2003 Total Dissolved Gas Management Plan

(091702)

1.0 Introduction

High total dissolved gas (TDG) saturation levels are observed in various parts of the Columbia and Snake River systems where spills occur, sometimes creating conditions that may adversely affect fish survival. Therefore, a plan to control TDG is developed annually along with a water management plan based on the runoff and the resulting spill for that year. This document outlines the TDG management plan adopted by the Technical Management Team (TMT) for 2002. It includes a review of voluntary and involuntary spill, applicable management options, expected flow and spill conditions, and a detailed TDG management plan with spill priority list and spill caps. This plan reflects relevant provisions of the 2000 U.S. Fish and Wildlife Service and the National Marine Fisheries Service Biological Opinions.

2.0 Voluntary and Involuntary Spill

2.1 Voluntary Spill

Voluntary spill, as the term implies, is not a physical constraint in that project operators have the means and capability to turn it off if needed. Spill for-fish-passage is a voluntary spill that will be adjusted by the action agencies so that the resulting TDG levels do not exceed the state standards variances. The planning dates for voluntary spill for spring/summer chinook migration as called for in the 2000 NMFS BiOp are April 3 through June 20 in the Snake River and April 10 through June 30 in the Columbia River. For fall chinook migration, the planning dates for spill are June 21 through August 31 in the Snake River and July 1 through August 31 in the Columbia River (Page 9-56). The 2000 NMFS BiOp (Pages 9.6.1.7.1, Water Quality Strategy, page 9-119) calls for spilling up to the 120% TDG spill caps at the lower Columbia and lower Snake Rivers Corps projects. A summary of the general guidance on spill requirements and other considerations is listed in Table 1 and shown on page 9-89 of the 2000 NMFS BiOp.

Table 1. Summary of 2000 NMFS BiOp Spill Requirements and Other Considerations

Project [1]	**Estimated Spill Level** [2]	**Hours**	**Limiting Factor**
Lower Granite	60 kcfs	6 p.m. - 6 a.m.	gas cap
Little Goose	42 kcfs	6 p.m. - 6 a.m.	gas cap
Lower Monumental	27 kcfs	24 hours	gas cap
Ice Harbor	105 kcfs (night) 45 kcfs (day)	24 hours	nighttime - gas cap daytime - adult passage
McNary	170 kcfs	6 p.m. - 6 a.m.	gas cap

Project [1]	**Estimated Spill Level** [2]	**Hours**	**Limiting Factor**
John Day	140 kcfs/60% [3] (night)	6 p.m. - 6 a.m. [4]	gas cap/percentage
The Dalles	40% of instant flow	24 hours	tailrace flow pattern and survival concerns (ongoing studies)
Bonneville	105 kcfs (night) 75 kcfs (day)	24 hours	

Notes

1 Summer spill is curtailed beginning on or about June 20 at the four transport projects (Lower Granite, Little Goose, Lower Monumental, and McNary dams) due to concerns about low inriver survival rates.

2 Estimated spill levels shown in the table will increase for some projects as spillway deflector optimization measures are implemented.

3 The TDG cap at John Day Dam is estimated at 85 to 160 kcfs, and the spill cap for tailrace hydraulics is 60%. At project flows up to 300 kcfs, spill discharges will be 60 % of instantaneous project flow. Above 300 kcfs project flow, spill discharges will be at the gas cap (up to the hydraulic limit of the powerhouse).

4 Spill at John Day Dam will be 7:00 p.m. to 6:00 a.m. (night) and 6:00 a.m. to 7:00 p.m. (day) between May 15 and July 31.

A discussion of April 2003 final volume forecasts that are [to be determined] at Lower Granite Dam and [to be determined] at McNary dam is found on pages 9-57 and 9-58 in the 2000 NMFS BiOp.

2.2 Involuntary Spill

Involuntary spill, on the other hand, is caused by project and/or system physical limitations. In general, there are two basic causes for involuntary spill:

1. When an above average water supply results in flows which exceed the hydraulic capacity of power generation facilities, and

2. When potential power generation from above average water supplies exceeds the available market, especially during light market hours at night and on weekends. Others causes are subsets of the first basic case.

