UNION PACIFIC RAILROAD RESPONSE TO UTAH DIVISION OF WATER QUALITY COMMENTS ON ANTIDEGRADATION REVIEW SUBMISSION OF DECEMBER 10, 2013

UNION PACIFIC RAILROAD – GREAT SALT LAKE CAUSEWAY
PROPOSED EMERGENCY CLOSURE OF EAST CULVERT
APPLICATION FOR CLEAN WATER ACT SECTION 401 CERTIFICATION

December 11, 2013

On December 10, the Union Pacific Railroad (UPRR) submitted a revised application for Clean Water Act Section 401 Certification to the Utah Division of Water Quality (DWQ) relating to an Emergency Temporary Closure Authorization issued by the Army Corps of Engineers (ACOE) on December 6, 2013 under Nationwide Permit 14. In order to maintain the structural integrity of the Great Salt Lake Cause, the ACOE authorized the temporary filling of the failing East Culvert and the temporary reduction in water flow and salt transfer between the Great Salt Lake's North and South Arms that would result from that temporary closure of the East Culvert. The Corps permit emphasizes that the emergency authorization for the fill to remain in the culvert is only temporary and that any permanent solution for maintaining rail operations on the causeway, such as keeping the culvert filled permanently and installing the proposed compensatory mitigation bridge, would be considered in an Standard Individual Permit process.

In support of its 401 certification application, UPRR also submitted a completed Antidegradation Review (ADR) Form and requested a Level II review exclusion on the grounds that water quality impacts would be temporary and limited. DWQ provided a number of comments on UPRR's analysis presented in support of the temporary and limited exclusion. This document provides a response to those questions.

In general, the comments sought a standalone summary of UPRR's analysis. Further, DWQ requested additional background on the ongoing modeling effort that UPRR has undertaken and that provided some of the information to support UPRR's conclusions in the ADR submission. In addition, DWQ requested additional information to support the conclusion that a temporary 0.5% reduction of South Arm salinity over the period authorized in the Corps permit would be properly considered temporary. Finally, DWQ commented on the potential relevance of UPRR's prior discussion of interim mitigation and alternatives that had been provided to the ACOE during its consideration of the emergency closure permit. The specific comments are set forth at the end of this document, with a reference back to the location where the comment is addressed. The following discussion provides a standalone review of UPRR's basis for concluding that any impacts of the temporary filling of the East culvert would be temporary and limited and, therefore, the requested Level II exclusion should be approved.

I. UPRR Temporary and Limited Impact Analysis

Modeling and Salt Transfer Review. UPRR is implementing a modeling plan that was described in a September 25, 2013 letter and discussed in a meeting with DWQ, ACOE and other coordinating agencies on October 3, 2012. As reflected in that letter, the objective of this modeling effort is to evaluate the potential impacts of the East and West culvert closures and construction of the proposed bridge on the water and salt transfer between the North and South Arms of the Great Salt Lake—using the 1998 USGS Water and Salt Balance Model (the 1998 USGS Model) as represented in the Water-Resources

Investigations Report 00-4221, *Water and Salt Balance of Great Salt Lake, Utah, and Simulation of Water and Salt Movement through the Causeway, 1987 – 98* (Loving, Waddell and Miller, 2000). This modeling effort is the focus of the effort to analyze the potential impacts of closing the two culverts and it was requested by DWQ, ACOE and virtually all other coordinating agencies. In response to that feedback, UPRR developed a three-step modeling effort to update, recalibrate and run the 1998 USGS Water and Salt Balance Model: 1) Run the existing 1998 USGS Model and simulations of 2012 culvert conditions and new bridge; 2) Develop and calibrate a new version of the USGS Model for the time period 1987-2012; and 3) Develop a new predictive model for selected climatology.

