Appendices
Willow Creek Subwatershed Plan, 2001

If you require this plan in another format, please contact NVCA at 705-424-1479 or admin@nvca.on.ca

APPENDIX A

Natural Heritage System Selection Criteria

Includes the following:

- Criteria for Identifying the Proposed Additions to the Natural Heritage System
- Criteria for Identification of the "No Development or Site Alteration Areas"

APPENDIX B

Stream Health Report

- Instantaneous loads were calculated using discharge measurements made at the time of sampling. In cases where discharge was not measured or where discharge measurements appeared to be inaccurate, discharge estimates were made using data from the ultrasonic level sensor at Simcoe Road 28. In this case, flows at upstream sites were estimated based on the observed relative flows measured on April 25 2001.
- In an attempt to determine the relative contribution of P loads from Willow and Matheson Creeks, instantaneous loads at the Simcoe Rd. 28 and St. Vincent Street Willow Creek sites were compared against the Matheson at Wilson Drive site (combined flow in relation to downstream-most tributary sites). Here a further assumption that no changes to relative loads occur between the upper Willow and Matheson Sites and the Willow @ Simcoe Rd 28 site was made. Since the instantaneous flows at the upper tributary sites did not add exactly to the flow observed at the Simcoe Rd. 28 site (due perhaps to additional tributary and groundwater inputs between the sites), flows were scaled up proportionally according to their relative contributions to the lower site.
- As student sampling crews did not maintain accurate temperature records to accompany water chemistry sampling runs, assumptions on water temperature were made to enable NH3+ concentrations to be derived from MOE lab reports for total ammonia N. PWQMN records for various streams sampled during the same period were used for this purpose. The relationship used to estimate free ammonia is given in figure B.1

$[NH_3^+]$=(Total $[NH_3^+$ & $NH_4^+])/(1+10^{[(0.0902-pH) + (2730/(273.2 + Temp))]})$
Where:
$[NH_3^+]$ is the free ammonia concentration in mg/l
$[NH_3^+$ & $NH_4^+]$ is the total ammonia N value reported by the lab in mg/l
Temp is the temperature in Celcius degrees

Figure B.1: Calculation equation for free ammonia

B.1.3. Phosphorus Loads and Nutrient Assimilation

Solute loads are defined as the mass of a given analyte carried past a given point in the channel per unit time and are usually reported in units such as mg/s or kg/year.

Proportional total phosphorus loads for Willow and Matheson Creeks are given in figure B.2. Based on April 25 instantaneous data, phosphorus loads at Simcoe Road 28 appear to account for approximately 84% of the phosphorus load delivered via lower Willow Creek to the Nottawasaga River. Matheson Creek appears to contribute only approximately 16% of the phosphorus load in lower Willow Creek

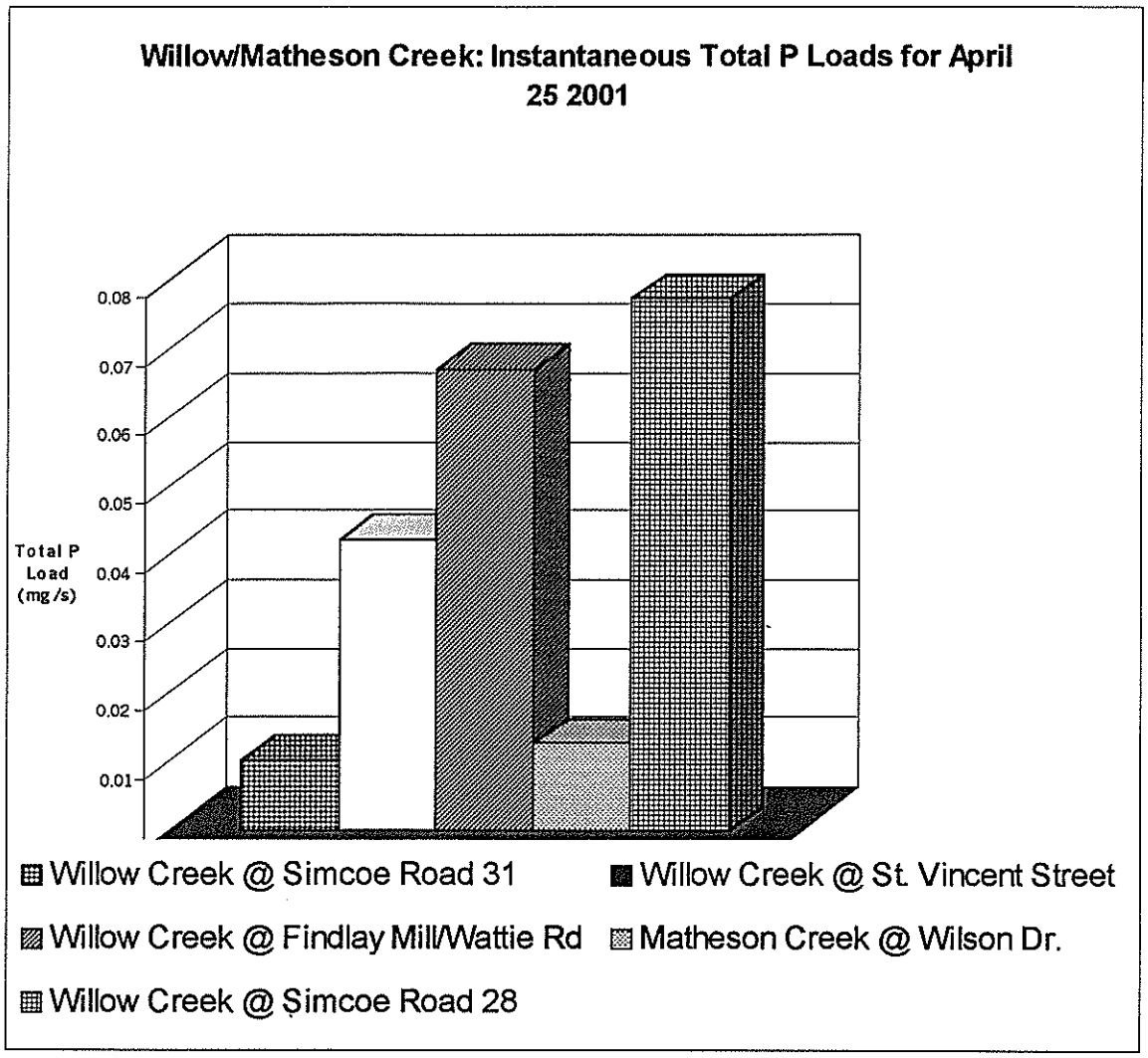


Figure B.3: Instantaneous P loads in Willow and Matheson Creeks derived from April 25 sampling data.

B.1.4. Spatial Trends in Water Chemistry

Summary statistics for each sampled parameter over the April-December 2001 sampling season are given in Table B.1.

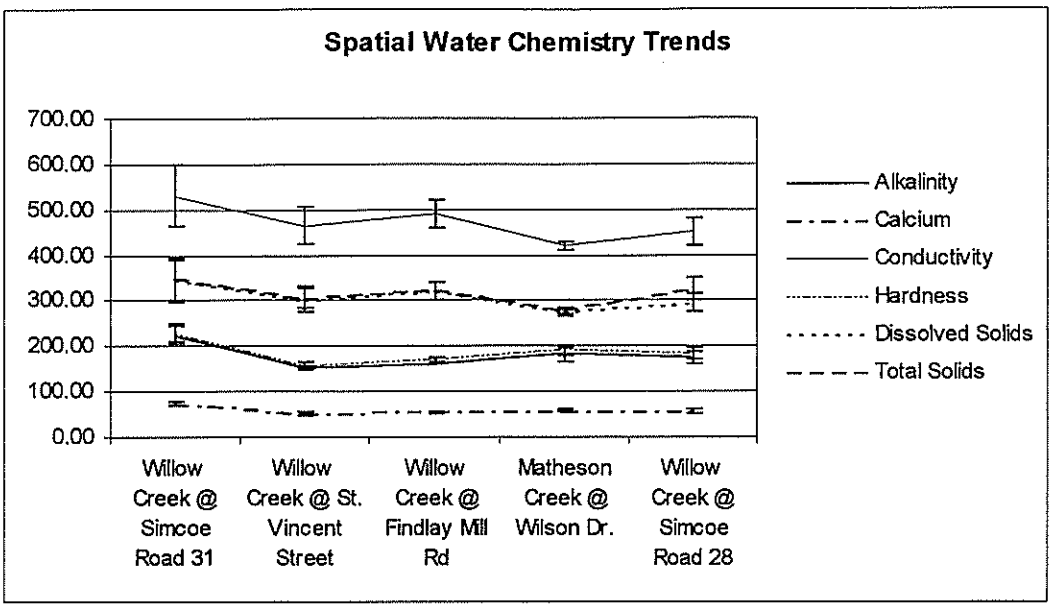


Figure B.4: High range analyte spatial trend analysis. Trend lines reflect seasonal arithmetic means in analyte concentrations +/- 1 standard deviation. Y-axis units are in mg/l, µS/cm (conductivity), and "mg/l as $CaCO_3$" (alkalinity)

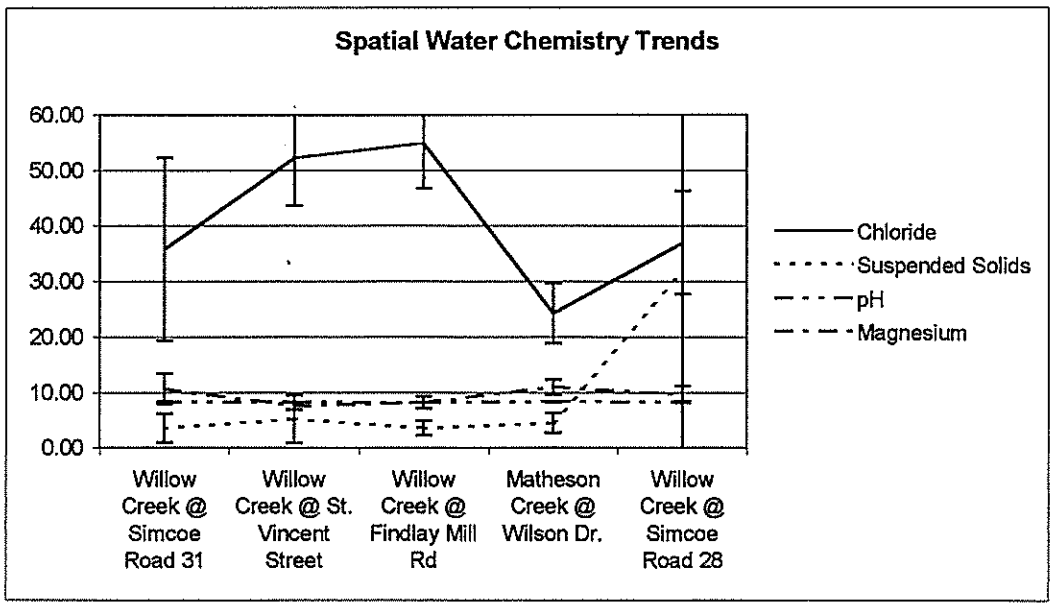


Figure B.5: Mid-range analyte spatial trend analysis. Trend lines reflect seasonal arithmetic means in analyte concentrations +/- 1 standard deviation. Y-axis units are in mg/l or are dimensionless (pH).

Table B.2: Incidence of phosphorus PWQO exceedences in Willow and Matheson Creeks during the 2001 sampling season.

Description	Date	Parameter	Value	Exceeds PWQO?
Willow Creek @ Simcoe Road 28, George Johnston Rd.	12/07/2001	Phosphorus (total)	0.016	No
Matheson Creek @ Wilson Dr.	12/07/2001	Phosphorus (total)	0.01	No
Willow Creek @ Findlay Mill/Wattie Rd	12/07/2001	Phosphorus (total)	0.032	Yes
Willow Creek @ St. Vincent Street	12/07/2001	Phosphorus (total)	0.036	Yes
Willow Creek @ Simcoe Road 31	12/07/2001	Phosphorus (total)	0.028	No
Willow Creek @ Simcoe Road 28, George Johnston Rd.	26/04/2001	Phosphorus (total)	0.022	No
Matheson Creek @ Wilson Dr.	26/04/2001	Phosphorus (total)	0.012	No
Willow Creek @ Findlay Mill/Wattie Rd	25/04/2001	Phosphorus (total)	0.036	Yes
Willow Creek @ St. Vincent Street	25/04/2001	Phosphorus (total)	0.024	No
Willow Creek @ Simcoe Road 31	25/04/2001	Phosphorus (total)	0.016	No
Willow Creek @ Simcoe Road 28, George Johnston Rd.	22/06/2001	Phosphorus (total)	0.116	Yes
Willow Creek @ Simcoe Road 28, George Johnston Rd.	06/06/2001	Phosphorus (total)	0.036	Yes
Matheson Creek @ Wilson Dr.	06/06/2001	Phosphorus (total)	0.016	No
Willow Creek @ Findlay Mill/Wattie Rd	07/06/2001	Phosphorus (total)	0.028	No
Willow Creek @ St. Vincent Street	07/06/2001	Phosphorus (total)	0.04	Yes
Willow Creek @ Simcoe Road 31	07/06/2001	Phosphorus (total)	0.02	No

enumeration, identification to "lowest practical level" and archiving for future reference.

This section describes stream health trends existing within the Willow Catchment based on an integration of results from October/November sampling at the above sites, as well as historical data available at NVCA.

B.2.6. Definition

Stream health, as indicated by BioMAP indices, is a measure of how closely a stream's habitat, water quality and living community match its historical and physiographic potential. We are able to evaluate a site's potential by comparing it to other streams (reference sites) that share similar physiological and historic attributes such as soil types, substrate, gradient, temperature, groundwater flows etc. but are still in a "pristine" or "minimally impacted" condition. "Impaired" reaches are those where samples communities diverge markedly from expectations based on physiographic potential. Reaches are considered "unimpaired" if their biological community agrees with our expectation based on physiography and minimally impacted reference sites. Stream reaches are considered "below potential" if there is some divergence from our expectation but the community retains elements of its historical biota

B.2.7. Results

Benthic invertebrate data summaries of Willow and Matheson Creek sites sampled between 1997-2000 are shown in figure B.7.

