Fact Sheet

The U.S. Environmental Protection Agency (EPA)
Proposes to Modify a National Pollutant Discharge Elimination System (NPDES) Permit to Discharge Pollutants Pursuant to the Provisions of the Clean Water Act (CWA) to:

West Boise Wastewater Treatment Facility
City of Boise, Idaho

Public Comment Start Date:
Public Comment Expiration Date:

Technical Contact: John Drabek
206-553-8257
800-424-4372, ext. 8257 (within Alaska, Idaho, Oregon and Washington)
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EPA Proposes NPDES Permit Modification

The EPA proposes to modify the NPDES permit for the facility referenced above. The permit places conditions on the discharge of pollutants from the wastewater treatment plant to waters of the United States. In order to ensure protection of water quality and human health, the permit places limits on the types and amounts of pollutants that can be discharged from the facility. The modification incorporates a pilot offset project to allow the City of Boise (City) to meet the final effluent limits using a combination of plant improvements and treatment of otherwise unregulated non-point source agricultural return flows in Dixie Slough. The offset would require the City to remove more total phosphorus within the watershed than if all phosphorus reductions occurred at the West Boise Wastewater Treatment Facility. The modification includes:

- Effluent concentration limits at the West Boise Wastewater Treatment Facility to prevent localized impact, i.e. prevent concentrations of the Boise River immediately downstream of the West Boise Wastewater Treatment Facility from exceeding 70 µg/L.
- A compliance schedule to construct and operate the Dixie Drain Treatment Facility (Dixie Drain Facility)
- Phosphorus Removal Requirements for the Dixie Drain Treatment Facility
- Monitoring and reporting requirements at both the West Boise and Dixie Drain Treatment Facilities

In addition, the modification revises the interim total phosphorus limit to be measured as a seasonal average instead of a monthly average. The interim total phosphorus modification is unrelated to the Dixie Drain Facility offset project.

This Fact Sheet includes:

- information on public comment, public hearing, and appeal procedures
- a listing of proposed effluent limitations and other conditions that the EPA proposes to

modify
- a map and description of the Dixie Drain Facility and project
- technical material supporting the modification

State Certification
The EPA is requesting that the Idaho Department of Environmental Quality (IDEQ) certify the NPDES permit for this facility, under Section 401 of the Clean Water Act. Comments regarding the certification should be directed to:

IDEQ Boise Regional Office
950 W Bannock, Suite 900
Boise, ID 83702
ph: (208) 373-0550
fx: (208) 373-0287

Public Comment
The EPA is accepting comments only on the modifications. Persons wishing to comment or request a Public Hearing on the modifications may do so in writing by the expiration date of the Public Comment period. A request for a Public Hearing must state the nature of the issues to be raised as well as the requester's name, address and telephone number. All comments and requests for Public Hearings must be in writing and should be submitted to the EPA as described in the Public Comments Section of the attached Public Notice.

After the Public Notice expires, and all comments have been considered, the EPA's Regional Director for the Office of Water and Watersheds will make a final decision regarding the modified permit. The EPA will address any comment received during this comment period before issuing the final permit to the facility. The permit modification will become effective 30 days after the date of issuance, unless an appeal is submitted to the Environmental Appeals Board within 30 days.

Documents are Available for Review
The draft modified NPDES permit and related documents can be reviewed or obtained by visiting or contacting the EPA's Regional Office in Seattle between 8:30 a.m. and 4:00 p.m., Monday through Friday at the address below. The draft permit, fact sheet, and other information can also be found by visiting the Region 10 NPDES website at:
http://yosemite.epa.gov/r10/WATER.NSF/NPDES+Permits/DraftPermitsID

United States Environmental Protection Agency
Region 10
1200 Sixth Avenue, OWW-130
Seattle, Washington 98101
(206) 553-0523 or
Toll Free 1-800-424-4372 (within Alaska, Idaho, Oregon and Washington)

The fact sheet and draft permit are also available at:

EPA Idaho Operations Office
950 W Bannock, Suite 900
Boise, ID 83702
(208) 378-5746

Idaho Department of Environmental Quality
Boise Regional Office
1445 N. Orchard
Boise, ID 83706
ph: (208) 373-0550
fx: (208) 373-0287

I. Introduction

The proposed Dixie Drain Facility offset is a pilot project to construct the Dixie Drain Treatment Facility (Dixie Drain Facility) to remove total phosphorus (phosphorus) from Dixie Slough, an agricultural return drain located downstream from the West Boise Wastewater Treatment Facility (West Boise Facility) (see Figure 1 Location Map in Appendix A). The Dixie Drain Facility is being constructed to offset phosphorus contributions from the West Boise Facility, which would allow the City of Boise (City) to discharge higher phosphorus concentrations from the West Boise Facility. The offset would yield a net environmental benefit by removing more phosphorus on an annual basis (approximately 5,000 lbs/year) from the Boise River and allow the City to treat an unregulated non-point source agricultural return drain.

II. Applicant

The City owns and operates two wastewater treatment facilities: Lander Street Wastewater Treatment Facility (hereafter referred to as the Lander Street facility) and the West Boise Facility. Both facilities treat wastewater from domestic and industrial sources. The discharge from the Lander Street Facility is located at approximately river mile 49.9 on the Boise River. The West Boise Facility discharge is located downstream of the Lander Street Facility at approximately river mile 42 of the Boise River (South Channel around Eagle Island).

The offset project assumes that the two treatment plants will be consolidated to one plant at the West Boise location, i.e. all flows from the Lander Street Facility will flow to the West Boise Facility.

III. Background

On September 6, 2012, the City submitted two Requests for Modification of the West Boise NPDES Permit (ID-002398-1). The first request was to incorporate a Dixie Slough offset for phosphorus limits. The second request was that the interim limit of phosphorus of 500 µg/L be expressed as a seasonal average instead of a monthly average.

The regulations at 40 CFR 122.62 allow for NPDES permits to be modified for cause. In this case, the cause for modification is information that was not available at the time of the current permit's issuance that would have justified the application of different permit conditions at the time of permit issuance if it had been available (40 CFR 122.62(a)(2)). Section II.I., *Modification for Cause*, in the current NPDES permit further defines new information for the Dixie Drain Facility offset project as the following:

- Information supporting a phosphorous offset at the Dixie Slough, including information that would describe the offset, how it would be implemented, measured and monitored.
- Effluent and/or receiving water quality and/or quantity data.
- New water quality modeling analyses, including modeling that demonstrates new phosphorous effluent limits would not adversely affect waters between the City of Boise and the Dixie Slough.

The City's request included new information supporting the phosphorus offset at the Dixie Slough with information that describes the offset, its implementation and suggested

compliance monitoring. The new information justifies modification of the West Boise Permit pursuant to 40 CFR 122.62(a)(2) *Information*.

The information included:

- A written commitment by the City of Boise for the Dixie Drain Facility offset, including a schedule for construction and operation of the facility.
- Performance criteria for the Dixie Drain Facility
- Results of two pilot studies demonstrating phosphorus removal at the Dixie Drain Facility.
- Suggestions on how the offset would be implemented, measured and monitoring.
- Water quality monitoring data for Dixie Drain Facility.
- Flow monitoring data for Dixie Drain Facility
- Cost information for the Dixie Drain Facility and the West Boise Facility Upgrade

Related to the request that the interim phosphorus concentration limit be expressed as a seasonal average instead of a monthly average, the City submitted:

- Modeling and data analysis for phosphorus removal improvements for the West Boise Facility during the interim period prior to achievement of the final phosphorus limit. The submittal indicated that the treatment facility would be incapable of meeting the interim limit on a monthly basis and that a seasonal limit would be more appropriate.

IV. Dixie Drain Facility

A. Project Summary

In December 2009, the City purchased 49 acres near the mouth of Dixie Slough, with the intent of pilot testing a treatment facility to reduce phosphorus from an agricultural return drain to the Boise River. The Dixie Slough was selected because of its high phosphorus load to the Boise River. The City saw the offset project as an opportunity to create a better environmental outcome for the Boise and Snake Rivers and help the City meet part of its phosphorus reduction obligation.

The current West Boise Facility permit includes a final phosphorus effluent limit of 70 µg/L with a compliance schedule to meet that limit within 10 years from the effective date of the permit (by July 31, 2022). Current effluent phosphorus concentrations from the facility are 6,000 µg/L. The City is preparing to upgrade the treatment process to enhanced biological phosphorus removal (EBPR) and cloth filtration. EBPR should provide a phosphorus effluent concentration in the 500 µg/L range. With cloth filtration, the effluent should be in the range of 350 µg/L phosphorus. The City is proposing the offset project to allow the West Boise Facility to discharge at 350 µg/L using EBPR and cloth filtration. The remaining phosphorus would be removed at the Dixie Drain Facility at a ratio of 1.5:1. For each pound of phosphorus the City discharges in excess of 70 µg/L, the City would be required to remove 1.5 pounds of phosphorus at the Dixie Drain Facility. The ratio of 1.5 was determined based on the break-even scenario at which point the Net Present Value (NPV) of the Dixie Drain Facility would be the same as the NPV of upgrading the West Boise Facility to meet an end-

of-pipe limit of 70 µg/L. The break-even scenario provided an incremental phosphorus offset ratio of 1.5:1. Additional detail on the 1.5 ratio is provided in Appendix B and C.

B. Dixie Drain Facility

Dixie Slough is a significant agricultural drain that discharges near the mouth of the Boise River (at Parma). The slough flows continuously. During the summer months, the slough consists of agricultural runoff and groundwater. During the winter months, the slough will also include effluent from the City of Greenleaf Wastewater Treatment Plant. During the summer months the City of Greenleaf Wastewater Treatment Plant will land apply.

Historic average monthly flows from 1986 to 2011 for Dixie Slough are provided in Table 1. The City has applied for a water right of 200 cfs from the Idaho Department of Water Resources of 200 cfs.

Table 1 Dixie Slough Average Flow 1986 - 2011

Month	Average Flow (cfs)
May	231
June	217
July	200
August	197
September	214

Data collected by the USGS in 2000 and 2005 demonstrated a phosphorus concentration of 381 µg/L for the period from May through September. The City of Boise collected phosphorus samples during May through September in 2010 and 2011. Data are summarized in Table 2, which also shows the phosphorus load based on the average monthly flow. The data indicate that, from a historical perspective, the Dixie Slough should have sufficient phosphorus load to sustain the project and meet the City's compliance obligation.

Dixie Slough is a neutral pH, well buffered, water body. Measured pH in the Dixie Slough ranges from 7.6 to 8.4. One hundred fifteen (115) Dixie Slough dissolved aluminum samples were collected and analyzed by the City in 2010 to 2011. Aluminum concentrations were generally below 60 µg/L but concentrations ranged from less than 10 to 319 µg/L.

Table 2 Dixie Slough phosphorus monthly Average Concentration and Load May – September 2010 and 2011

Month	Flow (cfs)	Phosphorus Concentration (µg/L)	Phosphorus Load (lbs/day)
May 2010	259	375	511
June 2010	207	317	354
July 2010	185	379	375
August 2010	229	337	415
September 2010	316	346	589
May 2011	194	296	312
June 2011	233	290	362
July 2011	227	345	423
August 2011	259	341	474
September 2011	293	278	439
Average	240	----	----
Source: City of Boise, 2012			

C. Dixie Drain Facility Treatment Process

The proposed Dixie Drain Facility is an enhanced constructed wetland system. A flow diagram of the project is presented as Figure 2 Appendix A. The treatment process will consist of a sedimentation basin, constructed wetlands, chemical addition and a settling pond.

Influent from Dixie Slough to the treatment facility enters near the southern corner of the property (see Appendix A, Figure 3). An automated remotely controllable inlet structure is designed to allow gravity flow throughout the entire treatment process and control the amount of water which is diverted through the treatment system.

Large sediment particles will settle by gravity in the sedimentation basin before entering the wetland cells. Sediment collected in the sedimentation basin will include phosphorus. Water will discharge from the sedimentation basin through an open channel into the wetland cells. Additional phosphorus will be removed in the wetland cells through additional particle trapping and nutrient uptake by plants. Narrow, serpentine channels will be used to reduce the potential for short circuiting.

Water will discharge from the wetland cells into the rapid mix basin at which point, an aluminum-based flocculant (alum or poly aluminum chloride) will be automatically added to the water on a flow proportionate basis; the water and chemical solution will be mixed vigorously. Aluminum-based flocculants are commonly used coagulants in the water and wastewater industry for precipitation of phosphorus. In the process of coagulation, coagulants are added to destabilize the colloidal state of suspended particles through "charge neutralization" allowing the particles to adhere to each other. The suspended particles can collide and form heavier particles called floc. The modified permit requires aluminum monitoring to determine impacts of alum addition on the receiving water.

The water will then enter the wet settling pond and floc will settle to the bottom of the pond. Floc that has settled to the bottom of the settling basin will be allowed to consolidate for some period of time to reduce the wet floc volume. Periodically, wet floc will be removed from the settling pond and dewatered. Preliminary design anticipates elevated drying beds located on the 13-acre portion of the property on the west side of the slough will be used for floc dewatering.

Design criteria for the Dixie Drain Facility are summarized in Table 3.

Table 3 Dixie Drain Facility Design Criteria

Design Flow	Up to 200 cfs
phosphorus Removal Efficiency	50 – 70%
phosphorus Removed (lbs/day)	Up to 171 lbs/day as a monthly average

Operation by chemical addition and flocculation will occur prior to and after the May 1 through September 30 compliance period for purposes of starting up and closing down the system to meet the seasonal compliance period.

D. Pilot Studies and Conceptual Design

The City has conducted laboratory jar testing and field pilot testing to demonstrate the viability of the technology. The results of this testing demonstrate that the technology has a high degree of success with removal efficiencies ranging from 60 to 75 percent. Follow-up pilot studies in 2011 found improved flocculants achieved 64 to 92 percent phosphorus removal rates. One pilot study result is provided in Appendix E.

In addition, the City looked at design characteristics, including phosphorus removal rates, of similar constructed wetland projects. The following projects were identified:

Constructed Wetland Project	Removal Rate
Orlando Easterly Wetland Treatment System	72
Lake Hancock outfalls treatment System	75
McIntosh Park	60

E. Project Schedule

As part of the modification request, the City identified a commitment to design, permitting, construction, pilot testing, and operation of the Dixie Drain Facility within the current permit cycle, provided that the current permit is modified with the offset.

The permit includes a compliance schedule for construction and operation of the facility by 2016. The compliance schedule requires that the City begin removing an average of 25 lbs per day of phosphorus when the facility begins operation in 2016. These interim removal requirements of 25 lbs per day may not used to offset the interim total phosphorus effluent limits. The City may begin using phosphorus removed at the Dixie Drain Facility to offset the West Boise effluent limits when the final total phosphorus effluent limits for West Boise must be achieved (10 years from the effective date of the permit).

F. Offset

With the offset, the final effluent concentration limits at the treatment plant will vary from 250 to 350 µg/L phosphorus (depending on flows at the West Boise Facility and in the Boise River) instead of the final effluent limit of 70 µg/L phosphorus. The phosphorus discharged from West Boise Facility in excess of 70 µg/L must be removed at 1.5 times that amount from the Dixie Drain Facility. In other words, for each pound of phosphorous the city discharges above 70 µg/L, it must remove 1.5 pounds from the Dixie Slough.

