Enclosure 2: EPA review of Idaho's Delisting Rationale for the Lower Boise River

In January 2008, the Idaho Department of Environmental Quality (IDEQ) released their draft 2008 Integrated Report for public comment. In that document, IDEQ sought to delist nutrient impairments in the Lower Boise River from Category 5 of Idaho's 2008 303(d) Integrated Report (IDEQ, 2008a). EPA provided comments to the proposed delisting (Croxton, 2008), and IDEQ responded and submitted their Final 2008 Integrated Report to EPA in July 2008 (IDEQ, 2008b).

This document describes the nutrient listing history and evaluates the evidence provided by IDEQ in their Draft 2008 Integrated Report, Final 2008 Integrated Report, and Final Response to Comments to delist nutrients in the Lower Boise River. It is organized in the following sections:

Listing History of Nutrients in the Lower Boise River
Idaho's Proposal to Delist Nutrients from Lower Boise River in 2008 Integrated Report
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## Listing History of Nutrients in the Lower Boise River

IDEQ first identified the Lower Boise River as polluted in Appendix A of the draft 1986 305(b) report. In a letter to EPA, IDEQ states that the basis for the list of segments not fully supporting protected beneficial uses is based solely on best professional judgment. The draft 1986 305(b) report does not specify the pollutants impairing the Lower Boise River (Burr, 1986). In 1992, IDEQ more specifically identified the Lower Boise River as impaired for nutrients, siltation/sedimentation, and organic enrichment/dissolved oxygen on Idaho's 1992 305(b) report, but not on Idaho's 1992 303(d) list. The 1992 305(b) report includes data from four stations: Boise River at Lucky Peak Dam, Glenwood Bridge, Middleton, and Parma. The narrative states:

> *"Stations in the Southwest Basin have the most complete data record. The Boise River Stations indicate a decline in water quality between the Lucky Peak and Parma stations, which was noted in the past. The water quality indices show a trend similar to trends reported in 1988 (IDEQ, 1992)."*

The report analyzes the trophic status at each station on the Boise River. At Lucky Peak Dam, the trophic status is good, but progressively worsens downstream. Boise River at Glenwood Bridge and Middleton show a fair trophic status, and Boise River at Parma shows a poor trophic status. Dissolved oxygen and pH measurements are good and fair (IDEQ, 1992).

The Lower Boise River was not included on Idaho's 1992 303(d) list (IDEQ, 1992). EPA was subsequently challenged regarding its approval of Idaho's 1992 303(d) list because it did not include waters for which data were available that indicated they were impaired. EPA was ordered by the court to develop the 303(d) list for Idaho, which was published as the 1994 list. The Lower Boise River was included in the 1994 list for nutrients and sediment, and this listing continued in 1996, 1998, and 2002. In 2002, tributaries on the Lower Boise River were also

listed for nutrients (IDEQ, 1994, 1996, 1998, 2005d). EPA approved each of these subsequent lists of impaired waters (EPA, 1993, 1994, 2001, 2005a).

### *Applicable Water Quality Standards for Nutrients in Idaho*

The Idaho water quality standards that address nutrients are as follows:

**Idaho Administrative Code (IDAPA 58.01.02-200.05, 06, 07)**

**05. Floating, Suspended or Submerged Matter**. Surface waters of the state shall be free from floating, suspended, or submerged matter of any kind in concentrations causing nuisance or objectionable conditions or that may impair designated beneficial uses. This matter does not include suspended sediment produced as a result of nonpoint source activities.

**06. Excess Nutrients.** Surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses.

**07. Oxygen-Demanding Materials.** Surface waters of the state shall be free from oxygen-demanding materials in concentrations that would result in an anaerobic water condition.

## Idaho's Proposal to Delist Nutrients from Lower Boise River in 2008 Integrated Report

In 2001, IDEQ completed the Lower Boise River Nutrient Subbasin Assessment (SBA) and concluded that nutrients were not impairing the river. In 2001, EPA provided several comment letters on the draft Lower Boise River Nutrient SBA and Tributary SBAs (Filippini, 2001). In these analyses, EPA concluded that

> *"After review of the SBAs and an analysis of the State of Idaho water quality standards by EPA staff, including our Standards and Planning Unit, EPA concludes that we cannot support delisting the Lower Boise River for nutrient loading at this time (Filippini, 2002)."*

In subsequent letters and in EPA's comments to the Draft 2008 Integrated Report, EPA presented concerns regarding information provided by IDEQ, and EPA provided information to Idaho which supported the 303(d) listing of nutrients on the Lower Boise River in Category 5, the impaired waters list (Croxton, 2008; Stewart, 2007; Cope, 2007; Nickel, 2007).

In January 2008, IDEQ released their draft 2008 Integrated Report for public comment, which included the proposal to delist the Lower Boise River for nutrients. Table 1 lists the impaired segments in the Lower Boise watershed which remained in Category 5 of the 2008 Draft Integrated Report. Table 2 lists the rationale provided by IDEQ to delist the Lower Boise River for nutrients.

**Table 1. Lower Boise River Category 5 Impaired Segments in 2008 Final Integrated Report**

| Waterbody Segment Number | Waterbody Name | River Miles | Impairment |
|---|---|---|---|
| ID17050114SW001_02 | Boise River – Indian Creek to mouth | 4.14 | Temperature, water |
| ID17050114SW001_06 | Boise River – Indian Creek to mouth | 45.43 | Temperature, water |
| ID17050114SW002_04 | Indian Creek – 4th order | 10.93 | Temperature, water; Fecal coliform |
| ID17050114SW003_02 | Indian Creek – 1st and 2nd order | 280.3 | Sedimentation/Siltation; Fecal Coliform; Nutrient/Eutrophication Biological Indicators (added 3/27/06) |
| ID17050114SW003_03 | Indian Creek – 3rd order | 57.21 | Sedimentation/Siltation, Temperature, water; Nutrient/Eutrophication Biological Indicators (added 3/27/06) |
| ID17050114SW003_04 | Indian Creek – 4th order | 27.26 | Sedimentation/Siltation; Temperature, water; Cause Unknown (Low DO due to suspected organic enrichment) |
| ID17050114SW004_06 | Lake Lowell | 6056.53 acres | Cause unknown (nutrients suspected impairments, low DO suspected organic enrichment) |
| ID17050114SW005_06 | Boise River – river mile 50 (T04N, R02W, Sec. 32) to Indian | 44.1 | Temperature, water |
| ID17050114SW006_02 | Mason Creek – entire watershed | 29.82 | Sedimentation/siltation; cause unknown (nutrients suspected impairment, low DO due to suspected organic enrichment) |
| ID17050114SW008_03 | Tenmile Creek – 3rd order below Blacks Creek Reservoir | 29.48 | Fecal coliform; cause unknown nutrients suspected impairment |
| ID17050114SW009_02 | Blacks Creek – 1st and 2nd order | 56.2 | Combined Biota/Habitat Bioassessments |
| ID17050114SW009_03 | Blacks Creek – 3rd order | 7.49 | Combined Biota/Habitat Bioassessments |
| ID17050114SW010_02 | Fivemile Creek – 1st and 2nd order | 65 | Fecal coliform |
| ID17050114SW010_03 | Fivemile Creek – 3rd order | 22.64 | Combined Biota/Habitat Bioassessments; Fishes Bioassessment, Unknown (nutrients suspected impairment, low DO due to suspected organic enrichment) |
| ID17050114SW011a_06 | Boise River – Diversion Dam to river mile 50 (T04N, R02W, Se) | 32.15 | Temperature, water; |
| ID17050114SW011b_06 | Boise River – Lucky Peak Dam to Diversion Dam | 2.31 | Other flow regime alterations |
| ID17050114SW012_02 | Stewart Gulch, Cottonwood and Crane Creeks – source to mouth | 63.71 | Combined Biota/Habitat Bioassessments |
| ID17050114SW012_03 | Stewart Gulch, Cottonwood and Crane Creeks – source to mouth | 5.92 | Combined Biota/Habitat Bioassessments |
| ID17050114SW015_02 | Willow Creek – source to mouth | 77.72 | Combined Biota/Habitat Bioassessments; Temperature/Water |
| ID17050114SW015_03 | Willow Creek – source to mouth | 18.36 | Combined Biota/Habitat Bioassessments; Temperature/Water |
| ID17050114SW016_03 | Langley/Graveyard Gulch complex | 5.58 | Sedimentation/Siltation; Cause unknown (low DO due to suspected organic enrichment) |
| ID17050114SW017_03 | Sand Hollow Creek – source to mouth | 18.24 | Sedimentation/Siltation; Fecal coliform; Cause unknown (low DO due to suspected organic |

