Table IV-8: Eagle Creek Subwatersheds – Impervious Surface Analysis

	Impervious		Pervious	
Subwatershed	*(mi^2)*	*%*	*(mi^2)*	*%*
Eagle Creek Dixon Branch	0.6	3.4%	16.0	96.1%
Eagle Creek-Finley Creek	0.6	5.4%	10.0	94.2%
Eagle Creek -Kreager Ditch	0.3	2.7%	11.9	96.7%
Little Eagle Branch-Headwaters	1.1	6.8%	14.7	92.9%
Mounts Run- Neese Ditch	0.2	1.3%	15.9	98.5%
Little Eagle Branch- Woodruff	1.7	12.5%	12.0	87.0%
Eagle Creek- Jackson Run	2.4	12.7%	16.4	86.6%
Fishback Creek (Eagle Creek Reservoir)	2.1	10.0%	18.9	89.2%
Eagle Creek- Long Branch/Irishman Run	5.2	27.3%	13.4	70.2%
Eagle Creek Reservoir-School Branch	3.0	14.9%	14.7	73.3%
Total Eagle Creek Watershed	17.2	10.5%	143.8	87.5%

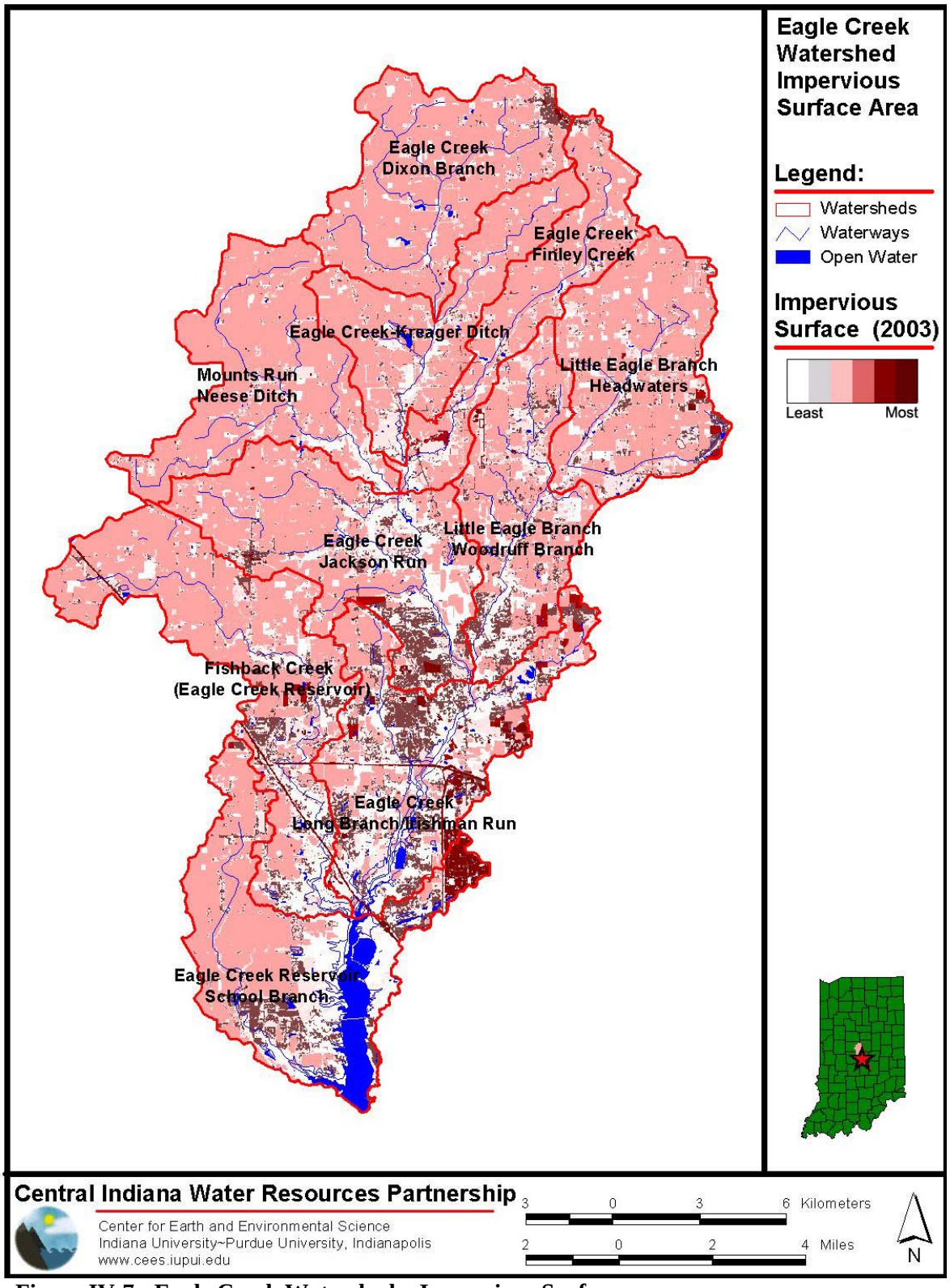


Figure IV-7: Eagle Creek Watershed – Impervious Surfaces

Recreation Areas

While the streams in Eagle Creek Watershed and Eagle Creek Reservoir are designated for use for Full Body Contact Recreation, much of the upstream reaches are bordered by agricultural land, making access to the streams limited. Public Access to Eagle Creek is limited to a few parks: Eagle Creek Park (Indianapolis), Starkey Nature Park (Zionsville), Creekside Nature Park (Zionsville), and Lions Park (Zionsville) (Table IV-9).

The main trunk of Eagle Creek in the Long Branch & Irishman Run subwatersheds are sufficiently deep to allow for shallow drafting, low horsepower or paddle driven water craft such as jon boats, kayaks and canoes. Boaters can access this area of the stream via under bridge put-ins or Eagle Creek Park.

