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Developing 2010 Impervious Surface Estimates for the Piscataque Region Estuaries Partnership Towns

David G. Justice
University of New Hampshire - Main Campus, david.justice@unh.edu

Fay A. Rubin
University of New Hampshire - Main Campus, Fay.Rubin@unh.edu

DEVELOPING 2010 IMPERVIOUS SURFACE ESTIMATES FOR THE PISCATAQUA REGION ESTUARIES PARTNERSHIP TOWNS

A Final Report to

The Piscataqua Region Estuaries Partnership

Submitted by

David Justice and Fay Rubin
Complex Systems Research Center
Institute for the Study of Earth, Oceans and Space
Morse Hall
University of New Hampshire, Durham, NH 03824

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Project Summary

Estimates of impervious surface acreage for 2010 were generated for the 59-town region covered by the Piscataqua Region Estuaries Partnership (PREP). The project extended previous work done in the region for the years 1990, 2000, and 2005 and relied on the same satellite-based data sources and image processing methodologies. As a result, standardized impervious surface estimates are now available for a 20-year time period in the PREP region.

The current project mapped impervious surfaces (buildings, pavement, etc.) based on a Landsat 5 Thematic Mapper (TM) image acquired on April 24, 2010. Processing used both traditional and sub-pixel image classification techniques, as described in previous efforts (see Justice and Rubin, 2006 and Justice and Rubin 2003 for a complete processing description). The current study utilized comparable satellite imagery, and applied consistent techniques to map the PREP area for 2010.

It should be noted that since the completion of the 2005 project, the U.S. Geological Survey (USGS) has modified its image offerings and now only serves TM data resampled using cubic convolution techniques. (Resampling algorithms are applied as part of the image registration processing, and describe the way output values are assigned to individual image pixels.) This is an important consideration because our previous sub-pixel classifications were conducted on data sets processed using nearest neighbor resampling (which is the recommended approach). While the classification process can be completed using data resampled using alternative techniques, the results may not be as reliable. Since the three previous data sets (1990, 2000, and 2005) were developed using images processed using the preferred nearest neighbor method, and because it is unlikely that features would revert from impervious to non-impervious status, we opted to use the 2005 impervious surface raster as the starting point for the current iteration. Accordingly, the 2005 impervious surface data was used to mask the 2010 TM image with any remaining, unmasked pixels classified using the techniques described in the documents referenced above.

A second departure from previous processing streams is that the TM data is now delivered as a georeferenced, terrain-corrected file. This eliminated the requirement for GRANIT to perform these steps locally.

The data set has been archived in the GRANIT GIS clearinghouse, thereby making it available to the coastal resource community as well as the general public. The data are appropriate for watershed and subwatershed level characterizations. Users are discouraged from accessing them to support larger scale mapping and applications.

Results and Discussion

The primary results of this project are 2010 impervious surface estimates for the towns in the Piscataqua Region Estuaries Partnership (Figure 1). Figures 2 thru 9 show both small-scale and large-scale illustrations of mapped impervious surface features for the study area. These figures (and especially the large-scale images) show evidence of new housing subdivisions and other development in 2000, 2005, and 2010 relative to the 1990 baseline data.

Tables 1 - 4 summarize these results by subwatershed, reporting acreages at 3 levels (low-range, mid-range, and high-range) for each reporting unit. As noted in prior reports, the subpixel classification reports results within percent impervious ranges. To convert the ranges to discrete acreage estimates, the low, mid and high points of each range were selected. All further discussion in this document utilizes the estimate derived from the midpoint of the range.

Note: The version of the subwatershed boundary data used to generate acreage summaries for this report was made available by the NH Department of Environmental Services in the spring of 2011. Because the subwatershed boundaries have changed since prior reports, all acreages in Tables 1-4 were regenerated based on the new delineations and may differ from those reported in prior impervious surface project reports.

Table 1 reveals that 40,277 acres, or 4.1% of the land surface area in the 73 subwatersheds, were estimated to be impervious in 1990. By the year 2000, Table 2 reports that the acreage had increased to 60,028 acres (6.1%), a marked increase of 19,751 acres. This represents a 2% increase in impervious surface coverage over the ten-year period (see Table 5). By 2005, the impervious area was estimated at 70,666 acres, an additional 1.1% from that of 2000. In the current time step (2010), impervious surface estimates have increased to 88,870 acres or 9.0% of the land area in the 59-town study area. In comparison to the rate of increase between 2000 and 2005 (1.1%), the 2005 – 2010 percent increase was larger, at 1.8% (see Table 5).

At the subwatershed level, the Portsmouth Harbor unit recorded the highest percentage of impervious surface acreage (by land area) in 2010 with 25.9% coverage (6,592 acres). The second largest percentage was the Hampton Harbor unit, 24.6% (2,980 acres) while the third largest unit was Cocheco River unit estimated at 19.8% (3,115 acres). As would be expected, the rural subwatersheds such as Branch Brook exhibited the lowest amounts of impervious surface area.

Tables 6 and 7 report on impervious surface acreage by state and town within the project area, for each of the 4 reporting intervals (1990, 2000, 2005, and 2010).

Associated with satellite image based mapping, error matrices are used to report the approximate accuracy of the results. Typically, the matrix presents classified data results (e.g. derived from image processing) relative to reference data (e.g. data acquired via field visits or from some other source of known reliability). While the assessments for this project utilized the standard assessment technique, the methodology cannot fully characterize the reliability of our results because the impervious surface pixels were mapped on a percentage basis. The accuracy assessment only evaluated the presence/absence of imperviousness at a given site, not the percentage impervious.

With this caveat, error matrices are presented in Table 8. The table shows an overall accuracy for this time step of 95.5%. A User's Accuracy of 93.0% and 98.0% was achieved for Impervious and Non impervious features. Likewise, percentages of 97.9% and 93.3% resulted for the Producer's accuracy (Impervious and Non impervious). By constraining our accuracy assessment selection technique, the site selections were probably

biased in favor of those areas that are most easily mapped (e.g. large parking lots, buildings, and residential subdivisions rather than single houses and isolated features). Nevertheless, the assessments provide a general estimate of the data reliability.

Figure 1. Project area.

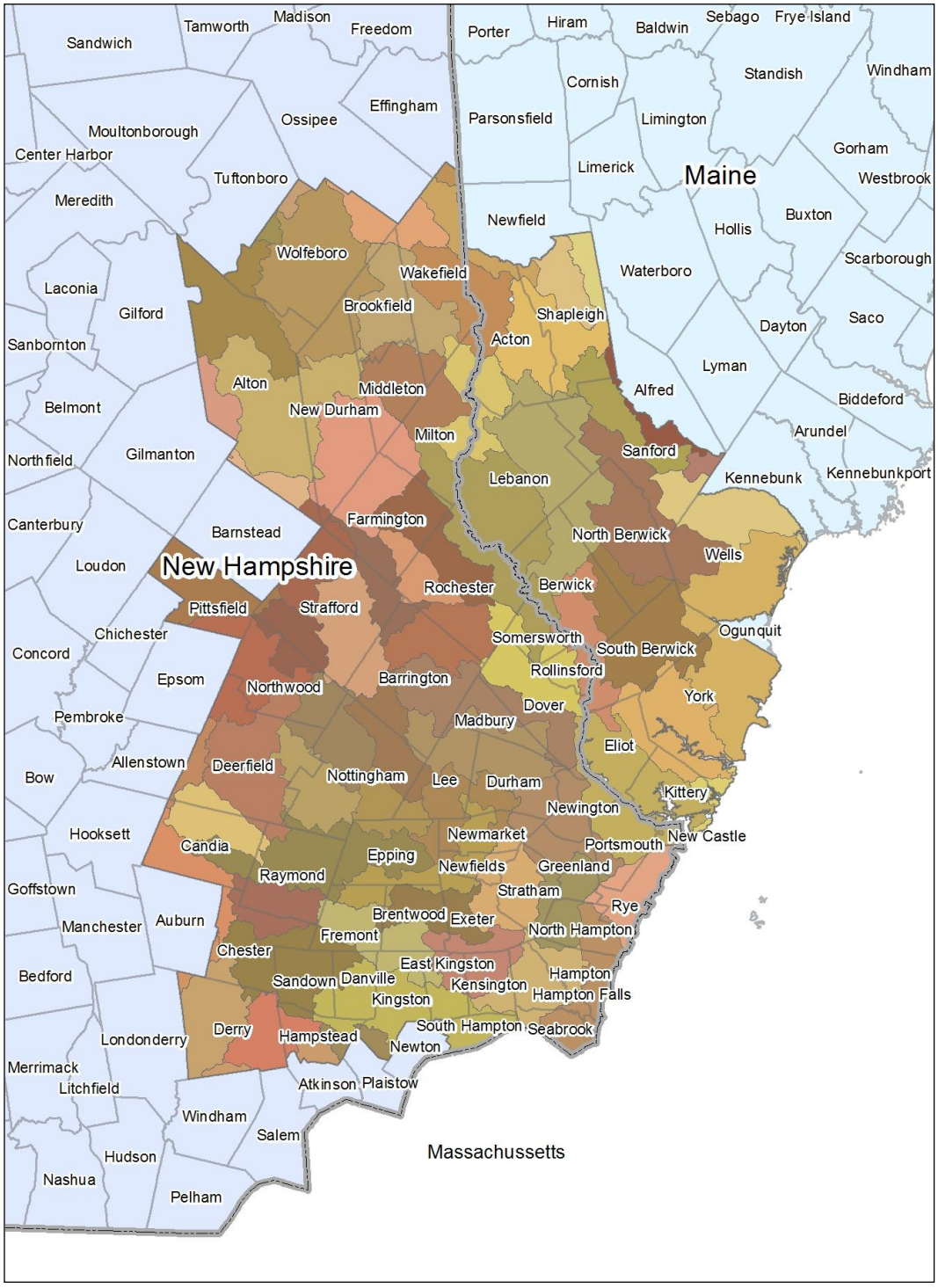

Figure 2. Regional mapping of impervious surfaces, 1990. Impervious surface features are shown in red, and are displayed on the 12-digit watershed units.