For example, the water supply forecast may underestimate the seasonal streamflows and causes the project operators to leave too little space in the reservoirs to catch the water. In other instances, unusually high winter precipitation may force the operators to store water in the reservoirs above the flood control elevations, causing involuntary spill to occur later as the water is evacuated to get to the reservoir flood control elevations.

Isolated instances of involuntary spill, prompted by scheduled or unscheduled turbine unit outages of various durations, are likely to occur in 2003.

The (February 03) January through July runoff volume forecasts indicate that 2003 will be [to be determined] and [to be determined]. As a result, it is anticipated that spill, both voluntary and involuntary, will prevail throughout the system.

2.3 Distinction Between Voluntary and Involuntary Spill

In some cases, the distinction between voluntary and involuntary spill may not be as straightforward as described above. A voluntary spill could become involuntary when the nature and extent of the circumstances causing the spill to occur in the first place change. For example, spill caused by service and maintenance schedules is normally voluntary when those schedules could have been postponed. The spill can become involuntary when turbine conditions demand that the service and maintenance work be done immediately, for public safety or other compelling reasons. Such unscheduled maintenance occurrences in any given year are theoretically always a possibility, but can never be accurately predicted..

3.0 Management Options

As defined above, voluntary spill for fish passage needs no further control other than making spill adjustments to keep the TDG within the allowable standards. In the 2000 NMFS BiOp, John Day will spill up to the 120% TDG cap or up to 60% of the flow, whichever is lower; and The Dalles will spill up to 120% TDG cap or up to 40% of the flow, whichever is lower. However, for 2003, [to be determined]. Juvenile salmonid survival studies and a prototype surface bypass system will be conducted at The Dalles in 2003. [to be determined]. At John Day Dam, spill will be provided for 11-hour periods (from 1900 to 0600 hours) between May 15 and July 31. At project flows up to 300,000 cfs, spill discharges will be 60% of the instantaneous project flow. Above 300,000 cfs project flow, spill discharges will be 180,000 cfs (up to the hydraulic limit of the powerhouse). [to be determined] at John Day Dam. At McNary Dam, [to be determined]. At Ice Harbor 24-hour spill to the gas cap will be implemented . However, it will be determined whether voluntary spill for fish passage cannot be provided at Lower Monumental Dam in 2003. If involuntary spill occurs, spill discharges may be implemented according to the specifications of Appendix E of the 2000 BiOp. Spill at Little Goose Dam and Lower Granite Dam will be provided during the spring out migration season under certain conditions of higher flow, according to Appendix E of the 2000 BiOp. Special nighttime spill patterns may be implemented to control TDG levels. A Removable Spillway

Weir was installed at Lower Granite Dam in 2001 and tested in 2002. It is expected that there will be three different spill operations during 2003.

Spill caps will be assigned to each project and will be adjusted in-season, based on actual TDG readings. In this case, there is no spill priority list to follow except for minor adjustments to take best advantage of the 120% TDG limits (115% TDG limit measured at Camas-Washougal is applied to the spill for-fish-passage at Bonneville). For example, to account for cumulative impacts, some spill reduction may be needed at upstream projects so that some meaningful spill can still occur in the lower river within the stated 120% TDG limits. The decision on where to cut or increase spill is highly fish-dependent, and will be based on salmon managers' recommendations.

Management options are limited to the following:

- More water can be stored in the reservoirs behind the dams,
- The quantity of spill can be shifted to various periods within the day,
- More water can be put through the turbines,
- Spill can be shifted within the system to avoid excessive local concentrations,
- Spill can be transferred outside the system, and
- Spill bays can be used more effectively.

Changing the spill from a crown to a uniform pattern, avoiding the use of spillway bays without deflectors, and allowing turbine units to operate outside their 1% peak efficiency flow range are additional management options. Proper scheduling of service and maintenance time tables, identifying additional energy loads to serve, and displacing available thermal projects that are serving the same loads also help relieve the need for spill. Some of these mitigation measures have potential impacts on the environment, fish survival, and other reservoir regulation requirements. Further, they must be implemented early enough in the season to be fully effective.

