

# GREAT SALT LAKE SALINITY ADVISORY COMMITTEE

## JULY 27, 2023

This meeting was held in person on July 27, 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=PC\\_5VhGaNP0](https://www.youtube.com/watch?v=PC_5VhGaNP0).

### ATTENDEES

Leila Ahmadi/Division of Water Resources (DWRe)\*\*  
Carly Biedul/Westminster University\*\*  
Jennifer Biggs/Division of Forestry, Fire & State Lands (DFFSL)  
Thomas Bosteels/GSLBSC  
Phil Brown/GSLBSC  
Lynn DeFreitas/FRIENDS of Great Salt Lake  
Jeff DenBleyker/Jacobs  
Rob Dubuc/FRIENDS of Great Salt Lake  
Jim Harris/DWQ\* (co-chair)  
Joe Havasi/Compass Minerals \*  
Tim Hawkes/GSLBSC\*\*  
Bill Johnson/University of Utah\*

John Luft/Division of Wildlife Resources (DWiR)\*  
John Mackey/DWQ  
Craig Miller/DWRe  
Mark Reynolds/US Magnesium\*\*  
Ryan Rowland/USGS\*  
Christine Rumsey/USGS\*\*  
Ben Stireman/DFFSL\* (co-chair)  
Tom Tripp/US Magnesium\*  
Laura Vernon/DWRe  
Marisa Weinberg/DFFSL\*\*  
Chris Yandell/Compass Minerals\*\*

\* 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 further modifications to 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. Tom Tripp made a motion to approve the meeting summary of the June 22 meeting; Thomas Bosteels seconded the motion. The motion was passed unanimously.

### UPDATE ON LAKE CONDITIONS

Christine Rumsey provided an overview of lake conditions. South Arm salinities were measured at four sites on July 5 and ranged from 123-134 g/L in the shallow zone. Salinities are more homogenous than last month. Tom Tripp noted that the salinity in April 2022 was approximately 158 g/L and wondered how that may have affected hatching rates for brine shrimp. Thomas Bosteels said that there was a 2 month delay last year due to the elevated salinity because cysts typically do not hatch at salinities above 130 g/L. Those that hatched did because they were in areas with lower salinity (freshwater inflows and precipitation). John Luft said that the cyst harvest was quite a bit lower last year. Tim Hawkes added that we also saw significant impacts upon brine flies due to the high salinities. Thomas said that their samples from July 13 had similar results to USGS values near 133 g/L and noted that the salinity was also quite homogeneous with depth.

### UPDATE ON BERM PROTOCOL

Ben Stireman said 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. DFFSL recommended that we move forward with the assumption that the berm protocol will not change.

## RUBRIC FOR SALINITY OBJECTIVES

Jeff DenBleyker provided an overview of the berm protocol, salinity objectives within the protocol, and the rubric that had been discussed at the previous meeting. The spring salinity objectives is a salinity of less than 130 g/L in the upper oxic brine layer and will be computed as a volume-weighted concentration for samples collected above the deep anoxic brine layer across all four USGS South Arm sampling points included in GSLEP's monitoring program (sampled monthly at three depths at each of the four sites). The minimum average value for the period of December – June will be used to evaluate the spring salinity objective. The fall salinity objective is a salinity of less than 160 g/L computed as a volume-weighted concentration for all depths (including the anoxic deep brine layer) and averaged across all four USGS South Arm sampling points.

Joe Havasi asked clarifying questions about how the volume-weighted value is computed. Christine clarified that USGS collects samples from 0.5m and 3m below the water surface and 0.5m above the lake bottom. If the 0.5m above bottom sample is anoxic then it is the deep brine layer and is not included in the spring average value. If it is oxic then it is included in the calculation. USGS measures dissolved oxygen at each depth to verify. Christine confirmed that that bottom depth would only represent that bottom layer and thus small percentage (Joe indicated 5%) of the overall volume. Christine also confirmed that for the fall objective, then all samples are used in the computation regardless of dissolved oxygen. Tom Tripp said we want to track the deep brine layer and evaluate how we might manage its formation. That might change if the lake level rises significantly. Tom also asked to clarify how the rubric might affect the salinity matrix. Jeff said that the salinity matrix is based upon the literature and how salinity affects uses. This rubric provides guidance on how to measure and compute salinity in the lake. The matrix helps interpret the results from implementing the rubric. Ben Stireman agreed that development of the matrix and rubric are separate.

