

Dave Taylor Visit, Oct 6, 2007

Dave Taylor (Strata Services) visited the Lake Tishomingo dam on Oct 6, 2007. Members of the LTPOA Board present were R. Sansone, L. Kimmel, P. Harting, M. Meyer, and J. Hirsch. Members of the Dam Committee present were R. Hirsch, C. Holland, M. Leiweke, K. Jost, R. Wilner, and R. Hannick.

Dave Taylor (DT) has 40 years experience working on leaking lakes. He has worked on the following local area lakes: Lorraine, Sherwood, Raintree II, Wauwanoka, Coke's Lake, Marshall's Lake (Dittmer), Carol (IL), an unnamed lake near Washington Mo, and an unnamed lake near Morse Mill. Dave is currently working on Lake Lorraine and Lake Sherwood. Dave's website is www.leakinglake.com.

Details

The project will consist of three phases:

- An exploration phase consisting of drilling test holes thru the top of the dam
- An analysis phase to determine where to grout
- A grouting phase

The Exploratory Phase

In the exploration phase eleven holes will be drilled thru the top of the dam. These holes will be evenly spaced ten feet apart. Even if a test hole does not penetrate the leak, the hole would still yield worthwhile information.

In drilling each hole a steel casing would be used until rock was hit. The casing would be socketed in rock and cement circulated down the inside of the casing and up the outside to completely isolate the dam embankment. The procedure used is similar to that used for a state-approved water well. Drilling would continue into the rock after the casing was put in place. The casings will be there forever. Water will be used to identify where fractures are located.

DT said that 90 percent of the battle of repairing a leak is getting test drill holes located in the right place.

DT indicated it should take about two weeks to complete the exploratory phase.

The Analysis Phase

The following data will be collected for each test hole: distance to the top of rock, permeability of the rock, hydraulic conductivity, the location of fractures in the rock, and more.

DT: When it's time to grout, you're probably only going to have one shot to get this right, so you want to take plenty of time preparing to grout. DT indicated it might take one to four weeks to complete the analysis phase.

The Grouting Phase

DT: The grouting phase will probably take very little time. "You only have one chance to do it. If you mess up you have to drill some offset holes."

DT: If you drill enough holes and pump enough grout the leak is going to be fixed. That's the name of the game. The type of grout that will be used will depend on the analysis phase.

DT: Grouting will take about one day if there is one leak, two days if there are two leaks.

Q & A

When will you start?

In terms of DT's schedule, preliminary work with engineer Don Eskridge will begin in the fall of 2007. Drilling will begin in spring 2008.

DT: Once I begin a job I will be here from dawn to dusk, every minute that something was being done, because this work is so specialized and there is no margin for error. This is especially true in this case because the leak is right up against the abutment of the dam.

DT: Once we start to drill holes we should be able to finish the whole job in one to two months.

DT said that although he usually works with his own engineer, since Don Eskridge (DE) is very familiar with our dam, he thought it best for him to work with DE on this project. *[DT is a geologist, not an engineer. For the necessary permits to be obtained from Mo DNR, a licensed engineer must approve of the plans. Rhh].*

DT explained that the way it will work would be for DT to write up what would be done and submit it to DE. DE would then take that information and produce a construction permit application. We would then approve and sign the document. It would then go to the state for their approval.

DT said he will put together a letter of intent for the LTPOA Board to approve.

What will the repair cost?

In terms of cost, DT thought that the work involved in writing procedures, obtaining permits, drilling the exploratory holes, and analyzing the results are so involved that the cost would be close to \$50,000. The cost of grouting cannot be predicted until the analysis phase is complete since the cost is dependent on the size of the opening in the rock. The total cost may be up to \$100,000. DT said he thought it would be less, but could not predict that at this time. DT thinks the leak is thru a crevice (seam) 2 inches wide by 10 to 20 feet long.

The letter of intent will contain a lump sum cost for the exploratory drilling phase and the analysis phase. There would be no surprises as to cost for the initial two phases of the project.

Where will the test holes be drilled?

The eleven test holes will be drilled based on the location of the leak. Effectively, this is where the manhole is located. *[When the seepage collector was installed, DE found two springs coming out of a bedding plane. The seepage collector (manhole) was located very close to this point. Bedding plane: As layers of sediment accumulate to great thickness, they are compacted and harden into sedimentary rock. Each layer they form is called a bed or stratum. The separation between each bed is called a bedding plane.]*

One reason that this technique should be successful was that in 1965, asphalt pumped into five holes drilled in the same general area markedly decreased the flow rate of the leak.