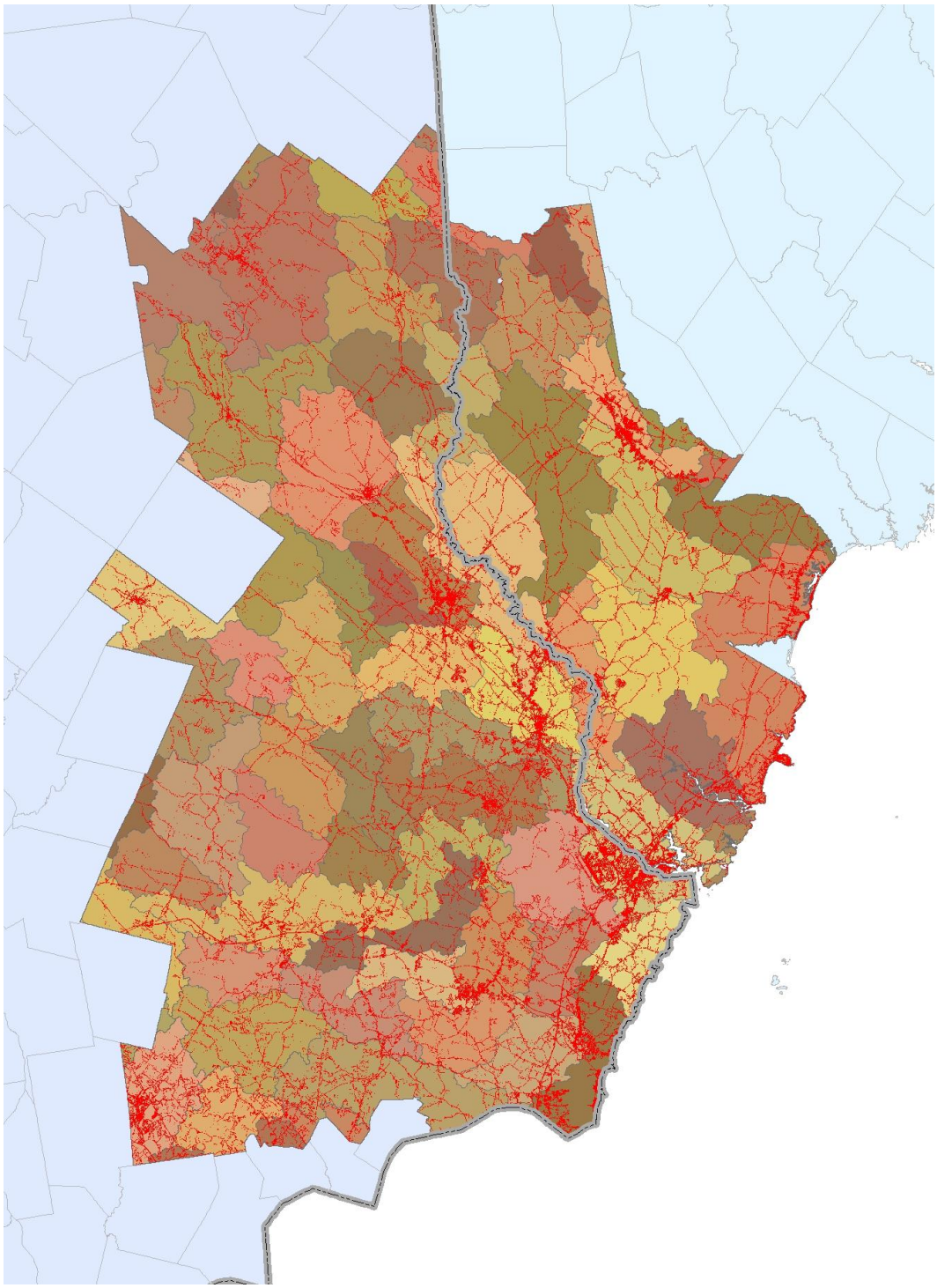

Figure 3. Regional mapping of impervious surfaces, 2000. Impervious surface features are shown in red, and are displayed on the 12-digit watershed units.

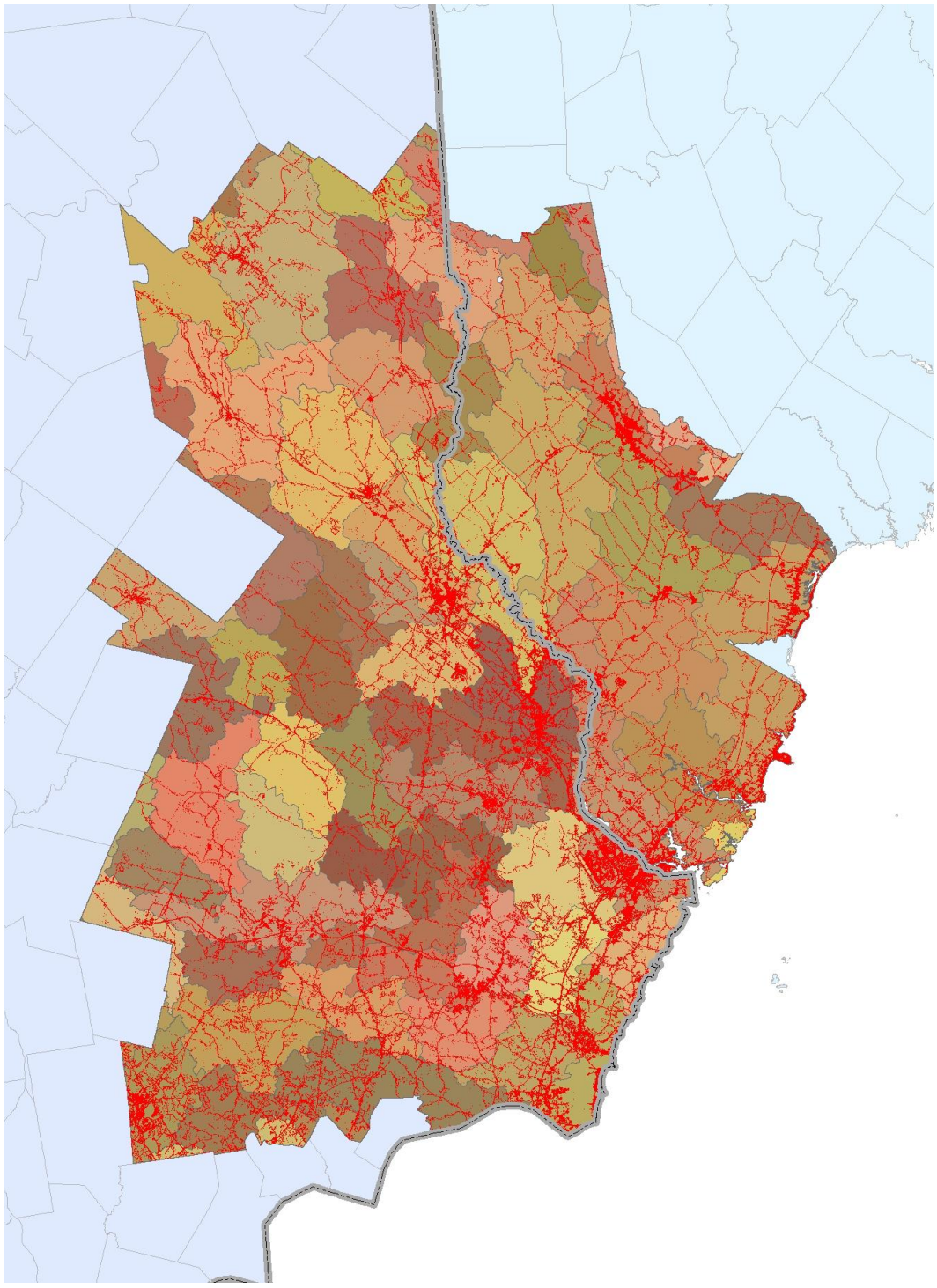

Figure 4. Regional mapping of impervious surfaces, 2005. Impervious surface features are shown in red, and are displayed on the 12-digit watershed units.

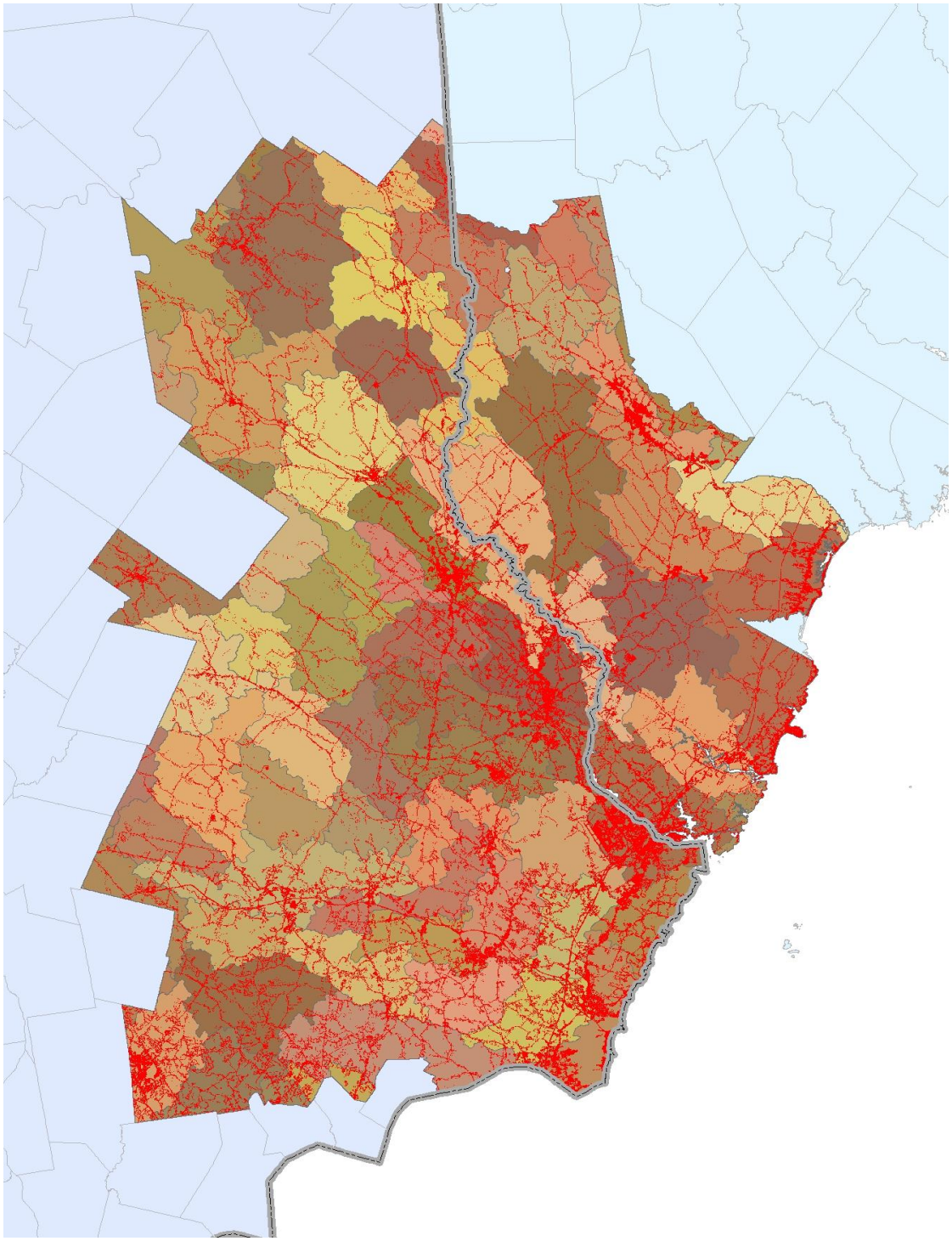

Figure 5. Regional mapping of impervious surfaces, 2010. Impervious surface features are shown in red, and are displayed on the 12-digit watershed units.

