Standard Operating Procedure for ArcGIS Impervious Cover Analysis

Table 2.4 Impervious Surface Area SOP and Tables

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STANDARD OPERATING PROCEDURE
GLRI
CURRENT IMPERVIOUS COVER PER SUB-BASIN

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DATE: JUNE 30, 2013

Problem: Determine the Current Impervious Cover for each sub-basin in the Niagara River Watershed

References:
- *NOAA Coastal Services Center Impervious Surface Analysis Tool (ISAT) for ArcGIS 10.x (Jan. 2013)*
- *A User's Guide to Watershed Planning in Maryland, CH4*

Step 1: Large areas of known "unbuildable land" are subtracted from the watershed area.

Datasets required:
- 2005 NOAA LULC
- Protected Lands layer previously created for the Niagara River watershed
- Niagara River watershed boundary

1. Use the ArcGIS erase tool to remove the Protected Land layers from the watershed boundary layer
2. Use the new layer with Spatial Analyst 'Extract by Mask' tool with the LULC layer to create a new LULC layer that has the protected lands layer removed from it.
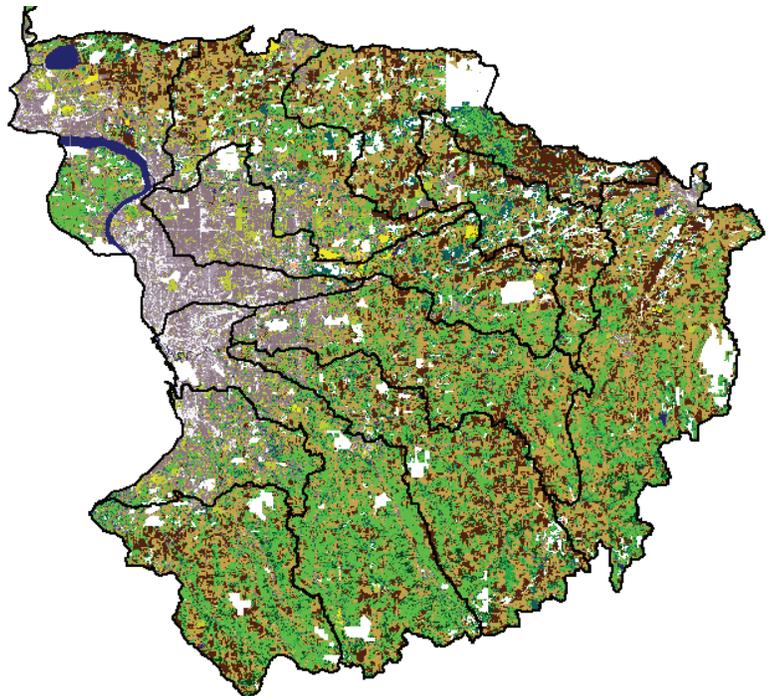
Step 2: The current land use distribution for the remaining buildable portions of the watershed are multiplied by impervious cover coefficients (ICC) to yield a provisional estimate of current IC.

3. The NOAA ISAT tool is used to calculate the percentage of impervious surface area within a user-specified area, and apply impervious surface coefficients to land cover data in its calculation.
Datasets required:

- USGS Hydrologic Units – sub-basin polygons of the Niagara River watershed
- NOAA 30m Land Use/Land Cover, 2005
- NOAA 30m Percent Developed Impervious Cover, 2005
- **Impervious Cover Coefficients**. *What is the Impervious Cover Coefficient? This number represents the percentage of land cover type that would be impervious in a HIGH, MEDIUM, and LOW population density area*
- Population statistics layer – U.S. Census Tracts 2010 population (http://www.census.gov/geo/maps-data/data/tiger-data.html)

4. ArcGIS 10x tool downloaded and used: NOAA ISAT for ArcGIS 10.x (http://www.csc.noaa.gov/digitalcoast/tools/isat)

5. Calculate the Impervious Cover Coefficient:
- First, calculate population density for the census tract data: population per square mile by census tract:
  - Create a 'MILES' field in the census tract attribute table
  - Use calculate geometry to calculate the area of each census tract
  - Create a numeric field called pop_dens
  - Use the Field Calculator to divide Total 2010 Population by MILES to calculate Population Density
    - i. Average 2010 Population in Niagara River Watershed: 4195 people/sq mile

