GSI Water Solutions, Inc.

March 23, 2022

Oregon Water Resources Department
Attn: Jen Woody
725 Summer Street NE, Suite A
Salem, OR 97301-1266

Re: Artificial Groundwater Recharge Limited License Application – Madison Ranches, Inc.

Enclosed is an application requesting a Limited License for Artificial Groundwater Recharge on behalf of Madison Ranches. This application requests continuation of the testing performed under LL 1628. Supporting documentation, and a check in the amount of $1,150 is enclosed.

A Land Use Information Form and Watermaster form are included with the application.

If you have any questions, please call me at 503-239-8799 ext. 130.

Sincerely,

Robyn Cook, RG, CWRE
Hydrogeologist
GSI Water Solutions, Inc.

Attachments: Artificial Groundwater Recharge Limited License Application
Supporting Documentation
Check in the amount of $1,150

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Limited License Application for Artificial Groundwater Recharge

Madison Ranches

Submitted to

Oregon Water Resources Department

March 23, 2022

Prepared by

GSI Water Solutions, Inc.

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Application for Limited Water Use License

Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem Oregon 97301-1271
(503) 986-0900
www.wrd.state.or.us

Application for Limited Water Use License

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License No.:_____

Applicant Information

NAME				PHONE (HM)
Jake Madison, Madison Ranches, Inc.				
PHONE (WK)	CELL			FAX
(541) 376-8107	(541) 571-0569			
ADDRESS				
29299 Madison Road				
CITY	STATE	ZIP	E-MAIL *	
Echo	OR	97826	Jake@MadisonRanches.com	

Agent Information

NAME			PHONE	FAX
Robyn Cook, GSI Water Solutions, Inc.			(971) 200-8532	
ADDRESS				CELL
55 SW Yamhill Street, Suite 300				
CITY	STATE	ZIP	E-MAIL *	
Portland	OR	97204	rcook@gsiws.com	

I (We) make application for a Limited License to use or store the following described surface waters or groundwater – not otherwise exempt, or to use stored water of for a use of a short-term or fixed-duration:

1. **SOURCE(S) OF WATER:** Butter Creek a tributary of_____
2. **AMOUNT OF WATER** to be diverted;
   Maximum and instantaneous rate (cubic feet or gallons per minute): 25 cfs 11,221 gpm
   Total volume (gallons or acre-feet): _____. If water is to be used from more than one source, give the quantity from each:_____
3. **INTENDED USE(S) OF WATER:** (check all that apply)
   - ☐ Road construction or maintenance
   - ☐ General construction
   - ☐ Forestland and rangeland management; or
   - ☒ Other: Artificial Recharge
4. **DESCRIPTION OF PROPOSED PROJECT:** Include a description of the place of use as shown on the accompanying site map, the method of water diversion, the type of equipment to be used (including pump horsepower, if applicable), length and dimensions of supply ditches and pipelines:
   Water will be diverted from Butter Creek at rates up to 25 cfs during periods when flow is less than 50 cfs or greater than 175 cfs, and will be conveyed to the place of use through the systems shown on the accompanying limited license application map. The specifics of the Butter Creek diversion are documented in certificate 20259. The lengths and dimensions of the supply pipelines and locations where water will be used for artificial recharge are shown on the accompanying limited license application map.
5. **PROJECT SCHEDULE:** (List day, month, and year)
   Date water use will begin: Upon issuance of limited license
   Date water use will be completed: 5 year after issuance of limited license

   Months of the year water would be diverted and used: Anticipated to be January through August

   If for other than irrigation from stored water, how and where will water be discharged after use:

_____

Applicant Signature

Jake Madison, President
Print Name *and title if applicable*

3-9-2022
Date

PLEASE READ CAREFULLY

NOTE: A completed water availability statement from the local watermaster, Land Use Information Form completed by the local Planning Department, fees and site map meeting the requirements of OAR 690-340-030 must accompany this request. The fee for this request is **$280** for the first point of diversion plus **$30** for each additional point of diversion. Please review the Department's fee schedule to view fees required to request a limited license for Aquifer Storage and Recovery testing purposes or for Artificial Groundwater Recharge testing purposes.

Failure to provide any of the required information will result in return of your application. The license, if granted, will not be issued or replaced by a new license for a period of more than five consecutive years. The license, if granted, will be subordinate to all other authorized uses that rely upon the same source, or water affected by the source, and may be revoked at any time it is determined the use causes injury to any other water right or minimum perennial streamflow.

If water source is well, well logs or adequate information for the Department to determine aquifer, well depth, well seal and open interval, etc. are required. The licensee shall indicate the intended aquifer. If for multiple wells, each map location shall be clearly tired to a well log.

If a limited license is approved, the licensee shall give notice to the Department (Watermaster) at least 15 days in advance of using the water under the Limited License and shall maintain a record of use. The record of use shall include, but need not be limited to, an estimate of the amount of water used, the period of use and the categories of beneficial use to which the water is applied. During the period of the Limited License, the record of use shall be available for review by the Department upon request.

**A summary of review criteria and procedures that are generally applicable to these applications is available at: http://www.oregon.gov/owrd/pages/pubs/forms.aspx*

Mapping Requirements (OAR 690-340-0030):

(1) A request for a limited license shall be submitted on a form provided by the Water Resources Department, and shall be accompanied by the following:

a. A site map of reproducible quality, drawn to a standard, even scale of not less than 2 inches = 1 mile, showing:

i. The locations of all proposed points of diversion referenced by coordinates or by bearing and distance to the nearest established or projected public land survey corner;

ii. The general course of the source for the proposed use, if applicable;

iii. Other topographical features such as roads, streams, railroads, etc., which may be helpful in locating the diversion points in the field.

REMARKS:

For WRD Use Only

Land Use Information Form

Oregon Water Resources Department
725 Summer Street NE, Suite A
Salem, Oregon 97301-1266
(503) 986-0900
www.wrd.state.or.us

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Applicant: Jake (First) MADISON (Last)

Mailing Address: 29299 MADISON ROAD

ECHO (City) OR (State) 97826 (Zip) Daytime Phone: (541) 376-8107

A. Land and Location

Please include the following information for all tax lots where water will be diverted (taken from its source), conveyed (transported), and/or used or developed. Applicants for municipal use, or irrigation uses within irrigation districts may substitute existing and proposed service-area boundaries for the tax-lot information requested below.

Township	Range	Section	¼ ¼	Tax Lot #	Plan Designation (e.g., Rural Residential/RR-5)	Water to be:			Proposed Land Use:
3N	27E	36		5900	EFU	☐ Diverted	☒ Conveyed	☒ Used	*ARTIFICAL GROUNDWATER RECHARGE*
2N	27E	1		5900	EFU	☐ Diverted	☒ Conveyed	☒ Used	
2N	27E	1		200	EFU	☒ Diverted	☒ Conveyed	☐ Used	
						☐ Diverted	☐ Conveyed	☐ Used	

List all counties and cities where water is proposed to be diverted, conveyed, and/or used or developed:

UMATILLA COUNTY

B. Description of Proposed Use

Type of application to be filed with the Water Resources Department:

☐ Permit to Use or Store Water ☐ Water Right Transfer ☐ Permit Amendment or Ground Water Registration Modification
☒ Limited Water Use License ☐ Allocation of Conserved Water ☐ Exchange of Water

Source of water: ☐ Reservoir/Pond ☐ Ground Water ☒ Surface Water (name) Butter Creek

Estimated quantity of water needed: 25 CFS ☒ cubic feet per second ☐ gallons per minute ☐ acre-feet

Intended use of water: ☐ Irrigation ☐ Commercial ☐ Industrial ☐ Domestic for _____ household(s)
☐ Municipal ☐ Quasi-Municipal ☐ Instream ☒ Other Artificial Groundwater Recharge

Briefly describe:

AN APPLICATION FOR A LIMITED WATER USE LICENSE IS BEING SUBMITTED TO THE OREGON WATER RESOURCES DEPARTMENT REQUESTING TO USE WATER FROM BUTTER CREEK FOR ARTIFICIAL GROUNDWATER RECHARGE

Note to applicant: If the Land Use Information Form cannot be completed while you wait, please have a local government representative sign the receipt at the bottom of the next page and include it with the application filed with the Water Resources Department.

See bottom of Page 3. →

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For Local Government Use Only

The following section must be completed by a planning official from each county and city listed unless the project will be located entirely within the city limits. In that case, only the city planning agency must complete this form. This deals only with the local land-use plan. Do not include approval for activities such as building or grading permits.

Please check the appropriate box below and provide the requested information

☑ Land uses to be served by the proposed water uses (including proposed construction) are allowed outright or are not regulated by your comprehensive plan. Cite applicable ordinance section(s): UCDC 152.056(A)

☐ Land uses to be served by the proposed water uses (including proposed construction) involve discretionary land-use approvals as listed in the table below. (Please attach documentation of applicable land-use approvals which have already been obtained. Record of Action/land-use decision and accompanying findings are sufficient.) **If approvals have been obtained but all appeal periods have not ended, check "Being pursued."**

Type of Land-Use Approval Needed (e.g., plan amendments, rezones, conditional-use permits, etc.)	Cite Most Significant, Applicable Plan Policies & Ordinance Section References	Land-Use Approval:	
		☐ Obtained ☐ Denied	☐ Being Pursued ☐ Not Being Pursued
		☐ Obtained ☐ Denied	☐ Being Pursued ☐ Not Being Pursued
		☐ Obtained ☐ Denied	☐ Being Pursued ☐ Not Being Pursued
		☐ Obtained ☐ Denied	☐ Being Pursued ☐ Not Being Pursued
		☐ Obtained ☐ Denied	☐ Being Pursued ☐ Not Being Pursued

Local governments are invited to express special land-use concerns or make recommendations to the Water Resources Department regarding this proposed use of water below, or on a separate sheet.

Name: CAROL JOHNSON Title: Planner

Signature: Carol Johnson Phone: 541-278-6252 Date: 03/14/2022

Government Entity: Umatilla County

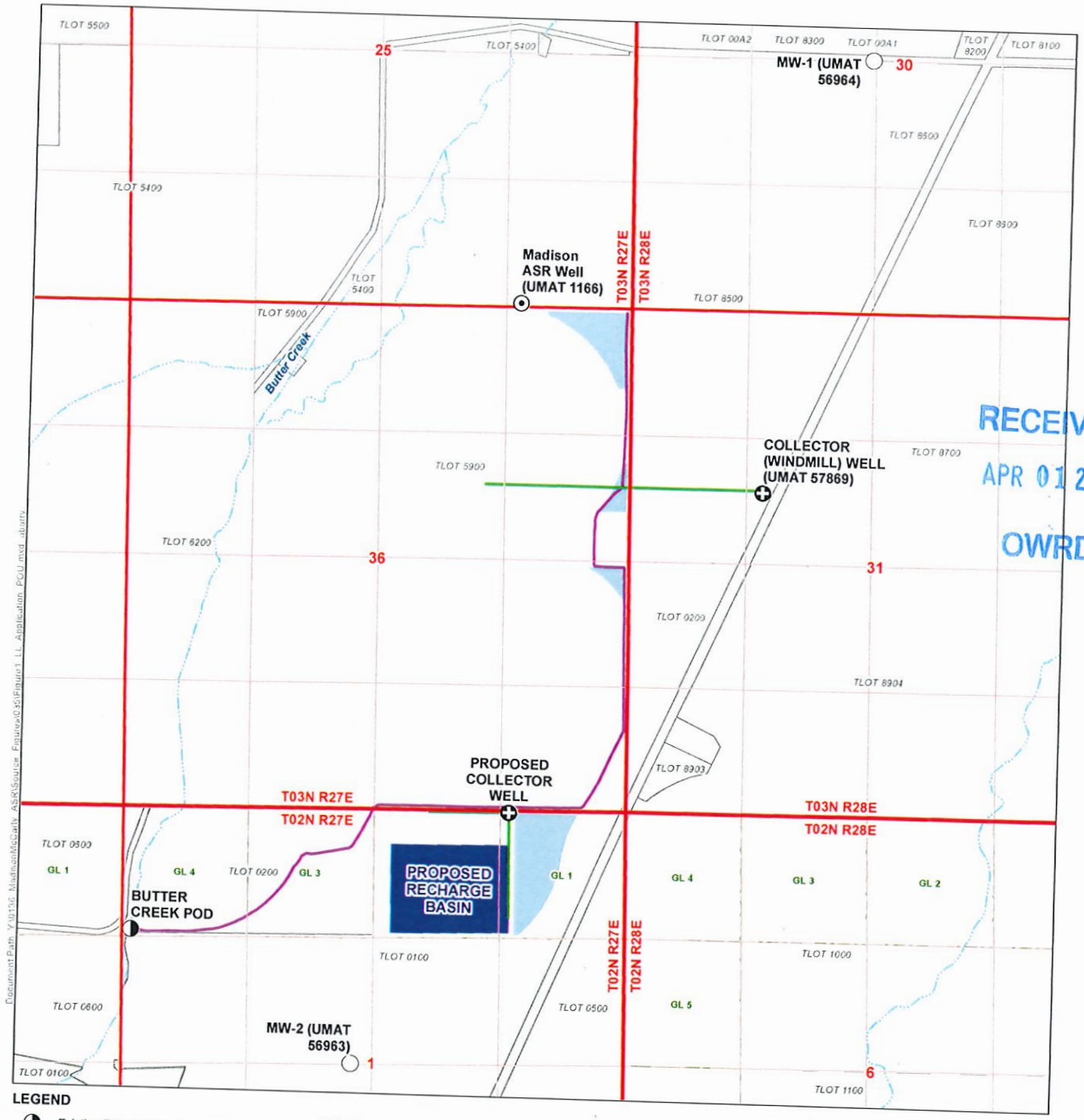
Note to local government representative: Please complete this form or sign the receipt below and return it to the applicant. If you sign the receipt, you will have 30 days from the Water Resources Department's notice date to return the completed Land Use Information Form or WRD may presume the land use associated with the proposed use of water is compatible with local comprehensive plans.

Receipt for Request for Land Use Information

Applicant name: _____

City or County: _____ Staff contact: _____

Signature: _____ Phone: _____ Date: _____



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LEGEND

- Existing Point of Diversion (POD)
- Monitoring Well
- Collector Well Sump
- ASR Well
- Place of Use (POU) - Existing Recharge Basin
- Proposed Recharge Basin
- Collector Well Perforated Pipeline
- Irrigation Ditch
- Tax Lot
- Watercourses

FIGURE 1
Limited License Application for Artificial Recharge

Umatilla County
Township 2 & 3 North, Range 27 & 28 East (W.M.)

DISCLAIMER
This map was prepared for the purpose of identifying the location of a water right only and it is not intended to provide legal dimensions or location of property ownership lines.

Date: February 28, 2022
Data Sources: BLM, ESRI, OWRD, USGS, Umatilla Co.

N
0 750 1,500
1 inch = 1,500 feet

GSI Water Solutions, Inc.

LOCATION DESCRIPTION
Butter Creek POD
Located 80 feet North and 100 feet West from the NW corner of the SW NW, Section 1, Township 2 North, Range 27 East (W.M.)

This page to be completed by the local Watermaster.

WATER AVAILABILITY STATEMENT

Name of Applicant: Jake Madison Limited License Number: Recharge app

1. To your knowledge, has the stream or basin that is the source for this application ever been regulated for prior rights? ◉Yes ○No

If yes, please explain:

Butter Creek is regulated annually. Recharge may only occur when there is enough water to satisfy all other existing water rights. This is determined based on calls for water from downstream users. Watermaster may ask recharge diversions to decrease or cease to prevent accumulation rotation system identified in the Butter Creek Management Plan from going into effect.