The Dixie Drain Facility must be capable of removing 136 pounds of phosphorus per day. This represents the amount required if the West Boise Facility were discharging at the highest effluent limit to prevent local impact (i.e. 350 µg/L) at a build-out average monthly flow rate of 39.0 mgd. The Dixie Drain Facility would need to remove the difference between 350 µg/L and 70 µg/L, at a 1.5 ratio, i.e.:

$$(350\ \mu g/L - 70\ \mu g/L) \times 8.34 \times 39.0\ mgd\ \times 1.5 \div 1{,}000 = 136\ pounds$$

Based on the Dixie Drain Facility design criteria and historic flows and phosphorus concentrations, the Dixie Slough should be capable of meeting the phosphorus offset requirements.

V. Effluent Limitations

The following summarizes the proposed modified effluent limits in the draft permit.

A. Effluent Limits West Boise Facility

The final phosphorus effluent limits at the West Boise Facility remains at 70 µg/L. The offset allows the permittee to meet the limit through a combination of treatment at West Boise Facility and the Dixie Drain Facility. With the offset, the West Boise facility will be allowed to discharge phosphorus at concentrations that exceed 70 µg/L at the facility outfall. However, the phosphorus concentrations discharged from the West Boise Facility must not cause a local impact downstream of the West Boise Facility. The EPA interprets this as an instream phosphorus concentration in the South Channel of the Boise River that does not exceed 70 µg/L under critical conditions after complete mixing with the flow in the river. To achieve this requirement, the permit includes flow-based average monthly limits at the West Boise Facility ranging from 252 to 350 µg/L phosphorus. Table 2A of the modified permit includes phosphorus limits at West Boise with the Dixie Drain Facility offset, which are also shown below in Table 4. Additional detail on the basis of the effluent concentrations is presented in Appendix B.

Table 4 Concentration Based Permit Limits for West Boise Facility with the Dixie Drain Facility Offset May 1 – September 30 (µg/L)[1]

Average Monthly Effluent Flow West Boise Facility		Average Monthly Flow in S. Channel of Boise River				
		≥ 340 cfs	≥ 310 cfs, but < 350 cfs	≥ 280 cfs, but < 310 cfs	≥ 250 cfs, but < 280 cfs	< 250 cfs
≤ 26 mgd	AML	350	350	350	350	343
	AWL	702	702	702	702	689
> 26 mgd, but ≤ 28 mgd	AML	350	350	350	350	324
	AWL	702	702	702	702	650
> 28 mgd, but ≤ 30 mgd	AML	350	350	350	339	307
	AWL	702	702	702	681	616
> 30 mgd, but ≤ 32 mgd	AML	350	350	350	322	292
	AWL	702	702	702	647	586
> 32 mgd, but ≤ 34 mgd	AML	350	350	336	308	279
	AWL	702	702	674	617	560
> 34 mgd, but ≤ 36 mgd	AML	350	348	321	294	267
	AWL	702	699	645	591	537
> 36 mgd, but ≤ 38 mgd	AML	350	334	308	283	257
	AWL	702	669	618	567	516
> 38 mgd	AML	350	327	302	277	252
	AWL	702	656	606	556	506
AML = Average Monthly Limit AWL = Average Weekly Limit						

B. Off-Set Pounds

For each pound of phosphorus the facility discharges at the West Boise Facility in excess of 70 µg/L, the permittee must remove a minimum of 1.5 pounds of total phosphorus at the Dixie Drain Facility. This may be viewed as an offset ratio:

$$\frac{Pounds\ Removed\ Dixie\ Drain\ Facilty}{Pounds\ Discharged\ at\ West\ Boise\ in\ Excess\ of\ 70\ \mu g/L} > 1.5$$

The pounds of phosphorus the West Boise Treatment Facility discharges in excess of 70 µg/L are calculated as:

$$= (Average\ Monthly\ Effluent\ Concentration - 70) \times Average\ Monthly\ Flow\ \times\ 8.34 \div 1{,}000$$

The pounds of phosphorus removed at the Dixie Drain Facility are calculated as:

$$= (Average\ Monthly\ Influent\ Concentration - Average\ Monthly\ Effluent\ Concentration) \times Average\ Monthly\ Flow\ \times 8.34 \div 1{,}000$$

The following example illustrates how the Dixie Drain Facility offset will work:

West Boise Facility Average Monthly Flow:	26 mgd
West Boise Facility Average Monthly Phosphorus Effluent Concentration:	300 µg/L
Dixie Drain Facility Average Monthly Flow	68 mgd
Dixie Drain Facility Influent Phosphorus Concentration	380 µg/L
Dixie Drain Facility Effluent Phosphorus Concentration	220 µg/L

The pounds of phosphorus the West Boise Treatment Facility discharges in excess of 70 µg/L:

$$= (Average\ Monthly\ Effluent\ Limit - 70) \times Average\ Monthly\ Flow\ \times\ 8.34 \div 1{,}000$$

$$= (300 - 70) \times 26\ \times\ 8.34 \div 1{,}000 = 49.87\ lbs/day$$

Pounds removed at Dixie Drain Facility:

$$= (Average\ Monthly\ Influent\ Concentration - Average\ Monthly\ Effluent\ Concentration) \times Average\ Monthly\ Flow\ \times 8.34 \div 1{,}000$$

$$= (380 - 220) \times 68 \times\ 8.34 \div 1{,}000 = 90.74\ pounds/day$$

Calculation of Offset Ratio:

$$\frac{Pounds\ Removed\ Dixie\ Drain\ Facilty}{Pounds\ Discharged\ at\ West\ Boise\ in\ Excess\ of\ 70\ \mu g/L} = \frac{90.74}{49.87} = 1.82$$

In this hypothetical example, since the offset ratio of 1.82 is greater than 1.5, the permittee would be in compliance.

C. Interim Total Phosphorus Limit

The modified draft permit revises the interim phosphorus concentration to be expressed as a seasonal average instead of a monthly average.

VI. Permit Monitoring

A. West Boise Facility Effluent Monitoring Requirements

The West Boise phosphorus effluent monitoring frequency is unchanged, remaining at once per week.

B. Dixie Drain Facility Monitoring Requirements

Table 5 presents the Dixie Drain Facility monitoring requirements for the permittee in the draft permit modification. These are included as Section I.F of the modified permit. Samples must be collected from both the inflow and outflow channels for the treatment system. Pursuant to Section 401(d) of the Clean Water Act continuous temperature and flow monitoring must also be established in the Dixie Slough above the water diversion structure for the Dixie Drain Facility (See Appendix A, Figure 3 and the Draft 401 Certification).

Table 5 Dixie Drain Facility Monitoring

Parameter	Unit	Sample Frequency	Sample Type
Flow	mgd	Continuous	Recording
pH	s.u.	Continuous	Recording
Total Phosphorus	µg/L	1/week	Grab
Total Phosphorus Removal	lbs/day	Monthly average	Calculation
Total Recoverable Aluminum	µg/l	1/week	Grab
Temperature	ºF	Continuous	Recording
Flocculant Usage	Lbs/year	Report	report
Cost of Treatment	$/year	Report	report

VII. Other Permit Conditions

A. Dixie Drain Facility Compliance Schedule

Condition I.C.4. of the permit is a compliance schedule for design, construction and operation of the Dixie Drain Facility. Construction design of the Dixie Drain Facility must begin by December 1, 2012. The plant must be in operation by May 1, 2016.

Schedules of compliance are authorized by federal NPDES regulations at 40 CFR 122.47(a)(3) and by Section 400.03 of the Idaho Water Quality Standards. The Idaho water quality standards allow for compliance schedules "when new limitations are in the permit for the first time." The federal regulations state when a permit establishes a schedule of compliance which exceeds 1 year from the date of permit issuance, the schedule shall set forth interim requirements and the dates for their achievement. The EPA has included interim requirements and dates for their achievement in the modified permit for the Dixie Drain Facility project.

An interim monthly average removal requirement of 25 pounds per day is required from the Dixie Drain Facility beginning May 1, 2016. The interim phosphorus limits for the West Boise Facility (i.e. of 600 µg/L and 500 µg/L) may not be offset by phosphorus removal at

the Dixie Drain Facility during this interim. The phosphorus offset only applies and is available once the final phosphorus effluent limits for the West Boise Facility are effective (July 1, 2022).

B. West Boise Interim Total Phosphorus Limits

The City submitted a separate request for modification that the interim limit of phosphorus of 500 µg/L be expressed as a seasonal average instead of a monthly average. In response to this request, the interim phosphorus limit of 500 µg/L in the modified permit is revised from a monthly average limit to be expressed as a seasonal average limit beginning in 2017 from May 1 through September 30 and every year thereafter until the final limit is achieved, or until July 1, 2022, whichever is sooner. See Table 3 Effluent Limits and Compliance Dates of the modified permit. This modification is based on new information provided by the City on expected treatment plant performance. See additional information in Appendix B Basis for Effluent Limits and Appendix F, Interim Performance of Treatment Facility.

C. Quality Assurance Plan

Dixie Drain Facility monitoring is required to meet the quality assurance plan in Part I.L. Quality Assurance Plan. A typographical error is corrected in the modified permit on page 19 Part I.F.1.(b) which references the Quality Assurance Plan. The correct reference is Part I.L. not Part II.E.

D. Operation and Maintenance Plan

A requirement for completion of the Operation and Manual for the Dixie Drain Facility is included in the draft permit (see Part I.C.4). Training will be provided for Boise personnel operating the system. Although the system will be completely automatic, site visits are anticipated to be performed at least two to three times each week. At one or more times a year, operators will dredge the wet floc from the settling ponds and transfer the wet floc to the drying area. The dewatered floc will be stockpiled and used on-site or hauled from the site.

Much of the chemical treatment systems will have telemetry. Telemetry equipment for the chemical dosing system will provide provisions to address system power failure, water depth, water flow rate, totalized water flow and chemical feed pump run. The remote monitoring will alert offsite personnel of system problems.

VIII. State Certification

The EPA will request that the IDEQ certify the NPDES permit modification for this facility, under Section 401 of the CWA. Comments regarding the certification should be directed to:

Idaho Department of Environmental Quality
Regional Administrator
Boise Regional Office
1445 N. Orchard St.
Boise, ID 83706-2239

IX. Permit Expiration

The expiration date is unchanged.

X. References

Technical Memorandum, Dixie Drain Phosphorus Removal Project, Update Concept Plan Based on Pilot Test Results, Brown and Caldwell, January 31, 2011

Predicted Effects of Dixie Drain Project on Phosphorus Concentrations in the Boise River, March 2012, Idaho Department of Environmental Quality, USEPA

City of Boise, Request for Modification of the West Boise NPDES Permit (ID-002398-1) to Provide for the Dixie Drain Offset, September 6, 2012

City of Boise, Request for Modification of the West Boise NPDES Permit (ID-002398-1) Interim Phosphorus Limits, September 6, 2012

EPA. 1991. Technical Support Document for Water Quality-based Toxics Control. US Environmental Protection Agency, Office of Water, EPA/505/2-90-001.

City of Boise, Cost Estimate, September, 2012.

