

Map No.	Aquifer Name	Number of Wells Within Mapped Aquifer Boundary		
		Gas Wells	Oil Wells	Other Wells*
1	Baldwinsville	37	0	3
2	Batavia	0	0	5
3	Corning	5	0	4
4	Cortland-Homer-Preble	0	0	2
5	Elmira-Horseheads-Big Flats	6	0	16
6	Endicott-Johnson City	0	0	3
7	Fulton	4	0	2
8	Jamestown	82	11	14
9	Lower Cohocton	4	0	24
10	Olean	7	310	81
11	Owego	0	0	2
12	Salamanca	14	2	6
13	Upper Cohocton	0	0	3
14	Waverly	0	0	1
	Principal Aquifer	1,664	749	1,344
	<i>Total</i>	<i>1,823</i>	<i>1,072</i>	<i>1,510</i>

Notes:  
 \* - Other wells include storage, solution brine, dry hole, injection, stratigraphic, geothermal, and not listed well types.

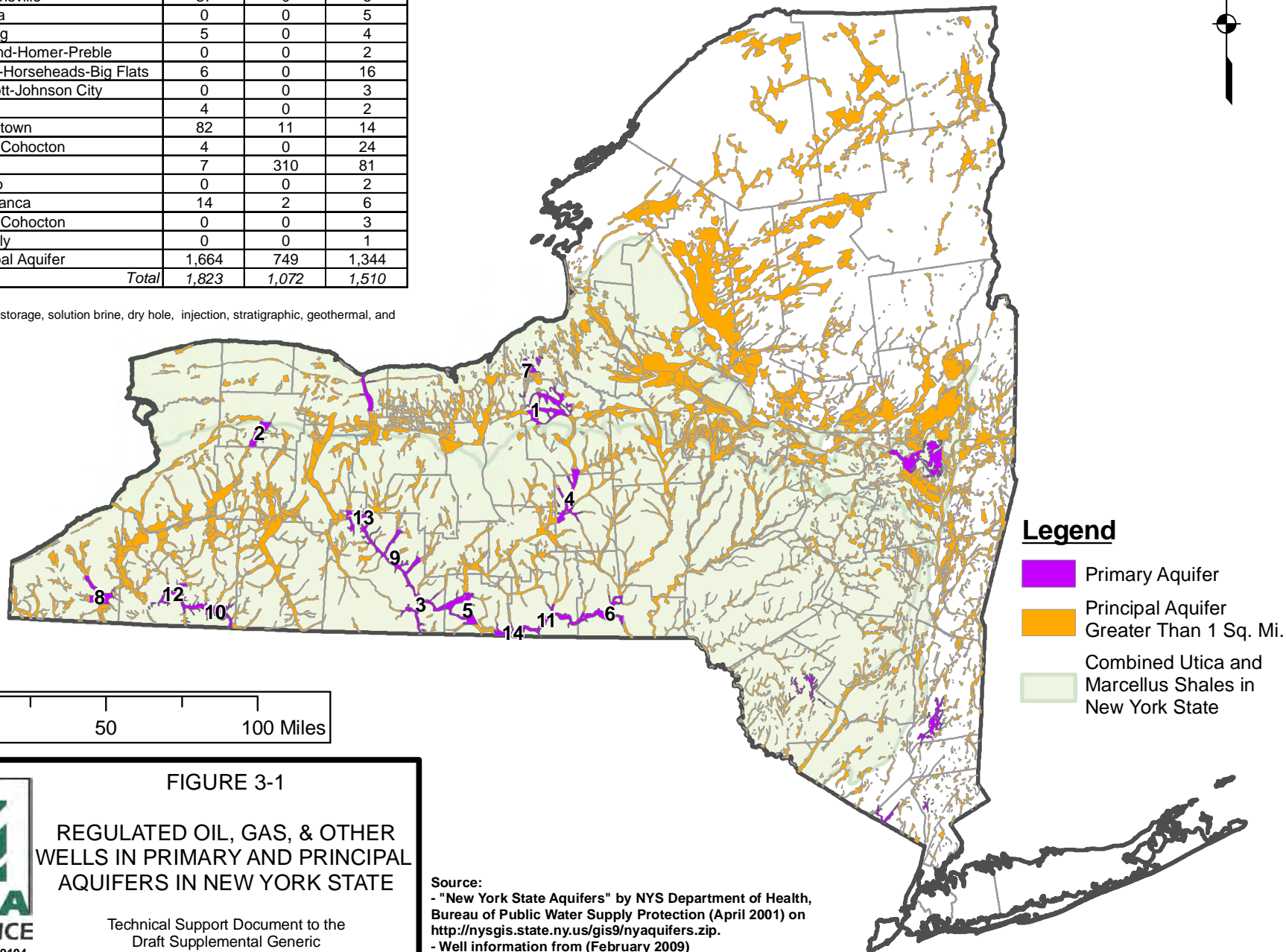


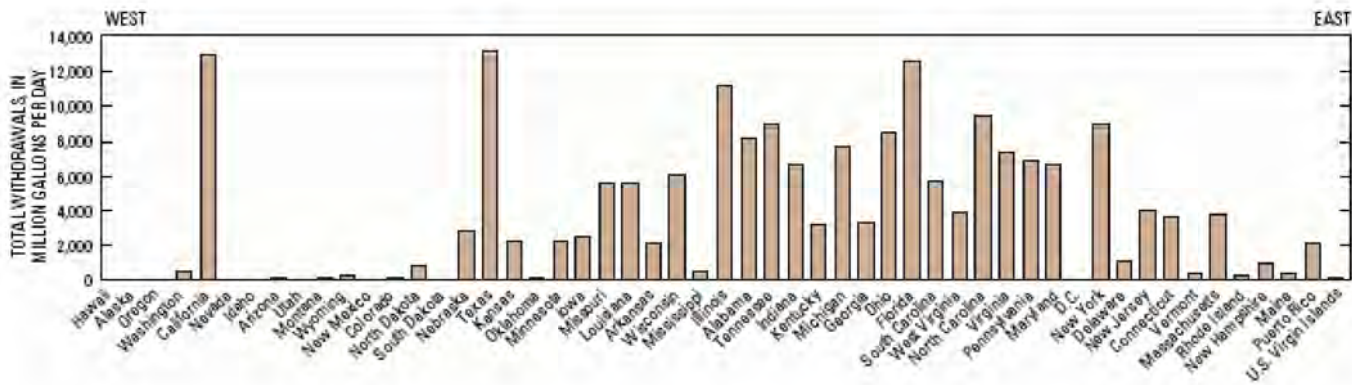
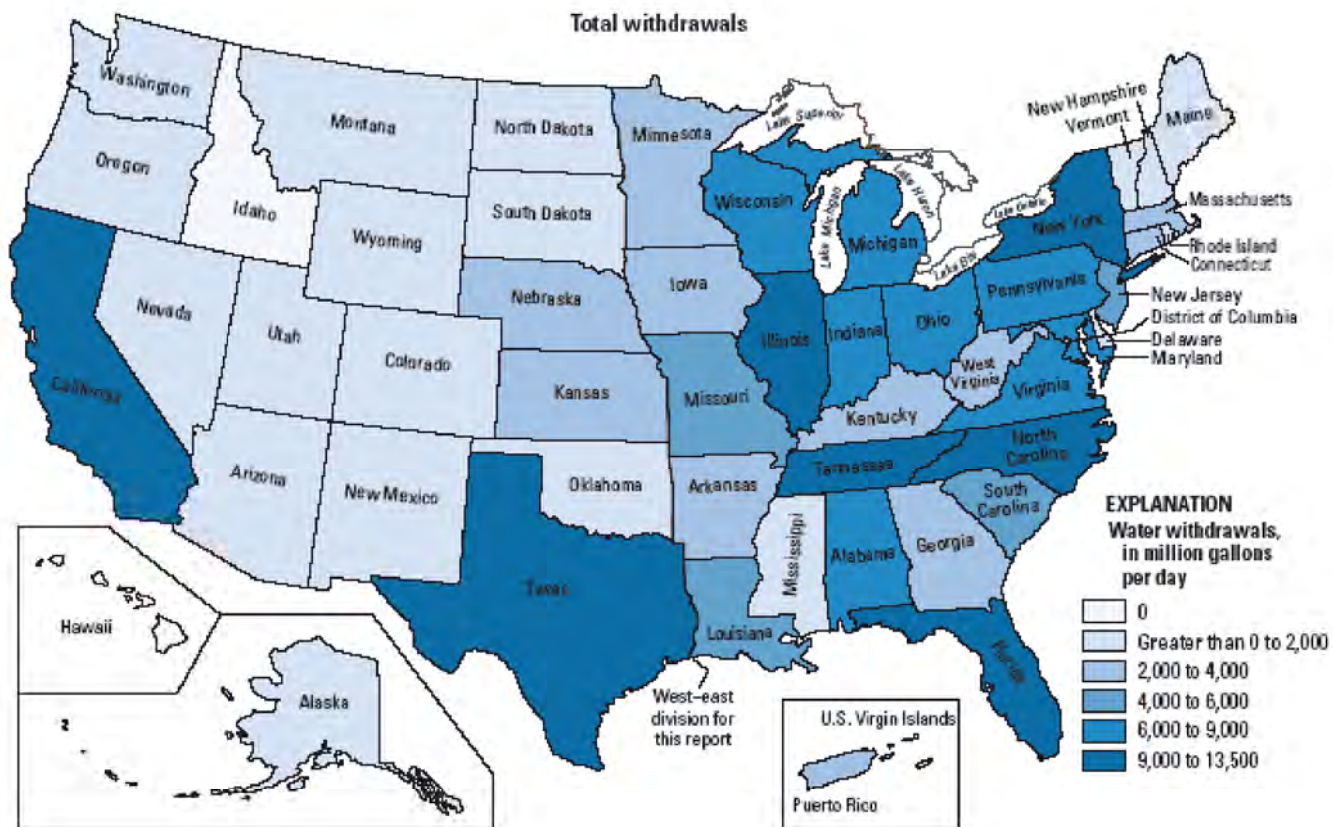
FIGURE 3-1

REGULATED OIL, GAS, & OTHER WELLS IN PRIMARY AND PRINCIPAL AQUIFERS IN NEW YORK STATE



Technical Support Document to the Draft Supplemental Generic Environmental Impact Statement

Source:  
 - "New York State Aquifers" by NYS Department of Health, Bureau of Public Water Supply Protection (April 2001) on <http://nysgis.state.ny.us/gis9/nyaquifers.zip>.  
 - Well information from (February 2009) <http://www.dec.ny.gov/energy/1603.html>

