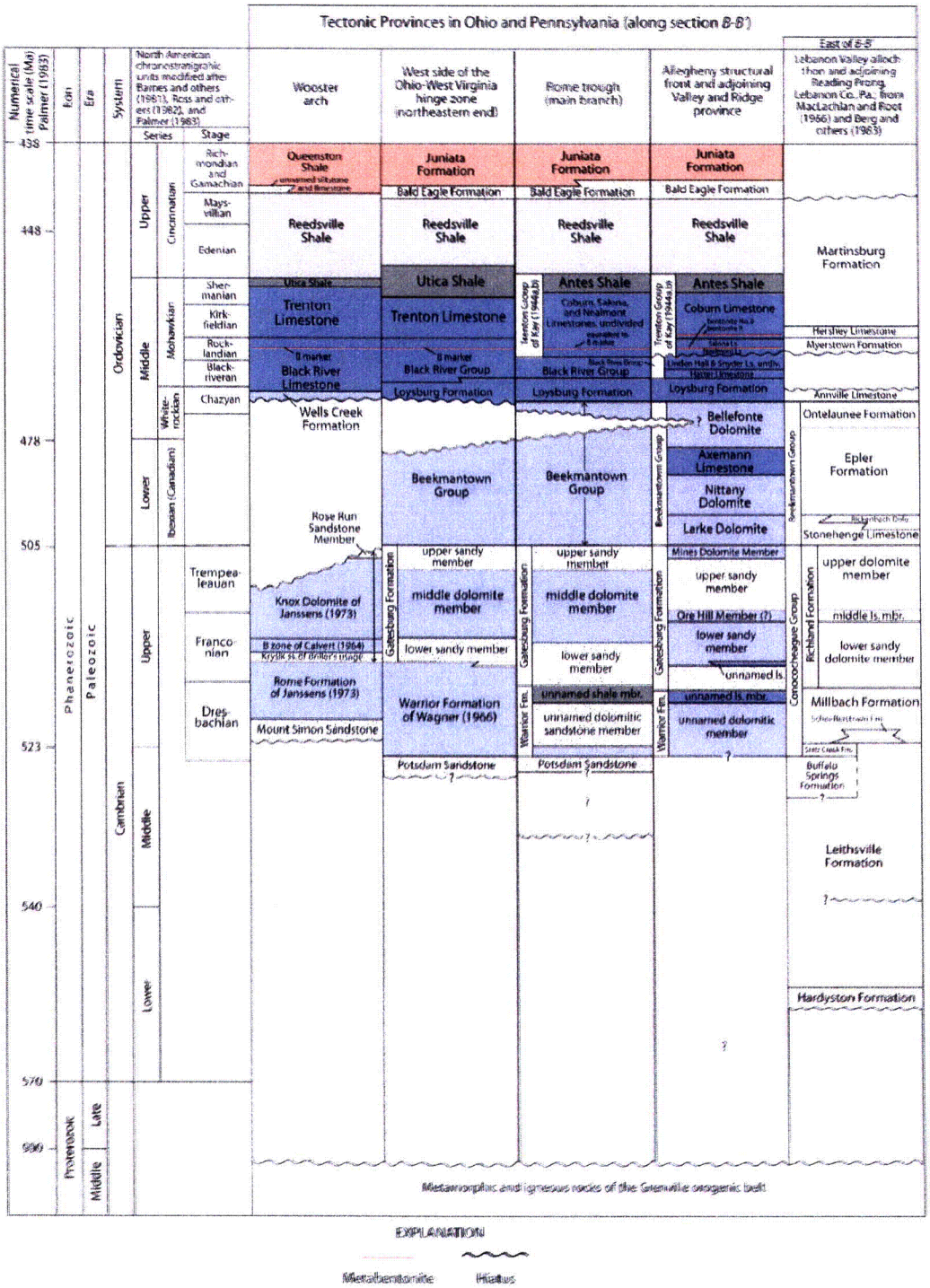
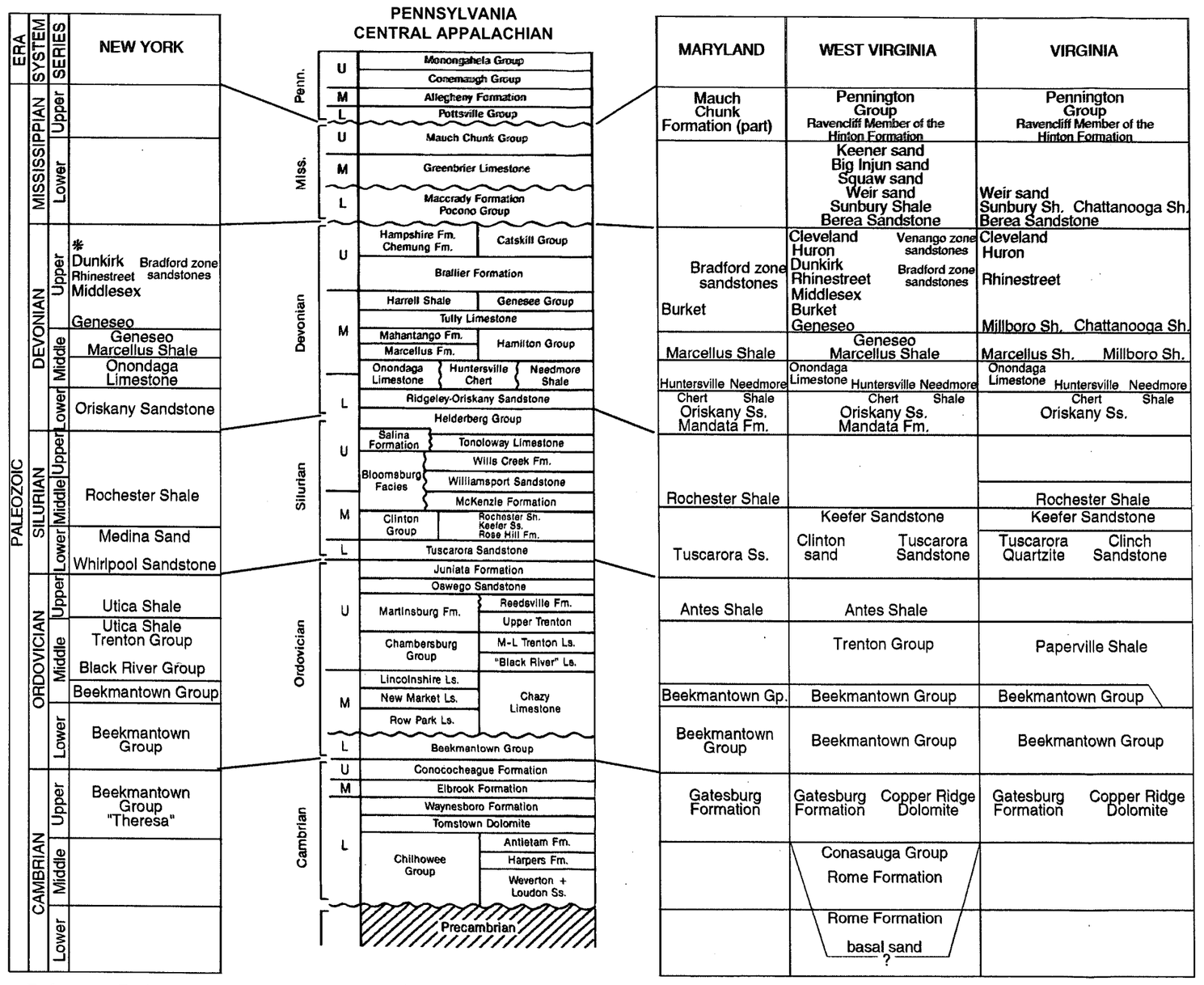
## Figure 2.5-13 Stratigraphic Correlation Chart of Appalachian Basin




REFERENCE:
- Crangle Jr. 2002.

# Figure 2.5-13a Regional Generalized Composite Stratigraphic Column

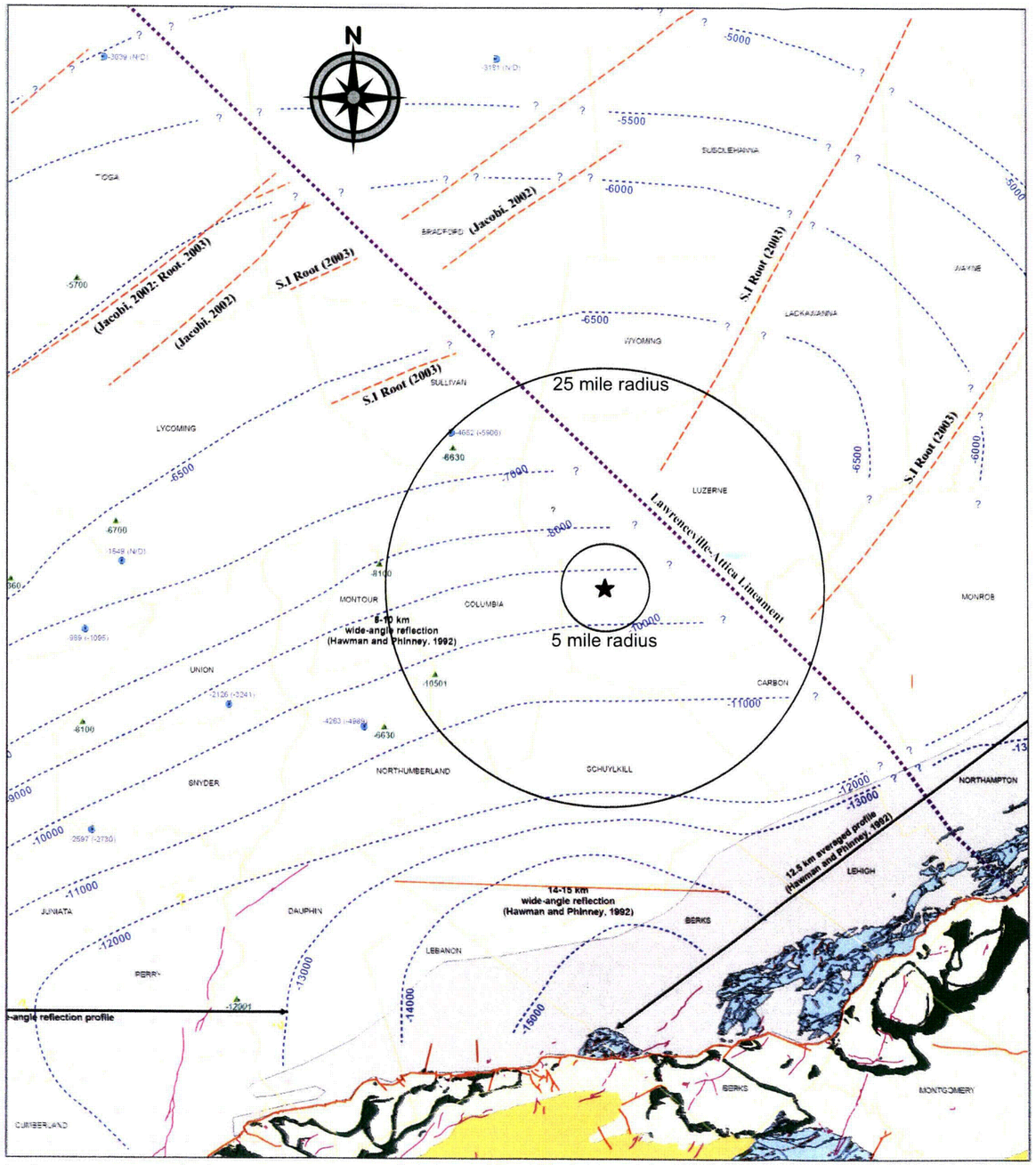



Reference: Ryder, 1995

Reference:` Mitra, 1988

Reference: Ryder, 1995

# Figure 2.5-14 Precambrian Basement Map of Appalachian Basin 25 mile (40 km) and 5 mile (8 km) Radii




Reference:
Modified from Gold, 2005

Note: Contours are in meters

Appalachian Basin (structure contours of Precambrian surface, 500 m interval)

- Paleozoic sedimentary rocks (undifferentiated)

Piedmont Physiographic Province (no contours shown)

- Tertiary and Cretaceous cover rocks
- Mesozoic cover rocks, with diabase sheets (dark green)
- Cambro-Ordovician sedimentary rocks; highly deformed, with nappes
- Lower Paleozoic metasediments
- Lower Paleozoic crystalline and metamorphic rocks
- Precambrian metavolcanic rocks (Catoctin), exposed/potential area coverage
- Precambrian crystalline and metamorphic rocks

## SYMBOLS LEGEND

**Pennsylvania database**

- Fault (tab indicates dip direction)
- Fault, inferred
- Fault, mapped
- Seismic fault (barb indicates inferred dip direction)
- Lineament
- -6000 Basement contours; depth in meters bellow sea level
- Structural trough, inferred
- S Structural arch, inferred
- -1811 (-2086) Deep drill hole in Paleozoic cover rocks; bottom elevation of hole in meters below sea level (estimated depth to basement)
- N/D or N/A Elevation not determined or not available
- -5150 Seismic depth in meters
- -7550 Seismic depth in meters
- Oriskany absent
- Jurassic diabase dike
- Jurassic Kimberlite dike
- Lower Paleozoic granitic pegmatite dike
- PreCambrian metadiabase dike

**West Virginia database**

- Normal fault; tab on downthrown side
- Thrust fault; barbs on upthrown side
- (-22000) - -6706 Basement contours; depth in feet and meters below sea level

**Ohio database**

- -1632 Drill hole, depth in meters below sea level
- Fault, inferred
- (-5600) - -1881 Basement contours; depth in feet and meters

**New York database**

- Fault

0 5 10 20 30 40 50 km

0 5 10 20 30 mi

# Figure 2.5-15 Regional Tectonic Features

**LEGEND**

- ★ Center Point of Proposed Bell Bend NPP (BBNPP)
- City
- NPP Reactor 200-mile (322 km) Radius
- Basin
- State Boundary

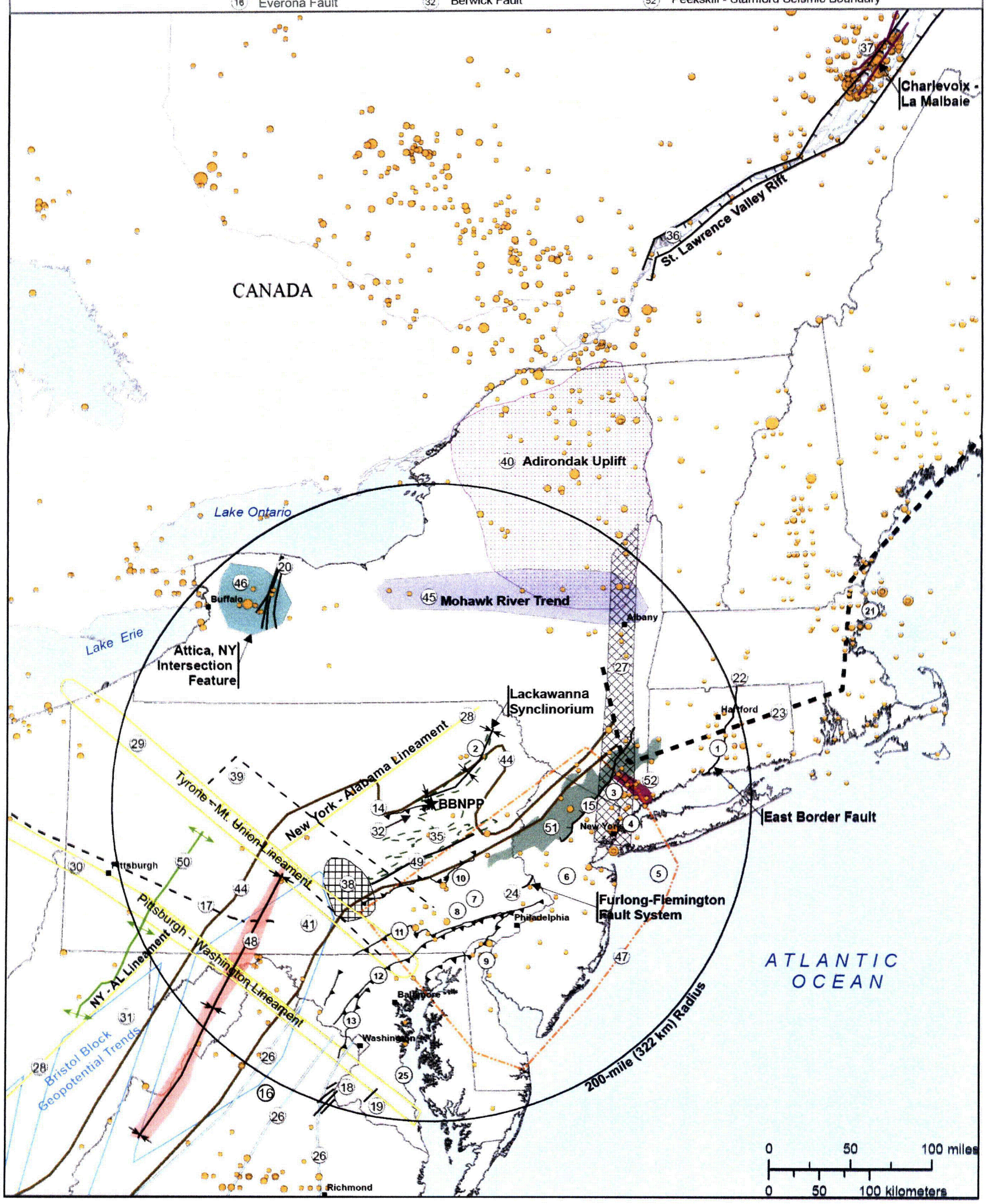
Earthquakes by Magnitude, $m_b$ (USGS, 2007)

