STANDARD OPERATING PROCEDURE FOR COLLECTION OF SEDIMENT SAMPLES IN WETLANDS

GSL IMPOUNDED WETLAND 2012 MONITORING ACTIVITIES

State of Utah
Department of Environmental Quality
Division of Water Quality

Revision 1
Effective 09/10/2011

Utah Division of Water Quality (DWQ) Standard Operating Procedures (SOPs) are adapted from published methods, or developed by in-house technical experts. The primary purpose of this document is for internal DWQ use. This SOP should not replace any official published methods.

Any references within this document to specific equipment, manufacturers, or supplies is only for descriptive purposes and does not constitute an endorsement of a particular product or service by the author or by DWQ. Additionally, any distribution of this SOP does not constitute an endorsement of a particular procedure or method.

Although DWQ will follow this SOP in most instances, there may be instances in which DWQ will use an alternative methodology, procedure, or process.

REVISION PAGE

Date	Revision #	Summary of Changes	Sections	Other Comments
09/10/2011	1	not applicable	not applicable	Adapted from GSL wetlands field manual and put into new standardized format, began document control/revision tracking

TABLE OF CONTENTS

1.0 SCOPE AND APPLICABILITY

This document presents the standard operating procedure (SOP) for the collection of sediment samples in THE Willard Spur wetlands, and applies to any Utah Division of Water Quality (DWQ) monitor or non-DWQ cooperator performing wetlands sampling. Sediment samples collected wetlands are typically analyzed for diatoms or chemical constituents.

Diatoms are increasingly used as indicators of water quality and the overall biological integrity of aquatic ecosystems (e.g., Dixit and Smol 1994, Hill et al. 2000, Pan et al. 2000). Diatom assemblages are diverse with a composition that varies with changes in the physical (i.e., hydrology, chemical) and biological characteristics of their environment (Robinson et al. 2000, Earle et al. 1988). Most importantly in an assessment context, diatom composition is known to vary predictably with changes in water chemistry (Van Dam et al. 1994). As a result, the composition of diatoms can be used to directly quantify the biological integrity of wetland ecosystems.

The composition and relative abundance of pelagic, epiphytic and benthic diatom taxa varies seasonally, so a single collection from a water sample may not capture the average or most limiting abiotic conditions in a wetland. However, a diatom collection from sediment integrates short-term variation and is likely a better indicator of wetland health. As diatoms die they settle to the bottom of wetlands. Long-term compositional changes are recorded in the sediment because diatoms have a silica cell wall that does not decompose and can be used to differentiate among diatoms species. The top 1 cm of sediment is collected to estimate changes in composition that have occurred over approximately a single productive season – spring through fall. Therefore these samples are ideally collected once per year at the end of the productive season.

Diatom composition also varies spatially within a wetland. Within site variation can provide insight into habitat heterogeneity, however DWQ is primarily concerned with comparisons between wetland sites, which is best accomplished by minimizing among-local variation. To minimize within-site variation, a total of 5 samples are collected and then composited because this represents the approximate asymptote of increases in species richness with increasing numbers of composite samples (Weilhoefer and Pan 2006) and improves among-site multivariate comparisons of biological composition (Cao et al. 2002).

Sediment chemistry plays an important role in wetlands ecosystems. Numerous studies (summarized in Hoven and Miller 2007) have shown that submergent and emergent vegetation in wetlands primarily derive their nutrient requirements from sediments rather than from the water column. Nutrients and chemical contaminants undergo sedimentation in wetlands where they can be stored for long periods altering both local and downstream water chemistry (Johnstone 1991). For many chemical parameters the temporal variability is lower in sediments, especially composite samples, than concentrations obtained from the water column, so sediment samples may provide a

more integrative measure of background chemical conditions that water chemistry alone.

This SOP has been created for Utah DWQ wetland monitoring purposes and is a modification of procedures described in *Survey of the Nation's Lakes: Field Operations Manual* (EPA, 2007).

2.0 SUMMARY OF METHOD

2.1 Sediment Diatoms

Each sample is comprised of a composite of 5 core samples (the top 1 cm of each core is retained). Core samples are collected with a modified KB coring device. The five core samples used in the composite are collected at five random points, “upstream” and between 5 to 15 m from the boat. The samples are combined into one 250 ml plastic container.