2. Based on your observations, would be there water available in the quantity and at the times needed to supply the use proposed by this application? ◉ Yes ○ No

3. Do you observe this stream system during regular fieldwork? ◉ Yes ○ No

If yes, what are your observations for the stream?

Seasonal and flashy.

4. If the source is a well and if WRD were to determine that there is the potential for substantial interference with nearby surface water sources, would there still be ground water and surface water available during the time requested and in the amount requested without injury to existing water rights? ○Yes ○No ◉ N/A

What would you recommend for conditions on a limited license that may be issued approving this application?

See question #1

5. Any other recommendations you would like to make?

See question #1

Signature _____ WM District #: 5 Date: 3/31/2022

Hydrologic Feasibility Assessment and Project Description Report

GSI Water Solutions, Inc.

TECHNICAL MEMORANDUM

Madison Ranches Artificial Groundwater Recharge Hydrologic Feasibility Report and Project Description Report

PREPARED FOR:	Jake Madison – Madison Ranches
PREPARED BY:	Robyn Cook, RG, CWRE – GSI Water Solutions, Inc. Bruce Brody-Heine, RG, CWRE – GSI Water Solutions, Inc.
CC:	Jen Woody, RG – Oregon Water Resources Department
DATE:	March 23, 2022

Madison Ranches (Madison) operates an artificial groundwater recharge (AR) program in Echo Junction, Oregon, most recently authorized for diversion and recharge testing by Limited License (LL) #1628 issued by the Oregon Water Resources Department in 2016. LL #1628 expired in April 2021. AR testing at Madison Ranches was initiated in 2002, and to date, a total of over 19,000 acre-feet of water have been diverted from Butter Creek and artificially recharged into Madison's AR basins, as authorized by the LLs listed below:

1. LL #764 2002-2006
2. LL #952 2006-2009
3. LL #1193 2009-2012
4. LL #1442 from 2013 to 2016, and
5. LL #1628 from 2016 to 2021.

Artificially recharged water has been recovered at Madison each year since 2012, authorized by the following limited licenses:

- LL 1424 in 2012,
- LL 1452 in 2013,
- LL 1510 in 2014,
- LL 1553 in 2015,
- LL 1615 in 2016,
- LL 1684 in 2017,
- LL-1717 in 2018, and

6. LL-1772 in 2019.

This technical memorandum contains project information required to apply for a new LL for continued AR testing. Testing is proposed to continue under the same conditions set by the previous LLs, and given the successful history of this project, Madison requests that the duration of the new

LL be set at five years, the maximum LL duration, with the understanding that the LL may be modified if unforeseen conditions develop.

AR testing has been successful and in our opinion, resulted in no negative impacts to the shallow alluvial groundwater system underlying the recharge basin. The purpose of continued testing under an LL is to evaluate infiltration characteristics of the existing and proposed expanded recharge area and to continue evaluating the shallow aquifer water level response to AR. In many respects, this artificial recharge program is an enhancement of flood irrigation practices that have been ongoing in the area for more than 100 years, so no negative impacts are expected. Based on the data collected to date, it is our opinion that the AR project actually results in improved shallow groundwater quality because the water quality of the Butter Creek recharge source is better than the underlying shallow groundwater quality.

In 2002, GSI completed a hydrogeologic feasibility assessment and work plan in support of the first LL application for Madison's AR project (GSI, 2002). This AR LL application proposes to utilize the same recharge basins as used for previous LL applications, but with approximately 26.5 acres of additional recharge basins in close proximity to the current recharge basins, the same additional area that was proposed in the previous LL application (GSI, 2016). Because the geology and feasibility information for the new recharge area is not significantly different, most of the information in this memorandum is based on the information and findings in previous LL applications. The monitoring plan proposed in this LL application is similar to the monitoring plan utilized under the previous LL, with some specific changes noted.

1. Project Description and System Design

The Madison AR program involves diverting winter/spring stream flows from Butter Creek to a series of recharge basins on Madison property (Figure 1). The combined area of the operational recharge basins is approximately 18.3 acres, and an additional 15-acre recharge basin on the southern end of the operational recharge basin system is being included in this application. The new recharge basin will likely be constructed in 2022 and 2023. Measurement devices will be installed in in the new basin. The following sections describe the AR system design and proposed operation. Most project infrastructure is in place and was utilized for AR testing under LL #1628.

Diversion and Recharge

The locations of the project diversion structure, conveyance, and recharge basins are shown on Figure 1. A 42-inch Palmer-Bowlus automatically operated diversion structure and flume are installed at the Butter Creek point of diversion. The flume (manufactured by Plasti-Fab) can measure flow between approximately 0.48 cubic feet per second (cfs) and 58 cfs. A second 30-inch flume is installed at the entrance to the recharge basins. Specifications for the flume and diversion structures are included in Attachment A. This system was installed and utilized for testing under Madison's previous AR LLs. As with previous AR LLs, this LL requests diversion of up to 25 cfs from Butter Creek for AR recharge testing. Specifically, diversion of water from Butter Creek is limited to periods when there is adequate flow in Butter Creek to satisfy all existing water rights and is further limited to times when streamflows are either less than 50 cfs or in excess of 175 cfs. Figure 1 shows diversion, conveyance, and recharge elements of the Madison Farms AR project.

The Madison AR facility is approximately 18.3 acres in size, with recharge previously tested on approximately 15 acres. This application proposes AR testing on an additional 15 acres of land located adjacent to the southern-most recharge basin (Figure 1). Each recharge basin is surrounded

by a 1- to 2-foot-high earthen berm to maintain water inside the recharge area. This application requests the use of a new proposed 15 acre recharge basin in the AR program. Each basin contains a series of cells separated by 20-foot-wide, 1-foot-high berms. Cell sizes range from 0.5 to 3.3 acres (the proposed basin would be the largest single area basin at approximately 15 acres). The cells have been designed so that water entering from the diversion structure fills the first southern-most cell and then the water flows north over the berm into the next cell and so on. The berms are generally covered with grass. The flow entering the recharge basin is manually adjusted so that the height of water in the last cell is maintained below the top of the berm.

Recovery

The existing Madison collector well (also referred to as the Windmill Well) develops shallow groundwater in the vicinity of the recharge basins and is intended to be used for recovery under this LL. The collector well is a horizontal well that is approximately 0.5 miles long and up to 25 feet deep. A 100-hp end suction centrifugal pump and 60-hp booster pump, capable of producing 2,500 gallons per minute (gpm), are located within a vertical pump chamber on the east end of the collector well. Water level and flow rate from the collector well are continuously monitored and data are logged hourly by an automated telemetry system. The well captures alluvial groundwater, moving generally downgradient and parallel to Butter Creek, and recharged water from the AR basins.

This application proposes using a new collector well proposed to be installed adjacent to the new recharge basin and designed to collect water from this basin. This collector well will also be a horizontal well that is approximately 2,200 feet long in an L shape surrounding the new recharge basin (on the north and east edges of the new basin – Figure 1) and up to 25 feet deep. A centrifugal pump and booster pump, capable of producing up to 3,000 gpm, will be located in a vertical pump chamber, located at the bend in the L northeast of the new recharge basin.

In most years, there is a sufficient amount of groundwater in the alluvium during the months of April through June to allow pumping from the collector well. Madison has water right certificates (75107, 83692, 83693, and T-11414) to withdraw up to 2.06 cfs (925 gpm) of native groundwater from the exiting Windmill collector well for irrigation purposes. The Windmill collector well is also used to pump groundwater from the alluvial aquifer for injection into the deep basalt aquifer as part of Madison's ASR project under ASR LL #020, issued by OWRD in 2013 (ASR testing has been conducted since 2006 under LL #014 and #007).

Water levels and flow rates are continuously monitored at the Windmill Well, and data are logged hourly by Madison's telemetry system. A similar system will be installed at the proposed new collector well to log the flow rates at this proposed well. Artificial recharge flow rates and volumes are monitored at flume-type monitoring stations located at the Butter Creek diversion and at the entrance to the recharge basins (including the proposed new recharge basin). Recharge rates and volumes are recorded at the flumes using ultrasonic flow meters and data loggers which are also connected to Madison's telemetry system, allowing for real-time monitoring and data archiving.

2. Hydrologic and Hydrogeologic Characterization

Butter Creek

The Butter Creek drainage basin is a sub-basin of the Umatilla River basin and has its headwaters in the uplands of the Blue Mountains. In the lower portion of the sub-basin, near the Madison property, the topography is characterized by gentle northward sloping plains, dissected in several

locations by geologic structures within the underlying Columbia River Basalt Group (Hogenson, 1964).

Butter Creek is the principal drainage in this area and is typically an intermittent stream. Flow in the creek is derived from snowmelt in the Blue Mountains, precipitation, and irrigation return flow. Creek discharge is greatest during the winter and spring months and generally approaches zero during late summer. Butter Creek provides some recharge to the shallow alluvial aquifer during the rainy season and receives groundwater discharge during late spring and summer months.

Streamflow Data

Butter Creek gauging station #14032000 is located approximately 15 miles upstream from the Madison property. Streamflow data from this gauging station was accessed from OWRD's online database. Figure 2 shows streamflow data from this gauging station over a 27-year period from October 1994 through October 2021. Maximum streamflow during this period was 1,430 cfs recorded on December 31, 1996, and the minimum streamflow of 0 cfs was recorded on August 9-11, 2014 and August 21-23, 2015.

Water Quality

Water quality data collected from Butter Creek were presented in the first AR feasibility report (GSI, 2002), and are included in Attachment B. The data set includes cations and anions, total dissolved solids (TDS), chemical oxygen demand (COD), pH, and temperature, and provides an indication of water quality in the creek during the time of year when diversion for the recharge project would occur. Nitrate concentrations were as high as 6.3 mg/L but were typically less than 3 mg/L. The available data presented in Attachment B indicate that the concentrations of dissolved constituents increase in the summer as expected when flows are lowest. To supplement the historical water quality data, 10 years of alluvial groundwater quality data from the Windmill Well are summarized in Table 1, indicating no degradation of alluvial aquifer water quality resulting from AR activities.

Geology

The subsurface stratigraphy of the Butter Creek Sub-basin generally consists of Holocene and Pleistocene-aged unconsolidated alluvial sediments and Pliocene-aged semi-consolidated alluvial sediments (fanglomerate or the Alkali Canyon Formation) overlying Miocene-aged basalt flows of the Columbia River Basalt Group (CRBG). The recharge basins overlie approximately 30 feet of Holocene-aged unconsolidated alluvial sand and gravel deposits that were deposited by historic Butter Creek. The alluvial deposits are underlain by the CRBG. Each unit is described regionally in greater detail below.

Holocene and Pleistocene sediments

The Holocene deposits consist of locally derived unconsolidated alluvial materials and are located in the flood plains of streams. These materials generally consist of sand, gravel, with some silt and can be up to 50 feet thick (Robinson, 1971).

The Pleistocene sediments are the most widespread surface unit in this area, locally underlying the Holocene deposits in the Butter Creek flood plain. These deposits are associated with the Missoula floods and are generally described as poorly sorted, consisting of sand, gravel and some silt (Robinson, 1971). Maximum thickness of this unit is approximately 200 feet (Robinson, 1971).

Pliocene Fanglomerate (Alkali Canyon Formation)

The Pliocene-aged fanglomerate is a weakly to moderately cemented, poorly sorted, rudely stratified alluvial fan deposit that consists of sand, silt, and basaltic gravel (Hogenson, 1964; Robinson, 1971). In some locations, the gravel is strongly cemented with calcium carbonate (Hogenson, 1964). This unit attains a maximum thickness of 250 feet, but is generally much less (Robinson, 1971).

Miocene basalt

The basaltic lava flows of the CRBG underlie all surface units in the Butter Creek Subbasin. These flows are dense and hard near the base, grading to vesicular and scoriaceous near the top of individual flows (Robinson, 1971). Between some interior flows, up to 100 feet of clay and/or tuffaceous sand layers may be present. Maximum thickness of the CRBG can be up to several thousand feet.

Hydrogeology

Madison Farms is located in a semiarid region that receives approximately 9 inches of precipitation annually and lies within the Butter Creek Critical Groundwater Area (BCCGA). Groundwater pumping from the deep basalt aquifers has been significantly reduced in the BCCGA since its designation in order to mitigate the effects of regional groundwater decline in the basalt aquifer. This section focuses on the characteristics of the shallow aquifer and includes a brief discussion on the basalt aquifer as it relates to the AR project.

Shallow Aquifer

Shallow groundwater occurs within the fanglomerate (Alkali Canyon Formation) and younger alluvial sediments. In some locations, there is perched groundwater of limited extent near Butter Creek. Perched groundwater generally lies within 30 feet of the ground surface and is recharged by Butter Creek and irrigation water (Norton and Bartholomew, 1984). Locally, soil thickness over the top of these deposits ranges from 3 to 12 feet. The static water level near the recharge area is generally 12 feet or more below the ground surface.

Unconfined groundwater also occurs in the lower portion of the alluvial sediments, and is found throughout this area at depths greater than approximately 110 feet. Depth to the top of the alluvial sediments locally ranges from 3 to 12 feet from the ground surface. Recharge is primarily from Butter Creek. Water from this aquifer is pumped from wells greater than 100 feet deep.

Groundwater level in the shallow aquifer generally fluctuates up to 20 feet per year, resulting from natural recharge from Butter Creek, infiltration from up-basin flood irrigation, and groundwater pumping for irrigation. Shallow groundwater in the vicinity of the Madison recharge project generally flows parallel to Butter Creek in a north-northeasterly direction with a gradient of approximately 0.006 ft/ft. The average linear groundwater flow velocity is on the order of 26 feet/year (GSI, 2002).

Two domestic water supply wells were identified in the vicinity of the AR project (GSI, 2002). The closest domestic water supply well (UMAT 1170) is located 1,950 feet to the southwest, generally upgradient of the project. No domestic water supply wells have been negatively impacted by artificial recharge activities to date.

No structures with basements are located nearby that could be affected by the elevated groundwater levels within the alluvial aquifer as a result of artificial recharge activities.

Basalt Aquifer

Historical pumping from the deep Columbia River Basalt Group (CRBG) aquifers has significantly reduced groundwater levels in the basalt aquifer. The shallow aquifer, which relates to the AR project, has not been affected by declining water levels in the basalt aquifer.

The proposed AR project will use a portion of the recovered AR water for ASR injection via Madison's ASR well completed in the CRBG aquifer.

Shallow Soils

Two soil types are present in the current recharge basins and planned additional recharge area. These soils are described in the Umatilla County Soil Survey Report as: (1) 72A-Powder silt loam and (2) 92A-Stanfield silt loam.

Powder silt loam is described as a deep, well-drained soil that typically forms in silty alluvium. Permeability of this soil ranges from 0.6 – 2.0 in/hr (Table 2), with runoff slow and erosion slight. The soil survey report recommends that irrigation water by applied by flood or sprinkler methods to minimize erosion.

Stanfield silt loam is described as a moderately deep, moderately well drained soil that typically forms in silty alluvium. Permeability of this soil also ranges from 0.6 – 2.0 in/hr (Table 2). Runoff is slow, with hazard of water erosion slight. Irrigation water can be applied by flood or sprinkler methods.

Table 2. Physical properties of the soil in the vicinity of the Madison artificial recharge basin. Number in parentheses is the soil map symbol from the Umatilla County Soil Survey Report (Johnson and Makinson, 1988).