Table IV-9: Recreational Areas in Eagle Creek Watershed

Park	City	Size	Amenities
Eagle Creek Park	Indianapolis	3,900 acres	Bait shop, Sailboat Marina, Outdoor Theater, Concession Stands, Fishing Areas, Fitness Course, Nature Center, Retreat Centers, Picnicking, Boat Ramps and Slips, Swim Beach,, Boat Rentals, Cross-Country Ski Paths, Marsh & Bird Sanctuary, Pistol/Archery Range, Woodland Wildlife Preserve
Starkey Nature Park	Zionsville	77 acres	Hiking Trails, Nature Study, Picnicking, Access to Stream
Creekside Nature Park	Zionsville	18 acres	Hiking Trails, Access to Stream
Lions Park	Zionsville	18 acres	Baseball and Softball Diamonds, Sand Volleyball, Picnicking

Farming Practices

Corn and soybeans are the predominant crops in Boone, Hamilton, and Hendricks Counties, the three agricultural counties in which Eagle Creek Watershed lies (Figure III-17). (The area of Marion County in which Eagle Creek Watershed lies does not have a significant amount of agriculture). In 2000, approximately 53,900 acres of land in Eagle Creek Watershed were used for agriculture (Tedesco *et al*., 2003). In 2004, 221,014 acres in Boone County, 106,430 acres in Hamilton County, and 114,085 acres in Hendricks County were used for the production of corn and soybean (Table IV-10).