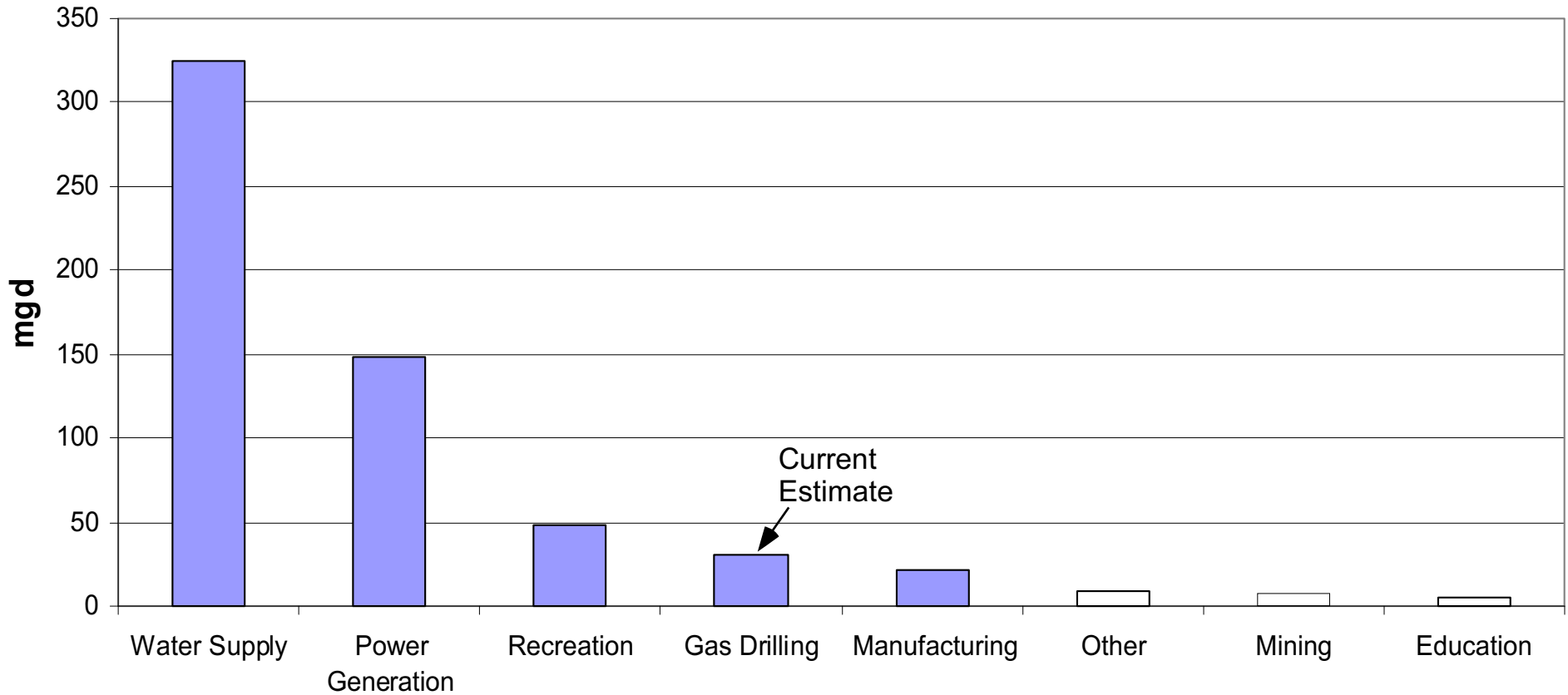


**FIGURE 3-2**  
**WATER WITHDRAWALS IN THE UNITED STATES**

Technical Support Docur  
Draft Supplemental Generic  
Environmental Impact Statement

Source: USGS, 2009  
<http://ga.water.usgs.gov/edu/wuvt.html>

### Maximum Approved Daily Consumptive Use (in mgd)



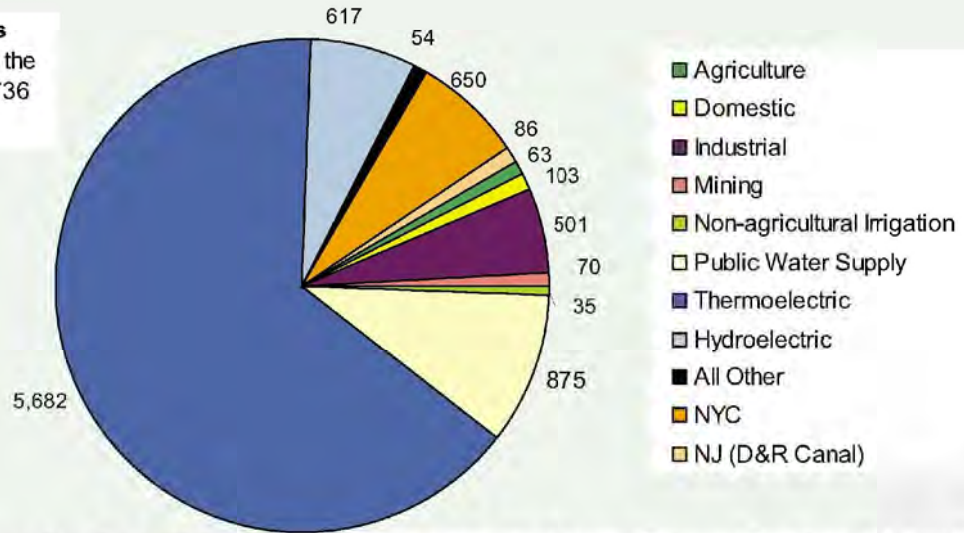
Source: Brownell, M., 2008, Balancing Economic Development & Environmental Impacts In The Susquehanna River Basin, Pennsylvania Natural Gas Summit, December 11, 2008.  
[Http://www.srbc.net/programs/docs/panatura%20gassummit-statecollege12-11-08.pdf](http://www.srbc.net/programs/docs/panatura%20gassummit-statecollege12-11-08.pdf)



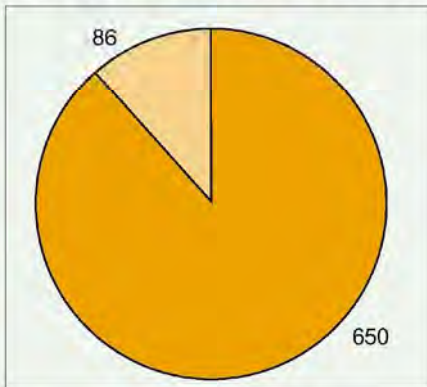
FIGURE 3-3  
MAXIMUM APPROVED DAILY CONSUMPTIVE USE IN THE SUSQUEHANNA RIVER BASIN

Technical Support Document to the Draft Supplemental Generic Environmental Impact Statement

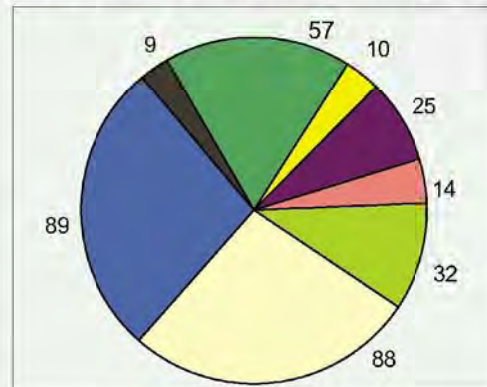
**Total Water Withdrawals**  
(ground and surface) from the Delaware River Basin: 8,736 mgd



**Major Exports** from the Delaware River Basin: 736 mgd



**Consumptive Use** in the the Delaware River Basin: 324 mgd



Pie chart values in mgd  
(million gallons per day)

Source: DRBC



FIGURE 3-4

**DAILY WATER WITHDRAWALS,  
EXPORTS, AND CONSUMPTIVE USES  
IN THE DELAWARE RIVER BASIN**

Technical Support Docurr  
Draft Supplemental Generic  
Environmental Impact Statement

**Legend**

- Delaware River Basin
- Susquehanna River Basin
- Utica and Marcellus Shales in New York State

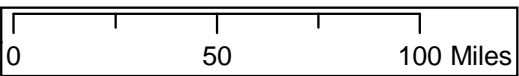
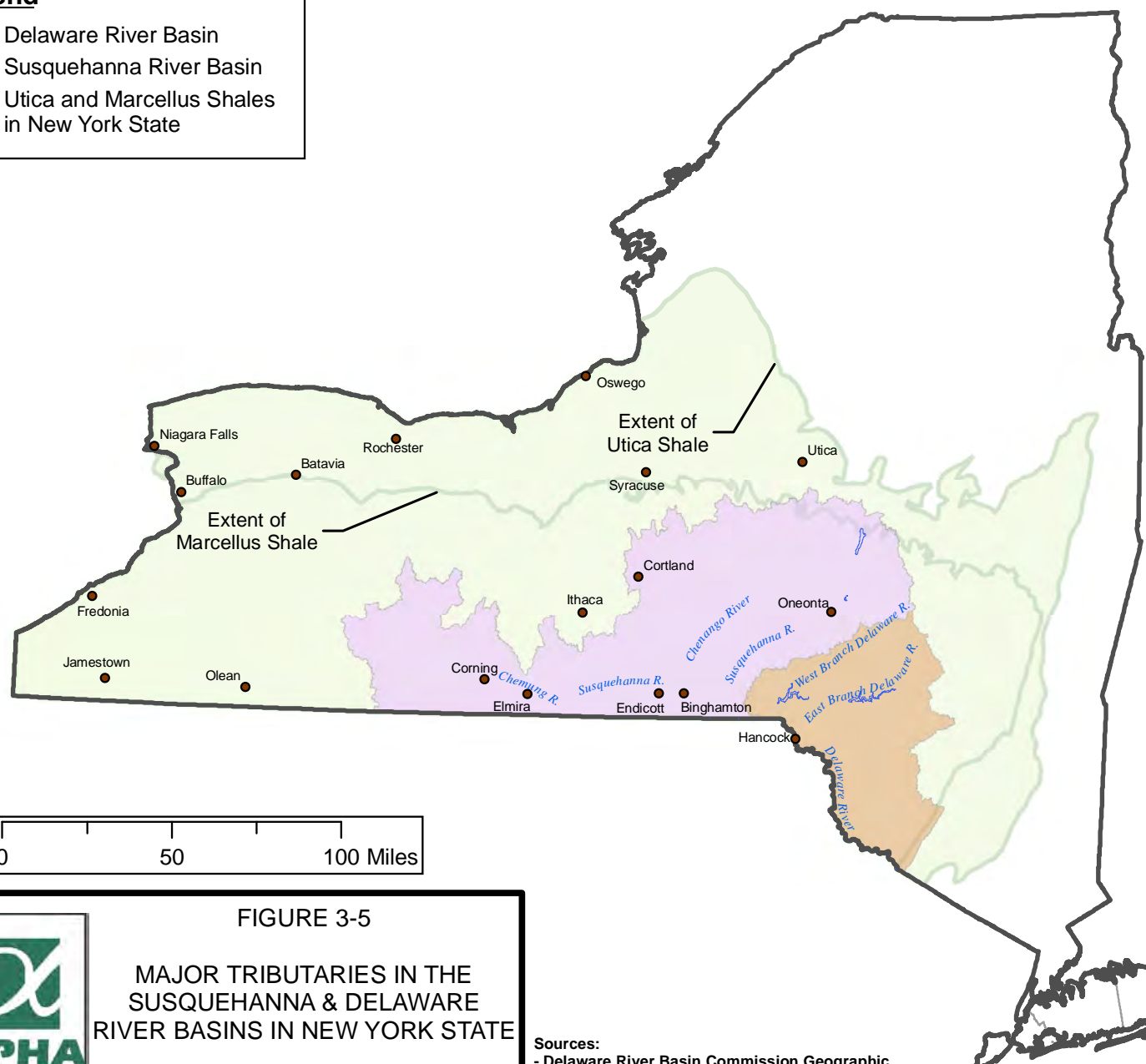


FIGURE 3-5

MAJOR TRIBUTARIES IN THE  
SUSQUEHANNA & DELAWARE  
RIVER BASINS IN NEW YORK STATE



Technical Support Document to the  
Draft Supplemental Generic  
Environmental Impact Statement

