MONTANA DEPARTMENT OF TRANSPORTATION
WETLAND MITIGATION MONITORING REPORT: YEAR 2008

Roundup Wetland
Roundup, Montana

Prepared for:

MONTANA DEPARTMENT OF TRANSPORTATION
2701 Prospect Ave
Helena, MT 59620-1001

Prepared by:

POST, BUCKLEY, SCHUH, & JERNIGAN
801 North Last Chance Gulch, Suite 101
Helena, MT 59601-3360

December 2008

PBS&J Project No: 0B4308801.06.05

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1.0 INTRODUCTION

This annual report summarizes methods and results of the eighth year of monitoring at the Montana Department of Transportation (MDT) Roundup mitigation site. The Roundup wetland site was created to provide wetland mitigation credits for MDT's reconstruction of U.S. Highway 12 in Watershed #10 located in District 5, Billings District. The site is located in Musselshell County, Montana, Section 18, Township 8 North, Range 26 East, immediately south of U.S. Highway 12 and approximately one mile east of the town of Roundup (**Figure 1**). Elevations range from approximately 3,169 to 3,175 feet above sea level.

The mitigation site is located at the site of the former wastewater lagoons for the city of Roundup (**Figure 2** in **Appendix A**). This former two-celled treatment facility, covering approximately 26 acres, contained sludge of varying depths with concentrations of nitrates, of which portions were capped during construction modification. The organic sludge was left in the west end of the southern end of the wetland bed and capped with one foot of soil to prevent potential biohazards risks. Five monitoring wells were installed around the lagoon to monitor any possible groundwater contamination from the sludge (**Figure 4** in **Appendix A**). The dike between cells was breached to allow water to access both cells (**Figures 2** and **3** in **Appendix A)**.

Construction was completed on this site in April of 2000 with a goal of creating at least 24 acres of wetlands with a diverse vegetative community. The site was designed to develop a hemi-marsh emergent wetland system with standing water depths no greater than three feet. Water depths vary within the wetland due to the natural topography behind the dike. Water was designed to enter the wetland mitigation system through two methods and locations (**Appendix D**).

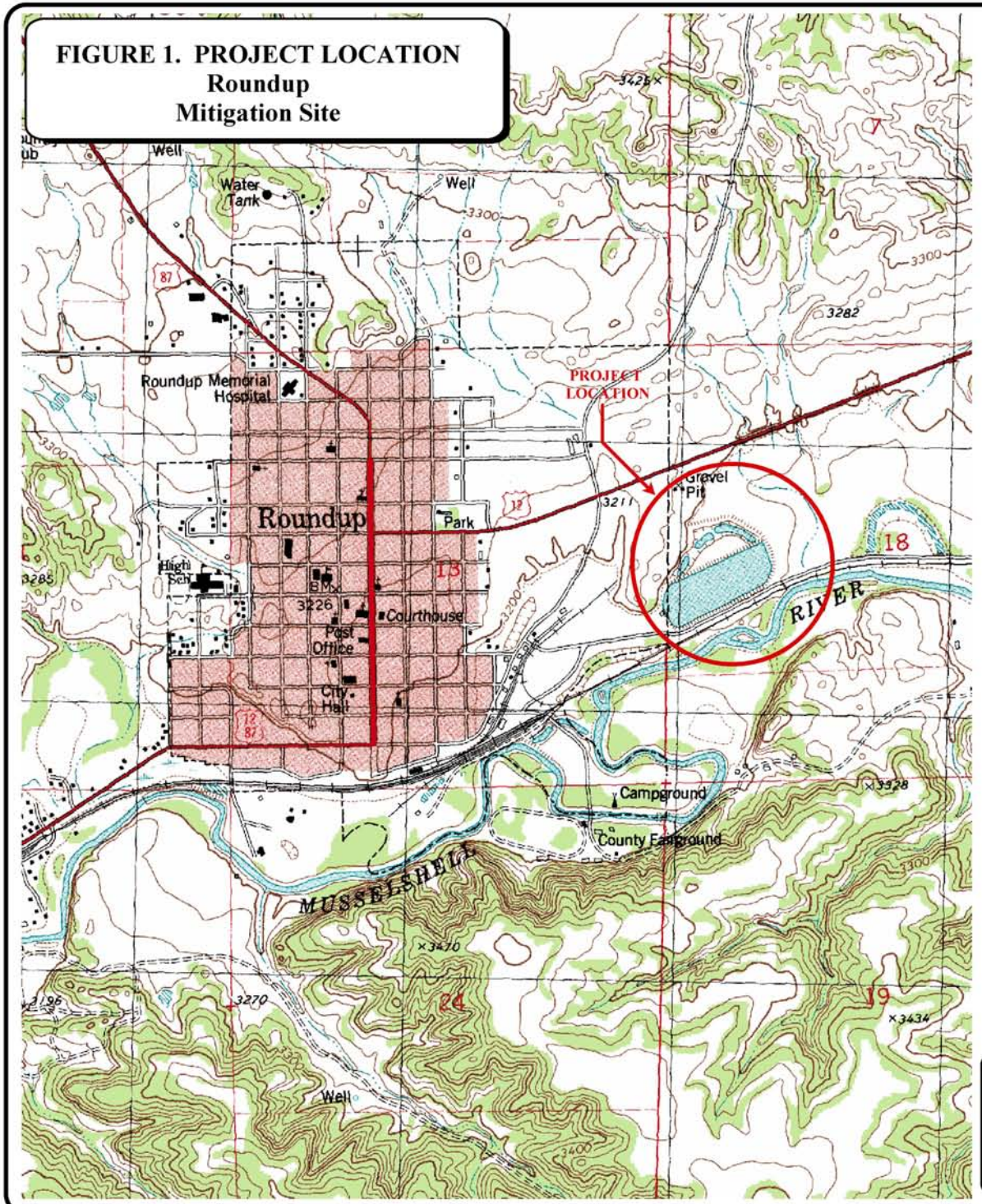
One source of hydrology is through a channel, which funnels storm water runoff from the northeastern section of the city of Roundup and U.S. Highway 12 into the southwestern end of the wetland. The estimated runoff volume for this system is 12,700 m^3 and 17,825 m^3 of water for the 5-and 25-year event, respectively (MDT 2000). A second source of hydrology is treated wastewater from the new Roundup sewage treatment facility which is discharged into the wetland to maintain the design water level elevation. There is no physical "outlet" designed for the system; water leaves only through evaporation and evapotranspiration. The site has been filling with the wastewater and stormwater since July of 2001. The Roundup lagoons are visited three times during the year: a spring and fall bird survey and during mid-summer to collect the monitoring data.

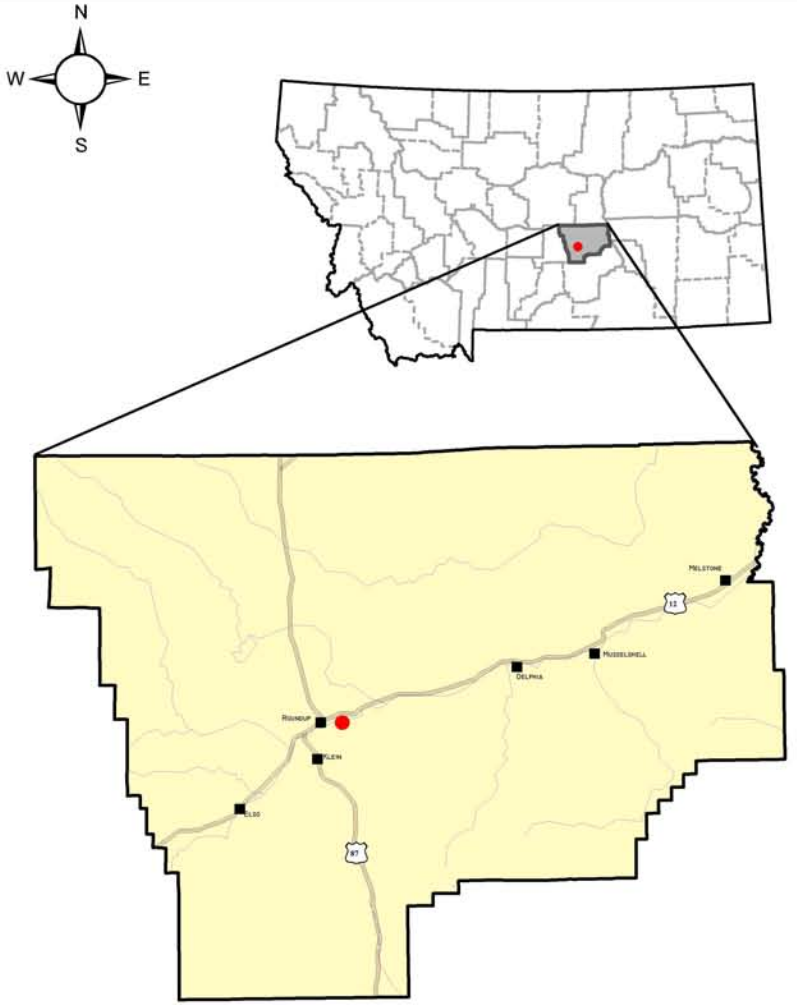
2.0 METHODS

2.1 Monitoring Dates and Activities

The Roundup wetland mitigation site was monitored three times in 2008: April 28/29 (bird observation), July 7 (monitoring event), and October 10 (bird observation). All information contained within the Wetland Mitigation Site Monitoring Form (**Appendix B**) was collected

FIGURE 1. PROJECT LOCATION
Roundup
Mitigation Site





800 0 800 1600 FEET

1: 24,000

PROJECT #: 0B430880I
DATE: Nov 2008
LOCATION: MUSSELSHELL CO
PROJECT MANAGER: J. BERGLUND
DRAWN BY: B. NOECKER

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801 N. LAST CHANCE GULCH
SUITE 101
HELENA, MT 59601-3360

during the monitoring event. Activities and information conducted/collected included: wetland delineation; wetland/open water boundary mapping; vegetation community mapping; vegetation transects; soils data; hydrology data; bird and general wildlife use; photograph points; functional assessment; and maintenance need assessment at bird nesting structures and inflow and outflow structures. Water quality well monitoring at five wells adjacent to the site was conducted on October 17, 2008.

2.2 Hydrology

Wetland hydrology indicators were recorded using procedures outlined in the U.S. Army Corps of Engineers (COE) 1987 Wetland Delineation Manual (Environmental Laboratory 1987). Hydrology data were recorded on the Routine Wetland Delineation Data Form (**Appendix B**) at each wetland determination point. Precipitation data for January through July, 2008 were compared to the 1914 – 2008 July averages (WRCC 2008).

All additional hydrologic data were recorded on the Wetland Mitigation Site Monitoring Form (**Appendix B**). The boundary between emergent vegetation and open water was mapped on the aerial photograph (**Figure 3** in **Appendix A**).

Groundwater level and several nutrients were monitored on October 17th at five well locations located between the wetland and the Musselshell River (**Figure 4** in **Appendix A; Appendix D**). Samples were analyzed for nutrient parameters including total phosphorus, total Kjeldahl nitrogen, nitrate+nitrite nitrogen, and total ammonia. Field measurements were also recorded for groundwater elevation, temperature, dissolved oxygen, specific conductance, and pH. Additionally, concentrations of ferrous iron and hydrogen sulfide were estimated on site using field test kits. A full hydrologic report is included in **Appendix G**.

2.3 Vegetation

General vegetation types were delineated on an aerial photograph during the site visit (**Figure 3** in **Appendix A**). Coverage of the dominant species in each community type is listed on the Wetland Mitigation Site Monitoring form (**Appendix B**). A comprehensive plant species list for the entire site was compiled. Minimal woody vegetation was planted at this site by the Conservation District. Willow sprigs were planted during the early spring of 2004 by MDT.

The transect was relocated and elongated during the 2002 visit to a site within the center of the constructed wetland (**Figure 2** in **Appendix A**). Percent cover for each species was recorded on the vegetation transect form (**Appendix B**). The transect is used to evaluate changes over time, especially the establishment and increase of hydrophytic vegetation. Transect ends were marked with metal fence posts and their locations hand-drawn on the vegetation map. Photos of the transect were taken from both ends during the site visit (**Appendix C**).

2.4 Soils

Soils were evaluated during the site visit according to the procedure outlined in the COE 1987 Wetland Delineation Manual. Soil data were recorded for each wetland determination point on the COE Routine Wetland Delineation Data Form (**Appendix B**). The most current terminology used by NRCS was used to describe hydric soils.

2.5 Wetland Delineation

Wetland delineation was conducted during the mid-season visit in accordance with the 1987 COE Wetland Delineation Manual. In July 2008, consultation with the COE (Steinle pers. comm.) confirmed that, where the 1987 manual was used to establish baseline wetland conditions at MDT wetland mitigation sites, it should continue to be applied at such sites for the duration of the monitoring period. Consequently, application of the new *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region* (COE 2008) was not required or undertaken at this site in 2008.

Wetland and upland areas within the monitoring area were investigated for the presence of wetland hydrology, hydrophytic vegetation and hydric soils. The indicator status of vegetation was derived from the National List of Plant Species that Occur in Wetlands: Northwest Region 9 (Reed 1988). The information was recorded on the COE Routine Wetland Delineation Forms (**Appendix B**). The wetland/upland and open water boundaries were used to calculate the wetland area.

2.6 Mammals, Reptiles, and Amphibians

Mammal, reptile, and amphibian species observations were recorded on the Wetland Mitigation Site Monitoring Form during the site visit **(Appendix B)**. Indirect use indicators were also recorded including tracks, scat and burrows. A comprehensive wildlife species list for the entire site was compiled and updated as new species were encountered.

2.7 Birds

Bird observations were recorded during the site visit according to the established Bird Survey Protocol (**Appendix E**). Four wood duck boxes have been installed on site. A general, qualitative bird list has been compiled using these observations.

2.8 Macroinvertebrates

One macroinvertebrate sample was collected during the site visit following the sampling protocol (**Appendix F**). Samples were preserved as outlined in the sampling procedure and sent to Rhithron Associates for analysis. The approximate sampling location is indicated on **Figure 2** in **Appendix A**.

2.9 Functional Assessment

Since 2001, functional assessments were conducted using the 1999 MDT Montana Wetland Assessment Method (Berglund 1999). In 2008, the 2008 MDT Montana Wetland Assessment Method (Berglund and McEldowney 2008) was applied (**Appendix B**). Field data necessary for this assessment were collected on a condensed data sheet. The remainder of the assessment was completed in the office.

2.10 Photographs

Photographs were taken showing the current land use surrounding the site, the wetland buffer, the monitored area, and the vegetation transect. A description and compass direction for each photograph were recorded on the wetland monitoring form.

During the 2001 monitoring season, each photograph point was marked on the ground with a wooden stake and the location recorded with a resource grade GPS (**Appendix E**). Photographs are retaken at the same locations each year (**Figure 2** in **Appendix A**).

2.11 GPS Data

During the 2001 monitoring season survey points were collected using a resource grade Trimble Geoexplorer III hand-held GPS unit (**Appendix E**). Points collected included: photograph locations; bird box locations, and the jurisdictional wetland boundary. In addition, during the August 2001 monitoring season survey points were collected at four landmarks recognizable on the air photo for purposes of line fitting to the topography. GPS points were not collected during the 2008 season; wetland boundaries and community types were mapped on a 2007 aerial photograph during the site visit.

2.12 Maintenance Needs

The condition of inflow and outflow structures, and nesting structures or other mitigation related structures were evaluated. This examination did not entail an engineering-level analysis. Any other management suggestions concerning wetland development are discussed in this section.

3.0 RESULTS

3.1 Hydrology

Groundwater elevations were found to be slightly higher than those measured during the 2007 sampling event in all five wells, indicating a return to similar levels found during prior sampling events. Field parameters also varied in 2008 from previous sample years. Field measurements of water temperature and pH both decreased slightly while electrical conductivity values increased notably among all sampling locations in 2008. Dissolved oxygen levels decreased little from previous years with the exception of Well #1, which jumped 6.1 mg/L from 2007.

Ferrous iron concentrations in 2008 decreased sharply from 2007 levels in the three wells that exhibited significant values in that year.

Nutrient concentrations were reported at decreased concentrations in all wells when compared to 2007 results (**Table 1**). As was the case in all other sampling years, the concentration of nitrate + nitrite nitrogen in Well #1 exceeded the human health standard of 10 mg/L for groundwater during 2008 (Montana DEQ 2008), with a concentration of 15.6 mg/L, but decreased from 2007 levels (16.1 mg/L). Nitrate + nitrite nitrogen concentrations were reported below the laboratory detection limits in all other wells during the 2008 sampling event. Additional results and discussion are provided in the complete groundwater monitoring report (**Appendix G**).

Analytical results suggest that the lagoons may be a source of nutrients in the vicinity of the wastewater lagoons. However, laboratory analytical results from the 2008 event indicate slight decreases in concentrations from 2007 sampling data throughout all sample locations.

Table 1: ***1998-2008 Roundup Wetland groundwater sampling nutrient parameter results.***

Well ID	Date	Total Phosphorus (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Ammonia (mg/L)	Total Nitrogen (mg/L)
1	04/09/98	0.01	<0.5	24.4	<0.1	24.4
	11/01/05	0.02	<0.5	14.0	<0.1	14.0
	10/24/06	0.03	<0.5	12.4	<0.1	12.4
	10/11/07	0.01	<0.5	16.1	<0.1	16.1
	10/17/08	<0.01	<0.5	15.6	<0.1	15.6
2	04/09/98	1.71	15.5	<0.05	15.0	15.5
	11/01/05	4.92	25.7	<0.05	18.5	25.7
	10/24/06	1.43	20.6	<0.05	18.8	20.6
	10/11/07	2.09	20.4	<0.05	19.0	20.4
	10/17/08	1.51	18.0	<0.05	17.0	18.0
3	04/09/98	0.29	15.8	<0.05	15.7	15.8
	11/01/05	2.36	25.0	<0.05	19.4	25.0
	10/24/06	3.84	15.9	0.94	14.3	16.8
	10/11/07	1.32	21.9	<0.05	18.1	21.9
	10/17/08	1.15	18.0	<0.05	16.6	18.0
4	04/09/98	0.02	8.9	<0.05	5.7	8.9
	11/01/05	0.13	16.9	<0.05	13.2	16.9
	10/24/06	0.14	14.9	<0.05	12.8	14.9
	10/11/07	0.21	13.9	<0.05	12.6	13.9
	10/17/08	0.20	13.0	<0.05	12.0	13.0
5	04/09/98	0.01	3.5	0.28	1.8	3.8
	11/01/05	0.30	7.5	<0.05	4.5	7.5
	10/24/06	0.02	4.1	<0.05	3.5	4.1
	10/11/07	0.02	4.8	<0.05	2.8	4.8
	10/17/08	0.01	4.3	<0.05	2.6	4.3

As mentioned previously, water was designed to enter the system by two methods and at two locations. One method of water entry is through a drainage channel which funnels storm water and roadway runoff from the northeastern section of the city of Roundup and U.S. Highway 12 into the southwestern end of the wetland (**Appendix D**). The other source of hydrology is the treated wastewater discharge from the new Roundup sewage treatment facility.

The wetland was originally designed with a flow-through system; treated water would have flowed into the wetland system and then into the Musselshell River. This design feature was eliminated by the Montana Department of Environmental Quality (MTDEQ) and the Environmental Protection Agency (EPA) primarily due to potential issues with heavy metals/contaminants in the remaining sewage system sludge. The COE would not allow the site to be used for mitigation if it was part of the treatment system. Water levels in the wetland decrease through evaporation and evapotranspiration during the growing season.

During the July 7, 2008 site visit, approximately 42% (8.85 acres) of the assessment area was inundated with less than 4 feet of standing water. Approximately half of the south lagoon was inundated at the time of the mid-season visit with <6 inches of water. During the spring and fall visits, the south lagoon inundation line included the entire Community Type 16 area.

According to the Western Regional Climate Center (WRCC), the Roundup station's annual mean (1914 – July 2008) precipitation was 8.5 inches. Precipitation from January through July, 2008 was 9.35 inches or 110% of the mean (WRCC 2008).

3.2 Vegetation

Vegetation species identified on the site are presented in **Table 2** and in the monitoring form (**Appendix B**). Five of the eighteen vegetation communities that have been identified on the site over the eight monitoring years are mapped on the mitigation area map (**Figure 3** in **Appendix A**). The communities include: Type 1-*Kochia scoparia*; Type 2-*Chenopodium* spp.; Type 3-*Alopecurus arundinaceus;* Type 4-*Alopecurus arundinaceus / Bare Ground* (dominant species in this type have changed since 2002); Type 5-*Agropyron cristatum / Kochia scoparia*; Type 6-*Scirpus* spp.; Type 7-*Chenopodium / Rumex*; Type 8-*Hordeum jubatum / Alopecurus arundinaceus*; Type 9-*Eleocharis palustris / Alopecurus arundinaceus*; Type 10-*Descurainia sophia*; Type 11-*Alopecurus arundinaceus / Chenopodium*; Type 12-*Cirsium arvense* / *Chenopodium*; Type 13-*Conyza canadensis*; Type 14-*Agropyron trachycaulum*; Type 15-*Elymus cinereus*; and Type 16-Shallow Water / *Chenopodium* / *Kochia*; Type 17-*Chenopodium / Descuriana sophia*; and Type 18-*Conium maculatum*. Dominant species within each community are listed on the Wetland Mitigation Site Monitoring Form (**Appendix B**).

Kochia (FAC) was the dominant vegetation along the transect from the initial monitoring season in 2001 until 2006-2007, when *Chenopodium* species began to dominate (**Charts 1** and **2**). *Chenopodium* has been a dominant species around the periphery of the lagoons since 2001. In 2008, dominant Canada thistle communities (CT 12) were observed along the northeast and south edge of the north lagoon; a portion of the thistle along the north edge of the lagoon appeared to have been sprayed, however actual kill rate is unknown. Mustard began to colonize

Table 2: ***2001-2008 Roundup Wetland vegetation species list.***[1]

Scientific Name	Region 9 (Northwest) Wetland Indicator Status[2]
Agropyron cristatum	Not Listed
Agropyron elongatum	Not Listed
Agropyron trachycaulum	FAC
Alopecurus arundinaceus	No Indicator
Asclepias spp.	(UPL)
Aster brachyactis	FACW
Chenopodium capitatum	Not Listed
Chenopodium leptophyllum	FACU
Chenopodium hybridum	Not Listed
Cirsium arvense	FACU+
Conium maculatum	FAC
Conyza canadensis	FACU
Descuraina sophia	Not Listed
Elaeagnus angustifolia	FAC
Eleocharis palustris	OBL
Elymus cinereus	No Indicator
Grindelia squarrosa	FACU
Helianthus annuus	FACU+
Hordeum jubatum	FAC+
Kochia scoparia	FAC
Lemna minor	OBL
Melilotus officinalis	FACU
Phalaris arundinacea	FACW
Polygonum spp.	(probably FACW-OBL)
Puccinellia nuttalliana	OBL
Rhus trilobata	No Indicator
Ribes aureum	FAC+
Rumex crispus	FACW
Rumex maritimus	FACW+
Scirpus acutus [3]	OBL
Scirpus maritimus	OBL
Scirpus pungens	OBL
Tamarix ramosissima	FACW

[1] **Bolded species** indicate those documented within the analysis area for the first time in 2008.

[2] Indicator status in parentheses was based only on the biologist's experience. "Not Listed" indicates that the species was not listed and "No Indicator" indicates that the plant was listed, but not classified in the *National List of Plant Species that Occur in Wetlands: Northwest (Region 9)* (Reed 1988).

[3] *Scirpus acutus* was not positively identified as it was growing in an inundated area.

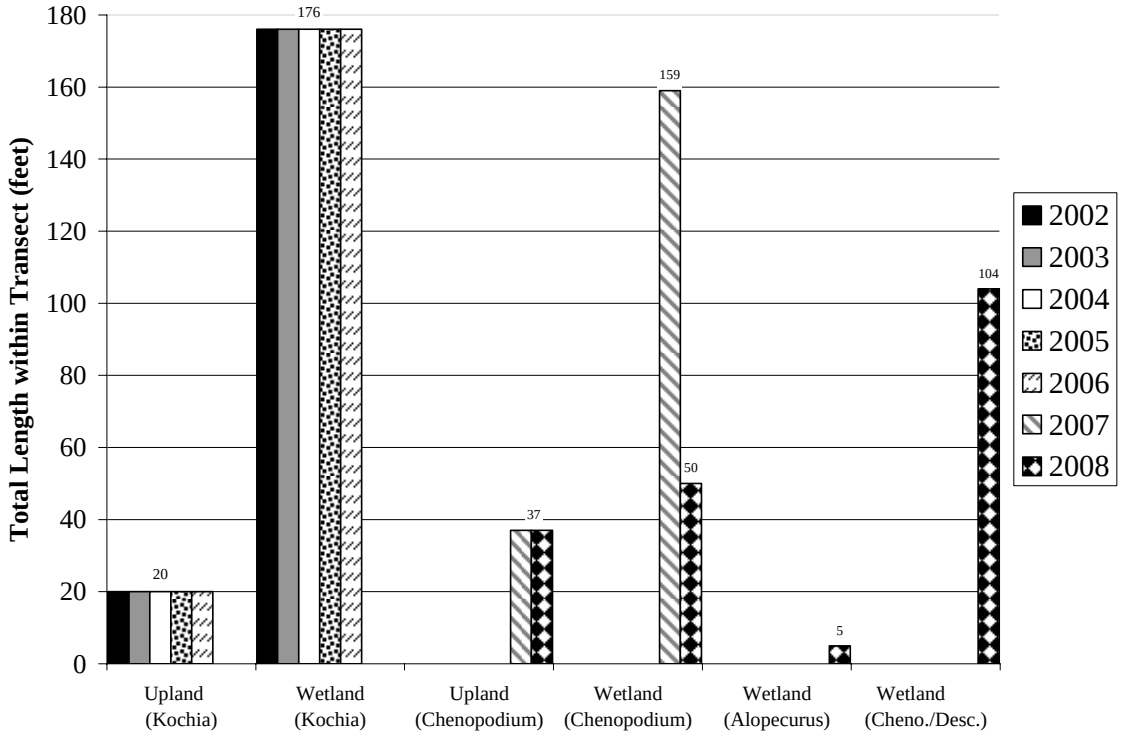
the upland areas during 2007, and in 2008, had reached almost 50% cover in substantial portions of the area between the lagoons, namely east and west of the vegetation transect. No other hydrophytic species have been observed along the transect since its installation in 2002. In general, preferred wetland vegetation communities that include a dominance of *Scirpus*, *Eleocharis*, *Carex*, or *Puccinellia*, for example, are absent from the mitigation site. These species do occur at <5% cover in 2008 in community types 3, 4, and 7, and >50% in the small community type 6. The vegetation transect results are detailed in the Monitoring Form (**Appendix B**), summarized in tabular format (**Table 3**), and graphically illustrated (**Charts 1** and **2**).