- In the Properties-->Symbology tab, classify by Natural Breaks, in four classes to determine Low, Medium, and High populations:

  LOW population : < 1842
  MEDIUM population: 1843 9126
  HIGH populations: > 9126
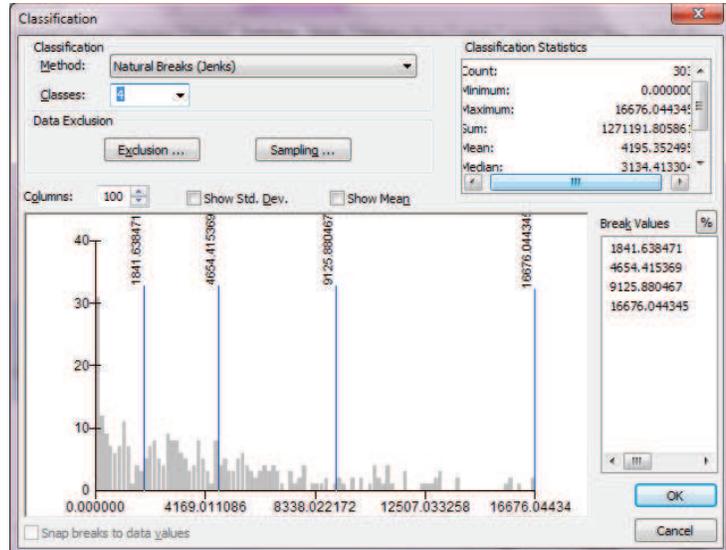
6. Following the tutorial, use the Spatial Analyst Zonal Statistics tool to determine the Mean percentage of impervious surface by land cover in High, Medium, and Low areas:

Value	LCName	High	Med	Low
0	Unclassified	0.00	0.00	0.00
2	Developed High Intensity	86.32	81.00	80.02
3	Developed Medium Intensity	62.78	56.92	56.16
4	Developed Low Intensity	31.06	27.63	27.32
5	Developed Open Space	10.17	11.69	12.11
6	Cultivated Crops	3.16	0.93	0.94
7	Pasture/Hay	1.74	0.98	1.01
8	Grassland/Herbaceous	2.50	2.67	2.70
9	Deciduous Forest	1.26	0.53	0.52
10	Evergreen Forest	5.77	0.55	0.44
11	Mixed Forest	2.67	0.69	0.66
12	Scrub/Shrub	1.99	0.90	0.92
13	Palustrine Forested Wetland	0.91	0.82	0.88
14	Palustrine Scrub/Shrub Wetland	4.12	3.87	4.00
15	Palustrine Emergent Wetland	5.56	3.31	3.36
19	Unconsolidated Shore	28.24	17.09	16.07
20	Bare Land	15.62	9.54	9.27
21	Open Water	0.77	1.23	1.32
22	Palustrine Aquatic Bed	9.17	7.81	8.21

Step 3: The contribution of impervious cover from existing freeways and limited access arterial roads is calculated based on their length and width, and incorporated into the IC estimate.

7. Generate a polygon layer of roads in the Niagara River Watershed
   - Datasets required:
     i. CSCIC Roads line layer of the watershed
     ii. FCC (Feature Class Code) in the attribute table denotes each record's road type. The FCC code descriptions can be found here: http://proximityone.com/tgrcfcc.htm
   - Determine the general width of each FCC road class in the project area.
     - Reference: "Highway Standards for Low-Volume Roads in NYS" 2009.
     - http://www.clrp.cornell.edu/PDF/Hwy_Standards_LVRNY_09-09.pdf
       i. MEDIANS : minimum width, 10ft
       ii. SHOULDERS: minimum width, 2ft per side
       iii. STANDARD LANE: minimum width, 12ft
   - Generate a buffer polygon layer for each FCC road class.   Use the Dissolve Type option of 'ALL' for each buffer.
   - Merge all resulting buffer layers (using the dissolve ALL option again) to create one polygon layer of road widths.

