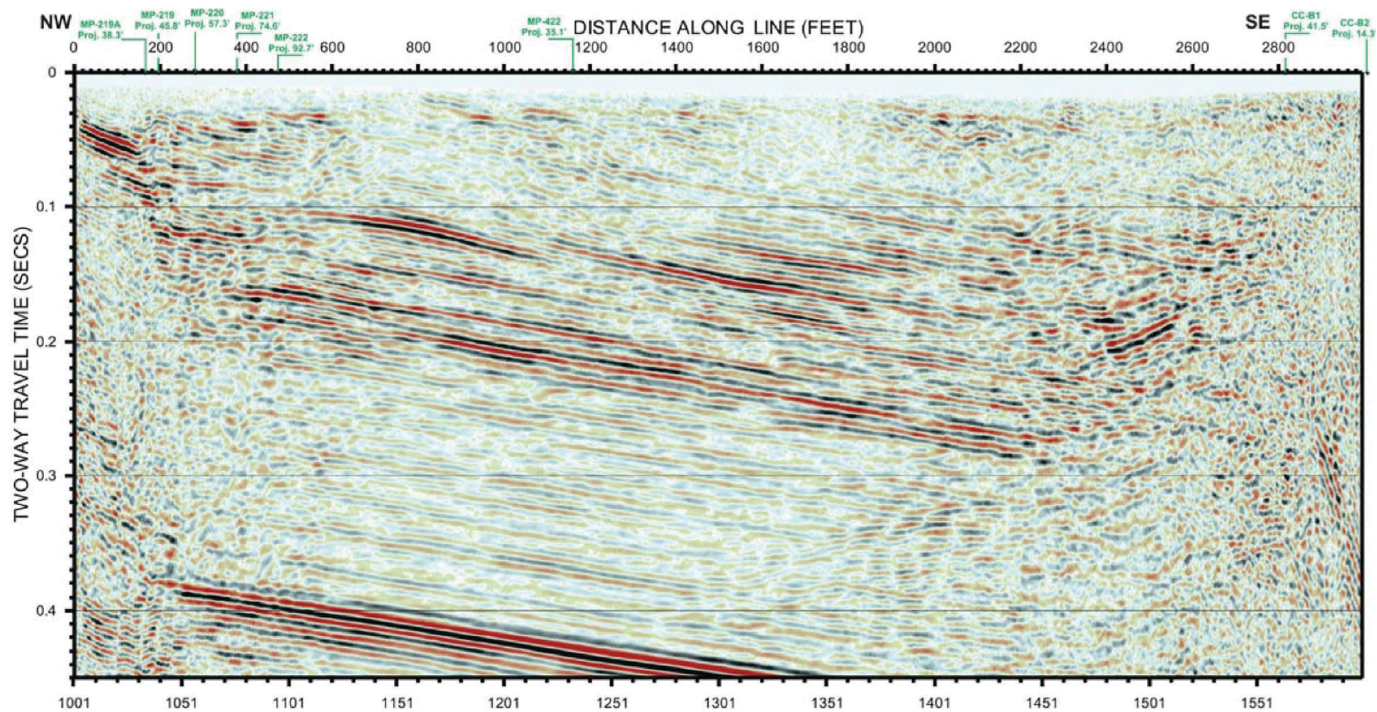


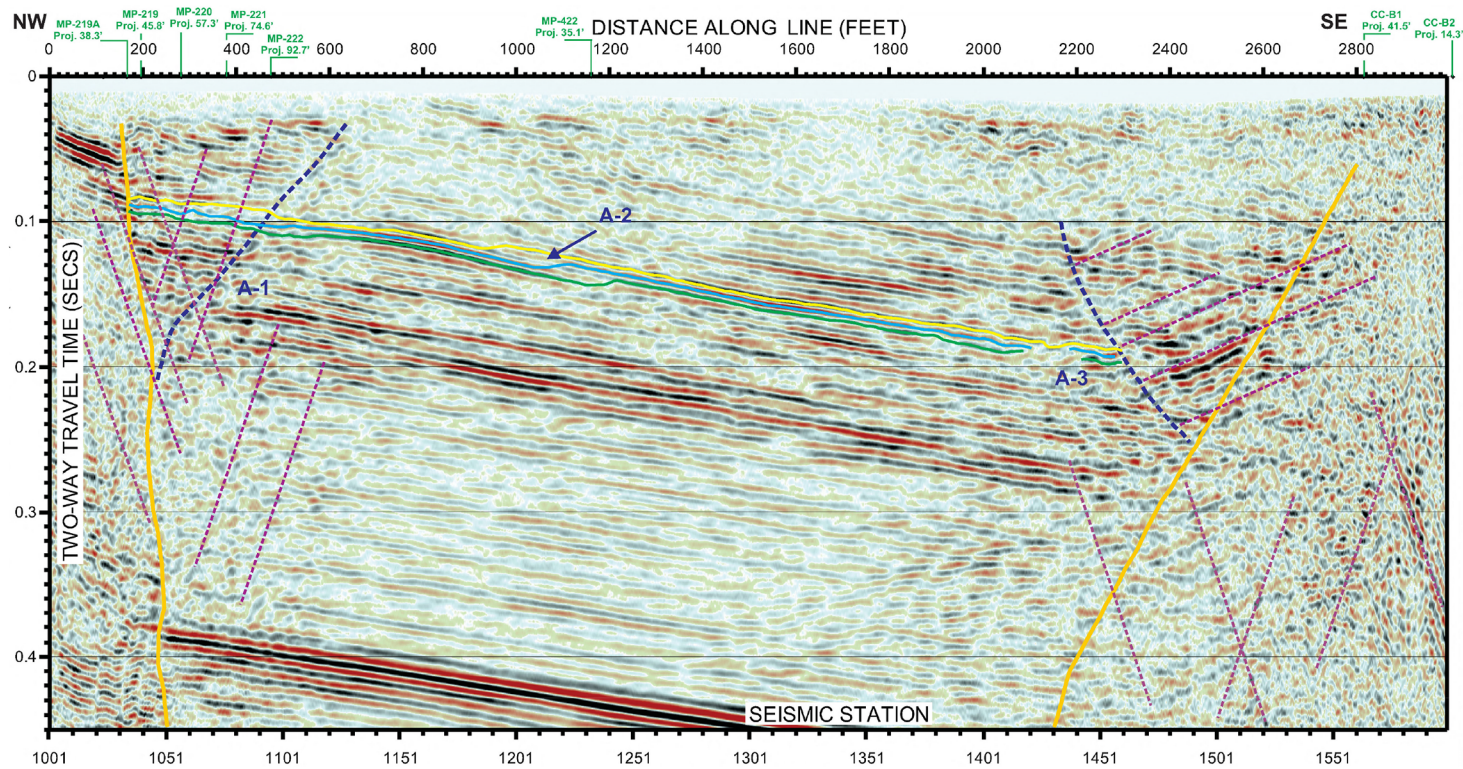
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Notes: Seismic reflection profile SRL-1 ([Reference 2.5.1-214](#)).

**Figure 2.5.1-36. (Sheet 1 of 5) Seismic Reflection SRL-1—Without Interpretation**

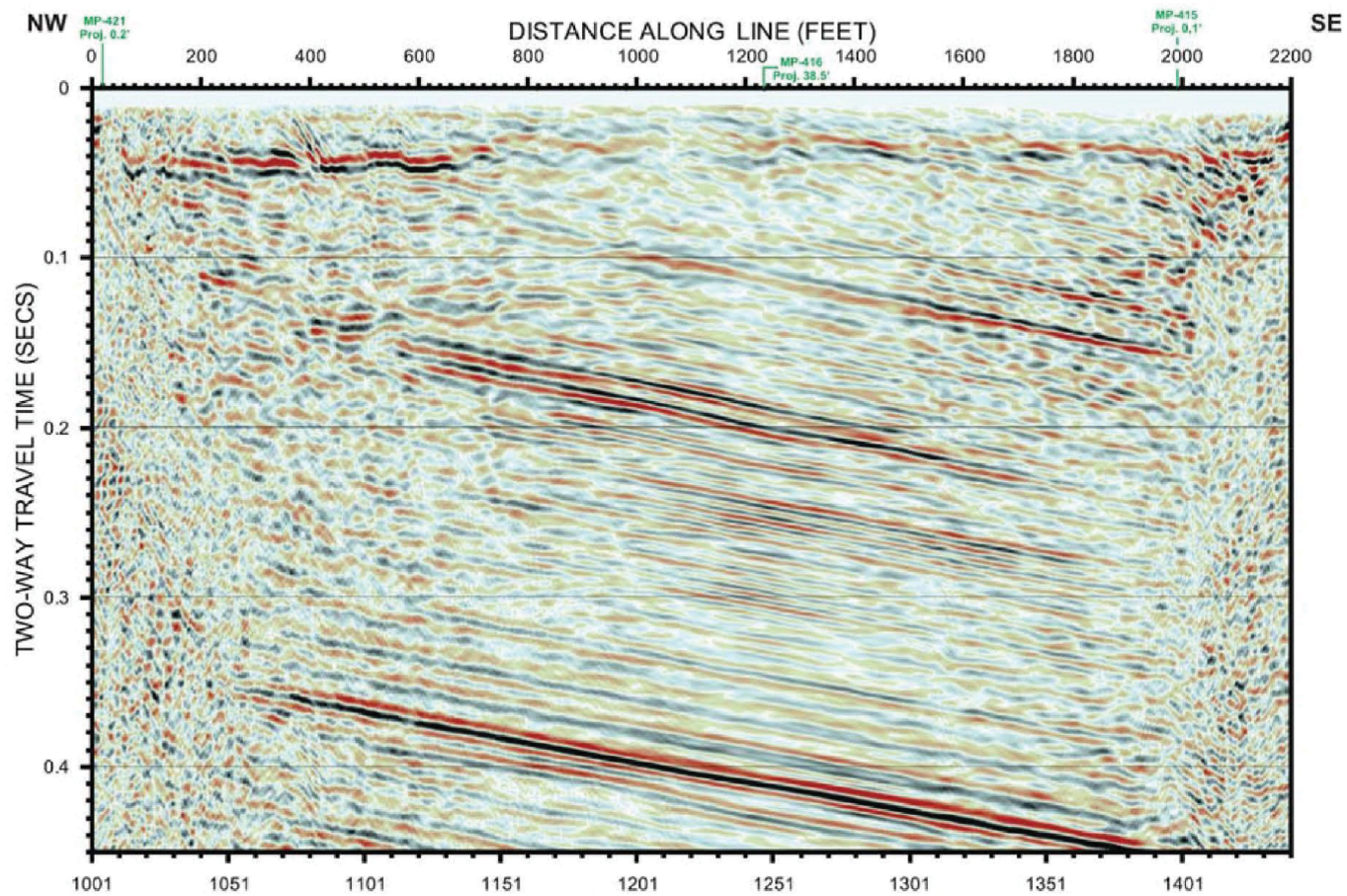
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Notes: Seismic reflection profile SRL-1 (Reference 2.5.1-214).

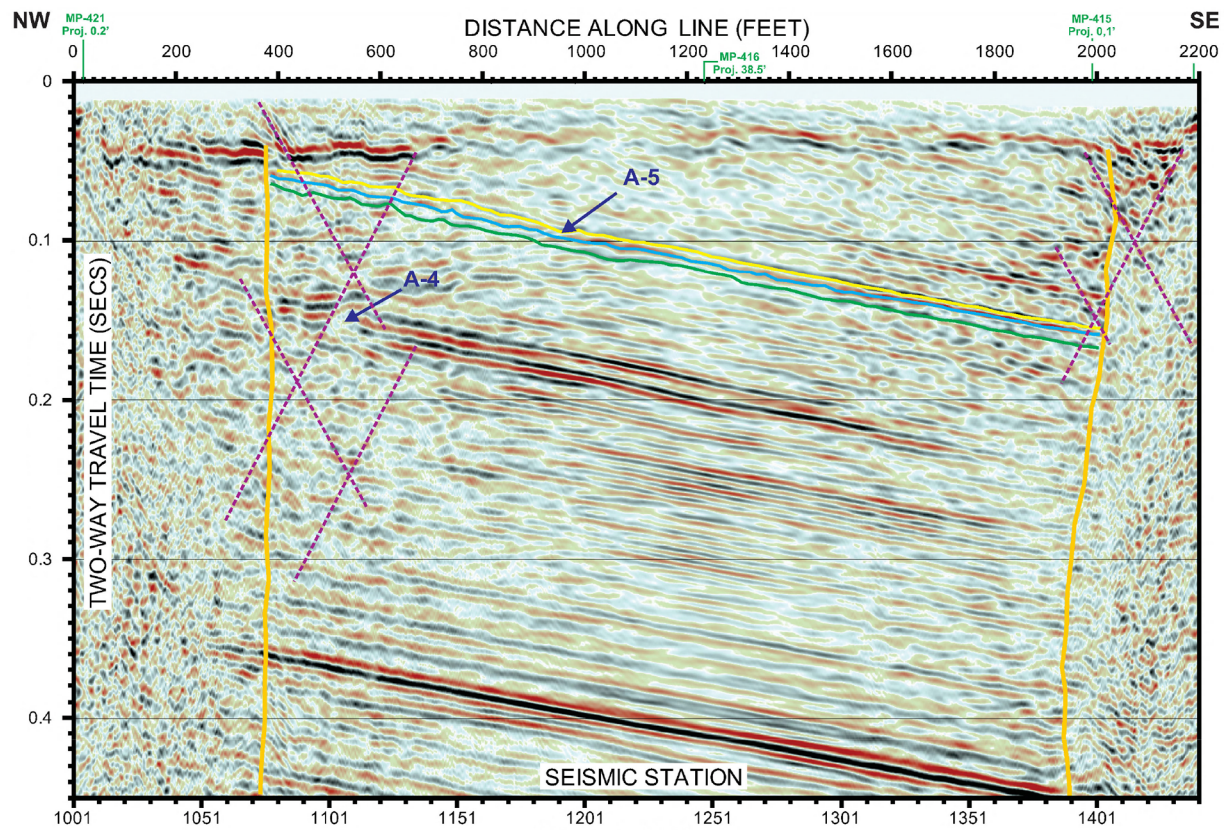
**Figure 2.5.1-36. (Sheet 2 of 5) Seismic Reflection SRL-1—With Interpretation**





Note: Seismic reflection profile SRL-2 ([Reference 2.5.1-214](#)).

**Figure 2.5.1-36. (Sheet 3 of 5) Seismic Reflection SRL-2—Without Interpretation**








Note: Seismic reflection profile SRL-2 (Reference 2.5.1-214).

**Figure 2.5.1-36. (Sheet 4 of 5) Seismic Reflection SRL-2—With Interpretation**



### Explanation for Annotated Seismic Reflection Lines

	Borehole Location
	Interpreted Knox Group Horizon
	Anomalous Zone
	Non-Interpretable Boundary
	Example Artifacts

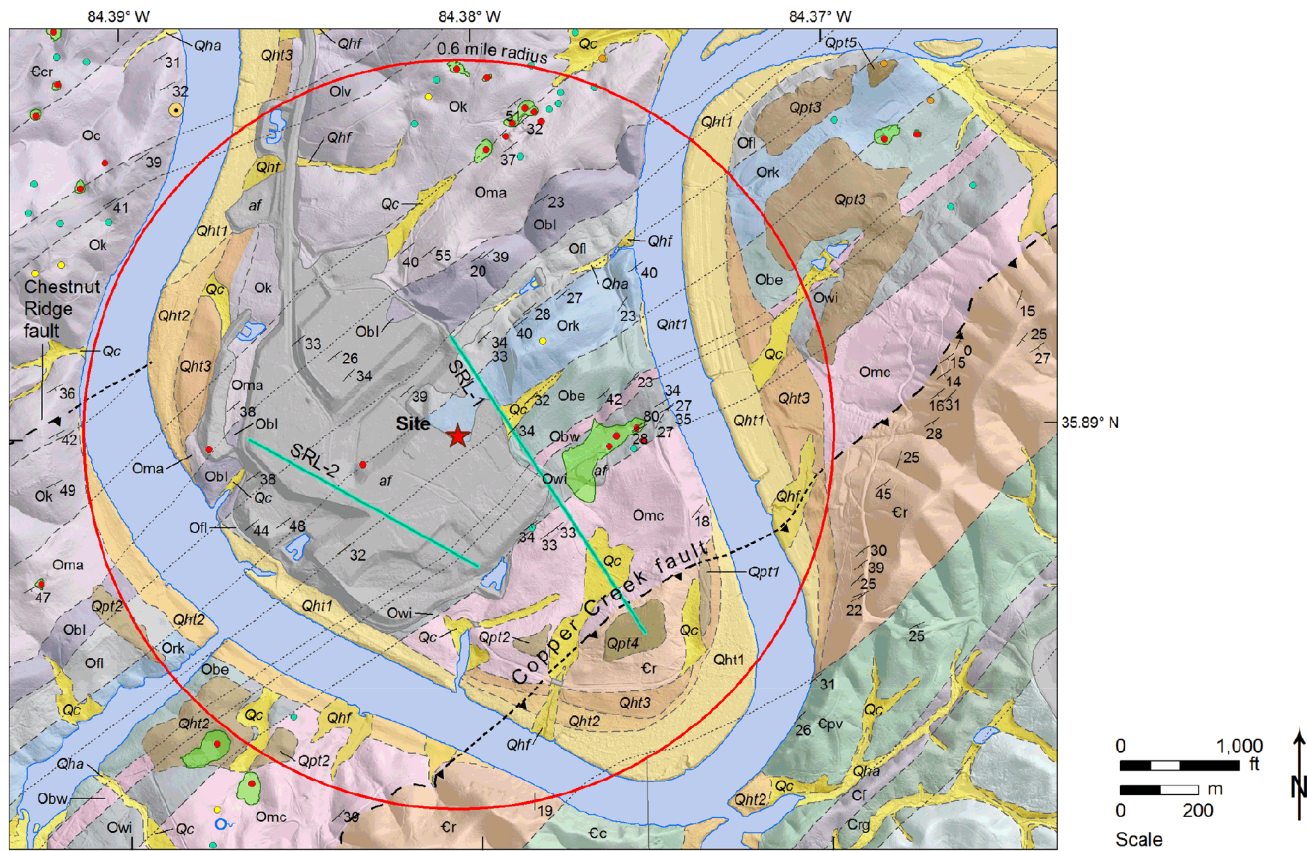
Notes:

Borehole locations are presented if projected less than 100 ft from the line unless noted.

Explanation for seismic reflection lines ([Reference 2.5.1-214](#))

**Figure 2.5.1-36. (Sheet 5 of 5) Explanation for Seismic Line Figures**

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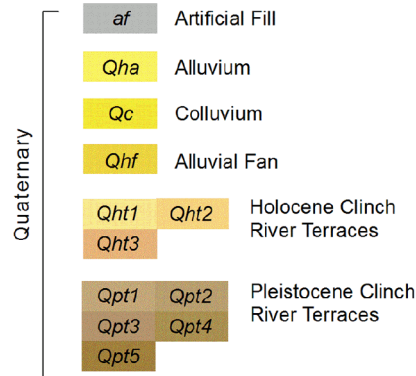
Note: Geologic map of the site (0.6-mi radius) with location of seismic reflection lines from [Figure 2.5.1-36](#).