Station Identifier (Report)	UTM	Date	Substrate	km^2	WQId	WQIq	Abundance	Richness
Keast Creek @ Simcoe Road 28 (Snow Valley #6)	594787,917522	4/29/1999	sand, gravel	<4	27.38	4.00	291	36
Keast Creek @ Simcoe Road 28 (Snow Valley #6)	594787,917522	10/27/1999	sand, gravel	<4	28.81	4.00	612	42
Matheson Creek (Tributary of) @ Gill Road Springwater	598284,927429	5/27/1999	sand/woody debris	20	11.60	3.86	40	28
Matheson Creek @ Nursery Road	597192,924110	9/22/1997	sand	70		3.20		20
Matheson Creek @ Nursery Road	597200,924116	10/26/2000	Sand	150		3.20	36	22
Matheson Creek Tributary @ Simcoe Road 31	599847,933454	10/18/2000	Sand	30		3.00	83	36
Matheson Creek-Spring Lakes EMP Site #1	598399,927353	5/5/1997	sand	35		3.20		22
Matheson Creek-Spring Lakes EMP Site #1	598399,927353	11/6/1996	sand	39	16.00	4.00	24	24
Matheson Creek-Spring Lakes EMP Site #1	598384,927388	5/23/2000	Sand, woody debris	54		3.60	6	20
Matheson Creek-Spring Lakes EMP Site #2	598379,928509	5/23/2000	Sand, woody debris	51		4.00	17	21
Matheson Creek-Spring Lakes EMP Site #3	598847,927892	5/23/2000	Sand, detritus, woody debris	1.7		4.00	32	28
Tibutary of Willow Creek (East Bayfield EMP)	602775,919142	5/7/1999	muck, sand, gravel	<4	5.36	3.44	175.33	44
Tibutary of Willow Creek (East Bayfield EMP)	602775,919142	11/15/1999	muck, sand, gravel	<4	7.12	3.10	1998.5	47
Tributary of Willow Creek (East Bayfield EMP)	602775,919142	5/4/1998	silt, detritus, sand, gravel, macrophytes	0.1	5.39	2.92	50	54
Tributary of Willow Creek (East Bayfield EMP)	602775,919142	11/3/1998	silt, detritus, sand, gravel, macrophytes	0.1	7.24	2.92	466	54
Tributary of Willow Creek (East Bayfield EMP)	602775,919142	4/23/2000	sand, silt, detritus			3.14	197	31
Tributary of Willow Creek (East Bayfield EMP)	602775,919142	10/18/2000	sand, silt, detritus			3.33	234	26
Willow Creek @ Oro Concession 2	609175, 924428	9/22/1998	sand, gravel, cobble	53	19.34	3.55	143	43
Willow Creek @ Simcoe Rd. 27	600136,922130	5/5/1997	cobble, boulder	140	22.16	3.83	173	20
Willow Creek @ Simcoe Rd. 27	600136,922130	10/18/1996	cobble/boulder	138	25.52	3.44	231	35
Willow Creek @ Simcoe Road 28	593601,919142	10/26/2000	Sand	240		3.20	3	23
Willow Creek @ Simcoe Road 31	607910,919791	10/16/1998	sand/gravel	94	12.06	3.14	56	25
Willow Creek @ Simcoe Road 31	607952,919777	10/26/2000	Gravel	95		3.22	528	38
Willow Creek @ Simcoe Road 31	607910,919791	5/5/1997	sand, gravel	95	14.45	3.43	78	26
Willow Creek @ St. Vincent Street, D/s of Little Lake	602366,920833	10/26/2000	Sand, pea gravel, silt, vegetation	133		2.40	1077	44
Willow Creek @ Wattie Road, Midhurst	601065,921857	9/22/1997	sand, some gravel	121	15.36	3.00	155	39
Willow Creek @ Wattie Road, Midhurst	601065,921857	5/4/1998	sand, gravel	121	15.96	3.33	158	51
Willow Creek @ Wattie Road, Midhurst	601055,921083	10/26/2000	Sand, Silt	130		3.13	62.5	35
Willow Creek Tributary - 20/21 Sideroad Oro-Medonte	606178,924495	10/18/2000	Sand/small gravel	15		3.36	366.5	47
Willow Creek Tributary - 3rd Line Oro-Medonte	609796,926142	10/18/2000	Gravel	15		3.11	233	41

Figure B.7: Benthic invertebrate data for Willow/Matheson Creeks

augmented with spot temperatures collected on hot summer days by volunteers over the 1997-2001 period to allow the thermal regime of stream reaches to be classified as "Cold", "Cool" and "Warm"

Thermal classifications were assigned according to Stoneman and Jones' (1996) protocol. In the case of temperature logger data, datapoints collected during the critical 16:00 to 17:00 period were extracted and screened for air temperature and precipitation effects to permit classification (weather data from the nearest Environment Canada Station was used for this purpose). In the case of volunteer spot temperature data, thermometers were calibrated to 0°C and 100°C prior to the sampling season.

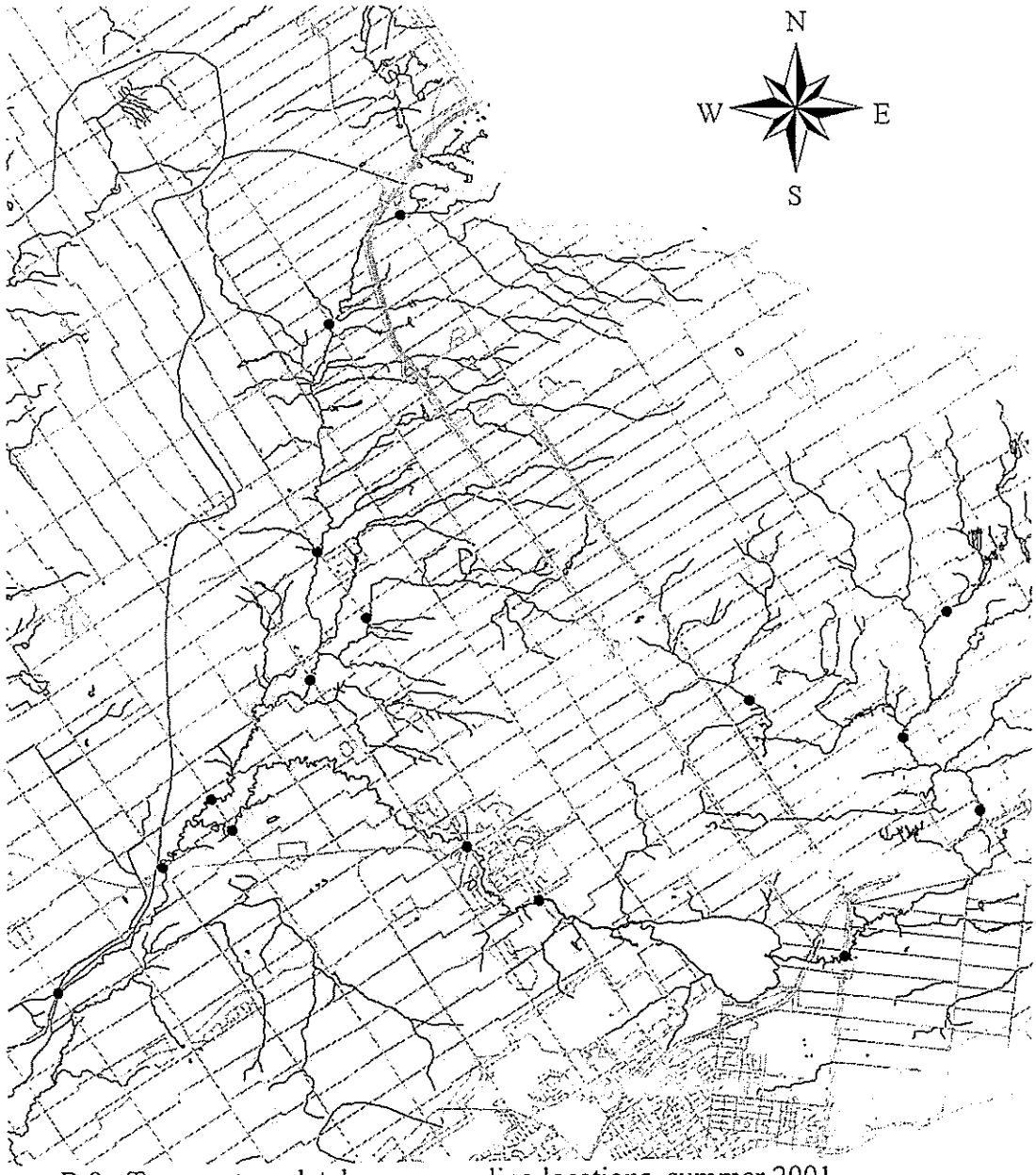


Figure B.9: Temperature datalogger sampling locations, summer 2001.

UTM		Stream Name	Road Crossing	Municipality	Date	Fecal Coliforms	E_coli	Fecal Streptococcus	Pseudomonas aeruginosa
597200	4924116	Matheson Creek	Nursery Road	Springwater	21-Jun-93	26000	26000	26000	10
597200	4924116	Matheson Creek	Nursery Road	Springwater	28-Jun-93	290	290	90	4
597200	4924116	Matheson Creek	Nursery Road	Springwater	05-Jul-93	410	410	120	2
597200	4924116	Matheson Creek	Nursery Road	Springwater	13-Jul-93	430	430	380	2
597200	4924116	Matheson Creek	Nursery Road	Springwater	19-Jul-93	10000	9600	3800	110
597200	4924116	Matheson Creek	Nursery Road	Springwater	26-Jul-93	290	290	190	
597200	4924116	Matheson Creek	Nursery Road	Springwater	03-Aug-93	300	292	308	2
597200	4924116	Matheson Creek	Nursery Road	Springwater	09-Aug-93	270	270	110	2
597200	4924116	Matheson Creek	Nursery Road	Springwater	16-Aug-93	1310	1290	790	4
597200	4924116	Matheson Creek	Nursery Road	Springwater	23-Aug-93	270	260	190	0
597200	4924116	Matheson Creek	Nursery Road	Springwater	30-Aug-93	380	360	180	4
597200	4924116	Matheson Creek	Nursery Road	Springwater	07-Sep-93	310	300	80	0
597200	4924116	Matheson Creek	Nursery Road	Springwater	13-Sep-93	190	180	80	0
597200	4924116	Matheson Creek	Nursery Road	Springwater	16-Sep-93	200	200	450	3
597200	4924116	Matheson Creek	Nursery Road	Springwater	20-Sep-93	100	100	50	0
597200	4924116	Matheson Creek	Nursery Road	Springwater	27-Sep-93	170	170	100	0
597200	4924116	Matheson Creek	Nursery Road	Springwater	14-Sep-94		480	250	0
607967	4919774	Willow Creek	Simcoe Road 31	Oro-medonte	21-Jun-93	1700	1700	3200	4
607967	4919774	Willow Creek	Simcoe Road 31	Oro-medonte	28-Jun-93	650	640	480	4
607967	4919774	Willow Creek	Simcoe Road 31	Oro-medonte	05-Jul-93	120	120	30	4
607967	4919774	Willow Creek	Simcoe Road 31	Oro-medonte	13-Jul-93	1700	1600	3200	2
607967	4919774	Willow Creek	Simcoe Road 31	Oro-medonte	19-Jul-93	620	620	350	4
607967	4919774	Willow Creek	Simcoe Road 31	Oro-medonte	26-Jul-93	68	64	152	0
607967	4919774	Willow Creek	Simcoe Road 31	Oro-medonte	03-Aug-93	88	88	140	2
607967	4919774	Willow Creek	Simcoe Road 31	Oro-medonte	09-Aug-93	140	140	140	4
607967	4919774	Willow Creek	Simcoe Road 31	Oro-medonte	16-Aug-93	1900	1900	2000	4
607967	4919774	Willow Creek	Simcoe Road 31	Oro-medonte	23-Aug-93	40	40	240	1
607967	4919774	Willow Creek	Simcoe Road 31	Oro-medonte	30-Aug-93	70	60	170	1
607967	4919774	Willow Creek	Simcoe Road 31	Oro-medonte	07-Sep-93	190	150	260	1
607967	4919774	Willow Creek	Simcoe Road 31	Oro-medonte	13-Sep-93	180	170	210	3
607967	4919774	Willow Creek	Simcoe Road 31	Oro-medonte	16-Sep-93	1500	1500	1500	11
607967	4919774	Willow Creek	Simcoe Road 31	Oro-medonte	20-Sep-93	140	140	70	0
607967	4919774	Willow Creek	Simcoe Road 31	Oro-medonte	27-Sep-93	480	480	330	3
600136	4922130	Willow Creek	Simcoe Road 27	Springwater	21-Jun-93	820	820	3300	4
600136	4922130	Willow Creek	Simcoe Road 27	Springwater	28-Jun-93	90	90	130	4
600136	4922130	Willow Creek	Simcoe Road 27	Springwater	05-Jul-93	80	80	90	2
600136	4922130	Willow Creek	Simcoe Road 27	Springwater	13-Jul-93	70	70	130	2
600136	4922130	Willow Creek	Simcoe Road 27	Springwater	19-Jul-93	470	470	900	8
600136	4922130	Willow Creek	Simcoe Road 27	Springwater	26-Jul-93	52	52	80	1
600136	4922130	Willow Creek	Simcoe Road 27	Springwater	03-Aug-93	36	36	112	2
600136	4922130	Willow Creek	Simcoe Road 27	Springwater	09-Aug-93	30	30	130	2
600136	4922130	Willow Creek	Simcoe Road 27	Springwater	16-Aug-93	100	100	310	4
600136	4922130	Willow Creek	Simcoe Road 27	Springwater	23-Aug-93	90	90	110	0
600136	4922130	Willow Creek	Simcoe Road 27	Springwater	30-Aug-93	60	60	70	0
600136	4922130	Willow Creek	Simcoe Road 27	Springwater	07-Sep-93	40	40	40	0
600136	4922130	Willow Creek	Simcoe Road 27	Springwater	13-Sep-93	40	40	50	0
600136	4922130	Willow Creek	Simcoe Road 27	Springwater	20-Sep-93	30	20	60	0
600136	4922130	Willow Creek	Simcoe Road 27	Springwater	27-Sep-93	20	20	120	0
595503	4921188	Willow Creek	Highway 26	Springwater	21-Jun-94		220	220	0
595503	4921188	Willow Creek	Highway 26	Springwater	05-Jul-94		140	220	0
595503	4921188	Willow Creek	Highway 26	Springwater	12-Jul-94		210	230	0
595503	4921188	Willow Creek	Highway 26	Springwater	19-Jul-94		1180	3000	76
595503	4921188	Willow Creek	Highway 26	Springwater	26-Jul-94		1140	1020	0
595503	4921188	Willow Creek	Highway 26	Springwater	04-Aug-94		560	1720	0
595503	4921188	Willow Creek	Highway 26	Springwater	09-Aug-94		340	640	0
595503	4921188	Willow Creek	Highway 26	Springwater	16-Aug-94		250	240	0
595503	4921188	Willow Creek	Highway 26	Springwater	30-Aug-94		110	170	0
595503	4921188	Willow Creek	Highway 26	Springwater	13-Sep-94		160	300	0
595503	4921188	Willow Creek	Highway 26	Springwater	14-Jun-94		210	390	0

Figure B.12: Bacteriological data from Willow/Matheson Creek surveys conducted during the C.U.R.B. Program (1993-1994)

Figure B.13 gives bacteriological data collected during 1997-98.

such as brown trout. The fact that cold-water species are supported may be at least partially due to the existence of significant inputs of groundwater occuring over a short reach of stream through the Midhurst area.

The deep valley system and good forest cover along the middle reaches of Willow Creek, coupled with inputs of groundwater through the Midhurst area, result in increasing stream health below Little Lake and downstream through to Minesing Swamp. Some localized impacts due to agricultural land uses (e.g. livestock grazing) do occur. The above factors mean that the Lower Willow Creek is rated as largely unimpaired.

With its largely forested valley and abundant groundwater inputs, Matheson Creek has significant reaches of cold and cool water habitats and supports a strong brook and brown trout fishery. While there are localized problem areas, the system as a whole is unimpaired.

