



WATER-RIGHT DOCKET

Mammoth Cave National Park

Docket No: 7

ECHO RIVER

Supporting Hydro Data

04-23-1958: memorandum to chief engineer from geologist regarding summary of maca

154-H

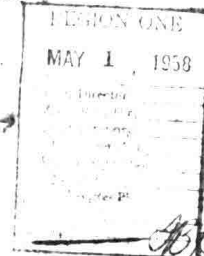
April 23, 1958

Memorandum

To: Chief Engineer

From: Geologist

Subject: Water Resources, Mammoth Cave National Park



SUMMARY

Present knowledge indicates that the Echo River system in Mammoth Cave discharges water from the Pennyroyal and Mammoth Cave Plateaus into Green River. Connecting the two streams is a siphon which readily permits large flows in either direction depending on hydrostatic head conditions. Normally the levels of the two streams are the same. Under such conditions, water pumped from Echo River will be replaced by water from the Green when Echo River receives little or no water from its source area.

A well could be located where visitors would not see it. The drilling costs would be known in advance, and an adequate source of water for future use would be assured.

From a geological standpoint, this well location is far superior to any other in the park.

Wells in Eaton Valley would supply uncertain quantities of water and costs of developing this source would be high in view of low production that could be expected. Maintenance would be high.

A well on the alluvial floor of Green River valley would be subjected to recurring floods and attendant damage. This site is not recommended.

INTRODUCTION

During the week of April 1-7 I was at Mammoth Cave National Park. At your request, I devoted considerable time to the possibility of meeting the area's water supply needs and the use of cave air for air conditioning. During my stay I was able to discuss water

hydrology with G. E. Hendrickson and Richmond Brown of the Geological Survey. They were most helpful to me in obtaining some knowledge of the subject. Mr. Brown is preparing a rather complete report on the groundwater hydrology of the Mammoth Cave area. It should be published soon.

The following discussion will consider the various methods by which additional water supplies could be obtained for park use. An evaluation of each method will be attempted.

GEOLOGIC BACKGROUND

General

Mammoth Cave is located beneath the Mammoth Cave Plateau south of the Green River. In the vicinity of the cave, the Big Clifty, or Cypress, sandstone caps the plateau. Beneath the Big Clifty lies a series of relatively pure limestones in which the caverns have developed.

South of the Mammoth Cave Plateau is the Pennyroyal Plateau. Separating the two is the Whipping Springs Escarpment. The Pennyroyal is the lower of the two plateaus and is underlain by limestones of Mississippian age. The Pennyroyal plateau is a karst topography pitted with sinkholes and having little surface drainage. Most streams there are lost part or all of their flow to subsurface drainage systems.

Rainfall on the Pennyroyal Plateau is carried northward under the Mammoth Cave Plateau through a system of subsurface streams into Green River. Raring River and Neko River are parts of this system, and probably receive much of their flow from this source.

Rock strata are almost horizontal, dipping 30 feet per mile to the northwest. Maximum cavern development seems to be aligned in the direction of dip.

Green River

Styx River in Mammoth Cave is herein considered to be a segment of Neko River. Raring River is considered a part of the Neko River system.

The surface stream called Styx River that flows into the Green may not be the discharge point of the cavern's Styx River. The surface Neko River does seem to discharge waters from Neko River within Mammoth Cave and the connection is probably a direct one.

The connection between Neko River and Green River has been noted by every geologist who has studied this area. In the spring Neko River rises in the east and discharges tremendous amounts of water to the Green. When heavy summer rains fall on the Pennyroyal Plateau,

Echo River may rise rapidly although Green River levels remain low. At such times, the flood of water discharged into the Green through the Echo River outlet is impressive.

Similarly, if no local rainfall occurs when the Green rises, flow is reversed. Water flows from the Green into the streams of Mammoth Cave. Thus the direction of flow depends upon the stream, Echo or Green, has the greater hydrostatic head.

Under normal conditions the cavern streams and the Green River maintain almost identical levels. This is verified by Geological Survey gages inside and outside the cave.

Although the Echo and Green Rivers are connected, the siphon connecting them is restricted. When Echo River receives a large quantity of water from its source area it may rise at a rate of five feet per hour. This indicates a restricted siphon between the cavern stream and the Green. That the siphon is large is proved when Echo River drops rapidly as flow from its headwaters diminishes.

It is almost a certainty that the Echo River system within Mammoth Cave is connected with Green River by a siphon. Normal rises and falls of the master stream, the Green River, are balanced by water flow through the siphon in the direction of lesser hydrostatic head. Only when unusual quantities of water are involved is there a lag in compensation between cave and surface stream. The siphon must be a large one.

METHODS OF MEETING WATER NEEDS

Present needs are met by using water from springs and a deep well at Bransford Springs. Spring flows vary greatly but are at a minimum when demand is highest in July and August. Flows from the well are disappointing. There is general agreement that present supplies must be supplemented to meet increasing demands.

Future needs can probably best be met by drilling water wells. Where the well, or wells, should be located depends upon geological and engineering considerations.

Green River Well

It would be possible to locate a well in alluvial deposits on the south bank of the Green River.

The advantage of such a well is obvious; it would tap a known source of water that could be depended upon to meet all water needs of the future.

There are serious disadvantages, too. The Green River flows through a narrow valley here and floods are common. It seems likely that the well location would be inundated during floods and the chance of breakdowns during floods cannot be overlooked. Such a breakdown could not be immediately repaired. Also, floating debris would be a hazard to any surface structures in the immediate vicinity of the well during floods. If the well were located to avoid flood damage it would not be on alluvium and would, therefore, have lost its main advantage.

