturity, of the number of years in the rotation.
IN THFUNCT	The name of the height growth function for regeneration in the unit. This is assigned during operation of WRNSSDR-MF.
IN RECORD	Block ID. This may be changed to a 15 character wide field if necessary to identify your blocks. This is not used in WRNSSDR-MF runs.

Reference 2 WRENSS

WRENSS

WRENSS (Water Resource Evaluation for Non-Point Silvicultural Sources) was developed by the U.S. Forest Service and the U. S. Environmental Protection Agency (EPA 1980). WRENSS was designed to be used as an operational tool for forest planning. It is relatively simple in concept and has modest data requirements. It is not a “high end” research model designed to simulate daily flows (i.e. routed runoff).

Swanson (1997) prepared a computer version of the procedure (WRENSS) for Alberta conditions and modified it by linking climate and flow databases to the program. WRENSS uses long-term monthly precipitation, annual flow data from representative watersheds, GIS-generated harvest data, watershed characteristics, and growth functions to estimate changes in annual water yield. Swanson also included methods for estimating changes in peak flows for 2, 10, 20, 50 and 100 year recurrence intervals. Estimates of watershed disturbance in terms of equivalent clear-cut area (ECA) (Ager A. A. and C. Clifton. 2005) based on recovery of basal area or water yield increases are included in WRENSS. Version 3.0 of WrnsEcaAb (Swanson 2000) was used in this assessment.

Estimated changes in annual water yield are based on seasonal water balance calculations of generated runoff (GRO), which is water that will eventually become runoff but has not reached the stream channel. Increases in water yield (ΔQ) are a change in evapotranspiration (ΔET) resulting from the removal of forest cover. Increases in water yield are obtained by taking the difference in GRO before and after harvesting.

$$\text{Eq.1 } \text{GRO} = \text{Input} - \text{Losses} = P - ET \pm \Delta S$$

P = precipitation
ET = evapotranspiration losses
 ΔS = change in watershed storage.

$$\text{Eq.2 } \Delta Q \sim \Delta ET = (P_{\text{after harvest}} - \text{GRO}_{\text{after}}) - (P_{\text{before harvest}} - \text{GRO}_{\text{before}}), \text{ where precipitation before and after harvest is assumed to be the same.}$$

GRO is strongly affected by watershed storage and in the short term may not equal actual flow (Q_A). Over the long-term however $\text{GRO} = Q_A$ as average annual change in watershed storage approaches zero ($\Delta S \sim 0$). Long term precipitation and streamflow data are essential for the application of WRENSS.

Increases in water yield in WRENSS are expressed as area-millimeters (area-mm) and percentages. Area – mm is the volume of increased flow (or reduced ET) expressed as a uniform depth over a watershed. Increases in water yield are expressed as percents of the mean annual water yield (base yield in WRENSS) for the watershed being analyzed or a nearby representative watershed, which is of similar size, forest cover and climate (i.e. precipitation).

Percent increases should be considered as relative changes (e.g. small, medium, and large). Few if any models are capable of providing exact, absolute outputs. Furthermore, annual water yields are highly variable among watersheds and hydrologic regions. For example, annual yields in some years in boreal forest watersheds can be 0-100 mm, while in the Rocky Mountains water yields can be 400-800 mm. An increase of 40 mm in a Rocky Mountain watershed would be a small percentage compared to a similar increase in a boreal forest watershed. Percentages must be carefully interpreted.

Water responses provided by WRENSS are cumulative in that they can show both water yield increases and the rate of hydrologic recovery, which is the time for evapotranspiration and water flows to return to pre-harvest levels. Hydrologic recovery in WRENSS is estimated in two ways. The first is the traditional approach based on the recovery of basal area to pre-harvest conditions with the establishment of forest regeneration. Recovery occurs when current basal area equals maximum basal area for a given site. The second is based on the recovery of simulated water yield increases to pre-harvest or undisturbed conditions ($\Delta Q \sim 0$). Hydrologic recovery based on water yield was defined as the time required for the maximum increases in annual flow (or peak flows) to decrease to levels equal to or less than 1%. The time required for hydrologic recovery is a function of the amount and frequency of harvesting in a watershed, and the occurrence and rate of growth of forest regeneration.

Equivalent Area Clearcut (ECA) is an index of hydrologic recovery. It is a measure of the disturbed area (i.e. harvest blocks) in a watershed that is in a condition to contribute extra water to streamflow. ECA is at a maximum at the time of harvest and then decreases with the establishment and growth of regeneration. The physical model supporting ECA is that vegetation removal changes water yield in rough proportion to the leaf surface area or basal area removed from a site (Ager and Clifton 2005).

ECA is defined as the area harvested times a reduction factor that describes the recovery of evapotranspiration losses. ECA estimates in WRENSS are provided in terms of basal area recovery (Eq.3) and recovery of water yield (Eq.4). ECA is expressed in hectares of harvested area and as a percent of the harvested area. %ECA in this assessment was reported as a percent of watershed area, which is hydrologically more informative.

$$\text{Eq.3} \quad ECA_{BA} = \frac{BA_{current}}{Max\ BA} \times Harvest\ Area$$

Max BA = maximum basal area possible for a given site
 BA_{current} = basal area for year -n of a specified time series

$$\text{Eq.4} \quad ECA_Q = \frac{\Delta Yield_{current}}{\Delta Yield_{max\ Q}} \times Harvested\ Area$$

$\Delta Yield_{maxQ}$ = maximum water yield increases in a given time series
 $\Delta Yield_{current}$ = water yield increase for year- n in a given time series

It should be noted that hydrologic recovery based on ECA_Q includes both recovery of basal area and the effects of snow redistribution in harvest blocks (i.e. snow scour/sublimation). Hydrologic recovery based on maximum water yield increase can be shorter by half the number of years obtained with basal area. ECA_Q is considered a more direct and realistic estimate of hydrologic recovery, and was used in this report.

WRENSS also estimates increases in maximum daily and instantaneous flows due to harvesting for return periods of 2, 5, 10, 20, 50 and 100-year events. WRENSS uses watershed area to estimate peak flows ($Q_{\text{peak-area}}$) for all return periods in the unharvested condition. The difference between the mean March to September streamflow in the unharvested and harvested condition is used to estimate the change in peak flow ($Q_{\text{peak mean flow}}$) caused by harvesting for each return period. The difference in $Q_{\text{peak mean flow}}$ between the harvested and unharvested conditions is added to $Q_{\text{peak-area}}$ to obtain the maximum flow for a given return period.

In WRENSS the maximum change in peak flow attributable to the effects of forest harvesting is constrained by the maximum reduction in daily evapotranspiration rate (i.e. the volume of extra water made available by harvesting), estimated by WRENSS for a completely undisturbed watershed.

In some situations (e.g. high precipitation) the change in peak flow can exceed the daily maximum evapotranspiration rate. When this occurs it is area weighted with respect to the amount of disturbance in the watershed. For example, if the maximum evapotranspiration was 5.0 mm/day and 47% of the watershed was undisturbed, it would be reduced to 2.65 mm/day (e.g. $5.0 \text{ mm/day} * (1 - 0.47) = 2.65 \text{ mm/day}$ or $4.13 \text{ m}^3/\text{sec}$). The adjusted value would then be added to the estimated peak flow (i.e. $Q_{\text{peak-area}}$).

This constraint is built into the WRENSS program. The assumption inherent in this constraint is that the increase in peak flow generated by harvesting “alone” is controlled by the maximum reduction in daily potential evapotranspiration. Under these conditions the increase in maximum daily flows attributable to harvesting can be similar for a range of return periods, and persist for sustained periods until evapotranspiration recovers with regrowth of harvested areas. When this occurs, a plot of peak flow increases will appear to be flat or truncated.

WRENSS simulations can be based on average, maximum or minimum precipitation conditions. For average conditions, estimated changes in flow are what can be expected in an “average” year. WRENSS cannot provide an estimate of the effects of climatic variation on water yield and peak flows. Simulations for maximum or minimum conditions can provide an estimate of the effects of climatic extremes. In years of high precipitation flow changes would be larger and in years of low precipitation smaller. Precipitation inputs are constant for the length of a simulation and conditions being simulated.

WRENSS does not estimate flow for ungauged basins and does not produce routed stream flow (i.e. it does not indicate how much water will flow on a given day). It also does not carry over surpluses or deficits from one year to the next. The reliability of results from WRENSS can only be as good as the precipitation and flow data used. If precipitation data is representative, accurate and of sufficient duration, then WRENSS will provide an estimate of average annual water yield that is generally within 10% of measured water yield (Swanson 2000). However, it is important to remember that most precipitation data is usually under estimated.

