PARAGON
CONSULTING GROUP

"SERVICE, QUALITY, AND INNOVATION"

1103 Oak Park Drive, Suite 110
Fort Collins, CO 80525
Phone (970) 377-1600
Fax (970) 377-1880
www.paragoneg.com

DAVID M. RAU, P.E., BCEE
SCOTT A. RUTHERFORD, P.E.
BRICK SMITH, P.E.
BRAD C. WOHLER
AMY D. WEBER, P.E.
HEATHER S. ALDERMAN
DAVID L. WALKER

SENT VIA EMAIL (hmickelson@utah.gov)
ORIGINAL TO FOLLOW US MAIL

January 4, 2013

Ms. Heather Mickelson, P.E.
Utah Department of Environmental Quality
Division of Air Quality
P.O. Box 144820
Salt Lake City, UT 84114-4820

RE: Addendum to the Revised Notice of Intent
Danish Flats Evaporation Ponds
Grand County, Utah
Project Number 1011007

Dear Ms. Mickelson:

The purpose of this letter is to summarize additional information regarding the revised Notice of Intent (NOI) for the above-referenced site as requested by the Utah Department of Environmental Quality, Division of Air Quality (DAQ) in an email dated August 30, 2012 and as discussed in subsequent phone calls and email messages. In the August 30, 2012 email, the DAQ requested additional analyses of three (3) treatment options that were discussed in the revised NOI dated June 22, 2012. In particular, the DAQ requested a detailed cost analysis and expected emission reductions for microfiltration with ceramic filters, dewvaporation, and carbon adsorption treatment technologies. Paragon Consulting Group, Inc. (Paragon) prepared this addendum to the revised NOI for the above-referenced site on behalf of Danish Flats Environmental Services, LLC (Danish Flats).

Based on further evaluation, it does not appear that microfiltration with ceramic filters is a technically feasible treatment option to reduce dissolved organic contaminants in the produced water at Danish Flats prior to evaporation in the evaporation ponds. Microfiltration with ceramic filters is better suited for removal of suspended organics rather than treatment of dissolved organics. Danish Flats currently employs primary, secondary and tertiary separation in the tanks, vaults and settling pond for the removal of suspended organics (i.e. condensate). Additional treatment technologies, such as air stripping or carbon adsorption, would still be required if microfiltration with ceramic filters were used at Danish Flats, making this technology technically infeasible and ineffective.

Dewvaporation may be technically feasible in the future for the treatment of dissolved organic contaminants in produced water. Currently, this treatment option appears to an emerging technology that has not reached full-scale commercial status based on Paragon's additional evaluation. Altela, Inc. (Altela) is currently testing its AltelaRain System in Pennsylvania, Colorado, New Mexico and Western Canada. Altela could not currently commit to a full-scale dewvaporation system for Danish Flats nor would they provide detailed costs or expected emission reductions for this best available control technology (BACT) analysis. Therefore, dewvaporation is eliminated as a technically feasible option for the Danish Flats facility.

Carbon adsorption is feasible for removal of most dissolved organic compounds from the Danish Flats produced water except for methanol, which is not effectively treated using carbon adsorption due to its high solubility in water. Paragon obtained detailed costs and expected emission reductions from CarbonAir for carbon adsorption. A more detailed cost analysis for carbon adsorption was performed and the costs are summarized in the attached spreadsheet. As seen from the attachment, the estimated net present value for carbon adsorption is approximately $64,091,250 for a 20 year operation period, using a real interest rate of 3% which was selected based on input from DAQ. These additional pollution control costs equate to a cost of approximately $1.20 per bbl of produced water treated at the facility, assuming that approximately 2,661,025 bbl are received annually for 20 years.

To estimate the emission reductions for carbon adsorption treatment, Paragon used the uncontrolled air emission estimates summarized in the June 22, 2012 Revised NOI and removal efficiencies for carbon adsorption. Based on manufacturer information, which is attached, the removal efficiency for carbon adsorption differs for each organic compound and ranges from approximately 75% to 89% percent, while some of the Danish Flats influent concentrations are already below a target effluent criteria of 5 milligrams/liter. As stated above, carbon adsorption is not feasible for removal of methanol due to its high solubility in water. Using the uncontrolled air emission estimates summarized in Table 1 that is attached to this letter for the reader's convenience, a mass balance was used to estimate the controlled emissions of HAPs and total VOCs from the evaporation ponds. Under this scenario, control of emissions from the primary separation tanks, secondary separation vaults, condensate storage tanks, condensate load out, and settling pond is not performed. The total estimated controlled emissions and emission reductions for benzene, toluene, ethylbenzene, xylenes, hexane, methanol, total HAPs and total VOCs are summarized below and in Table 2, which is attached to this letter.

Type of Pollutant	Total Estimated Uncontrolled Emissions (tons/year)	Total Estimated Controlled Emissions (tons/year)	Total Estimated Emissions Reductions (tons/year)
Benzene	11.2	3.10	8.20
Toluene	18.2	1.24	17.0
Ethylbenzene	0.856	0.856	No Reduction
Total Xylenes	14.0	4.43	9.57
Hexane	6.55	6.55	No Reduction
Methanol	55.2	55.2	No Reduction
Total HAPs	106	71.4	34.6
Total VOCs	332	222	100

The additional costs per ton of pollutant removed using carbon adsorption is approximately $92,617/ton for total HAPs and approximately $32,046/ton for total VOCs, assuming that approximately 2,661,025 bbl of produced water are received annually for 20 years.

The use of carbon adsorption for control of VOCs with high Henry's Law constants at Danish Flats will require use of additional electricity. The additional electricity usage for the associated equipment is estimated to be approximately 202,100 KWH per year. The total energy costs are estimated to be approximately $11,907 per year and the incremental energy costs are estimated to be approximately $344/ton for total HAPs and approximately $119/ton for total VOCs. Secondary environmental impacts may include emissions of HAPs, VOCs, particulate matter, CO_2, NO_x, CO, and SO_x from combustion of natural gas for additional electricity if electrical service cannot be brought into the facility.