- 3.0 - 3.9
- 4.0 - 4.9
- 5.0 - 5.9
- 6.0 - 6.9
- 7.0 - 7.9

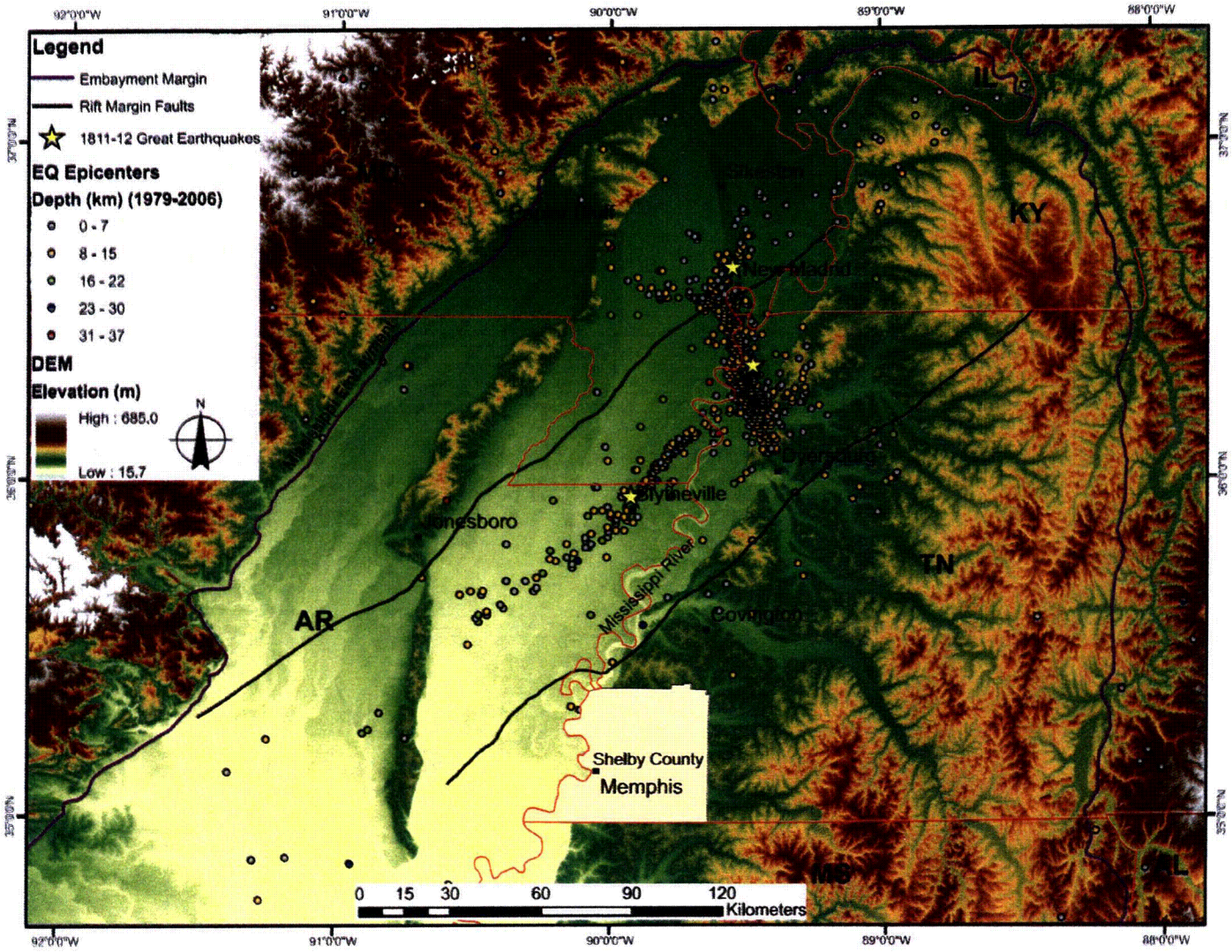
Tectonic Features

1. Moodus Seismic Zone
2. Lackawanna Synclinorium
3. Dobbs Ferry Fault Zone
4. Mosholu Fault
5. New York Bight Fault
6. Kingston Fault
7. Cacoosing Valley Earthquake
8. Lancaster Seismic Zone
9. New Castle County Faults
10. Yellow Breeches Fault
11. Martic Fault
12. Pleasant Valley - Huntingdon Valley Fault
13. Plummers Island Fault
14. Light Street Fault
15. Ramapo Fault
16. Everona Fault
17. Transylvania Fault System
18. Stafford Fault System
19. Brandywine Fault
20. Clarendon-Linden Fault Zone
21. Clinton-Newbury Liquefaction
22. East Border Fault
23. Offset Glaciated Surfaces
24. Furlong-Flemington Fault System
25. Upper Marlboro Faults
26. Fall Lines
27. Hudson River Valley Trend
28. New York-Alabama Lineament
29. Tyrone-Mt. Union Lineament
30. Pittsburgh-Washington Lineament
31. Bristol Block Geopotential Trends
32. Berwick Fault
35. Anthracite Region
36. St. Lawrence Valley Rift
37. Charlevoix - La Malbaie
38. Lebanon - Pennsylvania Geopotential Trend
39. Pennsylvania Aulacogen
40. Adirondack Uplift
41. Latitude 40° N Fault Zone
44. Valley and Ridge Fold and Thrust Zone
45. Mohawk River Trend
46. Attica, NY Intersection Feature
47. New Jersey Isostatic Gravity Saddle
48. Broadtop Synclinorium
49. Sweet Arrow Fault
50. Chestnut Ridge Anticlinorium
51. Reading Prong
52. Peekskill - Stamford Seismic Boundary

REFERENCES:
- EPRI, 1986.
- ESRI, 2007.
- Harrison, 2004.
- Hibbard, 2006.
- Jacobsen, 1974.
- King, 1978.
- National Atlas, 2008.
- Rogers, 1984.
- Senior, 2006.
- Shumaker, 2002.
- Sykes, 2008.
- Weems, 1998.
- Wheeler, 2006.
- Wood, 1960.

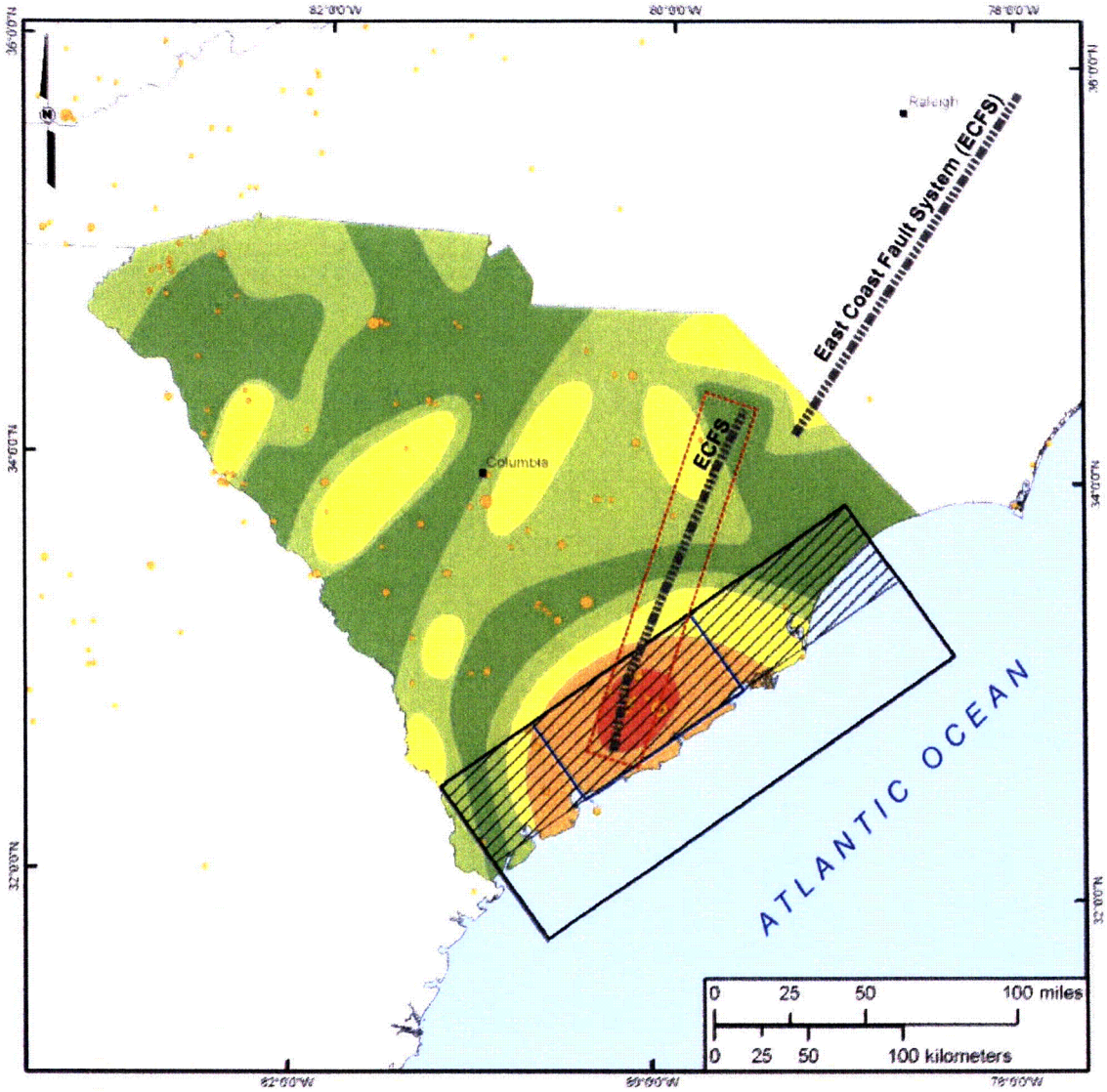


## Figure 2.5-15a New Madrid Seismic Zone with Microearthquake Activity (1979-2006)




Reference: Csontos, 2008

## Figure 2.5-15b Updated Charleston Seismic Zone (UCSS) Map




**LEGEND**

- City
- State/Province Boundary
- Postulated East Coast Fault System (Marple 2000)

Earthquakes by Magnitude, mb (USGS 2001 Catalog)

- 3.0 - 3.9
- 4.0 - 4.9
- 5.0 - 5.9
- 6.0 - 6.9
- 7.0 - 7.9

Updated Charleston Seismic Zones (UCSS)

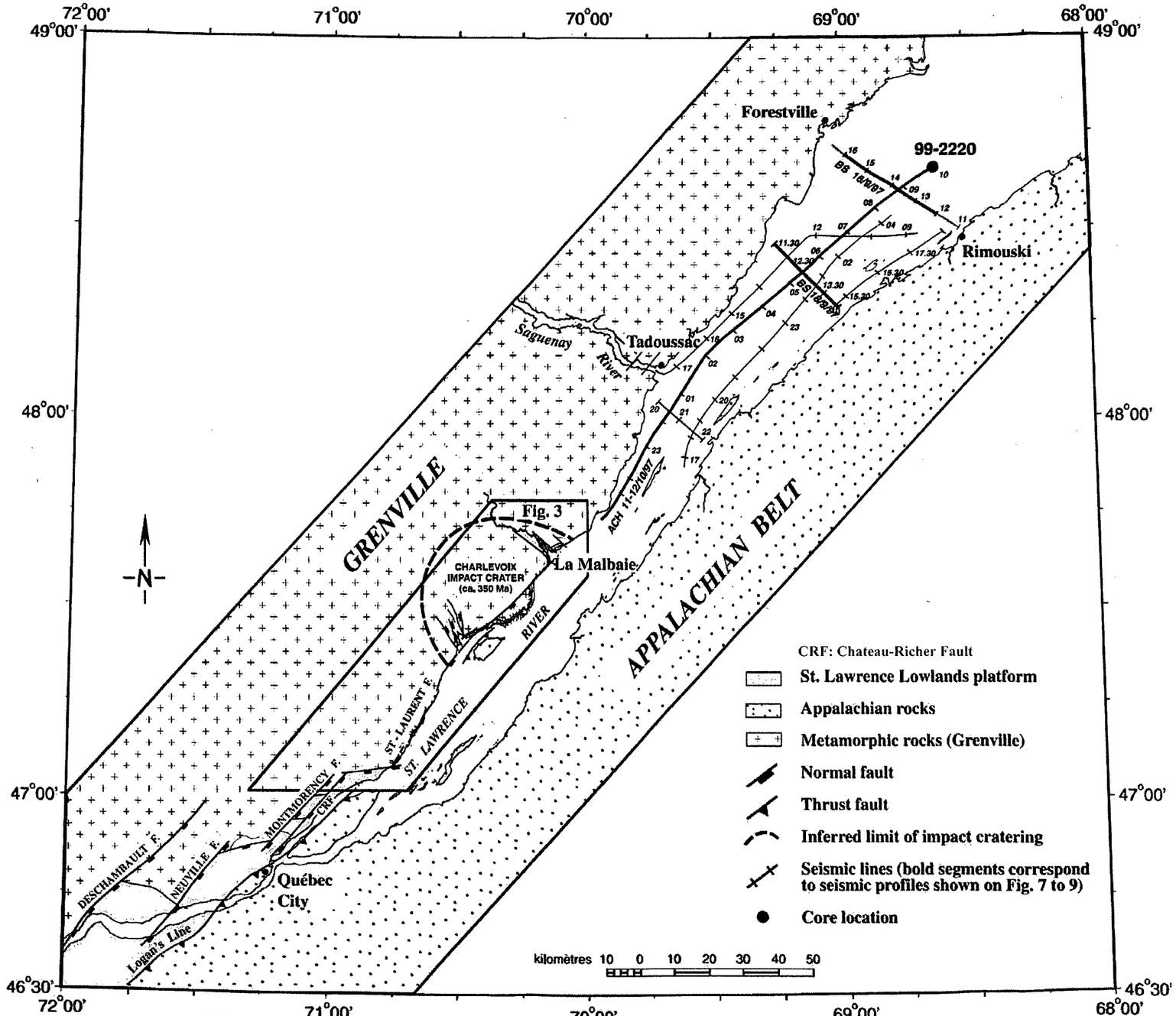
- A
- B
- B'
- C

1886 Charleston Isoseismals (Bollinger, 1977)

- VI
- VII
- VIII
- IX
- X

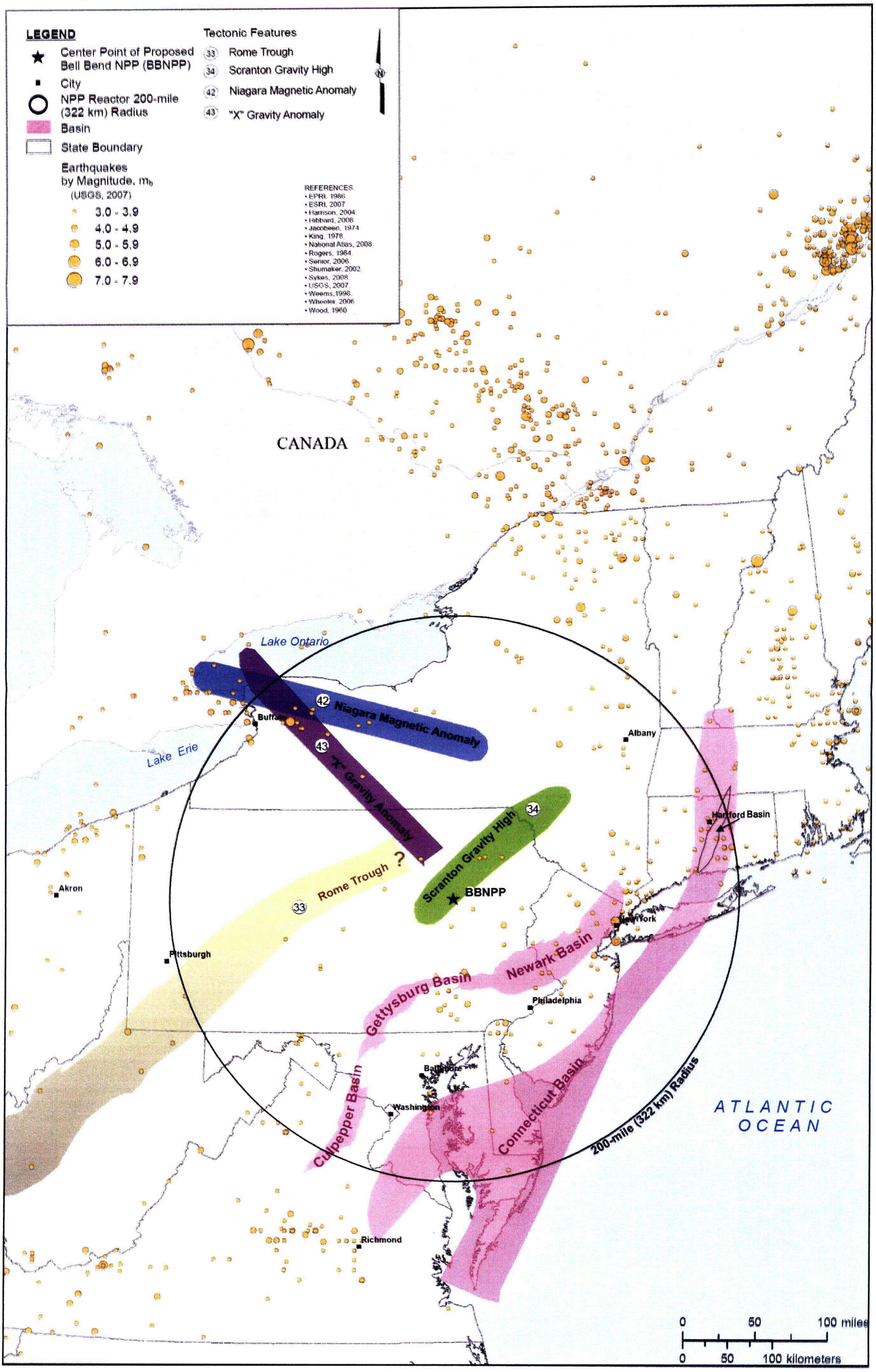
REFERENCES:
- ESRI, StreetMap Pro [CD-ROM]. City and State/Province Boundary

Figure 2.5-15c Geological Map of the St. Lawrence Rift System Between Quebec City and the St. Lawrence Estuary