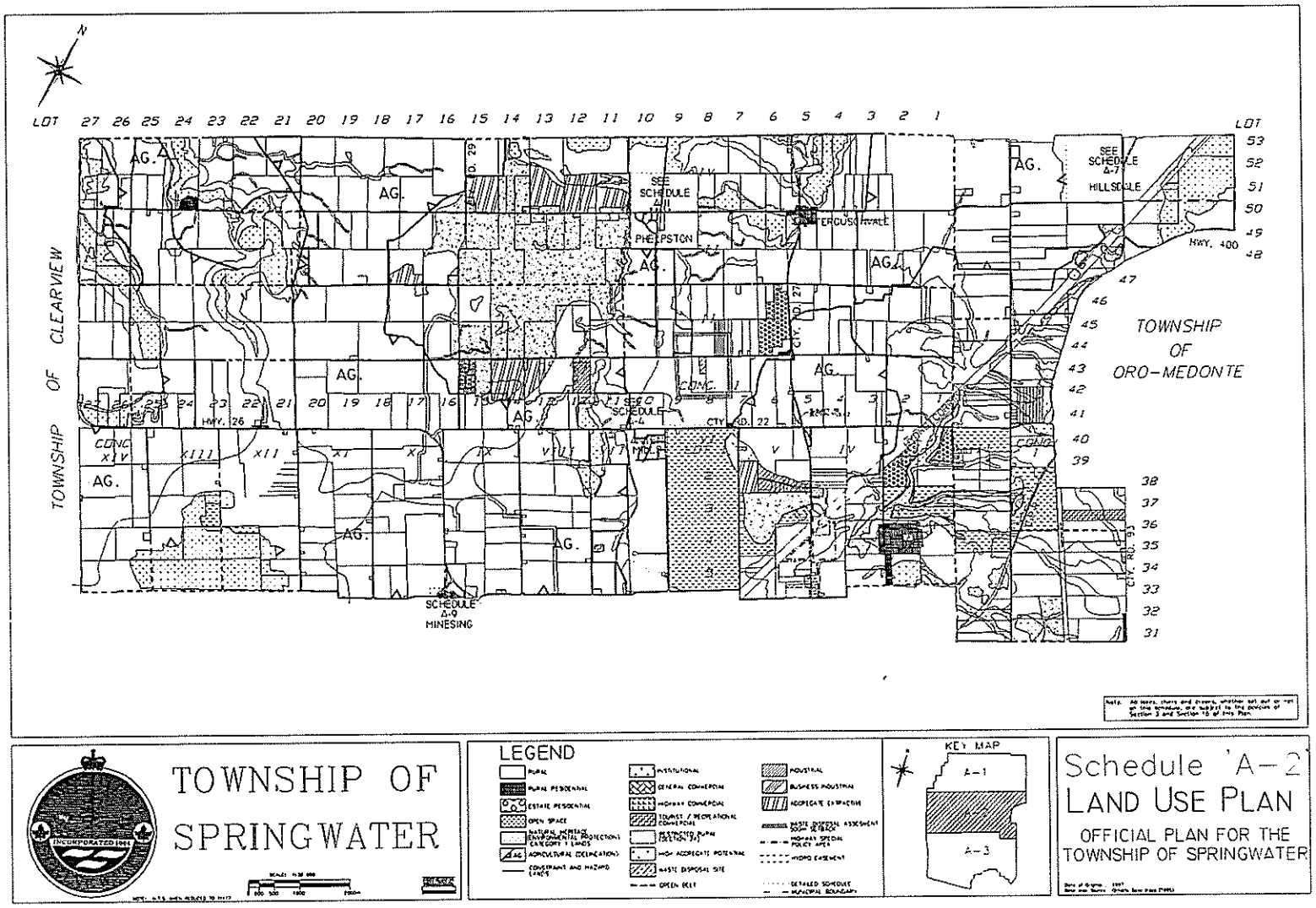
Since Matheson Creek has significant reaches of sand substrates combined with strong base flows, biomass in the channel tends to be concentrated along the margins where woody debris and organic material tend to accumulate. Aquatic organisms are concentrated along these edges where food and shelter are provided by aquatic vegetation and overhanging terrestrial vegetation. Many reaches of Matheson Creek have relatively low biomass and species richness because of these factors compared to most other systems of similar size in our watershed. As a result, Matheson Creek should be considered relatively sensitive due to lower than average assimilative capacity of nutrients.

APPENDIX C

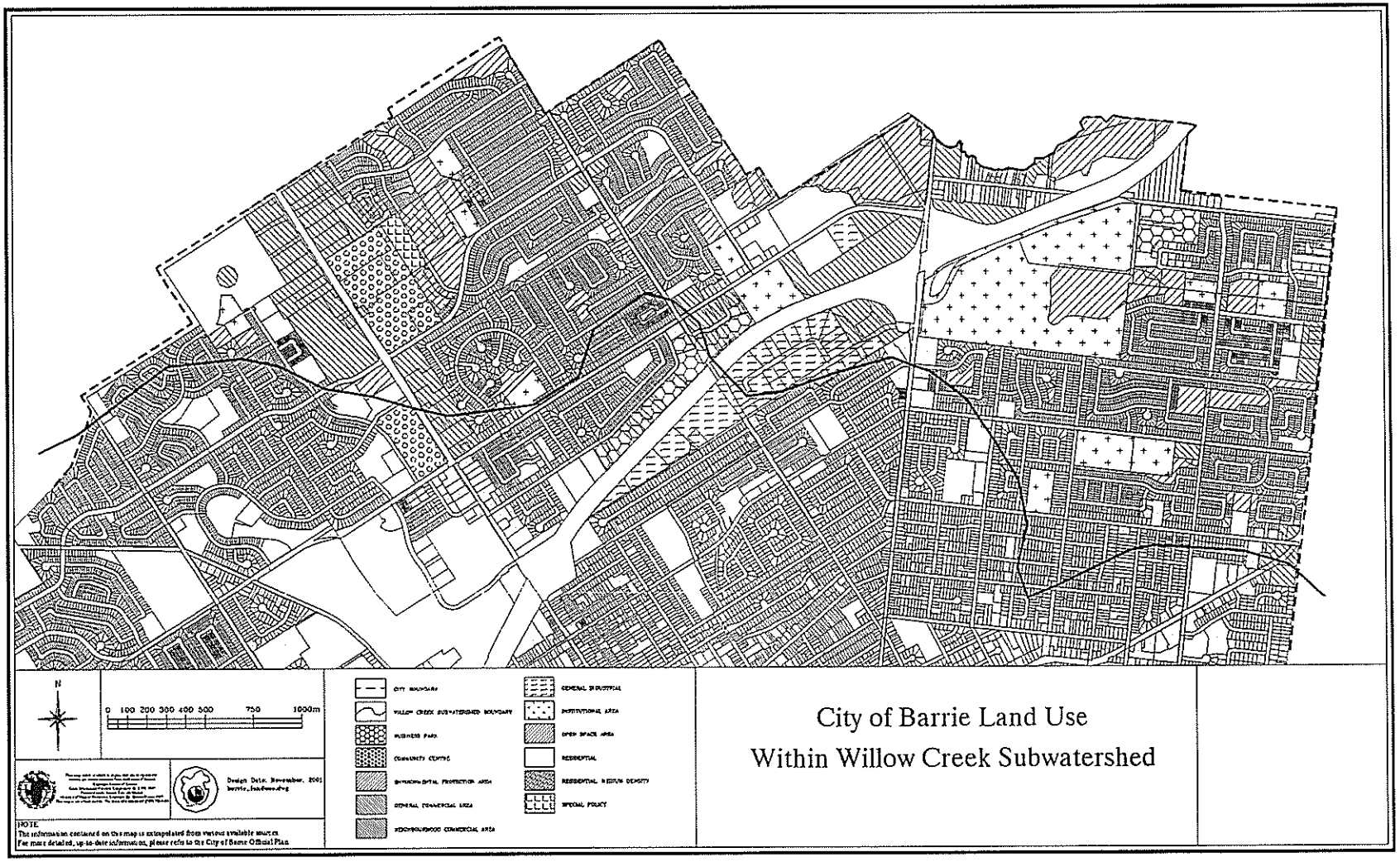
Official Plans Land Use Designations

Official Plan Land Use Designations for:

- Township of Oro-Medonte
- Township of Springville
- City of Barrie (area within Willow Creek Subwatershed only)



Appendix C
Township of Springwater Official Plan Schedule A-2



Appendix C
City of Barrie Landuse

APPENDIX D

Hydrology

Hydrologic information included:

- Hydrologic modelling Methodology and Technical Details
- Existing Conditions ISWMS Model Schematic
- Existing Conditions ISWMS Model Parameter Values
- Hydrologic Soil Groups and Curve Numbers
- Existing Conditions ISWMS Model Output File (100-yr Design Storm)
- Future Uncontrolled Conditions ISWMS Model Schematic
- Future Conditions ISWMS Model Parameter Values
- Future Uncontrolled Conditions ISWMS Model Output File (100-yr Design Storm)
- Comparison of Peak Flows
- Critical Distribution/Duration Determination

- future land use information (see **Appendix C**);
- digital elevation mapping (DEM);
- LandSAT imagery;
- soils mapping (see **Map 3**); and
- Ontario Base Maps (OBMs).

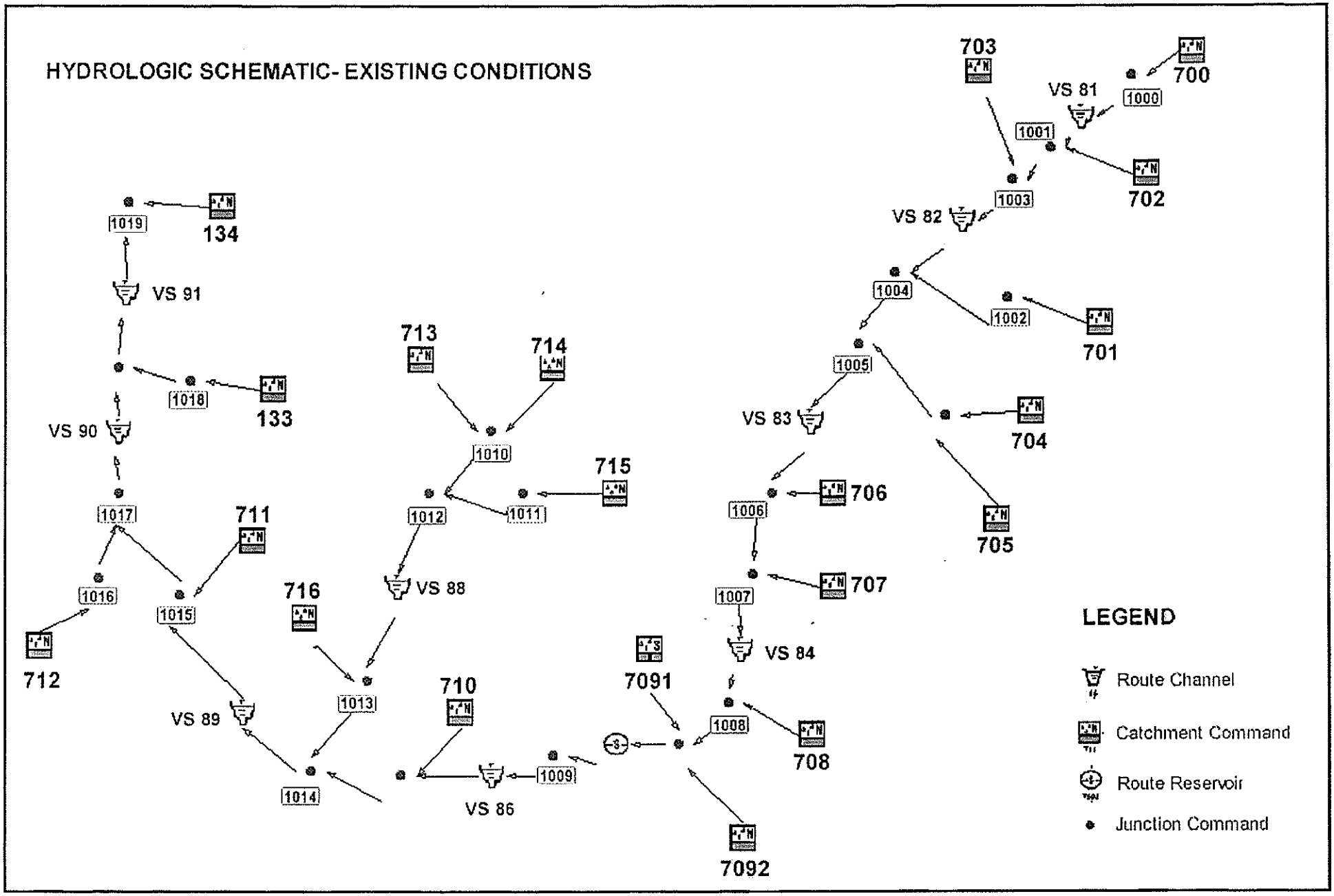
The existing conditions models for the Willow Creek Subwatershed were determined using the latest digital soils and landuse information. Digital soils information was provided by the NVCA. The current landuse information was also provided by the NVCA and was an unsupervised classification of generalized landuse based on the most recent LandSAT image. The existing landuse and soils information is shown in **Maps 7 and 3**, respectively. Using Ministry of Transportation Drainage Manual guidelines the appropriate Hydrologic Soils Group (HSG) was assigned to each soil type. Composite SCS curve numbers (CN) for each sub-catchment were calculated using the above information and the Modified SCS method was used to determine CN*. Future land use information was taken from the current Official Plans of the Townships of Springwater and Oro-Medonte and the City of Barrie. Copies of the Official Plans are found in **Appendix C**.

The total Willow Creek Subwatershed area of approximately 340 km^2 was broken down into 20 smaller sub-catchment areas to ensure that the ISWMS models accurately reflect the response characteristics of the watercourse systems. The recently completed "hydrologically correct" Digital Elevation Model (DEM) produced by the Ministry of Natural Resources in cooperation with the NVCA was used to determine and verify sub-catchment boundaries. The finalized sub-catchment boundaries are illustrated in **Map 6**.

All parameters were measured or calculated using well-established protocols and procedures. Hydrologic modeling schematics and parameter values for existing and future conditions follow in this Appendix.

Design Storms

Single event design storm intensities were derived from total precipitation volumes measured from the Barrie WPCC climate station. Existing conditions were evaluated using different distributions and several different storm durations ranging from 1 hour to 24 hours. The results of these simulations follow in this Appendix. The SCS Type II, 24-hr distribution was found to produce the highest (i.e. critical) peak flow for all design events from the 2-year to the 100-year. Therefore, the SCS Type II, 24-hr distribution and duration was used to calculate peak flows for this study. Pre-development and post-development flows were evaluated using the critical duration SCS-II storms for the 2, 5, 10, 25, 50 and 100-year storm events. Flows calculated using the Regional Storm (Timmins Storm) were also calculated.


