

**Technical Appendix:**  
**Section 5: Biological Stream Monitoring**

*Page left intentionally blank*

**Table of Contents**

List of Figures ..... 4

List of Tables ..... 6

**TA-5.1 Background..... 8**

**Examples of Tolerance Values and Functional Feeding Groups..... 8**

**Benthic Macroinvertebrate and Fish Metrics ..... 9**

**Biological Data Available for all Four SPAs ..... 10**

**Summary of Stream Monitoring Protocols ..... 11**

*Benthic Macroinvertebrates..... 11*

*Fish ..... 12*

*Habitat ..... 12*

*Physical Chemistry ..... 12*

**Maps of SPA Monitoring Stations and Year to Year Stream Conditions (Average of Benthic and Fish IBIs)..... 14**

*Clarksburg SPA ..... 14*

*Paint Branch SPA ..... 189*

*Piney Branch SPA..... 23*

*Upper Rock Creek SPA ..... 289*

**Maps of Year to Year Benthic IBI Narratives ..... 34**

*Clarksburg SPA ..... 344*

*Paint Branch SPA ..... 39*

*Piney Branch SPA..... 44*

*Upper Rock Creek SPA..... 49*

**TA-5.2 Stream Condition Comparison ..... 54**

**Paint Branch Brown Trout ..... 54**

**TA-5.3 Benthic Macroinvertebrate IBI Score Comparison..... 56**

**TA-5.4 Changes in Benthic Macroinvertebrate Community Structure and Function ..... 56**

**Examples of Community Structure and Function..... 56**

**Changes in Community Structure and Function..... 56**

*Clarksburg SPA ..... 56*

*Piney Branch SPA..... 58*

*Paint Branch SPA ..... 58*

*Upper Rock Creek SPA..... 59*

**Literature Cited ..... 66**

**Note to Reader..... 66**

List of Figures

Figure TA-5.1. 2006 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Clarksburg SPA. .... 14

Figure TA-5.2. 2007 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Clarksburg SPA. .... 15

Figure TA-5.3. 2008 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Clarksburg SPA. .... 16

Figure TA-5.4. 2009 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Clarksburg SPA. .... 17

Figure TA-5.5. 2010 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Clarksburg SPA. .... 19

Figure TA-5.6. 2006 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Paint Branch SPA. .... 20

Figure TA-5.7. 2007 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Paint Branch SPA. .... 21

Figure TA-5.8. 2008 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Paint Branch SPA. .... 22

Figure TA-5.9. 2009 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Paint Branch SPA. .... 24

Figure TA-5.10. 2010 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Paint Branch SPA. .... 25

Figure TA-5.11. 2006 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Piney Branch SPA. .... 26

Figure TA-5.12. 2007 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Piney Branch SPA. .... 27

Figure TA-5.13. 2008 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Piney Branch SPA. .... 29

Figure TA-5.14. 2009 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Piney Branch SPA. .... 30

Figure TA-5.15. 2010 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Piney Branch SPA. .... 31

Figure TA-5.16. 2006 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Upper Rock Creek SPA. .... 32

Figure TA-5.17. 2007 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Upper Rock Creek SPA. .... 34

Figure TA-5.18. 2008 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Upper Rock Creek SPA. .... 35

Figure TA-5.19. 2009 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Upper Rock Creek SPA. .... 36

Figure TA-5.20. 2010 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Upper Rock Creek SPA. .... 37

Figure TA-5.21. 2006 Map of Benthic IBI Narrative Conditions for Clarksburg SPA.... 39

Figure TA-5.22. 2007 Map of Benthic IBI Narrative Conditions for Clarksburg SPA.... 40

Figure TA-5.23. 2008 Map of Benthic IBI Narrative Conditions for Clarksburg SPA... 41

Figure TA-5.24. 2009 Map of Benthic IBI Narrative Conditions for Clarksburg..... 42

Figure TA-5.25. 2010 Map of Benthic IBI Narrative Conditions for Clarksburg..... 44

Figure TA-5.26. 2006 Map of Benthic IBI Narrative Conditions for Paint Branch SPA. 45

Figure TA-5.27. 2007 Map of Benthic IBI Narrative Conditions for Paint Branch SPA. 46

Figure TA-5.28. 2008 Map of Benthic IBI Narrative Conditions for Paint Branch SPA. 47

Figure TA-5.29. 2009 Map of Benthic IBI Narrative Conditions for Paint Branch SPA. 49

Figure TA-5.30. 2010 Map of Benthic IBI Narrative Conditions for Paint Branch SPA. 50

Figure TA-5.31. 2006 Map of Benthic IBI Narrative Conditions for Piney Branch SPA.51

Figure TA-5.32. 2007 Map of Benthic IBI Narrative Conditions for Piney Branch SPA.52

Figure TA-5.33. 2008 Map of Benthic IBI Narrative Conditions for Piney Branch SPA.55

Figure TA-5.34. 2009 Map of Benthic IBI Narrative Conditions for Piney Branch SPA.55

Figure TA-5.35. 2010 Map of Benthic IBI Narrative Conditions for Piney Branch SPA.48

Figure TA-5.36. 2006 Map of Benthic IBI Narrative Conditions for Upper Rock Creek SPA.  
..... 49

Figure TA-5.37. 2007 Map of Benthic IBI Narrative Conditions for Upper Rock Creek SPA.  
..... 62

Figure TA-5.38. 2008 Map of Benthic IBI Narrative Conditions for Upper Rock Creek SPA.  
.....**Error! Bookmark not defined.**

Figure TA-5.39. 2009 Map of Benthic IBI Narrative Conditions for Upper Rock Creek SPA.  
..... 64

Figure TA-5.40. 2010 Map of Benthic IBI Narrative Conditions for Upper Rock Creek SPA.  
..... 64

Figure TA-5.41. Brown Trout..... 65

Figure TA-5.42. Average number of brown trout adult and young of year individuals per station  
monitored per year found in Paint Branch SPA streams. .... 65

List of Tables

Table TA-5.1. Examples of tolerance values and functional feeding groups for select fish and benthic macroinvertebrates. .... 8

Table TA-5.2. Metrics Used in the Fish and Benthic Macroinvertebrate IBIs..... 9

Table TA-5.3. Biological monitoring data available for all four SPAs..... 10

*Page left intentionally blank*

## 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	Eccopectura 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.**

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

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

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

<sub>3</sub> EPT taxa fall into the taxonomic orders of mayflies (Ephemeroptera), 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	2010
GSWB201						BFH C	FHC	BHC		BFH C	BHC	BHC	BHC	BFH C	BFH C	BFH C	BFH C
LSCB101					BFHC		BFH C		BHC	BHC	BHC	BHC	BHC	BFH C	BFH C	BHC	BHC
LSCB201					BFHC		FHC		BFH C	BHC							
LSLS101		BFHC	BHC	BFHC		BFH C	BFH C	BFH C	BHC		BFH	BFH C	BFH C	BFH C	BFH C	BFH C	BFH C
LSLS102												BHC	BHC				BHC
LSLS103A		BHC	HC	C													
LSLS103B	FH	BHC	BHC	BFHC	BFHC	BFH C	BHC	BFH C									
LSLS103C				BFHC	BFHC	BFH C											
LSLS104					BFHC	BFH C	BFH C	B	BHC	BFH C	BHC	BFH C	BFH C	BFH C	BFH C	BFH C	BFH C
LSLS109					BHC	HC	FHC	B		BHC	BHC	BFH C	BFH C	BFH C	BFH C	BFH C	BFH C
LSLS110					BHC	BHC	BFH C	B		BHC		BHC	BHC				BHC
LSLS111						BHC	BHC										
LSLS203	BFH	BFHC	BHC	BFHC	BFHC	BFH C	BFH C	BFH C	FHC	BFH C	BHC						
LSLS204	BFH	BFHC	BHC	BFHC	BFHC	BFH C	BFH C	BFH C	FH	BFH C							
LSLS205	BFH	BFHC	BHC	BFHC	BFHC	BFH C		BFH C	BHC								
LSLS206	BFH	BFHC	BHC	HC	BFHC	BHC		B	BHC	BHC	BHC	BHC	BFH C				
LSLS301	BFH	BFHC	BHC	BFHC	FHC	BFH C	FC		BFH C								
LSLS302	BFH	BFHC	BHC	BFHC		BHC	BFH C										
LSLS303	FH	BFHC	BHC		BHC		BFH C										
LSTM106			C	BHC	BHC		BHC	B	BHC	BHC	BHC	BHC	BHC				
LSTM110			BHC	BHC	BHC					BHC	BHC		BHC	BHC		BHC	BHC
LSTM111										B		BHC					
LSTM112										BC		BHC	BHC	BFH C	BHC	BHC	BHC
LSTM201	BFH	BFHC	BHC	BFHC	BHC	BHC				BHC				BFH C	BFH C	BFH C	BFH C
LSTM202	BFH	BFHC	BHC	BFHC	BHC	BHC				BHC				BFH C	BFH C	BFH C	BFH C
LSTM203		BFH	BH							BH				BFH C	BFH C	BFH C	BFH C
LSTM204		BFHC	BHC	BHC						BH				BFH C	BFH C	BFH C	BFH C
LSTM206				BFHC	BFHC	BHC	BFH C										
LSTM302	BFH	BFHC	BHC	BFHC			BFH C			BFH C				BFH C	BFH C	BFH C	BFH C
LSTM303B	BFH	BFHC	BHC	BFHC	BFHC	BHC	BFH C	BFH C	BHC	BFH C							
LSTM304	BFH	BFHC	BHC	BFHC	FHC		BFH C			FHC		FHC	FHC				BHC

PAINT BRANCH																	
Data Available By Year																	
Station	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
PBAT101			BHC	BHC	BHC												
PBFF101				BHC		BHC	BHC										
PBGH108	FHC	BFH C	BFH C	BFH C	BHC	BFH C	BFH C		BHC	BHC	BHC	BFH C	BFH C	BHC	BFH C	BFH C	BFH C
PBGH202				BHC		BHC	BHC										
PBGH208A	FHC	BFH C	BFH C	FHC	BFH C	BFH C	BFH C	FHC	BFH C								
PBGH208B		BFH C	BFH C	BHC	HC					F							
PBGS102A				BHC	B												
PBGS102B				BHC	HC	BHC				BFH C							
PBGS111	BFH C	BHC	BFH C	BHC	BFH C	BFH C	BFH C	BFH C	BHC	BHC	BHC						
PBGS206	FHC	BFH C	BFH C	FHC	BFH C	BHC	BFH C										
PBLD101			BFH C	BFH C	BH	BHC	BHC	B		BHC	BHC						
PBLF202	FHC	BH	BFH C	BFH C		BFH C	BFH C	BFH C	BHC	BFH C	FH	BFH C	BFH C			BFH C	BFH C

PBLF203	FHC	BH	BFH C	BFH C	BHC	BFH C	BFH C	BFH C	BHC	BFH C		BFH C	BFH C	BFH C	BFH C	BFH C	BHC
PBPB302	FHC	BH	BFH C	BFH C	BFH C	BFH C	BFH C		BHC	BFH C							
PBPB305C	FHC	BFH C	BFH C	BFH C	BHC	BHC	FHC	BFH C	BHC	BFH C	BHC						
PBRF117	FHC	BH	BFH C	BFH C	BFH C	BHC	BFH C	BFH C	BFH C	BFH C	BHC	BFH C	BFH C	BFH C	BFH C	BFH C	BHC
PBRF118	FHC	BH	BFH C	HC	BHC	BHC	BHC	B	BHC	BHC	BHC	BHC	BHC	BFH C	BFH C	BFH C	BFH C
PBRF204	FHC	BH	BFH C														
PBRF206					BFH C	BHC	BFH C	BFH C	BHC	BHC	BFH C						

PINEY BRANCH	Data Available By Year																
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Station		BFH C	BFH C	BFH C	BFH C	BFH C	BFH C	BFC	BFH C	BHC							
WBPB101				BHC	BHC	BHC	BHC	B	BH	BHC							
WBPB102				BHC	BHC	BHC	BHC	B	BH	BHC							
WBPB103				BHC	BHC	BHC	BHC	B	BH	BHC							
WBPB201		BFH C	BHC	BFH C	FHC	BFH C	BFH C	BHC									
WBPB202		BFH C	BHC	BFH C	FHC	BFH C	BFH C	BFH C	BFH C	BFH C	BHC	BFH C	BFH C	BFH C	BFH C	BFH C	
WBPB203A		BFH C	BHC	FHC	BFH C												
WBPB203B				BFH C	BFH C	BFH C	BFH C	BFH C	BHC	BHC							
WBPB204A		BFH C	BHC	BFH C	FHC	BHC	BFH C	BFH C	BHC	BFH C							
WBPB204B		B		BHC	BFH C	BFH C	BFH C	BFH C	BHC	BFH C	BFH C	BFH C	BFH C				
WBPB205		BFH C	BHC	BFH C													

UPPER ROCK CREEK	Data Available By Year																
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
URNB103											BHC						
URNB105											BHC						
URNB110D											BHC	BHC	BHC	BC	BHC	BHC	B
URNB111											BHC						
URRC104											BHC	BHC	BHC	BHC	BHC	BHC	BH
URRC106											BHC	BH	BHC	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.

*Page left intentionally blank*



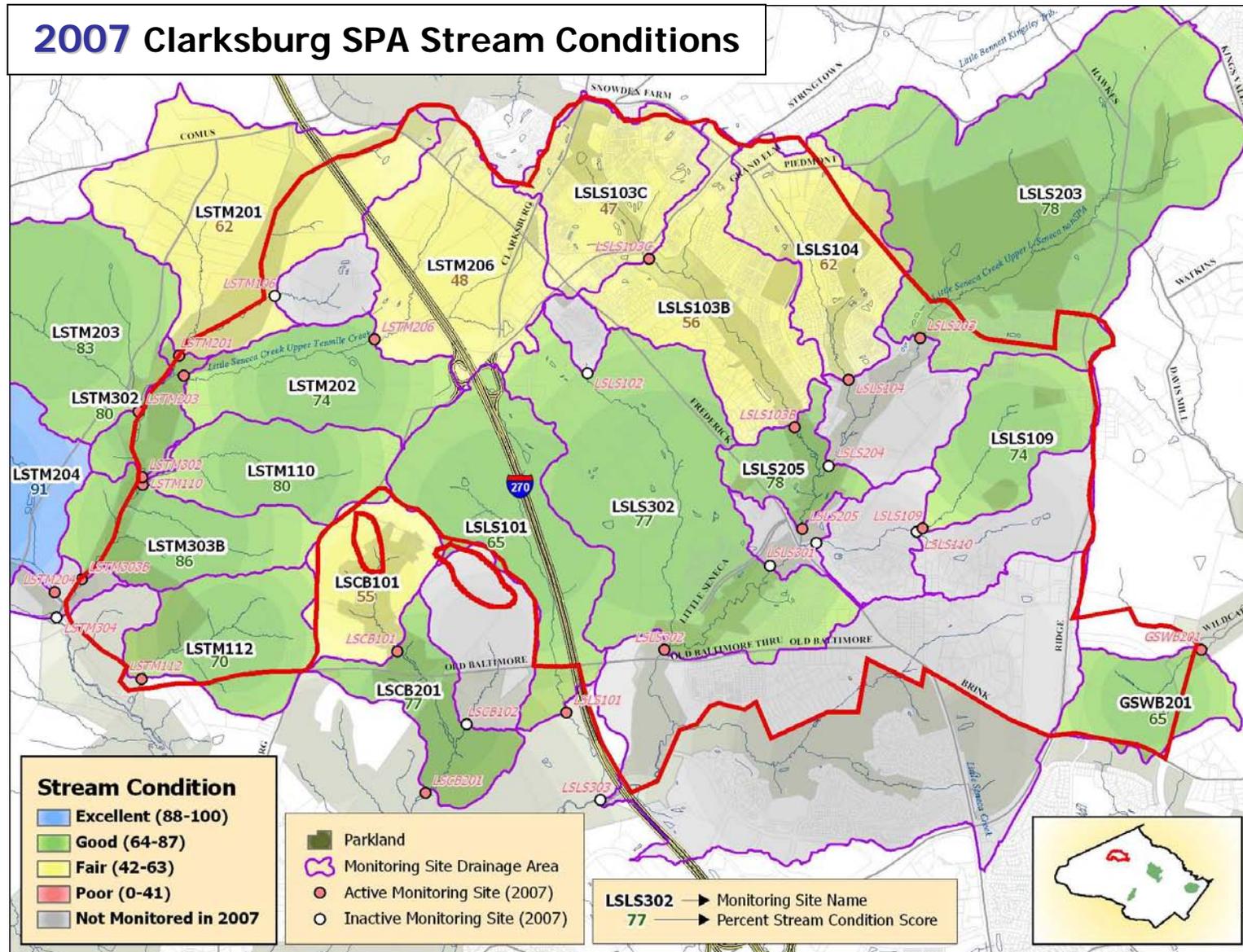


Figure TA-5.2. 2007 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Clarksburg SPA.









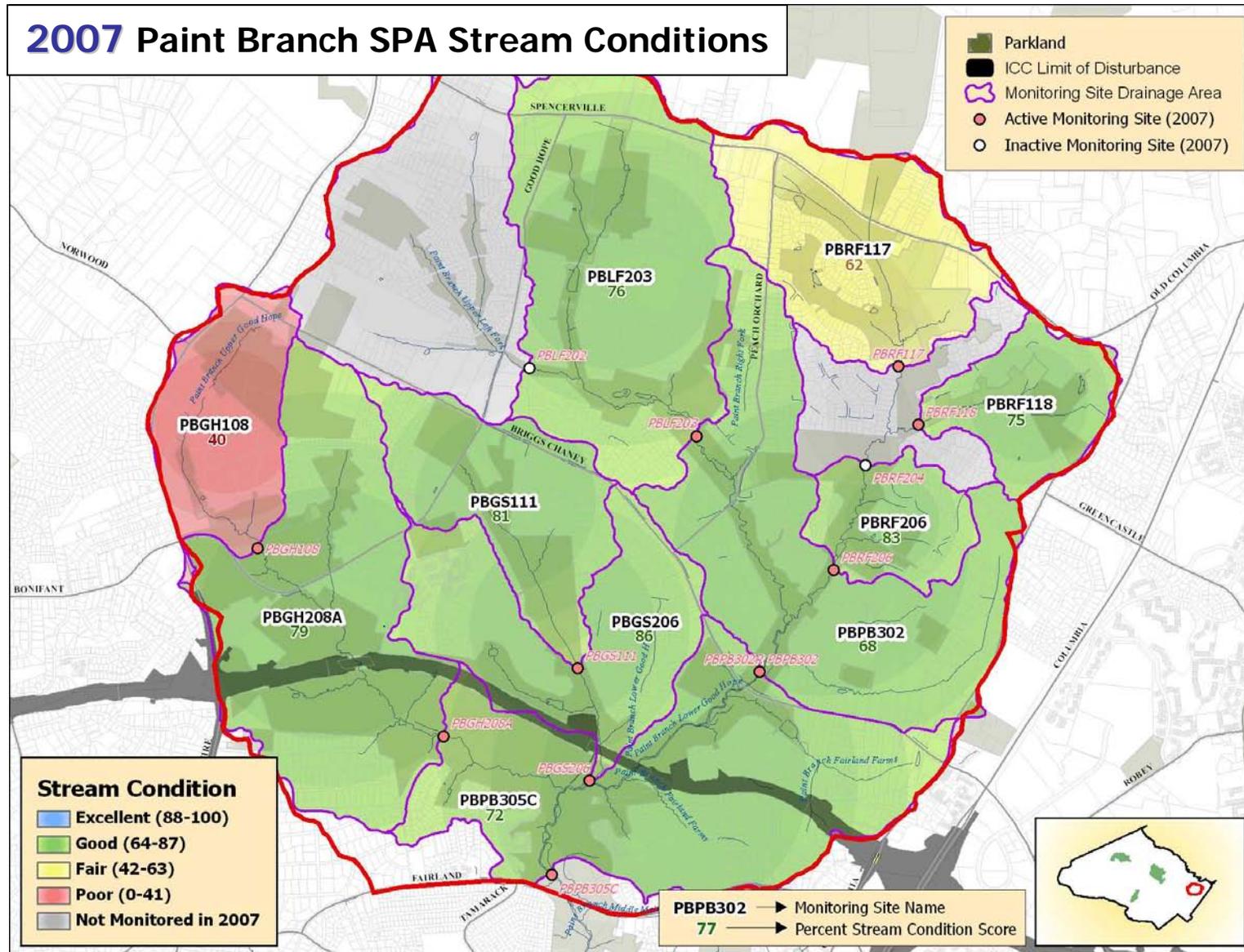


Figure TA-5.7. 2007 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Paint Branch SPA. Construction on this portion of the InterCounty Connector (ICC) (Contract B) did not begin until January 2009.