**Figure 2.5.1-37. (Sheet 1 of 2) Site Location Geologic Map**

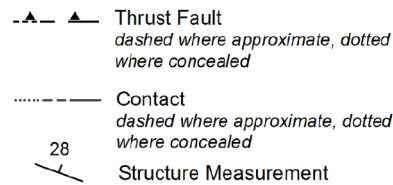


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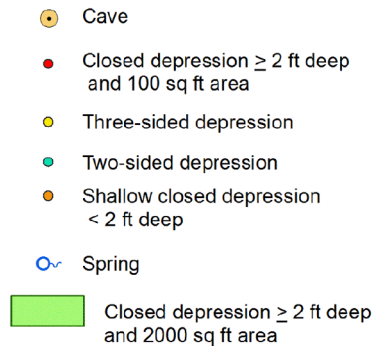
### Quaternary Units



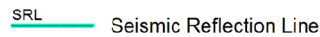
### Geologic Structures



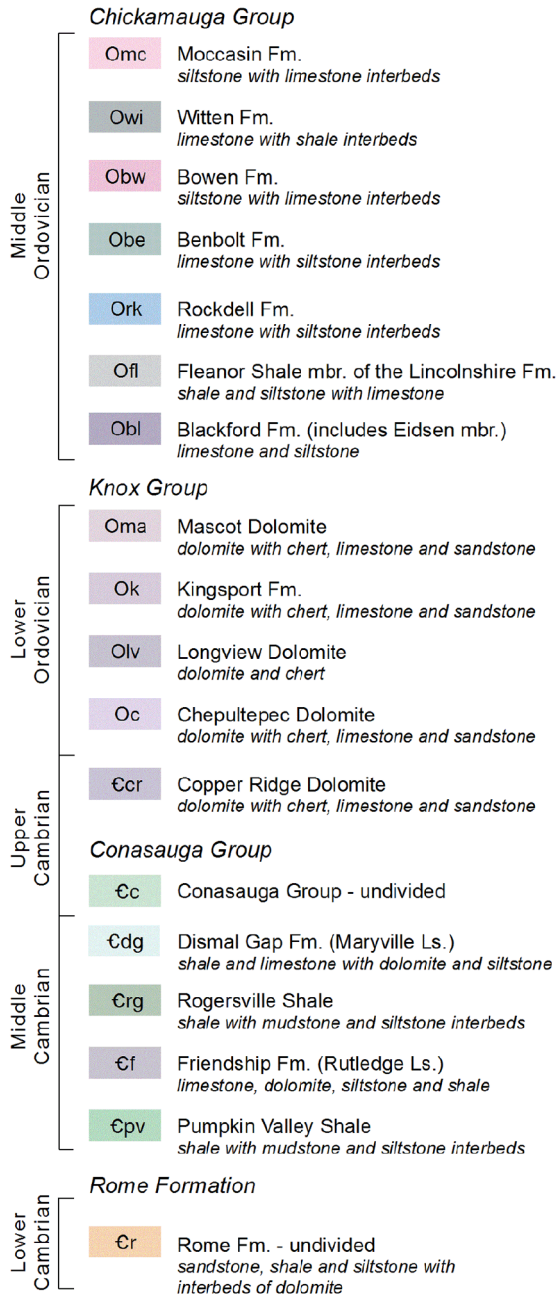
### Karst Features



### Explorations



### Bedrock Units



Note: Explanation for geologic map shown in (A) ([Reference 2.5.1-214](#))

**Figure 2.5.1-37. (Sheet 2 of 2) Site Location Geologic Map**

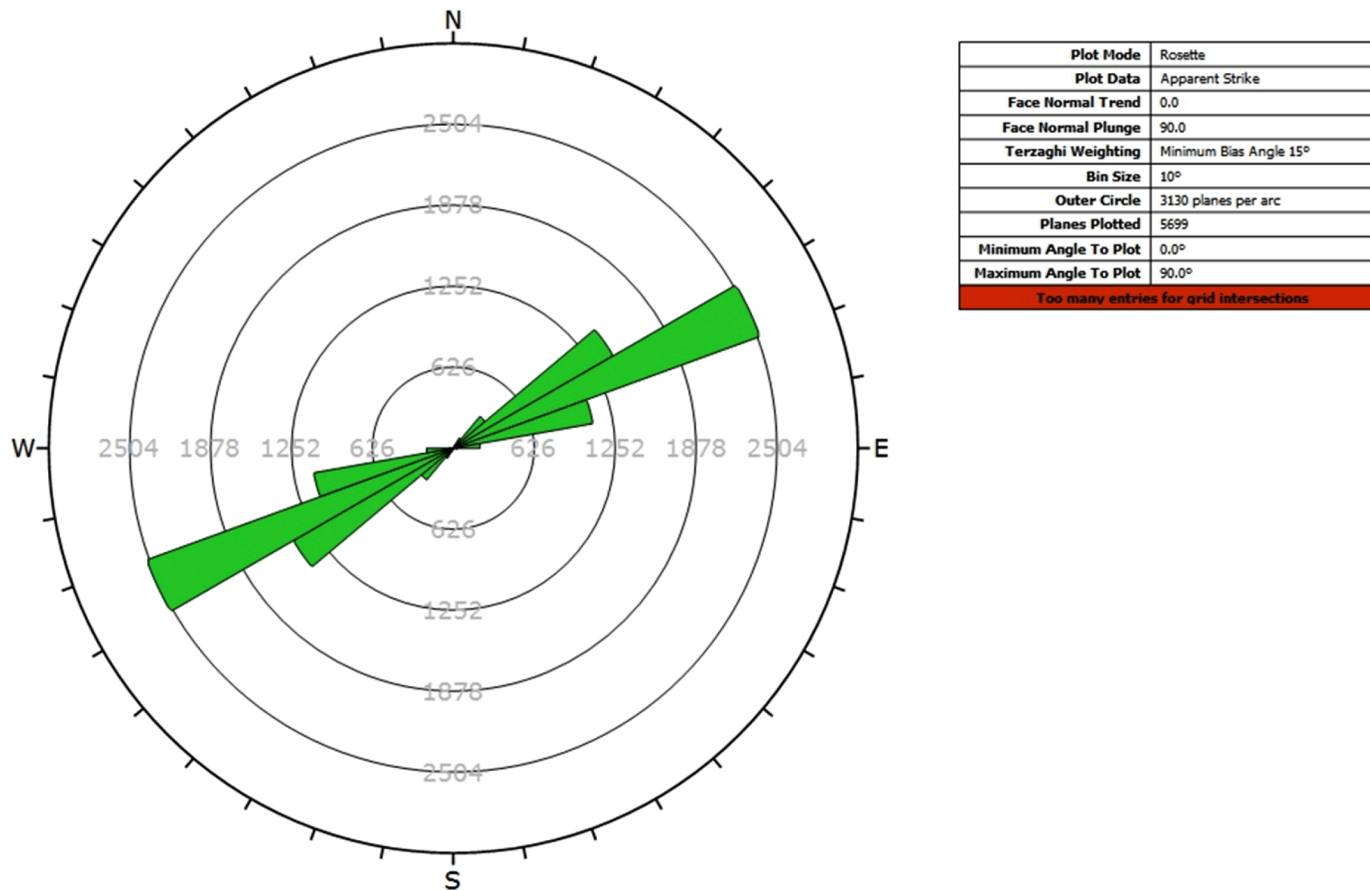


Figure 2.5.1-38. (Sheet 1 of 11) Acoustic Televiewer Data and Outcrop Mapping—Strike of Bedding



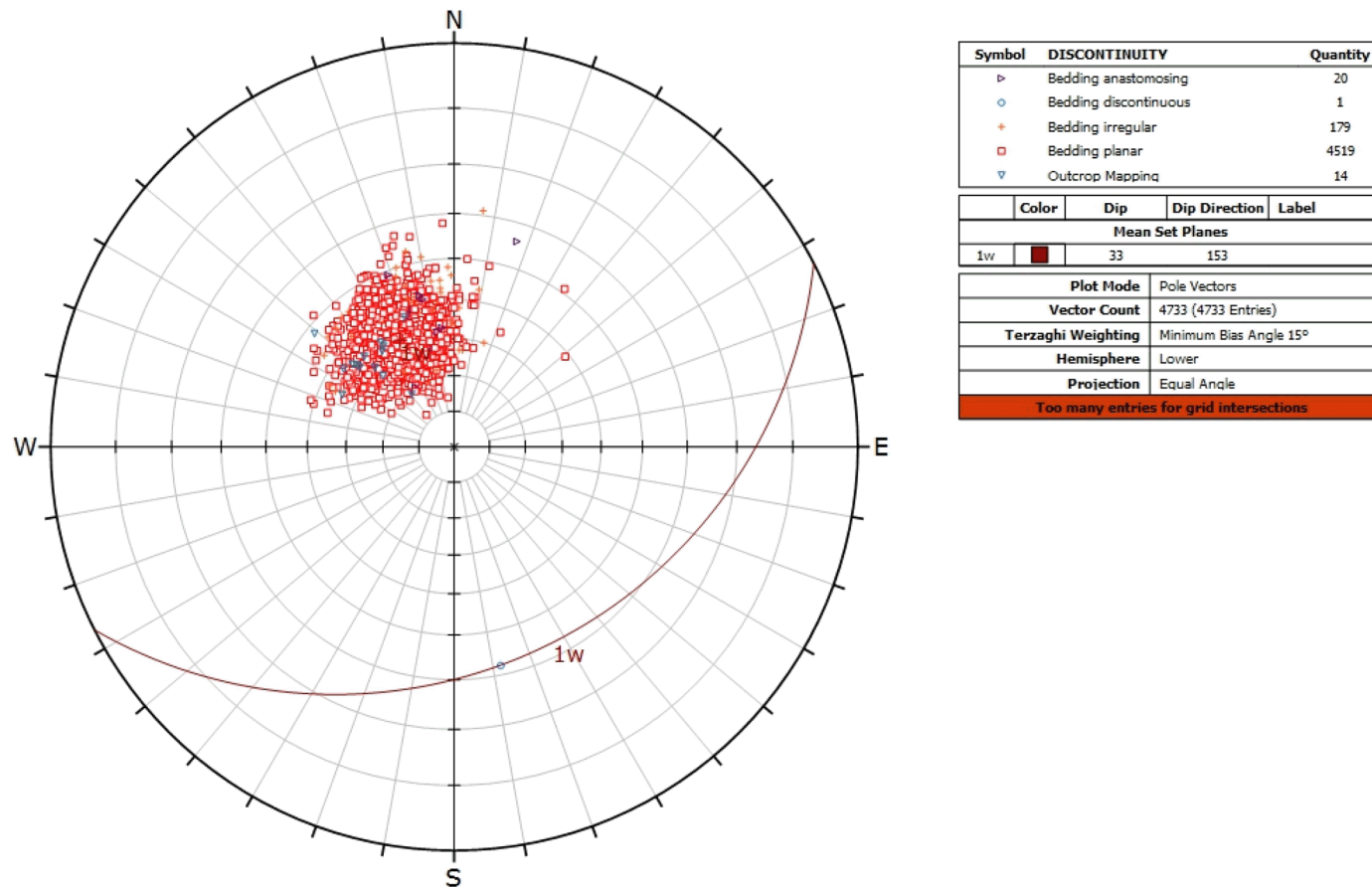


Figure 2.5.1-38. (Sheet 2 of 11) Acoustic Televiewer Data and Outcrop Mapping—Strike and Dip of Bedding Planes

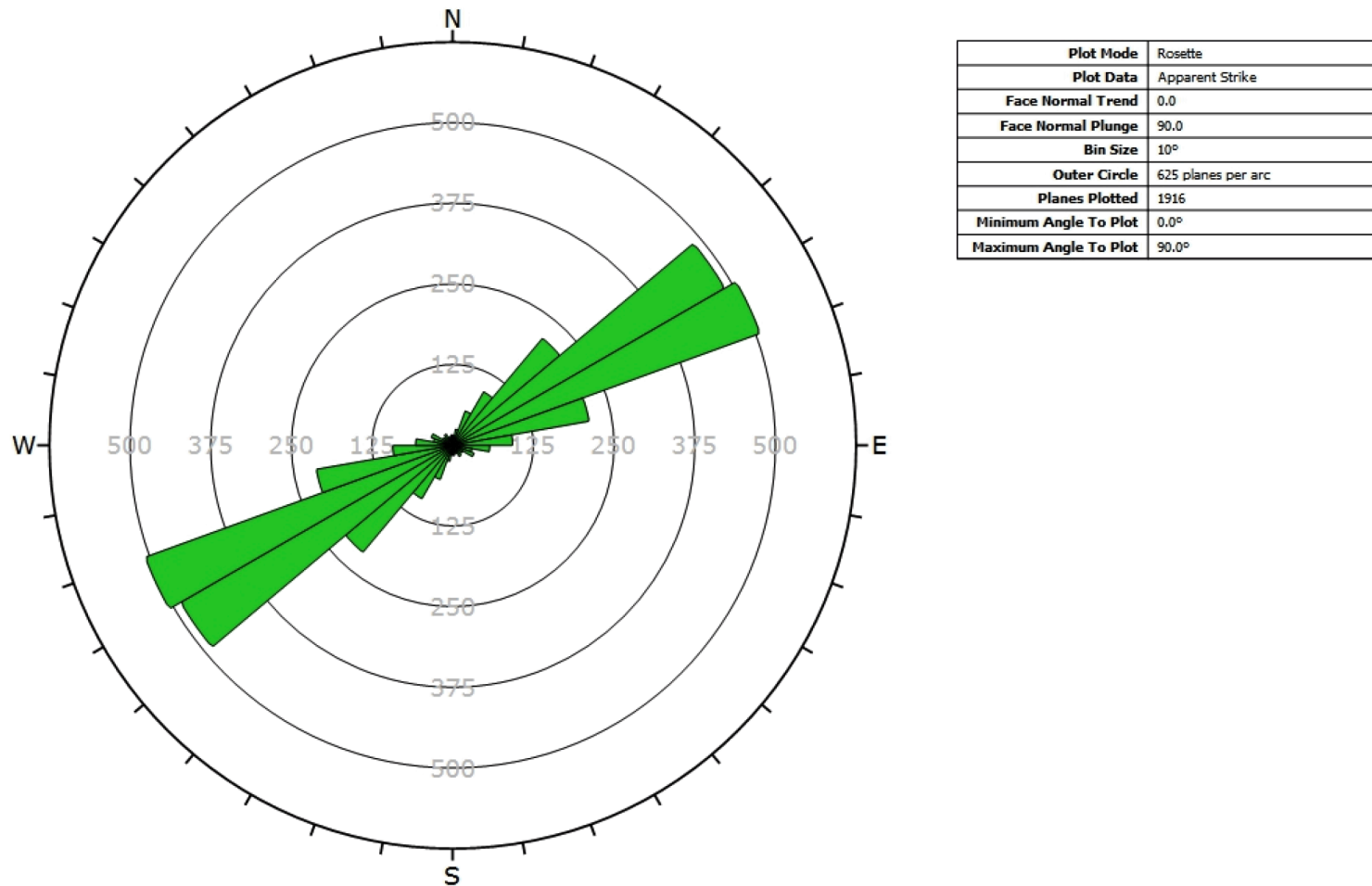


Figure 2.5.1-38. (Sheet 3 of 11) Acoustic Televiewer Data and Outcrop Mapping—Strike of Fractures



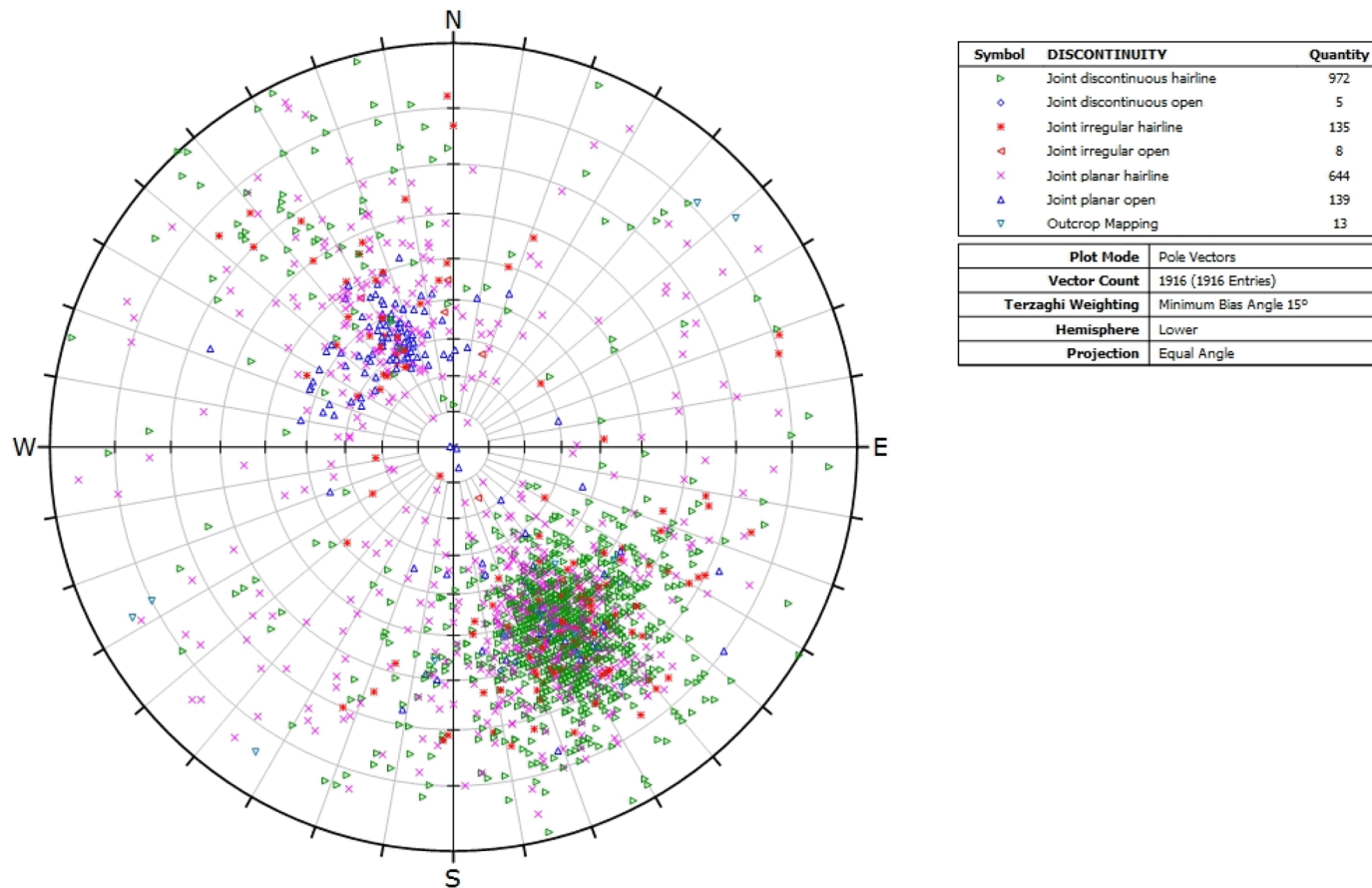


Figure 2.5.1-38. (Sheet 4 of 11) Acoustic Televiewer Data and Outcrop Mapping—Orientation of all Fractures

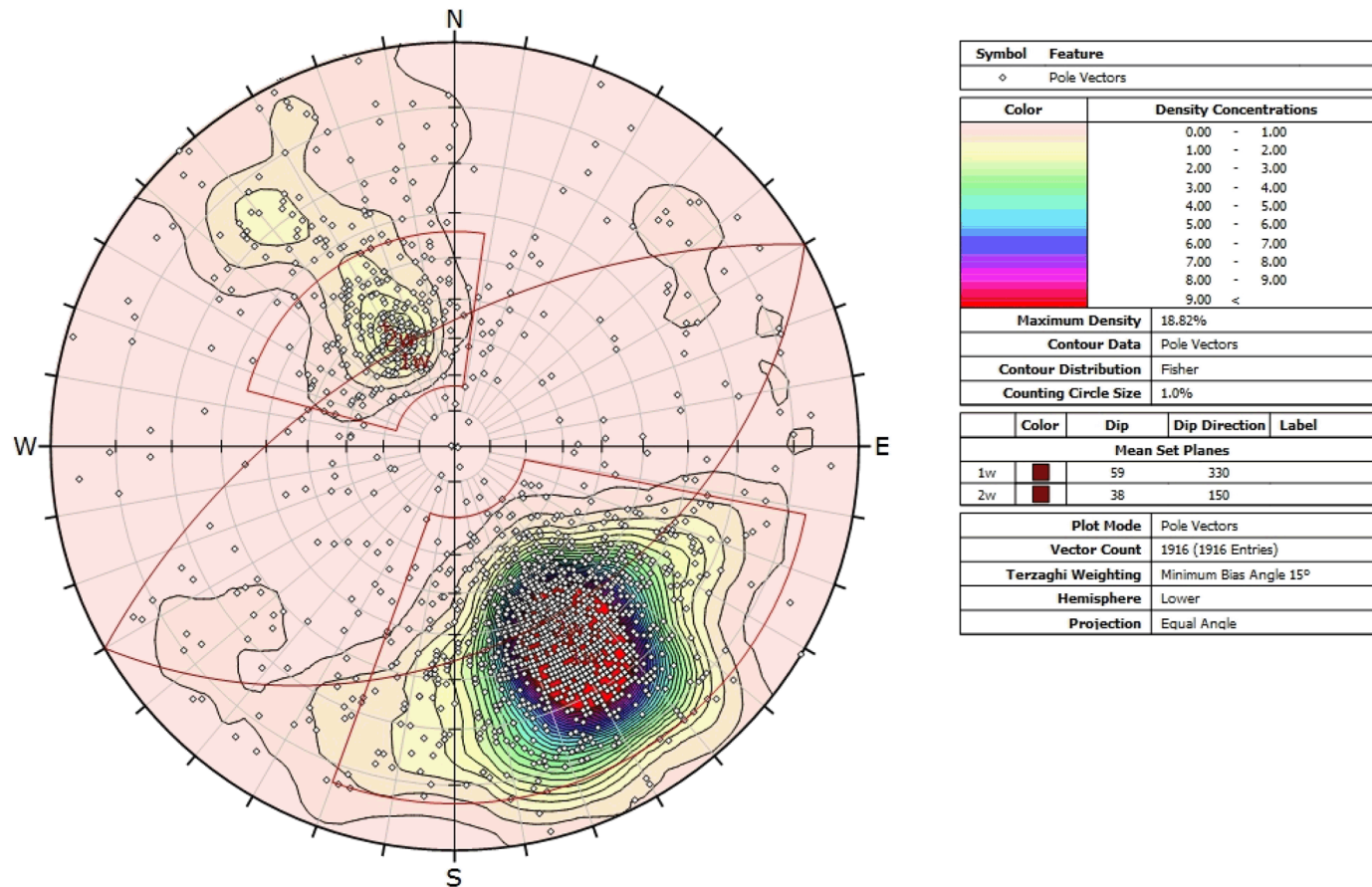


Figure 2.5.1-38. (Sheet 5 of 11) Acoustic Televiwer Data and Outcrop Mapping—Strike and Dip of Primary Fracture Sets

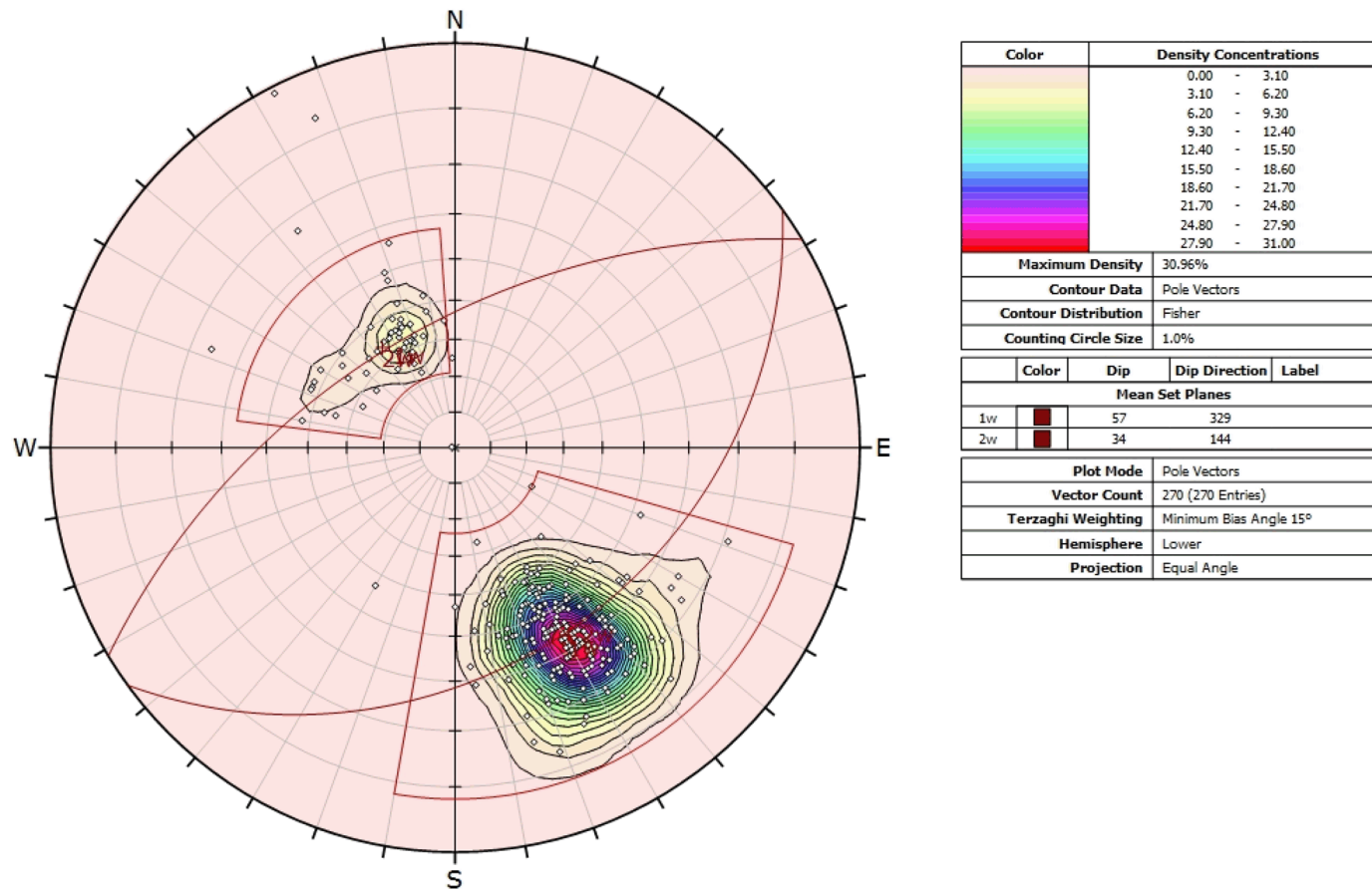


Figure 2.5.1-38. (Sheet 6 of 11) Acoustic Televiwer Data and Outcrop Mapping—Orientation of Fractures in the Benbolt Formation



