Technical Appendix:

Section 5. Biological Stream Monitoring

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TA-5.1 Background

Examples of Tolerance Values and Functional Feeding Groups

Table TA-5.1. Examples of tolerance values and functional feeding groups for select fish and benthic macroinvertebrates.

Fish			Benthic macroinvertebrates		
SPECIES	Tolerance Level **	Functional Feeding Group	SPECIES	Tolerance Level **	Functional Feeding Group
American eel	M	Generalist	Alloperla sp.	0	Predator
Blacknose dace	T	Omnivore	Ameletus sp.	0	Collector
Blue Ridge sculpin	I	Insectivore	Amphinemura sp.	3	Shredder
Bluegill	T	Invertivore	Asellus sp.	8	Collector
Bluntnose minnow	T	Omnivore	Baetis sp.	6	Collector
Brown bullhead	T	Omnivore	Boyeria sp.	2	Predator
Brown trout	I	Top Predator	Calopteryx sp.	6	Predator
Central stoneroller	M	Algavore	Cheumatopsyche sp.	5	Filterer
Channel catfish	M	Omnivore	Chimarra sp.	4	Filterer
Comely shiner	I	Invertivore	Chironomus sp.	10	Collector
Common carp	T	Omnivore	Cladotanytarsus sp.	7	Filterer
Common shiner	M	Omnivore	Clinocera sp.	6	Predator
Creek chub	T	Generalist	Clioperla sp.	1	Predator
Cutlips minnow	M	Invertivore	Corbicula sp.	6	Filterer
E. silvery minnow	M	Algavore	Crangonyx sp.	4	Collector
Eastern mosquitofish	T	Invertivore	Diploperla sp.	2	Predator
Fallfish	M	Generalist	Drunella sp.	0	Scraper
Fantail darter	M	Insectivore	Eccoptura sp.	3	Predator
Green sunfish	T	Generalist	Gomphus sp.	5	Predator
Largemouth bass	T	Top Predator	Glyptotendipes sp.	10	Filterer
Longnose dace	M	Omnivore	Haploperla sp.	1	Predator
Margined madtom	M	Invertivore	Hydropsyche sp.	4	Filterer
Northern hogsucker	I	Invertivore	Isonychia sp.	2	Collector
Potomac sculpin	M	Insectivore	Isoperla sp.	2	Predator
Pumpkinseed	T	Invertivore	Ironoquia sp.	4	Shredder
Redbreast sunfish	T	Generalist	Micropsectra sp.	7	Collector
Rosyside dace	M	Invertivore	Neophylax sp.	3	Scraper
Sea lamprey	M	Filter Feeder	Simulium sp.	5	Filterer
Shield darter	I	Insectivore	Spirosperma sp.	10	Collector
Silverjaw minnow	M	Omnivore	Tanytarsini sp.	6	Filterer
Smallmouth bass	M	Top Predator	Taeniopteryx sp.	2	Shredder
White sucker	T	Omnivore	Tropisternus sp.	10	Predator
Yellow bullhead	M	Omnivore	Viviparus sp.	1	Scraper

**** Fish tolerance values are I=Intolerant, M=Intermediate, T=Tolerant. Benthic tolerance values are from 0-10, 10 being most tolerant.**

Benthic Macroinvertebrate and Fish Metrics

Table TA-5.2. Metrics Used in the Fish and Benthic Macroinvertebrate IBIs.

Fish IBI	Benthic macroinvertebrate IBI
Total number of species	Taxa richness (Total number of taxa)
Total number of riffle benthic insectivore individuals	Biotic index [2]
Total number of minnow species (Cyprinidae)	Ratio of scrapers (Scrapers divided by (scrapers + filter feeding collectors))
Total number of intolerant species	Proportion of *Hydropsyche* sp. & *Cheumatopsyche* sp.
Proportion of tolerant individuals to total individuals	Proportion of dominant taxa
Proportion of individuals as omnivores/generalists	Total number of EPT taxa [3]
Proportion of individuals as pioneering species [1]	Proportion of EPT individuals
Total number of individuals (excluding tolerant sp.)	Proportion of shredders to total individuals
Proportion of individuals with disease/anomalies	

[1] Pioneering species are dominant in fluctuating environments such as streams affected by temporal dessication and/or anthropogenic stresses. Pioneer species include the Blacknose dace, Bluntnose minnow, Creek chub, Green sunfish, and Tessellated darter.

[2] Biotic index is [(number of individuals per taxa * Tolerance Values for all taxa and total) / total # of organisms]

[3] EPT taxa fall into the taxonomic orders of mayflies (Ephemoptera), stoneflies (Plecoptera), or caddisflies (Trichoptera); aquatic insects that spend all of their juvenile or larval life stages instream.

Biological Data Available for all Four SPAs

Table TA-5.3. Biological monitoring data available for all four SPAs.

Key: B=Benthic macroinvertebrate data; F=Fish data; H=Habitat data; C=Physical chemistry data.

CLARKSBURG	Data Available By Year															
Station	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
GSWB201						BFHC	FHC	BHC		BFHC	BHC	BHC	BHC	BFHC	BFHC	BFHC
LSCB101					BFHC		BFHC		BHC	BHC	BHC	BHC	BHC	BHC	BHC	BHC
LSCB201					BFHC		FHC		BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC
LSLS101		BFHC	BHC	BFHC		BFHC	BFHC	BFHC	BHC	BFHC	BFH	BFHC	BFHC	BFHC	BFHC	BFHC
LSLS102												BHC	BHC			
LSLS103A		BHC	HC	C												
LSLS103B	FH	BHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BHC	BFHC
LSLS103C				BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC
LSLS104					BFHC	BFHC	BFHC	B	BHC	BFHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC
LSLS109					BHC	HC	FHC	B		BHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC
LSLS110					BHC	BHC	BFHC	B		BHC		BHC	BHC			
LSLS111						BHC	BHC									
LSLS203	BFH	BFHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC	FHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC
LSLS204	BFH	BFHC	BHC	BFHC	BFHC	BFHC		BFHC	FH	BFHC	BFHC	BFHC	BFHC		BFHC	BFHC
LSLS205	BFH	BFHC	BHC	BFHC	BFHC	BFHC		BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC
LSLS206	BFH	BFHC	BHC	HC	BFHC	BHC		B	BHC	BHC	BHC	BHC	BFHC			
LSLS301	BFH	BFHC	BHC	BFHC	FHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	FC		BFHC
LSLS302	BFH	BFHC	BHC	BFHC		BHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	
LSLS303	FH	BFHC	BHC		BHC		BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC			
LSTM106			C	BHC	BHC		BHC	B	BHC	BHC	BHC	BHC	BHC			
LSTM110			BHC	BHC	BHC					BHC	BHC		BHC	BHC		BHC
LSTM111										B		BHC				
LSTM112										BC		BHC	BHC	BFHC	BHC	BHC
LSTM201	BFH	BFHC	BHC	BFHC	BHC	BHC				BHC				BFHC	BFHC	BFHC
LSTM202	BFH	BFHC	BHC	BFHC	BHC	BHC				BHC				BFHC	BFHC	BFHC
LSTM203		BFH	BH							BH				BFH	BFHC	BFHC
LSTM204		BFHC	BHC	BHC						BH				BFHC	BFHC	BFHC
LSTM206				BFHC	BFHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC
LSTM302	BFH	BFHC	BHC	BFHC			BFHC			BFHC				BFHC	BFHC	BFHC
LSTM303B	BFH	BFHC	BHC	BFHC	BFHC	BHC	BFHC	BFHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC
LSTM304	BFH	BFHC	BHC	BFHC	FHC		BFHC			FHC		FHC	FHC			

PAINT BRANCH	Data Available By Year															
Station	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
PBAT101			BHC	BHC	BHC											
PBFF101				BHC		BHC	BHC									
PBGH108	FHC	BFHC	BFHC	BFHC	BHC	BFHC	BFHC		BHC	BHC	BHC	BFHC	BFHC	BHC	BFHC	BFHC
PBGH202				BHC		BHC	BHC									
PBGH208A	FHC	BFHC	BFHC	FHC	BFHC	BFHC	BFHC	FHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC
PBGH208B		BFHC	BFHC	BHC	HC					F						
PBGS102A				BHC	B											
PBGS102B				BHC	HC	BHC					BFHC					
PBGS111	BFHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFH	BFHC	BHC	BFHC	BFHC	BFHC	BFHC	BHC	BHC
PBGS206	FHC	BFHC	BFHC	FHC	BFHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC
PBLD101					BH	BHC	BHC	B		BHC	BHC					
PBLF202	FHC	BH	BFHC	BFHC		BFHC	BFHC	BFHC	BHC	BFHC	FH	BFHC	BFHC			BFHC
PBLF203	FHC	BH	BFHC	BFHC	BHC	BFHC	BFHC	BFHC	BHC	BFHC		BFHC	BFHC	BFHC	BFHC	BFHC
PBPB302	FHC	BH	BFHC	BFHC	BFHC	BFHC	BFHC		BHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC
PBPB305C	FHC	BFHC	BFHC	BFHC	BHC	BHC	FHC	BFHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC
PBRF117	FHC	BH	BFHC	BFHC	BFHC	BHC	BFHC	BFHC	BFHC	BFHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC
PBRF118	FHC	BH	BFHC	HC	BHC	BHC	BHC	B	BHC	BHC	BHC	BHC	BHC	BFHC	BFHC	BFHC
PBRF204	FHC	BH	BFHC	BFHC	BFHC	BFHC	BFHC	BFH	BFHC	BFHC	BFHC	BFHC	BFHC		BFHC	BFHC
PBRF206					BFHC	BHC	BFHC	BFHC	BHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC

PINEY BRANCH	Data Available By Year															
Station	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
WBPB101		BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC
WBPB102				BHC	BHC	BHC	BHC	B	BH	BHC	BHC	BHC	BHC	BHC	BHC	BHC
WBPB103				BHC	BHC	BHC	BHC	B	BH	BHC	BHC	BHC	BHC	BHC	BHC	BHC
WBPB201		BFHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	FHC	BFHC	BFHC
WBPB202		BFHC	BHC	BFHC	FHC	BFHC	BFHC	BFHC	BFH	BFHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC
WBPB203A		BFHC	BHC	FHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC
WBPB203B				BFHC	BFHC	BFHC	BFHC	BFHC	BHC	BHC						
WBPB204A		BFHC	BHC	BFHC	FHC	BHC	BFHC	BFH	BHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC
WBPB204B		B		BHC	BFHC	BFHC	BFHC	BFHC	BHC	BFHC	BFHC	BFHC	BFHC			
WBPB205		BFHC	BHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC	BFHC

UPPER ROCK CREEK	Data Available By Year															
Station	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
URNB103											BHC	BHC	BHC	BHC	BHC	BHC
URNB105											BHC	BHC	BHC	BHC	BHC	BHC
URNB110D											BHC	BHC	BHC	BC	BHC	BHC
URNB111											BHC	BHC	BHC	BHC	BHC	BHC
URRC104											BHC	BHC	BHC	BHC	BHC	BHC
URRC106											BHC	BH	BHC	BHC	BHC	BHC

Summary of Stream Monitoring Protocols

Benthic Macroinvertebrates

Biological field collection of benthic macroinvertebrates is conducted during the spring index period (March 15 to April 30). Using a D-frame net, a total of twenty samples of the best habitat within a 75 meter stream segment are sampled, each sample confined to a one square foot area. The proportion of available habitat types (e.g., riffles, root wads) within the segment are noted and then used to determine the proportion of samples that are taken within each habitat site. For instance, if within a 75m segment it is noted that approximately 60% of the best available habitat are riffles, 20% root wads, and 20% undercut banks; then twelve samples would be collected within riffles, four at root wads, and four at undercut banks. After twenty samples have been collected, the material is gathered in a sieve bucket and large pieces of debris such as sticks, intact leaves, and stones are rinsed and removed from the sample. The remaining fine material is stored in denatured ethanol to preserve the sample. Back in the lab, the field sample is processed further to get a representative subsample, (must be at least 100 organisms) to identify every individual.

Fish

Fish are collected in the summer index period (June 1 through the middle of October). Block nets are used at the top and bottom of a 75 meter stream segment to prevent the movement of fish into or out of the sampling segment. The fish survey is conducted using a two pass electrofishing effort (walking upstream) within the 75 meter stream section, following Maryland Biological Stream Survey (MBSS) methods (Kayzak 2001). The fish are stunned momentarily and collected using dip nets and buckets. The fish are then counted, identified, and released after each electrofishing pass. Anomalies such as ulcerations, lesions, deformities, or parasites are tallied for each species as well.

Habitat

The objective of the habitat assessment is to describe the structure of the physical features that characterize the condition of the stream resource and influence the existing aquatic community (Barbour and Stribling 1991). A rapid habitat assessment is performed alongside benthic collection in the spring and fish sampling in the summer. Quality and/or extent of certain habitat parameters is assessed, including: 1) instream fish cover, 2) epifaunal substrate, 3) embeddedness, 4) channel alteration, 5) sediment deposition, 6) frequency of riffles, 7) channel flow status, 8) bank vegetative protection, 9) bank stability, and 10) riparian vegetative zone width.

Physical Chemistry

A multi-parameter probe is placed in the stream's laminar flow to measure water temperature, pH, dissolved oxygen, percent saturation, and conductivity. Air temperature and time of day is also recorded at all stations.

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Maps of SPA Monitoring Stations and Year to Year Stream Conditions (Average of Benthic and Fish IBIs)

Clarksburg SPA

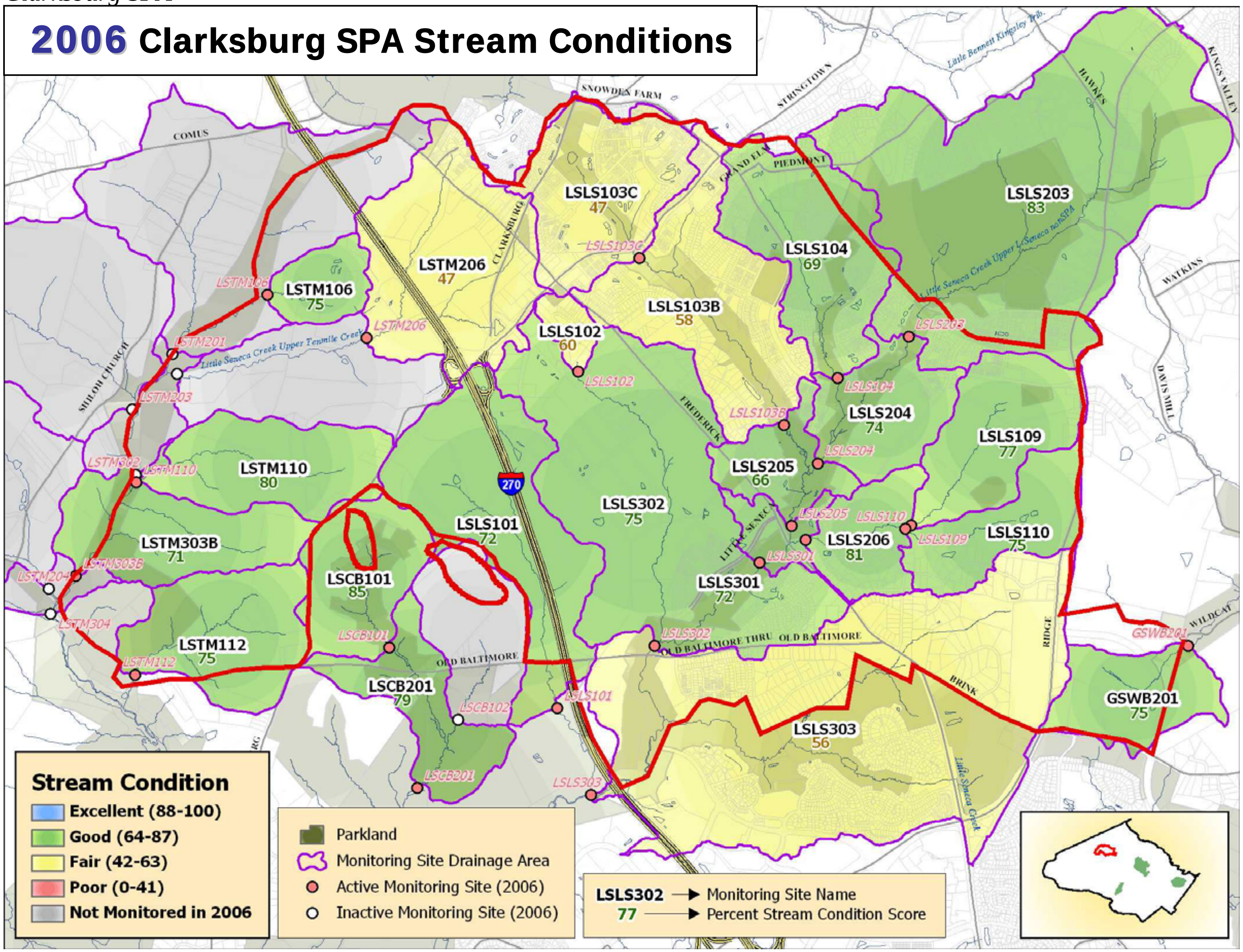

Figure TA-5.1. 2006 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Clarksburg SPA.

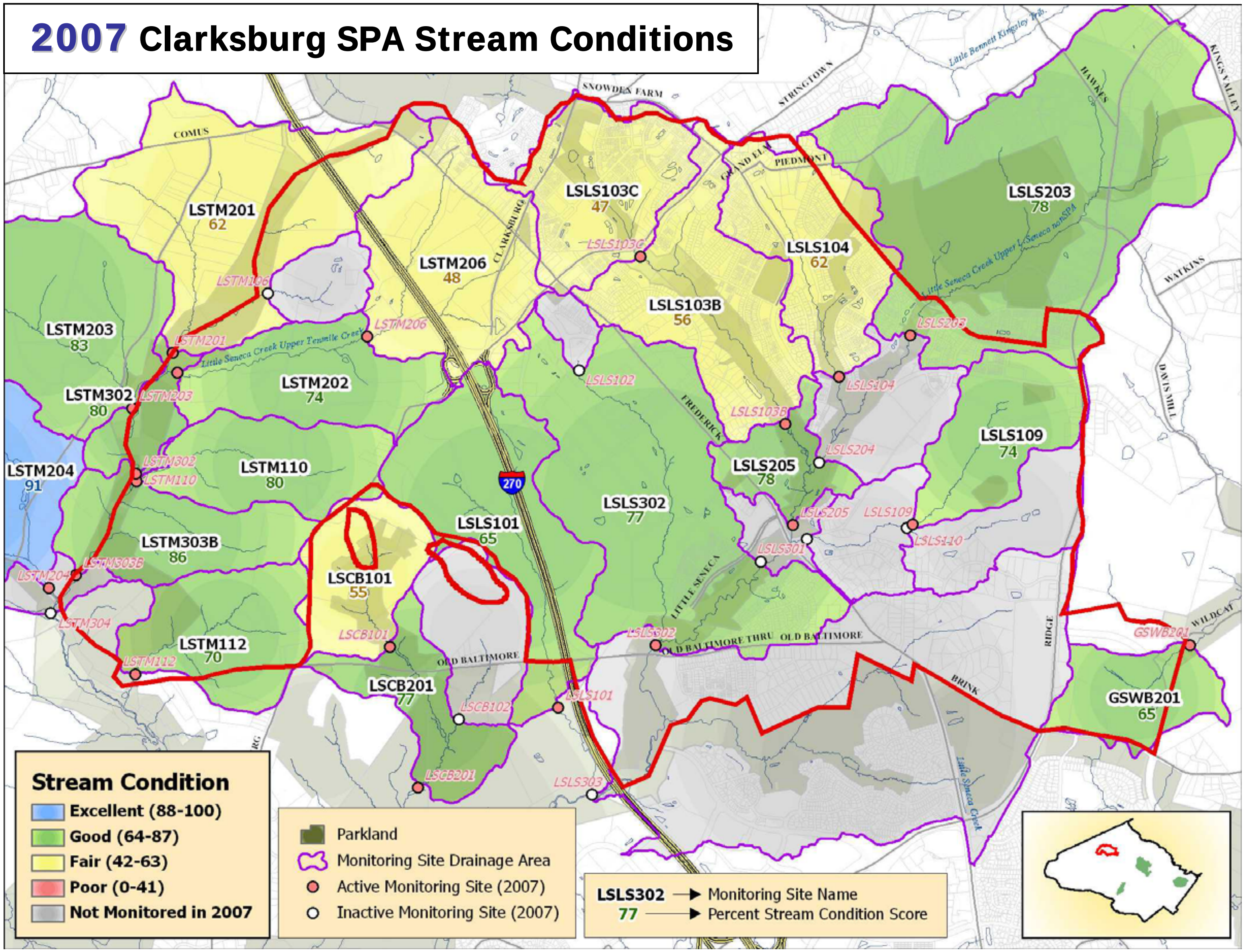

Figure TA-5.2. 2007 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Clarksburg SPA.