Appendix A Dixie Drain Facility Figures

Figure 1. Location Map

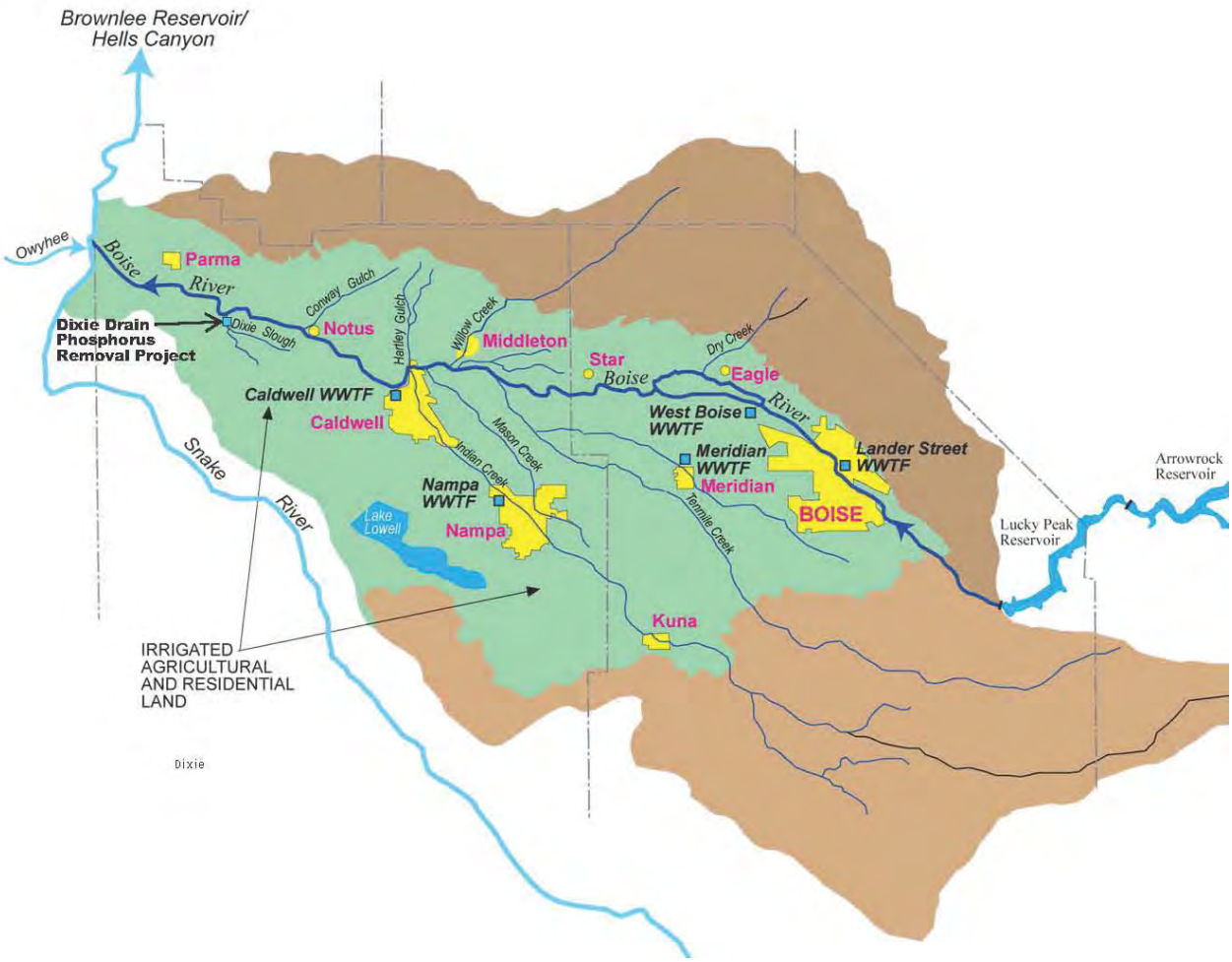


Figure 2. Dixie Drain Facility Treatment Facility Flow Diagram

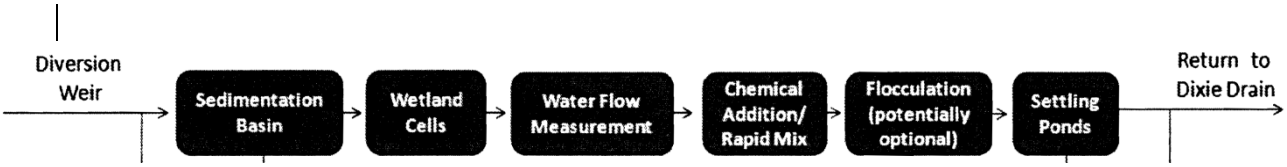
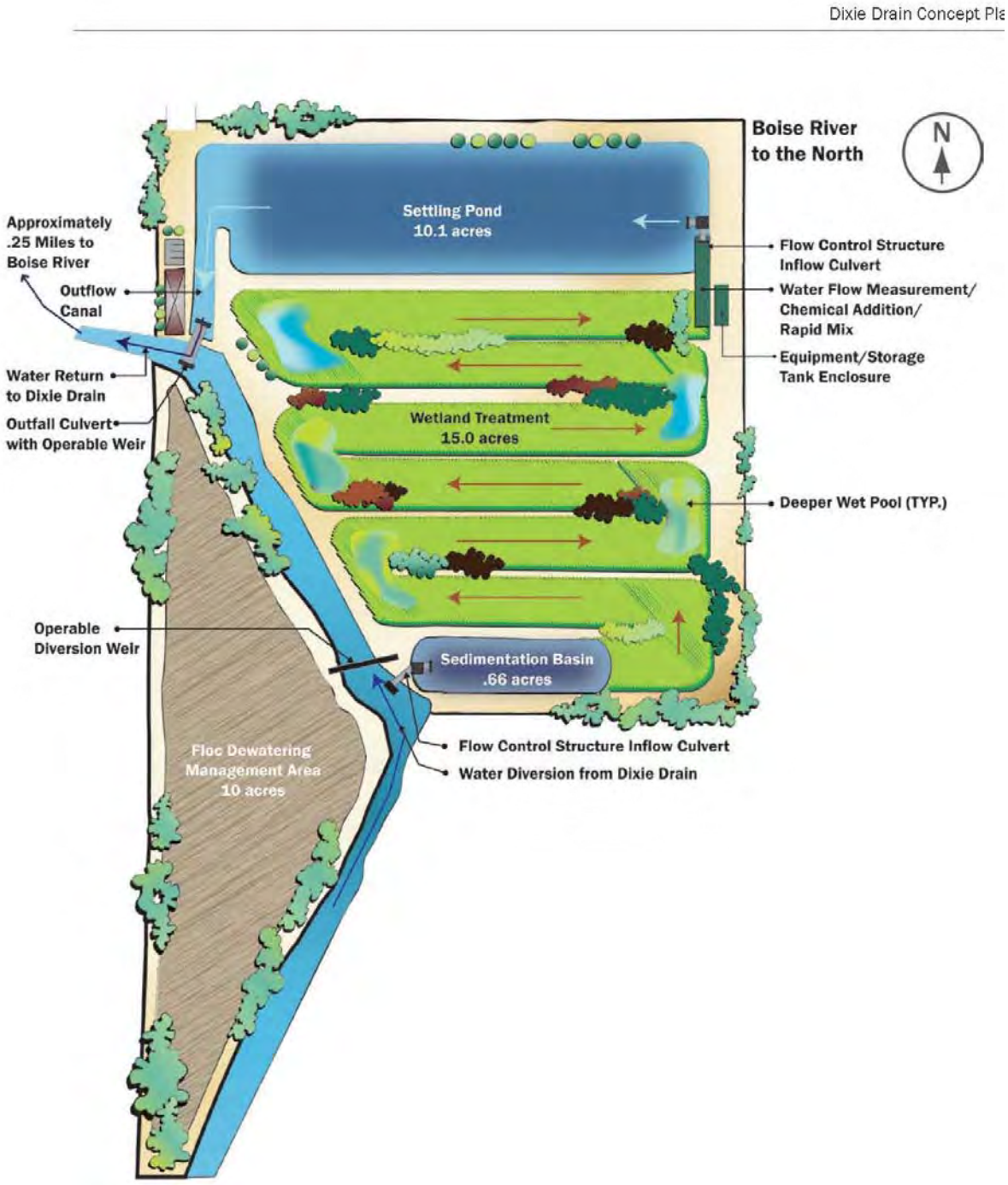


Figure 3. Dixie Drain Facility Schematic



Appendix B Basis for Permit Conditions

A. Phosphorus Offset Ratio

The City of Boise analyzed the net present value (NPV) of capital and annual operation and maintenance (O&M) costs for treatment scenarios with Dixie Drain Facility to determine the break-even scenario at which the NPV of the Dixie Drain Facility option would be the same as the NPV of upgrading the West Boise Facility to meet an end-of-pipe limit of 70 µg/L. The break-even scenario provided an incremental phosphorus offset ratio of 1.5:1. That is, for each pound of phosphorus the City discharges above 70 µg/L at the West Boise Facility, the City will remove 1.5 pounds from the Dixie Drain Facility.

The twenty year NPV for treatment at the West Boise Facility using a Single-stage Deep Bed Filter is $47.8 million at a flow capacity of 39.0 mgd.

The NPV for treatment at the Dixie Drain Facility is $47.7 million to achieve the 1.5 pounds for every pound in excess of the limit of 70 ug/L at the West Boise Facility.

Details on the Cost Analysis to determine the break even scenario for the offset ratio are provided in Appendix C.

B. Revised West Boise Facility phosphorus Effluent Concentrations and Predicted Effects of Dixie Drain Facility Project on phosphorus concentrations in the Boise River.

The draft modification includes modified phosphorus final effluent concentrations for the West Boise outfall. The phosphorus concentrations are capped in order to meet an instream phosphorus concentration of 70 µg/L or less in the South Channel of the Boise River after complete mix with the flow in the river. The capped flow-based limits range from 250 µg/L to 350 µg/L.

Impacts of Offset on Boise River

The EPA and IDEQ conducted a technical analysis of the watershed and proposed offset to determine whether, and to what extent the proposed offset would improve conditions in the Boise River compared to the alternative of advanced filtration treatment to achieve the phosphorus goal for the river (70 µg/L) at end-of-pipe. The results are provided in *Predicted Effects of Dixie Drain Project on Phosphorus Concentrations in the Boise River,* March 2012, which is included as Appendix D to this Fact Sheet.

The offset project will affect phosphorus concentrations in the Boise River from the West Boise outfall to Parma. The IDEQ and the EPA evaluated the impact of the Dixie Drain Facility offset for that entire reach.

The assessment tool is a simple mass balance model of total phosphorus in the mainstem Lower Boise River. The model domain is the mainstem reach from the Lucky Peak dam outflow to the USGS gauge at Parma. The modeling effort draws upon previous mass balance model development by CH2M Hill under contract to IDEQ during prior TMDL development. The model was simplified for the offset assessment because of the new focus on changes to the existing condition, rather than setting of pollutant allocations to achieve water quality standards over the long term. The offset project focuses on changes only in the city of Boise and Dixie Slough discharges to the main stem, and improvements in the current condition to be gained via the offset.

The EPA developed a streamlined spreadsheet of the main stem river using the tributary network from the CH2M Hill spreadsheets. The model provides a "snapshot" of phosphorus concentrations and loadings at a single period of time. Uncertainties and limits of the model are discussed in the model report (included as Appendix D.)

The first step in model development was a flow balance. Once the flow balance was complete, the phosphorus mass balance was developed by assigning phosphorus concentrations to each boundary input (upstream boundary, tributaries/drains, point sources and groundwater) and tracking the mass load in the river (and associated concentration). With the model providing reasonable predictions of the current conditions in the river, the offset was evaluated by changing (1) City of Boise flows, (2) City of Boise phosphorus concentrations or (3) Dixie Drain Facility phosphorus concentrations in accordance with the offset plan.

Figure 1 in Appendix D is a longitudinal plot of phosphorus concentration by river mile (river flows from left to right) for the July 2001 river conditions. The Lander Facility is near mile 50, the West Boise Facility is near mile 42 and Dixie Slough enters the river at mile 9. The City of Parma wastewater treatment plant is the last location depicted (approximately mile 3). Upstream of the Boise Facility, the Boise River has a phosphorus concentration of approximately 20 µg/L. From the West Boise Facility discharge to Parma, there are agricultural drains that enter the Lower Boise River which continue to increase concentrations above 70 µg/L. The modeling results illustrate the predicted benefits of the offset at Parma under the July 2001 conditions, with phosphorus of about 310 µg/L assuming end-of-pipe treatment (i.e. 70 µg/L) at the West Boise Facility, versus 255 µg/L phosphorus with the offset. The benefits illustrated assume the Dixie Drain Facility as a compliance option for all of the wastewater flow (both Lander Street facility and West Boise) and at full permitted build out of 39 MGD which is the combined permitted flow of both facilities. Actual benefits will be lower until the permitted build out, but there will always be benefit above end-of-pipe compliance. The actual benefit will depend on wastewater plant flows.

Calculation of Average Weekly Limits

The draft permit includes average monthly limits (AMLs) to ensure that the WLA is attained except for short-term excursions occurring within a calendar month. The EPA must comply with the NPDES regulations, 40 CFR § 122.45(d)(2), that requires that permit effluent limitations be expressed as both average monthly and average weekly discharge limitations for POTWs. Average weekly limits (AWLs) in the modified permit were calculated based on the EPA's Technical Support Document (EPA. 1991). (Technical Support Document for Water Quality-based Toxics Control US Environmental Protection Agency, Office of Water, EPA/505/2-90-001).

Each AWL is calculated from the AML using a ratio that accounts for expected effluent variability and sampling frequency. The equations in Tables 5-2 and 5-3 of the *TSD* were adapted to calculate the ratio. Although, the coefficient of variation (CV) for phosphorus for the current treatment system is known, the CV for the updated EBPR treatment system is not. The EPA assumed a CV of 0.6 which is the recommended default CV in the TSD and is also a typical CV for facilities removing phosphorus. Assuming a CV of 0.6 and a percentile exceedance probability of 99% results in an AWL/AML ratio of 2.01.

CV		0.6
samples per week	n=	1.0
samples per month	n=	4.0
LTA Multiplier-AWL	99%	3.1
LTA Multiplier-AML	95%	1.6
Factor = AWL/AML		2.01

C. Basis for Monitoring

Aluminum Monitoring

The Idaho Water Quality Standards do not have criteria for aluminum. The National Recommended Water Quality Criteria, 2002 (EPA-822-R-02-047) recommends a chronic water quality standard of 87 µg/L total recoverable aluminum between a pH of 6.5 and 9.0 and an acute water quality standard of 750 µg/L. Aluminum monitoring is required to determine impacts of alum addition on the receiving water.

pH

The Idaho Water Quality Standards (IDAPA 58.01.02.250.01.a) require surface waters of the State to have a pH value within the range of 6.5 - 9.5 standard units. Monitoring of the effluent to ensure compliance with pH is required.

Temperature

Prior to discharge to Dixie Slough, the City must develop and receive IDEQ approval of a Dixie Drain Temperature Monitoring Plan that depicts how the discharge and the receiving water body will be analyzed and monitored to ensure consistency with IDAPA 58.01.02.055.04. Refer to the draft 401 Certification.

D. Interim Total Phosphorus Concentration

The City of Boise requested a modification to the interim limit for phosphorus which is currently set as 500 µg/L as a monthly average limit beginning in 2017 from May 1through September 30, and every year thereafter until the final limit is achieved. The City's request was to modify the interim limit to be 500 µg/L as a seasonal average limit beginning in 2017 from May 1 through September 30, and every year thereafter. The EPA is modifying the interim limit based on information provided by the City on the expected performance of the treatment system. The modification to a seasonal average only applies to the interim limit, not the final limit.

The City projected phosphorus effluent concentrations for a range of dissolved reactive phosphorus conditions ranging from best, likely, and worse. The results of the City's analysis showed that a monthly average 500 µg/L limit would be exceeded for all three conditions (best, likely, worst) for any month that a monthly average of 10.9 mg/L TSS occurs. In contrast, a seasonal effluent 500 µg/L limit would be met for the best and likely case. The phosphorus under the worst case estimate ranged from 350-500 µg/L, with two of the five years being less than 5 µg/L under the 500 µg/L phosphorus seasonal average. The City's analysis is provided as Appendix F, Interim Performance of Treatment Facility.

Schedules of compliance are authorized by federal NPDES regulations at 40 CFR 122.47 and by Section 400.03 of the Idaho Water Quality Standards. The Idaho water quality standards allow for compliance schedules "when new limitations are in the permit for the first time." The federal regulation allows schedules of compliance "when appropriate," and requires that such schedules

require compliance as soon as possible. When the compliance schedule is longer than 1 year, federal regulations require that the schedule shall set forth interim requirements and the dates for their achievement. Interim limits in the permit are performance-based limits. Based on the City's analysis of the expected performance of the treatment system, the EPA is modifying the interim phosphorus limit (of 500 µg/L) for the West Boise Facility to be on a seasonal average instead of a monthly average.

Appendix C. Cost Estimate

September 18, 2012

Susan Poulsom, P.E.
EPA Region X
1200 6th Avenue
Seattle, WA 98101

RE: Cost analysis to support offset ratio

The Mayor and Council directed staff to develop the offset ratio that was equivalent in cost to end of pipe compliance in an effort to maximize the environmental benefit to the Boise River while maintaining the same cost impact to ratepayers for compliance with the new permit limits for phosphorus reduction. Staff developed a net present value analysis that covered a 20 year project cycle. The City understands that there is no guarantee that the project will be re-authorized in subsequent permit cycles, but is willing to look at cost equivalency over a 20 year period. If the Dixie Drain project is not authorized prior to the end of the 20 year period, the cost equivalency will not be realized but this is a risk the City is willing to take on. Below are the latest details of the net present value cost estimating for both the end-of-pipe compliance option to achieve 70 ug/L as well as the Dixie Drain compliance option:

End-of-pipe compliance option

The City contracted with CH2M Hill to evaluate tertiary treatment options for achieving end-of-pipe compliance for the new phosphorus limit of 70 ug/L. Several alternatives were identified and costs were estimated for both capital and operating expense. The alternatives included:

- Submerged membrane
- Disc Filter and closed-conduit membrane
- Two-stage continuous backwash up-flow filter
- Single-stage Deep Bed Filter

The most cost effective alternative was the Single-stage Deep Bed Filter. The capital cost, annual operating costs and 20 year net present value at a 3% discount rate are as follows:

Capital Cost:	$	34,112,000
Average Annual Operation and Maintenance:	$	925,000
20 year Net Present Value	$	47,874,000

Dixie Drain Offset

The City contracted with Ch2M Hill to develop the capital cost estimate for disc filtration at the plant to enable reliable removal efficiency to meet the total phosphorus limits of the proposal. The City contracted with Brown and Caldwell to develop a preliminary design and capital cost estimate of the Dixie Drain facility. The City conducted both bench and pilot scale tests to

estimate removal efficiency, chemical costs and operation and maintenance costs. The capital cost, annual operating costs and 20 year net present value at a 3% discount rate of operating the Dixie Drain Offset at a ratio of 1.5 pounds for every pound in excess of the limit of 70ug/L are as follows:

Capital Cost:	$	16,781,000
Average Annual Operation and Maintenance:	$	2,112,000
20 year Net Present Value	$	47,704,000

These cost estimates do not create cost savings over a 20 year period for compliance but the City believes the project does create a better environmental outcome. The proposal does require less upfront capital which will smooth out sewer rate increases as the City funds the improvements with funds on-hand, not debt, but the primary purpose is the added environmental benefit to the river.

Please contact me if you need additional information.