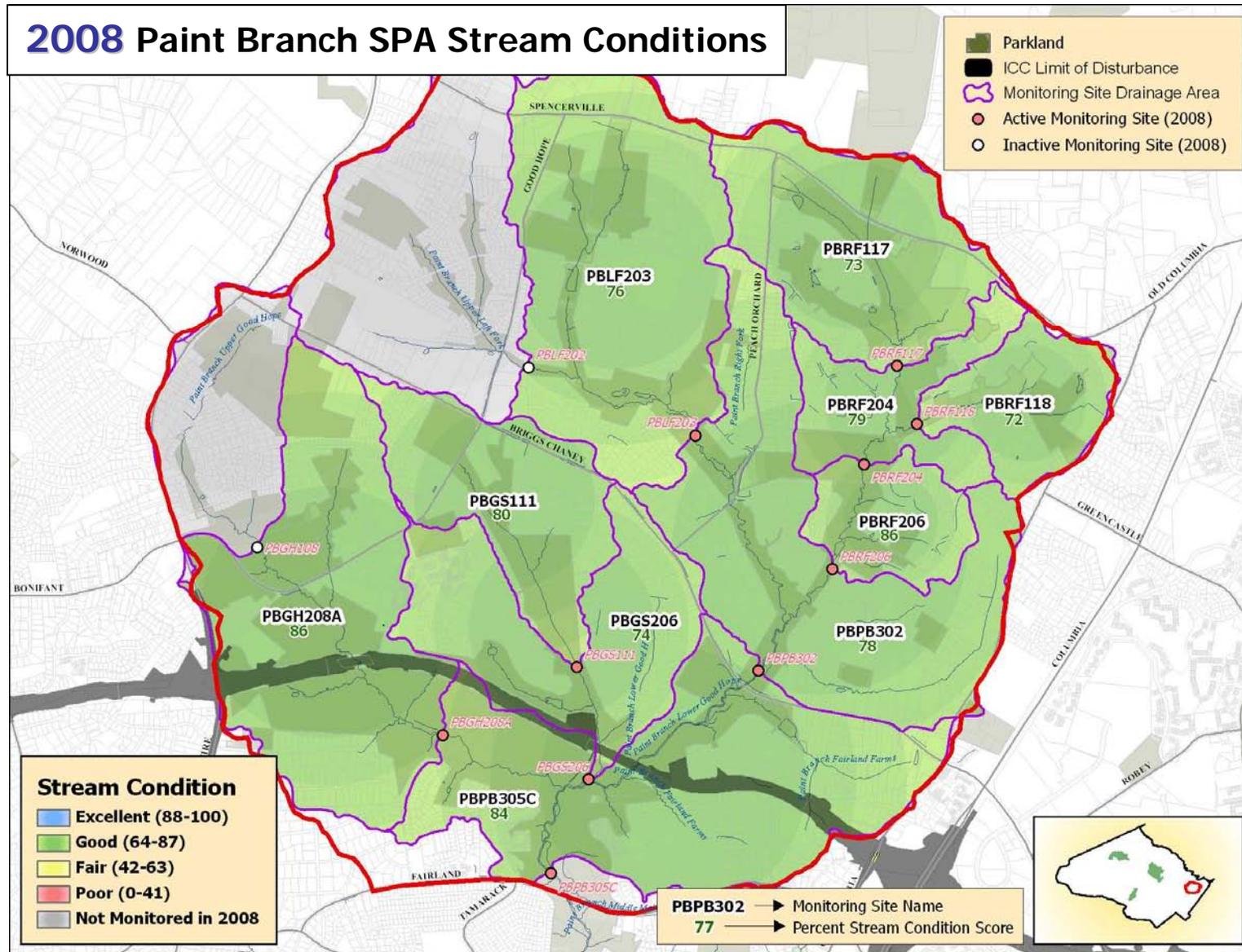


Figure TA-5.8. 2008 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Paint Branch SPA. Construction on this portion of the InterCounty Connector (ICC) (Contract B) did not begin until January 2009.

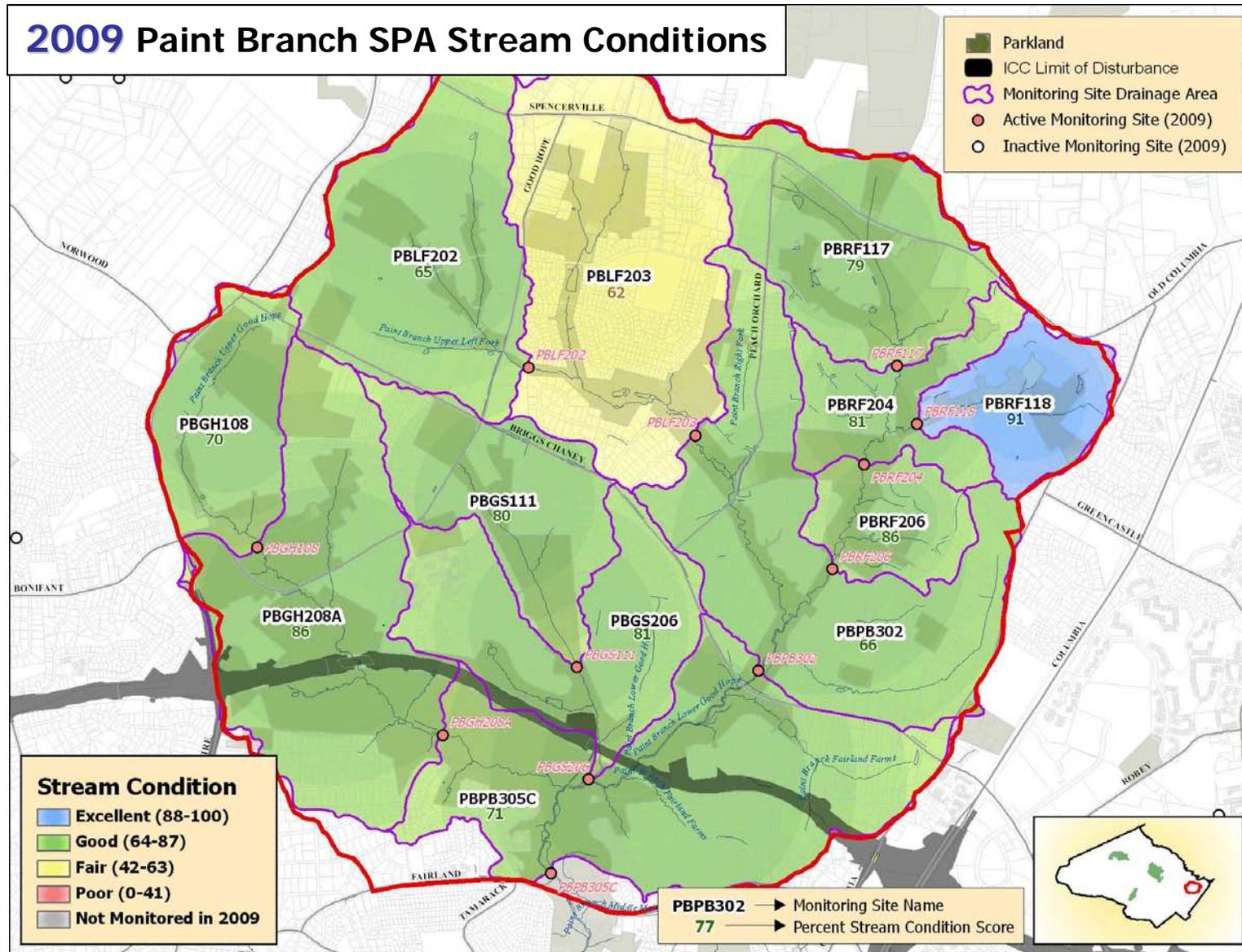


Figure TA-5.9. 2009 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Paint Branch SPA. Construction on this portion of the InterCounty Connector (ICC) (Contract B) began in January 2009.

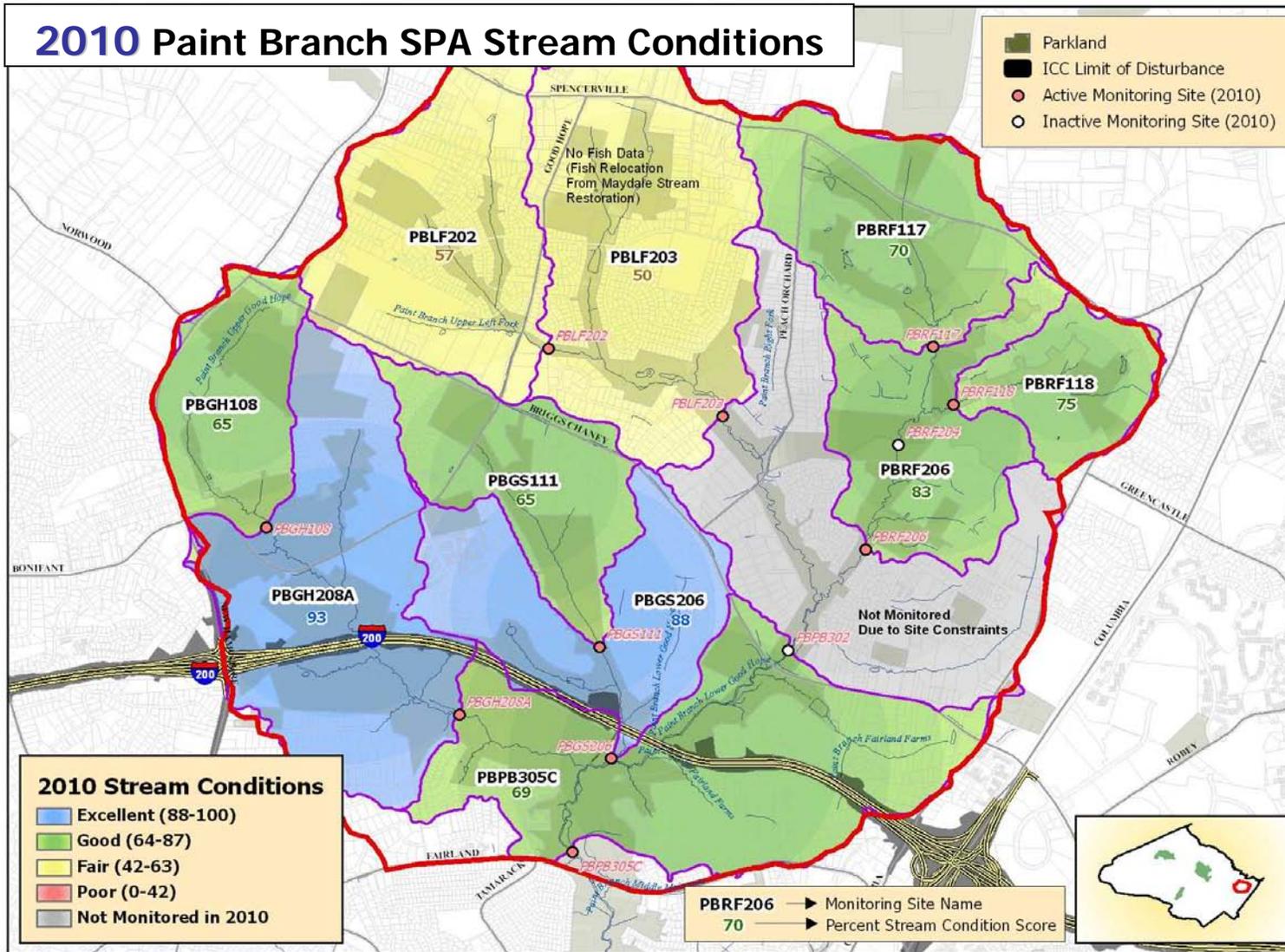


Figure TA-5.10. 2010 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Paint Branch SPA. Construction on this portion of the InterCounty Connector (ICC) (Contract B) began in January 2009.

Piney Branch SPA

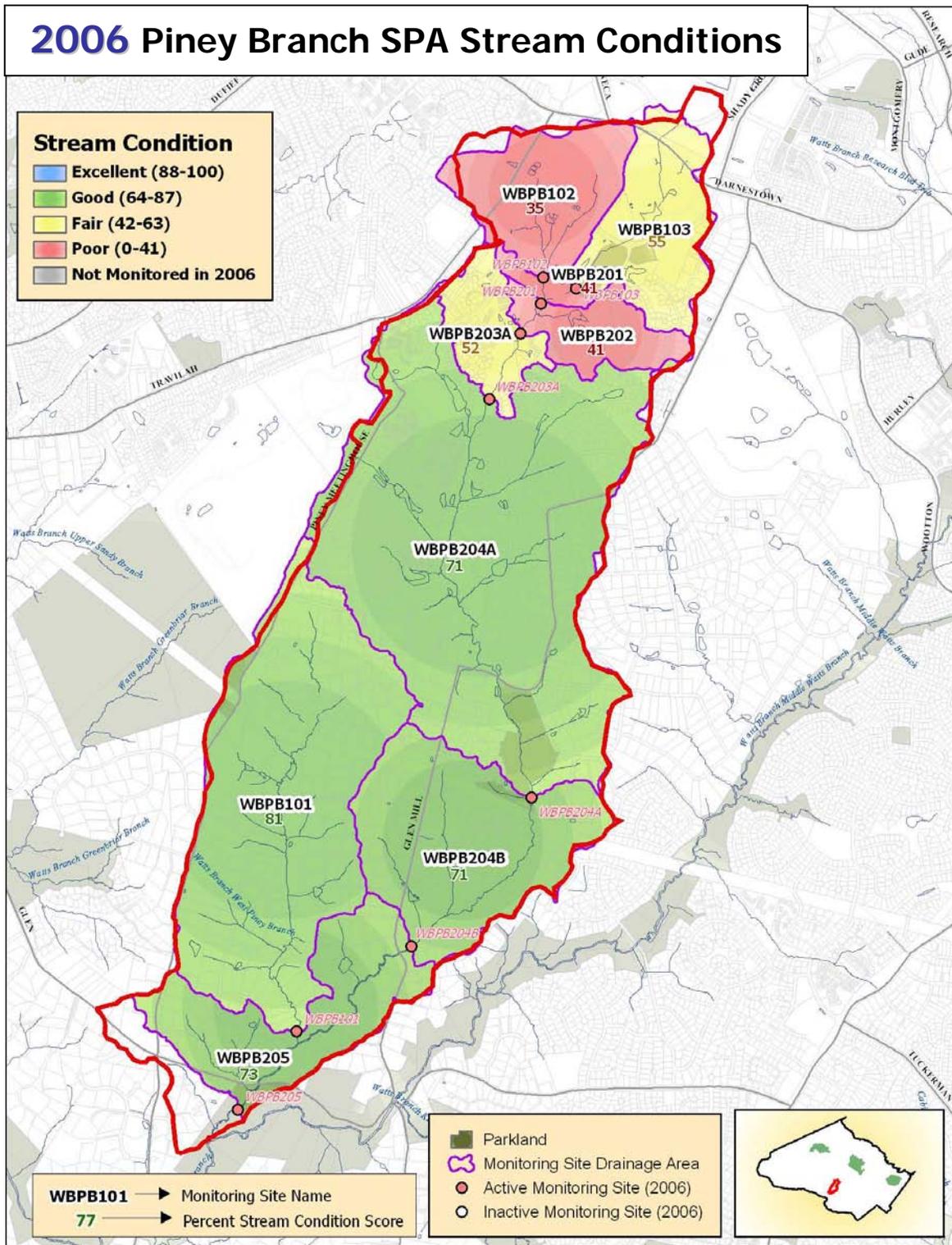


Figure TA-5.11. 2006 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Piney Branch SPA.

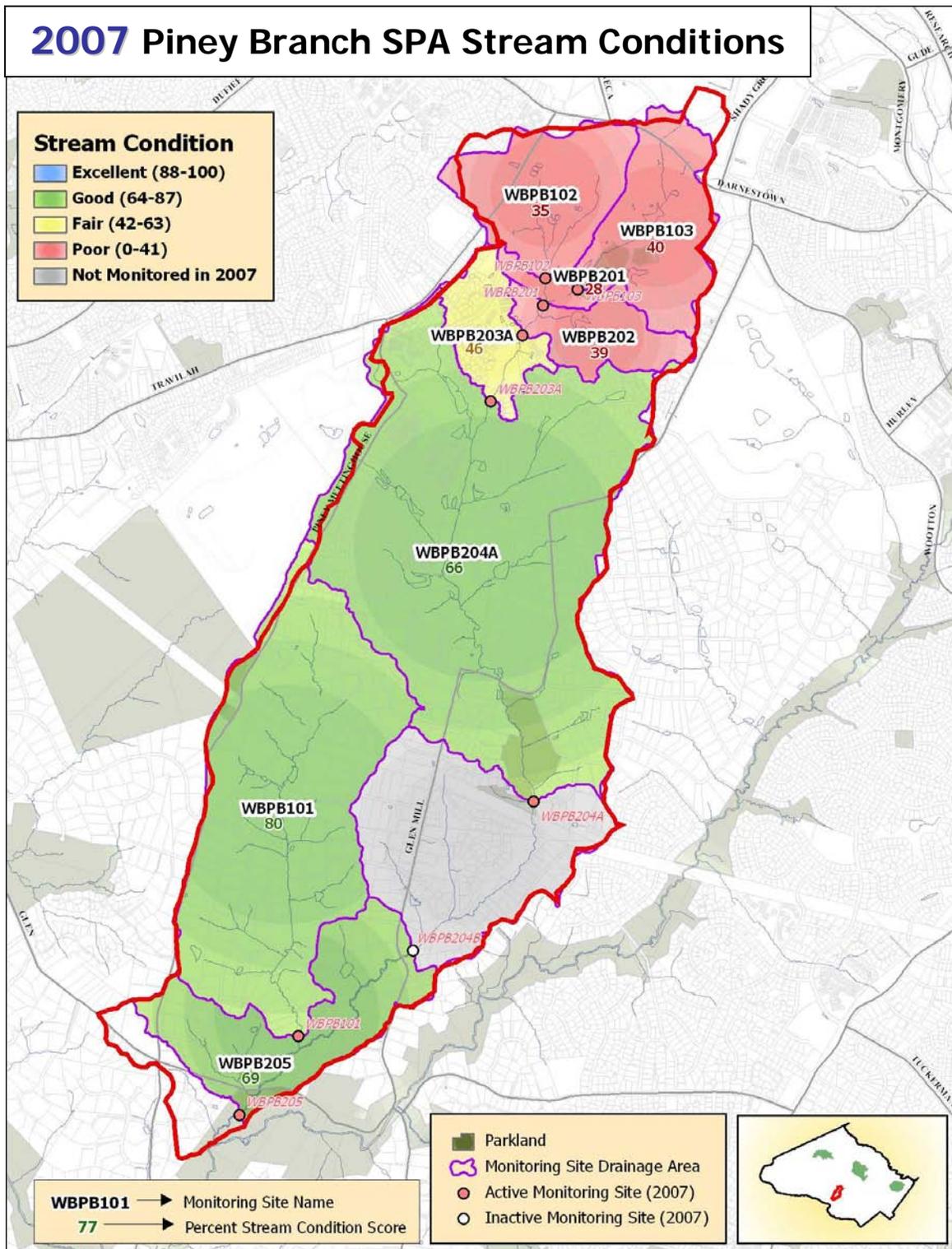


Figure TA-5. 12. 2007 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Piney Branch SPA.

