ASSOCIATION OF MISSOURI GEOLOGISTS
13th ANNUAL FIELD TRIP
SEPTEMBER 24, 1966

ENGINEERING GEOLOGY OF KAYSINGER BLUFF AND STOCKTON DAMS, WEST-CENTRAL MISSOURI

FIELD TRIP GUIDE BOOK

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Missouri Department of Natural Resources Division of Geology and Land Survey

CONDUCTED BY THE GEOLOGY SECTION OF THE KANSAS CITY DISTRICT, CORPS OF ENGINEERS
# AMG Field Trip, September 24, 1966

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OFFICERS OF THE ASSOCIATION - 1966

Paul E. Gerdemann
James A. Martin
Richard B. Aylor

President
Vice President
Secretary-Treasurer

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James A. Martin  Missouri Geological Survey
Richard B. Aylor  Missouri State Highway Department
Thomas R. Beveridge  University of Missouri at Rolla
G. Donald Emigh  Monsanto Co.

THIRTEENTH ANNUAL FIELD TRIP

September 24, 1966

Field Trip Committee  Local Arrangements Committee

C. R. Golder, Chairman  Gomer Jenkins, Chairman
A. G. McLoughlin  Howard Richards
H. R. Loepp
INTRODUCTION

Kaysinger Bluff and Stockton Dams are two of four multipurpose projects authorized by Congress in 1954 for the Missouri portion of the Osage River Basin. Other projects in the system are the Pomme de Terre Dam (now completed) near Hemitage, Missouri, and the proposed Hackleman Corner Dam located about 10 miles northwest of Stockton, Missouri.

Construction is currently in progress at both Kaysinger Bluff and Stockton Dams where excavations have exposed sections of Mississippian and Ordovician rocks.

Early geologic studies gave some indication of design and construction problems to be encountered, and foundation excavations to date have exposed bedrock anomalies which were not completely explained through the interpretation of drilling data. All of the foundation problems have not yet been resolved but contract specifications are flexible and allow for variations in foundation conditions.

Not all excavated areas will be open at the time of our field trip. It is certain, however, that much of the east abutment excavation at Kaysinger Bluff will be open, and that the major excavation at Stockton (for the Outlet Works-Spillway structure) will also be open. An effort will be made to allow the group to enter certain construction areas providing it can be done safely and without interfering with the Contractor's operations.

The Kansas City District of the Corps of Engineers is pleased to conduct this field trip and it is hoped that it will be interesting to all participants regardless of their respective geologic specialities.
AMG Field Trip, September 24, 1966

ITINERARY

Assemble in Sedalia near the junction of new Route 55 and Route 50. Cars should line up (facing north) on the shoulder.

8:00 a.m. c.s.t. Leave assembly point and travel north on Route 65 approximately 7.0 miles to Stop No. 1.

8:15 a.m. Arrive Stop No. 1. Park on right shoulder. The contact between Devonian and Mississippian rocks is exposed in this road cut. Samples may be taken.

8:30 a.m. Leave Stop No. 1. Proceed north on Route 65 approximately 1.0 mile.

8:35 a.m. Arrive Stop No. 2. Mississippian, Osagean-Kinderhookian contact is exposed here. Formations exposed are the Burlington, Northview, Sedalia, and Compton.

8:45 a.m. Leave Stop No. 2. Reverse direction and proceed west to starting point at new Route 65 and Route 50 junction. Proceed west on Route 50 approximately 3.0 miles. Turn into Howard Construction Co. Quarry on left.

9:05 a.m. Arrive Stop No. 3. Park south of crusher near quarry opening. Osagean-Kinderhookian is exposed in the quarry face. Note comparatively severe dipping of strata. The Devonian occurs at a higher elevation about 1/2 mile to the west. Feel free to collect samples.

9:20 a.m. Leave Stop No. 3. Return to Route 65 and Route 50 junction. Proceed south on Route 65 to Overlook Area at Kaysinger Bluff Dam. Refer to route map, page 5.

10:05 a.m. Arrive Stop No. 4. Kaysinger Bluff Dam Overlook Area. After a coffee break, an orientation and description of the job will be given by A. G. McLoughlin. The group will then inspect the left abutment area and then visit other construction areas if accessible, depending upon the Contractor's operations.

12:45 p.m. Lunch at White Branch Cafe.