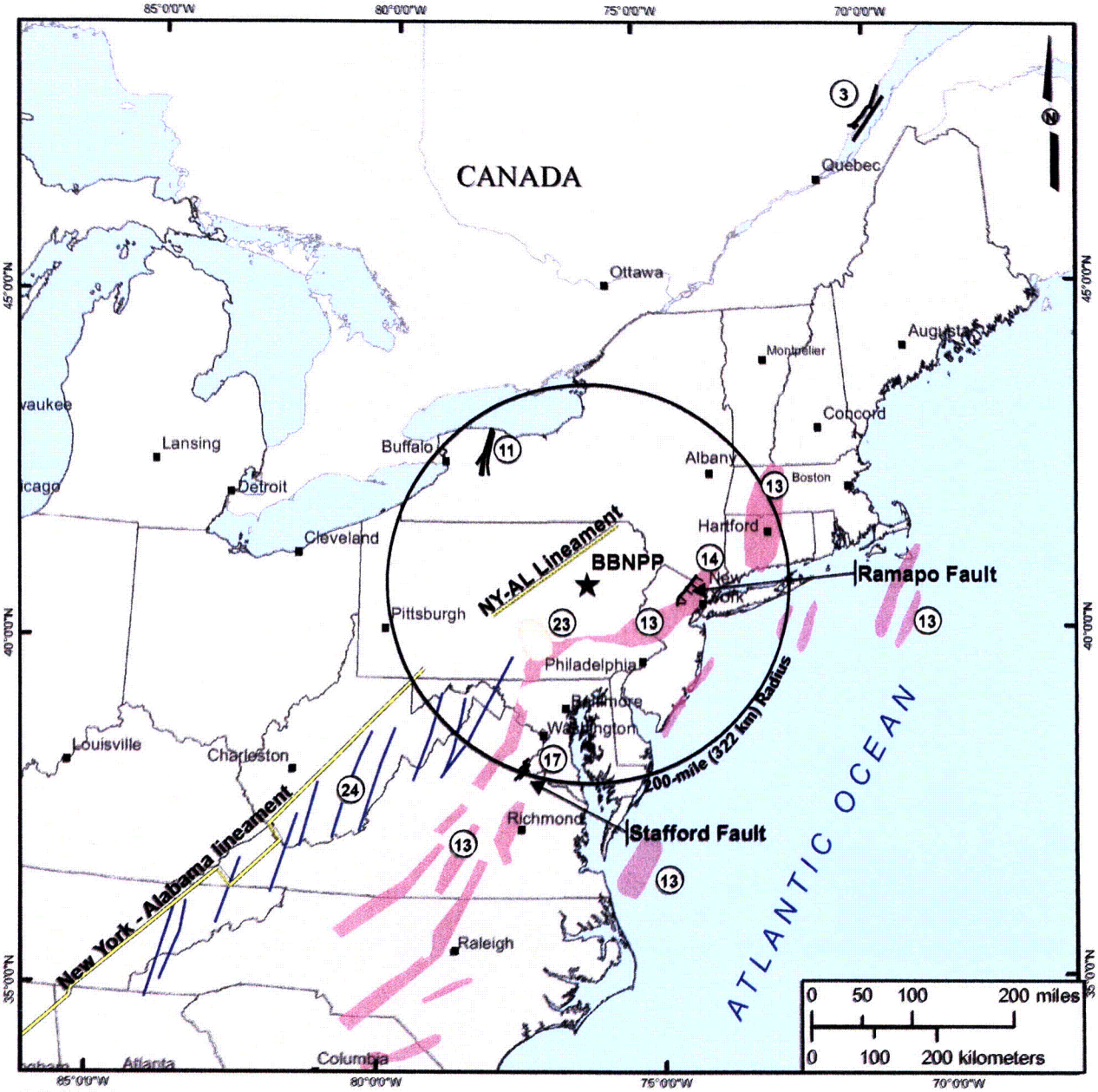



Reference: Tremblay, 2003

# Figure 2.5-15d Regional Tectonic Basins with Gravity and Magnetic Anomalies



## Figure 2.5-16 Tectonic Interpretations by Bechtel Group




**LEGEND**

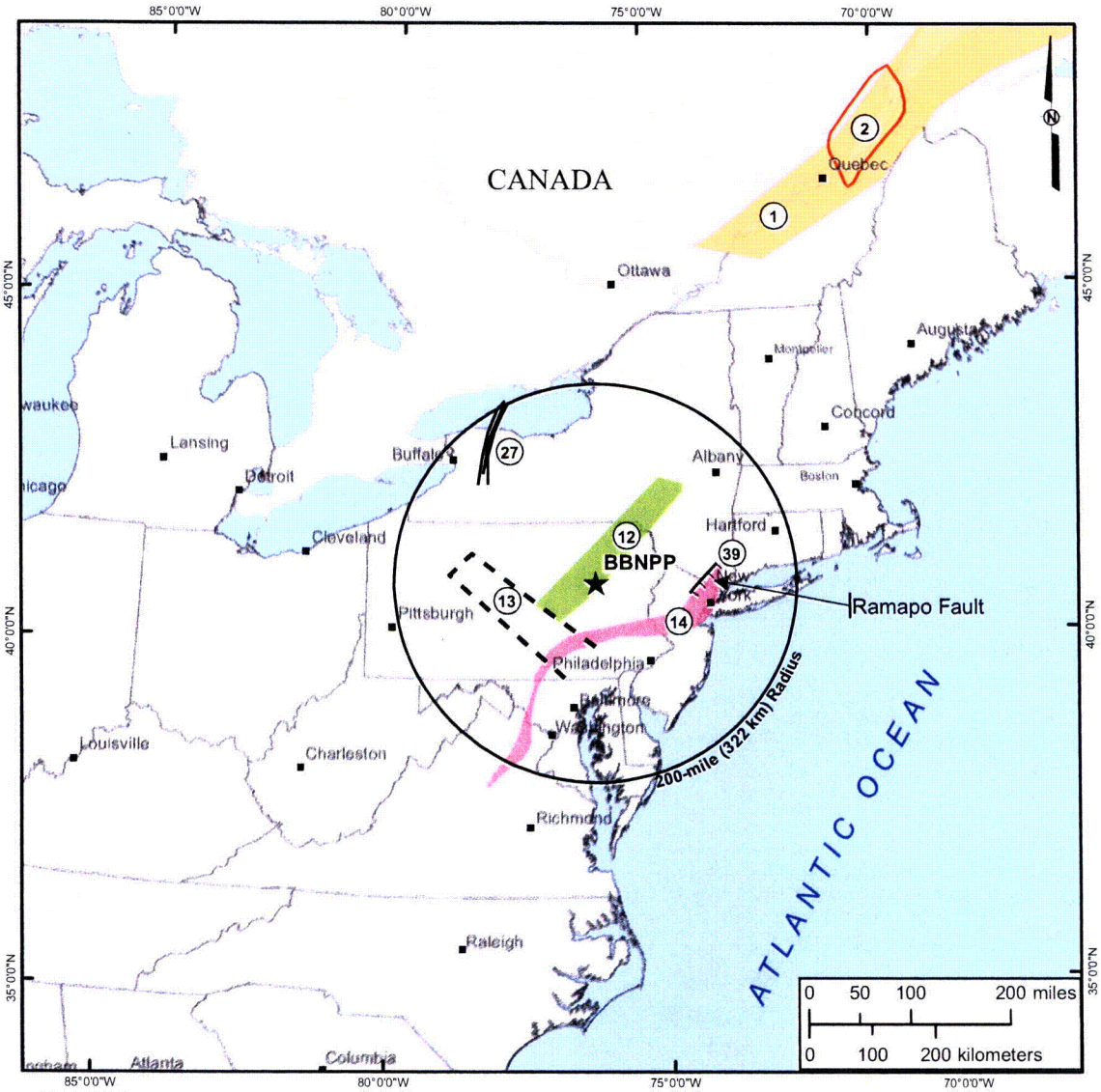
- ★ Center Point of Proposed Bell Bend NPP (BBNPP)
- ▪ City
- ○ NPP Reactor 200-mile (322 km) Radius
- ▭ State/Province Boundary

Bechtel Group Tectonic Interpretation

- (3) Charlevoix - La Malbaie
- (11) Clarendon - Linden Fault
- (13) Eastern Mesozoic Basins
- (14) Ramapo Fault
- (17) Stafford Fault
- (23) Lebanon - Pennsylvania Geopotential Trend
- (24) Bristol Block Geopotential Trends
- New York - Alabama Lineament

REFERENCES:
- ESRI, 2007.
- EPRI Volume IX: Bechtel Group, 1986.

## Figure 2.5-16a Tectonic Interpretations by Dames and Moore




**LEGEND**

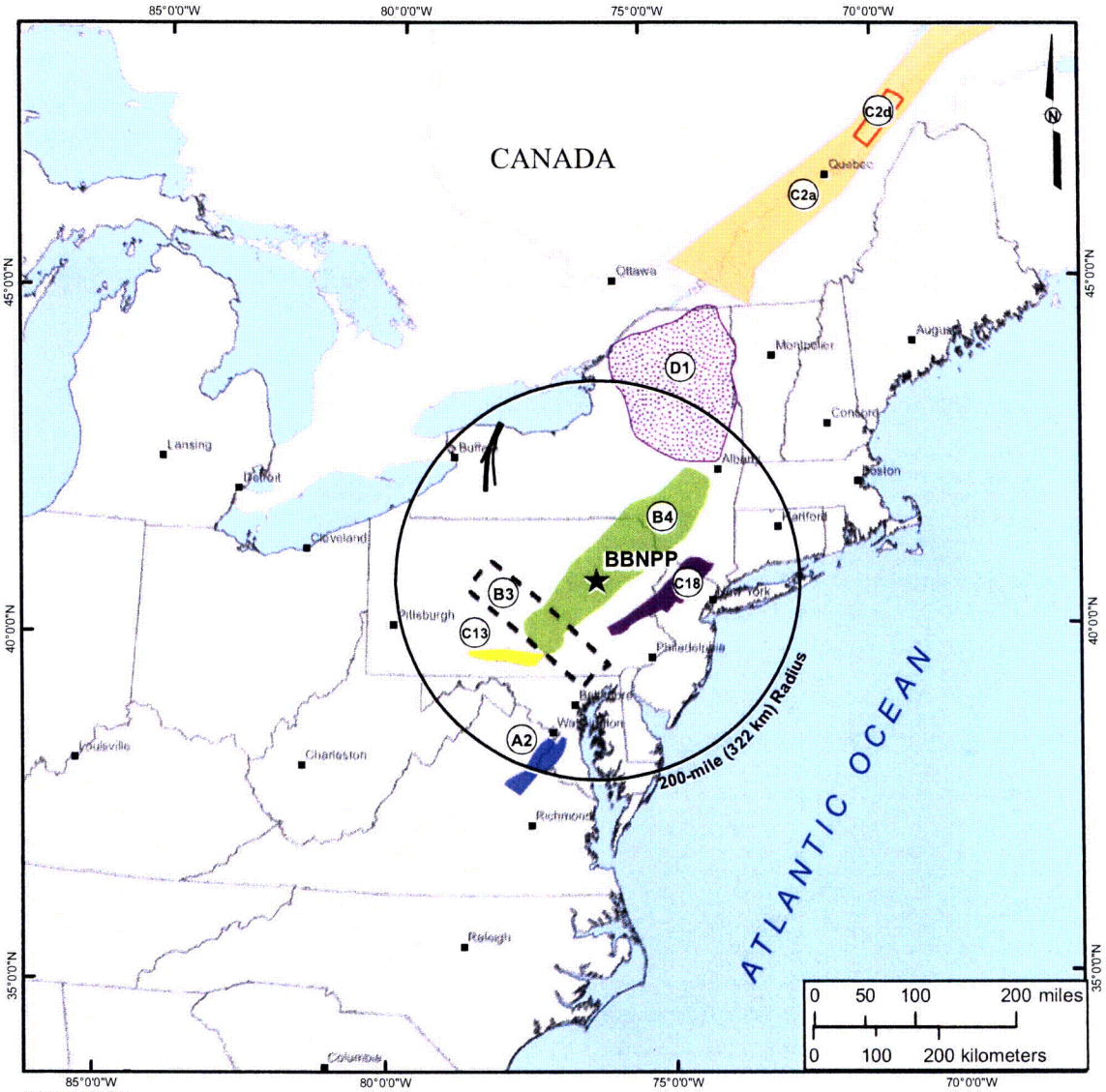
- ★ Center Point of Proposed Bell Bend NPP (BBNPP)
- ▪ City
- ○ NPP Reactor 200-mile (322 km) Radius
- ▭ State/Province Boundary

Dames and Moore Tectonic Interpretation

1. St. Lawrence Valley Rift
2. La Malbaie/Charlevoix Zone
12. Scranton Gravity Anomaly
13. Pennsylvania Aulacogen
14. Newark - Gettysburg Basin
27. Clarendon - Linden Fault Zone
39. Ramapo Fault

REFERENCES:
- ESRI, 2007.
- EPRI Volume VI: Dames and Moore, 1986.

## Figure 2.5-16b Tectonic Interpretations by Law Engineering




**LEGEND**

- ★ Center Point of Proposed Bell Bend NPP (BBNPP)
- ▪ City
- ○ NPP Reactor 200-mile (322 km) Radius
- ▭ State/Province Boundary

Law Engineering Tectonic Interpretation

Regional Features

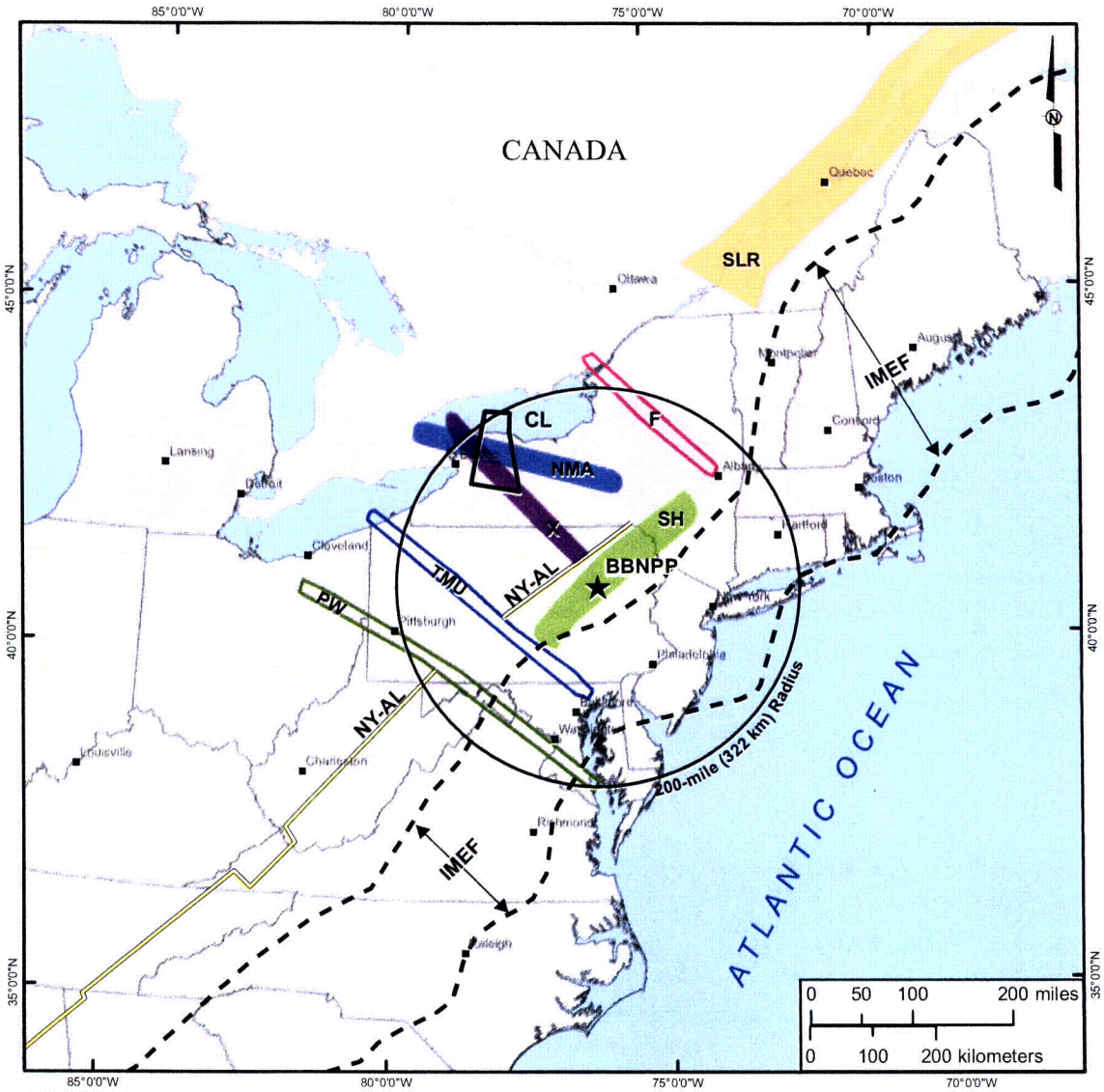
- (B3) Pennsylvania Aulacogen (EOCAMBRIAN RIFTS)
- (B4) Scranton Gravity High (EOCAMBRIAN RIFTS)
- (C2a) St Lawrence Valley Rift (ST. LAWRENCE RIFT SYSTEM)
- (C2d) Charlevoix - La Malbaie Area (ST. LAWRENCE RIFT SYSTEM)
- (D1) Adirondacks (MESOZOIC RIFTS)

Faults and Shear Zones

- (A2) Stafford - Brandywine Fault Zone
- (C14) Clarendon - Linden Structure
- (C13) Latitude 40° N Fault Zone
- (C18) Ramapo Fault

REFERENCES:
- ESRI, 2007.
- EPRI Volume VII: Law Engineering, 1986.