HYDROLOGIC SCHEMATIC- EXISTING CONDITIONS
703
700
VS 81
1000
1001
702
1003
VS 82
1019
134
VS 91
1004
1002
701
713
714
1005
1018
133
VS 83
704
VS 90
1010
715
706
1017
711
1012
1011
1006
705
1016
1015
716
VS 88
1007
707
712
7091
VS 84
710
VS 89
1013
1008
708
1014
1009
VS 86
7092
LEGEND
Route Channel
Catchment Command
Route Reservoir
Junction Command

HYDROLOGIC SOIL GROUPS AND CURVE NUMBERS

Symbol	SOIL NAME	HYDROLOGIC SOILS GROUP (HSG)	CN's				
			Crop	Pasture	Woodlot	Swamp/ Wetland	Impervious
Ans	Alliston sandy loam	AB	74	59	56	40	89
Bof	Bookton fine sandy loam	AB	74	59	56	40	89
Bl	Bondhead loam	B	78	68	63	55	91
Bs	Bondhead sandy loam	AB	74	59	56	40	89
Ds	Dundonald sandy loam	AB	74	59	56	40	89
Gg	Gwillimbury gravelly sandy loam	AB	74	59	56	40	89
Gsl	Granby sandy loam	B	78	68	63	55	91
Gul	Guerin loam	B	78	68	63	55	91
Gus	Guerin sandy loam	AB	74	59	56	40	89
Ll	Lyons loam	B	78	68	63	55	91
Ll-b	Lyons loam, stony phase	B	78	68	63	55	91
M	Muck	D	78	68	63	55	91
Mnc	Minesing marly clay	C	85	79	75	70	93
Mms	Minesing marly silty clay loam	BC	82	75	70	63	92
Shsc	Schomberg silty clay loam	C	85	79	75	70	93
Sisc	Simcoe silty clay loam	C	85	79	75	70	93
Smsc	Smithfield Silt Clay loam	C	85	79	75	70	93
Stsl	Sargent gravelly sandy loam	AB	74	59	56	40	89
Tis	Tioga loamy sand	A	68	49	48	25	86
Tisl	Tioga sandy loam	A	68	49	48	25	86
Tisl-Vasl	Tioga sandy loam-Vasey sandy loam	A	68	49	48	25	86
Vasl	Vasey sandy loam	AB	74	59	56	40	89
Vasl-b	Vasey sandy loam-stony phase	AB	74	59	56	40	89
Wg	Wyevale gravelly sandy loam	A	68	49	48	25	86

```
            Tributary Subareas........   706
      1007  No Tributary Channel/Pipes
            Tributary Subareas........   707
      1008  No Tributary Channel/Pipes
            Tributary Subareas........   708
         8  No Tributary Channel/Pipes
            Tributary Subareas........  7091  7092
      2001  No Tributary Channel/Pipes
            Tributary Subareas........   710
      1015  No Tributary Channel/Pipes
            Tributary Subareas........   711
      1016  No Tributary Channel/Pipes
            Tributary Subareas........   712
      1010  No Tributary Channel/Pipes
            Tributary Subareas........   713   714
      1011  No Tributary Channel/Pipes
            Tributary Subareas........   715
      1013  No Tributary Channel/Pipes
            Tributary Subareas........   716
      1019  No Tributary Channel/Pipes
            Tributary Subareas........   134
      1018  No Tributary Channel/Pipes
            Tributary Subareas........   133

*********************************************
*       Continuity Check for Surface Water  *
*********************************************
```

	cubic meters	Millimeters over Total Basin
Total Precipitation (Rain plus Snow)	4.335819E+07	128.320
Total Infiltration	2.403782E+07	71.141
Total Evaporation	2.694164E+06	7.973
Surface Runoff from Watersheds	1.683697E+07	49.830
Total Water remaining in Surface Storage	2.326055E-05	.000
Infiltration over the Pervious Area...	2.403782E+07	71.615

Infiltration + Evaporation + Surface Runoff + Snow removal + Water remaining in Surface Storage + Water remaining in Snow Cover.....	4.356896E+07	128.944
Total Precipitation + Initial Storage.	4.335819E+07	128.320

```
The error in continuity is calculated as
****************************************
* Precipitation + Initial Snow Cover  *
*      - Infiltration -               *
*Evaporation - Snow removal -         *
*Surface Runoff from Watersheds -     *
*Water in Surface Storage -           *
*Water remaining in Snow Cover        *
*-------------------------------------*
* Precipitation + Initial Snow Cover  *
****************************************
Error.................................        -.486 Percent
```

```
*******************************************************
*     SELECTED OUTFLOW HYDROGRAPHS AND POLLUTOGRAPHS  *
*******************************************************
```

ALL FLOW RATES ARE IN UNITS OF CU M/SEC.

DATE Mo/Da/Year	TIME HR:MIN:SEC	TIME STEP	OUTFLOW 1000	OUTFLOW 1001	OUTFLOW 1002	OUTFLOW 1003	OUTFLOW 1004	OUTFLOW 1005	OUTFLOW 1006	OUTFLOW 1007	OUTFLOW 1008	OUTFLOW 1009
AVERAGE FLOW.....			1.359	1.634	1.627	1.907	3.534	4.536	5.250	7.003	7.221	6.212
STANDARD DEVIATION OF FLOW.....			.110	.131	.135	.154	.288	.369	.423	.558	.574	.069
MAXIMUM FLOW.....			33.693	40.373	42.418	47.814	89.991	115.140	130.833	171.026	175.599	12.746
MINIMUM FLOW.....			.000	.000	.000	.000	.000	.000	.000	.000	.000	.257
FLOW VOLUME (CUBIC METERS).....			9.78E+05	1.18E+06	1.17E+06	1.37E+06	2.54E+06	3.27E+06	3.78E+06	5.04E+06	5.20E+06	4.47E+06

1

DATE Mo/Da/Year	TIME HR:MIN:SEC	TIME STEP	OUTFLOW 1010	OUTFLOW 1016	OUTFLOW 1011	OUTFLOW 1012	OUTFLOW 1013	OUTFLOW 1014	OUTFLOW 1015	OUTFLOW 1017	OUTFLOW 1018	OUTFLOW 1019
AVERAGE FLOW.....			3.294	1.958	.858	4.152	5.139	12.825	14.131	16.089	.747	21.184
STANDARD DEVIATION OF FLOW.....			.245	.149	.069	.313	.391	.490	.585	.731	.068	1.073
MAXIMUM FLOW.....			69.152	43.088	21.246	89.569	113.092	139.550	167.035	209.562	24.049	303.585
MINIMUM FLOW.....			.000	.000	.000	.000	.000	.243	.252	.252	.000	.325
FLOW VOLUME (CUBIC METERS).....			2.37E+06	1.41E+06	6.18E+05	2.99E+06	3.70E+06	9.23E+06	1.02E+07	1.16E+07	5.38E+05	1.53E+07

Transport simulation ended normally.

```
===> SWMM 4.40 simulation ended normally.
     Always check output file for possible warning messages.

===> Your input file was named : C:\1353- Willow Creek\Hydrology\Willow Creek ISWMS\Existing 2001.dat
===> Your output file was named: C:\1353- Willow Creek\Hydrology\Willow Creek ISWMS\Existing 2001.out

*****************************************************
*       SWMM 4.40 Simulation Date and Time Summary  *
*****************************************************
* Starting Date... November    8,  2001             *
*          Time...          10:30: 7.000            *
*   Ending Date... November    8,  2001             *
*          Time...          10:30:19.000            *
*  Elapsed Time...                  .200 minutes.   *
*  Elapsed Time...                12.000 seconds.    *
*****************************************************
```

FUTURE CONDITIONS - CATCHMENT PARAMETERS

CATCHMENT	700	701	702	703	704	705	706	707	708	7092
COMMAND	Nashyd	Nashyd	Nashyd	Nashyd	Nashyd	Nashyd	Nashyd	Nashyd	Nashyd	Nashyd
AREA (ha)	1794.55	2572.16	365.39	389.20	684.70	688.68	1011.16	2047.01	341.96	847.83
DWF (m^3/s)	0	0	0	0	0	0	0	0	0	0
CN* (AMC II)	64	57	67	64	64	61	64	69	61	75
tp (hr)-Airport Method	2.86	2.63	1.66	2.3	2.96	2.62	3.17	3.23	3.31	3.17
Ia (mm)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
N	3	3	3	3	3	3	3	3	3	3
PREDOMINANT HSG	AB	AB	AB	AB	AB	AB	AB	AB	AB	C

CATCHMENT	710	711	712	713	714	715	716	133	134
COMMAND	Nashyd	Nashyd	Nashyd	Nashyd	Nashyd	Nashyd	Nashyd	Nashyd	Nashyd
AREA (ha)	2492.1795	1733.64	2995.05	3122.84	3231.34	1551.97	1556.87	1185.5359	4952.00
DWF (m^3/s)	0	0	0	0	0	0	0	0	0
CN* (AMC II)	69	67	61	52	51	52	64	58	70
tp (hr)-Airport Method	4.68	3.44	3.39	3.42	3.81	2.84	2.86	1.85	4.03
Ia (mm)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
N	3	3	3	3	3	3	3	3	3
PREDOMINANT HSG	A	A	AB	A	A	A	AB	AB	MUCK

CATCHMENT	7091
COMMAND	Standhyd
Area (ha)	225.85
XIMP	99
TIMP	99
DWF (m^3/s)	0
SLPP (%)	0.1
LGP (m)	40
MNP	0.013
DPSI (mm)	1.0
SLPI (%)	0.1
LGI (m)	1230
MNI	0.3
PREDOMINANT HSG	MUCK

```
1007     No Tributary Channel/Pipes
         Tributary Subareas........   707
1008     No Tributary Channel/Pipes
         Tributary Subareas........   708
   8     No Tributary Channel/Pipes
         Tributary Subareas........  7091  7092
2001     No Tributary Channel/Pipes
         Tributary Subareas........   710
1015     No Tributary Channel/Pipes
         Tributary Subareas........   711
1016     No Tributary Channel/Pipes
         Tributary Subareas........   712
1010     No Tributary Channel/Pipes
         Tributary Subareas........   713   714
1011     No Tributary Channel/Pipes
         Tributary Subareas........   715
1013     No Tributary Channel/Pipes
         Tributary Subareas........   716
7094     No Tributary Channel/Pipes
         Tributary Subareas........   134
1018     No Tributary Channel/Pipes
         Tributary Subareas........   133
```

```
*********************************************
*       Continuity Check for Surface Water  *
*********************************************
```

	cubic meters	Millimeters over Total Basin
Total Precipitation (Rain plus Snow)	4.335819E+07	128.320
Total Infiltration	2.293261E+07	67.870
Total Evaporation	2.694164E+06	7.973
Surface Runoff from Watersheds	1.796215E+07	53.160
Total Water remaining in Surface Storage	2.326055E-05	.000
Infiltration over the Pervious Area...	2.293261E+07	68.322

Infiltration + Evaporation + Surface Runoff + Snow removal + Water remaining in Surface Storage + Water remaining in Snow Cover.....	4.358892E+07	129.003
Total Precipitation + Initial Storage.	4.335819E+07	128.320

```
The error in continuity is calculated as
****************************************
* Precipitation + Initial Snow Cover  *
*      - Infiltration -               *
*Evaporation - Snow removal -          *
*Surface Runoff from Watersheds -      *
*Water in Surface Storage -            *
*Water remaining in Snow Cover         *
*--------------------------------------*
* Precipitation + Initial Snow Cover  *
****************************************
Error.................................        -.532 Percent
```

```
*****************************************************
*     SELECTED OUTFLOW HYDROGRAPHS AND POLLUTOGRAPHS  *
*****************************************************
```

ALL FLOW RATES ARE IN UNITS OF CU M/SEC.

DATE Mo/Da/Year	TIME HR:MIN:SEC	TIME STEP	OUTFLOW 1000	OUTFLOW 1001	OUTFLOW 1002	OUTFLOW 1003	OUTFLOW 1004	OUTFLOW 1005	OUTFLOW 1006	OUTFLOW 1007	OUTFLOW 1008	OUTFLOW 1009
AVERAGE FLOW.....			2.265	2.758	2.712	3.248	5.960	7.630	8.912	11.834	12.237	8.129
STANDARD DEVIATION OF FLOW.....			.179	.217	.220	.257	.476	.608	.702	.923	.952	.093
MAXIMUM FLOW.....			33.693	40.882	42.418	48.957	91.138	116.279	133.328	173.522	178.685	13.117
MINIMUM FLOW.....			.000	.000	.000	.000	.000	.000	.000	.000	.000	.257
FLOW VOLUME (CUBIC METERS).....			9.78E+05	1.19E+06	1.17E+06	1.40E+06	2.57E+06	3.30E+06	3.85E+06	5.11E+06	5.29E+06	3.51E+06

DATE Mo/Da/Year	TIME HR:MIN:SEC	TIME STEP	OUTFLOW 1010	OUTFLOW 1016	OUTFLOW 1011	OUTFLOW 1012	OUTFLOW 1013	OUTFLOW 1014	OUTFLOW 1015	OUTFLOW 1017	OUTFLOW 1018	OUTFLOW 1019
AVERAGE FLOW.....			5.818	3.526	1.429	7.248	9.213	20.907	23.223	26.749	1.279	35.274
STANDARD DEVIATION OF FLOW.....			.422	.262	.113	.533	.684	.898	1.064	1.321	.114	1.912
MAXIMUM FLOW.....			73.191	46.603	21.246	93.617	121.711	160.096	189.642	235.513	24.709	337.474
MINIMUM FLOW.....			.000	.000	.000	.000	.000	.243	.252	.252	.000	.270
FLOW VOLUME (CUBIC METERS).....			2.51E+06	1.52E+06	6.18E+05	3.13E+06	3.98E+06	9.03E+06	1.00E+07	1.16E+07	5.52E+05	1.52E+07

Transport simulation ended normally.

```
===> SWMM 4.40 simulation ended normally.
     Always check output file for possible warning messages.

===> Your input file was named : C:\1353- Willow Creek\Hydrology\Willow Creek ISWMS\future.dat
===> Your output file was named: C:\1353- Willow Creek\Hydrology\Willow Creek ISWMS\future.out

*****************************************************
*       SWMM 4.40 Simulation Date and Time Summary   *
*****************************************************
* Starting Date... November    8,  2001              *
*          Time...           9:32:26.000             *
*   Ending Date... November    8,  2001              *
*          Time...           9:32:34.000             *
*  Elapsed Time...                  .133 minutes.    *
*  Elapsed Time...                 8.000 seconds.    *
*****************************************************
```

Critical Distribution Determination

	ISWMS Model						
Design Storm Return Period	1hr AES m^3/s	6hr AES m^3/s	12 hr AES m^3/s	24 hr AES m^3/s	6hr SCSII m^3/s	12 hr SCS II m^3/s	24 hr SCS II m^3/s
2 YR	9.3	23.7	27.0	23.7	17.0	17.6	20.4
5 YR	15.7	56.9	58.9	61.4	40.4	39.4	57.5
10 YR	20.9	83.9	84.1	91.6	59.0	56.1	86.5
25 YR	28.0	123.6	120.4	171.1	109.3	102.7	164.3
50 YR	34.1	156.1	149.9	198.2	123.4	120.8	188.5
100 YR	40.7	190.6	181.2	209.3	133.5	123.7	201.0

APPENDIX E

Water Balance Calculations
(Existing and Future Conditions)

Water balance information included:

- Water Balance Methodology and Technical Details
- Water Balance Calculation Sheets and Results for Existing and Future Conditions for All Catchments

NOTE:
The water balance calculation sheets that follow are as presented in the original 2001 document. Unfortunately the quality of the charts in the original document is poor compared to current standards. We include them here so that we are presenting the full and complete 2001 appendices.