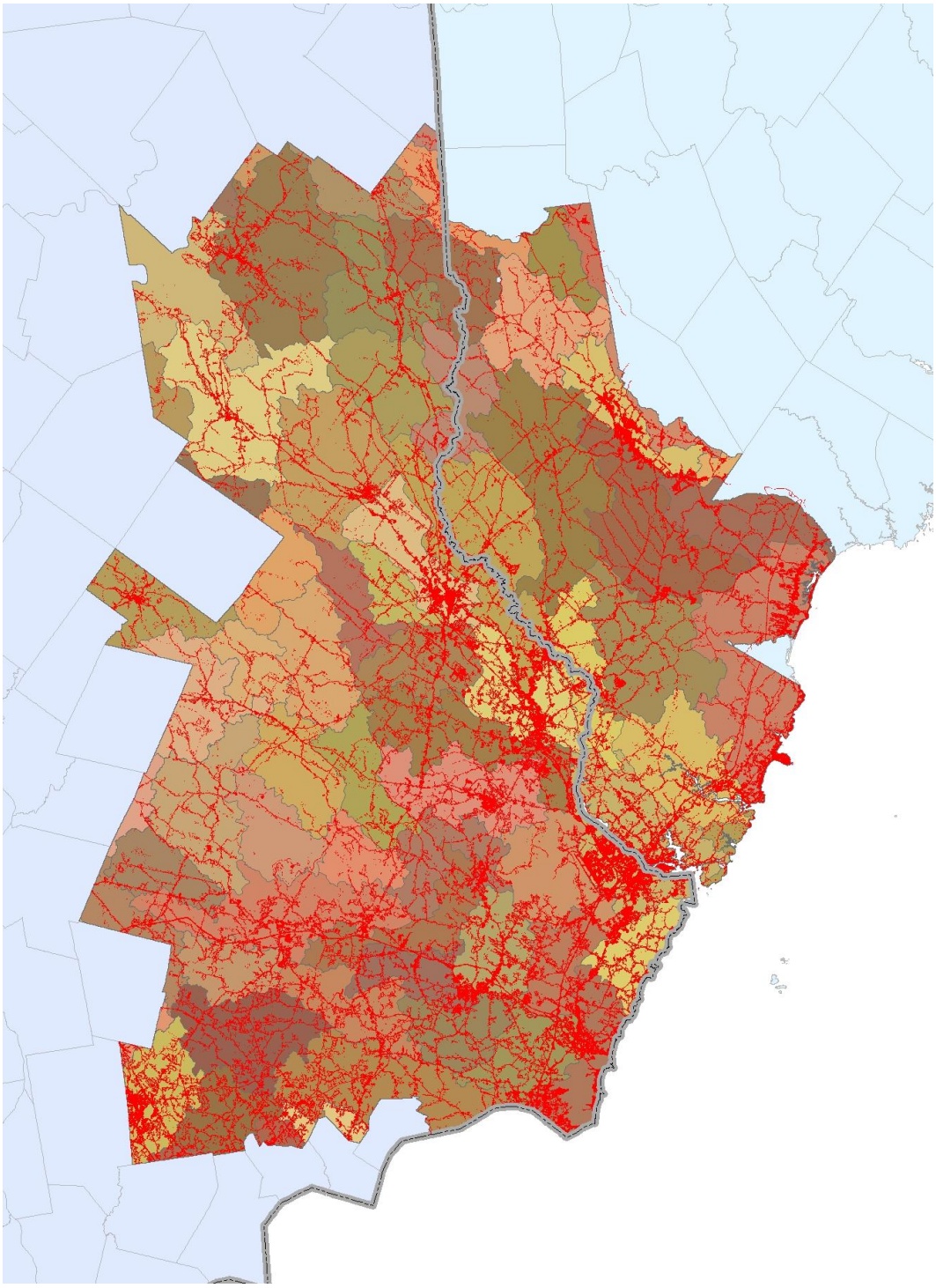

Figure 6. Regional mapping of impervious surfaces, 1990, for the York, ME vicinity.

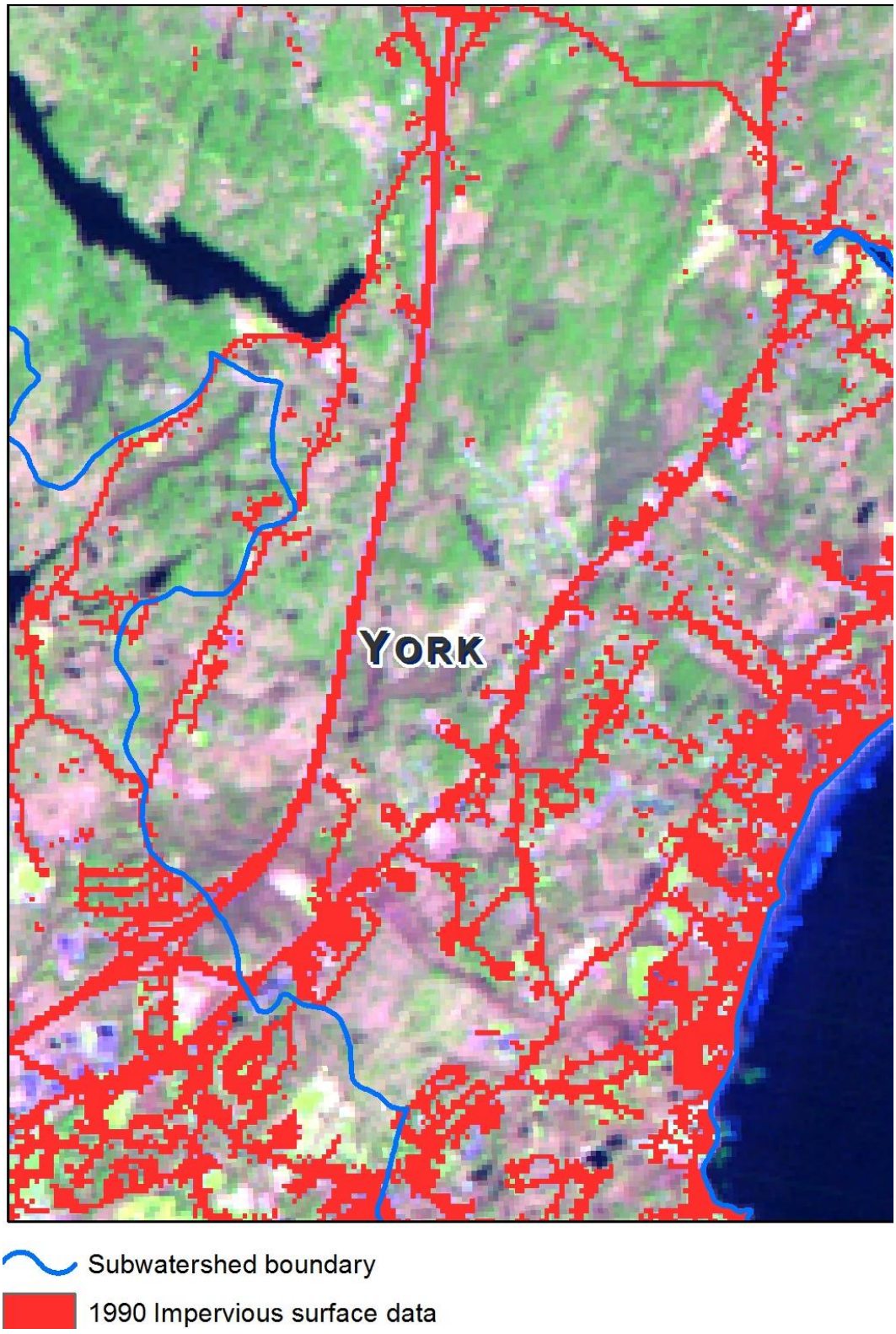

Figure 7. Regional mapping of impervious surfaces, 2000 for the York, ME vicinity.

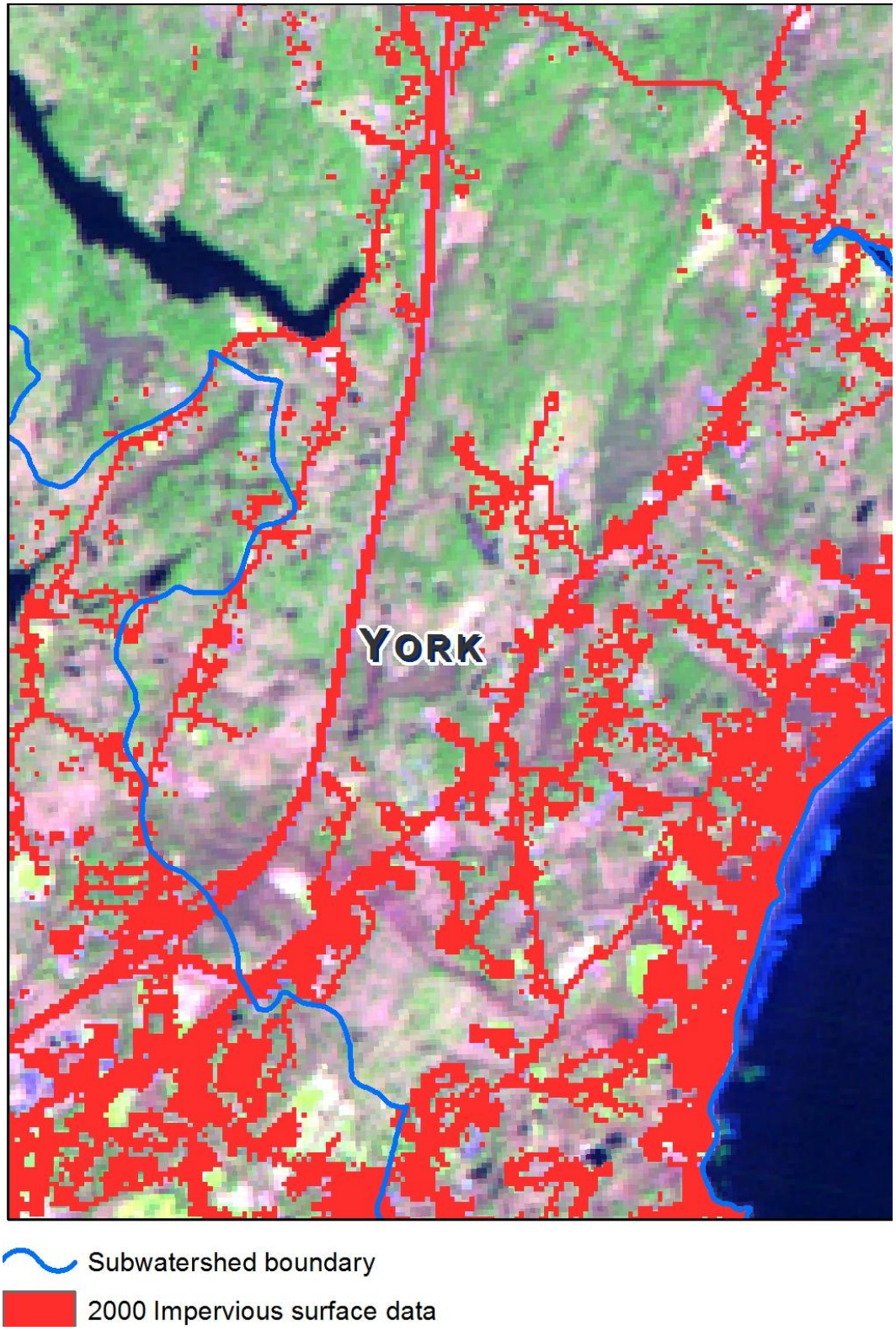

Figure 8. Regional mapping of impervious surfaces, 2005, for the York, ME vicinity.

