Project Completion Report

Grant Number: **G1000357**

Grant Title: **Bertrand Creek Flow Augmentation Project**

Recipient: **Bertrand Watershed Improvement District (BWID)**

Effective Date: **July 1, 2009** **End Date: December 31, 2012**

Final Award Amount: $283,570 **Final Expenditure Amount: $84,748.22**

Summary of Grant (address how each task was completed):

Component 1: Preconstruction Activities

Task 1 - Analysis of Anticipated Benefits to Bertrand Creek Flow Over Time

Deliverable – While the flow increases to Bertrand Creek should equal the amount of groundwater pumped early on during an augmentation event, this increase may decay over time as the effects of groundwater pumping reach the creek. In order to analyze tradeoffs the effects of the proposed augmentation will be modeled using STRMDEPL08 (Reeves, 2008), a one-dimensional, analytical computer code available from the U.S. Geological Survey. The goal of the modeling will be to estimate the amount of flow change over the duration of an irrigation season using a range of aquifer assumptions (transmissivity, storativity, etc.). The work shall include the production of a brief report indicating the modeling conducted and the results, including a graph indicating the predicted effects on the creek (e.g. cfs) versus days since augmentation began for the range of assumed parameters. The report shall also include a discussion of the tradeoffs between s flow increases as a result of augmentation and any flow decreases as a result of the effects of groundwater pumping.

Input parameters for the STRMDEPL08 model will include:

- Hydraulic parameters estimated from aquifer testing in the DeHaan well and other nearby wells.
- A range of stream bed conductance values obtained from the available literature.

Report – A report "Revised Bertrand Creek Flow Augmentation Project - Stream Flow Depletion Evaluation" was prepared that presents an analysis of potential stream flow depletion in Bertrand Creek from the operation of an existing stream flow augmentation well (AW-1) and two proposed augmentation wells (AW-2 and AW-3) located on the DeHaan property. The stream depletion modeling completed using the STREMDPL08 program indicated that a maximum 40 percent of the augmentation water routed to Bertrand Creek would be lost as depletion at the end of a 5-month period of simulated pumping the three augmentation wells at distances ranging from 1,200 feet to 3,000 feet away from the stream channel. The analyses also indicated that stream depletion is sensitive to the distance the wells are located from the stream.

Amended Task Budget: $ 8,120 Amount Expended: $ 8,118.17

Task 2 – Operational Conditions

Deliverable – Conditions to operate the ground water withdrawal to augment flows will be established. The RECIPIENT will obtain a non-consumptive water right development permit to determine how and when the ground water well is to be operated and include any mitigation required in 1 above.

Report - Based on Task 1 above, we worked with the Whatcom Conservation District and the owner of the property which the augmentation well is on to determine a method of which to transport the water to Bertrand Creek while minimizing the impact of the beneficial use of the owners property. We worked with the property owner to determine when farm irrigation would need to occur compared to the times at which flow augmentation would be required. As shown below, the entire amount was not expended. As costs and conditions were examined by the WID Board, a decision was made to hold off on continued efforts. The major hurdle for the Board is who will operate and fund the pumping long term.

Amended Task Budget: $ 6,911 Amount Expended: $ 3,984.87

Task 3 - Obtaining Necessary Easement and Permits for the Construction

Deliverable – The RECIPIENT will negotiate with the property owner(s) of the well, the transmission pipeline and the discharge point(s) to obtain the necessary easements to complete the project.

Report – The decision to not proceed with the original augmentation well due to water quality concerns delayed any need to seek timely permits or easements.

Amended Task Budget: $ 13,000 Amount Expended: $ 50.00

Task 4 – Alternative location documentation

Deliverable – Throughout the summer/fall of 2011 the Bertrand board considered the value of pursuing drilling another well(s) in the McClellan Branch and areas which drain to the Upper Bertrand. There have been multiple wells recently completed in this area yielding encouraging results. Information exists that these wells have significantly lower levels of iron, there are a greater number of tributaries which

help to minimize the length of conveyance systems, and could potentially benefit longer runs of the WDFW identified habitat areas.

Review literature regarding hydrogeologic and water quality conditions within the target area.