Water Balance Methodology and Technical Details

Water Balance Methodology

The existing water balance was calculated for the study area using an approach developed by Greenland International Consultants. As shown in **Figure E.1**, the approach combines existing methods of water balance modelling with available HYDAT streamflow data. The model provides output for various water balance components including, rainfall, snowmelt, actual evapotranspiration, runoff, baseflow, and deep groundwater storage.

The first step of the water balance method utilized Environment Canada's *AES Water Balance Model* to generate surplus water quantities on a monthly basis for the period of continuous climate data available (1967-1992) from the Midhurst climate station (Environment Canada), located in Midhurst (44.45°N and 79.76°W). Monthly data were then added to obtain annual quantities. The AES Water Balance Model is a modified approach to water budgeting and expands upon earlier techniques developed by Thornthwaite and Mather, whereby air temperature and precipitation are used to calculate the various additions, losses, and changes associated with the water budget. The AES Water Balance Model uses daily temperature and precipitation for the period of interest, which allows for improved modeling of snow storage and budget breakdown in either weeks or months. The output data from the AES Water Balance Model for the Willow Creek Subwatershed included the following components for the selected time-step:

- temperature
- precipitation;
- rain;
- snow storage;
- snow melt;
- potential evapotranspiration;
- water holding capacity and soil storage;
- actual evapotranspiration;
- moisture deficit; and
- accumulated precipitation.

Using a range of water holding capacities (50 mm through 400 mm) and regression analysis for pervious areas, various relationships between water holding capacity, water surplus and actual evapotranspiration were calculated using the period of record for the Midhurst climate station (see **Figure E.2**).

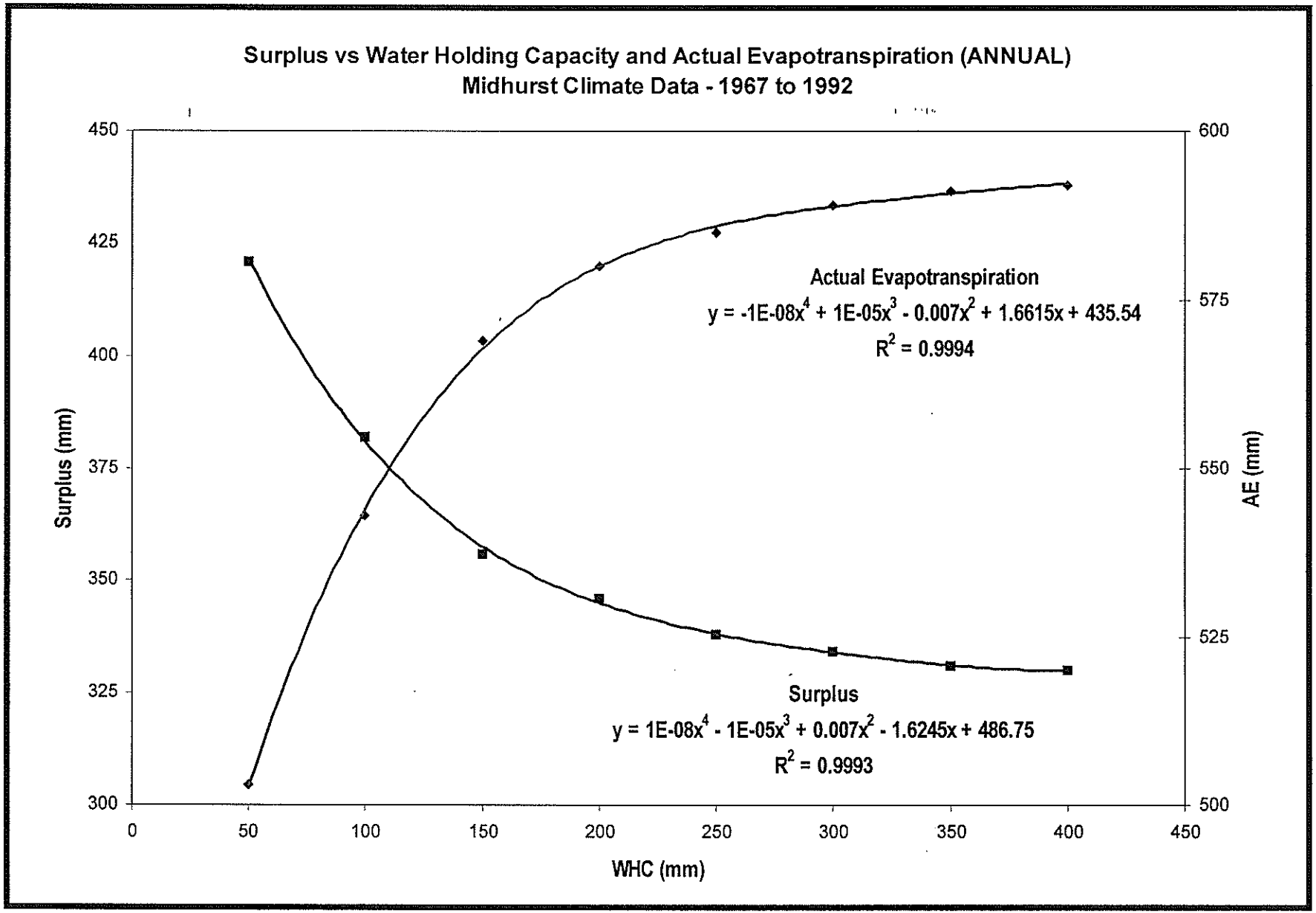


Figure E.2: Surplus vs water holding capacity and actual evapotranspiration

Annual Water Balance
Willow Creek Subwatershed
Catchment 700

EXISTING CONDITIONS

Calculated Water Balance Components
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)
Moderately Rooted Crops (corn and cereal grains)
Pasture and Shrubs
Mature Forests

Component Area (ha)	Weighted WHC (mm)	BF Factor
1751.2	159	0.883

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	571.2	354.8	181.5	297.3	124.0	173.3	57.5
Component Volume (m^3)									
12,555,970	3,659,969	10,384,505	10,002,730	6,213,209	3,178,305	5,205,686	2,170,782	3,034,904	1,007,523

Calculated Water Balance Components
Swamp/Fen/Marsh

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
27.1	100.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
193,976	56,542	160,429	160,429	90,089	0	90,089	0	90,089	0

Calculated Water Balance Components
Open Water

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
1.1	100.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
7,886	2,299	6,522	6,522	3,663	0	3,663	0	3,663	0

Calculated Water Balance Components
Impervious Urban Area

Component Area (ha)	AET as Percent of RAIN+MELT	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
0.0	10.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	92.6	833.4	0.0	833.4	0.0	833.4	0.0
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Sand/Gravel/Rock Pits

Component Area (ha)	AET as Percent of RAIN+MELT	BF as Percent of INF	RO Coefficient
15.2	30.0	70.0	0.5

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	277.8	648.2	324.1	551.0	226.9	324.1	97.2
Component Volume (m^3)									
109,056	31,789	90,196	42,254	98,592	49,296	83,803	34,507	49,296	14,789

TOTAL VOLUME (m^3)									
12,866,888	3,750,599	10,641,652	10,211,935	6,405,552	3,227,600	5,383,241	2,205,289	3,177,852	1,022,311
TOTAL DEPTH (mm)									
717.0	209.0	593.0	569.1	356.9	179.9	300.0	122.9	177.1	57.0

INPUTS		OUTPUTS		
% Rain	% Melt	% AET	% BF	% RO	% DGWS
77.4	22.6	61.5	13.3	19.1	6.2

FUTURE CONDITIONS

Calculated Water Balance Components
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)
Moderately Rooted Crops (corn and cereal grains)
Pasture and Shrubs
Mature Forests

Component Area (ha)	Weighted WHC (mm)	BF Factor
1747.0	159	0.883

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	571.3	354.7	181.4	297.2	123.9	173.3	57.5
Component Volume (m^3)									
12,525,907	3,651,206	10,359,641	9,980,013	6,197,099	3,169,587	5,192,340	2,164,828	3,027,512	1,004,759

Calculated Water Balance Components
Swamp/Fen/Marsh

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
27.1	100.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
193,976	56,542	160,429	160,429	90,089	0	90,089	0	90,089	0

Calculated Water Balance Components
Open Water

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
1.1	100.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
7,886	2,299	6,522	6,522	3,663	0	3,663	0	3,663	0

Calculated Water Balance Components
Impervious Urban Area

Component Area (ha)	AET as Percent of RAIN+MELT	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
4.2	10.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	92.6	833.4	0.0	833.4	0.0	833.4	0.0
Component Volume (m^3)									
30,114	8,778	24,906	3,889	35,003	0	35,003	0	35,003	0

Calculated Water Balance Components
Sand/Gravel/Rock Pits

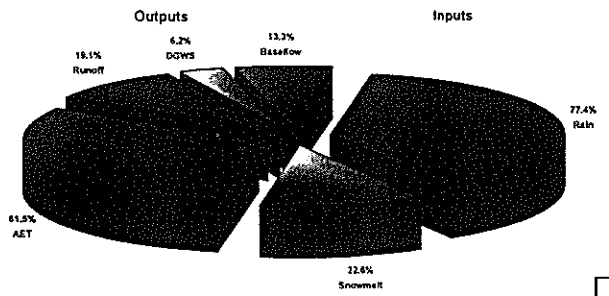
Component Area (ha)	AET as Percent of RAIN+MELT	BF as Percent of INF	RO Coefficient
15.2	30.0	70.0	0.5

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	277.8	648.2	324.1	551.0	226.9	324.1	97.2
Component Volume (m^3)									
109,056	31,789	90,196	42,254	98,592	49,296	83,803	34,507	49,296	14,789

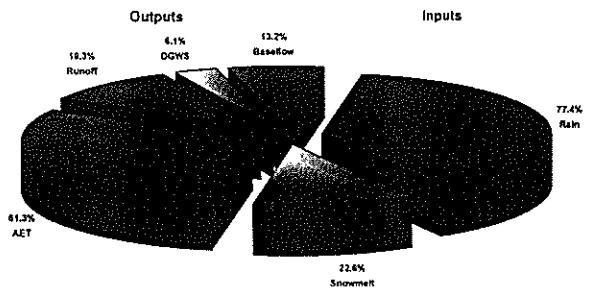
TOTAL VOLUME (m^3)									
12,866,939	3,750,614	10,641,694	10,193,107	6,424,446	3,218,883	5,404,898	2,199,335	3,205,563	1,019,548
TOTAL DEPTH (mm)									
717.0	209.0	593.0	568.0	358.0	179.4	301.2	122.6	178.6	56.8

INPUTS		OUTPUTS		
% Rain	% Melt	% AET	% BF	% RO	% DGWS
77.4	22.6	61.3	13.2	19.3	6.1

Willow Creek Existing Conditions Water Balance (Annual)
Midhurst Climate Data (1967 to 1992)



Willow Creek Future Conditions Water Balance (Annual)
Midhurst Climate Data (1967 to 1992)



GREENLAND

TOTAL AREA = 1,795 ha

TOTAL AREA = 1,795 ha

Annual Water Balance
Willow Creek Subwatershed
Catchment 702

EXISTING CONDITIONS

Calculated Water Balance Components
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)
Moderately Rooted Crops (corn and cereal grains)
Pasture and Shrubs
Mature Forests

Component Area (ha)	Weighted WHC (mm)	BF Factor
335.3	215	0.683

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	563.6	342.4	174.0	287.3	118.8	168.5	55.1
Component Volume (m^3)	2,404,277	700,828	1,988,475	1,956,810	1,148,295	583,373	963,366	398,444	564,922	184,929

Calculated Water Balance Components
Swamp/Fen/Marsh

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
21.6	100.0	0.0	0.0	0.0

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)	154,795	45,122	128,025	128,025	71,892	0	71,892	0	71,892	0

Calculated Water Balance Components
Open Water

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
0.0	100.0	0.0	0.0	0.0

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)	0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Impervious Urban Area

Component Area (ha)	AET as Percent of RAIN+MELT	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
0.0	10.0	0.0	0.0	0.0

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	92.6	833.4	0.0	833.4	0.0	833.4	0.0
Component Volume (m^3)	0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Sand/Gravel/Rock Pits

Component Area (ha)	AET as Percent of RAIN+MELT	BF as Percent of INF	RO Coefficient
8.5	30.0	70.0	0.5

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	277.6	648.2	324.1	551.0	226.9	324.1	97.2
Component Volume (m^3)	60,772	17,715	50,262	23,546	54,941	27,470	46,700	19,229	27,470	8,241

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
TOTAL VOLUME (m^3)	2,619,845	763,665	2,166,761	2,108,381	1,275,128	610,843	1,081,958	417,673	664,285	193,170
TOTAL DEPTH (mm)	717.0	209.0	593.0	577.0	349.0	167.2	296.1	114.3	181.8	52.9

INPUTS		OUTPUTS			
% Rain	% Melt	% AET	% BF	% RO	% DGWS
77.4	22.6	62.3	12.3	19.6	5.7

FUTURE CONDITIONS

Calculated Water Balance Components
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)
Moderately Rooted Crops (corn and cereal grains)
Pasture and Shrubs
Mature Forests

Component Area (ha)	Weighted WHC (mm)	BF Factor
335.3	215	0.683

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	583.6	342.4	174.0	287.3	118.8	168.5	55.1
Component Volume (m^3)	2,404,277	700,828	1,988,475	1,956,810	1,148,295	583,373	963,366	398,444	564,922	184,929

Calculated Water Balance Components
Swamp/Fen/Marsh

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
21.6	100.0	0.0	0.0	0.0

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)	154,795	45,122	128,025	128,025	71,892	0	71,892	0	71,892	0

Calculated Water Balance Components
Open Water

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
0.0	100.0	0.0	0.0	0.0

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)	0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Impervious Urban Area

Component Area (ha)	AET as Percent of RAIN+MELT	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
0.0	10.0	0.0	0.0	0.0

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	92.6	833.4	0.0	833.4	0.0	833.4	0.0
Component Volume (m^3)	0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Sand/Gravel/Rock Pits

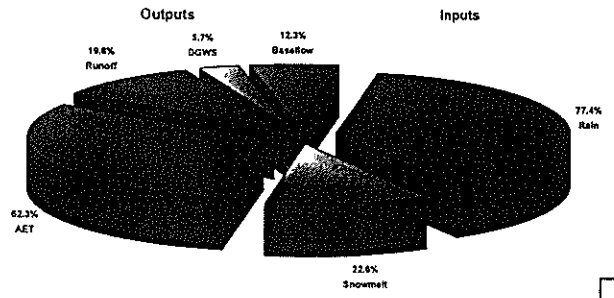
Component Area (ha)	AET as Percent of RAIN+MELT	BF as Percent of INF	RO Coefficient
8.5	30.0	70.0	0.5

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	277.6	648.2	324.1	551.0	226.9	324.1	97.2
Component Volume (m^3)	60,772	17,715	50,262	23,546	54,941	27,470	46,700	19,229	27,470	8,241

