GREAT SALT LAKE SALINITY ADVISORY COMMITTEE
JUNE 22, 2023

This meeting was held in person on June 22, 2023, at the Utah Department of Natural Resources with some members attending remotely via GoogleMeet. The following represents a summary of key points of discussion. It is not intended to represent meeting minutes. The meeting recording may be viewed at https://www.youtube.com/watch?v=aYuz-YgZhxU .

ATTENDEES

Leila Ahmadi/DWRe**
Bonnie Baxter/Westminster College*
Jennifer Biggs/Division of Forestry, Fire & State Lands (DFFSL)
Phil Brown/GSLBSC
Lynn DeFreitas/FRIENDS of Great Salt Lake
Jeff DenBleyker/Jacobs
Rob Dubuc/FRIENDS of Great Salt Lake
Joe Havasi/Compass Minerals *
Tim Hawkes/GSLBSC**
Elliott Jagniecki/Utah Geological Survey (UGS)**
Bill Johnson/University of Utah (UofU)*

Krishna Khatri/DWRe
John Luft/Division of Wildlife Resources (DWiR)*
Mark Reynolds/US Magnesium**
Ryan Rowland/USGS*
Christine Rumsey/USGS**
Andrew Rupke/UGS*
Ben Stireman/DFFSL* (co-chair)
Tom Tripp/US Magnesium*
Laura Vernon/DWRe
Marisa Weinberg/DFFSL**

* Salinity Advisory Committee (SAC) member
** SAC member alternate

OBJECTIVES

A key objective of the Salinity Advisory Committee (SAC) is to advise the State of Utah regarding how the salinity of Great Salt Lake (GSL) can best be managed and, more specifically, how the new Union Pacific causeway bridge may influence lake salinity. The objective of this meeting was to discuss lake conditions and develop a plan for the evaluations/sampling that will be required to make a decision about modifying the berm.

SUMMARY

A quorum was present for the meeting. Jeff DenBleyker opened the meeting with a review of objectives and agenda for the meeting and facilitated introductions of people attending in person and online. John Luft made a motion to approve the meeting summaries for the March 23 and May 17 meetings; Ryan Rowland seconded the motion. The motion was passed unanimously.

UPDATE ON BERM PROTOCOL

Ben Stireman noted that the berm protocol has not been formally adopted. DFFSL decided that it is important that the new GSL Commissioner have an opportunity to review and in agreement with the protocol. That will be happening soon.

UPDATE ON LAKE CONDITIONS

Ryan Rowland provided an overview of lake conditions. South Arm water levels have risen to 4194.0 on June 20 (up 5.5 ft since November 2022). The increase in South Arm water level did slow down since May. North Arm water levels have leveled off near 4189.3 feet (June 20) representing a rise of 0.8ft since November 2022. The effect of the berm is obvious. The water level in the South Arm increased significantly whereas the water level in the North Arm leveled off after the berm was raised.

Inflow volume year to date from the Bear River has risen to near the 75th percentile value from historical values. Approximately 1.1MAF so far this year. The Bear River had 1.25MAF in 2011 (2011 was a significant water year). Weber River inflows are above the 75th percentile; approximately 0.49 MAF this year vs 0.83 MAF in 2011. John
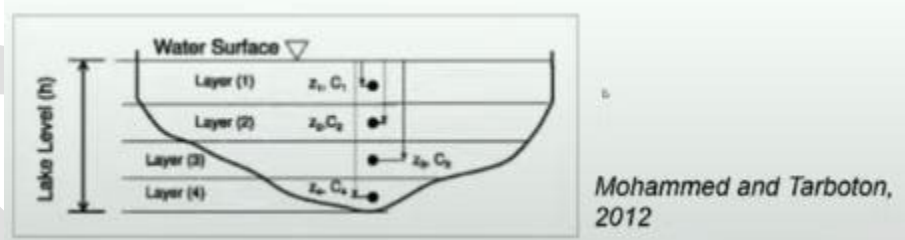
Luft pointed out that the Weber River gauge may not account for flows that are diverted to Willard Spur and bypass both the Bear River and Weber River gauges. Farmington Bay inflow volume is the highest ever measured since 2011; approximately 0.323 MAF this year vs 0.308MAF in 2011. Goggin Drain inflows are just above the 75th percentile value; approximately 0.164 MAF this year vs 0.382MAF in 2011. Tom Tripp noted that we have received about 11-12" of precipitation on the lake as well. He also noted that there is still substantial snowpack, we have filled our lakes and reservoirs, and given the lake is still rising that we have "lost" some of our evaporative season. Last year it started in April. Joe Havasi added that soil moisture in the watershed is also much improved this year setting us up well for this year and our upcoming winter.