Sincerely,

Paul R. Woods, P.E.
Environmental Manager

Appendix D. Predicted Effects of Dixie Drain Facility on Phosphorus Concentrations in the Boise River

Predicted Effects of Dixie Drain Project on Phosphorus Concentrations in the Boise River

Dixie Drain, December 2010

March 2012

For information about this document contact:

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Darcy Sharp, Idaho Department of Environmental Quality, Boise
Susan Beattie, Idaho Department of Environmental Quality, Boise

Project Description

The City of Boise (City) has purchased approximately 49 acres of property in Canyon County, adjacent to the Dixie Drain, located approximately 0.25 miles upstream and southerly of the Dixie Drain confluence with the Boise River (Figures A1 and A2). The city proposes to develop a treatment facility at this site to remove total phosphorus and sediment loads from the Dixie Drain (Figure A3). The Dixie Drain project would serve to offset discharges from the city's wastewater treatment facilities. The city's initial offset plan was outlined in an August 23, 2010, letter to EPA. A detailed plan for permitting the wastewater facilities with the Dixie Drain offset was developed in a collaborative process by the city, EPA, and the state of Idaho. The requirements of this plan are described in the fact sheet for the proposed NPDES permit for the city.

A technical analysis of the watershed and proposed offset is needed to determine whether, and to what extent, the proposed offset would improve conditions in the Boise River compared to the alternative of advanced filtration treatment at the two treatment plants to meet the phosphorus goal for the river (70 ug/L) at end-of-pipe.

This technical analysis of the Boise River assumes the following elements of the offset plan:

- Consolidation of Boise Treatment Plants. The city currently operates two treatment plants (Lander and West Boise). It is expected that these plants will be consolidated to an expanded plant at the West Boise location.

- Baseline for Offset. The expanded West Boise plant, in the absence of an offset, would be required to meet an effluent limit of 70 ug/L TP at end-of-pipe.

- West Boise Total Phosphorus (TP) Limits. The offset allows the city to discharge TP at concentrations higher than 70 ug/L at end-of-pipe. However, West Boise discharges are capped in order to meet an instream TP concentration of 70 ppb or less in the South Channel of the Boise River after complete mix with the flow in the river. To achieve this requirement, the permit would include flow-based limits at the West Boise plant ranging from 350 to 250 ug/L TP (as monthly average limits).

- Dixie Drain Treatment. Any discharge by the West Boise plant above 70 ug/L will be offset by a factor of 1.5 at Dixie Drain. The offset will be tracked in terms of load (lbs/day TP).

Scope of Analysis

Geographic Scope

The offset project will affect phosphorus conditions from the city of Boise discharge locations downstream to Parma. To evaluate the tradeoffs associated with the offset, the analysis includes this entire reach. The reach includes a split in the mainstem river at Eagle Island. Our study follows the south channel of the river in this 8 mile segment (RM 46 to RM 38), because the city discharges wastewater from its West Boise plant to this channel. The analysis represents the north channel as a diversion from the river (upstream of Eagle Island) and a tributary discharge (downstream of the island). Diversions from the north channel are subtracted from its flow. Since there is only one small drain discharging to the north channel, the phosphorus concentration is assumed to be unchanged in the Eagle Island segment.

While the entire river is assessed, key locations will include the area immediately downstream of the city discharges (to evaluate local impacts of the offset) and the area near Parma (to evaluate benefits relative to goals of the Snake River TMDL).

Time Frames

The Snake River TMDL sets a total phosphorus target of 70 ug/L for the Boise River at Parma between May and September to reduce the impact of nutrients on algae biomass and dissolved oxygen in Brownlee Reservoir. The offset analysis is also focused on the May to September time frame, particularly with respect to selection of flow regimes to be evaluated.

River, Tributary, and Irrigation Drain Flows

The Boise is a heavily managed river with a complex network of irrigation canals. At various points in the mainstem, substantial volumes of water are diverted for agricultural use. Irrigation flows are monitored extensively by the Idaho Department of Water Resources, and USGS gauges provide long term flow data at key locations. See Tables A1 and A2 in the appendix for a listing of tributaries, drains, diversions, and point sources included in the model.

Due to the management regime and natural characteristics of the system, low flows occur at different times of the year depending on the location of interest. The lowest flows at Parma occur in August. Based on USGS gauge data, the 10^{th} percentile flow for August is 350 cfs, and the mean August flow is 783 cfs (Table A3). In model development, EPA has focused on two periods that have reasonable data coverage and approximately same flow as these two statistical flow regimes for August: July 12, 2001 (360 cfs at Parma) and August 15, 2000 (761 cfs).

In the upstream reach near the West Boise plant, the lowest flows occur in September. As noted in the fact sheet for the West Boise permit, the permit limits are designed to meet 70 ug/L TP in the south channel under low flow conditions in that location (219 cfs). During the July 2001 and August 2000 assessment periods considered in this analysis, the flows in the south channel were substantially higher than this value (approximately 500 and 700 cfs in July 2001 and August

2000, respectively). In predicting effects of the offset project on water quality, this analysis focuses on periods of low instream flow at Parma; these periods are not representative of low flow at the West Boise discharge point.

Supporting Information for the Analysis

The following data was used in the development of the mass balance model and Dixie drain assessment.

Table 1: Available Data for the Lower Boise River and Tributaries

Data Type	Specific Data Description	Period of Record	Source
River Flow	Daily flow at Lucky Peak, Glenwood Bridge, Middleton, and Parma.	Long term (decades)	USGS NWIS website
Tributary Flow	Daily flow in agricultural diversions from the river and tributaries/drains to the river	1986 to present	Idaho Dept. of Water Resources (website database)
River and Tributary Total Phosphorus Concentration	Grab samples at highly varied frequency depending on location	Depends on location. Examples: Parma- 1969 to present Dixie- 1971-72;1994-2005 Thurmon Dr.– 1994-2001	USGS and Idaho State Dept. of Agriculture
Indian Creek Flow and Total Phosphorus Concentration	Daily Flow, Monthly Grab TP	2003-2009	City of Nampa
Point Source Phosphorus and Discharge Flow	Daily flow and weekly phosphorus	2000-2009	NPDES Permittee submittals to EPA
Groundwater Total Phosphorus Concentration	Well sampling. One-time reconnaissance.	2007	USGS

Figures A4 and A5 depict data summaries published by USGS for Boise River tributaries, drains, mainstem, and groundwater (USGS, 2004).

This offset analysis also draws upon data and information from previous studies as noted below.

Table 2: Previous studies of the Boise River

Info Type	Specific Info Description	Date	Source
Existing Boise River Spreadsheet Models	Mass balance model constructed to support draft TMDL and linked database spreadsheet	April 2006	CH2M Hill
Draft TMDL	Maps, source identification, summary water quality information	March 2007	IDEQ
Groundwater Elevation	Hydraulic head difference between surface water and groundwater – indicates inflow locations	2004	USGS
Point Source Expected Future Flows	Projected flows based on population growth estimates	Ongoing	NPDES Permittee submissions to EPA
Boise River phosphorus conditions	Measured phosphorus concentrations	2011	USGS

Data Quality and Data Gaps

The analysis is developed using measurements of flow and total phosphorus in the mainstem river, tributaries and drains, point source discharges, and groundwater. Overall, a significant database of measurements has been collected by the USGS and state of Idaho, and the quality of the data is underpinned by the agencies' quality control and assurance measures.

Data gaps present the most significant uncertainty in model development, because the model represents single "snapshots" of river conditions. Ideally, for the given day(s) chosen for the analysis, flow and total phosphorus samples would be available on that day at all drains and mainstem locations. The sampling program has not had "synoptic" (simultaneous) data collection as a goal, so the samples are taken at different times in different places. This requires the model developer to fill numerous gaps in the data with the information at hand. The gaps are far more substantial in the total phosphorus data than the flow data, because water flow is systematically monitored for water supply purposes.

For example, for the August 15, 2000 model setup, a number of drains have no phosphorus samples for the month of August 2000. These gaps were filled by using the mean summer value for the particular drain of interest. The goal in any effort to fill data gaps is to use values that are reasonably representative of the expected conditions in the system. For the Boise system, total phosphorus conditions in the mainstem and drains is fairly consistent within the irrigation season and from year to year, so the data gaps do not appear to be a significant problem in constructing

a reasonable model representation of the system.

Model Selection and Development

Simple Mass Balance Model

The assessment tool used to assess the effects of the offset project is a simple mass balance model of total phosphorus in the mainstem Lower Boise River. The model domain is the mainstem reach from the Lucky Peak dam outflow to the USGS gauge at Parma. The modeling effort draws upon previous mass balance model development by CH2M Hill under contract to IDEQ during TMDL development. The TMDL is on hold, but the CH2M Hill model and accompanying database can been used as a starting point. It has been simplified for the offset assessment because of the new focus on changes to the existing condition, rather than setting of pollutant allocations to achieve water quality standards over the long term. The offset project focuses on changes only to the city of Boise and Dixie Drain discharges to the mainstem, and improvements in the current condition to be gained via the offset.

EPA developed a streamlined spreadsheet of the mainstem river using the tributary network from the CH2M Hill spreadsheets. The following are important capabilities and limitations of this Boise River mass balance model:

Capabilities

1. The model can provide reasonable estimates of the current river conditions for phosphorus, including point source loadings and irrigation canal loadings.

2. The model can be used to evaluate the effect of pollution control on phosphorus concentrations from Lucky Peak dam to Parma (subject to the limitations below).

Limitations

1. The model provides a steady state "snapshot" of conditions, so predictions are limited to the time frames and/or flow conditions selected for analysis.

2. The model assumes no loss of instream phosphorus due to algae uptake or settling of particulate matter. These omissions would be expected to cause the model to over-predict the instream phosphorus concentration.

3. The model does not include stormwater and urban irrigation discharges due to lack of monitoring information. This omission may result in under-prediction of phosphorus concentrations in certain locations.

Model Development

The spreadsheet model is a simple mass balance tool that requires upfront decisions about the key conditions to be evaluated (described above). The model provides a "snapshot" of phosphorus concentrations and loadings at a single period of time. Once decisions were made about the time of year and flow condition of interest, the available data were reviewed to determine when sampling data are adequate to provide reasonable model input values and to allow for a comparison of measured and predicted instream phosphorus concentrations.

Once the simulation dates were selected, the model inputs are developed and the accuracy of the model predictions can be assessed. There are two basic steps to model development for this type of model. First, the flow balance is constructed, and predicted flows are compared to measured flows at USGS gauge stations. Second, once the flow balance is deemed acceptable, total phosphorus concentrations are assigned to the flow inputs (e.g., drains, WWTPs, groundwater) and the predicted instream phosphorus concentrations are compared to measured concentrations.

Mass balance models do not employ parameters that allow for substantial "tuning" of the model to achieve a good fit to measured conditions. Rather, boundary inputs and gaps in the data that characterize the boundary inputs are evaluated as the model predictions are compared to measured conditions.

Flow Balance

The first step in model development is the flow balance. The inflow to the reach, which is the release from Lucky Peak dam, is monitored continuously by USGS. For the model simulation date, tributary and drain inflows and water withdrawals measured by IDWR and USGS are added/subtracted from the mainstem flow in sequential order from Lucky Peak dam to Parma. The calculated flow is compared to measured flow at the available long term USGS gauge stations at Glenwood Bridge, Middleton, and Parma.

For the two conditions analyzed to date (July 12, 2001 and August 15, 2000), the calculated instream flow matches the measured flow at the Glenwood Bridge reasonably well, but the calculated flow is significantly lower than the measured flow at Parma. For July 2001, the calculated flow for Parma is 196 cfs while the measured flow is 360 cfs. For August 2000, the calculated flow is 554 cfs while the measured flow is 761 cfs. This disparity at Parma is attributed to the fact that groundwater inflows to the lower portion of mainstem are not included in the initial flow balance calculation.

Groundwater flow cannot be measured directly, but it is reasonable to assume that the groundwater flow equals difference in the surface flow balance and measured flow at Parma (164 cfs in July 2001 and 207 cfs in August 2000). This estimated groundwater flow upstream of Parma can then be distributed along the reach where groundwater inflow is estimated to occur. Based on a study of groundwater elevations (USGS 2004), substantial groundwater inflows would be expected in the 17 miles of river upstream of Parma (RM 20.4 to RM 3.4). In the model, the estimated groundwater flow was distributed evenly in this section of river.

The flow balance plots (see Figures A7 and A8) show the calculated river flow with and without the groundwater inflows in the lower 17 miles of the river.

Total Phosphorus Model

Once the flow balance is complete, the phosphorus mass balance is developed by assigning phosphorus concentrations to each boundary input (upstream boundary, tributaries/drains, point sources, and groundwater) and tracking the mass load in the river (and associated concentration). The model does not include any loss of phosphorus from the water column due to algal uptake or settling.

As noted above, there are data gaps in the phosphorus data, and the selected sample values may not have sample dates that align with the model simulation date.

Most samples of the upstream boundary location, near Lucky Peak Dam, have been non-detect for total phosphorus at a variety of detection levels from 10 ug/L to 60 ug/L. A few samples in the July/August time frame showed detectable phosphorus at a concentration of 20 ug/L. This value was used as the assumed upstream boundary concentration.

For groundwater, a single phosphorus value was used for all groundwater inflow in the lower reach of the river. Based on the assumption that a significant fraction of groundwater entering the river is associated with tributary/drain discharges, the mean value of the phosphorus concentrations in all tributary/drain discharges was used as the estimate of groundwater quality. For July 2001 and August 2000, the calculated total phosphorus values using this method were 250 ug/L and 260 ug/L, respectively. These values are consistent with average concentrations observed by USGS in wells near the river, and it is also similar to the concentrations in the river at Parma.

Model Corroboration with Measured Conditions

Figures A9 and A10 in the appendix show the predicted phosphorus from the mass balance calculations compared to measured concentrations. Despite the data gaps and limitations, the model predicts similar concentrations to the observed concentrations. In particular, there is good agreement between predicted and observed conditions at Parma, where the benefit of the proposed Dixie Drain offset will be estimated.

The corroboration at Parma also suggests that the groundwater flows and phosphorus concentrations in the model are reasonable estimates, since groundwater comprises a significant fraction of the flow in this area. These predictions also suggest that attenuation (due to algal uptake) and settling may be minor loss terms in the current mass transport through this reach of the river.

Model Application

With the model providing reasonable predictions of the current conditions in the river, the offset is evaluated by changing (1) city of Boise flows, (2) city of Boise phosphorus concentrations, and/or (3) Dixie Drain phosphorus concentrations in accordance with the offset plan. The scenarios represent the following conditions:

Existing Condition – estimated TP concentrations in the river in July 2001 and August 2000.

C45 – estimated TP concentrations in the river if there is no offset, the permit limit is 70 ug/L, and the West Boise facility discharges at 45 ug/L. The "C" designation refers the assumption that effluent flows are at the current flow of approximately 26 mgd.

C70 – estimated TP concentrations in the river if there is no offset, the permit limit is 70 ug/L, and the facility discharges at 70 ug/L.

C225 – estimated TP concentrations in the river if the offset is implemented, the permit limit is 350 ug/L, and the facility discharges at 225 ug/L.

C350 – estimated TP concentrations in the river if the offset is implemented, the permit limit is 350 ug/L, and the facility discharges at 350 ug/L.

The 45 ug/L and 225 ug/L scenarios represent the necessary long term average discharge from the plant to meet limits of 70 ug/L and 350 ug/L, respectively. The long term average performance must be less than the limit to account for effluent variability. The scale factor (1.55) used to estimate long term performance is based on recommended statistical procedures for NPDES permitting (see Table 5-2 of EPA's Technical Support Document for Water Quality-based Toxics Control). The 1.55 value assumes that the coefficient of variation for the effluent concentration is 0.6 and that monthly sampling would be conducted.