2.2 Sediment Chemistry

Each sample is comprised of a composite of 5 core samples (10 cm of each core is retained). Core samples are collected with a modified diameter KB coring device. The five core samples used in the composite are collected at five random points, “upstream” and between 5 to 15 m from the boat. The samples are combined into a stainless steel mixing bowl and stirred vigorously to homogenize the sediment. Once homogenized, sediment is scooped into one 1000 ml plastic container (for metals) and zip-lock bags (for nutrients).

3.0 DEFINITIONS

IW: impounded wetland(s)

PVC: polyvinyl chloride

SAV: submerged aquatic vegetation; for the purpose of this SOP, SAV includes vascular vegetation rooted in sediment for which most of the plant is submerged or floating on water

cm: centimeter(s)

ml: milliliter(s)

m: meter(s)

4.0 HEALTH AND SAFETY WARNINGS

Field personnel should take appropriate precautions when operating watercraft and working on, in, or around water.

Field personnel should be aware that hazardous conditions potentially exist at every waterbody. If unfavorable conditions are present at the time of sampling, the sample visit, it is recommended the sampling be rescheduled. If hazardous weather conditions such as lightning arise during sampling, personnel should cease sampling and move to a safe location.

All boats should be equipped with safety equipment such as personal flotation devices (PFD's), oars, air horn, etc. Utah's Boating Laws and Rules shall be followed by all field personnel.

5.0 CAUTIONS

Care should be taken to not place the corer into water that has a sediment plume caused by the sampler walking to the site and to not core into sediment that has been visibly disturbed. Also, the sampler should attempt to avoid trapping submerged aquatic vegetation while coring.

6.0 INTERFERENCES

Disturbance of the sediment by sampler's footsteps may cause collection of a non-representative core sample (sediment thickness and organic layer may be altered). It is critical that the corer strikes minimally disturbed surface sediments, especially for diatom sampling.

7.0 PERSONNEL QUALIFICATIONS/RESPONSIBILITIES

All personnel collecting wetlands sediment samples must read this SOP annually and acknowledge they have done so via a signature page (see **Appendix 1**). New field personnel must also demonstrate successful performance of the method. The signature page will be signed by both trainee and trainer to confirm that training was successfully completed and that the new monitor is competent in carrying out this SOP. The signature page will be kept on-file at DWQ along with the official hard copy of this SOP.

8.0 EQUIPMENT AND SUPPLIES

___ Copy of this SOP

_____ Field sheets, field notebook, pens, pencils and permanent Sharpies (preferably waterproof)

_____ Plastic, high-sided utility sled or float tube (fishing type) for toting equipment

_____ 250 ml plastic jars for diatom samples (such as Cole Parmer item# SI-06101-40)

_____ 1000 ml glass jars for chemistry (metals) samples (such as Cole Parmer item# SI-99535-44)

_____ zip-lock bags for chemistry (nutrient) samples (double bag each sample)

_____ 6.35 cm-diameter modified KB sediment corer (**Figure 1**), stage, plunger, rubber corks and 1.5 inch plastic putty knife

_____ Stainless steel mixing bowl and scoop, liquinox, and scrubbing brush

_____ DI water for decontamination

_____ Meter stick made of PVC and marked in centimeters for measuring water depth

_____ Sample labels (**Figures 2** and **3**)

_____ Sample tracking forms (see **Appendix 2, 3, 4**)

_____ Cooler, wet ice (for diatoms), and dry ice (for chemistry)

Figure 1. Illustration of the modified KB corer and sectioning apparatus (EPA, 2007).