Flows through the new breach dropped to nothing when the berm was raised in February but have come up again as the water level in the South Arm increased above the berm. Flows to the North Arm were measured at 898cfs on June 6. They did not observe an North to South flow. The increase in S-N flow follows the increase in water level in the South Arm . The new uplooker velocity sensor is being installed. Velocities measured with the current sensor match expected flow increases but the model to convert velocity to flow is not yet complete.

Christine Rumsey provided an update on salinity. The USGS measured salinity at Saltair on May 22 as 124 g/L, at the New Breach on June 9 at 114 g/L (S to N). The USGS measured the salinity most recently on June 5. At 3510 it was 132 g/L, at 2565 it was 124-125 g/L. Salinity at the deep samples were higher at around 158 g/L but didn't appear to be the deep brine layer. Salinity was much lower at 2267 near the Bear River inflow (89 g/L). UGS sampling in the South Arm on May 31 ranged from 117-153 g/L consistent with USGS values. Salinity values dropped nicely during the spring this year; we saw a 53 g/L drop at 3510 and 62 g/L drop at 2565 from Nov 22 to Jun 23. The lowest salinity in spring 2022 was 158 g/L. The spatial variability was low during Sept-Nov 2022 but started to see lower salinities near the Bear River inflows starting in January. This spatial difference continued and increased through June 5, 2023.

WHAT SALINITY VALUE DO WE USE AS REPRESENTATIVE OF THE SOUTH ARM?

Christine Rumsey prefaced the information she was going to present as preliminary. Christine recommended a volume weighted average based upon her analyses. This is similar to the method used

Mohammed and Tarboton, 2012

by Mohammed/Tarboton, associating a concentration to the depth interval and volume. This is a similar to approach to how USGS is computing the salt mass. She provided a comparison of using different combinations of depth intervals. Deeper salinities generally appear to skew the volume weighted average higher, shallower salinities skey it lower. Christine noted that UGS collects at many more depths than USGS but the volume weighted averages were comparable. The Bear River outflow does impact the shallow values at 2267.

Bill Johnson summarized that if we use the salinity from 3 or more depths that the average values do not vary much. It appears to be a robust method. Bonnie Baxter agreed. Tom Tripp asked where the brine shrimp live. Phil Brown said that their distribution is not well understood but will generally be in the oxygenated zone. Bonnie noted that the phytoplankton will likely prefer the same. John Luft said that they have seen an anoxic zone at depths of more than 4m. They think phytoplankton from inflows seem to be shocked by the lake's higher salinity, settle to the bottom and use up the oxygen at those depths. Phill said they have seem something similar at 5m, it doesn't seem to be North Arm water. He agreed with John's description but added that there are likely bacteria down there using up the oxygen and starting to generate H2S. Bonnie noted that brine shrimp can adjust to different oxygen levels too (their color can be an indication). Joe Havasi agreed that removing the 20ft depth values made sense but wondered about the 15ft depth values too. Some of the 15ft values are high too, should they be included? Christine agreed that the 15ft values from this sampling date could skew the average but we want a representative value. Andrew Rupke agreed that this year's values are very different than last year. Joe suggested that our objective is to protect the brine shrimp and so should focus on the depths they would be in. Bill noted that there is a difference between an explicit analysis where we are listing all of the values vs a representative analysis where we know "we are corner cutting". A representative approach seems appropriate. Joe agreed but noted that the representative approach depends upon which numbers we include. Jeff noted that

using the 5, 10, and 15 depths doesn't include the 0.5 depth either. The 0.5ft depth had been excluded due to the freshwater inflows. Joe suggested including the 0.5 and 15ft as they offset each other. Bonnie suggested that explicit and representative numbers can serve different purposes but we do need to find a means to compute a number for the protocol. Ryan pointed out that UGS, GSLEP and USGS collect samples at different depths. Joe asked where they cysts are located. Tim Hawkes said that they cannot really predict that; they can be anywhere in the water column. Phil agreed. Ben Stireman reminded the SAC that we are looking for a method to represent the salinities most important to the ecology; this applies to the berm but also potentially other triggers.