1:45 p.m. Leave Stop No. 4 and proceed as shown on the route map to Stop No. 5.
ITINERARY—con.

2:45 p.m. Arrive Stop No. 5, Stockton Dam, Overlook Area. An orientation and description of the job will be given by H. R. Loeppe, after which certain accessible construction areas will be visited, depending upon the Contractor's activities at the time.

4:30 p.m. Leave Stockton Dam, field trip completed.

The following automobile rules for safety should be observed:

(1) In order to reduce the number of cars in the caravan, it is suggested that those who return by way of Sedalia double up in other cars for the trip.

(2) Drivers should at all times be alert for danger points along the route.

(3) If you have motor or tire trouble, please STOP at the side of the road and let following cars pass.

(4) Under no circumstances pass another car in the caravan when the caravan is in motion, unless that car has dropped out of line.

(5) Maintain your position as close to the car ahead as is convenient for safety. Give proper signals.

(6) Have your car properly serviced and ready so that prompt departure may be made.

THANK YOU
AMG Field Trip, September 24, 1966

MULTIPLE-PURPOSE PROJECT

KAYSINGER BLUFF DAM AND RESERVOIR
OSAGE RIVER, MISSOURI

PERTINENT DATA

Authorization:

Flood Control Act of 1954 (Public Law 83-780) (House Document No. 549, Eighty-First Congress)
Flood Control Act of 1962 (House Document No. 578, Eighty-Seventh Congress)

Location:

Mile 175, Osage River. The dam is in Benton County, Missouri, about one and one half miles northwest of Warsaw, Missouri, in Section 7, T. 40 N., R. 22 W.

Elevations:

<table>
<thead>
<tr>
<th></th>
<th>Feet</th>
<th>m.s.l.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top of dam</td>
<td>756.0</td>
<td></td>
</tr>
<tr>
<td>Maximum surcharge,</td>
<td>751.1</td>
<td></td>
</tr>
<tr>
<td>Spillway Design Flood</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full pool</td>
<td>739.6</td>
<td></td>
</tr>
<tr>
<td>Top of power and conservation pool</td>
<td>706.0</td>
<td></td>
</tr>
</tbody>
</table>

Embankment:

Type: Rolled earthfill
Maximum height above riverbed: 126 feet
Base width, maximum: 1,400 feet
Total length: 5,000 feet

Sterett Creek Dike

Type: Rolled earthfill
Maximum height: 55 feet
Total length: 7,500 feet

Spillway:

Type: Gated ogee overfall
Elevation crest: 692.3 ft., m.s.l.
Width crest: 190 feet
Tainter gates, number, width and height:
Four 40' X 47.3'
Capacity:
(At power & conservation pool, elev. 706) 26,000 c.f.s.
(At maximum surcharge, elevation 751.1) 284,000 c.f.s.
Power output:
Dependable capacity: 160,000 kw.
KAYSINGER BLUFF DAM

Kaysinger Bluff Dam is located 1-1/2 miles northwest of Warsaw, Missouri, on the Osage River, in the Lake of the Ozarks headwaters. The Osage River basin, above the dam, consists of two topographically different divisions: the Ozark Plateau Province on the east, and the Osage physiographic section of the Central Lowland Province on the west. The Osage, South Grand, and Pomme de Terre Rivers and Tebo Creek are the major streams controlled by the reservoir.

Bedrock units at the dam (to the depth of explorations) are of Ordovician and Mississippian systems. Silurian and Devonian rocks are not present in this area. See the Geologic Column and Legend, plate No. 6.

The Osage River basin is located on the northwest side of the Ozark Dome, and hence, the bedrock in the basin has a west to northwest regional dip. Major faulting does not occur in the foundation area; however, minor faults and sink structures, are anticipated. Fractures and pockets filled with shale breccia are numerous in the cores taken from the Cotter-Jefferson City dolomite limestone. An extensive brecciated area is exposed on the left abutment occurring in Cotter-Jefferson City immediately below the Sylamore formation.

Several axes and spillway locations were studied and the final location was eventually resolved based on geologic and economic considerations. As a result of studies based on extensive core drilling, the spillway location was shifted several times. The exploration program for the entire project consisted of over 400 overburden and bedrock exploratory borings, four calyx holes, and test pits.