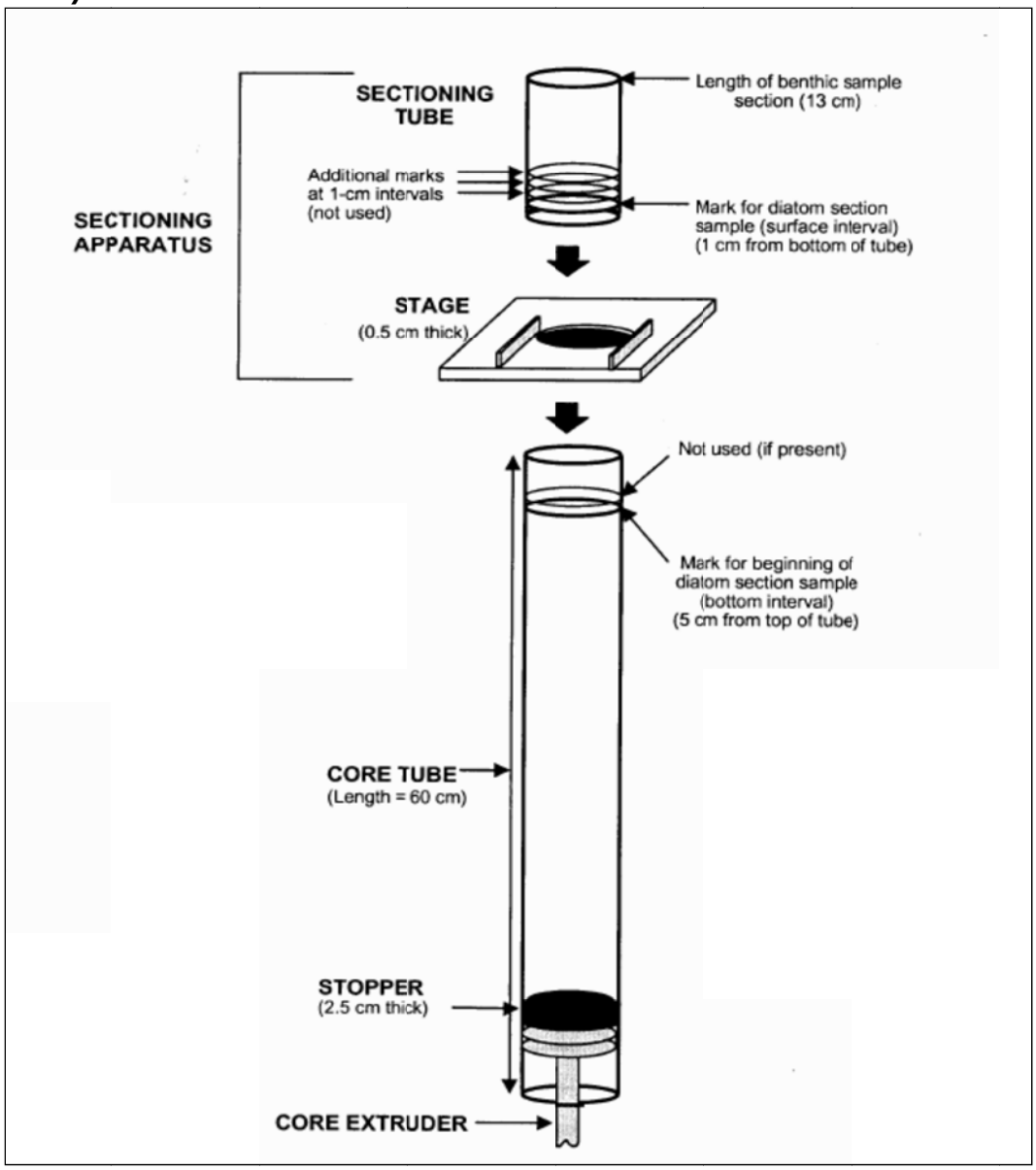

Figure 2. Sample label for sediment diatom samples (U:\WQ\PERMITS\MONITORS\Labels\diatoms (5163or5523).doc)

DIATOMS IN SEDIMENT - Rushforth Phycology

Site ID:_____

_____

STORET: _____ Replicate #:_____

Samplers: _____Date:_____

Collection Method: _____Composite of 5 cores (top 1 cm of each)

Figure 3. General sample label for sediment chemistry samples (U:\WQ\PERMITS\MONITORS\Labels\ sed chem (5163or5523).doc)

SEDIMENT CHEMISTRY Laboratory:_____

Site ID:_____

_____

STORET: _____ Replicate #:_____

Samplers: _____Date:_____

Collection Method: _____

Analyses Requested: _____

9.0 PROCEDURE

9.1 Sediment Sample Collection

9.1.1 Sediment Diatoms

1) Once at the sampling location decontaminate the sampling apparatus and tools with Liquinox and 3 DI water rinses. **Perform the decontamination process "downstream" of the boat.**

2) Starting "upstream" of the boat and pace off 5 to 15 m from the boat.

3) Measure and record water depth to the nearest 0.1 m with the metered PVC stick.

4) Push the core sampler (just the core tube) into the surface sediment about 40 centimeters (about 15 inches).

5) Place a rubber stopper on the top of the corer forcefully enough that suction prevents material from leaking out when the core is retrieved.

6) Push and tilt the corer to loosen/break the suction of the corer to the sediment on the outside of the corer. When the corer is relatively free from the surrounding sediment, pull the corer to the surface.

7) Place the plunger into the bottom of the corer. Remove the rubber stopper from the top of the corer.

8) Allow the flocculent material within the core tube to settle.