Tillage Practices

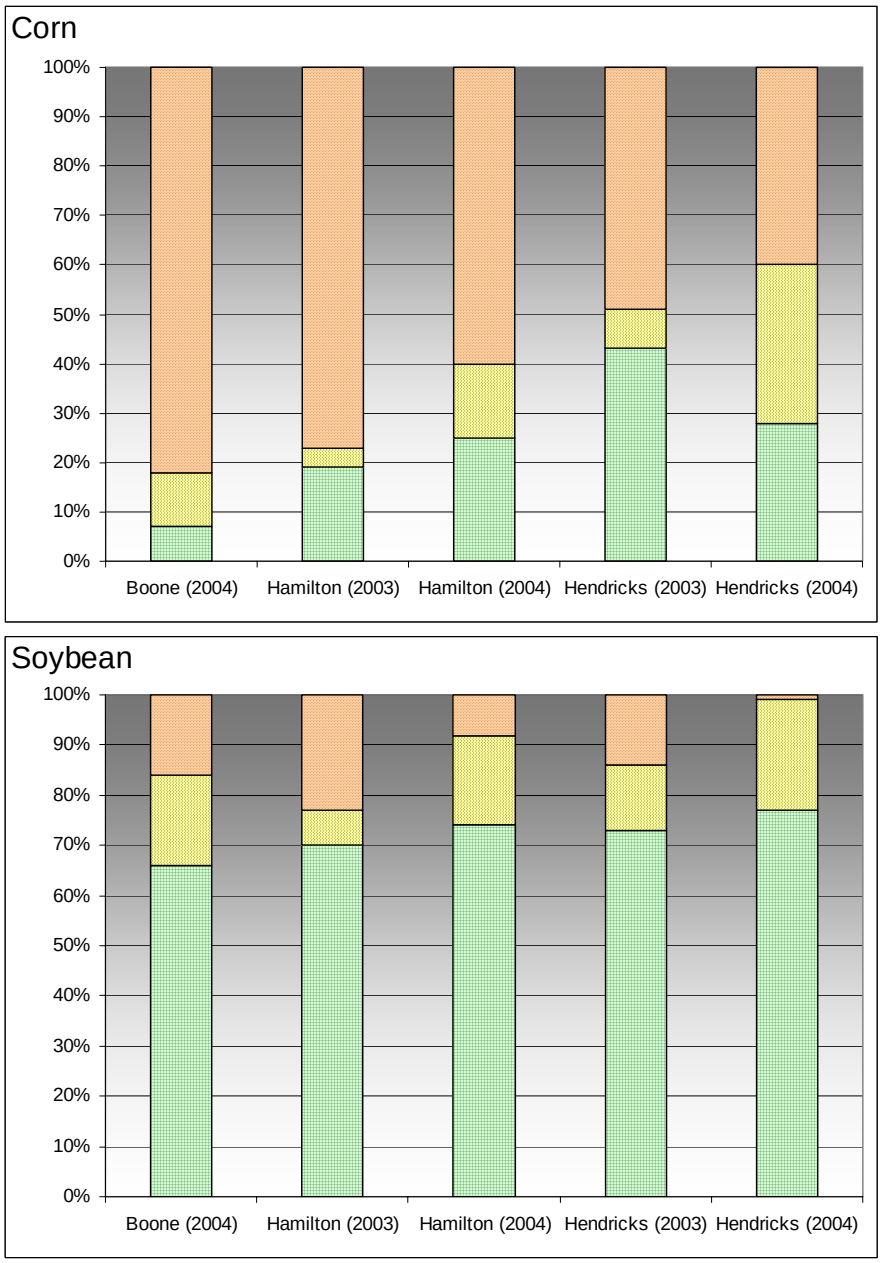
Tillage practices can affect water quality by influencing the amount of sediment that is eroded from fields and transported to streams, lakes, and reservoirs. Agricultural chemicals, such as nutrients and pesticides, are often transported along with eroded sediments, which can increase concentrations of these contaminants in surface water. Soil erosion and runoff are considered (by volume) the greatest surface water contaminant in Indiana watersheds (Evans *et al*., 2000). No-till, a conservation-tillage system, which leaves more than 30% crop residue cover on the fields, is the most effective soil conservation practice for reducing soil erosion and improving water quality. Leaving more than 30% crop cover increases infiltration rates, thus reducing the amount of soil lost to agricultural runoff. As such, conservation tillage[6] along with filter strips and buffers is recognized as a management practice necessary for reducing agricultural runoff and improving water quality (Evans *et al*., 2000) however, no-till practices can result in an increased use of agricultural chemicals.

Table IV-10: Corn and Soybean Acreage and Tillage Practices

		Corn						
		Total Acres	No Till		Mulch Till		Conventional	
Year	**County**	*(acres)*	*(acres)*	*%*	*(acres)*	*%*	*(acres)*	*%*
2004	Boone	114,543	8,018	*7%*	12,600	*11%*	93,925	*82%*
2003	Hamilton	59,058	11,221	*19%*	2,362	*4%*	45,475	*77%*
2004	Hamilton	48,372	12,093	*25%*	7,256	*15%*	29,023	*60%*
2003	Hendricks	68,679	29,532	*43%*	5,494	*8%*	33,653	*49%*
2004	Hendricks	49,525	13,867	*28%*	15,848	*32%*	19,810	*40%*

		Soybean						
		Total Acres	No-Till		Mulch Till		Conventional	
Year	**County**	*(acres)*	*(acres)*	*%*	*(acres)*	*%*	*(acres)*	*%*
2004	Boone	106,471	70,271	*66%*	19,165	*18%*	17,035	*16%*
2003	Hamilton	55,161	38,613	*70%*	3,861	*7%*	12,687	*23%*
2004	Hamilton	58,058	42,963	*74%*	10,450	*18%*	4,645	*8%*
2003	Hendricks	57,736	42,147	*73%*	7,506	*13%*	8,083	*14%*
2004	Hendricks	64,560	49,711	*77%*	14,203	*22%*	646	*1%*

[6] Any tillage system leaving at least 30% of the crop residue cover on the soil surface after planting.