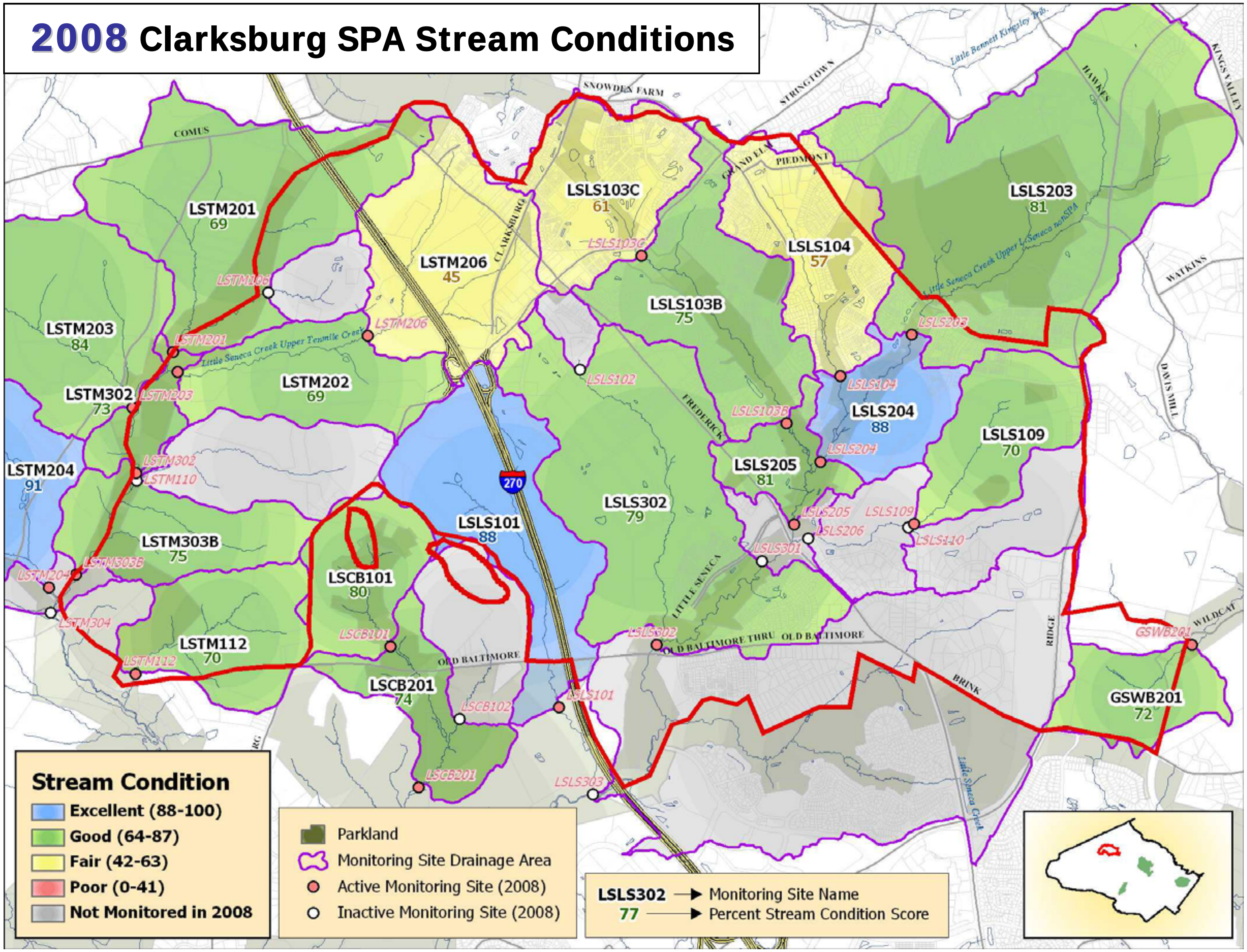

Figure TA-5.3. 2008 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Clarksburg SPA.

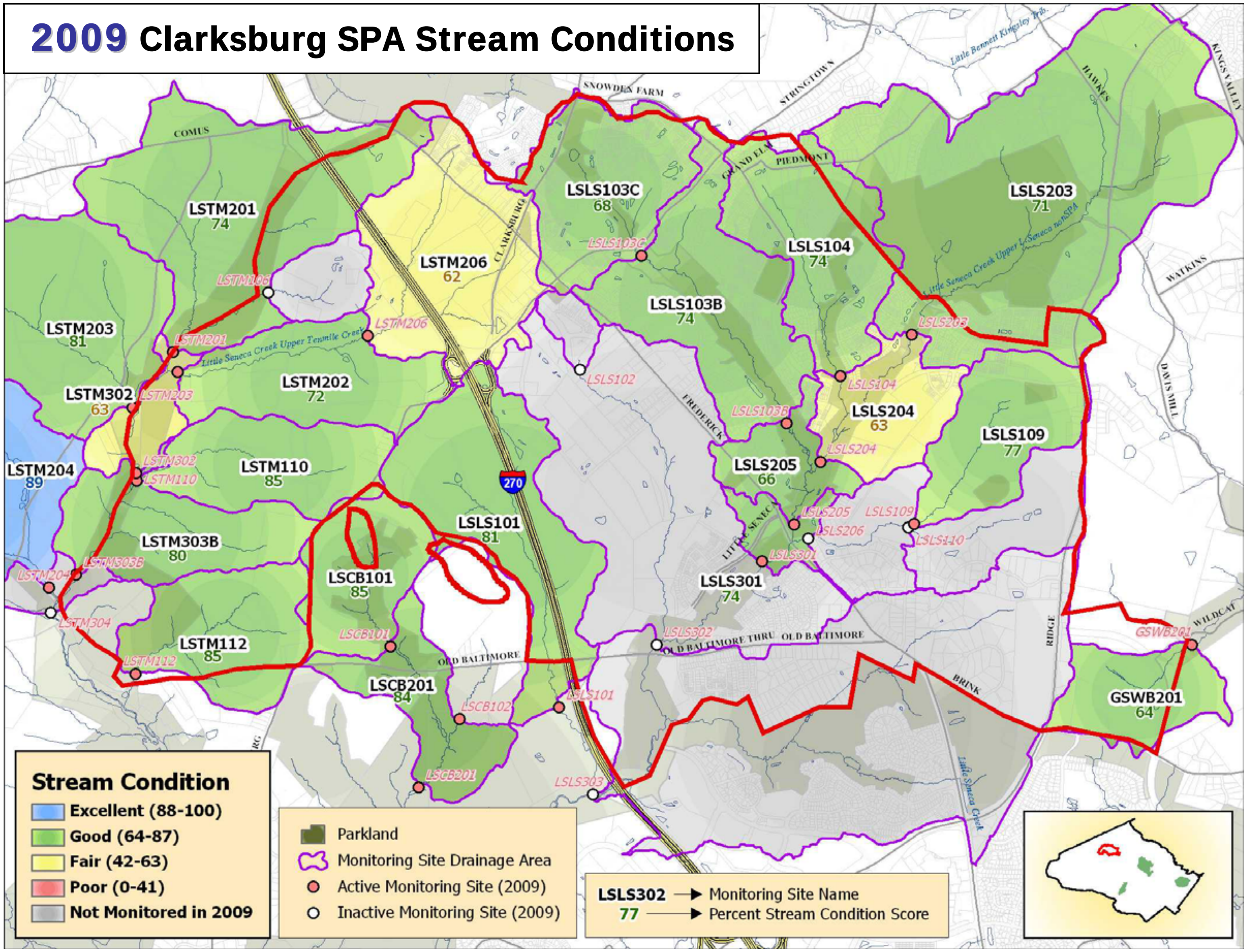

Figure TA-5.4. 2009 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Clarksburg SPA.

Paint Branch SPA

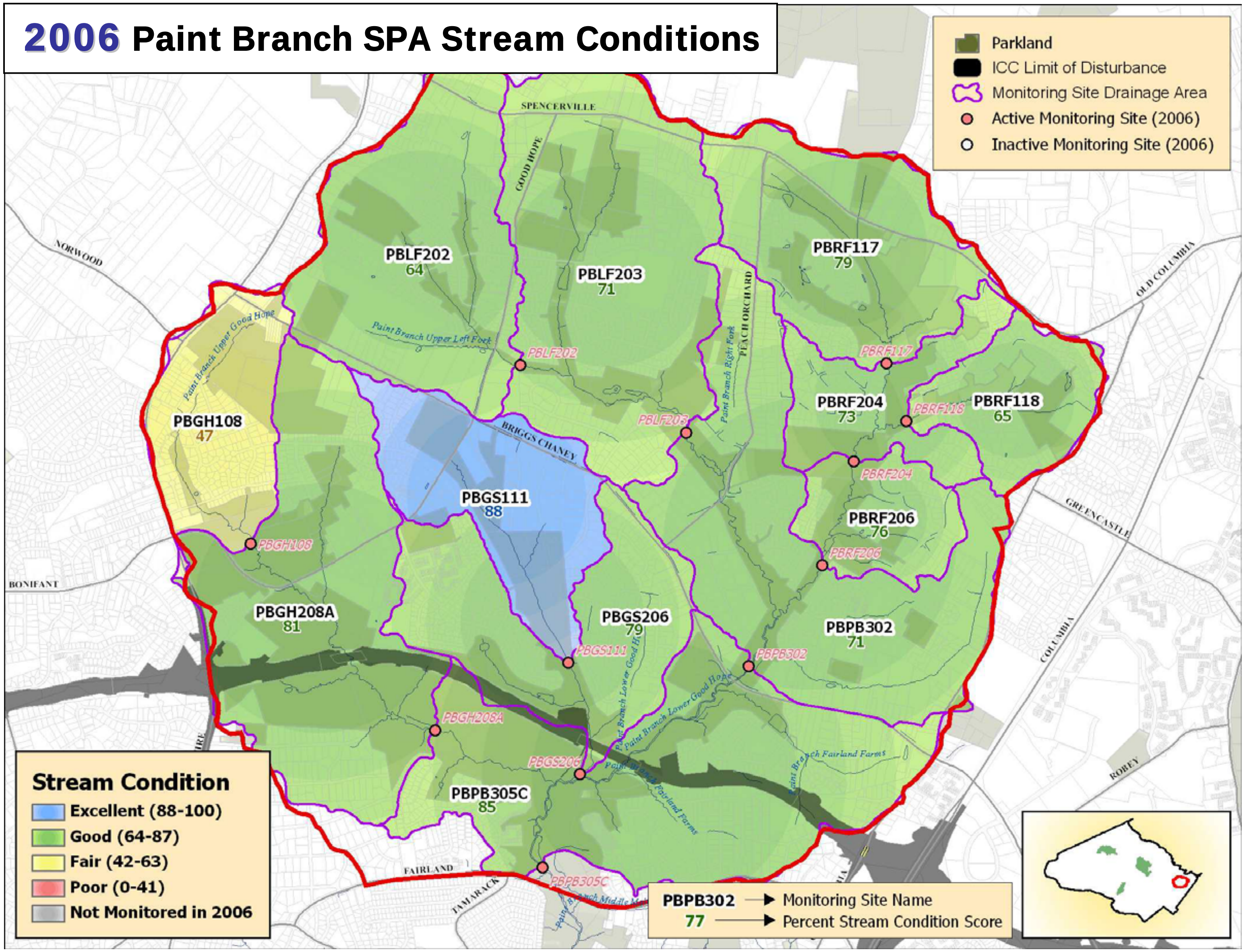

Figure TA-5.5. 2006 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Paint Branch SPA. Construction on this portion of the InterCounty Connector (ICC) (Contract B) did not begin until January 2009.

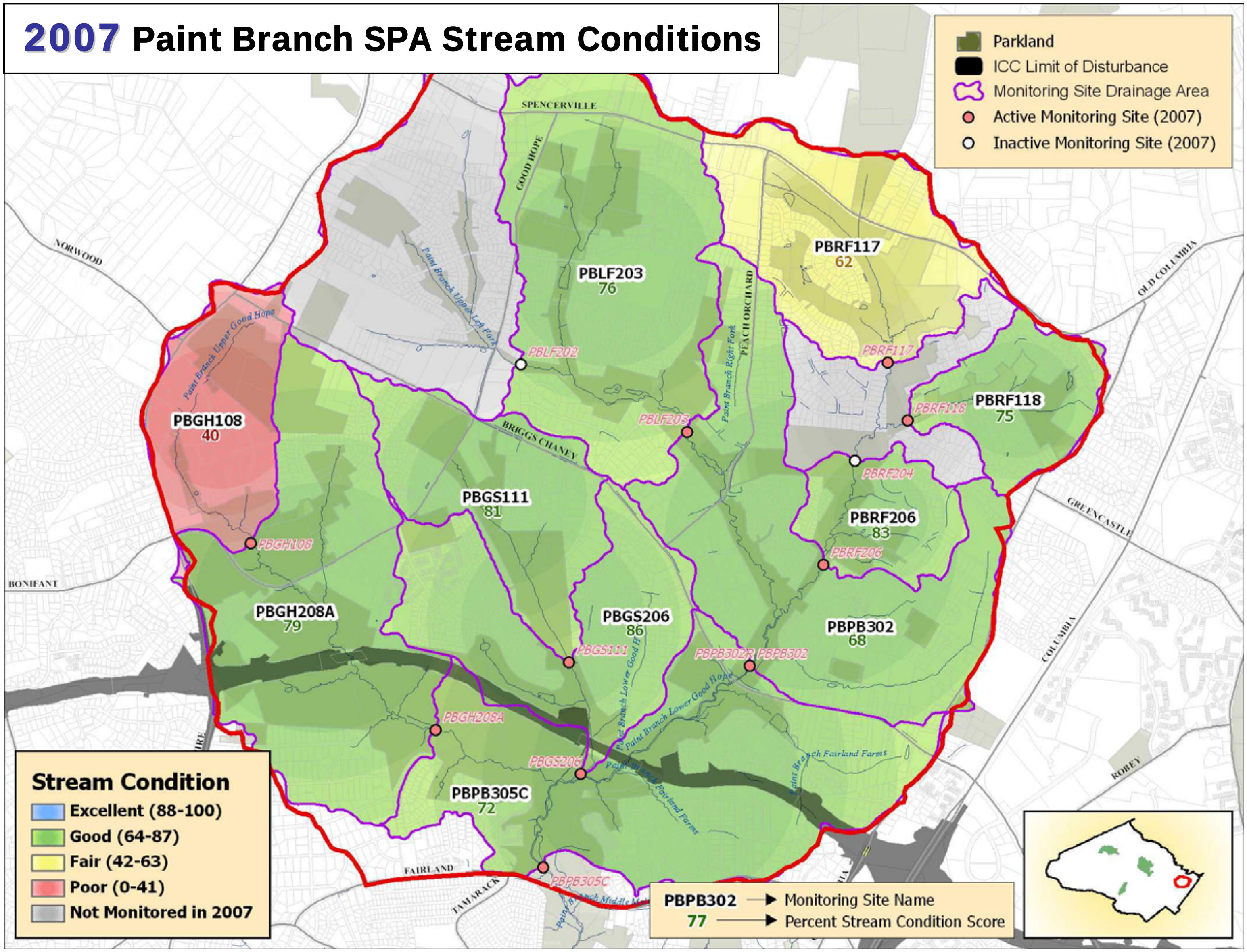

Figure TA-5.6. 2007 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Paint Branch SPA. Construction on this portion of the InterCounty Connector (ICC) (Contract B) did not begin until January 2009.

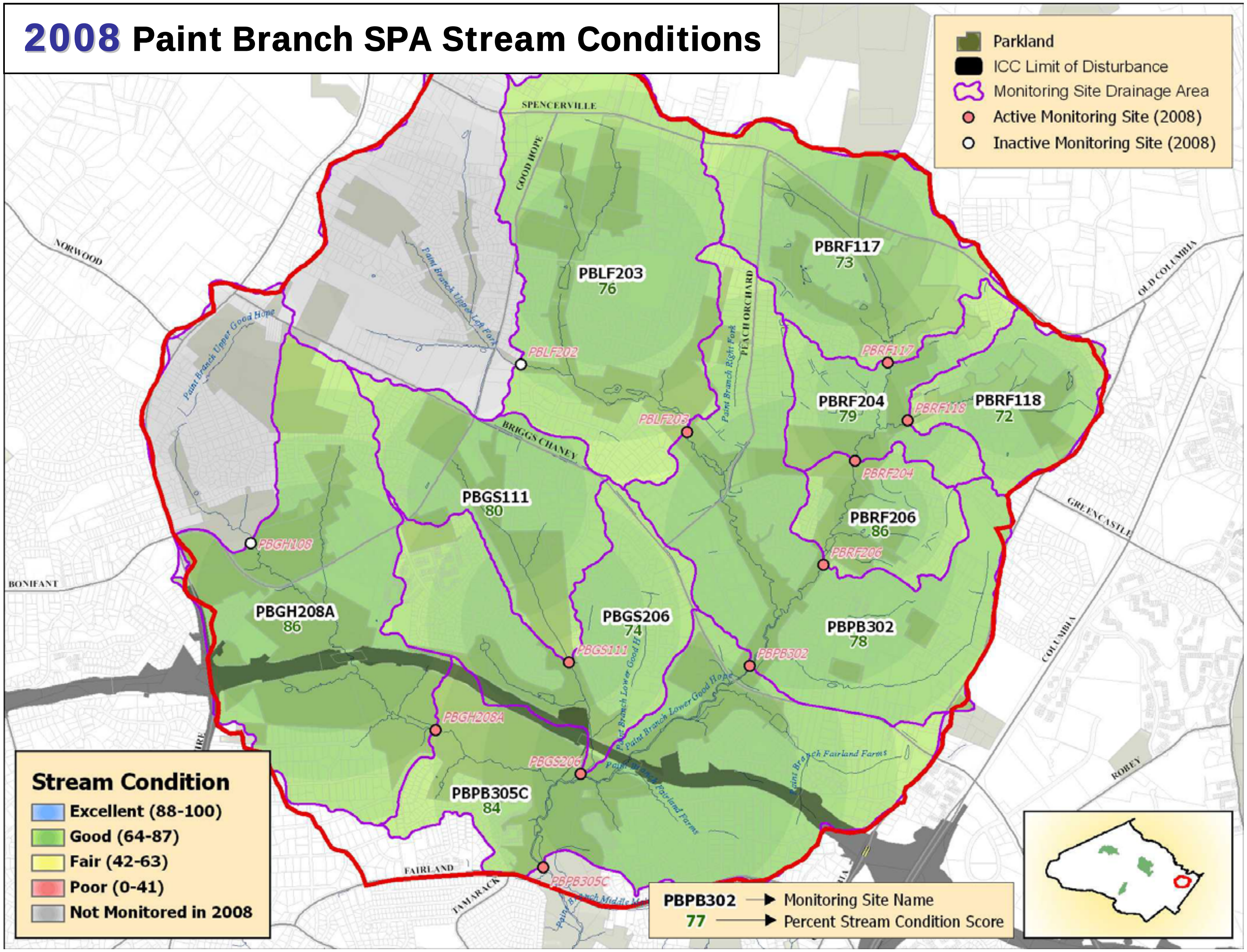

Figure TA-5.7. 2008 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Paint Branch SPA. Construction on this portion of the InterCounty Connector (ICC) (Contract B) did not begin until January 2009.

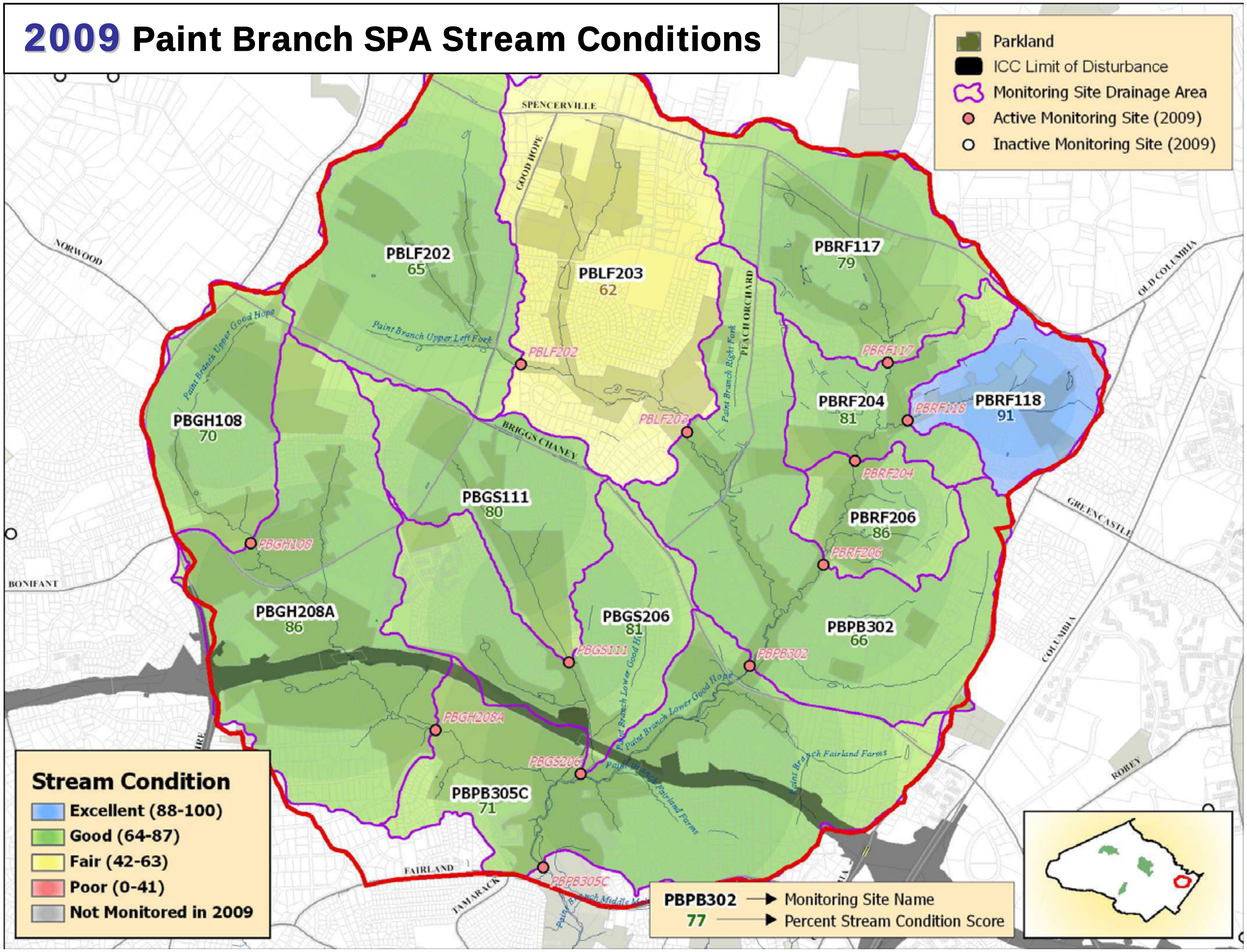

Figure TA-5.8. 2009 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Paint Branch SPA. Construction on this portion of the InterCounty Connector (ICC) (Contract B) began in January 2009.