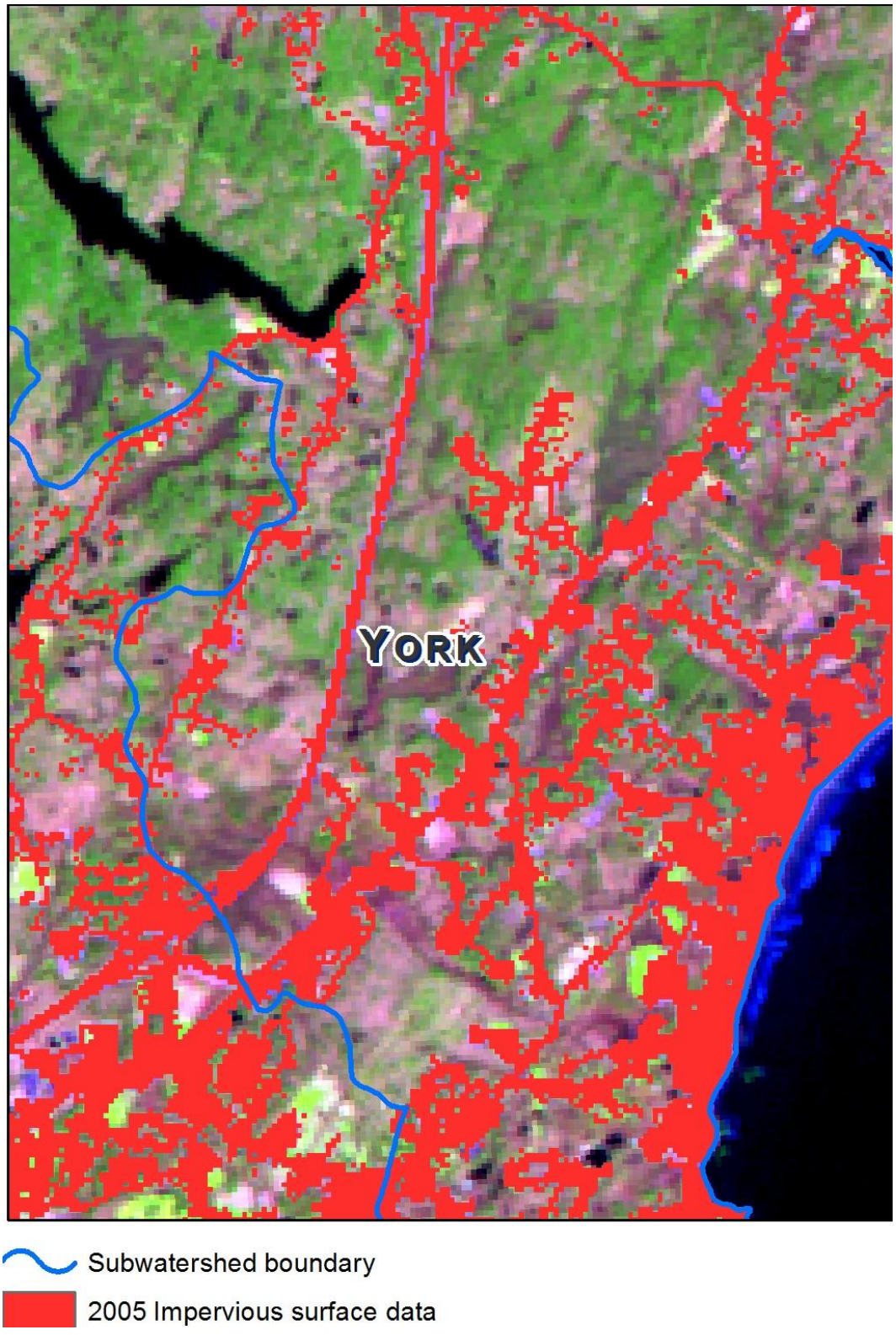

Figure 9. Regional mapping of impervious surfaces, 2005, for the York, ME vicinity.

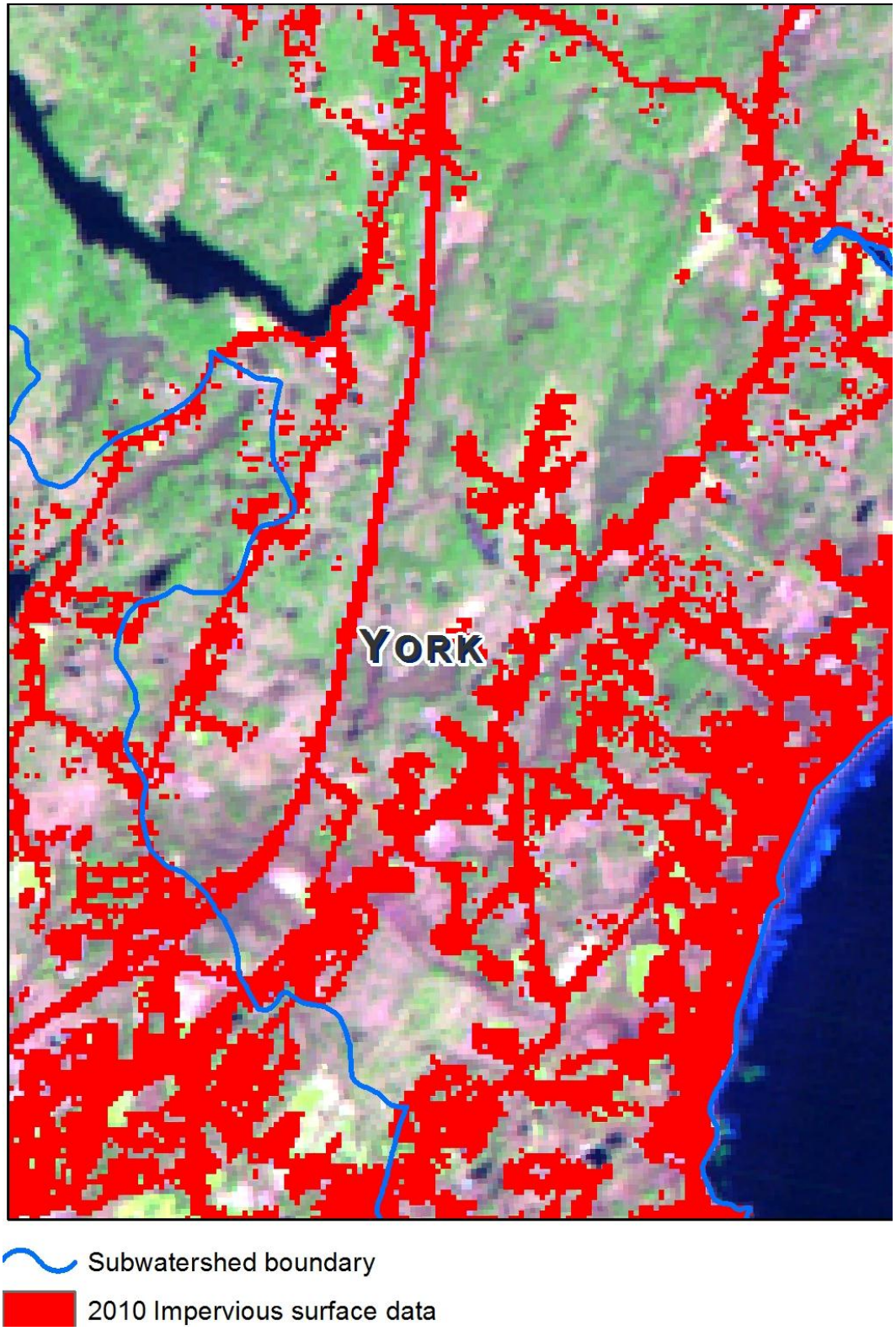

Table 1. Impervious surface acreage and total acreage by subwatershed, 1990.

12-Digit HUC Subwatershed Name	Impervious Acreage - 1990						Total Acres			
	Low Range	% Land Area	Mid Range	% Land Area	High Range	% Land Area	Mapped Area	Surface Water	Land Area	Total Watershed
Alton Bay	551	1.9	697	2.4	767	2.6	32,179	3,164.6	29,014	32,253
Arlington Mill Reservoir-Spickett River	493	4.5	604	5.5	661	6.1	11,568	655.0	10,913	14,687
Axe Handle Brook	179	2.5	217	3.1	237	3.4	7,441	368.7	7,072	7,441
Balch Pond-Shapleigh Pond	183	2.6	223	3.2	245	3.5	7,722	765.1	6,957	13,911
Bauneg Beg Pond-Great Works River	668	2.9	818	3.5	896	3.9	23,472	392.6	23,079	23,472
Bean River-North River	200	1.4	256	1.7	282	1.9	14,960	276.0	14,684	14,960
Beech River	12	1.0	15	1.1	16	1.2	1,439	145.1	1,294	12,827
Bellamy River	959	4.7	1,147	5.6	1,247	6.1	21,670	1,261.5	20,408	21,670
Berrys Brook-Rye Harbor	724	7.0	843	8.2	910	8.8	10,636	346.0	10,290	10,641
Berrys River	117	1.2	145	1.5	160	1.7	10,019	351.3	9,667	10,019
Big River	71	0.7	85	0.8	93	0.9	10,906	222.2	10,684	18,571
Bow Lake Headwaters Isinglass River	87	1.1	119	1.5	132	1.7	9,014	1,239.6	7,775	9,014
Branch Brook-Merriland River	384	2.3	480	2.8	525	3.1	17,105	64.4	17,040	20,044
Branch River	272	1.6	333	1.9	363	2.1	17,565	233.8	17,331	17,565
Brave Boat Harbor	46	1.7	60	2.2	66	2.5	2,664	9.5	2,655	2,780
Cocheco River	1,306	8.3	1,506	9.6	1,622	10.3	16,191	424.0	15,767	16,191
Cohas Brook	46	4.6	54	5.4	59	5.9	990	0.4	989	14,771
Day Brook-Mousam River	47	2.5	64	3.4	72	3.8	1,909	34.7	1,874	12,114
Estes Lake	92	2.3	122	3.0	136	3.4	4,218	182.6	4,035	19,154
Great Bay	721	5.8	840	6.8	907	7.3	18,496	6,124.0	12,372	18,496
Great Brook-Exeter River	398	3.2	494	4.0	540	4.4	12,452	173.9	12,278	12,452
Great Works River-Leighs Mill Pond	503	1.6	669	2.1	743	2.3	32,094	269.8	31,824	32,094
Hampton Harbor	1,340	11.1	1,533	12.7	1,642	13.5	14,366	2,247.0	12,119	19,737
Headwaters Beaver Brook	1,089	7.5	1,308	9.0	1,423	9.8	14,848	291.6	14,557	35,031
Headwaters Branch River	312	1.8	403	2.3	443	2.5	18,301	838.7	17,463	18,301
Headwaters Cocheco River	558	2.1	691	2.6	757	2.8	27,475	515.4	26,959	27,475
Headwaters Exeter River	490	2.4	630	3.1	694	3.4	20,755	201.3	20,553	20,755
Headwaters Lamprey River	291	1.3	373	1.7	409	1.9	21,977	208.6	21,768	21,977
Headwaters Salmon Falls River	204	1.3	266	1.8	297	2.0	17,698	2,554.5	15,143	17,699
Henderson Brook	67	1.7	89	2.3	98	2.5	4,069	182.2	3,887	13,057
Isinglass River	378	3.7	445	4.4	484	4.8	10,619	438.0	10,181	10,619
Lamprey River	443	3.4	539	4.1	590	4.5	13,544	412.3	13,132	13,544
Little River (Maine)	337	1.0	475	1.4	531	1.5	34,874	165.8	34,708	34,874
Little River (New Hampshire)	198	5.7	229	6.6	249	7.2	3,495	32.8	3,463	18,646
Little River-Exeter River	490	5.0	570	5.8	615	6.2	9,884	39.5	9,844	9,884
Little River-Lamprey River	229	1.8	289	2.3	317	2.5	13,117	360.4	12,756	13,117
Little Suncook River	266	2.0	334	2.5	368	2.7	15,279	1,696.6	13,582	25,408
Lower Salmon Falls River	535	4.0	665	5.0	727	5.5	13,612	378.7	13,233	13,800
Massabesic Lake	0	0.0	0	0.0	0	0.0	21	0.0	21	11,044
Middle Salmon Falls River	1,306	3.5	1,606	4.3	1,750	4.7	38,136	775.0	37,361	38,143
Moultonborough Bay	7	0.5	9	0.7	10	0.8	1,266	0.0	1,266	29,745
Mousam Lake	257	1.5	334	2.0	371	2.2	19,036	2,052.8	16,983	19,048

Table 2 (cont.). Impervious surface acreage and total acreage by subwatershed, 1990.