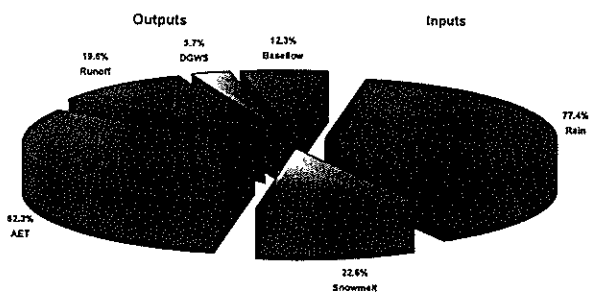
	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
TOTAL VOLUME (m^3)	2,619,845	763,665	2,166,761	2,108,381	1,275,128	610,843	1,081,958	417,673	664,285	193,170
TOTAL DEPTH (mm)	717.0	209.0	593.0	577.0	349.0	167.2	296.1	114.3	181.8	52.9

INPUTS		OUTPUTS			
% Rain	% Melt	% AET	% BF	% RO	% DGWS
77.4	22.6	62.3	12.3	19.6	5.7

Willow Creek Existing Conditions Water Balance (Annual)
Midhurst Climate Data (1967 to 1992)



Willow Creek Future Conditions Water Balance (Annual)
Midhurst Climate Data (1967 to 1992)



GREENLAND

TOTAL AREA = 365 ha

TOTAL AREA = 365 ha

Annual Water Balance
Willow Creek Subwatershed
Catchment 704

EXISTING CONDITIONS

Calculated Water Balance Components
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)
Moderately Rooted Crops (corn and cereal grains)
Pasture and Shrubs
Mature Forests

Component Area (ha): 684.7 | Weighted WHC (mm): 127 | BF Factor: 0.683

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	559.5	366.5	186.4	307.4	127.3	180.2	59.1
Component Volume (m^3)									
4,909,332	1,431,033	4,060,298	3,830,746	2,509,618	1,276,084	2,105,099	871,565	1,233,534	404,519

Calculated Water Balance Components
Swamp/Fen/Marsh

Component Area (ha): 0.0 | AET as Percent of PET: 100.0 | INF as Percent of Surplus: 0.0 | BF as Percent of Surplus: 0.0 | DGWS as % of Surplus: 0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Open Water

Component Area (ha): 0.0 | AET as Percent of PET: 100.0 | INF as Percent of Surplus: 0.0 | BF as Percent of Surplus: 0.0 | DGWS as % of Surplus: 0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Impervious Urban Area

Component Area (ha): 0.0 | AET as Percent of RAIN+MELT: 10.0 | INF as Percent of Surplus: 0.0 | BF as Percent of Surplus: 0.0 | DGWS as % of Surplus: 0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	92.6	833.4	0.0	833.4	0.0	833.4	0.0
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Sand/Gravel/Rock Pits

Component Area (ha): 0.0 | AET as Percent of RAIN+MELT: 30.0 | BF as Percent of INF: 70.0 | RO Coefficient: 0.5

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	277.8	648.2	324.1	551.0	226.9	324.1	97.2
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

TOTAL VOLUME (m^3)									
4,909,332	1,431,033	4,060,298	3,830,746	2,509,618	1,276,084	2,105,099	871,565	1,233,534	404,519
TOTAL DEPTH (mm)									
717.0	209.0	593.0	559.5	366.5	186.4	307.4	127.3	180.2	59.1

INPUTS		OUTPUTS			
% Rain	% Melt	% AET	% BF	% RO	% DGWS
77.4	22.6	60.4	13.7	19.5	6.4

FUTURE CONDITIONS

Calculated Water Balance Components
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)
Moderately Rooted Crops (corn and cereal grains)
Pasture and Shrubs
Mature Forests

Component Area (ha): 677.7 | Weighted WHC (mm): 129 | BF Factor: 0.683

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	559.5	366.5	186.3	307.4	127.3	180.1	59.1
Component Volume (m^3)									
4,859,115	1,416,395	4,018,766	3,791,952	2,483,558	1,262,759	2,083,263	862,465	1,220,798	400,295

Calculated Water Balance Components
Swamp/Fen/Marsh

Component Area (ha): 0.0 | AET as Percent of PET: 100.0 | INF as Percent of Surplus: 0.0 | BF as Percent of Surplus: 0.0 | DGWS as % of Surplus: 0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Open Water

Component Area (ha): 0.0 | AET as Percent of PET: 100.0 | INF as Percent of Surplus: 0.0 | BF as Percent of Surplus: 0.0 | DGWS as % of Surplus: 0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Impervious Urban Area

Component Area (ha): 7.0 | AET as Percent of RAIN+MELT: 10.0 | INF as Percent of Surplus: 0.0 | BF as Percent of Surplus: 0.0 | DGWS as % of Surplus: 0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	92.6	833.4	0.0	833.4	0.0	833.4	0.0
Component Volume (m^3)									
50,190	14,630	41,510	6,482	58,338	0	58,338	0	58,338	0

Calculated Water Balance Components
Sand/Gravel/Rock Pits

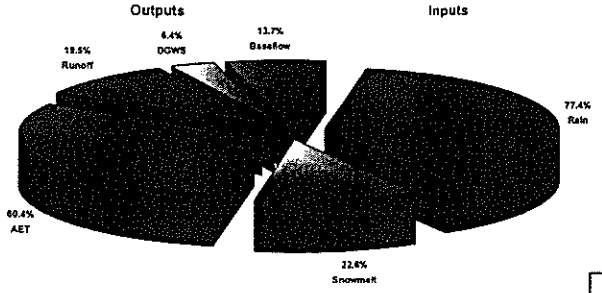
Component Area (ha): 0.0 | AET as Percent of RAIN+MELT: 30.0 | BF as Percent of INF: 70.0 | RO Coefficient: 0.5

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	277.8	648.2	324.1	551.0	226.9	324.1	97.2
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

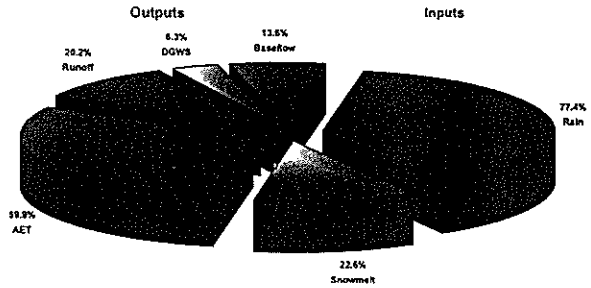
TOTAL VOLUME (m^3)									
4,909,305	1,431,025	4,060,276	3,798,434	2,541,896	1,262,759	2,141,601	862,465	1,279,136	400,295
TOTAL DEPTH (mm)									
717.0	209.0	593.0	554.8	371.2	184.4	312.8	126.0	186.8	58.5

INPUTS		OUTPUTS			
% Rain	% Melt	% AET	% BF	% RO	% DGWS
77.4	22.6	59.9	13.6	20.2	6.3

Willow Creek Existing Conditions Water Balance (Annual)
Midhurst Climate Data (1967 to 1992)



Willow Creek Future Conditions Water Balance (Annual)
Midhurst Climate Data (1967 to 1992)



GREENLAND

TOTAL AREA = 685 ha

TOTAL AREA = 685 ha

Annual Water Balance
Willow Creek Subwatershed
Catchment 706

EXISTING CONDITIONS

Calculated Water Balance Components
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)
Moderately Rooted Crops (corn and cereal grains)
Pasture and Shrubs
Mature Forests

Component Area (ha)	Weighted WHC (mm)	BF Factor
999.3	148	0.683

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	567.5	358.5	202.3	294.3	138.1	156.2	64.1
Component Volume (m^3)									
7,164,999	2,088,542	5,925,864	5,671,400	3,582,141	2,021,127	2,941,444	1,380,430	1,561,014	640,697

Calculated Water Balance Components
Swamp/Fen/Marsh

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
6.7	100.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
62,512	18,222	51,701	51,701	29,033	0	29,033	0	29,033	0

Calculated Water Balance Components
Open Water

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
3.1	100.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
22,517	6,563	18,623	18,623	10,457	0	10,457	0	10,457	0

Calculated Water Balance Components
Impervious Urban Area

Component Area (ha)	AET as Percent of RAIN+MELT	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
0.0	100.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	92.6	833.4	0.0	833.4	0.0	833.4	0.0
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Sand/Gravel/Rock Pits

Component Area (ha)	AET as Percent of RAIN+MELT	BF as Percent of INF	RO Coefficient
0.0	30.0	70.0	0.5

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	277.8	648.2	324.1	551.0	226.9	324.1	97.2
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

TOTAL VOLUME (m^3)									
7,250,028	2,113,327	5,996,187	5,741,724	3,621,631	2,021,127	2,980,934	1,380,430	1,600,504	640,697
TOTAL DEPTH (mm)									
717.0	209.0	593.0	567.8	358.2	199.9	294.8	136.5	158.3	63.4
INPUTS		OUTPUTS							
% Rain	% Melt	% AET					% BF	% RO	% DGWS
77.4	22.6	61.3					14.7	17.1	6.8

FUTURE CONDITIONS

Calculated Water Balance Components
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)
Moderately Rooted Crops (corn and cereal grains)
Pasture and Shrubs
Mature Forests

Component Area (ha)	Weighted WHC (mm)	BF Factor
930.0	150	0.683

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	568.2	357.8	201.9	293.8	137.9	155.9	64.0
Component Volume (m^3)									
6,668,076	1,943,693	5,514,880	5,284,373	3,327,395	1,877,476	2,732,235	1,282,316	1,449,919	595,160

Calculated Water Balance Components
Swamp/Fen/Marsh

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
6.7	100.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
62,512	18,222	51,701	51,701	29,033	0	29,033	0	29,033	0

Calculated Water Balance Components
Open Water

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
3.1	100.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
22,517	6,563	18,623	18,623	10,457	0	10,457	0	10,457	0

Calculated Water Balance Components
Impervious Urban Area

Component Area (ha)	AET as Percent of RAIN+MELT	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
69.3	100.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	92.6	833.4	0.0	833.4	0.0	833.4	0.0
Component Volume (m^3)									
496,881	144,837	410,949	64,172	577,546	0	577,546	0	577,546	0

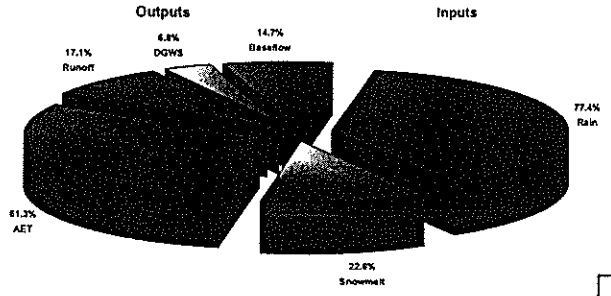
Calculated Water Balance Components
Sand/Gravel/Rock Pits

Component Area (ha)	AET as Percent of RAIN+MELT	BF as Percent of INF	RO Coefficient
0.0	30.0	70.0	0.5

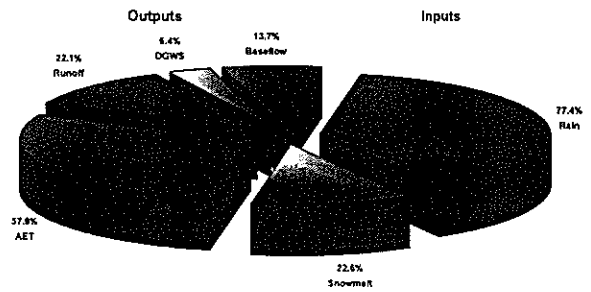
Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	277.8	648.2	324.1	551.0	226.9	324.1	97.2
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

TOTAL VOLUME (m^3)									
7,249,985	2,113,315	5,996,153	5,418,869	3,944,432	1,877,476	3,349,272	1,282,316	2,056,955	595,160
TOTAL DEPTH (mm)									
717.0	209.0	593.0	535.9	390.1	185.7	331.2	126.8	204.4	58.9
INPUTS		OUTPUTS							
% Rain	% Melt	% AET					% BF	% RO	% DGWS
77.4	22.6	57.9					13.7	22.1	6.4

Willow Creek Existing Conditions Water Balance (Annual)
Midhurst Climate Data (1967 to 1992)



Willow Creek Future Conditions Water Balance (Annual)
Midhurst Climate Data (1967 to 1992)



TOTAL AREA = 1,011 ha

GREENLAND

TOTAL AREA = 1,011 ha

Annual Water Balance
Willow Creek Subwatershed
Catchment 708

EXISTING CONDITIONS

Calculated Water Balance Components
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)
Moderately Rooted Crops (corn and cereal grains)
Pasture and Shrubs
Mature Forests

Component Area (ha)	Weighted WHC (mm)	BF Factor
334.8	164	0.680

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	572.7	353.3	188.1	293.7	128.5	165.2	59.6
Component Volume (m^3)	2,400,264	699,659	1,985,156	1,917,052	1,182,871	629,745	983,241	430,116	553,125	199,629

Calculated Water Balance Components
Swamp/Fen/Marsh

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
7.2	100.0	0.0	0.0	0.0

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)	51,573	15,033	42,654	42,654	23,952	0	23,952	0	23,952	0

Calculated Water Balance Components
Open Water

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
0.0	100.0	0.0	0.0	0.0

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)	0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Impervious Urban Area

Component Area (ha)	AET as Percent of RAIN+MELT	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
0.0	10.0	0.0	0.0	0.0

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	92.6	833.4	0.0	833.4	0.0	833.4	0.0
Component Volume (m^3)	0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Sand/Gravel/Rock Pits

Component Area (ha)	AET as Percent of RAIN+MELT	BF as Percent of INF	RO Coefficient
0.0	30.0	70.0	0.5

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	277.8	648.2	324.1	551.0	226.9	324.1	97.2
Component Volume (m^3)	0	0	0	0	0	0	0	0	0	0

TOTAL VOLUME (m^3)									
2,451,837	714,692	2,027,810	1,959,705	1,208,823	629,745	1,007,194	430,116	577,078	199,629
TOTAL DEPTH (mm)									
717.0	209.0	593.0	573.1	352.9	184.2	294.5	125.8	168.8	58.4

INPUTS		OUTPUTS		
% Rain	% Melt	% AET	% BF	% RO	% DGWS
77.4	22.6	61.9	13.6	18.2	6.3

FUTURE CONDITIONS

Calculated Water Balance Components
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)
Moderately Rooted Crops (corn and cereal grains)
Pasture and Shrubs
Mature Forests

Component Area (ha)	Weighted WHC (mm)	BF Factor
314.2	167	0.680

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	573.7	352.3	188.1	292.7	128.5	164.3	59.6
Component Volume (m^3)	2,252,583	656,611	1,863,015	1,802,229	1,106,965	590,851	919,665	403,551	516,114	187,300

Calculated Water Balance Components
Swamp/Fen/Marsh

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
7.2	100.0	0.0	0.0	0.0

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)	51,573	15,033	42,654	42,654	23,952	0	23,952	0	23,952	0

Calculated Water Balance Components
Open Water

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
0.0	100.0	0.0	0.0	0.0

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)	0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Impervious Urban Area

Component Area (ha)	AET as Percent of RAIN+MELT	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
20.6	10.0	0.0	0.0	0.0

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	92.6	833.4	0.0	833.4	0.0	833.4	0.0
Component Volume (m^3)	147,702	43,054	122,158	19,076	171,680	0	171,680	0	171,680	0