Table 3: ***2001-2008 transect data summary.***

Monitoring Year	2001[1]	2002	2003	2004	2005	2006	2007	2008
Transect Length (feet)	100	196	196	196	196	196	196	196
# Vegetation Community Transitions along Transect	1	2	2	2	2	2	2	4
# Vegetation Communities along Transect	2	2	2	2	2	2	2	4
# Hydrophytic Vegetation Communities along Transect	1	1	1	1	1	1	1	2[4]
Total Vegetative Species	4	2	2	2	2	2	5[3]	9[3]
Total Hydrophytic Species	2	2	2	2	2	2	3	5
Total Upland Species	2	0	0	0	0	0	2	4
Estimated % Total Vegetative Cover[2]	100	100	100	100	100	100	100	100
% Transect Length Comprised of Hydrophytic Vegetation Communities[2]	60	90	90	90	90	90	81	81
% Transect Length Comprised of Upland Vegetation Communities[2]	40	10	10	10	10	10	19	19
% Transect Length Comprised of Unvegetated Open Water	0	0	0	0	0	0	0	0
% Transect Length Comprised of Bare Substrate	0	0	0	0	0	0	0	0

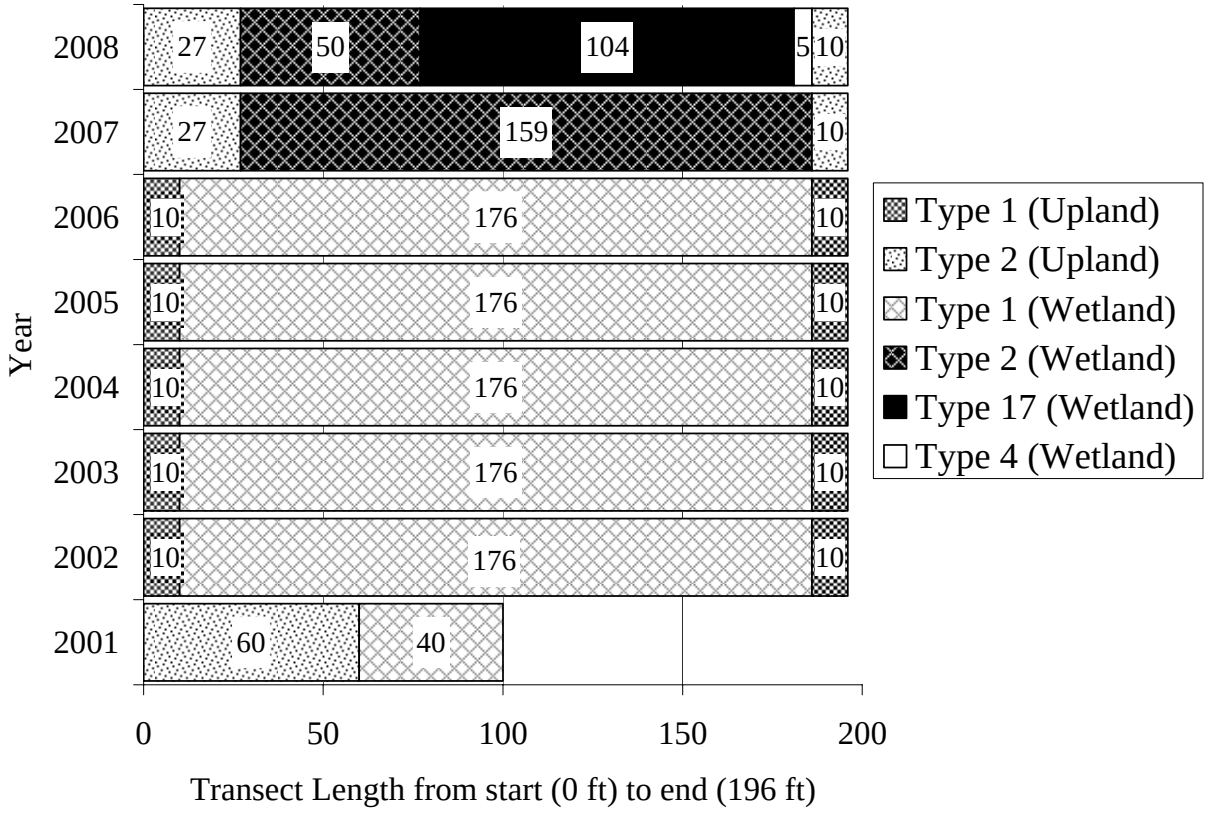
[1] Transect moved in 2002.
[2] Vegetation with no listing were assumed to be upland species unless stated otherwise in Footnote 3.
[3] Species assigned Indicator Status as follows: *Kochia scoparia*, a FAC species in "Upland" and "Wetland" communities; *Agropyron trachycaulum*, FAC; *Descuraina sophia*, No Listing (likely UPL); 2 of the 3 known *Chenopodium* on site have a No Listing (likely FAC-FACW based on behavior); *Alopecurus arundinacea*, No Indicator Status, behaves as a FACW.
[4] The new wetland community type is comprised of 50% *Chenopodium* (FAC), 5% *Agropyron trachycaulum* (FAC), 45% *Descuraina* (no listing, likely UPL), and <1% Canada thistle (FACU).

Chart 1: ***Length of vegetation communities along Transect 1 from 2002 to 2008.***[1]



[1] The 2001 transect is not shown for comparison as it was moved to its present position in 2002.

Chart 2: ***Transect maps showing vegetation types from start of transect (0 feet) to the end of transect (100 feet in 2001; 196 feet in 2002-2008).***



*Note: CT 17 is comprised of 45% mustard species and 50% *Chenopodium* species.

3.3 Soils

The site was mapped as part of the Musselshell County Soil Survey. The Havre-Glendive Complex (11A) is the dominant mapped soil at the site. The soil series is well drained and typical of floodplains, alluvial fans and stream terraces; it is classified as an Aridic Ustifluvent.

The original treatment lagoons were constructed entirely within this complex. The Havre component is a loamy texture and the Glendive component tends to be a fine, sandy loam. Construction of the lagoons has probably changed the accuracy of this soil mapping.

Soils were sampled at one wetland site (SP-1) and one upland site (SP-2); SP-1 is located between the old dike that historically separated the north and south lagoons and SP-2 is on the constructed island adjacent to the northern lagoon pond. At SP-1 (wetland) soils were a very dark gray (5Y 3/2) silt loam from 0 to 2 inches and a dark reddish brown (5Y 3/3) for 2 to 10 inches. Soils were saturated at a depth of 2 inches. At SP-2 (upland) on the island, the soil was a dark reddish gray (5Y 4/2) silt loam to a depth of 10 inches. No moisture was noted in the pit.

The soils within the site may have a high nitrogen level because of the former use as a sewage lagoon (Urban pers. communication 2008). Soil testing and correction may be warranted if a

nutrient imbalance is preventing colonization of preferred wetland vegetation communities (see *3.9 Maintenance Needs/Recommendations*).

3.4 Wetland Delineation

The 2008 delineation resulted in a total of 20.88 acres of gross wetland acreage, a decrease of 0.19 acre since 2007 (**Table 4**). The decrease in the 2008 gross wetland acreage is the direct result of an increase in upland weed cover, primarily Canada thistle. A new community type 17, located between the north and south lagoons and within the vegetation transect, is less than 5% from converting to an upland community type because of the increasing mustard cover **(Figure 3, Appendix A)**. Of the 20.88 acres, a total of 8.85 acres were shallow, open water (<4 feet deep) in the north lagoon and shallow inundation (< 6 inches) in the south lagoon. The COE Data Forms are included in **Appendix B.**

The gross wetland area has decreased since 2006 because of the increase in upland community acreage. Non-weedy hydrophytic species (e.g. *Carex, Scirpus, Eleocharis, Puccinellia*, and *Polygonum*) have comprised less than 1% of the net wetland acreage since the site was constructed.

The net wetland area has oscillated to a large degree over the eight years of monitoring as a result of water availability and the subsequent affect on open water and mud flat acreage in the south lagoon, not as a result of the change in desirable wetland vegetation species coverage (**Table 4**). Between the 2001 and 2002 mid-season visits the north lagoon filled and that area of open water area has remained fairly stable. The area of inundation within the south lagoon during the mid-season visits has varied over the eight monitoring years, from no inundation to complete submersion, which has resulted in an oscillating total open water acreage. The range of depths of the open water from 4 feet in the north lagoon to a depth of 0 to 12 inches in the south lagoon is the primary reason why the Roundup wetland has a high avian species occurrence.

Table 4: ***2001-2008 wetland acreage summary for the Roundup Wetland Mitigation Site.***

Habitat	ACREAGE BY YEAR							
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
Open Water	1.40	5.32	5.42	9.99	14.74	6.04	8.27[1]	8.85
Net Wetland	17.08	9.20	11.09	9.52	7.33	16.03	12.71	12.03
Mudflat	---[2]	7.48	5.49	2.51	0	---[2]	---[2]	---[2]
Gross Wetland	**18.50**	**22.00**	**22.00**	**22.02**	**22.07**	**22.07**	**21.07**	**20.88**

[1] In the 2007 report the shallow water in the south lagoon was inadvertently not counted as part of the open water acreage as had been done in previous years. To be able to fairly compare across years, the open water for 2007 was recalculated.

[2] During the 2001 mid-season visit, the large unvegetated mudflat area in the south lagoon was not calculated separately and was included in the net wetland area. From 2002 to 2004, the mudflat remained unvegetated at the mid-season visit and the area was calculated separately. In 2005, the entire south lagoon was inundated and from 2006 to 2008 the mudflat area was generally more than 30% vegetated with *Chenopodium* and was included in CT 16.

3.5 Wildlife

Observed wildlife species are listed in **Table 5.** Activities and densities associated with these observations are included on the **Monitoring Form** in **Appendix B**. Several mule deer and an unidentified turtle were observed during the 2007 site visits. Two new bird species were observed during 2008; a total of 77 avian species have been observed at the Roundup mitigation wetland to date. Four Wood Duck boxes are located with the site (**Figure 2** in **Appendix B**). No signs of habitation were observed in July, however a female Wood Duck was observed exhibiting defensive behavior during the mid-season visit.

3.6 Macroinvertebrates

Macroinvertebrate sampling results are provided in **Appendix F** and **Chart 3** and were summarized by Rhithron Associates, Inc. in the italicized section below (Bollman 2008).

> *Scores indicated poor biotic conditions at the Roundup site in 2008. Taxa richness remained low in 2008; unlike the previous year, midges (Chironomidae) were the dominant faunal component. Hypoxic conditions are suggested by the hemoglobin-bearing animals Chironomus sp., Dicrotendipes sp., and Glyptotendipes sp. Temperature preference for the invertebrate assemblage sampled here was calculated to be 17.5º C. The abundance of Cricotopus (Isocladius) spp. suggests that filamentous algae may have been an important floral component, and no predators were present in the sample collected in 2008. These findings suggest that aquatic habitats were underdeveloped at this site.*

Chart 3: ***Bioassessment scores using the wetland index at the Roundup Wetland Mitigation Site from 2001 to 2008.***

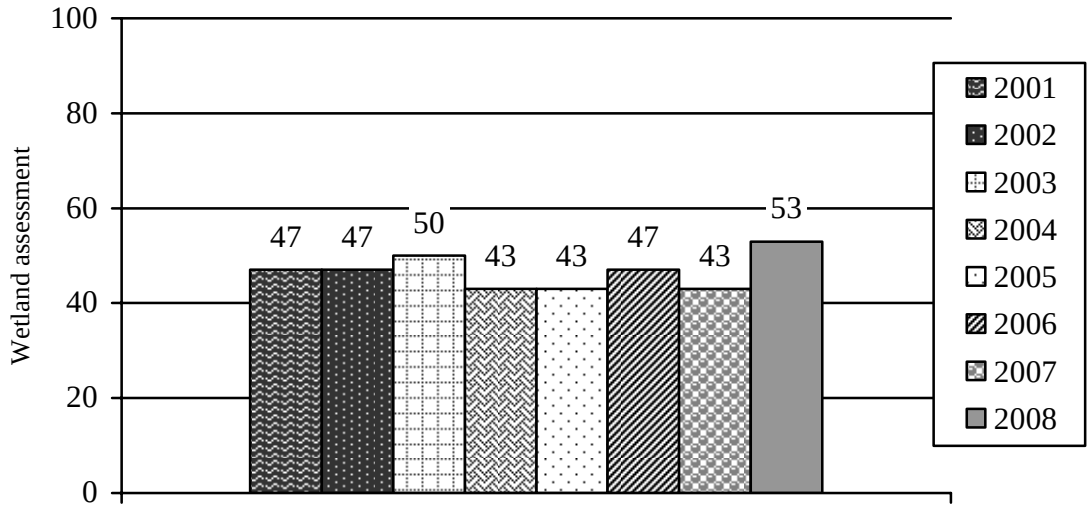


Table 5. ***2001-2008 wildlife species observed on the Roundup Wetland Mitigation Site[1].***

AMPHIBIAN AND REPTILE	
Unidentified Turtle (likely painted)	Frog (*Rana* spp.)
Painted Turtle (*Chrysemys picta*)	**Woodhouse Toad (*Bufo woodhousii*)**
Bull Snake (*Pituophis catenifer*)	
BIRDS	
American Avocet (*Recurvirostra americana*)	**Mallard (*Anas platyrhynchos*)**
American Coot (*Fulica americana*)	Marbled Godwit (*Limosa fedoa*)
American Kestrel (*Falco sparverius*)	Marsh Wren (*Cistohorus palustris*)
American Robin (*Turdus migratorius*)	Mourning Dove (*Zenaida macroura*)
American Wigeon (*Anas americana*)	Northern Harrier (*Circus cyaneus*)
Bank Swallow (*Riparia riparia*)	**Northern Pintail (*Anas acutus*)**
Barn Swallow (*Hirundo rustica*)	Northern Rough-winged Swallow (*Stelgidopteryx serripennis*)
Black-billed Magpie (*Pica Pica*)	**Northern Shoveler (*Anas clypeata)***
Black-necked Stilt (*Himantopus mexicanus*)	**Pied-billed Grebe (*Podilymbus podiceps*)**
Blue-winged Teal (*Anas discors*)	Redhead (*Aythya Americana*)
Bufflehead (*Bucephala albeola*)	Ring-billed Gull (Larus delawarensis)
Brewer's Blackbird (*Euphagus cyanocephalus*)	Red-necked Phalarope (*Phalaropus lobatus*)
California Gull (*Larus californicus*)	**Red-winged Blackbird (*Agelaius phoeniceus*)**
Canada Goose (*Branta canadensis*)	**Ring-necked Duck (*Aythya collaris*)**
Canvasback (*Aythya valisineria*)	Ring-necked Pheasant (*Phasianus colchicus*)
Cedar Waxwing (*Bombycilla cedrorum*)	Rock Dove (*Columba livia*)
Cinnamon Teal (*Anas cyanoptera*)	Ross Goose (*Chen rossii*)
Cliff Swallow (*Hirundo pyrrhonota*)	**Ruddy Duck (*Oxyura dominica*)**
Common Merganser (*Megus merganser*)	Sandhill Crane (*Grus canadensis*)
Common Snipe (*Gallinago gallinago*)	Sandpiper (species unidentified)
Common Yellowthroat (*Geothypis trichas*)	Semipalmated Sandpiper (*Charadrius semipalmatus*)
Cooper's Hawk (*Accipiter cooperii*)	Short-billed Dowitcher ((*Limnodromus griseus*)
Double-crested Cormorant (*Phalacrocorax auritus*)	Solitary Sandpiper (*Tringa solitaria*)
Eared Grebe (*Podiceps nigricollis*)	Song Sparrow (*Melospiza melodia*)
Eastern Kingbird (*Tyrannus tyrannus*)	**Spotted Sandpiper (*Actitis macularia*)**
European Starling (*Sturnus vulgaris*)	**Tree swallow (*Tachycineta bicolor*)**
Franklin's Gull (*Larus pipixcan*)	**Violet Green Swallow (*Tachycineta thalassina*)**
Gadwall (*Anas strepera*)	Western Grebe (*Aechmorphus occidentalis*)
Great Blue Heron (*Ardea herodias*)	Western Meadowlark (*Sturnella neglecta*)
Greater Yellow legs (*Tringa melanoleuca*)	Western Sandpiper (*Calidris mauri*)
Green-winged Teal (*Anas crecca*)	Whimbrel (*Numenius phaeopus*)
Hooded Merganser (*Lophodytes cucllatus*)	White-crowned Sparrow (Zonotrichia atricapilla)
House Sparrow (*Passer domesticus*)	Willet (*Catoptrophorus semipalmatus*)
Killdeer (*Charadrius vociferus*)	**Wilson's Phalarope (*Phalaropus tricolor*)**
Lazuli Bunting (*Passerina amoena*)	**Wood Duck (*Aix sponsa*)**
Least Sandpiper (*Calidris minitilla*)	**Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*)**
Lesser Scaup (*Aythya affinis*)	Yellow-rumped Warbler (*Dendroica coronata*)
Lesser Yellowlegs (*Tringa flavipes*)	Yellow Warbler (*Dendroica petichia*)
Long-billed Dowitcher (*Limnodromus scolopaceus*)	
MAMMAL	
Mule Deer (*Odocoileus hemionus)*	Domestic cat
Red Fox (*Vulpes vulpes*)	Muskrat (*Ondatra zibethica*)

[1]**Bolded** species indicate those documented within the analysis area in 2008.

3.7 Functional Assessment

Pre-construction conditions were assessed using the 1997 MDT Montana Wetland Assessment Method (MWAM). In 2002 through 2007 wetland function was assessed using the 1999 MDT MWAM. The 2008 conditions were assessed using the 2008 MDT MWAM. Although direct comparisons cannot be made, general trends in wetland development can still be determined (**Table 6**). Completed Functional Assessment Forms are included in **Appendix B** and summarized in **Table 6**. The site rated as an overall Category II wetland and scores 123 Functional Units. The decrease in the FU since 2007 is primarily the result of slight wetland decrease and use of the 2008 functional assessment. Values with the highest functional points include: general wildlife habitat, short and long term surface water storage, sediment / nutrient / toxicant removal, and production export / food chain support.

3.8 Photographs

Representative photos taken from photo points and transect ends are included in **Appendix C.** An extra photo was taken of the weedy conditions along the vegetation transect**.**

3.9 Maintenance Needs/Recommendations

All dikes and inlet structures were functioning satisfactorily. All bird boxes are in good condition. To determine if there is a soil nutrient imbalance, several composite and individual soil samples could be gathered and analyzed, and a soil augmentation management plan could be formulated depending on specific parameter results.

3.10 Current Credit Summary

The 2008 delineation resulted in a total of 20.88 acres of gross wetland acreage, a decrease of 0.19 acre since 2007. The decrease in the 2008 gross wetland acreage is the result of an increase in upland non-noxious weed cover. Of the 20.88 acres, a total of 8.85 acres were shallow, open water (<4 feet deep) in the north lagoon and shallow inundation (< 6 inches) in the south lagoon. The site rated as an overall Category II wetland and scores 123 Functional Units. Values with the highest functional points include: general wildlife habitat, short and long term surface water storage, sediment / nutrient / toxicant removal, and production export / food chain support. The Roundup wetland is highly utilized by avian wildlife species; to date a total of 77 avian species have been observed.

Table 6: ***Summary of 2001-2008 wetland function/value ratings and functional points at the Roundup Wetland Mitigation Site.***

Function and Value Parameters from the MDT Montana Wetland Assessment Method	2001[1]	2002[2]	2003[2]	2004[2]	2005[2]	2006[2]	2007[2]	2008[3]
Listed/Proposed T&E Species Habitat	Low (0.0)	Low (0.0)	Low (0.0)	Low (0.0)	Low (0.0)	Low (0.0)	Low (0.0)	Low (0.0)
MNHP Species Habitat	Low (0.0)	High (0.8)	High (0.8)	High (0.8)	High (0.8)	High (0.8)	High (0.8)	Low (0.2)
General Wildlife Habitat	Low (0.3)	Mod. (0.7)	High (0.9)	High (0.9)	High (0.9)	High (0.9)	High (0.9)	High (0.9)
General Fish/Aquatic Habitat	NA	NA	NA	NA	NA	NA	NA	NA
Flood Attenuation	High (1.0)	Mod. (0.6)	Mod. (0.6)	Mod. (0.6)	Mod. (0.6)	Mod. (0.6)	Mod. (0.6)	Mod (0.5)
Short and Long Term Surface Water Storage	High (0.8)	High (1.0)	High (1.0)	High (1.0)	High (1.0)	High (1.0)	High (1.0)	High (1.0)
Sediment/Nutrient/Toxicant Removal	Mod. (0.7)	Mod. (0.7)	Mod. (0.7)	Mod. (0.7)	Mod. (0.7)	Mod. (0.7)	Mod. (0.7)	Mod. (0.7)
Sediment/Shoreline Stabilization	NA	High (1.0)	High (1.0)	High (1.0)	High (1.0)	High (1.0)	Low (0.3)	Low (0.3)
Production Export/Food Chain Support	Mod. (0.6)	Mod. (0.6)	Mod. (0.6)	High (0.8)	High (0.8)	High (0.8)	High (0.8)	High (0.8)
Groundwater Discharge/Recharge	Low (0.1)	Low (0.1)	Low (0.1)	Low (0.1)	Low (0.1)	Low (0.1)	Low (0.1)	High (1.0)
Uniqueness	Low (0.2)	Low (0.3)	Low (0.3)	Low (0.3)	Low (0.3)	Low (0.3)	Low (0.3)	Low (0.3)
Recreation/Education Potential (Bonus)	Low (0.2)	High (1.0)	High (1.0)	High (1.0)	High (1.0)	High (1.0)	High (1.0)	High (0.2)
Actual Points / Possible Points	3.9/10	6.8/11	7/11	7.2/11	7.2/11	7.2/11	6.5/11	5.9/10
% of Possible Score Achieved	39%	61%	64%	65%	65%	65%	59%	59%
Overall Category	III	III	II	II	II	II	II	II
Total Acreage of Assessed Wetlands / Open Water within Easement	**18.51**	**22.00**	**22.00**	**22.0**	**22.07**	**22.07**	**21.07**	**20.88**
Functional Units (acreage x actual points)	**72.21**	**149.60**	**154.00**	**158.40**	**158.90**	**158.90**	**137.00**	**123.19**
Net Acreage Gain	**18.51**	**22.00**	**22.00**	**22.00**	**22.07**	**22.07**	**21.07**	**20.88**
Functional Unit "Gain"	**72.21**	**149.60**	**154.00**	**158.40**	**158.90**	**158.90**	**137.00**	**123.19**

[1] Assessed using the 1997 MDT Montana Wetland Assessment Method.
[2] Assessed using the 1999 MDT Montana Wetland Assessment Method.
[3] Assessed using the 2008 MDT Montana Wetland Assessment Method. The completed form is in **Appendix B**.