The principal features of the project are earth embankment, an overfall spillway, with an adjacent power installation in the right terrace, and a long earth dike crossing Sterett Creek. Rolled fill for the main embankment will amount to 7,400,000 cu. yds. and the dike will require an additional 1,600,000 cu. yds. The structure details are outlined in the preceding Pertinent Data Sheet and shown on plates Nos. 2, 3, and 5.

The first stage contract was awarded in September 1965 and includes excavating a cutoff trench in the valley and right terrace; removing weak overburden material from portions of the valley, excavating overburden and part of the bedrock from the outlet works area; constructing a grout curtain; and backfilling the cutoff trench. This contract is 60% complete. The next stage contract is to be advertised for bids early in 1967.
Authorization:

Flood Control Act of 1954 (Public Law 83-780) (House Document No. 642, Eighty-First Congress)

Location:

Mile 49.5 Sac River. The dam is located in the central part of Cedar County, about two miles east of Stockton, Missouri, in section 10, T. 34N., R. 26 W. The reservoir is located in Cedar, Dade, and Polk Counties, Missouri.

Elevations:

<table>
<thead>
<tr>
<th>Description</th>
<th>Feet, m.s.l.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Top of dam</td>
<td>912.0</td>
</tr>
<tr>
<td>Spillway crest (top of gates)</td>
<td>892.0</td>
</tr>
<tr>
<td>Flood control pool</td>
<td>892.0</td>
</tr>
<tr>
<td>Top of power and conservation pool</td>
<td>867.0</td>
</tr>
<tr>
<td>Bottom of power pool</td>
<td>830.0</td>
</tr>
</tbody>
</table>

Embankment:

Type: Rock shell with imprevious core

<table>
<thead>
<tr>
<th>Base width, maximum</th>
<th>750 ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum height</td>
<td>53 ft.</td>
</tr>
<tr>
<td>Total length</td>
<td>5,400 ft.</td>
</tr>
</tbody>
</table>

Dike:

Type: Rolled earthfill

Total length: 3,900 ft.

Spillway:

Type: Gated ogee

<table>
<thead>
<tr>
<th>Elevation crest</th>
<th>861.5, m.s.l.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Width crest</td>
<td>184 ft.</td>
</tr>
<tr>
<td>Capacity:</td>
<td></td>
</tr>
<tr>
<td>At full pool elevation 892</td>
<td>92,500 c.f.s.</td>
</tr>
<tr>
<td>At maximum surcharge, elevation 906.2</td>
<td>174,000 c.f.s.</td>
</tr>
</tbody>
</table>

Maximum power capability:

52,000 kw.
STOCKTON DAM

Stockton Dam, now approximately 25% complete, is located on the Sac River in southwestern Missouri about 45 air miles northwest of Springfield. It is west of the Eureka Springs escarpment in the Springfield Plateau section of the Ozark Plateaus physiographic province. The topography is characterized by dissected plateaus and broad, gently rolling uplands. Maximum topographic relief in the reservoir area is 270 feet. The major streams are the Sac and Little Sac Rivers which drain northward into the Osage River.

Rocks of the Ordovician, Mississippian, and Pennsylvanian systems crop out within the reservoir area; the Devonian and Silurian systems are not represented. See the Generalized Geologic Column, plate No. 13.

Regionally bedrock strata dip gently to the northwest, but in the vicinity of the dam there is a low dip to the east. Faulting occurs within the construction area, particularly in the Ordovician rocks. Boring and excavations indicate the presence of minor faults which are predominantly of the reverse type with medium to high angle fault planes. Maximum throw is probably less than 20 feet. It will be noted that the occurrence of breccia is common in the Cotter and Jefferson City formations and several types will be seen. Sink type structures with a filling of shale, sandstone, and dolomite fragments may be seen along the walls of the outlet works excavation, occurring just below the Sylamore bed.

Subsurface explorations for Stockton Dam began in 1958. In addition to many NK and 6-inch size core holes, three calyx holes were drilled (all more than 200 feet deep). Test trenches were excavated on both abutments. Several dam axes, both upstream and downstream from the present one, were investigated. In addition to the final spillway location, two alternates were studied, one in each abutment ridge.

The project is now in the second stage of construction, during which all of the major structures will be completed. The features of the project are a main embankment, one small and one large dike, and a combined spillway-powerhouse. The Stage I contract included partial excavation for the spillway-powerhouse and excavation of the embankment foundation on both sides of the river (except for the closure section). It also included construction of the small left abutment dike, a portion of the main embankment on both sides of the river and construction of a grout curtain in the Stage I embankment areas. Closure is planned for the summer of 1968.