In addition to the "C" series of scenarios that represent current discharge flows, an identical series of scenarios was evaluated with an assumed effluent flow of 39 mgd. This is the design flow for West Boise assuming the Lander Street plant is closed and flows are consolidated at West Boise. These future "buildout" flows are identified as "B" scenarios.

The flows, concentrations, and loads associated with the scenarios are listed in Tables 3 and 4 below.

Table 3: Dixie Drain Offset Scenarios for July 2001 Analysis

Scenario	Lander Plant			West Boise Plant			Dixie Drain		
	Flow (mgd)	TP (ug/L)	TP load (lbs/day)	Flow (mgd)	TP (ug/L)	TP load (lbs/day)	Flow (cfs)	TP (ug/L)	TP load (lbs/day)
Existing Condition	15.0	2940	367	12.6	5270	554	139	388	291
C45	0	NA	NA	26	45	10	139	388	291
C70	0	NA	NA	26	70	15	139	388	291
C225	0	NA	NA	26	225	49	139	321	240
C350	0	NA	NA	26	350	76	139	266	199
B45	0	NA	NA	39	45	15	139	388	291
B70	0	NA	NA	39	70	23	139	388	291
B225	0	NA	NA	39	225	73	139	287	215
B350	0	NA	NA	39	350	114	139	206	154

Permit = Permit only, no offset included
C = current effluent flows (26 mgd)
B = buildout effluent flows (39 mgd)

Table 4: Dixie Drain Offset Scenarios for August 2000 Analysis

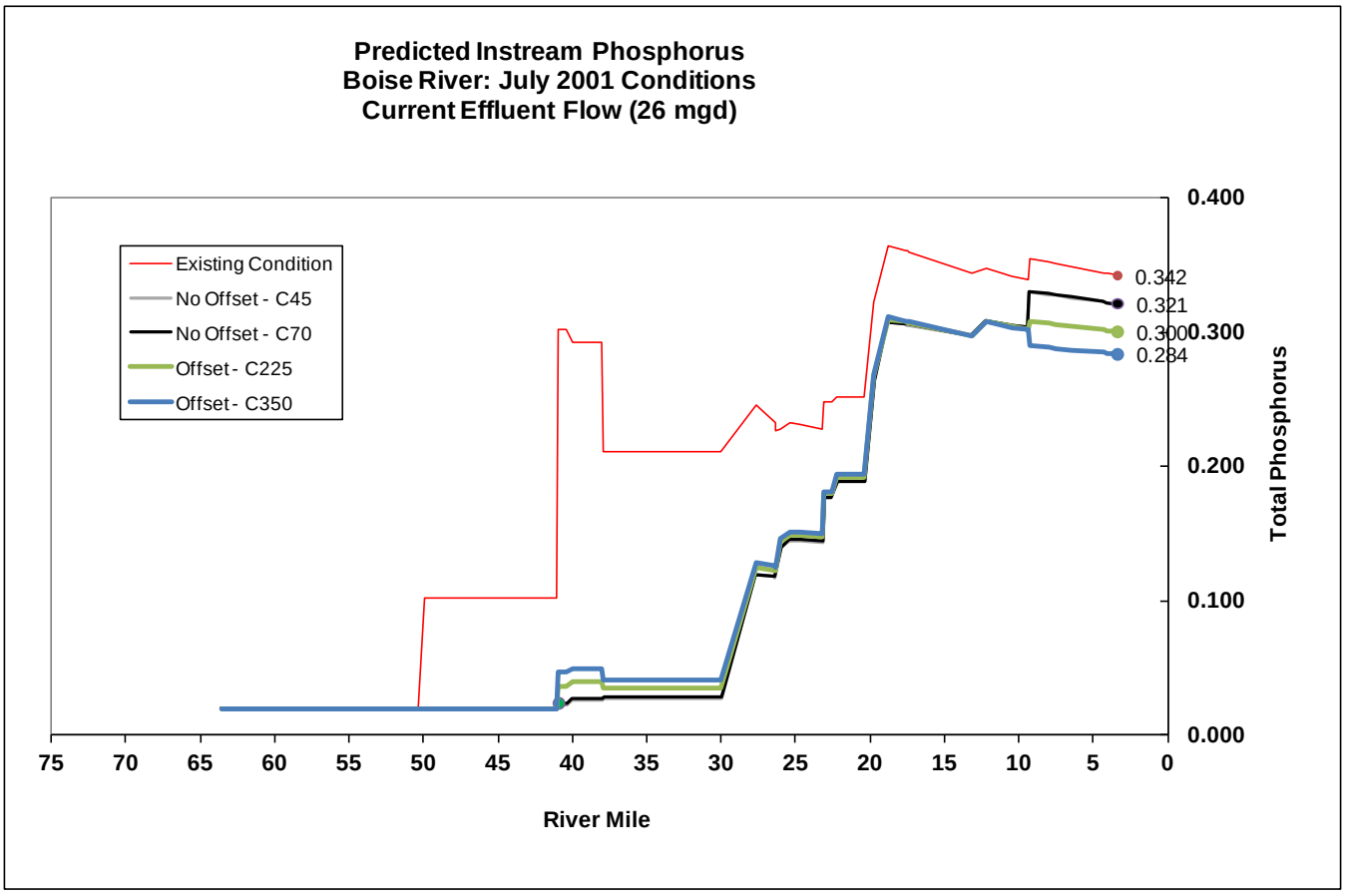
Scenario	Lander Plant			West Boise Plant			Dixie Drain		
	Flow (mgd)	TP (ug/L)	TP load (lbs/day)	Flow (mgd)	TP (ug/L)	TP load (lbs/day)	Flow (cfs)	TP (ug/L)	TP load (lbs/day)
Existing Condition	15.4	2940	377	12.7	5270	557	180	388	376
C45	0	NA	NA	26	45	10	180	388	376
C70	0	NA	NA	26	70	15	180	388	376
C225	0	NA	NA	26	225	49	180	336	326
C350	0	NA	NA	26	350	76	180	294	285
B45	0	NA	NA	39	45	15	180	388	376
B70	0	NA	NA	39	70	23	180	388	376
B225	0	NA	NA	39	225	73	180	310	301
B350	0	NA	NA	39	350	114	180	247	240

E. Results

Because of the linear relationships inherent in the simple mass balance approach, the results of the scenarios match expectations. Benefits of the offset increase when (1) river flows are reduced, (2) effluent flows are increased, and/or (3) effluent concentrations increase and thus require higher removal at Dixie drain.

Prediction results are provided in both graphical and tabular formats. Below is a longitudinal plot of total phosphorus concentration by river mile (river flows from left to right). The Lander plant is near mile 50, West Boise is near mile 42, and Dixie drain enters the river at mile 9. Parma is the last location depicted (approximately mile 3). Additional plots for August 2000 and different effluent flow assumptions are included in the appendix.

Figure 1: July 2001 Model Predictions for Current Effluent Flow (26 mgd)



The tables below provide predicted values at the West Boise discharge location and Parma.

Table 5: Scenario Results for July 2001 River Conditions

Scenario	**Total Phosphorus Downstream of West Boise**	**% Reduction from Existing Concentration at West Boise**		**Total Phosphorus at Parma**	**% Reduction from Existing Concentration at Parma**
	(ug/L)			(ug/L)	
Existing	.301	NA		.342	NA
C45	.022	93%		.321	6%
C70	.024	92%		.321	6%
C225	.036	88%		.300	12%
C350	.046	85%		.284	17%
B45	.023	92%		.316	8%
B70	.023	92%		.316	8%
B225	.044	85%		.304	11%
B350	.058	81%		.263	23%

Table 6: Scenario Results for August 2000 River Conditions

Scenario	**Total Phosphorus Downstream of West Boise**	**% Reduction from Existing Concentration at West Boise**		**Total Phosphorus at Parma**	**% Reduction from Existing Concentration at Parma**
	(ug/L)			(ug/L)	
Existing	.210	NA		.295	NA
C45	.021	90%		.264	12%
C70	.023	89%		.264	12%
C225	.031	85%		.253	17%
C350	.038	82%		.244	21%
B45	.022	90%		.261	11%
B70	.024	89%		.261	11%
B225	.037	82%		.245	14%
B350	.047	78%		.232	17%

F. Uncertainty and Limitations of the Model Predictions

All environmental models should be developed and applied with a recognition of the uncertainties in model predictions. The mass balance model used for this analysis is a highly simplified tool, and there are significant limitations in the data available to characterize the flow and phosphorus conditions of the river. Nevertheless, the general agreement of model-predicted phosphorus concentrations with the measured concentrations for July 2001 and August 2000 suggests that the model construct is reasonable.

A specific issue for this application is that the model does not track phosphorus loadings diverted into the complex irrigation system of the Boise River valley from the mainstem river. In addition, there is insufficient monitoring information to attribute the phosphorus observed at drain mouths to upstream sources (e.g., agriculture, diverted municipal wastewater, stormwater). Upstream discharges to the mainstem increase the phosphorus concentrations and loads in the river, and these loads are diverted at various locations to the irrigation system. It is unclear how much of this "background" phosphorus in the diversion water returns to the mainstem at a downstream drain mouth. The default assumption in the model is that changes to the mainstem concentrations (e.g., by reducing point source discharges) do not affect the phosphorus concentrations in downstream return drains. This assumption is executed in the model by fixing all drain mouth concentrations (except Dixie Drain) at current conditions for all scenarios. In one respect, this is a conservative assumption, because the model predicts a higher concentration at Parma for offset scenarios than it would predict under the alternative assumption (that a reduction in upstream phosphorus discharges will lead to a reduction in phosphorus in the return drains downstream). However, for the offset analysis, this assumption means that the model likely over-predicts the relative benefit of the Dixie Drain improvements compared to the benefits of City of Boise treatment improvements. In the future, this bias can be evaluated by monitoring the drains before and after the city has implemented phosphorus treatment to quantify the linkage between phosphorus levels in the mainstem and phosphorus levels in the return drains.

XI. References

City of Boise. 2010. Letter from Neal Oldemeyer (city of Boise) to Christine Psyk (EPA) re: Dixie Drain Project Information. Attachment: technical memorandum by Brown and Caldwell. August 23, 2010.

EPA. 1991. Technical Support Document for Water Quality-based Toxics Control.

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USGS. 2011. Water-Quality Conditions near the Confluence of the Snake and Boise Rivers, Canyon County, Idaho, 1994–2002. Prepared in cooperation with the cities of Boise, Caldwell, Meridian, and Nampa.

Appendix

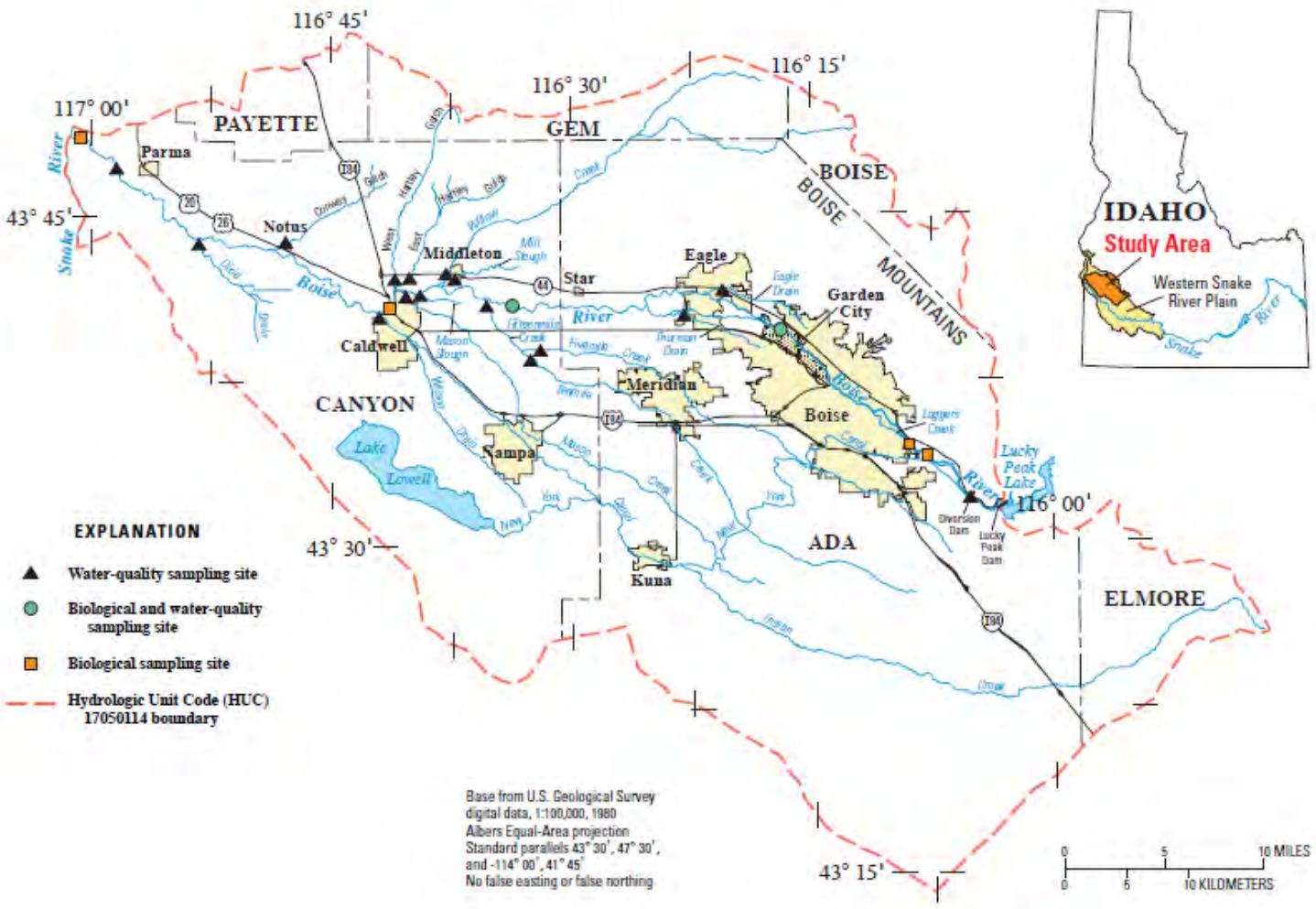


Figure A1: Lower Boise River Watershed
(source: USGS 2004)

Figure A2: Site Location
(source: City of Boise, August 2010)

Figure A3: Conceptual Design of Dixie Drain Treatment System
(source: City of Boise, August 2010)