Road Classes in the Niagara River Watershed	Width (ft)
A11 Primary road with limited access or interstate highway, unseparated	52
A15 Primary road with limited access or interstate highway, separated	62
A21 Primary road without limited access, US highways, unseparated	52
A25 Primary road without limited access, US highways, separated	62
A31 Secondary and connecting road, state highways, unseparated	28
A35 Secondary and connecting road, state highways, separated	38
A40 Local, neighborhood, and rural road	28
A41 Local, neighborhood, and rural road, city street, unseparated	28
A42 Local, neighborhood, and rural road, city street, unseparated, in tunnel	28
A45 Local, neighborhood, and rural road, city street, separated	38
A51 Vehicular trail, road passable only by 4WD vehicle, unseparated	12
A54Vehicular trail	12
A60 Special road feature, major category used when the minor category could not be determined	28
A61 Cul-de-sac, the closed end of a road that forms a loop or turn-around	28
A62 Traffic circle, the portion of a road or intersection of roads forming a roundabout	28
A63 Access ramp, the portion of a road that forms a cloverleaf or limited-access interchange	28
A64 Service drive, the road or portion of a road that provides access to businesses, facilities, and rest	28
A70 Other thoroughfare, major category used when the minor category could not be determined	16
A71 Walkway or trail for pedestrians, usually unnamed	16
A72 Stairway, stepped road for pedestrians, usually unnamed	16
A73 Alley, road for service vehicles, usually unnamed, located at the rear of buildings and property	16
A74 Driveway or service road, usually privately owned and unnamed, used as access to residences,	16
A75 Roads as Other Thoroughfare	16

Step 4: The percentage of imperviousness is calculated for the watershed.

8. Page 11 of the Tutorial. Using a custom "ISAT with Change Scenarios" Tool, run an analysis on the land cover data using the HIGH Impervious Cover Coefficient AND with the polygon road file as the Polygon Layer in the Apply Change Scenarios dropdown.

9. Based on the results on the results of running the ISAT tool, a summary table entitled "CURRENT IMPERVIOUS COVER WITHIN EACH 2005 LAND USE / LAND COVER CLASS BY SUB-BASIN" was created.

Step 5: Sub-basin maps showing impervious cover are created

10. Two map series were created:

    a. DEVELOPED LAND
        i. 11 maps (one for each sub-basin) show developed land use/land cover, the roads using their polygon widths, and Census Tracts of High and Medium population densities

    b. CURRENT IMPERVIOUS

i. 11 maps (one for each sub-basin) show the land use/land cover class that most greatly impacts that watershed. The sub-basin's total % impervious cover and the land cover's contribution to the overall percentage are included.

Limitations/Variables

- High – Medium-Low population density values are chosen by the user. I used ArcGIS's Natural Breaks method, but these ranges can be changed.
- LULC data is from 2005, so impervious data is outdated.
- Road width data is generalized, based on each road's FCC code. Actually road widths will vary from the width assigned.

CURRENT IMPERVIOUS COVER WITHIN EACH 2005 LAND USE / LAND COVER CLASS BY SUB-BASIN
Niagara River Watershed
Current impervious cover based on Impervious Cover Coefficient calculation, using standard
operating procedure "CURRENT IMPERVIOUS COVER PER SUB-BASIN" dated June 30, 2013
Prepared by L. Matthies-Wiza for BNR, July 1, 2013

Wooded land and wetland categories are highlighted.
Records are sorted by LULC with the Highest Percentage of Current Impervious Cover

Land Use/Land Cover	Cayuga Creek Sub-Basin Acres	%	Impervious Cover Coefficient	Current Impervious Cover Acreage	Current Impervious Cover as Percentage of Total Sub-Basin Acreage
Developed, Low Intensity	6,777.69	8.33%	0.31	2105.15	2.59%
Developed, Medium Intensity	1,542.08	1.90%	0.63	968.12	1.19%
Developed, High Intensity	646.72	0.79%	0.86	558.25	0.69%
Pasture/Hay	22,420.70	27.55%	0.02	390.12	0.48%
Cultivated Crops	12,084.47	14.85%	0.03	381.87	0.47%
Deciduous Forest	23,756.85	29.20%	0.01	299.34	0.37%
Developed, Open Space	1,369.95	1.68%	0.10	139.32	0.17%
Evergreen Forest	1,706.66	2.10%	0.06	98.47	0.12%
Mixed Forest	3,254.08	4.00%	0.03	86.88	0.11%
Scrub/Shrub	2,279.10	2.80%	0.02	45.35	0.06%
Palustrine Forested Wetland	3,522.51	4.33%	0.01	32.05	0.04%
Grassland/Herbaceous	1,064.16	1.31%	0.03	26.60	0.03%
Bare Land	137.00	0.17%	0.16	21.40	0.03%
Palustrine Emergent Wetland	366.73	0.45%	0.06	20.39	0.03%
Palustrine Scrub/Shrub Wetland	211.94	0.26%	0.04	8.73	0.01%
Unconsolidated Shore	9.34	0.01%	0.28	2.64	0.00%
Open Water	215.06	0.26%	0.01	1.66	0.00%
Palustrine Aquatic Bed	3.34	0.00%	0.09	0.31	0.00%
TOTAL ACRES	**81,368.37**	**100.00%**		**5186.66**	**6.37%**