Reference 3 Wrenss Inputs-Outputs

Note: %ECA estimates provided in input-output summaries are for the percent of disturbed area in a watershed. **Maximum percent watershed ECA was obtained by expressing the maximum ECA in hectares as a percent of the watershed area. Example: Watershed LS_10 %Maximum Watershed ECA = $4639.5/39400 = 11.78$.**

Little Smoky 1

Run Scenarios in database with Individual Blocks

Select Scenario: **LS_10** Run Scenario Return to Main

Simulate Each Unit From **1986** for **200** years with **1** year time steps

Watershed Area, km²: **394.0** Total Area Cut, ha: **21012.5** Percent Watershed Cut: **53.3%**

Appropriate Forest and Unit Group: **WHITECOURT ALL UNITS** Yield Data Selection: **Forest Unit Stations** Region: **New England/Boreal**

Watershed Yield Data Source: **WASKAHIGAN RIVER NEAR THE MDI** Year Progress

Statistic: **AVG** Period: **1968-1998** Yld, mm: **149.8** Area, km²: **1040**

Precipitation Data Source: **FOX CREEK RS** Units Progress

Statistic: **AVG** Period: **1966-1998** Annual Ppt. mm: **542.1**

Cut Block Details: **frmRunScenarios, Individual Blocks** Table View

Annual Harvest Data, Operational Unit

Cut, ha: **5.1** Year Cut: **1986**

Blks: **1** Blk Size, ha: **73.0**

Aspect: **S** Block Elev. m: **1292.0**

Regeneration Sp: **CONIFEROUS**

Basal Area Func: **LPP FAIR BA**

Tree Height Func: **LPP FAIR TH**

Surrounding Stand Data

Stand Species: **CONIFEROUS**

Stand BA: **37.5** Stand TH: **10.0**

Regional (Base) Silvicultural Data

Base BA: **35.0** Years To Base BA: **130**

Base TH, m: **20.0** Years To Base TH: **160**

Record: **14** of 1528

Results Scenario LS_10

Year	Yield, mm	%
1986	0.0	0.0%
1986	0.2	0.1%
1987	0.3	0.2%
1988	0.6	0.4%
1989	1.5	1.0%
1990	1.2	0.8%
1991	1.0	0.7%
1992	1.1	0.7%
1993	1.1	0.7%
1994	1.5	1.0%
1995	2.3	1.5%
1996	2.1	1.4%
1997	2.2	1.5%
1998	2.1	1.4%
1999	2.0	1.4%
2000	2.3	1.5%

MAX Yield Increase, mm: **16.8** Calibration value: **1.023**

MAX Percent Increase: **11.2%** Base Yield, mm: **149.8**

Year of MAX: **2049** Precipitation, mm: **542.1**

Scenario Name: **LS_10** Region: **New England/Boreal**

Save Yield Data ECA Mature Ba ECA Max Yld Max Day's Analysis Peak Flow Analysis Return

LS_10 ECA based on Maximum Water Yield Increase

Year	Eca, ha	Eca, %
1986	0.0	0.0%
1986	50.6	0.2%
1987	94.2	0.4%
1988	150.4	0.7%
1989	394.4	1.9%
1990	320.9	1.5%
1991	270.6	1.3%
1992	285.3	1.4%
1993	289.5	1.4%
1994	387.5	1.8%
1995	571.0	2.7%
1996	526.3	2.5%
1997	554.1	2.6%
1998	524.5	2.5%
1999	511.9	2.4%
2000	583.6	2.8%
2001	541.1	2.6%
2002	537.0	2.6%
2003	1019.1	4.9%
2004	1358.6	6.5%
2005	1198.8	5.7%
2006	1186.9	5.6%
2007	1410.7	6.7%

Maximum Eca, ha: **4639.5** Max Eca, %: **22.1%**

Year of max Eca: **2049**

Scenario: **LS_10** Region: **New England/Boreal**

About Eca Max Yield Save Data to Excel Return

Maximum day's flow results with scenario LS_10

Predicted Annual Day's Maximum Flow and Yield

Recurrence Interval	Without Harvest		With Harvest			
	Flow m ³ /s	Yield mm	Flow m ³ /s	Yield mm	Change m ³ /s	Percent Increase
2 Years	16.9	3.7	19.2	4.2	2.31	13.6%
5 Years	31.2	6.8	35.5	7.8	4.24	13.6%
10 Years	41.3	9.1	46.9	10.3	5.63	13.6%
20 Years	50.9	11.2	57.9	12.7	6.98	13.7%
50 Years	63.1	13.8	71.8	15.7	8.69	13.8%
100 Years	72.0	15.8	81.9	18.0	9.94	13.8%

Area Harvested, km²: **210.1** 53.3%

Watershed Area, km²: **394.0**

Peak Year: **2048**

Area Harvested: **210.1** 53.3%

Watershed Area: **394.0**

Peak Flow Function: **WHITECOURT ALL UNITS**

About Peak Flows Save Data To Excel Return to Results

Little Smoky 1a

Run Scenarios in database with Individual Blocks

Select Scenario: **LSm1a** [Run Scenario] [Return to Main]

Simulate Each Unit From **1986** for **200** years with **1** year time steps

Watershed Area, km²: **151.7** Total Area Cut, ha: **8857.2** Percent Watershed Cut: **58.4%**

Appropriate Forest and Unit Group: **WHITECOURT ALL UNITS** Yield Data Selection: **Forest Unit Stations** Region: **New England/Boreal**

Watershed Yield Data Source: **WASKAHIGAN RIVER NEAR THE MOI** Year Progress

Statistic **AVG** Period **1968-1998** Yld, mm **149.8** Area, km² **1040**

Precipitation Data Source: **FOX CREEK RS** Units Progress

Statistic **AVG** Period **1966-1998** Annual Ppt. mm: **542.1**

Cut Block Details: **frmRunScenarios, Individual Blocks** [Table View]

Annual Harvest Data, Operational Unit

Cut, ha **29.8** Year Cut **1986**

Blks **1** Blk Size, ha **29.8**

Aspect **EW** Block Elev, m **1281.0**

Regeneration Sp **CONIFEROUS**

Basal Area Func **LPP FAIR BA**

Tree Height Func **LPP FAIR TH**

Surrounding Stand Data

Stand Species **CONIFEROUS**

Stand BA **40.5** Stand TH **13.0**

Regional (Base) Silvicultural Data

Base BA **35.0** Years To Base BA **130**

Base TH, m **20.0** Years To Base TH **160**

Record: 14 of 582

Results Scenario LSm1a

Year	Yield, mm	%
1986	0.0	0.0%
1986	0.5	0.3%
1987	0.3	0.2%
1988	0.4	0.3%
1989	0.8	0.5%
1990	0.9	0.6%
1991	0.7	0.5%
1992	0.9	0.6%
1993	0.8	0.5%
1994	0.8	0.5%
1995	2.3	1.5%
1996	2.1	1.4%
1997	1.7	1.1%
1998	1.6	1.1%
1999	1.7	1.1%
2000	2.4	1.6%

Record: 14 of 1

MAX Yield Increase, mm **19.1** Calibration value **1.025**

MAX Percent Increase **12.8%** Base Yield, mm **149.8**

Year of MAX **2049** Precipitation, mm **542.1**

Scenario Name **LSm1a** Region **New England/Boreal**

[Save Yield Data] [ECA Mature Ba] [ECA Max Yld] [Max Day's Analysis] [Peak Flow Analysis] [Return]

LSm1a ECA based on Maximum Water Yield Increase

Year	Eca, ha	Eca, %
1986	0.0	0.0%
1986	50.6	0.6%
1987	35.1	0.4%
1988	44.3	0.5%
1989	76.9	0.9%
1990	86.6	1.0%
1991	73.8	0.8%
1992	85.8	1.0%
1993	81.0	0.9%
1994	77.9	0.9%
1995	232.8	2.6%
1996	210.9	2.4%
1997	173.9	2.0%
1998	165.8	1.9%
1999	171.0	1.9%
2000	252.8	2.9%
2001	217.2	2.5%
2002	194.3	2.2%
2003	226.9	2.6%
2004	654.0	7.4%
2005	592.1	6.7%
2006	588.7	6.6%
2007	696.2	7.9%

Maximum Eca, ha **2106.8** Max Eca, % **23.8%**

Year of max Eca **2049**

Scenario **LSm1a** Region **New England/Boreal**

[About Eca Max Yield] [Save Data to Excel] [Return]

Maximum day's flow results with scenario LSm1a

Recurrence Interval	Without Harvest		With Harvest			
	Flow m ³ /s	Yield mm	Flow m ³ /s	Yield mm	Change m ³ /s	Percent Increase
2 Years	7.0	4.0	8.2	4.7	1.20	17.1%
5 Years	12.9	7.3	15.1	8.6	2.21	17.1%
10 Years	16.9	9.6	19.9	11.3	2.93	17.3%
20 Years	20.8	11.8	24.4	13.9	3.63	17.5%
50 Years	25.6	14.6	30.1	17.1	4.52	17.7%
100 Years	29.1	16.6	34.3	19.5	5.17	17.8%

Area Harvested, km²: **88.6** 58.4% [14] [2048] [1]

Watershed Area, km²: **151.7** [Displayed Above]

Peak Flow Function: **WHITECOURT ALL UNITS**

[About Peak Flows] [Save Data To Excel] [Return to Results]

Time Course of Maximum Day's Flow

Peak Year **2048**

Little Smoky 1b

Run Scenarios in database with Individual Blocks

Select Scenario: **LSm1b** [Run Scenario] [Return to Main]

Simulate Each Unit From **1990** for **200** years with **1** year time steps

Watershed Area, km²: **76.1** Total Area Cut, ha: **3748.3** Percent Watershed Cut: **49.3%**

Appropriate Forest and Unit Group: **WHITECOURT ALL UNITS** Yield Data Selection: **Forest Unit Stations** Region: **New England/Boreal**