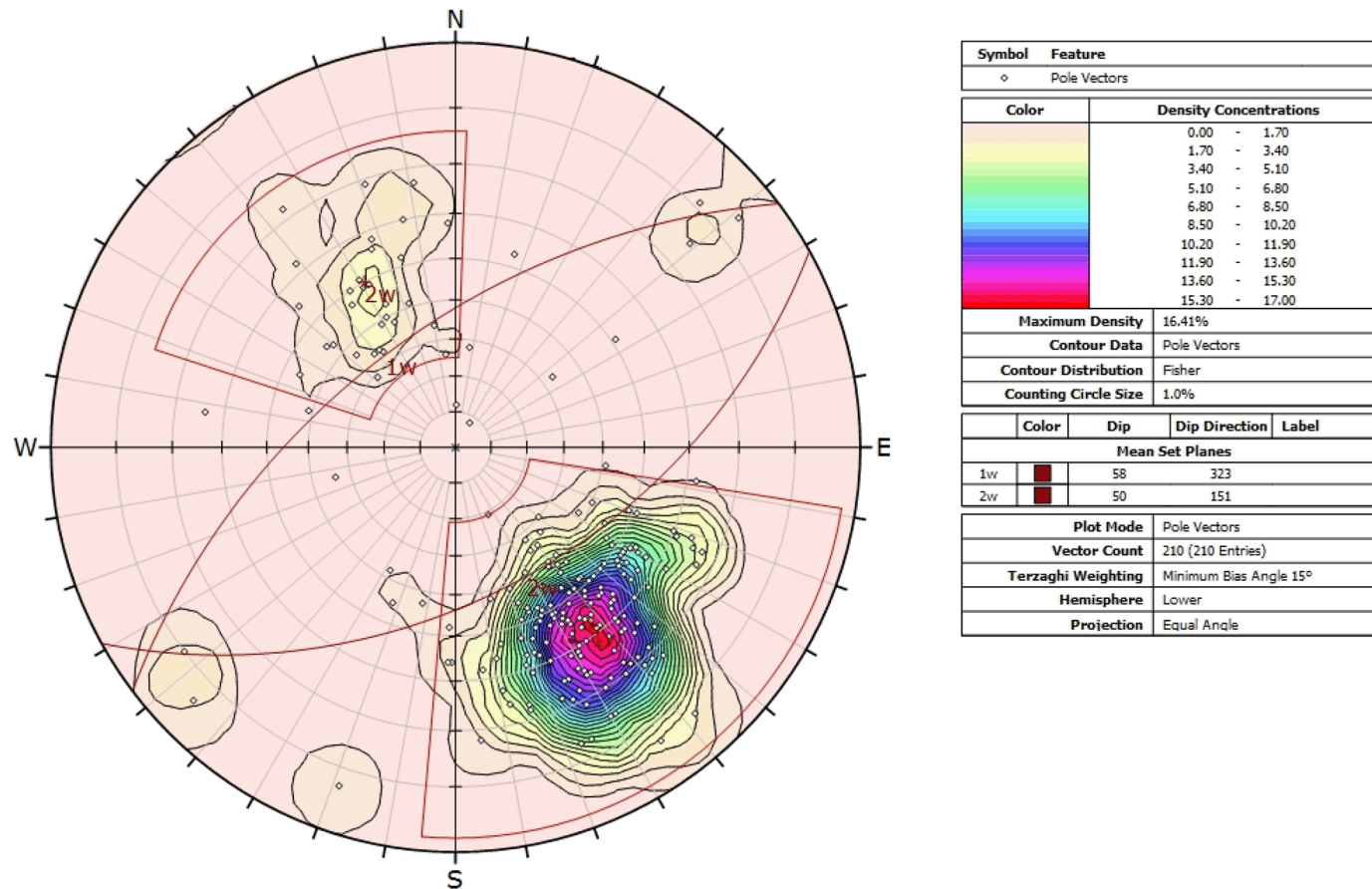


Figure 2.5.1-38. (Sheet 7 of 11) Acoustic Televiewer and Outcrop Mapping—Orientation of Fractures in the Blackford Formation

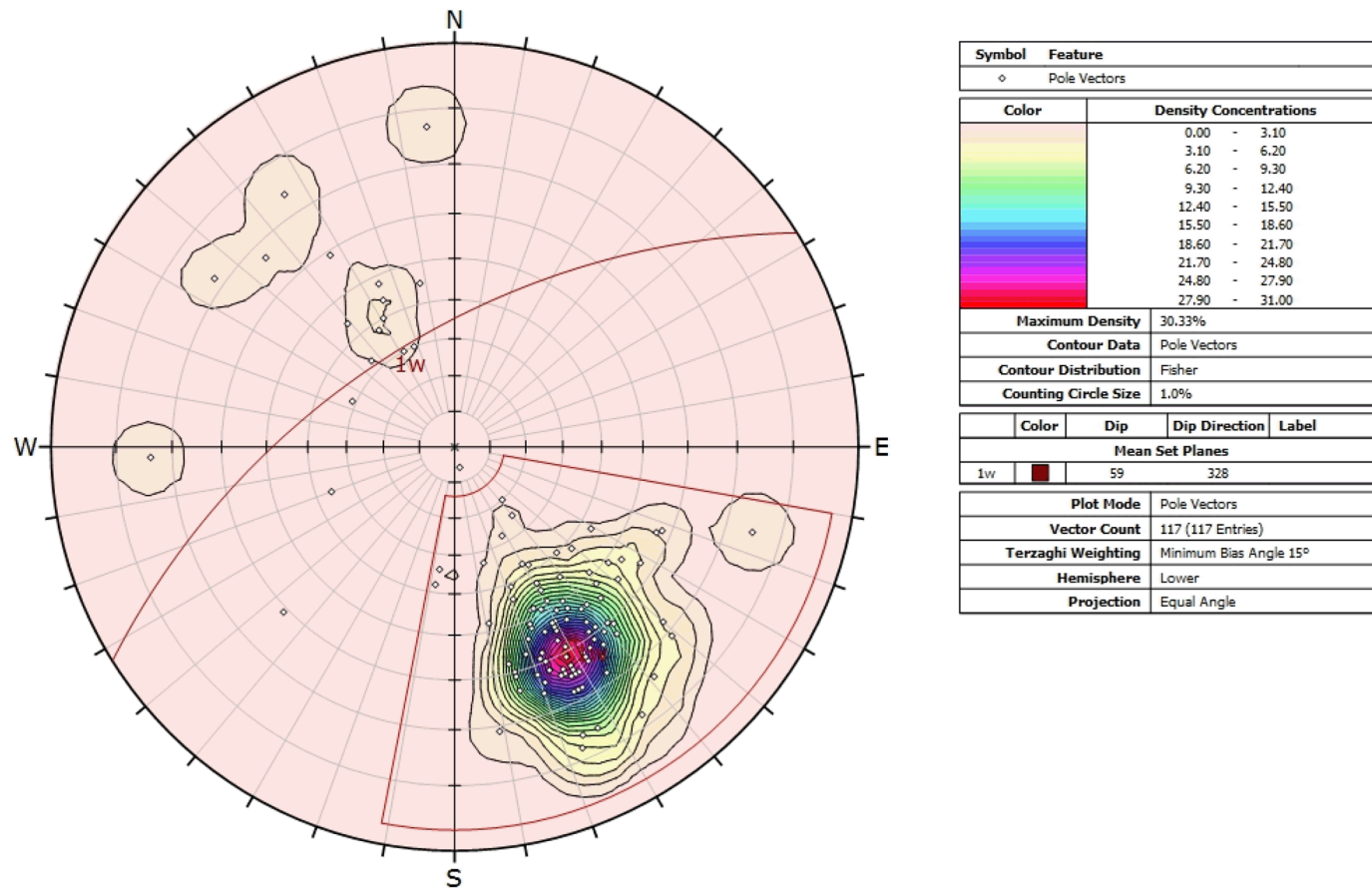


Figure 2.5.1-38. (Sheet 8 of 11) Acoustic Televiwer Data and Outcrop Mapping—Orientation of Fractures in the Eidson Formation

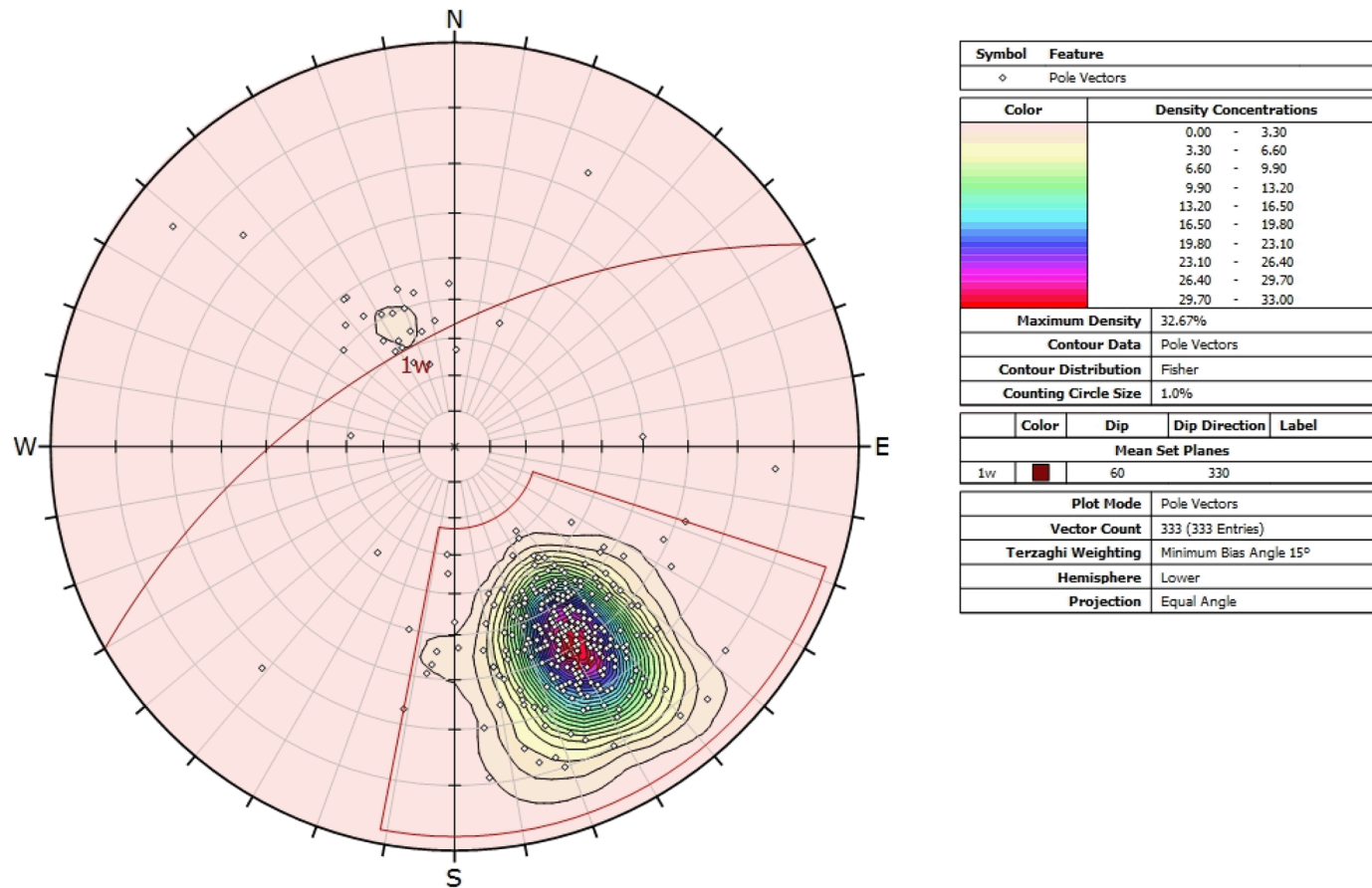


Figure 2.5.1-38. (Sheet 9 of 11) Acoustic Televiewer Data and Outcrop Mapping—Orientation of Fractures in the Fleanor Shale

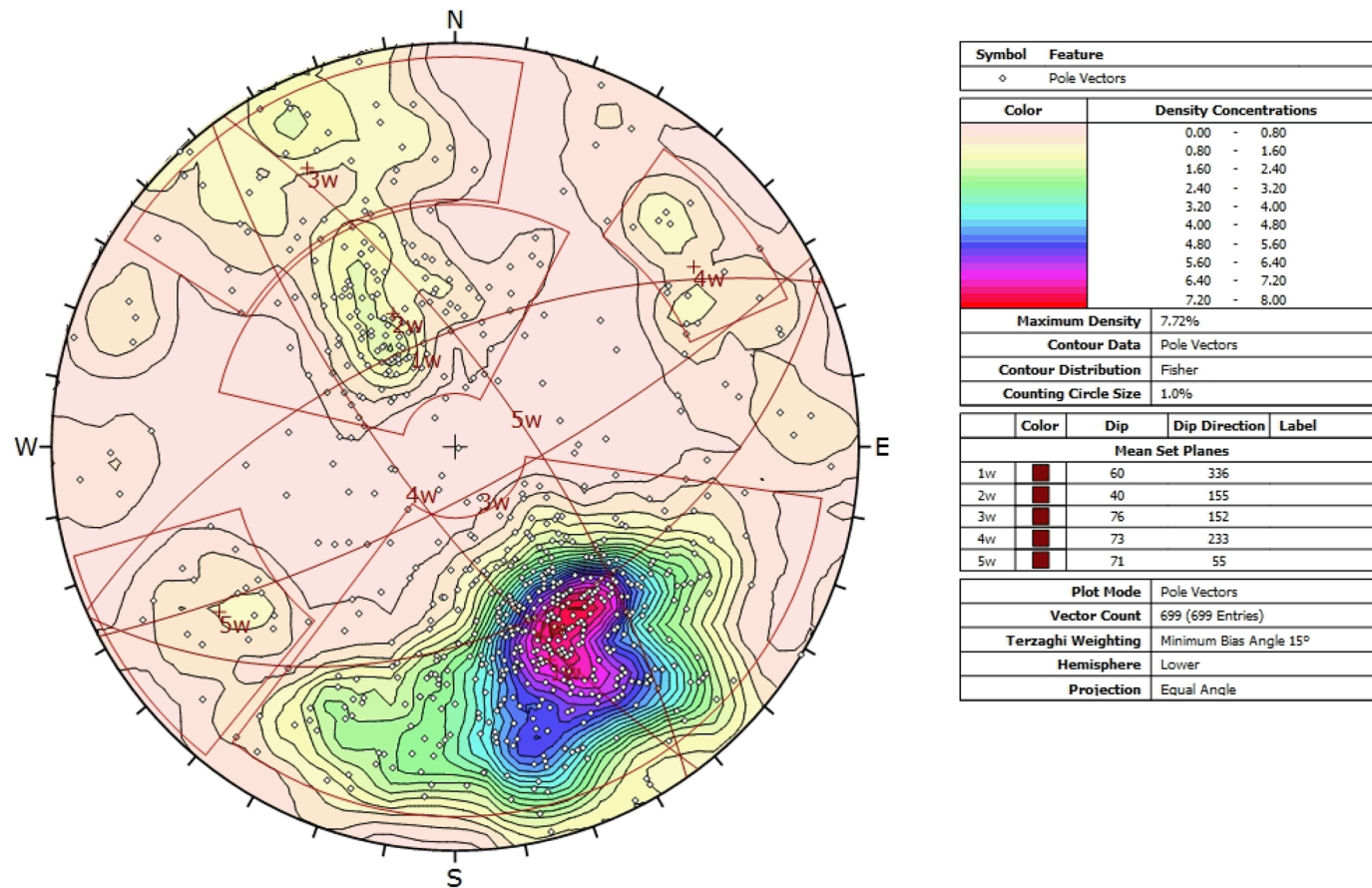


Figure 2.5.1-38. (Sheet 10 of 11) Acoustic Televiewer Data and Outcrop Mapping—Orientation of Fractures in the Newala Limestone



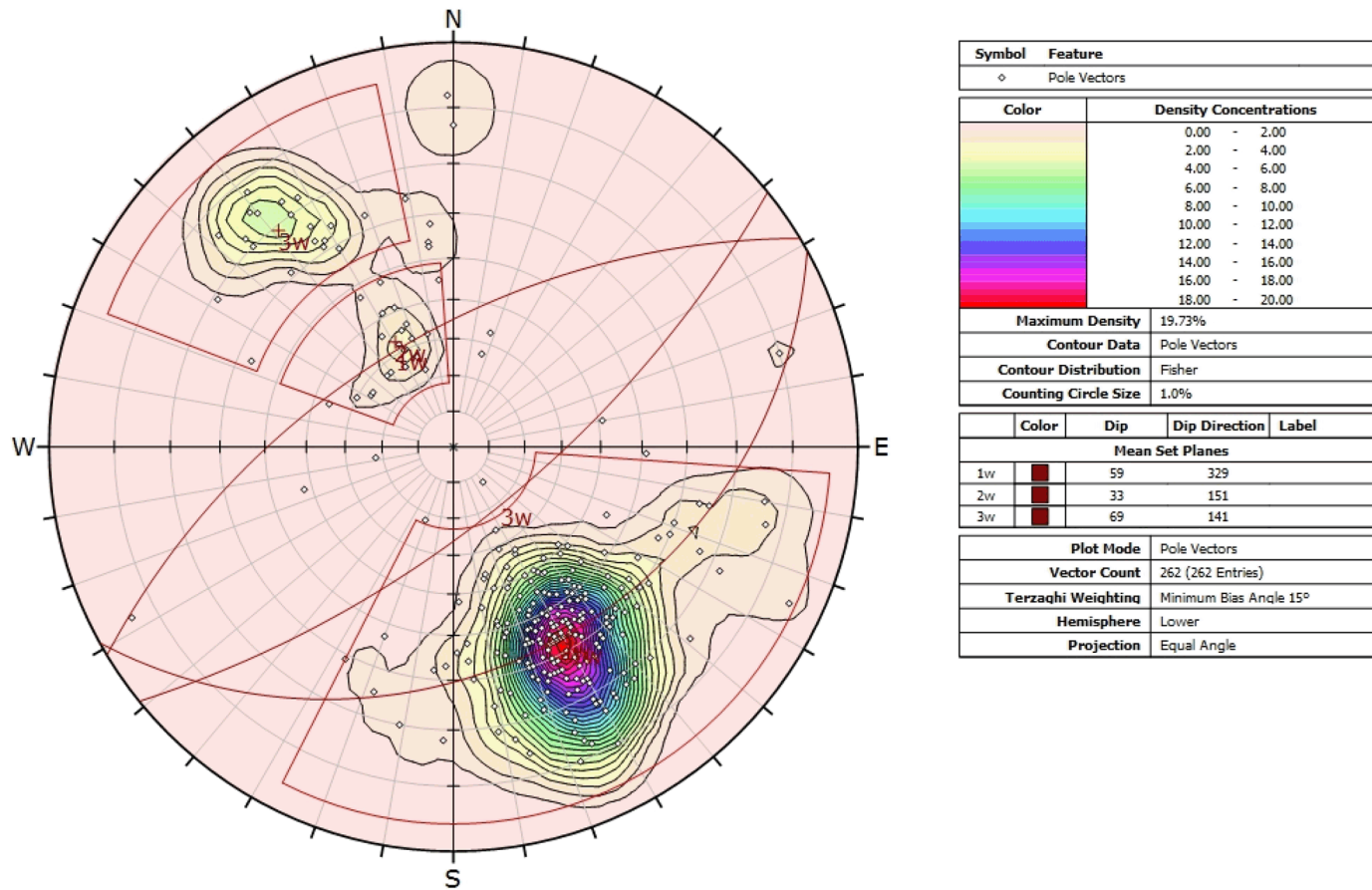
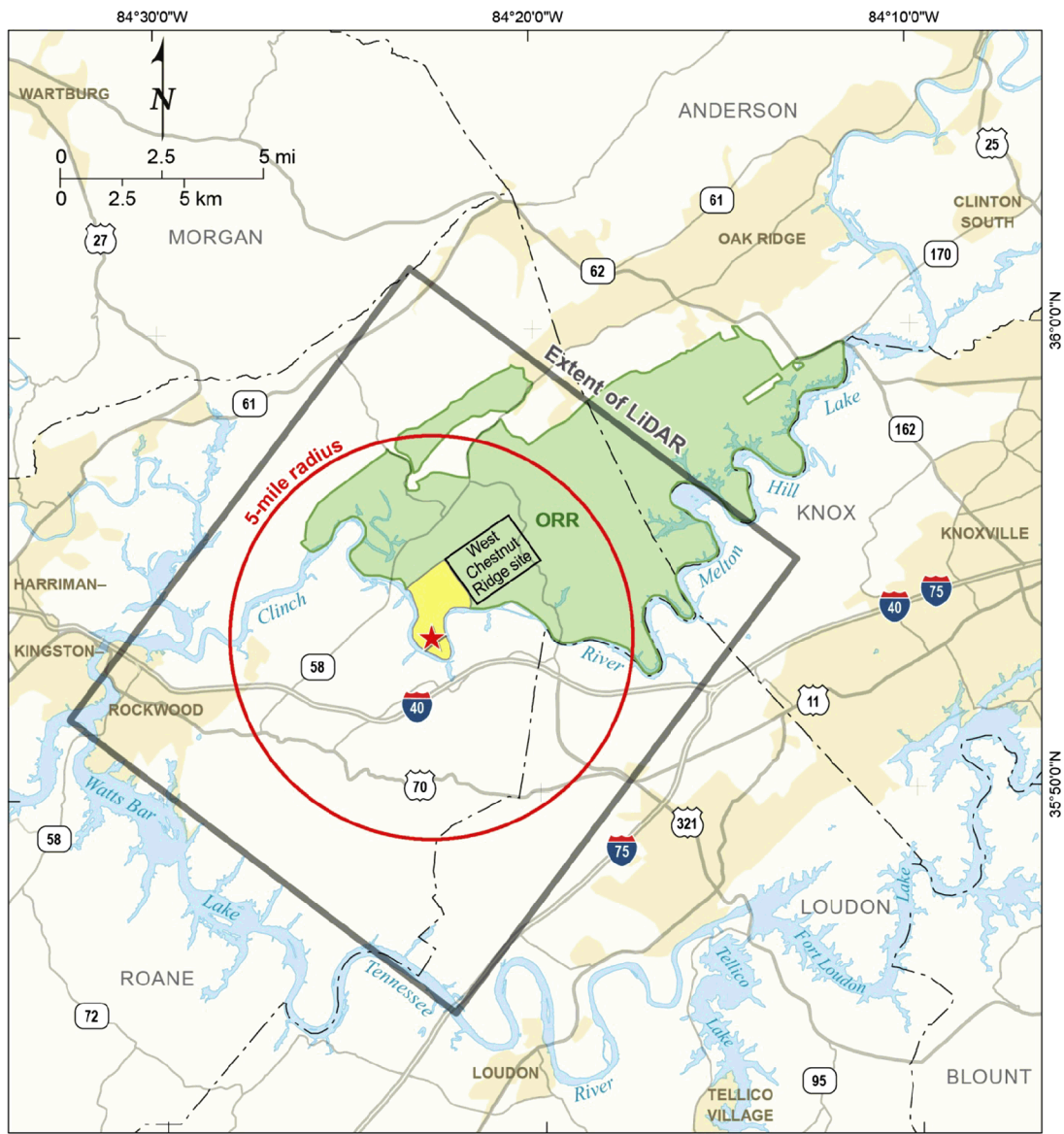