| Waterbody Segment Number | Waterbody Name | River Miles | Impairment |
|---|---|---|---|
| | | | enrichment) |
| ID17050114SW017_06 | Sand Hollow Creek – source to mouth | 2.67 | Sedimentation/Siltation; Cause unknown (nutrient suspected impairment, low DO due to suspected organic enrichment) |

**Table 2. Proposed Delisted Assessment Units in the Lower Boise River, Final Integrated Report 2008**

| **17050114 Lower Boise** |
|---|
| ID17050114SW001_06 Boise River- Indian Creek to mouth 45.43 MILES<br><br>**Phosphorus (Total) Applicable WQS attained; reason for recovery unspecified**<br><br>Lower Boise River Nutrient Sub-Basin Assessment, December 2001, pages 42-43:<br><br>Nutrient 303(d) Listing Status<br>The analysis indicates that nutrients are not impairing aquatic life or recreational beneficial uses in the lower Boise River. Hence, the DEQ proposes de-listing nutrients as a pollutant in the lower Boise River from the 2002 303(d) list. The proposal to de-list nutrients is consistent with 40 CFR 130.7 (6), whereby the state shall provide documentation that supports the listing determination. This assessment serves as the supporting documentation.<br>http://www.deq.idaho.gov/water/data_reports/surface_water/tmdls/boise_river_tribs/boise_river_nutrient.pdf |

## Federal Requirements to Evaluate Delisting from the 303(d) Integrated Report

In order for impaired waters to be delisted from Category 5 of the Integrated Report (303(d) list), the State must demonstrate a good cause to delist (40 CFR 130.7(b)(6)(iv)) and the rationale for excluding existing and readily available information (40 CFR 130.7(b)(6)(iii)). Specifically, in order for impaired waters to be delisted from Category 5 of the Integrated Report,

> *"each State must demonstrate good cause for not including a water or waters on the list. Good cause includes, but is not limited to, more recent or accurate data; more sophisticated water quality modeling; flaws in the original analysis that led to the water being listed in the categories in 130.7(b)(5); or changes in conditions, e.g., new control equipment, or elimination of discharges* (40 CFR 130.7(b)(6)(iv)).

In addition, the State must provide

> *"A rationale for any decision to not use any existing and readily available data and information for any one of the categories of waters as described in 130.7(b)(5)(40 CFR 130.7(b)(6)(iii)."*

EPA also describes the interpretation of these regulations in the report, "Guidance for 2006 Assessment, Listing, and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act (EPA, 2005b)."

IDEQ's basis for delisting relies on the Lower Boise River Nutrient SBA published by IDEQ in December 2001 and on information included in IDEQ's 2008 Integrated Report Final Response to Comments (IDEQ, 2008b). The Lower Boise River Nutrient SBA asserts that if excess nutrients do not impair the aquatic and recreational uses, a waterbody is not impaired by nutrients. Based on this premise, the report puts forth the following lines of evidence as a basis to demonstrate that excess nutrients do not impair uses: dissolved oxygen (DO) and pH data (aquatic life use), planktonic chlorophyll-a data (aquatic life, recreational use), lack of complaints on nuisance algae from 1997-2000 (recreational use), and velocity of the river higher than scouring thresholds (recreational use) (IDEQ, 2001). The Final Response to Comments also asserts that diurnal dissolved oxygen data from the City of Boise taken from 2004 through 2007 meet Idaho's water quality standards (IDEQ, 2008b).

The lines of evidence are summarized in IDEQ's response to comments on the Draft 2008 Integrated Report.

> *"Various nuisance thresholds have been established by different studies. However, no thresholds have been proposed in relation to the adverse impacts to aquatic life. Impacts to aquatic life are generally based on DO and pH problems and the reduction of living space for aquatic organisms due to excessive algal biomass. In August 1997, the USGS took hourly DO measurements over 24 hour periods at 5 sites (Eckert, Glenwood, Middleton, Caldwell and Parma). Normal diurnal DO patterns were observed but concentrations never dropped below the criteria. No DO measurements less than 6.0 mg/L have been recorded from Lucky Peak to the mouth of the river from 1986 to 1999 (by USGS). The City of Boise submitted diurnal dissolved oxygen data to IDEQ during the listing process. Dissolved oxygen data was collected at two sites, Glenwood and Linder bridges (both below the wastewater treatment plants), in 15 minute intervals July 2004 through 2007. Dissolved oxygen (mg/L) never dropped below 6.0 mg/L. 0.08% and 1.34% of the dissolved oxygen percent saturation values were below 75% saturation at Glenwood and Linder monitoring sites, respectively. The relationship between Lower Boise River channel hydraulics, nutrients, and periphyton growth was examined in the Lower Boise River Nutrient Subbasin Assessment (IDEQ 2001). Results indicated that during the irrigation season (April to October) when conditions are most suitable for periphyton growth, velocities in the Lower Boise River are higher than the scour threshold, even in low flow years. The absence of nuisance levels of periphyton indicates that the macroinvertebrates have ample living space and that the intergravel flows are not impeded. Hydraulic conditions in the Lower Boise River mitigate for nutrient enriched conditions. In addition, DEQ complaint logs (1997-2000) indicated no complaints of nuisance growth. Irrigation companies and other water users did not report algal impediment at river withdrawal locations during the same time period. Recreational and aesthetics beneficial uses are not impaired by algae (IDEQ, 2008b)."*

## EPA's Evaluation of the Proposed Nutrient Delisting for the Lower Boise River

To evaluate whether the proposed nutrient delisting is appropriate, EPA assesses the information IDEQ provides to support the delisting (40 CFR 130.7(b)(6)(iv)) and evaluates the rationale for excluding existing and readily available information (40 CFR 130.7(b)(6)(iii)).