Land Use/Land Cover	Buffalo River Sub-Basin Acres	%	Impervious Cover Coefficient	Current Impervious Cover Acreage	Current Impervious Cover as Percentage of Total Sub-Basin Acreage
Developed, Medium Intensity	6,109.18	5.80%	0.63	3835.34	3.64%
Developed, High Intensity	4,390.07	4.17%	0.86	3789.51	3.60%
Developed, Low Intensity	9,198.46	8.73%	0.31	2857.04	2.71%
Deciduous Forest	39,197.25	37.20%	0.01	493.89	0.47%
Evergreen Forest	5,452.22	5.17%	0.06	314.59	0.30%
Developed, Open Space	3,001.44	2.85%	0.10	305.25	0.29%
Pasture/Hay	16,117.60	15.29%	0.02	280.45	0.27%
Cultivated Crops	7,550.52	7.16%	0.03	238.60	0.23%
Mixed Forest	4,972.96	4.72%	0.03	132.78	0.13%
Bare Land	394.53	0.37%	0.16	61.63	0.06%
Scrub/Shrub	2,783.27	2.64%	0.02	55.39	0.05%
Palustrine Emergent Wetland	674.30	0.64%	0.06	37.49	0.04%
Palustrine Forested Wetland	3,540.08	3.36%	0.01	32.21	0.03%
Grassland/Herbaceous	1,093.96	1.04%	0.03	27.35	0.03%
Palustrine Scrub/Shrub Wetland	299.34	0.28%	0.04	12.33	0.01%
Unconsolidated Shore	16.23	0.02%	0.28	4.58	0.00%
Open Water	586.01	0.56%	0.01	4.51	0.00%
Palustrine Aquatic Bed	4.00	0.00%	0.09	0.37	0.00%
TOTAL ACRES	**105,381.41**	**100.00%**		**12483.30**	**11.85%**

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Land Use/Land Cover	Eighteenmile Creek Sub-Basin		Impervious Cover Coefficient	Current Impervious Cover Acreage	Current Impervious Cover as Percentage of Total Sub-Basin Acreage
	Acres	%			
Developed, Low Intensity	2,434.55	3.17%	0.31	756.17	0.98%
Cultivated Crops	12,446.98	16.20%	0.03	393.32	0.51%
Deciduous Forest	28,334.17	36.87%	0.01	357.01	0.46%
Pasture/Hay	17,322.53	22.54%	0.02	301.41	0.39%
Evergreen Forest	4,189.02	5.45%	0.06	241.71	0.31%
Developed, Medium Intensity	325.36	0.42%	0.63	204.26	0.27%
Mixed Forest	4,457.90	5.80%	0.03	119.03	0.15%
Developed, Open Space	727.45	0.95%	0.10	73.98	0.10%
Developed, High Intensity	81.40	0.11%	0.86	70.26	0.09%
Scrub/Shrub	2,034.02	2.65%	0.02	40.48	0.05%
Palustrine Emergent Wetland	438.78	0.57%	0.06	24.40	0.03%
Grassland/Herbaceous	967.42	1.26%	0.03	24.19	0.03%
Palustrine Forested Wetland	2,557.76	3.33%	0.01	23.28	0.03%
Palustrine Scrub/Shrub Wetland	244.19	0.32%	0.04	10.06	0.01%
Bare Land	60.94	0.08%	0.16	9.52	0.01%
Unconsolidated Shore	11.79	0.02%	0.28	3.33	0.00%
Open Water	207.72	0.27%	0.01	1.60	0.00%
Palustrine Aquatic Bed	1.11	0.00%	0.09	0.10	0.00%
TOTAL ACRES	**76,843.08**	**100.00%**		**2654.10**	**3.45%**