Soil name	Depth (in)	Clay (%)	Moist bulk Density (g/cc)	Permeability (in/hr)	Available water capacity (in/in)
Powder (72A)	0-15	10-18	1.25-1.35	0.6-2.0	0.18-0.25
	15-27	10-18	1.30-1.40	0.6-2.0	0.18-0.25
	27-60	10-18	1.40-1.60	0.6-2.0	0.18-0.25
Stanfield (92A)	0-6	10-15	1.25-1.35	0.6-2.0	0.23-0.29
	6-30	10-15	1.30-1.50	0.6-2.0	0.22-0.28

Madison has indicated that the time period required to fill the existing AR recharge basins at 25 cfs is 1 to 2 weeks and that the sustainable rate for maintaining a constant water level in the basins is approximately 12 to 15 cfs (GSI, 2009). The corresponding infiltration rate is 1.3 to 1.7 in/hr over a basin size of 9 acres. This infiltration rate appears to be consistent with the permeability values listed in the soil survey table above, and a similar infiltration rate is expected for the new recharge basins.

Groundwater Quality

As previously stated, alluvial groundwater quality degradation has not been observed since AR testing was initiated utilizing water from Butter Creek. This LL application proposes to continue to use water from Butter Creek for AR. Based on observations from historical AR testing, we do not anticipate any degradation issues in the alluvial groundwater system underlying the existing and proposed Madison AR basins.

Based on historical observations, the Madison AR program has generally improved the alluvial aquifer water quality, specifically with regard to lower TDS and nitrate concentrations in the recharge water (Table 1). As is the case with all recharge basins, periodic maintenance that includes disking and removal of fines will continue to be necessary in order to maintain infiltration capacity. No reductions in soil permeability or impacts to shallow groundwater quality have been observed during the AR testing completed to date.

Hydrogeologic Feasibility Assessment

Based on the local soil and hydrogeologic characteristics, water chemistry data, and the planned recharge system design, operation procedures, and information obtained from previous AR LL testing at the site, it is our professional opinion that the proposed AR project is hydrogeologically feasible. No negative impacts associated with the project, including impacts to alluvial groundwater quality, have been observed or are anticipated in the future.

3. AR Monitoring Plan

The following sections summarize the key components of Madison's AR monitoring plan. The monitoring plan proposed in this LL application is consistent with that approved by OWRD (the approved 2018 monitoring plan is included in Attachment D), which is part of Madison's AR/ASR combined monitoring program. Flow Rate Monitoring

This AR LL application proposes to divert water during periods when Butter Creek flow is less than 50 cfs or greater than 175 cfs and proposes a diversion rate up to 25 cfs. Madison Ranches has installed a telemetry system which allows continuous tracking of artificial recharge flow rates and volumes at the following locations: the diversion on Butter Creek, total recharge into the recharge basins, and recovery from the collector well. This system will be used to track instantaneous rates and cumulative volume during artificial recharge and will provide a summary report of project information on a daily basis. Specifically, the telemetry system will produce a daily report which will display 24 hours of recharge rates, minimum/maximum/average rates for the 24 hour period, cumulative AR storage volume, and net AR storage available for recovery. These reports can be provided to OWRD, if requested.

Water Level Monitoring

Collector Well and Observation Wells

Water level at the Madison collector wells will be continuously monitored with pressure transducers in each well maintained by Madison, and logged on an hourly basis through the telemetry system. The two alluvial monitoring wells installed in the vicinity of the recharge basins (see Figure 1; well logs included in Attachment C) are equipped with pressure transducers, installed in 2015 by OWRD and maintained by OWRD. OWRD collects manual depth-to-water measurements at the two observation wells and at the collector well access port during routine monitoring in the area.

Soil Moisture Monitoring

Madison requested to discontinue the soil moisture monitoring program in the 2016 LL application based on ten years of soil moisture monitoring during AR which consistently demonstrated that Madison AR activities do not create groundwater mounding within 10 feet of ground surface adjacent to the recharge basins. Soil moisture monitoring had coincided with AR testing at the maximum rates and volumes possible, given the limitations of the LLs and the limitations of the soil physical properties. OWRD agreed with this suggestion and it was not required in LL-1628.

Water Quality Monitoring

Nitrate concentrations will be continuously measured by a Hach OptiQuant UV Nitrate Analyzer at the two collector wells during use (typically January to June) associated with the Madison ASR project. Additionally, general water quality parameters (general chemistry, metals, etc.) from the Madison existing and new collector well are evaluated annually as described in the Combined Water Quality Monitoring Plan from 2018 (Attachment D). These data will continue to be provided to OWRD to evaluate water quality changes in the shallow groundwater system that may result from artificial groundwater recharge.

Reporting

Madison proposes to provide a project operations summary report by April 15th each year, which will include information related to the period of recharge, rate of recharge, volume of recharge, water level monitoring, and water quality monitoring.

References

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Table

Table 1. Madison Ranches Windmill Well (Collector Well) Water Quality Data Summary

Analyte	Lowest Regulatory Standard	Limited License Action Level	Units	Regulatory Criteria	MDL*	Source Water Minimum and Maximum Concentration (2006 to 2015)			
						Number of Samples	Number of Detections	Minimum	Maximum Detection
Total Coliform	<1/100 ML	None	CFU/100 mL	MML	1	8	6	ND	770.1
Chloroform (Trichloromethane)	None	None	mg/L	URC	0.0005	12	2	ND	0.0005
Bromodichloromethane	None	None	mg/L	None	0.0005	12	2	ND	0.0005
Dibromochloromethane	None	None	mg/L	None	0.0005	12	2	ND	0.0005
Bromoform (Tribromomethane)	None	None	mg/L	URC	0.0005	12	2	ND	0.0005
Total Trihalomethanes	0.08	0.08	mg/L	MCL, MML	0.0005	12	2	ND	0.0005
Monochloroacetic Acid	None	None	mg/L	None	0.002	12	2	ND	0.002
Dichloroacetic Acid	None	None	mg/L	None	0.001	12	2	ND	0.001
Trichloroacetic Acid	None	None	mg/L	None	0.001	12	2	ND	0.001
Monobromoacetic Acid	None	None	mg/L	None	0.001	12	2	ND	0.001
Dibromoacetic Acid	None	None	mg/L	None	0.001	12	2	ND	0.001
Total Haloacetic Acids	0.06	0.06	mg/L	MCL	0.001	12	2	ND	0.001
Temperature	None	None	Celsius	None	NA	13	13	7.4	13.2
Conductivity	None	None	µS/cm	None	NA	13	13	510	811
Dissolved Oxygen	None	None	mg/L	None	NA	9	9	4.1	12.7
pH	6 - 8.5	6 - 8.5	Units	SMCL	NA	13	13	6.32	7.6
Turbidity	1	0.5	NTU	MCL, MML	NA	7	7	0.21	0.95
ORP	None	None	mV	None	NA	13	13	-385	331
Bicarbonate	None	None	mg/L	None	2	14	14	188	320
Calcium	None	None	mg/L	None	0.1	15	15	38.7	67.4
Chloride	250	250	mg/L	SMCL	0.1-1	15	15	7.39	32.7
Hardness (as CaCO3)	250	None	mg/L	URC	1-4	14	14	119	260
Magnesium	None	None	mg/L	None	0.05-0.1	15	15	13.8	22.3
Nitrate as N	10	9.5	mg/L	MML	0.003-0.5	12	12	3.52	8.99
Total Nitrate-Nitrite	10	9.5	mg/L	MML	0.003-0.5	14	14	3.52	8.99
Potassium	None	None	mg/L	None	0.1	15	15	3.86	6.63
Silica (as SiO2)	None	None	mg/L	None	0.1-0.2	14	14	21.6	54
Silicon	None	None	mg/L	None	0.1-0.2	7	7	19.3	22.2
Sodium	20	None	mg/L	URC (advisory)	0.05-0.1	15	15	35.8	65.9
Sulfate	250	250	mg/L	URC, SMCL	1-5	15	15	26.9	87.2
Total Alkalinity	250	250	mg/L	SMCL	1-2	14	14	188	267
Total Dissolved Solids	500	500	mg/L	SMCL	0.7-10	14	14	305	525
Total Organic Carbon	None	None	mg/L	None	0.1-0.5	14	14	1.45	4.5
Total Suspended Solids	None	None	mg/L	None	1-10	14	5	ND	3.26
Aluminum	0.05	0.05	mg/L	SMCL	0.007-0.05	11	6	ND	0.0849

Analyte	Lowest Regulatory Standard	Limited License Action Level	Units	Regulatory Criteria	MDL*	Source Water Minimum and Maximum Concentration (2006 to 2015)			
						Number of Samples	Number of Detections	Minimum	Maximum Detection
Arsenic	0.05	0.025	mg/L	MCL, MML	0.0009-0.002	13	11	ND	0.002
Barium	1	0.5	mg/L	MCL, MML	0.001-0.05	13	13	0.0634	0.109
Copper	1.3	0.65	mg/L	MCL, MML	0.001-0.005	11	11	0.00154	0.0079
Iron (Total)	None	None	mg/L	None	0.01-0.05	13	9	ND	0.559
Iron (Dissolved)	0.3	0.3	mg/L	SMCL	0.01-0.05	10	6	ND	0.535
Selenium	0.01	0.005	mg/L	MCL, MML	0.0006-0.005	13	5	ND	0.00274
Zinc	5	5	mg/L	SMCL	0.001-0.01	13	8	ND	0.01
Fluoride	2	1	mg/L	MCL, MML, SMCL	0.1-0.5	10	9	ND	0.609
Combined Radium 226/228	5	2.5	pCi/L	MCL, MML	NA	8	6	ND	1.609
Uranium	0.03	0.015	mg.L	MCL	0.001	10	10	0.004	0.00944
Gross Alpha	15	7.5	pCi/L	MCL, MML	NA	10	10	3.7	7.89
Gross Beta	50	25	pCi/L	MML	NA	10	9	ND	8.6
2,4,5-TP (Silvex)	0.01	0.005	mg/L	MCL, MML	0.0004-0.0004	9	2	ND	0.0004
2,4-D	0.07	0.035	mg/L	MCL, MML	0.0001-0.0002	9	2	ND	0.0002
Alachlor	0.002	0.001	mg/L	MCL	0.00005-0.0004	9	2	ND	0.0004
Atrazine	0.003	0.0015	mg/L	MCL	0.00005-0.0002	9	2	ND	0.0002
Benzo[a]pyrene	0.0002	0.0001	mg/L	MCL	0.00002-0.00004	9	2	ND	0.00004
gamma-BHC (Lindane)	0.0002	0.0001	mg/L	MCL, MML	0.00001-0.00004	9	2	ND	0.00004
Carbofuran	0.04	0.02	mg/L	MCL	0.0005-0.002	9	2	ND	0.002
Chlordane	0.002	0.001	mg/L	MCL	0.00005-0.0004	9	2	ND	0.0004
Dalapon	0.2	0.1	mg/L	MCL	0.0001-0.002	9	2	ND	0.002
bis(2-ethylhexyl)phthalate	0.4	0.2	mg/L	MCL	0.0006-0.001	9	3	ND	0.001
bis-2(ethylhexyl)adipate	0.006	0.003	mg/L	MCL	0.0002-0.001	7	2	ND	0.001
1,2-Dibromo-3-chloropropane(DBC	0.0002	0.0001	mg/L	MCL	0.00001-0.00004	9	2	ND	0.00004
Dinoseb	0.007	0.0035	mg/L	MCL	0.0001-0.0004	9	2	ND	0.0004
Diquat	0.02	0.01	mg/L	MCL	0.0004-0.0008	9	2	ND	0.0008
1,2-Dibromoethane (EDB)	0.00005	0.000025	mg/L	MCL	0.00001-0.00002	9	2	ND	0.00002
Endothall	0.1	0.05	mg/L	MCL	0.005-0.01	9	2	ND	0.02
Endrin	0.0002	0.0001	mg/L	MCL, MML	0.00002	9	2	ND	0.0002
Glyphosate	0.7	0.35	mg/L	MCL	0.006-0.01	9	2	ND	0.01
Heptachlor	0.0004	0.0002	mg/L	MCL	0.00001-0.00008	9	2	ND	0.00008
Heptachlor Epoxide	0.0002	0.0001	mg/L	MCL	0.00001-0.00004	9	2	ND	0.00004
Hexachlorobenzene	0.001	0.0005	mg/L	MCL	0.00005-0.0002	9	2	ND	0.0002
Hexachlorocyclopentadiene	0.05	0.025	mg/L	MCL	0.00005-0.0002	9	2	ND	0.0002
Methoxychlor	0.04	0.02	mg/L	MCL, MML	0.00005-0.0002	9	2	ND	0.0002
Polychlorinated Biphenyls (PCBs)	0.0005	0.00025	mg/L	MCL	0.00008-0.0002	9	2	ND	0.0005
Pentachlorophenol	0.001	0.0005	mg/L	MCL	0.00008-0.001	9	2	ND	0.001

Analyte	Lowest Regulatory Standard	Limited License Action Level	Units	Regulatory Criteria	MDL*	*Source Water Minimum and Maximum Concentration (2006 to 2015)*			
						Number of Samples	*Number of Detections*	*Minimum*	*Maximum Detection*
Picloram	0.5	0.25	mg/L	MCL	0.0001-0.0002	9	2	ND	0.0002
Simazine	0.004	0.002	mg/L	MCL	0.00005-0.0001	9	2	ND	0.00015
Toxaphene	0.003	0.0015	mg/L	MCL, MML	0.0005-0.002	9	2	ND	0.002
Vydate (Oxamyl)	0.2	0.1	mg/L	MCL	0.0005-0.004	9	2	ND	0.004
1,1,1-Trichloroethane	0.2	0.1	mg/L	MCL, MML	0.0005	9	2	ND	0.0005
1,1,2-Trichloroethane	0.005	0.0025	mg/L	MCL	0.0005	9	2	ND	0.0005
1,1-Dichloroethene	0.007	0.0035	mg/L	MCL, MML	0.0005	9	2	ND	0.0005
1,2,4-Trichlorobenzene	0.07	0.035	mg/L	MCL	0.0005	9	2	ND	0.0005
1,2-Dichlorobenzene	0.6	0.3	mg/L	MCL	0.0005	9	2	ND	0.0005
1,2-Dichloroethane	0.005	0.0025	mg/L	MCL, MML	0.0005	9	2	ND	0.0005
1,2-Dichloropropane	0.005	0.0025	mg/L	MCL	0.0005	9	2	ND	0.0005
1,4-Dichlorobenzene	0.075	0.0375	mg/L	MCL, MML	0.0005	9	2	ND	0.0005
Benzene	0.005	0.0025	mg/L	MCL, MML	0.0005	9	2	ND	0.0005
Carbon Tetrachloride	0.005	0.0025	mg/L	MCL, MML	0.0005	9	2	ND	0.0005
Chlorobenzene	0.1	0.05	mg/L	MCL	0.0005	9	2	ND	0.0005
cis-1,2-dichloroethene	0.07	0.035	mg/L	MCL	0.0005	9	2	ND	0.0005
Ethylbenzene	0.7	0.35	mg/L	MCL	0.0005	9	2	ND	0.0005
Dichloromethane (methylene chlor	0.005	0.0025	mg/L	MCL	0.0005	9	2	ND	0.0005
Styrene	0.1	0.05	mg/L	MCL	0.0005	9	2	ND	0.0005
Tetrachloroethene	0.005	0.0025	mg/L	MCL	0.0005	9	2	ND	0.0005
Toluene	1	0.5	mg/L	MCL	0.0005	9	2	ND	0.0005
trans-1,2-Dichloroethene	0.1	0.05	mg/L	MCL	0.0005	9	2	ND	0.0005
Trichloroethene	0.005	0.0025	mg/L	MCL, MML	0.0005	9	2	ND	0.0005
Vinyl chloride	0.002	0.001	mg/L	MCL, MML	0.0003-0.0005	9	2	ND	0.0005
Total Xylene	10	5	mg/L	MCL	0.0005-0.0015	9	2	ND	0.0015
Bromoxynil			mg/L		0.0002	5	2	ND	0.2
MCPA			mg/L		0.0002	6	2	ND	0.2
Pronamide			mg/L		0.0002	6	2	ND	0.2
Terbacil			mg/L		0.0002	7	2	ND	0.2