There was agreement that we should track all of the depths. Bonnie summarized that we need a number that we can report to the public, one used for decisions, and a formula we can use to understand the dynamics. Ben noted that different numbers does create confusion. We need to develop an equation that generates a number for decisions. Jeff summarized that we do want to continue to measure at the various depths and track those – they help understand the dynamics. Jeff suggested using the USGS measurements at 0.5, 3 and 5m as it is representative of where the brine shrimp cysts are. Ryan clarified that if the water is not 5m deep then they sample at 0.5m above the bottom. Christine suggested that we use all of the depths to compute the salinity in the fall as we need to understand the complete mass. We should then use the brine layer values in the spring; we do not want the deep brine layer as the brine shrimp are not there. Mark Reynolds reminded everyone that the SAC was organized to wrestle with this and that it will likely continue to evolve and improve. Ben suggested tracking different options but asked that we settle on one method to use now. We can continue to evaluate and improve for the updated protocol to be developed in 2024. Tom agreed that we have a strawman and suggested we use that and keep studying it. He also noted that managing the berm without knowing the next year's hydrology is very complex. Christine noted that it seems important to consider the salt mass when managing the berm as it creates the conditions in the fall. Ben agreed.

Joe noted that he is concerned about the relevance of including the values from 5m due to where brine shrimp are found. We do not have a deep brine layer now but in prior years we would have. There was general agreement that the deep brine layer should not be included but we do not have that this year. Bill noted that we still need to track the salt mass in the deep brine layer as it will likely mix back into the water column.

Ben asked Tom and Joe what depth is representative of their withdrawal. Both agreed that it is shallow, probably more typical of the top 5 feet. Bonnie noted that we should be monitoring both brine shrimp and brine flies. Ben agreed that HB513 does focus triggers upon the ecology and we will need to develop these thresholds. This will likely be completed through the SAC and in coordination with the TAG.

Jeff summarized. For the spring value, we will use the volume weighted average for 0.5, 3 and 5m from all 4 sites assuming we do not include values from the anoxic zone. It represents the salt mass and represents a conservative value (higher than just the shallower values) that the brine shrimp are exposed to. We will report this calculated value but also a value that accounts for the entire water depth including the anoxic deep brine layer to reflect the salt mass that can mix and create the salinity value in the fall. Ben added that any emergency trigger will be evaluated later; the value we are discussing now is to help decide what to do with the berm this summer. Jeff will send a draft rubric out to the SAC to review.

OTHER SALINITY QUESTIONS

Christine Rumsey summarized the computed salt mass. Based upon salinity values from May 31 and June 5, the South Arm salt mass ranged from 1,111 – 1,092 million tons. The volume of the South Arm has increased by 2,114,184 acre feet since November 2022. Using the available data, Christine interpolated to estimate the volume of water exported to the North Arm. The USU model can estimate that flow on a daily basis but only up until the berm was changed in February. After that Christine had to use only discrete measurements by USGS. She has estimated an exported volume of 147,400 acre feet. We know this is not accurate but it is the best we can do. This volume of water represents an estimated 28.2MT of salt exported. The salt mass of surface inflows can range from 1-6MT per year, but that is still being evaluated. Using the current salinity of 134 g/L, lake volume of 6.61maf, and lake elevation of 4193.8ft and assuming the lake will fall 2.5ft, then we can estimate the fall salinity to be 158 g/L. Christine stressed that this includes many assumptions, is not accurate but it is the best we can estimate right now. Tom Tripp noted that this might be an overprediction of the salinity. Bill Johnson agreed but noted that this is probably the best we can do. There was agreement that the values via this method are likely conservative (high). Christine then summarized an analysis, assuming 158g/L this fall, of what the salinity might be in 2024. For a range of inflow volumes of 0.7 – 1.14 MAF, the spring salinity could range from 143 – 127 g/L. Jeff DenBleyker stressed

that these are very rough but give us an idea of the direction we are headed. These "conservative" values indicate we are close to the targets we have been talking about. Can we improve upon this methodology? To be discussed.

Bill noted that another options we might consider is to look at how we might modify the direction of the Bear River inflow so that the lower salinity water isn't just short-circuiting to the North Arm via the bridge.

Tom noted that we need to be cognizant that the railroad may not like their causeway to be serving as a dam.

The next steps will be to evaluate these results and decide whether we lower (and how much) the berm.

The meeting was adjourned.

ACTION ITEMS

- Jeff will summarize and send a summary of how we will calculate the spring salinity value.
- Jeff will summarize the status on each of our key questions.
- Christine, Leila and Craig will look at how to understand how flow through the bridge will affect the fall salinity and look at effect from lowering the berm.
- Jeff will schedule a call after July 4.