### IDEQ's Rationale for Delisting

The following section evaluates the five lines of evidence that IDEQ presents in its Draft 2008 Integrated Report, Final Integrated Report, and the Final Response to Comments to support its proposal to delist nutrients from the Lower Boise River. These are DO data, pH data, planktonic chlorophyll-a data, lack of nuisance complaints, and high river velocity.

#### *DO as an indicator of nutrient impairment*

According to EPA's Ambient Water Quality Criteria Recommendations: Rivers and Streams in Nutrient Ecoregion III, total phosphorus, total nitrogen, chlorophyll-a, and some measure of turbidity "are considered to be the best suited for protecting designated uses," while "[o]ther indicators such as dissolved oxygen and macrophyte growth or speciation, and other fauna and flora are also deemed useful" in waters impaired by nutrients (EPA, 2000).

The segment of the Lower Boise River proposed for delisting nutrients is not currently listed for DO (IDEQ, 2008b), but DO is a useful indicator of excess nutrients when combined with nutrient, chlorophyll-a, and biological data. Nutrient enrichment can cause excessive algal growth which can result in high DO during daylight hours when algae photosynthesize, and low DO during nighttime hours when algae respire. Bacterial decomposition of algae and other organic matter also reduces oxygen levels. Either low DO or supersaturated DO can have harmful effects on aquatic life and both can be a result of excess nutrient levels. DO levels can vary significantly each day, usually reaching the lowest levels early in the morning.

It is important to verify whether measurements have been taken at critical times, in order to fully assess compliance with DO criteria. While low DO may indicate excess nutrients and algal growth, DO measurements that meet the numeric criteria are not sufficient to conclude that excess nutrients are <u>not</u> present. DO levels may comply with criteria, but nutrient levels may still be high enough to cause nuisance growth of algae, macrophytes, etc. Although DO can be an indicator of nutrient impairment, DO data alone do not provide a complete assessment of nutrient impairment. At a minimum, nutrient data must also be considered.

IDEQ presents the following information on dissolved oxygen.

*"In August 1997, the USGS took hourly DO measurements over 24 hour periods at 5 sites (Eckert, Glenwood, Middleton, Caldwell and Parma). Normal diurnal DO patterns were observed but concentrations never dropped below the criteria. No DO measurements less than 6.0 mg/L have been recorded from Lucky Peak to the mouth of the river from 1986 to 1999 (by USGS). The City of Boise submitted diurnal dissolved oxygen data to IDEQ during the listing process. Dissolved oxygen data was*

*collected at two sites, Glenwood and Linder bridges (both below the wastewater treatment plants), in 15 minute intervals July 2004 through 2007. Dissolved oxygen (mg/L) never dropped below 6.0 mg/L. 0.08% and 1.34% of the dissolved oxygen percent saturation values were below 75% saturation at Glenwood and Linder monitoring sites, respectively (IDEQ, 2008a)."*

IDEQ presents data that USGS (1986 to 1999) and the City of Boise collected for the 2001 Lower Boise River Nutrient SBA. IDEQ states that the City of Boise's data is diurnal and DO samples were collected at two sites upstream of the most nutrient-impacted areas at 15-minute intervals from July 2004 through 2007. On at least three occasions, EPA requested from the City of Boise the 15-minute interval DO data cited in DEQ's Final Response to Comments to EPA. The information has not been provided, so EPA is only able to consider the data collected by USGS, and grab samples collected by the City of Boise.

DO data collected by USGS from 1994-2002 show that DO sags do not violate Idaho's water quality standards. However, USGS and City of Boise's data show DO levels that are at times supersaturated. DO saturation is defined as the amount of soluble DO. According to MacCoy's 2004 study,

> *"Supersaturated DO conditions indicated that photosynthetic production of DO by aquatic plants (phytoplankton, periphyton, and aquatic macrophytes) was in excess of oxygen demands from respiration and decomposition at all the mainstem sites at some time during the study. Dissolved oxygen was supersaturated (>100 percent saturation) at all the main-stem water quality sampling sites during more than half of the measurements at each site (MacCoy, 2004)."*

Therefore, DO data from USGS and City of Boise grab samples show the presence of aquatic algae that increase DO to supersaturated levels. Supersaturated DO can harmfully impact macroinvertebrates (Hayslip, 2008). In addition, DO exhibits a diurnal pattern when algae undergo photosynthesis and respiration, such that oxygen levels can be supersaturated in the afternoon and severely depleted just before dawn (Chapra, 1997). Grab samples and August 1997 continuous monitoring data on a single day do not show DO violating water quality standards. However, more recent continuous DO data at downstream locations is necessary to evaluate the diurnal pattern and to assess minimum DO levels.

In summary, DO data alone are not sufficient to determine whether nutrients are impairing a system. Used in conjunction with total phosphorus, chlorophyll-a, and macroinvertebrate data, they can be useful to assess nutrient impairment. The limitations of this data are significant. With the exception of one day in August 1997, the data are not diurnal. Supersaturated DO levels in the Lower Boise River indicate the presence of aquatic plants contributing higher than normal DO levels that can be harmful to macroinvertebrates. In addition, the only continuous (hourly) DO collected in the Lower Boise to evaluate diurnal patterns was one day in August 1997. It is unclear whether DO sags in violation of water quality standards may have occurred more recently at downstream stations, particularly where DO levels are lowest. Even if diurnal DO data show that DO is within standards, DO measurements alone are not a sufficient basis for delisting nutrients.

***pH as an indicator of nutrient impairment***

Similar to DO, pH is a secondary indicator of excess nutrients, since high pH may result from algal photosynthesis and harm aquatic life. Primary indicators are nutrients themselves, such as phosphorus or nitrogen. The segment of the Lower Boise River proposed for delisting is not currently listed for pH (IDEQ, 2008).

The 2001 Lower Boise Nutrient River SBA includes a figure of pH measured by USGS at four sites from 1990-1998. Idaho's water quality standard for pH is 6.5 to 9.0. pH increases downstream at Parma where the river becomes nutrient rich, but the pH values appear to be just within standards, with values equal to but not more than 9.0 in the 2001 Lower Boise Nutrient River SBA (IDEQ, 2001).

pH data from the Lower Boise River Nutrient SBA is limited to a graph and samples from Diversion, Glenwood, Middleton, and Parma summarizing information from 1990-1998. In the 2004 USGS Report, pH data taken at the same 4 stations from 1994-2002 is just within state standards, except at Middleton where a pH of 9.1 was recorded on October 31, 2002 (MacCoy, 2004). These more recent pH grab samples indicate pH levels close to exceeding the water quality standard, and in at least one case, exceeding Idaho's pH criteria. To demonstrate impacts on pH from algal growth, continuous pH monitoring is essential. It is unclear whether continuous pH data were collected.

In conclusion, pH data used with total phosphorus, chlorophyll-a, and macroinvertebrate data can be useful to assess nutrient impairment. However the pH data referenced by IDEQ does not support a basis for concluding the water is not impaired for nutrients. Moreover, continuous pH monitoring which would capture pH peaks has not been conducted. Moreover, pH data alone with no consideration of primary nutrient indicators could not be used as a basis to support delisting nutrients.