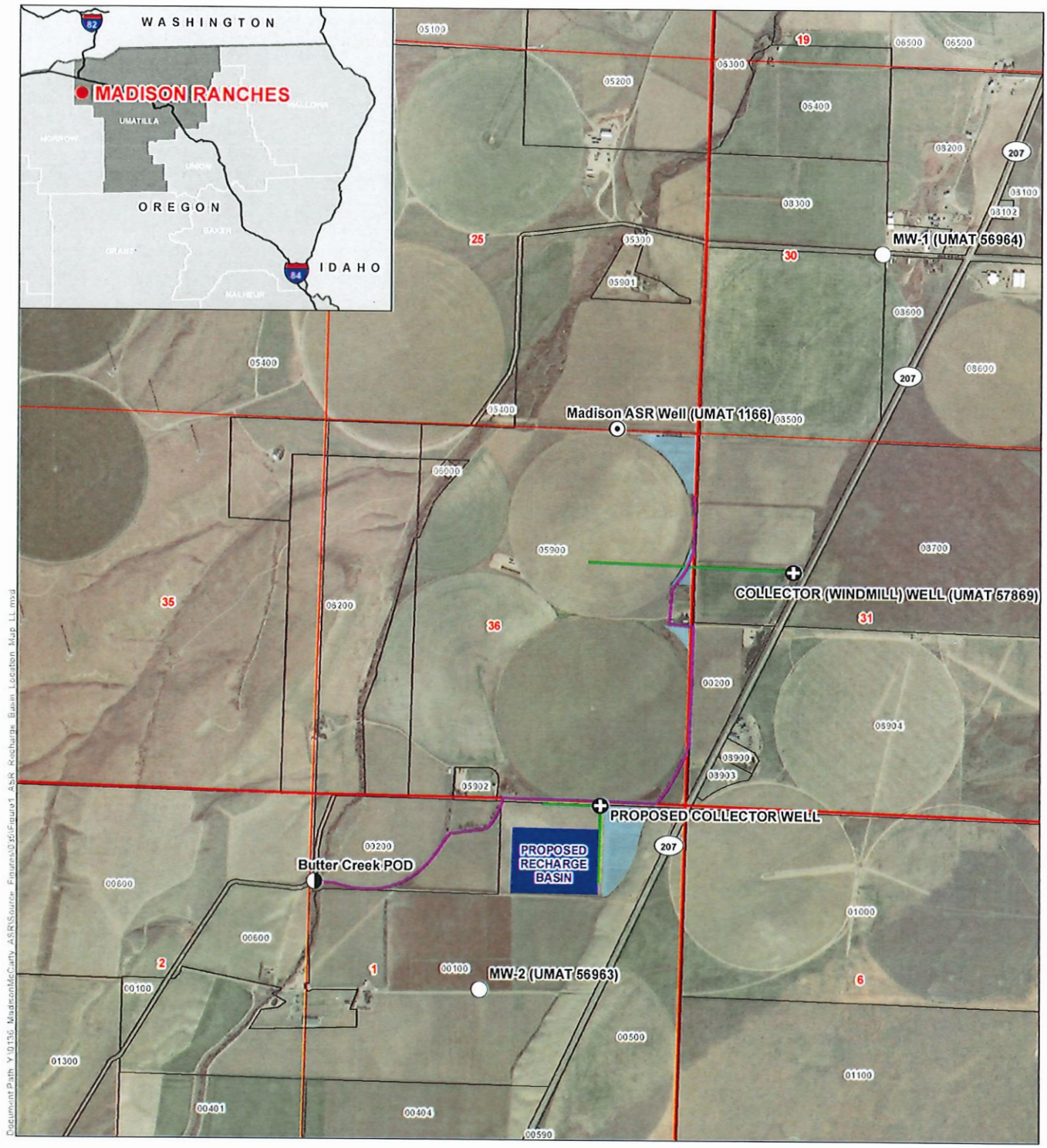
Notes:

*Detection limits vary. See the individual sample reports for specific detection limits.

NA = Not applicable.

ND = Analyte not detected above reporting limit.

Figures



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LEGEND

- Monitoring Well
- Collector Well Sump
- ASR Well
- Butter Creek POD
- Recharge Basin Cells
- Proposed Recharge Basin
- Collector Well Perforated Pipeline
- Madison AR Conveyance
- Tax Lot

Date: March 11, 2022
Data Sources: BLM, ESRI, OWRD, USGS, Umatilla Co., Maxar Imagery (2020)

N

0 1,000 2,000
1 inch = 2,000 feet

GSI Water Solutions, Inc.

FIGURE 1
AR Recharge Project
General Location Map
Madison Ranches

Butter Creek Mean Daily Streamflow
October 1994 - October 2021

Mean daily streamflow measured at OWRD/NWS gauging station #14032000 near Pine City.

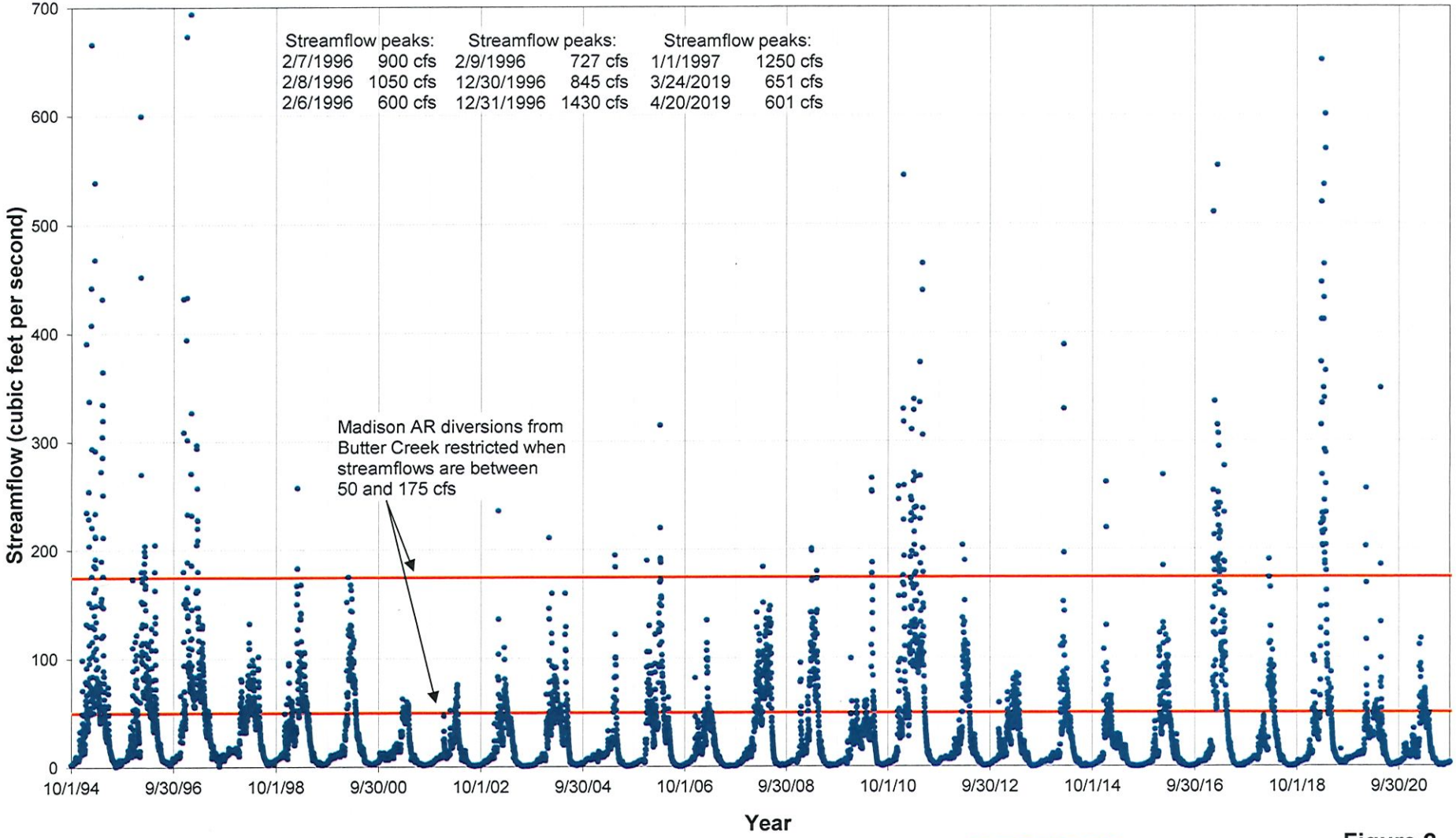


Figure 2
Butter Creek Streamflow

Attachment A

Flume and Diversion Specifications

Plasti-Fab®

9665 S.W. TUALATIN-SHERWOOD ROAD
PO BOX 100 ❖ TUALATIN OR 97062
PHONE: (503) 692-5460 FAX: (503) 692-1145
E-MAIL: sales@plasti-fab.com
WEB: http://www.plasti-fab.com

QUOTATION

Quote #: PQ-A-0206-047
Date: June 10, 2002
Method: **Fax: 541-376-8618**

Attention: Kent Madison
Madison Farms
Hermiston, OR

Phone: 541-376-8107

RE: Butler Creek

QUAN.	DESCRIPTION	PRICE
1 only	42" Palmer-Bowlus flume with approach, staff gage, s/s ultrasonic bracket and FRP caulking collars for 42" dia. corrugated metal pipe.	$ 4,670.00
1 only	30" Palmer-Bowlus flume with approach, staff gage, s/s ultrasonic bracket and FRP caulking collars for 30" dia. corrugated metal pipe.	$ 3,550.00
	Plus Estimated Freight.	$ Included Above
Notes:	1. Information on the Palmer-Bowlus flumes and flow ranges for the two sizes shown are attached. 2. The caulking collar can be sized so that it is larger that the OD of the corrugated pipe. This allows the flume to be leveled independently of any slope in the line. Grout or other form of caulk is used to seal between the collar and flume. 3. Please let me know if you have any questions. You can also contact our area representative, Mr. Jim Fitz with Whitney Equipment Co. in Vancouver, WA. His phone number is 360-694-9175.	

Freight	At cost
Drawings	1-2 wks
Shipping ARA	6-8 wks

SHIP TERMS: FOB our Factory
PAYMENT TERMS: NET 30
TAXES ARE NOT INCLUDED

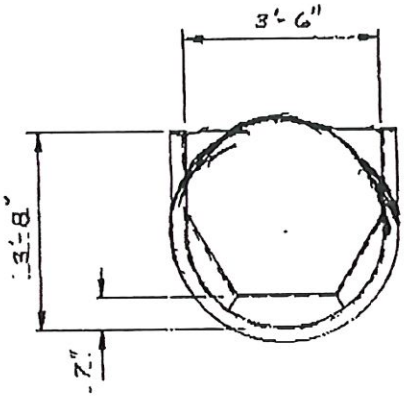
Quoted By: Alan Belyea

(Our representative in your area)
cc: Whitney Equipment Co.

M 3530-C

" FLANGE
L AROUND

NOTES:
1. ¼" MINIMUM WALL THICKNESS TO CONSIST OF ORTHOPHTHALIC POLYESTER RESIN w/30% MIN. GLASS CONTENT, EXCLUSIVE OF RESIN RICH SURFACES.
2. INSIDE SURFACE TO BE SMOOTH WHITE GELCOAT.
3. TEMPORARY WOOD STIFFENERS ACROSS TOP OF FLUME NOT SHOWN.
4. 2" x 2" ANGLE CLIPS ON SIDES (FOR ANCHORING IN CONCRETE) ARE NOT SHOWN.



CUSTOMER:

P.O. NO.
PLASTI-FAB JOB NO.
REP.

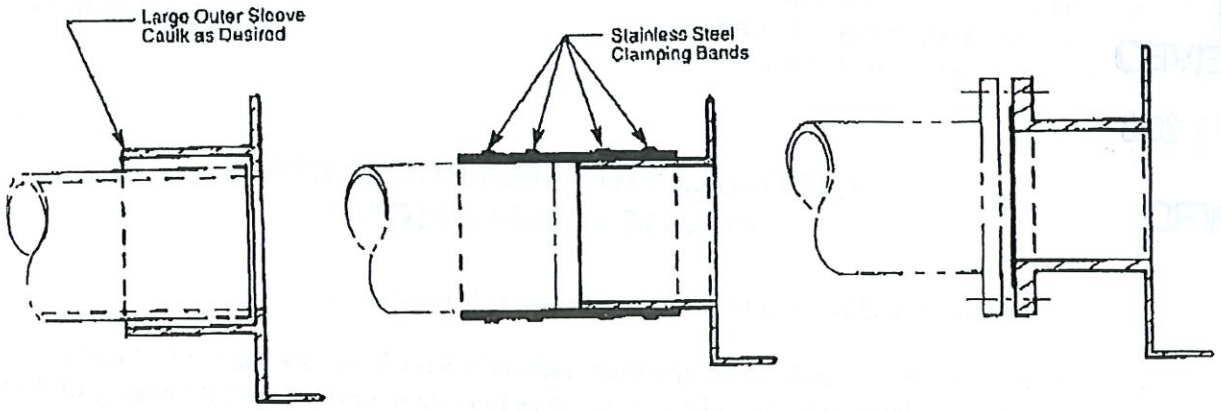
REVISIONS

Plasti-Fab INC
TUALATIN, OREGON

42" PALMER-BOWLUS
w/INTEGRAL APPROACH

DRAWN BY
DATE
SCALE: ½" = 1'-0"

M3530-C



Available for:

CAULKING COLLARS
Collars made 1" to 2" larger than pipe O.D. to allow for some adjustment in leveling flume.

NEOPRENE BOOTS
Boot with stainless steel bands slips over pipe stub, and is sized to match O.D. of connecting pipe.

BOLTED FLANGE
PVC, FRP or Van Stone flanges are available. Other special connections can be supplied when desired.

Plasti-Fab® INC.
P.O. Box 100
Tualatin, Oregon 97062
503/692-5460
FAX 503-692-1145

Plasti-Fab®, INC.

9665 S.W. TUALATIN-SHERWOOD ROAD
PO BOX 100 ❖ TUALATIN OR 97062
PHONE: (503) 692-5460 FAX: (503) 692-1145

E-MAIL: sales@plasti-fab.com
WEB: http://www.plasti-fab.com

INSTALLATION INSTRUCTIONS
PLASTI-FAB FLUMES

1. The flume should be installed level end-to-end and side-to-side.

2. Flume must be cribbed/shored up inside, especially with flumes having a 12" throat or larger, in order to keep the sidewalls plumb and maintain the dimensional integrity of the flume. The throat is the most critical portion of the flume to protect.