Sources:  
- Delaware River Basin Commission Geographic Information System <http://www.state.nj.us/drbc/gis.htm>.  
- Susquehanna River Basin Commission Map and Data Atlas <http://www.srb.com/atlas/whatgis.asp>

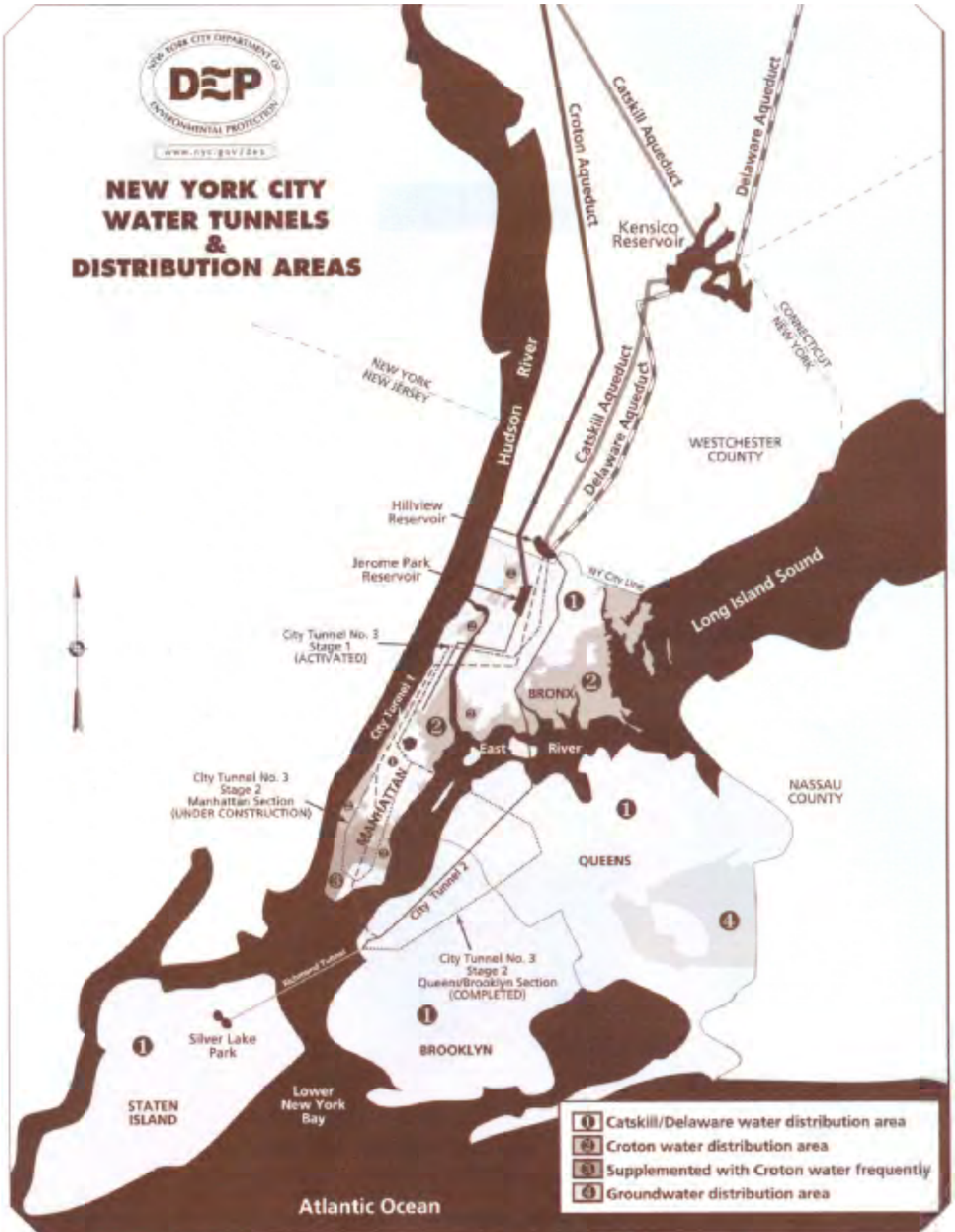
Figure 4-1



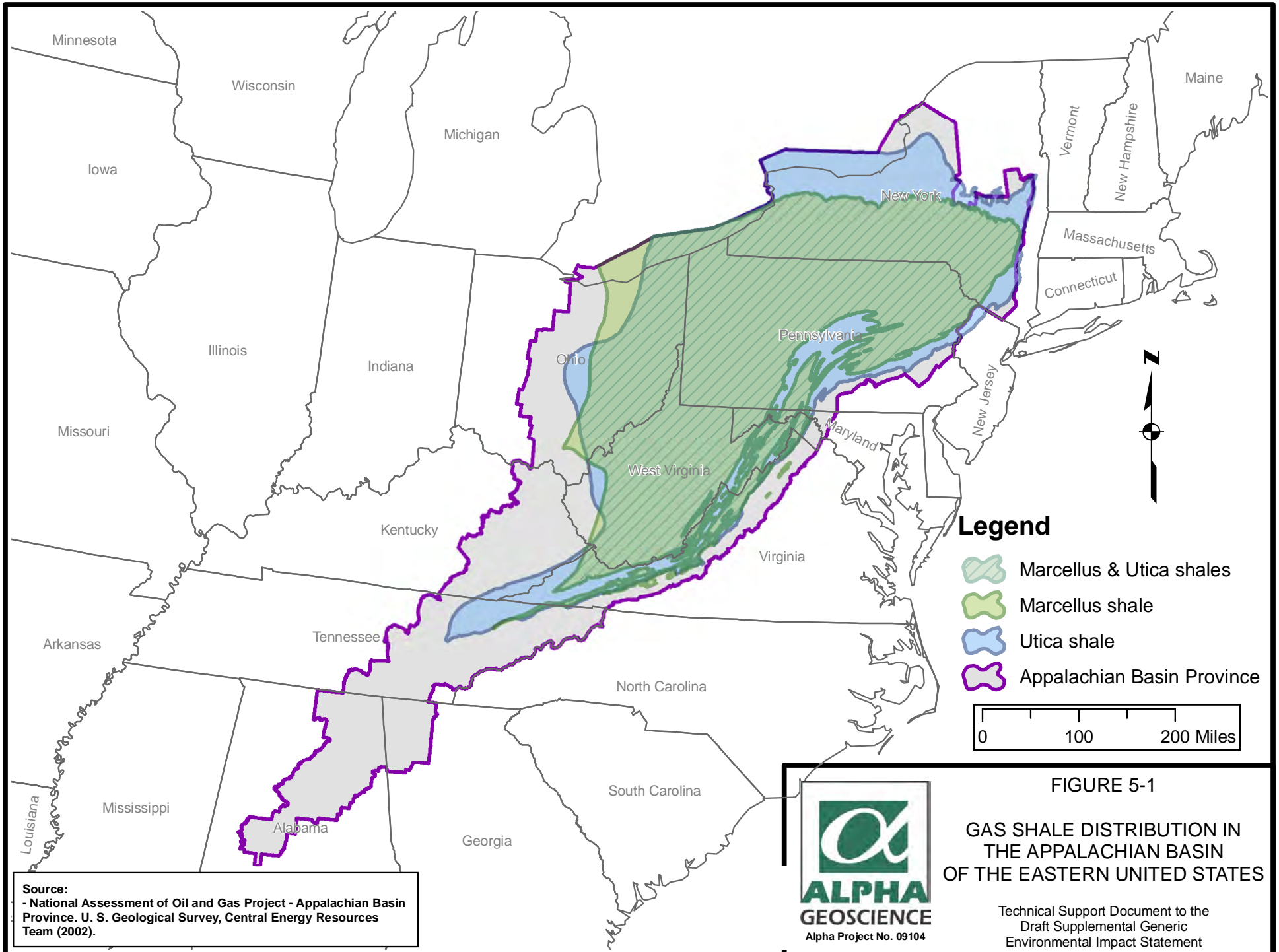
09104\alpha project report\task 3 - NYC watershed\fig 4-1.cvx

Source: NYCDEP, 2009; New York City 2008 Drinking Water Supply and Quality Report

Figure 4-2



This map of the City indicates the general areas where water can be supplied by the Catskill/Delaware, Croton and Groundwater Systems.



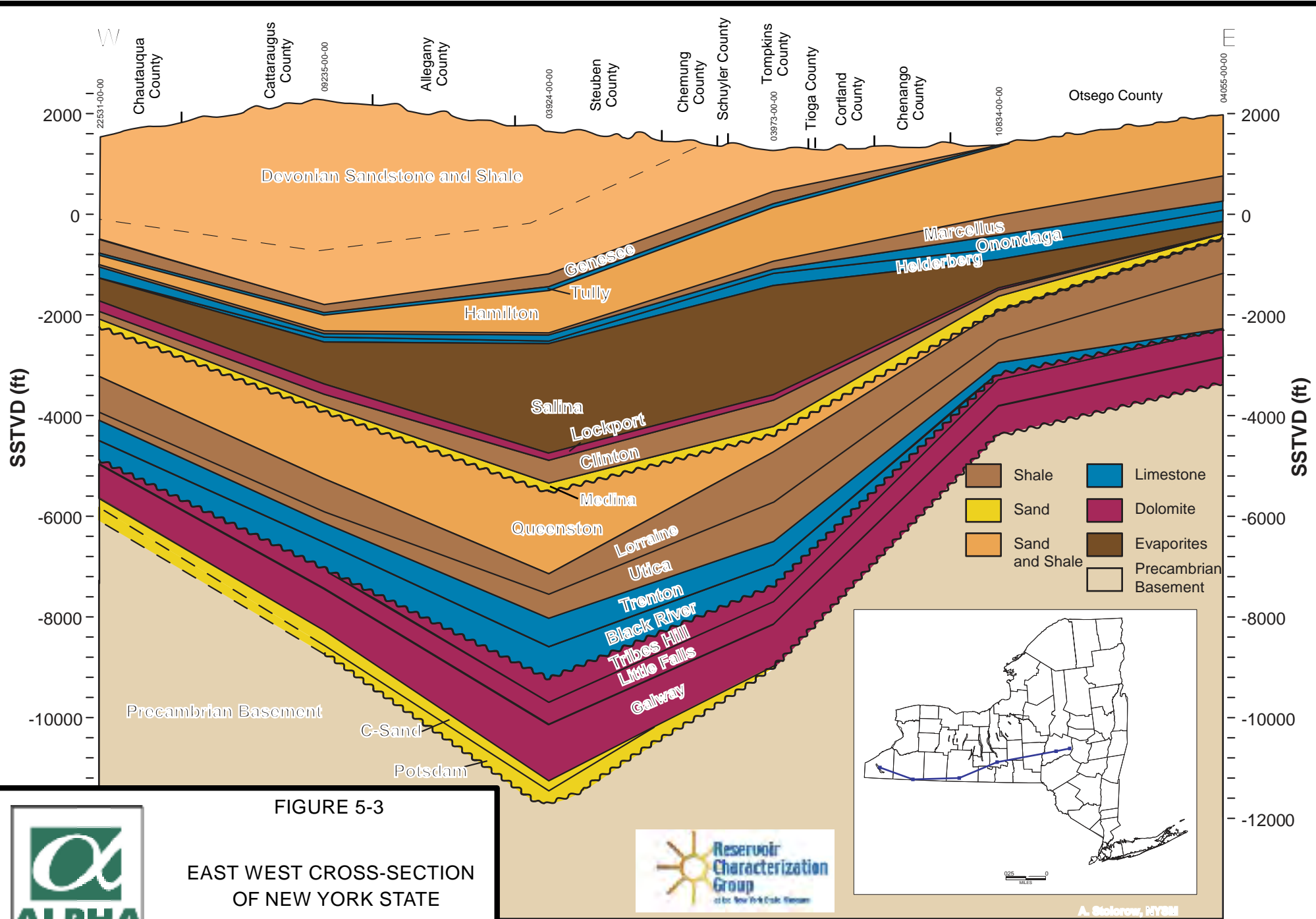
Source:  
 - National Assessment of Oil and Gas Project - Appalachian Basin Province. U. S. Geological Survey, Central Energy Resources Team (2002).