Land Use/Land Cover	Murder Creek Sub-Basin		Impervious Cover Coefficient	Current Impervious Cover Acreage	Current Impervious Cover as Percentage of Total Sub-Basin Acreage
	Acres	%			
Developed, Low Intensity	1,515.84	3.25%	0.31	470.82	1.01%
Cultivated Crops	10,122.29	21.69%	0.03	319.86	0.69%
Pasture/Hay	13,546.27	29.03%	0.02	235.71	0.51%
Deciduous Forest	9,885.66	21.18%	0.01	124.56	0.27%
Developed, Medium Intensity	191.48	0.41%	0.63	120.21	0.26%
Palustrine Forested Wetland	7,119.96	15.26%	0.01	64.79	0.14%
Developed, Open Space	496.16	1.06%	0.10	50.46	0.11%
Developed, High Intensity	52.04	0.11%	0.86	44.92	0.10%
Mixed Forest	1,498.05	3.21%	0.03	40.00	0.09%
Evergreen Forest	457.69	0.98%	0.06	26.41	0.06%
Palustrine Scrub/Shrub Wetland	392.53	0.84%	0.04	16.17	0.03%
Scrub/Shrub	707.44	1.52%	0.02	14.08	0.03%
Palustrine Emergent Wetland	193.26	0.41%	0.06	10.75	0.02%
Grassland/Herbaceous	327.81	0.70%	0.03	8.20	0.02%
Bare Land	29.13	0.06%	0.16	4.55	0.01%
Unconsolidated Shore	4.00	0.01%	0.28	1.13	0.00%
Open Water	126.54	0.27%	0.01	0.97	0.00%
Palustrine Aquatic Bed	0.44	0.00%	0.09	0.04	0.00%
TOTAL ACRES	**46,666.59**	**100.00%**		**1553.63**	**3.33%**

Land Use/Land Cover	Ellicott Creek Sub-Basin		Impervious Cover Coefficient	Current Impervious Cover Acreage	Current Impervious Cover as Percentage of Total Sub-Basin Acreage
	Acres	%			
Developed, Low Intensity	16,882.19	21.97%	0.31	5243.61	6.82%
Developed, Medium Intensity	4,448.56	5.79%	0.63	2792.80	3.63%
Developed, High Intensity	1,965.52	2.56%	0.86	1696.64	2.21%
Developed, Open Space	5,498.70	7.16%	0.10	559.22	0.73%
Cultivated Crops	8,033.11	10.46%	0.03	253.85	0.33%
Pasture/Hay	11,338.78	14.76%	0.02	197.29	0.26%
Deciduous Forest	15,295.63	19.91%	0.01	192.72	0.25%
Bare Land	966.08	1.26%	0.16	150.90	0.20%
Palustrine Forested Wetland	7,544.07	9.82%	0.01	68.65	0.09%
Mixed Forest	1,673.07	2.18%	0.03	44.67	0.06%
Evergreen Forest	750.58	0.98%	0.06	43.31	0.06%
Palustrine Emergent Wetland	302.23	0.39%	0.06	16.80	0.02%
Grassland/Herbaceous	662.29	0.86%	0.03	16.56	0.02%
Palustrine Scrub/Shrub Wetland	338.26	0.44%	0.04	13.94	0.02%
Scrub/Shrub	672.97	0.88%	0.02	13.39	0.02%
Open Water	449.46	0.58%	0.01	3.46	0.00%
Unconsolidated Shore	8.01	0.01%	0.28	2.26	0.00%
Palustrine Aquatic Bed	2.00	0.00%	0.09	0.18	0.00%
TOTAL ACRES	**76,831.52**	**100.00%**		**11310.26**	**14.72%**