3. The top cross ties should be left on the flume until it has been installed. If the flume is set in concrete the cross ties can be removed if desired.

4. Secure the 2" x 2" angle clips on flume to rebar with tie-wire, shove a rod through the clips or at least loop No. 8 wire through the clips to key the flume into the concrete. (Concrete does not bond well to fiberglass).

   The 2" x 2" angle clips are not made to prevent shifting. Additional cross beams and/or bracing, temporarily anchored into the channel wall or adjacent bench, is suggested to prevent possible floating during installation.

   NOTE: Flume **must** remain level both directions.

5. Provide adequate bottom support for flume and approach to prevent settling or shifting.

6. **Alternatives for setting flume:** Plasti-Fab flumes are designed to be free standing, and require no additional external support in order to maintain their dimensional integrity during operation.

   A. The flume can be grouted into a roughed-in concrete channel, either new or existing. Grouting is a preferred form of installation because it lessens the chance of wall deflection.

   B. If the flume is being placed in concrete do not pour the concrete so fast as to bulge the sides and floor of the flume. Excessive use of a vibrator can also cause distortion.

   NOTE: When setting flumes we would recommend that concrete be poured in successive lifts of not more than 6"- 10" per lift.

Plasti-Fab®, INC.

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5. Provide adequate bottom support for flume and approach to prevent settling or shifting.

6. **Alternatives for setting flume:** Plasti-Fab flumes are designed to be free standing, and require no additional external support in order to maintain their dimensional integrity during operation.

   A. The flume can be grouted into a roughed-in concrete channel, either new or existing. Grouting is a preferred form of installation because it lessens the chance of wall deflection.

   B. If the flume is being placed in concrete do not pour the concrete so fast as to bulge the sides and floor of the flume. Excessive use of a vibrator can also cause distortion.

   NOTE: When setting flumes we would recommend that concrete be poured in successive lifts of not more than 6"- 10" per lift.

PLASTI-FAB, INC.

30 inch Palmer-Bowlus Flume Free Flow Discharge

Head (feet)	MGD	CFS	GPM
0.11			
0.12			
0.13	0.14349	0.22201	99.644
0.14	0.16401	0.25380	113.91
0.15	0.18494	0.28614	128.43
0.16	0.20620	0.31904	143.20
0.17	0.22783	0.35251	158.22
0.18	0.24983	0.38654	173.49
0.19	0.27220	0.42110	189.03
0.20	0.29495	0.45636	204.83
0.21	0.31809	0.49216	220.90
0.22	0.34162	0.52857	237.24
0.23	0.36555	0.56558	253.85
0.24	0.38987	0.60322	270.75
0.25	0.41461	0.64149	287.92
0.26	0.43975	0.68040	305.36
0.27	0.46532	0.71995	323.14
0.28	0.49131	0.76016	341.18
0.29	0.51772	0.80103	359.53
0.30	0.54457	0.84256	378.17
0.31	0.57186	0.88480	397.13
0.32	0.59959	0.92771	416.38
0.33	0.62776	0.97132	435.96
0.34	0.65642	1.0156	455.85
0.35	0.68552	1.0607	476.05
0.36	0.71508	1.1061	496.59
0.37	0.74512	1.1529	517.45
0.38	0.77564	1.2001	538.64
0.39	0.80664	1.2481	560.16
0.40	0.83812	1.2968	582.03
0.41	0.87010	1.3463	604.24
0.42	0.90258	1.3965	626.79
0.43	0.93557	1.4475	649.70
0.44	0.96906	1.4994	672.96
0.45	1.0031	1.5520	696.57
0.46	1.0376	1.6054	720.55
0.47	1.0727	1.6596	744.90
0.48	1.1082	1.7147	769.61
0.49	1.1444	1.7706	794.69
0.50	1.1810	1.8273	820.15

Head (feet)	MGD	CFS	GPM
0.51	1.2182	1.8849	845.99
0.52	1.2560	1.9433	872.22
0.53	1.2943	2.0026	898.83
0.54	1.3332	2.0628	925.83
0.55	1.3726	2.1238	953.23
0.56	1.4127	2.1857	981.02
0.57	1.4533	2.2485	1,009.2
0.58	1.4945	2.3123	1,037.8
0.59	1.5362	2.3769	1,066.8
0.60	1.5786	2.4424	1,096.2
0.61	1.6216	2.5089	1,126.1
0.62	1.6651	2.5763	1,156.3
0.63	1.7093	2.6447	1,187.0
0.64	1.7541	2.7140	1,218.1
0.65	1.7995	2.7842	1,249.7
0.66	1.8455	2.8555	1,281.6
0.67	1.8922	2.9277	1,314.0
0.68	1.9395	3.0008	1,346.9
0.69	1.9874	3.0750	1,380.1
0.70	2.0360	3.1501	1,413.9
0.71	2.0852	3.2263	1,448.1
0.72	2.1351	3.3034	1,482.7
0.73	2.1856	3.3816	1,517.8
0.74	2.2368	3.4608	1,553.3
0.75	2.2886	3.5410	1,589.3
0.76	2.3411	3.6222	1,625.8
0.77	2.3943	3.7045	1,662.7
0.78	2.4482	3.7879	1,700.1
0.79	2.5027	3.8722	1,738.0
0.80	2.5579	3.9577	1,776.3
0.81	2.6138	4.0442	1,815.2
0.82	2.6704	4.1318	1,854.5
0.83	2.7277	4.2204	1,894.2
0.84	2.7857	4.3101	1,934.5
0.85	2.8444	4.4010	1,975.3
0.86	2.9038	4.4929	2,016.5
0.87	2.9639	4.5859	2,058.3
0.88	3.0247	4.6800	2,100.5
0.89	3.0863	4.7752	2,143.3
0.90	3.1485	4.8715	2,186.5

1) Pipes/channels larger than flume may cause over discharge up to 3% (as noted in chart for upper flow ranges).

2) Flow ranges are based on meter capability, freeboard allowances and flow studies. Points beyond these may perform satisfactorily.

PLASTI-FAB, INC.

30 inch Palmer-Bowlus Flume Free Flow Discharge

Head (feet)	MGD	CFS	GPM
0.91	3.2115	4.9690	2,230.2
0.92	3.2752	5.0675	2,274.5
0.93	3.3396	5.1672	2,319.2
0.94	3.4048	5.2680	2,364.4
0.95	3.4707	5.3700	2,410.2
0.96	3.5373	5.4730	2,456.5
0.97	3.6047	5.5772	2,503.2
0.98	3.6728	5.6826	2,550.5
0.99	3.7416	5.7891	2,598.3
1.00	3.8112	5.8968	2,646.6
1.01	3.8815	6.0055	2,695.5
1.02	3.9525	6.1155	2,744.8
1.03	4.0244	6.2266	2,794.7
1.04	4.0969	6.3389	2,845.1
1.05	4.1702	6.4523	2,896.0
1.06	4.2443	6.5668	2,947.4
1.07	4.3191	6.6826	2,999.3
1.08	4.3946	6.7995	3,051.8
1.09	4.4709	6.9175	3,104.8
1.10	4.5480	7.0367	3,158.3
1.11	4.6258	7.1571	3,212.3
1.12	4.7043	7.2786	3,266.9
1.13	4.7836	7.4013	3,322.0
1.14	4.8637	7.5252	3,377.5
1.15	4.9445	7.6502	3,433.7
1.16	5.0260	7.7764	3,490.3
1.17	5.1083	7.9037	3,547.4
1.18	5.1914	8.0322	3,605.1
1.19	5.2751	8.1618	3,663.3
1.20	5.3597	8.2926	3,722.0
1.21	5.4449	8.4246	3,781.2
1.22	5.5310	8.5577	3,840.9
1.23	5.6177	8.6919	3,901.2
1.24	5.7052	8.8272	3,961.9
1.25	5.7934	8.9637	4,023.2
1.26	5.8823	9.1013	4,085.0
1.27	5.9720	9.2401	4,147.2
1.28	6.0624	9.3799	4,210.0
1.29	6.1535	9.5209	4,273.3
1.30	6.2454	9.6630	4,337.1

Head (feet)	MGD	CFS	GPM
1.31	6.3379	9.8062	4,401.3
1.32	6.4312	9.9505	4,466.1
1.33	6.5251	10.096	4,531.3
1.34	6.6198	10.242	4,597.1
1.35	6.7152	10.390	4,663.3
1.36	6.8112	10.538	4,730.0
1.37	6.9079	10.688	4,797.2
1.38	7.0054	10.839	4,864.8
1.39	7.1035	10.991	4,933.0
1.40	7.2022	11.143	5,001.5
1.41	7.3016	11.297	5,070.6
1.42	7.4017	11.452	5,140.1
1.43	7.5025	11.608	5,210.0
1.44	7.6039	11.765	5,280.5
1.45	7.7059	11.923	5,351.3
1.46	7.8085	12.082	5,422.6
1.47	7.9118	12.241	5,494.3
1.48	8.0157	12.402	5,566.5
1.49	8.1202	12.564	5,639.1
1.50	8.2254	12.727	5,712.1
1.51	8.3311	12.890	5,785.5
1.52	8.4374	13.055	5,859.3
1.53	8.5443	13.220	5,933.5
1.54	8.6517	13.386	6,008.1
1.55	8.7597	13.553	6,083.2
1.56	8.8683	13.721	6,158.6
1.57	8.9774	13.890	6,234.3
1.58	9.0871	14.060	6,310.5
1.59	9.1973	14.230	6,387.0
1.60	9.3080	14.402	6,463.9
1.61	9.4192	14.574	6,541.1
1.62	9.5309	14.747	6,618.7
1.63	9.6431	14.920	6,696.6
1.64	9.7558	15.095	6,774.9
1.65	9.8690	15.270	6,853.5
1.66	9.9826	15.445	6,932.4
1.67	10.097	15.622	7,011.6
1.68	10.211	15.799	7,091.1
1.69	10.326	15.977	7,171.0
1.70	10.442	16.155	7,251.1

1) Pipes/channels larger than flume may cause over discharge up to 3% (as noted in chart for upper flow ranges).

2) Flow ranges are based on meter capability, freeboard allowances and flow studies. Points beyond these may perform satisfactorily.

PLASTI-FAB, INC.

30 inch Palmer-Bowlus Flume Free Flow Discharge

Head (feet)	MGD	CFS	GPM
1.71	10.557	16.335	7,331.5
1.72	10.674	16.514	7,412.2
1.73	10.790	16.693	7,493.1
1.74	10.907	16.873	7,574.4
1.75	11.024	17.057	7,655.9
*For points listed below please see footnote 1.			
1.76	11.142	17.239	7,737.6
1.77	11.260	17.422	7,819.6
1.78	11.379	17.605	7,901.8
1.79	11.497	17.789	7,984.2
1.80	11.616	17.973	8,066.9
1.81	11.736	18.158	8,149.8
1.82	11.855	18.343	8,232.9
1.83	11.975	18.529	8,316.2
1.84	12.096	18.715	8,399.7
1.85	12.216	18.901	8,483.4
1.86	12.337	19.088	8,567.3
1.87	12.458	19.275	8,651.3
1.88	12.579	19.463	8,735.5
1.89	12.701	19.651	8,819.9
1.90	12.822	19.839	8,904.5
1.91	12.944	20.028	8,989.2
1.92	13.067	20.217	9,074.0
1.93	13.189	20.406	9,159.0
1.94	13.312	20.596	9,244.1
1.95	13.434	20.786	9,329.4
1.96	13.557	20.976	9,414.8
1.97	13.680	21.167	9,500.3
1.98	13.804	21.358	9,585.9
1.99	13.927	21.549	9,671.7
2.00	14.051	21.740	9,757.6
2.01	14.175	21.932	9,843.6
2.02	14.299	22.123	9,929.7
2.03	14.423	22.315	10,016
2.04	14.547	22.508	10,102
2.05	14.672	22.700	10,189
2.06	14.796	22.893	10,275
2.07	14.921	23.086	10,362
2.08	15.046	23.279	10,448
2.09	15.171	23.473	10,535
2.10	15.296	23.666	10,622

Head (feet)	MGD	CFS	GPM
2.11	15.421	23.860	10,709
2.12	15.547	24.055	10,796
2.13	15.673	24.249	10,884
2.14	15.798	24.444	10,971
2.15	15.924	24.639	11,059
2.16	16.051	24.834	11,146
2.17	16.177	25.030	11,234
2.18	16.304	25.226	11,322
2.19	16.431	25.422	11,410

1) Pipes/channels larger than flume may cause over discharge up to 3% (as noted in chart for upper flow ranges).

2) Flow ranges are based on meter capability, freeboard allowances and flow studies. Points beyond these may perform satisfactorily.

PLASTI-FAB, INC.

42 inch Palmer-Bowlus Flume Free Flow Discharge

Head (feet)	MGD	CFS	GPM
0.15			
0.16			
0.17			
0.18	0.28731	0.44453	199.52
0.19	0.31498	0.48735	218.74
0.20	0.34342	0.53135	238.48
0.21	0.37261	0.57651	258.75
0.22	0.40254	0.62282	279.54
0.23	0.43321	0.67028	300.84
0.24	0.46462	0.71887	322.65
0.25	0.49675	0.76859	344.97
0.26	0.52961	0.81943	367.79
0.27	0.56319	0.87138	391.10
0.28	0.59748	0.92444	414.92
0.29	0.63247	0.97858	439.22
0.30	0.66817	1.0338	464.01
0.31	0.70457	1.0901	489.28
0.32	0.74166	1.1475	515.04
0.33	0.77944	1.2060	541.28
0.34	0.81791	1.2655	567.99
0.35	0.85705	1.3261	595.18
0.36	0.89688	1.3877	622.83
0.37	0.93738	1.4503	650.95
0.38	0.97854	1.5140	679.54
0.39	1.0204	1.5788	708.60
0.40	1.0629	1.6445	738.11
0.41	1.1060	1.7113	768.08
0.42	1.1499	1.7791	798.51
0.43	1.1943	1.8479	829.40
0.44	1.2395	1.9177	860.74
0.45	1.2852	1.9886	892.53
0.46	1.3317	2.0604	924.77
0.47	1.3787	2.1332	957.46
0.48	1.4265	2.2071	990.60
0.49	1.4748	2.2819	1,024.2
0.50	1.5238	2.3577	1,058.2
0.51	1.5735	2.4345	1,092.7
0.52	1.6238	2.5123	1,127.6
0.53	1.6747	2.5911	1,163.0
0.54	1.7263	2.6709	1,198.8

Head (feet)	MGD	CFS	GPM
0.55	1.7785	2.7517	1,235.0
0.56	1.8313	2.8334	1,271.7
0.57	1.8848	2.9162	1,308.9
0.58	1.9389	2.9999	1,346.4
0.59	1.9936	3.0846	1,384.5
0.60	2.0490	3.1703	1,422.9
0.61	2.1050	3.2569	1,461.8
0.62	2.1617	3.3446	1,501.2
0.63	2.2190	3.4332	1,540.9
0.64	2.2769	3.5229	1,581.2
0.65	2.3355	3.6135	1,621.8
0.66	2.3947	3.7051	1,663.0
0.67	2.4545	3.7977	1,704.5
0.68	2.5150	3.8913	1,746.5
0.69	2.5761	3.9858	1,789.0
0.70	2.6379	4.0814	1,831.9
0.71	2.7003	4.1780	1,875.2
0.72	2.7634	4.2756	1,919.0
0.73	2.8271	4.3741	1,963.3
0.74	2.8914	4.4737	2,007.9
0.75	2.9565	4.5743	2,053.1
0.76	3.0221	4.6759	2,098.7
0.77	3.0885	4.7786	2,144.8
0.78	3.1555	4.8822	2,191.3
0.79	3.2231	4.9869	2,238.3
0.80	3.2914	5.0926	2,285.7
0.81	3.3604	5.1993	2,333.6
0.82	3.4300	5.3071	2,382.0
0.83	3.5004	5.4159	2,430.8
0.84	3.5714	5.5257	2,480.1
0.85	3.6430	5.6366	2,529.9
0.86	3.7154	5.7486	2,580.1
0.87	3.7884	5.8616	2,630.9
0.88	3.8622	5.9757	2,682.1
0.89	3.9366	6.0908	2,733.7
0.90	4.0117	6.2070	2,785.9
0.91	4.0875	6.3243	2,838.6
0.92	4.1640	6.4427	2,891.7
0.93	4.2413	6.5622	2,945.3
0.94	4.3192	6.6828	2,999.4

1) Pipes/channels larger than flume may cause over discharge up to 3% (as noted in chart for upper flow ranges).