Report - For this task we worked with the Department of Ecology Bellingham Field office to locate all documented wells in the study area. We also located undocumented wells. We looked into power availability in the area, property owner cooperative nature, and reasonable points of discharge to the Bertrand system. This body of work was supplemented with the information found in Task 5 below. In Task 5 the water quality and pumping rates of a nearby water association that had recently drilled a replacement well.

Amended Task Budget: $ 7,289 Amount Expended: $ 7,288.46

Task 5 – Feasibility Analysis

Deliverable – Prepare analysis report with conclusions concerning the potential of the project area to develop groundwater resources for the purposes of stream augmentation. Provide recommendations of potential locations for the installation of streamflow augmentation wells.

Report – A Technical Memorandum – "Supplementary Ground Water Augmentation Source Investigation" was developed by the project management team with the cooperation and oversight of the Bertrand board members. The memorandum describes the geologic/hydrogeologic setting of the proposed exploration area and concluded that the pre-Fraser aquifer may have the potential to provide sufficient quantities of augmentation water for the Bertrand WID project.

Amended Task Budget: $ 6,000 Amount Expended: $ 6,000.00

Task 6 – Water Rights Guidance Document

Deliverable - a guidance document that can be used to assist farmers and other surface water users in completing the Washington State Department of Ecology (Ecology) process to transfer a Bertrand Creek surface water right to a ground water withdrawal located within the Bertrand Creek watershed.

Report – "A Farmer's Guide to the Water Right Transfer Process" was developed by the project management team with the cooperation and oversight of the Bertrand board members and assistance of the Dept. of Ecology. The purpose is to have a "how to" manual available to water right holders considering a transfer from surface water to ground water and to policy makers needed information illustrating the difficulties and hurdles inherent in the process.

Amended Task Budget: $ 23,000 Amount Expended: $ 23,292.94

Task 7 – Water Rights Pilot

Deliverable – Make use of the Guidance Document to process one or more requests to convert surface diversions to ground water withdrawals within the Bertrand Watershed. Funds would be used to

facilitate processing of applications to transfer water right place of use and/or new water rights. Funds would not be used to pay for well construction or other infrastructure.

Report – "Water Rights Change/Transfer for MDM Properties, LLC" was developed using the process outlined in the "A Farmer's Guide to the Water Right Transfer Process". The transfer application has been submitted and is currently under Ecology review.

Amended Task Budget: $7,500 Amount Expended: $ 8,907.18

Component 2: Installation and conveyance of groundwater to Bertrand Creek, Jackman Ditch

Task 1 - Well, power, pipeline

Deliverable – The test groundwater well on the DeHaan farm will be upgraded by this project and a 3,500 ft. pipe/hose will deliver the aerated, filtered groundwater through the DeHaan property and into upper Bertrand Creek, directly above the 1.8 mile critical reach. The addition of at least 1 cfs clean, cold ground water to the project reach will increase instream flow, decrease water temperature, improve water quality, and increase the overall availability of wetted juvenile rearing habitat.

Numerous discussions with the Washington State Department of Fish and Wildlife (WDFW) area habitat biologist determined that the best way to increase habitat in the Bertrand system was to discharge the groundwater as close as possible to the main stem of the Bertrand. Previous ideas included the use of existing ditches that would create lengths of habitat. This was later refuted based on logistical hurdles. These hurdles included sustainability of flow. The intent of the groundwater flow augmentation is to supplement Bertrand Creek's flow during periods of low flow. If additional habitat reaches were created as a means to convey the groundwater, they would go dry almost instantaneously after the well was shut off. This has the potential to strand fish utilizing the reaches. The ability to sustain flow in such reaches is not feasible. For this reason the intent is now to install a pipeline from the well to an outfall adjacent to the Main Stem.

Report – No construction activity took place.