***Chlorophyll-a measurements***

Chlorophyll-a is the primary pigment in all algae and is used as a measure for algae growth. Planktonic chlorophyll-a measures the amount of pigment in phytoplankton, or suspended algae. Phytoplankton consist of small plants that drift in the water column and have limited or no ability to move. Periphyton, also called attached or benthic algae, refers to microfloral growth on substrata on river bottoms (Wetzel, 2001). Both planktonic and periphytic chlorophyll-a data are used to reflect algal growth in river systems.

Planktonic chlorophyll-a data are useful to assess whether floating, suspended, or submerged matter are present. The Lower Boise River Nutrient SBA presents two types of information collected by the USGS: planktonic chlorophyll-a and benthic (periphyton) chlorophyll-a. To evaluate these data, IDEQ uses a threshold value for chlorophyll-a from North Carolina of 40 □g/L. Because none of the measured values in the Lower Boise exceed 40 ug/l, IDEQ concludes that nutrients are not causing excessive growth of water column algae (IDEQ, 2001).

This conclusion has two major flaws. First and most important, IDEQ's use of North Carolina's threshold of 40 □g/L to evaluate planktonic chlorophyll-a data is not supported based on Idaho's own practices or on the biology of the ecosystem. The use of this threshold is inconsistent with past interpretations in Idaho TMDLs. IDEQ has used 15 □g/L as a threshold or target in several recent TMDLs (IDEQ, 2008c, 2004, 2005b.) Furthermore, Oregon's ecosystem is much more similar to the Lower Boise River watershed than North Carolina's, and Oregon uses 15 ug/l chlorophyll-a as a water quality standard (EPA, 2003). Additionally, North Carolina's listing criteria of 40 □g/L is used for Class C waters and tidal waters not designated for trout. For waters designated as trout waters, North Carolina, consistent with Oregon and Idaho's past interpretations, uses a threshold of 15 □g/L (EPA, 2003). The 15 □g/L threshold for trout waters is more comparable to the Lower Boise River where salmonid spawning and coldwater biota are aquatic life beneficial uses. In our review, this is the only instance we could find where IDEQ used this 40 □g/L reference standard. Finally, IDEQ's own data show exceedances at Middleton and Parma of the 15 □g/L planktonic chlorophyll-a threshold used to define impairment in several Idaho TMDLs (Table 3).

The second flaw is that planktonic chlorophyll-a data alone is inadequate to assess whether excess nutrients cause excessive algae growth in the Lower Boise because it does not address algae attached to the substrate (periphyton). Planktonic chlorophyll-a represents algae suspended in the water column, but does not include periphyton, which is algal growth attached to substrate. According to the USGS, "*In the Lower Boise, the growth of aquatic plants is largely associated with periphyton* (MacCoy, 2004)." Periphytic chlorophyll-a data must also be considered in the delisting, because it is the most predominant form of algal growth in the Lower Boise, and relates to the narrative standards, which reference "submerged matter", "visible slime growths", and "other nuisance growths".

USGS sampled periphytic chlorophyll-a comparing it to the 100-200 $mg/m^2$ threshold that several authors suggest constitute a nuisance level (Horner et at., 1983, Watson and Gestring, 1996; Welch, et al., 1988; Welch, et al., 1989). The Lower Boise River Nutrient SBA cites data taken by the USGS from 1995 to 1999 and states that "chlorophyll-a in periphyton ranges from a low of 0.025 $mg/m^2$ at Eckert Road to a high of 933 $mg/m^2$ at Caldwell." In IDEQ's Boise River TMDL for sediment and bacteria (IDEQ, 1999), Figure 21 on page 46 shows 33 chlorophyll-a data points for five locations on the Lower Boise River. Fifteen of the measurements from Caldwell, Middleton and Glenwood Bridge are above 200 $mg/m^2$ with a maximum measurement above 900 $mg/m^2$ (Croxton, 2008). Given that periphyton levels are regularly well above nuisance levels suggested in the literature, these data indicate impairment triggered by elevated nutrient levels. IDEQ's own report states that "periphytic chlorophyll-a values exceed the literature nuisance thresholds in these segments." However, IDEQ discounts this data and instead relies on DO and pH data to indicate that aquatic life beneficial uses are not impaired. (See further discussion below on p. 14.)

In summary, while planktonic chlorophyll-a values alone are not a complete representation of the algal community in the Lower Boise River, data collected by IDEQ show exceedances of planktonic thresholds used in prior Idaho TMDLs. Furthermore, IDEQ has not demonstrated that a 40 □g/L planktonic chlorophyll-a threshold used in North Carolina is appropriate to determine impairment in the Lower Boise River. Finally, periphyton is the most predominant

form of algae in the Lower Boise River, and periphyton levels regularly exceed nuisance thresholds suggested in the literature. Based on the above discussion, IDEQ's interpretation and use of the planktonic and periphytic chlorophyll-a data does not support delisting of the Lower Boise River for nutrients.

***Lack of complaints on nuisance algae (1997-2000)***

IDEQ's Final Response to Comments based on information from the 2001 Nutrient SBA states, "*In addition, DEQ complaint logs (1997-2000) indicated no complaints of nuisance growth.. Irrigation companies and other water users did not report algal impediment at river withdrawal locations during the same time period (IDEQ, 2001).*" IDEQ uses the lack of complaints to justify that the recreational use of the Lower Boise River is being met.

EPA has several concerns with IDEQ's explanation that there was a lack of complaints of nuisance algae from 1997-2000. First, IDEQ does not outwardly solicit or encourage public feedback on recreational use experiences or problems on an ongoing basis, nor indicate to the public the significance of making such comments. If the public was aware that their recreational experiences and perspective on the Lower Boise River could be a major factor in determining whether a water was impaired and could trigger development of a pollution reduction plan, IDEQ may have received more public input. As a result, it is unclear whether the lack of complaints received during 1997 – 2000 accurately reflects public opinion regarding water quality in the Lower Boise River, or whether it is a reflection of the lack of public awareness and significance of making such comments. Second, the delisting proposal does not include any information from 2001 to 2008. Third, in the Final Response to Comments, at least one commenter indicated that macrophytes in the Lower Boise River are impairing recreational beneficial uses (DEQ, 2008b, Final Response to Comments, #261.)

Instream algae data are supported by photo logs of the Lower Boise River which EPA completed on July 9, 2008 and August 13, 2008 (See attachments 1 and 2). These photo logs present evidence of high levels of algae growth in segments in and near Parma, Idaho. Additionally, periphytic chlorophyll-a levels are well above nuisance algae levels identified in the literature, as noted previously.

In summary, the lack of complaints on nuisance algae from 1997-2000 does not demonstrate that the recreational use is met and does not support delisting nutrients from the Lower Boise River.

***Velocity of the Lower Boise River higher than scouring thresholds***

The Lower Boise River Nutrient SBA cites a reference value for scouring thresholds and concludes that the velocity of the Lower Boise River during the algae growing season is higher than the scouring threshold, so algae are not expected to grow. It is unclear why IDEQ focuses on algae scouring thresholds, when direct in-stream measurements of algae levels are available. Both total phosphorus and periphytic and planktonic chlorophyll-a measurements are above recommended thresholds, during both low and high flow years, despite stream velocities cited in the Lower Boise SBA. Recent photo logs from July 8, 2008 and August 13, 2008 confirm high levels of algal growth in the Lower Boise River.