The modeling and impacts analyses that are underway will help identify more specifically the contribution that the culverts made to the water and salt balance between the two parts of the Great Salt Lake before the culverts were closed. However, our analyses so far indicate the following:

UPRR has completed the first of its three-step modeling plan, using the USGS Water and Salt Balance computer model. The first step was to rerun the existing model calibrated for the period from 1987 through 1998 (12 years). This step included modeling a hypothetical scenario with two unobstructed culverts as they existed in November 2012, using 1987-1998 hydrology. In fact, during that period, the culverts were plugged with rubble and ineffective for most of this time. At the end of the modeling period (1998), the simulation produced a South Arm salinity of 11.3%. The average South Arm salinity based on actual measurements was 8.9%, a difference of 2.4%. This suggests that the average effect of the two unobstructed culverts on South Arm salinity was limited to about 0.2% per year over the 12-year period. In other words, during extended periods of high water levels, such as existed during the time period of 1987-1998, flows through the unobstructed culverts are estimated to contribute only about a 0.2% increase in South Arm salinity annually. This analysis is conducted over a range of South Arm water surface elevations of a high 4211 feet in 1987 to 4201 feet in 1998, higher water surface elevations than exist today.

South Arm Salinity Change, 1987-1998, Actual and Modeled

Initial Condition		Ending Condition			
		Actual[1]		Simulated Culverts	
Density, g/ml	% Salinity	Density, g/ml	% Salinity	Density, g/ml	% Salinity
1.051	7.7	1.060	8.9	1.077	11.3

1. UGS, average density at station RT-4, October 28,1998

Water and salt balance modeling has not yet been completed for the period from 1998 to 2012 (the second step of UPRR's impacts re-evaluation plan). However, in addition to the 1998 modeling summary above, salt transfers for the period from spring 2004 to spring 2009—a period of lower but relatively stable water elevations, can be calculated and evaluated using three sets of interrelated data from that period:

- Sampled North and South Arm salinities
- Measured bidirectional flows through the culverts
- Total salt load in the South Arm

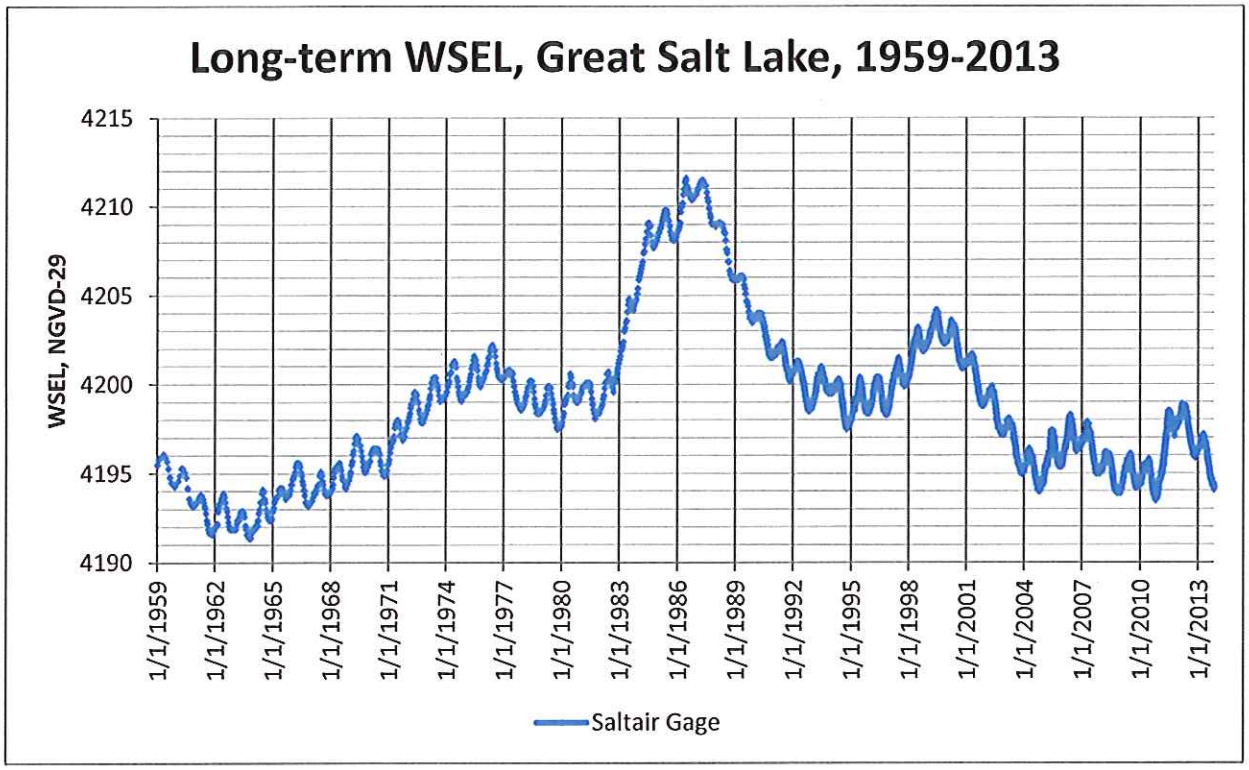
This period is the only one on record that is relevant for this purpose because it begins when UPRR removed all rubble from the culverts and constructed protective berms and ends with the latest known computation of salt load in the North and South Arms (Kidd M. Waddell, "The Potential Effects of the Proposed Great Salt Lake Minerals Project on the Water and Salt Balance of Great Salt Lake, Utah," 2010).