## Figure 2.5-16c Tectonic Interpretations by Rondout Associates




**LEGEND**

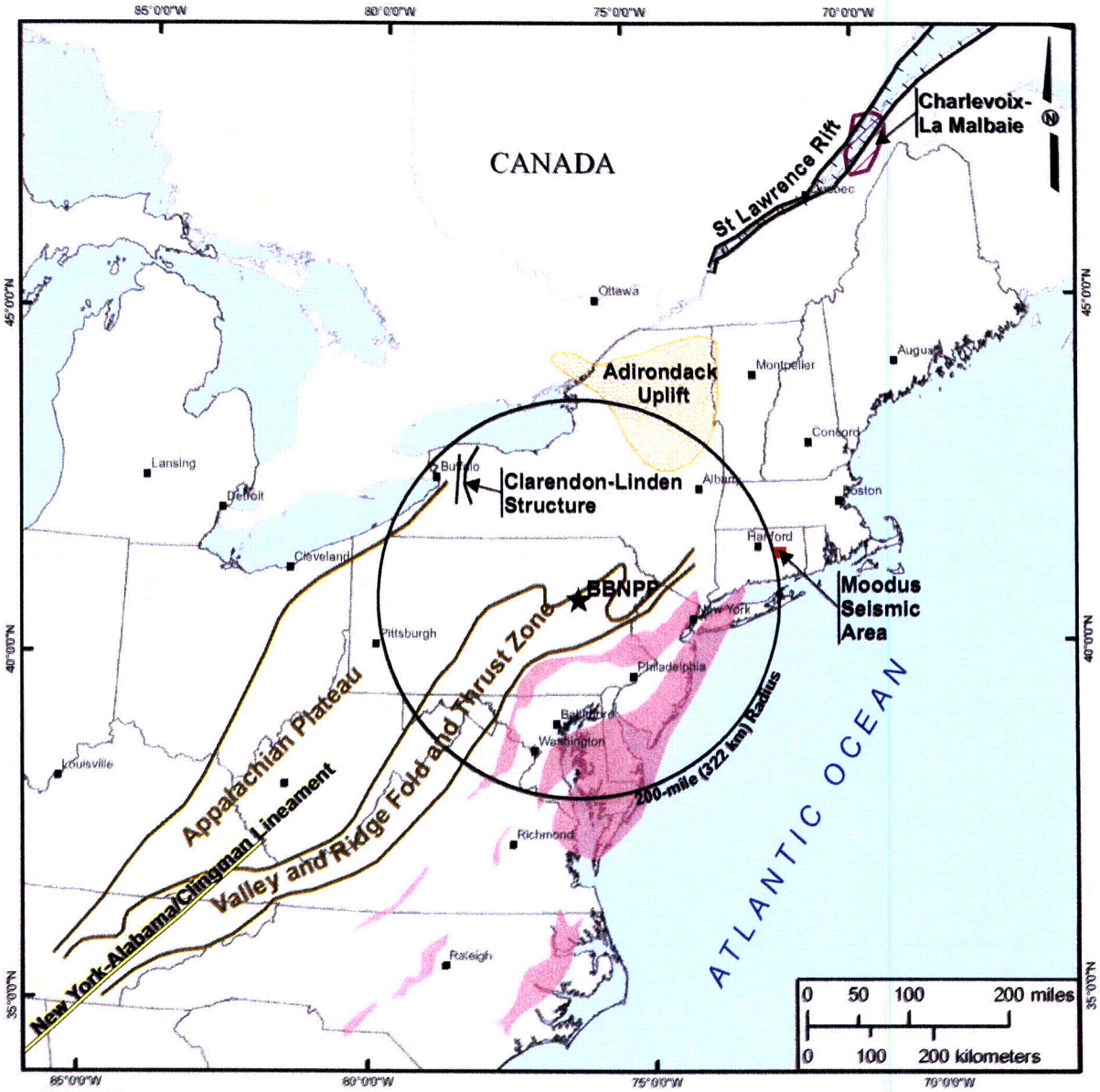
- ★ Center Point of Proposed Bell Bend NPP (BBNPP)
- ▪ City
- ○ NPP Reactor 200-mile (322 km) Radius
- ▭ State/Province Boundary

Rondout Associates Tectonic Interpretations

| | |
|---|---|
| CL | Clarendon-Linden |
| F | Gravity Lineament |
| IMEF | Inboard Mesozoic Extentional Fault Realm |
| NMA | Niagara Magnetic Anomaly |
| NY-AL | New York - Alabama Lineament |
| PW | Pittsburgh - Washington Lineament |
| SH | Scranton Gravity HIgh |
| SLR | St. Lawrence Rift |
| TMU | Tyrone - Mt. Union Lineament |
| X | Gravity Anomaly |

REFERENCES:
- ESRI, 2007.
- EPRI Volume X: Rondout Associates, 1986.

## Figure 2.5-16d Tectonic Interpretations by Weston Geophysical




**LEGEND**

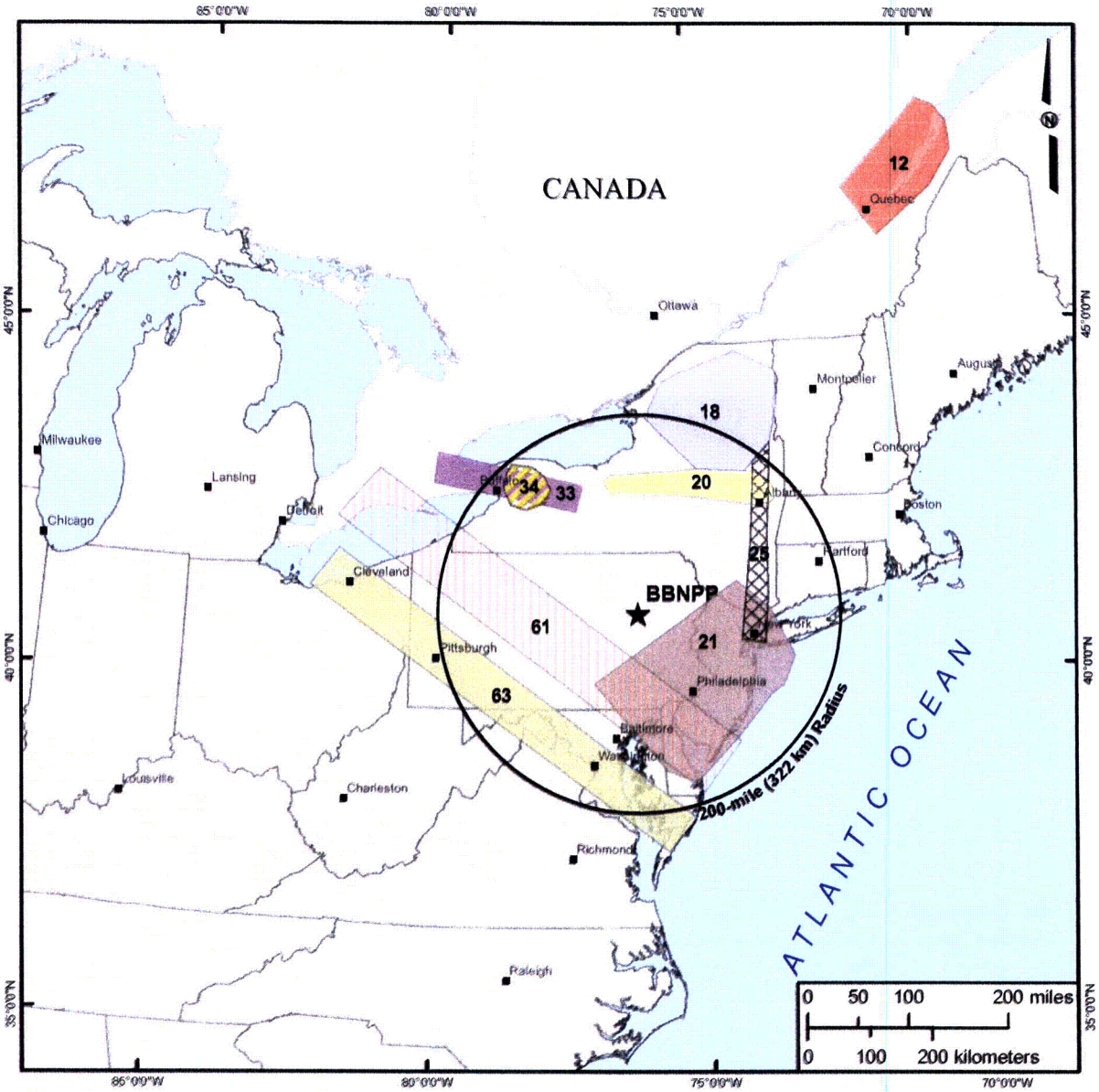
- ★ Center Point of Proposed Bell Bend NPP (BBNPP)
- ▪ City
- ○ NPP Reactor 200-mile (322 km) Radius

Weston Geophysical Tectonic Features

- Adirondack Uplift
- Charlevoix - La Malbaie
- Clarendon - Linden Structure
- N.Y. - Alabama/Clingman Lineaments
- St. Lawrence Rift
- Appalachian Plateau
- Valley and Ridge Fold and Thrust Zone
- Moodus Seismic Area
- Zone of Mesozoic Basins

REFERENCES:
- ESRI, 2007.
- EPRI Volume V: Weston Geophysical, 1986.

## Figure 2.5-16e Tectonic Interpretations by Woodward-Clyde Consultants




**LEGEND**

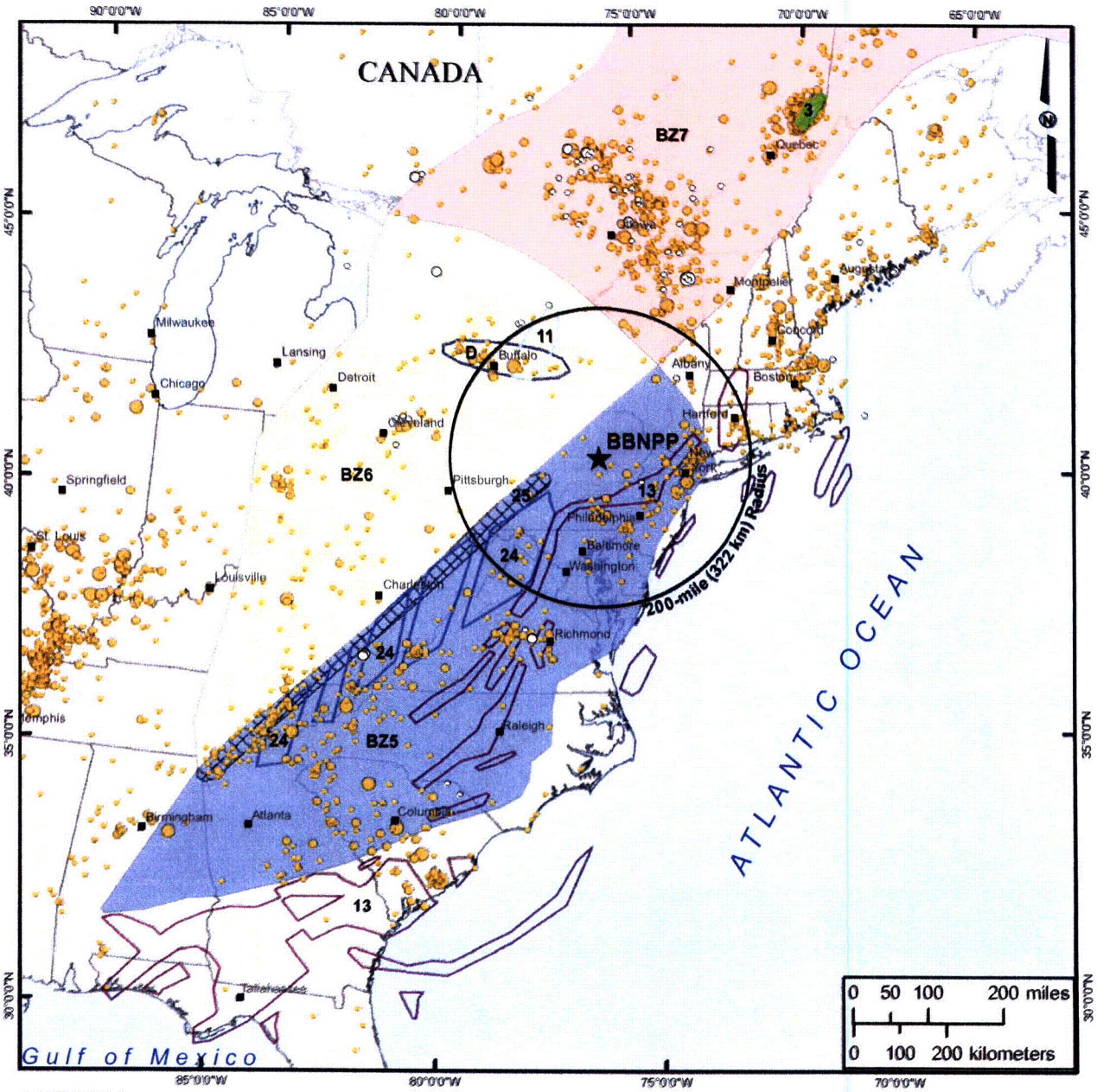
- ★ Center Point of Proposed Bell Bend NPP (BBNPP)
- ▪ City
- ○ NPP Reactor 200-mile (322 km) Radius

Woodward-Clyde Tectonic Interpretations

| | |
|---|---|
| 18 | Adirondack Uplift |
| 20 | Mohawk River Trend |
| 21 | NJ Isostatic Gravity Saddle |
| 25 | Hudson River Valley Trend |
| 33 | Western NY - Southern Ontario Trend |
| 34 | Attica, NY Intersection Feature |
| 63 | Pittsburgh-Washington Lineament |
| 12 | Charlevoix - La Malbaie Structure |
| 61 | Tyrone - Mt. Union Lineament |

REFERENCES:
- ESRI, 2007.
- EPRI Volume VIII: Woodward-Clyde Consultants, 1986.

## Figure 2.5-16f Bechtel Group EPRI Source Zones




**LEGEND**

- ★ Center Point of Proposed Bell Bend NPP (BBNPP)
- ▪ City
- ○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

| USGS 2001 | USGS 2002 to 2007 |
|---|---|
| 3.0 - 3.9 | 3.0 - 3.9 |
| 4.0 - 4.9 | 4.0 - 4.9 |
| 5.0 - 5.9 | 5.0 - 5.9 |
| 6.0 - 6.9 | |
| 7.0 - 7.9 | |

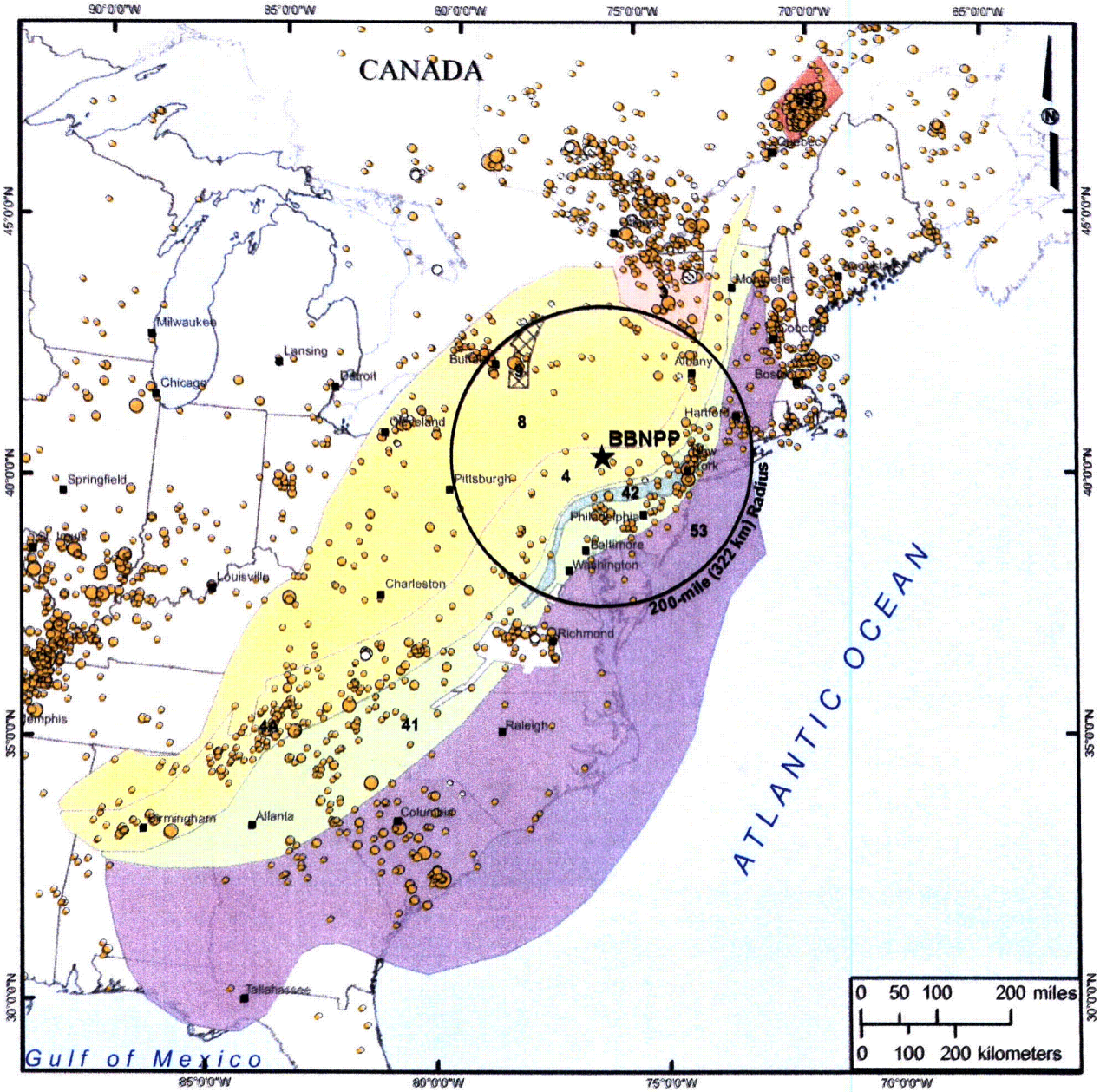
NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

Bechtel Group Sources contributing to 99% of BBNPP Site Hazard

- 3 La Malbaie
- 11 Clarendon-Linden
- 13 Mesozoic Basins
- 24 Bristol Block
- 25 NY-AL Lineament
- BZ5 Southern Appalachians Background
- BZ6 Southern Eastern Craton Background
- BZ7 Northern Eastern Craton Background
- D Niagara Area

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume IX: Bechtel Group, 1986.