No-till: Any direct seeding system including strip preparation with minimal soil disturbance.
Mulch Till: Any tillage system leaving greater than 30% of the crop residue cover after planting, excluding no-till.
Conventional: Any tillage system leaving less than 30% crop residue cover after planting.

Figure IV-8: Tillage Practices by County (Percent) (Indiana Division of Soil Conservation, 2003 and 2004)

Indiana's Division of Soil Conservation 2003 and 2004 data show that corn field tillage practices in the counties in which Eagle Creek Watershed lies are dominated by conventional tillage, while soybean crop tillage practices are dominated by no-till practices (Table IV-10 and

Figure IV-8). That corn is the most heavily fertilized of soybean and corn crops (see following section on Agricultural Chemicals) and that corn is most often farmed using conventional tillage practices suggests that corn field run-off is a possible source of nutrients and herbicides into Eagle Creek Watershed's streams.

Agricultural Chemicals

Agricultural fertilizers, herbicides, and pesticides are used extensively in crop production in Indiana. Soil erosion, runoff, and tile drainage from agricultural fields is a source of contaminants in Indiana watersheds; therefore, a major source of plant limiting nutrients (nitrogen and phosphorous), herbicides, and pesticides in the surface and ground water is from chemical applications to row crops.

As information on agricultural chemical use is not available for Eagle Creek Watershed, usage was estimated. Estimates of acres planted of each crop within Eagle Creek Watershed were based on the statewide percentages of soybean and corn acres. The state total acreage of soybean and corn fields was added to obtain the Total Agricultural Acreage. (Other crops such as wheat, hay, and oats were not included in the calculation as visual assessments of the Eagle Creek Subwatersheds show that they are negligible.) The acreage of soybeans was divided by the Total Agricultural Acreage to determine the percentage of agricultural land used for soybean production and the same calculation was completed for corn. These calculations resulted in an estimated annual state agricultural land-use average of 48% soybean and 52% corn production. These percentages were applied to the acreage of agricultural land delineated in 2002-2003 land cover assessment for each Eagle Creek Subwatershed to estimate acres of soybean and corn in the subwatersheds. (Visual assessment of the subwatersheds verifies that agricultural land is approximately 50% soybean fields and 50% corn fields.) To estimate the amount of agricultural chemicals used in Eagle Creek Basin, the total mass of chemicals applied in the state was divided by the total acreage of crop (soybean or corn) to determine an average statewide application rate (lbs/acre-year or ton/acre-year Mass of applied chemicals was based on NASS USDA 2002 Chemical Usage Reports. This rate was then applied to the Eagle Creek Subwatersheds to estimate mass of agricultural chemicals applied to agricultural fields in Eagle Creek Watershed (Table IV-11 and Table IV-12).

Of the crops to which fertilizer is applied (e.g., corn, soybean, and wheat) most is applied to corn—it receives 90 percent of the nitrogen and 76 percent of the phosphorus. One percent of the nitrogen and 13 percent of the phosphorus is applied to soybeans. Application methods and the types of fertilizer applied in Indiana varies depending on the weather, soil fertility, tillage systems, crop types, crop rotations, yield goals, and farmer preferences. Anhydrous ammonia, 28-percent-liquid nitrogen, and

urea in solid form are the most widely used nitrogen-based fertilizers for corn (Schnoebelen and others, 1996). Typically, two applications of nitrogen based fertilizer are applied in Indiana to corn per year (Indiana Agricultural Statistics Service, 1992). The initial treatment is anhydrous ammonia applied 1 to 2 weeks before planting or liquid nitrogen or urea applied at planting. After corn is about 1 foot tall (usually early to mid-June), a second, larger treatment is applied. Some farmers also apply nitrogen-based fertilizers after harvest, especially if they plan to grow winter wheat. As estimated fertilizer usage was based on acreage, those subwatersheds with the greatest amount of land in soybean and corn production (Dixon Branch, Mounts Run-Neese Ditch, and Fishback Creek) consistently show the highest estimated fertilizer application (Table IV-11– shaded rows).