The main embankment will be a rockfill structure 5,400 feet long and 153 feet high with an impervious core of clay. Zoning of the embankment is shown on plate No. 9. Including the 5,600-foot long
dike, the total embankment will contain 7,900,000 cu. yds. of which
4,300,000 cu. yds. will be rockfill. The "spillway-powerhouse"
unit will be built into the left abutment requiring an excavation
225 feet deep. Materials from this excavation will furnish slightly
less than half of the rock required for the embankment. Details
of the spillway-powerhouse structure are shown on plate No. 12.
It is estimated that 55,000 lineal feet of rock bolts will be
installed in rock walls and in the tunnel gallery. Groutable
expansion shell and "Perfo" type bolts will be used.

In Stage II construction the grout curtain will be extended across
the embankment closure section and grouting will extend through
the spillway-powerhouse area.

Quarries located upstream from the dam will supply concrete
aggregate, rockfill, and protection stone. The quarry ledges are
in the Burlington formation.
<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>STRATIGRAPHIC UNIT</th>
<th>GENERAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Siltstone</td>
<td>1</td>
<td>Siliciclastic, massive, grey to green, medium to coarse grained, well-sorted, commonly interbedded with fine- to medium-grained sandstone and silt.</td>
</tr>
<tr>
<td>Siltstone</td>
<td>2</td>
<td>Thin-bedded, dark grey sandstone with thin clay layers.</td>
</tr>
<tr>
<td>Siltstone</td>
<td>3</td>
<td>Thin-bedded, dark grey sandstone with thin clay layers.</td>
</tr>
<tr>
<td>Siltstone</td>
<td>4</td>
<td>Thin-bedded, dark grey sandstone with thin clay layers.</td>
</tr>
<tr>
<td>Siltstone</td>
<td>5</td>
<td>Thin-bedded, dark grey sandstone with thin clay layers.</td>
</tr>
<tr>
<td>Siltstone</td>
<td>6</td>
<td>Thin-bedded, dark grey sandstone with thin clay layers.</td>
</tr>
</tbody>
</table>

**ABBREVIATIONS**
- All alternations: PC
- Light: L
- Fine: F
- Medium: M
- Coarse: C
- Water: W
- Oxygen: O
- Sample: S
- Depth: D
- Lithology: L
- Vein: V
- Fault: F
- Andesite: A
- Basalt: B
- Granite: G
- Sandstone: S
- Siltstone: St
- Mudstone: M
- Limestone: L
- Dolomite: D
- Shale: Sh
- Clay: C
- Silt: S
- Sand: S
- Gravel: G
- Boulders: B
- Granite: G
- Sandstone: S
- Limestone: L
- Dolomite: D
- Shale: Sh
- Clay: C
- Silt: S
- Sand: S
- Gravel: G
- Boulders: B

**LEGEND FOR LOCUS OF BORINGS**
- Plasticity: Pl
- Liquid limit: Li
- Effective stress (min): E
- Soil type: St
- *Note: For site description.*
- Vertical high stand (VHS): VHS
- Lateral high stand (LHS): LHS
- Water level (WL): WL
- Dry density (g/cm³): D
- Unconfined compressive strength (kN/m²): UC

**NOTES**
- Idealized, linear fractures, prevalent throughout the Cottonwood Formation, were not included on the log of borings.

**TYPE OF EXPLORATION**
- Vertical boring: VB
- Induced boring: IB

**MAP SYMBOLS**
- Core hole: C
- Bored hole: B
- Opencast mine: M
- Drill hole: D
- Cross section: X
- Line drawing: L
- Geological section: G
- Cross section: X
- Line drawing: L
- Geological section: G

**CODE DESIGNATION**
- Tilted boring: TB
- Induced boring: IB
- Bored hole: B
- Opencast mine: M
- Drill hole: D
- Cross section: X
- Line drawing: L
- Geological section: G

**BEDROCK**
- Scale of hardness:
  - Very soft or plastic: V
  - Soft: S
  - Moderately hard: M
  - Hard: H

**GEOLOGIC COLUMN AND LEGEND**

**PLATE No. 6**

**GEOPHYSICAL DATA**
- Plan view: P
- Section view: S
- Depth: D
- Diameter of sample: D
- Sampling interval: I

**DATE:**
- September 1966