In spring 2009, total salt load in the South Arm was approximately 1.7 billion tons. Measured average South Arm salinity was 15.5% at a water surface elevation of about 4196 feet. Correlating the salinities and the bidirectional flows through the culverts, the net salt transfer through the two culverts (over a 5-year period ending spring 2009) was about 150 million tons north to south. Had the culverts been closed during that time, the estimated salt load in the South Arm in spring 2009 would therefore be 1.55 billion tons, or a salinity of 14.2%. This suggests that the average effect of the two culverts on South Arm salinity was limited to about 0.26% per year. In other words, during low water levels, such as existed at that time, flows through the unobstructed culverts are estimated to contribute about a 0.26% increase in South Arm salinity annually (although this might be partially offset by increased salt transfers through the causeway fill due to increased salinity differential). Lake elevations during this period were similar to the current elevation.

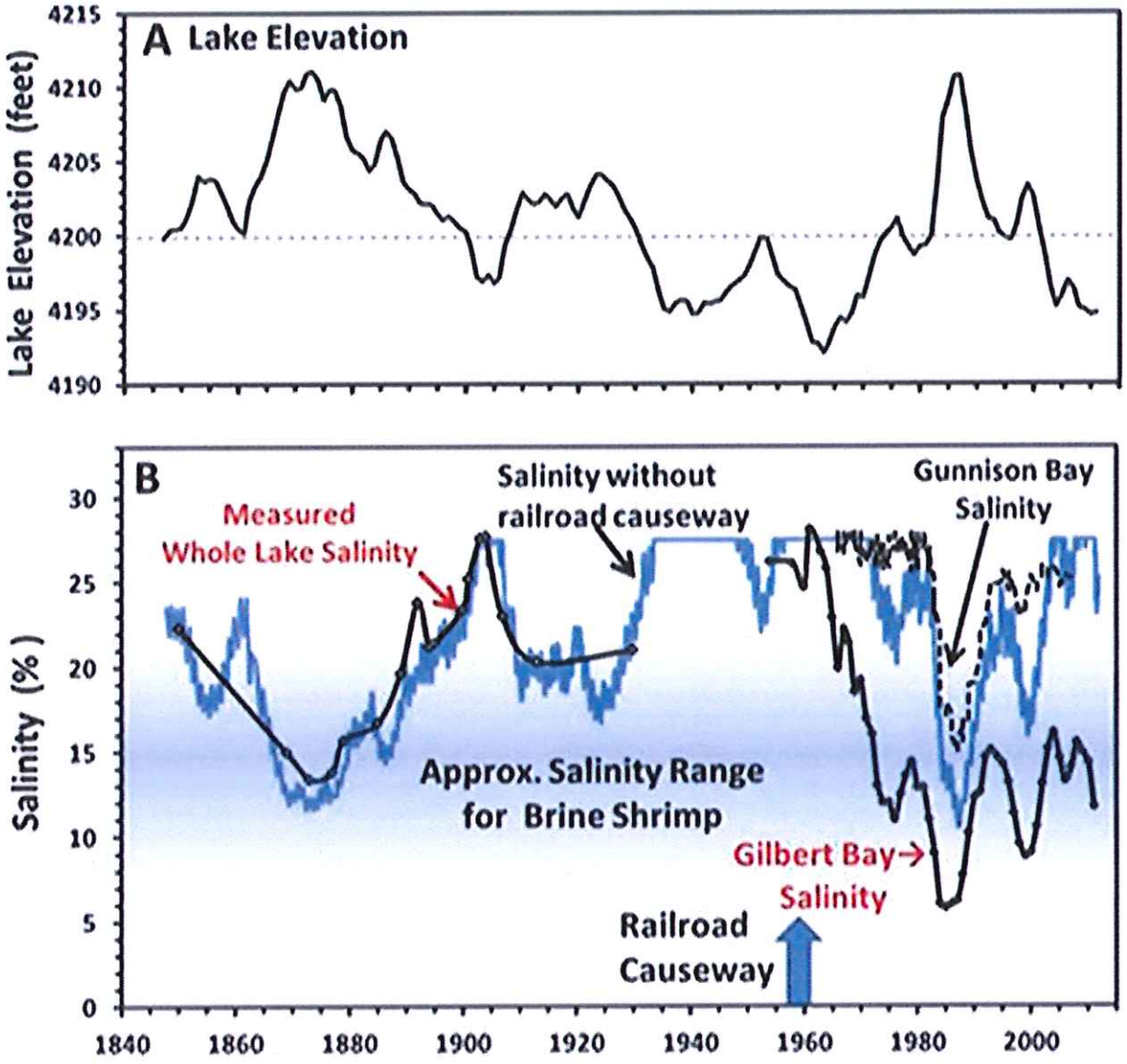
Therefore, using the 1998 modeling data, which is currently the best available until the completion of modeling effort, and the 2004-2009 salt transfer analysis, the estimated impact on South Arm salinity due to closure of both culverts would be expected to be on the order of 0.2% to 0.25% per year. During the 2004-2009 time period, South Arm salinity varied 4.3% (between 11.9% and 16.2%), an order of magnitude greater than the estimated annual contribution of the culverts, confirming that other factors affect salinity much more than the culverts.

Historical Water Surface Elevation and Salinity Review. As a closed basin system, the Great Salt Lake experiences annual variations in lake elevation and in salinity. Lake levels and average salinities are a result of the natural contribution of water inflows that bring water to the lake and evaporation, which removes water from the lake, and manmade influences such as surface water diversions, modifications to the causeway, the operation of the West Desert Pumping Project and industrial extractions. Generally, the lake level rises (and South Arm salinity decreases) during the winter and spring and the level recedes (and South Arm salinity increases) during the summer and fall. Annual variation averages about two feet.

Since the construction of the railroad causeway (completed in 1959), the lake has experienced record low elevation (4191.4 feet in October and November 1963) and record high elevation (4211.6 feet in June 1986). South Arm lake elevations, as recorded at the USGS Saltair gauge, are plotted below. Seasonal variations are apparent, but are greatly exceeded by long-term trends (over several years). For example, while "average" lake elevation is referenced as 4200 feet, the lake has been below that average elevation for over 12 consecutive years, since August 10, 2001.