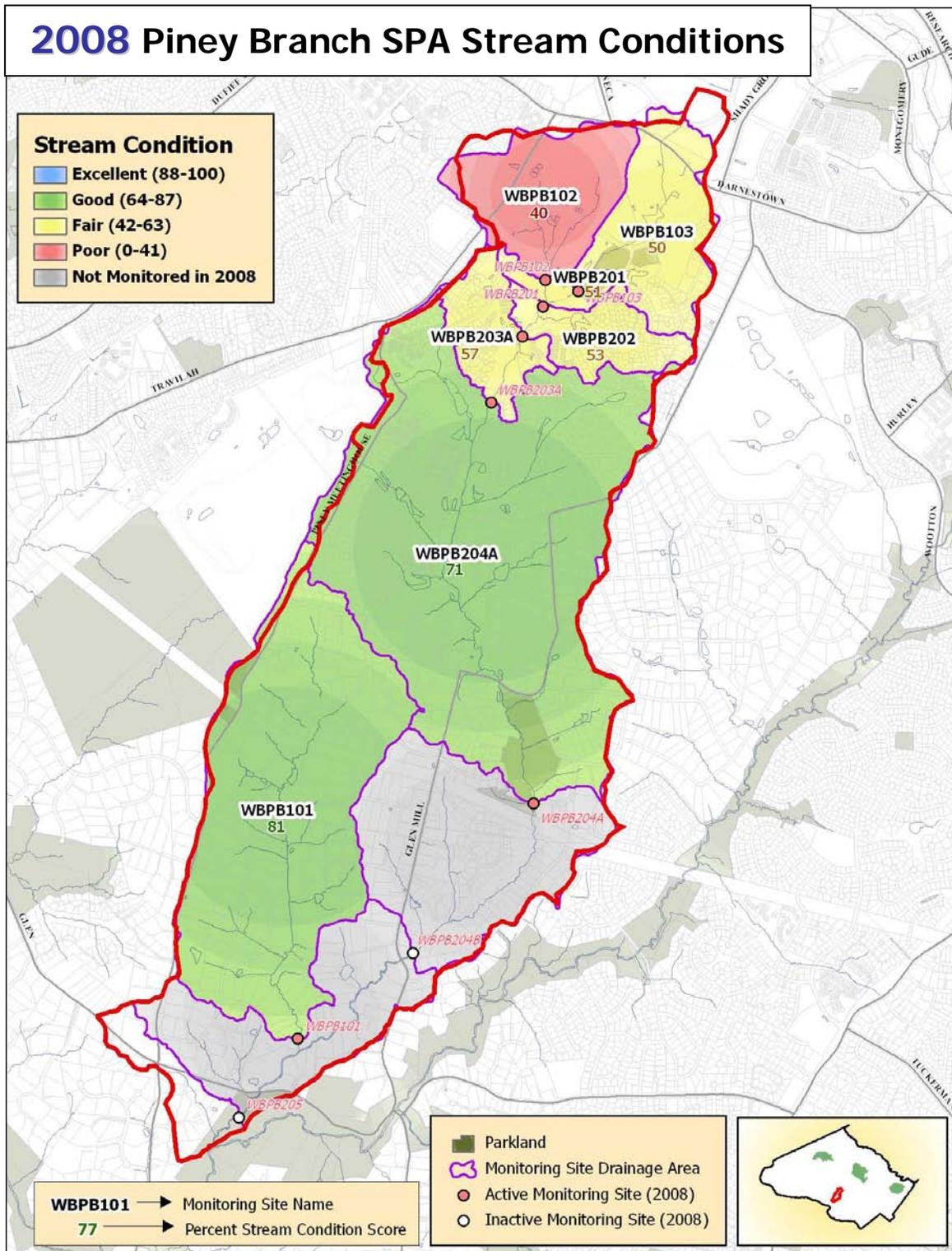


Figure TA-5.13. 2008 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Piney Branch SPA.

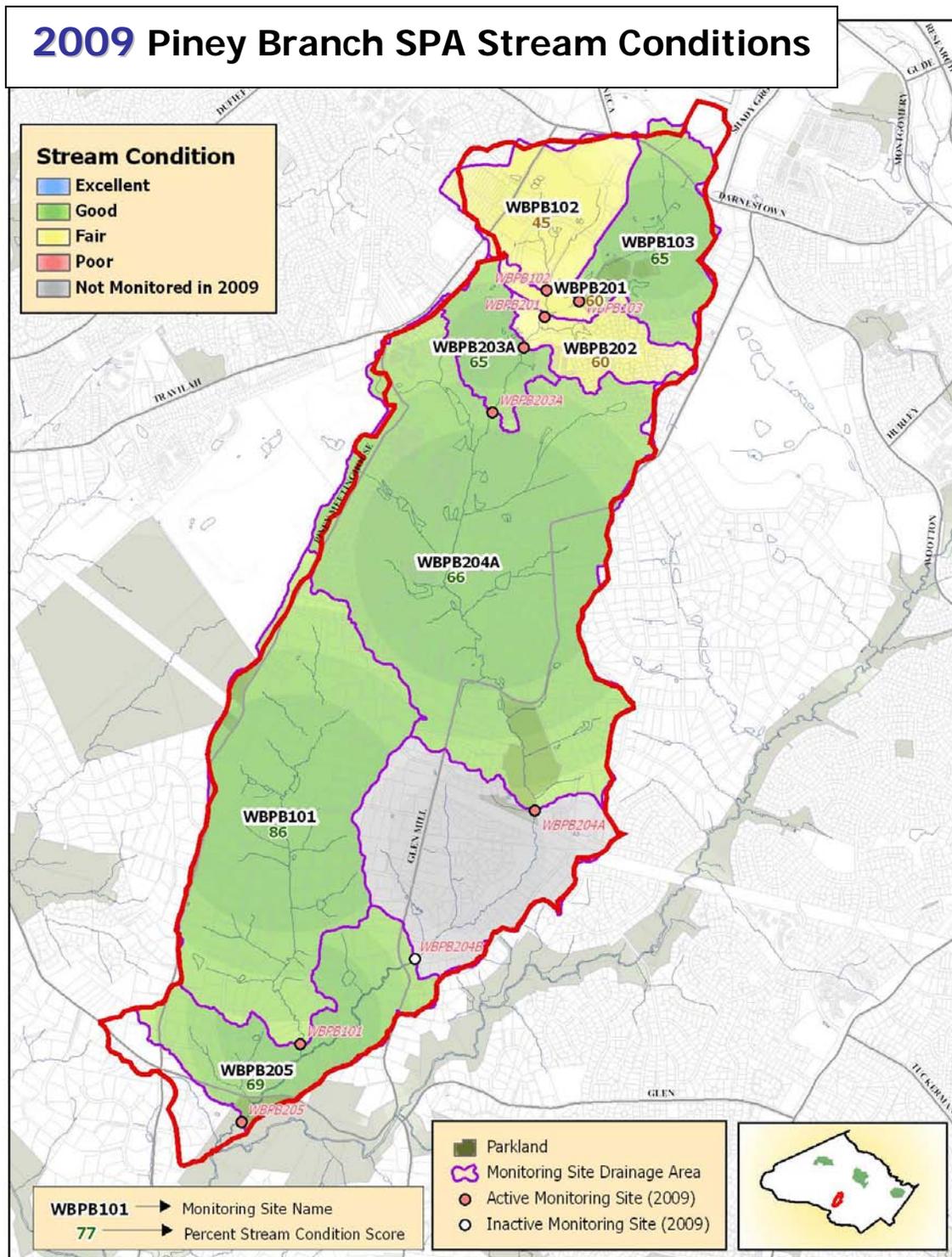


Figure TA-5.14. 2009 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Piney Branch SPA.

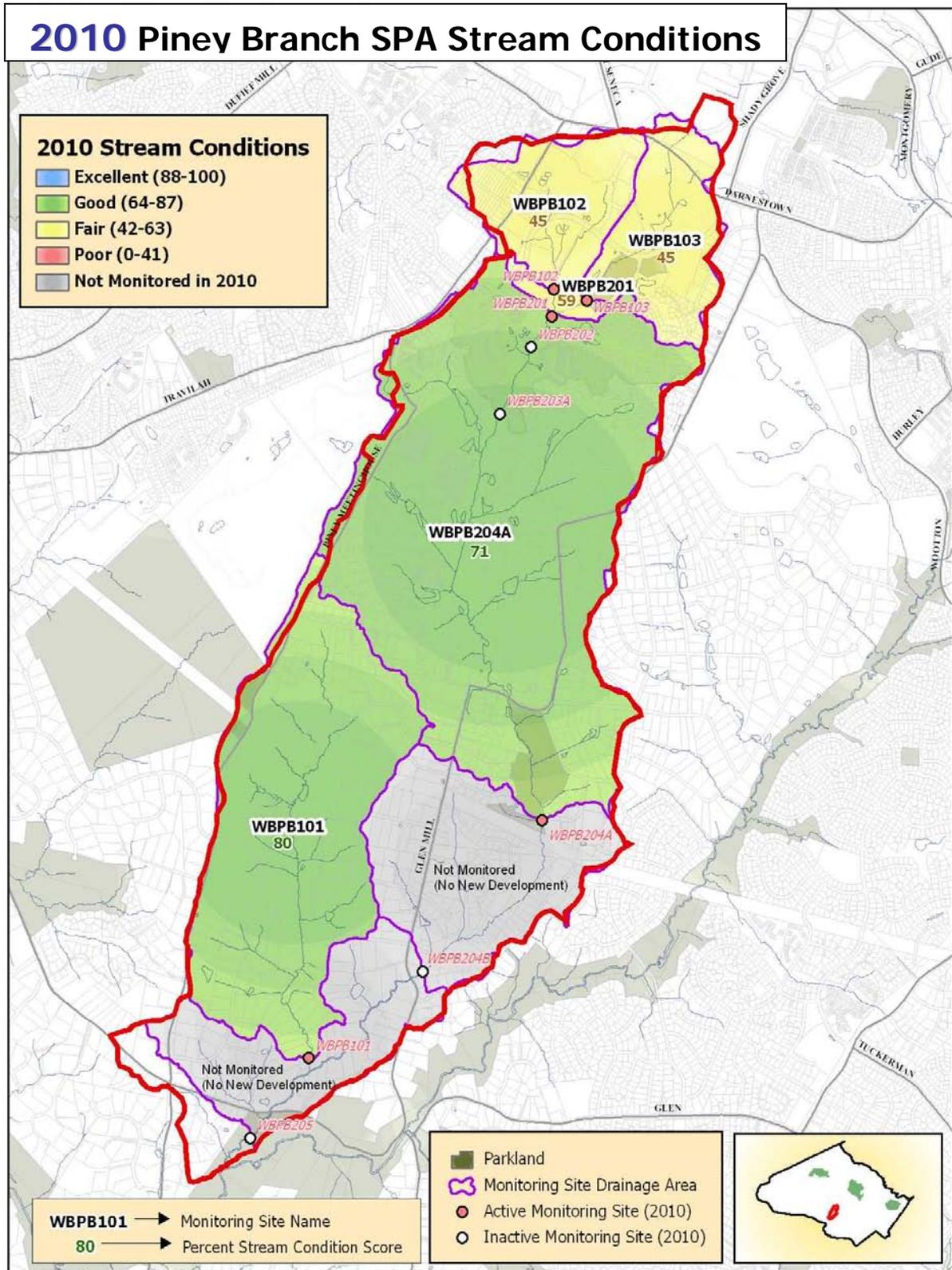


Figure TA-5.15. 2010 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Piney Branch SPA.

Upper Rock Creek SPA

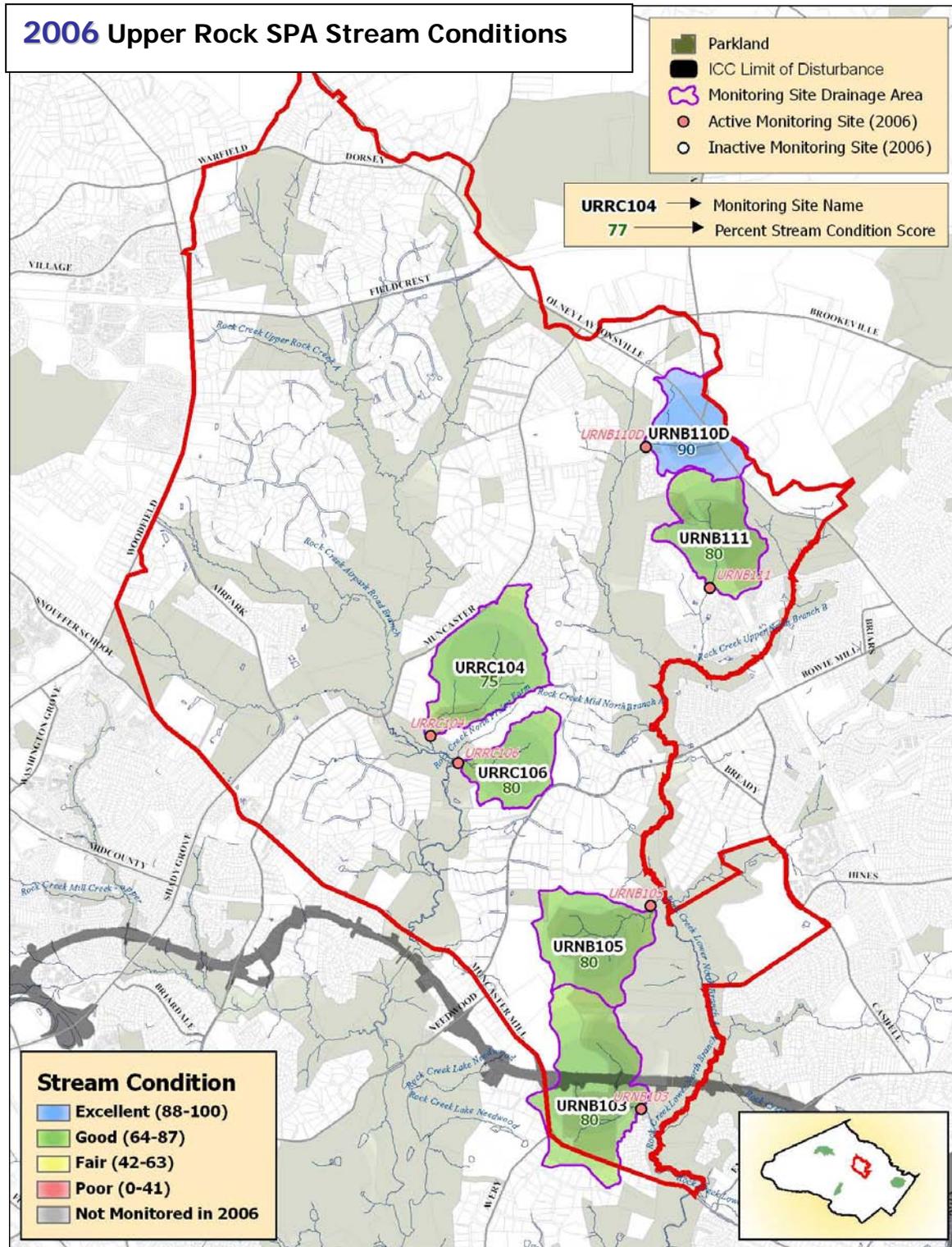


Figure TA-5.16. 2006 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Upper Rock Creek SPA. Construction and monitoring of the InterCounty Connector (ICC) is underway.

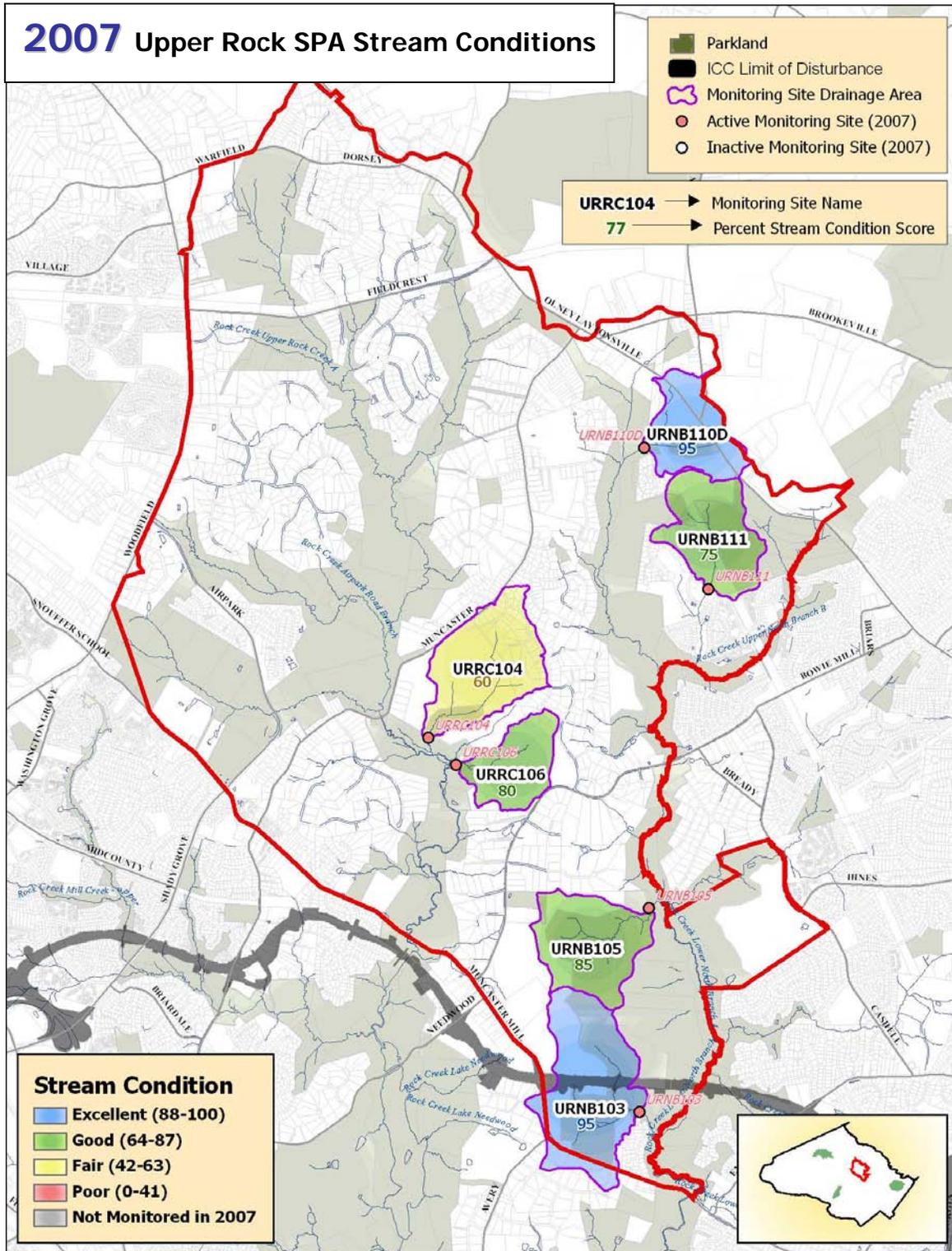


Figure TA-5.17. 2007 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Upper Rock Creek SPA. Construction and monitoring of the InterCounty Connector (ICC) is underway.