Since IDEQ's explanation that algae levels are sufficiently reduced by scouring river velocities is not supported by in-stream measurements of algae levels and photo logs, this explanation does not demonstrate that the recreational use is met and is not a basis to delist nutrients from the Lower Boise River.

## Consideration of Existing and Readily Available Information

In IDEQ's Draft Integrated Report, Final Integrated Report, and Final Response to Comments, IDEQ does not consider significant existing data to evaluate nutrient impairment and does not provide sufficient rationale to exclude these data. In some cases, water quality data collected over a 15-year period has not been considered. In order to evaluate whether nutrients are an impairment, nutrient data must be considered. To assess whether nuisance algae is an impairment, algal data must be considered. To determine whether beneficial uses are impaired, macroinvertebrate data must be considered. Finally, when determining the parameters to list or delist waters, IDEQ should apply consistent rationale. IDEQ has not provided sufficient rationale to exclude multiple years of data key to evaluating whether nutrients impair the Lower Boise River. The exclusion of pertinent, readily available information of nutrient-related parameters alone is a basis to deny IDEQ's proposal to delist nutrients from the Lower Boise River.

### *Nutrient data must be considered in a nutrient-impaired water.*

EPA's Ambient Water Quality Criteria Recommendations: Rivers and Streams in Nutrient Ecoregion III consider total phosphorus, total nitrogen, chlorophyll-a, and some measure of turbidity to be the best suited for protecting designated uses in waters impaired by nutrients (EPA, 2000).

Nutrient concentrations must be considered when evaluating whether a waterbody is impaired by nutrients. In the Lower Boise River, numerous studies have been conducted on nutrients such as phosphorus and nitrogen. The United States Geological Survey (USGS) collected information at five stations on the Lower Boise River from 1994 to 2002 (MacCoy, 2004), and continues to collect monthly or bi-monthly information on nutrients (USGS website http://id.water.usgs.gov/projects/lwr_boise/). The Lower Boise River Nutrient SBA includes information on total phosphorus data collected from 1989 to 2000 and on total nitrogen levels collected from 1990 to 1997. These data are not considered in IDEQ's proposal to delist nutrients for the Lower Boise River.

Over 15 years of data indicate nutrient impairment in the Lower Boise River. The following table compares data for phosphorus collected by USGS from 1994-2002 to targets recommended in EPA 304(a) guidance (ie. EPA's Water Quality Criteria Recommendations for Ecoregion III and EPA's Gold Book). Though recommended targets are not adopted as State water quality criteria, they may be used to interpret state narrative standards and may provide a baseline with

which to assess the degree of impairment. Data below show that total phosphorus (TP) on the Lower Boise exceeds these targets.

**Table 3. Comparison of Measured TP to Reference Targets**

| Location | Average TP Conc. (mg/L) | Range of TP (mg/L) | Example TP Targets |
|---|---|---|---|
| **Diversion Dam** | 0.03 | 0.01 – 0.09 | 0.010-0.055 mg/L TP[1] |
| **Glenwood** | 0.11 | 0.02 – 0.38 | 0.10 mg/L TP[2] |
| **Middleton** | 0.25 | 0.03 – 0.85 | 0.02 mg/L TP[3] |
| **Parma** | 0.29 | 0.08 – 0.55 | |

MacCoy, D.E., 2004
[1] EPA, 2000. Ambient Water Quality Criteria Recommendations, Nutrient Ecoregion III
[2] EPA, 1986. [Note: EPA's Gold Book reference values have been updated with nutrient ecoregion numbers.]
[3] Watson and Gestring, 1996

Total phosphorus data collected by the USGS from 1994-2002 show average total phosphorus levels increase by more than 8 times from Lower Boise River at Diversion Dam to Lower Boise River at Parma. The maximum concentration of TP in MacCoy's 2004 report in the Lower Boise River (0.85 mg/l) is 15 times higher than the upper range of EPA's ecoregional nutrient criteria (0.055 mg/L).

While DEQ states that DO, pH and planktonic chlorophyll-a are sufficient water quality parameters to evaluate whether designated and existing beneficial uses are impaired by nutrients, the decision to exclude total phosphorus data is not supported by any scientific documents and is inconsistent with IDEQ's interpretation of its narrative standard to list or delist waters for nutrients in other SBAs and TMDLs.

Table 4 describes the listing and delisting rationale for nutrients in IDEQ's most recent TMDLs approved by EPA. Total phosphorus data were considered in all of these TMDL as a basis for listing decisions. Several other TMDLs use additional parameters to evaluate nutrient impairment such as planktonic chlorophyll-a, DO, pH and macroinvertebrate data. However, total phosphorus data are not excluded in any TMDL. Though EPA-recommended ecoregional nutrient targets for total phosphorus are not State water quality criteria, they provide a baseline to assess impairment. IDEQ's rationale that EPA recommended targets are not legally enforceable is not an adequate justification to exclude 15 years of total phosphorus data. State development of numerical criteria should be based on EPA 304(a) guidance or other scientifically defensible methods. This approach is also appropriate for a State's interpretation of their narrative standard (40 C.F.R. 131.11(b)).

**Table 4. Listing and Delisting Rationale in Nutrient TMDLs in Idaho**

| Waterbody Name | Approval Date | Listing/Delisting Rationale |
|---|---|---|
| Bear River/<br>Malad River Basin | June 2006 (pages 112-125) | Listing rationale:<br>* BURP data not supporting beneficial uses;<br>* Water quality samples above 0.05 mg/L TP (EPA Gold Book, 1986), 0.075 mg/L TP (Ecosystems Research Institute, 1995);<br>* DO below standards<br>* Dense macrophyte stands |
| Lindsay Creek | June 2007 | Listing rationale:<br>* Taxa richness low; SMI = 0<br>* TP greater than 0.1 mg/L (EPA, 1986), TP greater than 0.030 mg/L (EPA, 2000).<br>* High nitrite+nitrate-N concentrations in groundwater above 2 mg/L (IDWR, 1995). |
| Upper Hangman | September 2007 | Delisting rationale:<br>* TP less than 0.1 mg/L (EPA, 1986) |
| North Fork Payette River | August 2005 | Delisting rationale for NF Payette River:<br>* TP less than 0.1 mg/L TP (EPA, 1986)<br>* DO meeting standards |
| Weiser (Mark, Leigh) | January 2007 | Delisting Rationale:<br>* Diel DO data below standards<br>* TP less than 0.1 mg/L TP (EPA, 1986) |
| Salmon Falls Creek | February 2008 | Listing rationale for free-flowing rivers:<br>* TP greater than 0.1 mg/L monthly average, 0.16 mg/L TP daily maximum<br>* Planktonic chlorophyll-a greater than 15 □g/L. |
| Snake River-Hells Canyon | September 2004 | Listing rationale for free-flowing rivers:<br>* TP greater than 0.070 mg/L monthly average<br>* Planktonic chlorophyll-a greater than 15 □g/L<br>* DO below standards |
| Beaver-Camas Creek | August 2005 | Delisting rationale:<br>* TP less than 0.05 mg/L and nitrite + nitrate-N less than 0.3 mg/L (EPA Gold Book, 1986). |
| Camas Creek | September 2005 | Delisting rationale for Soldier Creek:<br>* Planktonic chlorophyll-a below 15 □g/L<br>* TP below 0.1 mg/L average TP; below 0.16 mg/L instantaneous TP<br>* DO, pH and turbidity show that beneficial uses are fully supported |

In summary, IDEQ has not provided an adequate rationale for excluding phosphorus data to evaluate whether the Lower Boise River is impaired for nutrients. Over fifteen years of total phosphorus data indicate the Lower Boise River significantly exceeds recommended EPA 304(a) criteria targets and is impaired for nutrients.