4.0 REFERENCES

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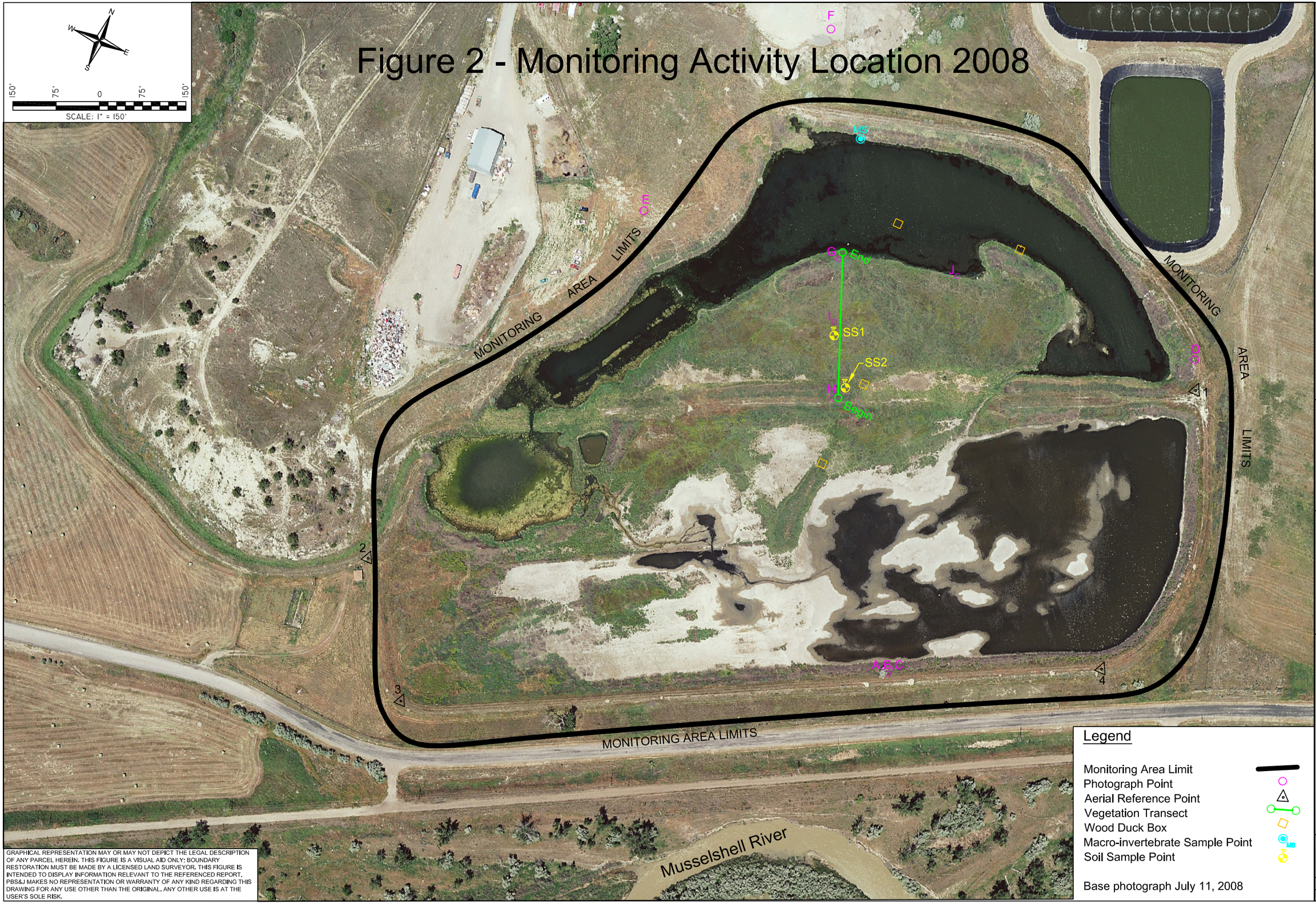
Appendix A

FIGURES 2, 3, & 4

MDT Wetland Mitigation Monitoring
Roundup Wetland
Roundup, Montana

Figure 2 - Monitoring Activity Location 2008



Legend

- Monitoring Area Limit
- Photograph Point
- Aerial Reference Point
- Vegetation Transect
- Wood Duck Box
- Macro-invertebrate Sample Point
- Soil Sample Point

Base photograph July 11, 2008

PROJECT NAME: MDT ROUNDUP LAGOON WETLAND MITIGATION

DRAWING TITLE: MONITORING ACTIVITY LOCATIONS 2008

PROJ NO: 0B4308801 06.05	DRAWN: JR		
LOCATION: ROUNDUP, MT	PROJ MGR: J. BERGLUND		
SCALE: NOTED	CHECKED: LB	APPVD: JB	
FILE NAME: BASE2008.dwg	PLOTTED: Nov/05/2008		

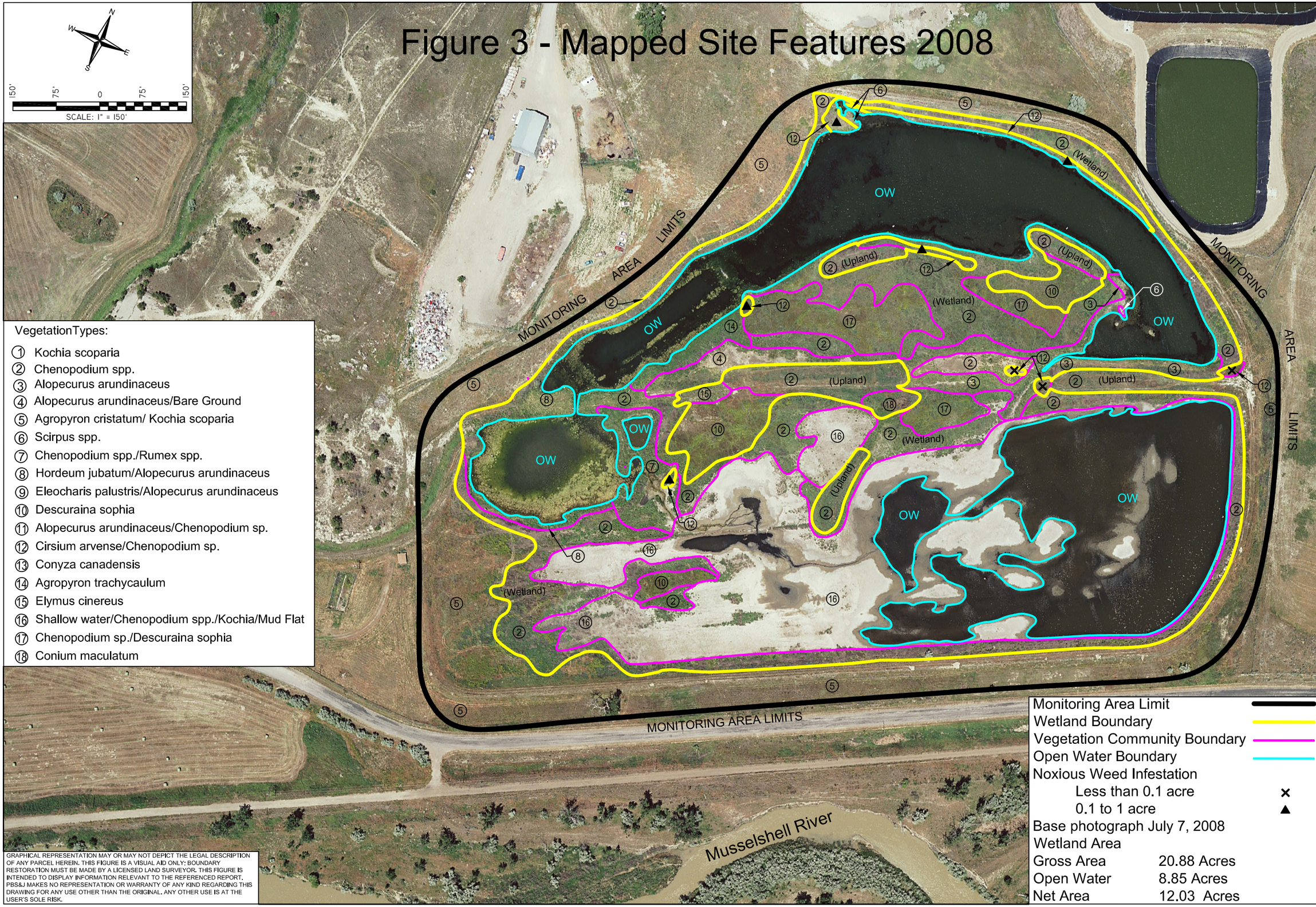
PBSJ
3810 Valley Commons Drive
Suite 4
Bozeman, MT 59718

FIGURE 2

REV -

11/05/2008

Figure 3 - Mapped Site Features 2008



VegetationTypes:

① Kochia scoparia
② Chenopodium spp.
③ Alopecurus arundinaceus
④ Alopecurus arundinaceus/Bare Ground
⑤ Agropyron cristatum/ Kochia scoparia
⑥ Scirpus spp.
⑦ Chenopodium spp./Rumex spp.
⑧ Hordeum jubatum/Alopecurus arundinaceus
⑨ Eleocharis palustris/Alopecurus arundinaceus
⑩ Descuraina sophia
⑪ Alopecurus arundinaceus/Chenopodium sp.
⑫ Cirsium arvense/Chenopodium sp.
⑬ Conyza canadensis
⑭ Agropyron trachycaulum
⑮ Elymus cinereus
⑯ Shallow water/Chenopodium spp./Kochia/Mud Flat
⑰ Chenopodium sp./Descuraina sophia
⑱ Conium maculatum

Monitoring Area Limit
Wetland Boundary
Vegetation Community Boundary
Open Water Boundary
Noxious Weed Infestation
Less than 0.1 acre ×
0.1 to 1 acre ▲
Base photograph July 7, 2008
Wetland Area

Gross Area	20.88 Acres
Open Water	8.85 Acres
Net Area	12.03 Acres

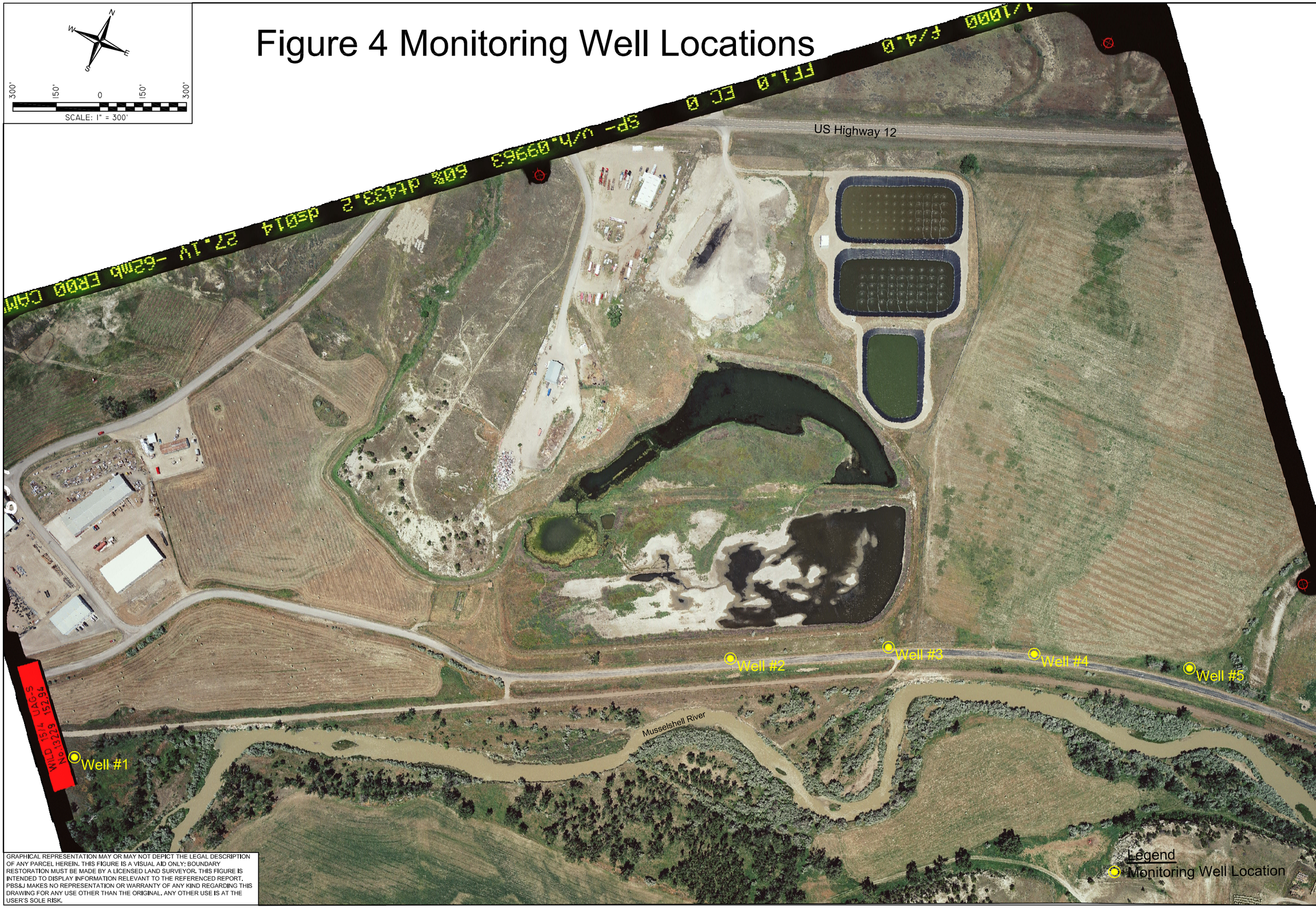
PROJECT NAME: MDT ROUNDUP LAGOON WETLAND MITIGATION
DRAWING TITLE: MAPPED SITE FEATURES 2008

PROJ NO: 0B4308801 06.05
LOCATION: ROUNDUP, MT
SCALE: NOTED
FILE NAME: BASE2008.dwg
DRAWN: JR
PROJ MGR: J. BERGLUND
CHECKED: LB
APPVD: JB
PLOTTED: Dec/10/2008

PBSJ
3810 Valley Commons Drive
Suite 4
Bozeman, MT 59718

FIGURE 3
REV -
10/22/2008

Figure 4 Monitoring Well Locations



GRAPHICAL REPRESENTATION MAY OR MAY NOT DEPICT THE LEGAL DESCRIPTION OF ANY PARCEL HEREIN. THIS FIGURE IS A VISUAL AID ONLY; BOUNDARY RESTORATION MUST BE MADE BY A LICENSED LAND SURVEYOR. THIS FIGURE IS INTENDED TO DISPLAY INFORMATION RELEVANT TO THE REFERENCED REPORT. PBS&J MAKES NO REPRESENTATION OR WARRANTY OF ANY KIND REGARDING THIS DRAWING FOR ANY USE OTHER THAN THE ORIGINAL. ANY OTHER USE IS AT THE USER'S SOLE RISK.

PROJECT NAME
MDT ROUNDUP LAGOON WETLAND MITIGATION

DRAWING TITLE
MONITORING WELL LOCATIONS

PROJ NO:	0B4308801 06.05
LOCATION:	ROUNDUP, MT
SCALE:	NOTED
FILE NAME:	BASE2008.dwg
DRAWN:	JR
PROJ MGR:	J. BERGLUND
CHECKED:	LB
APPV'D:	JB
PLOTTED:	Nov/19/2008

3810 Valley Commons Drive
Suite 4
Bozeman, MT 59718

FIGURE
4

REV -
11/05/2008

Appendix B

2008 WETLAND MITIGATION SITE MONITORING FORM
2008 BIRD SURVEY FORMS
2008 COE WETLAND DELINEATION FORMS
2008 FUNCTIONAL ASSESSMENT FORMS

MDT Wetland Mitigation Monitoring
Roundup Wetland
Roundup, Montana

PBS&J / MDT WETLAND MITIGATION SITE MONITORING FORM

Project Name:__Roundup____ Project Number:_B4308801 06.05.02_ Assessment Date:_7/7/08__
Location Roundup, MT_ MDT District:_____5_____ Milepost:____49_____
Legal description: T_8N___ R_26E___ Section_18___ Time of Day:__4:30 PM & 7 AM_
Weather Conditions:__clear_____ Person(s) conducting the assessment:__LB/PBS&J_____
Initial Evaluation Date:__8/14/01__ Visit #:_____8____ Monitoring Year:_2008_____
Size of evaluation area:__22__acres Land use surrounding wetland: sewer treatment plant; waste recovery site; hayfields_

HYDROLOGY

Surface Water Source:___stormwater and treated water from_treatment plant_____
Inundation**:** Present_X___ Absent____ Average depths:_4___ft Range of depths:_0__-_6___ft
Assessment area under inundation:_24%
Depth at emergent vegetation-open water boundary:_0.5___ft
If assessment area is not inundated are the soils saturated w/in 12" of surface**:** Yes_X___No ____
Other evidence of hydrology on site (drift lines, erosion, stained vegetation etc.):
The north lagoon is perennially inundated and the south lagoon has water intermittently. The are between the lagoons is intermittently saturated but does inundate.

Groundwater (*See Separate Groundwater Monitoring Report*)
Monitoring wells: Present__X____Absent_____
Record depth of water below ground surface

Well #	Depth	Well #	Depth	Well #	Depth

Additional Activities Checklist:
__X__Map emergent vegetation-open water boundary on air photo
__X__Observe extent of surface water during each site visit and look for evidence of past surface water elevations (drift lines, erosion, vegetation staining etc.)
__-___GPS survey groundwater monitoring wells locations if present

COMMENTS/PROBLEMS:
The following statement still applies in 2008: *Kochia* and *Chenopodium* infestation still an issue and comprises nearly 90% of the vegetation within the wetland boundaries. As a result of the FAC rating of these two species, the hydrophytic vegetation qualification has been technically fulfilled (hydric soils and hydrology are present) and the area subsequently qualifies as wetland.

In 2008, it was noted that Canada thistle is expanding between the north and south ponds and along the north edge of the north pond; these communities have a 50-100% cover of thistle. Mustard is also expanding site-wide. A new community type (17) was declared to recognize the mustard (45%)-chenopodium (50%) community; this community barely qualifies as wetland because of the FAC indicator status of chenopodium and the small inclusion of *Agropyron trachycaulum* (5%). CT 17 also includes Canada thistle (<5%, FACU).

VEGETATION COMMUNITIES

Community No.:__1__ Community Title (main species):__ *Kochia scoparia* ___

Dominant Species	% Cover	Dominant Species	% Cover
Kochia scoparia	15	*Asclepias sp.*	<1
Chenopodium spp.	80	*Aster brachyactis*	<1
Elymus cinereus	<1	*Descuraina sophia*	<1
Salix sprigs *(dead)*			
Agropyron elongatum	<5		
Agropyron trachycaulum	<5		

COMMENTS/PROBLEMS: _____

Community No.:__2__ Community Title (main species):___ *Chenopodium spp.*_____

Dominant Species	% Cover	Dominant Species	% Cover
Chenopodium spp.	95	*Alopecurus arundinacea*	<1
Elaeagnus angustifolia	<1	*Hordeum jubatum*	<1
Kochia scoparia	<5	*Scirpus maritimus*	<1
Rumex spp.	<1	*Descuraina sophia*	5
Salix sprigs *(dead)*		*Circium arvense*	1

COMMENTS/PROBLEMS: __ This CT occurs in upland and wetland areas, identified by "Upland:CT-2" and "Wetland: CT-2" on map. Mustard (DESOP) and Canada thistle are expanding site wide and in some areas has replaced the wetland community of *Chenopodium*. Thistle has been sprayed in some areas. _____

Community No.:__3__ Community Title (main species):_____ *Alopecurus arundinaceus* _____

Dominant Species	% Cover	Dominant Species	% Cover
Alopecurus arundinaceus	50	*Chenopodium sp.*	5
Salix sprigs (dead)	<1	*Elaeagnus angustifolia*	<1
Rumex spp.	<1	*Aster brachyactis*	<1
Scirpus acutuspungens	<1	*Agropyron trachycaulum*	1
Phalarus arundinacea	<5	*Scirpus maritimus*	<1
Hordeum jubatum	35		

COMMENTS/PROBLEMS: _____

Community No.:__4__ Community Title (main species):_____ *Alopecurus arundinaceus/Bare Ground* _____

Dominant Species	% Cover	Dominant Species	% Cover
Alopecurus arundinacea	30	*Agropyron elongata*	10
Scirpus maritimus	<1	*Kochia scoparia*	5
Aster brachyactis	<1	*Chenopodium spp.*	25
Puccinellia nuttalliana	<1	*Hordeum jubatum*	<5
Rumex spp.	<1	*Bare Ground*	30
Scirpus pungens	<1		

COMMENTS/PROBLEMS: *Eleocharis palustris, Scirpus acutus, Polygonum spp. not observed, however still may be present in very small quantities..* _____

VEGETATION COMMUNITIES (continued)

Community No.:__5__ Community Title (main species):__ *Agropyron cristatum/ Kochia scoparia* ___

Dominant Species	% Cover	Dominant Species	% Cover
Agropyron cristatum	40	*Rhus trilobata*	<1
Chenopodium spp.	25	*Ribes aureum*	<1
Cirsium arvense	<5		
Grindelia squarrosa.	<5		
Kochia scoparia	25		
Melilotus officinalis	<5		

COMMENTS/PROBLEMS: _community composition varies around site_____
_____

Community No.:_6__ Community Title (main species):_*Scirpus* spp._____

Dominant Species	% Cover	Dominant Species	% Cover
Scirpus maritimus	50-100		
Scirpus acutus	50-100		
Scirpus pungens	50-100		
Lemna minor	<5		
Chenopodium spp.	<1		

COMMENTS/PROBLEMS: _____
_____

Community No.:__7__ Community Title (main species)_*Chenopodium spp./Rumex spp.*___

Dominant Species	% Cover	Dominant Species	% Cover
Chenopodium spp.	35	*Aster brachyactis*	<1
Rumex maritimus +/or crispus	35	*Eleocharis palustris*	<5
Alopecurus arundinaceus	10		
Cirsium arvense	10		
Scipus maritimus	<5		
Hordeum jubatum	<5		

COMMENTS/PROBLEMS: _____
_____

Community No.:__8__ Community Title (main species):___*Hordeum jubatum/Alopecurus arundinaceus* _____

Dominant Species	% Cover	Dominant Species	% Cover
Hordeum jubatum	5		
Alopecurus arundinaceus	85		
Chenopodium spp.	5		
Rumex sp.	5		

COMMENTS/PROBLEMS: _____
_____

VEGETATION COMMUNITIES (continued)

Community No.:__9__ Community Title (main species) *Eleocharis palustris/Alopecurus arundinaceus* _____

Dominant Species	% Cover	Dominant Species	% Cover
Alopecurus arundinaceus	50	*Eleocharis palustris*	20
Lemna minor	5	*Scirpus acutus*	<1
Polygonum spp.	<1	*Kochia scoparia*	<5
Puccinellia nuttalliana	<5	*Chenopodium leptophyllum +/or hybridium*	<5
Rumex crispus+/or maritimus	<1	*Scirpus maritimus*	5
Scirpus pungens	<1		

COMMENTS/PROBLEMS: _____
_____

Community No.:__10__ Community Title (main species)_*Descuraina sophia*___

Dominant Species	% Cover	Dominant Species	% Cover
Descuraina sophia	95		
Chenopodium spp.	5		
Agropyron trachycaulum	<5		

COMMENTS/PROBLEMS: _____
_____

Community No.:__11__ Community Title (main species):___*Alopecurus arundinaceus/Chenopodium spp.*

Dominant Species	% Cover	Dominant Species	% Cover
Alopecurus arundinaceus	60	Bare ground	10
Chenopodium spp.	15		
Puccinellia nuttalliana	5		
Scirpus acutus	<1		
Hordeum jubatum	<1		
Scirpus maritimus	10		

COMMENTS/PROBLEMS: _____
_____

Community No.:__12_ Community Title (main species) *Cirsium arvense / Chenopodium* spp._____

Dominant Species	% Cover	Dominant Species	% Cover
Alopecurus arundinaceus	5		
Chenopodium spp.	15		
Cirsium arvense	80		
Aster brachyactis	<1		

COMMENTS/PROBLEMS: ___Some areas have been sprayed for thistle._____
_____

VEGETATION COMMUNITIES (continued)

Community No.:__13__ Community Title (main species)_ *Conyza canadensis* ___

Dominant Species	% Cover	Dominant Species	% Cover
Descuraina sophia	<5		
Chenopodium spp.	<5		
Conyza canadensis	90		
Elymus cinereus	<5		
Elaeagnus angustifolia	<5		

COMMENTS/PROBLEMS: _____
_____

Community No.:__14__ Community Title (main species):__ *Agropyron trachycaulum*_____

Dominant Species	% Cover	Dominant Species	% Cover
Agropyron trachycaulum	80		
Circium arvense	15		
Rumex spp.	<1		
Helianthus annuus	<1		
Aster brachyactis	<5		

COMMENTS/PROBLEMS: ___Aster not observed in 2008._____
_____

Community No.:__15_ Community Title (main species) ___ *Elymus cinereus* ___

Dominant Species	% Cover	Dominant Species	% Cover
Elymus cinereus	70	*Cirsium arvense*	<1
Chenopodium spp.	5		
Grindelia squarrosa	10		
Alopecurus arundinaceus	5		
Agropyron trachycaulum	5		

COMMENTS/PROBLEMS

Community No.:__16__ Community Title (main species)_*Shallow water/Chenopodium spp./Kochia*_/ mud flat__

Dominant Species	% Cover	Dominant Species	% Cover
Chenopodium leptophyllum/hybridium/ capitatum (seedlings)	25		
Shallow inundation or mud or dried mud	70		
Kochia scoparia (seedlings)	5		

COMMENTS/PROBLEMS: _____The percent cover of shallow inundation will change throughout the year, which will thus alter the cover of annual *Chenopodium* and other weed cover. No desirable wetland vegetation noted in this general area. _____

Additional Activities Checklist:
__X__Record and map vegetative communities on air photo

Community No.:__17__ Community Title (main species)_ *Chenopodium spp./ Desuriana sophia*___

Dominant Species	% Cover	Dominant Species	% Cover
Chenopodium spp.	50		
Desuriana sophia	45		
Agropyron trachycaulum	5		
Cirsium arvense	<5		

COMMENTS/PROBLEMS: _____This community type can be seen on the aerial photograph as a yellow signature (mustard flower). In some patches the mustard is at 100% cover, but overall <50% of the CT cover. It barely qualifies as a wetland community because of the FAC indicator status of AGRTRA and *Chenopodium*.

Community No.:__18__ Community Title (main species)_ *Conium maculatum* ___

Dominant Species	% Cover	Dominant Species	% Cover
Conium maculatum	95		
Chenopodium sp.	5		

COMMENTS/PROBLEMS: _____
_____

COMPREHENSIVE VEGETATION LIST

Species	Vegetation Community Number(s)
Agropyron cristatum	1
Agropyron elongatum	1,4
Agropyron trachycaulum	1, 3, 10, 13, 15, 17
Alopecurus arundinacea	2, 3, 4,7, 9,11, 15
Asclepias sp.	1
Aster brachyactis	1,3,7,12,14
Chenopodium capitatum/leptophyllum/hybridum	1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13,15, 17
Cirsium arvense	1, 2, 5,7,14, 15, 17
Conium maculatum	18
Conyza canadensis	13
Descuraina sophia	1, 2, 13, 17
Elaeagnus angustifolia	1,2,3,13
Eleocharis palustris	4, 7,
Elymus cinereus	1, 13,15
Grindelia squarrosa	1,5,15
Helianthus annuus	14
Hordeum jubatum	2, 3,4,7,8,11
Kochia scoparia	1, 2, 4, 5,9
Lemna minor	6,9
Melilotus officinalis	1, 5
Phalarus arundinacea	3, 4
Polygonum spp.	4,9
Puccinellia nuttalliana	4,9,11
Rhus trilobata	1, 5
Ribes aureum	1, 5
Rumex crispus/maritimus	2, 3, 4,7, 8, 9,14
Scirpus acutus	4, 6, 9,11
Scirpus maritimus	2, 3, 4, 6,7,9,11
Scirpus pungens	3, 6, 9
Salix sprigs (dead)	1,2,3
Tamarix ramosissima	2

COMMENTS/PROBLEMS: Mustard (DESSOP) and Canada thistle are spreading.

PLANTED WOODY VEGETATION SURVIVAL

Species	Number Originally Planted	Number Observed (Dead)	Mortality Causes
Willows	Unknown (hundreds?)	50-100	Likely died the first season planted.*

COMMENTS/PROBLEMS: Some sprigs were multi-stemmed; length above ground was 1 to 4 feet long. Sprigs were planted around the south and east circumference of south lagoon and near interior berm and islands. No live sprigs were found. Soil may be too tight for adequate oxygenation of cut ends to promote root growth.

WILDLIFE

BIRDS

(Attach Bird Survey Field Forms)

Were man made nesting structures installed? Yes__X__ No____Type:_wood duck_ How many?__3____ Are the nesting structures being utilized? Yes_likely, adults and young observed in summer and fall___ No____ Do the nesting structures need repairs? Yes____ No____

MAMMALS AND HERPTILES

Species	Number Observed	Indirect indication of use			
		Tracks	Scat	Burrows	Other
Mule deer	2 (+1 fawn)	X (also)			
Woodhouse's Toad	1				
Unidentified Turtle	1				

Additional Activities Checklist:
__X___Macroinvertebrate sampling (if required)

COMMENTS/PROBLEMS: Turtle was on a log and was disturbed by a duck before it could be identified.