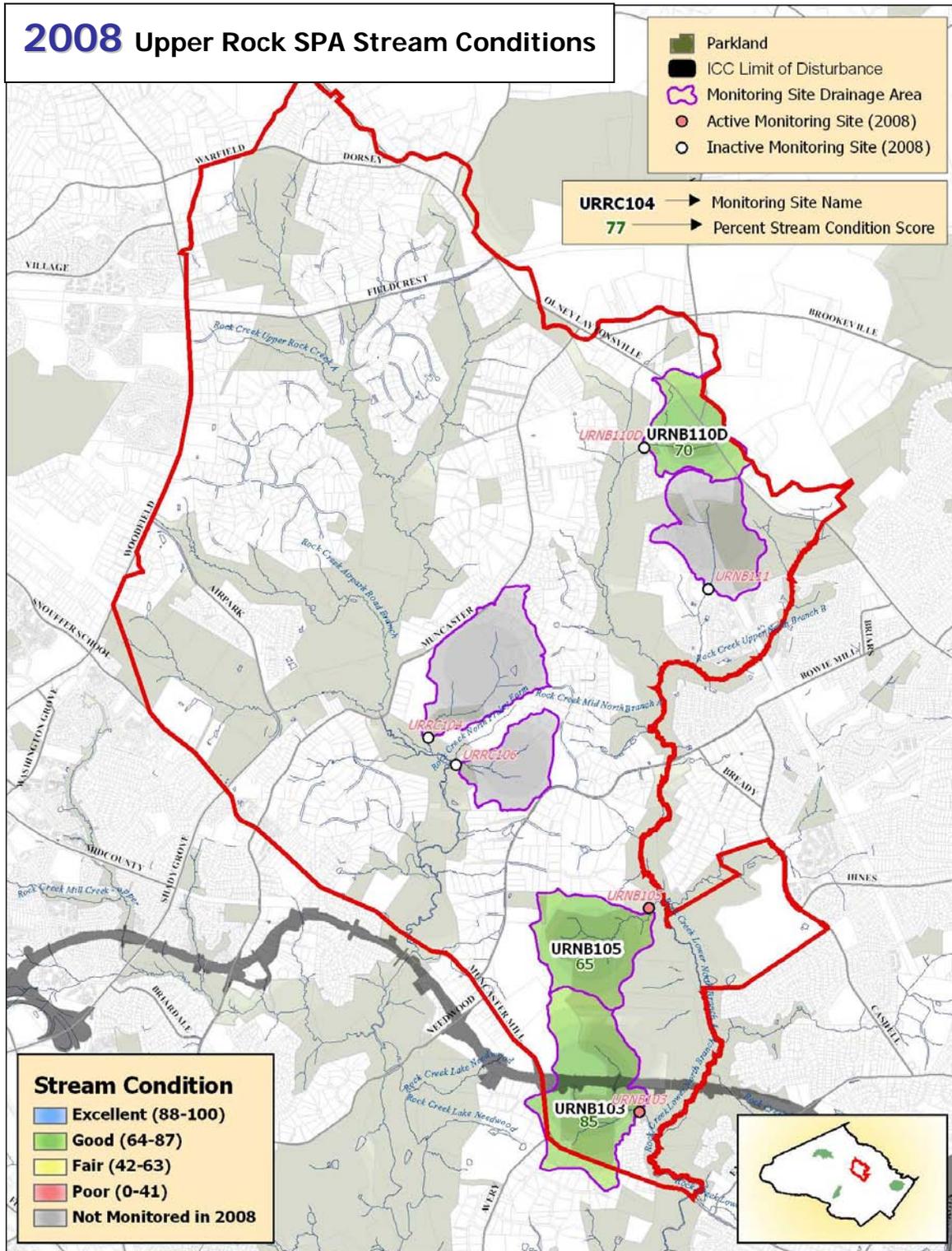


Figure TA-5.18. 2008 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Upper Rock Creek SPA. Construction and monitoring of the InterCounty Connector (ICC) is underway.

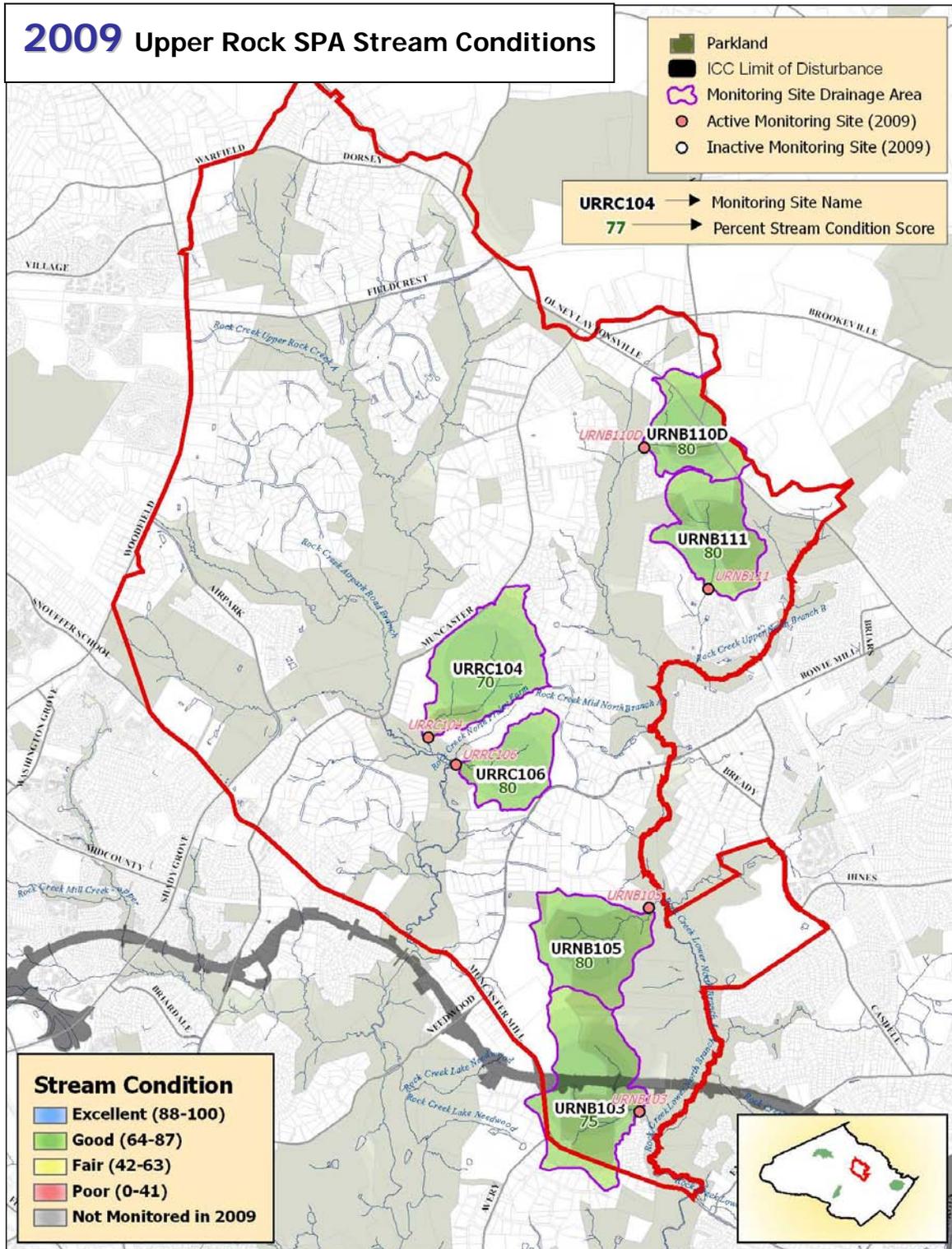


Figure TA-5.19. 2009 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Upper Rock Creek SPA. Construction and monitoring of the InterCounty Connector (ICC) is underway.

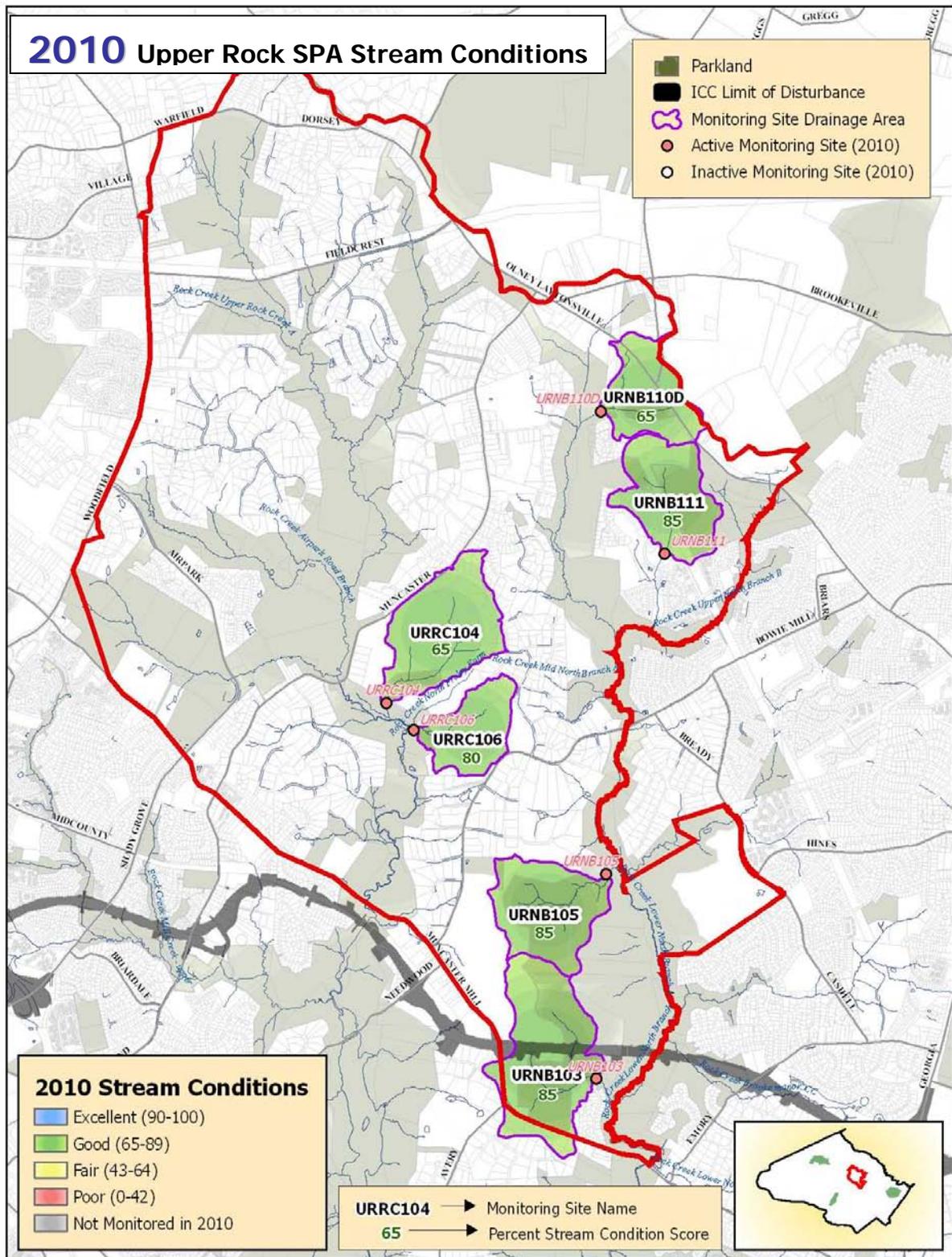
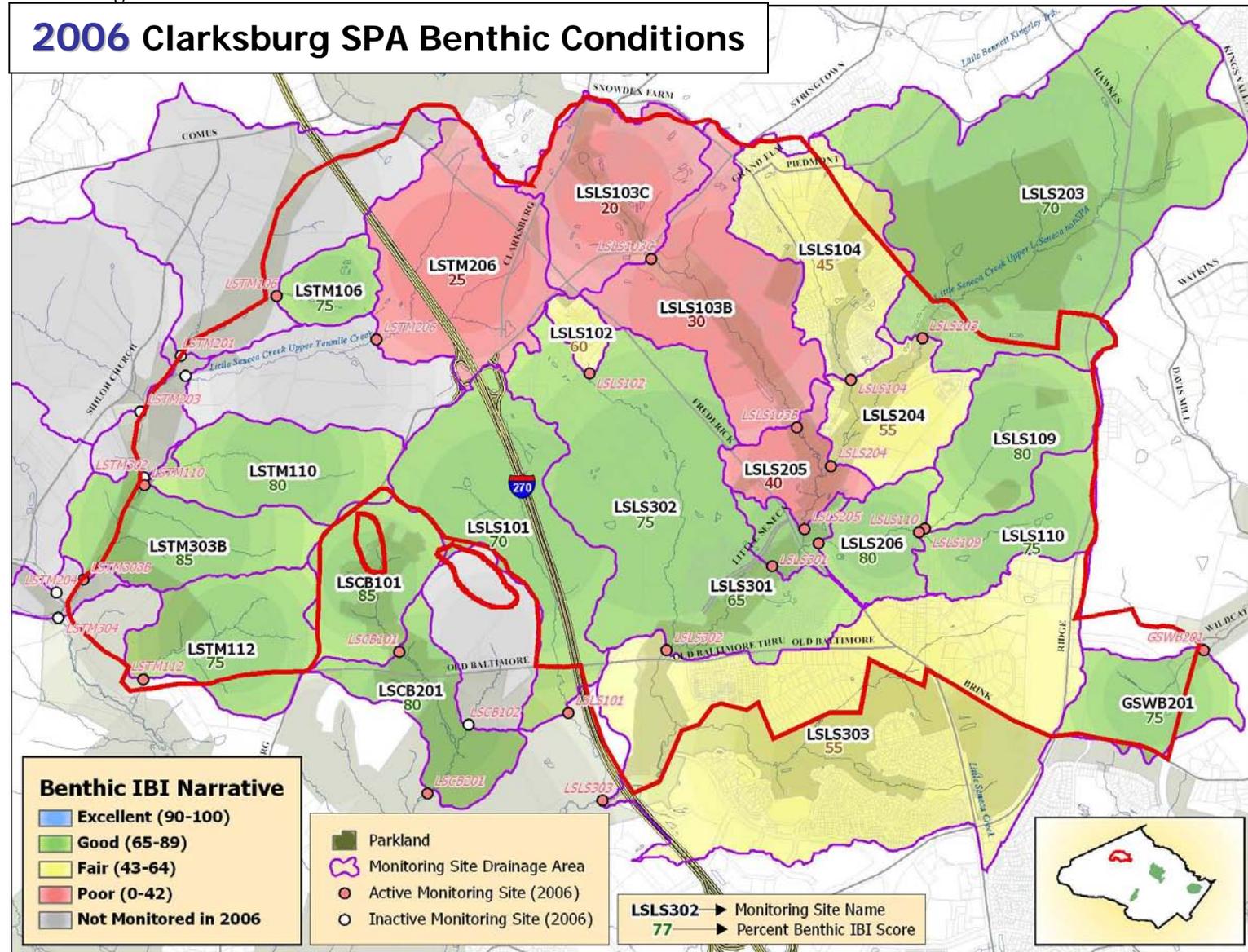


Figure TA-5.20. 2010 Map of SPA Biological Monitoring Locations and Associated Stream Conditions for the Upper Rock Creek SPA. Construction and monitoring of the InterCounty Connector (ICC) is underway.

Maps of Year to Year Benthic IBI Narratives

Clarksburg SPA









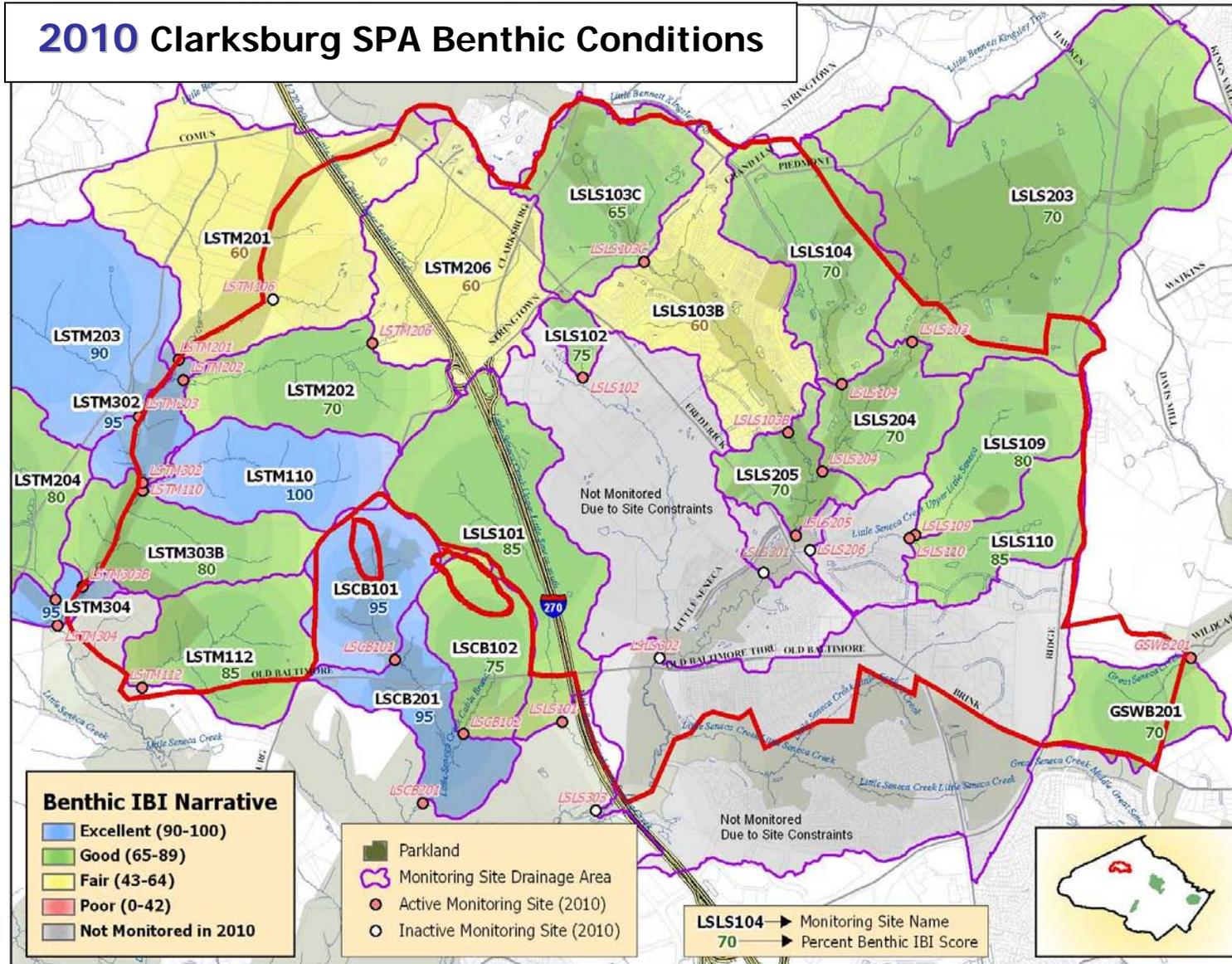


Figure TA-5.25. 2010 Map of Benthic IBI Narrative Conditions for the Clarksburg SPA.