Piney Branch SPA

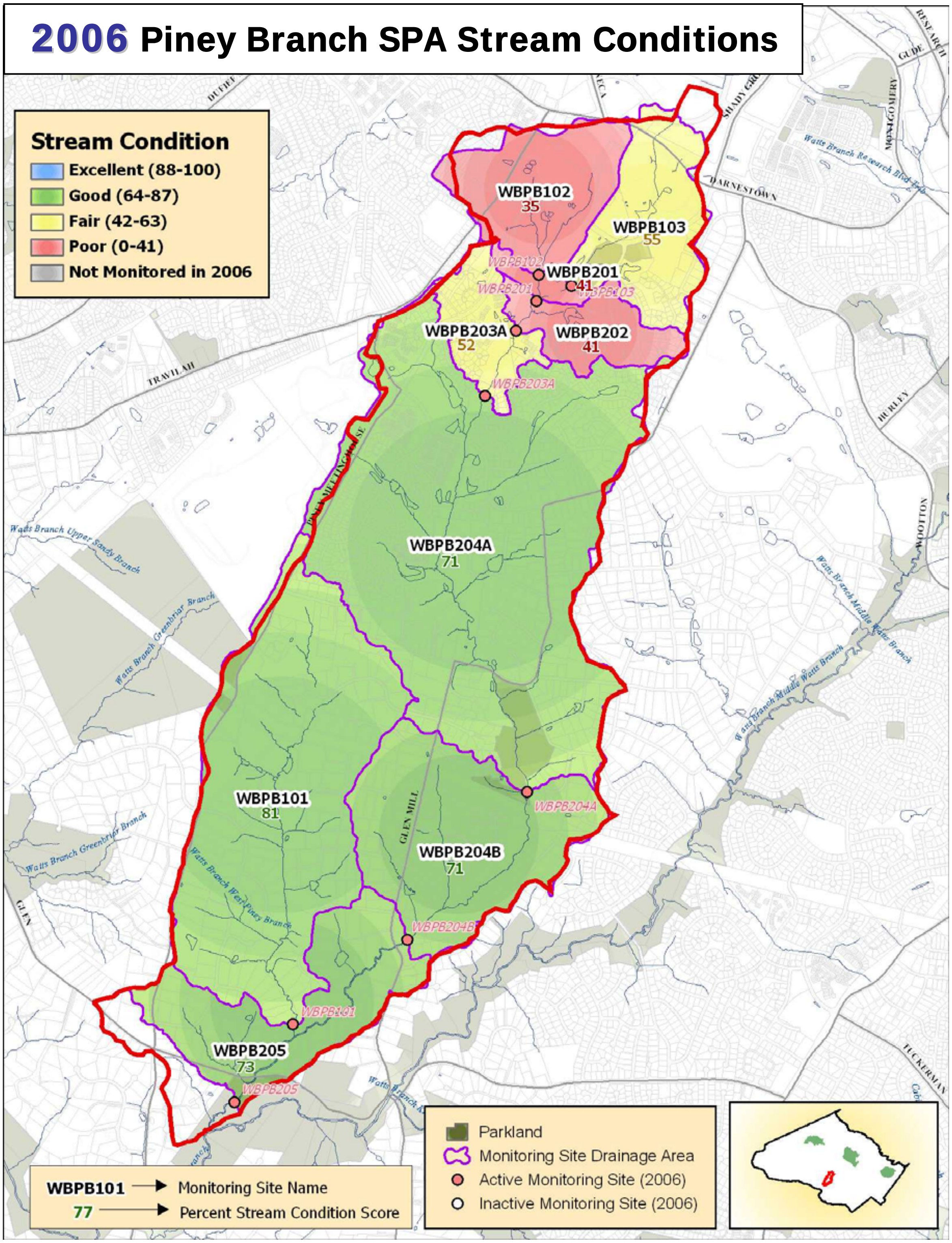

Figure TA-5.9. 2006 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Piney Branch SPA.

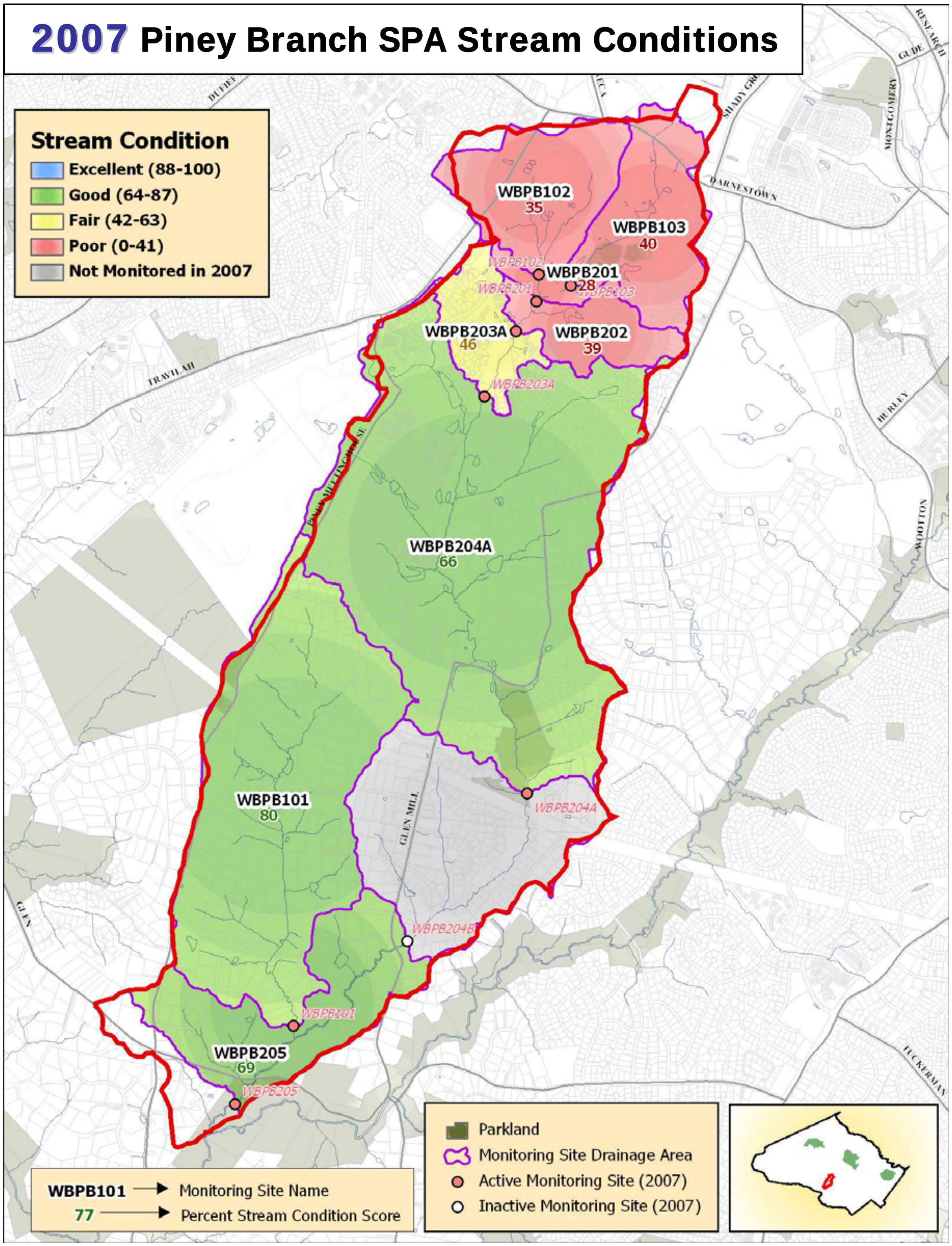

Figure TA-5.10. 2007 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Piney Branch SPA.

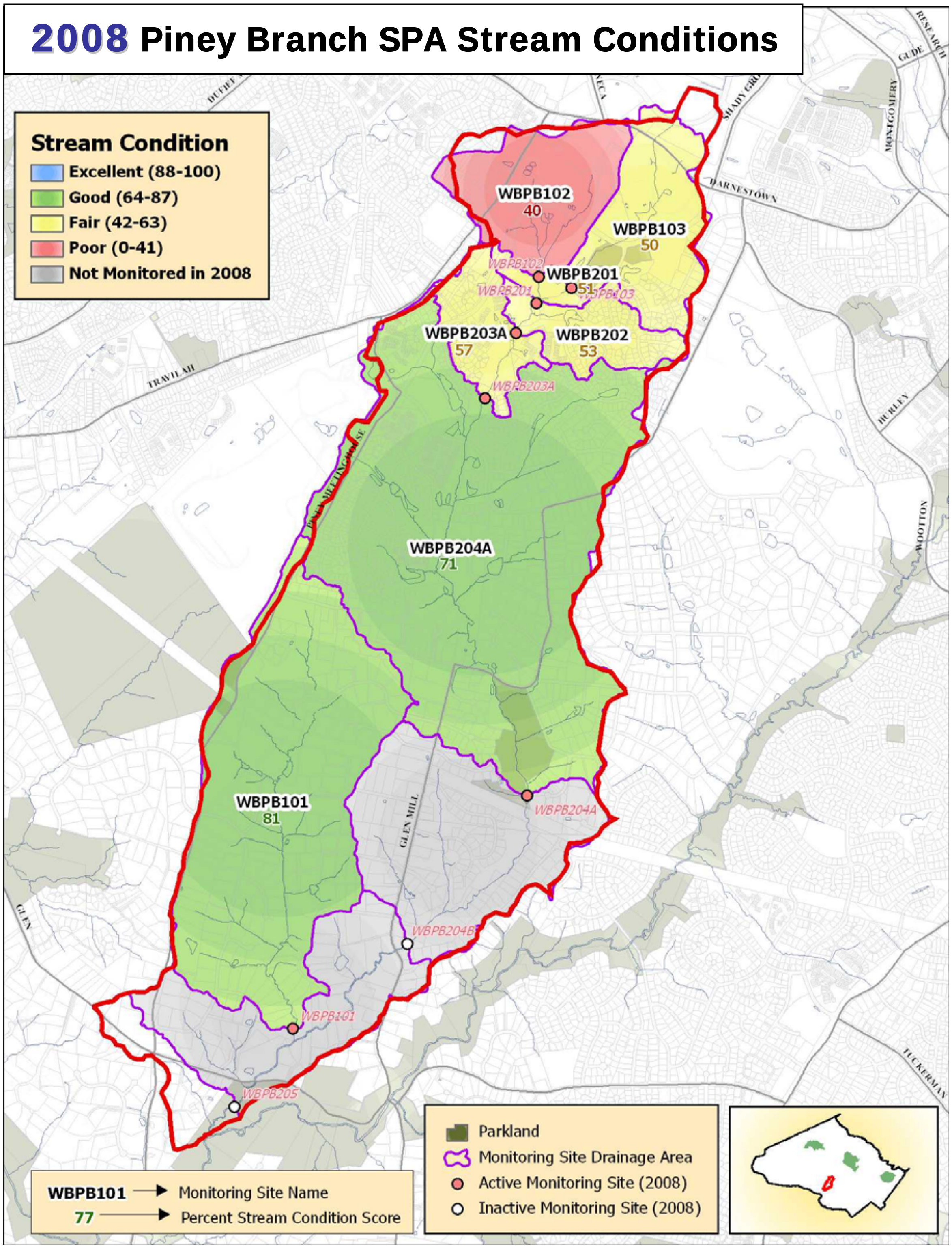

Figure TA-5.11. 2008 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Piney Branch SPA.

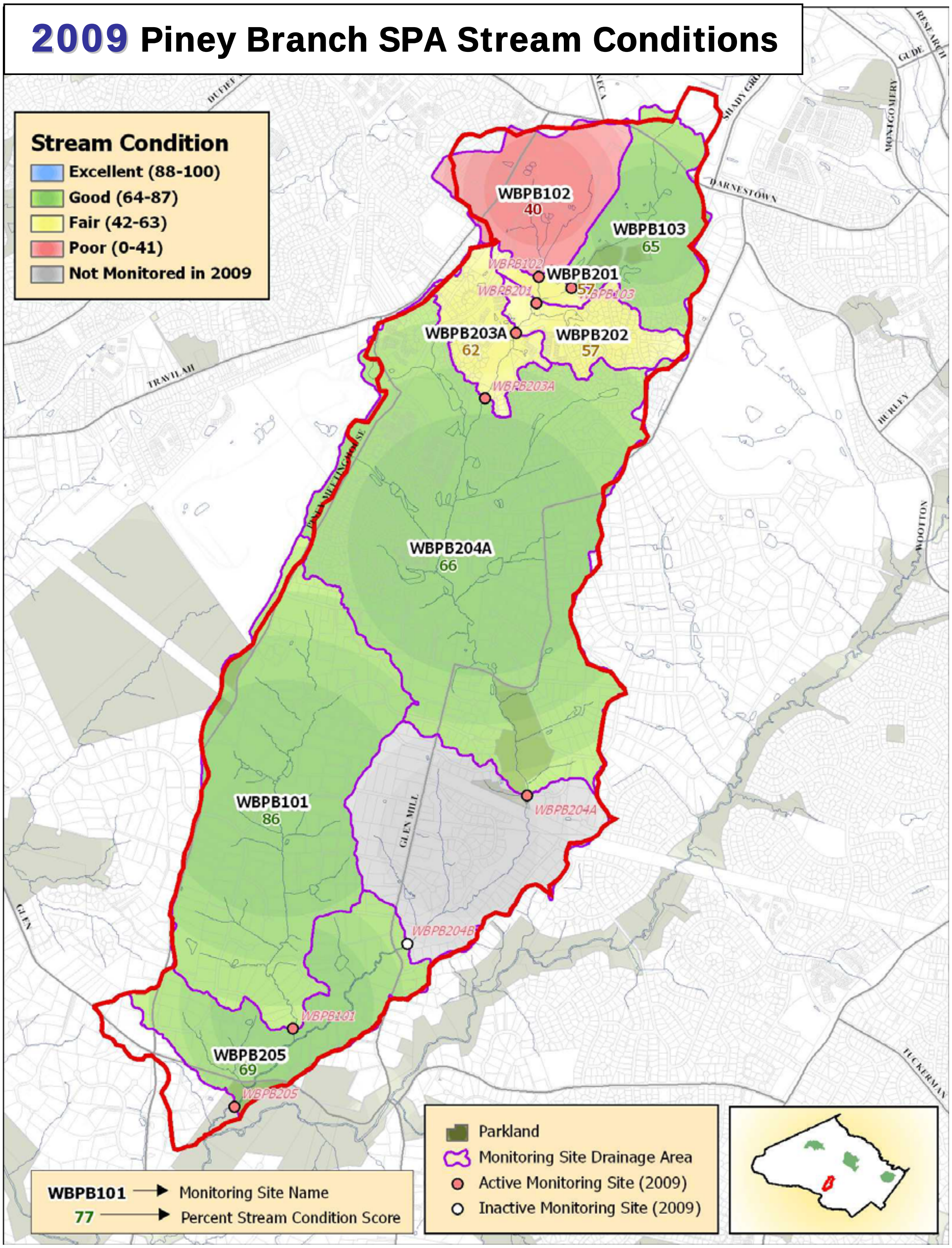

Figure TA-5.12. 2009 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Piney Branch SPA.

Upper Rock Creek SPA

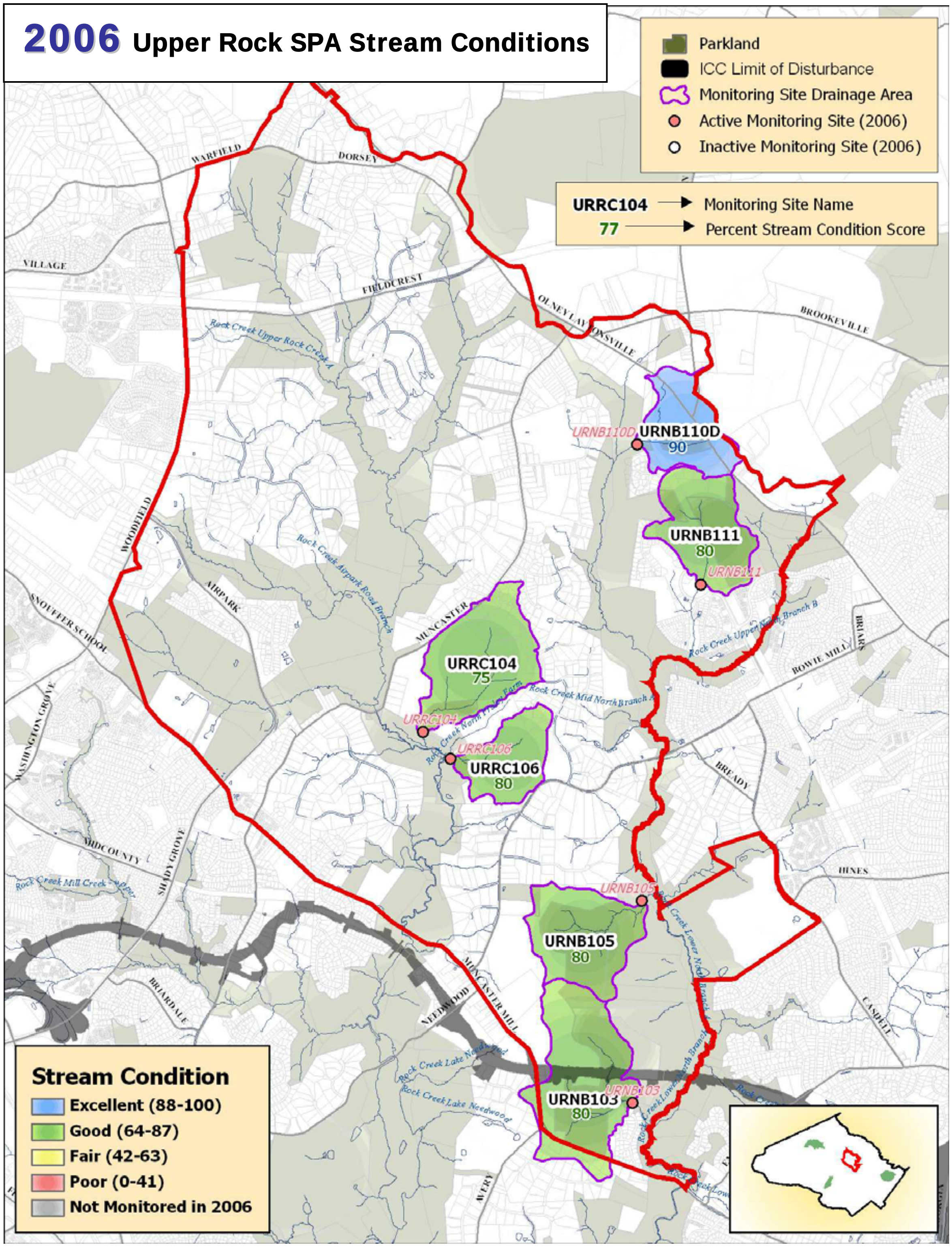

Figure TA-5.13. 2006 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Upper Rock Creek SPA. Construction and monitoring of the InterCounty Connector (ICC) is underway.

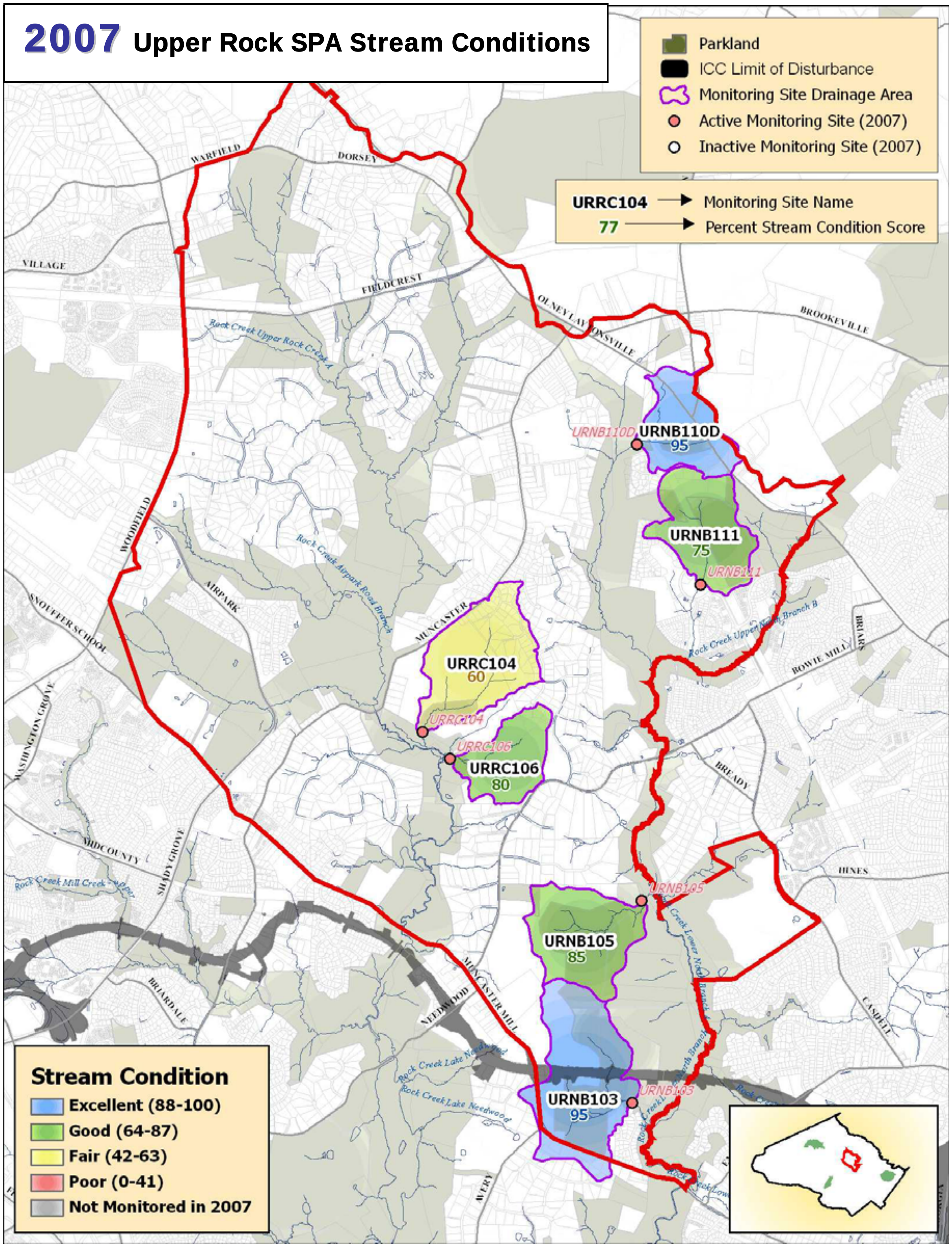

Figure TA-5.14. 2007 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Upper Rock Creek SPA. Construction and monitoring of the InterCounty Connector (ICC) is underway.