Amended Task Budget: $ 111,500 Amount Expended: $ 0

Task 2 - Treatment

Deliverable – The long term test also unveiled the need for an iron treatment system. During this test, high levels of iron were recorded. These levels being significantly higher than those recorded during the 24-hour stepped pump test. This discrepancy remains un-resolved. However, it is apparent that the levels of iron in the groundwater are not conducive to direct discharge into the Bertrand system. Bertrand itself has a measurable amount of iron within the system, but not to the levels found in the

groundwater. Discussions with the WDFW were held to determine the impacts to fish species present in the Bertrand system. The transition of iron from the Fe2+ phase to the Fe3 phase, once oxygenated, is what is detrimental to fish. Furthermore, the deposition of iron bacteria along the drainage ways is not perceived as a benefit. For these reasons it was determined that an iron treatment system would be required, prior to discharge in the surface water system.

Report – The cost of pursuing treatment along with the water quality concerns surrounding iron treatment caused the BWID to place this task 'on hold' and amending the budget to explore Aquifer Verification (Task 4.3).

Amended Task Budget: $ 0 Amount Expended: $ 0

Component 3: Project Administration, Reporting

Task 1 – WID Administration

Deliverable – Quarterly reports and corresponding vouchers; grant completion report detailing progress toward achieving project goals of developing a negotiated instream flow regime, coordinated monitoring plan, and water management MOU.

Report - The overall success of the entire effort to demonstrate the potential of using watershed improvement districts to achieve the purposes and goals of water, wildlife, and land managers depends on the active involvement of the watershed residents and specifically the WID Board of Directors.

The WID ensured that active community involvement occured through a number of activities including: Facilitated the meetings and education of the Board and watershed residents throughout the project. Solicited and summarized feedback on projects from local governments, agencies, Lummi Nation, Nooksack Tribe, wildlife agencies, and local non-profits dedicated to stream restoration. Ensured actions taken have the local support needed to move the WID closer to the goal of a fully functioning natural system that meets the goals of all water, wildlife, and land managers.

Amended Task Budget: $ 12,680 Amount Expended: $ 10,650.00

Task 2 - Project Management Administration

Deliverable – Quarterly reports and corresponding invoices; grant completion report detailing progress toward achieving project goals.

Report – The Project Manager provided timely information to the BWID Board and provided the engineering and engineering advice necessary to assist the board throughout the project. The Project Manager supervised the sub-contractors and reviewed their reports.

Amended Task Budget: $ 25,000 Amount Expended: $ 13,045.08

Component 4: Water Quantity and Quality Monitoring and Reporting

Task 1 – Quality and Quantity Monitoring

Deliverable – Based on the testing performed at the time of installation the technical team will implement an operations plan for the first year of operation. This plan will include a detailed monitoring and data collection plan that will enable a re-evaluation of operations before the next irrigation season. This monitoring plan will include a quality assurance project plan and will address the potential for additional production wells which will enable the REICPIENT to plan funding and construction for the next phase of groundwater augmentation.

The purpose of this task is to monitor stream flow, water temperature, dissolved oxygen (DO), and iron at three (3) locations in the watershed for the duration of ground water augmentation. The three sites are: Bertrand Creek just upstream and downstream of the ground water input, and at the confluence of Bertrand Creek and Jackman Ditch where the Manta water quality probe is located (please see attached map).

Streamflow measurements will be taken at the 3 sites and the difference calculated for seepage run analyses. One seepage run will be conducted prior to start-up of the well and several during the first week of augmentation. Following the start-up sampling phase, seepage data collection will occur on a monthly basis. One final seepage run will be done shortly after the pump has been shut down for the season. The discharge measurements will be taken as scheduled unless the discharge is above 100 cfs at which point wading becomes difficult. In addition, it will be difficult to detect an increase of 1 cfs at flows above 20 or 30 cfs, therefore measurements may not be taken when flows exceed 25 cfs.

Water quality monitoring will include temperature, dissolved oxygen, and iron as these were the key parameters measured during the feasibility phase. Sampling will occur at the 3 sites including once prior to pumping the well, several times during the first week of operation, and then on a monthly basis. In addition, the Manta Probe will be recalibrated and redeployed to collect continuous data on temperature, dissolved oxygen, conductivity, pH, and stage.

Report - As seen below, this body of work did not progress significantly. The small amount of funding spent was to investigate a method of iron removal to treat the existing augmentation well adjacent to Jackman Ditch. Iron removal is viewed as a critical step in implementing the existing augmentation well and one of the major reasons for a water quality monitoring plan. As stated above, upon consideration of the cost of implementation and on-going operation and maintenance, the Board chose to table further expenditure of funds.