Paint Branch SPA

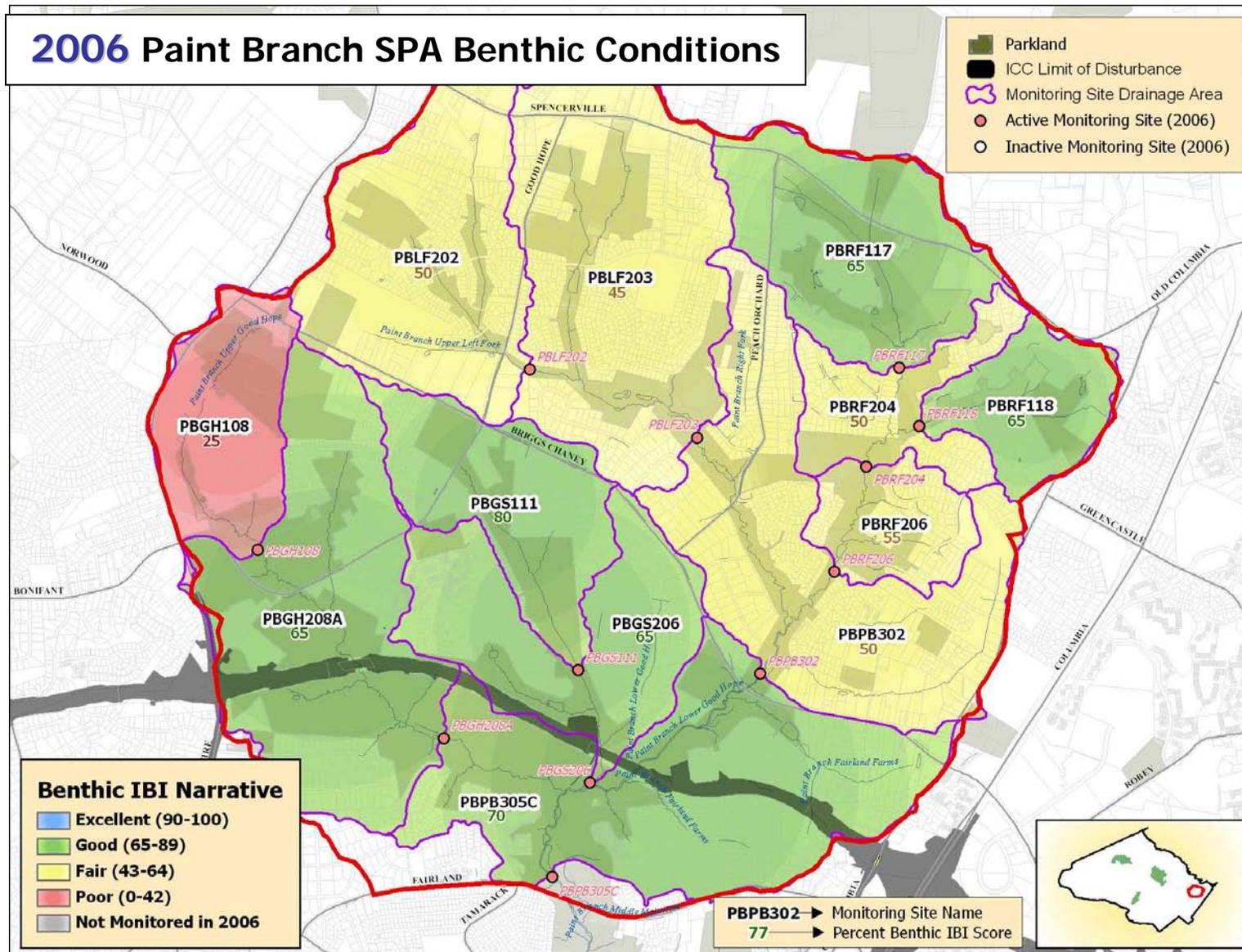


Figure TA-5.26. 2006 Map of Benthic IBI Narrative Conditions for the Paint Branch SPA. Construction on this portion of the InterCounty Connector (ICC) (Contract B) did not begin until January 2009.





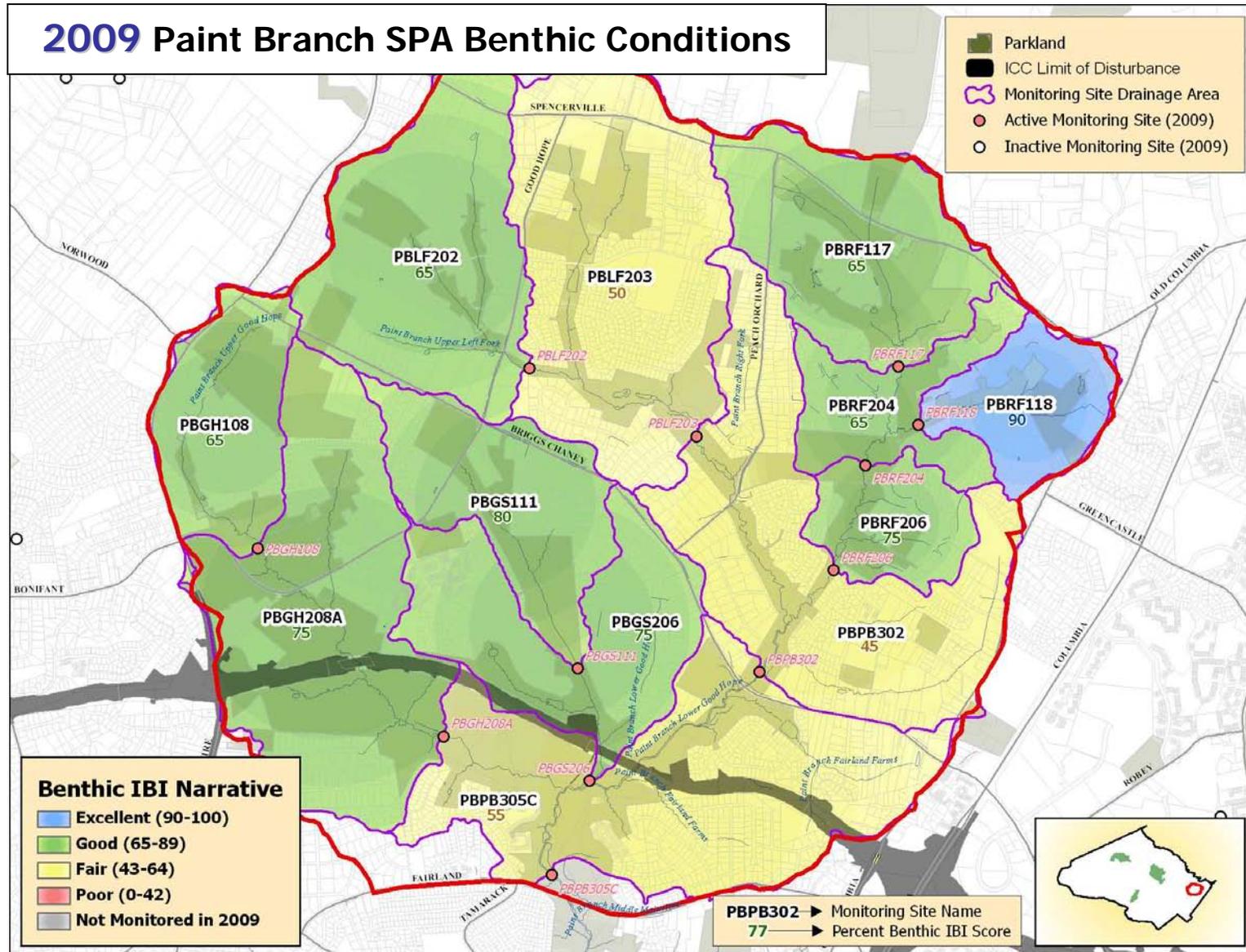


Figure TA-5.29. 2009 Map of Benthic IBI Narrative Conditions for the Paint Branch SPA. Construction on this portion of the InterCounty Connector (ICC) (Contract B) began in January 2009.

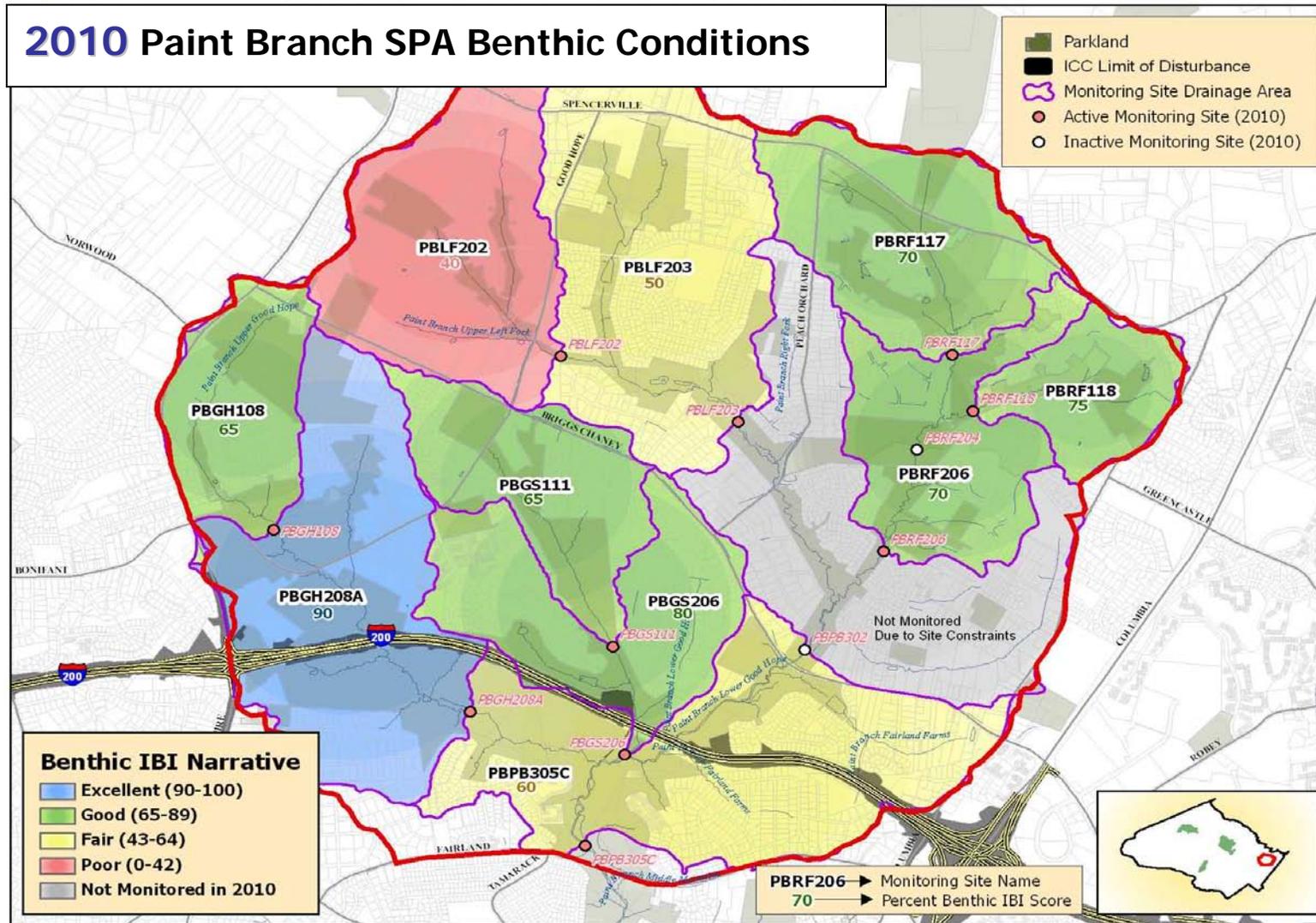


Figure TA-5.30. 2010 Map of Benthic IBI Narrative Conditions for the Paint Branch SPA. Construction on this portion of the InterCounty Connector (ICC) (Contract B) began in January 2009.

Piney Branch SPA

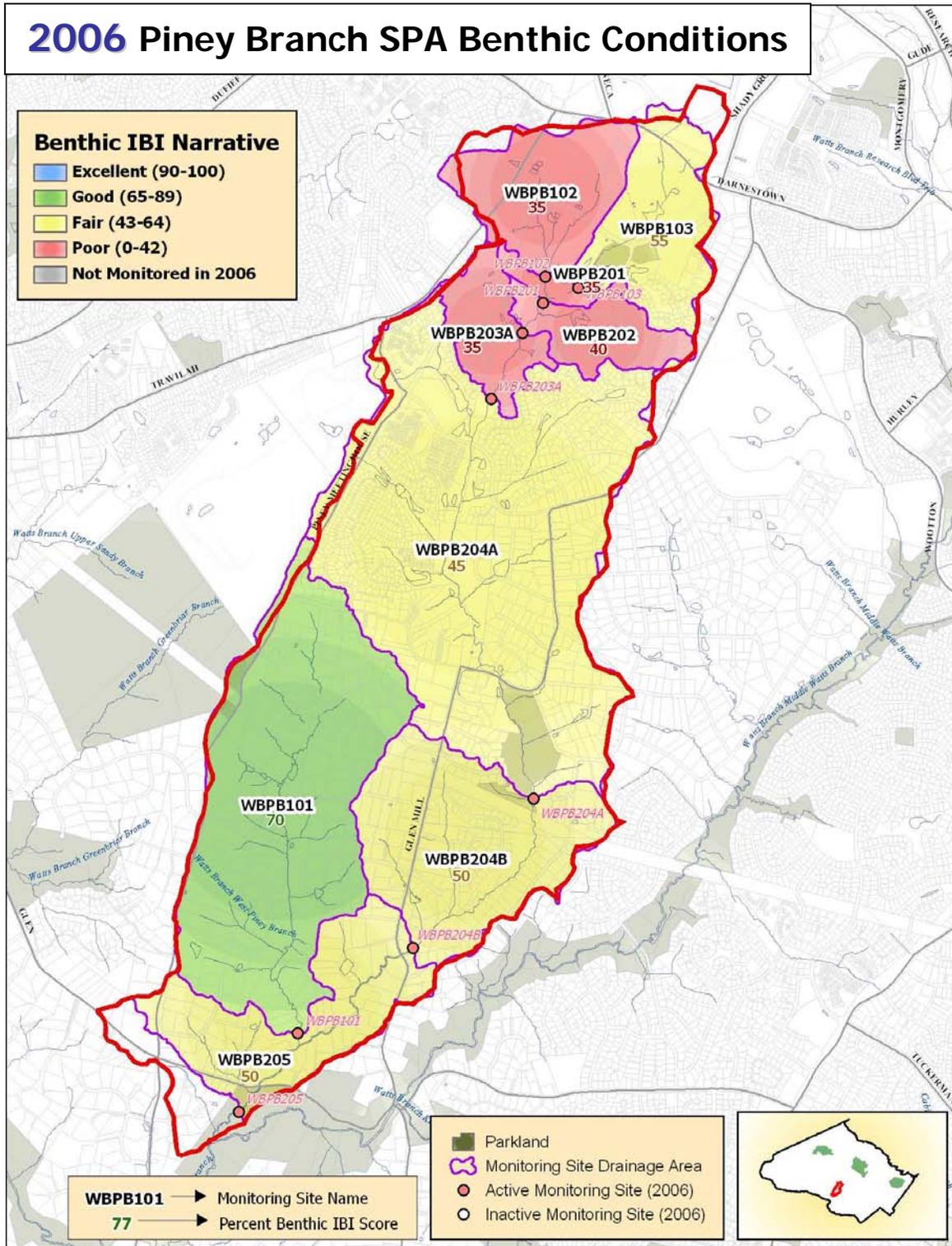


Figure TA-5.31. 2006 Map of Benthic IBI Narrative Conditions for the Piney Branch SPA.

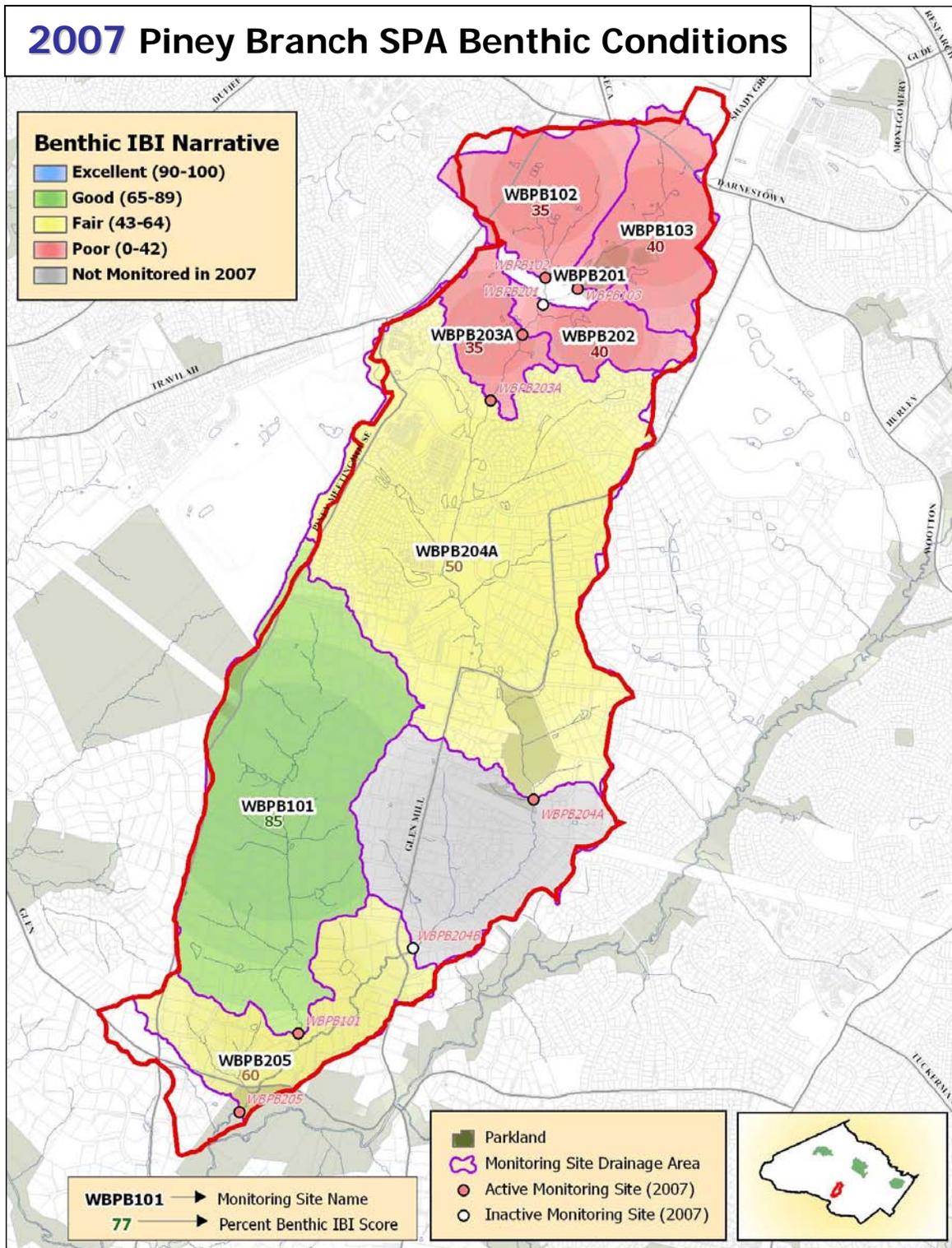


Figure TA-5.32. 2007 Map of Benthic IBI Narrative Conditions for the Piney Branch SPA.