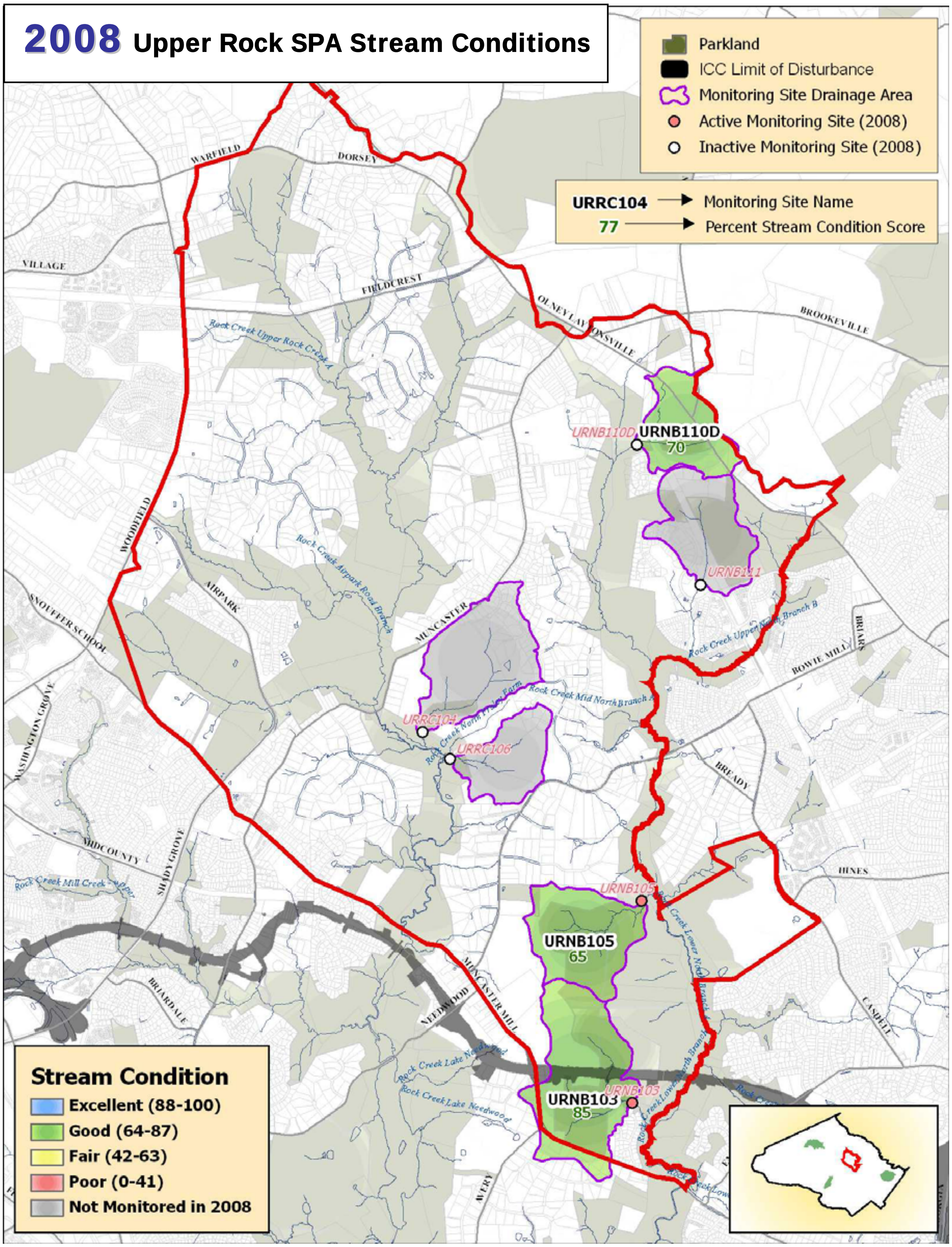

Figure TA-5.15. 2008 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Upper Rock Creek SPA. Construction and monitoring of the InterCounty Connector (ICC) is underway.

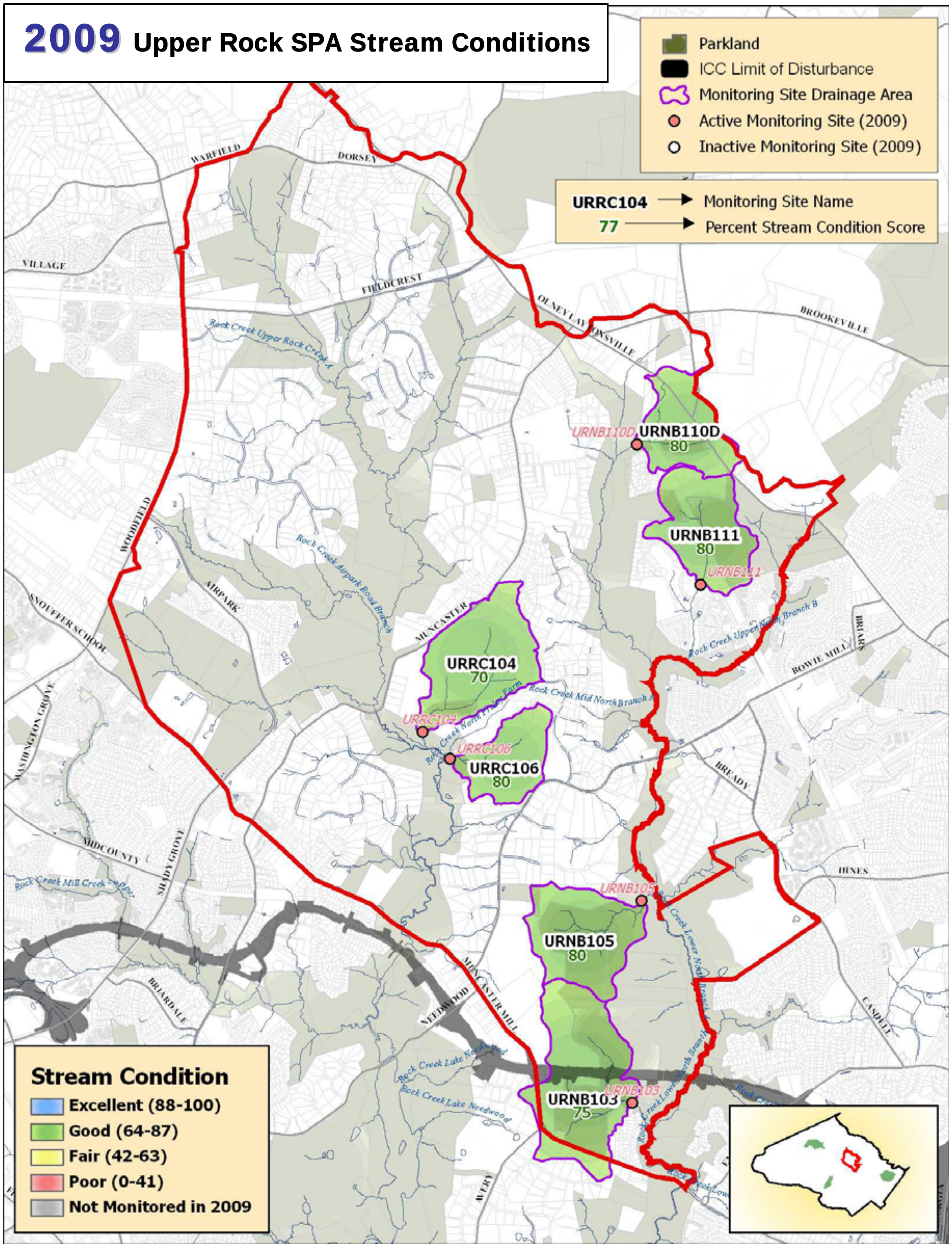

Figure TA-5.16. 2009 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Upper Rock Creek SPA. Construction and monitoring of the InterCounty Connector (ICC) is underway.

Maps of Year to Year Benthic IBI Narratives

Clarksburg SPA

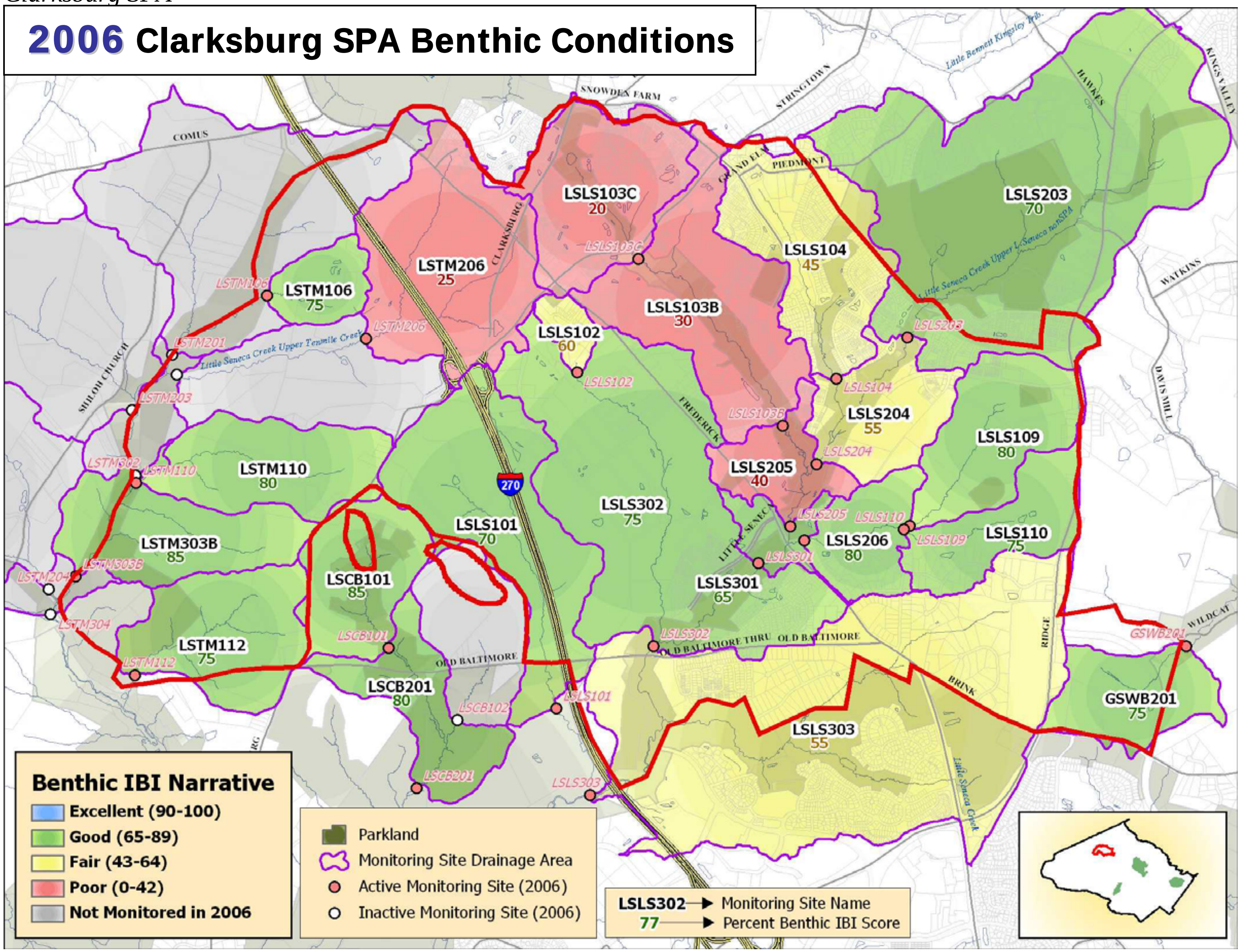

Figure TA-5.27. 2006 Map of Benthic IBI Narrative Conditions for the Clarksburg SPA.

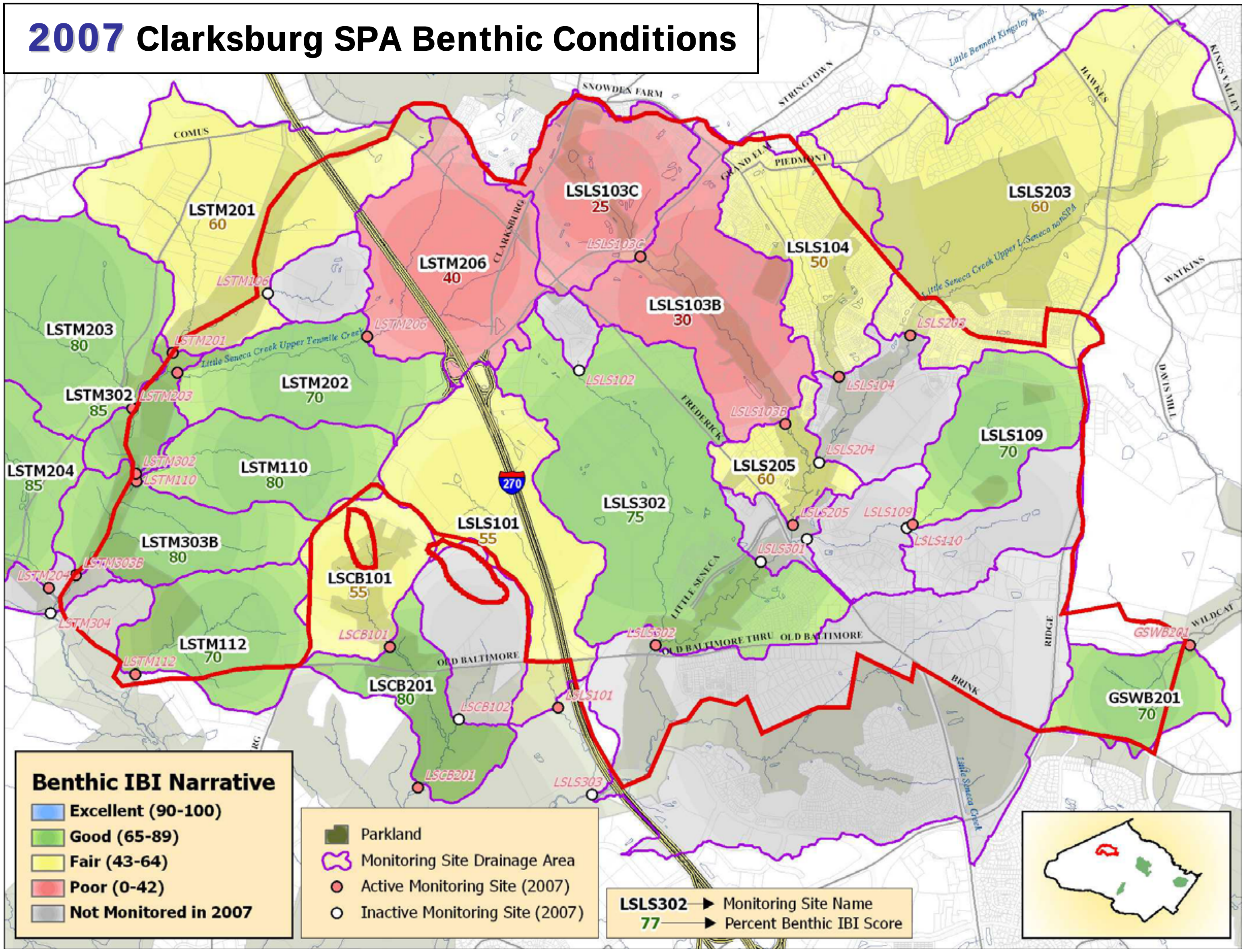

Figure TA-5.38. 2007 Map of Benthic IBI Narrative Conditions for the Clarksburg SPA.

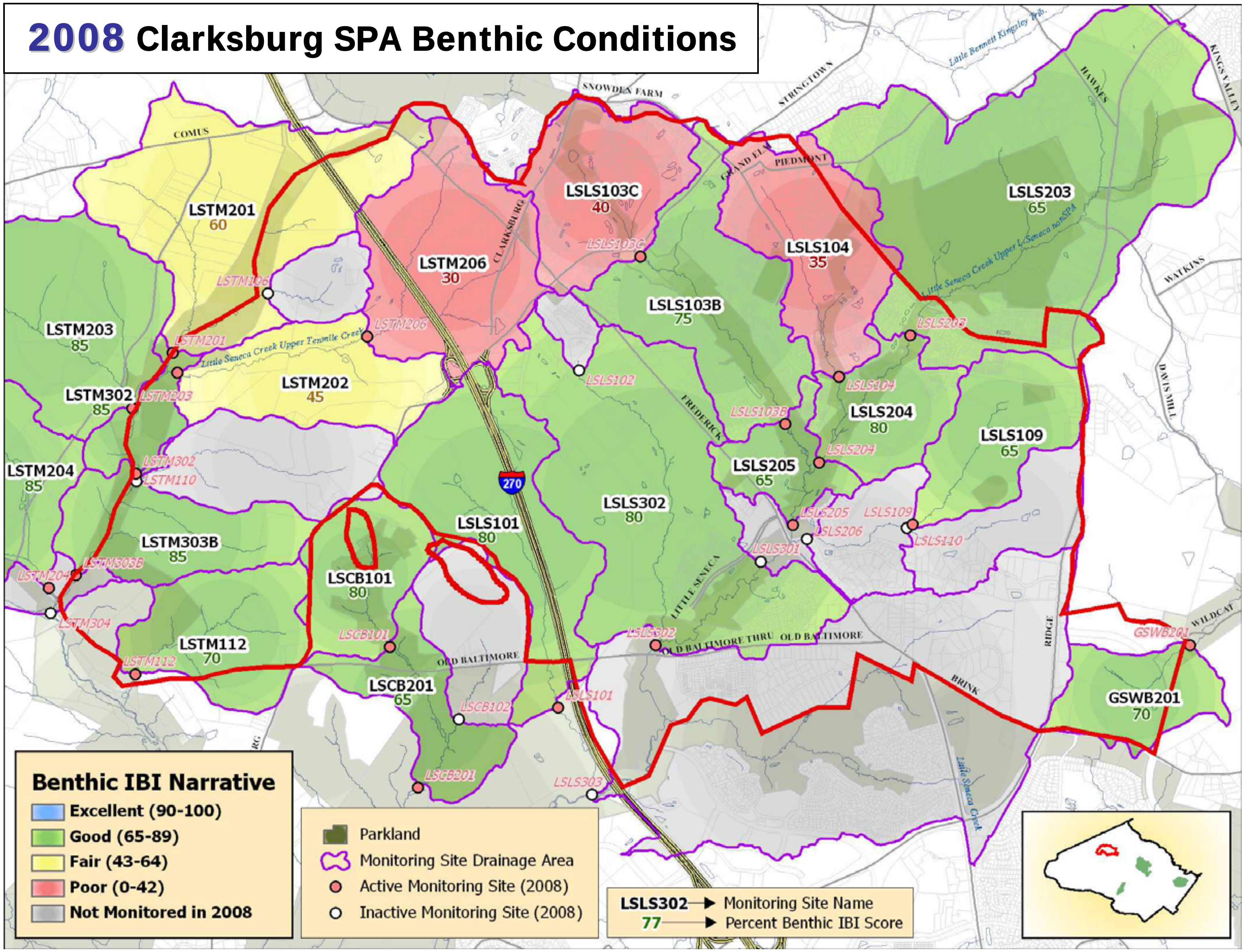

Figure TA-5.49. 2008 Map of Benthic IBI Narrative Conditions for the Clarksburg SPA.