2) Flow ranges are based on meter capability, freeboard allowances and flow studies. Points beyond these may perform satisfactorily.

PLASTI-FAB, INC.

42 inch Palmer-Bowlus Flume Free Flow Discharge

Head (feet)	MGD	CFS	GPM
0.95	4.3978	6.8045	3,054.1
0.96	4.4772	6.9273	3,109.2
0.97	4.5573	7.0512	3,164.8
0.98	4.6381	7.1762	3,220.9
0.99	4.7196	7.3023	3,277.5
1.00	4.8019	7.4296	3,334.6
1.01	4.8849	7.5580	3,392.3
1.02	4.9686	7.6876	3,450.4
1.03	5.0531	7.8183	3,509.1
1.04	5.1384	7.9502	3,568.3
1.05	5.2243	8.0832	3,628.0
1.06	5.3111	8.2175	3,688.3
1.07	5.3986	8.3529	3,749.0
1.08	5.4869	8.4894	3,810.3
1.09	5.5759	8.6272	3,872.2
1.10	5.6657	8.7662	3,934.5
1.11	5.7563	8.9063	3,997.4
1.12	5.8477	9.0477	4,060.9
1.13	5.9398	9.1903	4,124.9
1.14	6.0328	9.3341	4,189.4
1.15	6.1265	9.4791	4,254.5
1.16	6.2211	9.6254	4,320.2
1.17	6.3164	9.7730	4,386.4
1.18	6.4126	9.9217	4,453.2
1.19	6.5095	10.072	4,520.5
1.20	6.6073	10.223	4,588.4
1.21	6.7059	10.376	4,656.9
1.22	6.8054	10.529	4,725.9
1.23	6.9056	10.685	4,795.6
1.24	7.0067	10.841	4,865.8
1.25	7.1086	10.999	4,936.5
1.26	7.2114	11.158	5,007.9
1.27	7.3150	11.318	5,079.8
1.28	7.4194	11.480	5,152.4
1.29	7.5247	11.642	5,225.5
1.30	7.6309	11.807	5,299.2
1.31	7.7379	11.972	5,373.5
1.32	7.8458	12.139	5,448.5
1.33	7.9545	12.307	5,524.0
1.34	8.0641	12.477	5,600.1

Head (feet)	MGD	CFS	GPM
1.35	8.1746	12.648	5,676.8
1.36	8.2860	12.820	5,754.1
1.37	8.3982	12.994	5,832.1
1.38	8.5113	13.169	5,910.6
1.39	8.6253	13.345	5,989.8
1.40	8.7402	13.523	6,069.6
1.41	8.8560	13.702	6,150.0
1.42	8.9727	13.883	6,231.0
1.43	9.0902	14.065	6,312.7
1.44	9.2087	14.248	6,394.9
1.45	9.3280	14.433	6,477.8
1.46	9.4483	14.619	6,561.3
1.47	9.5695	14.806	6,645.5
1.48	9.6915	14.995	6,730.2
1.49	9.8145	15.185	6,815.6
1.50	9.9384	15.377	6,901.7
1.51	10.063	15.570	6,988.3
1.52	10.189	15.765	7,075.6
1.53	10.316	15.960	7,163.6
1.54	10.443	16.158	7,252.1
1.55	10.572	16.357	7,341.3
1.56	10.701	16.557	7,431.2
1.57	10.831	16.758	7,521.6
1.58	10.962	16.961	7,612.7
1.59	11.094	17.166	7,704.5
1.60	11.228	17.372	7,796.9
1.61	11.361	17.579	7,889.9
1.62	11.496	17.787	7,983.6
1.63	11.632	17.998	8,077.8
1.64	11.769	18.209	8,172.8
1.65	11.906	18.422	8,268.3
1.66	12.045	18.636	8,364.5
1.67	12.184	18.852	8,461.4
1.68	12.325	19.069	8,558.9
1.69	12.466	19.288	8,657.0
1.70	12.608	19.508	8,755.7
1.71	12.751	19.729	8,855.1
1.72	12.895	19.952	8,955.1
1.73	13.040	20.176	9,055.7
1.74	13.186	20.402	9,156.9

1) Pipes/channels larger than flume may cause over discharge up to 3% (as noted in chart for upper flow ranges).

2) Flow ranges are based on meter capability, free board allowances and flow studies. Points beyond those may perform satisfactorily.

PLASTI-FAB, INC.

42 inch Palmer-Bowlus Flume Free Flow Discharge

Head (feet)	MGD	CFS	GPM
1.75	13.333	20.629	9,258.8
1.76	13.480	20.857	9,361.3
1.77	13.629	21.087	9,464.4
1.78	13.778	21.318	9,568.2
1.79	13.928	21.551	9,672.5
1.80	14.080	21.784	9,777.5
1.81	14.232	22.020	9,883.1
1.82	14.385	22.256	9,989.3
1.83	14.538	22.494	10,096
1.84	14.693	22.733	10,203
1.85	14.849	22.974	10,312
1.86	15.005	23.216	10,420
1.87	15.162	23.459	10,529
1.88	15.320	23.704	10,639
1.89	15.479	23.950	10,749
1.90	15.639	24.197	10,860
1.91	15.800	24.446	10,972
1.92	15.961	24.695	11,084
1.93	16.123	24.947	11,197
1.94	16.286	25.199	11,310
1.95	16.450	25.452	11,424
1.96	16.615	25.707	11,538
1.97	16.781	25.963	11,653
1.98	16.947	26.221	11,769
1.99	17.114	26.479	11,885
2.00	17.282	26.739	12,001
2.01	17.450	27.000	12,118
2.02	17.620	27.262	12,236
2.03	17.790	27.525	12,354
2.04	17.961	27.790	12,473
2.05	18.133	28.055	12,592
2.06	18.305	28.322	12,712
2.07	18.478	28.590	12,832
2.08	18.652	28.859	12,953
2.09	18.826	29.129	13,074
2.10	19.002	29.400	13,196
2.11	19.178	29.672	13,318
2.12	19.354	29.945	13,440
2.13	19.532	30.220	13,564
2.14	19.709	30.495	13,687
2.15	19.888	30.771	13,811

Head (feet)	MGD	CFS	GPM
2.16	20.067	31.049	13,936
2.17	20.247	31.327	14,061
2.18	20.428	31.606	14,186
2.19	20.609	31.887	14,312
2.20	20.791	32.168	14,438
2.21	20.973	32.450	14,565
2.22	21.156	32.733	14,692
2.23	21.339	33.017	14,819
2.24	21.523	33.302	14,947
2.25	21.708	33.587	15,075
2.26	21.893	33.874	15,204
2.27	22.079	34.161	15,333
2.28	22.265	34.449	15,462
2.29	22.452	34.738	15,592
2.30	22.639	35.028	15,722
2.31	22.827	35.319	15,852
2.32	23.015	35.610	15,983
2.33	23.204	35.902	16,114
2.34	23.393	36.195	16,245
2.35	23.583	36.488	16,377
2.36	23.773	36.782	16,509
2.37	23.964	37.077	16,641
2.38	24.155	37.373	16,774
2.39	24.346	37.669	16,907
2.40	24.538	37.966	17,040
2.41	24.730	38.263	17,174
2.42	24.923	38.561	17,308
2.43	25.116	38.860	17,442
2.44	25.309	39.159	17,576
2.45	25.503	39.459	17,711
*For points listed below please see footnote 1.			
2.46	25.697	39.760	17,845
2.47	25.892	40.061	17,980
2.48	26.087	40.362	18,116
2.49	26.282	40.664	18,251
2.50	26.477	40.966	18,387
2.51	26.673	41.269	18,523
2.52	26.869	41.573	18,659
2.53	27.066	41.877	18,796
2.54	27.263	42.181	18,932
2.55	27.460	42.486	19,069

1) Pipes/channels larger than flume may cause over discharge up to 3% (as noted in chart for upper flow ranges).

2) Flow ranges are based on meter capability, freeboard allowances and flow studies. Points beyond these may perform satisfactorily.

PLASTI-FAB, INC.

42 inch Palmer-Bowlus Flume Free Flow Discharge

Head (feet)	MGD	CFS	GPM
2.56	27.657	42.792	19,206
2.57	27.855	43.097	19,343
2.58	28.053	43.404	19,481
2.59	28.251	43.710	19,619
2.60	28.449	44.017	19,756
2.61	28.648	44.325	19,894
2.62	28.847	44.633	20,033
2.63	29.046	44.941	20,171
2.64	29.246	45.250	20,310
2.65	29.446	45.559	20,448
2.66	29.646	45.869	20,587
2.67	29.846	46.179	20,726
2.68	30.047	46.489	20,866
2.69	30.247	46.800	21,005
2.70	30.449	47.111	21,145
2.71	30.650	47.423	21,285
2.72	30.852	47.735	21,425
2.73	31.054	48.047	21,565
2.74	31.256	48.360	21,705
2.75	31.458	48.673	21,846
2.76	31.661	48.987	21,987
2.77	31.864	49.301	22,128
2.78	32.068	49.616	22,269
2.79	32.271	49.931	22,411
2.80	32.475	50.247	22,552
2.81	32.680	50.563	22,694
2.82	32.884	50.880	22,836
2.83	33.090	51.197	22,979
2.84	33.295	51.515	23,122
2.85	33.501	51.834	23,265
2.86	33.707	52.153	23,408
2.87	33.914	52.472	23,551
2.88	34.121	52.793	23,695
2.89	34.329	53.114	23,839
2.90	34.537	53.436	23,984
2.91	34.745	53.759	24,129
2.92	34.954	54.082	24,274
2.93	35.164	54.407	24,419
2.94	35.374	54.732	24,565
2.95	35.585	55.058	24,712
2.96	35.797	55.385	24,859
2.97	36.009	55.714	25,006
2.98	36.221	56.043	25,154
2.99	36.435	56.373	25,302
3.00	36.649	56.705	25,451
3.01	36.865	57.038	25,600
3.02	37.081	57.372	25,750
3.03	37.297	57.708	25,901
3.04	37.515	58.046	26,052
3.05	37.734	58.383	26,204
3.06	37.954	58.723	26,357
3.07	38.175	59.065	26,510

1) Pipes/channels larger than flume may cause over discharge up to 3% (as noted in chart for upper flow ranges).

2) Flow ranges are based on meter capability, freeboard allowances and flow studies. Points beyond these may perform satisfactorily.

Attachment B

Butter Creek Historical Water Quality Data

Location	Sample Date & Time	Result	Units	Parameter	Suffix_1	Suffix_2	QA_QC_Type	Class	Data_Quality
Butter Creek @ Madison Bridge Off Hwy. 207	4/9/1997 19:12	132	mg/L	Alkalinity			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14:55	270	mg/L	Alkalinity	Field		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14:55	<0.010	mg/L	Aluminum	Dissolved		Sample	Metals	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/12/1996 16:15	0.04	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/9/1997 19:12	0.04	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/23/1997 8:55	0.05	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/23/1997 9:35	0.03	mg/L	Ammonia	Dissolved		Field Duplicate	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/7/1997 10:08	0.04	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/21/1997 9:27	0.04	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/4/1997 10:01	0.06	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/18/1997 14:11	0.31	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/22/1997 10:00	0.02	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/29/1997 9:18	<0.02	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/5/1998 10:59	0.04	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/20/1998 9:35	0.08	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/27/1998 9:52	0.08	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/10/1998 9:50	<0.02	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/17/1998 9:35	0.02	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/24/1998 10:00	0.02	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/3/1998 9:00	0.03	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/10/1998 9:07	0.03	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/17/1998 9:10	0.05	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/23/1998 9:20	0.05	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/31/1998 9:05	0.02	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/6/1998 9:35	0.03	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/14/1998 9:05	0.07	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14:55	0.05	mg/L	Ammonia	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/12/1996 16:15	3	mg/L	Biochemical Oxygen Demand	5 Day	Un-Diluted	Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/12/1996 16:15	3.9	mg/L	Biochemical Oxygen Demand	5 Day	Un-Diluted	Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14:55	0.0411	mg/L	Boron	Dissolved		Sample	Metals	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14:55	53.2	mg/L	Calcium	Dissolved		Sample	Metals	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/12/1996 16:15	6	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/9/1997 19:12	4	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/23/1997 9:35	5	mg/L	Carbon	Total	Organic	Field Duplicate	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/23/1997 8:55	4	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/7/1997 10:08	5	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/21/1997 9:27	12	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/4/1997 10:01	6	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/18/1997 14:11	7	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/15/1997 10:43	4	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/22/1997 10:00	3	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/29/1997 9:18	4	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/5/1998 10:59	4	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/20/1998 9:35	6	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/27/1998 9:52	6	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/10/1998 9:50	6	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/17/1998 9:35	5	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/24/1998 10:00	5	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/3/1998 9:00	3	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/10/1998 9:07	4	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/17/1998 9:10	5	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/23/1998 9:20	4	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/31/1998 9:05	5	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/6/1998 9:35	4	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/14/1998 9:05	8	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14:55	4	mg/L	Carbon	Total	Organic	Sample	Organic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/12/1996 16:15	25	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/9/1997 19:12	10	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/23/1997 9:35	11	mg/L	Chemical Oxygen Demand			Field Duplicate	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/23/1997 8:55	12	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/7/1997 10:08	16	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/21/1997 9:27	10	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/4/1997 10:01	15	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/18/1997 14:11	14	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/15/1997 10:43	6	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/22/1997 10:00	7	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/29/1997 9:18	6	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/5/1998 10:59	7	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/20/1998 9:35	22	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/27/1998 9:52	14	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/10/1998 9:50	12	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/17/1998 9:35	10	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/24/1998 10:00	15	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/3/1998 9:00	10	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/10/1998 9:07	12	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/17/1998 9:10	21	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/23/1998 9:20	24	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/31/1998 9:05	11	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/6/1998 9:35	9	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/14/1998 9:05	24	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14:55	10	mg/L	Chemical Oxygen Demand			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14:55	13	mg/L	Chloride	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/12/1996 16:15	134	CU	Color			Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/9/1997 19:12	20	CU	Color			Sample	Physical	A+