9) Using the plunger, extrude the sample towards the top of the corer until the sediment surface is about an inch from the top and any loose flocculent material that did not settle out with the sediment is pushed out.

10) Affix the clean stage to the top of the corer and extrude the core till the surface sediment is just below the stage, discarding the small amount of water from the surface of the sediment while being as careful as possible not to remove sediment (i.e., flocs).

11) Place the Plexiglas sectioning apparatus (marked with a line 1 cm from the bottom) on the stage directly over the coring tube. Slowly extrude the sediment core into the attached sectioning apparatus until the top of the sediment reaches the 1-cm line on the sectioning tube. Slide the top 1 cm section of sediment towards the opening on one side of the stage. If necessary, use a clean putty knife to slide the 1 cm core into the plastic container. Transfer the entirety of that centimeter of surface sediment into an appropriately labeled 250 ml plastic collection jar.

12) Rinse the corer and components with ambient water (at the point just sampled) to prevent carryover of sediment from one sampling point to another.

13) Repeat Steps 2 through 12 to sample the 4 remaining random points, compositing each individual sample into the same collection jar.

14) Return to the boat or staging area after collecting the composite sample. Seal the jar with electrical tape around the lid.

15) Affix the sample label and cover with clear tape.

16) Place the sample container in a dark cooler on wet ice for transportation.

17) Between sampling sites, decontaminate the sampling apparatus and tools as described in Step 1.

18) Upon returning from the field, fill out a sample tracking form, and store the samples with the form in the freezer for storage until delivery (samples may be delivered to the laboratory in batches). Alternatively, deliver the samples to the laboratory the day of sampling.

9.1.2 Sediment Chemistry

1) Once at the sampling location decontaminate the sampling apparatus and tools with Liquinox and 3 DI water rinses. Perform the decontamination process "downstream" of the boat.

2) Starting "upstream" of the boat and pace off 5 to 15 m from the boat.

3) Measure and record water depth to the nearest 0.1 m with the metered PVC stick.

4) Push the core sampler (just the core tube) into the surface sediment about 40 centimeters (about 15 inches).

5) Place a rubber stopper on the top of the corer forcefully enough that suction prevents material from leaking out when the core is retrieved.

6) Push and tilt the corer to loosen/break the suction of the corer to the sediment on the outside of the corer. When the corer is relatively free from the surrounding sediment, pull the corer to the surface.

7) Place the plunger into the bottom of the corer. Remove the rubber stopper from the top of the corer.

8) Allow the flocculent material within the core tube to settle.

9) Using the plunger, extrude the sample towards the top of the corer until the sediment surface is about an inch from the top and any loose flocculent material that did not settle out with the sediment is pushed out.

10) Affix the clean stage to the top of the corer and extrude the core till the surface sediment is just below the stage, discarding the small amount of water from the surface of the sediment while being as careful as possible not to remove sediment (i.e., flocs).

11) Place the Plexiglas sectioning apparatus (marked with a line 5 cm from the bottom) on the stage directly over the coring tube. Slowly extrude the sediment core into the attached sectioning apparatus until the top of the sediment reaches the 1-cm line on the sectioning tube. Slide the top 5 cm section of sediment towards the opening on one side of the stage. If necessary, use a clean putty knife to slide the 5 cm core into the plastic container. Repeat the above process for the next 5 cm.

12) Transfer the entirety of the 10 cm core into a stainless steel mixing bowl to be homogenized.

13) Rinse the corer and components with ambient water (at the point just sampled) to prevent carryover of sediment from one sampling point to another.

14) Repeat Steps 2 through 13 to sample the 4 remaining random points, compositing each 10 cm into the stainless steel bowl.

15) Once all 5 cores are in the mixing bowl, homogenize the sample, and scoop ~2 cups into a zip-lock bag.

16) Affix the sample label and cover with clear tape, and place the sample into a second zip-lock bag.

17) Place the sample in a dark cooler on dry ice for transportation.

18) Between sampling sites, decontaminate the sampling apparatus and tools as described in Step 1.

19) Upon returning from the field, fill out a sample tracking form, and store the samples with the form in the freezer for storage until delivery (samples may be delivered to the laboratory in batches). Alternatively, deliver the samples to the laboratory the day of sampling.