Based on the additional analysis performed for this addendum, air stripping and thermal oxidation still appears to be the most cost-effective technology to reduce the emission of organic contaminants in water with high Henry's Law constants prior to evaporation in the evaporation ponds. Air stripping is reasonably effective at removing dissolved VOCs with high Henry's Law constants from water but is not an effective approach for VOCs with low Henry's Law constants, which is primarily methanol at Danish Flats. Treatment options for methanol removal are limited due to its high solubility in water. A possible technically feasible option for methanol treatment in water is biological treatment using a membrane bioreactor (MBR) variant of an activated sludge treatment system. As presented in the June 22, 2012 Revised NOI, the incremental increase to the costs per ton of total VOCs removed using MBR activated sludge appears to be unreasonable as BACT based on cost.

Paragon is not a construction cost estimator or construction contractor, nor should Paragon's rendering of a probable construction cost be considered equivalent to the nature and extent of service a construction cost estimator or construction contractor would provide. Paragon's opinions have been based upon prior construction experience and information provided by equipment suppliers and manufacturers. This has required Paragon to make a number of assumptions as to actual conditions which will be encountered on-site; the means and methods of construction the contractor will employ; the cost and extent of labor, equipment and materials the contractor will employ; contractor's techniques for determining prices and market conditions at the time, as well as other factors over which Paragon has no control. Given the assumptions that must be made, Paragon cannot guarantee the accuracy of the opinions of cost presented in this report.

This report was prepared for the exclusive use of Danish Flats Environmental Services, LLC for specific application to the subject property and has been prepared in accordance with generally accepted environmental engineering practices. No warranties, either express or implied, are intended or made. In the event that changes in the nature or location of suspected sources of contamination as outlined in this report are observed, the conclusions and recommendations contained in this report shall not be valid unless these changes are reviewed and the opinions of this report are modified and verified in writing by Paragon.

If there are any questions concerning this Addendum to the Revised NOI, please contact us.

Sincerely,
PARAGON CONSULTING GROUP, INC.

Scott A. Rutherford
Project Manager

David M. Rau, P.E., BCEE
Utah No. 7971275-2202

PROFESSIONAL ENGINEER
1/4/13
No. 7971275-2202
DAVID M. RAU
STATE OF UTAH

SAR/DMR:sar2

enc: BACT Cost Estimate for Carbon Adsorption
Carbon Adsorption Information
Table 1 – Summary of Estimated Uncontrolled Air Emissions
Table 2 – Summary of Estimated Controlled HAP and VOC Air Emissions Using Carbon Adsorption

cc: Mr. Timothy R. Andrus/Utah DEQ DAQ (via email)
Mr. Jim Bradish/Danish Flats Environmental Services, LLC (via email)
Mr. Lee Shenton/Grand County (via email)

BACT COST ESTIMATE FOR CARBON ADSORPTION

PROJECT NAME: Danish Flats Produced Water Evaporation Ponds

PROJECT LOCATION: Grand County, Utah

PROJECT NUMBER: 1011007

Control Technologies: Primary separation, secondary separation, tertiary separation, and carbon adsorption.

PHASE OF WORK CODE (PWC)	ACTIVITY CODE (AC)	TASK OR LABOR CODE (TLC)	TASK DESCRIPTION	UNITS	QUANTITY	UNIT RATE	SUBTOTAL	MARKUP	SUBTOTAL BY ACTIVITY AND TASK GROUP	TOTAL
3A Pilot tests										
	a. Pilot test									
			Labor - sampling for carbon adsorption treatment assessment							
3A	a.	5.3	project manager	hours	4.00	$ 111.00	$ 444			$ 444.00
3A	a.	5.4	project engineer / scientist	hours	20.00	$ 96.00	$ 1,920			$ 1,920.00
3A	a.	5.9	clerical and courier	hours	1.00	$ 47.00	$ 47			$ 47.00
			TLC-5 group - Labor Subtotal						$ 2,411.00	
			Laboratory Analysis							
3A	a.	6.7	water analytical (BTEX, naphthalene, hexane, methanol & TVPH)	samples	3	$ 335.00	$ 1,005	$ 151		$ 1,155.75
3A	a.	6.38	alkalinity	samples	3	$ 20.00	$ 60	$ 9		$ 69.00
3A	a.	6.99	anion scan	samples	3	$ 100.00	$ 300	$ 45		$ 345.00
3A	a.	6.99	hardness	samples	3	$ 40.00	$ 120	$ 18		$ 138.00
3A	a.	6.99	TDS	samples	3	$ 20.00	$ 60	$ 9		$ 69.00
3A	a.	6.99	cation scan	samples	3	$ 250.00	$ 750	$ 113		$ 862.50
			TLC-6 group - Laboratory Analyses						$ 2,639.25	
			Travel							
3A	a.	9.2	lodging (GSA rate)	days	1	$ 84.00	$ 84			$ 84.00
3A	a.	9.3	meals (GSA rate)	days	1	$ 51.00	$ 51			$ 51.00
3A	a.	9.4	mileage	miles	800	$ 0.555	$ 444			$ 444.00
			TLC-9 group - Travel Subtotal						$ 579.00	
			Field Instrumentation							
3A	a.	12.1	misc field supplies	days	1	$ 12.00	$ 12			$ 12.00
3A	a.	12.7	DO/temp/pH/EC/ORP	days	1	$ 500.00	$ 500	$ 75		$ 575.00
			TLC-12 group - Field Instrumentation Subtotal						$ 587.00	
			Activity Code a. Subtotal						$ 6,216.25	
									CONTINGENCY FOR 3A (10%):	$ 621.63
									TOTAL 3A COSTS:	$ 6,837.88
3B System design										
	b. System design									
			Labor - data analyses; conceptual design & final design including plans & specs							
3B	b.	5.1	principal (conceptual design 3 hours; final design 5 hours)	hours	8.00	$ 140.00	$ 1,120			$ 1,120.00
3B	b.	5.3	project manager (data analyses 4 hours; conceptual design 8 hours; final design 12 hours)	hours	24.00	$ 111.00	$ 2,664			$ 2,664.00
3B	b.	5.4	project engineer / scientist (data analyses 16 hours; conceptual design 16 hours; final design 80 hours)	hours	112.0	$ 96.00	$ 10,752			$ 10,752.00
3B	b.	5.7	draftsperson (final design)	hours	60.00	$ 56.00	$ 3,360			$ 3,360.00
3B	b.	5.9	clerical and courier (final design)	hours	12.00	$ 47.00	$ 564			$ 564.00

BACT COST ESTIMATE FOR CARBON ADSORPTION

PROJECT NAME: Danish Flats Produced Water Evaporation Ponds

PROJECT LOCATION: Grand County, Utah

PROJECT NUMBER: 1011007

Control Technologies: Primary separation, secondary separation, tertiary separation, and carbon adsorption.