Watershed Yield Data Source: **WASKAHIGAN RIVER NEAR THE MDI** Year Progress

Statistic **AVG** Period **1968-1998** Yld, mm **149.8** Area, km² **1040**

Precipitation Data Source: **FOX CREEK RS** Units Progress

Statistic **AVG** Period **1966-1998** Annual Ppt, mm: **542.1**

Cut Block Details: **frmRunScenarios, Individual Blocks** [Table View]

Annual Harvest Data, Operational Unit

Cut, ha **0.2** Year Cut **1990**

Blks **1** Blk Size, ha **0.2**

Aspect **N** Block Elev, m **1384.0**

Regeneration Sp **CONIFEROUS**

Basal Area Func **LPP FAIR BA**

Tree Height Func **LPP FAIR TH**

Surrounding Stand Data

Stand Species **CONIFEROUS**

Stand BA **40.5** Stand TH **13.0**

Regional (Base) Silvicultural Data

Base BA **35.0** Years To Base BA **130**

Base TH, m **20.0** Years To Base TH **160**

Record: 1 of 286

Results Scenario LSm1b

Year	Yield, mm	%
1989	0.0	0.0%
1990	0.0	0.0%
1991	0.0	0.0%
1992	0.0	0.0%
1993	0.0	0.0%
1994	0.0	0.0%
1995	0.0	0.0%
1996	0.0	0.0%
1997	0.0	0.0%
1998	0.0	0.0%
1999	0.0	0.0%
2000	0.0	0.0%
2001	0.0	0.0%
2002	0.0	0.0%
2003	0.0	0.0%
2004	0.0	0.0%

Record: 14

MAX Yield Increase, mm **19.3** Calibration value **1.022**

MAX Percent Increase **12.9%** Base Yield, mm **149.8**

Year of MAX **2027** Precipitation, mm **542.1**

Scenario Name **LSm1b** Region **New England/Boreal**

[Save Yield Data] [ECA Mature Ea] [ECA Max Yld] [Max Day's Analysis] [Peak Flow Analysis] [Return]

LSm1b ECA based on Maximum Water Yield Increase

Year	Eca, ha	Eca, %
1989	0.0	0.0%
1990	0.2	0.0%
1991	0.1	0.0%
1992	0.1	0.0%
1993	0.1	0.0%
1994	0.1	0.0%
1995	0.1	0.0%
1996	0.3	0.0%
1997	0.2	0.0%
1998	0.2	0.0%
1999	0.2	0.0%
2000	0.2	0.0%
2001	0.2	0.0%
2002	0.2	0.0%
2003	0.2	0.0%
2004	0.2	0.0%
2005	0.2	0.0%
2006	0.2	0.0%
2007	0.1	0.0%
2008	88.2	2.4%
2009	62.2	1.7%
2010	46.7	1.2%
2011	82.2	2.2%

Maximum Eca, ha **1028.3** Max Eca, % **27.4%**

Year of max Eca **2027**

Scenario **LSm1b** Region **New England/Boreal**

[About Eca Max Yield] [Save Data to Excel] [Return]

Maximum day's flow results with scenario LSm1b

Predicted Annual Day's Maximum Flow and Yield

Recurrence Interval	Without Harvest		With Harvest			
	Flow m ³ /s	Yield mm	Flow m ³ /s	Yield mm	Change m ³ /s	Percent Increase
2 Years	3.7	4.2	4.4	5.0	0.72	19.6%
5 Years	6.8	7.7	8.1	9.2	1.34	19.7%
10 Years	8.9	10.1	10.7	12.1	1.78	20.0%
20 Years	10.9	12.3	13.1	14.8	2.20	20.3%
50 Years	13.3	15.1	15.6	17.7	2.26	17.0%
100 Years	15.1	17.2	17.4	19.7	2.26	14.9%

Area Harvested, km²: **37.5** **49.3%** [14] [2026] [Displayed Above]

Watershed Area, km²: **76.1**

Peak Flow Function: **WHITECOURT ALL UNITS** [About Peak Flows] [Save Data To Excel] [Return to Results]

Time Course of Maximum Day's Flow

Peak Year **2026**

Little Smoky 2

Run Scenarios in database with Individual Blocks

Select Scenario: **LSm_2** [Run Scenario] [Return to Main]

Simulate Each Unit From **1990** for **215** years with **1** year time steps

Watershed Area, km²: **51.4** Total Area Cut, ha: **2607.3** Percent Watershed Cut: **50.7%**

Appropriate Forest and Unit Group: **WHITECOURT ALL UNITS** Yield Data Selection: **Forest Unit Stations** Region: **New England/Boreal**

Watershed Yield Data Source: **WASKAHIGAN RIVER NEAR THE MDU** Year Progress

Statistic **AVG** Period **1968-1998** Yld. mm **149.8** Area, km² **1040**

Precipitation Data Source: **FOX CREEK RS** Units Progress

Statistic **AVG** Period **1966-1998** Annual Ppt. mm: **542.1**

Cut Block Details: **frmRunScenarios, Individual Blocks** [Table View]

Annual Harvest Data, Operational Unit

Cut, ha	9.3	Year Cut	1990
# Blks	1	Blk Size, ha	20.5
Aspect	EW	Block Elev, m	1400.0

Surrounding Stand Data

Stand Species	CONIFEROUS		
Stand BA	28.8	Stand TH	10.0

Regional (Base) Silvicultural Data

Base BA	35.0	Years To Base BA	130
Base TH, m	20.0	Years To Base TH	160

Regeneration Sp: **CONIFEROUS**

Basal Area Func: **LPP FAIR BA**

Tree Height Func: **LPP FAIR TH**

Record: 1 of 290

Results Scenario LSm_2

Year	Yield, mm	%
1989	0.0	0.0%
1990	0.4	0.3%
1991	3.4	2.2%
1992	2.4	1.6%
1993	1.8	1.2%
1994	1.8	1.2%
1995	4.0	2.6%
1996	3.7	2.5%
1997	3.4	2.3%
1998	3.4	2.3%
1999	3.4	2.3%
2000	4.1	2.8%
2001	4.0	2.7%
2002	4.0	2.6%
2003	6.6	4.4%
2004	6.8	4.5%

MAX Yield Increase, mm: **22.2** Calibration value: **1.036**

MAX Percent Increase: **14.8%** Base Yield, mm: **149.8**

Year of MAX: **2072** Precipitation, mm: **542.1**

Scenario Name: **LSm_2** Region: **New England/Boreal**

[Save Yield Data] [ECA Mature Ba] [ECA Max Yld] [Max Day's Analysis] [Peak Flow Analysis] [Return]

LSm_2 ECA based on Maximum Water Yield Increase

Year	Eca, ha	Eca, %
1989	0.0	0.0%
1990	13.9	0.5%
1991	113.1	4.3%
1992	79.6	3.1%
1993	62.1	2.4%
1994	62.5	2.4%
1995	135.9	5.2%
1996	124.9	4.8%
1997	115.1	4.4%
1998	113.6	4.4%
1999	114.7	4.4%
2000	133.5	5.1%
2001	130.2	5.0%
2002	127.5	4.9%
2003	214.1	8.2%
2004	218.0	8.4%
2005	207.9	8.0%
2006	248.4	9.5%
2007	267.4	10.3%
2008	277.7	10.6%
2009	325.8	12.5%
2010	322.4	12.4%
2011	327.4	12.6%

Maximum Eca, ha: **735.9** Max Eca, %: **28.2%**

Year of max Eca: **2075**

Scenario: **LSm_2** Region: **New England/Boreal**

[About Eca Max Yield] [Save Data to Excel] [Return]

Maximum day's flow results with scenario LSm_2

Predicted Annual Day's Maximum Flow and Yield

Recurrence Interval	Without Harvest		With Harvest		Change m³/s	Percent Increase
	Flow m³/s	Yield mm	Flow m³/s	Yield mm		
2 Years	2.6	4.3	3.2	5.4	0.62	24.1%
5 Years	4.7	7.9	5.9	9.9	1.15	24.3%
10 Years	6.2	10.4	7.7	12.9	1.52	24.7%
20 Years	7.5	12.6	9.2	15.5	1.72	22.8%
50 Years	9.2	15.5	10.9	18.3	1.72	18.6%
100 Years	10.4	17.5	12.1	20.4	1.72	16.4%

Area Harvested, km²: **26.1** 50.7%

Watershed Area, km²: **51.4** [Displayed Above]

Peak Flow Function: **WHITECOURT ALL UNITS** [About Peak Flows] [Save Data To Excel] [Return to Results]

Time Course of Maximum Day's Flow

Peak Year: **2071**

Little Smoky 3

Run Scenarios in database with Individual Blocks

Select Scenario: **LSm_3** Run Scenario Return to Main

Simulate Each Unit From **1989** for **200** years with **1** year time steps

Watershed Area, km²: **74.1** Total Area Cut, ha: **3985.1** Percent Watershed Cut: **53.8%**

Appropriate Forest and Unit Group: **WHITECOURT ALL UNITS** Yield Data Selection: **Forest Unit Stations** Region: **New England/Boreal**