**Figure 5-2**

**Stratigraphic Column of New York; Oil and Gas Producing Horizons  
(from D.G. Hill, T.E. Lombardi and J. P. Martin, 2002)**

PERIOD	GROUP	UNIT	LITHOLOGY	THICKNESS (feet)	PRODUCTION	
<b>PENNSYLVANIAN</b>	Pottsville	Olean	Ss, cgl	75 - 100		
<b>MISSISSIPPIAN</b>	Pocono	Knapp	Ss, cgl	5 - 100		
<b>DEVONIAN</b>	UPPER	Conewango	Riceville	Sh, ss, cgl	70	
		Conneuat	Chadakoin	Sh, ss	700	
		Canadaway	Undiff	Sh, Ss	1,100 - 1,400	Oil, Gas
			Perrysburg-Dunkirk	Sh, ss		Oil, Gas
				Sh, ss		
		West Falls	Java	Sh, ss	365 - 125	
			Nunda	Sh, ss		Oil, Gas
	Rhinestreet		Sh			
	Sonyea	Middlesex	Sh	0 - 400	Gas	
	Genesee	Geneseo	Sh	0 - 450	Gas	
	?		Tully	Ls	0 - 50	Gas
	MIDDLE	Hamilton	Moscow	Sh	200 - 600	
			Ludlowville	Sh		
			Skaneateles	Sh		
Marcellus			Sh	Gas		
		Onondaga	Ls	30 - 235	Gas, Oil	
LOWER	Tristates	Oriskany	Ss	0 - 40	Gas	
	Helderberg	Manlius	Ls	0 - 10		
		Rondout	Dol			
<b>SILURIAN</b>	UPPER		Akron	Dol	0 - 15	Gas
		Salina	Camillus	Sh, gyp	450 - 1,850	
			Syracuse	Dol, sh, slt		
			Vernon	Sh		Gas
		Lockport	Lockport	Dol	150 - 250	Gas
	LOWER	Clinton	Rochester	Sh	125	Gas
			Irondequoit	Ls		
			Sodus/Oneida	Sh/cgl	75	Gas
		Reynales	Ls			
		Medina	Grimsby	Sh, ss	75 - 150	Gas
		Whirlpool	Ss	0 - 25	Gas	
<b>ORDOVICIAN</b>	UPPER	Queenston	Sh	1,100 - 1,500	Gas	
		Oswego	Ss		Gas	
		Lorraine	Sh			
		Utica	Sh		900 - 1000	Gas
	MIDDLE	Trenton-Black River	Trenton	Ls	425 - 625	Gas
			Black River	Ls	225 - 550	Gas
LOWER	Beekmantown	Tribes Hill-Chuctanunda	Ls	0 - 550		
<b>CAMB.</b>	UPPER		Little Falls	Dol	0 - 350	
			Galway	Dol, ss	575 - 1,350	Gas
			Potsdam	Ss, dol	75 - 500	Gas
<b>PRECAMBRIAN</b>			Gneiss, marble, quartzite			



**Legend**

-  Utica Shale Outcrop\*
-  Extent of the Utica Shale in New York

\* - Outcrop extent includes Utica and Canajoharie shales (Fisher et al, 1970)

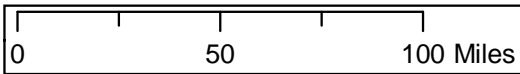
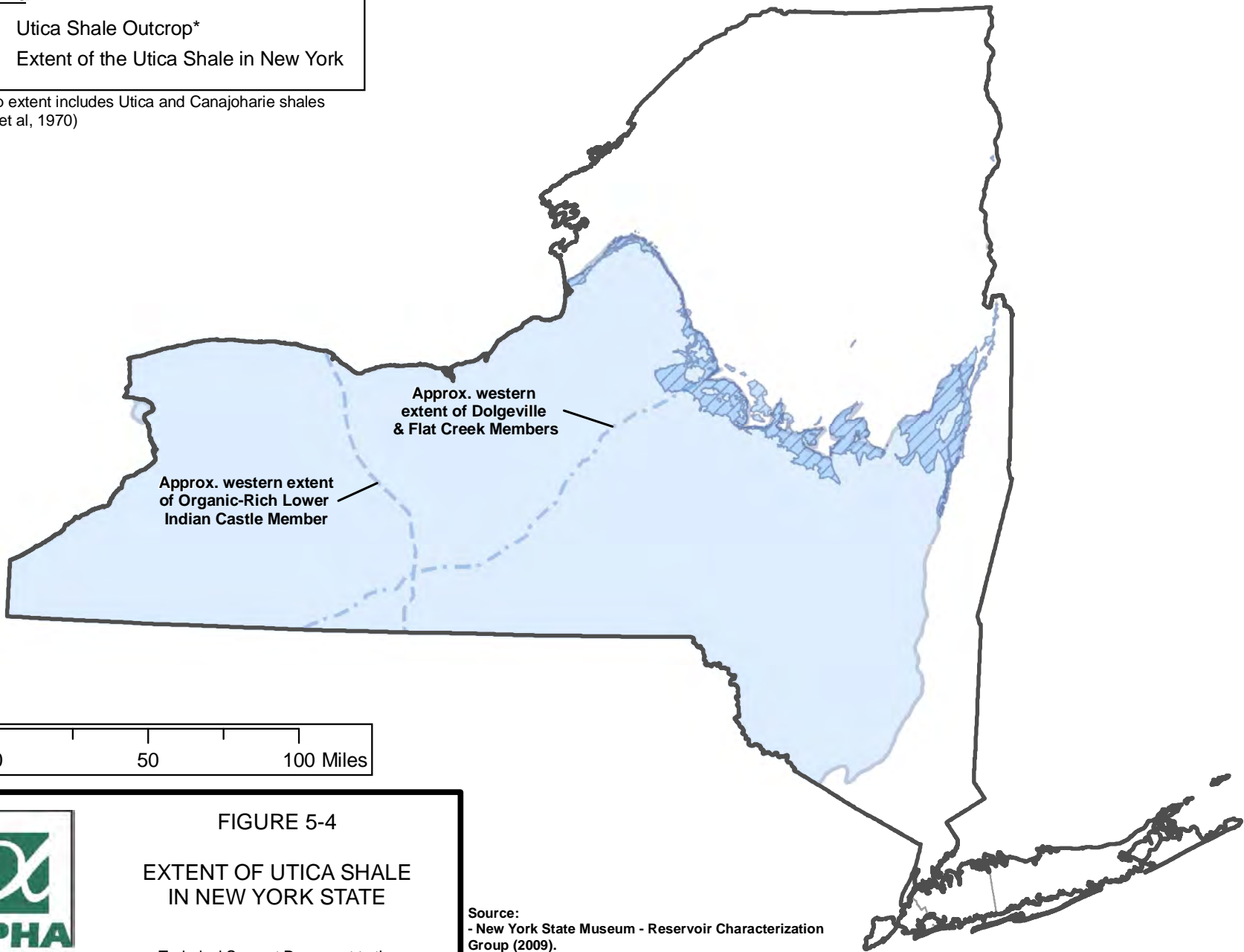


FIGURE 5-4

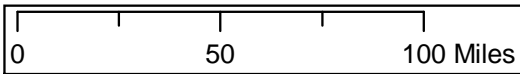
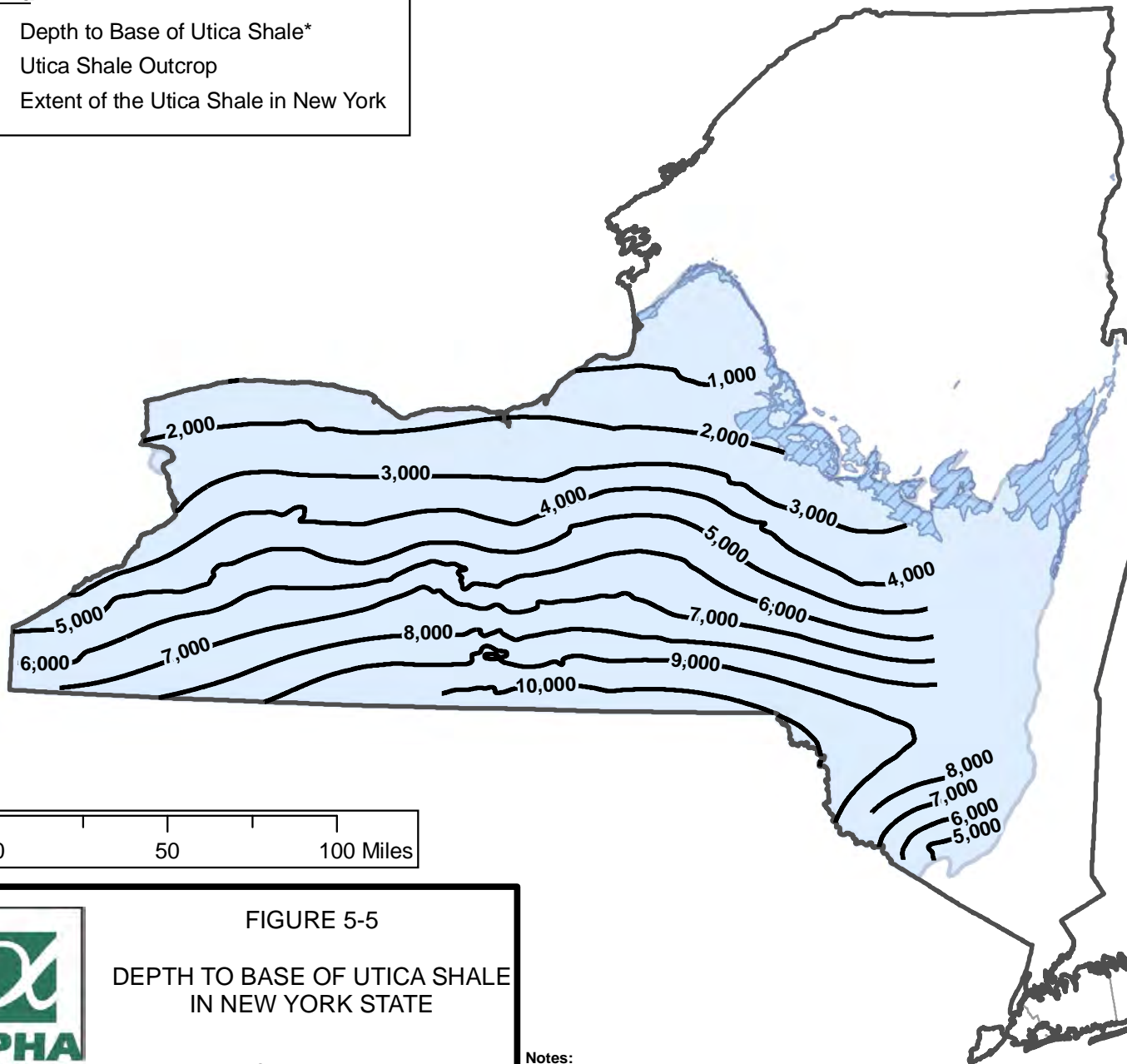
EXTENT OF UTICA SHALE  
IN NEW YORK STATE

Technical Support Document to the  
Draft Supplemental Generic  
Environmental Impact Statement

- Source:
- New York State Museum - Reservoir Characterization Group (2009).
  - Nyahay et al. (2007).
  - U. S. Geological Survey, Central Energy Resources Team (2002).
  - Fisher et al. (1970).