Herbicides applied to corn and soybeans dominate herbicide and pesticide use in Indiana and, therefore, it is reasonable to believe that, this is also true for the Eagle Creek Basin. Herbicides are applied in the spring during planting to virtually all corn and soybean crops. In Indiana, herbicide with the highest statewide average application rate are Sulfosate (1.22 lb/acre-year) and Glyphosate (1.58 lb/acre-year). Corn herbicides with the highest statewide average application rate are Atrazine (1.32 lb/acre-year), Dimethenamid (1.18 lb/acre-year), Metolachlor (1.66 lb/acre-year), and S-Metolachlor (1.23 lb/acre-year) (Table IV-12). Because of increased use of no-till farming practices in Indiana, there has been a significant increase in the use of glyphosate, 2,4-D, and pendimethalin in the last 7 years. These herbicides are used prior to planting to kill all plant growth. Insecticides are applied during the summer to about 25 percent of the corn crop and typically are not applied to soybeans (National Agricultural Statistics Service, 1998). As estimated herbicide usage was based on acreage, those subwatersheds with the greatest amount of land in soybean and corn production (Dixon Branch, Mounts Run-Neese Ditch, and Fishback Creek) consistently show the highest estimated herbicide application (Table IV-12– shaded rows).

Table IV-11: Estimated 2002 Fertilizer Application in Eagle Creek Subwatersheds

	Soybean			Corn		
	N*	P†	Potash	N*	P†	Potash
Application Rate (lbs/acre/yr)‡	2	52	111	147	71	125

	Acres Planted°		Soybean			Corn		
			N*	P†	Potash	N*	P†	Potash
Subwatershed	Soybean	Corn	*(tons)*	*(tons)*	*(tons)*	*(tons)*	*(tons)*	*(tons)*
Eagle Creek Dixon Branch	4,600	4,283	4.1	121	256	315	151	268
Eagle Creek-Finley Creek	2,504	2,332	2.2	66	139	172	82	146
Eagle Creek -Kreager Ditch	3,088	2,875	2.8	81	172	212	101	180
Little Eagle Branch-Headwaters	3,698	3,443	3.3	97	205	253	121	215
Mounts Run- Neese Ditch	4,497	4,187	4.0	118	250	308	148	262
Little Eagle Branch-Woodruff	2,455	2,286	2.2	64	136	168	81	143
Eagle Creek- Jackson Run	3,451	3,213	3.1	90	192	236	113	201
Fishback Creek (Eagle Creek Reservoir)	4,170	3,882	3.7	109	232	286	137	243
Eagle Creek- Long Branch/Irishman Run	1,550	1,443	1.4	41	86	106	51	90
Eagle Creek Reservoir-School Branch	2,724	2,536	2.4	71	151	187	89	159
Total Applied in Eagle Creek Watershed	32,738	30,480	29.3	858	1,819	2,243	1,075	1,905

* Nitrogen

† Phosphorous

‡ Application rate based on total mass applied in Indiana divided by total acres of land in Indiana used for each crop (NASS USDA 2002 Chemical Usage Reports).

° Acres Planted was estimated based on statewide averages for corn and soybean production. In Indiana, annual averages show that 52% of farmland is used for corn production while 48% is used for soybean production. These percentages were applied to the acreage of agricultural land delineated in 2002-2003 land cover assessment for each subwatershed to estimate how many acres were planted for each crop. Visual assessment of the subwatersheds verifies that agricultural land is approximately 50% corn fields and 50% soybean fields and that other crops (e.g., wheat, hay, and oats) were negligible.

Table IV-12: Estimated 2002 Herbicide Application in Eagle Creek Subwatersheds

	Soybean						
	2,4-D	**Chlorimuron-ethyl**	**Fenoxaprop**	**Fluazifop-P-butyl**	**Fomesafen**	**Glyphosate**	**Glyphosate, diam. Salt**
Common Name(s)		(Canopy, Classic, Authority)	(Fusion)	(Fusilade, Typhoon, Fusion)	(Reflex, Flextar, Typhoon)	(Roundup, Protocol, Extreme, Bronco)	(Touchdown)
Application rate (lbs/acre/yr)*	0.29	0.02	0.14	0.04	0.31	1.22	0.90