***Periphytic Chlorophyll-a must be considered when evaluating impairment from algae.***

IDEQ has also not provided sufficient rationale to exclude periphytic chlorophyll-a data. Periphytic chlorophyll-a measure the pigment in periphyton and are the most direct measurement of periphyton. All algae data should be considered when determining impairment from nuisance

algae. The 2001 Lower Boise River Nutrient SBA presents information on periphytic chlorophyll-a data collected by the USGS from 1995 to 1999 (IDEQ, 2001). The USGS continued to collect periphytic chlorophyll-a data until 2005 (USGS website: http://id.water.usgs.gov/projects/lwr_boise/site_list.html#null). MacCoy's 2004 USGS report states that aquatic plants in the Lower Boise River are mainly periphyton.

In the 2001 Lower Boise River Nutrient SBA, the report states that DO and pH supersede periphytic chlorophyll-a data in importance, since those parameters link directly to beneficial uses (IDEQ, 2001). We agree DO and pH have a direct bearing on aquatic life uses, but periphyton growth also has a direct bearing on aquatic life uses. Changes in plant assemblage structure also can affect habitat structure, for example by changing the availability of refugia, smothering coarse substrates and/or the trapping of fine organic matter particles (Hayslip, 2008).

Recreational beneficial uses also apply to the Lower Boise River, and periphytic chlorophyll-a data are a direct indicator of algae, which can be a nuisance and affect recreational uses. Nuisance thresholds described in the literature for chlorophyll-a are useful as a baseline comparison to determine the degree of impairment. Below are chlorophyll-a values collected from 1994 to 2002 in MacCoy's USGS study compared to various reference thresholds. Table 5 shows periphytic chlorophyll-a in the Lower Boise river as being above widely used nuisance thresholds of 100-150 mg/m$^2$ (Watson and Gestring, 1996; Welch et al, 1988, Welch et al, 1989). This table does not include periphytic chlorophyll-a data from 1995 to 1997 in the Lower Boise River TMDL for bacteria and sediment. In that TMDL fifteen of 33 measurements from Caldwell, Middleton, and Glenwood Bridge have values higher than 200 mg/m$^2$ and a maximum measurement greater than 900 mg/m$^2$ (IDEQ, 2000). IDEQ has not provided sufficient rationale to exclude these data.

**Table 5. Comparison of Measured Periphyton Chl a to Reference Targets**

| Location | Average Periphyton Chl a (mg/m$^2$) | Range of Periphyton Chl a (mg/m$^2$) | Example Periphyton Chl a Targets |
|---|---|---|---|
| **Diversion Dam** | 9 | <1 – 21 | 100 mg/m$^2$ [1]<br>100-150 mg/m$^2$ [2] |
| **Glenwood** | 116 | 22 – 267 | |
| **Middleton** | 264 | 23 – 477 | |
| **Parma** | 159 | 13 – 300 | |

[1] Nordin, 1985.
[2] Welch et al, 1987.

In summary, IDEQ has not provided an adequate rationale for excluding periphytic chlorophyll a data to evaluate whether the Lower Boise River is impaired for nutrients. Over ten years of periphytic chlorophyll-a data indicate the Lower Boise River significantly exceeds literature values and is impaired for nutrients.

***Macroinvertebrate data must be considered when considering beneficial use support.***

IDEQ also does not provide sufficient rationale to exclude macroinvertebrate data. Macroinvertebrate data are direct measurements of impacts to aquatic life. IDEQ states that the Lower Boise River is not nutrient-impaired, because beneficial uses are not impaired. However, IDEQ does not consider data on impaired macroinvertebrate assemblages in its proposal to delist. In IDEQ's Final Response to Comments to EPA, IDEQ concludes that impaired macroinvertebrate assemblages are due solely to sediment and not to nutrients. However, they do not present an adequate basis for their assertion that degraded macroinvertebrate assemblages are only due to sediment.

The following are EPA's comments on macroinvertebrate data:

> *"In the Boise River TMDL (1999), DEQ evaluated macroinvertebrate data available from the USGS for five sites sampled in October of 1995 and 1996. The macroinvertebrate data indicated that the Boise River had degraded conditions from Eckert Road to its mouth. Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa richness is a traditional metric that consistently has been used to detect impacts to macroinvertebrate assemblages in rivers and streams. In the Lower Boise, a limited number of EPT taxa was found at all sites indicating that the macroinvertebrate assemblage was in poor condition. In addition, there were other metrics (i.e. Plecoptera taxa richness, % predators, etc.) that also indicated poor biological condition.*
>
> *Since the time of the TMDL, USGS has continued to monitor water quality and biological conditions in the Lower Boise River (MacCoy, 2004). Macroinvertebrates were collected at five sites in the Lower Boise from 1995 to 2002. The average number of EPT taxa in the Lower Boise was less than half the average number at four least-impacted, similar-sized rivers in Idaho. USGS calculated the RMI (River Macroinvertebrate Index, developed by DEQ in 2002) scores for the Lower Boise and most scores indicated poor water quality and impaired biotic integrity. In addition, USGS used a fine-sediment index to evaluate the effect of fine sediment on insect populations (Relyea et al, 2000). This index, the Fine Sediment Biotic Index (FSBI), indicated fine sediments impacted macroinvertebrates in the Lower Boise.*
>
> *Macroinvertebrate assemblages are monitored in rivers because they are a direct measure of the aquatic life uses. Another reason that they are used in monitoring is because macroinvertebrates integrate the effects of multiple environmental factors such as water quality, substrate quality, and habitat. In both the TMDL and in more recent USGS studies, it is clear that the macroinvertebrate assemblages in the Lower Boise River are in poor condition. The more recent USGS study shows that fine sediments impact macroinvertebrates in the Lower Boise River, however*

> *this does not mean that fine sediment is the sole stressor. The macroinvertebrates are also exposed to increased temperatures, altered flow regimes, increased phosphorus and other anthropogenic environmental factors. The cumulative and synergistic effects of these pollutants in the Lower Boise may exceed the tolerance levels of many of these taxa (Croxton, 2008)."*

IDEQ concludes that sediment is the sole stressor for macroinvertebrate impairment. However, impairments to macroinvertebrate assemblages increase downstream. This parallels the increase in both sediment and total phosphorus loads as one moves downstream. No evidence is presented as to why only the increase in sediment load contributes to impairment (Hayslip, 2008). In conclusion, IDEQ does not provide a sufficient rationale to exclude macroinvertebrate data in its proposal to delist nutrients from the Lower Boise River.