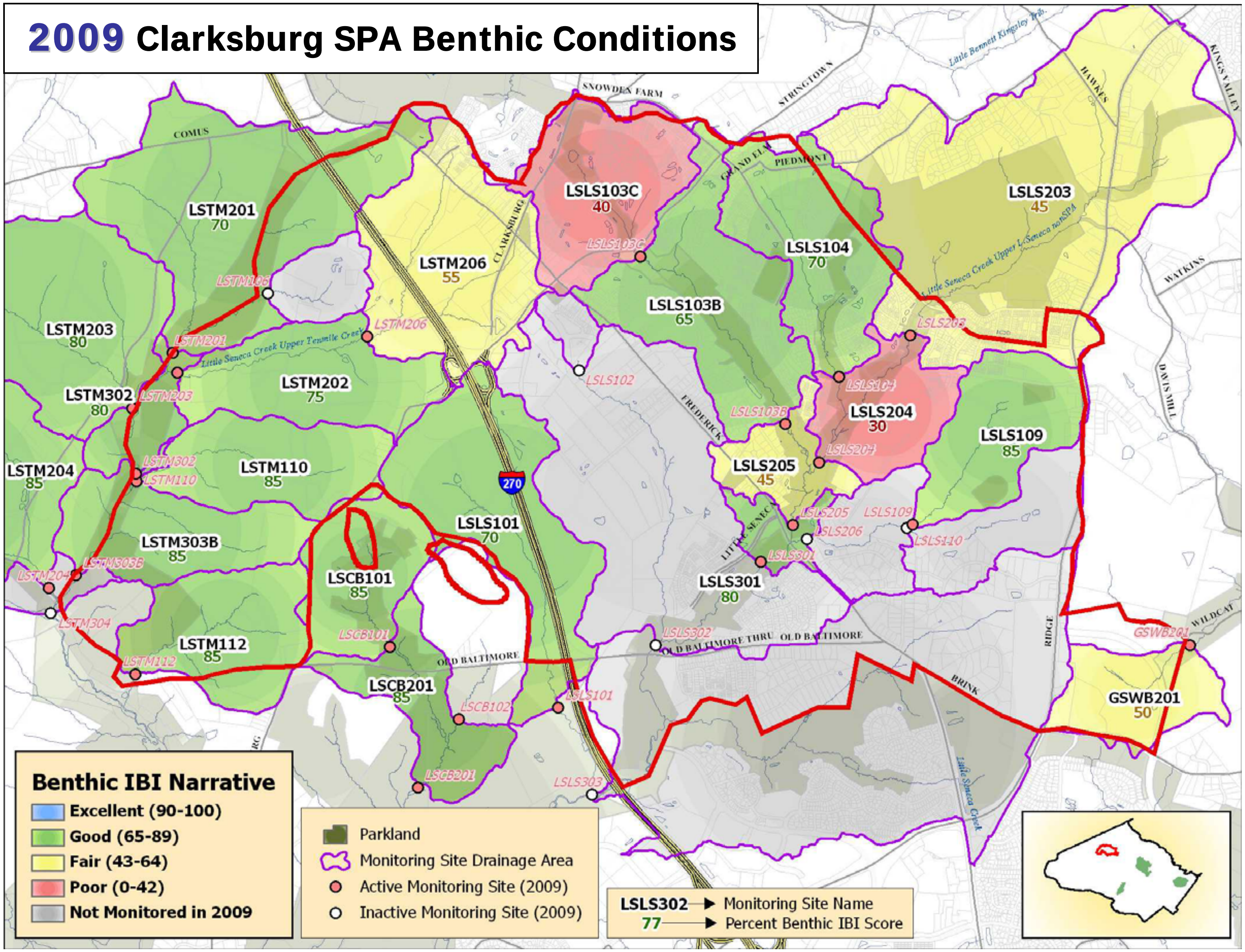

Figure TA-5.20. 2009 Map of Benthic IBI Narrative Conditions for the Clarksburg SPA.

Paint Branch SPA

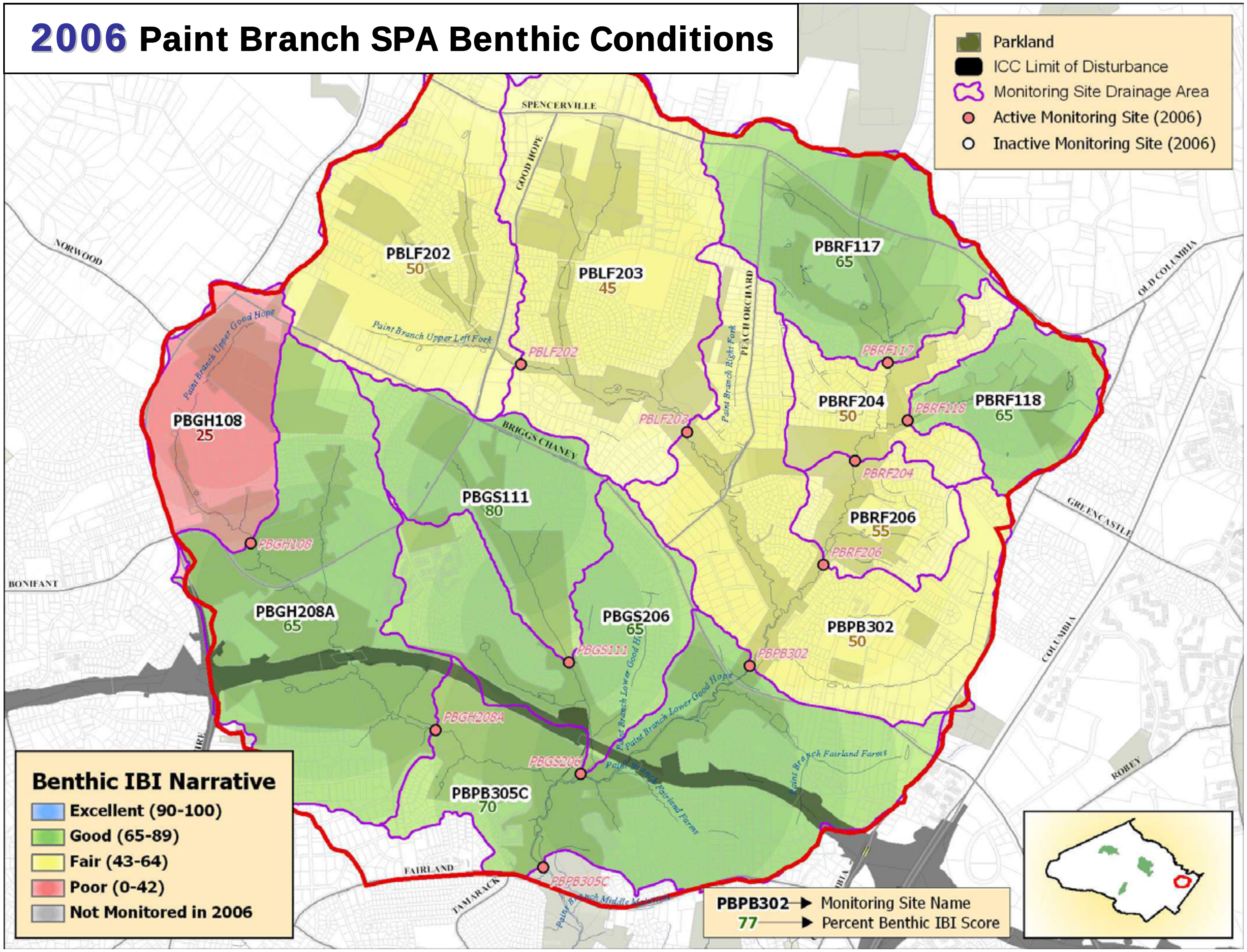

Figure TA-5.21. 2006 Map of Benthic IBI Narrative Conditions for the Paint Branch SPA. Construction on this portion of the InterCounty Connector (ICC) (Contract B) did not begin until January 2009.

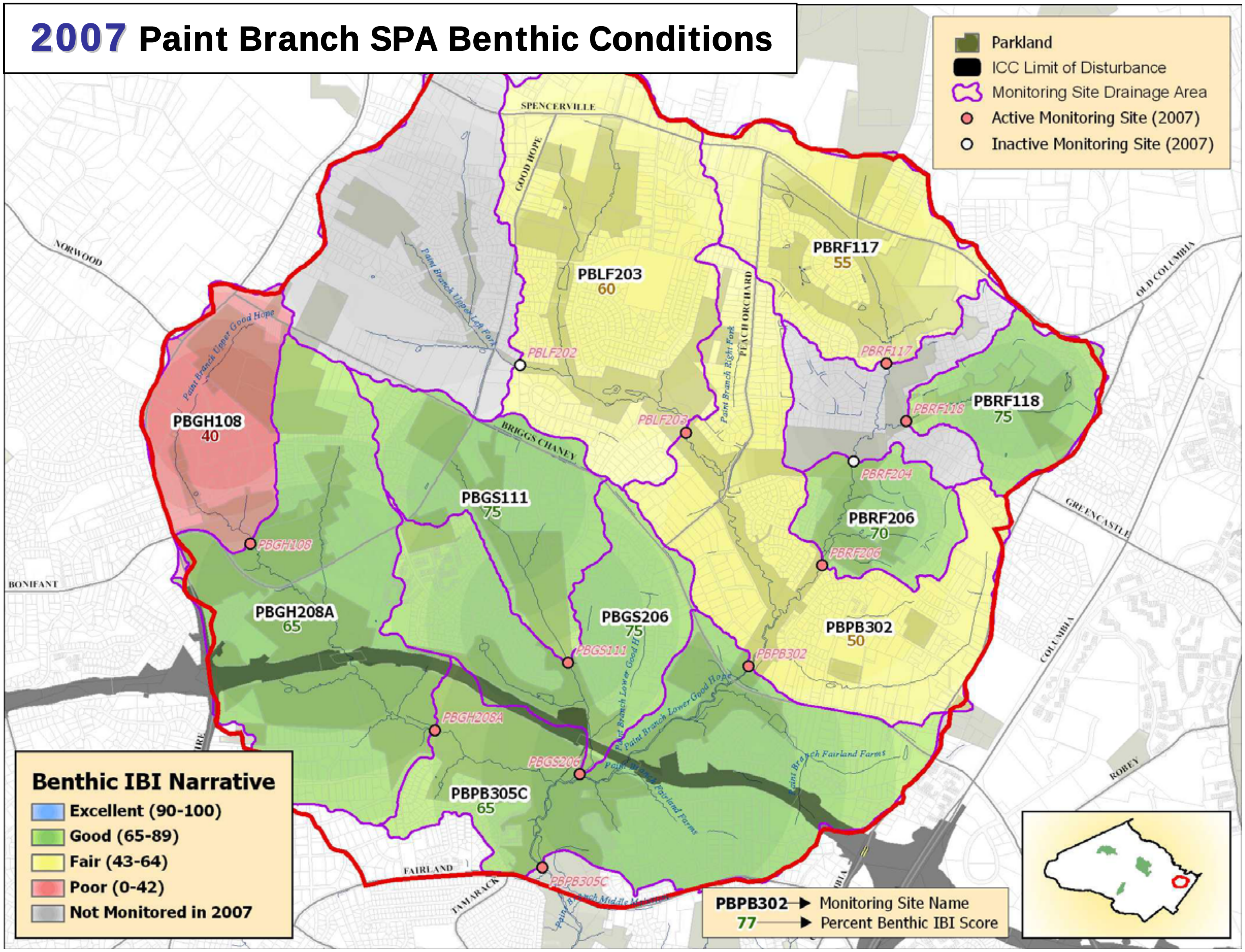

Figure TA-5.22. 2007 Map of Benthic IBI Narrative Conditions for the Paint Branch SPA. Construction on this portion of the InterCounty Connector (ICC) (Contract B) did not begin until January 2009.

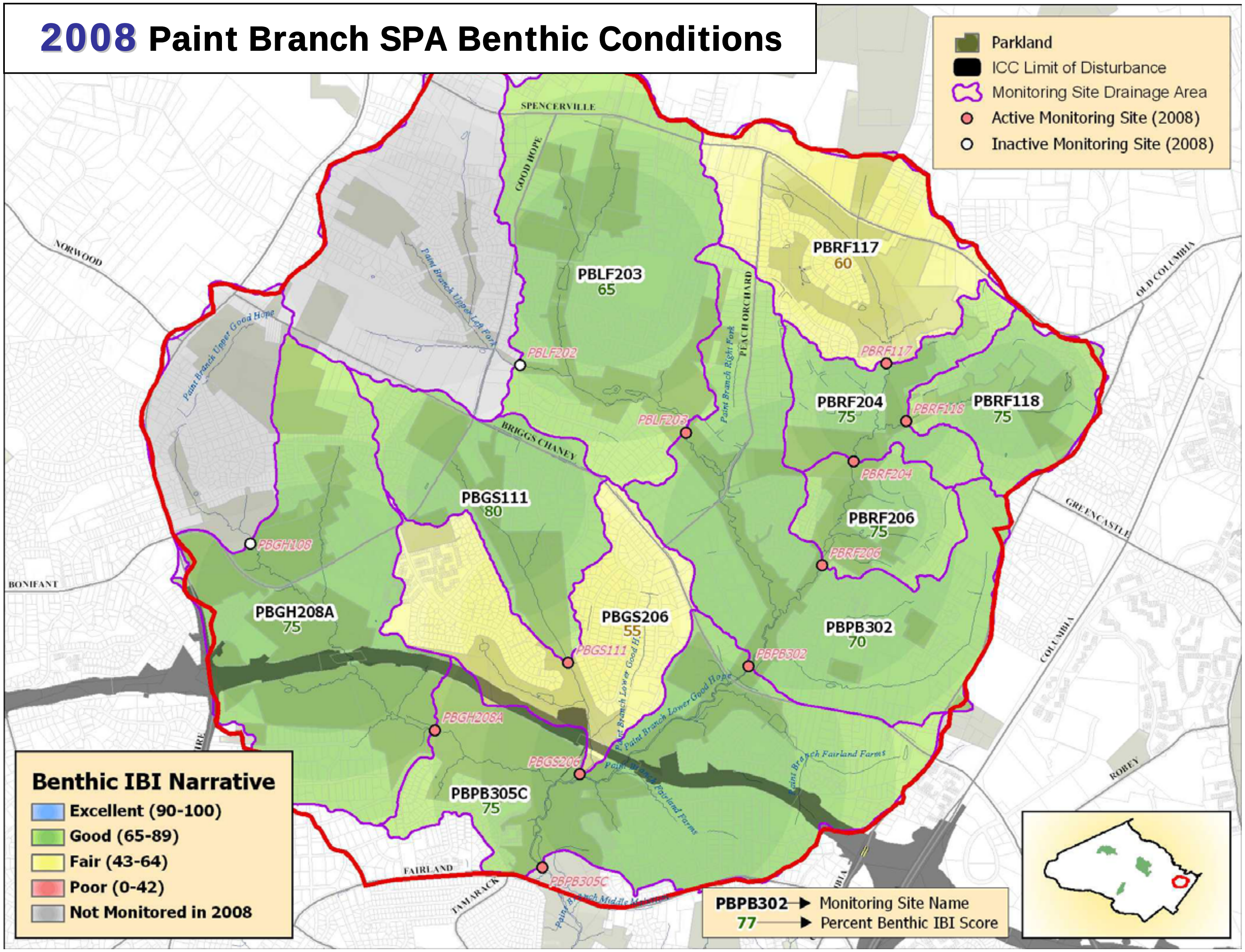

Figure TA-5.23. 2008 Map of Benthic IBI Narrative Conditions for the Paint Branch SPA. Construction on this portion of the InterCounty Connector (ICC) (Contract B) did not begin until January 2009.

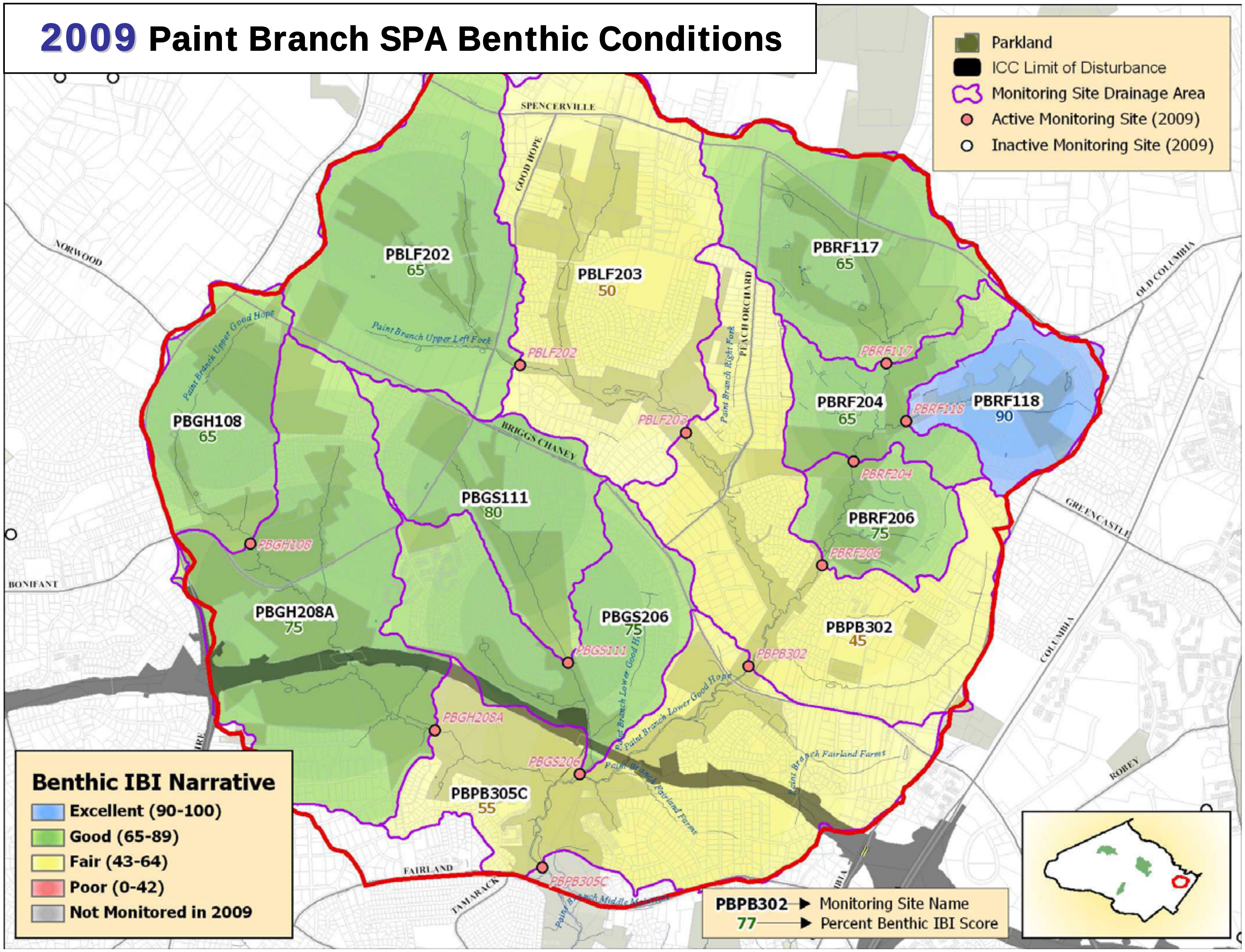

Figure TA-5.24. 2009 Map of Benthic IBI Narrative Conditions for the Paint Branch SPA. Construction on this portion of the InterCounty Connector (ICC) (Contract B) began in January 2009.

Piney Branch SPA

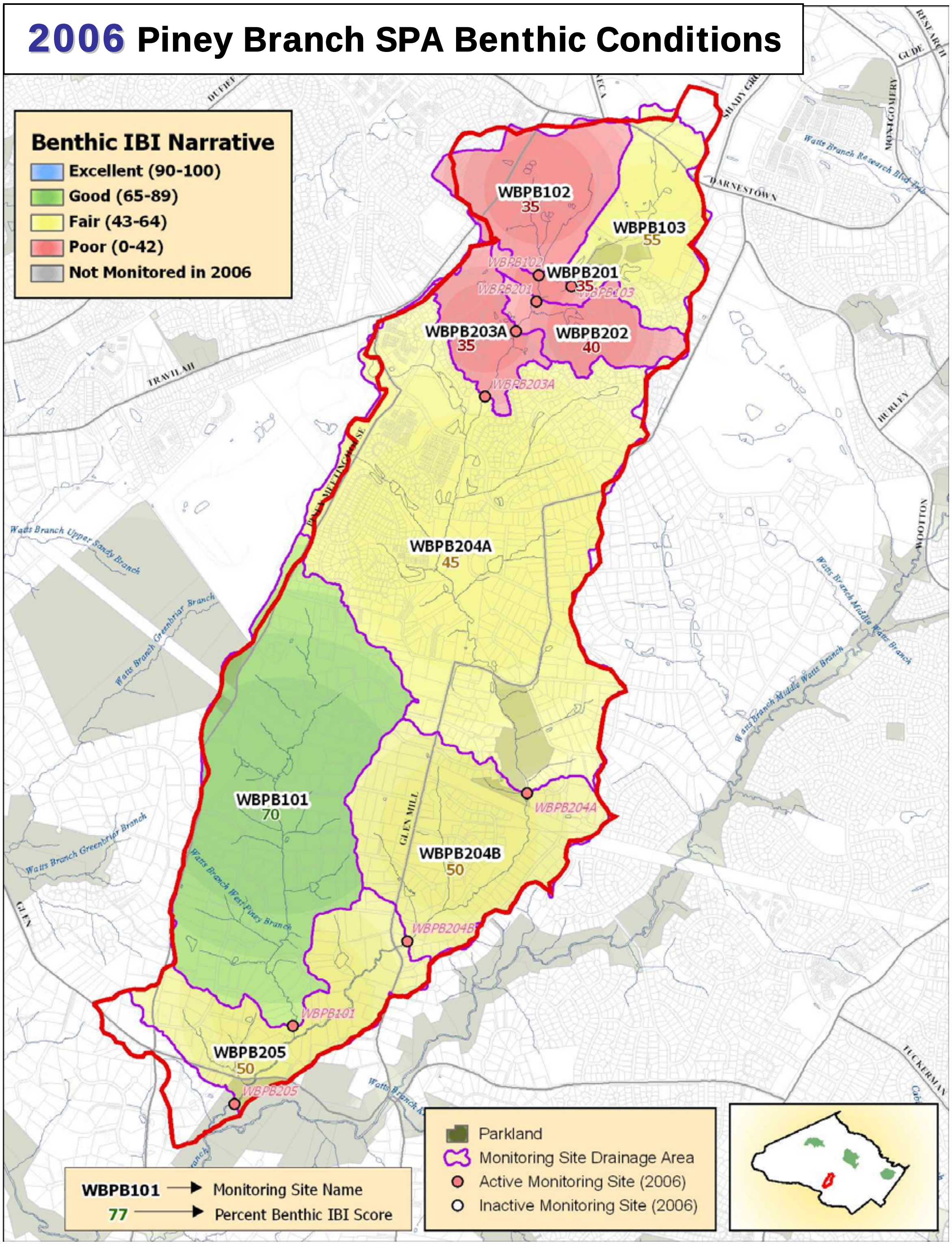

Figure TA-5.25. 2006 Map of Benthic IBI Narrative Conditions for the Piney Branch SPA.