Watershed Yield Data Source: **WASKAHIGAN RIVER NEAR THE MOI** Year Progress

Statistic **AVG** Period **1968-1998** Yld, mm **149.8** Area, km² **1040**

Precipitation Data Source: **FOX CREEK RS** Units Progress

Statistic **AVG** Period **1966-1998** Annual Ppt, mm: **542.1**

Cut Block Details: **frmRunScenarios, Individual Blocks** Table View

Annual Harvest Data, Operational Unit

Cut, ha	20.1	Year Cut	1989
# Blks	1	Blk Size, ha	21.1
Aspect	S	Block Elev, m	1364.0
Regeneration Sp	CONIFEROUS		
Basal Area Func	LPP FAIR BA		
Tree Height Func	LPP FAIR TH		

Surrounding Stand Data

Stand Species	CONIFEROUS
Stand BA	32.0
Stand TH	13.0

Regional (Base) Silvicultural Data

Base BA	35.0	Years To Base BA	130
Base TH, m	20.0	Years To Base TH	160

Record: 14 of 330

Results Scenario LSm_3

Year	Yield, mm	%
1988	0.0	0.0%
1989	0.4	0.3%
1990	0.5	0.3%
1991	3.8	2.6%
1992	2.7	1.8%
1993	5.4	3.6%
1994	8.0	5.4%
1995	13.3	8.9%
1996	18.4	12.3%
1997	17.4	11.6%
1998	16.0	10.7%
1999	15.7	10.5%
2000	18.9	12.6%
2001	23.3	15.6%
2002	21.2	14.1%
2003	21.5	14.3%

Record: 14

MAX Yield Increase, mm: **23.4** Calibration value: **1.032**

MAX Percent Increase: **15.6%** Base Yield, mm: **149.8**

Year of MAX: **2027** Precipitation, mm: **542.1**

Scenario Name: **LSm_3** Region: **New England/Boreal**

Save Yield Data ECA Mature Ba ECA Max Yld Max Day's Analysis Peak Flow Analysis Return

LSm_3 ECA based on Maximum Water Yield Increase

Year	Eca, ha	Eca, %
1988	0.0	0.0%
1989	20.1	0.5%
1990	25.2	0.6%
1991	202.2	5.1%
1992	143.5	3.6%
1993	282.5	7.1%
1994	426.1	10.7%
1995	690.2	17.3%
1996	942.1	23.6%
1997	884.7	22.2%
1998	816.3	20.5%
1999	804.6	20.2%
2000	957.0	24.0%
2001	1193.9	30.0%
2002	1079.3	27.1%
2003	1087.7	27.3%
2004	1052.3	26.4%
2005	1028.3	25.8%
2006	993.5	24.9%
2007	1013.5	25.4%
2008	1040.6	26.1%
2009	1010.0	25.3%
2010	1129.5	28.3%

Maximum Eca, ha: **1193.9** Max Eca, %: **30.0%**

Year of max Eca: **2001**

Scenario: **LSm_3** Region: **New England/Boreal**

About Eca Max Yield Save Data to Excel Return

Maximum day's flow results with scenario LSm_3

Recurrence Interval	Without Harvest		With Harvest		Change m ³ /s	Percent Increase
	Flow m ³ /s	Yield mm	Flow m ³ /s	Yield mm		
2 Years	3.6	4.2	4.4	5.2	0.84	23.4%
5 Years	6.6	7.7	8.2	9.6	1.56	23.6%
10 Years	8.7	10.1	10.7	12.5	2.08	23.9%
20 Years	10.6	12.3	13.0	15.1	2.38	22.5%
50 Years	13.0	15.2	15.4	17.9	2.38	18.3%
100 Years	14.7	17.2	17.1	20.0	2.38	16.1%

Area Harvested, km²: **39.9** Watershed Area, km²: **74.1** 14 | 2026 | 14

Peak Flow Function: **WHITECOURT ALL UNITS** About Peak Flows Save Data To Excel Return to Results

Predicted Annual Day's Maximum Flow and Yield

Time Course of Maximum Day's Flow

Peak Year: **2026**

Little Smoky 4

Run Scenarios in database with Individual Blocks

Select Scenario: **LSm_4** [Run Scenario] [Return to Main]

Simulate Each Unit From **1993** for **200** years with **1** year time steps

Watershed Area, km²: **43.1** Total Area Cut, ha: **2730.8** Percent Watershed Cut: **63.3%**

Appropriate Forest and Unit Group: **WHITECOURT ALL UNITS** Yield Data Selection: **Forest Unit Stations** Region: **New England/Boreal**

Watershed Yield Data Source: **WASKAHIGAN RIVER NEAR THE MOI** Year Progress

Statistic **AVG** Period **1968-1998** Yld, mm **149.8** Area, km² **1040**

Precipitation Data Source: **FOX CREEK RS** Units Progress

Statistic **AVG** Period **1966-1998** Annual Ppt. mm: **542.1**

Cut Block Details: **frmRunScenarios, Individual Blocks** [Table View]

Annual Harvest Data, Operational Unit		Surrounding Stand Data	
Cut, ha	16.2	Year Cut	1993
# Blks	1	Blk Size, ha	16.2
Aspect	N	Block Elev, m	1304.0
Regeneration Sp	CONIFEROUS	Stand Species	CONIFEROUS
Basal Area Func	LPP FAIR BA	Stand BA	37.5
Tree Height Func	LPP FAIR TH	Stand TH	10.0
Regional (Base) Silvicultural Data		Base BA	35.0
		Years To Base BA	130
		Base TH, m	20.0
		Years To Base TH	160

Record: 1 of 258

Results Scenario LSm_4

Year	Yield, mm	%
1992	0.0	0.0%
1993	0.8	0.6%
1994	0.6	0.4%
1995	2.3	1.5%
1996	2.0	1.3%
1997	8.3	5.6%
1998	15.7	10.5%
1999	21.4	14.3%
2000	23.8	15.9%
2001	22.4	14.9%
2002	28.7	19.1%
2003	27.8	18.6%
2004	26.2	17.5%
2005	25.5	17.0%
2006	25.3	16.9%
2007	25.1	16.7%

Record: 1

MAX Yield Increase, mm: **36.7** Calibration value: **1.049**

MAX Percent Increase: **24.5%** Base Yield, mm: **149.8**

Year of MAX: **2017** Precipitation, mm: **542.1**

Scenario Name: **LSm_4** Region: **New England/Boreal**

[Save Yield Data] [ECA Mature Ba] [ECA Max Yld] [Max Day's Analysis] [Peak Flow Analysis] [Return]

LSm_4 ECA based on Maximum Water Yield Increase

Year	Eca, ha	Eca, %
1992	0.0	0.0%
1993	29.1	1.1%
1994	21.3	0.8%
1995	68.7	2.5%
1996	58.6	2.1%
1997	221.8	8.1%
1998	452.9	16.6%
1999	597.6	21.9%
2000	658.9	24.1%
2001	610.6	22.4%
2002	796.5	29.2%
2003	768.8	28.2%
2004	721.4	26.4%
2005	701.7	25.7%
2006	696.7	25.5%
2007	688.1	25.2%
2008	747.2	27.4%
2009	750.6	27.5%
2010	753.5	27.6%
2011	768.9	28.2%
2012	773.0	28.3%
2013	909.1	33.3%
2014	983.6	36.0%

Maximum Eca, ha: **1022.2** Max Eca, %: **37.4%**

Year of max Eca: **2017**

Scenario: **LSm_4** Region: **New England/Boreal**

[About Eca Max Yield] [Save Data to Excel] [Return]

Maximum day's flow results with scenario LSm_4

Recurrence Interval	Without Harvest		With Harvest			
	Flow m³/s	Yield mm	Flow m³/s	Yield mm	Change m³/s	Percent Increase
2 Years	2.2	4.4	3.0	6.1	0.84	38.7%
5 Years	4.0	8.0	5.6	11.2	1.57	39.0%
10 Years	5.2	10.5	6.9	13.8	1.65	31.5%
20 Years	6.4	12.8	8.0	16.1	1.65	25.9%
50 Years	7.8	15.6	9.4	18.9	1.65	21.1%
100 Years	8.8	17.7	10.5	21.0	1.65	18.6%

Area Harvested, km²: **27.3** 63.3%

Watershed Area, km²: **43.1**

Peak Year: **2016**

Peak Flow Function: **WHITECOURT ALL UNITS**

[About Peak Flows] [Save Data To Excel] [Return to Results]

Little Smoky 5

Run Scenarios in database with Individual Blocks

Select Scenario: **LSm_5** [Run Scenario] [Return to Main]

Simulate Each Unit From **1988** for **200** years with **1** year time steps

Watershed Area, km²: **130.0** Total Area Cut, ha: **2607.2** Percent Watershed Cut: **20.1%**

Appropriate Forest and Unit Group: **WHITECOURT ALL UNITS** Yield Data Selection: **Forest Unit Stations** Region: **New England/Boreal**

Watershed Yield Data Source: **WASKAHIGAN RIVER NEAR THE MOI** Year Progress

Statistic: **AVG** Period: **1968-1998** Yld, mm: **149.8** Area, km²: **1040**

Precipitation Data Source: **FOX CREEK RS** Units Progress

Statistic: **AVG** Period: **1966-1998** Annual Ppt. mm: **542.1**

Cut Block Details: **frmRunScenarios, Individual Blocks** [Table View]