**Legend**

- Depth to Base of Utica Shale\*
- ▨ Utica Shale Outcrop
- Extent of the Utica Shale in New York



**FIGURE 5-5**

**DEPTH TO BASE OF UTICA SHALE  
IN NEW YORK STATE**



Technical Support Document to the  
Draft Supplemental Generic  
Environmental Impact Statement

**Notes:**

- Top of the Trenton limestone approximates the base of the Utica shale (New York State Museum - Reservoir Characterization Group, 2009).
- U. S. Geological Survey, Central Energy Resources Team (2002).

**Legend**

- Utica Shale Thickness Contour (in feet)
- ▨ Utica Shale Outcrop
- Extent of the Utica Shale in New York

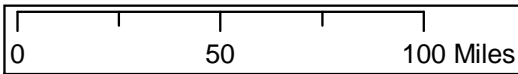
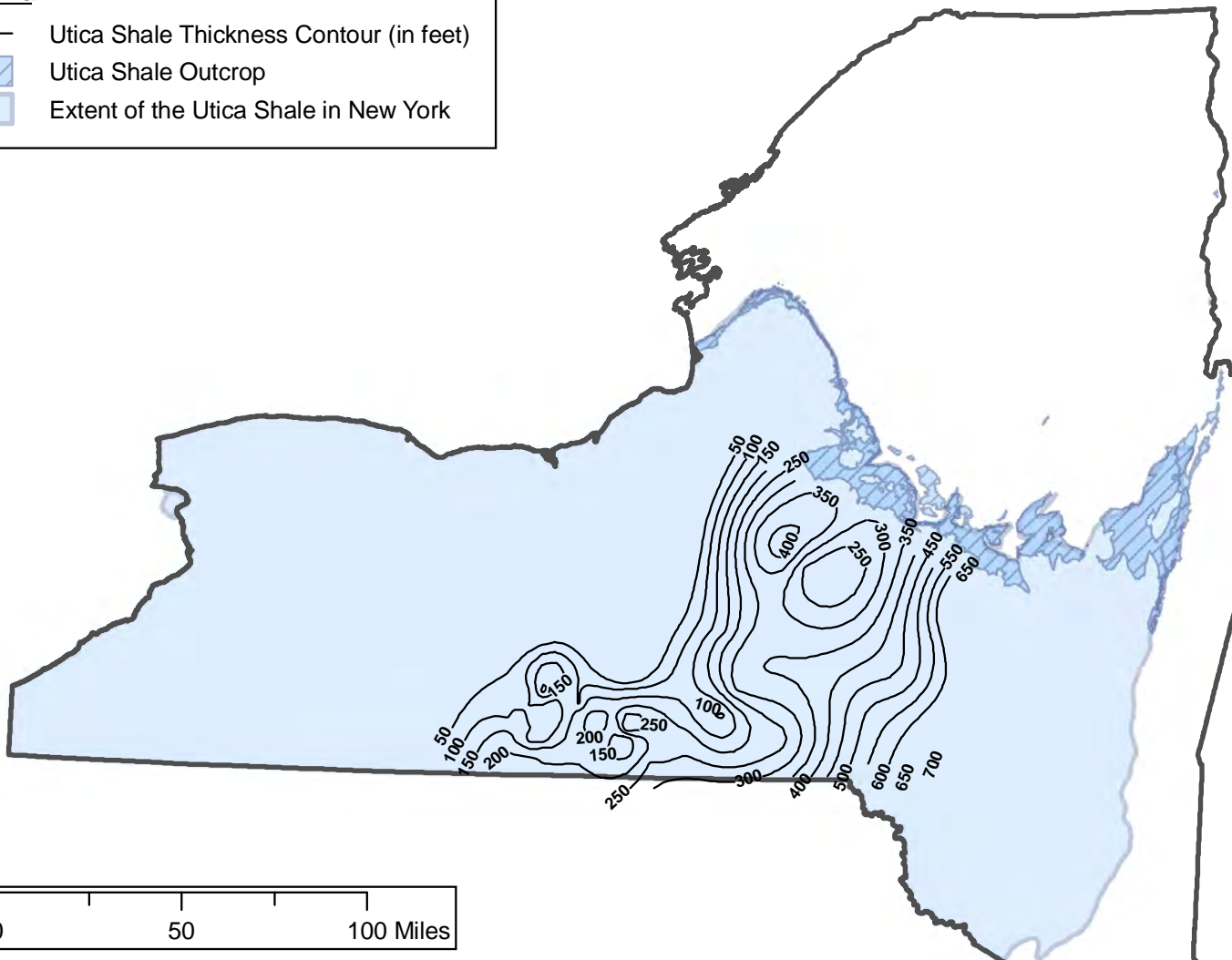


FIGURE 5-6

**THICKNESS OF HIGH-ORGANIC  
UTICA SHALE  
IN NEW YORK STATE**

Technical Support Document to the  
Draft Supplemental Generic  
Environmental Impact Statement



**Note:**

- Contours show the combined thickness of the high organic carbon interval (>1% TOC) lower Indian Castle, Dolgeville, Flat Creek members (New York State Museum - Reservoir Characterization Group, 2009).



## Legend

- Depth to the Top of the Marcellus Shale
- ▨ Marcellus Shale and Hamilton Group Outcrop
- Extent of the Marcellus Shale in New York

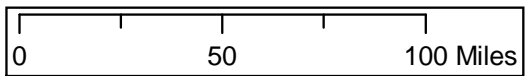
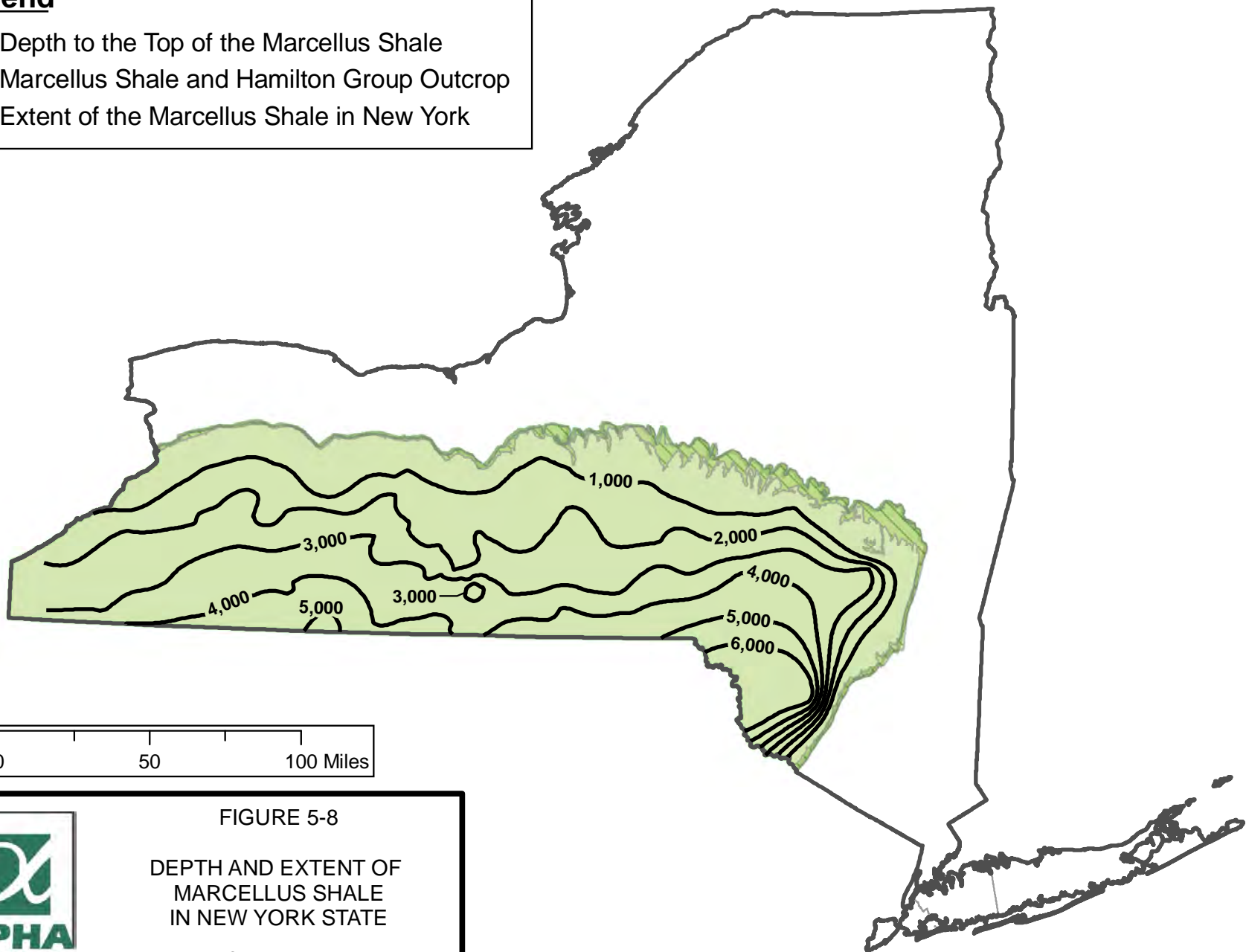


FIGURE 5-8

### DEPTH AND EXTENT OF MARCELLUS SHALE IN NEW YORK STATE

Technical Support Document to the  
Draft Supplemental Generic  
Environmental Impact Statement

Source:  
- New York State Museum - Reservoir Characterization Group (Leone, 2009).