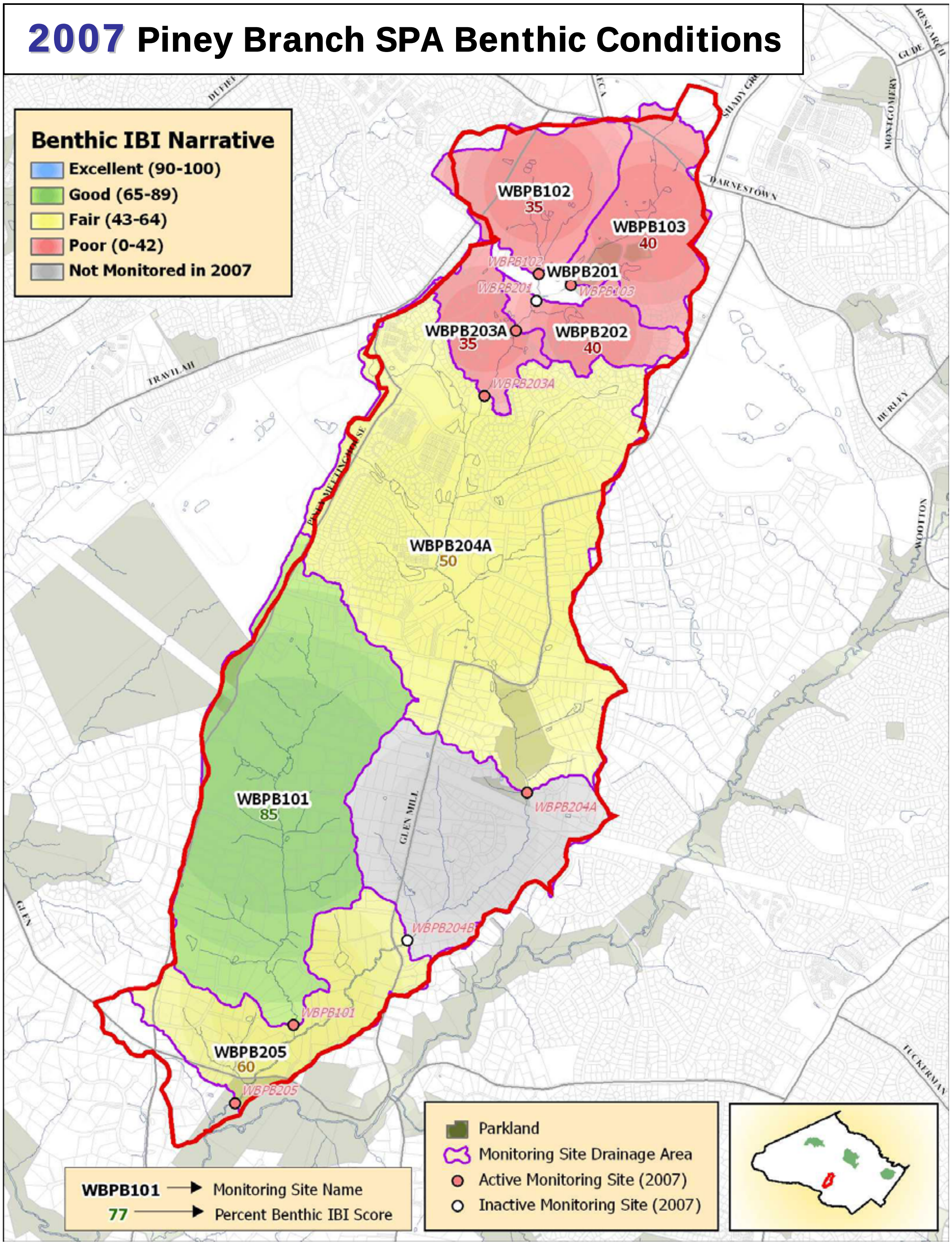

Figure TA-5.26. 2007 Map of Benthic IBI Narrative Conditions for the Piney Branch SPA.

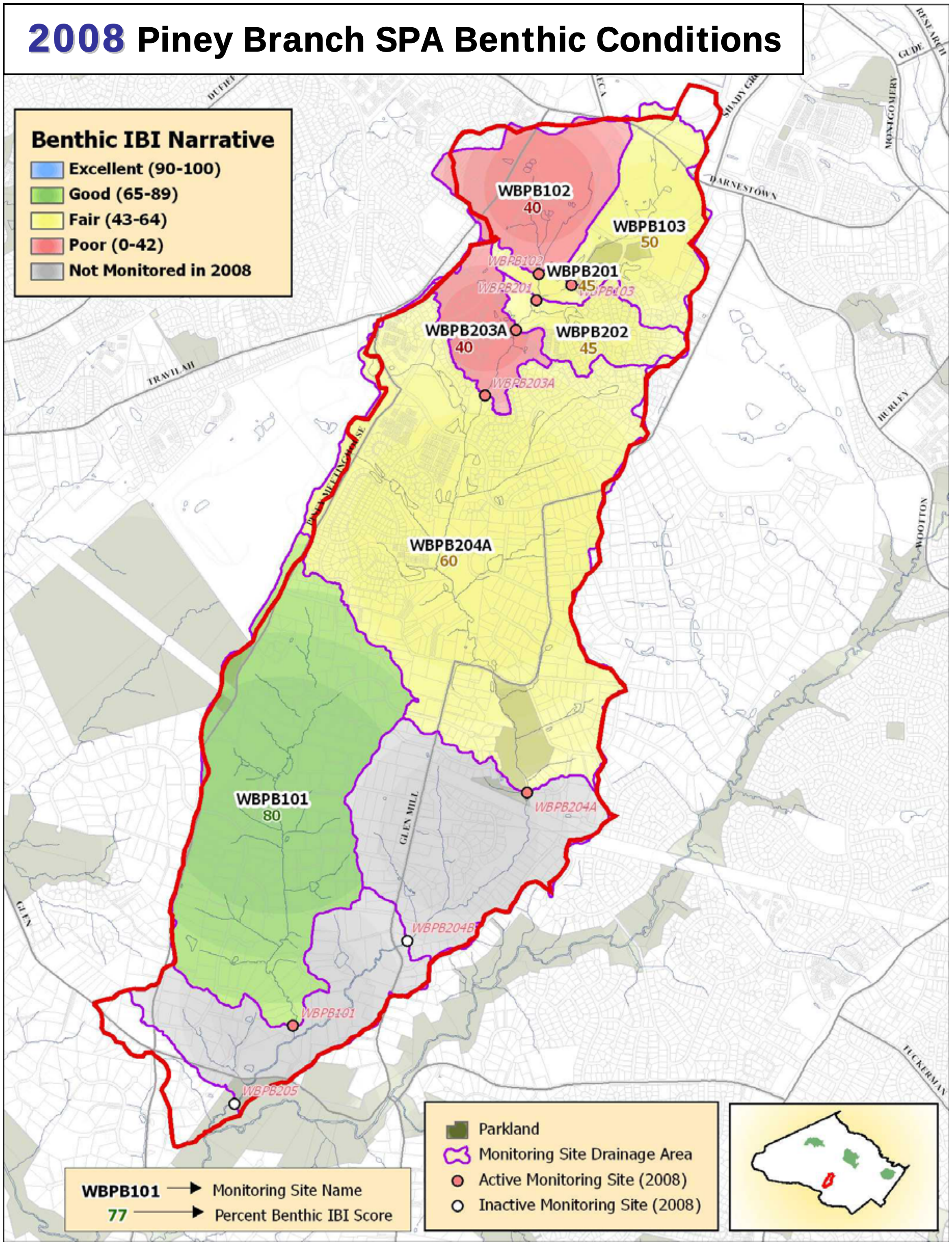

Figure TA-5.27. 2008 Map of Benthic IBI Narrative Conditions for the Piney Branch SPA.

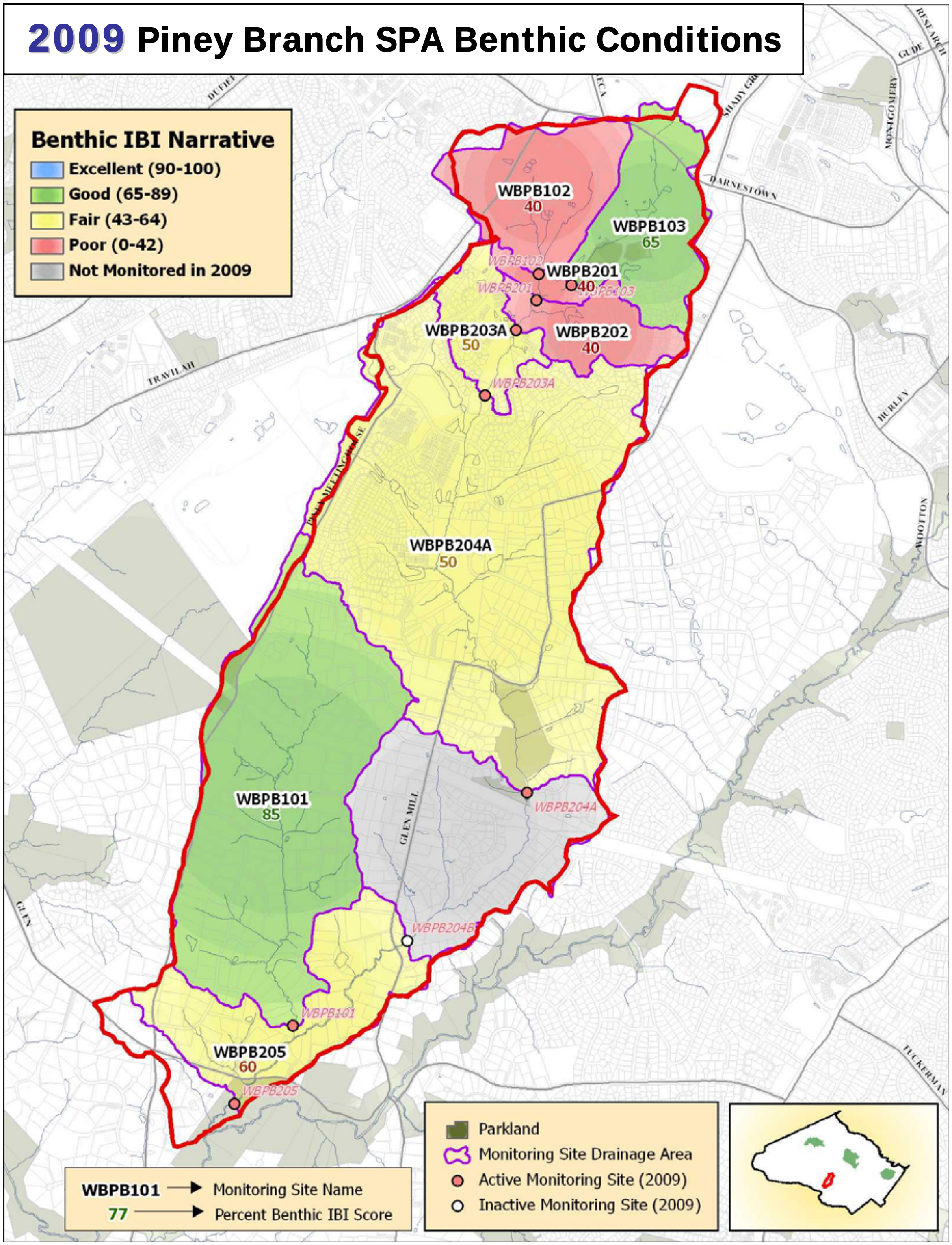

Figure TA-5.28. 2009 Map of Benthic IBI Narrative Conditions for the Piney Branch SPA.

Upper Rock Creek SPA

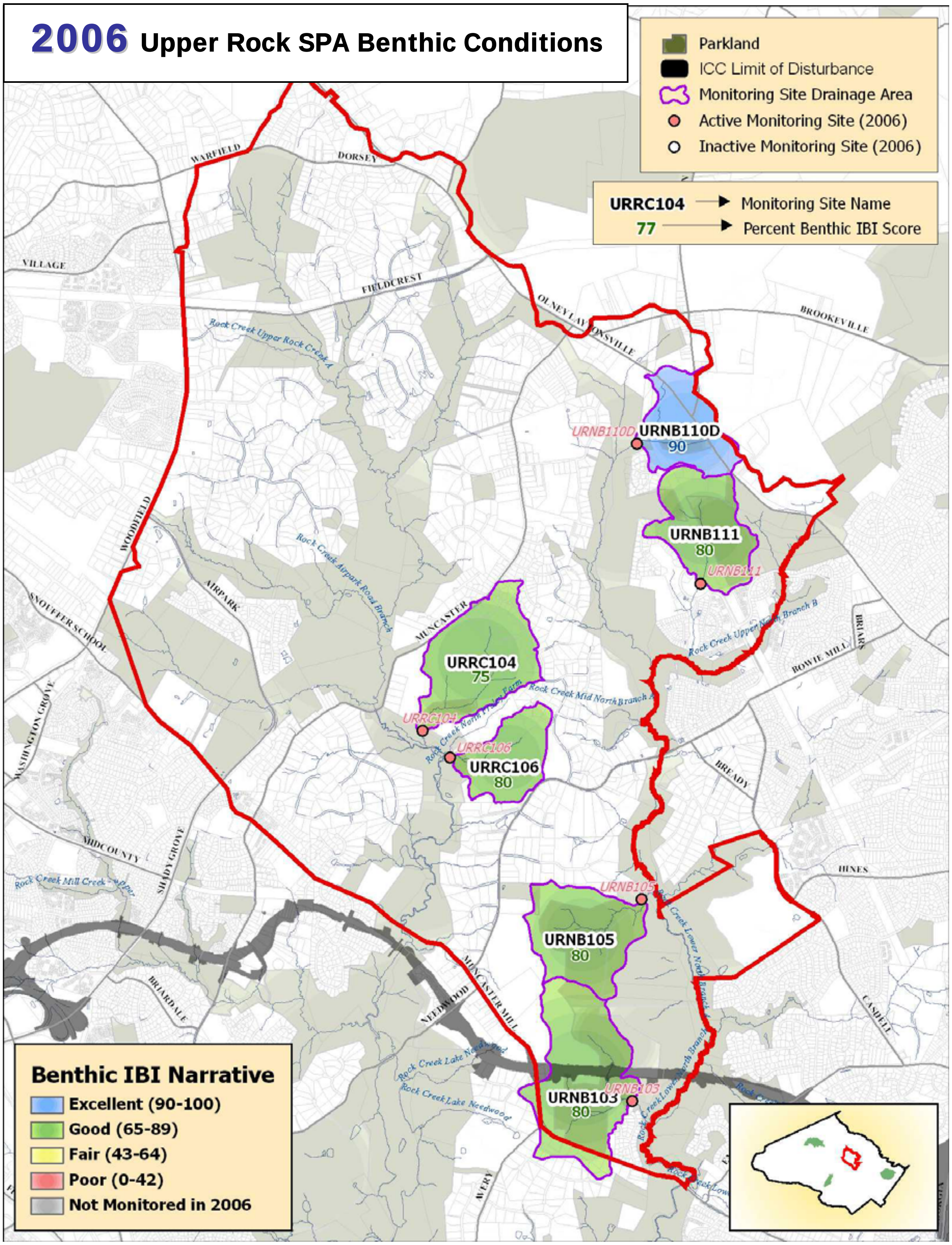

Figure TA-5.29. 2006 Map of Benthic IBI Narrative Conditions for the Upper Rock Creek SPA. Construction and monitoring of the InterCounty Connector (ICC) is underway.

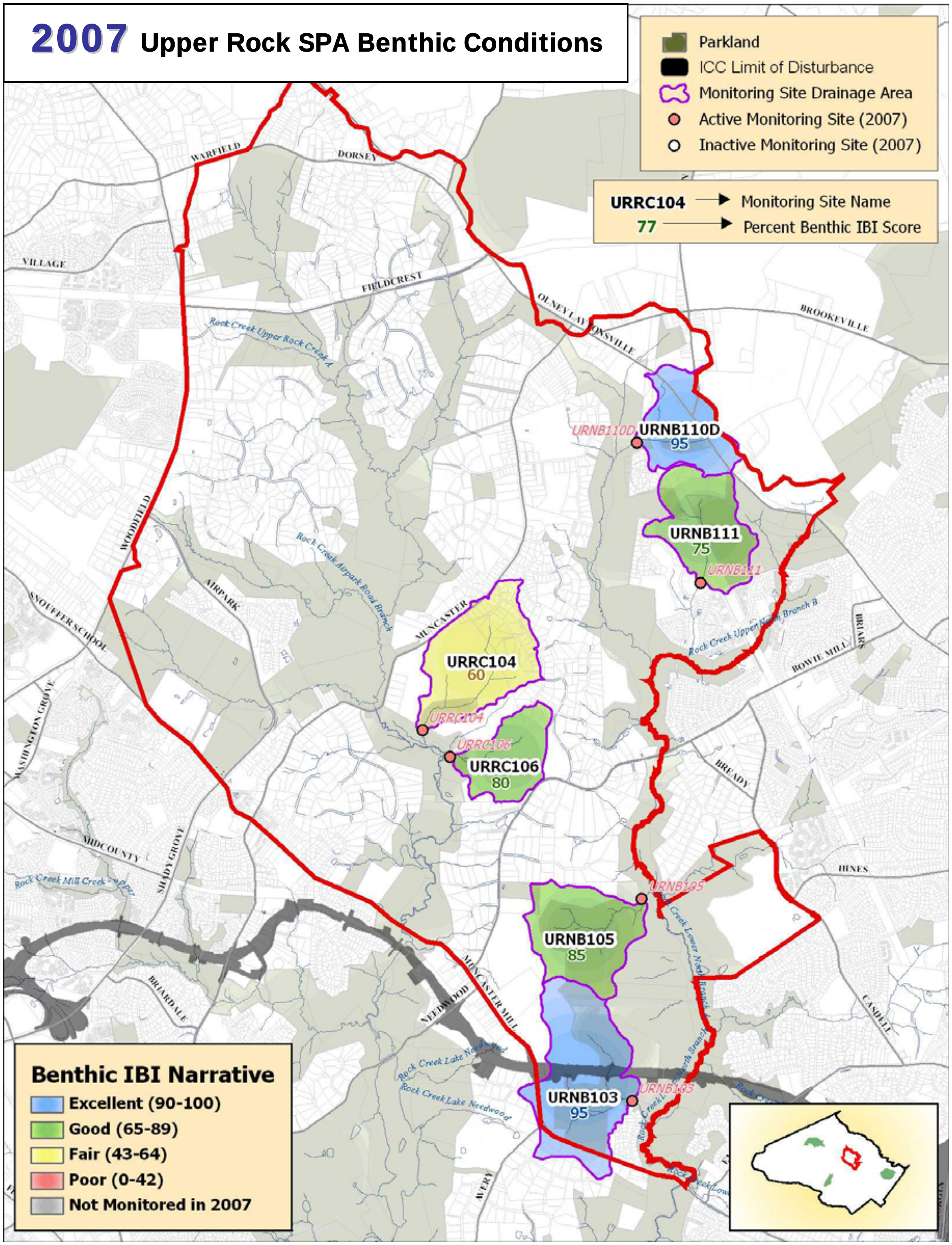

Figure TA-5.30. 2007 Map of Benthic IBI Narrative Conditions for the Upper Rock Creek SPA. Construction and monitoring of the InterCounty Connector (ICC) is underway.

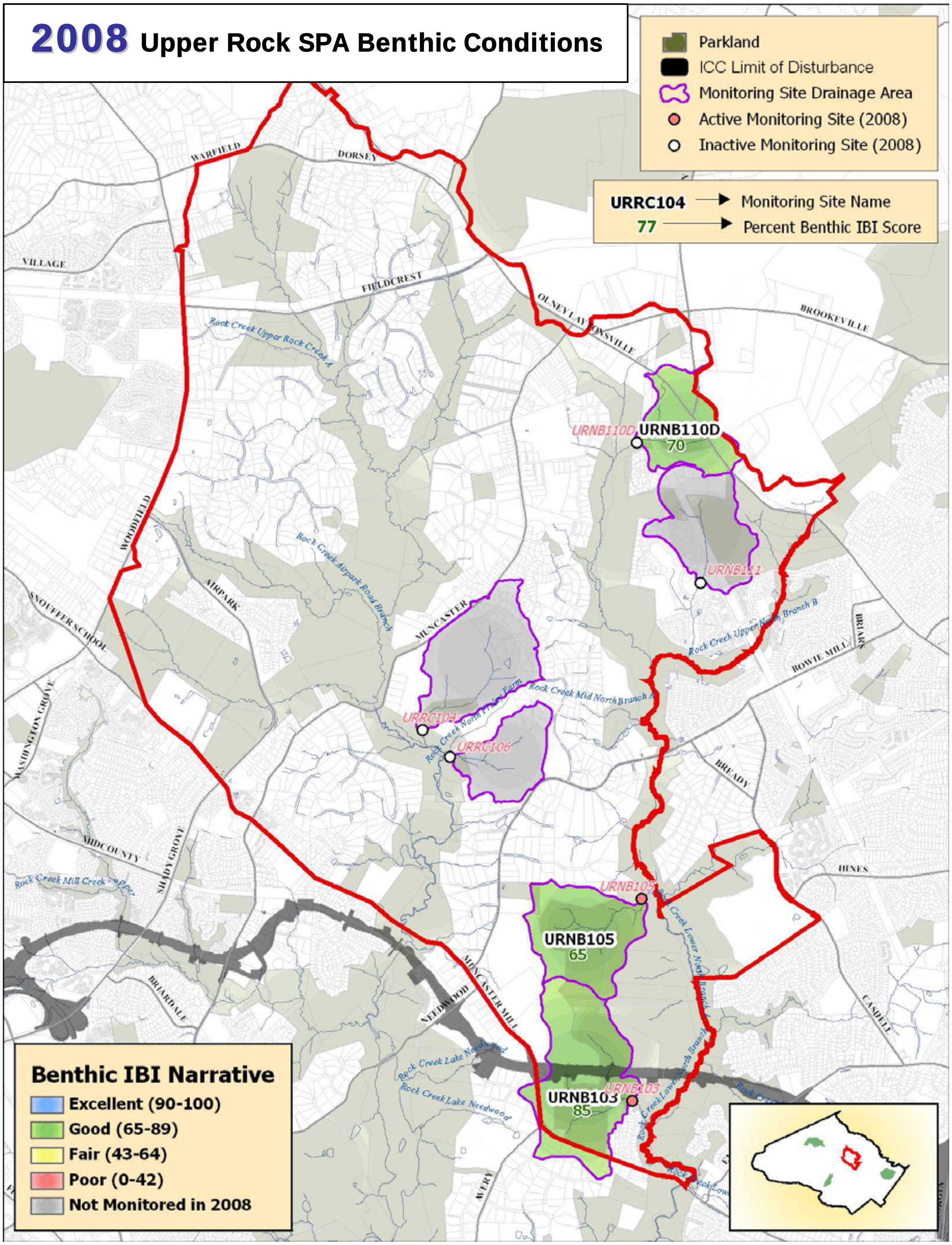

Figure TA-5.31. 2008 Map of Benthic IBI Narrative Conditions for the Upper Rock Creek SPA. Construction and monitoring of the InterCounty Connector (ICC) is underway.