Annual Harvest Data, Operational Unit		Surrounding Stand Data	
Cut, ha	60.9	Year Cut	1988
# Blks	1	Blk Size, ha	60.9
Aspect	N	Block Elev, m	1281.0
Regeneration Sp	CONIFEROUS	Stand Species	CONIFEROUS
Basal Area Func	LPP FAIR BA	Stand BA	28.8
Tree Height Func	LPP FAIR TH	Stand TH	10.0
Regional (Base) Silvicultural Data			
Base BA	35.0	Years To Base BA	130
Base TH, m	20.0	Years To Base TH	160

Record: **14** of 213

Results Scenario LSm_5

Year	Yield, mm	%
1987	0.0	0.0%
1988	0.6	0.4%
1989	1.3	0.9%
1990	1.0	0.6%
1991	0.8	0.5%
1992	0.8	0.6%
1993	0.9	0.6%
1994	0.9	0.6%
1995	0.9	0.6%
1996	3.2	2.1%
1997	8.5	5.7%
1998	8.9	5.9%
1999	7.9	5.3%
2000	8.0	5.3%
2001	8.4	5.6%
2002	8.5	5.7%

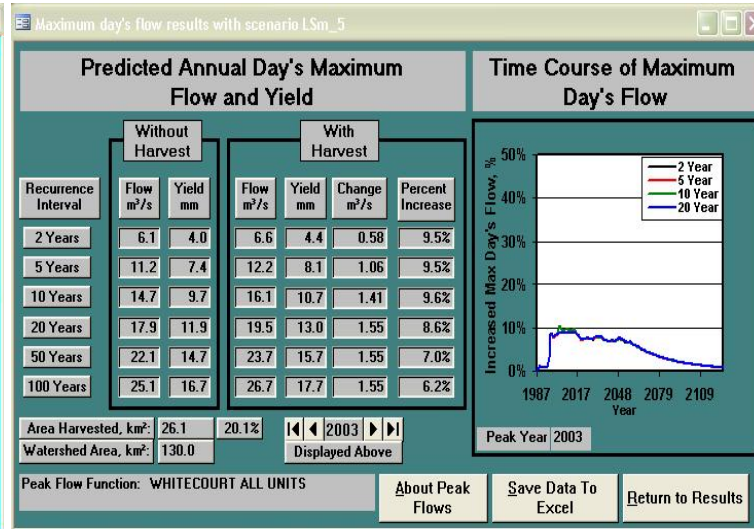
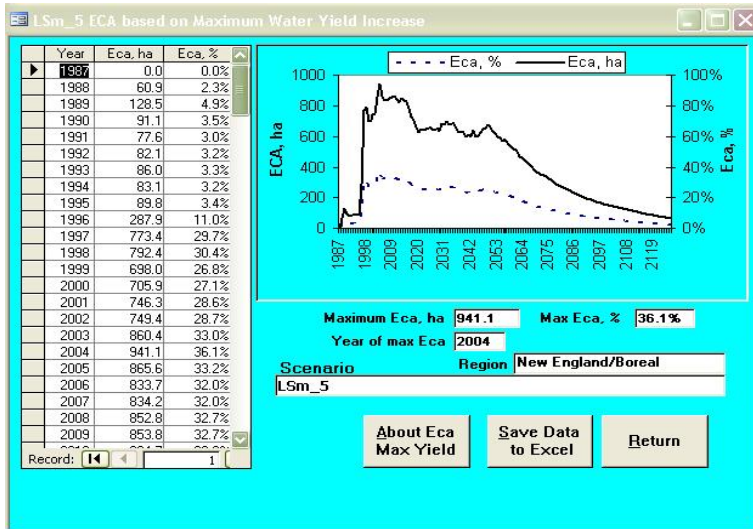
Record: **14**

MAX Yield Increase, mm: **10.6** Calibration value: **0.980**

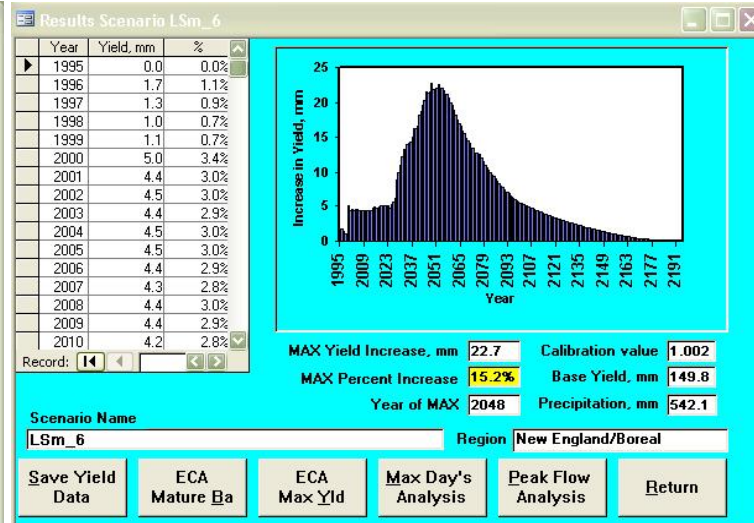
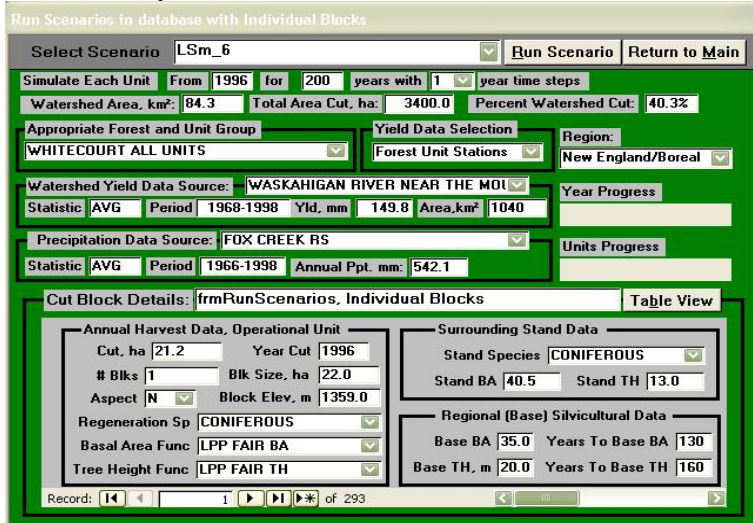
MAX Percent Increase: **7.1%** Base Yield, mm: **149.8**

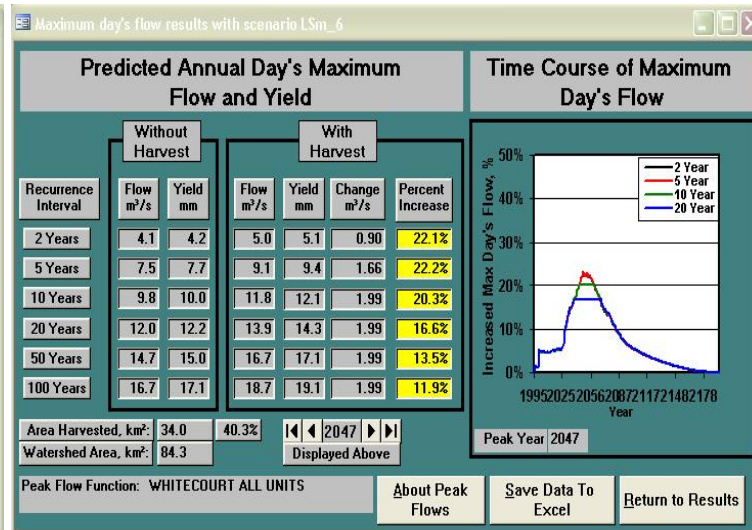
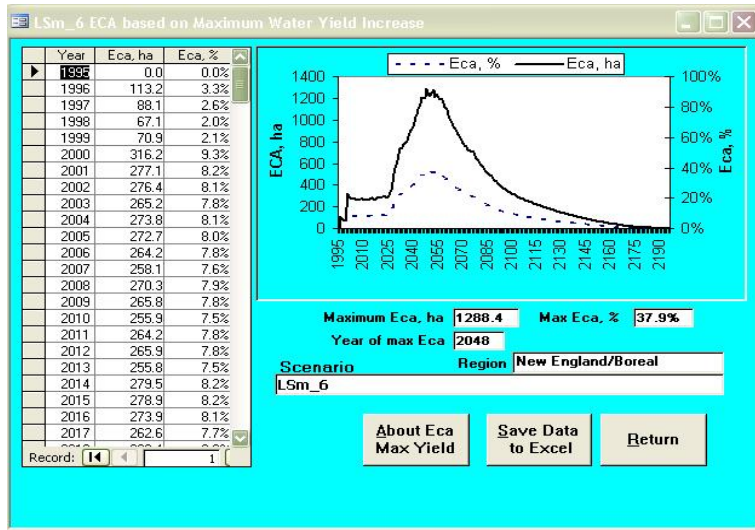
Year of MAX: **2004** Precipitation, mm: **542.1**