12-Digit HUC Subwatershed Name	Impervious Acreage - 1990						Total Acres			
	Low Range	% Land Area	Mid Range	% Land Area	High Range	% Land Area	Mapped Area	Surface Water	Land Area	Total Watershed
Nippo Brook-Isinglass River	211	1.2	262	1.5	288	1.7	17,483	274.3	17,208	17,483
North Branch River	202	1.9	248	2.3	271	2.5	11,055	146.2	10,909	11,055
North River	124	1.4	158	1.8	174	2.0	8,675	62.7	8,612	8,675
Number One Pond-Mousam River	753	6.4	889	7.5	962	8.2	12,190	384.2	11,806	12,225
Oyster River	787	4.1	959	5.0	1,050	5.5	19,616	536.9	19,079	19,616
Pawtuckaway Pond	87	0.7	111	0.9	122	1.0	13,039	922.8	12,117	13,039
Pawtuckaway River-Lamprey River	1,034	4.0	1,231	4.8	1,339	5.2	26,175	625.3	25,550	26,175
Perry Brook-Suncook River	318	2.5	382	3.0	415	3.3	13,101	369.2	12,732	34,279
Pine River	154	1.7	191	2.2	211	2.4	9,441	603.4	8,837	35,664
Piscassic River	418	2.9	509	3.6	556	3.9	14,378	102.7	14,275	14,378
Pokamoonshine Brook-Cocheco River	1,405	7.1	1,642	8.3	1,770	8.9	20,318	433.3	19,884	20,318
Portsmouth Harbor	3,008	11.8	3,524	13.9	3,801	14.9	27,922	2,479.3	25,443	30,548
Powwow River	898	3.7	1,096	4.5	1,198	4.9	25,807	1,413.0	24,394	37,966
Rock Haven Lake-Little Ossipee River	69	0.9	92	1.1	102	1.3	8,173	80.8	8,092	30,175
South River	15	2.2	20	3.0	23	3.3	1,058	378.5	680	20,121
Spickett River	173	5.6	206	6.7	225	7.3	3,115	41.6	3,074	35,108
Spruce Swamp-Exeter River	542	3.8	650	4.6	708	5.0	14,403	182.1	14,221	14,403
Squamscott River	768	6.1	904	7.1	978	7.7	13,199	544.0	12,655	13,199
Stevens Brook-Cape Neddick River	1,598	4.3	1,935	5.3	2,106	5.7	37,000	258.6	36,741	40,179
Sucker Brook	199	2.3	233	2.7	255	3.0	8,729	159.9	8,569	18,834
Suncook Lakes-Suncook River	69	0.9	90	1.1	99	1.2	8,569	478.4	8,091	45,314
Suncook River	22	0.7	30	1.0	34	1.1	3,148	7.1	3,141	40,121
Taylor River-Hampton River	1,003	7.0	1,170	8.1	1,263	8.8	14,726	336.8	14,390	14,726
The Broads	260	2.5	326	3.1	361	3.4	21,646	11,192.8	10,453	39,157
Upper Salmon Falls River	206	1.5	281	2.1	311	2.3	14,714	1,174.5	13,540	14,716
Watson Brook-Exeter River	282	2.7	332	3.2	362	3.4	10,629	103.6	10,525	10,629
Winnicut River	647	5.9	760	6.9	823	7.5	11,132	99.1	11,033	11,132
Wolfeboro Bay	655	2.1	825	2.7	907	2.9	36,861	5,815.3	31,045	36,921
York River	502	2.4	641	3.1	708	3.4	21,068	544.3	20,524	21,646
Total	33,265	3.4	40,277	4.1	43,875	4.5	1,044,451	59,847	984,604	1,454,827

Table 2. Impervious surface acreage and total acreage by subwatershed, 2000.

12-Digit HUC Subwatershed Name	Impervious Acreage - 2000						Total Acres			
	Low Range	% Land Area	Mid Range	% Land Area	High Range	% Land Area	Mapped Area	Surface Water	Land Area	Total Watershed
Alton Bay	741	2.6	930	3.2	1,021	3.5	32,179	3,164.6	29,014	32,253
Arlington Mill Reservoir-Spickett River	733	6.7	877	8.0	953	8.7	11,568	655.0	10,913	14,687
Axe Handle Brook	249	3.5	298	4.2	324	4.6	7,441	368.7	7,072	7,441
Balch Pond-Shapleigh Pond	253	3.6	304	4.4	332	4.8	7,722	765.1	6,957	13,911
Bauneg Beg Pond-Great Works River	1,113	4.8	1,290	5.6	1,385	6.0	23,472	392.6	23,079	23,472
Bean River-North River	298	2.0	371	2.5	406	2.8	14,960	276.0	14,684	14,960
Beech River	23	1.8	27	2.1	29	2.2	1,439	145.1	1,294	12,827
Bellamy River	1,460	7.2	1,709	8.4	1,842	9.0	21,670	1,261.5	20,408	21,670
Berrys Brook-Rye Harbor	1,080	10.5	1,236	12.0	1,325	12.9	10,636	346.0	10,290	10,641
Berrys River	178	1.8	216	2.2	236	2.4	10,019	351.3	9,667	10,019
Big River	121	1.1	142	1.3	153	1.4	10,906	222.2	10,684	18,571
Bow Lake Headwaters Isinglass River	138	1.8	181	2.3	200	2.6	9,014	1,239.6	7,775	9,014
Branch Brook-Merriland River	673	3.9	785	4.6	841	4.9	17,105	64.4	17,040	20,044
Branch River	383	2.2	462	2.7	503	2.9	17,565	233.8	17,331	17,565
Brave Boat Harbor	102	3.8	120	4.5	129	4.9	2,664	9.5	2,655	2,780
Cocheco River	1,828	11.6	2,084	13.2	2,232	14.2	16,191	424.0	15,767	16,191
Cohas Brook	66	6.7	76	7.7	83	8.4	990	0.4	989	14,771
Day Brook-Mousam River	85	4.5	104	5.6	113	6.1	1,909	34.7	1,874	12,114
Estes Lake	170	4.2	204	5.1	221	5.5	4,218	182.6	4,035	19,154
Great Bay	1,057	8.5	1,218	9.8	1,309	10.6	18,496	6,124.0	12,372	18,496
Great Brook-Exeter River	651	5.3	780	6.4	844	6.9	12,452	173.9	12,278	12,452
Great Works River-Leighs Mill Pond	948	3.0	1,148	3.6	1,244	3.9	32,094	269.8	31,824	32,094
Hampton Harbor	1,922	15.9	2,168	17.9	2,308	19.0	14,366	2,247.0	12,119	19,737
Headwaters Beaver Brook	1,559	10.7	1,837	12.6	1,984	13.6	14,848	291.6	14,557	35,031
Headwaters Branch River	439	2.5	559	3.2	612	3.5	18,301	838.7	17,463	18,301
Headwaters Cocheco River	781	2.9	954	3.5	1,040	3.9	27,475	515.4	26,959	27,475
Headwaters Exeter River	871	4.2	1,064	5.2	1,156	5.6	20,755	201.3	20,553	20,755
Headwaters Lamprey River	481	2.2	594	2.7	645	3.0	21,977	208.6	21,768	21,977
Headwaters Salmon Falls River	329	2.2	409	2.7	449	3.0	17,698	2,554.5	15,143	17,699
Henderson Brook	114	2.9	139	3.6	150	3.9	4,069	182.2	3,887	13,057
Isinglass River	577	5.7	667	6.6	720	7.1	10,619	438.0	10,181	10,619
Lamprey River	670	5.1	797	6.1	865	6.6	13,544	412.3	13,132	13,544
Little River (Maine)	636	1.8	796	2.3	866	2.5	34,874	165.8	34,708	34,874
Little River (New Hampshire)	329	9.5	374	10.8	401	11.6	3,495	32.8	3,463	18,646
Little River-Exeter River	727	7.4	836	8.5	897	9.1	9,884	39.5	9,844	9,884
Little River-Lamprey River	361	2.8	441	3.5	480	3.8	13,117	360.4	12,756	13,117
Little Suncook River	402	3.0	495	3.6	541	4.0	15,279	1,696.6	13,582	25,408
Lower Salmon Falls River	843	6.4	1,000	7.6	1,078	8.1	13,612	378.7	13,233	13,800
Massabesic Lake	0	0.0	0	0.0	0	0.0	21	0.0	21	11,044
Middle Salmon Falls River	2,054	5.5	2,423	6.5	2,608	7.0	38,136	775.0	37,361	38,143
Moultonborough Bay	9	0.7	12	0.9	13	1.0	1,266	0.0	1,266	29,745
Mousam Lake	464	2.7	555	3.3	601	3.5	19,036	2,052.8	16,983	19,048

Table 2 (cont.). Impervious surface acreage and total acreage by subwatershed, 2000

12-Digit HUC Subwatershed Name	Impervious Acreage - 2000						Total Acres			
	Low Range	% Land Area	Mid Range	% Land Area	High Range	% Land Area	Mapped Area	Surface Water	Land Area	Total Watershed
Nippo Brook-Isinglass River	307	1.8	372	2.2	407	2.4	17,483	274.3	17,208	17,483
North Branch River	321	2.9	384	3.5	415	3.8	11,055	146.2	10,909	11,055
North River	213	2.5	260	3.0	283	3.3	8,675	62.7	8,612	8,675
Number One Pond-Mousam River	1,140	9.7	1,294	11.0	1,380	11.7	12,190	384.2	11,806	12,225
Oyster River	1,240	6.5	1,470	7.7	1,592	8.3	19,616	536.9	19,079	19,616
Pawtuckaway Pond	139	1.1	171	1.4	186	1.5	13,039	922.8	12,117	13,039
Pawtuckaway River-Lamprey River	1,618	6.3	1,880	7.4	2,024	7.9	26,175	625.3	25,550	26,175
Perry Brook-Suncook River	411	3.2	494	3.9	538	4.2	13,101	369.2	12,732	34,279
Pine River	230	2.6	279	3.2	305	3.4	9,441	603.4	8,837	35,664
Piscassic River	738	5.2	868	6.1	936	6.6	14,378	102.7	14,275	14,378
Pokamoonshine Brook-Cocheco River	1,933	9.7	2,229	11.2	2,392	12.0	20,318	433.3	19,884	20,318
Portsmouth Harbor	4,278	16.8	4,888	19.2	5,223	20.5	27,922	2,479.3	25,443	30,548
Powwow River	1,419	5.8	1,684	6.9	1,823	7.5	25,807	1,413.0	24,394	37,966
Rock Haven Lake-Little Ossipee River	109	1.4	135	1.7	147	1.8	8,173	80.8	8,092	30,175
South River	22	3.3	30	4.4	34	5.0	1,058	378.5	680	20,121
Spickett River	267	8.7	311	10.1	337	11.0	3,115	41.6	3,074	35,108
Spruce Swamp-Exeter River	881	6.2	1,025	7.2	1,104	7.8	14,403	182.1	14,221	14,403
Squamscott River	1,183	9.3	1,366	10.8	1,466	11.6	13,199	544.0	12,655	13,199
Stevens Brook-Cape Neddick River	2,667	7.3	3,068	8.3	3,278	8.9	37,000	258.6	36,741	40,179
Sucker Brook	298	3.5	345	4.0	374	4.4	8,729	159.9	8,569	18,834
Suncook Lakes-Suncook River	99	1.2	126	1.6	139	1.7	8,569	478.4	8,091	45,314
Suncook River	32	1.0	43	1.4	47	1.5	3,148	7.1	3,141	40,121
Taylor River-Hampton River	1,535	10.7	1,758	12.2	1,884	13.1	14,726	336.8	14,390	14,726
The Broads	377	3.6	465	4.5	512	4.9	21,646	11,192.8	10,453	39,157
Upper Salmon Falls River	324	2.4	416	3.1	454	3.4	14,714	1,174.5	13,540	14,716
Watson Brook-Exeter River	458	4.4	529	5.0	571	5.4	10,629	103.6	10,525	10,629
Winnicut River	1,018	9.2	1,169	10.6	1,254	11.4	11,132	99.1	11,033	11,132
Wolfeboro Bay	973	3.1	1,199	3.9	1,309	4.2	36,861	5,815.3	31,045	36,921
York River	919	4.5	1,089	5.3	1,176	5.7	21,068	544.3	20,524	21,646
Total	51,066	5.2	60,028	6.1	64,731	6.6	1,044,451	59,847	984,604	1,454,827

Table 3. Impervious surface acreage and total acreage by subwatershed, 2005.