PHASE OF WORK CODE (PWC)	ACTIVITY CODE (AC)	TASK OR LABOR CODE (TLC)	TASK DESCRIPTION	UNITS	QUANTITY	UNIT RATE	SUBTOTAL	MARKUP	SUBTOTAL BY ACTIVITY AND TASK GROUP	TOTAL
			TLC-5 group - Labor Subtotal						$ 18,460.00	
			Activity Code b. Subtotal						$ 18,460.00	
								CONTINGENCY FOR 3B (10%):		$ 1,846.00
								TOTAL 3B COSTS:		$ 20,306.00
3D Remediation System Installation/Excavation										
	d. System Installation									
			Labor - for permitting; pre-construction meeting; coord & observation of installation of system							
3D	d.	5.1	principal	hours	8.00	$ 140.00	$ 1,120			$ 1,120.00
3D	d.	5.3	project manager	hours	60.00	$ 111.00	$ 6,660			$ 6,660.00
3D	d.	5.4	project engineer / scientist	hours	80.00	$ 96.00	$ 7,680			$ 7,680.00
3D	d.	5.5	staff engineer / scientist	hours	120.0	$ 77.00	$ 9,240			$ 9,240.00
3D	d.	5.9	clerical and courier	hours	4.00	$ 47.00	$ 188			$ 188.00
			TLC-5 group - Labor Subtotal						$ 24,888	
			Subcontractor - for system installation							
3D	d.	8.2	electrician	hours	60	$ 100	$ 6,000			$ 6,000.00
3D	d.	8.8	system subcontractors (5 man crew)	hours	120	$ 230.00	$ 27,600			$ 27,600.00
			TLC-8 group - Subcontractor Subtotal						$ 33,600	
			Travel costs							
3D	d.	9.2	lodging (GSA rate)	days	84	$ 84.00	$ 7,056			$ 7,056.00
3D	d.	9.3	meals (GSA rate)	days	84	$ 51.00	$ 4,284			$ 4,284.00
3D	d.	9.4	mileage (4 trips)	miles	3200	$ 0.555	$ 1,776			$ 1,776.00
			TLC-9 group - Travel Subtotal						$ 13,116	
			Equipment							
3D	d.	13.1	pump (portable 4" Godwin pump w/ diesel engine)	each	1	$ 25,000	$ 25,000			$ 25,000.00
3D	d.	13.99	other equipment - natural gas turbine generator	each	1	$ 15,000	$ 15,000			$ 15,000.00
3D	d.	13.99	other equipment - crane to unload carbon units	days	1	$ 2,500	$ 2,500			$ 2,500.00
			TLC-13 group - Equipment Subtotal						$ 42,500	
			Materials							
3D	d.	14.12	carbon canisters (includes freight)	each	2	$ 80,000.00	$ 160,000			$ 160,000.00
3D	d.	14.99	other materials - slab & footers for genset	sq feet	96	$ 12.00	$ 1,152			$ 1,152.00
3D	d.	14.99a	other materials - electrical supplies	each	1	$ 2,000	$ 2,000			$ 2,000.00
3D	d.	14.99b	other materials - misc	each	1	$ 500	$ 500			$ 500.00
			TLC-14 group - Materials Subtotal						$ 163,652	
			Activity Code d. Subtotal						$ 277,756	
	m. Trenching									
			Labor - for coordination & observation of trenching activities for process piping & electrical conduit							
3D	m.	5.3	project manager	hours	4.00	$ 111.00	$ 444			$ 444.00

BACT COST ESTIMATE FOR CARBON ADSORPTION

PROJECT NAME: Danish Flats Produced Water Evaporation Ponds

PROJECT LOCATION: Grand County, Utah

PROJECT NUMBER: 1011007

Control Technologies: Primary separation, secondary separation, tertiary separation, and carbon adsorption.