## Legend

- Thickness Organic-Rich Marcellus Shale (in feet)
- ▨ Marcellus Shale and Hamilton Group Outcrop
- Extent of the Marcellus Shale in New York

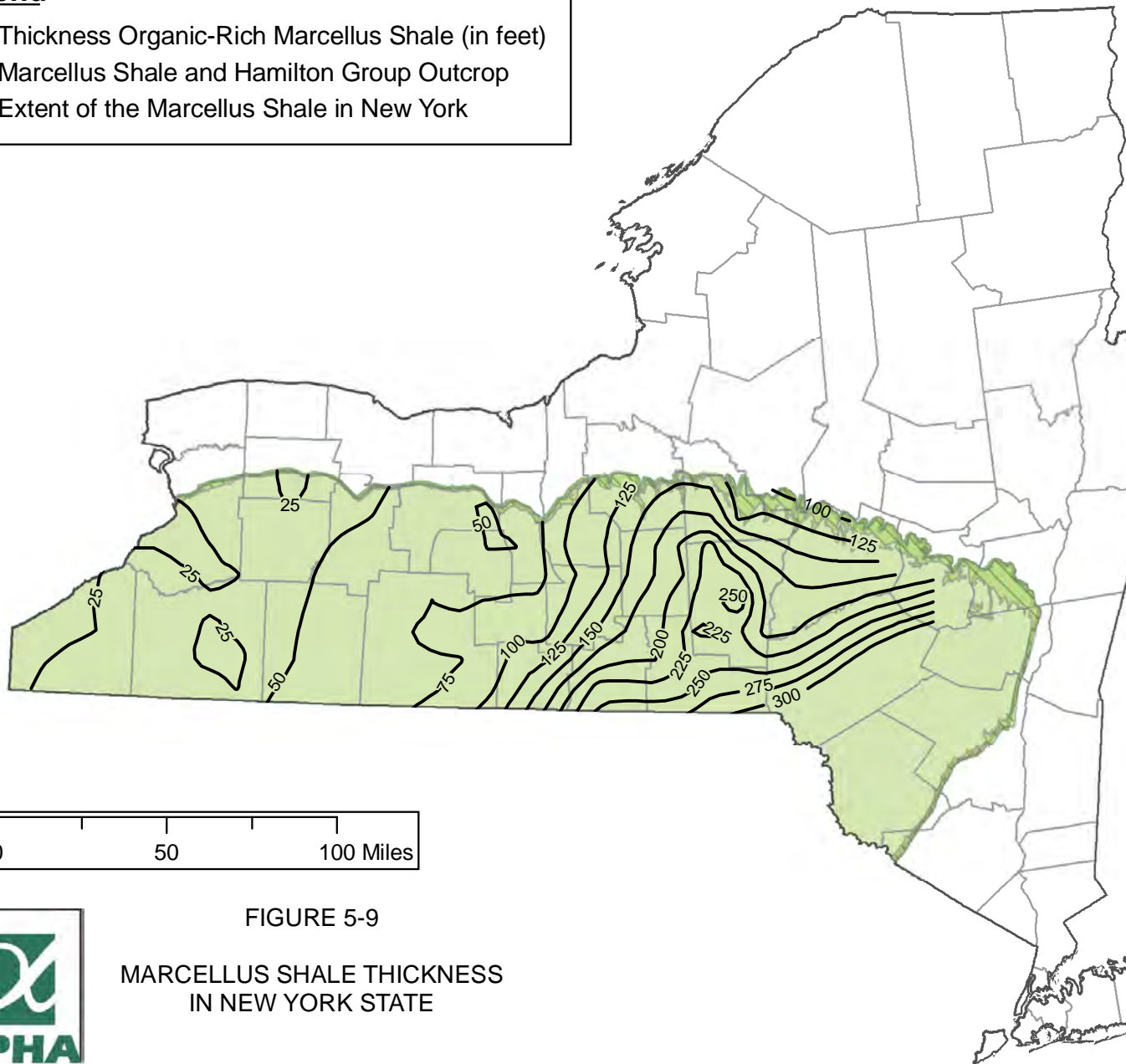


FIGURE 5-9

### MARCELLUS SHALE THICKNESS IN NEW YORK STATE



Technical Support Document to the  
Draft Supplemental Generic  
Environmental Impact Statement

**Notes:**

- Source: New York State Museum - Reservoir Characterization Group (Leone, 2009)
- Organic-rich Marcellus includes Union Springs and Oatka Creek Members and lateral equivalents.



**Legend**

- Total Organic Carbon (weight percent) in Organic-Rich Marcellus Shale
- ▨ Marcellus Shale and Hamilton Group Outcrop
- Extent of the Marcellus Shale in New York

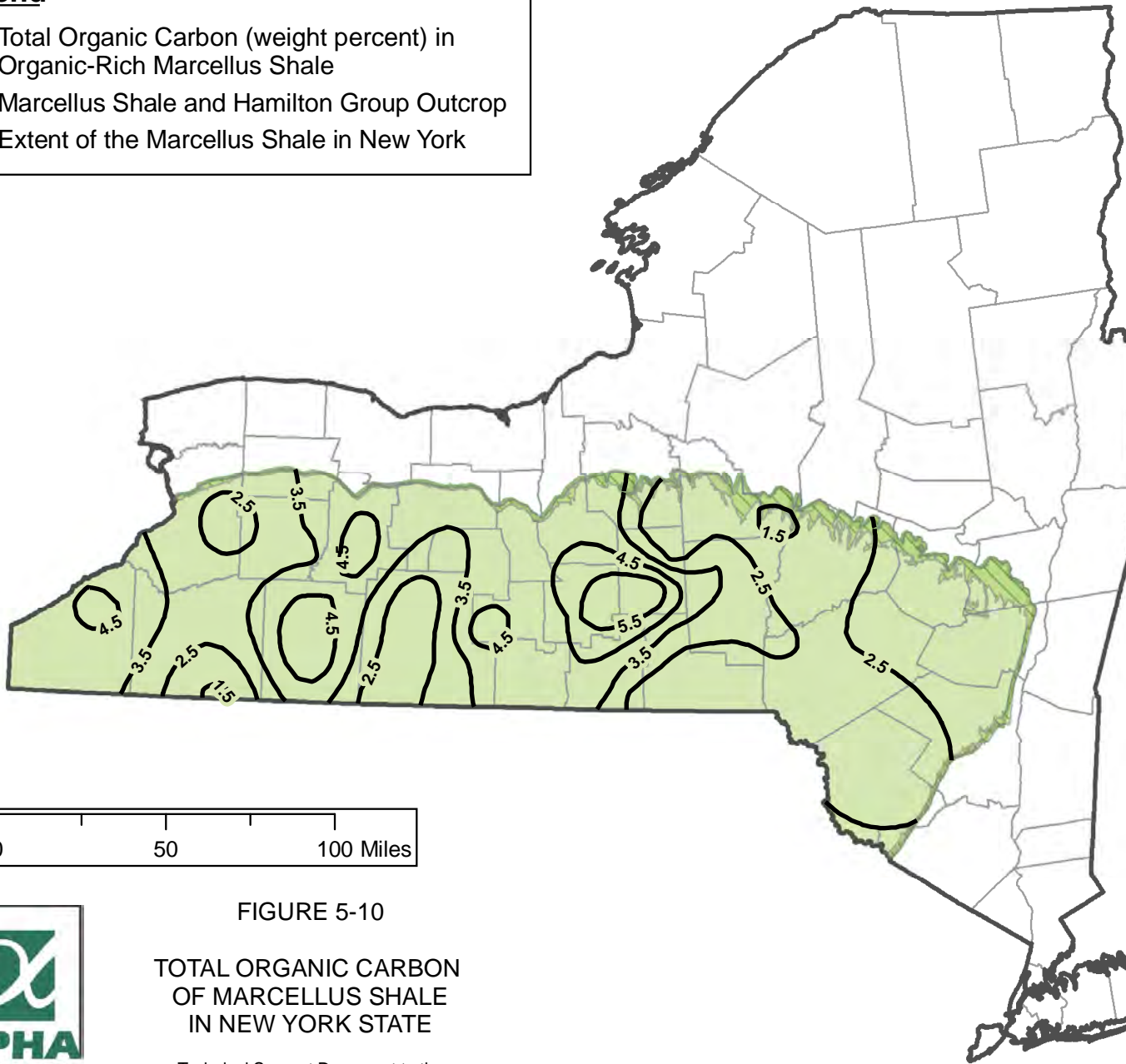


FIGURE 5-10

TOTAL ORGANIC CARBON  
OF MARCELLUS SHALE  
IN NEW YORK STATE

Technical Support Document to the  
Draft Supplemental Generic  
Environmental Impact Statement


Source:  
- Modified from New York State Museum - Reservoir Characterization  
Group (Leone, 2009).





**Legend**

 Extent of the Marcellus Shale in New York

**Vitrinite Reflection (%Ro)**

 Less than 0.6

 0.6 to 1.5

 1.5 to 3.0

 Greater than 3.0

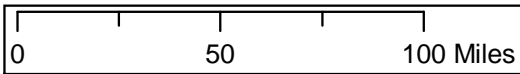
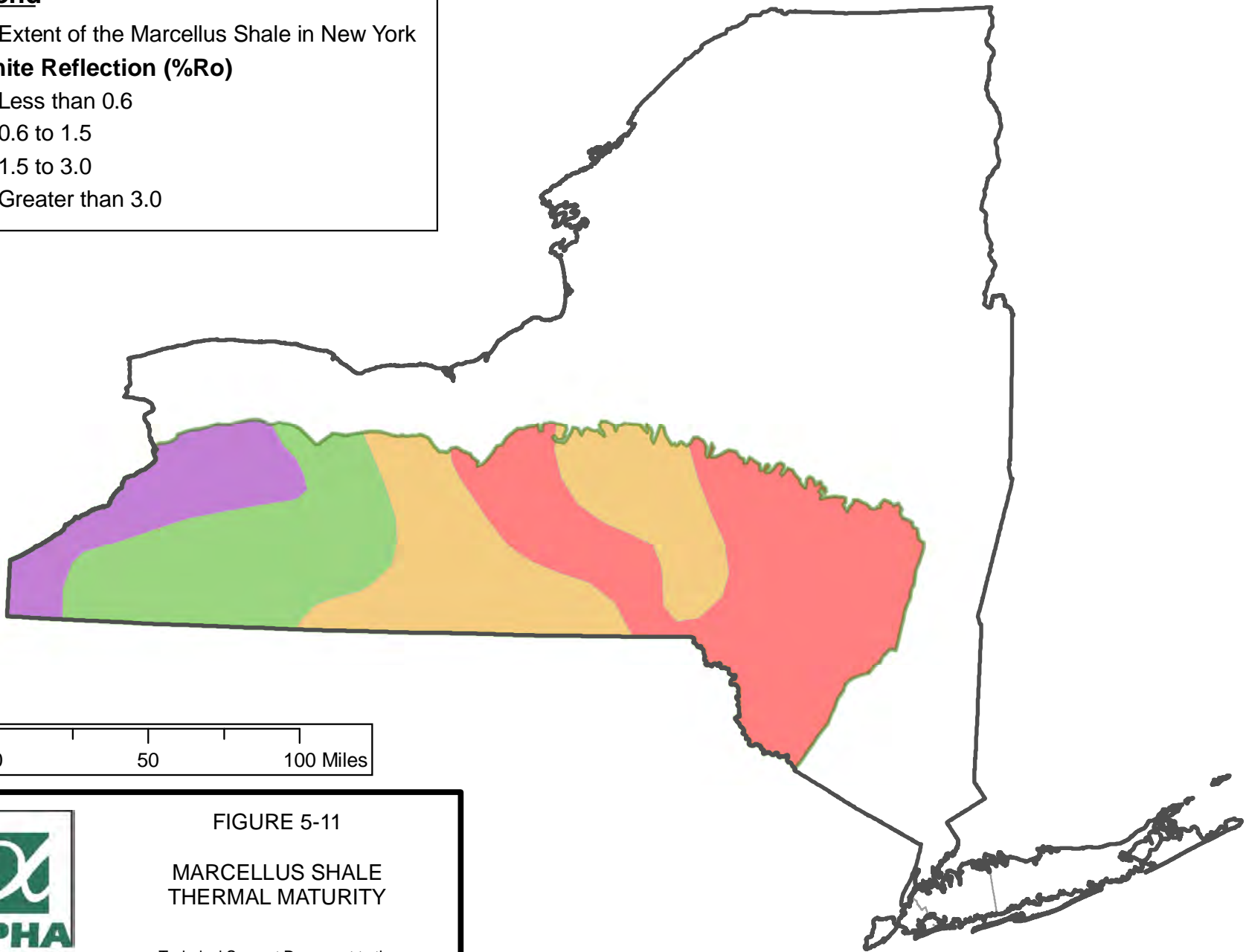





FIGURE 5-11

MARCELLUS SHALE  
THERMAL MATURITY

Technical Support Document to the  
Draft Supplemental Generic  
Environmental Impact Statement

Source:  
- Modified from Smith & Leone (2009).