River Mile (from mouth)	Tributary, Diversion, or Municipal Point Source	August 2000 Inflow/Outflow (cfs, minus sign denotes diversion)
63.6	Boise River nr Boise	4150.0
61.2	Penitentiary Canal	-6.0
61.2	New York Canal	-2203.0
61.2	Surprise Valley Canal	-4.6
58.3	Ridenbaugh	-432.0
57.5	Bubb	-7.0
56.8	Meeves	0.0
56.4	Rossi Mill	-6.0
56.1	River Run	0.0
55.9	Boise City Canal	-26.0
52.0	Settlers	-135.0
51.5	Boise City Parks	-0.2
51.1	Thurman Mill	-24.0
50.7	Boise Water Corp.	0.0
50.4	Farmers Union	-153.0
49.9	Boise WWTP Lander	23.8
46.0	New Dry Creek	-54.0
45.4	Lemp Ditch	-3.0
44.8	Warm Springs Ditch	-4.0
44.2	Graham-Gilbert	-1.0
43.0	Conway-Hamming	-3.0
42.4	Eagle Island Park	-0.2
41.8	Aiken, Thomas	0.0
41.2	Mace-Catlin	-6.0
40.9	Boise WWTP West Boise	19.6
40.5	Hart-Davis	0.0
40.4	Barber Pumps	0.0
40.4	Seven Suckers	-1.2
40.0	Thurman Drain	24.0
39.2	Phyllis Canal	-359.0
39.1	Eureka #1	-33.0
33.0	Canyon (County) Canal	-62.2
30.0	Caldwell High Line	-37.0
27.7	Fifteen Mile Mouth (includes Meridian WWTP)	111.0
26.4	Star Feeder	55.0
26.4	Long Feeder	10.0
26.4	Watts Creek	12.0
26.0	Mill Slough (includes Star WWTP)	127.0
25.4	Middleton WWTP	0.8
24.7	Willow Creek @ Middleton	8.0
23.2	Mason Creek	14.0
23.1	Mason Drain	123.0
22.6	Riverside	-215.0
22.2	Hartley (Combined)	82.6
21.9	Sebree	-293.0
21.8	Campbell	-20.0
21.0	Siebenberg	-10.0
20.8	Shipley Pumps	-0.2
20.4	Wagner Pumps	-0.4
19.7	Caldwell WWTP	14.4
18.8	Indian Creek (includes Nampa WWTP)	69.0
18.8	Simplot Pumps	-0.6
17.6	Eureka No.2	-93.0
17.5	Upper Center Point	-18.0
17.4	McManus-Teater	-6.7
14.1	Bowman & Swisher	-10.0
13.2	Lower Center Point	-24.0
12.2	Conway Gulch @ Notus	46.0
10.4	Baxter Canal	-8.0
9.4	Andrews Ditch	-7.8
9.3	Dixie Drain Near Wilder	180.0
8.0	Mammon Pumps	-7.0
7.5	Hass Canal	-6.8
6.5	Parma Canal	-18.0
4.3	Island High Line	-27.0
4.1	Crawforth Pumps	-0.8
4.1	McConnel Island	-40.0

G. Table A1: Inflows, Diversions and Point Sources along Mainstem

Tributary or Diversion	August 2000 Inflow/Outflow (cfs, minus sign denotes diversion)
Ballentyne	-9.0
Mace&Mace	-1.0
Eagle Drain @ Eagle	24.0
Hart-Davis	-6.0
Middleton Irrigation/Water Co. (Foothill Canal)	-138.3

H. Table A2: Inflows and Diversions in North Channel at Eagle Island

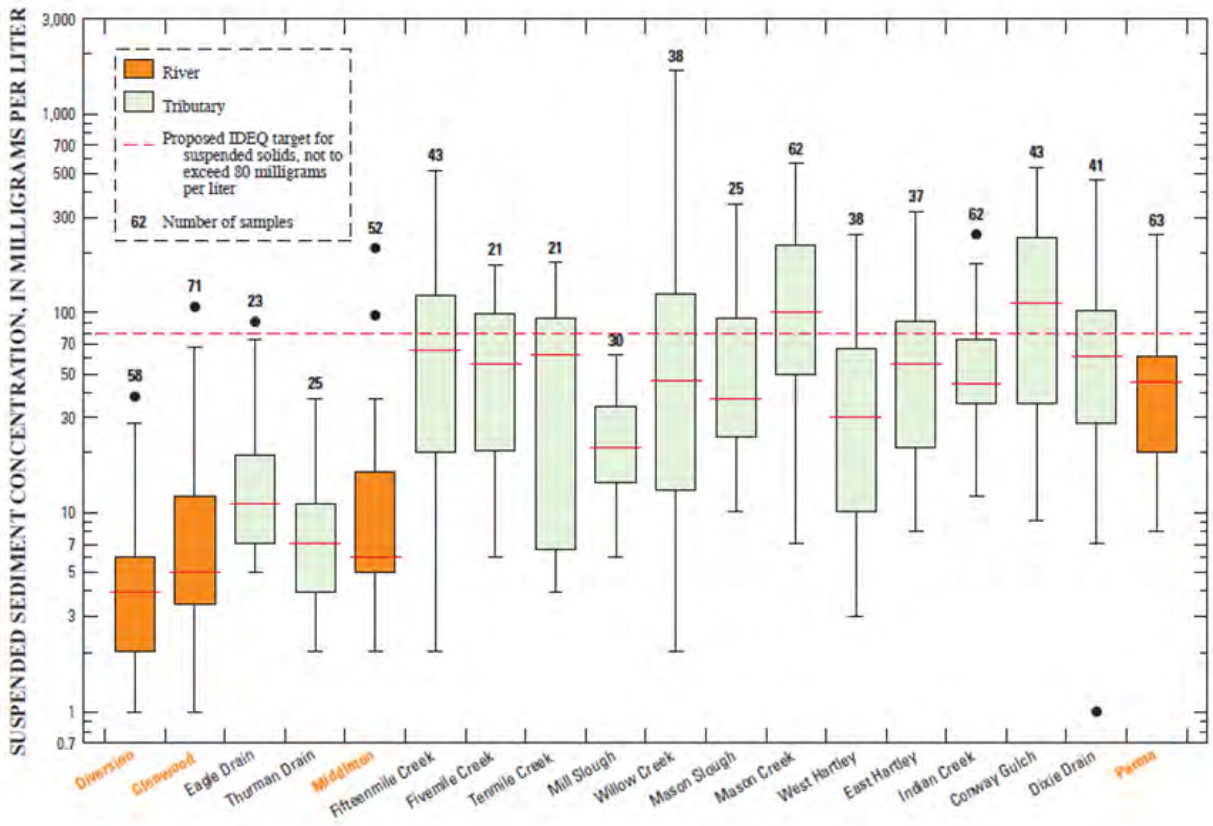


Figure A4: USGS Sampling Data for Total Phosphorus in Mainstem and Tributaries

Time Frame	Min	10th Percentile	25th Percentile	Mean	90th Percentile	Max
May – September	108	401	611	1510	4500	9140
August only	108	**350**	580	**783**	1200	2040

Table A3: Statistics of Daily Flow in the Boise River at Parma (cfs). USGS Gauge 13213000. The 10th percentile and mean values (bolded) have been selected as initial design target conditions for model development.

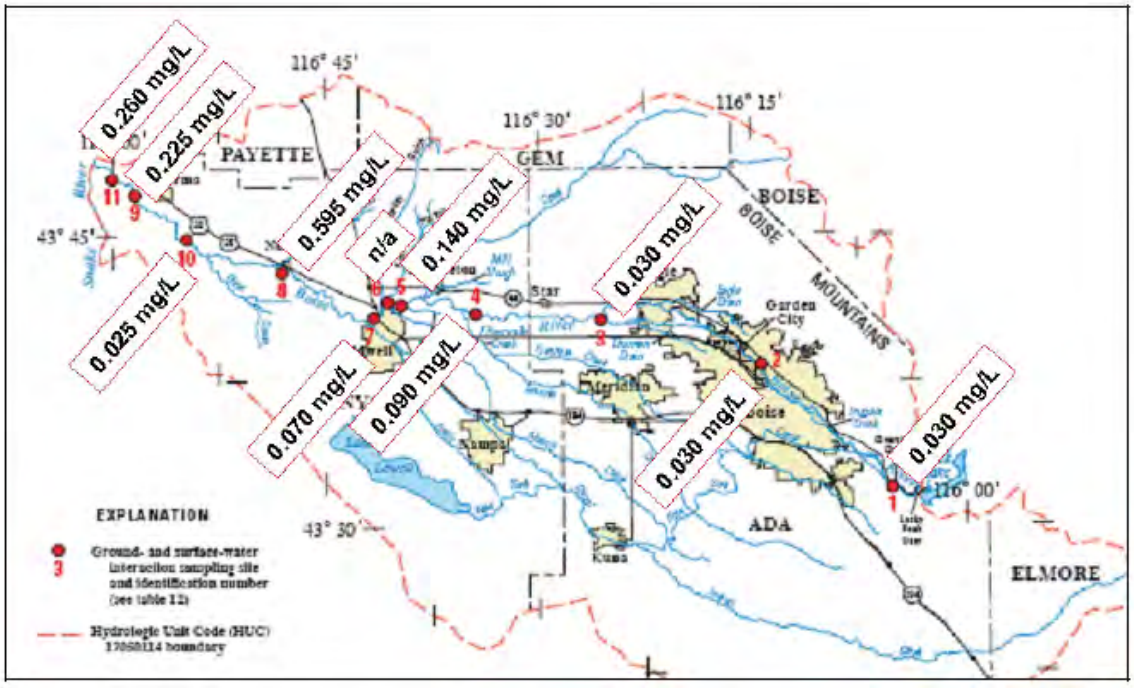


Figure A5: Groundwater Phosphorus Concentrations
(source: IDEQ (2007); data from USGS (2004))

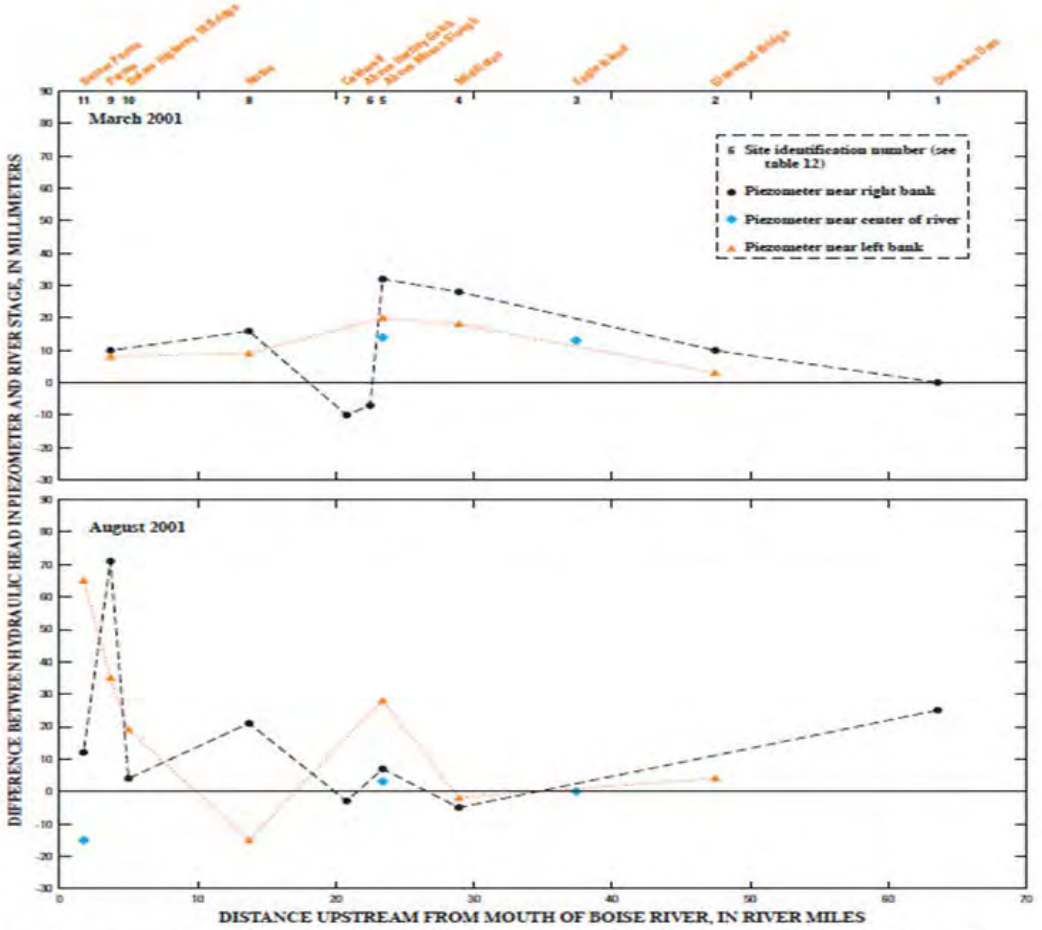


Figure 37. Difference between river stage and ground-water level (hydraulic head difference) at selected sites on the lower Boise River, Idaho, March and August 2001. (Negative values indicate ground-water head lower than surface-water stage, or a losing reach; positive values indicate surface-water stage lower than ground-water head, or a gaining reach; multiply millimeters by 0.03937 to obtain inches; measurement points are connected with lines to distinguish types of measurements and do not signify continuity between points)

Figure A6: Groundwater Hydraulic Head. Lower Frame is August 2001.
(source: USGS 2004)