## Summary of Delisting Evaluation

The following summarizes key points in EPA's evaluation of IDEQ's delisting of the Lower Boise River for nutrients:

- **Nutrients must be considered when evaluating a nutrient-impaired waterbody.** IDEQ has not provided sufficient rationale to exclude total phosphorus data in the Lower Boise River. The USGS has collected over 15 years of data on nutrients which are not included in IDEQ's evaluation of whether nutrients should be delisted. Total phosphorus data in the Lower Boise River are as high as 3 mg/L TP, 300 times the EPA's 1986 Gold Book standard of 0.1 mg/L, and 600 times higher than EPA's recommended Ecoregion Criteria. Ecoregional values are recommended criteria under CWA section 304(a) and appropriate for use in interpreting State narrative standards. The levels of TP in the Lower Boise River clearly show significant enrichment and nutrient impairment relative to the recommended 304(a) criteria. There is no adequate rationale to exclude nutrient TP data in assessing whether a water is impaired for excess nutrients.

- **All algae data in the Lower Boise River must be considered when evaluating a waterbody impaired by nutrients.** IDEQ has not provided sufficient rationale to exclude periphytic chlorophyll-a data. Periphytic chlorophyll-a data were collected from 1995 to 2005, and MacCoy's 2004 report notes that periphyton is the key algae of concern in the Lower Boise River. More than ten years of periphytic chlorophyll-a data show that concentrations are significantly above nuisance thresholds recommended in the literature.

- **Macroinvertebrate data must be considered when evaluating the potential impacts of nutrients on aquatic life.** Macroinvertebrate data are a direct measurement of aquatic life beneficial uses. Insufficient rationale has been provided to conclude that nutrients do not impair macroinvertebrate assemblages. Macroinvertebrate data show impairments increasing downstream, which parallels downstream increases in both nutrient and sediment loading and impairments.

- **DEQ must apply a consistent listing and delisting methodology.** Based on IDEQ's recent nutrient TMDLs, IDEQ has considered total phosphorus data in its basis to list or delist nutrients (IDEQ, 2008c, 2007a, 2007b, 2007c, 2006, 2005a, 2005b, 2005c, 2004). For the Lower Boise River, IDEQ has not been consistent with its past actions as to which information to consider to delist nutrients.

- **DO and pH data alone are insufficient to conclude whether nutrients can be delisted.** DO and pH data alone are not sufficient to determine whether nutrients impair a waterbody. They are only sufficient to determine whether a waterbody is impaired for DO or pH. It is not clear as to whether DO and pH data presented in IDEQ's proposal to delist are even adequate to conclude that DO and pH are not impaired in the Lower Boise River. pH data presented in the delisting proposal were collected from 1990-1998. In more recent data presented in the 2004 USGS Report, pH reaches 9.1 at the Middleton station in data collected from 1994 to 2002, exceeding Idaho's state standard of 9.0 (MacCoy, 2004). USGS and City of Boise DO data show supersaturated levels at all stations monitored, which indicates heightened algal growth that can be harmful to macroinvertebrates. Supersaturated DO during photosynthesis (afternoon) is often associated with DO sags during respiration (early morning). However, continuous DO monitoring has been limited to one day in August 1997 . In summary, DO and pH data in the Lower Boise River do not support delisting nutrients from the Lower Boise River.

- **Planktonic chlorophyll-a do not support a delisting of nutrients.** IDEQ uses North Carolina's threshold of 40 □g/L to assess planktonic chlorophyll-a levels. However, North Carolina's threshold is used for non-trout bearing streams. For streams with trout, North Carolina uses 15 □g/L which is identical to Oregon's and several other states with ecoregions similar to Lower Boise Watershed's (EPA, 2003). IDEQ data shows that planktonic chlorophyll-a levels exceed 15 □g/L. Additionally, algae in the Lower Boise River is primarily periphyton, so planktonic chlorophyll-a data alone cannot be used to conclude that nutrients do not impair the Lower Boise River. Planktonic chlorophyll-a data presented by IDEQ do not support delisting nutrients from the Lower Boise River.

- **The record of complaints for nuisance algae does not include information from 2001 to 2008.** IDEQ presents information from 1997 to 2000. However, IDEQ does not advertise or outwardly solicit on Boise River water quality on a regular basis and has no information from 2001 to 2008. Water quality data indicate nuisance algae levels and activity. Photo logs taken by EPA on July 8, 2008 and August 13, 2008 show algae present in the Lower Boise River. This rationale is not sufficient to support delisting nutrients from the Lower Boise River.

- **Elevated periphyton levels are still present despite river velocities cited by IDEQ.** IDEQ cites that river velocities in the Lower Boise River are above algae scouring thresholds even at low flow. However, periphytic chlorophyll-a have been measured at levels more than four times above the least stringent nuisance threshold of 200 $mg/m^2$, and recent photo logs confirm the presence of attached and filamentous algal growth. The rationale above is not a sufficient basis to delist nutrients from the Lower Boise River.

## Conclusion

In making its assessment, IDEQ has focused on a few of the indicators of nutrient impairment while ignoring other parameters which are equally critical to assessing nutrient impairment. EPA concludes that IDEQ has not demonstrated sufficient good cause to delist the Lower Boise River for nutrients, and that IDEQ has provided insufficient rationale to justify the exclusion of all existing and readily available data. While DO, pH and planktonic chlorophyll-a are useful indicators of nutrient impairment, there is not sufficient rationale to exclude data on other key water quality parameters: total phosphorus, periphytic chlorophyll-a and macroinvertebrate data. While EPA 304(a) criteria are not legally binding, they are a valid basis to interpret State narrative standards. Total phosphorus, periphytic chlorophyll-a and macroinvertebrate data clearly indicate that the Lower Boise River is impaired for nutrients (Croxton, 2008).

Data presented by IDEQ on DO, pH and planktonic chlorophyll-a do not demonstrate good cause to delist the Lower Boise for nutrients. The indicators IDEQ selected to make a delisting decision when considered in combination with other indicators are in fact supportive of the conclusion that the Lower Boise is impaired. DO grab samples show supersaturated levels indicative of higher than normal algal activity. Additionally, the 2004 USGS report shows an exceedance of pH at Middleton of 9.1 (MacCoy, 2004). Information presented on nuisance algae reports is at least seven years old, and IDEQ does not present more recent information on nuisance algae complaints. Recent photo logs show that algae are present. IDEQ's conclusions on scouring do not reconcile with field observations and data.

These water quality data and the water quality data which were excluded show that nutrients should not be delisted from Idaho's 303(d) Integrated Report. Based on EPA's review of the information and documentation provided, IDEQ has not demonstrated good cause or sufficient rationale to exclude readily and existing information to support the delisting of nutrients from the Lower Boise River.

**Attachment 1: July 8, 2008 photo log**
**Attachment 2: August 13, 2008 photo log**
**Attachment 3: Hayslip memo**

**References**

Burr, 1986. Letter to Sally Marquis, EPA Region 10, from Gwen Burr, Principal Water Quality Analyst, State of Idaho Department of Health and Welfare. August 8, 1986.

Chapra, Steven, 1997. Surface Water-Quality Modeling. McGraw-Hill.

City of Boise, 2008. Received City of Boise XL and Axess data on CD on July 15, 2008.