Calculated Water Balance Components
Sand/Gravel/Rock Pits

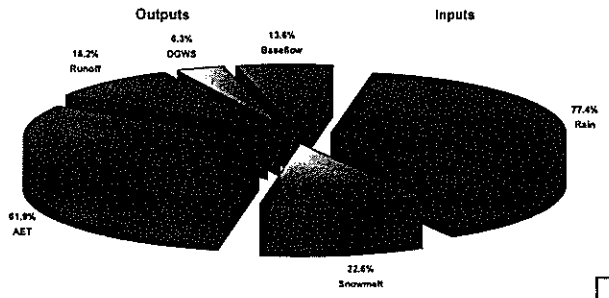
Component Area (ha)	AET as Percent of RAIN+MELT	BF as Percent of INF	RO Coefficient
0.0	30.0	70.0	0.5

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	277.8	648.2	324.1	551.0	226.9	324.1	97.2
Component Volume (m^3)	0	0	0	0	0	0	0	0	0	0

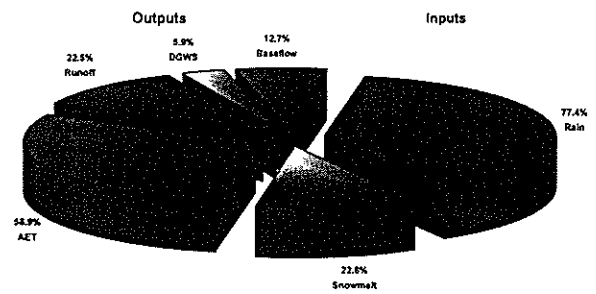
TOTAL VOLUME (m^3)									
2,451,859	714,698	2,027,827	1,863,959	1,302,598	590,851	1,115,298	403,551	711,747	187,300
TOTAL DEPTH (mm)									
717.0	209.0	593.0	545.1	380.9	172.6	325.1	118.0	208.1	54.8

INPUTS		OUTPUTS		
% Rain	% Melt	% AET	% BF	% RO	% DGWS
77.4	22.6	58.9	12.7	22.5	5.9

Willow Creek Existing Conditions Water Balance (Annual)
Midhurst Climate Data (1967 to 1992)



Willow Creek Future Conditions Water Balance (Annual)
Midhurst Climate Data (1967 to 1992)



GREENLAND

TOTAL AREA = 342 ha

TOTAL AREA = 342 ha

Annual Water Balance
Willow Creek Subwatershed
Catchment 7092

EXISTING CONDITIONS

Calculated Water Balance Components
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)
Moderately Rooted Crops (corn and cereal grains)
Pasture and Shrubs
Mature Forests

Component Area (ha)	Weighted WHC (mm)	BF Factor
834.7	228	0.653

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	585.3	340.7	163.5	288.9	111.6	177.2	51.8
Component Volume (m^3)									
5,984,777	1,744,516	4,949,752	4,885,544	2,843,749	1,364,463	2,411,214	931,928	1,479,286	432,535

Calculated Water Balance Components
Swamp/Fen/Marsh

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
13.1	100.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
94,152	27,445	77,869	77,869	43,728	0	43,728	0	43,728	0

Calculated Water Balance Components
Open Water

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
0.0	100.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Impervious Urban Area

Component Area (ha)	AET as Percent of RAIN+MELT	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
0.0	10.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	92.5	833.4	0.0	833.4	0.0	833.4	0.0
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Sand/Gravel/Rock Pits

Component Area (ha)	AET as Percent of RAIN+MELT	BF as Percent of INF	RO Coefficient
0.0	30.0	70.0	0.5

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	277.8	648.2	324.1	551.0	226.9	324.1	97.2
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

TOTAL VOLUME (m^3)									
6,078,929	1,771,961	5,027,622	4,963,413	2,887,477	1,364,463	2,454,942	931,928	1,503,014	432,535
TOTAL DEPTH (mm)									
717.0	209.0	593.0	585.4	340.6	160.9	289.6	109.9	179.6	51.0

INPUTS		OUTPUTS		
% Rain	% Melt	% AET	% BF	% RO	% DGWS
77.4	22.6	63.2	11.9	19.4	5.5

FUTURE CONDITIONS

Calculated Water Balance Components
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)
Moderately Rooted Crops (corn and cereal grains)
Pasture and Shrubs
Mature Forests

Component Area (ha)	Weighted WHC (mm)	BF Factor
762.7	235	0.683

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	586.3	339.7	161.2	288.6	110.1	178.5	51.1
Component Volume (m^3)									
5,468,560	1,594,049	4,522,828	4,471,564	2,591,065	1,229,778	2,201,226	839,938	1,361,287	389,840

Calculated Water Balance Components
Swamp/Fen/Marsh

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
13.1	100.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
94,152	27,445	77,869	77,869	43,728	0	43,728	0	43,728	0

Calculated Water Balance Components
Open Water

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
0.0	100.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Impervious Urban Area

Component Area (ha)	AET as Percent of RAIN+MELT	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
72.0	10.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	92.6	833.4	0.0	833.4	0.0	833.4	0.0
Component Volume (m^3)									
516,240	150,480	426,960	66,672	600,048	0	600,048	0	600,048	0

Calculated Water Balance Components
Sand/Gravel/Rock Pits

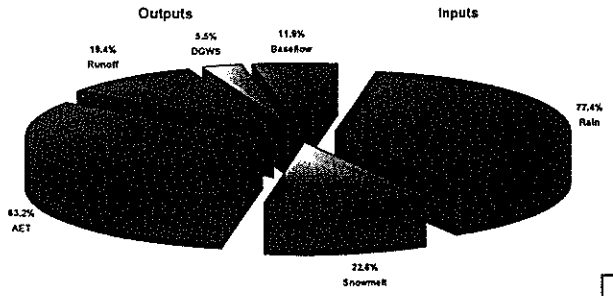
Component Area (ha)	AET as Percent of RAIN+MELT	BF as Percent of INF	RO Coefficient
0.0	30.0	70.0	0.5

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	277.8	648.2	324.1	551.0	226.9	324.1	97.2
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

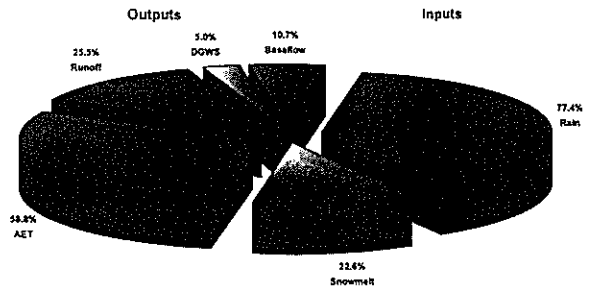
TOTAL VOLUME (m^3)									
6,078,972	1,771,974	5,027,658	4,616,105	3,234,841	1,229,778	2,845,001	839,938	2,005,063	389,840
TOTAL DEPTH (mm)									
717.0	209.0	593.0	544.5	381.5	145.0	335.6	99.1	236.5	46.0

INPUTS		OUTPUTS		
% Rain	% Melt	% AET	% BF	% RO	% DGWS
77.4	22.6	58.8	10.7	25.5	5.0

Willow Creek Existing Conditions Water Balance (Annual)
Midhurst Climate Data (1967 to 1992)



Willow Creek Future Conditions Water Balance (Annual)
Midhurst Climate Data (1967 to 1992)



GREENLAND

TOTAL AREA = 849 ha

TOTAL AREA = 849 ha

Annual Water Balance
Willow Creek Subwatershed
Catchment 711

EXISTING CONDITIONS

Calculated Water Balance Components
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)
Moderately Rooted Crops (corn and cereal grains)
Pasture and Shrubs
Mature Forests

Component Area (ha)	Weighted WHC (mm)	BF Factor
1569.3	201	0.683

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	581.2	344.8	172.2	290.2	117.6	172.5	54.6
Component Volume (m^3)									
12,112,496	3,530,700	10,017,727	9,818,554	5,824,642	2,909,832	4,902,225	1,987,415	2,914,810	922,417

Calculated Water Balance Components
Swamp/Fen/Marsh

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
22.4	100.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
160,393	46,753	132,654	132,654	74,492	0	74,492	0	74,492	0

Calculated Water Balance Components
Open Water

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
0.0	100.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Impervious Urban Area

Component Area (ha)	AET as Percent of RAIN+MELT	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
0.1	10.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	92.6	833.4	0.0	833.4	0.0	833.4	0.0
Component Volume (m^3)									
574	167	474	74	667	0	667	0	667	0

Calculated Water Balance Components
Sand/Gravel/Rock Pits

Component Area (ha)	AET as Percent of RAIN+MELT	BF as Percent of INF	RO Coefficient
21.9	30.0	70.0	0.5

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	277.8	648.2	324.1	551.0	226.9	324.1	97.2
Component Volume (m^3)									
156,736	45,687	129,630	60,727	141,697	70,848	120,442	49,594	70,848	21,254

TOTAL VOLUME (m^3)									
12,430,199	3,623,308	10,280,485	10,012,009	6,041,497	2,980,660	5,097,826	2,037,009	3,060,817	943,671
TOTAL DEPTH (mm)									
717.0	209.0	593.0	577.5	348.5	171.9	294.1	117.5	176.6	54.4

INPUTS		OUTPUTS		
% Rain	% Melt	% AET	% BF	% RO	% DGWS
77.4	22.6	62.4	12.7	19.1	5.9

FUTURE CONDITIONS

Calculated Water Balance Components
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)
Moderately Rooted Crops (corn and cereal grains)
Pasture and Shrubs
Mature Forests

Component Area (ha)	Weighted WHC (mm)	BF Factor
1567.7	201	0.683

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	581.2	344.8	171.7	290.4	117.3	173.1	54.4
Component Volume (m^3)									
11,957,624	3,485,556	9,889,639	9,692,890	5,750,290	2,864,151	4,842,351	1,956,222	2,886,129	907,939

Calculated Water Balance Components
Swamp/Fen/Marsh

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
22.4	100.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
160,393	46,753	132,654	132,654	74,492	0	74,492	0	74,492	0

Calculated Water Balance Components
Open Water

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
0.0	100.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Impervious Urban Area

Component Area (ha)	AET as Percent of RAIN+MELT	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
21.7	10.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	92.6	833.4	0.0	833.4	0.0	833.4	0.0
Component Volume (m^3)									
155,446	45,311	128,562	20,076	180,681	0	180,681	0	180,681	0

Calculated Water Balance Components
Sand/Gravel/Rock Pits

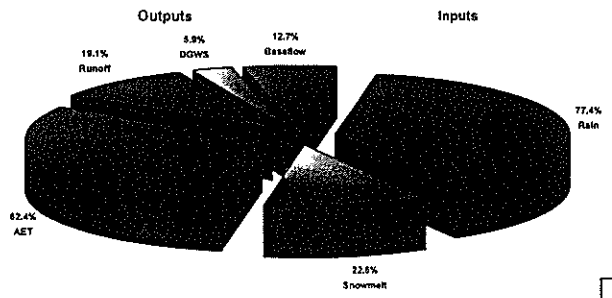
Component Area (ha)	AET as Percent of RAIN+MELT	BF as Percent of INF	RO Coefficient
21.9	30.0	70.0	0.5

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	277.8	648.2	324.1	551.0	226.9	324.1	97.2
Component Volume (m^3)									
156,736	45,687	129,630	60,727	141,697	70,848	120,442	49,594	70,848	21,254

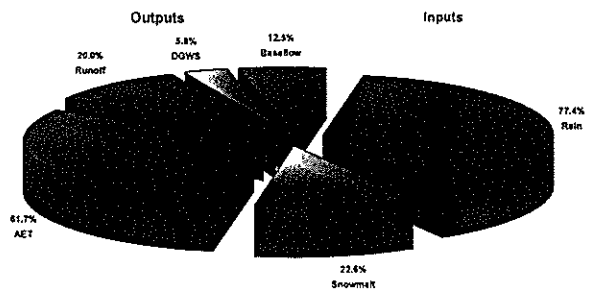
TOTAL VOLUME (m^3)									
12,430,199	3,623,308	10,280,485	9,906,347	6,147,150	2,935,009	5,217,966	2,005,815	3,212,151	929,193
TOTAL DEPTH (mm)									
717.0	209.0	593.0	571.4	354.6	169.3	301.0	115.7	185.3	53.6

INPUTS		OUTPUTS		
% Rain	% Melt	% AET	% BF	% RO	% DGWS
77.4	22.6	61.7	12.5	20.0	5.8

Willow Creek Existing Conditions Water Balance (Annual)
Midhurst Climate Data (1967 to 1992)



Willow Creek Future Conditions Water Balance (Annual)
Midhurst Climate Data (1967 to 1992)



GREENLAND

TOTAL AREA = 1,734 ha

TOTAL AREA = 1,734 ha

Annual Water Balance
Willow Creek Subwatershed
Catchment 713

EXISTING CONDITIONS

Calculated Water Balance Components
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)
Moderately Rooted Crops (corn and cereal grains)
Pasture and Shrubs
Mature Forests

Component Area (ha)	Weighted WHC (mm)	BF Factor
3083.0	205	0.683

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	581.9	344.1	212.6	276.7	145.2	131.5	67.4
Component Volume (m^3)	22,105,038	6,443,449	18,282,131	17,941,277	10,607,210	6,553,067	8,529,888	4,475,745	4,054,143	2,077,322

Calculated Water Balance Components
Swamp/Fen/Marsh

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
37.6	100.0	0.0	0.0	0.0

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)	269,735	78,626	223,087	223,087	125,275	0	125,275	0	125,275	0

Calculated Water Balance Components
Open Water

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
2.2	100.0	0.0	0.0	0.0

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)	15,989	4,661	13,224	13,224	7,426	0	7,426	0	7,426	0

Calculated Water Balance Components
Impervious Urban Area

Component Area (ha)	AET as Percent of RAIN+MELT	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
0.0	10.0	0.0	0.0	0.0

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	92.6	833.4	0.0	833.4	0.0	833.4	0.0
Component Volume (m^3)	0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Sand Gravel Rock Pits

Component Area (ha)	AET as Percent of RAIN+MELT	BF as Percent of INF	RO Coefficient
0.0	30.0	70.0	0.5

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	277.8	648.2	324.1	551.0	226.9	324.1	97.2
Component Volume (m^3)	0	0	0	0	0	0	0	0	0	0

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
TOTAL VOLUME (m^3)	22,390,763	6,526,736	18,518,441	18,177,588	10,739,911	6,553,067	8,662,588	4,475,745	4,186,844	2,077,322
TOTAL DEPTH (mm)	717.0	209.0	593.0	582.1	343.9	209.8	277.4	143.3	134.1	66.5

INPUTS		OUTPUTS			
% Rain	% Melt	% AET	% BF	% RO	% DGWS
77.4	22.6	62.9	15.5	14.5	7.2

FUTURE CONDITIONS

Calculated Water Balance Components
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)
Moderately Rooted Crops (corn and cereal grains)
Pasture and Shrubs
Mature Forests

Component Area (ha)	Weighted WHC (mm)	BF Factor
2991.6	207	0.683

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	582.2	343.8	212.2	276.5	144.9	131.6	67.3
Component Volume (m^3)	21,449,700	6,252,423	17,740,129	17,417,615	10,284,508	6,348,393	8,272,068	4,335,952	3,936,115	2,012,441

