

Evaluation of Disposal of Reverse Osmosis By-Product; Alternative H - Distillation and Disposal of Salts

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EXECUTIVE SUMMARY

This alternative consists of distilling the Zone B and Lost Use Reverse Osmosis (RO) by-product on-site and disposing the remaining dry salts at an off-site landfill. The distillation process will result in approximately 40 tons per day of solids (salts), which require disposal. This memorandum focuses on disposal options at an EPA-approved landfills within Salt Lake County. This option includes transport of the salts to the landfill and disposal. Assuming the reverse osmosis plant will operate 330 days per year, the approximate annual cost for transport and disposal of the salts ranges from \$413,000 to \$623,000. The cost is dependent on the water content of the salts and mode of transport. The cost range assumes water content of zero to 15 percent.

BACKGROUND

Mining activities in southwestern Salt Lake Valley have created groundwater contamination with elevated sulfate concentrations. A 1995 federal Consent Decree negotiated by Jordan Valley Water Conservancy District (JVWCD), Kennecott Utah Copper Corporation (KUCC) and Utah Department of Environmental Quality (UDEQ), established a natural resource damage Trust Fund which was paid by KUCC. The Consent Decree established purposes for use of the Trust Fund as:

- remediating the aquifer
- containing the contamination plumes; and
- restoring the beneficial use by producing municipal quality water through treatment.

Dr. Dianne R. Nielson, Executive Director of UDEQ, has been appointed as Trustee of the Trust Fund and of projects to accomplish the Consent Decree purposes.

JVWCD and KUCC have submitted a Joint Proposal project to the Trustee to accomplish the Consent Decree purposes. The Joint Proposal involves one reverse osmosis (RO) treatment plant and facilities to treat western Zone A deep groundwater; and one RO plant to treat eastern Zone B deep groundwater and Lost Use shallow groundwater. The Trustee held a public information and public comment period during August through November 2003.

As a result of the public comments, JVWCD withdrew its Zone B/Lost Use RO by-product water discharge permit to the Jordan River and renewed efforts to find a better disposal alternative. The Trustee established a Stakeholder Forum for southwest groundwater

remediation issues in early 2004. JWCD has sought input from the Stakeholders Forum as it considers various alternatives for disposal of Zone B/Lost Use RO by-product water.

Zone B/Lost Use by-product water is projected to have the following characteristics:

	Flow Rate (cfs)	TDS Concentration (mg/L)	Selenium Concentration (µg/L)
Zone B	1.24	8,300	25
Lost Use	0.51	8,200	47
Total Common Range	1.75	8,200 -8,300	32-47

Notes: cfs – cubic feet per second
mg/L – milligram per liter
µg/L – microgram per liter

PURPOSE

The purpose of this memo is to describe the cost of transporting and disposing of Zone B and Lost Use RO by-product after distillation.

AUTHOR'S CREDENTIALS

I am an Engineer in Training (E.I.T.) specializing in the area of environmental compliance and remediation. I have completed Bachelor and Master of Science degrees in civil engineering. Following graduation, I have been working at CH2M HILL as a civil engineer for the last 3 years. My current title is project engineer, in which I manage project tasks and provide support on environmental and water resource projects. I have worked on several Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) projects, developing remedial alternatives to handle contaminated soils and sediments. I have written Engineering Evaluation/Cost Analysis Reports, discussing remediation technologies and providing cost estimates to implement the technologies. I have an understanding of the Resource, Conservation, and Recovery Act (RCRA) program under the U.S. Environmental Protection Agency (EPA), which regulates waste disposal and have used this knowledge for several environmental projects.

DESCRIPTION OF ALTERNATIVE

This alternative consists of distilling the discharge by-product from the Zone B/ Lost Use Reverse Osmosis (RO) Plant in West Jordan. The salts remaining from the distillation process would be transported to roll-off containers for storage. The containers would then be transported daily to a non-hazardous landfill within Salt Lake County.

Based on the concentration of Total Dissolved Solids (TDS) and a total flow rate of 1.75 cfs, approximately 78,000 pounds (40 tons) per day of solids would remain after distillation. The solids contain a high concentration of salts, consisting mostly of calcium sulfate (gypsum) and calcium carbonate (calcite). Forty tons per day assumes that the solids are dry, although the actual water content may range between 5 and 15 percent. As the water content increases, the

mass of the solids increase, thereby, increasing the cost of transport and disposal. Transport and disposal costs are based on the tonnage of waste. For this alternative, costs are provided for a water content range of zero to 15 percent.

TRANSPORTATION

At this point, it is assumed that the salts would be transported to the landfill in lined 25 cubic yard roll-off containers or end dump trucks. After the distillation process, the salts would either be placed directly in the lined roll-off containers or in a lined end dump truck. It is unknown what technique will be used to load the salts. The liners are used to prevent leakage during storage and transport. The benefit of using roll-off containers is that the salts can be stored onsite prior to transport. End dump trucks would require loading into the dump truck at the time of transport.

To comply with Utah Department of Transportation regulations, the maximum load limit is 80,000 pounds (40 tons), which includes the transport vehicle. Dry salts weigh approximately 40 tons and salts with 15 percent water content weigh approximately 45 tons. The capacity of a single roll-off container is about 17 tons and the capacity of an end dump truck is about 20 tons. Therefore, 3 trips would be required for the roll-off containers and 2 trips with an end dump truck. Again, the weight and the number of trips increase as the water content increases.

The cost to transport the salts is based on the weight. TW Company, a local transporter, quoted \$10 per ton for transport via end dump trucks and \$20 per ton for transport via roll-off containers. With this rate, the daily transportation costs range from \$400 to \$900, depending upon the water content of the material and the mode of transport.