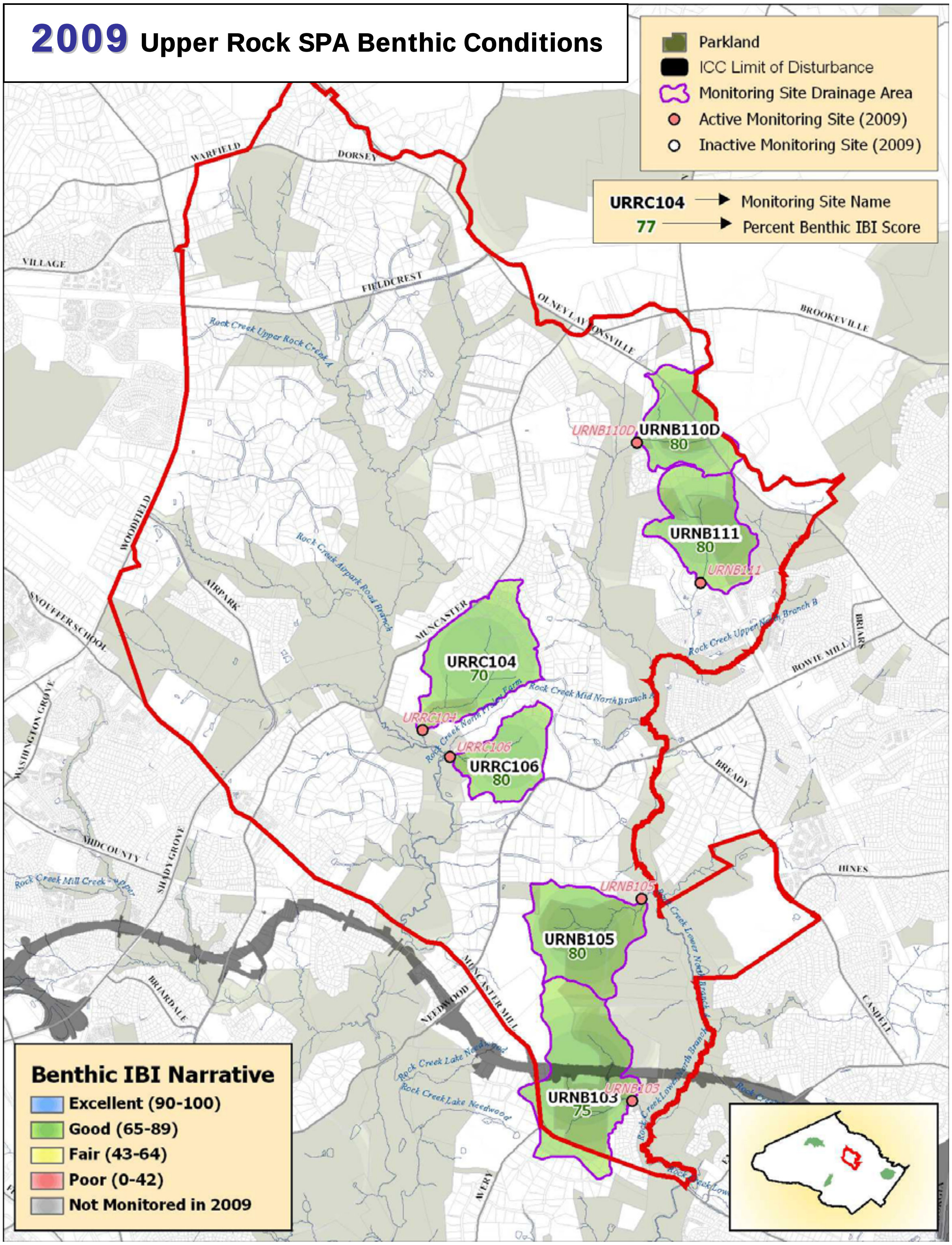

Figure TA-5.32. 2009 Map of Benthic IBI Narrative Conditions for the Upper Rock Creek SPA. Construction and monitoring of the InterCounty Connector (ICC) is underway.

TA-5.2 Stream Condition Comparison

Refer to Section TA-5.1 for year to year benthic IBI narrative condition maps.

Paint Branch Brown Trout

The Paint Branch watershed is designated as a class III naturally reproducing brown trout stream (Fig. TA-5.33). The ability to support trout populations is indicative of excellent water quality, which is rare in suburban settings. Cool, clean groundwater-fed streams are necessary for reproduction and survival. The Good Hope and Gum Springs tributaries are the primary brown trout spawning and nursery areas (M-NCPPC 1995; MCDEP 1998).

Numerous studies have generally found that the Good Hope tributary is the most dependable spawning and nursery area. Reasons the Good Hope tributary is so suitable for trout spawning are: 1) cool water temperatures (class III streams require temperatures below 68° F), 2) stable and clean gravel & cobble substrate, 3) forested stream buffers, and 4) good baseflow during dry periods. The other Paint Branch tributaries serve as adequate spawning and nursery grounds, but are less reliable.

The Gum Springs tributary suffered from several acute impacts in 1994, 1995, and 1996, which degraded stream habitat and water quality for a number of years (MCDEP 1999). In 1999, it was determined that the Oak Springs stormwater management pond was discharging warm water to the Gum Springs tributary, and the thermal impact may have had an effect on cold-water trout spawning in the tributary. The thermal impacts were rectified in 2000 by diverting the water from the pond to the mainstem through an underground pipe (MCDEP 2000).

The Right Fork of the Paint Branch also has been known to support young of year and sometimes adult trout. However, the Columbia Park tributary (feeding station PBRF118) does not provide enough base flow, especially during dry years, to provide the habitat necessary to sustain a fish community equal to that of the mainstem. The Left Fork of the Paint Branch has a fish blockage below the Maydale Nature Center, with PBLF202 as the associated station. Stream restoration at Maydale Nature Center to remove the fish blockage and improve instream habitat is scheduled to be completed by late 2010. Monitoring results from this effort will be covered in the 2010 SPA report.

Figure TA-5.34 shows the number of adult and young of year trout found each year in the Paint Branch SPA, divided by the number of stations monitored that year. For example, not all stations were monitored in 1999 due to a drought. Trout populations were affected by two droughts during the monitoring period—one in 1999 and one in 2002. Trout populations plummeted in 2000 and 2003, immediately following the drought years. The decline in population is likely due to the difficulty spawning in the drought-affected headwater areas. The 2007 spawning period (fall and winter) also had below average rainfall, which may have caused the lower numbers of adult and young of year trout observed in 2008. 2009 numbers of young of year recover slightly, possibly due to more normal rain amounts during the 2008 fall/winter spawning period. Populations of trout seem to be persisting (mainly in the Good Hope tributary and the mainstem), but have not yet recovered to pre-2000 levels.

Figure TA-5.33. Brown Trout.

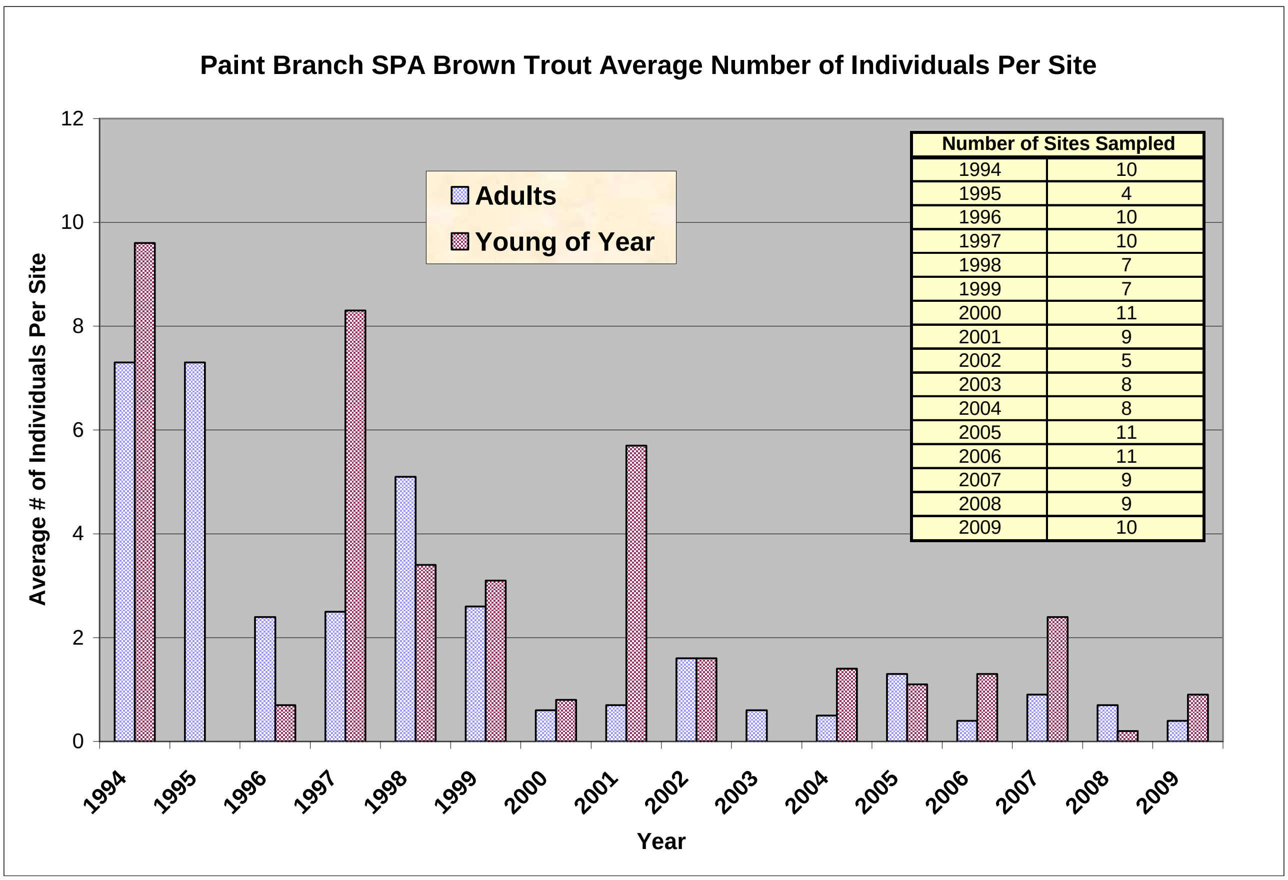

Figure TA-5.34. Average number of brown trout adult and young of year individuals per station monitored per year found in Paint Branch SPA streams.

TA-5.3 Benthic Macroinvertebrate IBI Score Comparison

Refer to Section TA-5.1 for year to year benthic IBI narrative condition maps.

Refer to Section TA-5.2 for a discussion of Paint Branch brown trout populations.

TA-5.4 Changes in Benthic Macroinvertebrate Community Structure and Function

Refer to Table TA-5.2 for a complete list of metrics that comprise both the fish and benthic IBIs.

Examples of Community Structure and Function

Functional feeding groups within a benthic community respond differently to stressors. Shredders are organisms that feed primarily on coarse organic matter such as leaves and plant materials (and the fungi and bacteria that colonize them) that wash into a stream. Plant materials are present as dead material (detritus) that has fallen and washed into the stream from the surrounding watershed. Shredders cling to the stream substrate and crawl about looking for detritus or burrow within clumps of detritus to live and feed. Shredders are considered specialized feeders and sensitive organisms, and are thought to be well-represented in healthy streams (U.S. EPA 2008).

Organisms identified as collectors, on the other hand, are generalists with a broader range of acceptable food materials, making them more tolerant to pollution that might alter availability of certain food. Collectors also tend to either filter feed or obtain food from loose surface filter films and sediment, and do not require the complex habitat on which shredders rely. Without relatively stable food dynamics, an imbalance in functional feeding groups will result, reflecting stressed conditions (U.S. EPA 2008).

Members of the family Chironimidae (midges) fit a wide variety of functional feeding groups and habits, but are generally tolerant to pollution and environmental stressors. In addition to their tolerance for environmental disturbance, many have a preference for habitats where food accumulation and particle size are low. As a result, this group of benthic macroinvertebrates is identified as having a rapid habitat invasion potential (Pedersen and Perkins 1986; Jones & Clark 1987), meaning they actually favor these disturbed conditions and take over in a benthic community. When present as the dominant taxa, Chironimidae are an indication that the overall structure of benthic community is out of balance.

Changes in Community Structure and Function

Clarksburg SPA

The benthic macroinvertebrate community composition of the Clarksburg test stations (primarily Town Center and Newcut Road neighborhood stream stations) changed drastically during the development process (2003 to 2009) (Fig. TA-5.35). Shredders declined from 47% to 11% of the community and the more general feeding group, called collectors, increased from a third (32%) to over half of the community (51%).

There was also a shift in the test stations during the construction period where the family Chironomidae became the dominant group and the pollution intolerant and highly sensitive spring stonefly, *Amphinemura* sp., declined dramatically. This shift from sensitive, specialized shredders to collectors (primarily in the Family Chironomidae) suggests that food availability and habitat quality was altered during the construction process. The clearing of vegetation in the landscape and movement of sediment during the construction process reduced the amount of coarse, organic material, such as leaves, entering the streams and replaced it with dissolved and suspended food particles, permitting collectors to thrive.

An overall shift in community structure and function was not evident in the control sites in the Clarksburg SPA (including Ten Mile Creek) where development was not occurring (Fig. TA-5.36).

In 2008 and 2009, after a lull in construction activities, there were certain sites in the Clarksburg SPA that improved from *fair* to *good*. LSLS103B and LSLS104 were sites with consistent *fair* stream conditions through the development process, with benthic scores even dropping down to *poor* here and there. These sites were analyzed further for changes in benthic community structure, so that conclusions can be drawn about the potential for recovery.

Monitoring site LSLS103B showed an improvement in stream conditions from *fair* (in 2007) to *good* (in 2008) with conditions remaining *good* in 2009 (Fig. 5.2 and associated text in the 2009 report). This shift in condition may reflect a change in benthic macroinvertebrate community function. Pre-construction conditions at this site represented a community dominated (57%) by shredders, in particular the sensitive, pollution intolerant spring stonefly, *Amphinemura* sp. (Fig. TA-5.37). During the construction period (Fig. TA-5.37, chart 2003-2007), shredders were nearly eliminated, only making up 2% of the community. Characteristic of sites disturbed by the construction process, there was a dramatic shift (from 22% to 68%) to collectors, primarily in the family Chironomidae.

In 2008-2009 (Fig. TA-5.37, third chart in the series), there is a slight reduction in collectors (from 68%to 43%), an increase in filterers (from 10% to 30%), and the reemergence of some shredders (at 6%). The other functional feeding groups, predators and scrapers, shifted less dramatically. The improvement in overall stream condition and shift in benthic macroinvertebrate community structure occurred following a lull in construction activities and conversion to stormwater management of some properties in the drainage area to this station. The shift in community structure may be the result of stabilization and growing vegetation of the drainage area to the station. However, the dominant taxon, Chironomidae, remains and there has been little shift from that group and other pollution tolerant taxa back to the dominance of a pollution intolerant taxon.

This station, and other stations in the test groups, needs to be further in the development process to verify trends and determine the level of recovery to the impacted benthic macroinvertebrate communities.

LSLS104's stream condition improved to *good* in 2009, after being *fair* through the development process. Benthic scores averaged just above *poor* (43%) from 2006-2008. In 2009, the benthic score jumped to *good* (70%). The 2008-2009 combined community structure indicates a different story however, with collectors still dominating at 64% (Fig. TA-5.38, third chart in the series). The community is still drastically different than the preconstruction community (Fig. TA-5.38, first chart) which had a thriving shredder community (53%). The current shredder community is barely holding on at 12%. This site may have had a sudden reoccurrence of sensitive taxa like *Amphinemura* sp. in 2009, but the community needs more time to recover its former numbers.

Piney Branch SPA

A similar observation to the Clarksburg SPA was made for the Piney Branch SPA test areas. For data through the construction period, there was a loss of shredders and a shift to collectors becoming the most prevalent functional feeding group in the test areas (Fig. TA-5.39). In the test areas, the dominant taxa were Chironimidae (midges) and *Cheumatopsyche* sp., a type of net-spinning caddisfly. Although caddisflies as a family are considered among the most sensitive stream organisms, net-spinning caddisflies are generalist feeders that remain fairly sedentary, spinning nets to capture fine suspended particles of food. Like Chironimidae, *Cheumatopsyche* sp. is considered very tolerant to disturbance and environmental stressors.

Only one station is available as a control. For this control area (Fig. TA-5.40), there was a shift in dominant taxa from tolerant organisms, prior to 1997, to the prevalence of the sensitive stonefly *Amphinemura* sp. from 1997 to 2009. For the control, there was an increase in collectors and scrapers as the percentage of filterers was reduced from 39% to 17%.

Paint Branch SPA

The observations for the Paint Branch SPA benthic communities differ from the other two SPAs analyzed. Dramatic shifts in the community structure, particularly in the functional feeding group of collectors, were not observed. Collectors were consistently the predominant feeding group in both the test and control areas. Collectors make up roughly half of the community before and through construction in the test group (Fig. TA-5.41); the same is true of the control group (Fig. TA-5.42).

One notable difference between the test and control groups is that while the percentage of collectors and filterers remain fairly consistent, the other functional feeding groups do not. The percentage of shredders in the test areas of the Paint Branch is reduced by over half, from 13% pre-construction to 5% through construction. Slight increases in the percentages of predators and scrapers are also observed. In contrast, these shifts are not as dramatic in the control areas and the ratio of functional feeding groups remains fairly consistent over time. The dominant taxon is Chironimidae during the pre-construction and during construction periods for both the test and control stations. The pre-existing dominance of Chironomidae and other collectors in the Paint Branch SPAs may be the result of prior disturbance from construction from existing development activities. However, change in the benthic community structure and function appeared to be limited in the Paint Branch SPA. The Clarksburg SPA is unique in that the pre-existing development was limited due to the formerly rural and agricultural land use.

Upper Rock Creek SPA

No test stations have been designated so no analyses of community structure and function are completed at this time.

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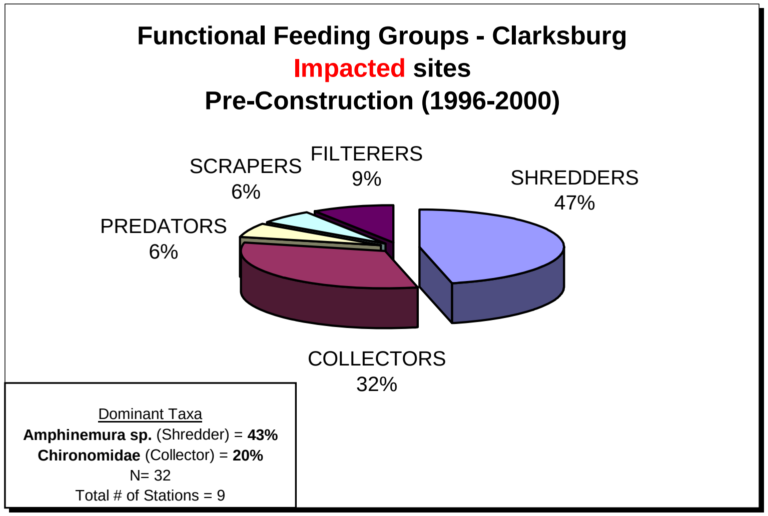


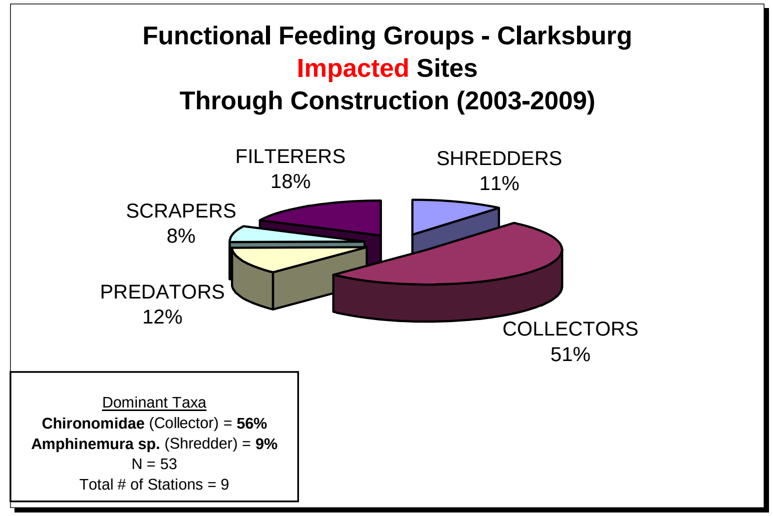
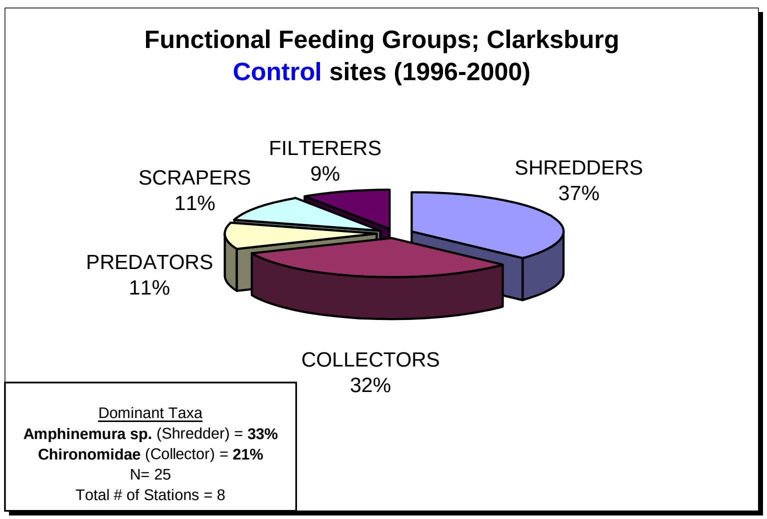


Figure TA-5.35. Functional feeding groups and dominant taxa in the test areas of the Clarksburg SPA.