PHASE OF WORK CODE (PWC)	ACTIVITY CODE (AC)	TASK OR LABOR CODE (TLC)	TASK DESCRIPTION	UNITS	QUANTITY	UNIT RATE	SUBTOTAL	MARKUP	SUBTOTAL BY ACTIVITY AND TASK GROUP	TOTAL
3D	m.	5.4	project engineer / scientist	hours	12.00	$ 96.00	$ 1,152			$ 1,152.00
3D	m.	5.5	staff engineer / scientist	hours	80.0	$ 77.00	$ 6,160			$ 6,160.00
3D	m.	5.9	clerical and courier	hours	2.00	$ 47.00	$ 94			$ 94.00
			TLC-5 group - Labor Subtotal						$ 7,850	
			Subcontractor - for trenching to install process piping & electrical conduit							
3D	m.	8.3	excavator (backhoe with operator for trenching)	each	80	$ 150.00	$ 12,000			$ 12,000.00
			TLC-8 group - Subcontractor Subtotal						$ 12,000	
			Travel costs							
3D	m.	9.2	lodging (GSA rate)	days	10	$ 84.00	$ 840			$ 840.00
3D	m.	9.3	meals (GSA rate)	days	10	$ 51.00	$ 510			$ 510.00
3D	m.	9.4	mileage (3 trips)	miles	2400	$ 0.555	$ 1,332			$ 1,332.00
			TLC-9 group - Travel Subtotal						$ 2,682	
			Materials							
3D	m.	14.6b	piping (2" electrical conduit)	feet	910	$ 2.95	$ 2,685			$ 2,684.50
3D	m.	14.6c	piping (4" HDPE for lines from tanks to carbon adsorption & carbon adsorption to ponds)	feet	1000	$ 5.53	$ 5,530			$ 5,530.00
3D	m.	14.7	sand (bedding for pipe)	lf	435	$ 8.69	$ 3,780			$ 3,780.15
3D	m.	14.8	aggregate base (gravel for resurfacing)	lf	435	$ 11.23	$ 4,885			$ 4,885.05
3D	m.	14.99	other materials - misc	each	1	$ 300	$ 300			$ 300.00
			TLC-14 group - Materials Subtotal						$ 17,180	
			Activity Code m. Subtotal						$ 39,712	
	n. System Enclosure									
			Labor - for coordination & observation of installation of equipment building							
3D	n.	5.3	project manager	hours	5.00	$ 111.00	$ 555			$ 555.00
3D	n.	5.4	project engineer / scientist	hours	10.00	$ 96.00	$ 960			$ 960.00
3D	n.	5.5	staff engineer / scientist	hours	100.0	$ 77.00	$ 7,700			$ 7,700.00
			TLC-5 group - Labor Subtotal						$ 9,215	
			Travel costs							
3D	n.	9.2	lodging (GSA rate)	days	7	$ 84.00	$ 588			$ 588.00
3D	n.	9.3	meals (GSA rate)	days	7	$ 51.00	$ 357			$ 357.00
3D	n.	9.4	mileage (2 trips)	miles	1600	$ 0.555	$ 888			$ 888.00
			TLC-9 group - Travel Subtotal						$ 1,833	
			Project Related Office Expenses / Onsite Utilities / Permits							
3D	n.	10.9	permits (bldg permit)	each	1	$ 1,250.00	$ 1,250	$ 188		$ 1,437.50
			TLC-10 group - Project-Related Office Expenses - On-Site Utilities - Permits Subtotal						$ 1,438	
			Equipment							
3D	n.	13.10	system enclosure (constructed on site with overhead door; man door; and passive vents)	each	1	$ 15,920	$ 15,920			$ 15,920.00

BACT COST ESTIMATE FOR CARBON ADSORPTION

PROJECT NAME: Danish Flats Produced Water Evaporation Ponds

PROJECT LOCATION: Grand County, Utah

PROJECT NUMBER: 1011007

Control Technologies: Primary separation, secondary separation, tertiary separation, and carbon adsorption.

PHASE OF WORK CODE (PWC)	ACTIVITY CODE (AC)	TASK OR LABOR CODE (TLC)	TASK DESCRIPTION	UNITS	QUANTITY	UNIT RATE	SUBTOTAL	MARKUP	SUBTOTAL BY ACTIVITY AND TASK GROUP	TOTAL
3D	n.	13.25	LEL sensor (room environment)	each	1	$ 3,082	$ 3,082			$ 3,081.86
3D	n.	13.30	heater	each	1	$ 473	$ 473			$ 473.34
3D	n.	13.99a	room temperature transducer	each	1	$ 247	$ 298			$ 298.00
3D	n.	13.99b	exhaust fan with shutter	each	1	$ 638	$ 638			$ 637.98
3D	n.	13.99c	heater/exhaust fan thermostat	each	1	$ 875	$ 875			$ 874.65
			TLC-13 group - Equipment Subtotal						$ 21,286	
			Materials							
3D	n.	14.99	other materials - slab & footers for bldg	sq feet	400	$ 16.04	$ 6,416			$ 6,416.00
3D	n.	14.99a	other materials - electrical supplies	each	1	$ 4,015	$ 4,015			$ 4,015.00
3D	n.	14.99b	other materials - misc hardware	each	1	$ 250	$ 250			$ 250.00
			TLC-14 group - Materials Subtotal						$ 10,681	
			Activity Code n. Subtotal						$ 44,452	
								CONTINGENCY FOR 3D (20%):		$ 72,384.01
								TOTAL 3D COSTS:		$ 434,304.03
3E Remediation System Startup & Implementation Report										
	e. System Startup									
			Labor - for shakedown & startup of system							
3E	e.	5.3	project manager	hours	4.00	$ 111.00	$ 444			$ 444.00
3E	e.	5.4	project engineer / scientist	hours	12.00	$ 96.00	$ 1,152			$ 1,152.00
3E	e.	5.5	staff engineer / scientist	hours	46.00	$ 77.00	$ 3,542			$ 3,542.00
3E	e.	5.6	senior technician	hours	46.00	$ 67.00	$ 3,082			$ 3,082.00
3E	e.	5.9	clerical and courier	hours	2.00	$ 47.00	$ 94			$ 94.00
			TLC-5 group - Labor Subtotal						$ 8,314	
			Laboratory Analyses (influent & effluent water samples daily for 1 week)							
3E	e.	6.7	water analytical (BTEX, naphthalene, hexane, methanol & TVPH)	samples	10	$ 335.00	$ 3,350	$ 503		$ 3,852.50
			TLC-6 group - Laboratory Analyses						$ 3,853	
			Travel costs							
3E	e.	9.2	lodging (GSA rate)	days	6	$ 84.00	$ 504			$ 504.00
3E	e.	9.3	meals (GSA rate)	days	6	$ 51.00	$ 306			$ 306.00
3E	e.	9.4	mileage	miles	800	$ 0.555	$ 444			$ 444.00
			TLC-9 group - Travel Subtotal						$ 1,254	
			Activity Code e. Subtotal						$ 13,421	
	i. Data Review & Reporting									
			Labor - for data review & implementation/record report							
3E	i.	5.1	principal	hours	1.00	$ 140.00	$ 140			$ 140.00
3E	i.	5.3	project manager	hours	6.00	$ 111.00	$ 666			$ 666.00
3E	i.	5.4	project engineer / scientist	hours	24.00	$ 96.00	$ 2,304			$ 2,304.00
3E	i.	5.5	staff engineer / scientist	hours	10.00	$ 77.00	$ 770			$ 770.00

BACT COST ESTIMATE FOR CARBON ADSORPTION

PROJECT NAME: Danish Flats Produced Water Evaporation Ponds

PROJECT LOCATION: Grand County, Utah

PROJECT NUMBER: 1011007

Control Technologies: Primary separation, secondary separation, tertiary separation, and carbon adsorption.