Subwatershed	**2,4-D** *(lbs)*	**Chlorimuron-ethyl** *(lbs)*	**Fenoxaprop** *(lbs)*	**Fluazifop-P-butyl** *(lbs)*	**Fomesafen** *(lbs)*	**Glyphosate** *(lbs)*	**Glyphosate, diam. Salt** *(lbs)*
Eagle Creek Dixon Branch	1,348	79	650	206	1,428	5,590	4,142
Eagle Creek-Finley Creek	734	43	354	112	777	3,043	2,255
Eagle Creek -Kreager Ditch	905	53	437	138	958	3,753	2,781
Little Eagle Branch-Headwaters	1,084	64	523	166	1,148	4,494	3,330
Mounts Run- Neese Ditch	1,318	78	636	202	1,396	5,465	4,049
Little Eagle Branch- Woodruff	720	42	347	110	762	2,984	2,211
Eagle Creek- Jackson Run	1,012	60	488	155	1,071	4,194	3,107
Fishback Creek (Eagle Creek Reservoir)	1,222	72	590	187	1,294	5,067	3,754
Eagle Creek- Long Branch/Irishman Run	454	27	219	69	481	1,883	1,395
Eagle Creek Reservoir-School Branch	798	47	385	122	845	3,310	2,453
Total for Eagle Creek Watershed	**9,596**	**564**	**4,628**	**1,468**	**10,160**	**39,784**	**29,477**

* Application rate based on total mass applied in Indiana divided by total acres of land in Indiana used for each crop (NASS USDA 2002 Chemical Usage Reports). These estimates show the amount of herbicide possibly applied if all farms used all herbicides at all times. This is not the case: each farm utilizes only one to a few chemicals for each crop. Therefore, these estimates only give the possible amount of herbicide used in each watershed.

Table IV-12: Estimated 2002 Herbicide Application in Eagle Creek Subwatersheds (continued)

	Soybean					
	Imazaquin	**Imazethapyr**	**Metribuzin**	**Pendimethalin**	**Sulfentrazone**	**Sulfosate**
Common Name(s)	(Scepter, Squadron, TriScept, Steel)	(Pursuit, Lightnight, Steel, Extreme, Res.)	(Canopy, Turbo, Sencor, Aziom, Boundary)	(Prowl, Steel, Pursuit Plus, Squadron)	(Authority, Canopy, Gauntlet)	(Touchdown) (2001 Data)
Application rate (lbs/acre/yr)*	0.07	0.06	0.16	0.90	0.10	1.58

	Imazaquin	**Imazethapyr**	**Metribuzin**	**Pendimethalin**	**Sulfentrazone**	**Sulfosate**
Subwatershed	*(lbs)*	*(lbs)*	*(lbs)*	*(lbs)*	*(lbs)*	*(lbs)*
Eagle Creek Dixon Branch	337	262	730	4,124	465	7,257
Eagle Creek-Finley Creek	184	142	397	2,245	253	3,951
Eagle Creek -Kreager Ditch	226	176	490	2,769	312	4,872
Little Eagle Branch-Headwaters	271	210	587	3,315	373	5,834
Mounts Run- Neese Ditch	330	256	713	4,032	454	7,094
Little Eagle Branch- Woodruff	180	140	389	2,201	248	3,874
Eagle Creek- Jackson Run	253	196	547	3,094	349	5,445
Fishback Creek (Eagle Creek Reservoir)	306	237	661	3,738	421	6,578
Eagle Creek- Long Branch/Irishman Run	114	88	246	1,389	156	2,445
Eagle Creek Reservoir-School Branch	200	155	432	2,442	275	4,297
Total for Eagle Creek Watershed	**2,399**	**1,863**	**5,193**	**29,351**	**3,306**	**51,647**

* Application rate based on total mass applied in Indiana divided by total acres of land in Indiana used for each crop (NASS USDA 2002 Chemical Usage Reports). These estimates show the amount of herbicide possibly applied if all farms used all herbicides at all times. This is not the case: each farm utilizes only one to a few chemicals for each crop. Therefore, these estimates only give the possible amount of herbicide used in each watershed.