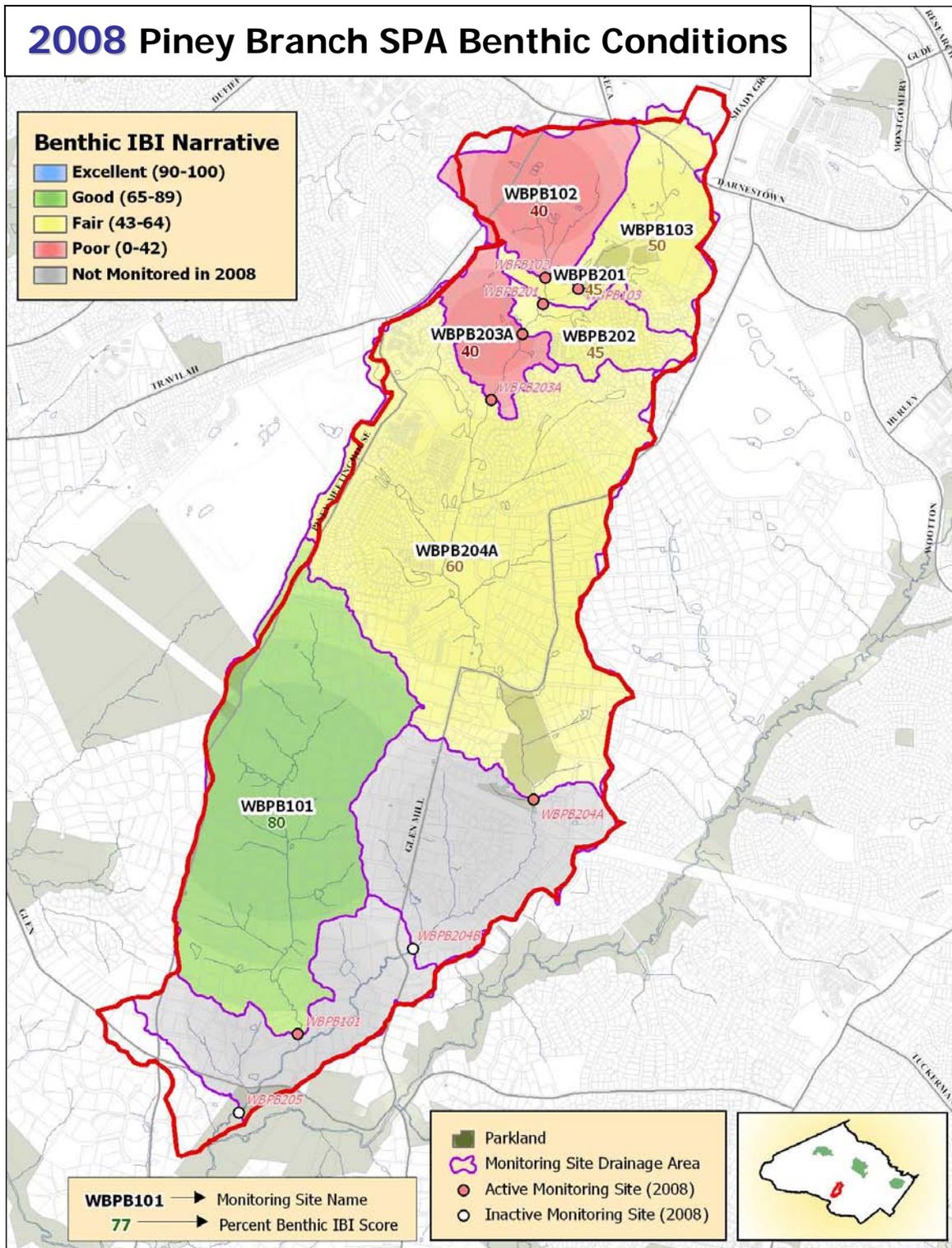


Figure TA-5.33.. 2008 Map of Benthic IBI Narrative Conditions for the Piney Branch SPA.

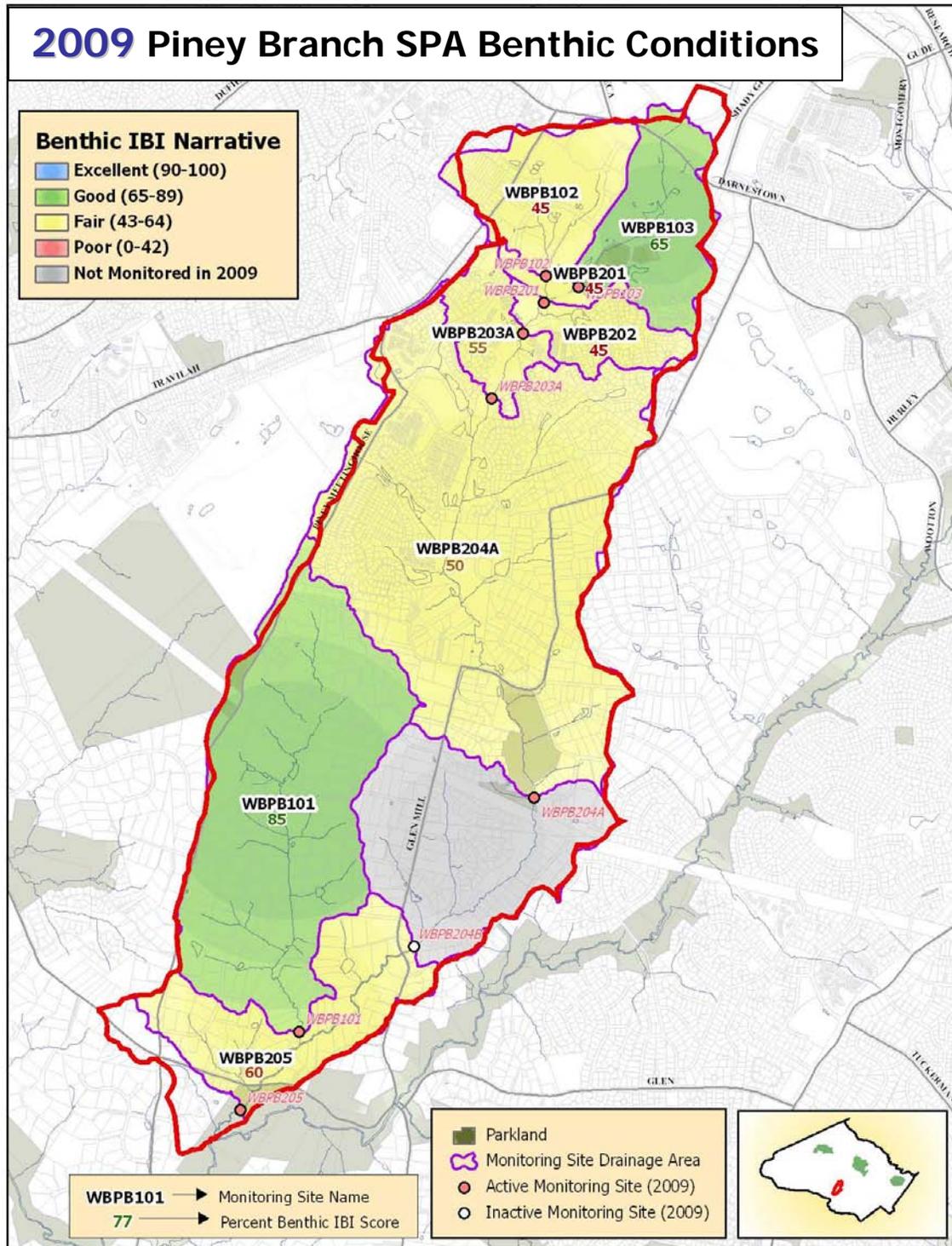


Figure TA-5.34. 2009 Map of Benthic IBI Narrative Conditions for the Piney Branch SPA.



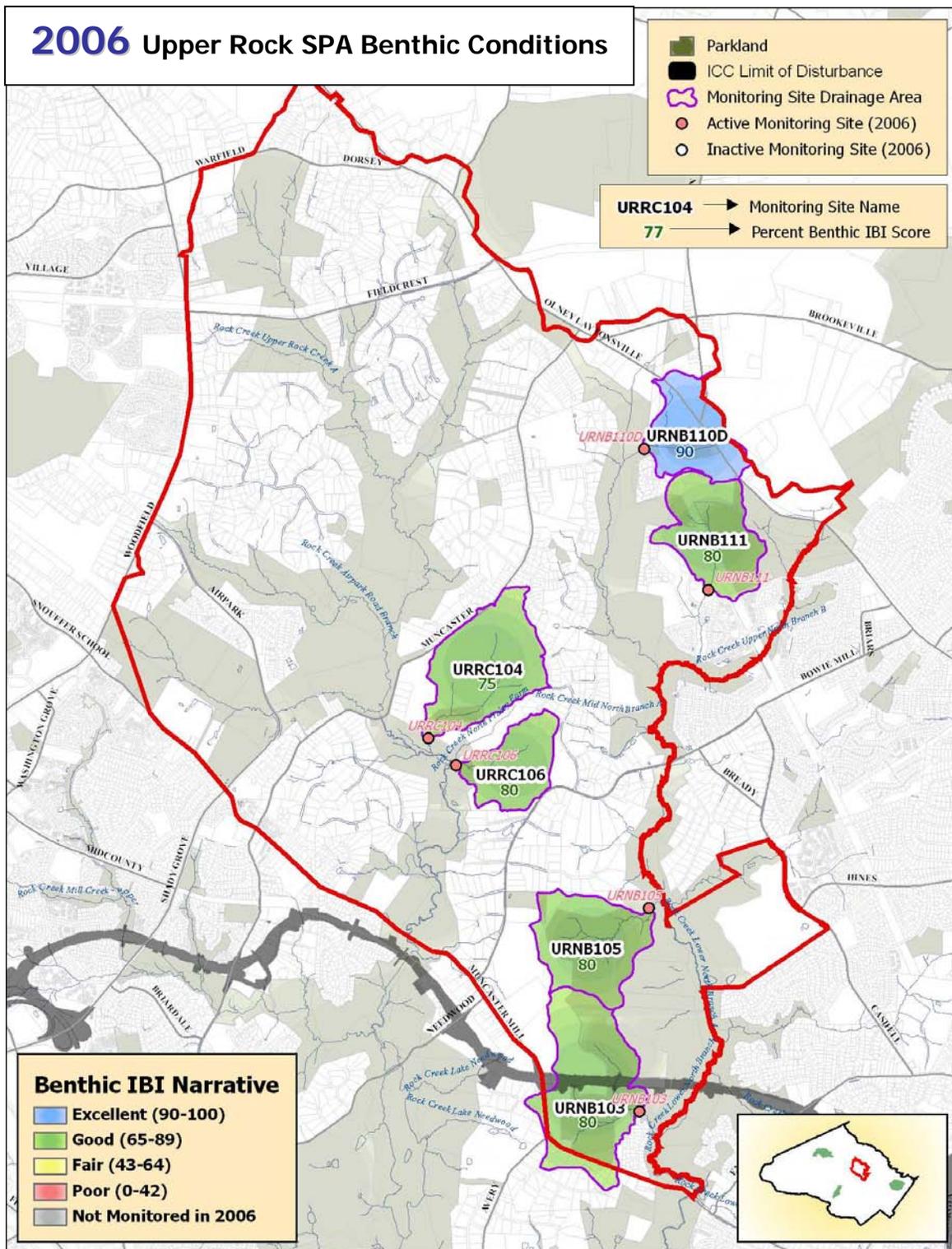


Figure TA-5.36. 2006 Map of Benthic IBI Narrative Conditions for the Upper Rock Creek SPA. Construction and monitoring of the InterCounty Connector (ICC) is underway.

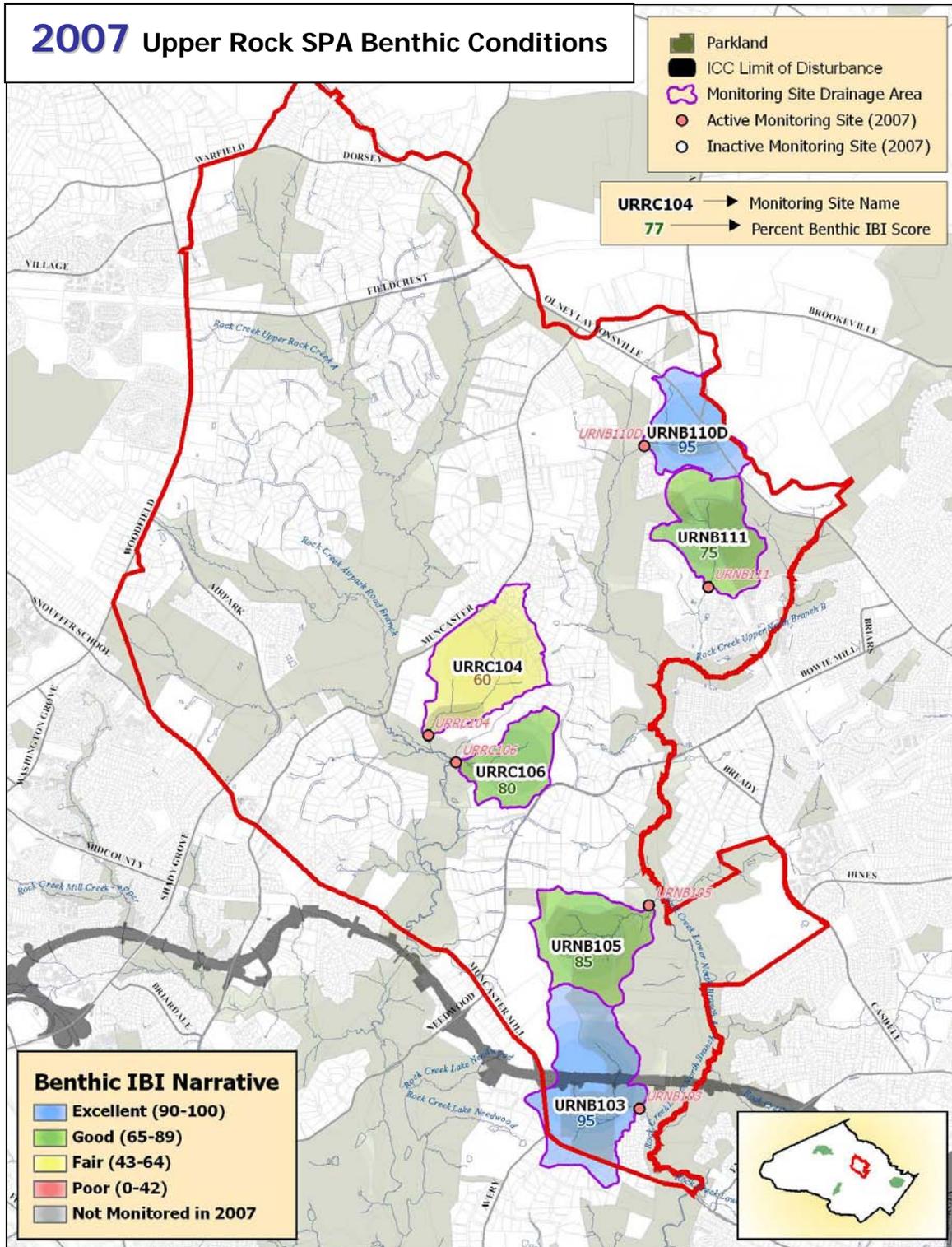


Figure TA-5.37. 2007 Map of Benthic IBI Narrative Conditions for the Upper Rock Creek SPA. Construction and monitoring of the InterCounty Connector (ICC) is underway.

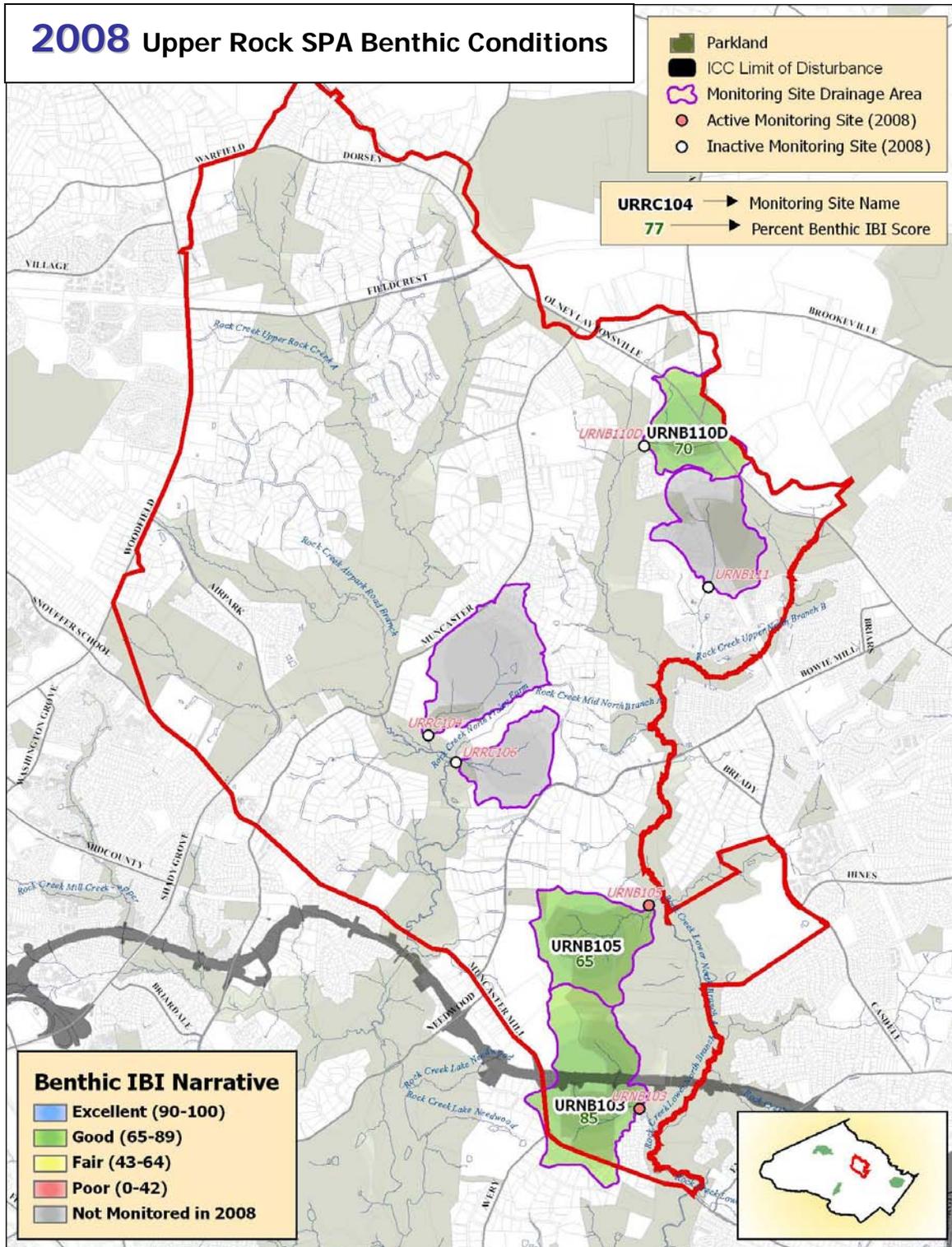


Figure TA-5.38. 2008 Map of Benthic IBI Narrative Conditions for the Upper Rock Creek SPA. Construction and monitoring of the InterCounty Connector (ICC) is underway.