PHASE OF WORK CODE (PWC)	ACTIVITY CODE (AC)	TASK OR LABOR CODE (TLC)	TASK DESCRIPTION	UNITS	QUANTITY	UNIT RATE	SUBTOTAL	MARKUP	SUBTOTAL BY ACTIVITY AND TASK GROUP	TOTAL
3E	i.	5.7	draftsperson	hours	16.00	$ 56.00	$ 896			$ 896.00
3E	i.	5.9	clerical and courier	hours	4.00	$ 47.00	$ 188			$ 188.00
			TLC-5 group - Labor Subtotal						$ 4,964	
			Activity Code i. Subtotal						$ 4,964	
								CONTINGENCY FOR 3E (10%):		$ 1,838.45
								TOTAL 3E COSTS:		$ 20,222.95
3F System Operation & Maintenance										
	f. System O & M									
			Labor - for system sampling, system adjustments, downloading statistics & routine maintenance							
3F	f.	5.3	project manager (0.5 hrs/mo)	hours	6.00	$ 111.00	$ 666			$ 666.00
3F	f.	5.4	project engineer / scientist (1 hr/mo)	hours	12.00	$ 96.00	$ 1,152			$ 1,152.00
3F	f.	5.5	staff engineer / scientist (2 hrs/mo)	hours	24.00	$ 77.00	$ 1,848			$ 1,848.00
3F	f.	5.6	on-site technician (30 hrs/mo)	hours	360.0	$ 22.00	$ 7,920			$ 7,920.00
3F	f.	5.9	clerical and courier (1 hr/qtr)	hours	4.00	$ 47.00	$ 188			$ 188.00
			TLC-5 group - Labor Subtotal						$ 11,774	
			Laboratory Analyses - Gen IV tank effluent water samples monthly; effluent from 2 GAC units quarterly							
3F	f.	6.7	water analytical (BTEX, naphthalene, hexane, methanol & TVPH)	samples	20	$ 335.00	$ 6,700			$ 6,700.00
3F	f.	6.33	sample shipping	samples	12	$ 25.00	$ 300			$ 300.00
			TLC-6 group - Laboratory Analyses						$ 7,000	
			Project Related Office Expenses / Onsite Utilities / Permits							
3F	f.	10.6a	on-site utilities (diesel fuel for portable pump)	months	12	$ 847.81	$ 10,174			$ 10,173.71
3F	f.	10.6a	on-site utilities (natural gas for genset)	months	12	$ 144.43	$ 1,733			$ 1,733.12
			TLC-10 group - Project-Related Office Expenses - On-Site Utilities - Permits Subtotal						$ 11,907	
			Equipment							
3F	f.	13.7	blower (prorated monthly fund for replacement blowers)	months	12	$ 200	$ 2,400			$ 2,400.00
3F	f.	13.99	other (prorated monthly fund for replacement equipment)	months	12	$ 100	$ 1,200			$ 1,200.00
			TLC-13 group - Equipment Subtotal						$ 3,600	
			Materials							
3F	f.	14.12	carbon canisters (includes freight)	each	44	$ 80,000.00	$ 3,520,000			$ 3,520,000
3F	f.	14.19	filters	each	8	$ 50	$ 400			$ 400.00
3F	f.	14.99a	other materials (acid for scale control)	drum	4	$ 324	$ 1,296			$ 1,296.00
			TLC-14 group - Materials Subtotal						$ 3,521,696	
								CONTINGENCY FOR 3F (20%):		$ 711,195.37
								TOTAL ANNUAL 3F COSTS:		$ 4,267,172.2

BACT COST ESTIMATE FOR CARBON ADSORPTION

PROJECT NAME: Danish Flats Produced Water Evaporation Ponds

PROJECT LOCATION: Grand County, Utah

PROJECT NUMBER: 1011007

Control Technologies: Primary separation, secondary separation, tertiary separation, and carbon adsorption.

PHASE OF WORK CODE (PWC)	ACTIVITY CODE (AC)	TASK OR LABOR CODE (TLC)	TASK DESCRIPTION	UNITS	QUANTITY	UNIT RATE	SUBTOTAL	MARKUP	SUBTOTAL BY ACTIVITY AND TASK GROUP	TOTAL
3G Monitoring plan implementation & report preparation										
	i. Data review & reporting									
		Labor								
3G	i.	5.1	principal (1 hr/qtr)	hours	4.00	$ 140.00	$ 560			$ 560.00
3G	i.	5.3	project manager (1 hr/mo)	hours	12.00	$ 111.00	$ 1,332			$ 1,332.00
3G	i.	5.4	project engineer / scientist (4 hrs/mo)	hours	48.00	$ 96.00	$ 4,608			$ 4,608.00
3G	i.	5.9	clerical and courier (2 hrs/mo)	hours	24.00	$ 47.00	$ 1,128			$ 1,128.00
			TLC-5 group - Labor Subtotal						$ 7,628.00	
			Activity Code i. Subtotal						$ 7,628.00	
								CONTINGENCY FOR 3G (10%):		$ 762.80
								TOTAL ANNUAL 3G COSTS:		$ 8,390.80

COST SUMMARY (NET PRESENT VALUE)

PHASE OF WORK CODE AND DESCRIPTION		EFS TOTAL COSTS
3A	**Pilot tests**	**$ 6,837.88**
3B	**System design**	**$ 20,306.00**
3D	**System installation**	**$ 434,304.03**
3E	**System startup & implementation report**	**$ 20,222.95**
3F	**System operation & maintenance (20 years)**	**$ 63,484,747.08**
3G	**Monitoring plan implementation & report preparation (20 years)**	**$ 124,833.92**
		$ 64,091,251.85