# Legend

-  Marcellus Shale and Hamilton Group Outcrop
-  Marcellus Shale Fairway
-  Extent of the Marcellus Shale in New York

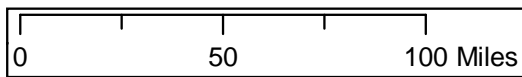
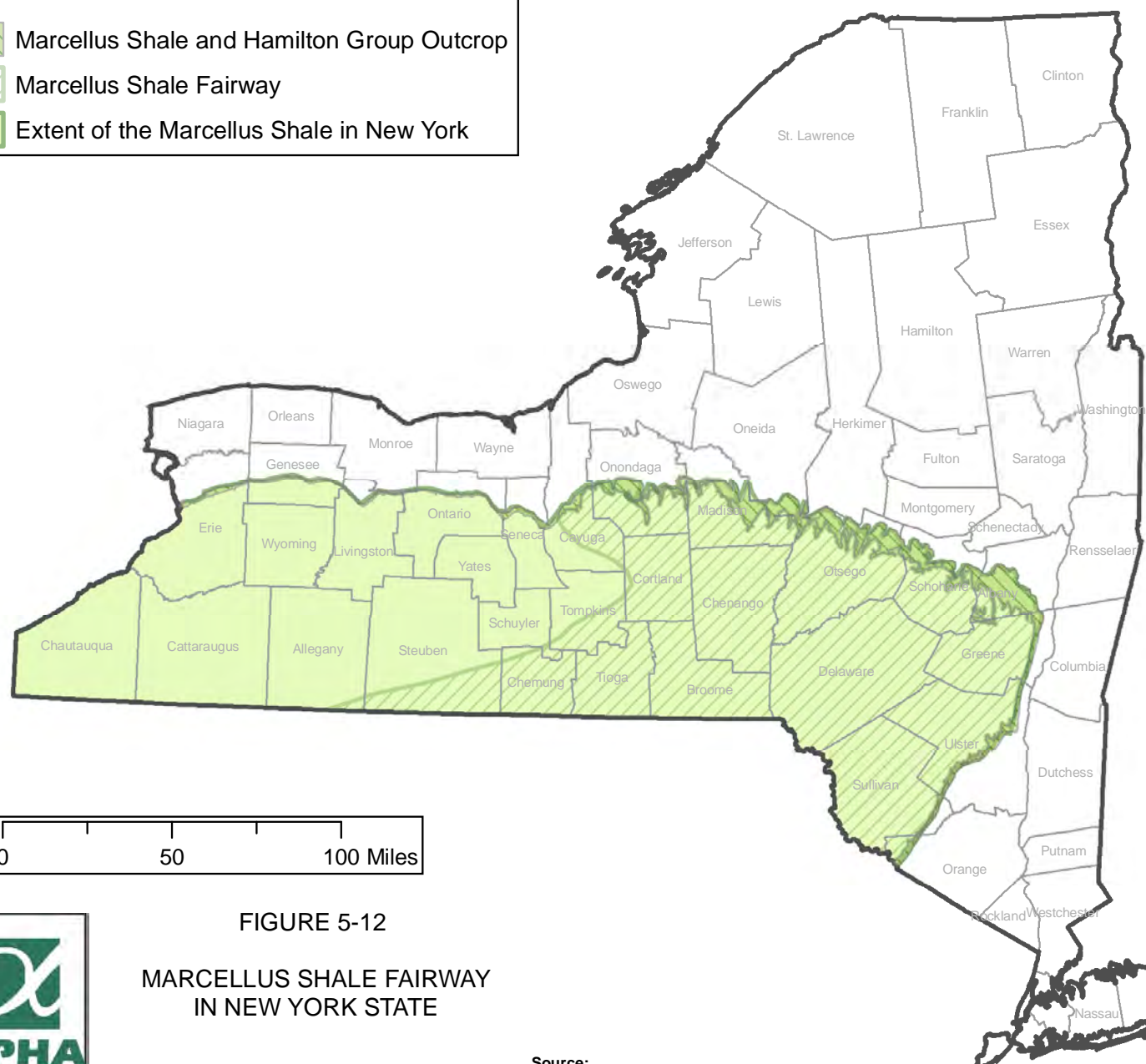


FIGURE 5-12

## MARCELLUS SHALE FAIRWAY IN NEW YORK STATE



Technical Support Document to the  
Draft Supplemental Generic  
Environmental Impact Statement

**Source:**

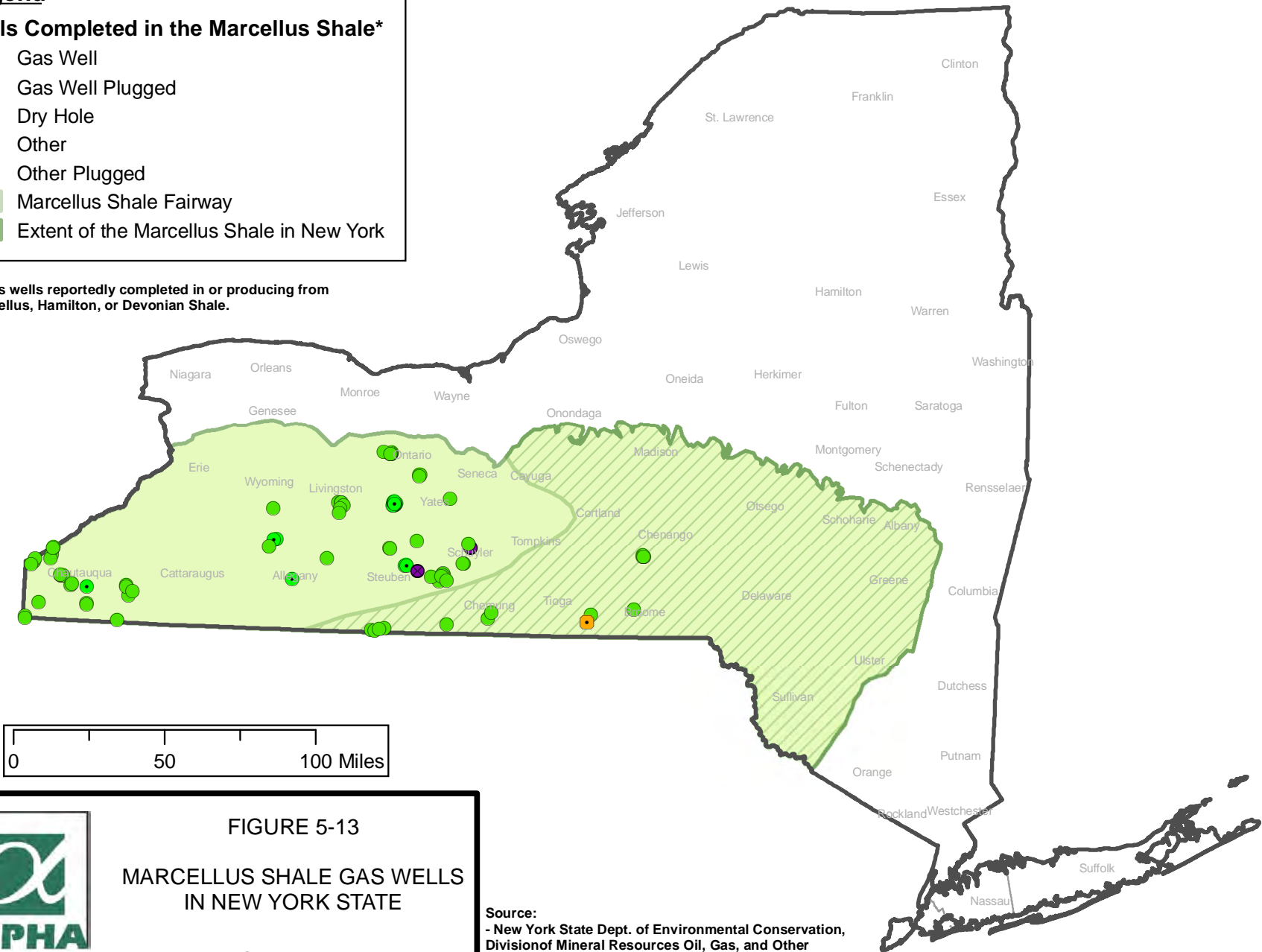
- US Geological Survey, Central Energy Resources Team (2002)
- New York State Museum - Reservoir Characterization Group
- Nyahay et al. (2007)

**Legend**

**Wells Completed in the Marcellus Shale\***

- Gas Well
- Gas Well Plugged
- Dry Hole
- Other
- Other Plugged
- ▨ Marcellus Shale Fairway
- Extent of the Marcellus Shale in New York

**Note:**  
- Includes wells reportedly completed in or producing from the Marcellus, Hamilton, or Devonian Shale.



**FIGURE 5-13**

**MARCELLUS SHALE GAS WELLS  
IN NEW YORK STATE**

Technical Support Document to the  
Draft Supplemental Generic  
Environmental Impact Statement

**Source:**

- New York State Dept. of Environmental Conservation, Division of Mineral Resources Oil, Gas, and Other Regulated Wells Database (July 9, 2009)
- New York State Museum - Reservoir Characterization Group
- Nyahay et al. (2007)