LANDFILL OPTIONS

Trans-Jordan Landfill in South Jordan, Utah will accept the solid waste, upon compliance with their permit. Dwayne Woolley of Trans-Jordan stated that Trans-Jordan has a strict requirement for wastes containing arsenic and lead above background concentrations. Mr. Woolley has been provided the preliminary metals profile of the salts waste for review. Based on RCRA criteria, the salts are considered non-hazardous and can be disposed accordingly. Trans-Jordan Landfill meets EPA requirements for classification as a Subtitle D Facility, which accept non-hazardous waste.

The disposal fee at Trans-Jordan Landfill is \$22 per ton. The disposal cost for landfilling the salts ranges from \$860 to \$1,000 per day depending on the water content of the salts.

ENVIRONMENTAL CONCERNS

Landfilling is a proven technique for disposing of wastes, although environmental concerns do exist. An environmental concern with landfilling is burying large volumes of waste within the landfill, which shortens the life of the landfill. Landfilling does not reduce the volume or mass of the waste. With the current assumed loading rate of 300,000 tons per year, this alternative will increase the annual loading of the Trans-Jordan Landfill by approximately 5 percent. The projected life of the Trans-Jordan Landfill is 25 years, which may be reduced with the influx of the salts wastestream.

Another environmental concern is the leachability of the salts. The landfilled salts are susceptible to being leached by infiltrating precipitation, which will make the salts mobile within the subsurface of the landfill. The Trans-Jordan Landfill is lined with impermeable material and is equipped with a leachate collection system, but the possibility still exists for the compounds to leach into the subsurface and potentially reach the water table. This is unlikely, but is still a possibility.

LEGALITY

No regulatory problems appear to exist with the alternative of disposing the salts in the Trans-Jordan Landfill. This alternative of disposing the salts in the Trans-Jordan Landfill was discussed with a representative from the Utah Department of Solid and Hazardous Waste, which did not object to landfilling the salts. Calls are currently in to two representatives at the Salt Lake Valley Health Department to discuss the feasibility of this alternative.

Trans-Jordan Landfill meets U.S. Environmental Protection Agency's (EPA) requirements for classification as a Subtitle D Facility. Subtitle D facilities accept wastes that are classified as non-hazardous. The Trans-Jordan Landfill contains a double composite liner system constructed of a 3/8-inch Geosynthetic Clay Liner (GCL) overlaid with a 60-mil high density polyethylene (HDPE) liner. The landfill is equipped with a leachate collection system, which utilizes evaporation for disposal. The design of the Trans-Jordan Landfill is more than adequate to meet the regulations for disposing the salts from the distillation process.

COST

As discussed above, cost for transport and disposal are based on the mass of the waste. The cost for transport is \$10 per ton via end dump truck and \$20 per ton via roll-off containers. Disposal cost is \$22 per ton. These are preliminary cost quotes, which may vary. It is assumed that the reverse osmosis plant will operate 330 days per year, therefore the annual transportation costs range from approximately \$129,000 to \$297,000. The annual disposal costs range from approximately \$284,000 to \$327,000. The combined annual cost ranges from approximately \$413,000 to \$623,000. The least cost being the salt waste with zero water content, with a daily load of 40 tons and transportation via a dump truck. The highest cost is for transport via roll-off containers and disposal of salts with 15 percent water content.

See the attached spreadsheet for details and calculations of the cost estimate.

Table 1
 Cost Estimate for Alternative H - Disposal of Salt Waste
 Memorandum 7 - Jordan Valley Water Conservancy District

Assumptions	
Total Dissolved Solids (TDS) (lbs/day)	78,122
Total Dissolved Solids (TDS) (tons/day)	39
Transportation Cost per Ton (end dump truck)	10
Transportation Cost per Ton (roll-offs)	20
Disposal Cost per Ton (Trans Jordan)	22
Operational Days per Year	330

Daily Costs	Water Content (%)	Daily Load (tons)	Transportation				Total Daily Cost (end dump truck)	Total Daily Cost (roll-offs)	Total Daily Cost
			Cost (end dump trucs)	Trans Jordan Disposal Cost	Transportation Cost (roll-offs)	Trans Jordan Disposal Cost			
	0	39	\$390.61	\$859.34	\$781.22	\$859.34	\$1,249.95	\$1,640.56	\$1,640.56
	5	41	\$410.14	\$902.31	\$820.28	\$902.31	\$1,312.45	\$1,722.59	\$1,722.59
	10	43	\$429.67	\$945.28	\$859.34	\$945.28	\$1,374.95	\$1,804.62	\$1,804.62
	15	45	\$449.20	\$988.24	\$898.40	\$988.24	\$1,437.44	\$1,886.65	\$1,886.65

Annual Costs	Water Content (%)	Annual Load (tons)	Transportation				Total Annual Cost (end dump truck)	Total Annual Cost (roll-offs)	Total Annual Cost
			Cost (end dump truck)	Trans Jordan Disposal Cost	Transportation Cost (roll-offs)	Trans Jordan Disposal Cost			
	0	12,890	\$128,901.30	\$283,582.86	\$257,802.60	\$283,582.86	\$412,484.16	\$541,385.46	\$541,385.46
	5	13,535	\$135,346.37	\$297,762.00	\$270,692.73	\$297,762.00	\$433,108.37	\$568,454.73	\$568,454.73
	10	14,179	\$141,791.43	\$311,941.15	\$283,582.86	\$311,941.15	\$453,732.58	\$595,524.01	\$595,524.01
	15	14,824	\$148,236.50	\$326,120.29	\$296,472.99	\$326,120.29	\$474,356.78	\$622,593.28	\$622,593.28

Notes:
 water content = (water weight/solid weight)*100