12-Digit HUC Subwatershed Name	Impervious Acreage - 2005						Total Acres			
	Low Range	% Land Area	Mid Range	% Land Area	High Range	% Land Area	Mapped Area	Surface Water	Land Area	Total Watershed
Alton Bay	966	3.3	1,146	3.9	1,235	4.3	32,179	3,164.6	29,014	32,253
Arlington Mill Reservoir-Spickett River	865	7.9	1,008	9.2	1,084	9.9	11,568	655.0	10,913	14,687
Axe Handle Brook	325	4.6	370	5.2	397	5.6	7,441	368.7	7,072	7,441
Balch Pond-Shapleigh Pond	311	4.5	348	5.0	371	5.3	7,722	765.1	6,957	13,911
Bauneg Beg Pond-Great Works River	1,316	5.7	1,507	6.5	1,610	7.0	23,472	392.6	23,079	23,472
Bean River-North River	396	2.7	459	3.1	493	3.4	14,960	276.0	14,684	14,960
Beech River	28	2.2	32	2.4	34	2.6	1,439	145.1	1,294	12,827
Bellamy River	1,786	8.8	2,030	9.9	2,164	10.6	21,670	1,261.5	20,408	21,670
Berrys Brook-Rye Harbor	1,261	12.3	1,415	13.7	1,503	14.6	10,636	346.0	10,290	10,641
Berrys River	211	2.2	247	2.6	266	2.8	10,019	351.3	9,667	10,019
Big River	141	1.3	160	1.5	171	1.6	10,906	222.2	10,684	18,571
Bow Lake Headwaters Isinglass River	176	2.3	214	2.8	231	3.0	9,014	1,239.6	7,775	9,014
Branch Brook-Merriland River	794	4.7	916	5.4	977	5.7	17,105	64.4	17,040	20,044
Branch River	447	2.6	519	3.0	556	3.2	17,565	233.8	17,331	17,565
Brave Boat Harbor	123	4.6	143	5.4	153	5.8	2,664	9.5	2,655	2,780
Cocheco River	2,276	14.4	2,537	16.1	2,690	17.1	16,191	424.0	15,767	16,191
Cohas Brook	76	7.7	86	8.7	93	9.4	990	0.4	989	14,771
Day Brook-Mousam River	100	5.3	121	6.4	130	7.0	1,909	34.7	1,874	12,114
Estes Lake	207	5.1	244	6.0	262	6.5	4,218	182.6	4,035	19,154
Great Bay	1,229	9.9	1,380	11.2	1,467	11.9	18,496	6,124.0	12,372	18,496
Great Brook-Exeter River	800	6.5	927	7.6	993	8.1	12,452	173.9	12,278	12,452
Great Works River-Leighs Mill Pond	1,186	3.7	1,403	4.4	1,510	4.7	32,094	269.8	31,824	32,094
Hampton Harbor	2,262	18.7	2,519	20.8	2,666	22.0	14,366	2,247.0	12,119	19,737
Headwaters Beaver Brook	1,871	12.9	2,145	14.7	2,293	15.7	14,848	291.6	14,557	35,031
Headwaters Branch River	519	3.0	616	3.5	664	3.8	18,301	838.7	17,463	18,301
Headwaters Cocheco River	997	3.7	1,160	4.3	1,245	4.6	27,475	515.4	26,959	27,475
Headwaters Exeter River	1,142	5.6	1,328	6.5	1,424	6.9	20,755	201.3	20,553	20,755
Headwaters Lamprey River	627	2.9	727	3.3	778	3.6	21,977	208.6	21,768	21,977
Headwaters Salmon Falls River	407	2.7	475	3.1	514	3.4	17,698	2,554.5	15,143	17,699
Henderson Brook	132	3.4	158	4.1	169	4.3	4,069	182.2	3,887	13,057
Isinglass River	652	6.4	736	7.2	786	7.7	10,619	438.0	10,181	10,619
Lamprey River	738	5.6	855	6.5	918	7.0	13,544	412.3	13,132	13,544
Little River (Maine)	812	2.3	985	2.8	1,064	3.1	34,874	165.8	34,708	34,874
Little River (New Hampshire)	421	12.1	467	13.5	496	14.3	3,495	32.8	3,463	18,646
Little River-Exeter River	895	9.1	1,007	10.2	1,071	10.9	9,884	39.5	9,844	9,884
Little River-Lamprey River	459	3.6	526	4.1	564	4.4	13,117	360.4	12,756	13,117
Little Suncook River	485	3.6	563	4.1	604	4.4	15,279	1,696.6	13,582	25,408
Lower Salmon Falls River	1,037	7.8	1,200	9.1	1,283	9.7	13,612	378.7	13,233	13,800
Massabesic Lake	0	0.2	0	0.3	0	0.3	21	0.0	21	11,044
Middle Salmon Falls River	2,640	7.1	3,016	8.1	3,212	8.6	38,136	775.0	37,361	38,143
Moultonborough Bay	5	0.4	7	0.5	8	0.6	1,266	0.0	1,266	29,745
Mousam Lake	544	3.2	640	3.8	690	4.1	19,036	2,052.8	16,983	19,048

Table 3 (cont.). Impervious surface acreage and total acreage by subwatershed, 2005.

12-Digit HUC Subwatershed Name	Impervious Acreage - 2005						Total Acres			
	Low Range	% Land Area	Mid Range	% Land Area	High Range	% Land Area	Mapped Area	Surface Water	Land Area	Total Watershed
Nippo Brook-Isinglass River	385	2.2	448	2.6	482	2.8	17,483	274.3	17,208	17,483
North Branch River	390	3.6	450	4.1	482	4.4	11,055	146.2	10,909	11,055
North River	279	3.2	323	3.8	347	4.0	8,675	62.7	8,612	8,675
Number One Pond-Mousam River	1,253	10.6	1,412	12.0	1,501	12.7	12,190	384.2	11,806	12,225
Oyster River	1,436	7.5	1,651	8.7	1,770	9.3	19,616	536.9	19,079	19,616
Pawtuckaway Pond	172	1.4	195	1.6	209	1.7	13,039	922.8	12,117	13,039
Pawtuckaway River-Lamprey River	1,950	7.6	2,210	8.7	2,357	9.2	26,175	625.3	25,550	26,175
Perry Brook-Suncook River	552	4.3	632	5.0	677	5.3	13,101	369.2	12,732	34,279
Pine River	274	3.1	309	3.5	329	3.7	9,441	603.4	8,837	35,664
Piscassic River	942	6.6	1,073	7.5	1,145	8.0	14,378	102.7	14,275	14,378
Pokamoonshine Brook-Cocheco River	2,267	11.4	2,546	12.8	2,704	13.6	20,318	433.3	19,884	20,318
Portsmouth Harbor	5,003	19.7	5,636	22.2	5,986	23.5	27,922	2,479.3	25,443	30,548
Powwow River	1,792	7.3	2,049	8.4	2,189	9.0	25,807	1,413.0	24,394	37,966
Rock Haven Lake-Little Ossipee River	129	1.6	155	1.9	168	2.1	8,173	80.8	8,092	30,175
South River	25	3.6	30	4.4	32	4.8	1,058	378.5	680	20,121
Spickett River	336	10.9	380	12.4	405	13.2	3,115	41.6	3,074	35,108
Spruce Swamp-Exeter River	1,035	7.3	1,178	8.3	1,259	8.8	14,403	182.1	14,221	14,403
Squamscott River	1,424	11.3	1,611	12.7	1,715	13.6	13,199	544.0	12,655	13,199
Stevens Brook-Cape Neddick River	3,256	8.9	3,692	10.0	3,926	10.7	37,000	258.6	36,741	40,179
Sucker Brook	366	4.3	415	4.8	445	5.2	8,729	159.9	8,569	18,834
Suncook Lakes-Suncook River	127	1.6	150	1.9	162	2.0	8,569	478.4	8,091	45,314
Suncook River	36	1.1	45	1.4	49	1.6	3,148	7.1	3,141	40,121
Taylor River-Hampton River	1,905	13.2	2,141	14.9	2,275	15.8	14,726	336.8	14,390	14,726
The Broads	400	3.8	478	4.6	519	5.0	21,646	11,192.8	10,453	39,157
Upper Salmon Falls River	420	3.1	504	3.7	543	4.0	14,714	1,174.5	13,540	14,716
Watson Brook-Exeter River	564	5.4	637	6.1	681	6.5	10,629	103.6	10,525	10,629
Winnicut River	1,217	11.0	1,371	12.4	1,460	13.2	11,132	99.1	11,033	11,132
Wolfeboro Bay	1,091	3.5	1,293	4.2	1,394	4.5	36,861	5,815.3	31,045	36,921
York River	1,125	5.5	1,309	6.4	1,405	6.8	21,068	544.3	20,524	21,646
Total	61,812	6.3	70,666	7.2	75,459	7.7	1,044,451	59,847	984,604	1,454,827

Table 4. Impervious surface acreage and total acreage by subwatershed, 2010.

12-Digit HUC Subwatershed Name	Impervious Acreage -2010						Total Acres			
	Low Range	% Land Area	Mid Range	% Land Area	High Range	% Land Area	Mapped Area	Surface Water	Land Area	Total Watershed
Alton Bay	1,310	4.5	1,531	5.3	1,648	5.7	32,179	3,164.6	29,014	32,253
Arlington Mill Reservoir-Spickett River	1,120	10.3	1,304	11.9	1,403	12.9	11,568	655.0	10,913	14,687
Axe Handle Brook	434	6.1	495	7.0	530	7.5	7,441	368.7	7,072	7,441
Balch Pond-Shapleigh Pond	430	6.2	485	7.0	518	7.4	7,722	765.1	6,957	13,911
Bauneg Beg Pond-Great Works River	1,578	6.8	1,807	7.8	1,929	8.4	23,472	392.6	23,079	23,472
Bean River-North River	524	3.6	608	4.1	653	4.4	14,960	276.0	14,684	14,960
Beech River	39	3.0	45	3.5	48	3.7	1,439	145.1	1,294	12,827
Bellamy River	2,274	11.1	2,573	12.6	2,737	13.4	21,670	1,261.5	20,408	21,670
Berrys Brook-Rye Harbor	1,530	14.9	1,709	16.6	1,812	17.6	10,636	346.0	10,290	10,641
Berrys River	279	2.9	323	3.3	348	3.6	10,019	351.3	9,667	10,019
Big River	186	1.7	215	2.0	230	2.2	10,906	222.2	10,684	18,571
Bow Lake Headwaters Isinglass River	269	3.5	320	4.1	347	4.5	9,014	1,239.6	7,775	9,014
Branch Brook-Merriland River	971	5.7	1,120	6.6	1,192	7.0	17,105	64.4	17,040	20,044
Branch River	609	3.5	692	4.0	740	4.3	17,565	233.8	17,331	17,565
Brave Boat Harbor	151	5.7	177	6.7	191	7.2	2,664	9.5	2,655	2,780
Cocheco River	2,803	17.8	3,115	19.8	3,298	20.9	16,191	424.0	15,767	16,191
Cohas Brook	99	10.0	112	11.3	120	12.1	990	0.4	989	14,771
Day Brook-Mousam River	125	6.7	150	8.0	162	8.6	1,909	34.7	1,874	12,114
Estes Lake	262	6.5	308	7.6	331	8.2	4,218	182.6	4,035	19,154
Great Bay	1,513	12.2	1,692	13.7	1,797	14.5	18,496	6,124.0	12,372	18,496
Great Brook-Exeter River	1,014	8.3	1,168	9.5	1,251	10.2	12,452	173.9	12,278	12,452
Great Works River-Leighs Mill Pond	1,477	4.6	1,746	5.5	1,877	5.9	32,094	269.8	31,824	32,094
Hampton Harbor	2,694	22.2	2,980	24.6	3,148	26.0	14,366	2,247.0	12,119	19,737
Headwaters Beaver Brook	2,299	15.8	2,626	18.0	2,801	19.2	14,848	291.6	14,557	35,031
Headwaters Branch River	682	3.9	802	4.6	863	4.9	18,301	838.7	17,463	18,301
Headwaters Cocheco River	1,341	5.0	1,546	5.7	1,658	6.2	27,475	515.4	26,959	27,475
Headwaters Exeter River	1,509	7.3	1,766	8.6	1,897	9.2	20,755	201.3	20,553	20,755
Headwaters Lamprey River	831	3.8	968	4.4	1,037	4.8	21,977	208.6	21,768	21,977
Headwaters Salmon Falls River	550	3.6	643	4.2	696	4.6	17,698	2,554.5	15,143	17,699
Henderson Brook	164	4.2	197	5.1	211	5.4	4,069	182.2	3,887	13,057
Isinglass River	853	8.4	964	9.5	1,030	10.1	10,619	438.0	10,181	10,619
Lamprey River	939	7.2	1,084	8.3	1,164	8.9	13,544	412.3	13,132	13,544
Little River (Maine)	1,033	3.0	1,259	3.6	1,360	3.9	34,874	165.8	34,708	34,874
Little River (New Hampshire)	532	15.4	591	17.1	627	18.1	3,495	32.8	3,463	18,646
Little River-Exeter River	1,129	11.5	1,266	12.9	1,345	13.7	9,884	39.5	9,844	9,884
Little River-Lamprey River	622	4.9	714	5.6	765	6.0	13,117	360.4	12,756	13,117
Little Suncook River	656	4.8	763	5.6	818	6.0	15,279	1,696.6	13,582	25,408
Lower Salmon Falls River	1,289	9.7	1,481	11.2	1,581	11.9	13,612	378.7	13,233	13,800
Massabesic Lake	0	0.2	0	0.3	0	0.3	21	0.0	21	11,044
Middle Salmon Falls River	3,342	8.9	3,809	10.2	4,055	10.9	38,136	775.0	37,361	38,143
Moultonborough Bay	12	0.9	14	1.1	16	1.2	1,266	0.0	1,266	29,745
Mousam Lake	710	4.2	840	4.9	906	5.3	19,036	2,052.8	16,983	19,048