BACT COST ESTIMATE - NET PRESENT VALUE

PROJECT NAME: Danish Flats Produced Water Evaporation Ponds
PROJECT LOCATION: Grand County, Utah
PROJECT NUMBER: 1011007

Real Interest Rate	Year	Discount Factor	3F Costs	3G Costs
0.03	1	0.97087	$ 4,142,885.63	$ 8,146.41
	2	0.94260	$ 4,022,219.06	$ 7,909.13
	3	0.91514	$ 3,905,067.04	$ 7,678.77
	4	0.88849	$ 3,791,327.23	$ 7,455.12
	5	0.86261	$ 3,680,900.22	$ 7,237.98
	6	0.83748	$ 3,573,689.54	$ 7,027.16
	7	0.81309	$ 3,469,601.49	$ 6,822.49
	8	0.78941	$ 3,368,545.14	$ 6,623.78
	9	0.76642	$ 3,270,432.17	$ 6,430.85
	10	0.74409	$ 3,175,176.87	$ 6,243.54
	11	0.72242	$ 3,082,695.99	$ 6,061.69
	12	0.70138	$ 2,992,908.72	$ 5,885.14
	13	0.68095	$ 2,905,736.63	$ 5,713.73
	14	0.66112	$ 2,821,103.52	$ 5,547.31
	15	0.64186	$ 2,738,935.46	$ 5,385.74
	16	0.62317	$ 2,659,160.64	$ 5,228.87
	17	0.60502	$ 2,581,709.36	$ 5,076.57
	18	0.58739	$ 2,506,513.94	$ 4,928.71
	19	0.57029	$ 2,433,508.68	$ 4,785.16
	20	0.55368	$ 2,362,629.78	$ 4,645.78
			$ 63,484,747.08	$ 124,833.92

North Pole Reps
Dba: Jeff Petricka
4452 Slater Rd
Eagan, MN 55122
Phone: 612-703-1063

EQUIPMENT QUOTATION

DATE	QUOTE No.
9/20/2012	120920-51

Quote To	Quote By
Scott Rutherford	Jeff Petricka

Terms	Project
50% Down 50% Net 30	Danish Flats-Moab UT

QUOTATION TO:

Scott Rutherford
Paragon Consulting Group
1103 Oak Park Drive Ste 110
Fort Collins, CO 80525

QTY	DESCRIPTION	UNIT PRICE	AMOUNT
1	Option 1 Carbonair STAT 400 Airstripper,SST, Gravity Discharge, 4 Trays 25 Hp 230/460V Motor (2100 CFM), Pressure Switch, Pressure Guage Blower Silencer, Air Flow Meter, Control Panel, Skid Mounted Turnkey System. Note: Price Does Not Include Shipping or Tax (Estimated Freight $3500)	$64,651.00	$64,651.00
		Sub Total	**$64,651.00**
		Sales Tax	
		TOTAL	**$64,651.00**
2	Option 2 PC78 Carboon Vessels, 10 foot Diameter 10,000 Lbs of Liquid Phase Carbon Each 6" Flanged Inlet/Outlet, 4" Carbon Slurry Flange (2) 12"x16" Access Ports (14) 4" Butterfly Valves for various flow 4" Decon Piping System with gauges and sample ports Note: Price Does Not Include Shipping or Tax	$77,800.00	$155,600.00
		Sub Total	**$155,600.00**
		Sales Tax	
		TOTAL	**$155,600.00**

QUOTE IS GOOD FOR 30 DAYS ***Thank You!***

We appreciate the opportunity to work with you on this project, please do not hestitate to contact me with any questions you have.

Sincerely

Jeff Petricka

CARBONAIR

Your Mobile Water Treatment Specialists

7500 Boone Ave N, Suite 101, Brooklyn Park, MN 55428 Ph: 800-526-4999 Fax: 763-315-4614 www.carbonair.com

Customer: North Pole Reps
Site: Danish Flats, Moab, Utah
Date: 9/19/12

Design Basis:

Flow rate:	200	gpm
Water temperature:	55	°F (assumed)

Contaminant	Influent Conc.[(a)] (mg/L)	Effluent Criteria[(b)] (mg/L)
Benzene	20.0	5
Toluene	45.6	5
Ethylbenzene	2.0	5
Xylenes	32.4	5
Hexane	2.7	5
Methanol	153	-
TOC	1,023	-
Chloride	9,402	-

Recommendations: Liquid Phase Carbon Adsorbers

Two PC78's in series, each with 10,000 lbs of granular activated carbon

- The interior coating of the carbon vessels must withstand the high chloride concentration of 9,400 mg/L.
- Benzene is the critical contaminant.
- Both adsorbers are predicted to require carbon change-out every 16 days of continuous operation at 200 gpm or every 4.6 million gallons of water (see the modeling below).