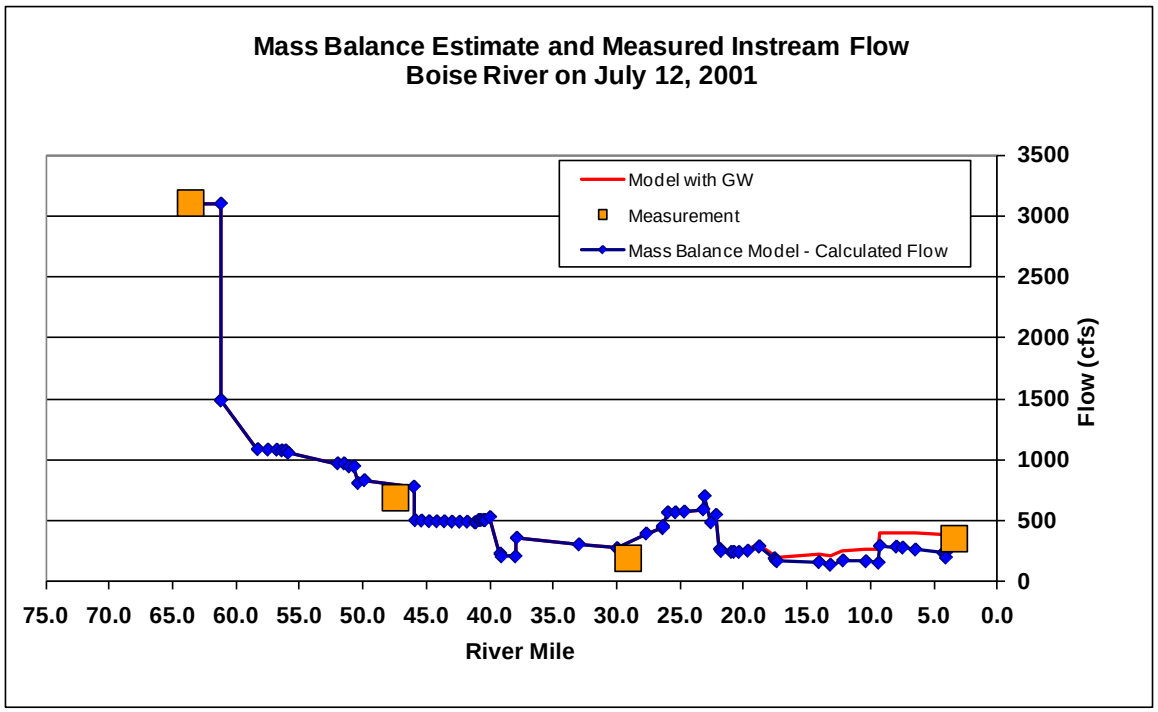


Figure A7: Flow Balance for July 2001

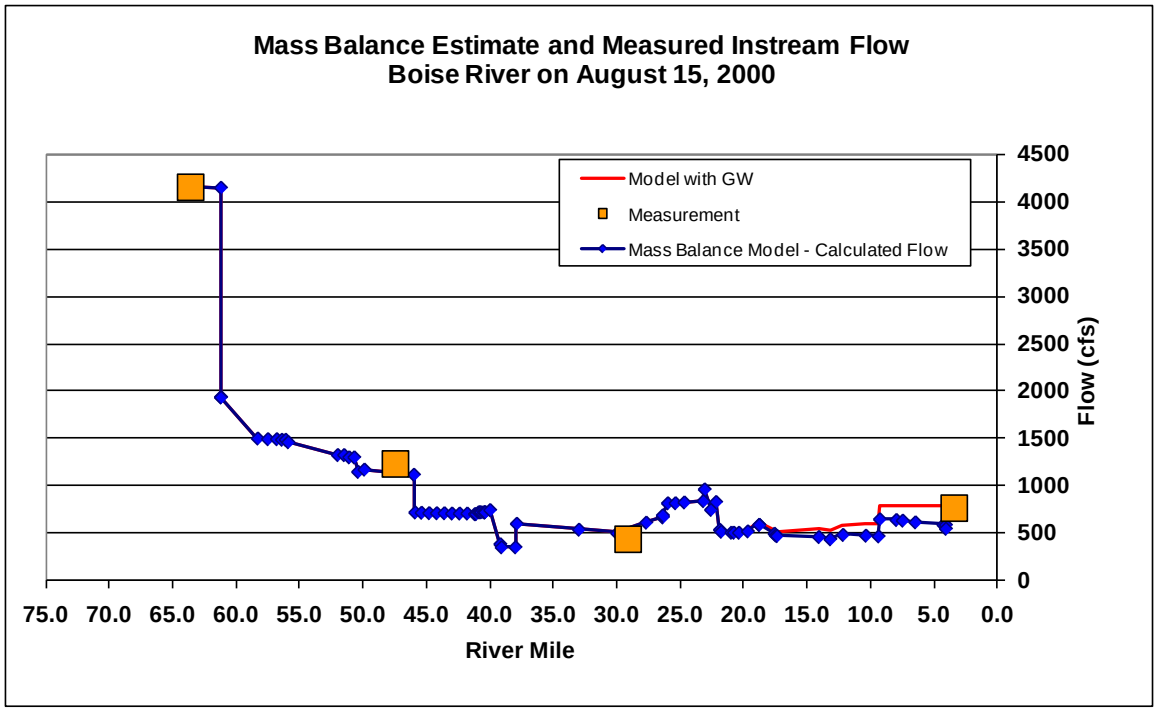


Figure A8: Flow Balance for August 2000

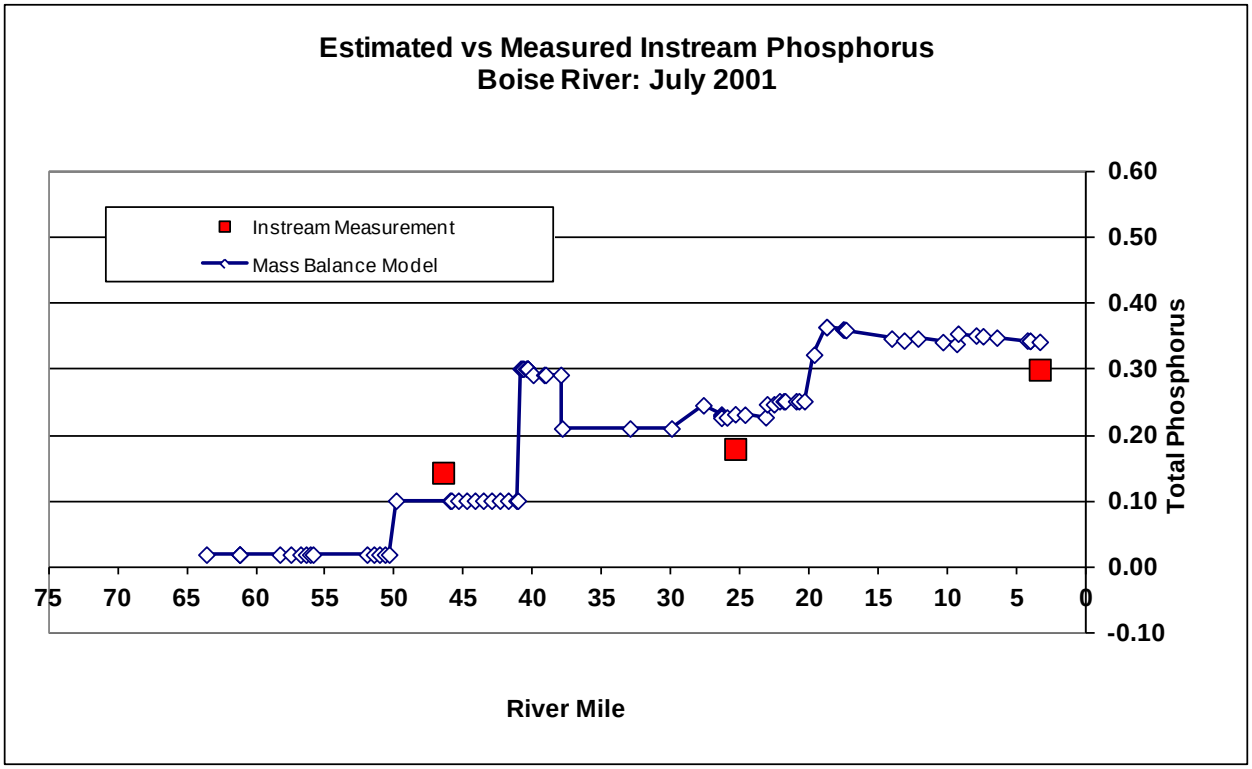


Figure A9: Predicted and Measured Phosphorus for July 12, 2001

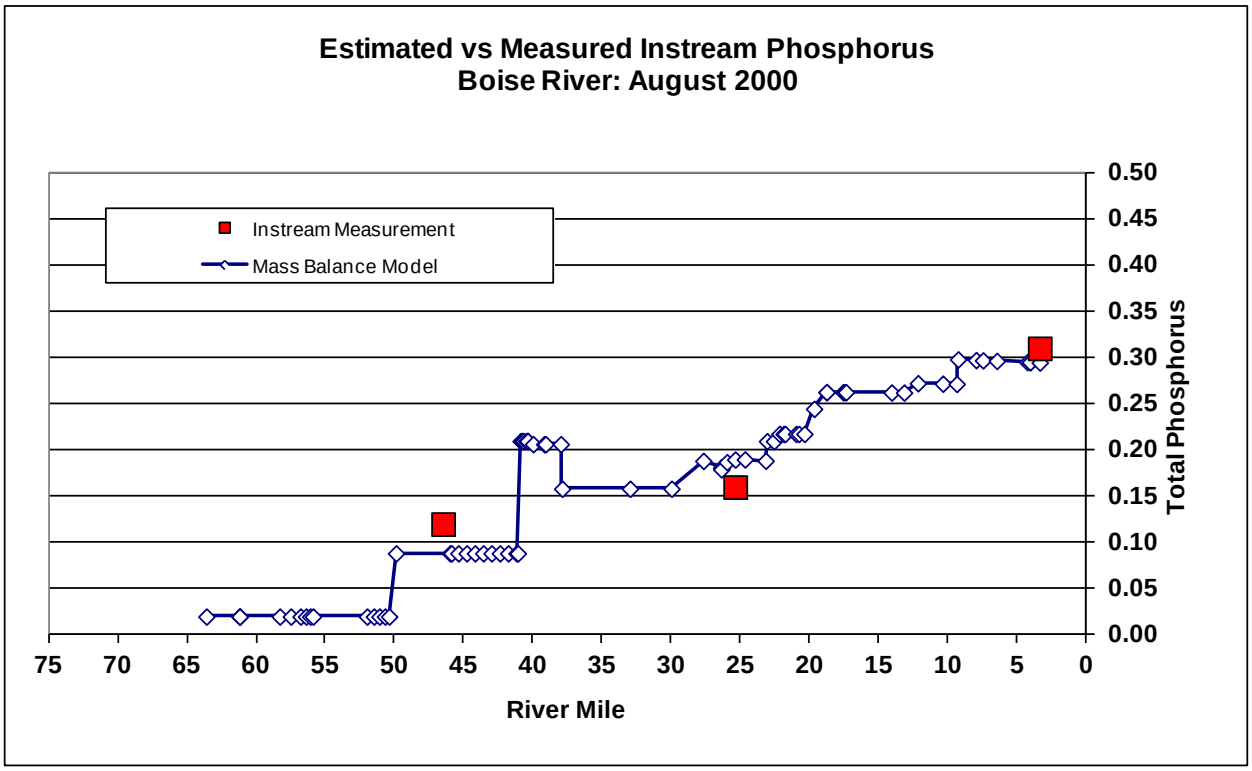
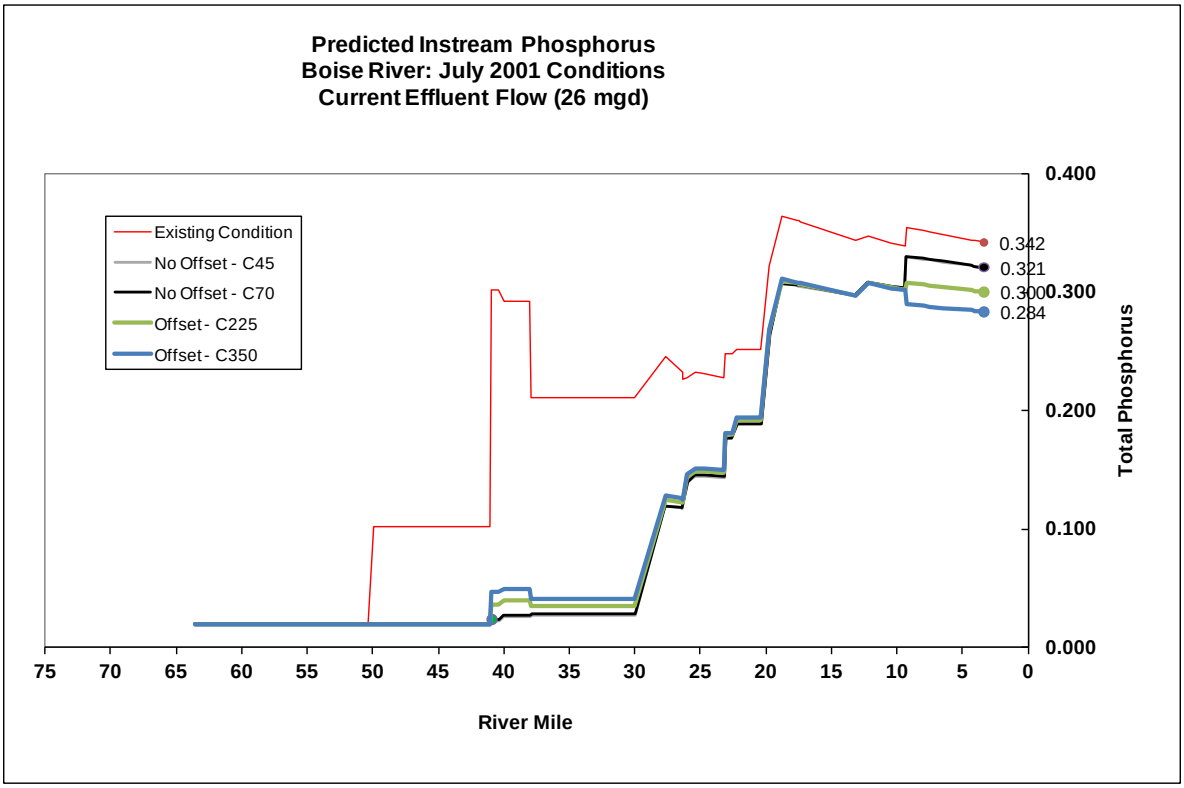
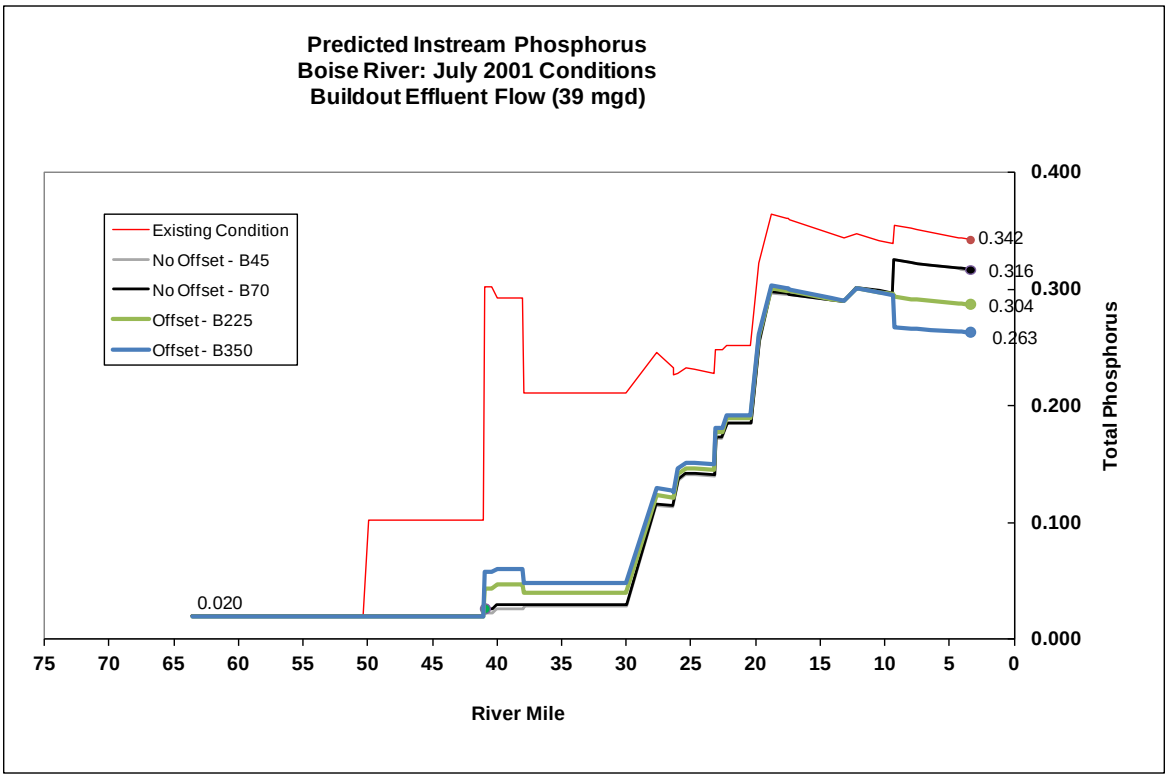