Table IV-12: Estimated 2002 Herbicide Application in Eagle Creek Subwatersheds (continued)

	Corn						
	Acetamide	**Acetochlor**	**Atrazine**	**Clopyralid**	**Dicamba**	**Dicamba, Dimet. Salt**	**Dimethenamid**
Common Name(s)	(Axiom, Epic, Definte, Domain).	(Harness Plus, Surpass, TopNotch)	(Atrazine, Bicep, Degree, Xtra)	(Curtail, Stinger, Hornet)	(Banvel, North Star, Celebrity, Op Till)	(Distinct, Range Star, Sterlin)	(Guardsman, Frontier, Op Till)
Application rate (lbs/acre/yr)*	0.44	0.19	1.32	0.10	0.12	0.10	1.18

	Acetamide	**Acetochlor**	**Atrazine**	**Clopyralid**	**Dicamba**	**Dicamba, Dimet. Salt**	**Dimethenamid**
Subwatershed	*(lbs)*	*(lbs)*	*(lbs)*	*(lbs)*	*(lbs)*	*(lbs)*	*(lbs)*
Eagle Creek Dixon Branch	1,903	807	5,640	419	529	416	5,036
Eagle Creek-Finley Creek	1,036	439	3,071	228	288	227	2,742
Eagle Creek -Kreager Ditch	1,278	542	3,787	281	355	280	3,381
Little Eagle Branch-Headwaters	1,530	649	4,534	337	425	335	4,049
Mounts Run- Neese Ditch	1,861	789	5,514	410	517	407	4,923
Little Eagle Branch- Woodruff	1,016	431	3,011	224	282	222	2,688
Eagle Creek- Jackson Run	1,428	605	4,232	315	397	312	3,779
Fishback Creek (Eagle Creek Reservoir)	1,725	731	5,113	380	479	377	4,565
Eagle Creek- Long Branch/Irishman Run	641	272	1,900	141	178	140	1,697
Eagle Creek Reservoir-School Branch	1,127	478	3,340	248	313	247	2,982
Total for Eagle Creek Watershed	**13,547**	**5,743**	**40,141**	**2,984**	**3,763**	**2,963**	**35,842**

* Application rate based on total mass applied in Indiana divided by total acres of land in Indiana used for each crop (NASS USDA 2002 Chemical Usage Reports). These estimates show the amount of herbicide possibly applied if all farms used all herbicides at all times. This is not the case: each farm utilizes only one to a few chemicals for each crop. Therefore, these estimates only give the possible amount of herbicide used in each watershed.

Table IV-12: Estimated 2002 Herbicide Application in Eagle Creek Subwatersheds (continued)

	Corn						
	Flumetsulam	**Glyphosate**	**Imazapyr**	**Imazethapyr**	**Isoxaflutole**	**Metolachlor**	**Nicosulfuron**
Common Name(s)	(Broadstrike, Accent Gold, Bicep)	(Roundup, Protocol, Extreme, Glyphomax)	(Lightning, Pursuit, Steel)	(Pursuit, Lightning, Steel)	(Balance, Epic)	(Dual, Dual II, Bicep, Turbo)	(Accent Gold, Celebrity, Steadfast)
Application rate (lbs/acre/yr)*	0.10	0.68	0.00	0.01	0.06	1.66	0.02

Subwatershed	**Flumetsulam** *(lbs)*	**Glyphosate** *(lbs)*	**Imazapyr** *(lbs)*	**Imazethapyr** *(lbs)*	**Isoxaflutole** *(lbs)*	**Metolachlor** *(lbs)*	**Nicosulfuron** *(lbs)*
Eagle Creek Dixon Branch	412	2,895	16	32	256	7,112	79
Eagle Creek-Finley Creek	225	1,576	9	17	140	3,872	43
Eagle Creek -Kreager Ditch	277	1,944	11	21	172	4,775	53
Little Eagle Branch-Headwaters	332	2,327	13	26	206	5,717	64
Mounts Run- Neese Ditch	403	2,830	16	31	250	6,952	78
Little Eagle Branch- Woodruff	220	1,545	8	17	137	3,796	42
Eagle Creek- Jackson Run	309	2,172	12	24	192	5,336	60
Fishback Creek (Eagle Creek Reservoir)	374	2,624	14	29	232	6,446	72
Eagle Creek- Long Branch/Irishman Run	139	975	5	11	86	2,396	27
Eagle Creek Reservoir-School Branch	244	1,714	9	19	152	4,211	47
Total for Eagle Creek Watershed	**2,935**	**20,602**	**113**	**226**	**1,824**	**50,612**	**564**

* Application rate based on total mass applied in Indiana divided by total acres of land in Indiana used for each crop (NASS USDA 2002 Chemical Usage Reports). These estimates show the amount of herbicide possibly applied if all farms used all herbicides at all times. This is not the case: each farm utilizes only one to a few chemicals for each crop. Therefore, these estimates only give the possible amount of herbicide used in each watershed.