PHOTOGRAPHS

Using a camera with a 50 mm lenses and color film take photographs of the following permanent reference points listed in the checklist below. Record the direction of the photograph using a compass. (The first time at each site establish a permanent reference point by setting a ½ inch rebar or fencepost extending 2-3' above ground, survey the location with a resource grade GPS and mark the location on the air photo.)
Checklist:

__X___ One photo for each of the 4 cardinal directions surrounding wetland
__X___ At least one photo showing upland use surrounding wetland – if more than one upland use exists, take additional photos
__X___ At least one photo showing buffer surrounding wetland
__X*___ One photo from each end of vegetation transect showing transect

Location	Photo Frame #	Photograph Description	Compass Reading
A		wetland view	N
B		upland use	S
C		wetland view	E
D		wetland view	W
E		wetland view	S
F		wetland view	E
G		transect end on island	S
H		transect end on old dike	N
I		Panorama of *Chenopodium*/Mustard community between ponds in area of transect.	S

COMMENTS/PROBLEMS:

_____

_____

_____

GPS SURVEYING

Using a resource grade GPS survey the items on the checklist below. Collect at least 3 location points with the GPS unit set at 5 second recording rate. Record file numbers fore site in designated GPS field notebook

Checklist:

__X*___ Jurisdictional wetland boundary
__-___ 4-6 landmarks recognizable on the air photo
__X___ Start and end points of vegetation transect(s)
__X___ Photo reference points
__X___ Groundwater monitoring well locations

COMMENTS/PROBLEMS: __* Data hand-drawn during 2008 monitoring event. _____

WETLAND DELINEATION

(Attach Corps of Engineers delineation forms)

At each site conduct the items on the checklist below:
__X___Delineate wetlands according to the 1987 Army Corps manual.
__X____Delineate wetland-upland boundary on the air photo
__X*___Survey wetland-upland boundary with a resource grade GPS survey

COMMENTS/PROBLEMS: _*Hand-drawn 2008. _____
_____
_____
_____
_____

FUNCTIONAL ASSESSMENT

(Complete and attach full MDT Montana Wetland Assessment Method field forms; also attach abbreviated field forms, if used)

COMMENTS/PROBLEMS: _____
_____
_____
_____
_____

MAINTENANCE

Were man-made nesting structures installed at this site? YES_X__ NO____
If yes, do they need to be repaired? YES____ NO_X_
If yes, describe problems below and indicate if any actions were taken to remedy the problems.

Were man-made structures build or installed to impound water or control water flow into or out of the wetland? YES__X____ NO____
If yes, are the structures working properly and in good working order? YES_X__ NO___
If no, describe the problems below.

COMMENTS/PROBLEMS:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

MDT WETLAND MONITORING – VEGETATION TRANSECT

Site: Roundup Date: 7/7/08 Examiner: LB/PBSJ Transect #1

Approx. transect length: 196’ Compass Direction from Start (Upland): 14 degrees (S to N)

Vegetation type A:	CT 2 (Upland)	
Length of transect in this type:	27	feet
Species:		Cover:
KOCSCO		5
CHEHYB		95
HELANN		<1
	Total Vegetative Cover:	100%

Vegetation type B:	CT 2 (Wetland)	
Length of transect in this type:	50	feet
Species:		Cover:
KOCSCO		5
CHEHYB		45
DESSOP		40
AGRTRA		5
		100

Vegetation type C:	CT 17 (Wetland)	
Length of transect in this type:	104	feet
Species:		Cover:
CHEHYB		50
DESSOP		45
AGRTRA		5
CIRARV		<1
	Total Vegetative Cover:	100%

Vegetation type D:	CT 4 (Wetland)	
Length of transect in this type:	5	feet
Species:		Cover:
ALOARU		60
Bare Ground		20
HORJUB		20
	Total Vegetative Cover:	80%

MDT WETLAND MONITORING – VEGETATION TRANSECT (cont'd)

Site: Roundup Date: 7/7/08 Examiner: LB/PBSJ Transect # 1 (cont'd)

Approx. transect length: 196' Compass Direction from Start (Upland): 14 degrees (S to N)

Vegetation type A:	CT 2 (Upland)
Length of transect in this type:	10 feet
Species:	Cover:
KOCSCO	10
CHEHYB	90
Total Vegetative Cover:	100%

Vegetation type B:	
Length of transect in this type:	feet
Species:	Cover:

Vegetation type C:	
Length of transect in this type:	feet
Species:	Cover:
Total Vegetative Cover	

Vegetation type D:	
Length of transect in this type:	feet
Species:	Cover:
Total Vegetative Cover:	

:

MDT WETLAND MONITORING – VEGETATION TRANSECT (back of form)

Cover Estimate		**Indicator Class:**	**Source:**
+ = <1%	3 = 11-20%	+ = Obligate	P = Planted
1 = 1-5%	4 = 21-50%	- = Facultative/Wet	V = Volunteer
2 = 6-10%	5 = >50%	0 = Facultative	

Percent of perimeter 100%* % developing wetland vegetation – excluding dam/berm structures.

Establish transects perpendicular to the shoreline (or saturated perimeter). The transect should begin in the upland area. Permanently mark this location with a standard metal fencepost. Extend the imaginary transect line towards the center of the wetland, ending at the 3 food depth (in open water), or at a point where water depths or saturation are maximized. Mark this location with another metal fencepost.

Estimate cover within a 10 ft wide "belt" along the transect length. At a minimum, establish a transect at the windward and leeward sides of the wetland. Remember that the purpose of this sampling is to monitor, not inventory, representative portions of the wetland site.

Notes:

* Most of open water edges are vegetated with *Chenopodium leptophylulm* (FACW), *C. hybridium* (No listing)/ *C. capitatum* (No listing); assume all species have a FAC-FACW tendency as a result of their colonization of saturated conditions.

3

BIRD SURVEY – FIELD DATA SHEET

Date: **see below**

SITE: Roundup: 2008 April, July and October Surveys

Bird Species	#	Behavior	Habitat	Bird Species	#	Behavior	Habitat
SPRING: (4/28-29/08)				**MID-SEASON (7/7/08):**			
American Avocet	8	F	OW/MA	American Avocet	3	F	MA
				American Wigeon	6 (5 were chicks)	F	OW
American Coot	12	F	OW	Black-billed Magpie	2	F	UPL
American Wigeon	10	F	OW	Blue-winged Teal	3	Flushed	OW
Canada Goose	30	N/F	OW/WL/UPL	Canada Goose	20	F/BR	OW/UPL
Eared Grebe	15			Cinnamon Teal	2	F	OW
Franklin's Gull	1			Cliff Swallow	30	F/FO	OW/MA/UPL
Green-winged Teal	65	F	OW	Killdeer	16	BR/F	MA
Killdeer	5	BR	MA	Mallard	40	LO	OW
Lesser Yellowlegs	4	F	OW	Northern Pintail	1	F	OW
Mallard	12	F	OW	Red-winged Blackbird	5	F/FO	MA/OW/UPL
Northern Shoveler	135	F	OW	Ruddy Duck	2	F	OW
Red-winged Blackbird	6	BR	MA/OW/UPL	Spotted Sandpiper	2	F	MA
Ring-necked Duck	5	F	OW	Violet Green Swallow	1 (at least)	F/FO	OW/MA/UPL
Ruddy Duck	18			Wilson's Phalarope	1	F	OW/MA
Tree Swallow	4	F	OW/MA	Wood Duck	1 (chicks somewhere?)	defensive	OW
Unidentified Gull	2	FO	OW/MA	Yellow-headed Blackbird	2	F	MA
Wood Duck	2	BR	OW	**FALL (10/10/08):**			
Yellow-headed Blackbird	1	BR	UPL	American Coot	15	15	
				American Wigeon	20	F	OW
				Blue-winged Teal	5	F	OW
				Canada Goose	4	flush	OW
				Eared Grebe	1	F	OW
				European Starling	100	F	UPL
				Gadwall	15	F	OW
				Green-winged Teal	25	F	OW/MA
				Mallard	100	F	OW
				Northern Shoveler	20	F	OW/MA
				Pied-billed Grebe	5	F	OW
				Ring-necked Duck	5	F	OW
				Ruddy Duck	15	F	OW
				Unident Scaup	1	F	OW
				Wood Duck	1	F	OW/MA

Behavior: BP – one of a breeding pair; BD – breeding display; F – foraging; FO – flyover; L – loafing; N – nesting

Habitat: AB – aquatic bed; FO – forested; I – island; MA – marsh; MF – mud flat; OW – open water; SS – scrub/shrub; UP – upland buffer; WM – wet meadow, US – unconsolidated shoreline

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	Roundup			Date:	7/7/08
Applicant/Owner:	MDT			County:	Musselshell
Investigator:	LB/PBS&J			State:	MT
Do Normal Circumstances exist on the site:	X	Yes		No	Community ID: CT 17
Is the site significantly disturbed (Atypical Situation)?	X	Yes		No	Transect ID: 1
Is the area a potential Problem Area?:		Yes	X	No	Plot ID: SP-1
(If needed, explain on reverse.)					

VEGETATION

	Dominant Plant Species	Stratum	Indicator		Dominant Plant Species	Stratum	Indicator
1	*Chenopodium Hybridium/Leptophylum*	H	FAC	9			
2	*Descurania sophia*	H	No listing (UPL)	10			
3				11			
4				12			
5				13			
6				14			
7				15			
8				16			

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-). 1/2

Within the area along the transect and in general between the north and south lagoons *Chenopodium* has almost completely replaced *Kochia* and mustard is replacing *Chenopodium.* Some areas of CT 17 have 100% chenopodium cover but overall is 50% cover. Canada thistle cover is also expanding. DESSOP is approximately 45% cover within the transect.

HYDROLOGY

X Recorded Data (Describe in Remarks):
- Stream, Lake, or Tide Gauge
- X Aerial Photographs
- Other

No Recorded Data Available

Field Observations:

Depth of Surface Water: - (in.)

Depth to Free Water in Pit: - (in.)

Depth to Saturated Soil: 6 (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- Inundated
- X Saturated in Upper 12 Inches
- Water Marks
- Drift Lines
- Sediment Deposits
- Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- Oxidized Root Channels in Upper 12 Inches
- Water-Stained Leaves
- Local Soil Survey Data
- FAC-Neutral Test
- Other (Explain in Remarks)

Remarks:

More saturation in this area may be beneficial in eliminating the FAC weedy species and mustard.

SOILS

Map Unit Name (Series and Phase): Havre-Glendive Complex (11A)

Drainage Class: well

Field Observations

Taxonomy (Subgroup): NA

Confirm Mapped Type? ____ Yes X No

Profile Description:

Depth inches	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
0-2	A	5Y 3/2	5 YR 4/4	small, distinct	sandy loam
2-10	A	5Y 3/3	5 YR 4/4	small, distinct	sandy loam

Hydric Soil Indicators:

____	Histosol	____	Concretions
____	Histic Epipedon	____	High Organic Content in surface Layer in Sandy Soils
____	Sulfidic Odor	____	Organic Streaking in Sandy Soils
____	Aquic Moisture Regime	____	Listed on Local Hydric Soils List
____	Reducing Conditions	____	Listed on National Hydric Soils List
X	Gleyed or Low-Chroma Colors	____	Other (Explain in Remarks)

WETLAND DETERMINATION

Hydrophytic Vegetation Present?	X	Yes	____	No	
Wetland Hydrology Present?	X	Yes	____	No	
Hydric Soils Present?	X	Yes	____	No	Is this Sampling Point Within a Wetland? X Yes ____ No

Remarks:

Chenopodium replacing *Kochia and Descurania* is replacing *Chenopodium.* Area between ponds may be converting to upland.

DATA FORM
ROUTINE WETLAND DETERMINATION
(1987 COE Wetlands Delineation Manual)

Project/Site:	Roundup	Date:	7/07/08
Applicant/Owner:	MDT	County:	Musselshell
Investigator:	LB/LWC	State:	MT

Do Normal Circumstances exist on the site:	X	Yes		No	Community ID: CT 2 Upland
Is the site significantly disturbed (Atypical Situation)?	X	Yes		No	Transect ID: 1
Is the area a potential Problem Area?:		Yes	X	No	Plot ID: SP-2
(If needed, explain on reverse.)					

VEGETATION

	Dominant Plant Species	Stratum	Indicator		Dominant Plant Species	Stratum	Indicator
1	*Kochia scoparia*	H	FAC	9			
2	*Chenopodium sp.*	H	FAC-FACW	10			
3	*Agropyron trachycaulum*	H	FAC	11			
4				12			
5				13			
6				14			
7				15			
8				16			

Percent of Dominant Species that are OBL, FACW, or FAC (excluding FAC-). 3/3

All vegetation on the upland island in the SP area has a FAC to FACW indicator status.

HYDROLOGY

X Recorded Data (Describe in Remarks):
- Stream, Lake, or Tide Gauge
- X Aerial Photographs
- Other

No Recorded Data Available

Field Observations:

Depth of Surface Water: - (in.)

Depth to Free Water in Pit: - (in.)

Depth to Saturated Soil: - (in.)

Wetland Hydrology Indicators:

Primary Indicators:
- Inundated
- Saturated in Upper 12 Inches
- Water Marks
- Drift Lines
- Sediment Deposits
- Drainage Patterns in Wetlands

Secondary Indicators (2 or more required):
- Oxidized Root Channels in Upper 12 Inches
- Water-Stained Leaves
- Local Soil Survey Data
- FAC-Neutral Test
- Other (Explain in Remarks)

Remarks:

This SP is located on the constructed island and though it has the same spp. profile as SP-1 the island has less hydrology because it is elevated.

SOILS

Map Unit Name (Series and Phase): Havre-Glendive Complex (11A)

Drainage Class: well

Field Observations

Taxonomy (Subgroup): NA

Confirm Mapped Type? _____ Yes _____ No

Profile Description:

Depth inches	Horizon	Matrix Color (Munsell Moist)	Mottle Colors (Munsell Moist)	Mottle Abundance/Contrast	Texture, Concretions, Structure, etc.
10	A-B (berm)	5Y 4/2			silt loam

Hydric Soil Indicators:

_____ Histosol
_____ Histic Epipedon
_____ Sulfidic Odor
_____ Aquic Moisture Regime
_____ Reducing Conditions
_____ Gleyed or Low-Chroma Colors
_____ Concretions
_____ High Organic Content in surface Layer in Sandy Soils
_____ Organic Streaking in Sandy Soils
_____ Listed on Local Hydric Soils List
_____ Listed on National Hydric Soils List
_____ Other (Explain in Remarks)

Non-hydric soil.

WETLAND DETERMINATION

Hydrophytic Vegetation Present? X Yes ____ No
Wetland Hydrology Present? ____ Yes X No
Hydric Soils Present? ____ Yes X No

Is this Sampling Point Within a Wetland? ____ Yes X No

Remarks:

Unchanged upland sample point, more weedy species (Canada thistle, mustard and poison hemlock) are invading these upland islands though not at specific sample point.

MDT MONTANA WETLAND ASSESSMENT FORM (revised March 2008)

1. Project Name: Roundup Wetland **2. MDT Project #:** 0B4308801.06.05 **3. Control #:** _____

3. Evaluation Date: 7/7/08 **4. Evaluator(s):** L. Bacon, PBS&J **5. Wetland/Site #(s):** _____

6. Wetland Location(s): Township 8 N, Range 26 E, Section 18; Township ___ N, Range ___ E, Section _____

Approximate Stationing or Roadposts: _____

Watershed: 10 - Musselshell **County:** _ Musselshell _ _____

7. Evaluating Agency: PBS&J

Purpose of Evaluation:

- ☐ **Wetland potentially affected by MDT project**
- ☐ **Mitigation wetlands; pre-construction**
- ☒ **Mitigation wetlands; post-construction**
- ☐ **Other** _____

8. Wetland Size (acre): _____ (visually estimated)
20.88 (measured, e.g. GPS)

9. Assessment Area (AA) Size (acre): _____ (visually estimated)
(see manual for determining AA) 20.88 (measured, e.g. GPS)

10. CLASSIFICATION OF WETLAND AND AQUATIC HABITATS IN AA (See manual for definitions.)

HGM Class (Brinson)	Class (Cowardin)	Modifier (Cowardin)	Water Regime	% OF AA
Depressional	Emergent Wetland	Diked	Seasonal / Intermittent	60
Depressional	Unconsolidated Bottom	Diked	Permanent / Perennial	15
Depressional	Aquatic Bed	Diked	Permanent / Perennial	25

Comments: _____

11. ESTIMATED RELATIVE ABUNDANCE (of similarly classified sites within the same Major Montana Watershed Basin; see manual.)
common

12. GENERAL CONDITION OF AA

i. Disturbance: Use matrix below to select the appropriate response; see manual for Montana listed noxious weed and aquatic nuisance vegetation species lists.

Conditions within AA	Predominant Conditions Adjacent to (within 500 feet of) AA		
	Managed in predominantly natural state; is not grazed, hayed, logged, or otherwise converted; does not contain roads or buildings; and noxious weed or ANVS cover is ≤15%.	Land not cultivated, but may be moderately grazed or hayed or selectively logged; or has been subject to minor clearing; contains few roads or buildings; noxious weed or ANVS cover is ≤30%.	Land cultivated or heavily grazed or logged; subject to substantial fill placement, grading, clearing, or hydrological alteration; high road or building density; or noxious weed or ANVS cover is >30%.
AA occurs and is managed in predominantly natural state; is not grazed, hayed, logged, or otherwise converted; does not contain roads or occupied buildings; and noxious weed or ANVS cover is ≤15%.	---	---	moderate disturbance
AA not cultivated, but may be moderately grazed or hayed or selectively logged; or has been subject to relatively minor clearing, fill placement, or hydrological alteration; contains few roads or buildings; noxious weed or ANVS cover is ≤30%.	---	---	---
AA cultivated or heavily grazed or logged; subject to relatively substantial fill placement, grading, clearing, or hydrological alteration; high road or building density; or noxious weed or ANVS cover is >30%.	---	---	---

Comments (types of disturbance, intensity, season, etc.)**:** _____

ii. Prominent noxious, aquatic nuisance, and other exotic vegetation species: *Chenopodium spp., Descuraina, Kochia, Cirsium arvense, Conium maculatum*

iii. Provide brief descriptive summary of AA and surrounding land use/habitat: Sewage treatment plant, garbage transfer station, stockpile for roadwork refuse (concrete, etc.)

13. STRUCTURAL DIVERSITY (Based on number of "Cowardin" ***vegetated*** classes present [do not include unvegetated classes]; see #10 above.)

Existing # of "Cowardin" Vegetated Classes in AA	Initial Rating	Is current management preventing (passive) existence of additional vegetated classes?		Modified Rating
≥3 (or 2 if one is forested) classes	---	NA	NA	NA
2 (or 1 if forested) classes	mod	NA	NA	NA
1 class, but not a monoculture	---	←NO	YES→	---
1 class, monoculture (1 species comprises ≥90% of total cover)	---	NA	NA	NA

Comments: The 2 classes are aquatic and emergent; the presence of the exotic species listed in 12.ii may inhibit colonization of preferred wetland species. Soil chemical profiles may also be unbalanced (e.g. high nitrogen) and thus inhibit growth of preferred species.

Wetland/Site #(s): 0B4308801.06.05

14A. HABITAT FOR FEDERALLY LISTED OR PROPOSED THREATENED OR ENDANGERED PLANTS OR ANIMALS

i. AA is Documented (D) or Suspected (S) to contain: Check box based on definitions in manual.

Primary or critical habitat (**list species**) ☐ D ☐ S _____
Secondary habitat (**list species**) ☐ D ☐ S _____
Incidental habitat (**list species**) ☐ D ☐ S _____
No usable habitat ☒ S

ii. Rating: Based on the strongest habitat chosen in 14A(i) above, select the corresponding functional point and rating.

Highest Habitat Level	Doc/Primary	Sus/Primary	Doc/Secondary	Sus/Secondary	Doc/Incidental	Sus/Incidental	None
Functional Point/Rating	---	---	---	---	---	---	0L

Sources for documented use (e.g. observations, records): _____

14B. HABITAT FOR PLANTS OR ANIMALS RATED S1, S2, OR S3 BY THE MONTANA NATURAL HERITAGE PROGRAM
Do not include species listed in 14A above.

i. AA is Documented (D) or Suspected (S) to contain: Check box based on definitions in manual.

Primary or critical habitat (**list species**) ☐ D ☐ S _____
Secondary habitat (**list species**) ☐ D ☐ S _____
Incidental habitat (**list species**) ☒ D ☐ S Rana sp., likely Northern Leopard (S2) observed several years ago, none seen since, likely that was an incidental sighting.
No usable habitat ☐ S

ii. Rating: Based on the strongest habitat chosen in 14A(i) above, select the corresponding functional point and rating.

Highest Habitat Level	Doc/Primary	Sus/Primary	Doc/Secondary	Sus/Secondary	Doc/Incidental	Sus/Incidental	None
S1 Species Functional Point/Rating	---	---	---	---	---	---	---
S2 and S3 Species Functional Point/Rating	---	---	---	---	.2L	---	---

Sources for documented use (e.g. observations, records): Rana not positively identified to Northern Leopard, however MDT biologist has documented occasional sightings.

14C. GENERAL WILDLIFE HABITAT RATING

i. Evidence of Overall Wildlife Use in the AA: Check substantial, moderate, or low based on supporting evidence.

☒ ***Substantial:*** Based on any of the following [check].
- ☒ observations of abundant wildlife #s or high species diversity (during any period)
- ☐ abundant wildlife sign such as scat, tracks, nest structures, game trails, etc.
- ☐ presence of extremely limiting habitat features not available in the surrounding area
- ☒ interview with local biologist with knowledge of the AA

☐ ***Minimal:*** Based on any of the following [check].
- ☐ few or no wildlife observations during peak use periods
- ☐ little to no wildlife sign
- ☐ sparse adjacent upland food sources
- ☐ interview with local biologist with knowledge of AA

☐ ***Moderate:*** Based on any of the following [check].
- ☐ observations of scattered wildlife groups or individuals or relatively few species during peak periods
- ☐ common occurrence of wildlife sign such as scat, tracks, nest structures, game trails, etc.
- ☐ adequate adjacent upland food sources
- ☐ interview with local biologist with knowledge of the AA

ii. Wildlife Habitat Features: Working from top to bottom, check appropriate AA attributes in matrix to arrive at rating. Structural diversity is from #13. For class cover to be considered evenly distributed, the most and least prevalent **vegetated** classes must be within 20% of each other in terms of their percent composition of the AA (see #10). Abbreviations for surface water durations are as follows: P/P = permanent/perennial; S/I = seasonal/intermittent; T/E = temporary/ephemeral; and A = absent [see manual for further definitions of these terms].

Structural Diversity (see #13)	☐ **High**								☒ **Moderate**								☐ **Low**			
Class Cover Distribution (all vegetated classes)	☐ **Even**				☐ **Uneven**				☐ **Even**				☒ **Uneven**				☐ **Even**			
Duration of Surface Water in ≥ 10% of AA	**P/P**	**S/I**	**T/E**	**A**	**P/P**	**S/I**	**T/E**	**A**	**P/P**	**S/I**	**T/E**	**A**	**P/P**	**S/I**	**T/E**	**A**	**P/P**	**S/I**	**T/E**	**A**
☐ **Low Disturbance** at AA (see #12i)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
☒ **Moderate Disturbance** at AA (see #12i)	---	---	---	---	---	---	---	---	---	---	---	---	H	---	---	---	---	---	---	---
☐ **High Disturbance** at AA (see #12i)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

iii. Rating: Use the conclusions from i and ii above and the matrix below to select the functional point and rating.

Evidence of Wildlife Use (i)	**Wildlife Habitat Features Rating (ii)**			
	☐ **Exceptional**	☒ **High**	☐ **Moderate**	☐ **Low**
☒ **Substantial**	---	.9H	---	---
☐ **Moderate**	---	---	---	---
☐ **Minimal**	---	---	---	---

Comments: A total of 77 avian speceis have been observed within the Roundup wetland.

Wetland/Site #(s): 0B4308801.06.05

14D. GENERAL FISH HABITAT ☒ **NA** (proceed to 14E)

If the AA is not used by fish, fish use is not restorable due to habitat constraints, or is not desired from a management perspective [such as fish entrapped in a canal], then check the NA box and proceed to 14E.

Assess this function if the AA is used by fish or the existing situation is "correctable" such that the AA could be used by fish [i.e., fish use is precluded by perched culvert or other barrier].

Type of Fishery: ☐ Cold Water (**CW**) ☐ Warm Water (**WW**) **Use the CW or WW guidelines in the manual to complete the matrix.**

i. Habitat Quality and Known / Suspected Fish Species in AA: Use matrix to select the functional point and rating.

Duration of Surface Water in AA	☐ **Permanent / Perennial**						☐ **Seasonal / Intermittent**						☐ **Temporary / Ephemeral**					
Aquatic Hiding / Resting / Escape Cover	☐ **Optimal**		☐ **Adequate**		☐ **Poor**		☐ **Optimal**		☐ **Adequate**		☐ **Poor**		☐ **Optimal**		☐ **Adequate**		☐ **Poor**	
Thermal Cover: optimal / suboptimal	**O**	**S**	**O**	**S**	**O**	**S**	**O**	**S**	**O**	**S**	**O**	**S**	**O**	**S**	**O**	**S**	**O**	**S**
FWP Tier I fish species	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
FWP Tier II or **Native Game** fish species	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
FWP Tier III or **Introduced Game** fish	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
FWP Non-Game Tier IV or **No** fish species	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Sources used for identifying fish spp. potentially found in AA: _____

ii. Modified Rating: NOTE: Modified score cannot exceed 1.0 or be less than 0.1.

a) Is fish use of the AA significantly reduced by a culvert, dike, or other man-made structure or activity, ***or*** *is the waterbody included on the current final MDEQ list of waterbodies in need of TMDL development with listed "Probable Impaired Uses" including cold or warm water fishery or aquatic life support,* ***or*** *do aquatic nuisance plant or animal species (see* ***Appendix E****) occur in fish habitat?* ☐ **YES**, reduce score in **i** by 0.1 = __ or ☐ **N0**

b) Does the AA contain a documented spawning area or other critical habitat feature (i.e., sanctuary pool, upwelling area; specify in comments) for native fish or introduced game fish? ☐ **YES**, add to score in **i** or **iia** 0.1 = __ or ☐ **N0**

iii. Final Score and Rating: _ **Comments:** _____

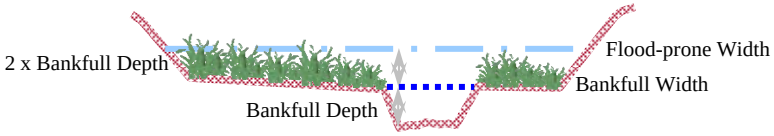
14E. FLOOD ATTENUATION ☐ **NA** (proceed to 14F)

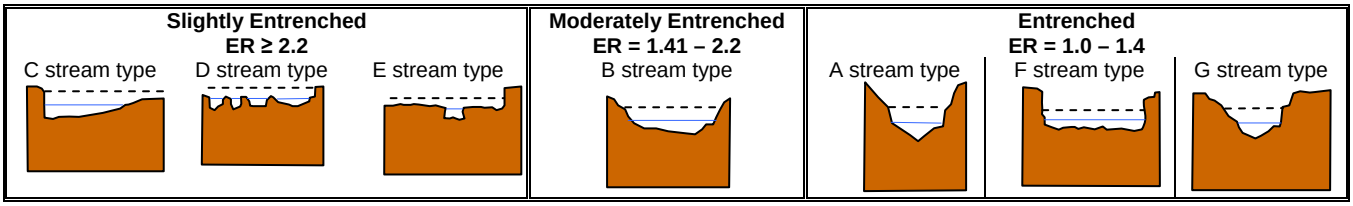
Applies only to wetlands that are subject to flooding via in-channel or overbank flow.
If wetlands in AA are not flooded from in-channel or overbank flow, check the NA box and proceed to 14F.