The development of salinity differentials between the two arms of the lake following construction of the causeway is well documented. By the mid-1970s, the South Arm salinity appears to have reached a new equilibrium, and thereafter generally tracked inversely with the lake elevation. Since then, South Arm salinity has varied between about 6% and 16%. (Figure below from Null, Wurtsbaugh, and Miller, "Can the causeway in the Great Salt Lake be used to manage salinity?", http://www.usu.edu/ecology/files/uploads/FOGSL_newsletter_Null_Draft_4_Feb_2013.pdf)



Low South Arm salinities occurred in the mid-1980s (about 5%) and around 2000 (about 9%), both coinciding with higher water elevations. Conversely, higher salinities, about 15%, occurred around 1995 and from 2002 to 2004, coinciding with lower water elevations. The Comprehensive Great Salt Lake Management Plan states that, since 1984, the average salinity in the South Arm is 11% (Utah Forestry, Fire and State Lands, 2012).

Below is a graphical representation of the North and South Arms salinity values over various lake elevations and with respect to causeway opening modifications (e.g., Lakeside breach) for two time periods 1996-1984 and 1984-2010. (Open-File Report 596, Utah Geological Survey, 2012).

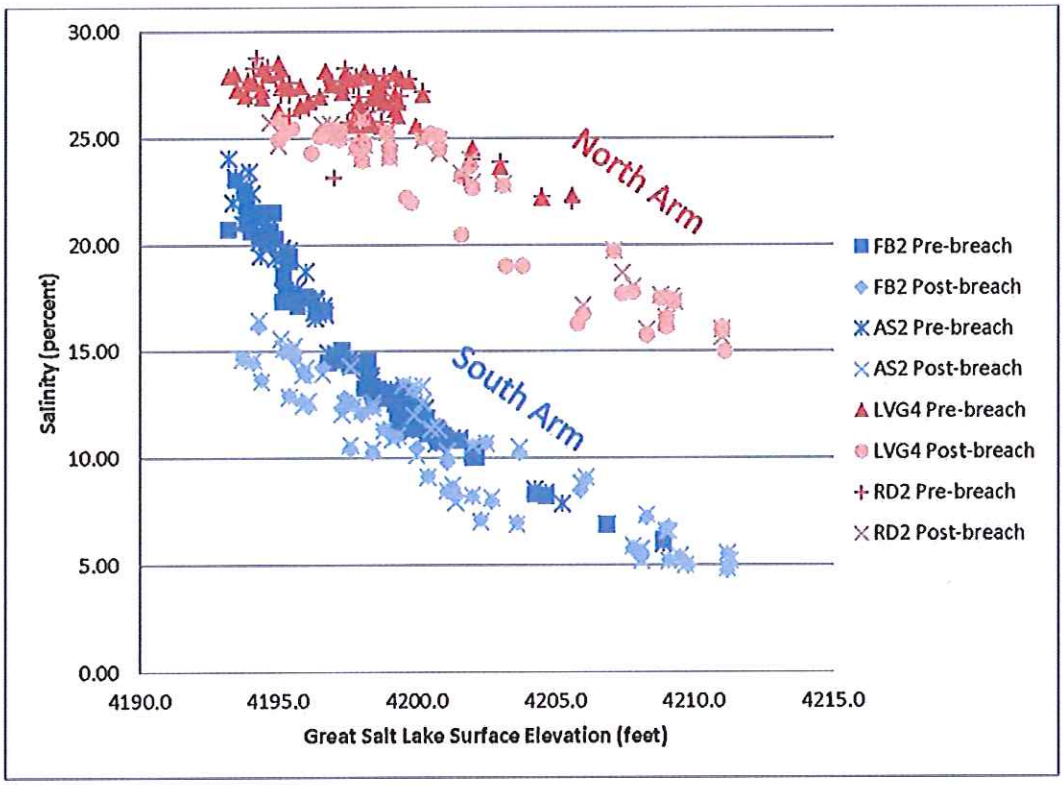


Figure 2. Salinity of Great Salt Lake versus surface elevation of Great Salt Lake. Blue symbols represent data from the south arm of Great Salt Lake and red symbols represent data from the north arm. For each point, salinity of brine has been averaged from sample depths of 5 to 15 feet. Deeper sample depths were not included to remove effects of deep brine layer. For each sample site, the data before and after the railroad causeway breach in 1984 have been represented differently to highlight changes in salinity trends.