Land Use/Land Cover	Niagara River Sub-Basin Acres	%	Impervious Cover Coefficient	Current Impervious Cover Acreage	Current Impervious Cover as Percentage of Total Sub-Basin Acreage
Developed, Medium Intensity	13,558.73	13.19%	0.63	8512.17	8.28%
Developed, Low Intensity	23,786.20	23.13%	0.31	7387.99	7.19%
Developed, High Intensity	7,254.29	7.05%	0.86	6261.90	6.09%
Developed, Open Space	8,304.88	8.08%	0.10	844.61	0.82%
Cultivated Crops	7,929.48	7.71%	0.03	250.57	0.24%
Pasture/Hay	10,928.69	10.63%	0.02	190.16	0.18%
Deciduous Forest	14,916.89	14.51%	0.01	187.95	0.18%
Bare Land	575.56	0.56%	0.16	89.90	0.09%
Open Water	6,762.57	6.58%	0.01	52.07	0.05%
Palustrine Forested Wetland	4,855.76	4.72%	0.01	44.19	0.04%
Palustrine Scrub/Shrub Wetland	786.61	0.76%	0.04	32.41	0.03%
Palustrine Emergent Wetland	557.54	0.54%	0.06	31.00	0.03%
Scrub/Shrub	1,009.45	0.98%	0.02	20.09	0.02%
Grassland/Herbaceous	765.48	0.74%	0.03	19.14	0.02%
Mixed Forest	660.73	0.64%	0.03	17.64	0.02%
Evergreen Forest	139.22	0.14%	0.06	8.03	0.01%
Unconsolidated Shore	25.35	0.02%	0.28	7.16	0.01%
Palustrine Aquatic Bed	7.56	0.01%	0.09	0.69	0.00%
TOTAL ACRES	**102,824.99**	**100.00%**		**23957.67**	**23.30%**

Land Use/Land Cover	Buffalo Creek Sub-Basin Acres	%	Impervious Cover Coefficient	Current Impervious Cover Acreage	Current Impervious Cover as Percentage of Total Sub-Basin Acreage
Developed, Low Intensity	3,238.06	3.48%	0.31	1005.74	1.08%
Cultivated Crops	17,861.84	19.17%	0.03	564.43	0.61%
Pasture/Hay	25,370.99	27.23%	0.02	441.46	0.47%
Developed, Medium Intensity	548.42	0.59%	0.63	344.30	0.37%
Deciduous Forest	26,023.05	27.93%	0.01	327.89	0.35%
Evergreen Forest	4,412.75	4.74%	0.06	254.62	0.27%
Developed, High Intensity	198.60	0.21%	0.86	171.43	0.18%
Mixed Forest	5,799.38	6.22%	0.03	154.84	0.17%
Developed, Open Space	894.92	0.96%	0.10	91.01	0.10%
Scrub/Shrub	2,729.23	2.93%	0.02	54.31	0.06%
Palustrine Forested Wetland	4,184.13	4.49%	0.01	38.08	0.04%
Palustrine Emergent Wetland	539.75	0.58%	0.06	30.01	0.03%
Grassland/Herbaceous	876.68	0.94%	0.03	21.92	0.02%
Bare Land	58.71	0.06%	0.16	9.17	0.01%
Palustrine Scrub/Shrub Wetland	205.05	0.22%	0.04	8.45	0.01%
Unconsolidated Shore	13.12	0.01%	0.28	3.71	0.00%
Open Water	206.16	0.22%	0.01	1.59	0.00%
Palustrine Aquatic Bed	3.78	0.00%	0.09	0.35	0.00%
TOTAL ACRES	**93,164.61**	**100.00%**		**3523.30**	**3.78%**