Thomas Bosteels made a motion to approve the rubric. John Luft seconded the motion. Joe suggested that it is important to understand how inclusion of the deep brine layer might affect the value for historic data – this is in reference to the fall salinity objective. Jeff agreed and noted that while we are all now measuring salinity the same, we are often measuring at different locations and depths. The rubric helps define how salinity measurements are consolidated into a value used for comparisons; it is not necessarily changing how the salt mass is computed. Evaluating this data with historical data could be useful. Joe asked to delay approval on how to report fall salinity values that may include the deep brine layer. Bill Johnson noted that we have a long record of measuring and evaluating salinity in the lake. Joe agreed but would like to understand how the average salinity might have changed if we did or did not include the deep brine layer. Jeff added that the USGS salt mass calculations and models do include the full depth when they reported a lake salinity. The difference here is that we are recognizing that the spring salinity is most important for brine shrimp cyst hatching and that will most likely only occur in the upper oxic zone. The fall value is intended to capture the total salt mass that includes the deep brine layer.

Tom Tripp suggested an amendment to the motion to modify the rubric to include an evaluation of the data and methods and be reviewed annually before decisions are made. Bill Johnson agreed and made the motion to add the phrase: These values and protocols will be evaluated at the end of each calendar year and modified as appropriate. Tom seconded the motion. The motion to add this text to the rubric was approved with 7 votes to approve, one against. One SAC member was absent and co-chairs are non-voting members.

Joe made a motion to amend the rubric to continue to measure salinity at all depths but not include the deep 0.5m above lake bottom measurement in the average salinity computation. Bill Johnson clarified that there is a difference between anoxia and density at that depth. The density is typically homogeneous if we do not see anoxia; density is higher if there is anoxia at depth. Bill asked if Joe wanted to keep the deep brine layer out for decision making but not for data gathering purposes. Joe confirmed that is what he is proposing. Thomas clarified that we are only using a deep brine layer measurement to evaluate the salt mass and not to evaluate the ecological endpoint in the spring. Joe noted that we are in a new paradigm with the flow control berm largely eliminating the deep brine layer. Jeff clarified that the fall value of 160 g/L is used to evaluate impacts upon the beneficial uses of the lake and more importantly the complete salt mass is needed to forecast what the salinity might be the subsequent spring. We didn't want to only use the upper brine layer in the fall because we are evaluating the effectiveness of the berm. To do so we need to evaluate the salt mass, thus including the deep

brine layer if it is present. The salt mass in the fall is critical to evaluate what the spring salinity concentration may be but also in how we modify the berm. We make decisions about the berm based upon the salt mass that we need to manage.

Joe clarified that he does not want to exclude data. He simply doesn't want to make a big change in our regulatory paradigm. Joe agrees that there is lake mixing but there is still density stratification with a higher density at depth. Bill noted that even with some stratification, the full depth often fully mixes. We can't evaluate the effect of these mixing events or the influence of the causeway and berm without evaluating salt mass over the entire depth. Jeff agreed that Christine's calculations to forecast salinity in the spring are dependent upon the salt mass over the entire depth. Jeff also agreed that Christine's current forecast is based upon measurements over the last 6 months. It makes sense to look back at previous data. A key guiding principle of the SAC is to make decisions based upon the science. When data have indicated our assumptions or recommendations were not accurate, we have changed them.

Chris Yandell agreed that we should continue to collect all of this data and that we should continue to evaluate our methods. He wondered whether the fall salinity objective of 160 g/L was developed using data that included the deep brine layer. Would the value of 160 g/L change if we did or did not include the deep brine layer? Bill said that he did not know the specific answer to that but that the values were identified by the SAC as protective. He added that we do know that the lake mixes frequently, thus the deep brine layer is very important in determining the salinity across the full depth. He is a proponent of including the deep brine layer in the calculation. Thomas clarified that the value of 160 g/L came from a review of the literature that studied this issue at GSL and elsewhere. The literature indicated that at 160 g/L and above there was a significant impact upon the brine shrimp population. More recent studies at GSL indicate the number should be closer to 150 g/L. If, hypothetically, the 160 g/L is the right number, then we have to ask what the salinity is in the lake. If the deep brine layer, even if only 5% of the volume, does mix with the upper brine layer and contributes to the salinity experienced by the biota, then it should be included in the calculated value compared with 160 g/L. Jeff added that the reason the salt mass models going back to the 1980's integrate salinity across the full depth is because the deep brine layer is so dynamic and is subject to mixing events. The depth integrated value was used to provide a long-term record to evaluate changes; there is a long history of doing this. The salinity matrix was developed based upon the literature independent of measurements. The rubric provides additional clarity on how salinity is measured and reported.

Bill proposed to amend the rubric to include the word "potential" in front of "...including the potential deep brine layer" for the fall salinity objective. John Luft seconded the motion. The motion passed 7-1; Joe added that he appreciated the discussion and understands better.

The SAC voted on the motion to approve the rubric as amended. The motion passed 7-1. Jeff added that a key action item will be to look at the historic data through the lens of the rubric.