10.0 LABORATORY ANALYSES

10.1 Sediment Diatoms

In order for accurate identification, diatom samples must be subjected to an acid digestion to remove organic matter from the sample. This process is critical and takes several days to complete. Permanent strewn mount slides are then prepared and examined under oil immersion using a high-quality microscope at high magnification. Species are identified to the lowest possible taxonomic category (generally species) and counted. Identification is made based on cell wall structure, symmetry, valve structure, and other physical characteristics and both standard taxonomic works as well as Rushforth Phycology and national laboratory slide collections are referenced. Analysis is either semi-quantitative (because of sample volume tracking during slide preparation) or based upon relative density of the species present and enumeration using high-quality digital microscopy. The specific methodology and quality assurance and quality control procedures for this analysis and analyzing laboratory can be obtained from:

Dr. Samuel R. Rushforth
Rushforth Phycology, LLC
Orem, UT
(801) 225-5736
sam@rushforthphycology.com
http://rushforthphycology.com/201.html

10.2 Sediment Chemistry

Sediment samples are typically analyzed for nutrients, metals, and/or trace elements using EPA or equivalent methods, depending on specific project goals. The specific methodology and quality control samples run for these analyses can be obtained from the analyzing laboratory. Specific methodology and quality assurance procedures for sediment nutrients can be obtained from:

Pam Hole
Utah State University Analytical Labs (USUAL)
Soil Testing Lab
Email: usual@usu.edu
Office Phone: 435-797-2217
4830 Old Main Hill AGS 168
Logan Utah 84322-4830

Specific methodology and quality assurance procedures for sediment metals can be obtained from:

Dr. William Johnson
Geology & Geophysics
Frederick Albert Sutton Building
115 S 1460 East Room 383
Salt Lake City, Ut 84112
(801) 581-5033
william.johnson@utah.edu

11.0 DATA AND RECORDS MANAGEMENT

Date, time, sampler(s), and sampling method are noted on the field sheet and sample tracking form as indicated. Monitors should review the field sheet and sample tracking form for completeness and accuracy in the field before leaving the site. It is critical the information on the paperwork is consistent with the information on the sample container label.

Upon returning to the office/laboratory, both the monitor collecting the sample and the field team leader sign/initial that they have reviewed the field sheet. The field sheet is then scanned and the PDF file saved into the shared “Monitors” folder. The original form is placed in the project file.

The data from the field form is entered into the water quality database at the same time as the other field data collected for that day (ideally within 2 weeks from the date of the site visit).

12.0 QUALITY ASSURANCE AND QUALITY CONTROL

Field replicates for sediment samples should be collected at a minimum rate of 1 replicate for every 10 regular samples, or at a frequency required in a program/project specific quality assurance plan or sampling and analysis plan. To collect the replicate sample, follow the step outlined in this SOP under **Section 9.0**. This replicate sample should be collected immediately following the collection of the first sample. Note on the field sheet and in the field notebook that a replicate was collected. Refer to the program/project specific quality assurance plan or sampling and analysis plan for performance goals for replicate samples.

13.0 REFERENCES

Cao, Y., D.P. Larsen, R.M. Hughes, P.L. Angermeier, and T.M. Patton. 2002. Sampling effort affects multivariate comparisons of stream assemblages. Journal of the North American Benthological Society 21:701-714.

Dixit, S.S. and J.P. Smol. 1994. Diatoms as indicators in the Environmental Monitoring and Assessment Program - Surface Waters. Environmental Monitoring and Assessment 31: 275-306.

Earle, J.C., H.C. Duthie, W.A. Glooschenko, and P.B. Hamilton. 1988. Factors affecting the spatial distribution of diatoms on the surface sediments of Precambrian Shield lakes. Canadian Journal of Fisheries and Aquatic Sciences 45: 469-478.

Hill, B.H., A.T. Herlihy. P.R. Kaufman, R.J. Stevenson, F.J. McCormick, and C.B. Johnson. 2000. Use of periphyton assemblage data as an index of biological integrity. Journal of the North American Bethological Society 19: 50-67.

Johnstone, C. 1993. Sediment and nutrient retention in freshwater ecosystems: effects on surface water quality. Critical Reviews in Environmental Science and Technology 21(5&6): 491-565.

Pan, Y., R.J. Stevenson, P. Vaithiyanathan, J. Slate, and C.J. Richardson. 2000. Changes in algal assemblages along observed and experimental phosphorous gradients in a subtropical wetland, USA. Freshwater Biology 44: 339-354.

Robinson, G.G.C., S.E. Gurney, and L.G. Goldsborough. 1997. Response of benthic and planktonic algal biomass to experimental water-level manipulation in prairie lakeshore wetlands. Wetlands 17: 167-181.