Table 4 (cont.). Impervious surface acreage and total acreage by subwatershed, 2010.

12-Digit HUC Subwatershed Name	Impervious Acreage -2010						Total Acres			
	Low Range	% Land Area	Mid Range	% Land Area	High Range	% Land Area	Mapped Area	Surface Water	Land Area	Total Watershed
Nippo Brook-Isinglass River	537	3.1	621	3.6	668	3.9	17,483	274.3	17,208	17,483
North Branch River	528	4.8	604	5.5	646	5.9	11,055	146.2	10,909	11,055
North River	381	4.4	441	5.1	473	5.5	8,675	62.7	8,612	8,675
Number One Pond-Mousam River	1,452	12.3	1,627	13.8	1,722	14.6	12,190	384.2	11,806	12,225
Oyster River	1,877	9.8	2,134	11.2	2,282	12.0	19,616	536.9	19,079	19,616
Pawtuckaway Pond	231	1.9	269	2.2	289	2.4	13,039	922.8	12,117	13,039
Pawtuckaway River-Lamprey River	2,527	9.9	2,857	11.2	3,042	11.9	26,175	625.3	25,550	26,175
Perry Brook-Suncook River	710	5.6	810	6.4	866	6.8	13,101	369.2	12,732	34,279
Pine River	371	4.2	422	4.8	450	5.1	9,441	603.4	8,837	35,664
Piscassic River	1,242	8.7	1,411	9.9	1,504	10.5	14,378	102.7	14,275	14,378
Pokamoonshine Brook-Cocheco River	2,824	14.2	3,166	15.9	3,357	16.9	20,318	433.3	19,884	20,318
Portsmouth Harbor	5,878	23.1	6,592	25.9	6,986	27.5	27,922	2,479.3	25,443	30,548
Powwow River	2,285	9.4	2,615	10.7	2,795	11.5	25,807	1,413.0	24,394	37,966
Rock Haven Lake-Little Ossipee River	170	2.1	207	2.6	224	2.8	8,173	80.8	8,092	30,175
South River	37	5.4	43	6.4	47	6.9	1,058	378.5	680	20,121
Spickett River	428	13.9	483	15.7	515	16.8	3,115	41.6	3,074	35,108
Spruce Swamp-Exeter River	1,345	9.5	1,532	10.8	1,636	11.5	14,403	182.1	14,221	14,403
Squamscott River	1,809	14.3	2,027	16.0	2,152	17.0	13,199	544.0	12,655	13,199
Stevens Brook-Cape Neddick River	3,818	10.4	4,337	11.8	4,609	12.5	37,000	258.6	36,741	40,179
Sucker Brook	477	5.6	541	6.3	579	6.8	8,729	159.9	8,569	18,834
Suncook Lakes-Suncook River	174	2.2	205	2.5	221	2.7	8,569	478.4	8,091	45,314
Suncook River	46	1.5	58	1.9	64	2.0	3,148	7.1	3,141	40,121
Taylor River-Hampton River	2,385	16.6	2,670	18.6	2,833	19.7	14,726	336.8	14,390	14,726
The Broads	535	5.1	639	6.1	694	6.6	21,646	11,192.8	10,453	39,157
Upper Salmon Falls River	557	4.1	659	4.9	709	5.2	14,714	1,174.5	13,540	14,716
Watson Brook-Exeter River	739	7.0	839	8.0	897	8.5	10,629	103.6	10,525	10,629
Winnicut River	1,541	14.0	1,724	15.6	1,831	16.6	11,132	99.1	11,033	11,132
Wolfeboro Bay	1,462	4.7	1,717	5.5	1,850	6.0	36,861	5,815.3	31,045	36,921
York River	1,384	6.7	1,610	7.8	1,726	8.4	21,068	544.3	20,524	21,646
Total	77,935	7.9	88,870	9.0	94,809	9.6	1,044,451	59,847	984,604	1,454,827

Table 5. Impervious surface acreage change by subwatershed: 1990 – 2010.

12-Digit HUC Subwatershed Name	Imp. Acres, 1990 (mid point)	% Imp., 1990	Imp. Acres, 2000 (mid point)	% Imp., 2000	Imp. Acres, 2005 (mid point)	% Imp., 2005	Imp. Acres, 2010 (mid point)	% Imp. 2010	Change in % Imp., 1990-2000	Change in % Imp., 2000-2005	Change in % Imp., 2005-2010
Alton Bay	697	2.4	930	3.2	1,146	3.9	1,531	5.3	0.8	0.7	1.3
Arlington Mill Reservoir-Spickett River	604	5.5	877	8.0	1,008	9.2	1,304	11.9	2.5	1.2	2.7
Axe Handle Brook	217	3.1	298	4.2	370	5.2	495	7.0	1.1	1.0	1.8
Balch Pond-Shapleigh Pond	223	3.2	304	4.4	348	5.0	485	7.0	1.2	0.6	2.0
Bauneg Beg Pond-Great Works River	818	3.5	1,290	5.6	1,507	6.5	1,807	7.8	2.0	0.9	1.3
Bean River-North River	256	1.7	371	2.5	459	3.1	608	4.1	0.8	0.6	1.0
Beech River	15	1.1	27	2.1	32	2.4	45	3.5	0.9	0.4	1.0
Bellamy River	1,147	5.6	1,709	8.4	2,030	9.9	2,573	12.6	2.8	1.6	2.7
Berrys Brook-Rye Harbor	843	8.2	1,236	12.0	1,415	13.7	1,709	16.6	3.8	1.7	2.9
Berrys River	145	1.5	216	2.2	247	2.6	323	3.3	0.7	0.3	0.8
Big River	85	0.8	142	1.3	160	1.5	215	2.0	0.5	0.2	0.5
Bow Lake Headwaters Isinglass River	119	1.5	181	2.3	214	2.8	320	4.1	0.8	0.4	1.4
Branch Brook-Merriland River	480	2.8	785	4.6	916	5.4	1,120	6.6	1.8	0.8	1.2
Branch River	333	1.9	462	2.7	519	3.0	692	4.0	0.7	0.3	1.0
Brave Boat Harbor	60	2.2	120	4.5	143	5.4	177	6.7	2.3	0.9	1.3
Cocheco River	1,506	9.6	2,084	13.2	2,537	16.1	3,115	19.8	3.7	2.9	3.7
Cohas Brook	54	5.4	76	7.7	86	8.7	112	11.3	2.3	1.0	2.6
Day Brook-Mousam River	64	3.4	104	5.6	121	6.4	150	8.0	2.1	0.9	1.6
Estes Lake	122	3.0	204	5.1	244	6.0	308	7.6	2.0	1.0	1.6
Great Bay	840	6.8	1,218	9.8	1,380	11.2	1,692	13.7	3.1	1.3	2.5
Great Brook-Exeter River	494	4.0	780	6.4	927	7.6	1,168	9.5	2.3	1.2	2.0
Great Works River-Leighs Mill Pond	669	2.1	1,148	3.6	1,403	4.4	1,746	5.5	1.5	0.8	1.1
Hampton Harbor	1,533	12.7	2,168	17.9	2,519	20.8	2,980	24.6	5.2	2.9	3.8
Headwaters Beaver Brook	1,308	9.0	1,837	12.6	2,145	14.7	2,626	18.0	3.6	2.1	3.3
Headwaters Branch River	403	2.3	559	3.2	616	3.5	802	4.6	0.9	0.3	1.1
Headwaters Cocheco River	691	2.6	954	3.5	1,160	4.3	1,546	5.7	1.0	0.8	1.4
Headwaters Exeter River	630	3.1	1,064	5.2	1,328	6.5	1,766	8.6	2.1	1.3	2.1
Headwaters Lamprey River	373	1.7	594	2.7	727	3.3	968	4.4	1.0	0.6	1.1
Headwaters Salmon Falls River	266	1.8	409	2.7	475	3.1	643	4.2	0.9	0.4	1.1
Henderson Brook	89	2.3	139	3.6	158	4.1	197	5.1	1.3	0.5	1.0
Isinglass River	445	4.4	667	6.6	736	7.2	964	9.5	2.2	0.7	2.2
Lamprey River	539	4.1	797	6.1	855	6.5	1,084	8.3	2.0	0.4	1.7
Little River (Maine)	475	1.4	796	2.3	985	2.8	1,259	3.6	0.9	0.5	0.8
Little River (New Hampshire)	229	6.6	374	10.8	467	13.5	591	17.1	4.2	2.7	3.6
Little River-Exeter River	570	5.8	836	8.5	1,007	10.2	1,266	12.9	2.7	1.7	2.6
Little River-Lamprey River	289	2.3	441	3.5	526	4.1	714	5.6	1.2	0.7	1.5
Little Suncook River	334	2.5	495	3.6	563	4.1	763	5.6	1.2	0.5	1.5
Lower Salmon Falls River	665	5.0	1,000	7.6	1,200	9.1	1,481	11.2	2.5	1.5	2.1
Massabesic Lake	0	0.0	0	0.0	0	0.3	0	0.3	0.0	0.3	0.0
Middle Salmon Falls River	1,606	4.3	2,423	6.5	3,016	8.1	3,809	10.2	2.2	1.6	2.1
Moultonborough Bay	9	0.7	12	0.9	7	0.5	14	1.1	0.2	-0.4	0.6
Mousam Lake	334	2.0	555	3.3	640	3.8	840	4.9	1.3	0.5	1.2

Table 5 (cont.). Impervious surface acreage change by subwatershed: 1990 – 2010.