Location	Sample Date & Time	Result	Units	Parameter	Suffix_1	Suffix_2	QA_QC_Type	Class	Data_Quality
Butter Creek @ Madison Bridge Off Hwy. 207	8/12/1996 16.15	194	umhos/cm	Conductivity	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/6/1998 9.35	587	umhos/cm	Conductivity	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14.55	645	umhos/cm	Conductivity	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/9/1997 19.12	333	umhos/cm	Conductivity			Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/15/1997 10.43	597 Est	umhos/cm	Conductivity			Sample	Physical	B
Butter Creek @ Madison Bridge Off Hwy. 207	12/29/1997 9.18	632	umhos/cm	Conductivity			Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/5/1998 10.59	662	umhos/cm	Conductivity			Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/20/1998 9.35	335	umhos/cm	Conductivity			Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/27/1998 9.52	425	umhos/cm	Conductivity			Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/10/1998 9.50	448	umhos/cm	Conductivity			Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/17/1998 9.35	529	umhos/cm	Conductivity			Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/24/1998 10.00	436	umhos/cm	Conductivity			Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/3/1998 9.00	379	umhos/cm	Conductivity			Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/10/1998 9.07	375	umhos/cm	Conductivity			Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/17/1998 9.10	259	umhos/cm	Conductivity			Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/23/1998 9.20	229	umhos/cm	Conductivity			Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/31/1998 9.05	396	umhos/cm	Conductivity			Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/6/1998 9.35	559	umhos/cm	Conductivity			Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/14/1998 9.05	396	umhos/cm	Conductivity			Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14.55	209	mg/L	Hardness	Dissolved	Calculated	Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14.55	0.0054	mg/L	Iron	Dissolved		Sample	Metals	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/12/1996 16.15	0.7	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/9/1997 19.12	0.5	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/23/1997 9.35	0.6	mg/L	Kjeldahl Nitrogen	Total		Field Duplicate	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/23/1997 8.55	0.6	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/7/1997 10.08	0.6	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/21/1997 9.27	0.8	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/4/1997 10.01	1	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/18/1997 14:11	1.2	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/22/1997 10.00	0.3	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/29/1997 9.18	0.3	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/5/1998 10.59	0.4	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/20/1998 9.35	1.7	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/27/1998 9.52	0.8	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/10/1998 9.50	0.5	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/17/1998 9.35	0.4	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/24/1998 10.00	0.5	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/3/1998 9.00	0.5	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/10/1998 9.07	0.5	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/17/1998 9.10	1	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/23/1998 9.20	1	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/31/1998 9.05	0.5	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/6/1998 9.35	0.4	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/14/1998 9.05	1.1	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14.55	0.6	mg/L	Kjeldahl Nitrogen	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14.55	<0.0010	mg/L	Lanthanum	Dissolved		Sample	Metals	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14.55	0.0105	mg/L	Lithium	Dissolved		Sample	Metals	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14.55	18.5	mg/L	Magnesium	Dissolved		Sample	Metals	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14.55	0.0205	mg/L	Manganese	Dissolved		Sample	Metals	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/12/1996 16.15	0.93	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/9/1997 19.12	1.3	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/23/1997 8.55	1	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/23/1997 9.35	1	mg/L as N	Nitrate/nitrite	Dissolved		Field Duplicate	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/7/1997 10.08	1.3	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/21/1997 9.27	0.94	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/4/1997 10.01	1.1	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/18/1997 14:11	6.3	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/22/1997 10.00	3.7	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/29/1997 9.18	3.8	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/5/1998 10.59	4.1	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/20/1998 9.35	1.3	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/27/1998 9.52	3	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/10/1998 9.50	3	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/17/1998 9.35	3.3	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/24/1998 10.00	2.4	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/3/1998 9.00	1.6	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/10/1998 9.07	1.7	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/17/1998 9.10	0.75	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/23/1998 9.20	0.53	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/31/1998 9.05	2.4	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/6/1998 9.35	3.6	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/14/1998 9.05	2	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14.55	4.8	mg/L as N	Nitrate/nitrite	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14.55	0.105	mg/L as P	Orthophosphate	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/9/1997 19.12	8.3	SU	pH	Field		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/23/1997 8.55	7.9	SU	pH	Field		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/7/1997 10.08	7.3	SU	pH	Field		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/21/1997 9.27	8.5	SU	pH	Field		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/4/1997 10.01	8.1	SU	pH	Field		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/18/1997 14:11	7.1	SU	pH	Field		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/15/1997 10.43	7	SU	pH	Field		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/22/1997 10.00	7.8	SU	pH	Field		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/29/1997 9.18	7.9	SU	pH	Field		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/6/1998 9.35	7.1	SU	pH	Field		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14.55	7.4	SU	pH	Field		Sample	Inorganic	A+

Location	Sample Date & Time	Result	Units	Parameter	Suffix_1	Suffix_2	QA_QC_Type	Class	Data_Quality
Butter Creek @ Madison Bridge Off Hwy. 207	8/12/1996 16:15	7.2	SU	pH			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/9/1997 19:12	8.3	SU	pH			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/15/1997 10:43	7.7 Est	SU	pH			Sample	Inorganic	B
Butter Creek @ Madison Bridge Off Hwy. 207	12/29/1997 9:18	7.6	SU	pH			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/5/1998 10:59	7.6	SU	pH			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/20/1998 9:35	8.1	SU	pH			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/27/1998 9:52	8.2	SU	pH			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/10/1998 9:50	8.3	SU	pH			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/17/1998 9:35	8.3	SU	pH			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/24/1998 10:00	8.2	SU	pH			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/3/1998 9:00	8.3	SU	pH			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/10/1998 9:07	8.1	SU	pH			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/17/1998 9:10	8	SU	pH			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/23/1998 9:20	8.1	SU	pH			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/31/1998 9:05	8.1	SU	pH			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/6/1998 9:35	7.5	SU	pH			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/14/1998 9:05	8	SU	pH			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/12/1996 16:15	0.22	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/9/1997 19:12	0.05	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/23/1997 9:35	0.13	mg/L as P	Phosphate	Total		Field Duplicate	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/23/1997 8:55	0.13	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/7/1997 10:08	0.09	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/21/1997 9:27	0.13	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/4/1997 10:01	0.19	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/18/1997 14:11	0.2	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/22/1997 10:00	0.12	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/29/1997 9:18	0.12	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/5/1998 10:59	0.2	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/20/1998 9:35	0.54	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/27/1998 9:52	0.35	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/10/1998 9:50	0.16	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/17/1998 9:35	0.13	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/24/1998 10:00	0.15	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/3/1998 9:00	0.14	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/10/1998 9:07	0.16	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/17/1998 9:10	0.39	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/23/1998 9:20	0.32	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/31/1998 9:05	0.13	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/6/1998 9:35	0.12	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/14/1998 9:05	0.3	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14:55	0.14	mg/L as P	Phosphate	Total		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14:55	5.59	mg/L	Potassium	Dissolved		Sample	Metals	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14:55	64.1	mg/L	Sodium	Dissolved		Sample	Metals	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/29/1997 9:18	410	mg/L	Solids	Total	Dissolved	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/5/1998 10:59	440	mg/L	Solids	Total	Dissolved	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/20/1998 9:35	240	mg/L	Solids	Total	Dissolved	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/27/1998 9:52	280	mg/L	Solids	Total	Dissolved	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/10/1998 9:50	270	mg/L	Solids	Total	Dissolved	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/17/1998 9:35	340	mg/L	Solids	Total	Dissolved	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/24/1998 10:00	290	mg/L	Solids	Total	Dissolved	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/3/1998 9:00	250	mg/L	Solids	Total	Dissolved	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/10/1998 9:07	68	mg/L	Solids	Total	Dissolved	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/17/1998 9:10	190	mg/L	Solids	Total	Dissolved	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/23/1998 9:20	195	mg/L	Solids	Total	Dissolved	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/31/1998 9:05	260	mg/L	Solids	Total	Dissolved	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/6/1998 9:35	370	mg/L	Solids	Total	Dissolved	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/14/1998 9:05	260	mg/L	Solids	Total	Dissolved	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/12/1996 16:15	5	mg/L	Solids	Total	Suspended	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/9/1997 19:12	12	mg/L	Solids	Total	Suspended	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/23/1997 8:55	36	mg/L	Solids	Total	Suspended	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/23/1997 9:35	33	mg/L	Solids	Total	Suspended	Field Duplicate	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/7/1997 10:08	2	mg/L	Solids	Total	Suspended	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/21/1997 9:27	8	mg/L	Solids	Total	Suspended	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/4/1997 10:01	47	mg/L	Solids	Total	Suspended	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/18/1997 14:11	17	mg/L	Solids	Total	Suspended	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/29/1997 9:18	2	mg/L	Solids	Total	Suspended	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/5/1998 10:59	18	mg/L	Solids	Total	Suspended	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/20/1998 9:35	180	mg/L	Solids	Total	Suspended	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/27/1998 9:52	32 Est	mg/L	Solids	Total	Suspended	Sample	Physical	B
Butter Creek @ Madison Bridge Off Hwy. 207	2/10/1998 9:50	22	mg/L	Solids	Total	Suspended	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/17/1998 9:35	6	mg/L	Solids	Total	Suspended	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/24/1998 10:00	20	mg/L	Solids	Total	Suspended	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/3/1998 9:00	41	mg/L	Solids	Total	Suspended	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/10/1998 9:07	34	mg/L	Solids	Total	Suspended	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/17/1998 9:10	280	mg/L	Solids	Total	Suspended	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/23/1998 9:20	206	mg/L	Solids	Total	Suspended	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/31/1998 9:05	11	mg/L	Solids	Total	Suspended	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/6/1998 9:35	6	mg/L	Solids	Total	Suspended	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/14/1998 9:05	65	mg/L	Solids	Total	Suspended	Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14:55	VOID	mg/L	Solids	Total	Suspended	Sample	Physical	C

Location	Sample Date & Time	Result	Units	Parameter	Suffix_1	Suffix_2	QA_QC_Type	Class	Data_Quality
Butter Creek @ Madison Bridge Off Hwy. 207	8/12/1996 16.15	170	mg/L	Solids	Total		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/9/1997 19.12	240	mg/L	Solids	Total		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/23/1997 8.55	230	mg/L	Solids	Total		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/23/1997 9.35	270	mg/L	Solids	Total		Field Duplicate	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/7/1997 10.08	250	mg/L	Solids	Total		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/21/1997 9.27	280	mg/L	Solids	Total		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/4/1997 10.01	300	mg/L	Solids	Total		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/18/1997 14.11	490	mg/L	Solids	Total		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/29/1997 9.18	410	mg/L	Solids	Total		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/5/1998 10.59	450	mg/L	Solids	Total		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/20/1998 9.35	460	mg/L	Solids	Total		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/27/1998 9.52	350	mg/L	Solids	Total		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/10/1998 9.50	320 Est	mg/L	Solids	Total		Sample	Physical	B
Butter Creek @ Madison Bridge Off Hwy. 207	2/17/1998 9.35	370	mg/L	Solids	Total		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/24/1998 10.00	300	mg/L	Solids	Total		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/3/1998 9.00	290	mg/L	Solids	Total		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/10/1998 9.07	100	mg/L	Solids	Total		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/17/1998 9.10	480	mg/L	Solids	Total		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/23/1998 9.20	390	mg/L	Solids	Total		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/31/1998 9.05	280	mg/L	Solids	Total		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/6/1998 9.35	390	mg/L	Solids	Total		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/14/1998 9.05	340	mg/L	Solids	Total		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14.55	460	mg/L	Solids	Total		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14.55	38	mg/L	Sulfate	Dissolved		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/12/1996 16.15	17.3	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/9/1997 19.12	13.5	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/23/1997 9.35	12	°C	Temperature	Field		Field Duplicate	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/23/1997 8.55	11	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/7/1997 10.08	15.3	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/21/1997 9.27	14.5	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/4/1997 10.01	16.3	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/18/1997 14.11	17.6	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/15/1997 10.43	11.2	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/22/1997 10.00	8.2	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/29/1997 9.18	11.9	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/5/1998 10.59	10	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/20/1998 9.35	4.7	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/27/1998 9.52	8.7	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/10/1998 9.50	5.9	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/17/1998 9.35	7.4	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/24/1998 10.00	8.3	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/3/1998 9.00	5.7	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/10/1998 9.07	7.7	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/17/1998 9.10	7.2	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/23/1998 9.20	10.4	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/31/1998 9.05	8.3	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/6/1998 9.35	9.6	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/14/1998 9.05	7.9	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14.55	16.5	°C	Temperature	Field		Sample	Physical	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/21/1997 9.27	NOT	NTU	Turbidity	Field		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/4/1997 10.01	NOT	NTU	Turbidity	Field		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/27/1998 14.55	2.7	NTU	Turbidity	Field		Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	8/12/1996 16.15	20	NTU	Turbidity			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/9/1997 19.12	9	NTU	Turbidity			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/23/1997 8.55	14	NTU	Turbidity			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/23/1997 9.35	12	NTU	Turbidity			Field Duplicate	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/7/1997 10.08	4	NTU	Turbidity			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	5/21/1997 9.27	3	NTU	Turbidity			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/4/1997 10.01	19	NTU	Turbidity			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	6/18/1997 14.11	6	NTU	Turbidity			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/22/1997 10.00	4	NTU	Turbidity			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	12/29/1997 9.18	3	NTU	Turbidity			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/5/1998 10.59	6	NTU	Turbidity			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/20/1998 9.35	143	NTU	Turbidity			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	1/27/1998 9.52	33	NTU	Turbidity			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/10/1998 9.50	15	NTU	Turbidity			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/17/1998 9.35	7	NTU	Turbidity			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	2/24/1998 10.00	12	NTU	Turbidity			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/3/1998 9.00	27	NTU	Turbidity			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/10/1998 9.07	27	NTU	Turbidity			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/17/1998 9.10	98	NTU	Turbidity			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/23/1998 9.20	97	NTU	Turbidity			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	3/31/1998 9.05	15	NTU	Turbidity			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/6/1998 9.35	4	NTU	Turbidity			Sample	Inorganic	A+
Butter Creek @ Madison Bridge Off Hwy. 207	4/14/1998 9.05	41	NTU	Turbidity			Sample	Inorganic	A+

Attachment C
Well Logs

UMAT 56963

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-0395)

01-06-2012

WELL LABEL # L 108663

START CARD # 1015655

(1) LAND OWNER

Owner Well I.D. MW-2

First Name KENT Last Name MADISON

Company

Address 29299 MADISON RD

City ECHO State OR Zip 97822

(2) TYPE OF WORK

☒ New ☐ Deepening ☐ Conversion ☐ Alteration (repair/recondition) ☐ Abandonment

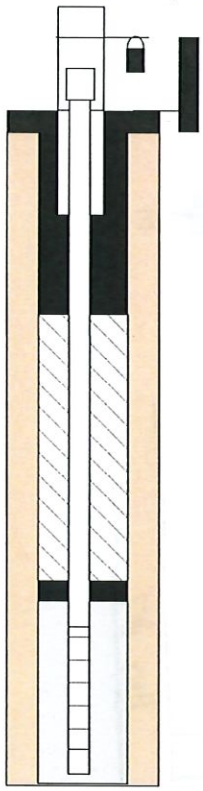
(3) DRILL METHOD

☐ Rotary Air ☒ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud ☐ Reverse Rotary ☐ Other

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well 25 ft. Special Standard ☐



MONUMENT/VAULT Above Ground From 0 To 1

BORE HOLE

Diameter 10 From 0 To 25.5

CASING

Dia. 2 From ☐ 0 To 25

Gauge SCH40 Wld ☐ Thrd ☒

Material ◯ Steel ◉ Plastic

LINER

Dia. From ☐ To

Gauge Wld ☐ Thrd ☐

Material ◯ Steel ◯ Plastic

SEAL

From 1 To 8

Material Bentonite Chips

Amount 6.00 S Grout weight

SCREEN

Casing/Liner Casing Material PVC

Diameter 2 From 10 To 25

Slot Size .010

FILTER

From 8 To 25 Material SCCS Size of pack 10/20

(5) WELL TESTS

◯ Pump ◯ Bailer ◯ Air ◯ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature 56 °F Lab analysis ☐ Yes By

Supervising Geologist/Engineer

Water quality concerns? ☐ Yes (describe below)

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)

County Umatilla Twp 3.00 N N/S Range 28.00 E E/W WM

Sec 30 NE 1/4 of the SW 1/4 Tax Lot 330

Tax Map Number Lot

Lat ° ' " or DMS or DD

Long ° ' " or DMS or DD

◉ Street address of well ◯ Nearest address

28800 MADISON RD, ECHO OR

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+ SWL(ft)
Existing Well / Predeepening			
Completed Well			

WATER BEARING ZONES Flowing Artesian? ☐ Dry Hole? ☐

Depth water was first found

SWL Date	From	To	Est Flow	SWL(psi)	+ SWL(ft)

(8) WELL LOG

Ground Elevation

Material	From	To
SAND	0	13
SAND AND GRAVEL	13	25

RECEIVED
APR 01 2022
OWRD

Date Started 12-28-2012 Completed 12-28-2012

(unbonded) Monitor Well Constructor Certification

I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number 10357 Date 01-06-2012

Electronically Submitted

Signed TERRENCE JACQUES (E-filed)

(bonded) Monitor Well Constructor Certification

I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon monitoring well construction standards. This report is true to the best of my knowledge and belief.