Figure 2.5.1-38. (Sheet 11 of 11) Acoustic Televiewer Data and Outcrop Mapping—Orientation of Fractures in the Rockdell Formation

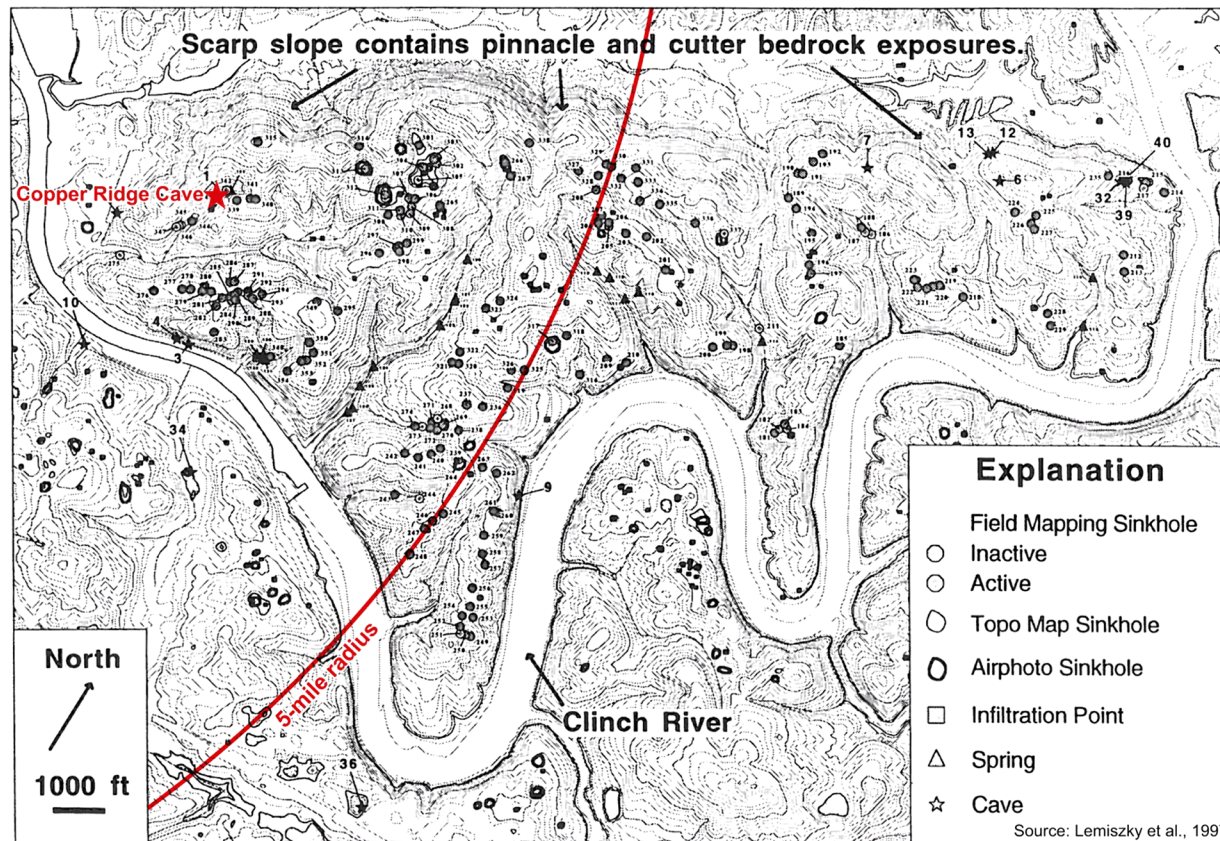
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**Explanation**

- Current DOE Oak Ridge Reservation (ORR)
- TVA Clinch River property
- CRN site centerpoint

**Figure 2.5.1-39. Site Area Map**

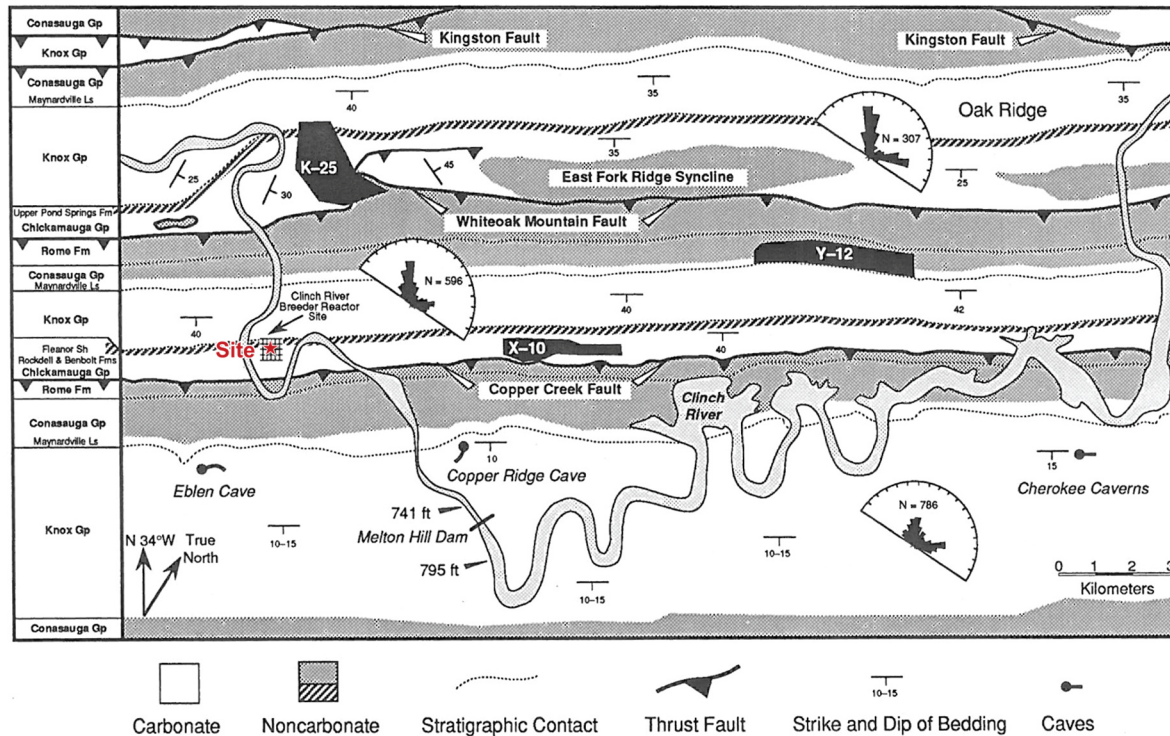


Source: Reference 2.5.1-239

Figure 2.5.1-40. Karst Features near Copper Ridge Cave



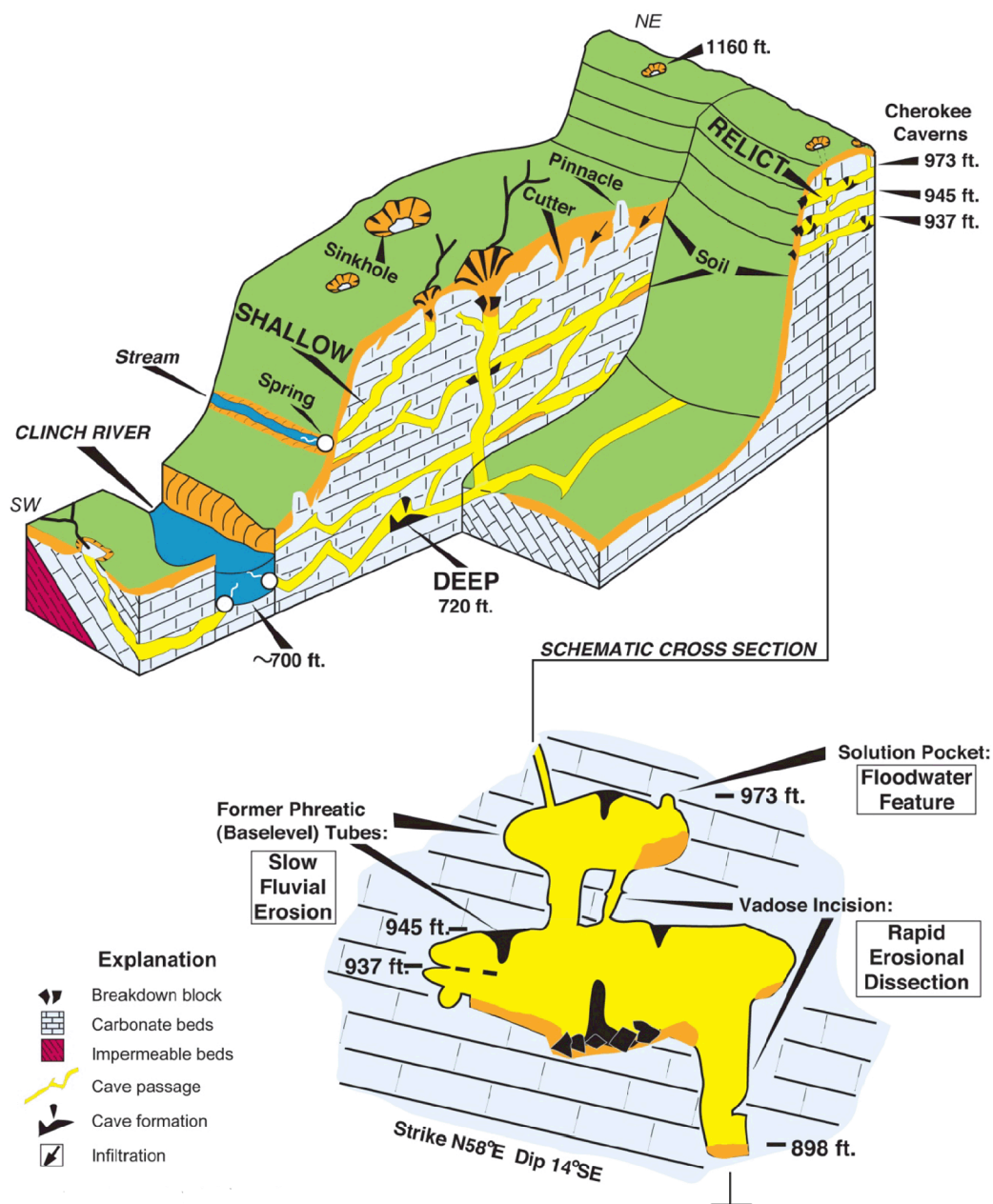
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Source: Reference 2.5.1-240

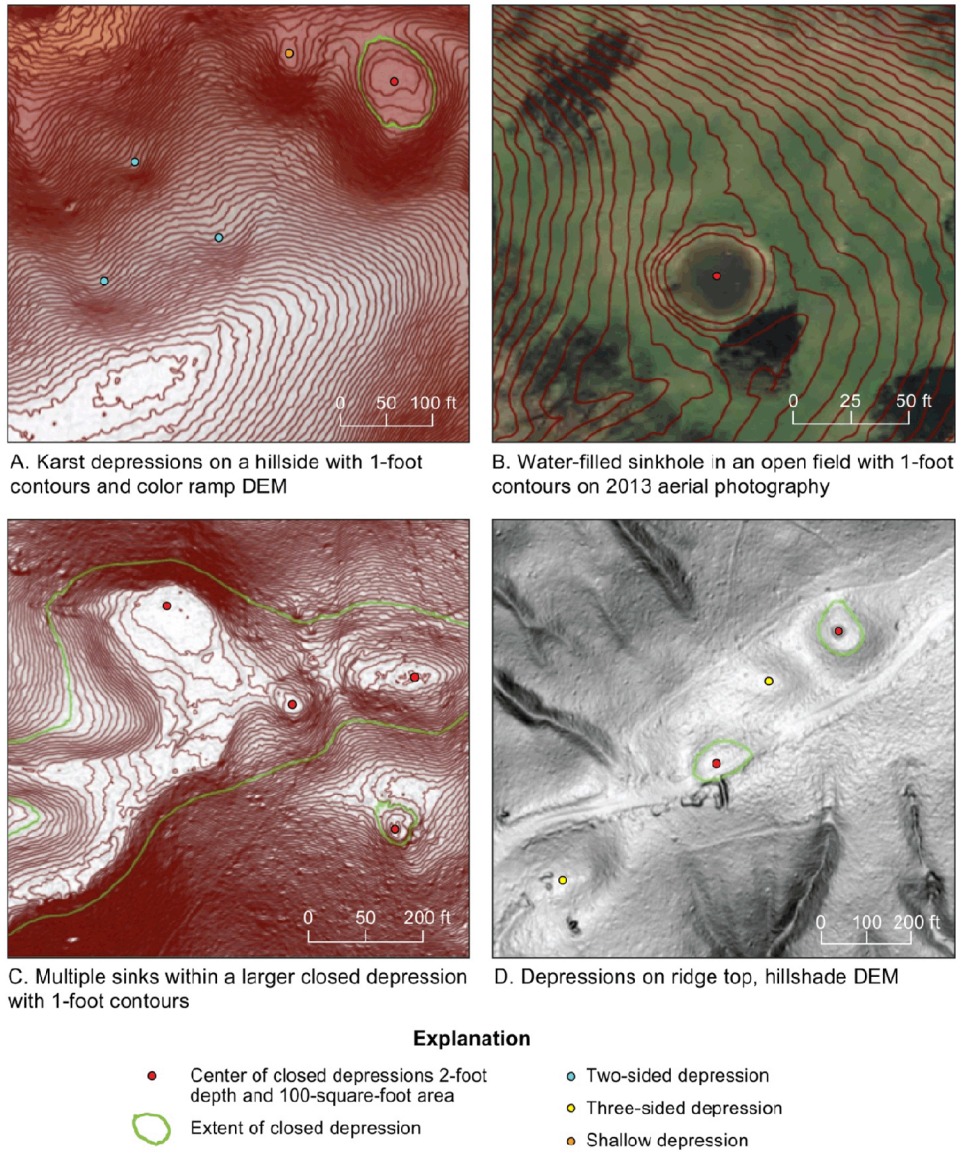
**Figure 2.5.1-41. Generalized Geologic Map of the Oak Ridge Area**





Source: Reference 2.5.1-240

**Figure 2.5.1-42. Conceptual Model for Karst Systems in the Oak Ridge Area**



**Figure 2.5.1-43. Examples of Karst Depressions Mapped from LiDAR Data**



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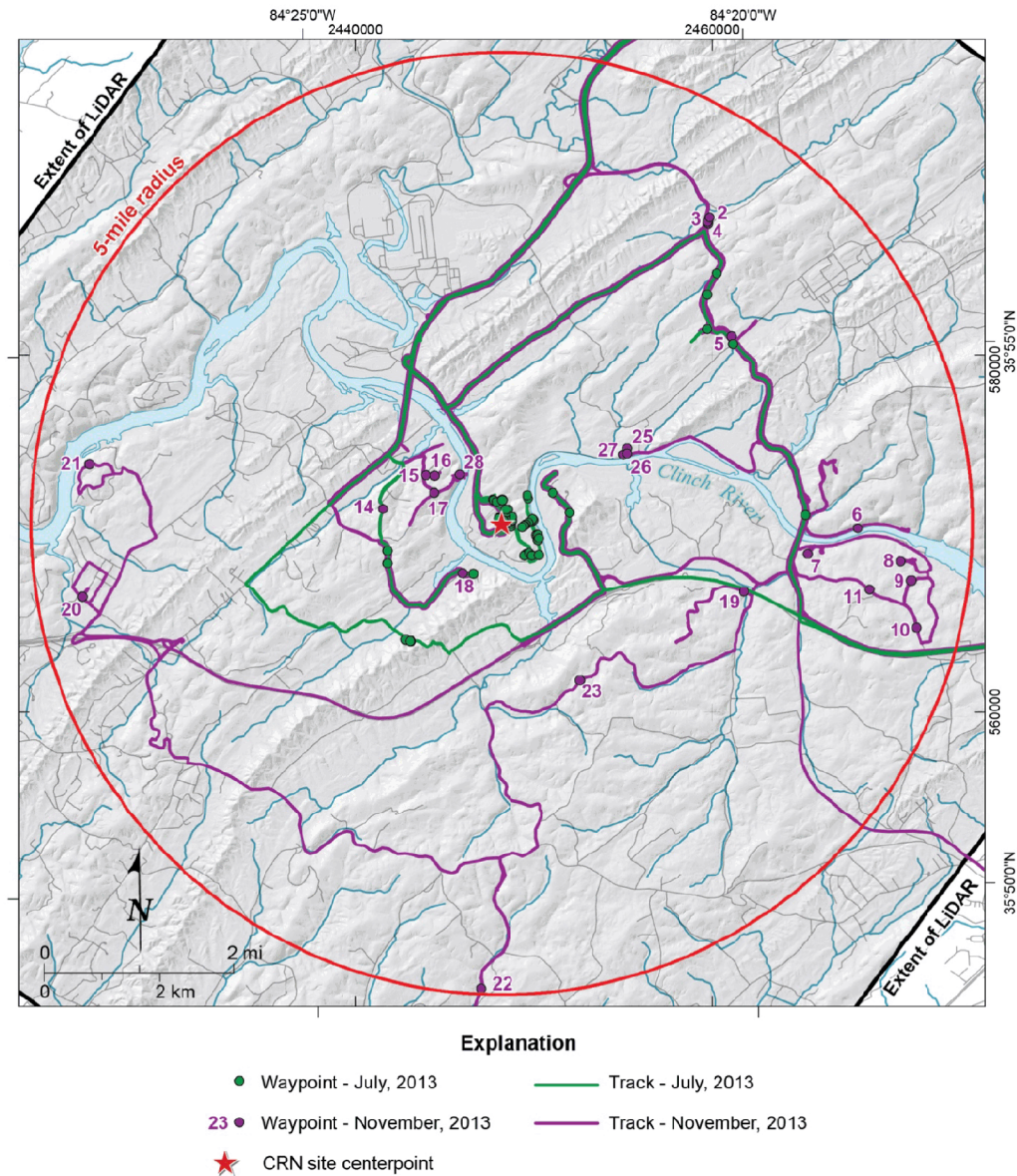