## Figure 2.5-16g Dames & Moore EPRI Source Zones




**LEGEND**

★ Center Point of Proposed Bell Bend NPP (BBNPP)

▪ City

○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

| USGS 2001 | USGS 2002 to 2007 |
|---|---|
| 3.0 - 3.9 | 3.0 - 3.9 |
| 4.0 - 4.9 | 4.0 - 4.9 |
| 5.0 - 5.9 | 5.0 - 5.9 |
| 6.0 - 6.9 | |
| 7.0 - 7.9 | |

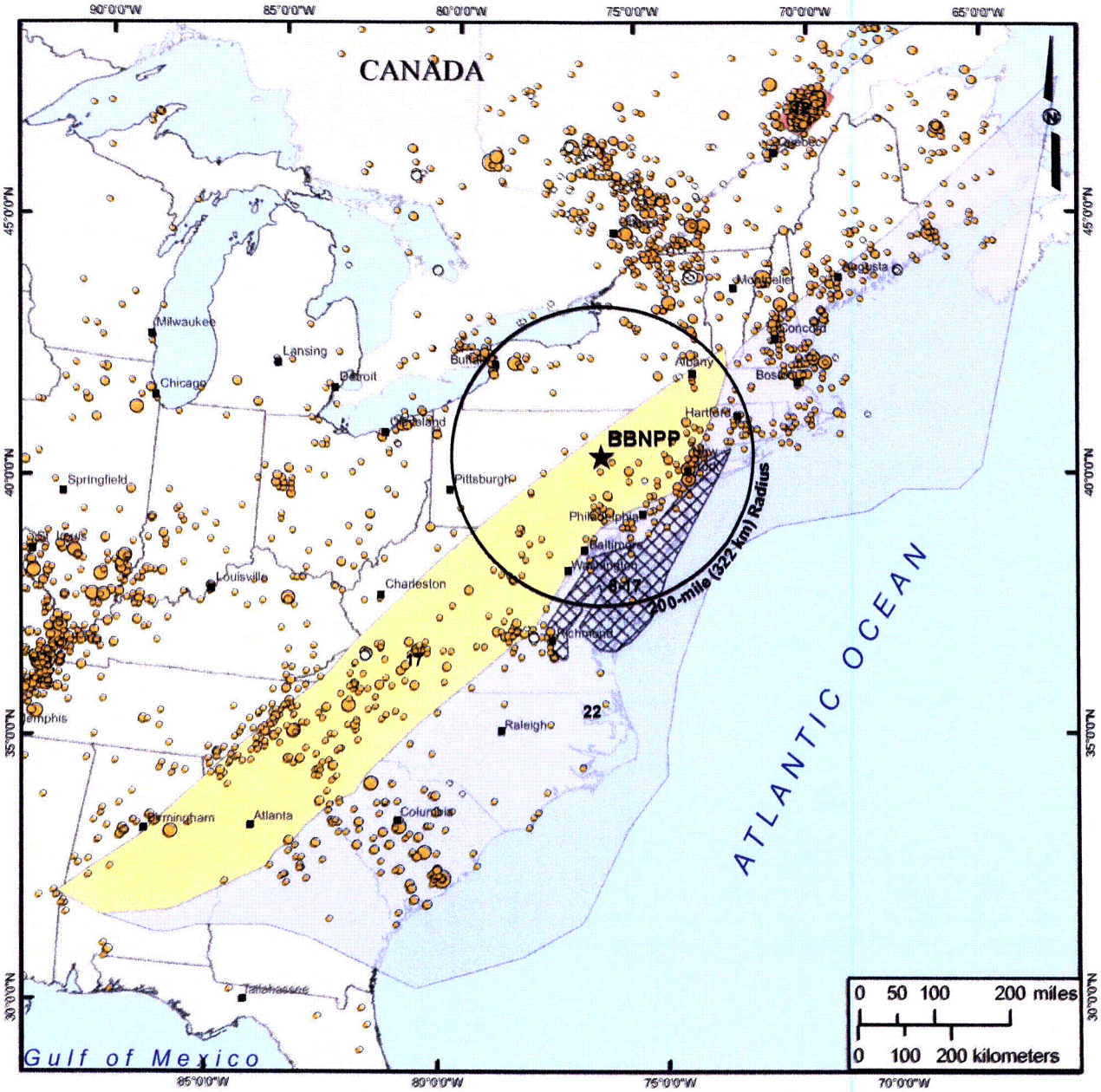
NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

Dames and Moore Sources contributing to 99% of BBNPP Site Hazard

- 3 Adirondacks Zone
- 4 Paleozoic Fold Belts
- 8 Eastern Marginal Basin
- Clarendon-Linden Zone
- 41 Southern Cratonic Margin (default)
- 42 Newark-Gettysburg Basin
- 53 Southern Appalachian Mobile Belt (default)
- 59 La Malbaie/Charlevoix Zone

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume VI: Dames and Moore, 1986.

## Figure 2.5-16h Law Engineering EPRI Source Zones




**LEGEND**

- ★ Center Point of Proposed Bell Bend NPP (BBNPP)
- ▪ City
- ○ NPP Reactor 200-mile (322 km) Radius

Law Engineering Sources contributing to 99% of BBNPP Site Hazard

- 2-12 Buried East Coast Mesozoic Basins
- 17 Eastern Basements
- 22 Reactivated Eastern Seaboard Normal Faults
- 12 Charlevoix Seismic Zone

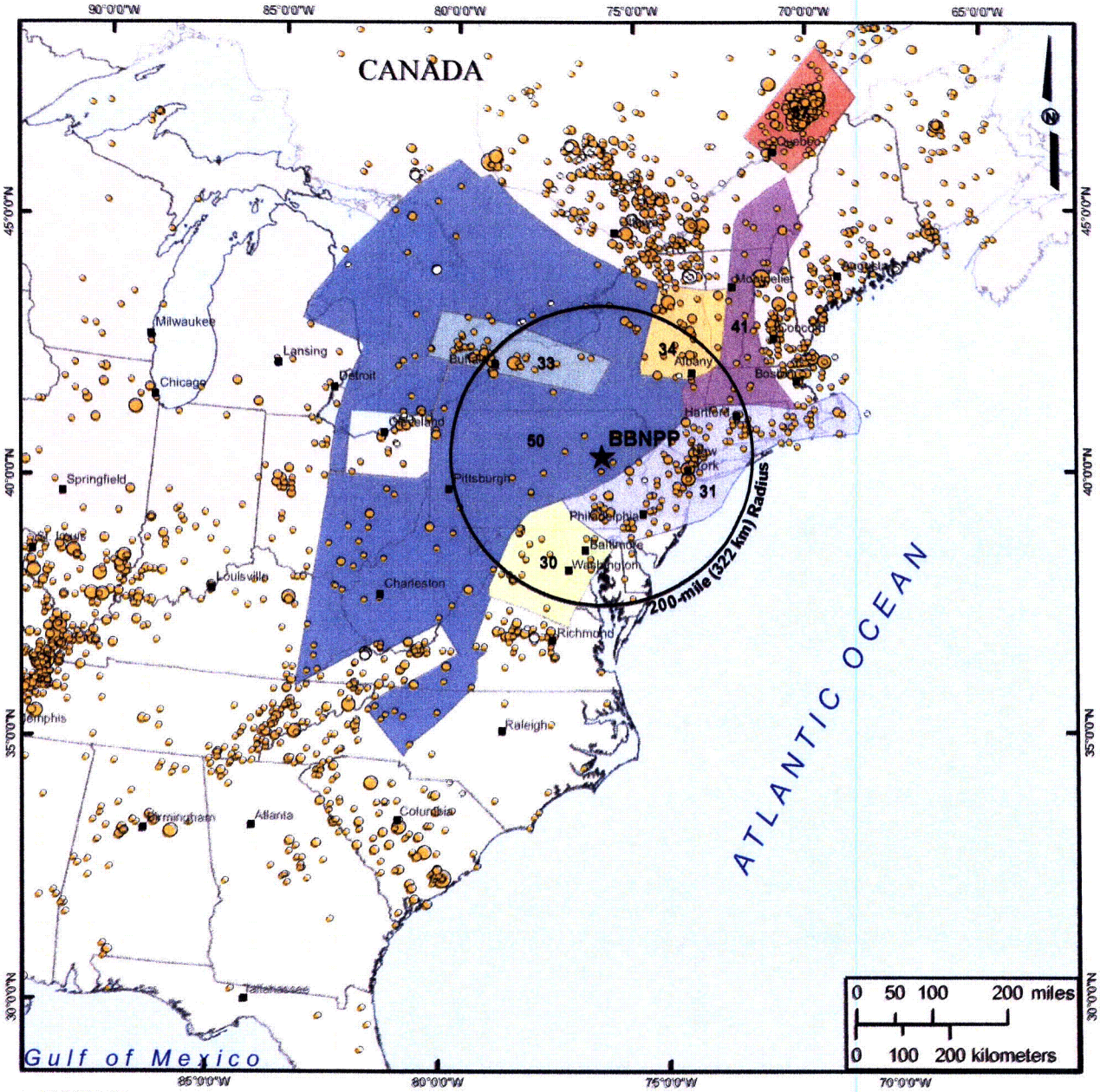
REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume VII: Law Engineering, 1986.

Earthquakes by Magnitude, mb (SEE NOTE)

| USGS 2001 | USGS 2002 to 2007 |
|---|---|
| 3.0 - 3.9 | 3.0 - 3.9 |
| 4.0 - 4.9 | 4.0 - 4.9 |
| 5.0 - 5.9 | 5.0 - 5.9 |
| 6.0 - 6.9 | |
| 7.0 - 7.9 | |

NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

**Figure 2.5-16i Rondout Associates EPRI Source Zones**




## LEGEND

★ Center Point of Proposed Bell Bend NPP (BBNPP)

▪ City

○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

| USGS 2001 | USGS 2002 to 2007 |
|---|---|
| 3.0 - 3.9 | 3.0 - 3.9 |
| 4.0 - 4.9 | 4.0 - 4.9 |
| 5.0 - 5.9 | 5.0 - 5.9 |
| 6.0 - 6.9 | |
| 7.0 - 7.9 | |

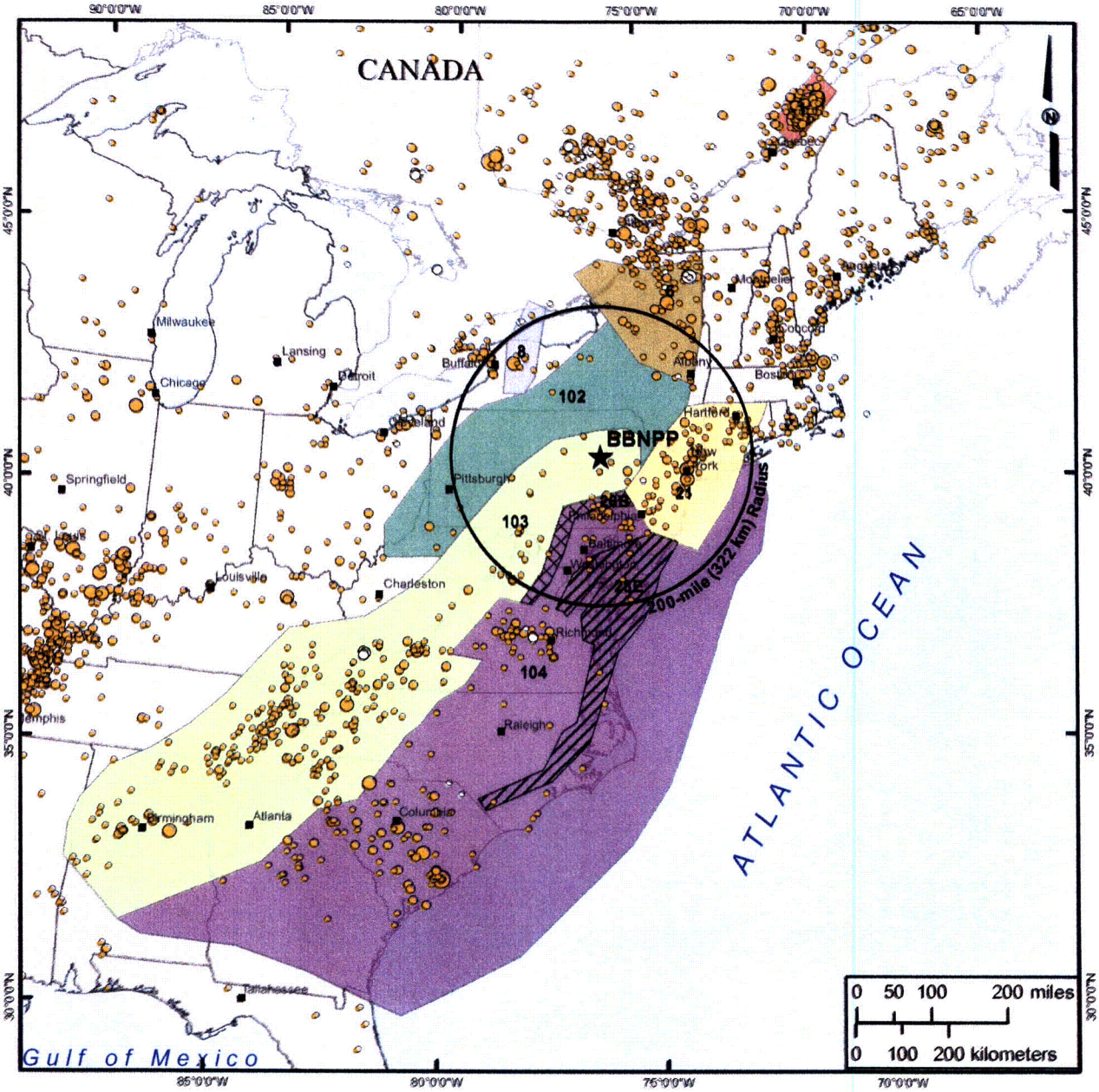
NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

Rondout Associates Sources contributing to 99% of BBNPP Site Hazard

- 30 Shenandoah
- 31 Quakers
- 33 Niagara
- 34 Nessmuk
- 37 La Malbaie (Charlevoix) Seismic Zone
- 41 Vermont
- 50 Grenville (Background)

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume X: Rondout Associates, 1986.

## Figure 2.5-16j Weston Geophysical EPRI Source Zones




**LEGEND**

- ★ Center Point of Proposed Bell Bend NPP (BBNPP)
- ▪ City
- ○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

| USGS 2001 | USGS 2002 to 2007 |
|---|---|
| 3.0 - 3.9 | 3.0 - 3.9 |
| 4.0 - 4.9 | 4.0 - 4.9 |
| 5.0 - 5.9 | 5.0 - 5.9 |
| 6.0 - 6.9 | |
| 7.0 - 7.9 | |

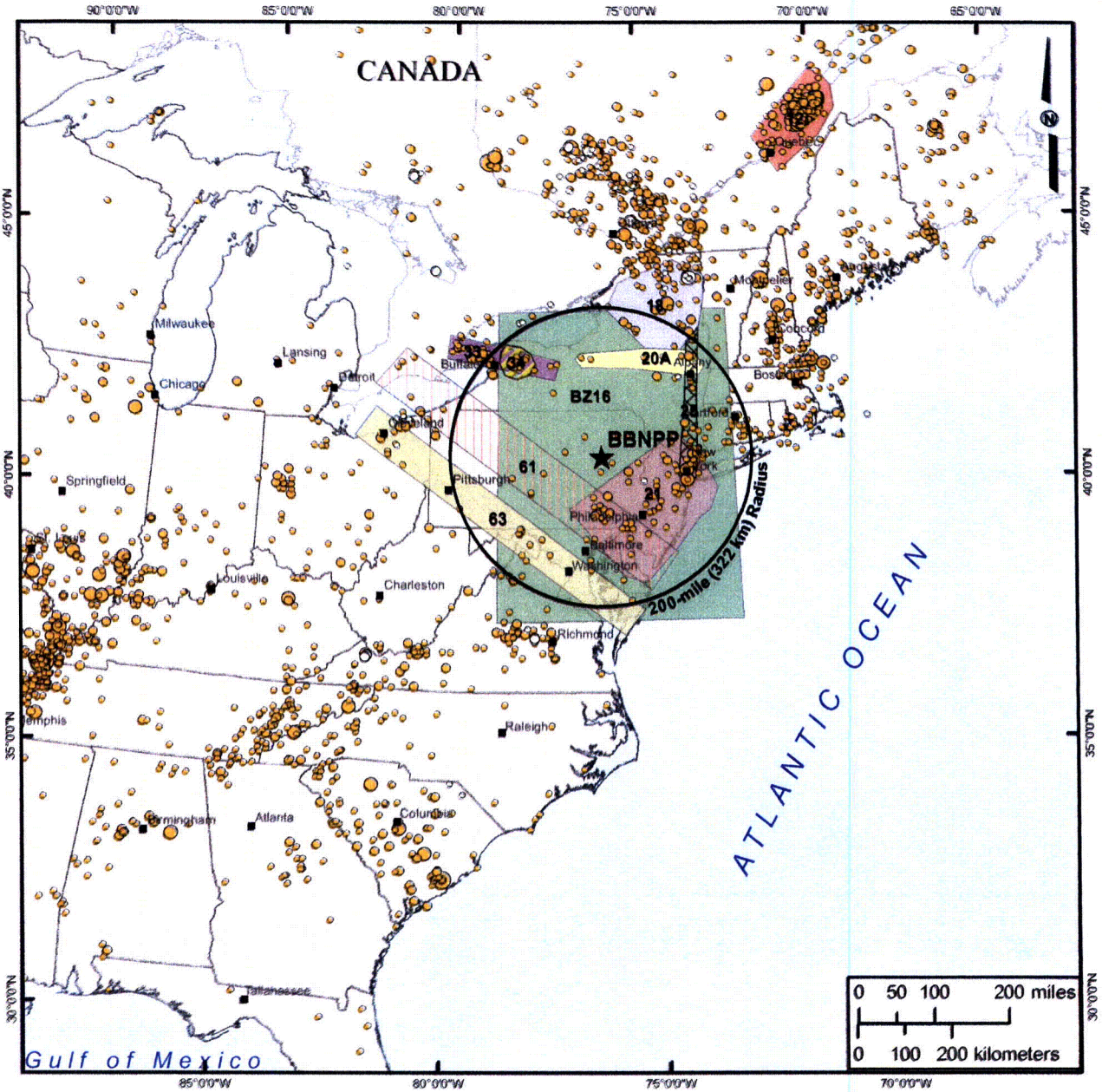
NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

Weston Geophysical Sources contributing to 99% of BBNPP Site Hazard

- 1 Charlevoix - La Malbaie Seismic Zone
- 6 Adirondack Mountains
- 8 Clarendon-Linden
- 21 New York Nexus
- 265 Zone of Mesozoic Basin
- 262 Zone of Mesozoic Basin
- 102 Appalachian Plateau Background
- 103 Southern Appalachian Background
- 104 Southern Coastal Plain Background

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume V: Weston Geophysical, 1986.