Entrenchment Ratio (ER) Estimation (see manual for additional guidance). Entrenchment ratio = (flood-prone width) / (bankfull width).
Flood-prone width = estimated horizontal projection of where 2 X maximum bankfull depth elevation intersects the floodplain on each side of the stream.

_____ / _____ = _____

flood prone width / bankfull width = entrenchment ratio





i. Rating: Working from top to bottom, use the matrix below to select the functional point and rating.

Estimated or Calculated Entrenchment (Rosgen 1994, 1996)	☐ Slightly Entrenched C, D, E stream types			☒ Moderately Entrenched B stream type			☐ Entrenched A, F, G stream types		
Percent of Flooded Wetland Classified as Forested and/or Scrub/Shrub	☐ 75%	☐ 25-75%	☐ <25%	☐ 75%	☐ 25-75%	☒ <25%	☐ 75%	☐ 25-75%	☐ <25%
AA contains **no outlet or restricted outlet**	---	---	---	---	---	.5M	---	---	---
AA contains **unrestricted outlet**	---	---	---	---	---	---	---	---	---

ii. Are ≥10 acres of wetland in the AA subject to flooding AND are man-made features which may be significantly damaged by floods located within 0.5 mile downstream of the AA? ☐ YES ☒ NO **Comments:** Marginal to rate for this function, but site receives stormwater flow via drainage / ditch.

Wetland/Site #(s): 0B4308801.06.05

14F. SHORT AND LONG TERM SURFACE WATER STORAGE ☐ **NA** (proceed to 14G)

Applies to wetlands that flood or pond from overbank or in-channel flow, precipitation, upland surface flow, or groundwater flow.
If no wetlands in the AA are subject to flooding or ponding, then check the NA box and proceed to 14G.

i. Rating: Working from top to bottom, use the matrix below to select the functional point and rating. Abbreviations for surface water durations are as follows: P/P = permanent/perennial; S/I = seasonal/intermittent; and T/E = temporary/ephemeral [see manual for further definitions of these terms].

Estimated Maximum Acre Feet of Water Contained in Wetlands within the AA that are Subject to Periodic Flooding or Ponding	☒ **>5 acre feet**			☐ **1.1 to 5 acre feet**			☐ **≤1 acre foot**		
Duration of Surface Water at Wetlands within the AA	☒ **P/P**	☐ **S/I**	☐ **T/E**	☐ **P/P**	☐ **S/I**	☐ **T/E**	☐ **P/P**	☐ **S/I**	☐ **T/E**
Wetlands in AA flood or pond **≥ 5 out of 10 years**	1H	---	---	---	---	---	---	---	---
Wetlands in AA flood or pond **< 5 out of 10 years**	---	---	---	---	---	---	---	---	---

Comments: The shallow open-water lagoons are flooded each year, however the interior areas between the lagoons does not, and the south lagoon floods in the spring and fall and is 50% dry in the summer. The interior areas may require a higher degree of saturation and even flooding to break the cycle of non-preferred weedy speceis colonization and trend toward upland weedy species. The .9H rating was assigned rather than the 1.0H rating to acknowledge those areas that do not flood and are progressing toward upland communites.

14G. SEDIMENT / NUTRIENT / TOXICANT / RETENTION AND REMOVAL ☐ **NA** (proceed to 14H)

Applies to wetland with potential to receive sediments, nutrients, or toxicants through influx of surface or ground water or direct input.
If no wetlands in the AA are subject to such input, check the NA box and proceed to 14H.

i. Rating: Working from top to bottom, use the matrix below to select the functional point and rating.

Sediment, Nutrient, and Toxicant Input Levels within AA	**AA receives or surrounding land use has potential to deliver sediments, nutrients, or compounds at levels such that other functions are not substantially impaired. Minor sedimentation, sources of nutrients or toxicants, or signs of eutrophication present.**				**Waterbody is on MDEQ list of waterbodies in need of TMDL development for "probable causes" related to sediment, nutrients, or toxicants or AA receives or surrounding land use has potential to deliver high levels of sediments, nutrients, or compounds such that other functions are substantially impaired. Major sedimentation, sources of nutrients or toxicants, or signs of eutrophication present.**			
% Cover of Wetland Vegetation in AA	☐ **≥ 70%**		☒ **< 70%**		☐ **≥ 70%**		☐ **< 70%**	
Evidence of Flooding / Ponding in AA	☐ **Yes**	☐ **No**	☒ **Yes**	☐ **No**	☐ **Yes**	☐ **No**	☐ **Yes**	☐ **No**
AA contains **no or restricted outlet**	---	---	.7M	---	---	---	---	---
AA contains **unrestricted outlet**	---	---	---	---	---	---	---	---

Comments: Stormwater from the city of Roundup enters the wetland site, it is one of the 2 major sources of hydrology, the other being treated water from the sewage treatment plant.

14H. SEDIMENT / SHORELINE STABILIZATION ☐ **NA** (proceed to 14I)

Applies only if AA occurs on or within the banks of a river, stream, or other natural or man-made drainage, or on the shoreline of a standing water body which is subject to wave action.
If 14H does not apply, check the NA box and proceed to 14I.

% Cover of Wetland Streambank or Shoreline by Species with Stability Ratings of ≥6 (see Appendix F).	**Duration of Surface Water Adjacent to Rooted Vegetation**		
	☒ **Permanent / Perennial**	☐ **Seasonal / Intermittent**	☐ **Temporary / Ephemeral**
☐ **≥ 65%**	---	---	---
☐ **35-64%**	---	---	---
☒ **< 35%**	.3L	---	---

Comments: Chenopodium, an anuual species, is the primary vegetation comprising the communities along the edge of shoreline.

14I. PRODUCTION EXPORT / FOOD CHAIN SUPPORT

i. Level of Biological Activity: Synthesis of wildlife and fish habitat rates (select).

General Fish Habitat Rating (14Diii)	**General Wildlife Habitat Rating (14Ciii)**		
	☒ **E/H**	☐ **M**	☐ **L**
☐ **E/H**	---	---	---
☐ **M**	---	---	---
☐ **L**	---	---	---
☒ **NA**	H	---	---

ii. Rating: Working from top to bottom, use the matrix below to select the functional point and rating. Factor A = acreage of vegetated wetland component in the AA; Factor B = level of biological activity rating from above (14Ii); Factor C = whether or not the AA contains a surface or subsurface outlet; the final three rows pertain to the duration of surface water in the AA, where P/P, S/I, and T/E were previously defined, and A = "absent" [see manual for further definitions of these terms].

A	☒ **Vegetated Component >5 acres**						☐ **Vegetated Component 1-5 acres**						☐ **Vegetated Component <1 acre**					
B	☒ **High**		☐ **Moderate**		☐ **Low**		☐ **High**		☐ **Moderate**		☐ **Low**		☐ **High**		☐ **Moderate**		☐ **Low**	
C	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
P/P	---	.7M	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S/I	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
T/E/A	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Wetland/Site #(s): 0B4308801.06.05

14I. PRODUCTION EXPORT / FOOD CHAIN SUPPORT (continued)

iii. Modified Rating: Note: Modified score cannot exceed 1.0 or be less than 0.1.

Vegetated Upland Buffer: Area with ≥ 30% plant cover, ≤ 15% noxious weed or ANVS cover, AND that is not subjected to periodic mechanical mowing or clearing (unless for weed control).
Is there an average ≥ 50-foot wide vegetated upland buffer around ≥ 75% of the AA's perimeter? ☒ **YES**, add 0.1 to score in **ii** = 0.70 ☐ **NO**

iv. Final Score and Rating: .8H **Comments:** _____

14J. GROUNDWATER DISCHARGE / RECHARGE
Check the appropriate indicators in i and ii below.

i. Discharge Indicators
- ☐ The AA is a slope wetland.
- ☐ Springs or seeps are known or observed.
- ☐ Vegetation growing during dormant season/drought.
- ☐ Wetland occurs at the toe of a natural slope.
- ☐ Seeps are present at the wetland edge.
- ☐ AA permanently flooded during drought periods.
- ☐ Wetland contains an outlet, but no inlet.
- ☐ Shallow water table and the site is saturated to the surface.
- ☐ Other: _____

ii. Recharge Indicators
- ☒ Permeable substrate present without underlying impeding layer.
- ☐ Wetland contains inlet but no outlet.
- ☐ Stream is a known 'losing' stream. Discharge volume decreases.
- ☐ Other: _____

iii. Rating: Use the information from i and ii above and the table below to select the functional point and rating.

Criteria	Duration of Saturation at AA Wetlands ***FROM GROUNDWATER DISCHARGE*** or ***WITH WATER THAT IS RECHARGING THE GROUNDWATER SYSTEM*** ☒ **P/P**	☐ **S/I**	☐ **T**	☐ **None**
☒ **Groundwater Discharge or Recharge**	1H	---	---	---
☐ **Insufficient Data/Information**	---			

Comments: MDT Biologists, Larry Urban, reported to the author (11/5/08) that water does seep out of the wetland, however he said not likely water is seeping into the site from groundwater sources.

14K. UNIQUENESS

i. Rating: Working from top to bottom, use the matrix below to select the functional point and rating.

Replacement Potential	**AA contains fen, bog, warm springs or mature (>80 yr-old) forested wetland** OR **plant association listed as "S1" by the MTNHP**			**AA does not contain previously cited rare types** AND **structural diversity (#13) is high** OR **contains plant association listed as "S2" by the MTNHP**			**AA does not contain previously cited rare types** OR **associations** AND **structural diversity (#13) is low-moderate**		
Estimated Relative Abundance (#11)	☐ Rare	☐ Common	☐ Abundant	☐ Rare	☐ Common	☐ Abundant	☐ Rare	☒ Common	☐ Abundant
☐ **Low Disturbance** at AA (#12i)	---	---	---	---	---	---	---	---	---
☒ **Moderate Disturbance** at AA (#12i)	---	---	---	---	---	---	---	.3L	---
☐ **High Disturbance** at AA (#12i)	---	---	---	---	---	---	---	---	---

Comments: _____

14L. RECREATION / EDUCATION POTENTIAL ☐ NA (proceed to Overall Summary and Rating page)
Affords 'bonus' points if AA provides a recreational or educational opportunity.

i. Is the AA a known or potential recreational or educational site? ☒ **YES**, go to ii. ☐ **NO**, check the NA box.

ii. Check categories that apply to the AA: ☒ Educational/Scientific Study ☐ Consumptive Recreational ☒ Non-consumptive recreational ☐ Other: _____

iii. Rating: Use the matrix below to select the functional point and rating.

Known or Potential Recreational or Educational Area	**Known**	**Potential**
Public ownership or public easement with general public access (no permission required)	.2H	---
Private ownership with general public access (no permission required)	---	---
Private or public ownership without general public access, or requiring permission for public access	---	---

Comments: _____

15. GENERAL SITE NOTES: The Roundup Mitigation site is a fantastic birding site with an overview vantage point on the north side and the berm on the south affords great viewing if approached slowly.

Wetland/Site #(s): 0B4308801.06.05

Function & Value Variables	Rating – Actual Functional Points	Possible Functional Points	Functional Units: Actual Points x Estimated AA Acreage	Indicate the Four Most Prominent Functions with an Asterisk
A. Listed / Proposed T&E Species Habitat	low 0.00	1.00		
B. MT Natural Heritage Program Species Habitat	low 0.20	1.00		
C. General Wildlife Habitat	high 0.90	1.00		*
D. General Fish Habitat	NA	NA		
E. Flood Attenuation	mod 0.50	1.00		
F. Short and Long Term Surface Water Storage	high 1.00	1.00		*
G. Sediment / Nutrient / Toxicant Removal	mod 0.70	1.00		*
H. Sediment / Shoreline Stabilization	low 0.30	1.00		
I. Production Export / Food Chain Support	high 0.80	1.00		*
J. Groundwater Discharge / Recharge	high 1.00	1.00		
K. Uniqueness	low 0.30	1.00		
L. Recreation / Education Potential (bonus point)	high 0.20			
Total Points	**5.9**	**10**	**123 Total Functional Units**	
Percent of Possible Score 59% (round to nearest whole number)				

Category I Wetland: (must satisfy **one** of the following criteria; otherwise go to Category II)
- ☐ Score of 1 functional point for Listed/Proposed Threatened or Endangered Species; **or**
- ☐ Score of 1 functional point for Uniqueness; **or**
- ☐ Score of 1 functional point for Flood Attenuation **and** answer to Question 14E.ii is "yes"; **or**
- ☐ Percent of possible score > 80% (round to nearest whole #).

Category II Wetland: (Criteria for Category I not satisfied **and** meets any **one** of the following criteria; otherwise go to Category IV)
- ☐ Score of 1 functional point for MT Natural Heritage Program Species Habitat; **or**
- ☒ Score of .9 or 1 functional point for General Wildlife Habitat; **or**
- ☐ Score of .9 or 1 functional point for General Fish Habitat; **or**
- ☐ "High" to "Exceptional" ratings for **both** General Wildlife Habitat **and** General Fish/Aquatic Habitat; **or**
- ☐ Score of .9 functional point for Uniqueness; **or**
- ☐ Percent of possible score > 65% (round to nearest whole #).

☐ **Category III Wetland:** (Criteria for Categories I, II, or IV not satisfied)

Category IV Wetland: (Criteria for Categories I or II are not satisfied and all of the following criteria are met; if not go to Category III)
- ☐ "Low" rating for Uniqueness; **and**
- ☐ Vegetated wetland component < 1 acre (do not include upland vegetated buffer); **and**
- ☐ Percent of possible score < 35% (round to nearest whole #).

OVERALL ANALYSIS AREA (AA) RATING: Check the appropriate category based on the criteria outlined above.

☐ **I** ☒ **II** ☐ **III** ☐ **IV**

Appendix C

2008 REPRESENTATIVE PHOTOGRAPHS

MDT Wetland Mitigation Monitoring
Roundup Wetland
Roundup, Montana

2008 ROUNDUP WETLAND MITIGATION SITE

Location: A **Description:** Wetland view
Compass Reading: N

Location: B **Description:** Wetland view
Compass Reading: S

Location: C **Description:** Wetland view
Compass Reading: E

Location: D **Description:** Wetland view
Compass Reading: W

Location: E **Description:** Wetland view
Compass Reading: S

Location: F **Description:** Wetland view
Compass Reading: E

Location: G **Description:** Transect end
Compass Reading: N

Location: H **Description:** Transect end on old dike
Compass Reading: S

Photo I Panoramic. Photo taken from Photo Point F location to illustrate the widespread presence of mustard. View South.

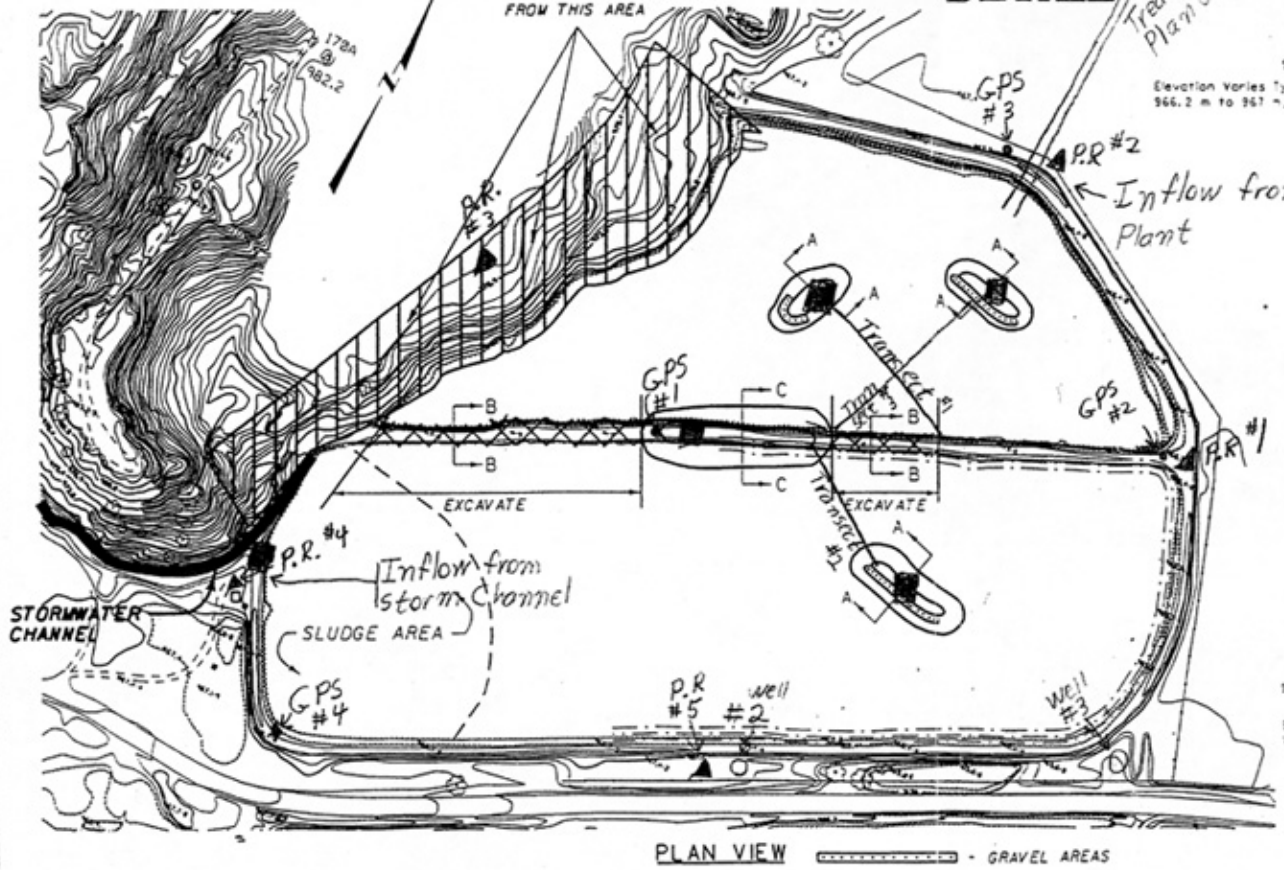
Appendix D

ROUNDUP EAST LAGOON WETLAND FINAL PLAN

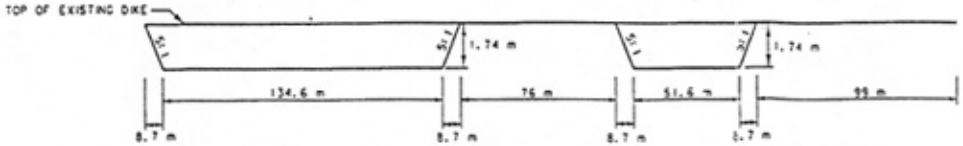
MDT Wetland Mitigation Monitoring
Roundup Wetland
Roundup, Montana

Figure 2

DETAIL

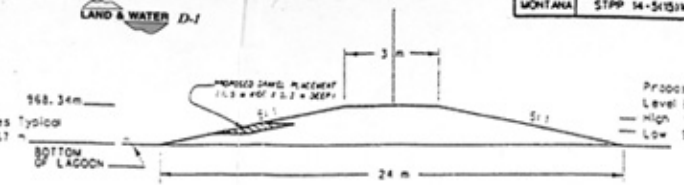


PLAN VIEW — GRAVEL AREAS



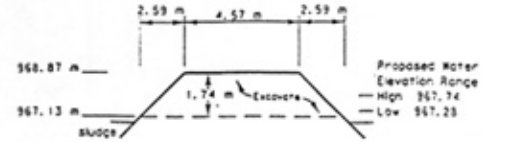
LONGITUDINAL SECTION OF EXISTING DIKE (between north & south lagoon cells)

NOT TO SCALE



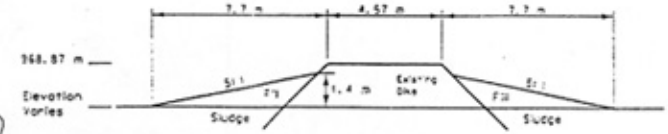
SECTION A-A (Islands)

NOT TO SCALE



SECTION B-B (Existing Dike Excavation)

NOT TO SCALE



SECTION C-C (Remaining Portion of Existing Dike)

NOT TO SCALE

▲ Photo Reference points
○ Well
• G.P.S Point
▩ Wood Duck Box

SCALE = 1:1250

ROUNDUP EAST
LAGOON WETLAND

FINAL PLAN

Appendix E

BIRD SURVEY PROTOCOL
GPS PROTOCOL

MDT Wetland Mitigation Monitoring
Roundup Wetland
Roundup, Montana

BIRD SURVEY PROTOCOL

This protocol was developed by the Montana Department of Transportation (MDT) to monitor bird use within their Wetland Mitigation Sites. Though each wetland mitigation site is vastly different, the bird survey data collection methods were standardized to order to increase repeatability. The protocol uses an "area search within a restricted time frame" to collect data on bird species, density, behavior, and habitat-type use.

Survey Area

Sites that can be entirely walked: Sites where the entire perimeter or area can be walked include, but are not limited to: small ponds, enhanced historic river channels, and wet meadows. If the wetland is not uncomfortably inundated, walk several meandering transects to sufficiently cover the wetland. Meandering transects can be used, even if a small portion of the area is inaccessible (e.g. cannot cross due to inundation). Use binoculars to identify the bird species, to count the number of individuals, and to identify their behavior and habitat type. Data can be recorded directly onto the bird survey form or into a field notebook. The number of meandering transects and their direction (or location) should be recorded in the field notebook and/or drawn onto the aerial photograph or topographic map. Meandering transects are not formal and should not be staked. Each site should be walked and surveyed to the fullest extent within the set time limit.

Sites than cannot be entirely walked: Sites where the entire perimeter or area cannot be walked include, but are not limited to: very large sites (i.e. perimeter of 2-3 miles), and large-bodied waters (i.e. reservoirs), where deep water habitat (> 6 feet) is close to shore. For large-bodied waters where only one area was graded to create or enhance the development of wetland, bird surveys should be walked along meandering transects within or around the graded area (see above.). For sites that cannot be walked, bird surveys should be conducted from many lookout posts, established at key vantage points. The general location of lookout posts should be recorded in the field notebook or drawn onto the aerial photograph or topographic map. Lookout post locations do not need to be staked. Both binoculars and spotting scopes may be used in order to accurately identify and count the birds. Depending upon the size of the open water, more time may be spent viewing the mitigation area from lookout posts than is spent traveling between posts.

Survey Time

Ideally, bird surveys should be conducted in the morning hours when bird activity is often greatest (i.e. sunrise to no later than 11:00 am). Surveys can be completed before 11am if all transects have been walked or all lookout posts have been viewed with no new bird activity observed. For some sites bird surveys may need to be performed in the late afternoon or evening due to traveling constraints or weather. The overall limiting time factor will be the number of budgeted hours for the project.

Data Recording

Bird Species List: Record each bird species observed onto the Bird Survey-Field Data Sheet (or field notebook). Record the bird's common name using the appropriate 4-letter code. The 4-letter code uses the first two letters of the first two word's of the bird's common name or if one name, the first four letters. For example, Mourning Dove is coded as MODO while Mallard is coded as MALL. If an unknown individual is observed, use the 4-letter protocol, but define your

abbreviation at the bottom of the field data sheet. For example, unknown shorebird is UNSB; unknown brown bird is UNBR; unknown warbler is UNWA; and unknown waterfowl is UNWF. For a flyover of a flock of unknown species, use a term that describes the birds' general characteristics and include the approximate flock size in parenthesis; do not fill in the habitat column. For example, a flock of black, medium-sized birds could be coded as UNBB / FO (25).

Bird Density: For each observation record the actual or estimated number of individuals observed per species and per behavior. Totals can be tallied in the office and entered onto the Bird Survey-Field Data Sheet.

Bird Behavior: Bird behavior must be identified by what is known. When a species is observed, the behavior that is immediately exhibited is recorded. Only behaviors that have discreet descriptive terms should be used. The following terms are recommended: breeding pair (BP); foraging (F); flyover (FO); loafing (L), which is defined as sleeping, roosting, or floating with head tucked under wing; and nesting (N). If other behaviors that have a specific descriptive word are observed then it can be used and should later be added to the protocol. Descriptive words or phrases such as "migrating" or "living on site" are unknown behaviors.

Bird Species Habitat Use: When a species is observed, the habitat is also recorded. The following broad habitat categories are used:

- aquatic bed (AB), defined as rooted-floating, floating-leaved, or submergent vegetation.
- marsh (MA), defined as emergent (e.g. cattail, bulrush) vegetation with surface water.
- wet meadow (WM), defined as grasses, sedges, or rushes with little to no surface water.
- scrub-shrub (SS), defined as shrub covered wetland.
- forested (FO), defined as tree covered wetland.
- open water (OW), defined as unvegetated surface water.
- upland (UP), defined as the upland buffer.

Other categories can be used and defined on the data sheet and should later be added to the protocol.

Other Fields

Bird Visit: Each bird survey (i.e. spring, fall, and mid-season) should be completed on separate Bird Survey-Field Data Sheets.

Time: Record the start time and end time on the Bird Survey-Field Data Sheet.

Date: Record the date of the bird survey.

Weather: Record the weather conditions (i.e. temperature, wind, condition).

Notes: Note if a particular individual bird is using a constructed nest box and note the condition of constructed nest box(es). Also record any comments about the site, wildlife, wetland conditions, etc.

GPS MAPPING AND AERIAL PHOTO REFERENCING PROCEDURE

From 2001 through 2006, PBS&J mapped the vegetation community boundaries, photograph points, and other sampling locations in the field using the resource-grade Trimble GEO III GPS (Global Positioning System) unit. The data were collected with a minimum of three positions per feature using Course/Acquisition code. The collected data were then transferred to a personal computer (PC) and differentially corrected to the nearest operating Community Base Station. The corrected data were then exported to ACAD drawings in Montana State Plain Coordinates NAD 83 international feet. The Trimble GEO III GPS unit was also used for some sites in 2007.

The collected and processed Trimble Geo III GPS positions had a 68% accuracy of 7 feet except in isolated areas where accuracy fell to 12 feet. This is within the 1 to 5 meter range listed as the expected accuracy of the mapping grade Trimble GPS.

In 2007 and 2008 sites were mapped using the resource-grade Magellan MobileMapper Office GPS unit. The Magellan GPS unit has a comparable accuracy level to the Trimble Geo III unit.

Each year, MDT photographs each mitigation site from the air. These aerial photographs are not geo-referenced, but serve as a visual aid to map wetland development and vegetation communities, and to show approximate locations for various monitoring activities (i.e. photograph points, transects, or macroinvertebrate sampling). Reference points that are observable on the aerial photo (i.e. road, stream channel, or fence) were also marked with the GPS unit in order to better position the aerial photograph. This positioning did not remove any of the distortion inherent to all photos. All mapped features and community boundaries were reviewed by the wetland biologist, to increase the figure's accuracy.