Amended Task Budget: $ 22,000 Amount Expended: $ 1,882.75

Task 2 – Quarterly and Final Reporting

Deliverable – The work shall include the production of a report including summary tables of all data collected and an analysis of these data relative to effects on the water quantity (including the tradeoffs between flow increases as a result of augmentation and any flow decreases as a result of the effects of groundwater pumping) and quality in Bertrand Creek.

Report - Final report was generated detailing actions throughout the project period and documents and studies produced with grant dollars.

Amended Task Budget: $ 10,570 Amount Expended: $ 1,529.37

Task 3 – Aquifer verification

Deliverable – Updated technical memorandum which identified the true nature of the aquifer, the prioritization of alternative sites, preliminary cost estimates of conveyance and power facilities. The technical memorandum will include an analysis of anticipated benefits to Bertrand Creek flow over time similar to subtask 1.1 in the original grant agreement, with the following minor changes: 1. The analysis will be performed for a test well that has been found to provide adequate quality and quantity of water for significant augmentation flow, not the DeHaan well, 2. Input parameters will include hydraulic parameters estimated from the new wells aquifer testing. Among other things the analysis will include an evaluation of the extent to which pumping the new well(s) will deplete flows in the creek, with that analysis incorporating use of the U.S.G.S. STRMDEPL model (as described in the October 22, 2010 AES memo) and employing a range of aquifer parameters in instances where assumptions have been made.

Report - No funds were spent on this project due to uncertainty surrounding the wisest course of action to produce the greatest amount of stream augmentation. The focus shifted to surface to groundwater conversions as a more probable augmentation tool.

Amended Task Budget: $ 30,000 Amount Expended: $ 0

Include a list of all reports, maps, plans, and other documents prepared under this grant, indicating for each whether it is in published or unpublished form as defined in the grant. Copies of each document must be submitted to Ecology.

A Farmer's Guide to the Water Right Transfer Process
Water Rights Change/Transfer for MDM Properties, LLC
Technical Memorandum – "Supplementary Ground Water Augmentation Source Investigation
Revised Bertrand Creek Flow Augmentation Project - Stream Flow Depletion Evaluation

			Initial Budget	Revised Budget	TOTAL SPENT	TOTAL AVAILABLE
1	**Preconstruction Activities**					
	Task 1	Analysis of Anticipated Benefits	8,000	8,120	8,118.17	1.83
	Task 2	Operational Conditions	5,000	6,911	3,984.87	2,926.13
	Task 3	Permits, Easements	25,000	13,000	50.00	12,950.00
	Task 4	Alternate location documentation		7,289	7,288.46	0.54
	Task 5	Feasibility Analysis		6,000	6,000.00	0.00
	Task 6	Water Rights Guidance		23,000	23,292.94	-292.94
	Task 7	Water Rights Transfer Pilot		7,500	8,964.41	-1,464.41
Component 1 Total			**38,000**	**71,820**	**57,698.85**	**14,121.15**
2	**Installation and conveyance of groundwater to Bertrand Creek, Jackman Ditch**					
	Task 1	Well, Power, Pipeline	153,000	111,500	0.00	111,500.00
	Task 2	Treatment	30,000	0	0.00	0.00
Component 2 Total			**183,000**	**111,500**	**0.00**	**111,500.00**
3	**Project Administration, Reporting**					
	Task 1	WID Administration	10,000	12,680	10,650.00	2,030.00
	Task 2	Project Manager Administration	20,000	25,000	13,609.34	11,390.66
Component 3 Total			**30,000**	**37,680**	**24,259.34**	**13,420.66**
4	**Water Quantity and Quality Monitoring and Reporting**					
	Task 1	Quality and Quantity Monitoring	22,000	22,000	1,882.75	20,117.25
	Task 2	Quarterly and Final Reporting	10,570	10,570	1,529.37	9,040.63
	Task 3	Aquifer Verification	0	30,000	0.00	30,000.00
Component 4 Total			**32,570**	**62,570**	**3,412.12**	**59,157.88**
	Total		**$283,570**	**283,570**	**85,370.31**	**198,199.69**