## Figure 2.5-16k Woodward-Clyde Consultants EPRI Source Zones




**LEGEND**

- ★ Center Point of Proposed Bell Bend NPP (BBNPP)
- ■ City
- ○ NPP Reactor 200-mile (322 km) Radius

Earthquakes by Magnitude, mb (SEE NOTE)

| USGS 2001 | USGS 2002 to 2007 |
|---|---|
| 3.0 - 3.9 | 3.0 - 3.9 |
| 4.0 - 4.9 | 4.0 - 4.9 |
| 5.0 - 5.9 | 5.0 - 5.9 |
| 6.0 - 6.9 | |
| 7.0 - 7.9 | |

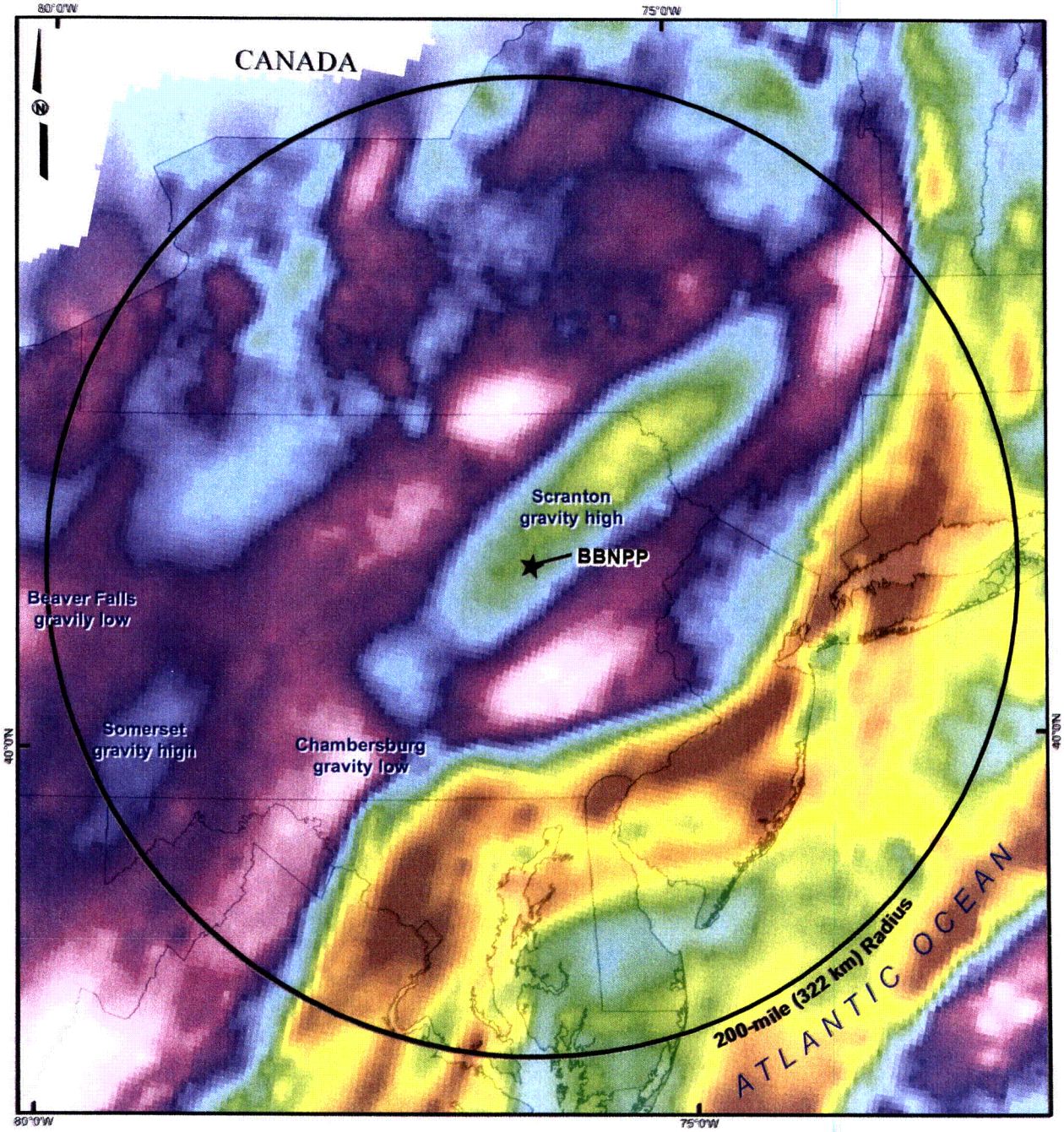
NOTE: The 2002 to 2007 seismicity shown in 500-mile (805 km) radius.

Woodward-Clyde Sources contributing to 99% of BBNPP Site Hazard

- 18 Adirondack Uplift
- 20A Mohawk River Trend
- 21 NJ Isostatic Gravity Saddle
- 26 Hudson River Valley Trend
- 33 W. NY-S Ontario Trend
- 34 Attica, NY Intersection
- 63 Pittsburgh - Washington Lineament
- BZ16 Susquehanna Background
- 12 Charlevoix Seismic Zone
- 61 Tyrone - Mt. Union Lineament

REFERENCES:
- ESRI, 2007.
- USGS 2007.
- ANSS, 2007.
- EPRI Volume VIII: Woodward-Clyde Consultants, 1986.

## Figure 2.5-17 Regional Bouguer Gravity Anomaly Map




**LEGEND**

★ Center Point of Proposed Bell Bend NPP (BBNPP)

○ NPP Reactor 200-mile (322 km) Radius

**Gravity Anomaly**

0 — 95 mgals

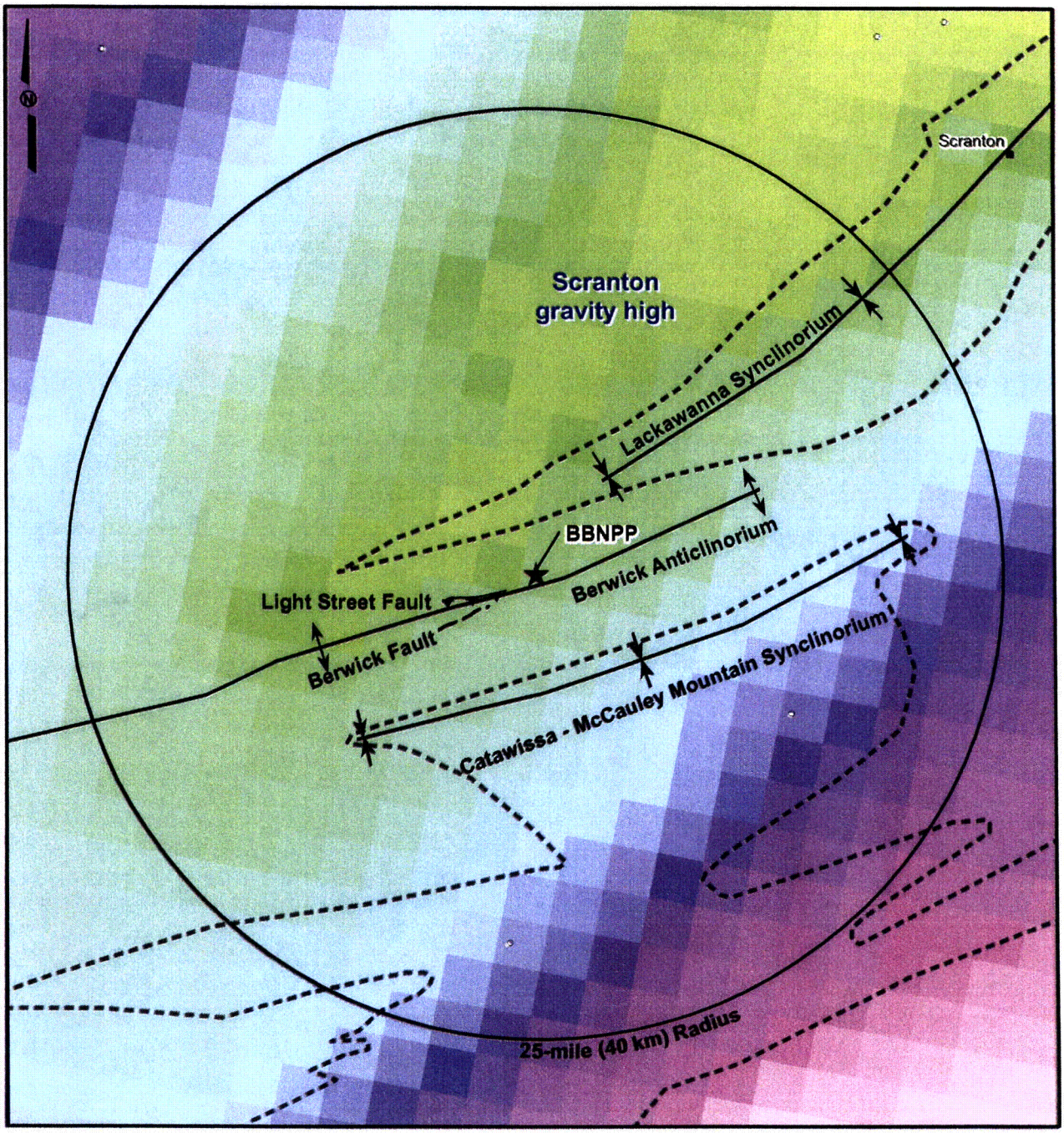
-340 mgals

0 25 50 100 miles

0 25 50 100 kilometers

REFERENCE:
- Kucks, 1999.

## Figure 2.5-17a Site Vicinity Bouguer Gravity Anomaly Map




**LEGEND**

★ Center Point of Proposed Bell Bend NPP (BBNPP)

O NPP Reactor 25-mile (40 km) Radius

— — Anthracite Region

Earthquakes by Magnitude, $m_b$

- 3.0 - 3.9
- 4.0 - 4.9
- 5.0 - 5.9

**Gravity Anomaly**

0 95 mgals

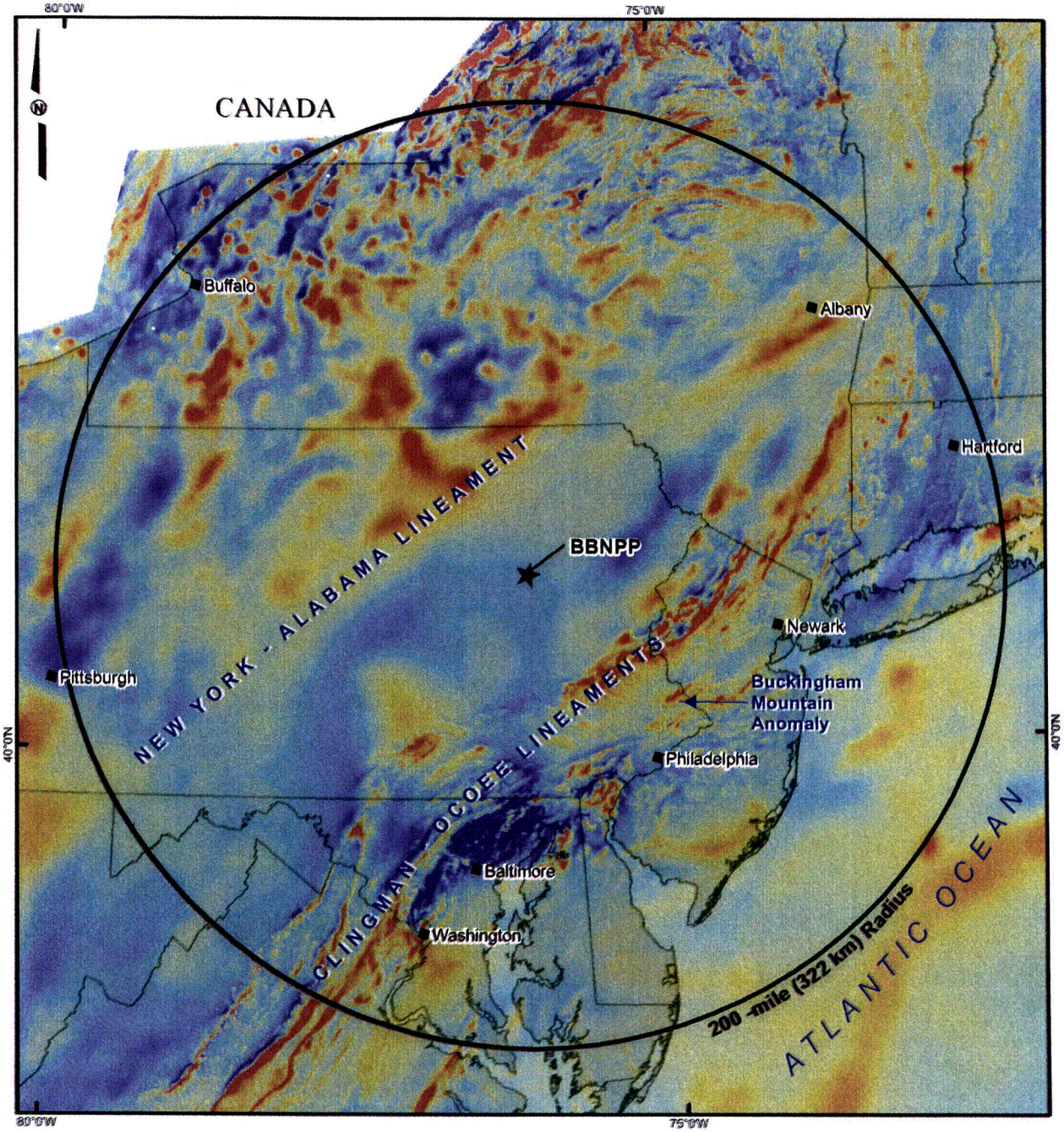
-340 mgals

0 2.5 5 10 miles

0 2.5 5 10 kilometers

REFERENCE:
- Kucks, 1999.
- Harrison, 2004.
- USGS, 2007.

## Figure 2.5-18 Regional Magnetic Anomaly Map




**LEGEND**

★ Center Point of Proposed Bell Bend NPP (BBNPP)

○ NPP Reactor 200-mile (322 km) Radius

**Aeromagnetics**

8215 nanoteslas

0

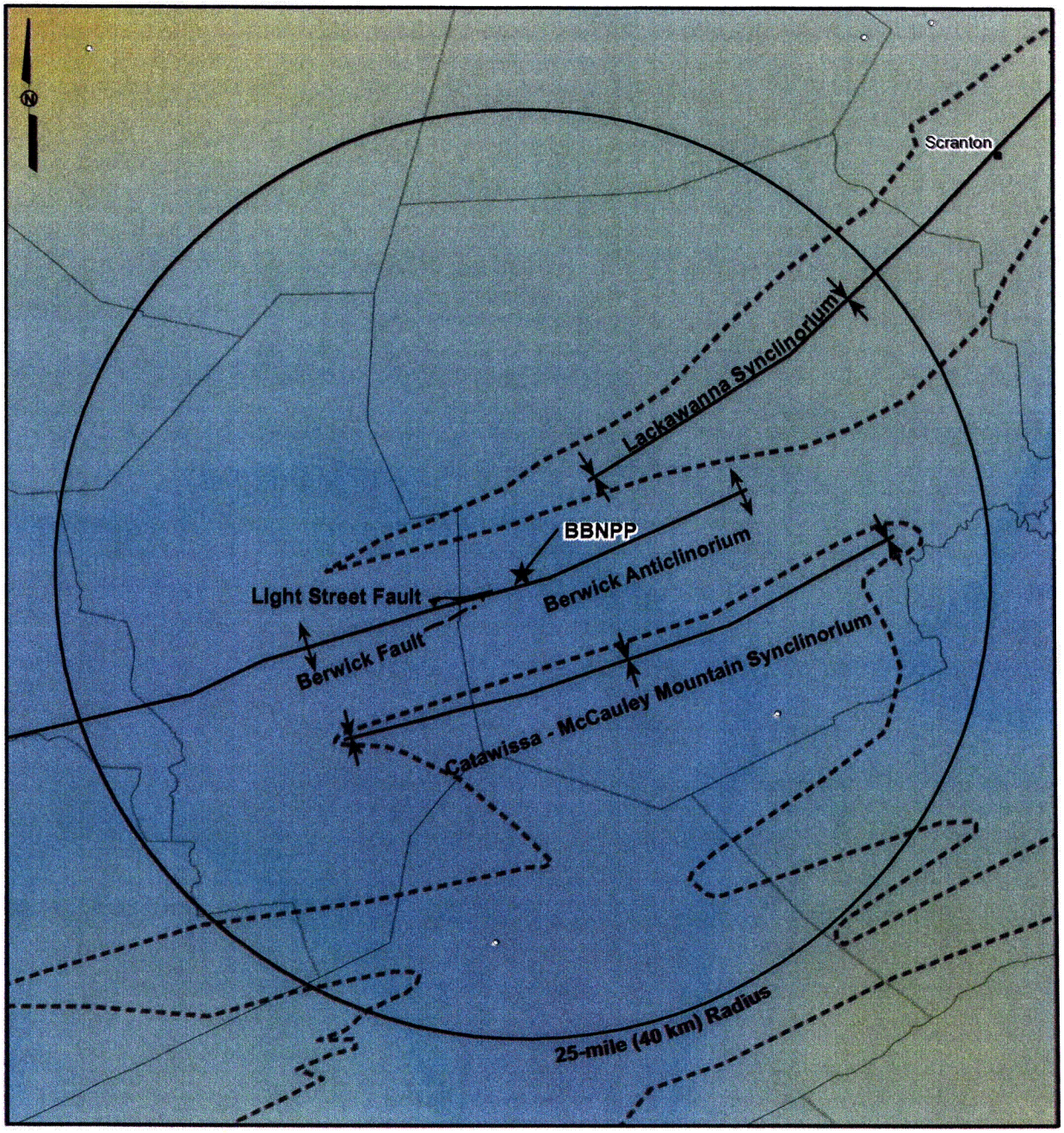
-1730 nanoteslas

0 25 50 100 miles

0 25 50 100 kilometers

REFERENCE:
- Bankey, 2002.