Any relationship of features located to easement or property lines are not to be construed from these figures. These relationships can only be determined with a survey by a licensed surveyor.

Appendix F

2008 MACROINVERTEBRATE SAMPLING PROTOCOL AND DATA

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AQUATIC INVERTEBRATE SAMPLING PROTOCOL

Equipment List

- D-frame sampling net with 1 mm mesh.
- 1-liter, wide-mouth, plastic sample jars provided by Rhithron Associates, Inc. (Quart sized, wide-mouthed canning jars can be substituted.)
- 95% ethanol (alternatively isopropyl alcohol).
- Pre-printed sample labels (printed on rite-in-the-rain paper); two labels per sample.
- Pencil.
- Clear packaging tape.
- 3-5 gallon plastic pail.
- Large tea strainer or framed screen.
- Cooler with ice for storing sample.

Site Selection

Select a site that is accessible with hip waders or rubber boots. If the substrate is too soft, place a wide board down to walk on. Choose a site that is representative of the overall condition of the wetland. Annual sampling should occur at the same site within the wetland.

Sampling Procedure

Wetland invertebrates (macroinvertebrates) inhabit the substrate, the water column, the stems and leaves of aquatic vegetation, and the water surface. At the given location, each habitat type is sampled and combined into a single 1-liter sample jar. Pre-cautions are made to minimize disturbing the sample site in order to maximize the number of animals collected.

Fill the pail with approximately 1 gallon of wetland water. Ideally, sample the water column from near-shore outward to a depth of 3 feet. Sample the water column using a long sweep of the net, keeping the net at about half the depth of the water. Sample the water surface with a long sweep of the net. Aquatic vegetation is sampled by pulling the net beneath the water surface, for at least a meter in distance. The substrate is sampled by pulling the net along the bottom, bumping it against the substrate several times as you pull. Be sure to place some muck, mud, and/or vegetation into the jar. After sampling a habitat, rinse the net in the bucket and look for insects, crustaceans, and other aquatic invertebrates. It is not necessary to sample habitats in any specific order, but all habitats, if present, are to be sampled. Habitats can be sampled more than once.

Fill about 1 cup of ethanol into the sample jar. Sieve the contents of the bucket through the straining device and pour or carefully scrape the contents of the strainer into the sample jar. Top off the jar with enough ethanol to cover all the material and leave as little headroom as possible. Alternatively, sampled materials can be lifted out of the net and put directly into the jar. Be sure to include some muck, mud, and/or vegetation into the jar. Each macroinvertebrate sampling site should have only one sampling jar.

Using pencil, complete two labels with the required information: project name, project number, date, collector's name, and habitats sampled. Do not complete the label with ink as it will dissolve in ethanol. For wetlands with at least two macroinvertebrate sampling sites, number the site consecutively followed by the total number of sites (e.g. Sample 2 of 3 sites). Place one label into the jar and seal the jar. Dry the jar off, if necessary, and tape the second label to the outside of the jar.

Photograph each macroinvertebrate sampling site.

Sample Handling/Delivery

In the field, keep sample jars cool by placing in a cooler with a small amount of ice.
Deliver samples to the PBS&J office in Missoula, where they will be inventoried and delivered to Rhithron Associates, Inc.

MDT Mitigated Wetland Monitoring Project: Aquatic Invertebrate Monitoring
Summary 2001 – 2008

Prepared for Post, Buckley, Schuh, and Jernigan (PBS&J)
Prepared by W. Bollman, Rhithron Associates, Inc.

INTRODUCTION

This report summarizes data generated from eight years of mitigated wetland monitoring from sites throughout the State of Montana. Over all years of sampling, a total of 210 invertebrate samples have been collected. Table 1 lists the currently monitored sites at which aquatic invertebrates were collected in 2008, and summarizes the sampling history of each.

METHODS

Sample processing

Aquatic invertebrate samples were collected at mitigated wetland sites in the summer months of 2001, 2002, 2003, 2004, 2005, 2006, 2007, and 2008 by personnel of PBS&J (Table 1). Sampling procedures were based on the protocols developed by the Montana Department of Environmental Quality (MDEQ) for wetland sampling. Sampling consisted of D-frame net sweeps through emergent vegetation (when present), the water column, and over the water surface, and included disturbing and scraping substrates at each sampled site. These sample components were composited and preserved in ethanol at each wetland site. Samples were delivered to Rhithron Associates, Inc. for processing, taxonomic determinations, and data analysis.

Standard sorting protocols were applied to achieve representative subsamples of a minimum of 100 organisms. Caton sub-sampling devices (Caton 1991), divided into 30 grids, each approximately 5 cm by 6 cm, were used. Grid contents were examined under stereoscopic microscopes using 10x-30x magnification. All aquatic invertebrates from each selected grid were sorted from the substrate, and placed in 95% ethanol for subsequent identification. Grid selection, examination, and sorting continued until at least 100 organisms were sorted. A large/rare search was conducted to collect any taxa not found in the subsampling procedure.

Organisms were individually examined using 10x – 80x stereoscopic dissecting scopes (Leica S8E and S6E) and identified to the lowest practical taxonomic levels using appropriate published taxonomic references. Identification, counts, life stages, and information about the condition of specimens were recorded on bench sheets. To obtain accuracy in richness measures, organisms that could not be identified to the target level specified in MDEQ protocols were designated as “not unique” if other specimens from the same group could be taken to target levels. Organisms designated as “unique” were those that could be definitively distinguished from other organisms in the sample. Identified organisms were preserved in 95% ethanol in labeled vials, and archived at the Rhithron laboratory. Midges were morphotyped using 10x – 80x stereoscopic dissecting microscopes (Leica S8E and S6E) and representative specimens were slide mounted and examined at 200x – 1000x magnification using an Olympus BX 51 compound microscope. Slide mounted organisms were also archived at the Rhithron laboratory.

Assessment

The method employed to assess these wetlands is based on an index incorporating a battery of 12 bioassessment metrics or attributes (Table 2) tested and recommended by Stribling et al. (1995) in a report to the Montana Department of Health and Environmental Science. In that study, it was determined that some of the metrics were of limited use in some geographic regions, and for some wetland types. Despite that finding, all 12 metrics are used in this evaluation of mitigated wetlands, since detailed geographic information and wetland classifications were unavailable. Scoring criteria for the 12 metrics were developed specifically for this project, since mitigated wetlands were not included in original criteria development.

Scoring criteria for wetland metrics were developed by generally following the tactic used by Stribling et al. (1995). Boxplots were generated using a statistical software package (Statistica™), and distributions, median values, ranges, and quartiles for each metric were examined. For the wetland sites, “good” scores were generally

those that fell above the 75th percentile (for those metrics that decrease in value in response to stress) or below the 25th percentile (for metrics that respond to stress by an increase in value) of all scores. Additional scoring ranges were established by bisecting the range below the 75th percentile for decreasing scores (or above the 25th percentile for increasing scores) into "sub-optimal" and "poor" assessment categories. A score of 5, 3, or 1 was assigned to good, sub-optimal, and poor metric performance, respectively. In this way, metric values were translated into normalized metric scores, and scores for all metrics were summed to produce a total bioassessment score, which is expressed as a percentage of the maximum possible score (60). Total bioassessment scores were classified according to a similar process, using the ranges and distributions of total scores for all sites studied in all years. Data from a total of 167 samples were used to develop criteria.

Six sites in this study supported aquatic fauna characteristic of lotic habitats rather than lentic wetland habitats; these sites were excluded from mitigated wetland scoring criteria development, and were evaluated with a metric battery specific to flowing water habitats. In 2008, the lotic sites were Camp Creek (2 sites), Cloud Ranch stream, Jack Creek – McKee Spring, and Jocko Spring Creek (2 sites). Invertebrate assemblages at these sites were generally characteristic of montane or foothill stream conditions and were assessed using the tested metric battery developed for montane streams of Western Montana (MVFP index: Bollman 1998).

The purpose of constructing an index from biological attributes or metrics is to provide a means of integrating information to facilitate the determination of whether management action is needed. However, the nature of the action needed is not determined solely by the index score or impairment classification, but by consideration of an analysis of the component metrics, the taxonomic composition of the assemblages, and other issues. The diagnostic functions of the metrics and taxonomic data need more study since our understanding of the interrelationships of natural environmental factors and anthropogenic disturbances is tentative. Thus, the further interpretive remarks accompanying the raw taxonomic and metric data in this summary are offered cautiously. Year-to-year comparisons depend on an assumption that specific sites were revisited in each year, and that equivalent sampling methods were utilized at each site revisit.

Bioassessment metrics – wetlands

An index based on the performance of 12 metrics was constructed, as described above. Table 2 lists those metrics, describes their calculation and the expected response of each to increased degradation or impairment of the wetland.

In addition to the summed scores of each metric and the associated impairment classification described above, each individual metric informs the bioassessment to some degree. The four richness metrics (Total taxa, POET, Chironomidae taxa, and Crustacea taxa + Mollusca taxa) can be interpreted to express habitat complexity as well as water quality. Complex, diverse habitats consist of variable substrates, emergent vegetation, variable water depths and other factors, and are potential features of long-established stable wetlands with minimal human disturbance. In the study conducted by Stribling et al. (1995), all four richness metrics were found to be significantly associated with water quality parameters including conductance, salinity, and total dissolved solids.

Four composition metrics (%Chironomidae, %Orthocladiinae of Chironomidae, %Crustacea + %Mollusca, and %Amphipoda) measure the relative contributions of certain taxonomic groups that may have significant responses to habitat and/or water quality impacts. For example, amphipods have been demonstrated to increase in abundance in alkaline conditions. Short-lived, relatively mobile taxa such as chironomids dominate ephemeral environments; many are hemoglobin-bearers capable of tolerating de-oxygenated conditions.

Two tolerance metrics (Hilsenhoff Biotic Index and %Dominant taxon) were included in the bioassessment battery. The HBI indicates the overall invertebrate assemblage tolerance to nutrient enrichment, warm water, and/or low dissolved oxygen conditions. The percent abundance of the dominant taxon has been demonstrated to be strongly associated with pH, conductance, salinity, total organic carbon, and total dissolved solids.

Two trophic measures (%Collector-gatherers and %Filterers) may be helpful in expressing functional integrity of the invertebrate assemblage, which can be impacted by poor water quality or habitat degradation. High proportions of filtering organisms suggest nutrient and/or organic enrichment, while abundant collectors suggest

more positive functional conditions and well-developed wetland morphology. These organisms graze periphyton growing on stable surfaces such as macrophytes.

Summary metric values and scores for the 2008 samples are given in Tables 4a-4c and 5. Thermal preference of invertebrate assemblages was calculated using Brandt 2001.

Bioassessment metrics – lotic habitats

For sites supporting rheophilic invertebrate assemblages, bioassessment was based on a metric battery and scoring criteria developed for montane regions of Montana (MVFP index: Bollman 1998). The six metrics constituting the bioassessment index used for MVFP sites in this study were selected because, both individually and as an integrated metric battery, they are robust at distinguishing impaired sites from relatively unimpaired sites (Bollman 1998). They have been demonstrated to be more variable with anthropogenic disturbance than with natural environmental gradients (Bollman 1998). Each of the six metrics, and their expected responses to various stressors is described below.

1. Ephemeroptera (mayfly) taxa richness. The number of mayfly taxa declines as water quality diminishes. Impairments to water quality which have been demonstrated to adversely affect the ability of mayflies to flourish include elevated water temperatures, heavy metal contamination, increased turbidity, low or high pH, elevated specific conductance and toxic chemicals. Few mayfly species are able to tolerate certain disturbances to instream habitat, such as excessive sediment deposition.

2. Plecoptera (stonefly) taxa richness. Stoneflies are particularly susceptible to impairments that affect a stream on a reach-level scale, such as loss of riparian canopy, streambank instability, channelization, and alteration of morphological features such as pool frequency and function, riffle development and sinuosity. Just as all benthic organisms, they are also susceptible to smaller scale habitat loss, such as by sediment deposition, loss of interstitial spaces between substrate particles, or unstable substrate.

3. Trichoptera (caddisfly) taxa richness. Caddisfly taxa richness has been shown to decline when sediment deposition affects habitat. In addition, the presence of certain case-building caddisflies can indicate good retention of woody debris and lack of scouring flow conditions.

4. Number of sensitive taxa. Sensitive taxa are generally the first to disappear as anthropogenic disturbances increase. The list of sensitive taxa used here includes organisms sensitive to a wide range of disturbances, including warmer water temperatures, organic or nutrient pollution, toxic pollution, sediment deposition, substrate instability and others. Unimpaired streams of western Montana typically support at least four sensitive taxa (Bollman 1998).

5. Percent filter feeders. Filter-feeding organisms are a diverse group; they capture small particles of organic matter, or organically enriched sediment material, from the water column by means of a variety of adaptations, such as silken nets or hairy appendages. In forested montane streams, filterers are expected to occur in insignificant numbers. Their abundance increases when canopy cover is lost and when water temperatures increase and the accompanying growth of filamentous algae occurs. Some filtering organisms, specifically the Arctopsychid caddisflies (*Arctopsyche* spp. and *Parapsyche* spp.) build silken nets with large mesh sizes that capture small organisms such as chironomids and early-instar mayflies. Here they are considered predators, and, in this study, their abundance does not contribute to the percent filter feeders metric.

6. Percent tolerant taxa. Tolerant taxa are ubiquitous in stream sites, but when disturbance increases, their abundance increases proportionately. The list of taxa used here includes organisms tolerant of a wide range of disturbances, including warmer water temperatures, organic or nutrient pollution, toxic pollution, sediment deposition, substrate instability and others.

Table 1. Montana Department of Transportation Mitigated Wetlands Monitoring Project sites: sampling history. Only those sites sampled in 2008 are included. An asterisk indicates lotic sites.

Site Identifier	2001	2002	2003	2004	2005	2006	2007	2008
Roundup	+	+	+	+	+	+	+	+
Hoskins Landing MS-1		+	+	+	+	+	+	+
Peterson Ranch Pond 2		+		+	+	+	+	+
Peterson Ranch Pond 4		+	+	+	+	+	+	+
Perry Ranch		+			+			+
Camp Creek MS-1*		+	+	+	+	+	+	+
Camp Creek MS-2*						+	+	+
Cloud Ranch Pond				+	+		+	+
Cloud Ranch Stream*				+			+	+
Jack Creek – Pond				+	+	+	+	+
Jack Creek – McKee*							+	+
Norem				+	+	+	+	+
Rock Creek Ranch					+	+	+	+
Wagner Marsh					+	+	+	+
Alkali Lake 1						+	+	+
West Fork of Charley Creek							+	+
Woodson Pond MI 1							+	+
Woodson Stream MI 2*							+	+
Little Muddy Creek							+	+
Selkirk Ranch							+	+
DH Ranch							+	+
Jocko Spring Creek MS-1								+
Jocko Spring Creek MS-2								+
Sportsman's Campground Site #1								+
Sportsman's Campground Site #2								+
Sportsman's Campground Site #3								+
Lonepine #1								+
Lonepine #2								+

Table 2. Aquatic invertebrate metrics employed for wetland (lentic) invertebrate assemblages in the MDT mitigated wetlands study, 2001 – 2008.

Metric	Metric Calculation	Expected response to degradation or impairment
Total taxa	Count of unique taxa identified to lowest recommended taxonomic level	Decrease
POET	Count of unique Plecoptera, Trichoptera, Ephemeroptera, and Odonata taxa identified to lowest recommended taxonomic level	Decrease
Chironomidae taxa	Count of unique midge taxa identified to lowest recommended taxonomic level	Decrease
Crustacea taxa + Mollusca taxa	Count of unique Crustacea taxa and Mollusca taxa identified to lowest recommended taxonomic level	Decrease
% Chironomidae	Percent abundance of midges in the subsample	Increase
Orthocladiinae / Chironomidae	Number of individual midges in the sub-family Orthocladiinae / total number of midges in the subsample.	Decrease
% Amphipoda	Percent abundance of amphipods in the subsample	Increase
% Crustacea + % Mollusca	Percent abundance of crustaceans in the subsample plus percent abundance of molluscs in the subsample	Increase
HBI	Relative abundance of each taxon multiplied by that taxon's modified Hilsenhoff Biotic Index (tolerance) value. These numbers are summed over all taxa in the subsample.	Increase
%Dominant taxon	Percent abundance of the most abundant taxon in the subsample	Increase
%Collector-Gatherers	Percent abundance of organisms in the collector-gatherer functional group	Decrease
%Filterers	Percent abundance of organisms in the filterer functional group	Increase

RESULTS

(Note: Individual site discussions were removed from this report by PBS&J and are included in the macroinvertebrate sections of individual monitoring reports. Summary tables for lentic (4a – 4c) and lotic (5) sites and project specific taxa listing(s) and metrics report(s) are provided on the following pages.)

Table 4a. Metric values and scores for wetland (lentic) sites in the MDT mitigated wetland study – 2008 sampling.

METRIC	Roundup	Hoskins Landing MS 1	Peterson Ranch Pond 2	Peterson Ranch Pond 4	Perry Ranch	Cloud Ranch Pond	Jack Creek Pond	Norem
Total taxa	9	18	13	25	11	27	21	14
POET	0	2	1	3	0	5	2	0
Chironomidae taxa	4	5	3	6	5	14	7	6
Crustacea + Mollusca	3	6	3	5	2	4	6	2
% Chironomidae	80.37%	17.00%	3.70%	13.21%	88.79%	49.53%	42.86%	34.69%
Orthocladiinae/Chir	0.63	0.18	1.50	0.21	0.82	0.66	0.40	0.53
% Amphipoda	0.00%	8.00%	0.00%	0.00%	0.00%	6.54%	15.24%	0.00%
% Crustacea + % Mollusca	15.89%	48.00%	86.11%	43.40%	6.54%	10.28%	30.48%	26.53%
HBI	8.01	7.62	7.85	7.40	7.37	5.94	8.17	7.61
% Dominant taxon	50.47%	27.00%	84.26%	25.47%	62.62%	13.08%	19.05%	26.53%
% Collector-Gatherers	31.78%	54.00%	87.96%	20.75%	20.56%	56.07%	65.71%	44.90%
% Filterers	2.80%	10.00%	0.00%	1.89%	0.00%	3.74%	1.90%	0.00%
Total taxa	1	3	1	5	1	5	5	1
POET	1	1	1	3	1	5	1	1
Chironomidae taxa	3	3	3	3	3	5	5	3
Crustacea + Mollusca	1	5	1	3	1	3	5	1
% Chironomidae	1	5	5	5	1	1	1	3
Orthocladiinae/Chir	5	1	5	3	5	5	3	5
% Amphipoda	5	3	5	5	5	3	3	5
% Crustacea + % Mollusca	5	3	1	3	5	5	5	5
HBI	1	1	1	3	3	5	1	1
% Dominant taxon	1	5	1	5	1	5	5	5
% Collector-Gatherers	1	3	5	1	1	3	3	1
% Filterers	3	1	3	3	3	3	3	3
Total Score	**28**	**34**	**32**	**42**	**30**	**48**	**40**	**34**
Percent of Maximum Score	**46.67%**	**56.67%**	**53.33%**	**70.00%**	**50.00%**	**80.00%**	**66.67%**	**56.67%**
Impairment Classification	**poor**	**sub-optimal**	**sub-optimal**	**good**	**poor**	**good**	**sub-optimal**	**sub-optimal**

Table 4b. Metric values and scores for wetland (lentic) sites in the MDT mitigated wetland study – 2008 sampling.

METRIC	Rock Creek Ranch	Wagner Marsh	Alkali Lake	West Fork of Charley Creek	Woodson Pond	Woodson Stream	Little Muddy Creek	Selkirk Ranch
Total taxa	23	11	10	9	13	7	14	17
POET	1	4	0	0	1	3	1	1
Chironomidae taxa	5	2	2	1	7	0	2	8
Crustacea + Mollusca	5	2	3	3	2	2	3	5
% Chironomidae	28.97%	2.83%	5.41%	0.91%	60.00%	0.00%	55.00%	23.38%
Orthocladiinae/Chir	0.97	0.00	0.00	0.00	0.52	0	0.64	0.33
% Amphipoda	0.00%	0.00%	0.00%	67.27%	0.00%	7.69%	0.00%	5.19%
% Crustacea + % Mollusca	28.97%	39.62%	32.43%	70.91%	25.45%	15.38%	17.00%	48.05%
HBI	6.91	7.45	8.57	8.19	8.14	4.62	6.97	7.76
% Dominant taxon	22.43%	48.11%	48.65%	67.27%	25.45%	30.77%	35.00%	32.47%
% Collector-Gatherers	30.84%	52.83%	21.62%	68.18%	86.36%	23.08%	29.00%	16.88%
% Filterers	1.87%	0.00%	0.00%	0.00%	0.00%	30.77%	0.00%	32.47%
Total taxa	5	1	1	1	1	1	1	3
POET	1	5	1	1	1	3	1	1
Chironomidae taxa	3	1	1	1	5	1	1	5
Crustacea + Mollusca	3	1	1	1	1	1	1	3
% Chironomidae	3	5	5	5	1	5	1	3
Orthocladiinae/Chir	5	1	1	1	5	Not Scored	5	3
% Amphipoda	5	5	5	1	5	3	5	3
% Crustacea + % Mollusca	5	3	5	1	5	5	5	3
HBI	3	3	1	1	1	5	3	1
% Dominant taxon	5	3	3	1	5	5	3	5
% Collector-Gatherers	1	3	1	3	5	1	1	1
% Filterers	3	3	3	3	3	1	3	1
Total Score	**42**	**34**	**28**	**20**	**38**	**31**	**30**	**32**
Percent of Maximum Score	**70.00%**	**56.67%**	**46.67%**	**33.33%**	**63.33%**	**56.36%**	**50.00%**	**53.33%**
Impairment Classification	**good**	**sub-optimal**	**poor**	**poor**	**sub-optimal**	**sub-optimal**	**poor**	**sub-optimal**

Table 4c. Metric values and scores for wetland (lentic) sites in the MDT mitigated wetland study – 2008 sampling.

METRIC	DH Ranch	Sportsman's Campground Site # 1	Sportsman's Campground Site # 2	Sportsman's Campground Site # 3	Lonepine # 1	Lonepine # 2
Total taxa	15	16	9	12	18	4
POET	1	1	0	0	2	0
Chironomidae taxa	6	6	3	7	12	3
Crustacea + Mollusca	2	5	3	4	1	1
% Chironomidae	52.29%	10.91%	41.18%	69.09%	81.82%	57.14%
Orthocladiinae/Chir	0.09	0.17	0.00	0.25	0.13	0.00
% Amphipoda	0.00%	24.55%	5.88%	27.27%	0.00%	0.00%
% Crustacea + % Mollusca	30.28%	83.64%	23.53%	29.09%	7.27%	42.86%
HBI	7.33	7.55	8.76	7.55	7.60	8.14
% Dominant taxon	33.03%	56.36%	29.41%	25.45%	25.45%	42.86%
% Collector-Gatherers	49.54%	20.91%	11.76%	57.27%	55.45%	28.57%
% Filterers	0.92%	63.64%	11.76%	25.45%	22.73%	42.86%
Total taxa	3	3	1	1	3	1
POET	1	1	1	1	1	1
Chironomidae taxa	3	3	3	5	5	3
Crustacea + Mollusca	1	3	1	3	1	1
% Chironomidae	1	5	3	1	1	1
Orthocladiinae/Chir	1	1	1	3	1	1
% Amphipoda	5	1	3	1	5	5
% Crustacea + % Mollusca	5	1	5	5	5	3
HBI	3	3	1	3	3	1
% Dominant taxon	5	1	5	5	5	3
% Collector-Gatherers	3	1	1	3	3	1
% Filterers	3	1	1	1	1	1
Total Score	**34**	**24**	**26**	**32**	**34**	**22**
Percent of Maximum Score	**56.67%**	**40.00%**	**43.33%**	**53.33%**	**56.67%**	**36.67%**
Impairment Classification	**sub-optimal**	**poor**	**poor**	**sub-optimal**	**sub-optimal**	**poor**

Table 5. Metric values and scores for stream (lotic) sites in the MDT mitigated wetland study – 2008 sampling.

METRIC	Camp Creek MS-1	Camp Creek MS-2	Cloud Ranch Stream	Jack Creek – McKee Spring	Jocko Spring Creek MS-1	Jocko Spring Creek MS-2
E Richness	7	5	4	1	0	1
P Richness	2	2	0	0	0	1
T Richness	4	6	5	3	2	5
Pollution Sensitive Richness	0	1	0	0	0	0
Filterer Percent	29.00%	37.00%	5.00%	40.00%	15.00%	11.00%
Pollution Tolerant Percent	5.00%	3.00%	28.00%	1.00%	62.00%	15.00%
E Richness	3	2	2	0	0	0
P Richness	2	2	0	0	0	1
T Richness	2	3	3	2	1	3
Pollution Sensitive Richness	0	1	0	0	0	0
Filterer Percent	1	0	3	0	1	1
Pollution Tolerant Percent	3	3	0	3	0	1
Total score	**11**	**11**	**8**	**5**	**2**	**6**
Percent of maximum score	**61%**	**61%**	**44%**	**28%**	**11%**	**33%**
Impairment classification	**slight**	**slight**	**moderate**	**moderate**	**severe**	**moderate**

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Caton, L. W. 1991. Improving subsampling methods for the EPA's "Rapid Bioassessment" benthic protocols. Bulletin of the North American Benthological Society, 8(3): 317-319.

Stribling, J.B., J. Lathrop-Davis, M.T. Barbour, J.S. White, and E.W. Leppo. 1995. Evaluation of environmental indicators for the wetlands of Montana: the multimetric approach using benthic macroinvertebrates. Report to the Montana Department of Health and Environmental Science, Helena, Montana.