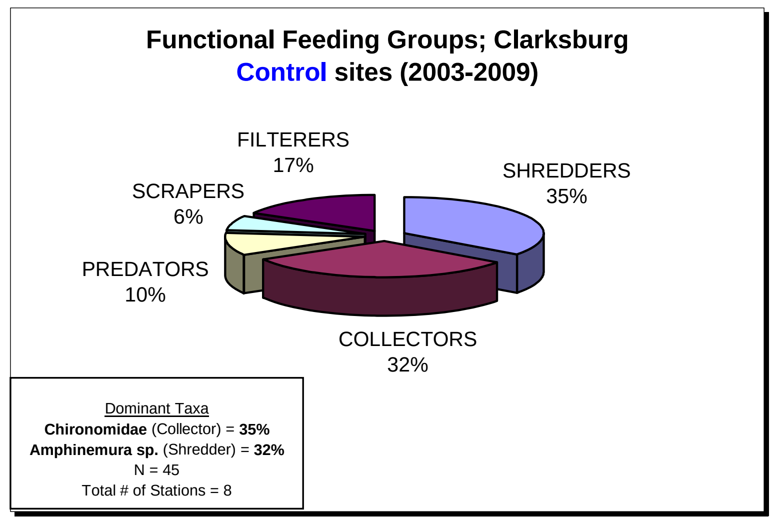


Figure TA-5.36. Functional feeding groups and dominant taxa in the control areas of the Clarksburg SPA.

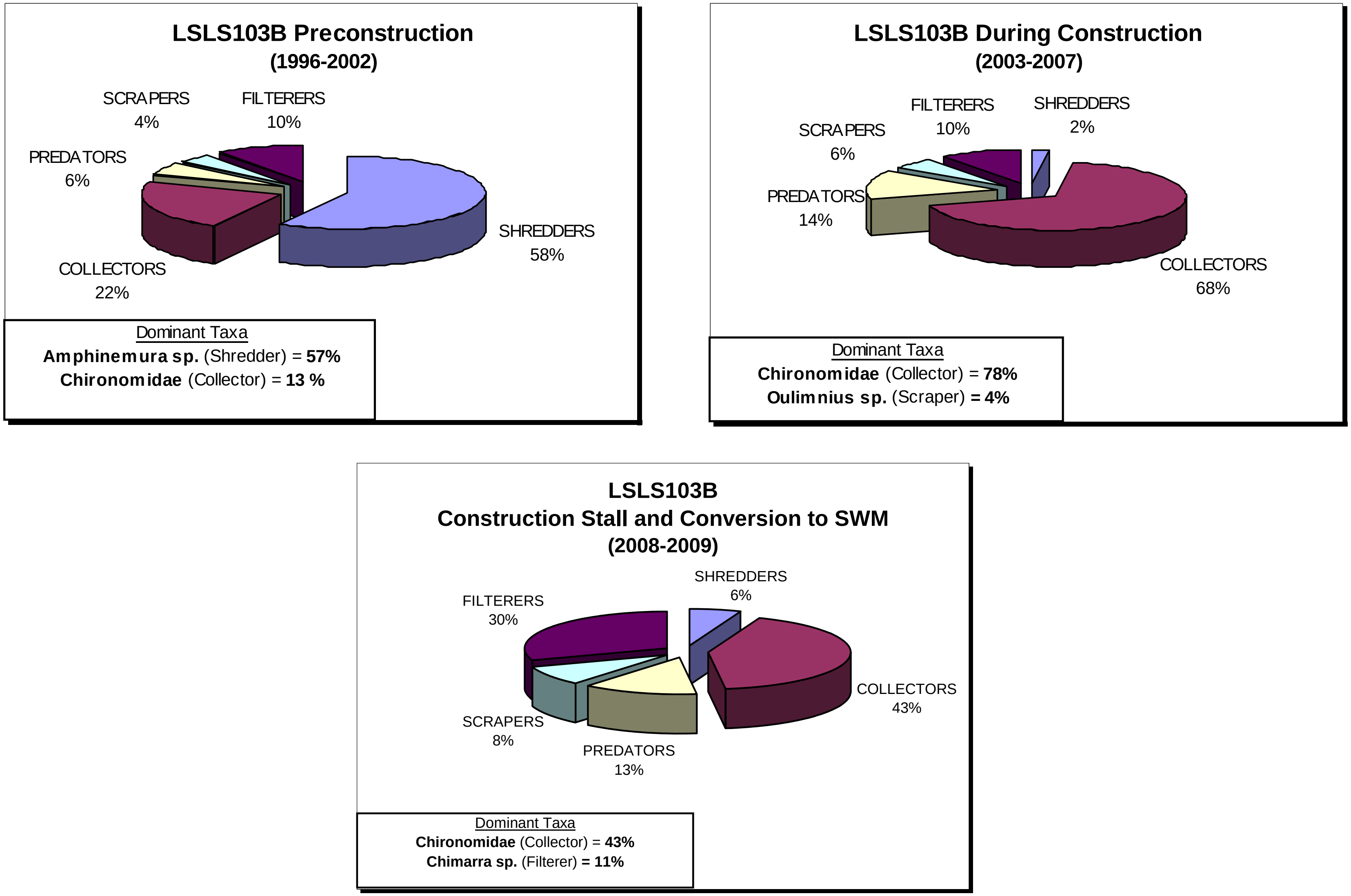


Figure TA-5.37. Functional feeding groups and dominant taxa over the course of development in the drainage area to LSLS103B.

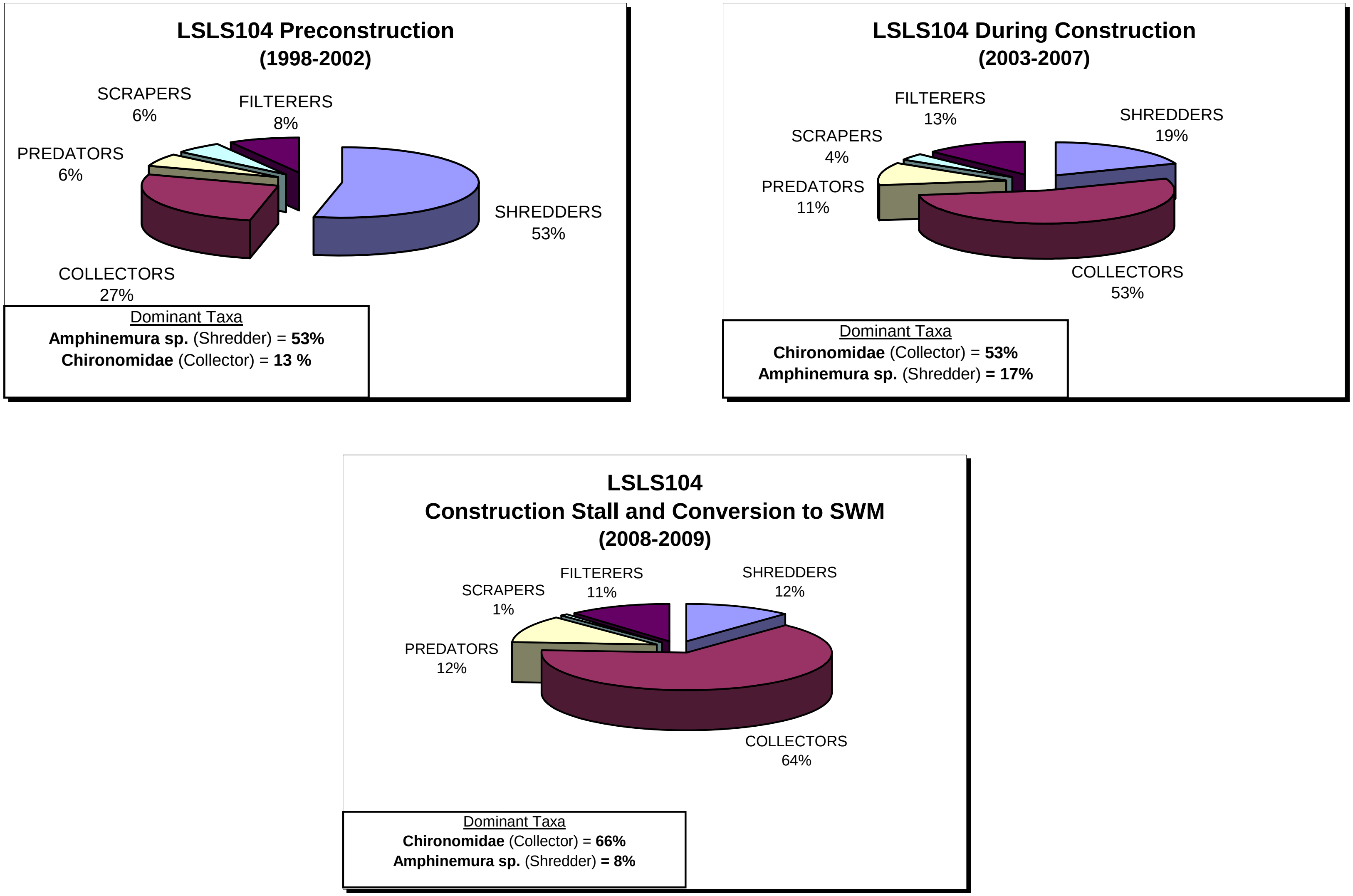


Figure TA-5.38. Functional feeding groups and dominant taxa over the course of development in the drainage area to LSLS104.

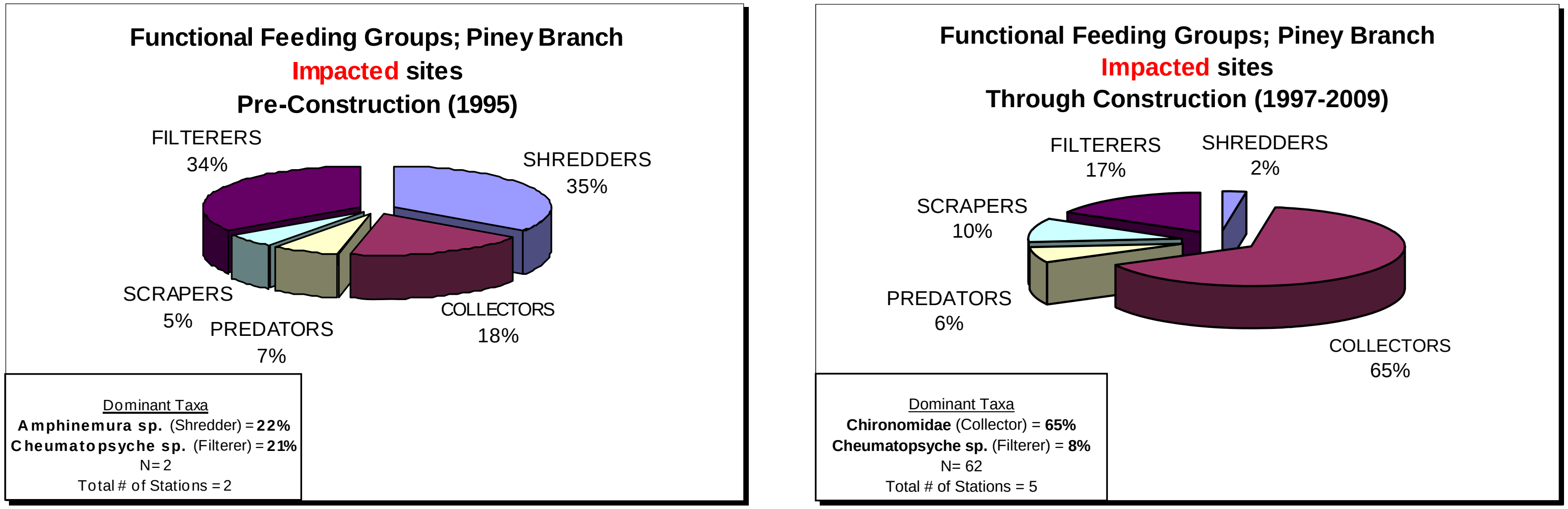


Figure TA-5.39. Functional feeding groups and dominant taxa in the test areas of the Piney Branch SPA.

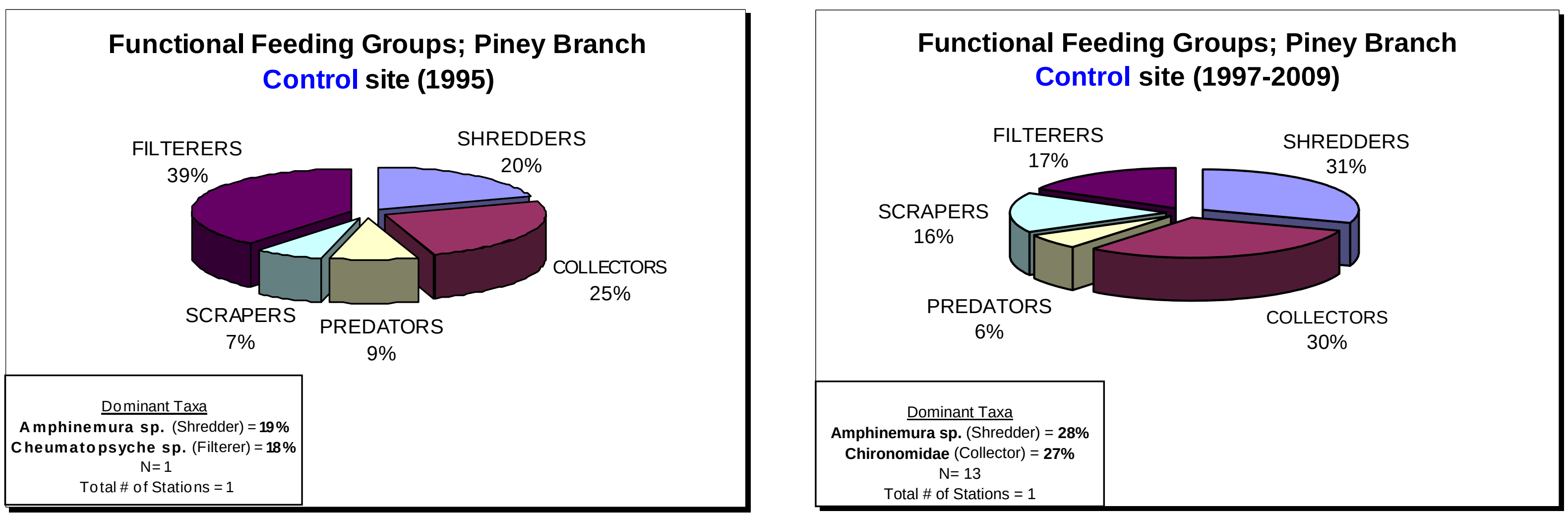


Figure TA-5.40. Functional feeding groups and dominant taxa in the control areas of the Piney Branch SPA.

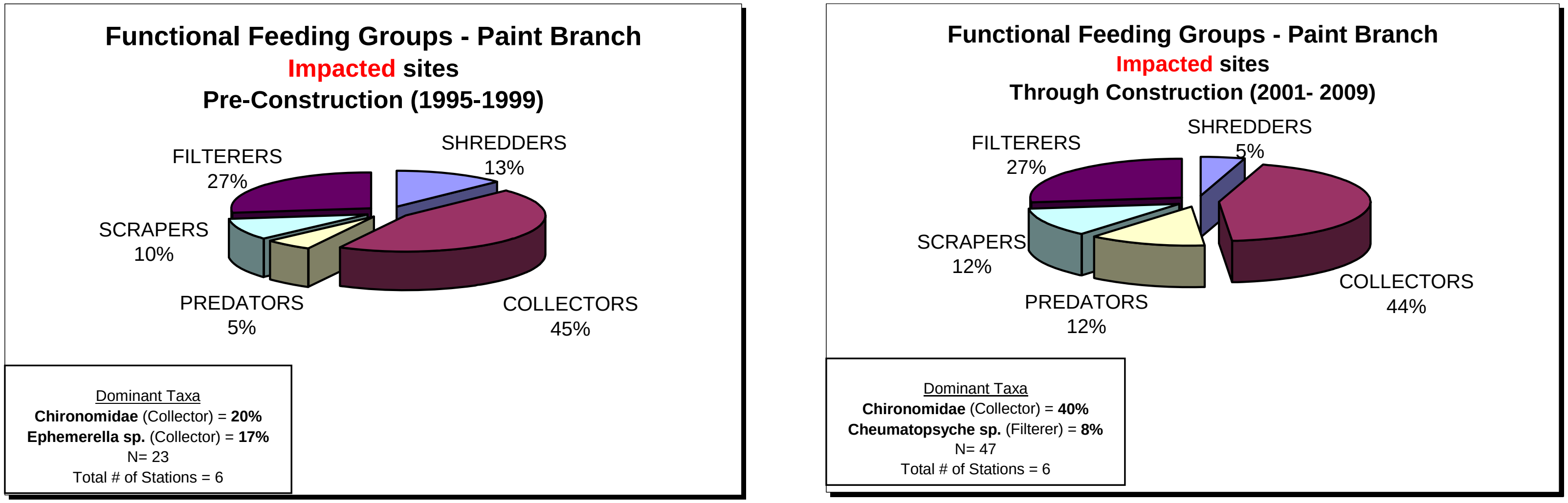


Figure TA-5.41. Functional feeding groups and dominant taxa in the test areas of the Paint Branch SPA.

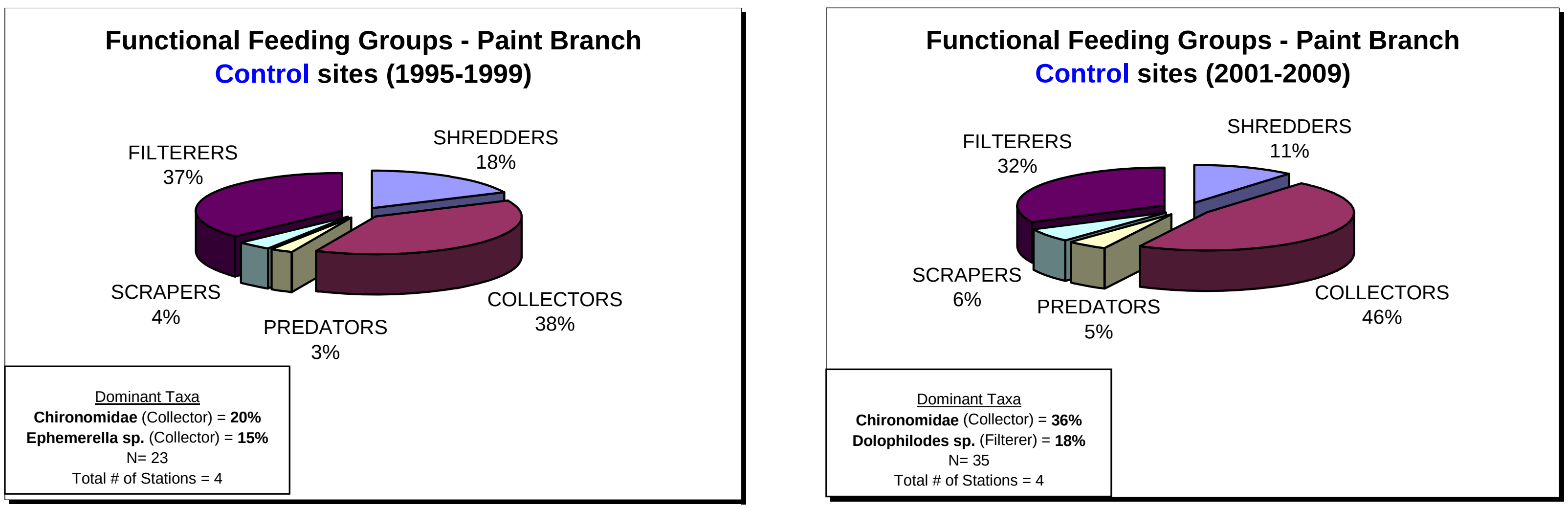


Figure TA-5.42. Functional feeding groups and dominant taxa in the control areas of the Paint Branch SPA.

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Note to Reader

For more information on Section 5 or Technical Appendix materials, please contact DEP at AskDEP@montgomerycountymd.gov, 240-777-7700.