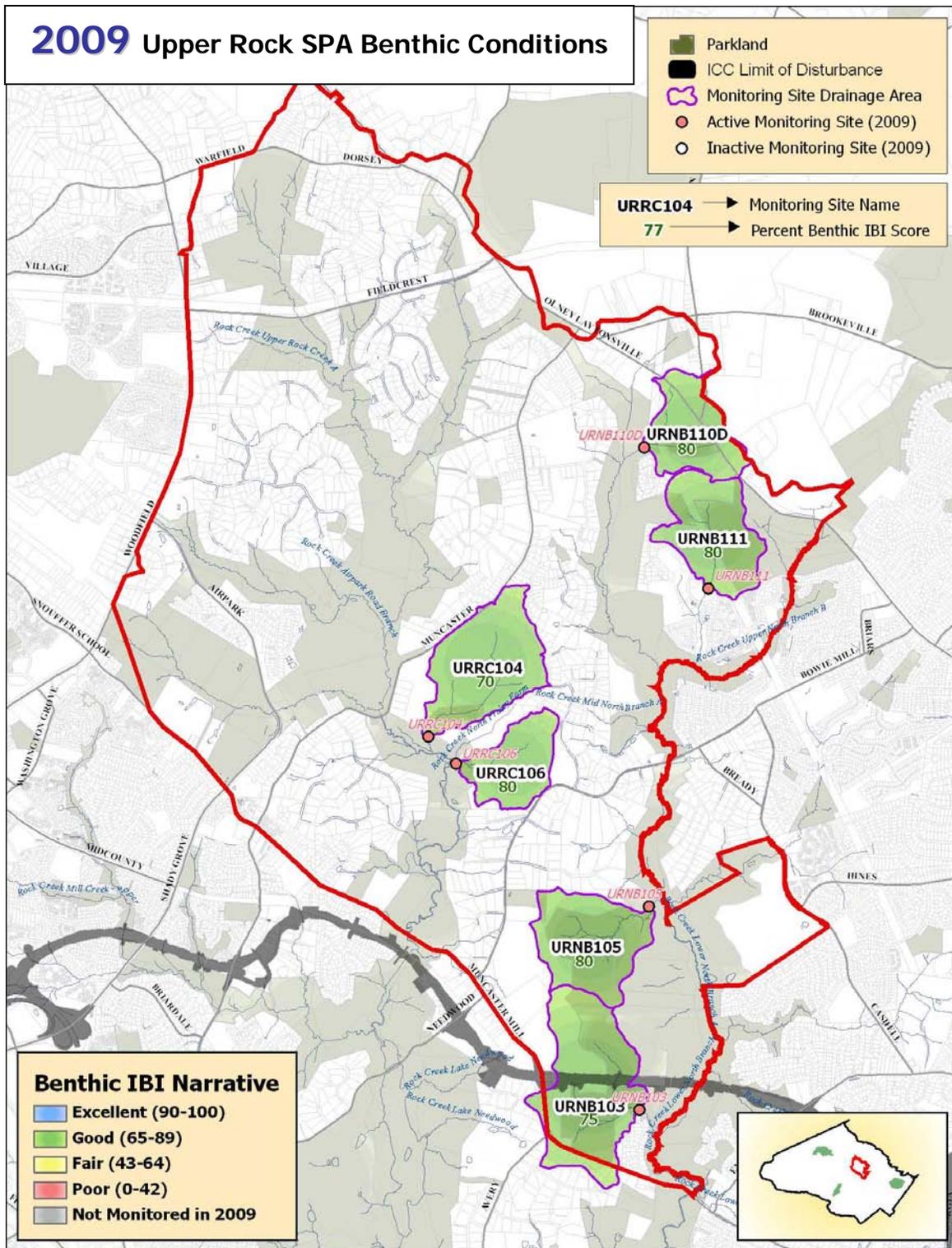


Figure TA-5.39. 2009 Map of Benthic IBI Narrative Conditions for the Upper Rock Creek SPA. Construction and monitoring of the InterCounty Connector (ICC) is underway.

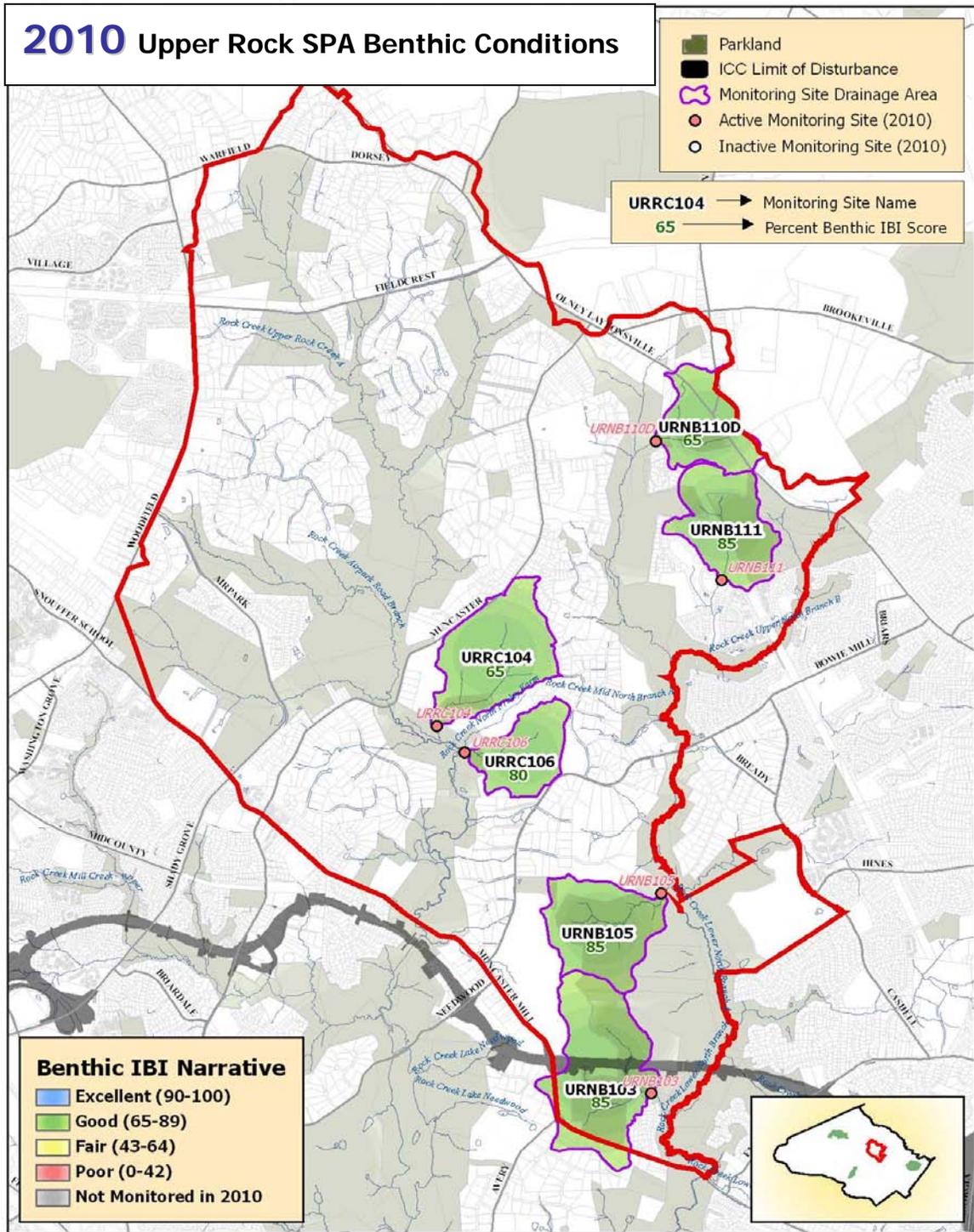


Figure TA-5.40. 2010 Map of Benthic IBI Narrative Conditions for the Upper Rock Creek SPA. Construction and monitoring of the InterCounty Connector (ICC) is underway.

## **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-5.41). 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. The Good Hope tributary is a suitable spawning area because there exists cool water temperatures (class III streams require temperatures below 68° F), stable, clean, gravel/cobble substrate, forested stream buffers, and a 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 from 1994 to 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. A limiting factor is that the Columbia park tributary which is associated with monitoring station PBRF118 does not provide enough base flow. This is especially true during drier years. The low base flow restricts the habitat required to sustain a vigorous fish community. 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 the Maydale Nature Center was completed October 2010. The goals of the stream restoration project were to remove the fish blockages, improve instream and riparian habitat, and minimize sediment loadings. Post construction monitoring will commence during spring 2011.

Figure TA-5.42 displays the number of adult and young of year trout found per station monitored in the Paint Branch SPA from 1994 to 2010. The trout population was affected by droughts in the 1999 and 2002 monitoring periods. Because of drought conditions not all stations were monitored in 1999. 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. In the spawning months of 2009 precipitation was

normal. Adult populations increased to their highest numbers since 2002. Populations of trout seem to be persisting mainly in the Good Hope tributary and the mainstem, While the numbers have not recovered to pre-2000 levels they have remained rather consistent since 2002.



Figure TA-5.41. Brown Trout.

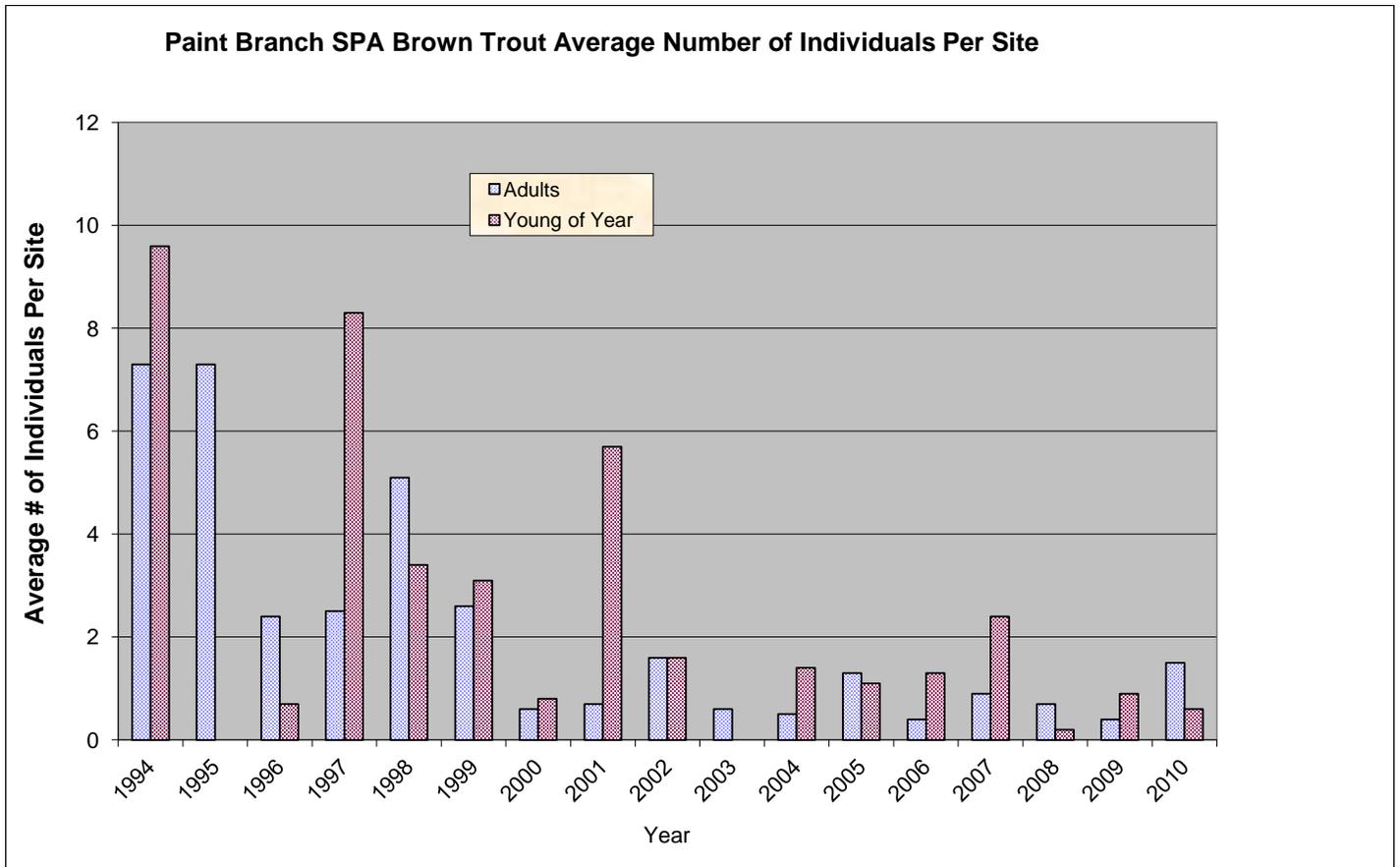


Figure TA-5.42. Average number of brown trout adult and young of year individuals per station monitored per year found in Paint Branch SPA streams.

### **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 2010) (Fig. TA-5.43). Shredders declined from 47% to 12% of the community. Collectors, the more general feeding group, increased from 32% to 49% of the community.

The family Chironomidae replaced the highly sensitive spring stonefly *Amphinemura* sp. as the dominant taxa found at the test stations during the construction period. *Amphinemura* declined dramatically from 43% to 9% of the population. 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-5.44).

In 2008 and 2009, after a lull in construction activities, there were certain sites in the Clarksburg SPA where the average stream condition score improved from *fair* to *good*. LSL103B and LSL104 were sites with consistently *fair* stream conditions through the development process, although benthic scores were sometimes reported as *poor*. These sites were analyzed further for changes in benthic community structure, so that conclusions can be drawn about the potential for recovery.

The stream conditions of monitoring site LSL103B improved from fair in 2007 to good in 2008. A borderline good score was reported in 2009. In 2010 the site returned to the fair category. This shift in condition may reflect a change in benthic macroinvertebrate community function due to construction resuming in this area. The construction was closer to the monitoring site than in prior years. During the pre-construction period, shredders accounted for 57% of the community; the dominant taxon of this group was *Amphinemura* sp. Characteristic of construction disturbance, there was a dramatic shift in the community from shredders to collectors. Shredders were reduced to only 2% of the population while collectors, represented primarily by the family Chironomidae increased to 68%. From 2008 to 2009 there was a reduction in collectors from 68% to 43%, an increase in filterers from 10% to 30% and the reemergence of some shredders (at 6%). The predators and scrapers feeding groups shifted little (Fig. TA-5.45).

In 2010 no major change in this trend was evident. The 2009 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 in the drainage area to the station. Chironomidae remains as the dominant taxon. There has been little shift from pollution tolerant taxa back to the dominance of a pollution intolerant taxon. The level of recovery and any trends of the

impacted benthic macroinvertebrate communities will continue to be analyzed as the development process continues.

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-5.46, third chart in the series). The community is still drastically different than the preconstruction community (Fig. TA-5.46, 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. Noticeable shifts occurring in 2010 included the reduction in shredders and collectors to 6% and 48% respectively. The scrapers increased from 1% to 6%; filterers increased from 11% to 27%. The differences between the preconstruction and current communities remain large. More time is required to determine the extent of the community recovery.

#### *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-5.47). 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.

WBPB101 serves as the control site for the Piney Branch SPA. In 1995 and 2009 *Amphinemura* sp. has been the dominant taxon by 1%. For 2010 Chironomidae assumed the dominant taxon over *Amphinemura* sp., 28% to 27% (Fig. TA-5.48). The increase in collectors and scrapers as the percentage of filterers was reduced from 39% to 17% noticed 2009 remains unchanged.

#### *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-5.49). the same is true of the control group (Fig. TA-5.50).

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.

*Page left intentionally blank*

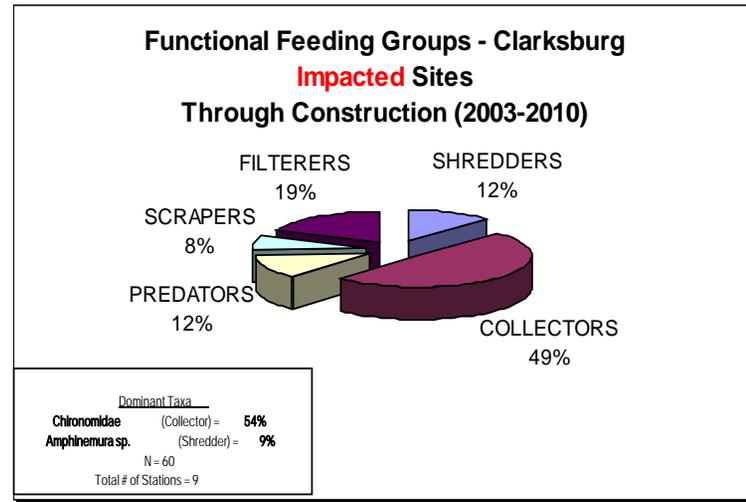
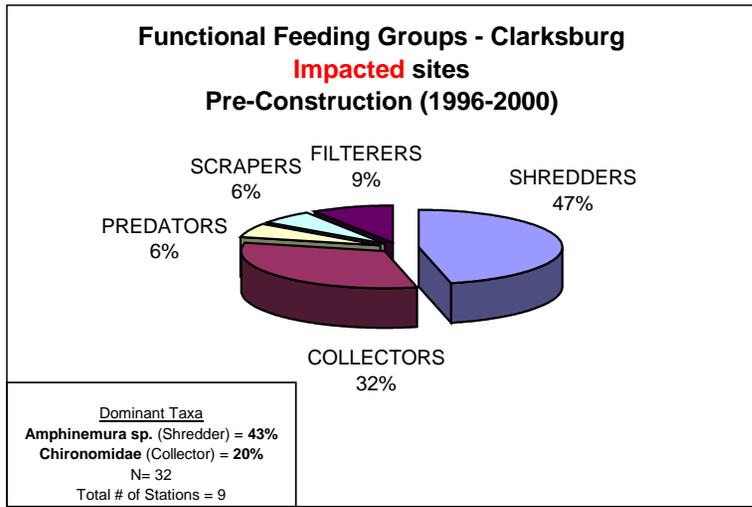


Figure TA-5.43. Functional feeding groups and dominant taxa in the test areas of the Clarksburg SPA.