Taxa Listing

Project ID: MDT08PBSJ
RAI No.: MDT08PBSJ016

RAI No.: MDT08PBSJ016 **Sta. Name:** MDT Roundup
Client ID:
Date Coll.: 7/7/2008 **No. Jars:** 1 **STORET ID:**

Taxonomic Name	Count	PRA	Unique	Stage	Qualifier	BI	Function
Non-Insect							
Cladocera	3	2.80%	Yes	Unknown		8	CF
Copepoda	1	0.93%	Yes	Unknown		8	CG
Ostracoda	13	12.15%	Yes	Unknown		8	CG
Heteroptera							
Corixidae							
Corixidae	1	0.93%	No	Larva		10	PH
Sigara sp.	2	1.87%	Yes	Adult		5	PH
Coleoptera							
Haliplidae							
Haliplus sp.	1	0.93%	Yes	Larva		5	PH
Chironomidae							
Chironomidae							
Chironomidae	3	2.80%	No	Pupa		10	CG
Chironomus sp.	16	14.95%	Yes	Larva		10	CG
Cricotopus (Isocladius) sp.	54	50.47%	Yes	Larva		7	SH
Dicrotendipes sp.	1	0.93%	Yes	Larva		8	CG
Glyptotendipes sp.	12	11.21%	Yes	Larva		10	SH
Sample Count	**107**						

Metrics Report

Project ID: MDT08PBSJ
RAI No.: MDT08PBSJ016
Sta. Name: MDT Roundup
Client ID:
STORET ID:
Coll. Date: 7/7/2008

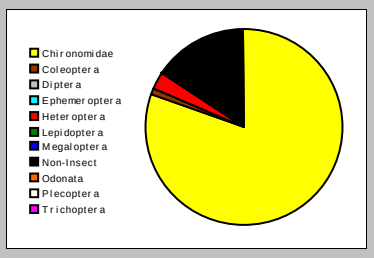
Abundance Measures

Sample Count: 107
Sample Abundance: 535.00 20.00% of sample used

Coll. Procedure:
Sample Notes:

Taxonomic Composition

Category	R	A	PRA
Non-Insect	3	17	15.89%
Odonata			
Ephemeroptera			
Plecoptera			
Heteroptera	1	3	2.80%
Megaloptera			
Trichoptera			
Lepidoptera			
Coleoptera	1	1	0.93%
Diptera			
Chironomidae	4	86	80.37%

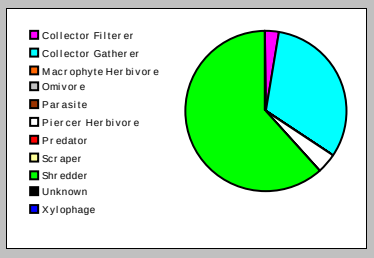


Dominant Taxa

Category	A	PRA
Cricotopus (Isocladius)	54	50.47%
Chironomus	16	14.95%
Ostracoda	13	12.15%
Glyptotendipes	12	11.21%
Cladocera	3	2.80%
Chironomidae	3	2.80%
Sigara	2	1.87%
Haliplus	1	0.93%
Dicrotendipes	1	0.93%
Corixidae	1	0.93%
Copepoda	1	0.93%

Functional Composition

Category	R	A	PRA
Predator			
Parasite			
Collector Gatherer	4	34	31.78%
Collector Filterer	1	3	2.80%
Macrophyte Herbivore			
Piercer Herbivore	2	4	3.74%
Xylophage			
Scraper			
Shredder	2	66	61.68%
Omivore			
Unknown			

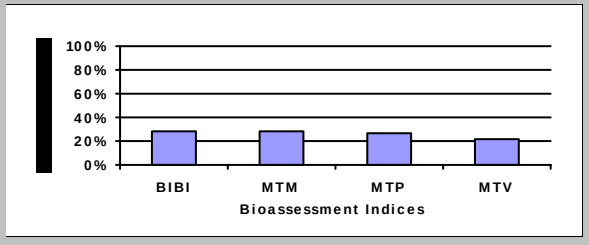


Metric Values and Scores

Metric	Value	BIBI	MTP	MTV	MTM
Composition					
Taxa Richness	9	1	0		0
Non-Insect Percent	15.89%				
E Richness	0	1		0	
P Richness	0	1		0	
T Richness	0	1		0	
EPT Richness	0		0		0
EPT Percent	0.00%		0		0
Oligochaeta+Hirudinea Percent					
Baetidae/Ephemeroptera	0.000				
Hydropsychidae/Trichoptera	0.000				
Dominance					
Dominant Taxon Percent	50.47%		1		0
Dominant Taxa (2) Percent	65.42%				
Dominant Taxa (3) Percent	77.57%	1			
Dominant Taxa (10) Percent	99.07%				
Diversity					
Shannon H (loge)	1.454				
Shannon H (log2)	2.098		1		
Margalef D	1.726				
Simpson D	0.323				
Evenness	0.132				
Function					
Predator Richness	0		0		
Predator Percent	0.00%	1			
Filterer Richness	1				
Filterer Percent	2.80%			3	
Collector Percent	34.58%		3		3
Scraper+Shredder Percent	61.68%		3		3
Scraper/Filterer	0.000				
Scraper/Scraper+Filterer	0.000				
Habit					
Burrower Richness	3				
Burrower Percent	27.10%				
Swimmer Richness	2				
Swimmer Percent	3.74%				
Clinger Richness	1	1			
Clinger Percent	50.47%				
Characteristics					
Cold Stenotherm Richness	0				
Cold Stenotherm Percent	0.00%				
Hemoglobin Bearer Richness	3				
Hemoglobin Bearer Percent	27.10%				
Air Breather Richness	0				
Air Breather Percent	0.00%				
Voltinism					
Univoltine Richness	1				
Semivoltine Richness	1	1			
Multivoltine Percent	96.26%		0		
Tolerance					
Sediment Tolerant Richness	0				
Sediment Tolerant Percent	0.00%				
Sediment Sensitive Richness	0				
Sediment Sensitive Percent	0.00%				
Metals Tolerance Index	4.000				
Pollution Sensitive Richness	0	1		0	
Pollution Tolerant Percent	16.82%	5		1	
Hilsenhoff Biotic Index	8.009		0		0
Intolerant Percent	0.00%				
Supertolerant Percent	46.73%				
CTQa	94.500				

Bioassessment Indices

BioIndex	Description	Score	Pct	Rating
BIBI	B-IBI (Karr et al.)	14	28.00%	
MTP	Montana DEQ Plains (Bukantis 1998)	8	26.67%	Moderate
MTV	Montana Revised Valleys/Foothills (Bollman 1998)	4	22.22%	Moderate
MTM	Montana DEQ Mountains (Bukantis 1998)	6	28.57%	Moderate



Appendix G

2008 ROUNDUP WASTEWATER LAGOONS/MDT WETLAND GROUNDWATER MONITORING REPORT

MDT Wetland Mitigation Monitoring
Roundup Wetland
Roundup, Montana

MONTANA DEPARTMENT OF TRANSPORTATION

2008
ROUNDUP WASTEWATER LAGOONS/MDT WETLAND GROUNDWATER MONITORING REPORT

Roundup Wetland
Roundup, Montana

Prepared for:

MONTANA DEPARTMENT OF TRANSPORTATION
2701 Prospect Ave
Helena, MT 59620-1001

Prepared by:

801 N. Last Chance Gulch, Suite 101
Helena, MT 59601

November 2008

Project No: 0B4308801.06.05

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1.0 INTRODUCTION

This report summarizes the methods and results of groundwater monitoring conducted at the Montana Department of Transportation's (MDT) Roundup mitigation site in October 2008. The Roundup wetland site was created to provide wetland mitigation credits for MDT's reconstruction of U.S. Highway 12 in Watershed #10 located in District 5, Billings District. The site is located in Musselshell County, Montana, Section 18, Township 8 North, Range 26 East, immediately south of U.S. Highway 12 and approximately one mile east of the town of Roundup. The mitigation site is located at the site of the former wastewater lagoons for the city of Roundup.

There are five groundwater monitoring wells in the vicinity of the Roundup wetland **(Figure 1)**. The 4-inch diameter PVC monitoring wells were installed in March 1998, and have previously been sampled in April 1998, November 2005, and in October of 2006 and 2007. The wells are stick-up wells, with approximately 2 feet of casing above the ground surface. The wells were installed south of the wastewater lagoons and north of the Musselshell River. One well (Well #1) is located upstream (west) of the lagoons; two wells (Well #2 and #3) are located adjacent to the lagoons; and two wells (Well #4 and #5) are located downstream (east) of the lagoons.

Water samples were collected from each monitoring well on October 17, 2008. Samples were analyzed for nutrient parameters including total phosphorus, total Kjeldahl nitrogen, nitrate+nitrite nitrogen, and total ammonia. Field measurements were also recorded for groundwater elevation, temperature, dissolved oxygen, specific conductance, and pH. Additionally, concentrations of ferrous iron and hydrogen sulfide were estimated on site using field test kits.

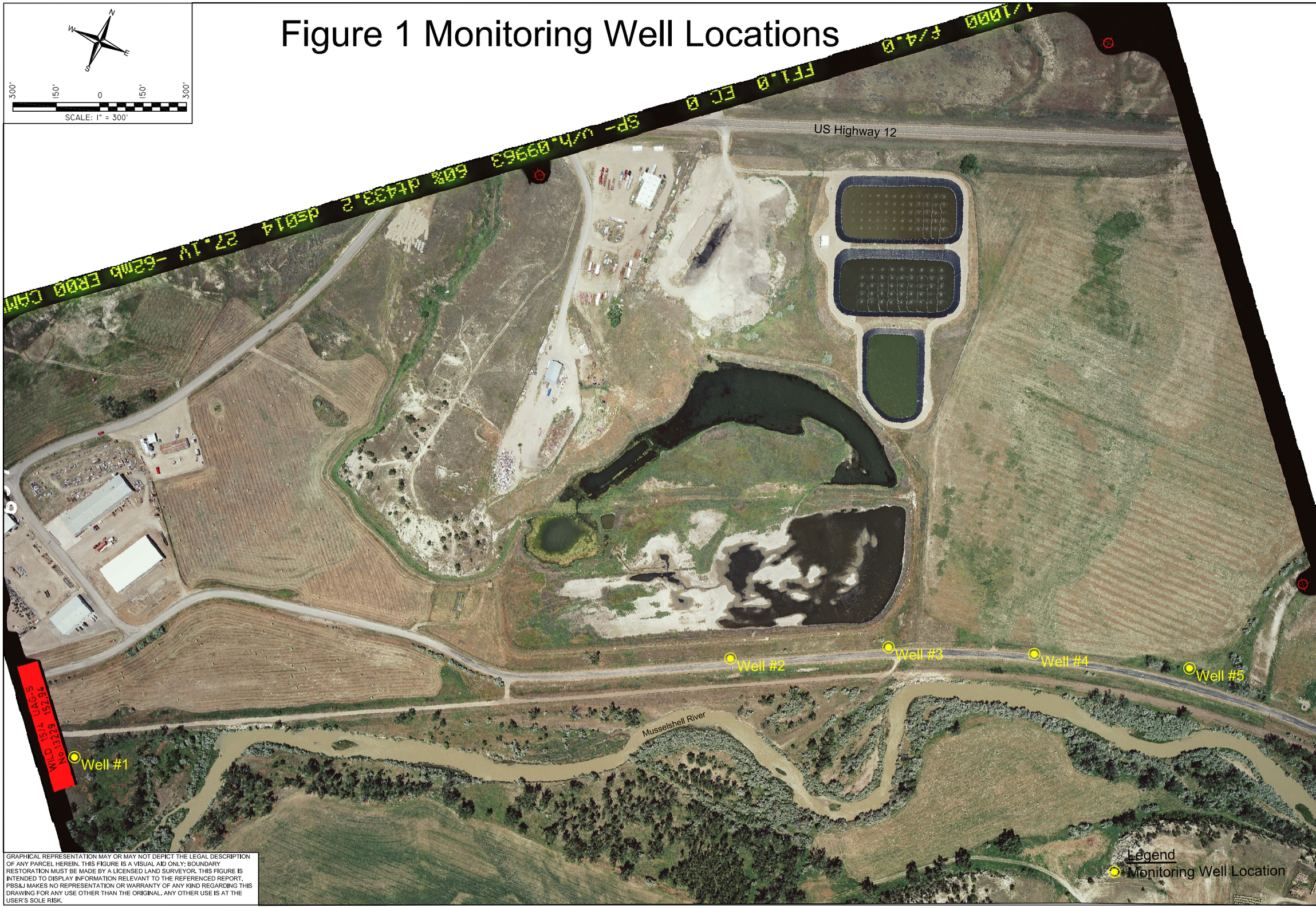
2.0 METHODS

Static water measurements were collected from each well prior to sampling. Depth to water was measured with an electric static water tape from the top of the PVC casing, and corresponding groundwater elevations were calculated by subtracting depth to water from the known PVC casing elevation.

Dissolved oxygen (DO) concentrations were measured in each well before sampling using an Oxy-Guard® dissolved oxygen meter which was calibrated to site elevation prior to use. Dissolved oxygen concentrations were measured near the middle of the water column within the screened interval in each well.

All five site-related monitoring wells were sampled using decontaminated battery operated low-flow submersible pumps and new disposable vinyl tubing. The pumps were powered with a vehicle battery, and were set within the screened interval. The pumps were set to purge at a rate of approximately one gallon per minute. A minimum of three well volumes were purged from each well before sample collection.

Figure 1 Monitoring Well Locations



GRAPHICAL REPRESENTATION MAY OR MAY NOT DEPICT THE LEGAL DESCRIPTION OF ANY PARCEL HEREIN. THIS FIGURE IS A VISUAL AID ONLY; BOUNDARY RESTORATION MUST BE MADE BY A LICENSED LAND SURVEYOR. THIS FIGURE IS INTENDED TO DISPLAY INFORMATION RELEVANT TO THE REFERENCED REPORT. PBS&J MAKES NO REPRESENTATION OR WARRANTY OF ANY KIND REGARDING THIS DRAWING FOR ANY USE OTHER THAN THE ORIGINAL. ANY OTHER USE IS AT THE USER'S SOLE RISK.

PROJECT NAME
MDT ROUNDUP LAGOON WETLAND MITIGATION

DRAWING TITLE
MONITORING WELL LOCATIONS

PROJ NO:	0B4308801 06.05
LOCATION:	ROUNDUP, MT
SCALE:	NOTED
FILE NAME:	BASE2008.dwg
DRAWN:	JR
PROJ MGR:	J. BERGLUND
CHECKED:	LB
APPV'D:	JB
PLOTTED:	Nov/19/2008

3810 Valley Commons Drive
Suite 4
Bozeman, MT 59718

FIGURE
1
REV -
11/05/2008

Field parameters, including water temperature, conductivity and pH, were monitored at five to ten minute intervals while purging each well. Field parameters were measured using a WTW® water quality multi-meter, which was calibrated in the field prior to use.

Concentrations of ferrous iron (Fe) were estimated in the field using a Hach® colorimeter, which was calibrated in the field prior to use. Additionally, concentrations of hydrogen sulfide (H_2S) were estimated in the field using a Hach® Model HS-C field test kit.

After purging a minimum of three well volumes, water samples were collected from each well in 500 milliliter polyethylene bottles. The sample bottles were rinsed twice with well water before collection, and were preserved with H_2SO_4. Samples were stored on ice and were delivered to Energy Laboratories in Billings, MT approximately five hours after collection. Samples were analyzed for nutrient parameters including total phosphorus, total Kjeldahl nitrogen, nitrate+nitrite nitrogen, and total ammonia. Total nitrogen was calculated by summing the concentrations of total Kjeldahl nitrogen and nitrate+nitrite nitrogen. The analytical methods and detection limits specified by Energy Laboratories are provided below in **Table 1**.

Table 1: ***Analytical methods and detection limits.***

Nutrient Parameter	Analytical Method	Detection Limit
Total Phosphorus (TP)	EPA 365.1	0.01 mg/L
Total Kjeldahl Nitrogen (TKN)	EPA 351.2	0.5 mg/L
Nitrate+Nitrite Nitrogen (NO_2+NO_3)	EPA 353.2	0.05 mg/L
Total Ammonia Nitrogen (NH_4)	EPA 350.1	0.1 mg/L

3.0 GROUNDWATER MONITORING RESULTS

Groundwater monitoring results, including groundwater elevations, field parameter results, and nutrient parameter results are presented and summarized below in **Sections 3.1, 3.2** and **3.3**.

3.1 Groundwater Elevation Results

Groundwater elevations ranged from 3164.19 to 3170.16 feet during the 2008 sampling event (**Table 2**). Groundwater elevations were similar to those measured during events prior to the 2007 event, where groundwater levels were found to be lower than during any previous sampling event.

The groundwater elevations indicate that groundwater flows in an easterly direction in the vicinity of the wastewater lagoons. Groundwater flow directions are roughly parallel with the Musselshell River, which also flows in an easterly direction.

Table 2: ***Groundwater elevations.***

Well ID	Well Depth (ft)	Screened Interval (ft)	PVC Casing Elevation (ft)	Date	Depth to Water (ft)	Groundwater Elevation (ft)
1	22.0	17.0-22.0	3182.81	04/09/98	12.47	3170.34
				04/28/98	12.63	3170.18
				11/01/05	12.84	3169.97
				10/24/06	12.88	3169.93
				10/11/07	13.18	3169.63
				10/17/08	12.65	3170.16
2	16.0	10.5-15.5	3174.61	04/09/98	6.17	3168.44
				04/28/98	6.42	3168.19
				11/01/05	6.58	3168.03
				10/24/06	6.22	3168.39
				10/11/07	6.81	3167.80
				10/17/08	5.99	3168.62
3	16.0	11.0-16.0	3174.25	04/09/98	7.75	3166.50
				04/28/98	7.85	3166.40
				11/01/05	8.18	3166.07
				10/24/06	7.82	3166.79
				10/11/07	8.40	3165.85
				10/17/08	7.90	3166.35
4	16.2	11.2-16.2	3174.56	04/09/98	9.54	3165.02
				04/28/98	9.61	3164.95
				11/01/05	9.83	3164.73
				10/24/06	9.83	3165.02
				10/11/07	10.26	3164.30
				10/17/08	9.80	3164.76
5	16.0	11.0-16.0	3169.82	04/09/98	5.36	3164.46
				04/28/98	5.45	3164.37
				11/01/05	5.71	3164.11
				10/24/06	5.66	3164.16
				10/11/07	6.09	3163.73
				10/17/08	5.66	3164.16

3.2 Field Parameter Results

Field measurements of dissolved oxygen, water temperature, conductivity, pH, ferrous iron, and hydrogen sulfide are presented below in **Table 3**. Dissolved oxygen concentrations were recorded in-situ prior to sampling, while the remaining field parameters were recorded during or after purging at least three well volumes from each well. Groundwater sampling and monitoring forms are included in **Appendix A**.

Electrical conductivity measurements showed a sizeable increase in all wells. Overall, the greatest increase from the 2007 event appeared in Well #5 with an increase from 5,890 us/cm to 6,300 us/cm in 2008. The average measured conductivity increase across all five wells from 2007 data was 290 us/cm. Conversely, potential of hydrogen (pH) values dropped across the 2008 data set, with an average decrease of 0.15.

Post-purge water temperatures were found to be slightly lower at all locations during the 2008 sampling event than in 2007. Dissolved oxygen concentrations varied little during the October 2008 sampling event from 2007, with the exception of well #1, which increased from 1.1 mg/L to 7.2 mg/L.

In general, concentrations of hydrogen sulfide exhibited little change when compared to previous results. Ferrous iron concentrations, however, were observed to decrease significantly from 2007 results. Water from wells #2, #3 and #4 continued to exhibit a yellow tint and/or moderate to strong sulfur odor and, consequently, yielded the higher concentrations of ferrous iron.

Table 3: ***Field parameter results.***

Well #	Date	Dissolved Oxygen (mg/L)	Water Temp. (oC)	Conductivity (us/cm)	pH	Ferrous Iron (mg/L)	Hydrogen Sulfide (mg/L)
1	04/09/98	NM	11.5	6200	7.1	~0.1	<0.1
	11/01/05	0.5	11.6	3300	8.2	~0.0	~0.1
	10/24/06	3.0	11.1	4500	7.3	~0.0	<0.1
	10/11/07	1.1	12.7	5040	7.45	~0.0	<0.1
	10/17/08	7.2	11.9	5300	7.06	~0.0	<0.1
2	04/09/98	NM	11.0	6260	7.6	~3-4	<0.1
	11/01/05	0.2	12.9	4890	7.8	~4.6	~0.3
	10/24/06	0.3	11.9	7260	7.4	~5.1	~0.2
	10/11/07	0.6	13.3	7160	7.48	>5.10	~0.1
	10/17/08	0.3	12.7	7370	7.37	~1.29	<0.1
3	04/09/98	NM	11.0	6040	7.6	~3-4	<0.1
	11/01/05	0.3	11.2	4770	7.9	~4.5	~0.1
	10/24/06	0.2	10.5	7350	7.8	~4.2	~0.1
	10/11/07	0.7	11.9	6260	7.56	~4.99	~0.1
	10/17/08	0.2	11.5	6510	7.42	~0.62	~0.1
4	04/09/98	NM	9.0	6040	7.4	~7-8	<0.1
	11/01/05	0.5	12.3	5000	7.8	~4.1	~0.1
	10/24/06	0.1	11.6	5430	7.3	~5.1	~0.1
	10/11/07	0.7	12.9	6100	7.28	>5.10	<0.1
	10/17/08	0.1	12.2	6420	7.27	~1.89	<0.1
5	04/09/98	NM	9.0	6470	7.3	(note)	<0.1
	11/01/05	1.5	13.1	4450	7.7	~0.3	~0.5
	10/24/06	0.6	12.3	6190	7.2	~0.1	~0.1
	10/11/07	0.5	13.6	5890	7.25	~0.0	<0.1
	10/17/08	0.4	12.8	6300	7.14	~0.02	<0.1

> = Ferrous iron present in levels above equipment reporting limits
NM = not measured
Note – Fe was not detected in field, but water turned orange when bleach was added (Morrison-Maierle, April 1998)

3.1 Nutrient Parameter Results

Water samples from each well were analyzed for nutrient parameters including total phosphorus, total Kjeldahl nitrogen, nitrate + nitrite nitrogen, and total ammonia nitrogen during the 2008 sampling event. Total nitrogen was subsequently calculated by summing the concentrations of total Kjeldahl and nitrate + nitrite nitrogen. The analytical results,

including those from the 1998, 2005, 2006, and 2007 sampling events, are presented below in **Table 4**. The laboratory analytical summary report is included in **Appendix B**.

Total phosphorus (TP) concentrations decreased slightly from 2007 data in all wells during the 2008 sampling event. TP concentrations in Well #3 exhibited the greatest change from 2007, with a decrease from 1.32 mg/L to 1.15 mg/L. Concentrations of total Kjeldahl nitrogen (TKN) showed a slight decrease from previous sampling results at all locations in 2008. The largest change from 2007 occurred in Well #3 with a 3.9 mg/L decrease.

Concentrations of nitrate + nitrite nitrogen (NO_2+NO_3) continued to be reported below the analytical detection limit at all sites except for Well #1. Along with other analytes, NO_2+NO_3 concentrations decreased slightly in Well #1 from 16.1 mg/L in 2007 to 15.6 mg/L. Ammonia nitrogen (NH_4) concentrations decreased slightly from 2007 data in Well #2, 3, 4, and 5 while Well #1 remained below the analyte reporting limit of 0.1 mg/L.

Consequently, concentrations of total nitrogen (TN) were reported to decrease slightly at all locations during the 2008 sampling event.

Table 4: ***Nutrient parameter results.***

Well ID	Date	Total Phosphorus (mg/L)	Total Kjeldahl Nitrogen (mg/L)	Nitrate + Nitrite (mg/L)	Ammonia (mg/L)	Total Nitrogen (mg/L)
1	04/09/98	0.01	<0.5	24.4	<0.1	24.4
	11/01/05	0.02	<0.5	14.0	<0.1	14.0
	10/24/06	0.03	<0.5	12.4	<0.1	12.4
	10/11/07	0.01	<0.5	16.1	<0.1	16.1
	10/17/08	<0.01	<0.5	15.6	<0.1	15.6
2	04/09/98	1.71	15.5	<0.05	15.0	15.5
	11/01/05	4.92	25.7	<0.05	18.5	25.7
	10/24/06	1.43	20.6	<0.05	18.8	20.6
	10/11/07	2.09	20.4	<0.05	19.0	20.4
	10/17/08	1.51	18.0	<0.05	17.0	18.0
3	04/09/98	0.29	15.8	<0.05	15.7	15.8
	11/01/05	2.36	25.0	<0.05	19.4	25.0
	10/24/06	3.84	15.9	0.94	14.3	16.8
	10/11/07	1.32	21.9	<0.05	18.1	21.9
	10/17/08	1.15	18.0	<0.05	16.6	18.0
4	04/09/98	0.02	8.9	<0.05	5.7	8.9
	11/01/05	0.13	16.9	<0.05	13.2	16.9
	10/24/06	0.14	14.9	<0.05	12.8	14.9
	10/11/07	0.21	13.9	<0.05	12.6	13.9
	10/17/08	0.20	13.0	<0.05	12.0	13.0
5	04/09/98	0.01	3.5	0.28	1.8	3.8
	11/01/05	0.30	7.5	<0.05	4.5	7.5
	10/24/06	0.02	4.1	<0.05	3.5	4.1
	10/11/07	0.02	4.8	<0.05	2.8	4.8
	10/17/08	0.01	4.3	<0.05	2.6	4.3

4.0 CONCLUSIONS

Groundwater elevations were found to be slightly higher than those measured during the 2007 sampling event in all five wells, indicating a return to similar levels found during prior sampling events. Field parameters also varied in 2008 from previous sample years. Field measurements of water temperature and pH both decreased slightly while electrical conductivity values increased notably among all sampling locations in 2008. Dissolved oxygen levels decreased little from previous years with the exception of Well #1, which jumped 6.1 mg/L from 2007. Ferrous iron concentrations in 2008 decreased sharply from 2007 levels in the three wells that exhibited significant values in that year.

Nutrient concentrations were reported at decreased concentrations in all wells when compared to 2007 results. As was the case in all other sampling years, the concentration of nitrate + nitrite nitrogen in Well #1 exceeded the human health standard of 10 mg/L for groundwater during 2008 (Montana DEQ 2008), with a concentration of 15.6 mg/L. Nitrate + nitrite nitrogen concentrations were reported below the laboratory detection limits in all other wells during the 2008 sampling event.

Analytical results suggest that the lagoons may be a source of nutrients in the vicinity of the wastewater lagoons. However, laboratory analytical results from the 2008 event indicate slight decreases in concentrations from 2007 sampling data throughout all sample locations.

Well caps and locks were installed on all monitoring wells; however, seals on the well caps were found to be worn and could be removed simply by pulling lightly on the well cap. To prevent future introduced contamination or tampering, it is recommended that the well caps be replaced with new tight fitting locking seals or locking steel covers be welded to each stickup casing as soon as possible.

Based on the conclusions in this report, MDT is planning to conduct annual groundwater monitoring and sampling for one additional year, which is planned for 2009. Following the 2009 sampling event, MDT will evaluate the groundwater data and present a recommendation to DEQ on continuing (or discontinuing) groundwater monitoring and sampling at this site.

5.0 REFERENCES

Montana DEQ. February 2008. *Circular DEQ-7 – Montana Numeric Water Quality Standards.* Montana Department of Environmental Quality. Helena, MT.

Olympus Technical Services, Inc. 2005. *Groundwater Monitoring Report - Former Roundup Wastewater Lagoons/MDT Wetland*. Prepared for Montana Department of Transportation. Billings, MT.

PBS&J. 2007. *Roundup Wastewater Lagoons/MDT Wetland Groundwater Monitoring Report 2007.* Prepared for Montana Department of Transportation. Helena, Mt.