Cope, B., 2007. Memorandum to Bill Stewart, Office of Water and Watersheds, EPA Region 10, from Ben Cope, EPA re: Comments on a Phosphorus Mass Balance Model and Draft TMDL for the Boise River, Idaho. May 3, 2007.

Croxton, D., 2008. Letter to Michael McIntyre, Surface Water Quality Division, IDEQ, from David Croxton, Watershed Unit Manager, EPA re: U.S. Environmental Agency (EPA) Comments on Idaho's Draft 2008 Integrated Report. February 20, 2008..

EPA, 2006. Memorandum from Diane Regas re: Information Concerning 2008 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions. October 12, 2006.

EPA, 2005a. Letter to Barry N. Burnell, IDEQ, from Michael Gearheard, EPA re: Approval of Idaho State Final Integrated Report 2002 (303(d) List and 305(b) Report) submitted for approval July 23, 2004. December 20, 2005.

EPA, 2005b. Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b), and 314 of the Clean Water Act. July 29, 2005.

EPA, 2003. Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and its Tidal Tributaries, April 2003. Appendix D: Narrative, Numerical and Method-based Chlorophyll a Criteria Adopted as Water Quality Standards by States Across the U.S. U.S. Environmental Protection Agency, Washington, D.C., EPA-903-R-03-002.

EPA, 2001. Letter to David Mabe, IDEQ, from Randall F. Smith, EPA. January 25, 2001.

EPA, 2000. Ambient Water Quality Criteria Recommendations, Rivers and Streams in Nutrient Ecoregion III. U.S. Environmental Protection Agency, Washington, DC, EPA-822-B-00-016.

EPA, 1994. Letter to Walton C. Poole, IDEQ, from Charles Findley, EPA re: Partial Approval of Idaho's 1994 Section 303(d) list. May 13, 1994.

EPA, 1993. Letter to Walton C. Poole, IDEQ, from Charles E. Findley, EPA re: Approval of Idaho's 1992 303(d) list. August 18, 1993.

EPA, 1986. Methods for chemical analysis of water and wastes. U.S. Environmental Protection Agency, Washington, DC, EPA-440/5-86-001.

Filippini, M., 2002. Letter to Bryan Horsburgh, IDEQ, from Mark Filippini, EPA re: Lower Boise River Nutrient & Tributary Subbasin Assessments, December 2001. May 7, 2002.

Hayslip, 2008. Memorandum from Gretchen Hayslip, EPA, to Jennifer Wu, EPA re: Macroinvertebrate Data Related to the Delisting of Nutrients on the Lower Boise River. September 2008.

IDWR, 1995. Idaho Statewide Ground Water Quality Monitoring Program – Summary of Results, 1991 through 1993. Idaho Department of Water Resources. Boise, Idaho. Page 67.

IDEQ, 2008a. Draft Department of Environmental Quality Working Principles and Policies for the 303(d)/305(b) Report. Idaho Department of Environmental Quality. January 2008.

IDEQ, 2008b. Final Department of Environmental Quality Working Principles and Policies for the 303(d)/305(b) Report. Idaho Department of Environmental Quality.

IDEQ, 2008c. Salmon Falls Creek Subbasin Assessment and Total Maximum Daily Load. Idaho Department of Environmental Quality. February 2008.

IDEQ, 2007a. Lindsay Creek Watershed Assessment and Total Maximum Daily Load. Idaho Department of Environmental Quality. June 2007.

IDEQ, 2007b. Upper Hangman Creek Subbasin Assessment and Total Maximum Daily Load. Idaho Department of Environmental Quality. September 2007.

IDEQ, 2007c. Weiser River Subbasin Assessment and Total Maximum Daily Load. Idaho Department of Environmental Quality. February 2007.

IDEQ, 2006. Bear River/Malad River Subbasin Assessment and Total Maximum Daily Load. Idaho Department of Environmental Quality. June 2006.

IDEQ, 2005a. Beaver-Camas Creek Subbasin Assessment and Total Maximum Daily Load. Idaho Department of Environmental Quality. August 2005.

IDEQ, 2005b. Camas Creek Subbasin Assessment and Total Maximum Daily Load. Idaho Department of Environmental Quality. September 2005.

IDEQ, 2005c. North Fork Payette River Subbasin Assessment and Total Maximum Daily Load. Idaho Department of Environmental Quality. August 2005.

IDEQ, 2005d. Principles and Policies for the 2002 Integrated (303(d)/305(b)) Report. September, 30, 2005.

IDEQ, 2004. Snake River-Hells Canyon Subbasin Assessment and Total Maximum Daily Load. Boise, ID: Boise Regional Office, Idaho Department of Environmental Quality. September 2004.

IDEQ, 2001. Lower Boise River Nutrient Subbasin Assessment. Idaho Department of Environmental Quality. December 2001.

IDEQ, 2002. Water Body Assessment Guidance, Second Edition – Final, January 2002. Idaho Department of Environmental Quality.

IDEQ, 1999. Lower Boise River Subbasin Assessment and Total Maximum Daily Loads for Bacteria and Sediment.

IDEQ, 1998. 1998 303(d) List. Idaho Division of Environmental Quality. 1998.

IDEQ, 1996. 1996 303(d) List. Idaho Division of Environmental Quality. 1996.

IDEQ, 1994. 1994 303(d) List. Idaho Division of Environmental Quality. 1994.

IDEQ, 1992. The 1992 Idaho Water Quality Status Report. Idaho Division of Environmental Quality. December 1992.

MacCoy, D.E. 2004. Water Quality and Biological Conditions in the Lower Boise River, Ada and Canyon Counties, Idaho, 1994-2002. U.S. Geological Survey Scientific Investigations Report 2004-5128.

Nickel, B., 2007. Memorandum to William C. Stewart, Environmental Protection Specialist, Watershed Unit from Brian Nickel, EPA re: Comments on the Lower Boise River Total Maximum Daily Load for Total Phosphorus. May 3, 2007.

Nordin, R.N., 1985. Water quality criteria for nutrients and algae (report overview): Victoria, B.C., British Columbia Ministry of the Environment, Water Management Branch, Resource Quality Section, Water Quality Unit.

Relyea, C.D., Minshall, G.W., and Danehy, R.J., 2000. Stream insects as bioindicators of fine sediment: Proceedings of Watershed 2000, Water Environment Specialty Conference, Vancouver, B.C., 19 p. plus apps.

Stewart, W., 2007. Memorandum to Craig Shepard, Boise Regional Office, IDEQ, from William Stewart, EPA re: Comments on the Draft Lower Boise River, Total Maximum Daily Load, Total Phosphorus, March 2007. May 3, 2007.

Watson, V. and Gestring, B., 1996. Monitoring Algae levels in the Clark Fork River: Intermountain Journal of Sciences, v.2, no. 2, p. 17-26.

Welch E.B., Jacoby, J.M., Horner, R.R., and Seeley, M.R., 1987. Nuisance biomass levels of periphytic algae in streams: Hydrobiologia, v. 157, p. 161-168.

Welch, E.B., Horner, R.R., and Patmont, C.R., 1989. Prediction of nuisance periphytic biomass: a management approach: Water Research, v. 23, no. 4, p. 401-405.

Wetzel, 2001. Limnology: Lake and River Ecosystems. CBS College Publishing.