### Legend

- Geologic Fault
- Combined Utica and Marcellus Shales in New York State

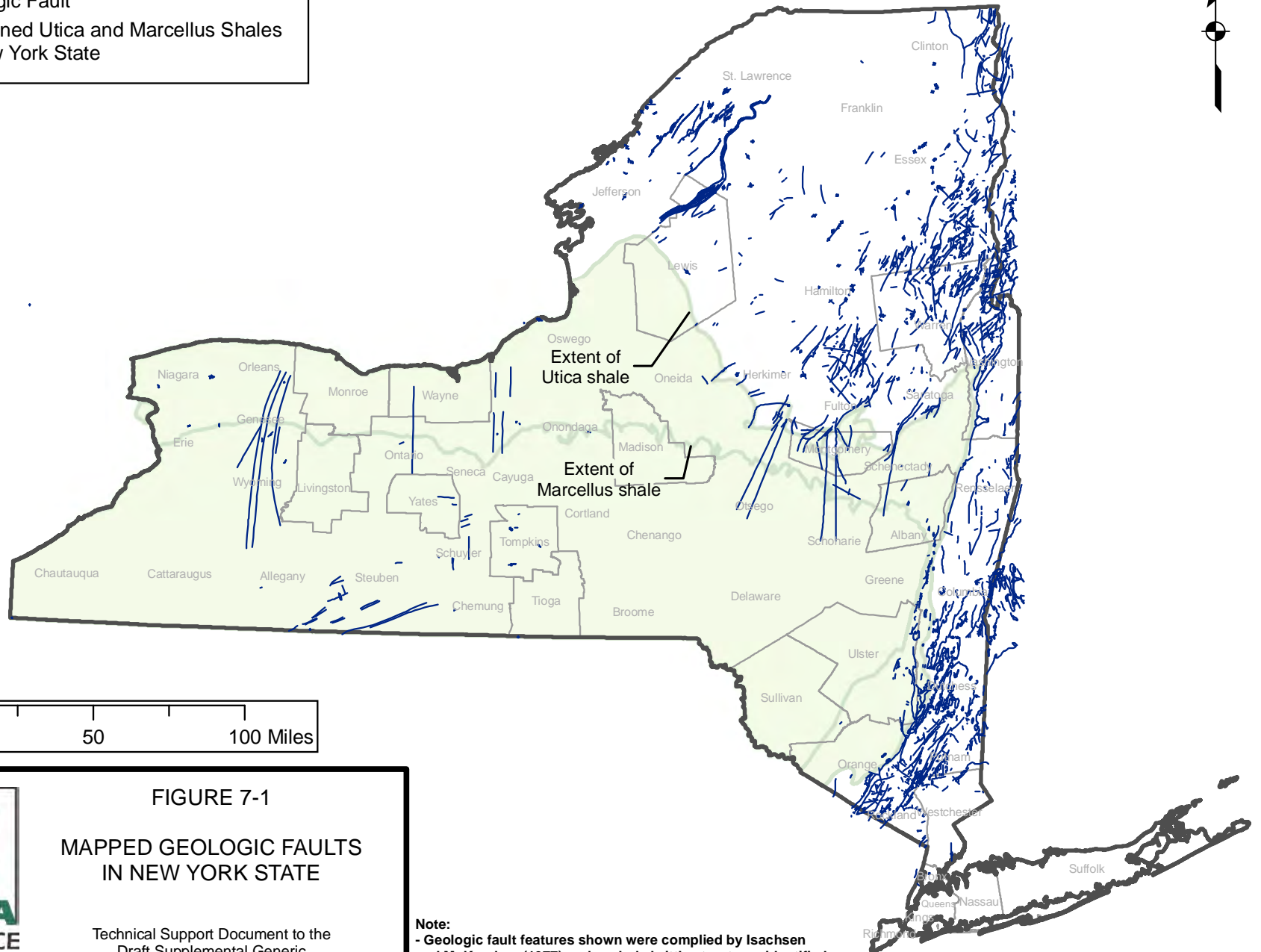


FIGURE 7-1

### MAPPED GEOLOGIC FAULTS IN NEW YORK STATE

Technical Support Document to the  
Draft Supplemental Generic  
Environmental Impact Statement



**Note:**

- Geologic fault features shown were compiled by Isachsen and McKendree (1977) and exclude brittle structures identified as drillholes, topographic, and tonal linear features.

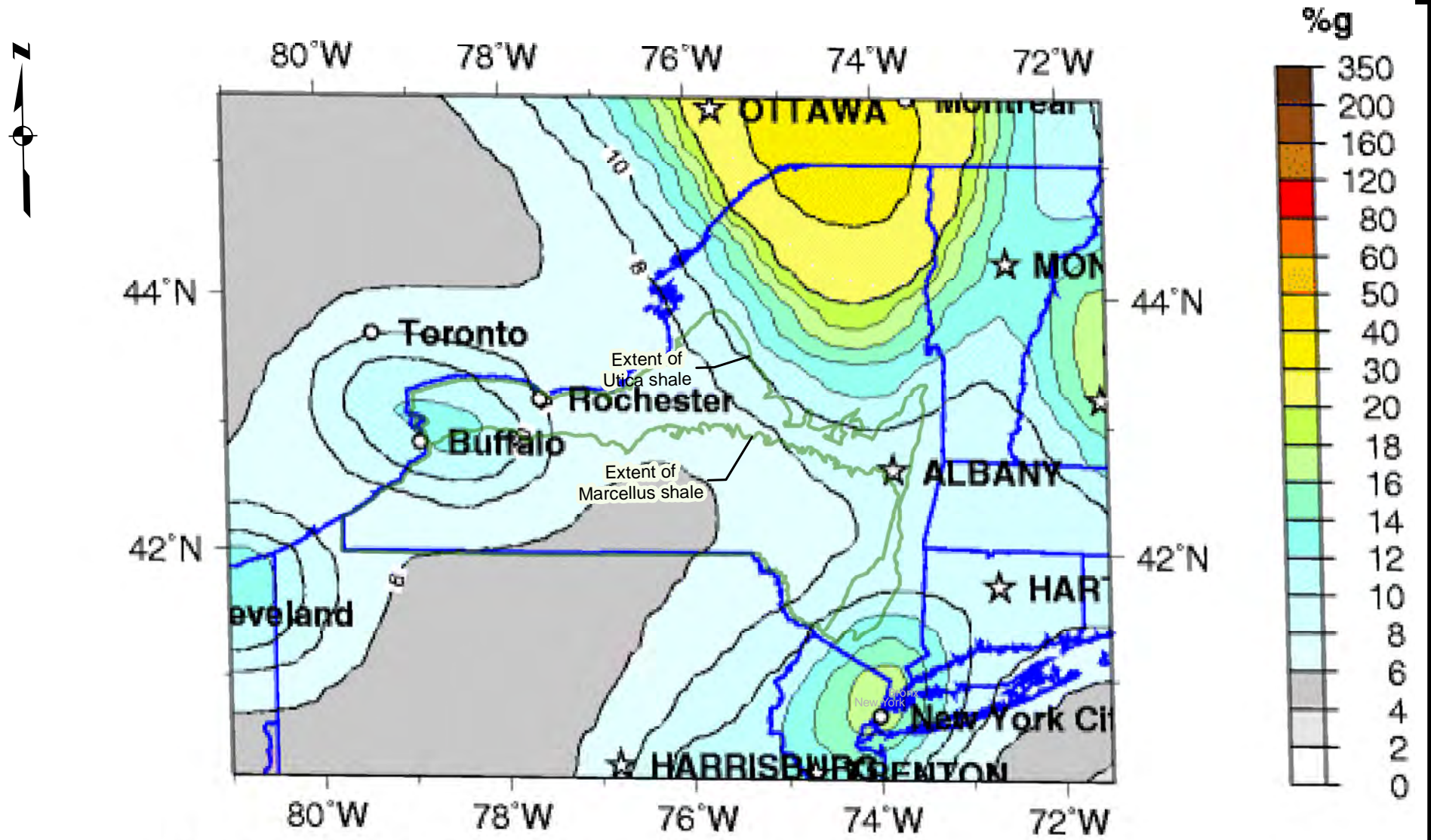


FIGURE 7-2

NEW YORK STATE  
SEISMIC HAZARD MAP



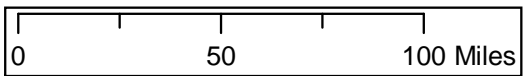
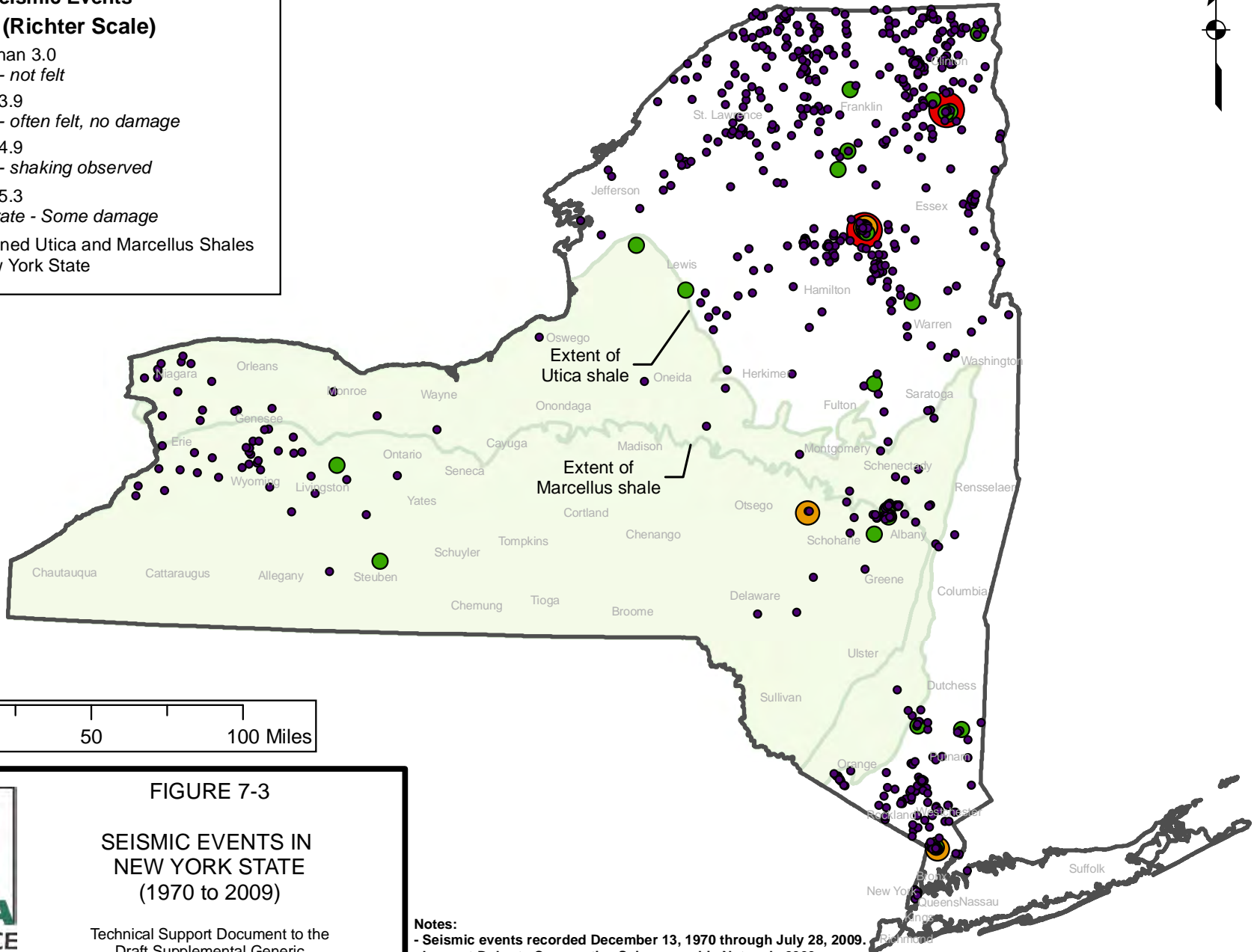
Technical Support Document to the  
Draft Supplemental Generic  
Environmental Impact Statement

- Notes:
- Map shows peak acceleration (%g) with 2% probability of exceedence in 50 years.
  - Source - USGS National Seismic Hazard Maps (2008).

**Legend**

**Recorded Seismic Events  
Magnitude (Richter Scale)**

- Less than 3.0  
*Minor - not felt*
- 3.0 to 3.9  
*Minor - often felt, no damage*
- 4.0 to 4.9  
*Minor - shaking observed*
- 5.0 to 5.3  
*Moderate - Some damage*
- Combined Utica and Marcellus Shales  
in New York State



**FIGURE 7-3**

**SEISMIC EVENTS IN  
NEW YORK STATE  
(1970 to 2009)**

Technical Support Document to the  
Draft Supplemental Generic  
Environmental Impact Statement



**Notes:**  
- Seismic events recorded December 13, 1970 through July 28, 2009.  
- Lamont-Doherty Cooperative Seismographic Network, 2009  
(<http://almaty.ldeo.columbia.edu:8080/data.search.html>)