LIQUID-PHASE CARBON ADSORPTION MODEL CALCULATIONS

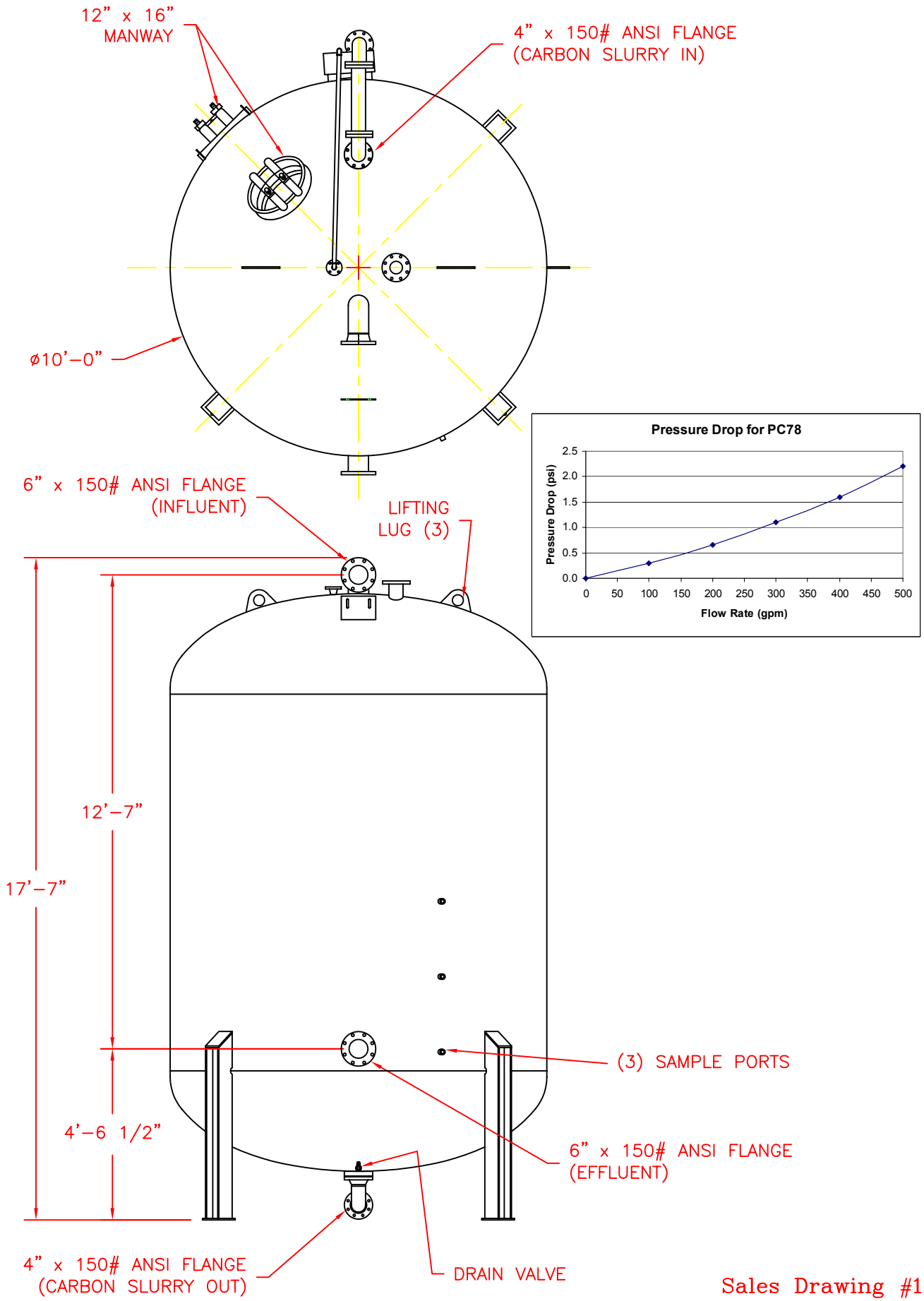
CARBONAIR ENVIRONMENTAL SYSTEMS
7500 BOONE AVENUE NORTH, SUITE 101
BROOKLYN PARK, MN 55428
PHONE: 800-526-4999
FAX: 763-315-4614

CARBON ADSORBERS:	PC78
NO OF ADSORBERS IN SERIES:	2
TOTAL MASS OF CARBON (LBS):	40000.
FLOW RATE (GPM):	200.00
HYDRAULIC LOADING (GPM/SQ.FT):	2.5765
EMPTY BED CONTACT TIME (MIN.):	54.521
DESIGN COMPOUND:	BENZENE
EXPECTED INFLUENT CONCENTRATION (PPB):	20000.
MODEL INFLUENT CONCENTRATION (PPB):	0.10300E+06
EFFLUENT CRITERIA (PPB):	5000.0
EFFECTIVE K-VALUE (%):	50.000

TIME(DAYS)	VOLUME TREATED(GAL)	EFF. CONC.(PPB)	
2.0	576000.	0.0000	
4.0	1152000.	0.0000	
6.0	1728000.	0.0000	
8.0	2304000.	0.0000	
10.0	2880000.	0.0000	
12.0	3456000.	0.0000	
14.0	4032000.	0.0000	
16.0	4608000.	106.2671	← BREAKTHROUGH
18.0	5184000.	5290.8472	
20.0	5760000.	86760.4746	
22.0	6336000.	100824.6272	
24.0	6912000.	102659.0167	
26.0	7488000.	102926.5026	
28.0	8064000.	102986.5221	
30.0	8640000.	102994.5741	
32.0	9216000.	102998.5128	
34.0	9792000.	103000.2881	
36.0	10368000.	103000.6553	
38.0	10944000.	103000.6795	
40.0	11520000.	103000.4514	

Note: The model influent concentration results from the impact of the other background compounds, which is determined by using a competitive adsorption model

Carbon Adsorber–Liquid Phase
PC 78



Sales Drawing #111467
03/22/05

TABLE 1
SUMMARY OF ESTIMATED UNCONTROLLED AIR EMISSIONS

PROJECT NAME: Danish Flats Produced Water Evaporation Ponds
PROJECT LOCATION: Grand County, Utah
PROJECT NUMBER: 1011007