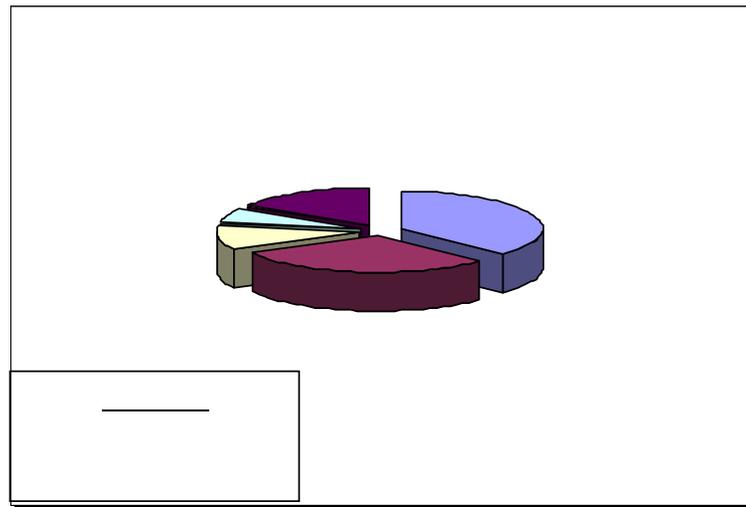
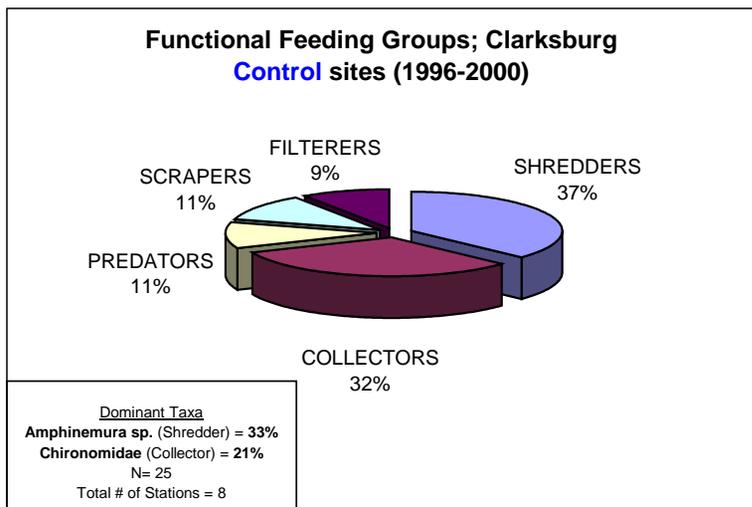
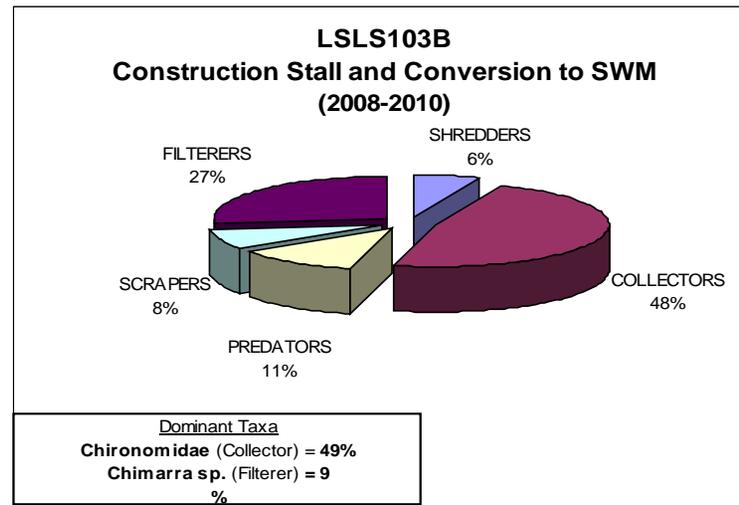
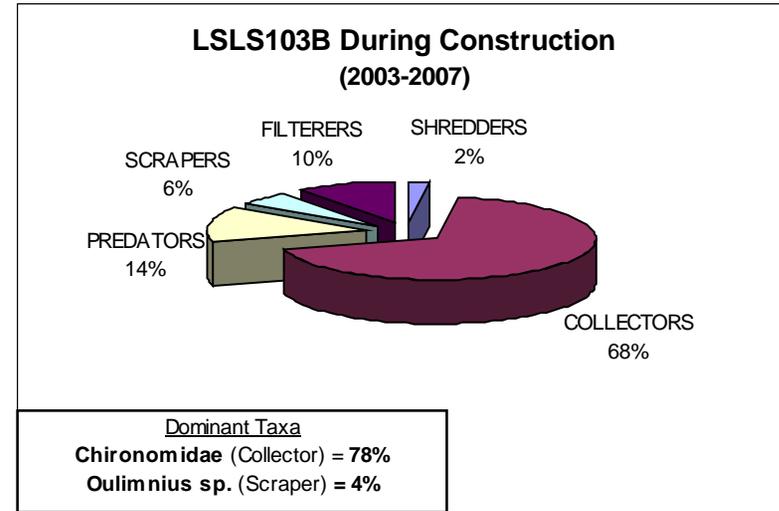
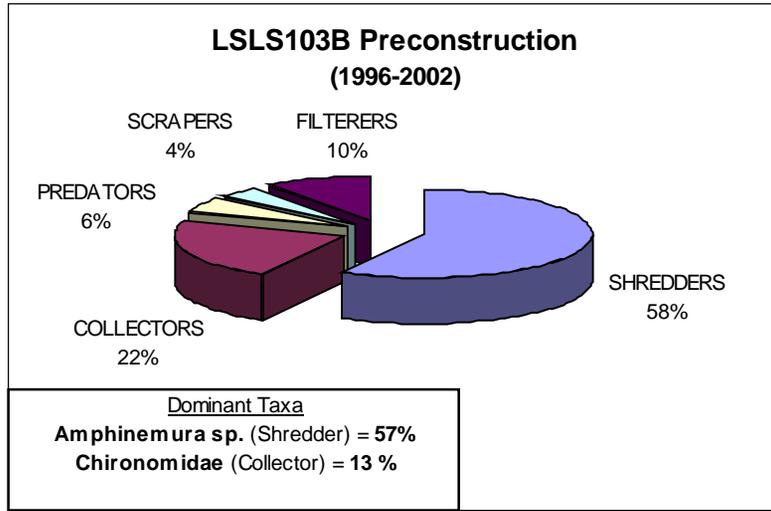


Figure TA-5.44. Functional feeding groups and dominant taxa in the control areas of the Clarksburg SPA.



**Figure TA-5.45. Functional feeding groups and dominant taxa over the course of development in the drainage area to LSLS103B.**

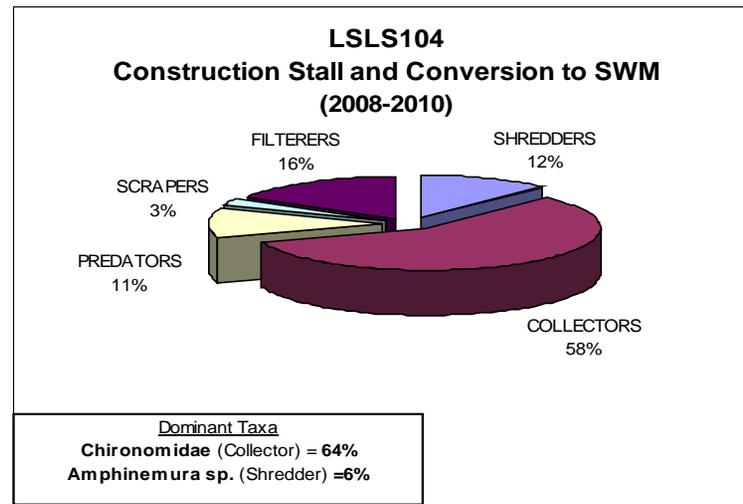
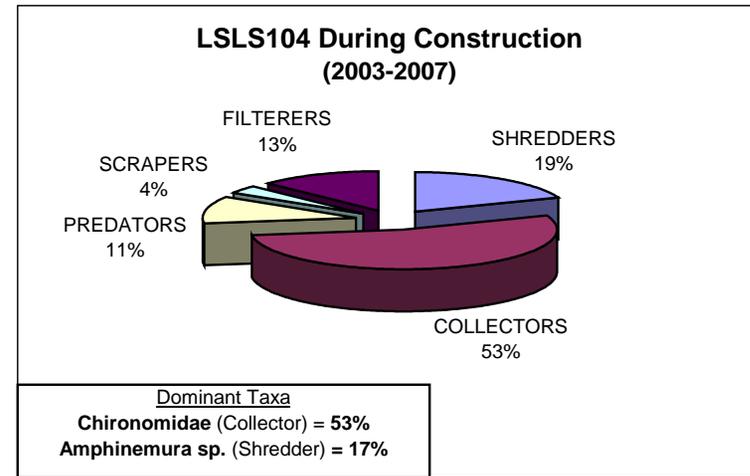
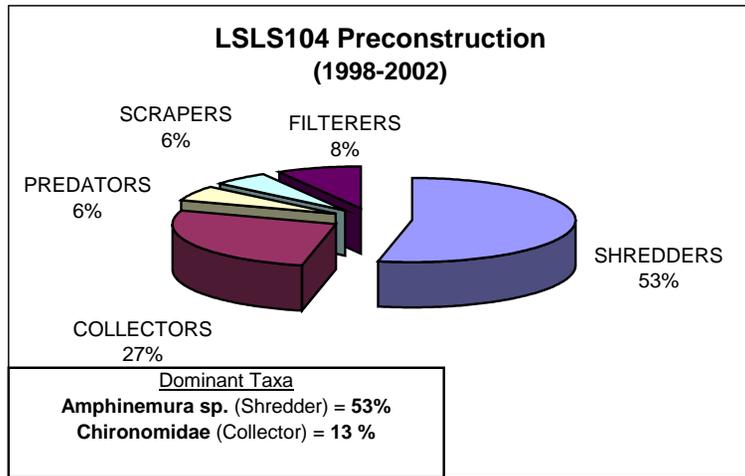


Figure TA-5.46. Functional feeding groups and dominant taxa over the course of development in the drainage area to LSLS104.

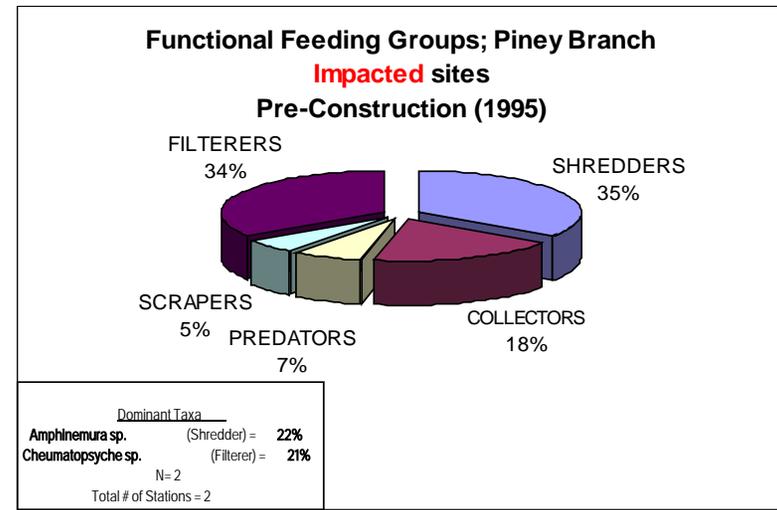
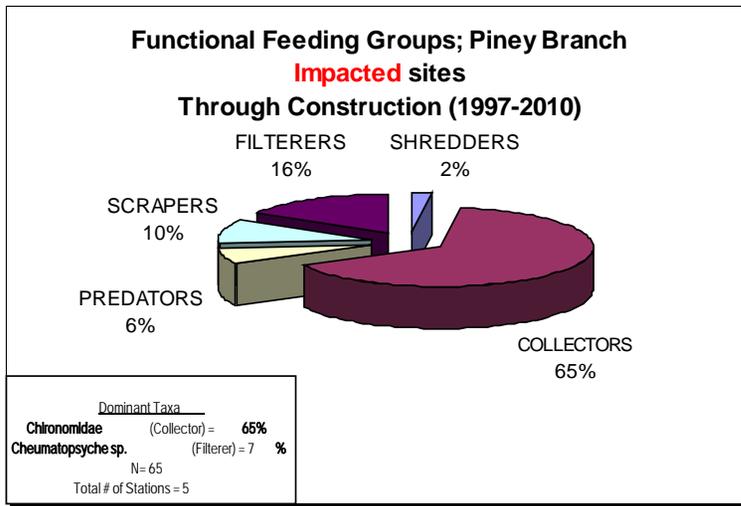


Figure TA-5.47. Functional feeding groups and dominant taxa in the test areas of the Piney Branch SPA.

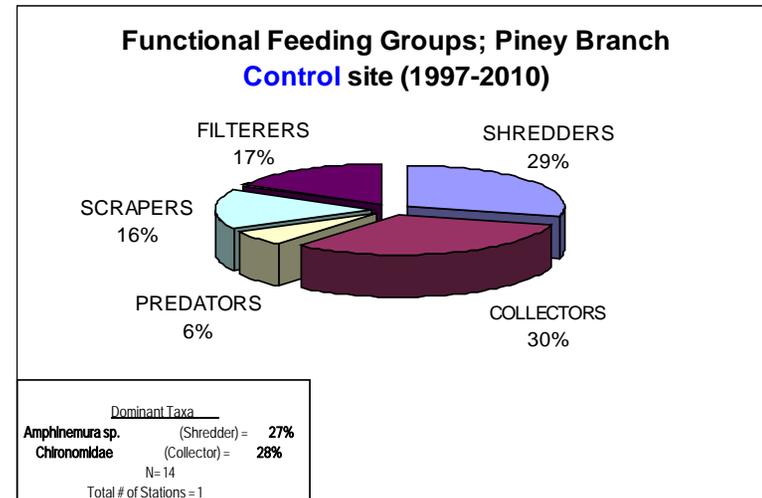
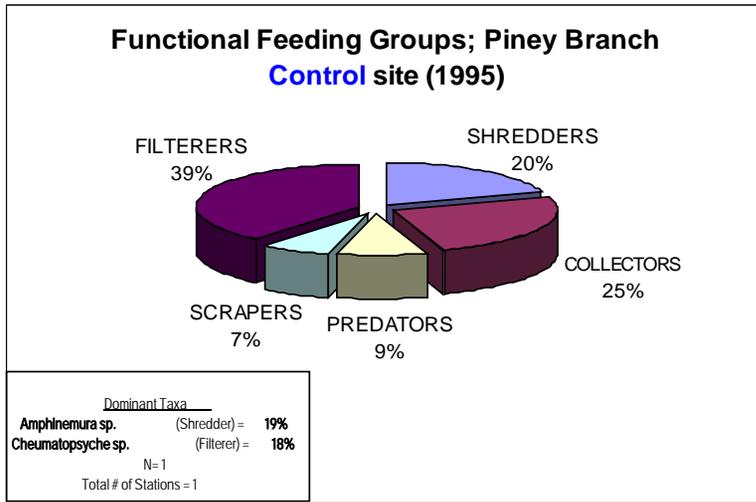


Figure TA-5.48. Functional feeding groups and dominant taxa in the control areas of the Piney Branch SPA.

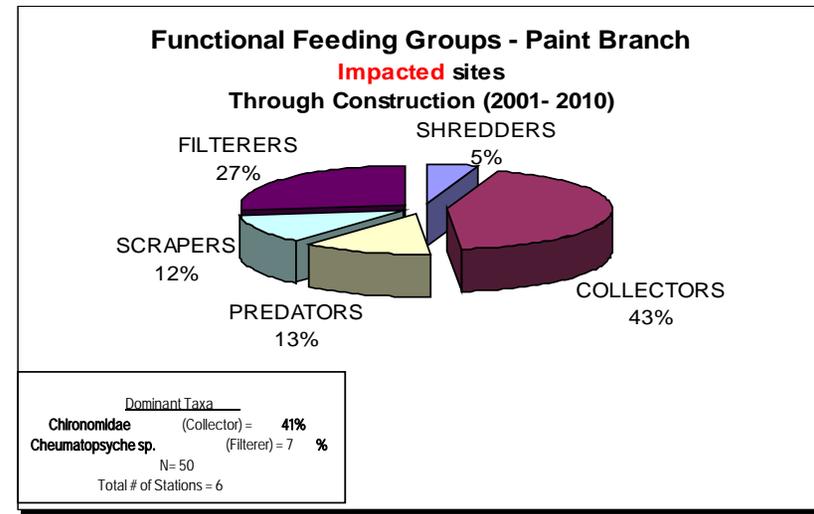
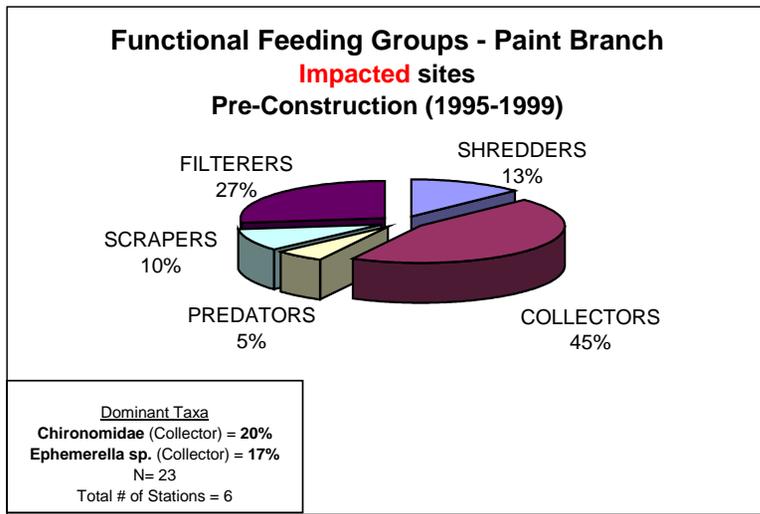


Figure TA-5. 49. Functional feeding groups and dominant taxa in the test areas of the Paint Branch SPA.

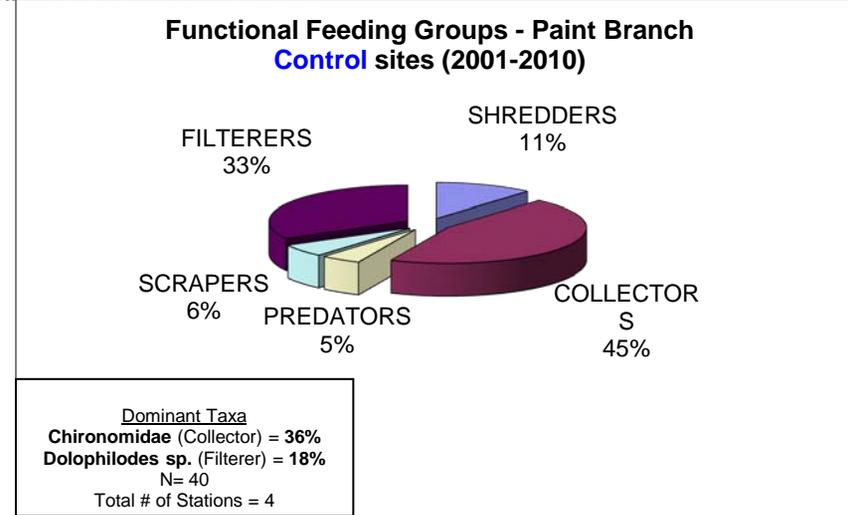
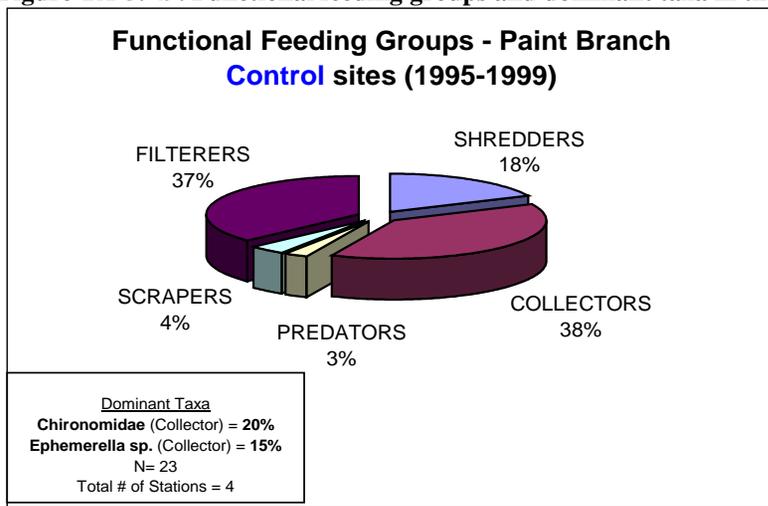


Figure TA-5.50. Functional feeding groups and dominant taxa in the control areas of the Paint Branch SPA.

### Literature Cited

- Barbour M and Stribling J. 1991. Use of habitat assessment in evaluating the biological integrity of stream communities. In Gibson G. editor. Biological criteria: Research and regulation, proceedings of a symposium; 1990 Dec 12-13; Arlington, VA. Office of Water, U.S. Environmental Protection Agency, Washington, D.C. EPA-440-5-91-005.
- Jones R and Clark C. 1987. Impact of watershed urbanization on stream insect communities. American Water Resources Association: Water Resources Bulletin. 23(6):1047-1055.
- Kayzak, P. 2001. Maryland Biological Stream Survey sampling manual. Maryland Department of Natural Resources, Monitoring and Non-Tidal Assessment Division, Annapolis, MD.
- [MCDEP] Montgomery County Department of Environmental Protection. 1998. Countywide stream protection strategy.
- [MCDEP] Montgomery County Department of Environmental Protection. 1999. Special protection area conservation plan for Upper Paint Branch.
- [MCDEP] Montgomery County Department of Environmental Protection. 2000. Special protection area program annual report.
- [M-NCPPC] Maryland National Capital Park and Planning Commission. 1995. Upper Paint Branch watershed planning study – technical report.
- Pederson E, Perkins M. 1986. The use of benthic invertebrate data for evaluating impacts of urban runoff. Hydrobiologia 139:13-22.
- [U.S. EPA] United States Environmental Protection Agency. 2008. Classification of Macroinvertebrates. <http://www.epa.gov/bioiweb1/html/invertclass.html>.

### **Note to Reader**

*For more information on Section 5 or Technical Appendix materials, please contact DEP at [AskDEP@montgomerycountymd.gov](mailto:AskDEP@montgomerycountymd.gov), 240-777-7700.*