DT suggested that we try to find the five drill holes from 1965 that were used to repair the leak. Six inch steel casings were used in the holes and should be detectable with a metal detector if they are within one foot of the surface. These old holes would not be used, but it would be nice to know where they are.

Will the leak be shut off completely?

DT: I won't know until I do it. The lake I worked on recently near Washington MO was shut off 100 percent. When the lake was full it was flowing 500 GPM. *[Our leak is currently at 300 GPM]* What makes the difference is if the leak is all in one spot, you'll get 100 percent shut off. If the leak is diffused, then you might not get it completely shut off. I won't know if the leak can be shut off completely until I do it.

ML: Is it better for you if the lake is down when you do the work, because it may be full by next spring?

DT: If the lake were down 12 feet, that would be better. If the lake is down 3 feet or less, it won't affect my work.

LK: If we don't do anything in the next 18 to 24 months are we likely to lose the dam?

DT: No, that won't happen. But I will say this, the leak at Lake Loraine is located 1/4 mile away from the dam, so their dam is not at risk. Your leak is on the back of the dam, so there is the potential for a slide. The seepage collector should prevent that, but if the amount of seepage increases there is the slight possibility that the water could "blow a hole" thru the soil on the back of the dam. I know you are mainly concerned with fixing the leak to conserve water, but it's not a good situation.

RH: Once you start work in spring 2008, how long will it take until you have the eleven holes drilled?

DT: One to two weeks to finish the exploratory phase. Grouting will take about one day if there is one leak, two days if there are two leaks. You're probably only going to have one shot to get this right, so you want to take plenty of time preparing to grout. Once we start to drill holes we should be able to finish in one to two months.

LK: If we accept your letter of intent, how much money will you need before spring to obtain permits and get ready for drilling?

DT: To do the prep work, I'd say it might take about \$5,000.

KJ: If the lake is leaking from a more distant cove, would the repair procedure be the same?

DT: Yes. We could do selective dye tracing to establish the source of the leak to an area with a diameter of about 100 feet. But it would take a lot of time and you still would have to stop it at the dam.

DT: It's actually an advantage that the leak comes out the back of the dam because it helps us know where to start drilling. The leak at Lake Loraine is located 1/4 mile away from the dam. Our leak is up close so the repair here will be more tricky.

KJ: Is there a possibility of making the leak worse by drilling the exploratory holes?

DT: It is possible, but I've never seen it. But even if the leak is made worse by the drilling, when the holes were grouted the leak would be shut off.

RHan: What are the odds of a leak developing elsewhere if we plug this one?

DT: Probably slim to none.

KJ: How deep are the holes that you plan to drill?

DT: We would go at least 20 to 30 feet below where the spring comes out that feeds the seepage collector. The problem is not with the soil in the dam, it is down in the rock.

RW: What do you think are the odds that there are multiple fractures feeding the leak?

DT: My experience out here with leaks thru bedding planes tells me that there should be a single channel. But I don't want to become narrow minded about this.

KJ: Do we need to involve an engineer?

DT: Yes. We need an engineer to get the construction permit and you want an engineer of record to document everything.

JH: Why does the dam leak?

DT: Your problem is due to the builders of the dam not understanding the geology of the area and not drilling test holes. Otherwise they would have recognized that there was fractured bedrock in the dam abutment and they would have built a core trench in excavated rock to prevent the leak. *[Abutment: The sloping sides of valley that supports the ends of a dam.]*

DT: There are two reasons for your leak to increase in flow rate over time. The first (and most important) is because the leak was repaired in 1965 with asphalt and the asphalt is slowly being pushed out of the fracture. The second reason is that residual clay in the fractures is being eroded as the water moves thru. The rock itself is not being eroded by the water. That process takes tens of thousands of year and can't happen in just a few years.

RH: Can you say what kind of grout you would use? Asphalt? Urethane?

DT: I would not use asphalt. Urethanes are expensive and sometimes they work and sometimes they don't.

When we find a hole into the leak, before we grout that hole we will use dye to calculate a flow velocity. The composition of the grout will depend on the flow. I will probably use a sand and cement fly ash slurry. A sodium silicate product might also be used based on flow.

■ Rich Hirsch for the Dam Committee