Source of Air Emissions	Benzene (tons/year)	Toluene (tons/year)	Ethylbenzene (tons/year)	Total Xylenes (tons/year)	Hexane (tons/year)	Methanol (tons/year)	Total HAPs (tons/year)	Total VOCs (tons/year)	Particulate Matter PM2.5 (tons/year)	Particulate Matter PM10 (tons/year)	CO2 (tons/year)	NOx (tons/year)	CO (tons/year)	SOx (tons/year)
Primary Separation Tanks (4 tanks)	0.005	<0.001	<0.001	0.003	0.108	NR	0.117	0.269	ATBN	ATBN	ATBN	ATBN	ATBN	ATBN
Secondary Separation Vaults (6 vaults)	0.012	<0.001	<0.001	0.007	0.273	NR	0.294	0.681	ATBN	ATBN	ATBN	ATBN	ATBN	ATBN
Condensate Storage Tanks (5 tanks)	0.017	<0.001	0.001	0.010	0.390	NR	0.418	0.973	ATBN	ATBN	ATBN	ATBN	ATBN	ATBN
Condensate Load Out	0.002	<0.001	<0.001	0.001	0.049	NR	0.054	0.122	ATBN	ATBN	ATBN	ATBN	ATBN	ATBN
Settling Pond (1 pond)	0.350	0.010	0.135	2.65	5.04	NR	8.18	25.5	ATBN	ATBN	ATBN	ATBN	ATBN	ATBN
Shallow Evaporation Ponds (8 ponds)	6.14	10.3	0.406	6.43	0.389	31.2	54.9	171.	ATBN	ATBN	ATBN	ATBN	ATBN	ATBN
Deep Evaporation Ponds (6 ponds)	4.71	7.93	0.312	4.94	0.298	24.0	42.2	132.	ATBN	ATBN	ATBN	ATBN	ATBN	ATBN
Vehicle Traffic on Unpaved Roads	ATVO	ATVO	ATVO	ATVO	ATVO	ATVO	ATVO	ATVO	1.50	15.0	ATVO	ATVO	ATVO	ATVO
Natural Gas Combustion (9 tank heaters)	<0.001	<0.001	ATBN	ATBN	0.002	ATBN	ATBN	0.006	0.008	0.008	133.	0.110	0.093	0.001
Natural Gas Combustion (generator)	<0.001	<0.001	<0.001	<0.001	ATBN	ATBN	ATBN	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Diesel Combustion	0.003	0.001	ATBN	0.001	ATBN	ATBN	0.005	0.963	0.843	0.843	440.	11.9	2.56	0.785
Total Estimated Uncontrolled Emissions	11.2	18.2	0.856	14.0	6.55	55.2	106.	332.	2.35	15.9	573.	12.0	2.65	0.786

Notes:
1) HAPs = Hazardous Air Pollutants.
2) VOCs = Volatile Organic Compounds.
3) Emissions from the primary separation tanks, secondary separation vaults, and condensate storage tanks were estimated using TANKS 4.0.9d.
4) Emissions from the condensate load out were estimated using equations from Section 5.2 of AP-42.
5) Emissions from the settling pond were estimated using equations from *Air Emissions Models for Waste and Wastewater* (EPA-453/R-94-080A) for a quiescent impoundment with no biodegradation and an oil film surface.
6) Emissions from the evaporation ponds were estimated using equations from *Air Emissions Models for Waste and Wastewater* (EPA-453/R-94-080A) for a quiescent impoundment with no biodegradation.
7) The total VOC emissions for the settling pond and evaporation ponds were estimated by multiplying the total HAPs emissions by 3.12, which is the ratio of the average TOC concentration divided by the average total HAP concentrations for the Tank IV Discharge between April 2011 & September 2011.
8) Emissions from unpaved roads were estimated using equations from Section 13.2.2 of AP-42.
9) Emissions from natural gas combustion were estimated using emission factors from Section 1.4 of AP-42.
10) Emissions from diesel fuel combustion were estimated using emission factors from Section 3.3 of AP-42.
11) NR = Methanol Not Reported as being present in condensate sample collected and analyzed by Weaver Boos Consultants, LLC.
12) ATBN = Assumed To Be Negligible.
13) ATVO = Attributable To Vehicle Owner.

TABLE 2
SUMMARY OF ESTIMATED CONTROLLED HAP AND VOC AIR EMISSIONS
USING CARBON ADSORPTION

PROJECT NAME: Danish Flats Produced Water Evaporation Ponds
PROJECT LOCATION: Grand County, Utah
PROJECT NUMBER: 1011007

Source of Air Emissions	Benzene (tons/year)	Toluene (tons/year)	Ethylbenzene (tons/year)	Total Xylenes (tons/year)	Hexane (tons/year)	Methanol (tons/year)	Total HAPs (tons/year)	Total VOCs (tons/year)
Primary Separation Tanks (4 tanks)	0.005	<0.001	<0.001	0.003	0.108	NR	0.117	0.269
Secondary Separation Vaults (6 vaults)	0.012	<0.001	<0.001	0.007	0.273	NR	0.294	0.681
Condensate Storage Tanks (5 tanks)	0.017	<0.001	0.001	0.010	0.390	NR	0.418	0.973
Condensate Load Out	0.002	<0.001	<0.001	0.001	0.049	NR	0.054	0.122
Settling Pond (1 pond)	0.350	0.010	0.135	2.65	5.04	NR	8.18	25.5
Shallow Evaporation Ponds (8 ponds)	1.54	1.13	0.406	0.992	0.389	31.2	35.7	111.
Deep Evaporation Ponds (6 ponds)	1.18	0.096	0.312	0.762	0.298	24.0	26.6	82.9
Natural Gas Combustion (9 tank heaters)	<0.001	<0.001	ATBN	ATBN	0.002	ATBN	ATBN	0.006
Natural Gas Combustion (generator)	<0.001	<0.001	<0.001	<0.001	ATBN	ATBN	ATBN	<0.001
Diesel Combustion	0.003	0.001	ATBN	0.001	ATBN	ATBN	0.005	0.963
Total Estimated Controlled Emissions	3.11	1.24	0.856	4.43	6.55	55.2	71.4	222.

Notes:
1) HAPs = Hazardous Air Pollutants.
2) VOCs = Volatile Organic Compounds.
3) Emissions from the primary separation tanks, secondary separation vaults, and condensate storage tanks remain the same as in Table 1.
4) Emissions from the condensate load out remain the same as in Table 1.
5) Emissions from the settling pond remain the same as in Table 1.
6) Emissions from the evaporation ponds were estimated using the uncontrolled emissions in Table 1 and removal efficiencies provided by Carbonair for carbon adsorption.
7) Emissions from natural gas combustion for the tank heaters remain the same as Table 1.
8) Emissions from diesel fuel combustion remain the same as Table 1.
9) NR = Methanol Not Reported as being present in condensate sample collected and analyzed by Weaver Boos Consultants, LLC.
10) ATBN = Assumed To Be Negligible.