Figure 2.5.1-44. Location of Karst Field Reconnaissance





A. Pond in depression, Knox Group



B. Gentle depression, Knox Group



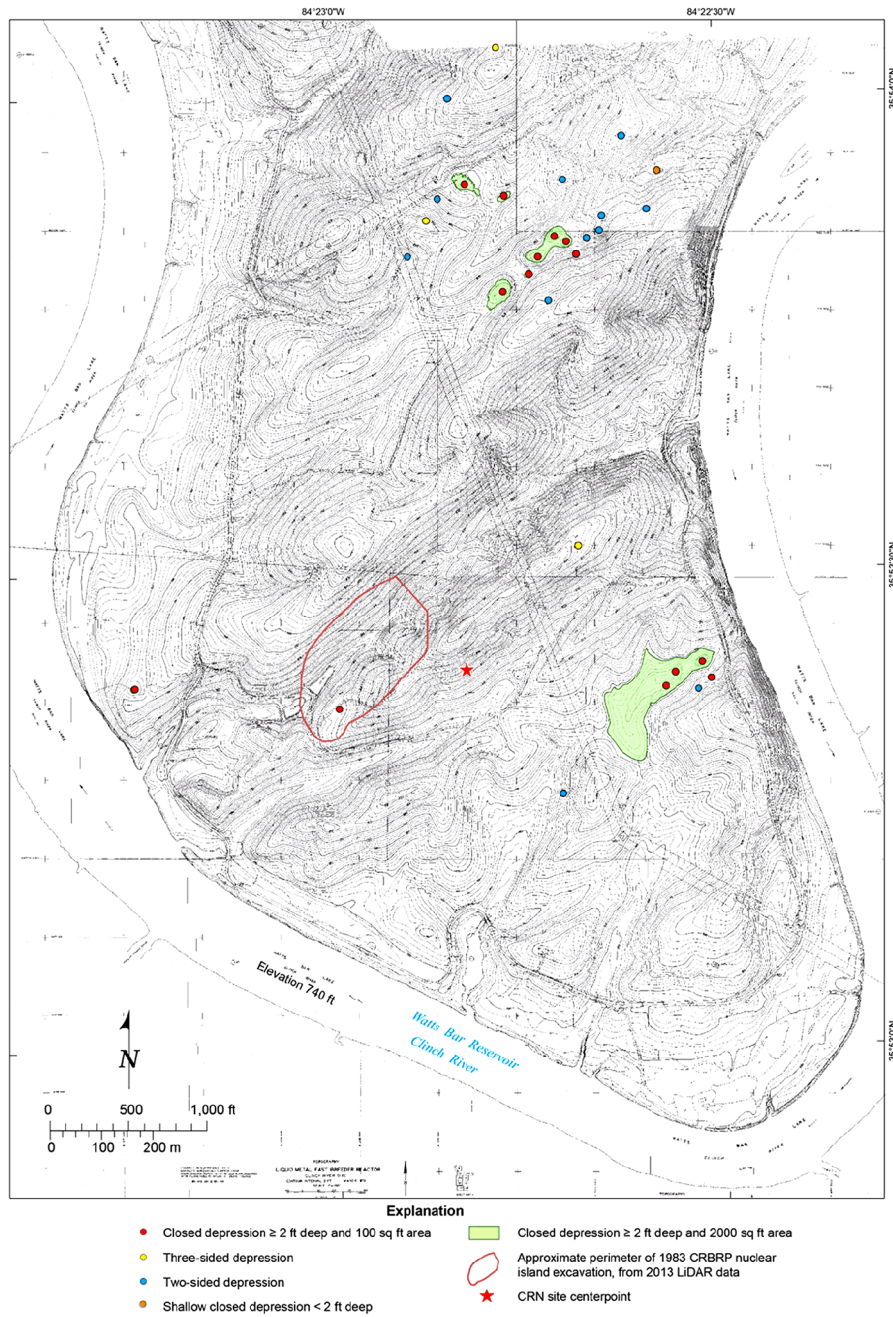
C. Active swallow, Witten Formation



D. Flat floor of depression, Witten Formation

**Figure 2.5.1-45. Field Photographs of Karst Depressions**

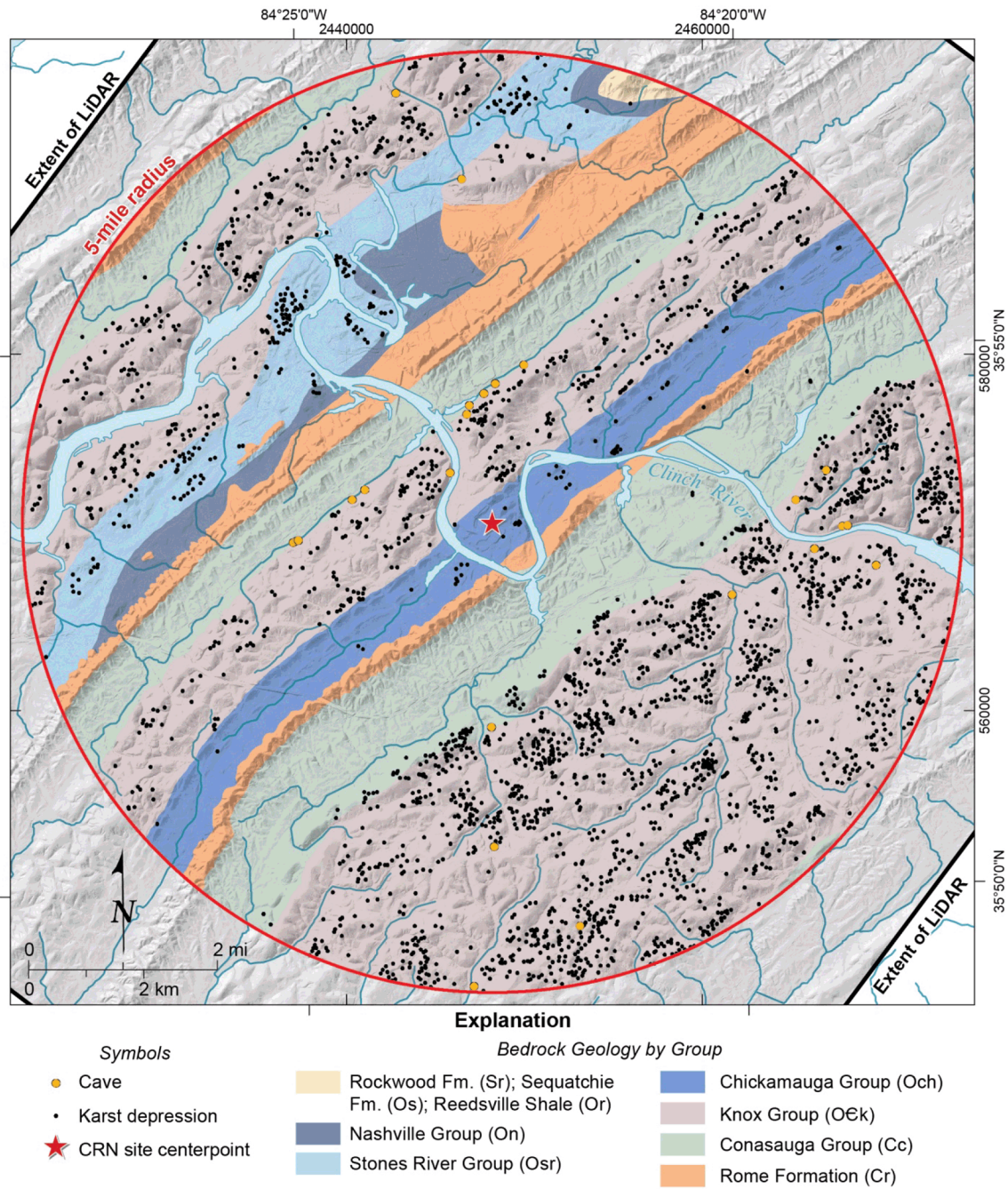
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**Figure 2.5.1-46. Surface Karst Features and Site Topography Associated with CRBRP Investigations (1973)**



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**Figure 2.5.1-47. Distribution of Mapped Karst Features in the Site Area**



A. Small stream passage, 3 ft-high, with alluvial deposits on floor



B. Large stream passage, 16 ft-wide, following bedding dip



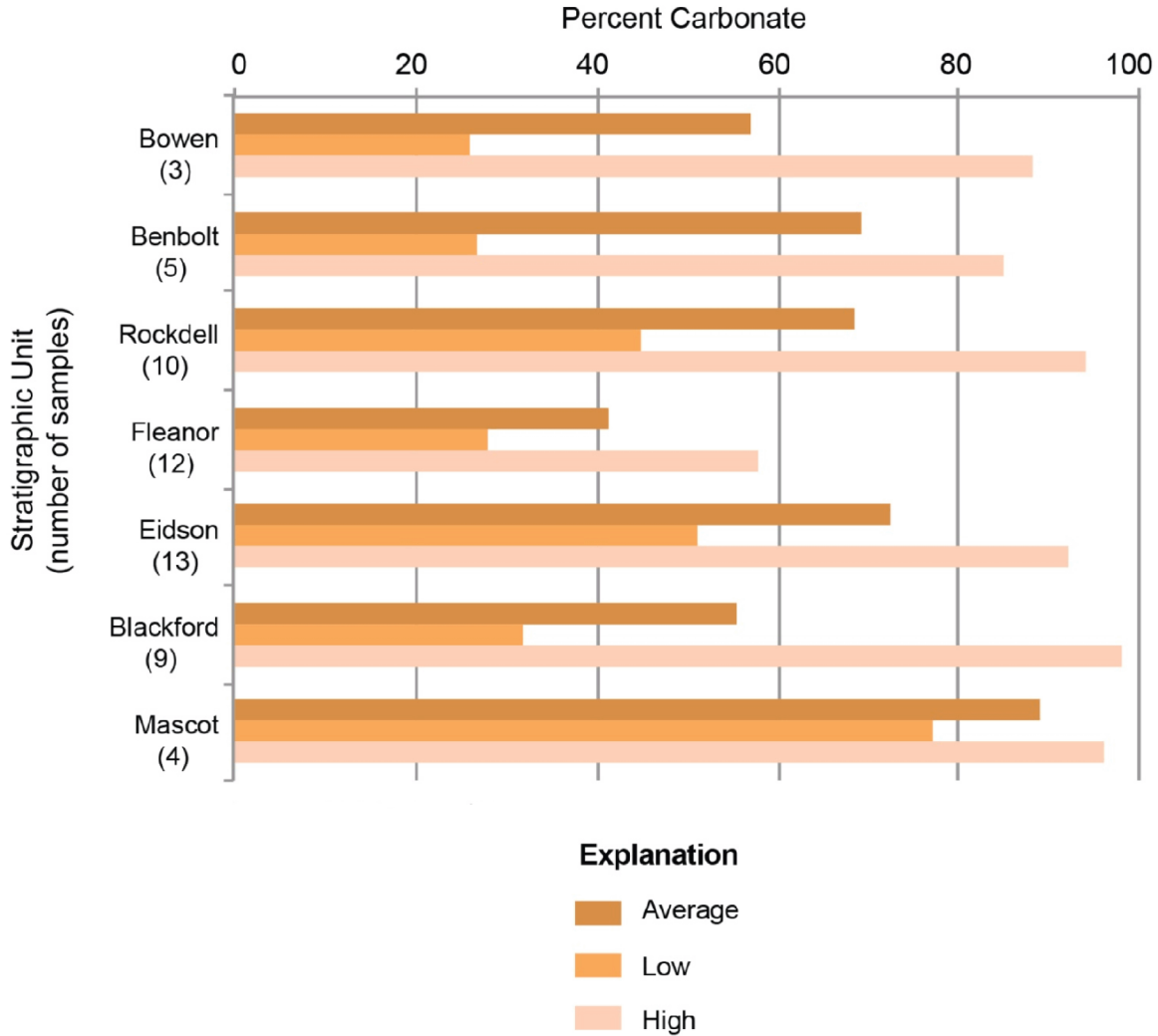
C. Solution enlargement at the intersection of joint and bedding plane



D. Ceiling collapse along bedding plane.

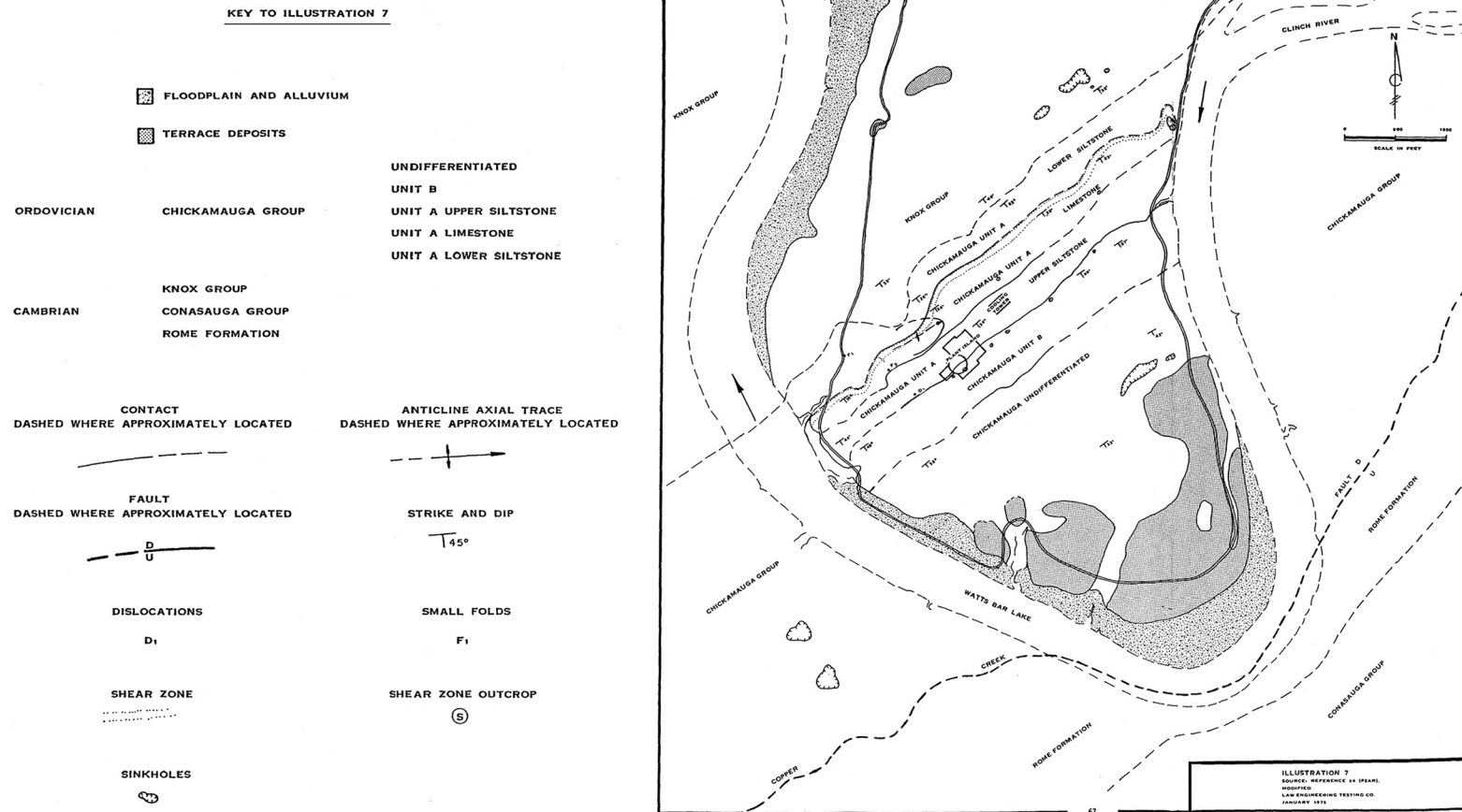
**Figure 2.5.1-48. Field Photographs of Cave Features**





**Figure 2.5.1-49. Carbonate Content of Rock Core Samples by Stratigraphic Unit**

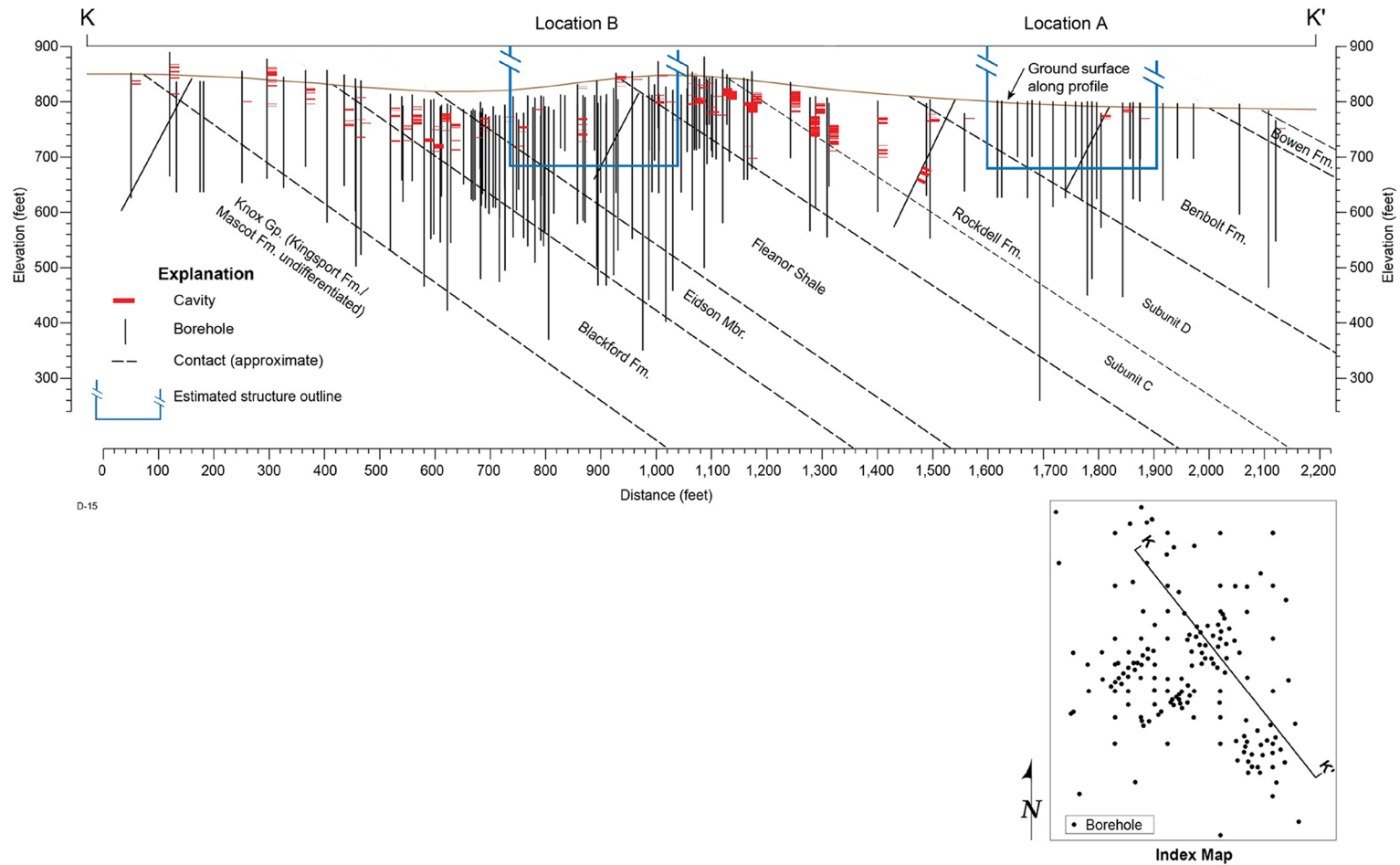
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Source: Page 216 of Reference 2.5.1-238

**Figure 2.5.1-50. Clinch River Breeder Reactor Project Geologic Map**

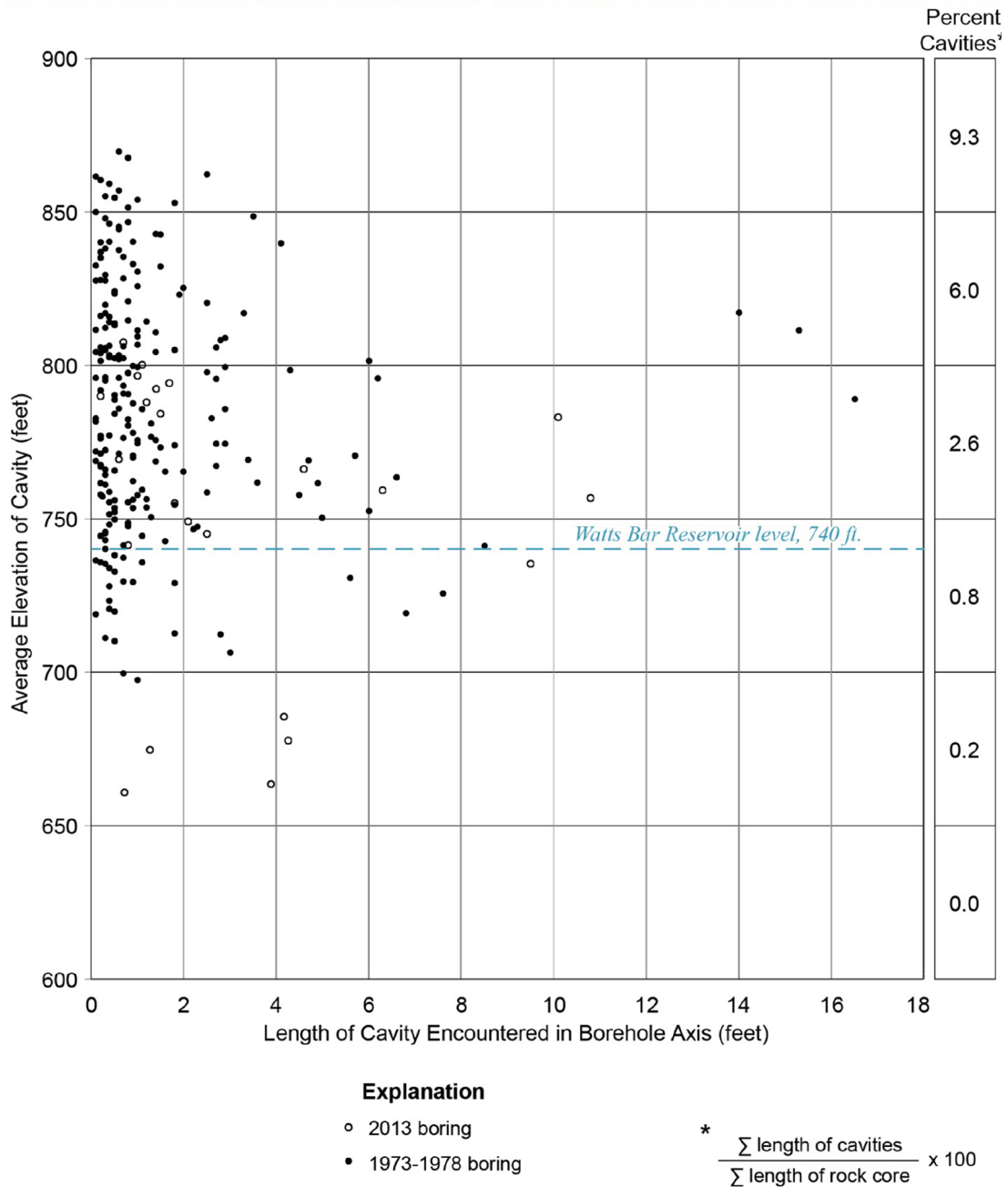
Clinch River Nuclear Site  
Early Site Permit Application  
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**Notes:**

1. Disconformity at the top of the Knox Group is not depicted in this Cross-Section.
2. Boreholes are projected on to a vertical plane oriented perpendicular to bedding strike of N52°E.
3. Borehole data are compiled from the CRBRP (Reference 2.5.1-100) and the CR SMR Project investigation (Reference 2.5.1-214).