Scenario Name: **LSm_5** Region: **New England/Boreal**

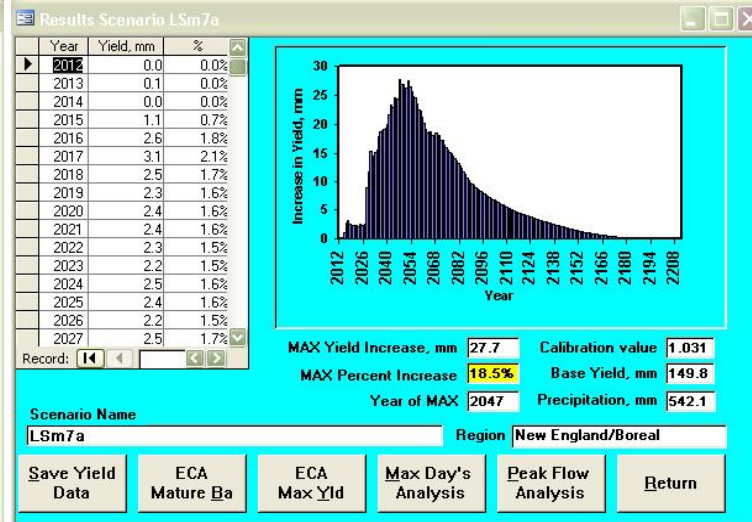
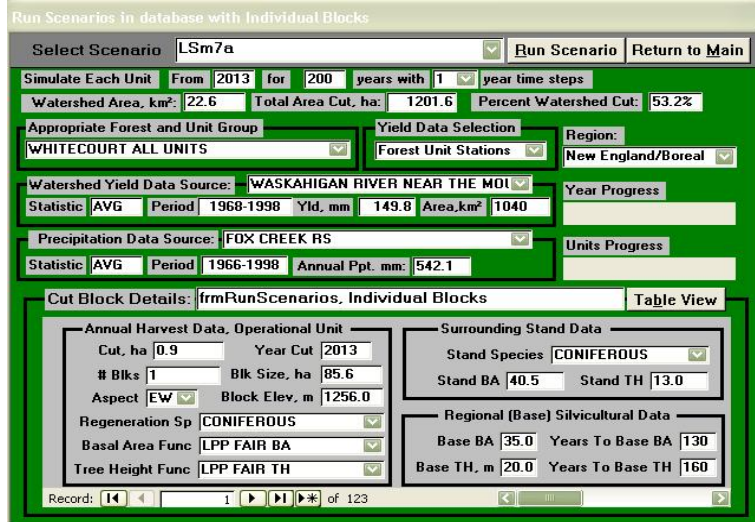


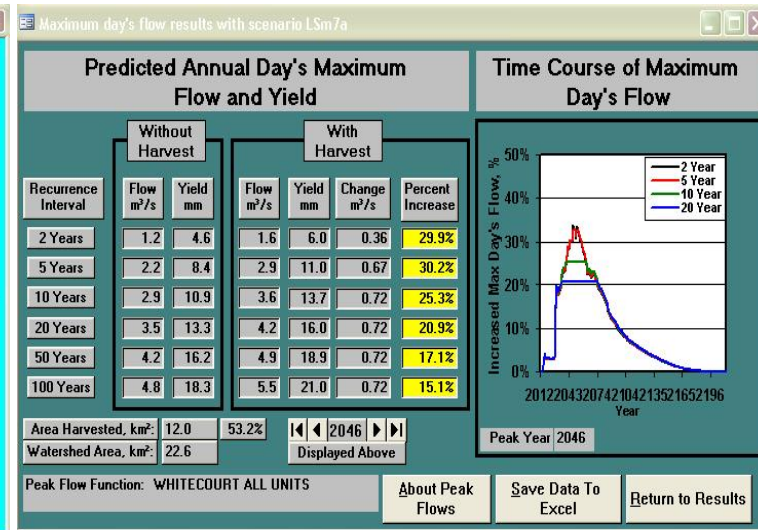
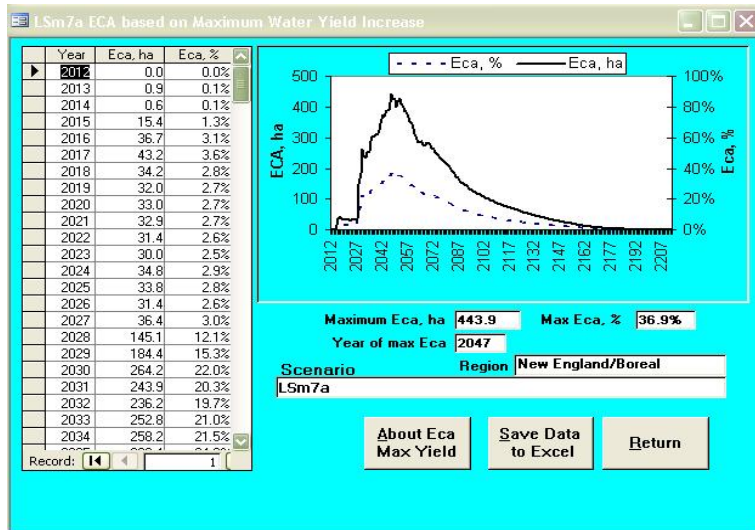
Little Smoky 6





Little Smoky 7





Little Smoky L1

Run Scenarios in database with Individual Blocks

Select Scenario: **LSmL1** [Run Scenario] [Return to Main]

Simulate Each Unit From **1987** for **200** years with **1** year time steps

Watershed Area, km²: **105.2** Total Area Cut, ha: **5533.2** Percent Watershed Cut: **52.6%**

Appropriate Forest and Unit Group: **WHITECOURT ALL UNITS** Yield Data Selection: **Forest Unit Stations** Region: **New England/Boreal**

Watershed Yield Data Source: **WASKAHIGAN RIVER NEAR THE MDI** Year Progress

Statistic **AVG** Period **1968-1998** Yld, mm **149.8** Area, km² **1040**

Precipitation Data Source: **FOX CREEK RS** Units Progress

Statistic **AVG** Period **1966-1998** Annual Ppt, mm: **542.1**

Cut Block Details: **frmRunScenarios, Individual Blocks** [Table View]

Annual Harvest Data, Operational Unit

Cut, ha	23.7	Year Cut	1987
# Blks	1	Blk Size, ha	41.7
Aspect	EW	Block Elev, m	1500.0
Regeneration Sp	CONIFEROUS		
Basal Area Func	LPP FAIR BA		
Tree Height Func	LPP FAIR TH		

Surrounding Stand Data

Stand Species	CONIFEROUS
Stand BA	40.5
Stand TH	13.0

Regional (Base) Silvicultural Data

Base BA	35.0	Years To Base BA	130
Base TH, m	20.0	Years To Base TH	160

Record: 14 of 480

Results Scenario LSmL1

Year	Yield, mm	%
1986	0.0	0.0%
1987	0.8	0.5%
1988	1.5	1.0%
1989	4.6	3.1%
1990	3.4	2.3%
1991	2.8	1.9%
1992	2.9	1.9%
1993	3.0	2.0%
1994	4.5	3.0%
1995	5.1	3.4%
1996	4.8	3.2%
1997	5.7	3.8%
1998	5.4	3.6%
1999	5.1	3.4%
2000	5.0	3.3%
2001	4.9	3.3%

Record: 14

MAX Yield Increase, mm: **21.7** Calibration value: **1.024**

MAX Percent Increase: **14.5%** Base Yield, mm: **149.8**

Year of MAX: **2027** Precipitation, mm: **542.1**

Scenario Name: **LSmL1** Region: **New England/Boreal**

[Save Yield Data] [ECA Mature Ba] [ECA Max Yld] [Max Day's Analysis] [Peak Flow Analysis] [Return]

LSmL1 ECA based on Maximum Water Yield Increase

Year	Eca, ha	Eca, %
1986	0.0	0.0%
1987	59.1	1.1%
1988	106.1	1.9%
1989	317.4	5.7%
1990	234.1	4.2%
1991	196.7	3.6%
1992	199.5	3.6%
1993	208.4	3.8%
1994	309.3	5.6%
1995	338.1	6.1%
1996	315.2	5.7%
1997	380.0	6.9%
1998	358.5	6.5%
1999	340.6	6.2%
2000	330.6	6.0%
2001	323.6	5.8%
2002	342.6	6.2%
2003	792.0	14.3%
2004	704.2	12.7%
2005	606.6	11.0%
2006	597.9	10.8%
2007	714.4	12.9%
2008	741.0	13.4%

Maximum Eca, ha: **1547.7** Max Eca, %: **28.0%**

Year of max Eca: **2027**

Scenario: **LSmL1** Region: **New England/Boreal**

[About Eca Max Yield] [Save Data to Excel] [Return]

Maximum day's flow results with scenario LSmL1

Recurrence Interval	Without Harvest		With Harvest			
	Flow m ³ /s	Yield mm	Flow m ³ /s	Yield mm	Change m ³ /s	Percent Increase
2 Years	5.0	4.1	6.0	4.9	1.04	20.8%
5 Years	9.2	7.5	11.1	9.1	1.92	20.9%
10 Years	12.0	9.9	14.6	12.0	2.55	21.2%
20 Years	14.7	12.1	17.9	14.7	3.16	21.4%
50 Years	18.1	14.9	21.4	17.5	3.25	17.9%
100 Years	20.6	16.9	23.8	19.6	3.25	15.8%