Calculated Water Balance Components
Swamp/Fen/Marsh

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
37.6	100.0	0.0	0.0	0.0

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)	269,735	78,626	223,087	223,087	125,275	0	125,275	0	125,275	0

Calculated Water Balance Components
Open Water

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
2.2	100.0	0.0	0.0	0.0

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)	15,989	4,661	13,224	13,224	7,426	0	7,426	0	7,426	0

Calculated Water Balance Components
Impervious Urban Area

Component Area (ha)	AET as Percent of RAIN+MELT	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
91.4	10.0	0.0	0.0	0.0

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	92.6	833.4	0.0	833.4	0.0	833.4	0.0
Component Volume (m^3)	655,338	191,026	542,002	84,636	761,728	0	761,728	0	761,728	0

Calculated Water Balance Components
Sand Gravel Rock Pits

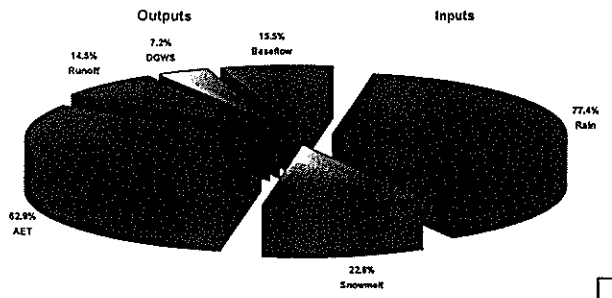
Component Area (ha)	AET as Percent of RAIN+MELT	BF as Percent of INF	RO Coefficient
0.0	30.0	70.0	0.5

	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
	717.0	209.0	593.0	277.8	648.2	324.1	551.0	226.9	324.1	97.2
Component Volume (m^3)	0	0	0	0	0	0	0	0	0	0

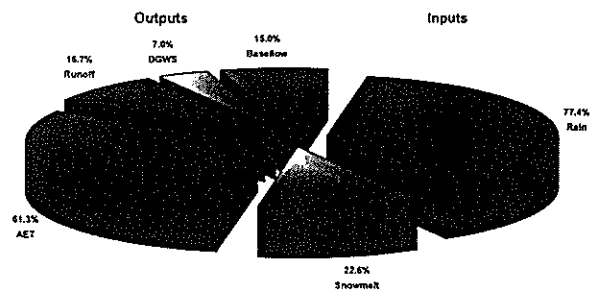
	Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
TOTAL VOLUME (m^3)	22,390,763	6,526,736	18,518,441	17,738,562	11,178,936	6,348,393	9,166,496	4,335,952	4,830,543	2,012,441
TOTAL DEPTH (mm)	717.0	209.0	593.0	568.0	358.0	203.3	293.5	138.8	154.7	64.4

INPUTS		OUTPUTS			
% Rain	% Melt	% AET	% BF	% RO	% DGWS
77.4	22.6	61.3	15.0	16.7	7.0

Willow Creek Existing Conditions Water Balance (Annual)
Midhurst Climate Data (1967 to 1992)



Willow Creek Future Conditions Water Balance (Annual)
Midhurst Climate Data (1967 to 1992)



TOTAL AREA = 3,123 ha

GREENLAND

TOTAL AREA = 3,123 ha

Annual Water Balance
Willow Creek Subwatershed
Catchment 715

EXISTING CONDITIONS

Calculated Water Balance Components
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)
Moderately Rooted Crops (corn and cereal grains)
Pasture and Shrubs
Mature Forests

Component Area (ha)		Weighted WHC (mm)					BF Factor		
1439.1		181					0.683		
Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	577.2	348.8	201.2	285.1	137.4	147.7	63.8
Component Volume (m^3)									
10,318,204	3,007,677	8,533,744	8,305,795	5,020,086	2,894,982	4,102,376	1,977,273	2,125,104	917,709

Calculated Water Balance Components
Swamp/Fen/Marsh

Component Area (ha)			AET as Percent of PET		INF as Percent of Surplus		BF as Percent of Surplus		DGWS as % of Surplus
10.1			100.0		0.0		0.0		0.0
Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
72,489	21,130	59,952	59,952	33,666	0	33,666	0	33,666	0

Calculated Water Balance Components
Open Water

Component Area (ha)			AET as Percent of PET		INF as Percent of Surplus		BF as Percent of Surplus		DGWS as % of Surplus
0.0			100.0		0.0		0.0		0.0
Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Impervious Urban Area

Component Area (ha)			AET as Percent of RAIN+MELT		INF as Percent of Surplus		BF as Percent of Surplus		DGWS as % of Surplus
9.1			10.0		0.0		0.0		0.0
Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	92.6	833.4	0.0	833.4	0.0	833.4	0.0
Component Volume (m^3)									
65,175	18,998	53,904	8,417	75,756	0	75,756	0	75,756	0

Calculated Water Balance Components
Sand/Gravel/Rock Pits

Component Area (ha)			AET as Percent of RAIN+MELT				BF as Percent of INF	RO Coefficent	
93.7			30.0				70.0	0.5	
Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	277.8	648.2	324.1	551.0	226.9	324.1	97.2
Component Volume (m^3)									
671,757	195,812	555,582	260,271	607,299	303,649	516,204	212,555	303,649	91,095

TOTAL VOLUME (m^3)									
11,127,625	3,243,617	9,203,182	8,634,435	5,736,807	3,198,631	4,728,003	2,189,827	2,538,175	1,008,804
TOTAL DEPTH (mm)									
717.0	209.0	593.0	556.4	369.6	206.1	304.6	141.1	163.5	65.0

INPUTS		OUTPUTS		
% Rain	% Melt	% AET	% BF	% RO	% DGWS
77.4	22.6	60.1	15.2	17.7	7.0

FUTURE CONDITIONS

Calculated Water Balance Components
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)
Moderately Rooted Crops (corn and cereal grains)
Pasture and Shrubs
Mature Forests

Component Area (ha)		Weighted WHC (mm)					BF Factor		
1435.1		182					0.683		
Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	577.2	348.8	201.2	285.0	137.4	147.6	63.8
Component Volume (m^3)									
10,289,524	2,999,317	8,510,024	8,283,803	5,005,038	2,886,766	4,089,933	1,971,661	2,118,272	915,105

Calculated Water Balance Components
Swamp/Fen/Marsh

Component Area (ha)			AET as Percent of PET		INF as Percent of Surplus		BF as Percent of Surplus		DGWS as % of Surplus
10.1			100.0		0.0		0.0		0.0
Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
72,489	21,130	59,952	59,952	33,666	0	33,666	0	33,666	0

Calculated Water Balance Components
Open Water

Component Area (ha)			AET as Percent of PET		INF as Percent of Surplus		BF as Percent of Surplus		DGWS as % of Surplus
0.0			100.0		0.0		0.0		0.0
Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Impervious Urban Area

Component Area (ha)			AET as Percent of RAIN+MELT		INF as Percent of Surplus		BF as Percent of Surplus		DGWS as % of Surplus
13.1			10.0		0.0		0.0		0.0
Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	92.6	833.4	0.0	833.4	0.0	833.4	0.0
Component Volume (m^3)									
93,855	27,358	77,624	12,121	109,092	0	109,092	0	109,092	0

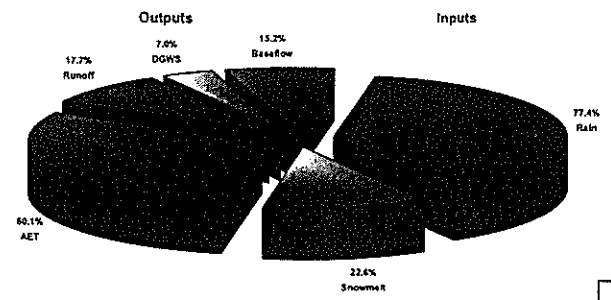
Calculated Water Balance Components
Sand/Gravel/Rock Pits

Component Area (ha)			AET as Percent of RAIN+MELT				BF as Percent of INF	RO Coefficent	
93.7			30.0				70.0	0.5	
Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	277.8	648.2	324.1	551.0	226.9	324.1	97.2
Component Volume (m^3)									
671,757	195,812	555,582	260,271	607,299	303,649	516,204	212,555	303,649	91,095

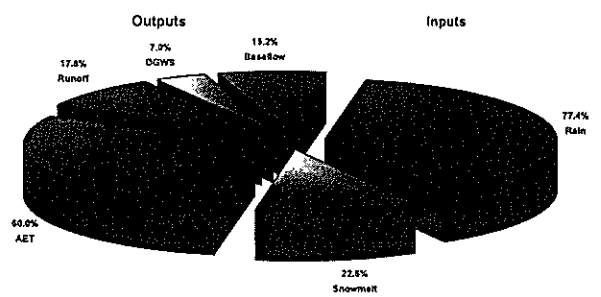
TOTAL VOLUME (m^3)									
11,127,625	3,243,617	9,203,182	8,616,147	5,755,095	3,190,415	4,748,895	2,184,216	2,564,680	1,006,200
TOTAL DEPTH (mm)									
717.0	209.0	593.0	555.2	370.8	205.6	306.0	140.7	165.3	64.8

INPUTS		OUTPUTS		
% Rain	% Melt	% AET	% BF	% RO	% DGWS
77.4	22.6	60.0	15.2	17.8	7.0

Willow Creek Existing Conditions Water Balance (Annual)
Midhurst Climate Data (1967 to 1992)



Willow Creek Future Conditions Water Balance (Annual)
Midhurst Climate Data (1967 to 1992)



GREENLAND

TOTAL AREA = 1,552 ha

TOTAL AREA = 1,552 ha

Annual Water Balance
Willow Creek Subwatershed
Catchment 133

EXISTING CONDITIONS

Calculated Water Balance Components
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)
Moderately Rooted Crops (corn and cereal grains)
Pasture and Shrubs
Mature Forests

Component Area (ha)	Weighted WHC (mm)	BF Factor
1023.6	227	0.683

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	585.2	340.8	185.6	281.9	126.8	155.1	58.8
Component Volume (m^3)									
7,339,521	2,139,414	6,070,204	5,990,846	3,488,090	1,899,570	2,885,799	1,297,680	1,588,120	602,291

Calculated Water Balance Components
Swamp/Fen/Marsh

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
116.7	100.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
836,739	243,903	692,031	692,031	388,611	0	388,611	0	388,611	0

Calculated Water Balance Components
Open Water

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
0.0	100.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Impervious Urban Area

Component Area (ha)	AET as Percent of RAIN+MELT	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
0.0	10.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	92.6	833.4	0.0	833.4	0.0	833.4	0.0
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Sand/Gravel/Rock Pits

Component Area (ha)	AET as Percent of RAIN+MELT	BF as Percent of INF	RO Coefficient
45.2	30.0	70.0	0.5

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	277.8	648.2	324.1	551.0	226.9	324.1	97.2
Component Volume (m^3)									
324,032	94,453	267,993	125,545	292,939	146,470	248,998	102,529	146,470	43,941

TOTAL VOLUME (m^3)									
8,500,292	2,477,770	7,030,228	6,808,422	4,169,640	2,046,440	3,523,409	1,400,209	2,123,200	646,232
TOTAL DEPTH (mm)									
717.0	209.0	593.0	574.3	351.7	172.6	297.2	118.1	179.1	54.5

INPUTS		OUTPUTS		
% Rain	% Melt	% AET	% BF	% RO	% DGWS
77.4	22.6	62.0	12.8	19.3	5.9

FUTURE CONDITIONS

Calculated Water Balance Components
Urban Lawns/Shallow Rooted Crops (spinach, beans, beets, carrots)
Moderately Rooted Crops (corn and cereal grains)
Pasture and Shrubs
Mature Forests

Component Area (ha)	Weighted WHC (mm)	BF Factor
1023.6	227	0.683

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	585.2	340.8	185.6	281.9	126.8	155.1	58.8
Component Volume (m^3)									
7,339,521	2,139,414	6,070,204	5,990,846	3,488,090	1,899,570	2,885,799	1,297,680	1,588,120	602,291

Calculated Water Balance Components
Swamp/Fen/Marsh

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
116.7	100.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
836,739	243,903	692,031	692,031	388,611	0	388,611	0	388,611	0

Calculated Water Balance Components
Open Water

Component Area (ha)	AET as Percent of PET	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
0.0	100.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	593.0	333.0	0.0	333.0	0.0	333.0	0.0
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Impervious Urban Area

Component Area (ha)	AET as Percent of RAIN+MELT	INF as Percent of Surplus	BF as Percent of Surplus	DGWS as % of Surplus
0.0	10.0	0.0	0.0	0.0

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	92.6	833.4	0.0	833.4	0.0	833.4	0.0
Component Volume (m^3)									
0	0	0	0	0	0	0	0	0	0

Calculated Water Balance Components
Sand/Gravel/Rock Pits

Component Area (ha)	AET as Percent of RAIN+MELT	BF as Percent of INF	RO Coefficient
45.2	30.0	70.0	0.5

Rain (mm)	Snowmelt (mm)	Potential ET (mm)	Actual ET (mm)	Surplus (mm)	Infiltration (mm)	Streamflow (mm)	Baseflow (mm)	Runoff (mm)	DGWS (mm)
717.0	209.0	593.0	277.8	648.2	324.1	551.0	226.9	324.1	97.2
Component Volume (m^3)									
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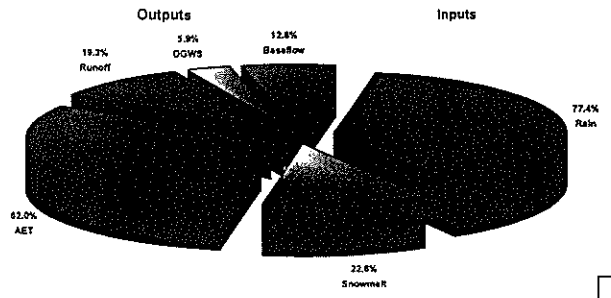
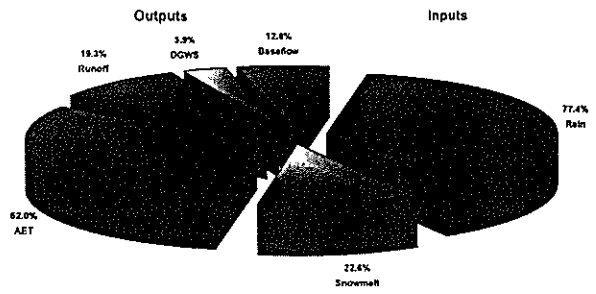
TOTAL VOLUME (m^3)									
8,500,292	2,477,770	7,030,228	6,808,422	4,169,640	2,046,440	3,523,409	1,400,209	2,123,200	646,232
TOTAL DEPTH (mm)									
717.0	209.0	593.0	574.3	351.7	172.6	297.2	118.1	179.1	54.5

INPUTS		OUTPUTS		
% Rain	% Melt	% AET	% BF	% RO	% DGWS
77.4	22.6	62.0	12.8	19.3	5.9

Willow Creek Existing Conditions Water Balance (Annual)
Midhurst Climate Data (1967 to 1992)



Willow Creek Future Conditions Water Balance (Annual)
Midhurst Climate Data (1967 to 1992)



GREENLAND

TOTAL AREA = 1,186 ha

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