## Figure 2.5-18a Site Vicinity Magnetic Anomaly Map




**LEGEND**

- ★ Center Point of Proposed Bell Bend NPP (BBNPP)
- ○ NPP Reactor 25-mile (40 km) Radius
- — — Anthracite Region

Earthquakes by Magnitude, $m_b$

- 3.0 - 3.9
- 4.0 - 4.9
- 5.0 - 5.9

**Aeromagnetics**

8215 nanoteslas

0

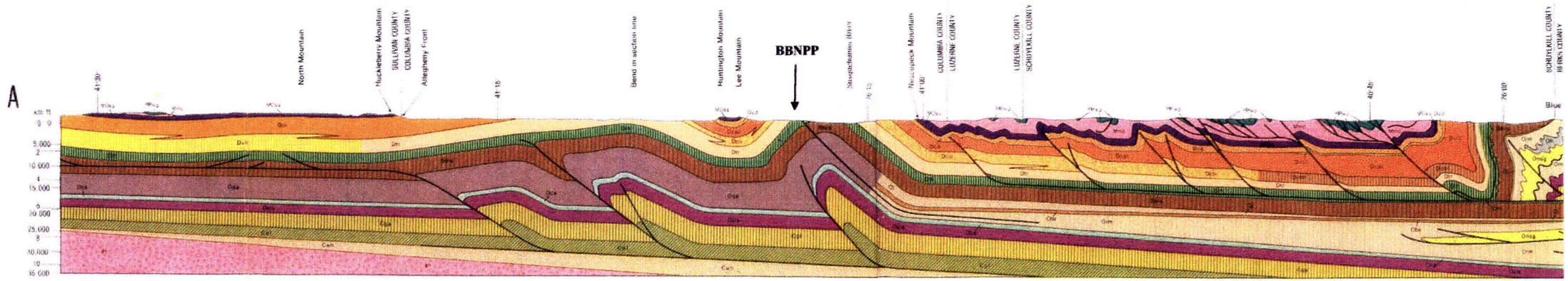
-1730 nanoteslas

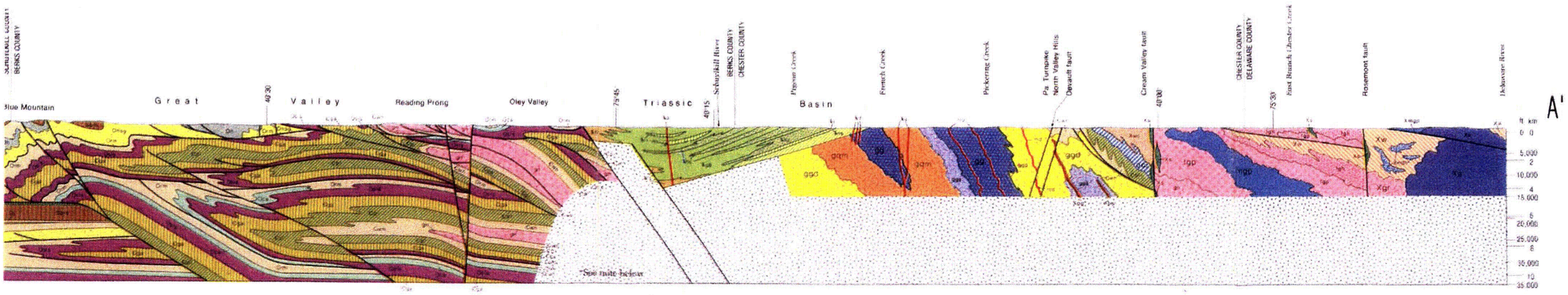
0 2.5 5 10 miles

0 2.5 5 10 kilometers

REFERENCE:
- Bankey, 2002.
- Harrison, 2004.
- USGS, 2007.

# Figure 2.5-19 Regional Cross Section




**NOTES:**

-BBNPP approximate location is extrapolated and is not the true geological location of Bell Bend NPP.

-Refer to Figure 2.5-5 for Cross Section A-A' location.

-Refer to subsequent figure for Cross Section A-A' descriptions.

REFERENCE:

King, 1974.

## Figure 2.5-20 Stratigraphic Description for Regional Cross Section

### TRIASSIC

- DIABASE
- LIMESTONE FANGLOMERATE
- QUARTZ FANGLOMERATE
- GETTYSBURG, HAMMER CREEK, AND BRUNSWICK FORMATIONS, UNDIVIDED
- HEIDLERSBURG MEMBER OF GETTYSBURG FORMATION
- LOCKATONG FORMATION
- HAMMER CREEK CONGLOMERATE
  Also includes some conglomerate in Gettysburg Formation.
- NEW OXFORD AND STOCKTON FORMATIONS, UNDIVIDED
- NEW OXFORD CONGLOMERATE

### PERMIAN AND PENNSYLVANIAN

- WAYNESBURG FORMATION, MONONGAHELA GROUP, CONEMAUGH GROUP, ALLEGHENY GROUP, AND POTTSVILLE GROUP, UNDIVIDED (western Pennsylvania); LLEWELLYN FORMATION AND POTTSVILLE GROUP, UNDIVIDED (eastern Pennsylvania)

### MISSISSIPPIAN

- MAUCH CHUNK FORMATION

### MISSISSIPPIAN AND DEVONIAN

- Same as MDss (described below), but also includes MAUCH CHUNK FORMATION
- SHENANGO FORMATION, CUYAHOGA GROUP, BEREA OR CORRY SANDSTONE, BEDFORD SHALE, CUSSEWAGO SANDSTONE, AND RICEVILLE FORMATION OR OSWAYO FORMATION, UNDIVIDED (northwestern Pennsylvania); BURGOON SANDSTONE AND HUNTLEY MOUNTAIN FORMATION OR ROCKWELL FORMATION, UNDIVIDED (northern and western Pennsylvania); POCONO AND SPECHTY KOPF FORMATIONS, UNDIVIDED (eastern Pennsylvania)

### DEVONIAN

#### UPPER

- CATSKILL FORMATION
- DUNCANNON MEMBER OF CATSKILL FORMATION
- CLARKS FERRY MEMBER OF CATSKILL FORMATION
- SHERMAN CREEK MEMBER OF CATSKILL FORMATION
- IRISH VALLEY MEMBER OF CATSKILL FORMATION
- BEAVERDAM RUN, WALCKSVILLE, AND TOWAMENSING MEMBERS OF CATSKILL FORMATION, UNDIVIDED
- TRIMMERS ROCK FORMATION
  Includes Harrell Formation in part of section A-A'.
- VENANGO GROUP, CHADAKOIN FORMATION, GIRARD SHALE, NORTHEAST SHALE, SHUMLA SILTSTONE, WESTFIELD SHALE, LAONA SILTSTONE, PERRYSBURG FORMATION, JAVA FORMATION, WEST FALLS FORMATION, SONYEA FORMATION, AND GENESEE FORMATION, UNDIVIDED (northwestern Pennsylvania); VENANGO GROUP, CHADAKOIN FORMATION, BRADFORD GROUP, ELK GROUP, BRALLIER FORMATION, AND HARRELL FORMATION, UNDIVIDED (western Pennsylvania); LOCK HAVEN, FOREKNOBS, SCHERR, BRALLIER, AND HARRELL FORMATIONS, UNDIVIDED (Valley and Ridge province; northern Pennsylvania)
  Also includes equivalents of Ohio Shale, Chagrin Formation, and Huron Shale in parts of westernmost Pennsylvania.

#### MIDDLE AND LOWER

- TULLY LIMESTONE, HAMILTON GROUP, ONONDAGA FORMATION, BOIS BLANC FORMATION, ORISKANY SANDSTONE, AND MANLIUS FORMATION, UNDIVIDED (northwestern Pennsylvania); HAMILTON GROUP, ONONDAGA FORMATION, OLD PORT FORMATION, AND UPPER PART OF KEYSER FORMATION, UNDIVIDED (western Pennsylvania; Valley and Ridge province); MAHANTANGO FORMATION, MARCELLUS FORMATION, BUTTERMILK FALLS LIMESTONE, PALMERTON SANDSTONE, SCHOHARIE FORMATION, ESOPUS FORMATION, RIDGELEY SANDSTONE, SHRIVER CHERT, AND HELDERBERG GROUP, UNDIVIDED (eastern Pennsylvania)

### SILURIAN

- BASS ISLANDS GROUP, SALINA GROUP, LOCKPORT DOLOMITE, ROCHESTER SHALE, IRONDEQUOIT DOLOMITE, REYNALES DOLOMITE, AND MEDINA GROUP, UNDIVIDED (northwestern and western Pennsylvania); LOWER AND MIDDLE PARTS OF KEYSER FORMATION, TONOLOWAY FORMATION, WILLS CREEK FORMATION, BLOOMSBURG FORMATION, MIFFLINTOWN FORMATION, CLINTON GROUP, AND TUSCARORA FORMATION, UNDIVIDED (Valley and Ridge province); DECKER FORMATION, BOSSARDVILLE LIMESTONE, POXONO ISLAND FORMATION, BLOOMSBURG FORMATION, AND SHAWANGUNK FORMATION, UNDIVIDED (eastern Pennsylvania)

### ORDOVICIAN

- QUEENSTON SHALE, JUNIATA FORMATION, BALD EAGLE FORMATION, REEDSVILLE FORMATION, AND UTICA FORMATION OR ANTES SHALE, UNDIVIDED
- JUNIATA FORMATION
- BALD EAGLE FORMATION
- REEDSVILLE FORMATION AND UTICA FORMATION OR ANTES SHALE, UNDIVIDED (western Pennsylvania; Valley and Ridge province); MARTINSBURG FORMATION (Great Valley)
- HAMBURG SEQUENCE ROCKS (phyllitic shale)
  Includes some limestone.
- HAMBURG SEQUENCE ROCKS (shale and graywacke)
- COBURN, SALONA, NEALMONT, BENNER, SNYDER, HATTER, AND LOYSBURG FORMATIONS, UNDIVIDED (western Pennsylvania; Valley and Ridge province); CHAMBERSBURG FORMATION, ST. PAUL GROUP, HERSHEY FORMATION, MYERSTOWN FORMATION, JACKSONBURG FORMATION, AND ANNVILLE FORMATION, UNDIVIDED (Great Valley)
- SHADOW LAKE, BELLEFONTE, AXEMANN, NITTANY, AND STONEHENGE/LARKE FORMATIONS, UNDIVIDED (western Pennsylvania; Valley and Ridge province); PINESBURG STATION, ROCKDALE RUN, STONEHENGE, AND STOUFFERSTOWN FORMATIONS (BEEKMANTOWN GROUP), UNDIVIDED (Cumberland Valley sequence); ONTELAUNEE, EPLER, RICHENBACH, AND STONEHENGE FORMATIONS (BEEKMANTOWN GROUP), UNDIVIDED (Lebanon and Lehigh Valley sequences; northern Piedmont)

### ORDOVICIAN AND CAMBRIAN

- CONESTOGA FORMATION

### CAMBRIAN

- GATESBURG FORMATION AND UPPER PART OF WARRIOR FORMATION, UNDIVIDED (western Pennsylvania; Valley and Ridge province); SHADYGROVE FORMATION, ZULLINGER FORMATION, AND UPPER PART OF ELBROOK FORMATION, UNDIVIDED (Cumberland Valley sequence); RICHLAND, MILLBACH, SCHAEFFERSTOWN, AND SNITZ CREEK FORMATIONS, UNDIVIDED (Lebanon Valley sequence); ALLENTOWN FORMATION (Lehigh Valley sequence)
- GATESBURG, WARRIOR, PLEASANT HILL, POTSDAM, ELBROOK, AND WAYNESBORO FORMATIONS, UNDIVIDED
  Also includes lateral equivalents of Tomstown Formation and Chilhowee Group (if present).
- POTSDAM FORMATION (western Pennsylvania); MIDDLE AND LOWER PARTS OF ELBROOK FORMATION, LOWER PART OF WARRIOR FORMATION, AND PLEASANT HILL FORMATION, UNDIVIDED (Valley and Ridge province); BUFFALO SPRINGS AND ZOOKS CORNER FORMATIONS, UNDIVIDED (Lebanon Valley sequence); LEITHSVILLE FORMATION (Lehigh Valley sequence)
- WAYNESBORO, TOMSTOWN, ANTIETAM, HARPERS, AND WEVERTON FORMATIONS, UNDIVIDED (south-central Pennsylvania); LEDGER, KINZERS, VINTAGE, ANTIETAM, HARPERS, CHICKIES, AND HARDYSTON FORMATIONS, UNDIVIDED (Lebanon Valley and Lehigh Valley sequences; northern Piedmont)

### PRECAMBRIAN

- METAVOLCANIC ROCKS
  Includes metabasalt, metarhyolite, and greenstone schist.
- METADIABASE
- QUARTZ MONZONITE AND QUARTZ MONZONITE GNEISS
- GRANODIORITE AND GRANODIORITE GNEISS
- GABBROIC GNEISS AND GABBRO
- GRAPHITIC GNEISS
- FELSIC GNEISS, HORNBLENDE-BEARING
- FELSIC GNEISS, PYROXENE-BEARING
- HORNBLENDE GNEISS
- MAFIC GNEISS, PYROXENE-BEARING
- GRANITIC GNEISS
  Includes all Precambrian and undifferentiated basement crystalline rocks (igneous or metamorphic).

### PROBABLY LOWER PALEOZOIC

- PEGMATITE
- ANORTHOSITE
- GRANITIC GNEISS AND GRANITE
- MAFIC GNEISS, HORNBLENDE-BEARING
- MAFIC GNEISS, PYROXENE-BEARING
- SERPENTINITE
- PEACH BOTTOM SLATE AND CARDIFF CONGLOMERATE, UNDIVIDED
- PETERS CREEK SCHIST
- WISSAHICKON FORMATION, ALBITE-CHLORITE SCHIST
- WISSAHICKON FORMATION, OLIGOCLASE-MICA SCHIST
- COCKEYSVILLE MARBLE
- SETTERS QUARTZITE

- INSUFFICIENT DATA FOR INTERPRETATION

*Note: Decollement surfaces may extend under the Pennsylvania Piedmont, based on seismic research in the southern Appalachians and in Quebec, but no data are presently available to extend this structural interpretation into Pennsylvania.

REFERENCE:
King, 1974.

## Figure 2.5-21 Site Specific Stratigraphic Column

| Era | Period | Epoch | Age (Ma) | Unit | Thickness (ft) |
|---|---|---|---|---|---|
| Cenozoic | Quaternary | Holocene | 0.01 | **Stratified Drift** | 38.5 |
| | | Pleistocene | 1.8 | | |
| Paleozoic | Devonian | Upper | 360 | **Harrell Formation** | 150 |
| | | Middle | 370 | Hamilton Group: **Mahantango Formation** | 1,500 |
| | | | | Hamilton Group: **Marcellus Formation** | 350 |
| | | | | **Onondaga Formation** | 175 |
| | | Lower | 391 | **Old Port Formation** | 100-150 |
| | Silurian | Upper | 417 | **Keyser Formation** | 125 |
| | | | | **Tonoloway Formation** | 100 |
| | | | | **Wills Creek Formation** | 750 |
| | | Lower | 423 | **Bloomsburg Formation** | 464 |
| | | | | **Mifflintown Formation** | 336 |
| | | | | **Keefer Formation** | 670-1,070 |
| | | | | **Rose Hill Formation** | |
| | | | | **Tuscarora Formation** | 400-700 |
| | Ordovician | Upper | 443 | **Juniata Formation** | 600-1,125 |
| | | | | **Bald Eagle Formation** | 700-1,313 |
| | | | | **Reedsville Formation** | 600-1,800 |
| | | Middle | 458 | **Trenton Group**<br>Antes Shale<br>Coburn Limestone<br>Salona Limestone | 842 |
| | | | | **Black River Group** | 632 |
| | | | | **Loysburg Formation** | 263-475 |
| | | Lower | 470 | **Beekmantown Group**<br>Bellefonte Dolomite<br>Axemann Limestone<br>Nittany Dolomite<br>Stonehenge Formation | 3,159-4,200 |
| | Cambrian | Upper | 490 | **Gatesburg Formation** | 1,211 |
| | | Middle | 510 | **Warrior Formation** | 400-1,340 |
| | | | | **Pleasant Hill Formation** | NOT REPORTED |
| | | Lower | 520 | **Waynesboro Formation** | 1,000+ |
| Neo-Proterozoic | Ediacaran | | 543 | Metamorphic/Igneous | |

REFERENCES:
- Crangle, 2002
- Gold, 2003
- Inmers, 1978
- Kauffman, 1999
- Laughrey, 1999
- McElroy, 2007
- Thompson, 1999

# Figure 2.5-22 {Deleted}

# Figure 2.5-23 Bedrock Geologic Map Berwick Quadrangle

**LEGEND:**

★ Center Point of Proposed Bell Bend NPP (BBNPP)

○ BBNPP Reactor 0.6-mile (1 km) Radius

A — A' Cross Section

| WOOD-FORDIAN OUTWASH | MAUCH CHUNK FORMATION | POCONO FORMATION | SPECHTY KOPF FORMATION | CATSKILL FORMATION | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | DUNCANNON MEMBER | SHERMAN CREEK MEMBER | IRISH VALLEY MEMBER | TRIMMERS ROCK FORMATION | HARRELL FORMATION |
| Qwo | Mmc | Mp | MDisk | Dcd | Dcs | Dci | Dtr | Dh |

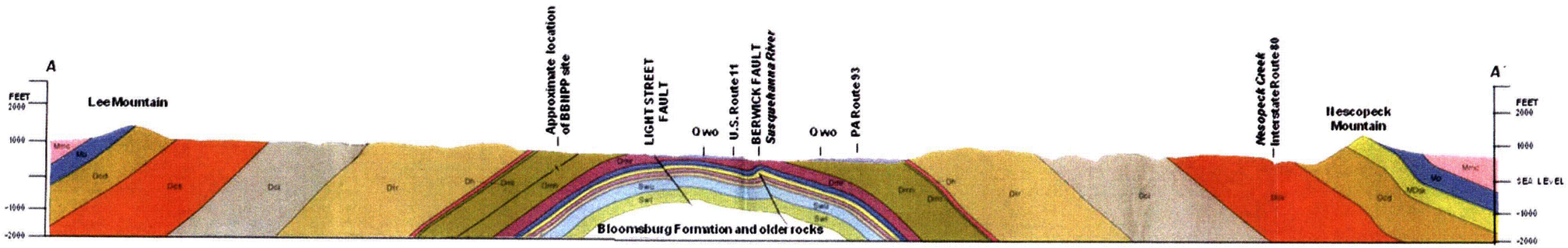
| MANHATTAN FORMATION | | | | | | | WILLS CREEK FORMATION | |
|---|---|---|---|---|---|---|---|---|
| TULLY MEMBER | | MANDELLUS FORMATION | ONONDAGA FORMATION | OLD PORT FORMATION | KEYSER FORMATION | TONOLOWAY FORMATION | UPPER MEMBER | |
| Dmh | | Dmr | Don | Do | DSk | Sto | SWU | LOWER MEMBER Swl |

NOTE: See Figure 2.5-23a for Cross Section.

REFERENCE:
- Inners, 1978.
- Harrison, 2004.