Land Use/Land Cover	Smoke Creek Sub-Basin Acres	%	Impervious Cover Coefficient	Current Impervious Cover Acreage	Current Impervious Cover as Percentage of Total Sub-Basin Acreage
Developed, Low Intensity	9,711.52	24.57%	0.31	3016.40	7.63%
Developed, Medium Intensity	2,889.79	7.31%	0.63	1814.21	4.59%
Developed, High Intensity	1,833.42	4.64%	0.86	1582.61	4.00%
Developed, Open Space	3,752.46	9.49%	0.10	381.63	0.97%
Deciduous Forest	9,246.05	23.39%	0.01	116.50	0.29%
Pasture/Hay	4,512.38	11.42%	0.02	78.52	0.20%
Bare Land	265.32	0.67%	0.16	41.44	0.10%
Cultivated Crops	1,101.52	2.79%	0.03	34.81	0.09%
Evergreen Forest	594.02	1.50%	0.06	34.27	0.09%
Mixed Forest	1,215.61	3.08%	0.03	32.46	0.08%
Palustrine Forested Wetland	2,368.50	5.99%	0.01	21.55	0.05%
Grassland/Herbaceous	700.32	1.77%	0.03	17.51	0.04%
Palustrine Emergent Wetland	311.57	0.79%	0.06	17.32	0.04%
Palustrine Scrub/Shrub Wetland	314.24	0.79%	0.04	12.95	0.03%
Scrub/Shrub	530.41	1.34%	0.02	10.56	0.03%
Unconsolidated Shore	12.68	0.03%	0.28	3.58	0.01%
Open Water	162.35	0.41%	0.01	1.25	0.00%
Palustrine Aquatic Bed	7.78	0.02%	0.09	0.71	0.00%
TOTAL ACRES	**39,529.96**	**100.00%**		**7218.27**	**18.26%**

Land Use/Land Cover	Upper Tonawanda Sub-Basin		Impervious Cover Coefficient	Current Impervious Cover Acreage	Current Impervious Cover as Percentage of Total Sub-Basin Acreage
	Acres	%			
Developed, Low Intensity	2,847.09	2.24%	0.31	884.31	0.69%
Pasture/Hay	41,338.69	32.48%	0.02	719.29	0.57%
Cultivated Crops	22,733.17	17.86%	0.03	718.37	0.56%
Developed, Medium Intensity	704.32	0.55%	0.63	442.17	0.35%
Deciduous Forest	32,159.80	25.27%	0.01	405.21	0.32%
Developed, High Intensity	314.47	0.25%	0.86	271.45	0.21%
Mixed Forest	7,939.26	6.24%	0.03	211.98	0.17%
Evergreen Forest	2,638.49	2.07%	0.06	152.24	0.12%
Scrub/Shrub	7,137.31	5.61%	0.02	142.03	0.11%
Developed, Open Space	738.13	0.58%	0.10	75.07	0.06%
Palustrine Forested Wetland	5,491.81	4.32%	0.01	49.98	0.04%
Palustrine Emergent Wetland	657.40	0.52%	0.06	36.55	0.03%
Bare Land	184.14	0.14%	0.16	28.76	0.02%
Grassland/Herbaceous	1,107.75	0.87%	0.03	27.69	0.02%
Palustrine Scrub/Shrub Wetland	505.73	0.40%	0.04	20.84	0.02%
Open Water	740.80	0.58%	0.01	5.70	0.00%
Palustrine Aquatic Bed	14.01	0.01%	0.09	1.28	0.00%
Unconsolidated Shore	4.23	0.00%	0.28	1.19	0.00%
TOTAL ACRES	**127,256.58**	**100.00%**		**4194.12**	**3.30%**

Land Use/Land Cover	Middle Tonawanda Sub-Basin		Impervious Cover Coefficient	Current Impervious Cover Acreage	Current Impervious Cover as Percentage of Total Sub-Basin Acreage
	Acres	%			
Developed, Low Intensity	2,791.94	3.53%	0.31	867.18	1.10%
Cultivated Crops	21,244.68	26.86%	0.03	671.33	0.85%
Pasture/Hay	21,571.38	27.27%	0.02	375.34	0.47%
Deciduous Forest	15,999.28	20.23%	0.01	201.59	0.25%
Developed, Medium Intensity	259.31	0.33%	0.63	162.80	0.21%
Palustrine Emergent Wetland	2,168.57	2.74%	0.06	120.57	0.15%
Palustrine Forested Wetland	10,327.56	13.06%	0.01	93.98	0.12%
Developed, Open Space	573.11	0.72%	0.10	58.29	0.07%
Mixed Forest	1,316.13	1.66%	0.03	35.14	0.04%
Developed, High Intensity	35.14	0.04%	0.86	30.33	0.04%
Palustrine Scrub/Shrub Wetland	520.18	0.66%	0.04	21.43	0.03%
Evergreen Forest	332.03	0.42%	0.06	19.16	0.02%
Scrub/Shrub	660.51	0.84%	0.02	13.14	0.02%
Grassland/Herbaceous	359.17	0.45%	0.03	8.98	0.01%
Bare Land	46.93	0.06%	0.16	7.33	0.01%
Open Water	887.80	1.12%	0.01	6.84	0.01%
Unconsolidated Shore	4.00	0.01%	0.28	1.13	0.00%
Palustrine Aquatic Bed	0.22	0.00%	0.09	0.02	0.00%
TOTAL ACRES	**79,097.94**	**100.00%**		**2694.58**	**3.41%**