License Number 10357 Date 01-06-2012

Electronically Submitted

Signed TERRENCE JACQUES (E-filed)

Contact Info (optional)

ORIGINAL - WATER RESOURCES DEPARTMENT

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

Map of well

RECEIVED
APR 01 2022
OWRD

Major Drilling Env. Project No. 339 990

Oregon Water Resources Department (OWRD) requires completion of a Geotechnical Hole Report if any of the following apply:

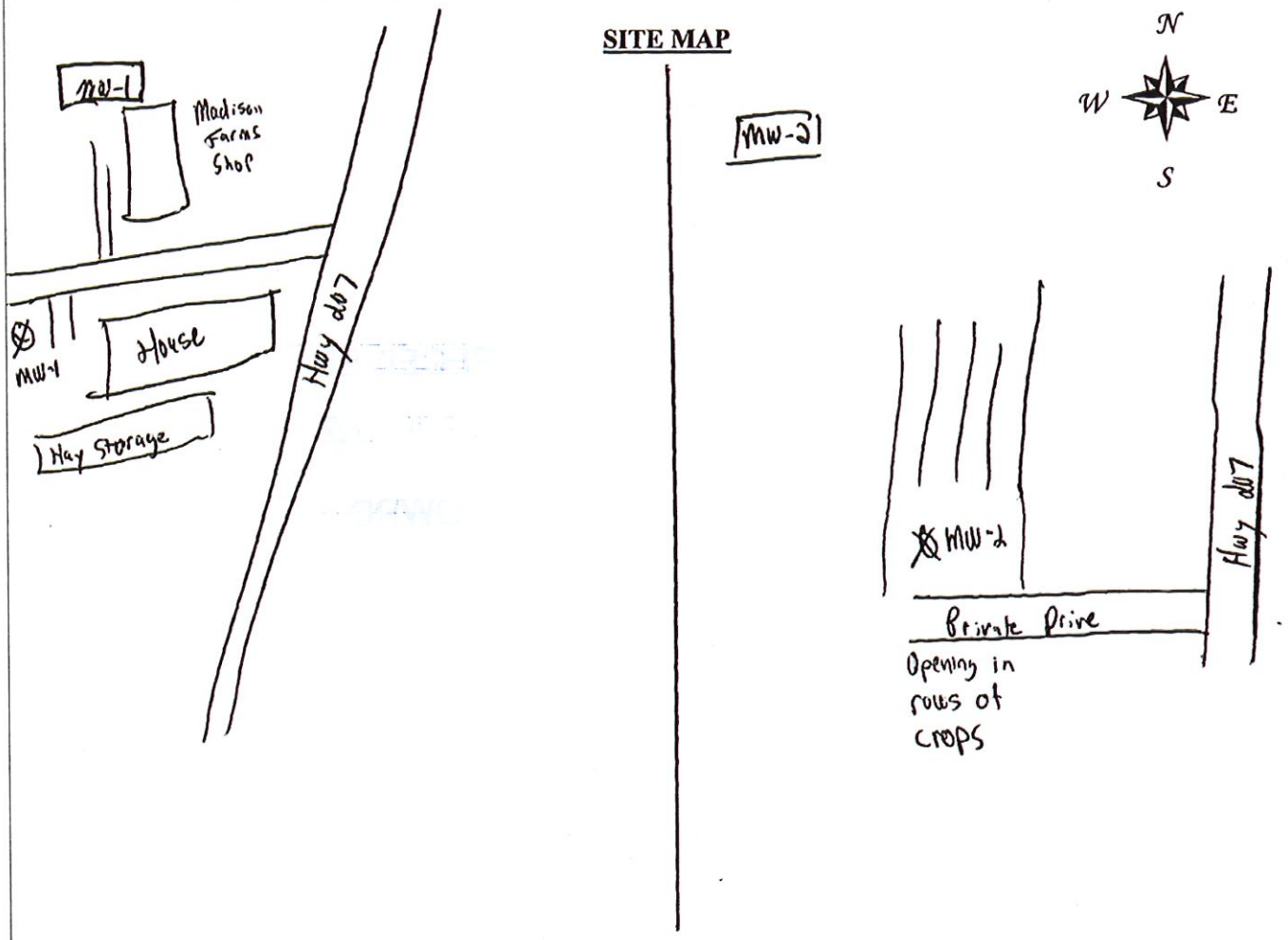
- Geotechnical hole is greater than 18 feet deep;
- Within 50 feet of a water supply or monitoring well;
- Used to make a determination of water quality;
- Constructed in an area of known or reasonably suspected contamination.

In order to comply with OWRD requirements, please provide a Site Map:

Map shall include an approximate scale of north arrow. Upon completion of well activities, a site map with each well location identified must be filed with each Geotechnical Hole Report (OR 690-240-035).

Thank You for your information and assistance on compliance with Oregon Administrative Rules.

SITE MAP



Site Address: _____
Client: _____
Major Drilling Project No.: _____

Scale: 1 Inch = 50 feet

UMAT 56964

01-06-2012

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-0395)

WELL LABEL # L 108662

START CARD # 1015656

(1) LAND OWNER

Owner Well I.D. MW-1

First Name KENT Last Name MADISON

Company

Address 29299 MADISON RD

City ECHO State OR Zip 97822

(2) TYPE OF WORK

☒ New ☐ Deepening ☐ Conversion ☐ Alteration (repair/recondition) ☐ Abandonment

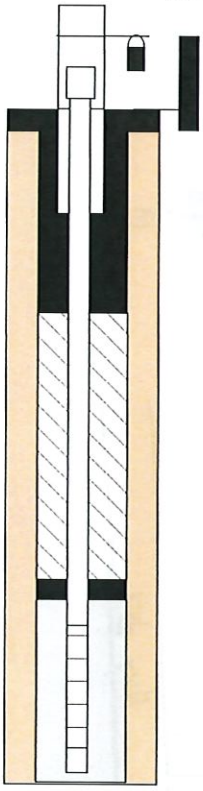
(3) DRILL METHOD

☐ Rotary Air ☒ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud ☐ Reverse Rotary ☐ Other

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well 25 ft. Special Standard ☐



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BORE HOLE
Diameter 10 From 0 To 25.5

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Dia. 2 From 0 To 25
Gauge SCH40 Wld ☐ Thrd ☒
Material ○ Steel ◉ Plastic

LINER
Dia. From To
Gauge Wld ☐ Thrd ☐
Material ○ Steel ○ Plastic

SEAL
From 1 To 8
Material Bentonite Chips
Amount 6.00 S Grout weight

SCREEN
Casing/Liner Casing Material PVC
Diameter 2 From 10 To 25
Slot Size .010

FILTER
From 8 To 25 Material SCCS Size of pack 10/20

(5) WELL TESTS

○ Pump ○ Bailer ○ Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

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Supervising Geologist/Engineer

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From	To	Description	Amount	Units

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Tax Map Number Lot

Lat ° ' " or DMS or DD

Long ° ' " or DMS or DD

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28800 MADISON RD, ECHO OR

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+ SWL(ft)
Existing Well / Predeepening			
Completed Well			

WATER BEARING ZONES Flowing Artesian? ☐ Dry Hole? ☐

Depth water was first found

SWL Date	From	To	Est Flow	SWL(psi)	+ SWL(ft)

(8) WELL LOG

Ground Elevation

Material	From	To
SAND	0	13
SAND AND GRAVEL	13	25

RECEIVED
APR 01 2022
OWRD

Date Started 12-28-2012 Completed 12-28-2012

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License Number 10357 Date 01-06-2012

Electronically Submitted
Signed TERRENCE JACQUES (E-filed)

(bonded) Monitor Well Constructor Certification

I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon monitoring well construction standards. This report is true to the best of my knowledge and belief.

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Electronically Submitted
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Contact Info (optional)

ORIGINAL - WATER RESOURCES DEPARTMENT

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

Map of well

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APR 01 2022
OWRD

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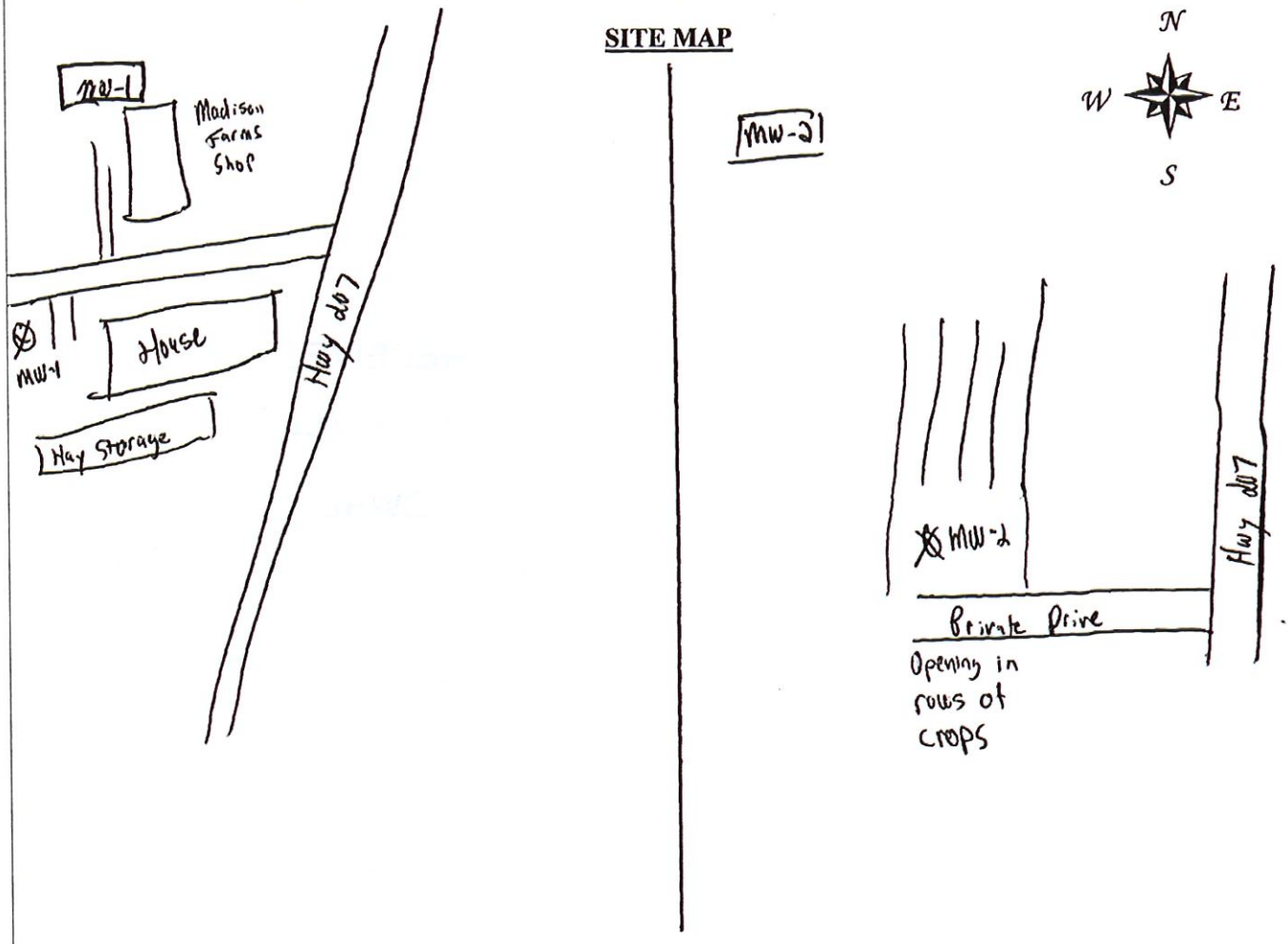
SITE MAP



Site Address: _____
Client: _____
Major Drilling Project No.: _____

Scale: 1 Inch = 50 feet

RECEIVED
APR 01 2022
OWRD

Attachment D

Approved Water Quality Monitoring Program

Madison ASR/AR Combined Water Quality Monitoring Schedule

Updated March 8, 2018

1. End of recovery/before recharge (ASR Requirement) – **1 event, 1 sample:**
   Field parameters are required.
   a. Deep well
      Nitrate only - Kuo
2. Nitrate monitoring during recharge (ASR and AR requirement)
   a. Calibrate the meter once per week. (Professional service twice per year.)
   b. Stop injection if nitrate concentration exceeds 9.5 mg/L. Don't restart until monitoring shows concentrations below 9.25 mg/L, and DEQ and OHA concur.
   c. **Lab samples to verify meter readings – At least 2 events:**
      Nitrate only - Kuo
      i. First week of Recharge: Source water at the meter
      ii. Second week of Recharge: Source water at the meter
      iii. If the meter reads 7 mg/L or higher, collect weekly samples until readings drop below 7 mg/L.
      iv. If the meter reading is outside of the lab result minus 0.33 or plus 1.01 mg/L for 2 weeks in a row, correct the meter.
      v. If the meter reading is outside the range above, and the lab result is greater than 8.5 mg/L, stop injection until the meter is corrected.
3. Middle of Recharge – **1 event, 4 samples:**
   Field parameters are required for every sample.
   a. Windmill well (ASR and AR Requirement)
      Nitrate/Nitrite and Total/Fecal Coliforms to Kuo, others to Anatek
      i. Table B1 most years: 2019, 2020, - , 2022, 2023, - ...
      ii. Table B2 every three years: 2018, 2021, 2024 ...
   b. Monitoring well UMAT 56993 (AR Requirement)
      Total/Fecal Coliforms – Kuo
   c. Monitoring well UMAT 56994 (AR Requirement)
      Total/Fecal Coliforms – Kuo
   d. Butter Creek diversion (AR Requirement)
      Total/Fecal Coliforms – Kuo

55 SW Yamhill Street, Suite 300 Portland, OR 97204 USA P: 503.239.8799 info@gsiws.com www.gsiws.com