Table IV-12: Estimated 2002 Herbicide Application in Eagle Creek Subwatersheds (continued)

	Corn						
	Primisulfuron	**S-Metolachlor**	**Chlorpyrifos**	**Clyfluthrin**	**Fipronil**	**Teupirimphos**	**Tefluthrin**
Common Name(s)	(Exceed, North Star, Beacon)	(Gual Mag, Dual II, Bicep Mag, Bound	(Lorsban, Dursban)	(Baythroid, Leverage, Aztec)	(Regent)	(Aztec)	(Force)
Application rate (lbs/acre/yr)*	0.02	1.23	0.90	0.00	0.13	0.11	0.12

Subwatershed	**Primisulfuron** *(lbs)*	**S-Metolachlor** *(lbs)*	**Chlorpyrifos** *(lbs)*	**Clyfluthrin** *(lbs)*	**Fipronil** *(lbs)*	**Teupirimphos** *(lbs)*	**Tefluthrin** *(lbs)*
Eagle Creek Dixon Branch	99	5,289	3,847	20	544	466	523
Eagle Creek-Finley Creek	54	2,879	2,094	11	296	254	285
Eagle Creek -Kreager Ditch	67	3,551	2,583	13	365	313	351
Little Eagle Branch-Headwaters	80	4,251	3,092	16	437	375	421
Mounts Run- Neese Ditch	97	5,170	3,760	19	532	455	512
Little Eagle Branch- Woodruff	53	2,823	2,053	11	290	249	279
Eagle Creek- Jackson Run	74	3,968	2,886	15	408	350	393
Fishback Creek	90	4,794	3,487	18	493	422	474
Eagle Creek- Long Branch/Irishman Run	33	1,782	1,296	7	183	157	176
Eagle Creek Reservoir-School Branch	59	3,132	2,278	12	322	276	310
Total for Eagle Creek Watershed	**706**	**37,638**	**27,376**	**141**	**3,870**	**3,316**	**3,725**

* Application rate based on total mass applied in Indiana divided by total acres of land in Indiana used for each crop (NASS USDA 2002 Chemical Usage Reports). These estimates show the amount of herbicide possibly applied if all farms used all herbicides at all times. This is not the case: each farm utilizes only one to a few chemicals for each crop. Therefore, these estimates only give the possible amount of herbicide used in each watershed.

Herbicides are the most commonly occurring agricultural pesticides in surface waters in the White River Basin (Crawford, 1995; Crawford, 1996). Typically, 1 percent of the applied herbicide is washed into surface water (Crawford, 1995). Most of this wash off usually occurs during the first rainfall after application. The percentage of the herbicides applied that wash off increases as the time between pesticide application and the next rainfall decreases. Concentrations of herbicides in streams are usually elevated for a several week to several month period from mid-May to early July (Crawford, 1995). Herbicides washed into Eagle Creek Reservoir can accumulate there because of the reservoir residence time (51 days) and the persistence of some chemicals. For example, depending on temperature, pH, and organic matter content, Atrazine has a half-life of 64 days. Given an increase in organic matter, degradation can be twice as fast; however, given a pH of 7-9 (typical of Eagle Creek Watershed Streams), degradation can be 2-3 times as slow. In general, herbicide persistence is dependent on the degradation kinetics of the particular herbicide and the presence of bacteria capable of facilitating degradation.

Tile Drains

Water quality in many parts of Indiana is affected by tile drains. Since the beginning of the 20th Century many poorly drained soils in Indiana have been improved for farming by the installation of tile-drain systems (Figure IV-1). Newer tile drains commonly consist of perforated, flexible tubes buried in trenches in fields beneath the plow zone. Older systems are usually clay tile. Tile drains short circuit the natural flow of water through soil by removing standing water in fields, draining excess soil moisture in the unsaturated zone, draining seasonally high ground-water tables, and transporting water to nearby ditches or streams. Information on the number and location of tile-drain systems in Indiana is not available, but agricultural experts expect that nearly all poorly drained farmlands contain tile-drain systems (Schnoebelen *et al*., in press) which would include much of the Eagle Creek Watershed. As tile drains are a transport mechanism that often bypasses riparian buffers, tile drainage can be particularly problematic to surface-water quality if rainfall occurs immediately following application of fertilizers or pesticides. Tile drains have been shown to be a significant pathway for nutrient and herbicide transport to streams in central Indiana (Fenelon, 1998; Fenelon and Moore, 1998).