Area Harvested, km²: **55.3** **52.6%**

Watershed Area, km²: **105.2**

Peak Year: **2026**

Area Harvested, km²: **55.3** **52.6%** Watershed Area, km²: **105.2**

Peak Flow Function: **WHITECOURT ALL UNITS**

[About Peak Flows] [Save Data To Excel] [Return to Results]

Little Smoky U1

Run Scenarios in database with Individual Blocks

Select Scenario: **LSmU1** Run Scenario Return to Main

Simulate Each Unit From **2008** for **200** years with **1** year time steps

Watershed Area, km²: **11.5** Total Area Cut, ha: **737.6** Percent Watershed Cut: **64.2%**

Appropriate Forest and Unit Group: **WHITECOURT ALL UNITS** Yield Data Selection: **Forest Unit Stations** Region: **New England/Boreal**

Watershed Yield Data Source: **WASKAHIGAN RIVER NEAR THE MOU** Year Progress

Statistic: **AVG** Period: **1968-1998** Yld, mm: **149.8** Area, km²: **1040**

Precipitation Data Source: **FOX CREEK RS** Units Progress

Statistic: **AVG** Period: **1966-1998** Annual Ppt, mm: **542.1**

Cut Block Details: **frmRunScenarios, Individual Blocks** Table View

Annual Harvest Data, Operational Unit

Cut, ha: **3.4** Year Cut: **2008**

Blks: **1** Blk Size, ha: **3.4**

Aspect: **EW** Block Elev, m: **1307.0**

Regeneration Sp: **CONIFEROUS**

Basal Area Func: **LPP FAIR BA**

Tree Height Func: **LPP FAIR TH**

Surrounding Stand Data

Stand Species: **CONIFEROUS**

Stand BA: **37.5** Stand TH: **10.0**

Regional (Base) Silvicultural Data

Base BA: **35.0** Years To Base BA: **130**

Base TH, m: **20.0** Years To Base TH: **160**

Record: 14 of 78

Results Scenario LSmU1

Year	Yield, mm	%
2007	0.0	0.0%
2008	0.4	0.3%
2009	0.4	0.2%
2010	4.3	2.9%
2011	3.1	2.1%
2012	2.5	1.7%
2013	2.5	1.6%
2014	3.1	2.1%
2015	3.0	2.0%
2016	4.9	3.3%
2017	4.6	3.1%
2018	4.1	2.7%
2019	4.9	3.3%
2020	6.0	4.0%
2021	5.3	3.5%
2022	4.8	3.2%

Record: 14

MAX Yield Increase, mm: **31.7** Calibration value: **0.992**

MAX Percent Increase: **21.1%** Base Yield, mm: **149.8**

Year of MAX: **2077** Precipitation, mm: **542.1**

Scenario Name: **LSmU1** Region: **New England/Boreal**

Save Yield Data ECA Mature Ba ECA Max Yld Max Day's Analysis Peak Flow Analysis Return

LSmU1 ECA based on Maximum Water Yield Increase

Year	Eca, ha	Eca, %
2007	0.0	0.0%
2008	3.4	0.5%
2009	2.9	0.4%
2010	35.4	4.8%
2011	25.1	3.4%
2012	20.1	2.7%
2013	20.0	2.7%
2014	25.4	3.4%
2015	24.3	3.3%
2016	39.8	5.4%
2017	36.6	5.0%
2018	32.7	4.4%
2019	39.2	5.3%
2020	47.8	6.5%
2021	42.3	5.7%
2022	38.8	5.3%
2023	37.8	5.1%
2024	36.9	5.0%
2025	41.6	5.6%
2026	37.2	5.0%
2027	33.9	4.6%
2028	69.6	9.4%
2029	61.4	8.3%

Maximum Eca, ha: **254.0** Max Eca, %: **34.4%**

Year of max Eca: **2077**

Scenario: **LSmU1** Region: **New England/Boreal**

About Eca Max Yield Save Data to Excel Return

Maximum day's flow results with scenario LSmU1

Predicted Annual Day's Maximum Flow and Yield

Recurrence Interval	Without Harvest		With Harvest			
	Flow m ³ /s	Yield mm	Flow m ³ /s	Yield mm	Change m ³ /s	Percent Increase
2 Years	0.6	4.8	0.9	6.7	0.25	39.6%
5 Years	1.2	8.9	1.6	12.2	0.44	37.3%
10 Years	1.5	11.4	2.0	14.7	0.44	28.9%
20 Years	1.8	13.8	2.3	17.1	0.44	23.9%
50 Years	2.2	16.8	2.7	20.1	0.44	19.7%
100 Years	2.5	18.9	3.0	22.2	0.44	17.5%

Area Harvested, km²: **7.4** 64.2%

Watershed Area, km²: **11.5**

Peak Year: **2076**

Time Course of Maximum Day's Flow

Peak Flow Function: **WHITECOURT ALL UNITS**

About Peak Flows Save Data To Excel Return to Results

Little Smoky W1

Run Scenarios in database with Individual Blocks

Select Scenario **LSmW1** Run Scenario Return to Main

Simulate Each Unit From **2028** for **200** years with **1** year time steps

Watershed Area, km²: **26.9** Total Area Cut, ha: **934.3** Percent Watershed Cut: **34.7%**

Appropriate Forest and Unit Group: **WHITECOURT ALL UNITS** Yield Data Selection: **Forest Unit Stations** Region: **New England/Boreal**

Watershed Yield Data Source: **WASKAHIGAN RIVER NEAR THE MOI** Year Progress

Statistic **AVG** Period **1968-1998** Yld, mm **149.8** Area, km² **1040**

Precipitation Data Source: **FOX CREEK RS** Units Progress

Statistic **AVG** Period **1966-1998** Annual Ppt. mm: **542.1**

Cut Block Details: **frmRunScenarios, Individual Blocks** Table View

Annual Harvest Data, Operational Unit

Cut, ha **7.4** Year Cut **2028**

Blks **1** Blk Size, ha **7.4**

Aspect **EW** Block Elev, m **1427.0**

Regeneration Sp **CONIFEROUS**

Basal Area Func **LPP FAIR BA**

Tree Height Func **LPP FAIR TH**

Surrounding Stand Data

Stand Species **CONIFEROUS**

Stand BA **28.8** Stand TH **10.0**

Regional (Base) Silvicultural Data

Base BA **35.0** Years To Base BA **130**

Base TH, m **20.0** Years To Base TH **160**

Record: **14** of 83

Results Scenario LSmW1

Year	Yield, mm	%
2027	0.0	0.0%
2028	2.5	1.7%
2029	2.0	1.3%
2030	2.1	1.4%
2031	2.2	1.5%
2032	4.1	2.7%
2033	3.4	2.3%
2034	3.2	2.2%
2035	3.2	2.1%
2036	3.2	2.1%
2037	4.0	2.7%
2038	4.1	2.7%
2039	4.8	3.2%
2040	6.1	4.0%
2041	5.3	3.6%
2042	5.0	3.3%

MAX Yield Increase, mm **18.6** Calibration value **0.994**

MAX Percent Increase **12.4%** Base Yield, mm **149.8**

Year of MAX **2074** Precipitation, mm **542.1**

Scenario Name **LSmW1** Region **New England/Boreal**

Save Yield Data ECA Mature Ba ECA Max Yld Max Day's Analysis Peak Flow Analysis Return

LSmW1 ECA based on Maximum Water Yield Increase

Year	Eca, ha	Eca, %
2027	0.0	0.0%
2028	48.2	5.2%
2029	38.5	4.1%
2030	40.2	4.3%
2031	43.0	4.6%
2032	84.2	9.0%
2033	69.9	7.5%
2034	65.5	7.0%
2035	64.1	6.9%
2036	65.2	7.0%
2037	81.8	8.8%
2038	84.5	9.0%
2039	96.3	10.3%
2040	120.7	12.9%
2041	107.1	11.5%
2042	99.7	10.7%
2043	97.2	10.4%
2044	95.3	10.2%
2045	121.8	13.0%
2046	135.4	14.5%
2047	133.4	14.3%
2048	118.9	12.7%
2049	126.8	13.6%

Maximum Eca, ha **360.4** Max Eca, % **38.6%**

Year of max Eca **2074**

Scenario **LSmW1** Region **New England/Boreal**

About Eca Max Yield Save Data to Excel Return

Maximum day's flow results with scenario LSmW1

Predicted Annual Day's Maximum Flow and Yield

Recurrence Interval	Without Harvest		With Harvest		Change m³/s	Percent Increase
	Flow m³/s	Yield mm	Flow m³/s	Yield mm		
2 Years	1.4	4.5	1.7	5.5	0.30	21.1%
5 Years	2.6	8.3	3.1	10.0	0.51	19.6%
10 Years	3.4	10.8	3.9	12.4	0.51	15.1%
20 Years	4.1	13.1	4.6	14.8	0.51	12.4%
50 Years	5.0	16.0	5.5	17.6	0.51	10.2%
100 Years	5.7	18.1	6.2	19.7	0.51	9.0%