The Utah Division of Water Quality has documented that the different bays within the Great Salt Lake vary in salinity from 2% to 27%, with Gilbert Bay ranging from 7% to 15% (A Great Salt Lake Water Quality Strategy, DWQ 2012).

Current (December 10, 2013) South Arm lake elevation is 4194.3 feet. South Arm salinity was about 13.1% on October 31, 2012 (latest available data for UGS station AS-2 reported average upper layer density). Water surface elevation has declined nearly two feet since then, however, so the historical record indicates that current salinity is likely about 15%.

Conclusion. The temporary closure of the East Culvert will not affect the amount of annual inflows to the lake. The temporary closure will have a limited effect on the exchange of water and salt through the causeway, with the actual effect dependent on lake elevations and salinity values. Therefore, a projected temporary 0.5% decline in South Arm salinity (from a current value of 15%) is minor in comparison to historical salinity values and variations, which historically are in the range of 11 percent (between approximately 5% and 16%).

II. DWQ Individual Comments and UPRR Specific Responses

DWQ provided the following specific comments. The analysis above addresses all of the comments except #5. This section repeats DWQ's comments and provides a specific reference or a cross-reference in the above discussion where the comment is addressed.

DWQ Comment 1. It would be helpful if the justification for a temporary and limited determination was summarized in a separate document, including supporting figures and tables, and provided as an attachment, rather than as a response to questions from the ACOE.

> *UPRR Response: Agreed. The discussion above sets forth a standalone description of UPRR's analysis. It incorporates the substance of submissions made to the ACOE regarding the limited effect of a temporary culvert closure on salinity and added historical context*]

2. The conclusion that the impact is limited partially relies on results from the model update effort; however, no documentation was provided regarding the methods, results and conclusions of the model update. We will need to take the modeling effort on faith to allow the culverts to be filled on an emergency basis per UPRR's schedule. More detailed model review will have to be postponed until the SIP.

> *UPRR Response. The above discussion provides the background on the modeling effort and the initial results that support the conclusion regarding the percent change in South Arm salinity that would result from temporary filling of the East culvert.*

3. The conclusion that 0.20-0.26% reduction in salinity per year in the South Arm is limited potentially has merit; however, little context is provided to what relative change this represents and how this relates to historical water and salinity levels in the South Arm.

> *UPRR Response. As per the comment, the above discussion provides additional context in regard to the relative change of an annual 0 .2-0.26% reduction in salinity represents and how it relates to historical South Arm water and salinity levels.*

4. The conclusion that one-year of closure, or three-years per the ACOE NWP, is temporary potentially has merit; however, little justification is provided as to why this should be considered temporary for the GSL. Again, how this relates to historical water and salinity levels in the South Arm would be helpful. One year would typically not be considered temporary for freshwater systems.

> *UPRR Response. As per the comment, the above discussion provides additional justification for the conclusion that the term of the permit should be considered temporary in the context of the Great Salt Lake. As discussed in response 3, the document also provides additional discussion on how the term relates to historical South Arm water and salinity levels.*

5. The response to comments to the ACOE includes discussion of alternatives that would be germane to a Level II ADR. I would like to see that left in the ADR even if they provide a separate justification, i.e. interim mitigation measures were considered but aren't feasible.

UPRR Response. UPRR has included the referenced information in the supporting documentation for our application. As discussed in these submissions to ACOE, UPRR evaluated both alternatives to closing the culvert and interim mitigation measures but all those measures were found to be infeasible.