## Figure 2.5-23a Cross Section of Berwick Anticlinorium - Bedrock Geology of Berwick Quadrangle

# CROSS SECTION




Location Map of Cross Section

Legend

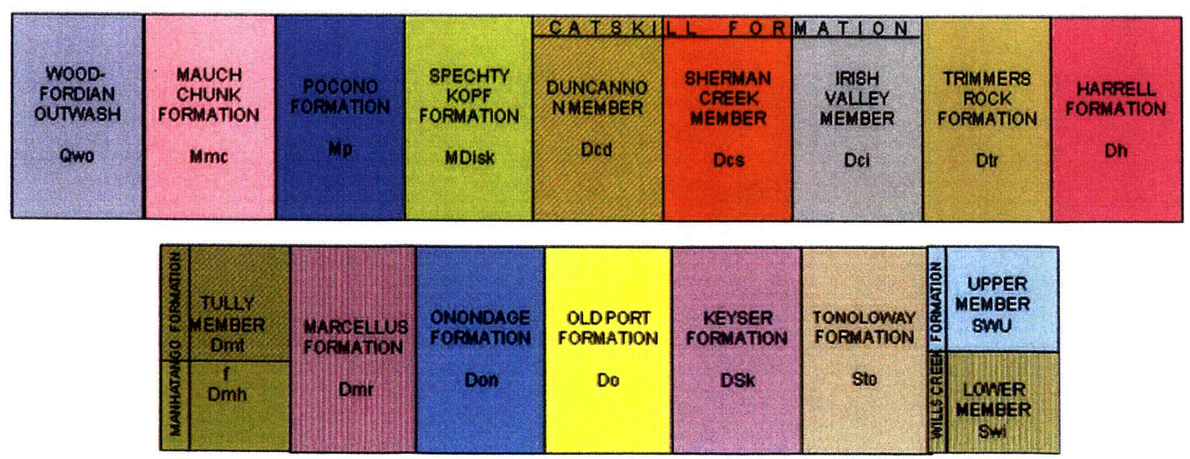


Figure 2.5-24 Surficial Geologic Site Map 0.6 Mile (1 km)

**LEGEND:**

☆ Proposed Center Point of Bell Bend NPP (BBNPP)

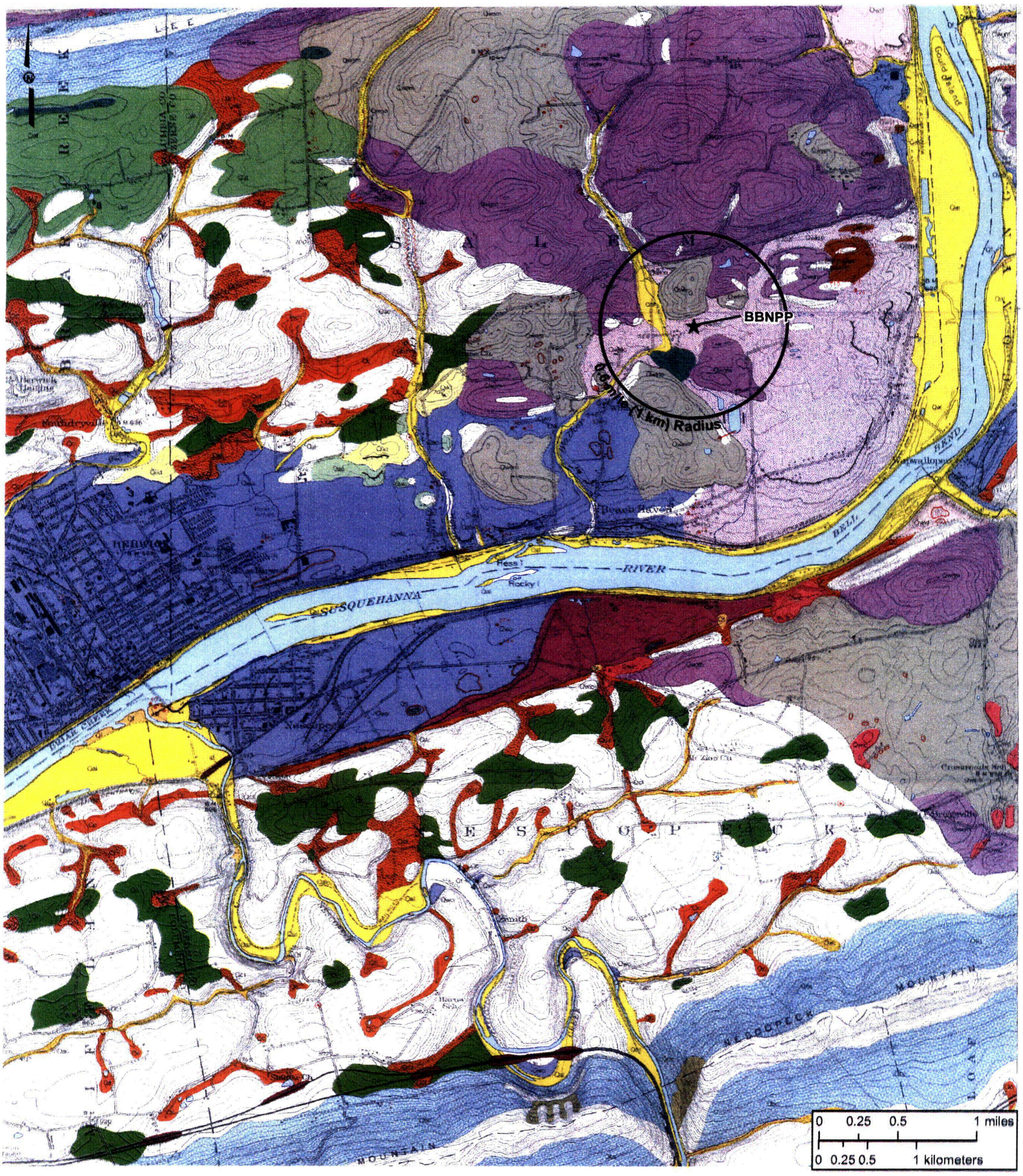
◯ NPP Reactor 0.6-mile (1 km) Radius

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ARTIFICIAL FILL af | ALLUVIUM Qal | ALLUVIAL FAN Qf | ALLUVIUM AND WOOD-FORDIAN OUTWASH, UNDIVIDED Qwoa | SWAMP DEPOSIT Qs | ALLUVIUM AND COLLUVIUM UNDIVIDED Qac | COLLUVIUM Qc | COLLUVIUM AND TILL, UNDIVIDED Qct | EOLIAN MANTLE Qem | TALUS Qt | BOULDER COLLUVIUM Qbc |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WOOD-FORDIAN OUTWASH Qwo | WOOD-FORDIAN KAME TERRACE Qwkt | WOOD-FORDIAN KAME TERRACE AND OUTWASH, UNDIVIDED Qwkto | WOOD-FORDIAN FRONTAL KAME Qwfk | WOOD-FORDIAN ICE-CONTACT STRATIFIED DRIFT Qwic | WOOD-FORDIAN GROUND MORAINE Qwgm | WOOD-FORDIAN END MORAINE Qwem | ALTONIAN OUTWASH Qao | ALTONIAN TILL Qat | ILLINOIAN KAME TERRACE Qikt | ILLINOIAN TILL Qit |

REFERENCE:
• Inners, 1978.

## Figure 2.5-25 Surficial Sediments Description




**LEGEND:**

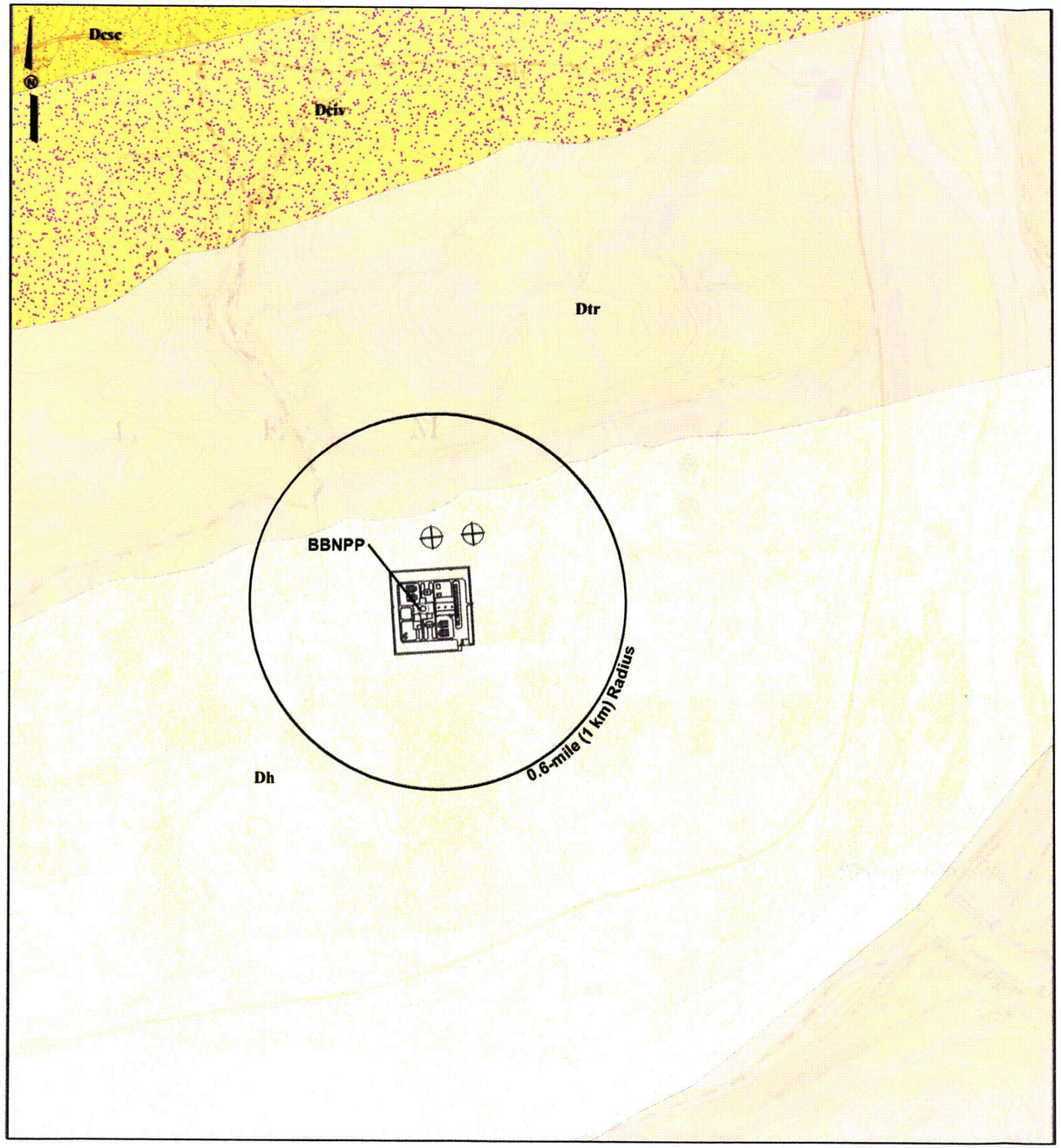
★ Proposed Center Point of Bell Bend NPP (BBNPP)

○ NPP Reactor 0.6-mile (1 km) Radius

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ARTIFICIAL FILL af | ALLUVIUM Qal | ALLUVIAL FAN Qf | ALLUVIUM AND WOODFORDIAN OUTWASH, UNDIVIDED Qwoa | SWAMP DEPOSIT Qs | ALLUVIUM AND COLLUVIUM UNDIVIDED Qac | COLLUVIUM Qc | COLLUVIUM AND TILL, UNDIVIDED Qct | EOLIAN MANTLE Qem | TALUS Qt | BOULDER COLLUVIUM Qbc |
| WOOD-FORDIAN OUTWASH Qwo | WOOD-FORDIAN KAME TERRACE Qwkt | WOOD-FORDIAN KAME TERRACE AND OUTWASH, UNDIVIDED Qwkto | WOOD-FORDIAN FRONTAL KAME Qwfk | WOOD-FORDIAN ICE-CONTACT STRATIFIED DRIFT Qwic | WOOD-FORDIAN GROUND MORAINE Qwgm | WOOD-FORDIAN END MORAINE Qwem | ALTONIAN OUTWASH Qao | ALTONIAN TILL Qat | ILLINOIAN KAME TERRACE Qikt | ILLINOIAN TILL Qit |

REFERENCE:
• Inners, 1978.

# Figure 2.5-26 Site Area Geologic Map 0.6-mile (1 km) Radius




**LEGEND**

Unit Descriptions

Pennsylvanian

- Pl — Llewellyn Formation
- Pp — Pottsville Formation

Mississippian

- Mmc — Mauch Chunk Formation
- Mb — Burgoon Sandstone
- Mp — Pocono Formation
- MDhm — Huntley Mountain Formation
- MDsk — Spechty Kopf Formation

Devonian

- Dck — Catskill Formation

Catskill Formation Members:

- Dcb — Buddys Run Member
- Dcd — Duncannon Member
- Dccf — Clarks Ferry Member
- Dcsc — Sherman Creek Member
- Dcbs — Berry Run & Sawmill Run Members, undivided
- Dcp — Packerton Member
- Dclr — Long Run Member
- Dciv — Irish Valley Member
- Dtr — Trimmers Rock Formation
- Dh — Hamilton Group
- Doo — Onondaga & Old Port Formations, undivided
- DSkt — Keyser & Tonoloway Formations, undivided

Silurian

- Swc — Wills Creek Formation
- Sbm — Bloomsburg & Mifflintown Formations, undivided
- Sc — Clinton Group

---- Fault - Inferred

—— Fault

★ Center Point of Proposed Bell Bend NPP (BBNPP)

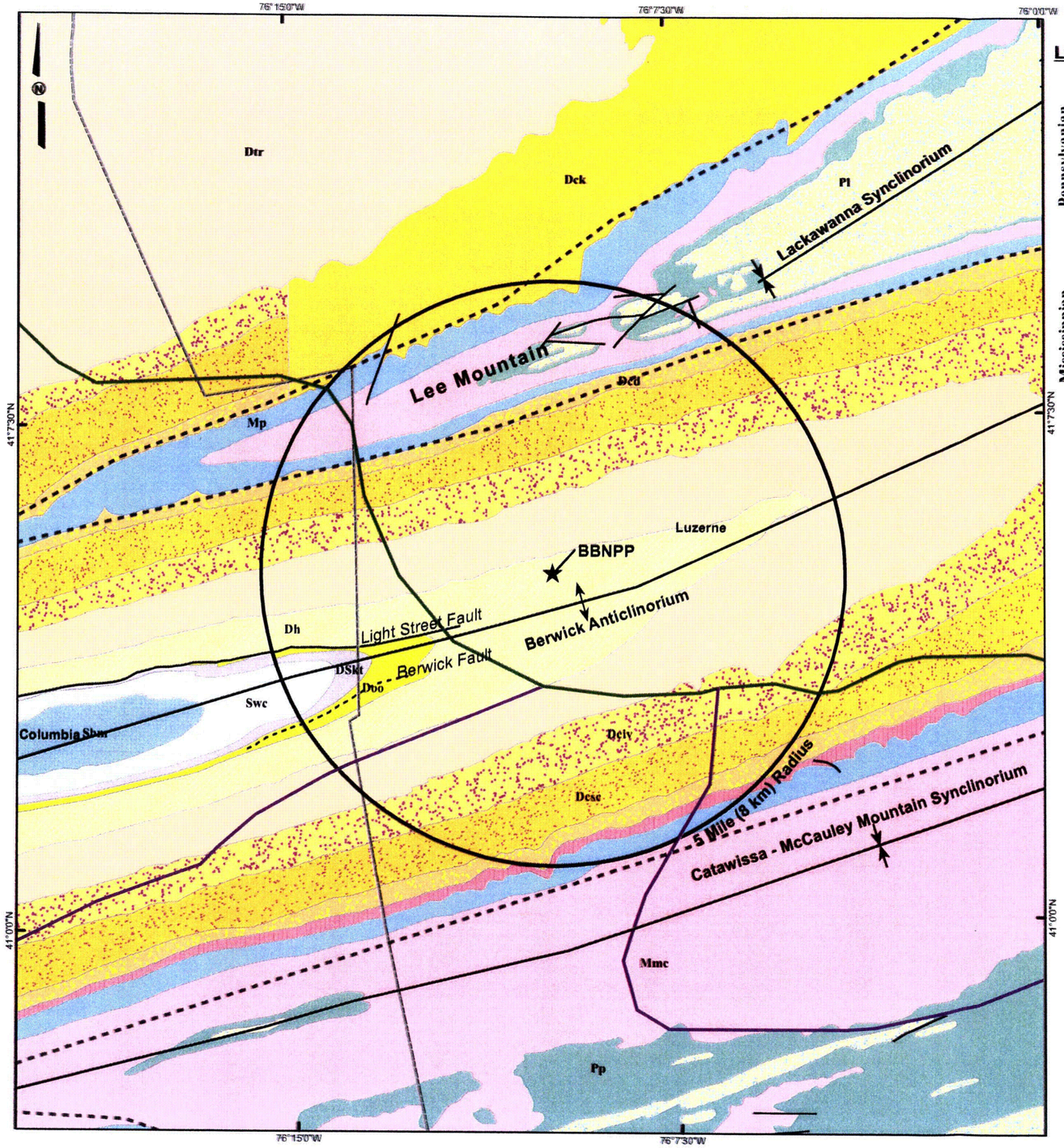
○ NPP Reactor 0.6-mile (1 km) Radius

0 0.25 0.5 1 miles

0 0.5 1 kilometers

REFERENCES:
- sk-12198-004-001, 2008.
- Berg, 1980.
- King, 1974.
- USGS, 1989.
- ESRI, 2007.

# Figure 2.5-27 Site Area Geologic Map 5-mile (8km) Radius




**LEGEND**

Unit Descriptions

Pennsylvanian

- Pl — Llewellyn Formation
- Pp — Pottsville Formation

Mississippian

- Mmc — Mauch Chunk Formation
- Mb — Burgoon Sandstone
- Mp — Pocono Formation
- MDhm — Huntley Mountain Formation
- MDsk — Spechty Kopf Formation

Devonian

- Dck — Catskill Formation

Catskill Formation Members:

- Dcb — Buddys Run Member
- Dcd — Duncannon Member
- Dccf — Clarks Ferry Member
- Dcsc — Sherman Creek Member
- Dcbs — Berry Run & Sawmill Run Members, undivided
- Dcp — Packerton Member
- Dclr — Long Run Member
- Dclv — Irish Valley Member
- Dtr — Trimmers Rock Formation
- Dh — Hamilton Group
- Doo — Onondaga & Old Port Formations, undivided
- DSkt — Keyser & Tonoloway Formations, undivided

Silurian

- Swc — Wills Creek Formation
- Sbm — Bloomsburg & Mifflintown Formations, undivided
- Sc — Clinton Group

- Fault - Inferred
- Fault
- Pre-Wisconsinan Glacial Limit
- Wisconsinan Glacial Limit
- Anthracite Region
- ★ Center Point of Proposed Bell Bend NPP (BBNPP)
- ○ NPP Reactor 5-mile (8 km) Radius
- County Line

0 0.5 1 2 miles

0 1 2 kilometers

REFERENCES:
- Berg, 1980.
- Harrison, 2004.
- King, 1974.
- ESRI, 2007.