Area Harvested, km²: **9.3** 34.7%

Watershed Area, km²: **26.9**

Peak Year **2073**

Time Course of Maximum Day's Flow

Area Harvested, km²: **9.3** 34.7%

Watershed Area, km²: **26.9**

Peak Flow Function: **WHITECOURT ALL UNITS**

About Peak Flows Save Data To Excel Return to Results

Muskeg Confluence 1a

Run Scenarios in database with Individual Blocks

Select Scenario: **MC_1a** [Run Scenario] [Return to Main]

Simulate Each Unit From **1984** for **200** years with **1** year time steps

Watershed Area, km²: **10.4** Total Area Cut, ha: **1043.6** Percent Watershed Cut: **100.0%**

Appropriate Forest and Unit Group: **GRANDE PRAIRIE G3 TO G7** Yield Data Selection: **Forest Unit Stations** Region: **New England/Boreal**

Watershed Yield Data Source: **Muskeg River near Grande Cache** Year Progress

Statistic: **AVG** Period: **1972-2003** Yld, mm: **226.4** Area, km²: **706**

Precipitation Data Source: **GRANDE CACHE** Units Progress

Statistic: **AVG** Period: **1985-1995** Annual Ppt. mm: **590.4**

Cut Block Details: **frmRunScenarios, Individual Blocks** [Table View]

Annual Harvest Data, Operational Unit

Cut, ha: **95.0** Year Cut: **1984**

Blks: **1** Blk Size, ha: **95.0**

Aspect: **S** Block Elev. m: **1433.0**

Regeneration Sp: **CONIFEROUS**

Basal Area Func: **LPP FAIR BA**

Tree Height Func: **LPP FAIR TH**

Surrounding Stand Data

Stand Species: **CONIFEROUS**

Stand BA: **40.5** Stand TH: **13.0**

Regional (Base) Silvicultural Data

Base BA: **35.0** Years To Base BA: **130**

Base TH, m: **20.0** Years To Base TH: **160**

Record: 1 of 75

Results Scenario MC_1a

Year	Yield, mm	%
1983	0.0	0.0%
1984	13.8	6.1%
1985	11.5	5.1%
1986	23.1	10.2%
1987	18.4	8.1%
1988	16.3	7.2%
1989	15.6	6.9%
1990	19.2	8.5%
1991	17.6	7.8%
1992	17.0	7.5%
1993	17.4	7.7%
1994	17.5	7.7%
1995	17.3	7.6%
1996	16.7	7.4%
1997	16.0	7.1%
1998	15.8	7.0%

Record: 14

MAX Yield Increase, mm: **41.9** Calibration value: **1.109**

MAX Percent Increase: **18.5%** Base Yield, mm: **226.4**

Year of MAX: **2010** Precipitation, mm: **590.4**

Scenario Name: **MC_1a** Region: **New England/Boreal**

[Save Yield Data] [ECA Mature Ba] [ECA Max Yld] [Max Day's Analysis] [Peak Flow Analysis] [Return]

MC_1a ECA based on Maximum Water Yield Increase

Year	Eca, ha	Eca, %
1983	0.0	0.0%
1984	95.0	9.1%
1985	78.1	7.5%
1986	153.9	14.7%
1987	123.4	11.8%
1988	109.2	10.5%
1989	105.0	10.1%
1990	129.1	12.4%
1991	118.5	11.4%
1992	114.5	11.0%
1993	116.8	11.2%
1994	117.5	11.3%
1995	116.1	11.1%
1996	112.5	10.8%
1997	107.3	10.3%
1998	106.1	10.2%
1999	98.7	9.5%
2000	90.4	8.7%
2001	93.7	9.0%
2002	83.4	8.0%
2003	108.0	10.4%
2004	91.3	8.7%
2005	81.5	7.8%

Maximum Eca, ha: **293.0** Max Eca, %: **28.1%**

Year of max Eca: **2010**

Scenario: **MC_1a** Region: **New England/Boreal**

[About Eca Max Yield] [Save Data to Excel] [Return]

Maximum day's flow results with scenario MC_1a

Predicted Annual Day's Maximum Flow and Yield

Recurrence Interval	Without Harvest		With Harvest		
	Flow m ³ /s	Yield mm	Flow m ³ /s	Yield mm	Percent Increase
2 Years	0.8	6.5	1.0	8.3	26.8%
5 Years	1.4	11.7	1.8	14.9	27.2%
10 Years	1.8	14.9	2.3	19.1	27.8%
20 Years	2.2	17.9	2.8	23.0	28.2%
50 Years	2.6	21.6	3.2	26.7	23.7%
100 Years	2.9	24.3	3.6	29.4	21.0%

Area Harvested, km²: **10.4** 100.0%

Watershed Area, km²: **10.4**

Peak Flow Function: **GRANDE PRAIRIE G3 TO G7**

Time Course of Maximum Day's Flow

Peak Year: **2009**

[About Peak Flows] [Save Data To Excel] [Return to Results]

Muskeg Confluence 2a

Run Scenarios in database with Individual Blocks

Select Scenario: **MC_2a** [Run Scenario] [Return to Main]

Simulate Each Unit From **1982** for **200** years with **1** year time steps

Watershed Area, km²: **27.7** Total Area Cut, ha: **2052.4** Percent Watershed Cut: **74.1%**

Appropriate Forest and Unit Group: **GRANDE PRAIRIE G3 TO G7** Yield Data Selection: **Forest Unit Stations** Region: **New England/Boreal**

Watershed Yield Data Source: **Muskeg River near Grande Cache** Year Progress: []

Statistic: **AVG** Period: **1972-2003** Yld, mm: **226.4** Area, km²: **706**

Precipitation Data Source: **GRANDE CACHE** Units Progress: []

Statistic: **AVG** Period: **1985-1995** Annual Ppt. mm: **590.4**

Cut Block Details: **frmRunScenarios, Individual Blocks** [Table View]

Annual Harvest Data, Operational Unit

Cut, ha	73.6	Year Cut	1982
# Blks	1	Blk Size, ha	73.6
Aspect	EW	Block Elev, m	1482.0
Regeneration Sp	CONIFEROUS		
Basal Area Func	WS FAIR BA		
Tree Height Func	WS FAIR TH		

Surrounding Stand Data

Stand Species	CONIFEROUS
Stand BA	35.3
Stand TH	16.0

Regional (Base) Silvicultural Data

Base BA	30.0	Years To Base BA	140
Base TH, m	20.0	Years To Base TH	170

Record: 1 of 119

Results Scenario MC_2a

Year	Yield, mm	%
1981	0.0	0.0%
1982	3.6	1.6%
1983	3.7	1.6%
1984	4.3	1.9%
1985	15.2	6.7%
1986	16.6	7.3%
1987	31.6	14.0%
1988	26.3	11.6%
1989	23.6	10.4%
1990	23.9	10.6%
1991	23.8	10.5%
1992	28.2	12.4%
1993	27.8	12.3%
1994	27.6	12.2%
1995	27.5	12.2%
1996	27.3	12.1%

Record: 14

MAX Yield Increase, mm: **31.6** Calibration value: **1.111**

MAX Percent Increase: **14.0%** Base Yield, mm: **226.4**

Year of MAX: **1987** Precipitation, mm: **590.4**

Scenario Name: **MC_2a** Region: **New England/Boreal**

[Save Yield Data] [ECA Mature Ba] [ECA Max Yld] [Max Day's Analysis] [Peak Flow Analysis] [Return]

MC_2a ECA based on Maximum Water Yield Increase

Year	Eca, ha	Eca, %
1981	0.0	0.0%
1982	59.8	2.9%
1983	61.3	3.0%
1984	71.8	3.5%
1985	277.5	13.5%
1986	304.9	14.9%
1987	580.1	28.3%
1988	478.7	23.3%
1989	429.6	20.9%
1990	437.1	21.3%
1991	434.2	21.2%
1992	515.3	25.1%
1993	508.6	24.8%
1994	504.5	24.6%
1995	503.4	24.5%
1996	500.1	24.4%
1997	485.1	23.6%
1998	506.7	24.7%
1999	476.3	23.2%
2000	478.5	23.3%
2001	521.9	25.4%
2002	485.5	23.7%
2003	438.5	21.4%

Maximum Eca, ha: **580.1** Max Eca, %: **28.3%**

Year of max Eca: **1987**

Scenario: **MC_2a** Region: **New England/Boreal**

[About Eca Max Yield] [Save Data to Excel] [Return]

Maximum day's flow results with scenario MC_2a

Predicted Annual Day's Maximum Flow and Yield

Recurrence Interval	Without Harvest		With Harvest			
	Flow m ³ /s	Yield mm	Flow m ³ /s	Yield mm	Change m ³ /s	Percent Increase
2 Years	2.1	6.5	2.4	7.4	0.30	14.5%
5 Years	3.8	11.8	4.3	13.5	0.55	14.6%
10 Years	4.8	15.1	5.6	17.4	0.72	14.9%
20 Years	5.9	18.3	6.7	21.0	0.89	15.1%
50 Years	7.1	22.2	8.2	25.6	1.09	15.3%
100 Years	8.0	25.1	9.3	28.9	1.24	15.4%

Area Harvested, km²: **20.5** 74.1% [] [1986] []

Watershed Area, km²: **27.7** [Displayed Above]

Peak Flow Function: **GRANDE PRAIRIE G3 TO G7** [About Peak Flows] [Save Data To Excel] [Return to Results]

Time Course of Maximum Day's Flow

Peak Year: **1986**