Appendix A

GROUNDWATER SAMPLING AND MONITORING FORMS

ROUNDUP WASTEWATER LAGOONS/MDT WETLAND
GROUNDWATER MONITORING REPORT 2008

PBS&J

GROUNDWATER SAMPLING & MONITORING FORM

ver. 9/24/07 S. Jarsky

Project:	Roundup/MDT Wetlands GWM *Roundup, Montana*	**Project #**	0B4308801
Date:	October 16, 2008	**Time:**	1130
Personnel:	S. Jarsky	**Form#**	---
Sample Location:	Well #1	**F.B. #**	---
Aquifer Type:	Unconfined	**Well Type:**	monitoring
Total Depth:	22.8 *feet*	**SWL:**	12.65 *feet*
Measuring Point Description:	top PVC, black mark north		
Casing Type:	PVC	**Well Ø:**	4"

Well Log: ☑ Yes ☐ No **Well Locked:** ☑ Yes ☐ No **Mount Type:** ☐ Flush ☑ Stickup:

Purge & Sampling Equipment

Instrument	Calibration	Operational Notes:
LoFlo 12v Pump	N/A	Set at 20 feet
WTW Multimeter (pH/eH/Cond/TDS)	16-Oct-08	
In-Situ DO meter	16-Oct-08	Calibrated to 88% saturation (elev: 3300')
Hach HS-C field colorimeter	16-Oct-08	

Standard Operating Procedures

Number	Description
3401, 3402	Corning Checkmate 90: pH, Eh, Conductivity, TDS
4203	Well Static H2O Level Measurement w/ Solinst Well Probe
5201	Monitoring Well Purging & Sampling
5211	Major Minerals (INORGANICS) Sampling
5212	Volatile Organic Analysis (VOA) Sampling
6210	Groundwater Equipment Decontamination
8210	Sample Packaging & Shipping for Groundwater Samples
8300 8400 8500	Field QA/QC, Sample Custody, Sample ID and Analytical Results

Well Evaucation & Monitoring Data

Time	Temp (deg C)	pH	Eh (mV)	Conductivity (uS)	Q (gpm)	Elapsed (gallons)
1155	–	–	–	–	–	–
1205	12.9	7.21		5260	1	10
1215	12.2	7.06		5290	1	20
1220	11.9	7.18		5300	1	25
1225	11.9	7.06		5300	1	30

Bore Volume Calculation: $(\pi\phi^2/4)\cdot(TD-SWL)\cdot(7.48\ gal/ft^3)$ = 6.6 gal (2" casing calc = .163)

Water Description: clear no odor

Sampling Data

Bottle Label	Sampling Parameter	Preservative	Sample Time	Other
B43088-1	TP, TKN, Nox, NH4	H2SO4	1225	500 ml plastic

Samples analyzed by:	**Energy Laboratories** **Billings, MT**

Comments:

Dissolved Oxygen @ 18 ' = 7.2 ppm

Fe = Ø

H2S = Ø

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GROUNDWATER SAMPLING & MONITORING FORM

ver. 9/24/07 S. Jarsky

Project:	Roundup/MDT Wetlands GWM *Roundup, Montana*	**Project #**	0B4308801
Date:	October 16, 17, 2008	**Time:**	1350
Personnel:	S. Jarsky	**Form#**	---
Sample Location:	Well #2	**F.B. #**	---
Aquifer Type:	Unconfined	**Well Type:**	monitoring
Total Depth:	16 *feet*	**SWL:**	5.99 *feet*
Measuring Point Description:	top PVC, black mark north		
Casing Type:	PVC	**Well ϕ**	4"

Well Log: ☑ Yes ☐ No **Well Locked:** ☑ Yes ☐ No **Mount Type:** ☐ Flush ☑ Stickup:

Purge & Sampling Equipment

Instrument	Calibration	Operational Notes:
Peristaltic Pump	N/A	Set at 10 feet
WTW Multimeter (pH/eH/Cond/TDS)	16-Oct-08	
In-Situ DO meter	16-Oct-08	Calibrated to 88% saturation (elev: 3300')
Hach HS-C field colorimeter	16-Oct-08	

Standard Operating Procedures

Number	Description
3401, 3402	Corning Checkmate 90: pH, Eh, Conductivity, TDS
4203	Well Static H2O Level Measurement w/ Solinst Well Probe
5201	Monitoring Well Purging & Sampling
5211	Major Minerals (INORGANICS) Sampling
5212	Volatile Organic Analysis (VOA) Sampling
6210	Groundwater Equipment Decontamination
8210	Sample Packaging & Shipping for Groundwater Samples
8300 8400 8500	Field QA/QC, Sample Custody, Sample ID and Analytical Results

Well Evaucation & Monitoring Data

Time	Temp (deg C)	pH	Eh (mV)	Conductivity (uS)	Q (gpm)	Elapsed (gallons)
1357	—	—		—	—	—
1402	13.0	7.35		7370	1	10
1412	13.0	7.37		7346	1	20
1417	12.7	7.37		7370	1	25

Bore Volume Calculation: $(\pi\phi^2/4)\cdot(TD-SWL)\cdot(7.48\ gal/ft^3)$ = 6.5 gal (2" casing calc = .163)

Water Description: yellow tint, strong sewage/sulfur odor

Sampling Data

Bottle Label	Sampling Parameter	Preservative	Sample Time	Other
B43088-2	TP, TKN, Nox, NH4	H2SO4	1420	500 ml plastic

Samples analyzed by:	**Energy Laboratories** **Billings, MT**

Comments:

Dissolved Oxygen @ 10 ' = 0.3 ppm

Fe = 1.29

H2S = Ø

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GROUNDWATER SAMPLING & MONITORING FORM

ver. 9/24/07 S. Jarsky

Project: Roundup/MDT Wetlands GWM — *Roundup, Montana*

Project #: 0B4308801

Date: October 17, 2008

Time: 1245

Personnel: S. Jarsky

Form#: ---

Sample Location: Well #3

F.B. #: ---

Aquifer Type: Unconfined

Well Type: monitoring

Total Depth: 16 *feet*

SWL: 7.90 *feet*

Measuring Point Description: top PVC, black mark north

Casing Type: PVC

Well ϕ: 4"

Well Log: ☑ Yes ☐ No

Well Locked: ☑ Yes ☐ No

Mount Type: ☐ Flush ☑ Stickup:

Purge & Sampling Equipment

Instrument	Calibration	Operational Notes:
Peristaltic Pump	N/A	Set at 12 feet
WTW Multimeter (pH/eH/Cond/TDS)	17-Oct-08	
In-Situ DO meter	17-Oct-08	Calibrated to 88% saturation (elev: 3300')
Hach HS-C field colorimeter	17-Oct-08	

Standard Operating Procedures

Number	Description
3401, 3402	Corning Checkmate 90: pH, Eh, Conductivity, TDS
4203	Well Static H2O Level Measurement w/ Solinst Well Probe
5201	Monitoring Well Purging & Sampling
5211	Major Minerals (INORGANICS) Sampling
5212	Volatile Organic Analysis (VOA) Sampling
6210	Groundwater Equipment Decontamination
8210	Sample Packaging & Shipping for Groundwater Samples
8300 8400 8500	Field QA/QC, Sample Custody, Sample ID and Analytical Results

Well Evaucation & Monitoring Data

Time	Temp (deg C)	pH	Eh (mV)	Conductivity (uS)	Q (gpm)	Elapsed (gallons)
1304	–	–		–	–	–
1314	12.0	7.31		6530	1	10
1324	11.6	7.40		6540	1	20
1329	11.5	7.42		6510	1	25

Bore Volume Calculation: $(\pi\phi^2/4)\cdot(TD-SWL)\cdot(7.48\ gal/ft^3)$ = 5.3 gal (2" casing calc = .163)

Water Description: clear, sulfur odor

Sampling Data

Bottle Label	Sampling Parameter	Preservative	Sample Time	Other
B43088-3	TP, TKN, Nox, NH4	H2SO4	1330	500 ml plastic

Samples analyzed by:	Energy Laboratories Billings, MT

Comments:

Dissolved Oxygen @ 12 ' = 0.2 ppm

Fe = 0.62

H2S = 0.1

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GROUNDWATER SAMPLING & MONITORING FORM

ver. 9/24/07 S. Jarsky

Project: Roundup/MDT Wetlands GWM — *Roundup, Montana*

Project #: 0B4308801

Date: October 17, 2008

Time: 1430

Personnel: S. Jarsky

Form#: ---

Sample Location: Well #4

F.B. #: ---

Aquifer Type: Unconfined

Well Type: monitoring

Total Depth: 16 *feet*

SWL: 9.80 *feet*

Measuring Point Description: top PVC, black mark north

Casing Type: PVC

Well ϕ: 4"

Well Log: ☑ Yes ☐ No

Well Locked: ☑ Yes ☐ No

Mount Type: ☐ Flush ☑ Stickup:

Purge & Sampling Equipment

Instrument	Calibration	Operational Notes:
Peristaltic Pump	N/A	Set at 12 feet
WTW Multimeter (pH/eH/Cond/TDS)	17 16-Oct-08	
In-Situ DO meter	17 16-Oct-08	Calibrated to 88% saturation (elev: 3300')
Hach HS-C field colorimeter	17 16-Oct-08	

Standard Operating Procedures

Number	Description
3401, 3402	Corning Checkmate 90: pH, Eh, Conductivity, TDS
4203	Well Static H2O Level Measurement w/ Solinst Well Probe
5201	Monitoring Well Purging & Sampling
5211	Major Minerals (INORGANICS) Sampling
5212	Volatile Organic Analysis (VOA) Sampling
6210	Groundwater Equipment Decontamination
8210	Sample Packaging & Shipping for Groundwater Samples
8300 8400 8500	Field QA/QC, Sample Custody, Sample ID and Analytical Results

Well Evaucation & Monitoring Data

Time	Temp (deg C)	pH	Eh (mV)	Conductivity (uS)	Q (gpm)	Elapsed (gallons)
1430	—	—		—	—	—
1440	13.0	7.28		6420	1	10
1450	12.4	7.26		6460	1	20
1455	12.2	7.27		6470	1	25

Bore Volume Calculation: $(\pi\phi^2/4)\cdot(TD-SWL)\cdot(7.48\ gal/ft^3)$ = 4 gal (2" casing calc = .163)

Water Description: clear, moderate odor

Sampling Data

Bottle Label	Sampling Parameter	Preservative	Sample Time	Other
B43088-4	TP, TKN, Nox, NH4	H2SO4	1500	500 ml plastic

Samples analyzed by: Energy Laboratories, Billings, MT

Comments:

Dissolved Oxygen @ 12 ' = 0.1 ppm

Fe = 1.89

H2S = Ø

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GROUNDWATER SAMPLING & MONITORING FORM

ver. 9/24/07 S. Jarsky

Project:	Roundup/MDT Wetlands GWM *Roundup, Montana*	**Project #**	0B4308801
Date:	October 17, 2008	**Time:**	1510
Personnel:	S. Jarsky	**Form#**	---
Sample Location:	Well #5	**F.B. #**	---
Aquifer Type:	Unconfined	**Well Type:**	monitoring
Total Depth:	16 *feet*	**SWL:**	5.66 *feet*
Measuring Point Description:	top PVC, black mark north		
Casing Type:	PVC	**Well ϕ**	4"

Well Log: ☑ Yes ☐ No **Well Locked:** ☑ Yes ☐ No **Mount Type:** ☐ Flush ☑ Stickup:

Purge & Sampling Equipment

Instrument	Calibration	Operational Notes:
Peristaltic Pump	N/A	Set at 10 feet
WTW Multimeter (pH/eH/Cond/TDS)	16-Oct-08	
In-Situ DO meter	16-Oct-08	Calibrated to 88% saturation (elev: 3300')
Hach HS-C field colorimeter	16-Oct-08	

Standard Operating Procedures

Number	Description
3401, 3402	Corning Checkmate 90: pH, Eh, Conductivity, TDS
4203	Well Static H2O Level Measurement w/ Solinst Well Probe
5201	Monitoring Well Purging & Sampling
5211	Major Minerals (INORGANICS) Sampling
5212	Volatile Organic Analysis (VOA) Sampling
6210	Groundwater Equipment Decontamination
8210	Sample Packaging & Shipping for Groundwater Samples
8300 8400 8500	Field QA/QC, Sample Custody, Sample ID and Analytical Results

Well Evaucation & Monitoring Data

Time	Temp (deg C)	pH	Eh (mV)	Conductivity (uS)	Q (gpm)	Elapsed (gallons)
1512	—	—		—	—	—
1522	12.9	7.14		6310	1	10
1532	12.9	7.15		6300	1	20
1537	12.8	7.14		6300	1	25

Bore Volume Calculation: $(\pi\phi^2/4)\cdot(TD-SWL)\cdot(7.48\ gal/ft^3)$ = 6.8 gal (2" casing calc = .163)

Water Description: clear no odor

Sampling Data

Bottle Label	Sampling Parameter	Preservative	Sample Time	Other
B43088-5	TP, TKN, Nox, NH4	H2SO4	1540	500 ml plastic

Samples analyzed by:	Energy Laboratories Billings, MT

Comments:

Dissolved Oxygen @ 9 = 0.4 ppm

Fe = .02

H2S = 0

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Appendix B

LABORATORY ANALYTICAL RESULTS

ROUNDUP WASTEWATER LAGOONS/MDT WETLAND
GROUNDWATER MONITORING REPORT 2008

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LABORATORY ANALYTICAL REPORT

Client: PBS and J
Project: Roundup GWM
Lab ID: B08101643-001
Client Sample ID: B43088-1

Report Date: 10/31/08
Collection Date: 10/17/08 12:25
DateReceived: 10/20/08
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
NUTRIENTS							
Nitrogen, Ammonia as N	ND	mg/L		0.1		E350.1	10/20/08 13:20 / sam
Nitrogen, Nitrate+Nitrite as N	15.6	mg/L		0.05		E353.2	10/21/08 11:38 / bls
Nitrogen, Kjeldahl, Total as N	ND	mg/L		0.5		E351.2	10/21/08 11:02 / sam
Nitrogen, Total	15.6	mg/L		0.5		Calculation	10/24/08 14:15 / mep
Phosphorus, Total as P	ND	mg/L		0.01		E365.1	10/22/08 11:30 / sam

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: PBS and J
Project: Roundup GWM
Lab ID: B08101643-002
Client Sample ID: B43088-2

Report Date: 10/31/08
Collection Date: 10/17/08 14:20
DateReceived: 10/20/08
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
NUTRIENTS							
Nitrogen, Ammonia as N	17.0	mg/L	D	0.2		E350.1	10/20/08 14:35 / sam
Nitrogen, Nitrate+Nitrite as N	ND	mg/L		0.05		E353.2	10/21/08 11:37 / bls
Nitrogen, Kjeldahl, Total as N	18	mg/L	D	1		E351.2	10/24/08 08:27 / sam
Nitrogen, Total	18	mg/L		1		Calculation	10/24/08 14:15 / mep
Phosphorus, Total as P	1.51	mg/L	D	0.05		E365.1	10/29/08 16:58 / sam

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: PBS and J
Project: Roundup GWM
Lab ID: B08101643-003
Client Sample ID: B43088-3

Report Date: 10/31/08
Collection Date: 10/17/08 13:30
DateReceived: 10/20/08
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
NUTRIENTS							
Nitrogen, Ammonia as N	16.6	mg/L	D	0.2		E350.1	10/20/08 14:36 / sam
Nitrogen, Nitrate+Nitrite as N	ND	mg/L		0.05		E353.2	10/21/08 11:49 / bls
Nitrogen, Kjeldahl, Total as N	18	mg/L	D	1		E351.2	10/24/08 08:28 / sam
Nitrogen, Total	18	mg/L		1		Calculation	10/24/08 14:15 / mep
Phosphorus, Total as P	1.15	mg/L	D	0.05		E365.1	10/29/08 17:00 / sam

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: PBS and J
Project: Roundup GWM
Lab ID: B08101643-004
Client Sample ID: B43088-4

Report Date: 10/31/08
Collection Date: 10/17/08 15:00
DateReceived: 10/20/08
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
NUTRIENTS							
Nitrogen, Ammonia as N	12.0	mg/L	D	0.2		E350.1	10/20/08 14:37 / sam
Nitrogen, Nitrate+Nitrite as N	ND	mg/L		0.05		E353.2	10/21/08 11:50 / bls
Nitrogen, Kjeldahl, Total as N	13	mg/L	D	1		E351.2	10/24/08 08:29 / sam
Nitrogen, Total	13	mg/L		1		Calculation	10/24/08 14:15 / mep
Phosphorus, Total as P	0.20	mg/L		0.01		E365.1	10/22/08 11:36 / sam

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
D - RL increased due to sample matrix interference.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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LABORATORY ANALYTICAL REPORT

Client: PBS and J
Project: Roundup GWM
Lab ID: B08101643-005
Client Sample ID: B43088-5

Report Date: 10/31/08
Collection Date: 10/17/08 15:40
DateReceived: 10/20/08
Matrix: Aqueous

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
NUTRIENTS							
Nitrogen, Ammonia as N	2.6	mg/L		0.1		E350.1	10/20/08 13:25 / sam
Nitrogen, Nitrate+Nitrite as N	ND	mg/L		0.05		E353.2	10/21/08 11:51 / bls
Nitrogen, Kjeldahl, Total as N	4.3	mg/L		0.5		E351.2	10/21/08 11:07 / sam
Nitrogen, Total	4.3	mg/L		0.5		Calculation	10/24/08 14:15 / mep
Phosphorus, Total as P	0.01	mg/L		0.01		E365.1	10/22/08 11:38 / sam

Report Definitions:
RL - Analyte reporting limit.
QCL - Quality control limit.
MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

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QA/QC Summary Report

Client: PBS and J
Project: Roundup GWM

Report Date: 10/31/08
Work Order: B08101643

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E350.1								Analytical Run: FIA202-B_081020B	
Sample ID: ICV	Initial Calibration Verification Standard							10/20/08 12:53	
Nitrogen, Ammonia as N	5.69	mg/L	0.11	104	90	110			
Method: E350.1								Batch: R119443	
Sample ID: MBLK	Method Blank				Run: FIA202-B_081020B			10/20/08 12:54	
Nitrogen, Ammonia as N	ND	mg/L	0.02						
Sample ID: LFB	Laboratory Fortified Blank				Run: FIA202-B_081020B			10/20/08 12:55	
Nitrogen, Ammonia as N	1.07	mg/L	0.10	108	90	110			
Sample ID: B08101226-004CMS	Sample Matrix Spike				Run: FIA202-B_081020B			10/20/08 13:16	
Nitrogen, Ammonia as N	1.06	mg/L	0.10	101	90	110			
Sample ID: B08101226-004CMSD	Sample Matrix Spike Duplicate				Run: FIA202-B_081020B			10/20/08 13:17	
Nitrogen, Ammonia as N	1.07	mg/L	0.10	102	90	110	1.1	10	
Sample ID: B08101641-001DMS	Sample Matrix Spike				Run: FIA202-B_081020B			10/20/08 13:31	
Nitrogen, Ammonia as N	1.55	mg/L	0.10	78	90	110			S
Sample ID: B08101641-001DMSD	Sample Matrix Spike Duplicate				Run: FIA202-B_081020B			10/20/08 13:32	
Nitrogen, Ammonia as N	1.54	mg/L	0.10	77	90	110	0.7	10	S
Sample ID: B08101579-011BMS	Sample Matrix Spike				Run: FIA202-B_081020B			10/20/08 14:28	
Nitrogen, Ammonia as N	1.02	mg/L	0.10	96	90	110			
Sample ID: B08101579-011BMSD	Sample Matrix Spike Duplicate				Run: FIA202-B_081020B			10/20/08 14:29	
Nitrogen, Ammonia as N	1.05	mg/L	0.10	99	90	110	2.5	10	
Method: E351.2								Analytical Run: FIA202-B_081021A	
Sample ID: ICV	Initial Calibration Verification Standard							10/21/08 10:50	
Nitrogen, Kjeldahl, Total as N	5.41	mg/L	0.50	108	90	110			
Method: E351.2								Batch: R119507	
Sample ID: MBLK	Method Blank				Run: FIA202-B_081021A			10/21/08 10:52	
Nitrogen, Kjeldahl, Total as N	0.09	mg/L	0.03						
Sample ID: LFB	Laboratory Fortified Blank				Run: FIA202-B_081021A			10/21/08 10:53	
Nitrogen, Kjeldahl, Total as N	5.57	mg/L	0.50	110	90	110			
Sample ID: B08101643-001AMS	Sample Matrix Spike				Run: FIA202-B_081021A			10/21/08 11:03	
Nitrogen, Kjeldahl, Total as N	5.09	mg/L	0.50	102	90	110			
Sample ID: B08101643-001AMSD	Sample Matrix Spike Duplicate				Run: FIA202-B_081021A			10/21/08 11:04	
Nitrogen, Kjeldahl, Total as N	4.99	mg/L	0.50	100	90	110	1.9	10	

Qualifiers:

RL - Analyte reporting limit.
ND - Not detected at the reporting limit.
S - Spike recovery outside of advisory limits.

ENERGY LABORATORIES, INC. • P.O. Box 30916 • 1120 South 27th Street • Billings, MT 59107-0916
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QA/QC Summary Report

Client: PBS and J
Project: Roundup GWM

Report Date: 10/31/08
Work Order: B08101643

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E351.2								Analytical Run: FIA202-B_081024B	
Sample ID: ICV	Initial Calibration Verification Standard							10/24/08 08:19	
Nitrogen, Kjeldahl, Total as N	5.49	mg/L	0.50	110	90	110			
Method: E351.2								Batch: R119707	
Sample ID: MBLK	Method Blank				Run: FIA202-B_081024B			10/24/08 08:21	
Nitrogen, Kjeldahl, Total as N	ND	mg/L	0.1						
Sample ID: LFB	Laboratory Fortified Blank				Run: FIA202-B_081024B			10/24/08 08:22	
Nitrogen, Kjeldahl, Total as N	5.52	mg/L	0.50	110	90	110			
Sample ID: B08101773-005CMS	Sample Matrix Spike				Run: FIA202-B_081024B			10/24/08 08:23	
Nitrogen, Kjeldahl, Total as N	5.39	mg/L	0.50	108	90	110			
Sample ID: B08101773-005CMSD	Sample Matrix Spike Duplicate				Run: FIA202-B_081024B			10/24/08 08:24	
Nitrogen, Kjeldahl, Total as N	5.30	mg/L	0.50	106	90	110	1.6	10	
Sample ID: B08101782-001CMS	Sample Matrix Spike				Run: FIA202-B_081024B			10/24/08 08:32	
Nitrogen, Kjeldahl, Total as N	5.50	mg/L	0.50	107	90	110			
Sample ID: B08101782-001CMSD	Sample Matrix Spike Duplicate				Run: FIA202-B_081024B			10/24/08 08:33	
Nitrogen, Kjeldahl, Total as N	5.23	mg/L	0.50	102	90	110	5	10	
Method: E353.2								Analytical Run: FIA203-B_081021A	
Sample ID: ICV	Initial Calibration Verification Standard							10/21/08 11:18	
Nitrogen, Nitrate+Nitrite as N	36.2	mg/L	0.050	102	90	110			
Method: E353.2								Batch: R119517	
Sample ID: MBLK	Method Blank				Run: FIA203-B_081021A			10/21/08 11:19	
Nitrogen, Nitrate+Nitrite as N	0.002	mg/L	0.002						
Sample ID: LFB	Laboratory Fortified Blank				Run: FIA203-B_081021A			10/21/08 11:21	
Nitrogen, Nitrate+Nitrite as N	0.991	mg/L	0.050	101	90	110			
Sample ID: B08101597-001CMS	Sample Matrix Spike				Run: FIA203-B_081021A			10/21/08 11:43	
Nitrogen, Nitrate+Nitrite as N	1.57	mg/L	0.050	106	90	110			
Sample ID: B08101597-001CMSD	Sample Matrix Spike Duplicate				Run: FIA203-B_081021A			10/21/08 11:44	
Nitrogen, Nitrate+Nitrite as N	1.57	mg/L	0.050	106	90	110	0.1	10	
Sample ID: B08101646-001CMS	Sample Matrix Spike				Run: FIA203-B_081021A			10/21/08 12:00	
Nitrogen, Nitrate+Nitrite as N	1.03	mg/L	0.050	101	90	110			
Sample ID: B08101646-001CMSD	Sample Matrix Spike Duplicate				Run: FIA203-B_081021A			10/21/08 12:01	
Nitrogen, Nitrate+Nitrite as N	1.03	mg/L	0.050	100	90	110	0.9	10	

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QA/QC Summary Report

Client: PBS and J
Project: Roundup GWM

Report Date: 10/31/08
Work Order: B08101643

Analyte	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E365.1									Batch: 35375
Sample ID: MBLK	Method Blank				Run: FIA202-B_081022B				10/22/08 10:44
Phosphorus, Total as P	ND	mg/L	0.005						
Sample ID: LFB	Laboratory Fortified Blank				Run: FIA202-B_081022B				10/22/08 10:46
Phosphorus, Total as P	0.0949	mg/L	0.010	95	90	110			
Sample ID: B08101375-003AMS	Sample Matrix Spike				Run: FIA202-B_081022B				10/22/08 11:18
Phosphorus, Total as P	0.108	mg/L	0.010	96	90	110			
Sample ID: B08101375-003AMSD	Sample Matrix Spike Duplicate				Run: FIA202-B_081022B				10/22/08 11:20
Phosphorus, Total as P	0.109	mg/L	0.010	97	90	110	0.6	10	
Method: E365.1									Analytical Run: FIA202-B_081029C
Sample ID: ICV	Initial Calibration Verification Standard								10/29/08 16:28
Phosphorus, Total as P	0.251	mg/L	0.010	100	90	110			
Method: E365.1									Batch: 35514
Sample ID: MBLK-35514	Method Blank				Run: FIA202-B_081029C				10/29/08 16:34
Phosphorus, Total as P	0.007	mg/L	0.005						
Sample ID: LFB-35514	Laboratory Fortified Blank				Run: FIA202-B_081029C				10/29/08 16:36
Phosphorus, Total as P	0.104	mg/L	0.010	104	90	110			
Sample ID: B08102204-002BMS	Sample Matrix Spike				Run: FIA202-B_081029C				10/29/08 17:08
Phosphorus, Total as P	0.0962	mg/L	0.010	85	90	110			S
Sample ID: B08102204-002BMSD	Sample Matrix Spike Duplicate				Run: FIA202-B_081029C				10/29/08 17:10
Phosphorus, Total as P	0.0979	mg/L	0.010	86	90	110	1.8	10	S
Method: E365.1									Analytical Run: FIA202-B_081022B
Sample ID: ICV	Initial Calibration Verification Standard								10/22/08 10:38
Phosphorus, Total as P	0.238	mg/L	0.010	95	90	110			

Qualifiers:

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ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.