Land Use/Land Cover	Lower Tonawanda Sub-Basin		Impervious Cover Coefficient	Current Impervious Cover Acreage	Current Impervious Cover as Percentage of Total Sub-Basin Acreage
	Acres	%			
Developed, Low Intensity	10,101.38	12.82%	0.31	3137.49	3.98%
Developed, Medium Intensity	1,764.70	2.24%	0.63	1107.88	1.41%
Developed, Open Space	4,830.85	6.13%	0.10	491.30	0.62%
Developed, High Intensity	563.55	0.72%	0.86	486.45	0.62%
Cultivated Crops	11,693.50	14.84%	0.03	369.51	0.47%
Pasture/Hay	19,156.17	24.31%	0.02	333.32	0.42%
Bare Land	1,721.56	2.18%	0.16	268.91	0.34%
Deciduous Forest	16,102.03	20.43%	0.01	202.89	0.26%
Palustrine Forested Wetland	7,951.72	10.09%	0.01	72.36	0.09%
Mixed Forest	1,200.93	1.52%	0.03	32.06	0.04%
Palustrine Scrub/Shrub Wetland	654.73	0.83%	0.04	26.97	0.03%
Evergreen Forest	387.41	0.49%	0.06	22.35	0.03%
Grassland/Herbaceous	888.69	1.13%	0.03	22.22	0.03%
Palustrine Emergent Wetland	358.94	0.46%	0.06	19.96	0.03%
Scrub/Shrub	828.86	1.05%	0.02	16.49	0.02%
Open Water	577.78	0.73%	0.01	4.45	0.01%
Unconsolidated Shore	14.01	0.02%	0.28	3.96	0.01%
Palustrine Aquatic Bed	1.33	0.00%	0.09	0.12	0.00%
TOTAL ACRES	**78,798.15**	**100.00%**		**6618.70**	**8.40%**

Land Use/Land Cover	TOTAL WATERSHED		Impervious Cover Coefficient	Current Impervious Cover Acreage	Current Impervious Cover as Percentage of Total Sub-Basin Acreage
	Acres	%			
Developed, Low Intensity	89,284.94	9.84%	0.31	27731.90	3.05%
Developed, Medium Intensity	32,341.94	3.56%	0.63	20304.27	2.24%
Developed, High Intensity	17,335.21	1.91%	0.86	14963.75	1.65%
Cultivated Crops	132,801.54	14.63%	0.03	4196.53	0.46%
Pasture/Hay	203,624.18	22.43%	0.02	3543.06	0.39%
Developed, Open Space	30,188.05	3.33%	0.10	3070.12	0.34%
Deciduous Forest	230,916.66	25.44%	0.01	2909.55	0.32%
Evergreen Forest	21,060.09	2.32%	0.06	1215.17	0.13%
Mixed Forest	33,988.11	3.74%	0.03	907.48	0.10%
Bare Land	4,439.88	0.49%	0.16	693.51	0.08%
Palustrine Forested Wetland	59,463.84	6.55%	0.01	541.12	0.06%
Scrub/Shrub	21,372.56	2.35%	0.02	425.31	0.05%
Palustrine Emergent Wetland	6,569.09	0.72%	0.06	365.24	0.04%
Grassland/Herbaceous	8,813.72	0.97%	0.03	220.34	0.02%
Palustrine Scrub/Shrub Wetland	4,472.80	0.49%	0.04	184.28	0.02%
Open Water	10,922.24	1.20%	0.01	84.10	0.01%
Unconsolidated Shore	122.76	0.01%	0.28	34.67	0.00%
Palustrine Aquatic Bed	45.59	0.01%	0.09	4.18	0.00%
TOTAL ACRES	907,763.20	100.00%		81394.60	8.97%