USEPA. 2007. Survey of the Nation's Lakes. Field Operations Manual. EPA 841-B-07-004. U.S. Environmental Protection Agency, Washington, DC.

Van Dam, H., A. Mertens, and J. Sinkeldam. 1994. A coded checklist and ecological indicator values of freshwater diatoms from the Netherlands. Netherlands Journal of Aquatic Ecology 28: 117-133.

Weilhoefer, C.L. and Y. Pan. 2006. Diatom-based bioassessment in wetlands: How many samples do we need to characterize the diatom assemblage in a wetland adequately? Wetlands 26(3): 793-802.

14.0 APPENDICES

Appendix 1 - SOP Acknowledgment and Training Form (front and back)

(U:\WQ\PERMITS\MONITORS\QAQC\Helpful Templates\SOP Acknowledgement and Training Form.doc)

DWQ SOP Acknowledgement and Training Form
2/28/2011
Page 1 of 2

SOP Acknowledgement and Training Form

This SOP must be read and this form signed annually. This form must be kept with the current version of the SOP.

Document Title:	
Document Revision Number:	
Document Revision Date:	

Please sign below in accordance with the following statement: "I have read and understood the above referenced document. I agree to perform the procedures described in this SOP in accordance with the document until such time that it is superseded by a more recent approved revision."

Printed Name	Signature	Date

SOP Acknowledgement and Training Form (continued)

Trainee: Sign below to acknowledge that training on this SOP was received, understood, and all questions/concerns were addressed by the trainer.

Trainer: Sign below to acknowledge that training on this SOP was completed for the individual listed and that trainee is competent to perform the procedures described within.

Date of Training	Trainee Printed Name	Trainee Signature	Trainer Printed Name	Trainer Signature

Appendix 2 – Sample Tracking Form for sediment diatom samples analyzed by Rushforth Phycology
(U:\WQ\PERMITS\MONITORS\Willard Spur\Field Sampling\Chain of Custody Forms\COC_sediment diatoms wetlands_Rushforth lab.doc)

UTAH DIVISION OF WATER QUALITY	SEDIMENT DIATOMS CHAIN OF CUSTODY RECORD (Rushforth Phycology, LLC)	
PROJECT: Willard Spur – Sediment Diatoms Collection	**Sampling Method:** Composite of 5 random cores	**Preservation:** frozen
Sample Date Range:		**Length of each core (cm):** top 1

Sample Number	Date Collected	Time Collected	STORET	Site Name	Average Water Depth (m)	Collector Initials	Remarks/Analysis Requested

Relinquished By:	**Date:**	**Time:**	**REMARKS:**
Received By:	**Date:**	**Time:**	

Page ______ of ______

Appendix 3 – Sample Tracking Form for sediment nutrients samples

(U:\WQ\PERMITS\MONITORS\Willard Spur\Field Sampling\Chain of Custody Forms\COC_sediment nutrients wetlands_USU lab.doc)

UTAH DIVISION OF WATER QUALITY	SEDIMENT NUTRIENT CHAIN OF CUSTODY RECORD		Laboratory: USU Analytical Laboratory
PROJECT: Willard Spur – Sediment NUTRIENT Sample Collection	**Sampling Method:** Composite of 5 random cores		**Preservation:** frozen
Sample Date Range:			**Length of each core (cm):** top 10 cm
Analyses Requested:			

Sample Number	Date Collected	Time Collected	STORET	Site Name	Average Water Depth (m)	Collector Initials	Remarks

Relinquished By:	Date:	Time:	REMARKS:
Received By:	Date:	Time:	

Page _____ of _____

Appendix 4 – Sample Tracking Form for sediment metals samples

(U:\WQ\PERMITS\MONITORS\Willard Spur\Field Sampling\Chain of Custody Forms\COC_sediment metals wetlands_UofU lab.doc)

UTAH DIVISION OF WATER QUALITY	SEDIMENT METALS CHAIN OF CUSTODY RECORD		Laboratory: U of U – Bill Johnson Laboratory			
PROJECT: Willard Spur – Sediment Metals Sample Collection		Sampling Method: Composite of 5 random cores		Preservation: frozen		
Sample Date Range:				Length of each core (cm): top 10 cm		
Analyses Requested:						
Sample Number	Date Collected	Time Collected	STORET	Site Name	Average Water Depth (m)	Collector Initials	Remarks
Relinquished By:			Date:	Time:	REMARKS:		
Received By:			Date:	Time:			

Page _____ of _____