## **SALINITY APPROXIMATION FOR FALL 2023 AND SPRING 2024**

Christine Rumsey reviewed her approach and results with the SAC. She began with a spring salinity concentration of 134 g/L as measured on June 5. The most recent volume weighted concentration from July 5 of 137 g/L to estimate the salinity this fall. Her previous forecast assumed 2.5 ft drop in water level due to exporting 1ft to the North Arm and 1.5 ft drop due to evaporation and had estimated a fall salinity of 158 g/L with only evaporation and 148 g/L with the export/evaporation combination. Her new forecast for fall 2023 accounted for spring 2023 inflows, measured export, measured precipitation, and estimated evaporation and started with a spring 2023 salinity of 137 g/L. She estimated spring 2024 salinity with previous assumptions plus the assumption that the berm is raised back to 4192 by February 2024 and no south-north flow starting in March. Calculated numbers with the 10-year average for precipitation/evaporation and for the 90<sup>th</sup> percentile values. Estimated fall 2023 salinities ranged from 139-143 g/L and spring 2024 salinities ranged from 12-127. Exporting water to the north had small impact on salinity in the South Arm. It will be long-term effort to affect the salinity in the South Arm via exports to the north Arm.

Tom Tripp noted that modifying the berm to export salt to the north appears to be a fine-tuning tool. Removing a little bit of salt mass from the South Arm doesn't do too much. Adding freshwater to and diluting the salt in the South Arm is what is most effective. He suggested that we leave the berm as is; the extra water buffers problems throughout the lake. Ben Stireman noted spring inflows do help but they need to mix into the South Arm and not

just go straight to the North Arm. Bill Johnson agreed that we need to better mix the inflows. Tom added that the UP causeway is the reason we were able to preserve the ecology this year.

Jeff clarified that the objective in raising the berm to 4192 this year was to be above the water level. Inflows would be captured and dilute the salt mass before overtopping to the North Arm. We have been exporting salt to the North Arm ever since it overtopped. If we lower the berm now that will increase the export of salt and water to the North Arm. The gamble is that we are then counting on spring inflows to bring the South Arm water level back up and dilute the salt mass. Leaving the berm where it is means that we will more likely export salt/water next year. Per our current protocol, the fall forecast of 143 and spring forecast of 125 achieves the goals.

Craig Miller noted that leaving the berm means that we are not exporting water to the North Arm too. Joe agreed and said that lowering the berm appears to have minimal benefit. Much of that inflow appears to be consumed by evaporation. The North Arm level is still close to the all-time low. The key is that the berm is temporary. Compass Minerals is managing okay right now but the low water levels in the North Arm do affect their operation as well as other uses (pelicans in the North Arm). He would prefer to open the berm up to add water to the North Arm. Ben wondered that if we export water now, the water might be lost to evaporation. Compass Minerals has extended its canals to continue its operation. Ben asked if the berm at 4192 was a problem for Compass Minerals. Joe said that they could adjust their pumping schedule to later in the year if we released water to the North Arm later in the evaporative season. That might reduce the amount of water lost right now if it was exported to the North Arm now.

Bill summarized that the berm did accomplish the goal of capturing inflow, diluting the salt mass, reducing salinity concentrations, and exporting a minimal mass of salt to the North Arm. Exporting water/salt to the north is limited; the most important variable is inflow to the lake. It then becomes more of a question of elevation of the North Arm vs the South Arm. Is that the purview of the SAC? Ben confirmed that salinity is the primary goal for the SAC, but it is difficult to completely separate it from water elevation. Forecasts do look like we are in good shape and may not need to export salt. Tom added that the current water level in the South Arm protects microbialites. Ben interpreted the data to indicate that the North Arm is leveling off with the South Arm. The maximum flow over the berm appeared to be 900 cfs. If we drop the berm now, we may export only a minimal salt mass and still only keep up with evaporation. Joe agreed that there would be unnecessary loss now. It would make sense to leave the berm where it is and lower it and begin to export post evaporative season.

Ben suggested we wait to make a recommendation on a berm change. We should do some additional monitoring, modeling, and evaluate the condition of the berm. Jeff summarized that the SAC would leave the berm as is and continue to evaluate. The key is that the berm is temporary, and we want to keep evaluating whether it is doing what it is intended to do and evaluate potential impacts. Joe agreed; he wants to make sure we stay true to that. He is very supportive of opening the berm post evaporative season. He would like to see 200-300,000 acre feet moved to the North Arm.

Christine asked for input on assumptions and calculations that would be helpful. Bill doesn't see much influence on export from the berm, thus more climatic scenarios are probably not helpful. Jeff suggested that we improve our estimates of flow over the berm. Ben added that we need to better understand flow through the causeway too. Jeff asked the SAC to send Christine any requests for information, calculations and scenarios by the next Wednesday.

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

The meeting was adjourned.

## ACTION ITEMS

- The SAC will send Christine requests as soon as possible.
- USGS and DWRe will continue to improve estimates of flow over the berm and forecasts of salinity.