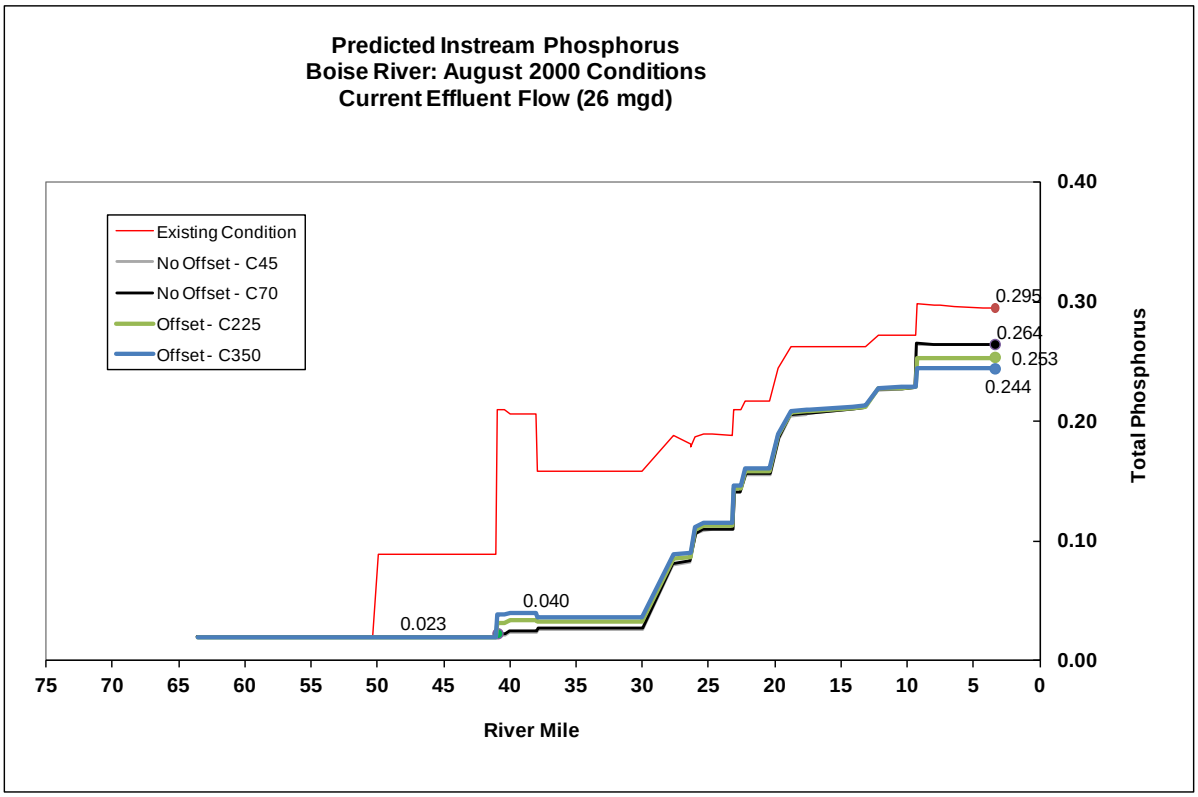
Figure A10: Predicted and Measured Phosphorus for August 15, 2000



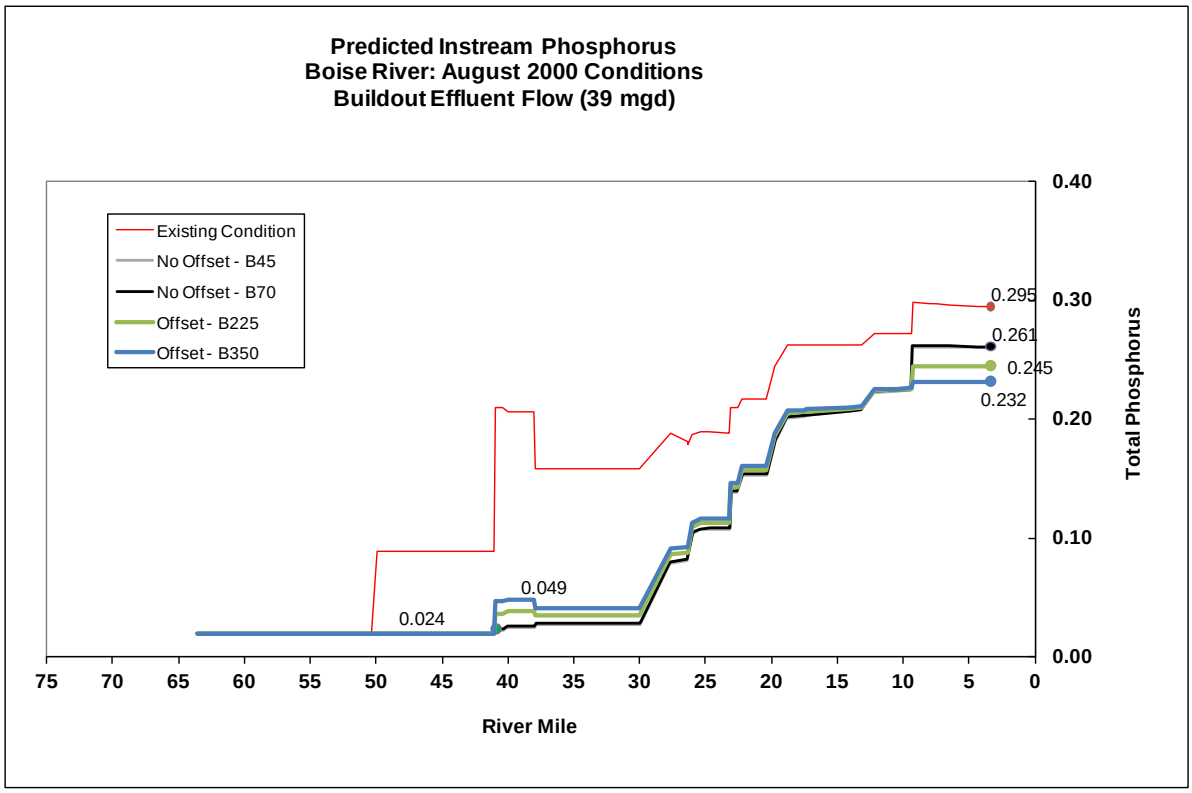
I. Figure A11: Scenario Results – July 2001 and Current Effluent Flow



J. Figure A12: Scenario Results – July 2001 and Build-Out Effluent Flow



K. Figure A13: Scenario Results – August 2000 and Current Effluent Flow

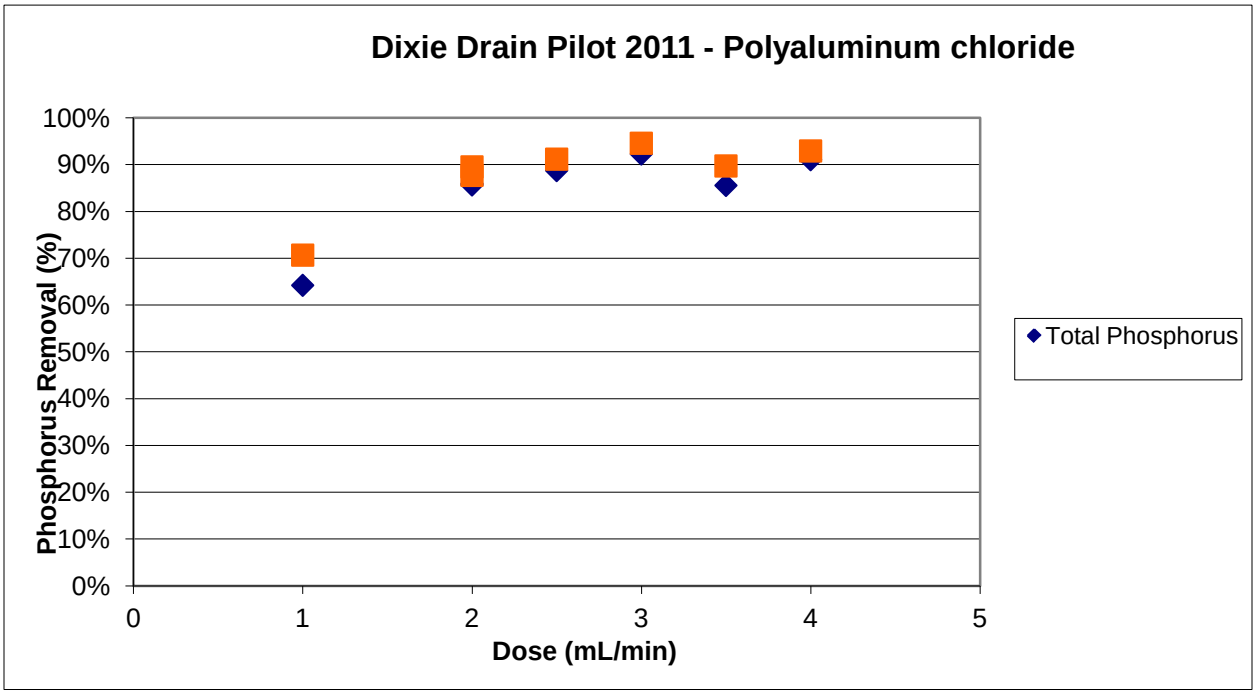


L. Figure A14: Scenario Results – August 2000 and Build-Out Effluent Flow

Appendix E. Pilot Study (Source: City of Boise, 2011)

PAX dose (mL/min)	Total Phosphorus Removed	Dissolved Phosphorus Removed
1	64%	71%
2	86%	88%
4	91%	93%
3.5	86%	90%
2.5	89%	91%
3	92%	95%
2	86%	90%

Removal calculated using the average of the influent (DPI) and the average of the effluent (DPE) concentrations



Appendix F. Interim Performance of Treatment Facility (Provided by City of Boise)

The evaluation of the West Boise WWTF has been completed using CH2M HILL's Pro2D™ process simulation as the primary tool to predict the performance of the planned WWTF configuration. Pro2D is a whole-plant simulator developed by CH2M HILL process engineers on the MS Excel™ platform. Pro2D tracks 70 wastewater constituents through the treatment facility, providing a complete mass-balance for the system. Three additional models, the International Water Association (Activated Sludge Model(2D), an Anaerobic Digestion Model, and an intentional struvite reactor model are included Pro2D to simulator l the behavior of the West Boise enhanced biological phosphorus removal systems.

CH2M HILL's Pro2D process simulator was customized specifically for the West Boise WWTF. The whole plant simulator was calibrated against data collected through previous studies with the City. The goal of the calibration was to approximate the actual plant performance. A significant number of kinetic and stoichiometric values are included in Pro2D to help simulate a particular wastewater. Typical industry-standard values, along with those modified by CH2M HILL process experience, are included as the default values within the Pro2D simulator. Some of these values, however, have been adjusted to better reflect the wastewater particular to the West Boise WWTF.

Data and Assumptions for Estimation of Plant Performance

Plant performance for Total Phosphorus (phosphorus) is the sum of Dissolved Reactive Phosphorus (DRP) and Particle Attached Phosphorus (West Boise phosphorus Performance = DRP + TSS).

An estimate of monthly and seasonal plant performance was developed using the last five years of daily TSS data and the likely range of DRP during the May-September time period based on Pro2D and enhanced biological phosphorus removal process knowledge.

Particle Attached Phosphorus:

Estimated % phosphorus associated with TSS = 4.25-4.75% For this evaluation, an average value of 4.5% phosphorus was used and multiplied by actual daily TSS except for four months that had unusually high TSS values (June 2007 and May-July 2011). For these months, the maximum observed value (10 ug/l TSS) was used.

Dissolved Reactive Phosphorus:

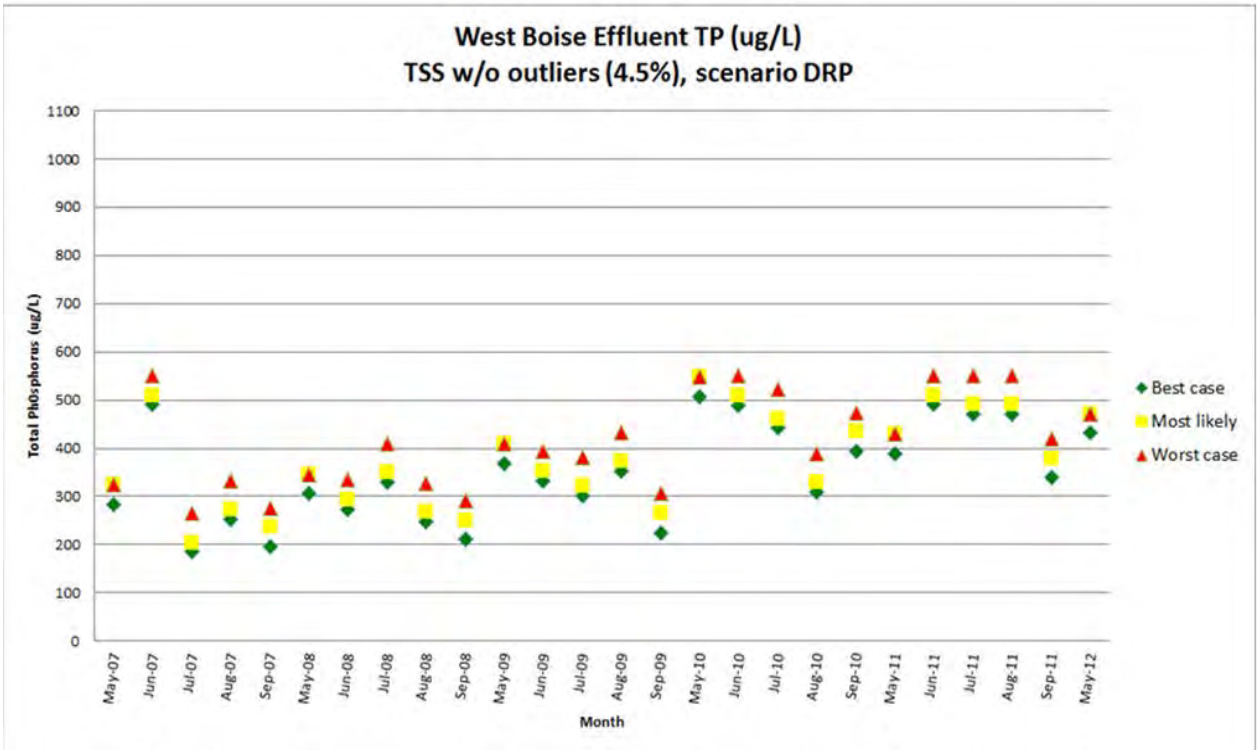
Pro2D anticipates a range of 20-100 ug/l. DRP performance is unrelated to TSS performance and varies seasonally in response to temperature (lower performance in spring and late fall when temperature is lower). A range of DRP values representing best, most likely, and worst case DRP performance were used.

Total phosphorus performance was the sum of the daily particle attached plus DRP calculated on a Monthly and Seasonal basis.

Monthly Phosphorus Performance Results

Monthly average phosphorus performance results are shown in the graph below based on actual TSS performance with the four high TSS months removed and replaced by 10 mg/l TSS monthly average. Estimated most likely or worst case phosphorus performance are at or above 500 ug/l

phosphorus for seven of the 26 months or 27% of the time.



Monthly average phosphorus performance was also estimated using a maximum TSS value of 10.9 mg/l TSS plus the DRP values described above. The results of that analysis showed that 500 ug/l monthly average was exceeded for all three conditions (best, likely, worst) for any month that monthly average of 10.9 mg/l TSS occurs.

Seasonal phosphorus Performance

Seasonal phosphorus performance was estimated using the assumptions and method described above. Results are that for the best and likely case, a seasonal effluent limit of 500 ug/l would be met. The worst case estimate ranged from 350-500 ug/l, with two of the five years being less than 5 ug/l under the 500 ug/l phosphorus seasonal average.

Table B-1 West Boise Seasonal (May-September) phosphorus (µg/L)

Year	Best case	Likely	Worst case
2007	282	310	350
2008	273	301	341
2009	316	344	384
2010	428	456	496
2011	432	460	500