Eaton Valley Wells

This location is near the present pipe line carrying water from Bransford Springs area to headquarters. It is known from eye tests that subsurface water flows from Three Springs to the surface Sixx River. This water must flow under Eaton Valley. Also, Eaton Valley is low and depth to the water table is less than elsewhere in the park. If wells are drilled here, they should be in a line perpendicular to the strike of Mammoth Cove. Such a line would roughly parallel the power line. I would consider this a better choice than a well on the Green River.

The main disadvantage to drilling here is the odds against encountering adequate water. In limestone areas such as this one, the subsurface drainage is well integrated. The water flows through large passages. Unless we drilled into such a passage the well would not be satisfactory, and the odds against hitting such a passage are rather high. It would probably take several wells to produce a minimum flow of 200 gallons per minute. Superintendent Brown told me the operating cost of the well at Bransford Spring is quite high. Wells in Eaton Valley would cost no less to operate. If we were lucky enough to hit a water-filled passage, the water would have to be filtered since water in it would be similar to that of Sixx River. Storage tanks of large capacity would probably have to be built to assure supplies during times of peak use.

Sixx River Well

In my opinion, a well located to tap Sixx River in Mammoth Cove would best meet our needs. Its cost would be known in advance; its location would be in the area of development. Its greatest advantage would be the knowledge of an inexhaustible supply of water adequate to meet any foreseeable future demands.

At present, the best location for the well in the cave would seem to be near the Mammoth Island, inside the north wall of Milnes's Avenue where it would not be seen by visitors. This suggested location assumes the surface structure for such a well would be acceptable.

If the well were completed in Sixx River, the present source of water could be abandoned or put on a standby basis.

Several questions come to mind when one considers using Echo River as the water supply for the park. Would the withdrawal of large quantities of water from Echo River lower its level to a degree where boat trips on the river would be impossible? Would the installation intrude upon visitors' enjoyment of the cave?

I think we can safely answer no to both questions. Since Echo River and Green River are known to flow from either one to the other, we would, in effect, be pumping out of the Green when Echo River was low. Since the siphon between the two streams allows the passage of more than 1,250 cubic feet per minute, there is no possibility of drawing down Echo River. With regard to intrusions upon the visitor, I doubt that he would know the well was there. In any case, the pumping schedule could be arranged so that no pumping would be done when visitors were near the well.

In conclusion I would like to point out that even if something unforeseen should render an Echo River well useless, we would spend no more for a "dry" hole here than we would spend for one in Eaton Valley. If Eaton Valley is drilled, I would expect at least one dry hole during the drilling program.

CAVE AIR CONDITIONING

The use of cave air conditioning was predicated on a need to conserve water. I think that the need for water conservation can be safely disregarded. If not, there are still several reasons why cave air conditioning may prove impractical. The passage nearest the visitor center is that leading from the Natural Entrance to the Rotunda. This passage receives heavy use during the summer and there are no side passages leading off of it in which any installation can be made. Main Street, the only other available passage, is also heavily used and contains no adequate side passages. Both of these passages are estimated to be more than 300 feet from the visitor center.

Admittedly little time was spent surveying the cave, and the compass was badly effected by power lines in the cave. However, I still think my brief survey was adequate to cast serious doubt on the advisability of using cave air for air conditioning.

CONCLUSIONS

On the basis of the above data I believe that a well drawing water from Echo River within Mammoth Cave would most economically meet the entire needs of Mammoth Cave. Second choice would be a series of wells in Eaton Valley. Third choice would be a well in the alluvium along the south bank of Green River.

The proposal to use cave air conditioning is considered unnecessary since water for this purpose can be obtained. Also, the location and configuration of cave passages near the visitor center do not favor such a plan.

John H. Good
Geologist

Copy to: Chief, BDEC
Regional Director, Region One, (2)

PROV. AL RECORDS, SUBJECT TO REVISION
 UNITED STATES DEPARTMENT OF THE INTERIOR
 GEOLOGICAL SURVEY
 WATER ANALYSIS

2GW

Location Mammoth Cave, Kentucky County Edmonson
 Source Babe River Depth (ft) _____ Diam (in.) _____
 Cased to (ft) _____ Date drilled _____ Point of coll. At outlet
 Owner National Park Service Use _____
 Treatment _____
 WBF _____ WL GH: 24.80 Yield _____
 Temp (°F) 55 Appear when coll. Muddy
 Collected April 14, 1962, 9:30 AM By National Park Service
 Remarks Outflow

	ppm	epm		ppm	epm
Silica (SiO ₂)			Bicarbonate (HCO ₃)		
Aluminum (Al)			Carbonate (CO ₃)		
Iron (Fe)					
			Sulfate (SO ₄)		
			Chloride (Cl)	2.0	0.06
			Fluoride (F)		
Calcium (Ca)					
Magnesium (Mg)			Nitrate (NO ₃)		
Sodium (Na)					
Potassium (K)					
Total			Total		

	ppm		
		Specific conductance (micromhos at 25° C)	218
Dissolved solids:		pH	
Calculated		Color	
Residue on evaporation at 180°C			
Hardness as CaCO ₃			
Noncarbonate			

Lab. No. Col **25941** Field No. _____ Project **EY MAMMOTH CAVE Q GW**

Docket Information

Number of Documents in Docket 6
 Documents Dated from 4/23/1958 to 4/23/1958
 Docket Compiled: 4/27/2011