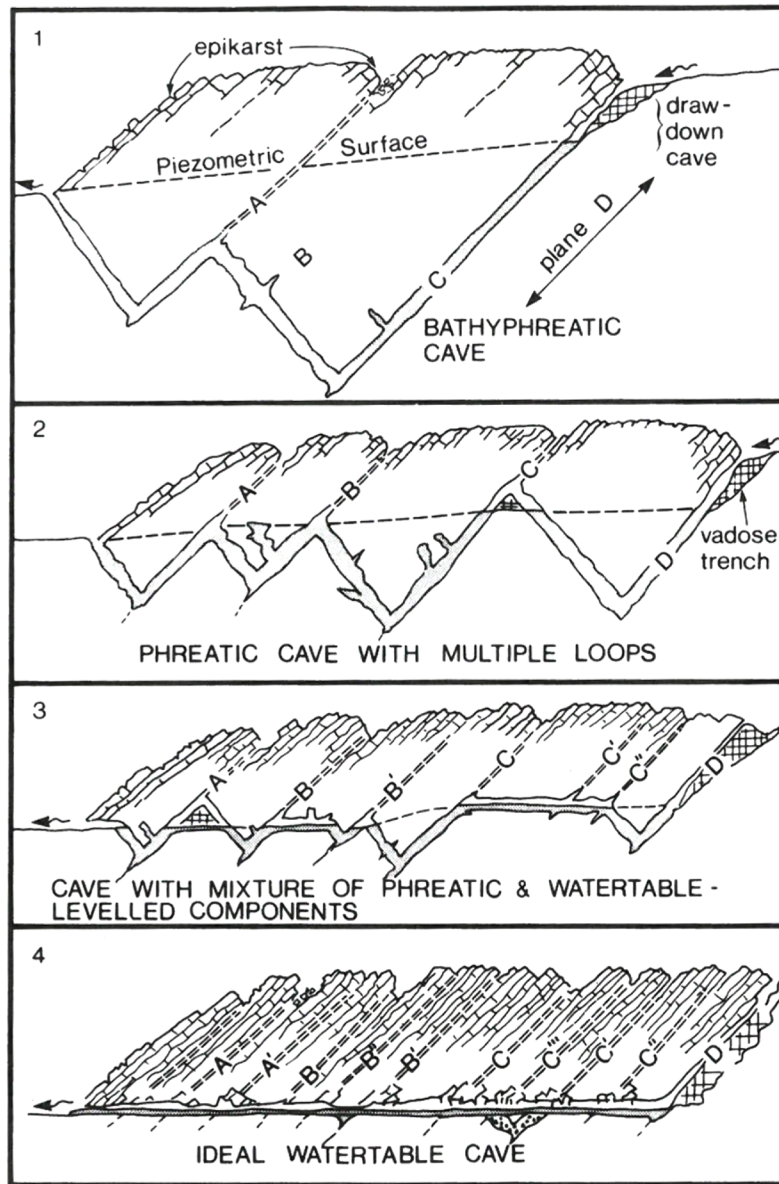
**Figure 2.5.1-51. Cross-Section Distribution of Cavities in Rock Core**



Sources: [Reference 2.5.1-100](#), [Reference 2.5.1-214](#)

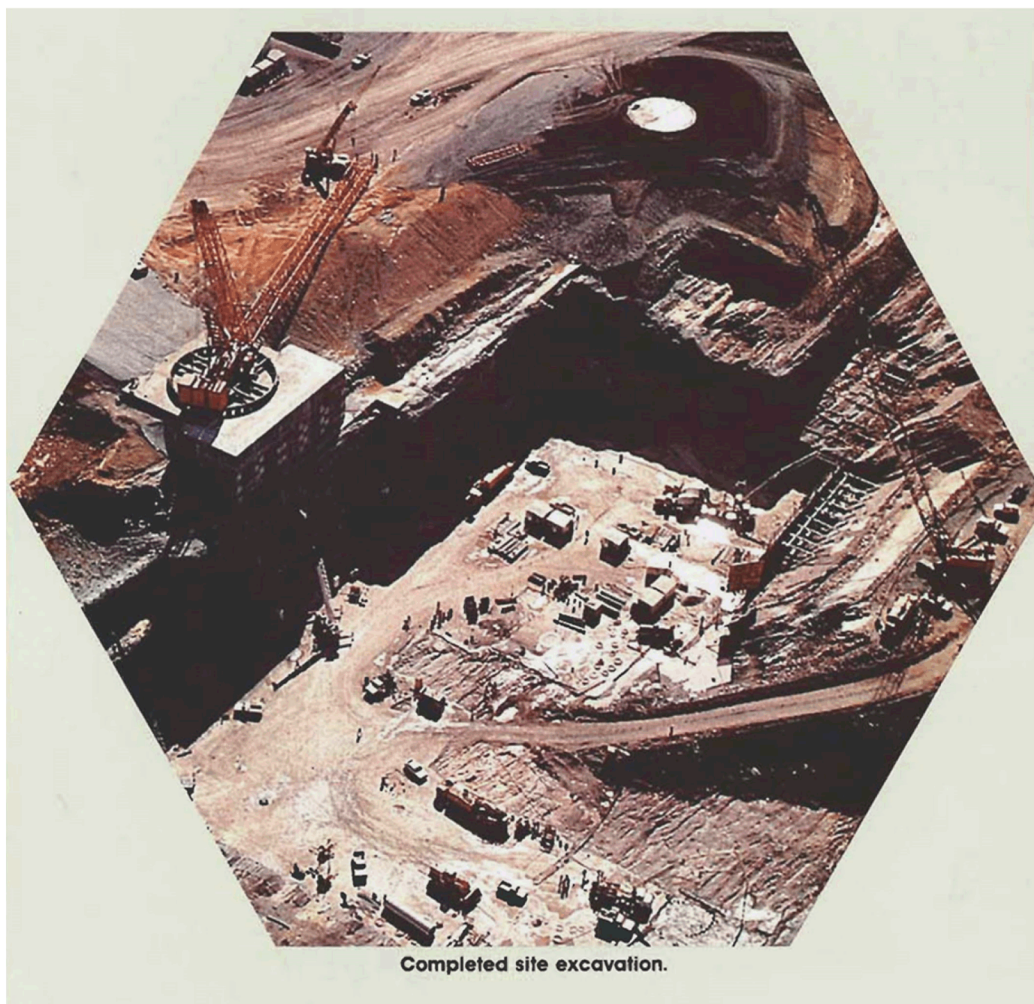
**Figure 2.5.1-52. Cavity Size and Elevation in Borings**





Source: Reference 2.5.1-7

**Figure 2.5.1-53. Model Showing Types of Phreatic and Water Table Caves**

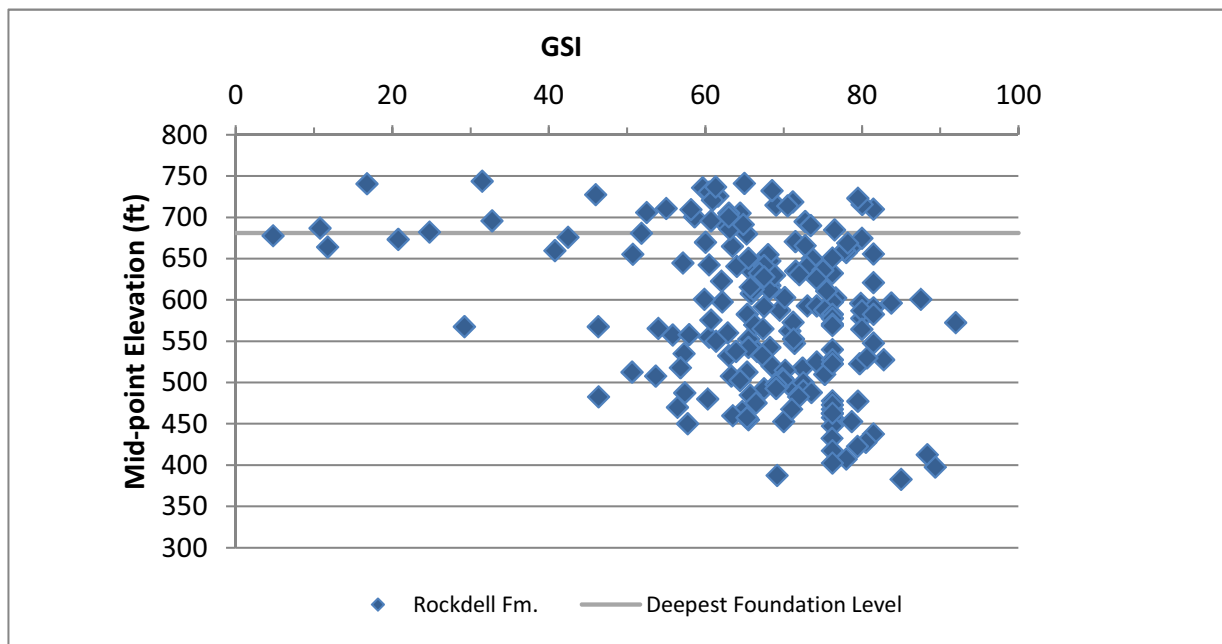
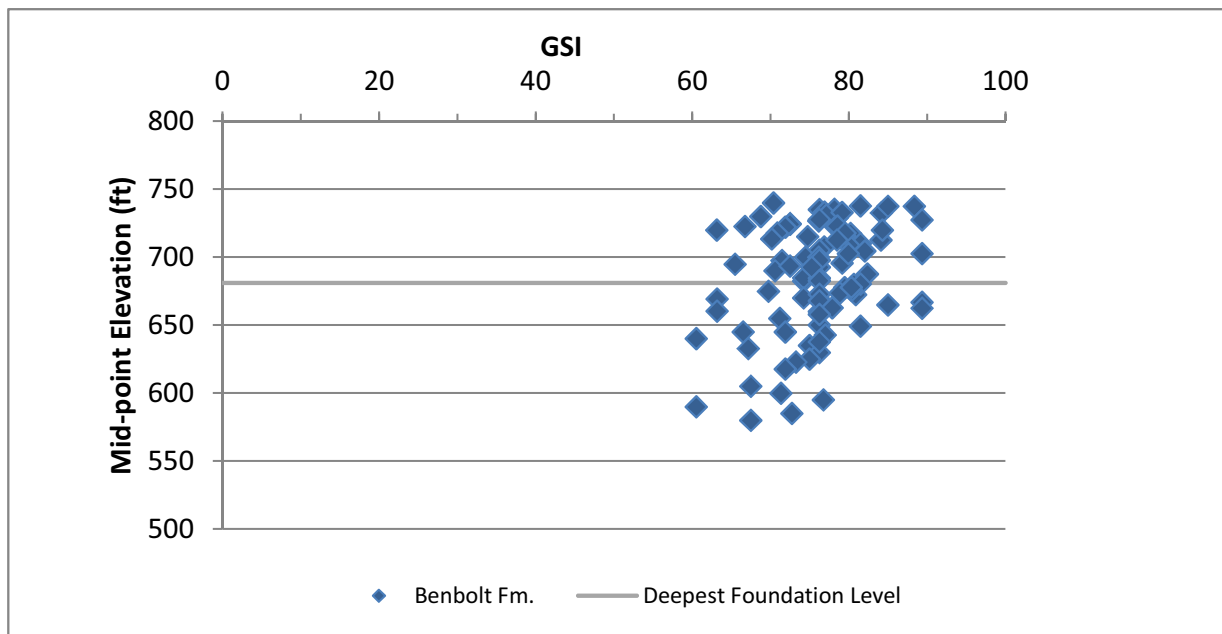


Source: [Reference 2.5.1-246](#)  
Oblique view south.

**Figure 2.5.1-54. Photograph of Completed Clinch River Breeder Reactor Project Excavation, 1983**



**Figure 2.5.1-55. Dissolution of Limestone Interbeds in the Blackford Formation**



**Figure 2.5.1-56. (Sheet 1 of 3) Scatter Plots of Geological Strength Index per Bedrock Unit**



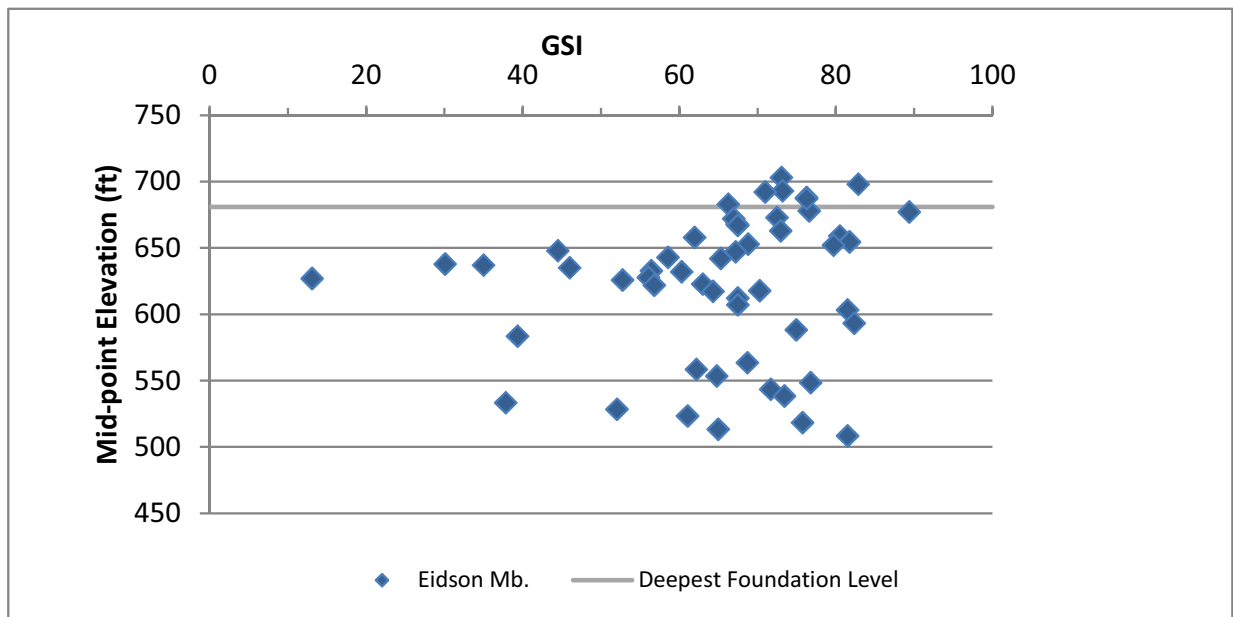
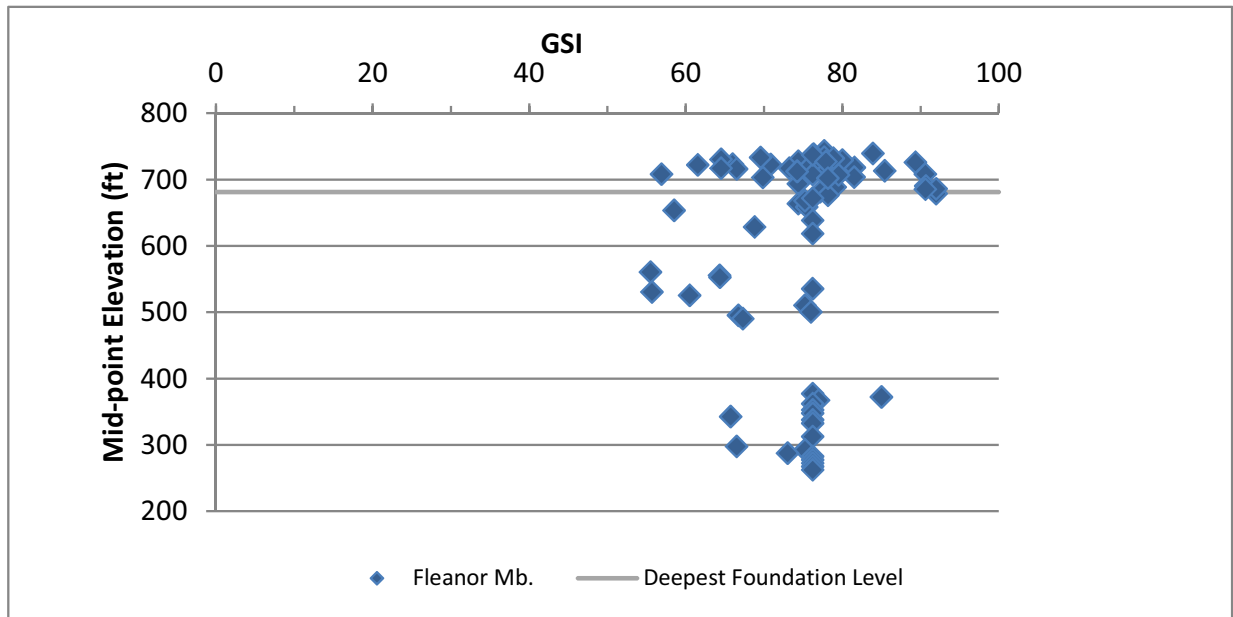
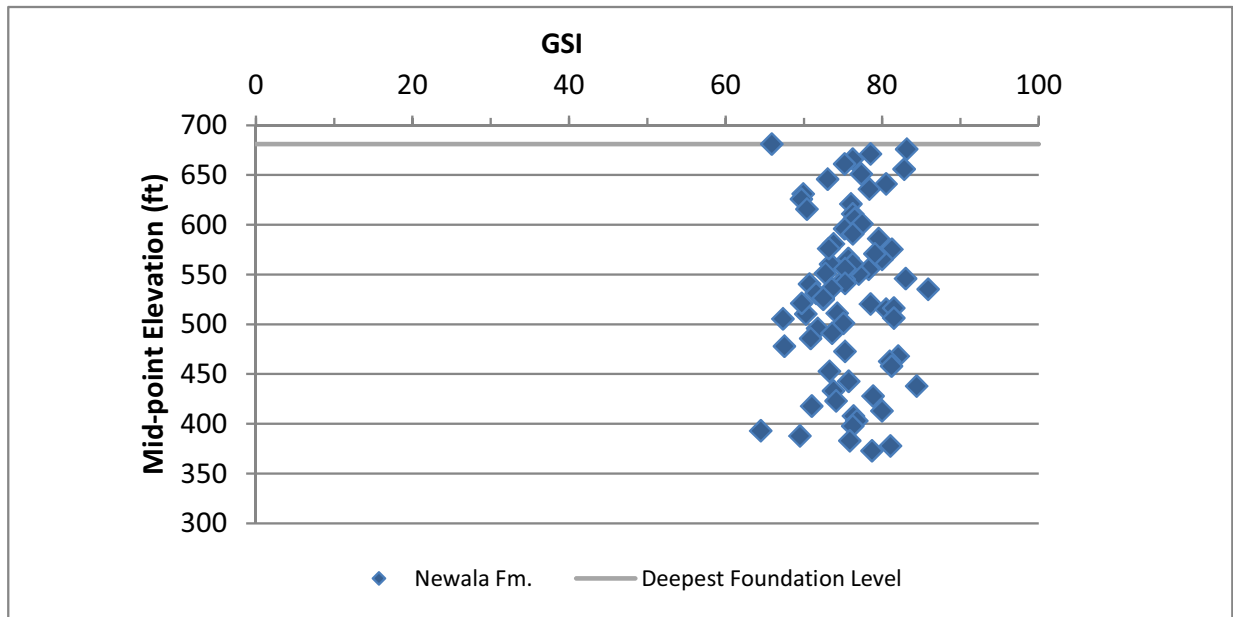
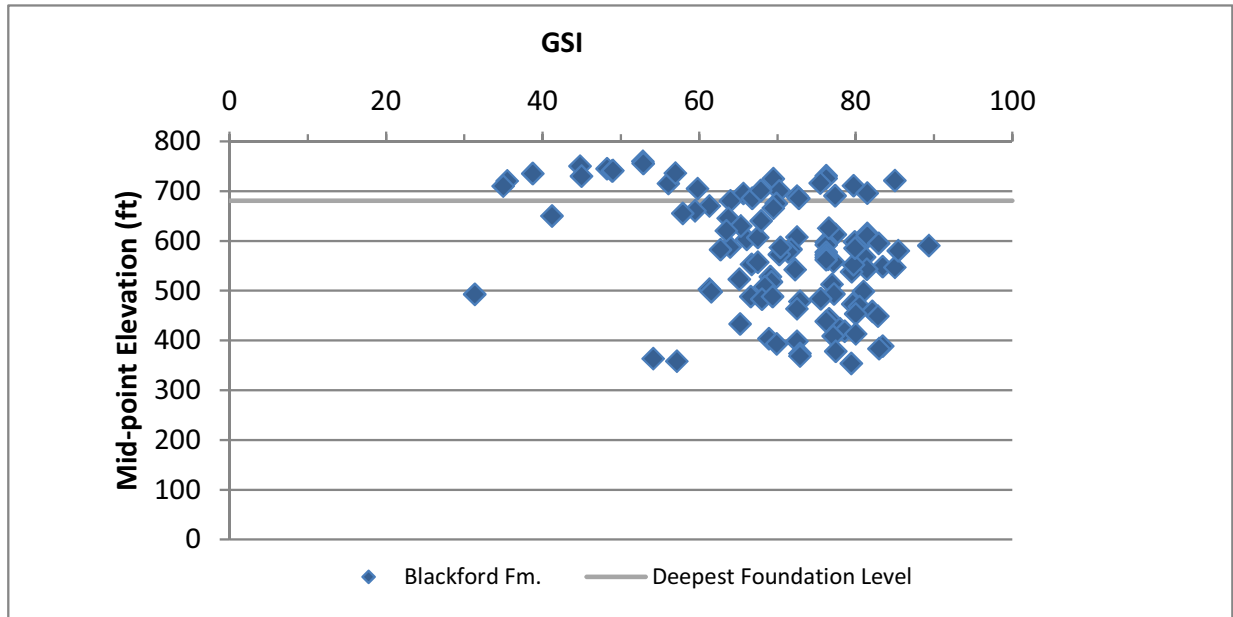
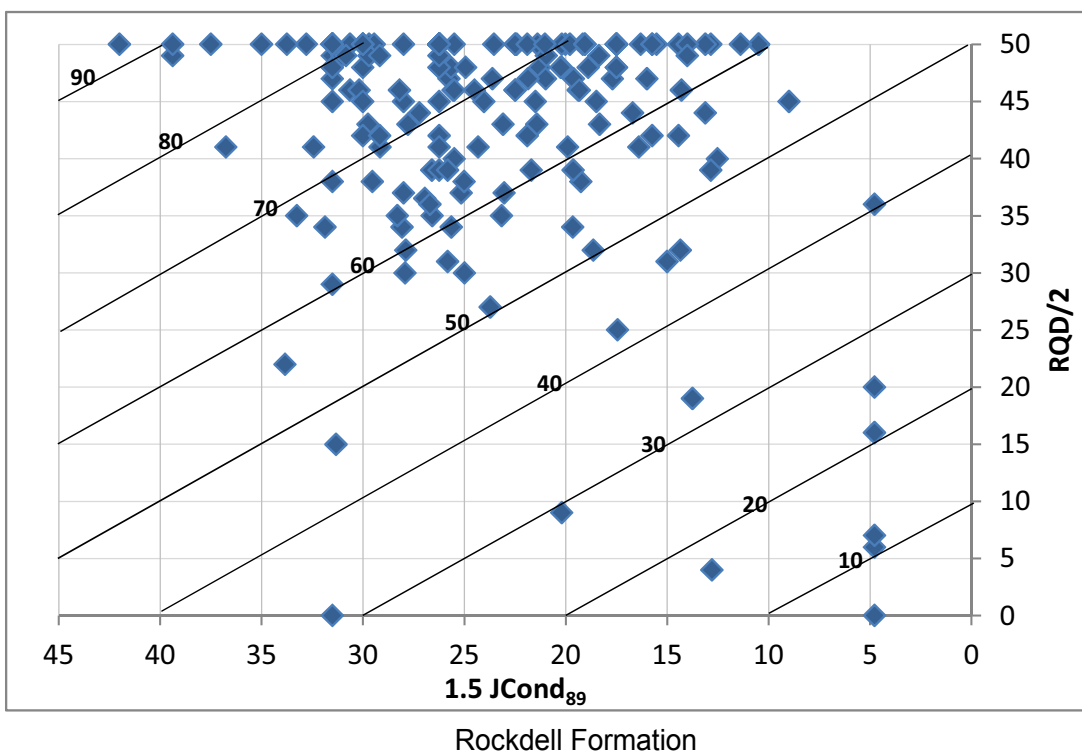
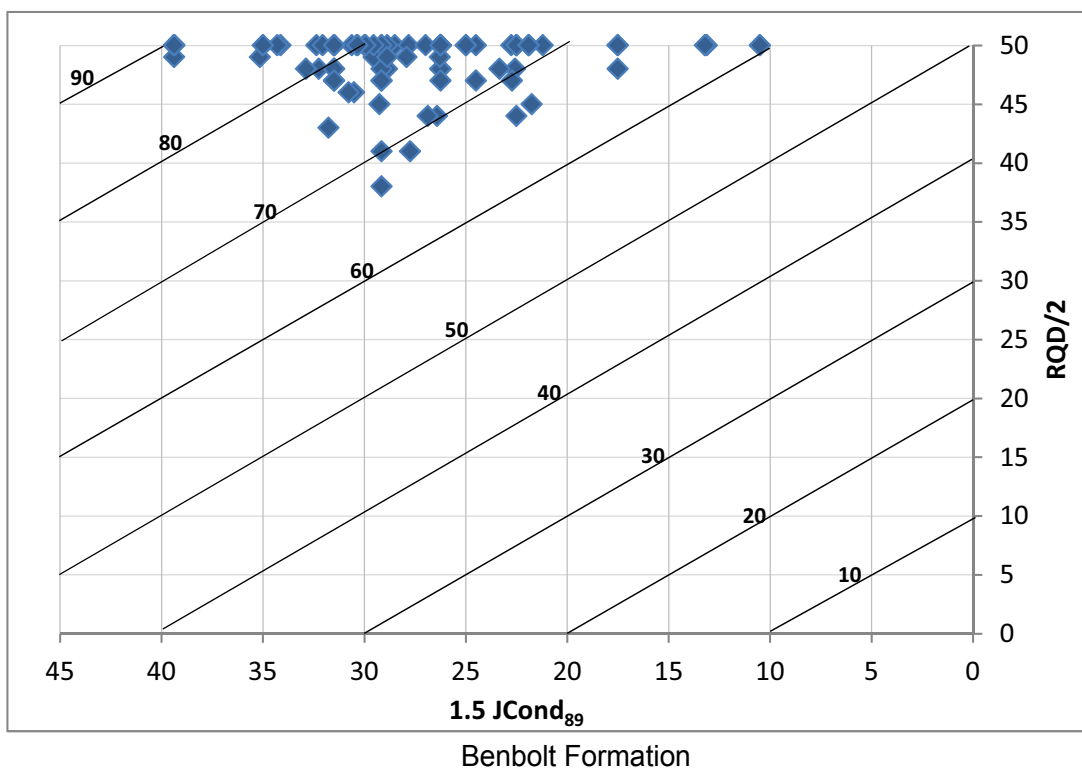