12-Digit HUC Subwatershed Name	Imp. Acres, 1990 (mid point)	% Imp., 1990	Imp. Acres, 2000 (mid point)	% Imp., 2000	Imp. Acres, 2005 (mid point)	% Imp., 2005	Imp. Acres, 2010 (mid point)	% Imp. 2010	Change in % Imp., 1990-2000	Change in % Imp., 2000-2005	Change in % Imp., 2005-2010
Nippo Brook-Isinglass River	262	1.5	372	2.2	448	2.6	621	3.6	0.6	0.4	1.0
North Branch River	248	2.3	384	3.5	450	4.1	604	5.5	1.2	0.6	1.4
North River	158	1.8	260	3.0	323	3.8	441	5.1	1.2	0.7	1.4
Number One Pond-Mousam River	889	7.5	1,294	11.0	1,412	12.0	1,627	13.8	3.4	1.0	1.8
Oyster River	959	5.0	1,470	7.7	1,651	8.7	2,134	11.2	2.7	1.0	2.5
Pawtuckaway Pond	111	0.9	171	1.4	195	1.6	269	2.2	0.5	0.2	0.6
Pawtuckaway River-Lamprey River	1,231	4.8	1,880	7.4	2,210	8.7	2,857	11.2	2.5	1.3	2.5
Perry Brook-Suncook River	382	3.0	494	3.9	632	5.0	810	6.4	0.9	1.1	1.4
Pine River	191	2.2	279	3.2	309	3.5	422	4.8	1.0	0.3	1.3
Piscassic River	509	3.6	868	6.1	1,073	7.5	1,411	9.9	2.5	1.4	2.4
Pokamoonshine Brook-Cocheco River	1,642	8.3	2,229	11.2	2,546	12.8	3,166	15.9	3.0	1.6	3.1
Portsmouth Harbor	3,524	13.9	4,888	19.2	5,636	22.2	6,592	25.9	5.4	2.9	3.8
Powwow River	1,096	4.5	1,684	6.9	2,049	8.4	2,615	10.7	2.4	1.5	2.3
Rock Haven Lake-Little Ossipee River	92	1.1	135	1.7	155	1.9	207	2.6	0.5	0.3	0.6
South River	20	3.0	30	4.4	30	4.4	43	6.4	1.5	-0.1	2.0
Spickett River	206	6.7	311	10.1	380	12.4	483	15.7	3.4	2.2	3.4
Spruce Swamp-Exeter River	650	4.6	1,025	7.2	1,178	8.3	1,532	10.8	2.6	1.1	2.5
Squamscott River	904	7.1	1,366	10.8	1,611	12.7	2,027	16.0	3.6	1.9	3.3
Stevens Brook-Cape Neddick River	1,935	5.3	3,068	8.3	3,692	10.0	4,337	11.8	3.1	1.7	1.8
Sucker Brook	233	2.7	345	4.0	415	4.8	541	6.3	1.3	0.8	1.5
Suncook Lakes-Suncook River	90	1.1	126	1.6	150	1.9	205	2.5	0.4	0.3	0.7
Suncook River	30	1.0	43	1.4	45	1.4	58	1.9	0.4	0.1	0.4
Taylor River-Hampton River	1,170	8.1	1,758	12.2	2,141	14.9	2,670	18.6	4.1	2.7	3.7
The Broads	326	3.1	465	4.5	478	4.6	639	6.1	1.3	0.1	1.5
Upper Salmon Falls River	281	2.1	416	3.1	504	3.7	659	4.9	1.0	0.7	1.1
Watson Brook-Exeter River	332	3.2	529	5.0	637	6.1	839	8.0	1.9	1.0	1.9
Winnicut River	760	6.9	1,169	10.6	1,371	12.4	1,724	15.6	3.7	1.8	3.2
Wolfeboro Bay	825	2.7	1,199	3.9	1,293	4.2	1,717	5.5	1.2	0.3	1.4
York River	641	3.1	1,089	5.3	1,309	6.4	1,610	7.8	2.2	1.1	1.5
Total	40,277	4.1	60,028	6.1	70,666	7.2	88,870	9.0	2.0	1.1	1.8

Table 6. Impervious surface acreage for towns in Maine.

Town	Mapped Area (acres)			Impervious Surface (acres)				% Imp. Land Area			
	Total	Water	Land	1990	2000	2005	2010	1990	2000	2005	2010
Acton	26,408	2,146	24,262	374	597	693	920	1.5	2.5	2.9	3.8
Berwick	24,227	225	24,002	617	1,053	1,308	1,624	2.6	4.4	5.4	6.8
Eliot	13,650	1,041	12,609	522	937	1,158	1,415	4.1	7.4	9.2	11.2
Kittery	48,199	36,824	11,375	917	1,345	1,574	1,822	8.1	11.8	13.8	16.0
Lebanon	35,633	600	35,033	627	1,065	1,304	1,645	1.8	3.0	3.7	4.7
North Berwick	24,423	129	24,293	526	848	1,018	1,266	2.2	3.5	4.2	5.2
Sanford	31,205	621	30,584	1,780	2,745	3,068	3,582	5.8	9.0	10.0	11.7
Shapleigh	26,361	1,665	24,696	383	616	711	923	1.6	2.5	2.9	3.7
South Berwick	20,891	330	20,561	482	795	965	1,207	2.3	3.9	4.7	5.9
Wells	46,857	10,427	36,430	1,377	2,188	2,703	3,246	3.8	6.0	7.4	8.9
York	84,348	49,428	34,919	1,503	2,471	2,907	3,461	4.3	7.1	8.3	9.9
Total	382,203	103,437	278,765	9,108	14,659	17,409	21,111	3.3	5.3	6.2	7.6

Note: Acreages based on 1:24,000-scale town boundary and surface water data, both retrieved in December, 2008 from the Maine GIS Data Catalog (http://megis.maine.gov/catalog). The total area of the coastal towns includes significant water acreage (as legal town bounds extend into the Atlantic Ocean).

Table 7. Impervious surface acreage for towns in New Hampshire.

Town	Mapped Area (acres)			Impervious Surface (acres)				% Imp. Land Area			
	Total	Water	Land	1990	2000	2005	2010	1990	2000	2005	2010
Alton	53,231	12,602	40,629	872	1,208	1,434	1,918	2.1	3.0	3.5	4.7
Barrington	31,117	1,398	29,719	763	1,187	1,387	1,879	2.6	4.0	4.7	6.3
Brentwood	10,862	121	10,742	532	829	1,023	1,314	5.0	7.7	9.5	12.2
Brookfield	14,880	287	14,593	139	191	198	268	1.0	1.3	1.4	1.8
Candia	19,557	215	19,342	531	794	931	1,243	2.7	4.1	4.8	6.4
Chester	16,718	98	16,620	423	720	856	1,138	2.5	4.3	5.1	6.8
Danville	7,569	131	7,439	260	445	534	707	3.5	6.0	7.2	9.5
Deerfield	33,349	762	32,587	492	768	969	1,297	1.5	2.4	3.0	4.0
Derry	23,226	545	22,680	1,826	2,567	2,966	3,690	8.0	11.3	13.1	16.3
Dover	18,592	1,498	17,094	1,873	2,626	3,172	3,874	11.0	15.4	18.6	22.7
Durham	15,852	1,543	14,308	675	1,026	1,098	1,403	4.7	7.2	7.7	9.8
East Kingston	6,381	62	6,319	221	335	439	565	3.5	5.3	7.0	8.9
Epping	16,776	308	16,468	658	1,071	1,292	1,695	4.0	6.5	7.8	10.3
Exeter	12,814	261	12,553	937	1,376	1,559	1,959	7.5	11.0	12.4	15.6
Farmington	23,640	419	23,221	687	966	1,090	1,421	3.0	4.2	4.7	6.1
Fremont	11,143	107	11,036	329	538	654	869	3.0	4.9	5.9	7.9
Greenland	8,524	1,744	6,780	455	713	845	1,059	6.7	10.5	12.5	15.6
Hampstead	9,014	471	8,543	640	974	1,172	1,486	7.5	11.4	13.7	17.4
Hampton	9,071	754	8,317	1,179	1,605	1,717	2,050	14.2	19.3	20.6	24.7
Hampton Falls	8,077	358	7,719	342	536	699	898	4.4	6.9	9.1	11.6
Kensington	7,668	31	7,637	243	378	470	599	3.2	5.0	6.2	7.8
Kingston	13,450	955	12,495	651	1,019	1,212	1,560	5.2	8.2	9.7	12.5
Lee	12,928	248	12,680	468	740	841	1,108	3.7	5.8	6.6	8.7

Table 7 (cont.). Impervious surface acreage for towns in New Hampshire.

Town	Mapped Area (acres)			Impervious Surface (acres)				% Imp. Land Area			
	Total	Water	Land	1990	2000	2005	2010	1990	2000	2005	2010
Madbury	7,799	396	7,403	251	394	392	535	3.4	5.3	5.3	7.2
Middleton	11,843	283	11,560	204	284	350	477	1.8	2.5	3.0	4.1
Milton	21,935	836	21,099	597	839	985	1,317	2.8	4.0	4.7	6.2
New Castle	1,348	843	504	108	155	171	207	21.4	30.7	33.9	41.1
New Durham	28,054	1,707	26,347	458	628	727	990	1.7	2.4	2.8	3.8
Newfields	4,647	105	4,542	142	251	308	391	3.1	5.5	6.8	8.6
Newington	7,916	2,701	5,215	687	941	1,056	1,248	13.2	18.0	20.2	23.9
Newmarket	9,080	1,007	8,073	480	707	819	1,010	5.9	8.8	10.1	12.5
North Hampton	8,922	57	8,865	647	958	1,100	1,362	7.3	10.8	12.4	15.4
Northwood	19,356	1,380	17,976	424	610	717	976	2.4	3.4	4.0	5.4
Nottingham	30,997	1,116	29,880	448	693	842	1,143	1.5	2.3	2.8	3.8
Pittsfield	15,559	369	15,190	429	555	702	903	2.8	3.7	4.6	5.9
Portsmouth	10,763	762	10,001	2,128	2,726	3,054	3,502	21.3	27.3	30.5	35.0
Raymond	18,944	495	18,448	977	1,484	1,714	2,179	5.3	8.0	9.3	11.8
Rochester	29,081	750	28,331	2,395	3,304	3,942	4,920	8.5	11.7	13.9	17.4
Rollinsford	4,843	161	4,682	266	381	437	554	5.7	8.1	9.3	11.8
Rye	8,424	426	7,997	587	878	1,026	1,253	7.3	11.0	12.8	15.7
Sandown	9,232	343	8,889	337	544	701	930	3.8	6.1	7.9	10.5
Seabrook	6,160	491	5,669	802	1,206	1,539	1,808	14.1	21.3	27.1	31.9
Somersworth	6,399	179	6,220	768	1,021	1,257	1,517	12.3	16.4	20.2	24.4
South Hampton	5,147	102	5,044	123	193	241	303	2.4	3.8	4.8	6.0
Strafford	32,779	1,626	31,153	434	638	727	992	1.4	2.0	2.3	3.2
Stratham	9,901	228	9,672	628	979	1,246	1,569	6.5	10.1	12.9	16.2
Wakefield	28,716	3,452	25,264	878	1,225	1,407	1,879	3.5	4.8	5.6	7.4
Wolfeboro	37,406	6,713	30,693	870	1,275	1,399	1,871	2.8	4.2	4.6	6.1
Total	759,686	51,445	708,241	31,267	45,479	53,415	67,833	4.4	6.4	7.5	9.6

Note: Minor differences in total impervious acreage estimates (e.g. < 20 acres) reported at the town vs. subwatershed levels result from discrepancies in coastline delineations between the two data sets.

Table 8. Accuracy assessment error matrix, 2010.

REFERENCE DATA

CLASSIFIED DATA	2010 Data	Impervious	Non Impervious	Total	User's Accuracy
	Impervious	93	7	100	93.0
	Non impervious	2	98	100	98.0
	Total	95	105	200	
	Producer's Accuracy	97.9	93.3		
	Overall Accuracy				95.5

References

Justice, D. and Rubin, F. 2006. Final Report: Impervious Surface Mapping in Coastal New Hampshire (2005). 24 p.

Justice, D. and Rubin, F. 2003. Final Report: Developing Impervious Surface Estimates for Coastal New Hampshire. 25 p.