Figure 2.5.1-56. (Sheet 2 of 3) Scatter plots of Geological Strength Index per Bedrock Unit



**Figure 2.5.1-56. (Sheet 3 of 3) Scatter Plots of Geological Strength Index per Bedrock Unit**



Note: JCond<sub>89</sub> = Joint Condition Rating; GSI = Geological Strength Index; RQD = Rock Quality Designation

**Figure 2.5.1-57. (Sheet 1 of 3) Portion of GSI Chart Showing 1.5 JCond<sub>89</sub> Against RQD/2 and GSI per Bedrock Unit (Extended to Show RQD/2 > 40)**

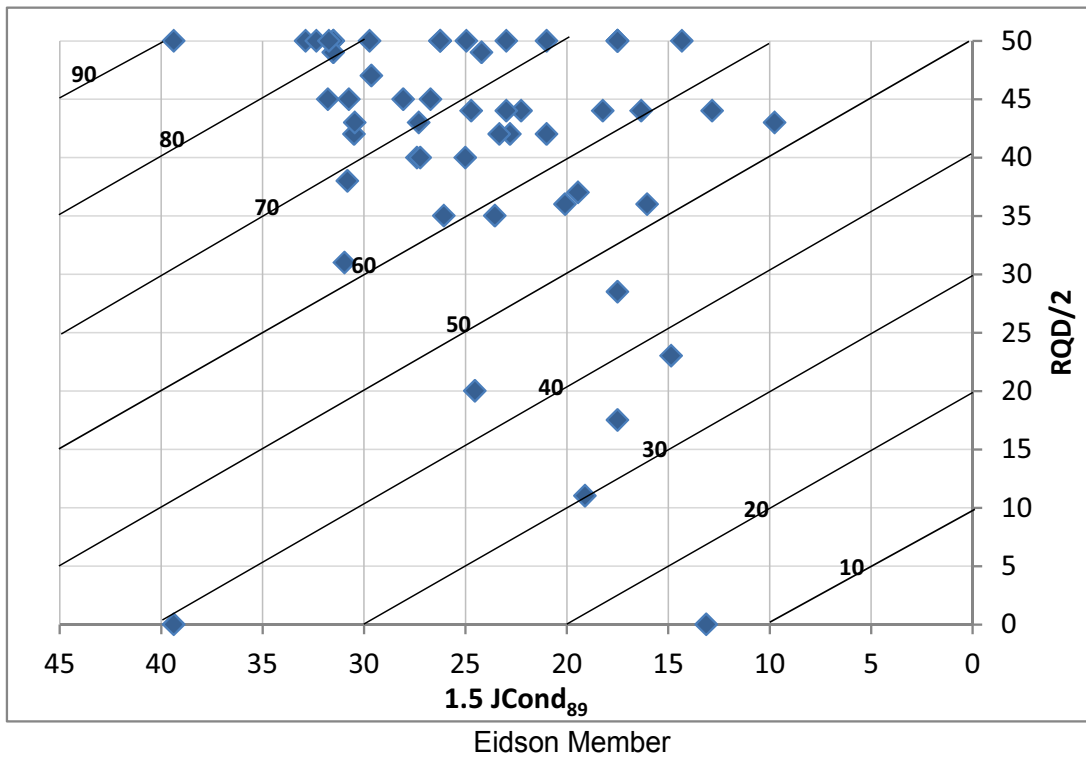
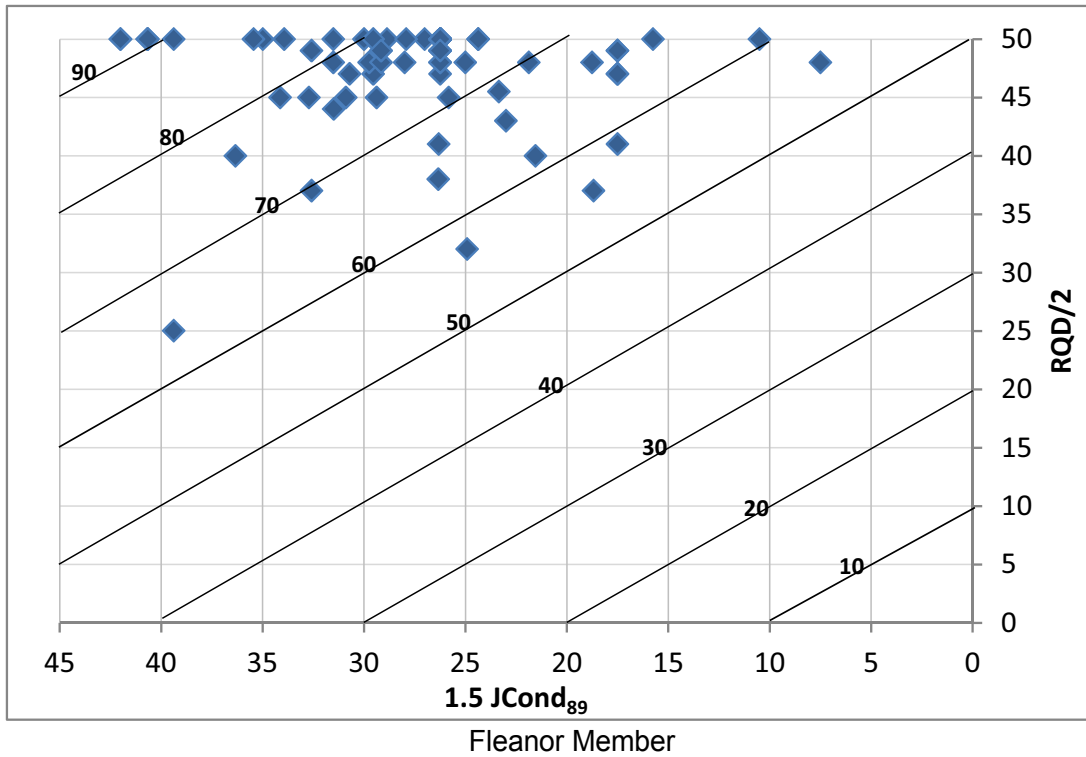


Figure 2.5.1-57. (Sheet 2 of 3) Portion of GSI Chart Showing  $1.5 JCond_{89}$  Against  $RQD/2$  and GSI per Bedrock Unit (Extended to Show  $RQD/2 > 40$ )



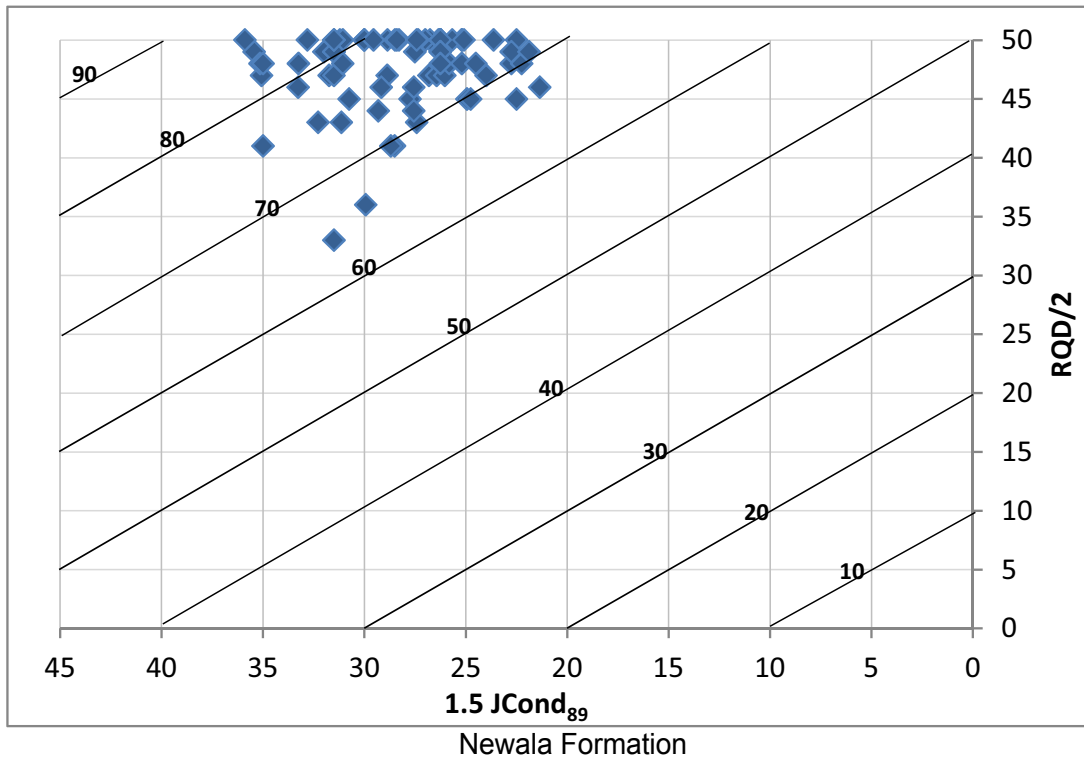
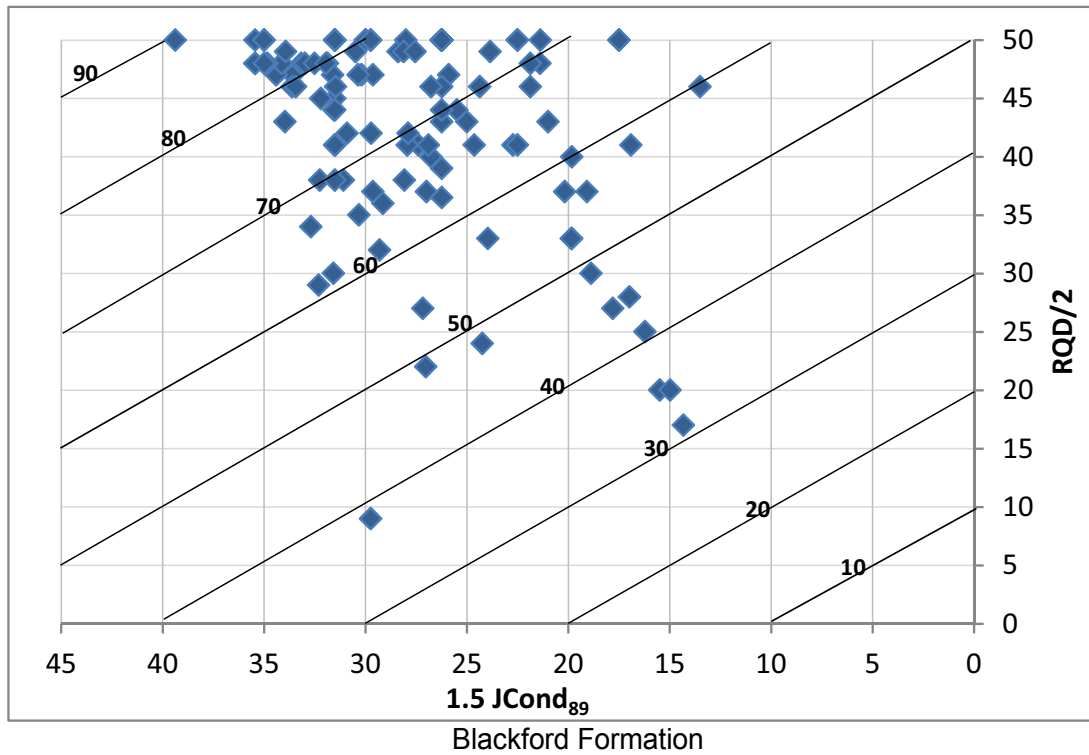
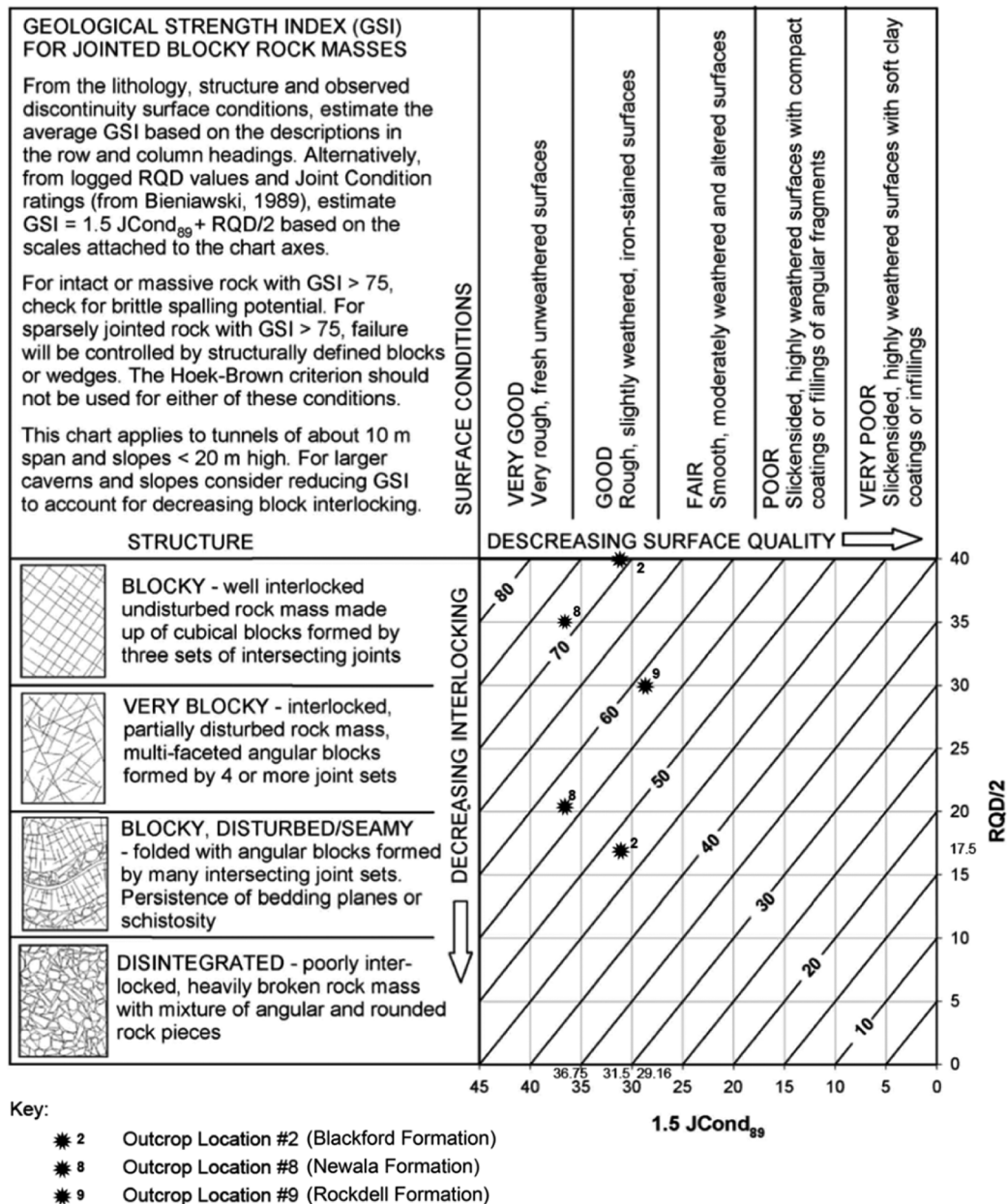


Figure 2.5.1-57. (Sheet 3 of 3) Portion of GSI Chart Showing  $1.5 JCond_{89}$  Against  $RQD/2$  and GSI per Bedrock Unit (Extended to Show  $RQD/2 > 40$ )



Note: JCond<sub>89</sub> = Joint Condition Rating; RQD = Rock Quality Designation

Source: [Reference 2.5.1-265](#)

**Figure 2.5.1-58. Estimates of Geological Strength Index at Outcrop Locations 2, 8, and 9**

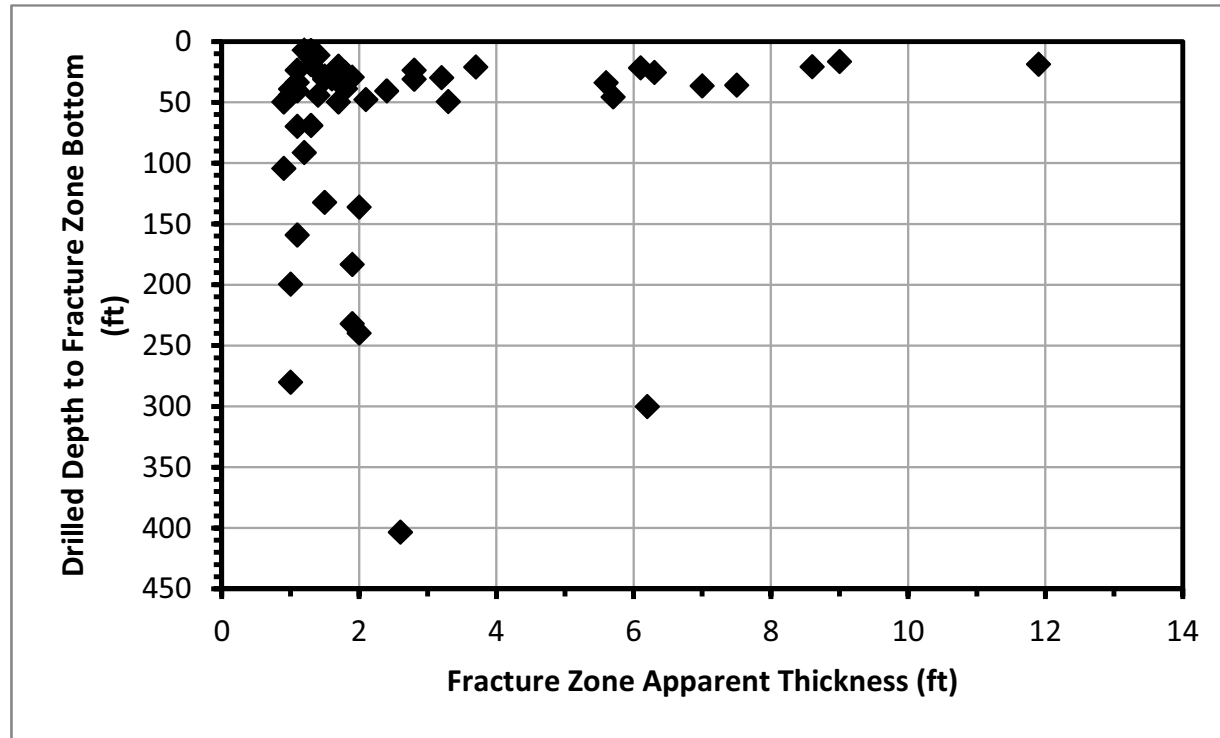


Figure 2.5.1-59. (Sheet 1 of 2) Scatter Plot of Fracture Zone Apparent Thickness—Against Drilled Depth to Fracture Zone Bottom  
(Using the 100- and 200-Series Borings)



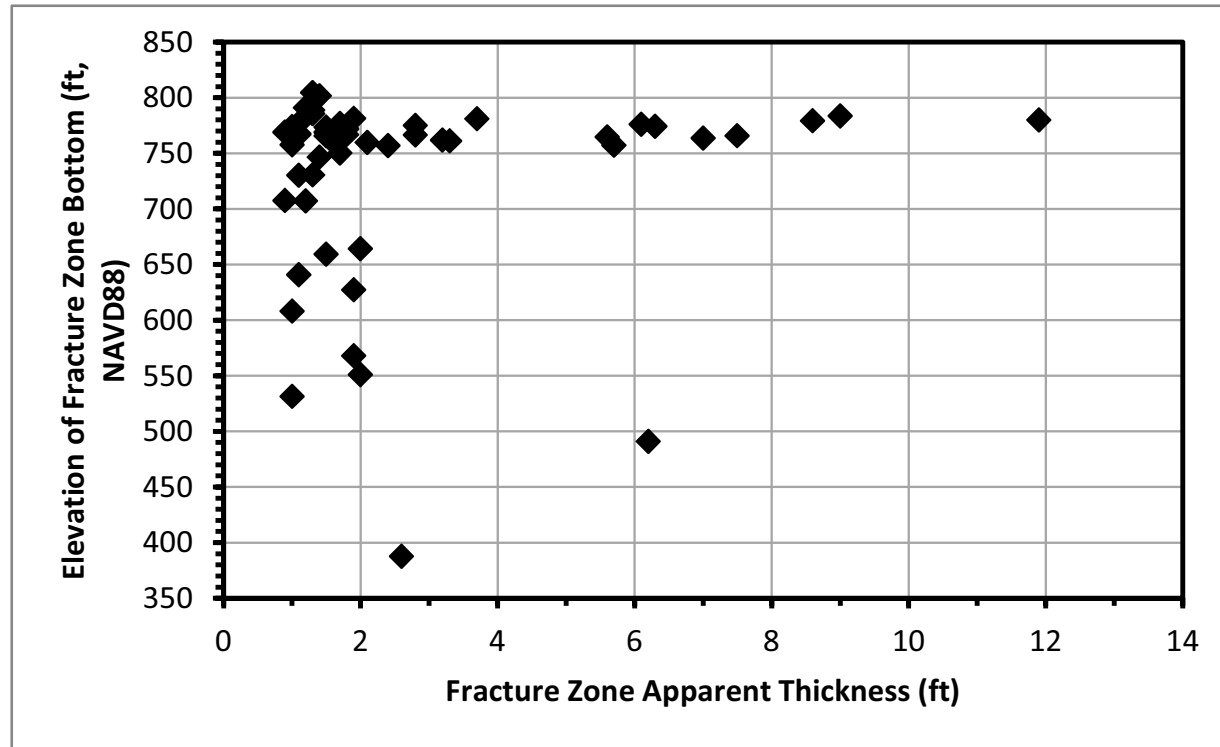
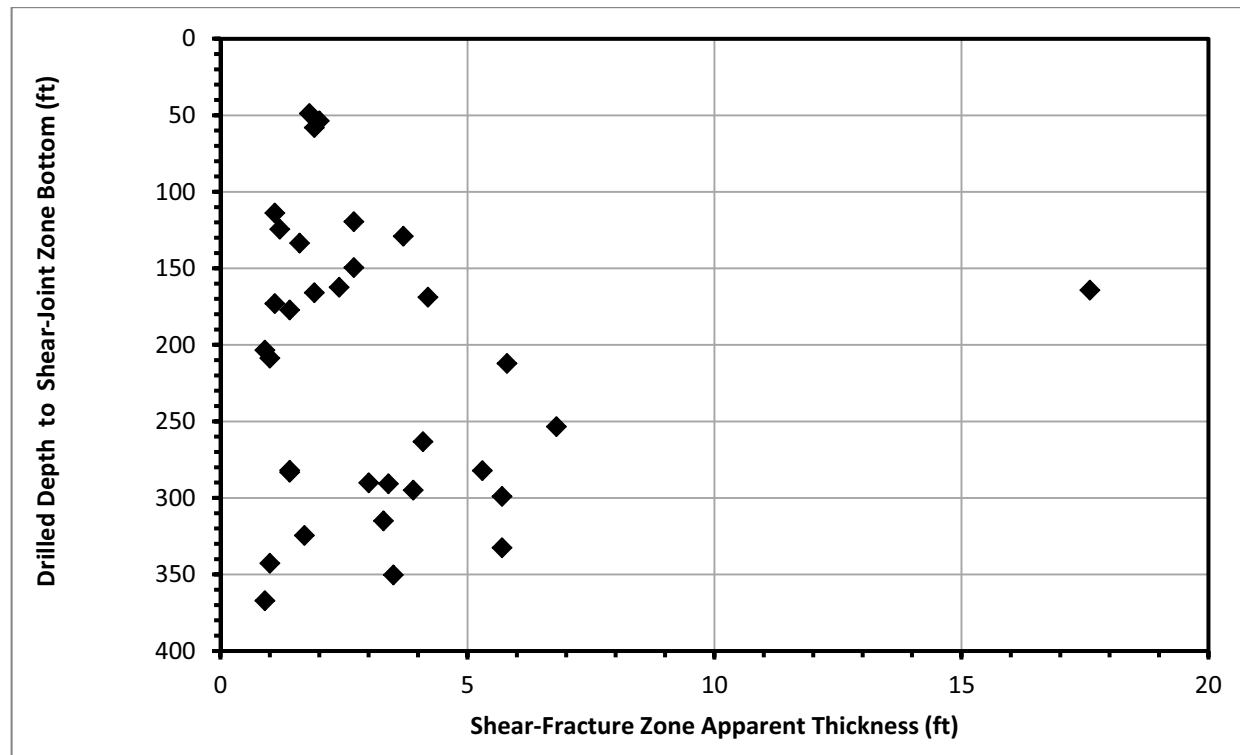
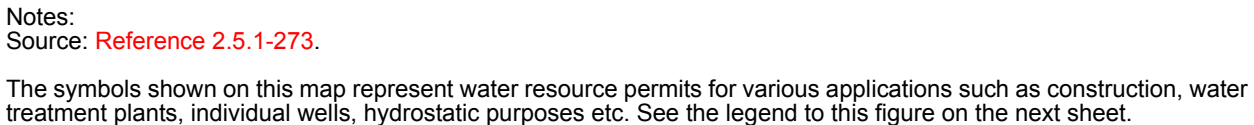


Figure 2.5.1-59. (Sheet 2 of 2) Scatter Plot of Fracture Zone Apparent Thickness—Against Elevation of Fracture Zone Bottom (Using the 100- and 200-Series Borings)



**Figure 2.5.1-60. (Sheet 1 of 2) Scatter Plot of Shear-Fracture Zone Apparent Thickness—Against Drilled Depth to Shear-Fracture Zone Bottom (Using 100- and 200-Series Borings)**





Roane County Quarry: Crushed and Broken Limestone  
Dixie Lee Quarry: Crushed and Broken Limestone  
Oak Ridge Quarry: Crushed and Broken Limestone  
Clear Energy Corporation (formerly Dalco of Tennessee LLC.): Bituminous Coal and Lignite, Surface.  
Dalco Coal of Tennessee, LLC. Bituminous Coal and Lignite, Underground.





Notes:  
Source: [Reference 2.5.1-273](#).

**Figure 2.5.1-61. (Sheet 2 of 2) Map Showing the Water Resource Permit Application Sites Within Approximately 10 Miles of the Clinch River Nuclear Site**

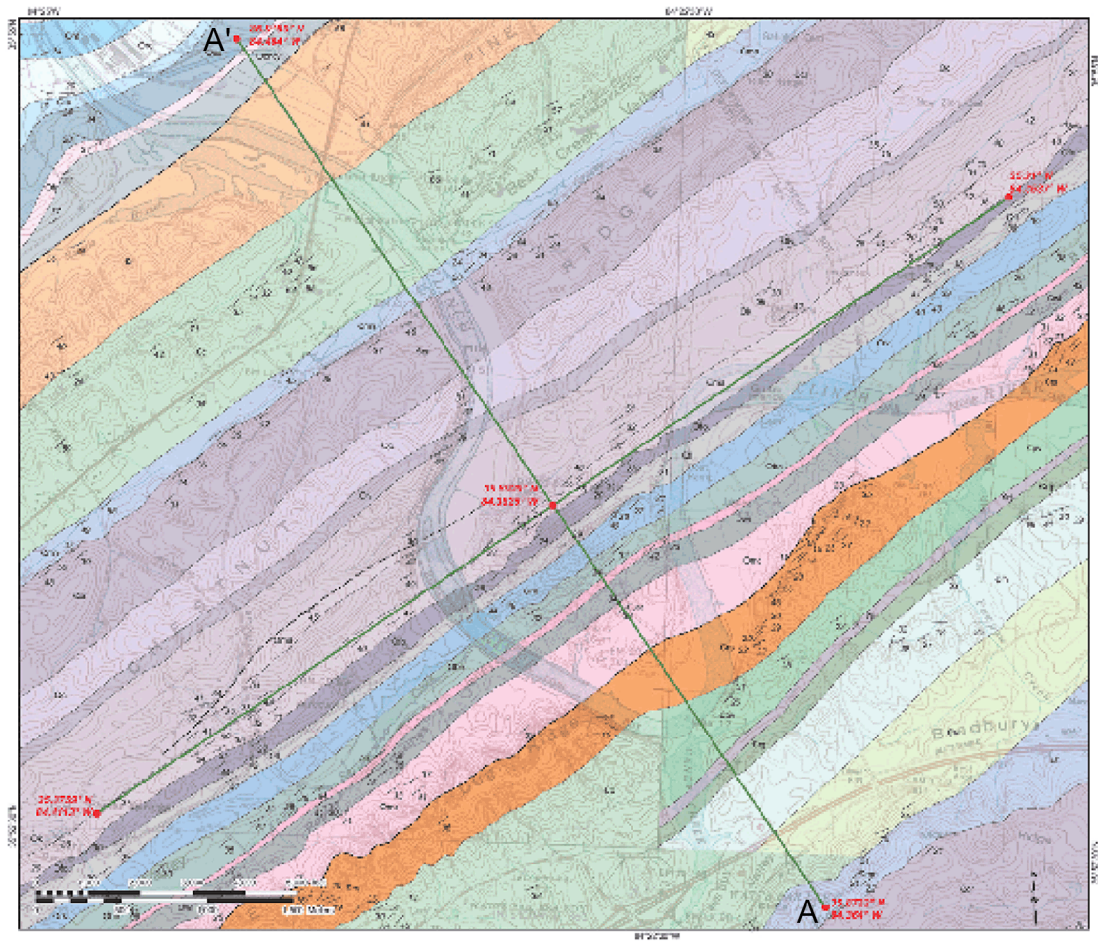
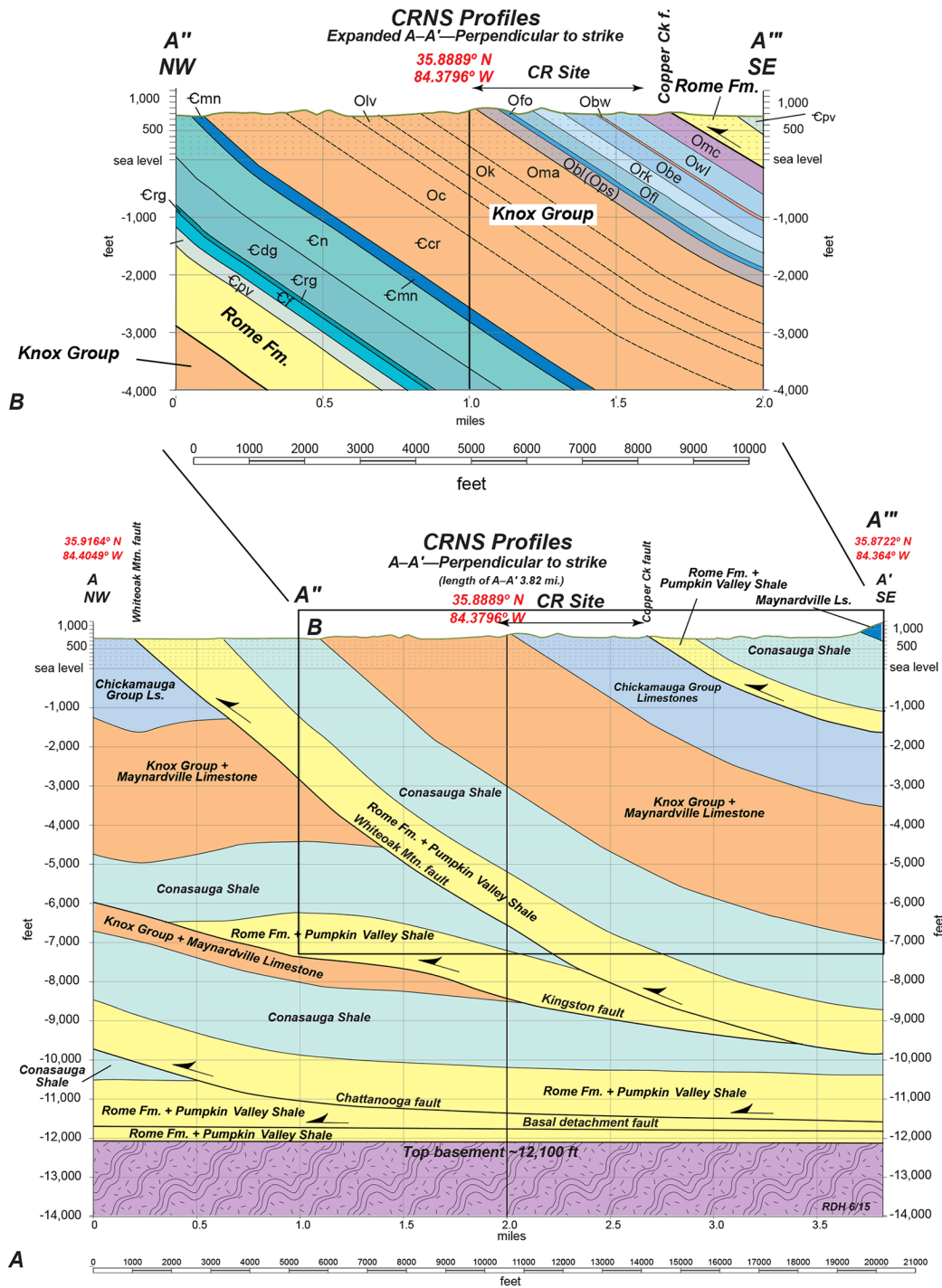


Figure 2.5.1-62. Map Showing the Location of Geologic Cross-Section A-A' to Basement

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Note:

A. Across-strike geologic cross-section A-A' with an expanded section, the location of which is indicated in the rectangle in the center of the diagram.

B. Upper part of Figure A with additional detail. Location of section line is indicated in the geologic map on Figure 2.5.1-62.

**Figure 2.5.1-63. (Sheet 1 of 2) Geologic Cross-Section A-A' Ground Surface to Basement**

## CRN Cross Sections Explanation

<div style="border: 1px solid black; padding: 5px; width: 60px; text-align: center; margin: 10px auto;">Och</div>	<p>Chickamauga Group, undivided Mostly limestone, some shale 1,500 to 2,000 ft thick</p>	<div style="display: flex; align-items: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg); margin-right: 10px;">Clinch River Site</div> <div style="margin-left: 10px;"> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; width: 30px; height: 15px; background-color: #d8bfd8;">Omc</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; width: 30px; height: 15px; background-color: #add8e6;">Owt</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; width: 30px; height: 15px; background-color: #ff69b4;">Obw</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; width: 30px; height: 15px; background-color: #add8e6;">Obe</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; width: 30px; height: 15px; background-color: #add8e6;">Ork</div> <div style="display: flex; align-items: center;"> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; width: 30px; height: 15px; background-color: #90ee90;">Ofi</div> <div style="margin: 0 5px;">{</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; width: 30px; height: 15px; background-color: #4682b4;">Ofa</div> </div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; width: 30px; height: 15px; background-color: #8b4513;">Obl</div> </div> <div style="margin-left: 10px;"> <p>Moccasin Formation Argillaceous limestone, shale, redbeds</p> <p>Witten Formation Thin-bedded limestone</p> <p>Bowen Formation Calcareous siltstone, redbeds</p> <p>Benbolt Formation Thin- to medium-bedded limestone</p> <p>Rockdell Formation Thick- to thin-bedded limestone</p> <p>Lincolnshire (Five Oaks) Limestone { Fleenor Shale Member Siltstone &amp; shale</p> <p>Eidson Member Thin- to medium-bedded limestone</p> <p>Blackford (Pond Spring) Formation Calcareous siltstone and thin-bedded limestone (Ops)</p> </div> </div>
<div style="border: 1px solid black; padding: 5px; width: 60px; text-align: center; margin: 10px auto;">OEk</div>	<p>Knox Group, undivided Mostly dolostone, some limestone 2,800 to 3,200 ft thick</p>	<div style="display: flex; align-items: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg); margin-right: 10px;">Newala Fm.</div> <div style="margin-left: 10px;"> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; width: 30px; height: 15px; background-color: #ff8c00;">Oma</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; width: 30px; height: 15px; background-color: #ff8c00;">Ok</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; width: 30px; height: 15px; background-color: #ff8c00;">Olv</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; width: 30px; height: 15px; background-color: #ff8c00;">Oc</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; width: 30px; height: 15px; background-color: #ff8c00;">€cr</div> </div> <div style="margin-left: 10px;"> <p>Mascot Dolomite Medium- to thick-bedded dolomite, some chert and chert-matrix sandstone at base</p> <p>Kingsport Formation Medium- to thick- bedded dolomite and limestone</p> <p>Longview Dolomite Medium- to thick- bedded very cherty dolomite</p> <p>Chepultepec Dolomite Medium- to thick- bedded dolomite, chert with white ooids, sandstone at base</p> <p>Copper Ridge Dolomite Medium- to thick- bedded dolomite, abundant chert, some with black ooids and stromatolites</p> </div> </div>
<div style="border: 1px solid black; padding: 5px; width: 60px; text-align: center; margin: 10px auto;">€c</div>	<p>Conasauga Group, undivided Mostly shale, minor limestone, 300-400 ft of massive limestone at top. 1,800 to 2,200 ft thick</p>	<div style="display: flex; align-items: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg); margin-right: 10px;">Newala Fm.</div> <div style="margin-left: 10px;"> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; width: 30px; height: 15px; background-color: #4682b4;">€mn</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; width: 30px; height: 15px; background-color: #90ee90;">€n</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; width: 30px; height: 15px; background-color: #4682b4;">€dg</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; width: 30px; height: 15px; background-color: #4682b4;">€rg</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; width: 30px; height: 15px; background-color: #4682b4;">€f</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; width: 30px; height: 15px; background-color: #90ee90;">€pv</div> </div> <div style="margin-left: 10px;"> <p>Maynardville Limestone Massive limestone</p> <p>Nolichucky Shale Mostly shale, minor limestone, siltstone</p> <p>Dismal Gap Formation Mostly shale, some limestone</p> <p>Rogersville Shale Mostly shale</p> <p>Friendship Formation Mostly shale, some limestone</p> <p>Pumpkin Valley Shale Mostly shale</p> </div> </div>
<div style="border: 1px solid black; padding: 5px; width: 60px; text-align: center; margin: 10px auto;">€r</div>	<p>Rome Formation, sandstone &amp; shale &lt;1,000 to &gt;1,500 ft thick, base commonly truncated by faulting.</p>	<div style="display: flex; align-items: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg); margin-right: 10px;">Newala Fm.</div> <div style="margin-left: 10px;"> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; width: 30px; height: 15px; background-color: #ff8c00;">€rs</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px; width: 30px; height: 15px; background-color: #90ee90;">€ra</div> </div> <div style="margin-left: 10px;"> <p>Rome Formation Mostly sandstone &amp; shale</p> <p>Apison Shale Member of Rome Fm. Mostly shale</p> </div> </div>
<div style="border: 1px solid black; padding: 5px; width: 60px; text-align: center; margin: 10px auto;">p €b</div>	<p>Basement gneisses, granites, amphibolite Thickness is that of the crust: 24-30 mi (40-50 km)</p>	

Note: Explanation of symbols used to identify the different geologic units in [Figures 2.5.1-62](#) and [2.5.1-63](#).

**Figure 2.5.1-63. (Sheet 2 of 2) Geologic Cross-Section A-A' Ground Surface to Basement**