To maintain uniformly low TDG conditions or to avoid spill in river reaches where the greatest number of fish are actively migrating, spill may be distributed to various other projects in a pre-planned sequence. This requires starting with projects with the least propensity for developing high TDG level or those located outside the fish migration corridor. A spill priority list will establish the order in which projects will start spilling and the maximum amount of water these projects are allowed to spill.

In general, spill will first occur at projects with assigned spill for fish passage levels; any other spill will be distributed to other projects in the system as conceptually illustrated in Figures 1 and 2. The two periods shown are April 3 through April 20 (voluntary spill at lower Snake projects only) and April 20through August 31 (voluntary spill at both lower Snake and lower

Columbia River projects). The TMT will recommend adjustments to the spill priority based on real-time TDG and fish migration conditions and/or other relevant considerations.

4.0 Projected High Spill/High TDG Periods

Pertinent water supply forecasts issued by the River Forecast Center are summarized in Table 2 for key locations on the Columbia and Snake Rivers. The 2003 (April Final) January through July forecast for the Columbia River at The Dalles is [to be determined] million acre-feet (maf), [to be determined] of normal. The April through July runoff forecasts for Reclamation reservoirs above Brownlee are [to be determined] percent of normal range.

Table 2. 2003 Runoff Volume Forecasts

[to be determined]

Location	Jun Final '00	% of Normal April Fin. '03
	Maf	%
Libby (Apr-Sep) *		
Hungry Horse (Apr-Sep)		
Grand Coulee (Apr-Sep)		
Dworshak (Apr-Jul) *		
Lower Granite (Apr-Jul)		
The Dalles (Apr-Sep)		
Brownlee(Apr-Jul)		

(*) COE official Forecast

Consequently, there are no projected high spill/high TDG periods for the spring or summer of 2003. [to be determined]

The COE Power Branch made a 59-year (1929-1987) monthly flow computer simulation based on the March Final 2002 runoff forecasts at Lower Granite and The Dalles. The model simulation provides an estimate of the expected flows at Lower Granite and McNary for any of the 59 years having the January through July runoff volume as the water supply volume forecasted for 2002. The results of the 59-year monthly study are superceded by weekly spreadsheet flow projections made more specifically for 2002.

The Power Branch's analysis produced a wide range of flow and spill conditions as a result of meeting relevant 2002 system requirements for flood control, power, Libby sturgeon operation, and the BiOp seasonal flow objectives. Using the monthly simulation output from this power model run, a more detailed analysis was performed to provide expected ranges of TDG levels. Three years with different timing for peak runoff were selected and used in a more detailed simulation of the spill operation on an hourly basis. The first two water years (1934 and 1957) had their peak runoff in April and in May respectively. Runoff in the third water year (1951) was more normally distributed. Shown in Table 3 are the projected spill and TDG levels for the 3 years at Lower Granite, Ice Harbor and McNary.

Table 3. Projected Flow, Spill, and Max. TDG at Lower Granite, Ice Harbor, and McNary

Projects/ Characteristics	**1934 (Early Runoff)**	**1951 (Normal Runoff)**	**1957 (Late Runoff)**
ICE HARBOR			
Peak Runoff Period	April 11-30	April 11- May 26	May 1-26
High Flow, kcfs	145-180	106-133	123-146
High Spill, kcfs	90-100	90-95	82-95
Max Hourly TDG, %	122	122	122
MCNARY			
Peak Runoff Period	April 14-30	April 25-30	May 2-31
High Flow, kcfs	423-462	367-440	388-459
High Spill, kcfs	250-292	200-270	240-270
Max Hourly TDG, %	137	132	135

JOHN DAY			
Peak Runoff Period	April 14-30	April 17-June 3	May 18-May 26
High Flow, kcfs	489-530	321-406	422-468
High Spill, kcfs	188-230	143-150	136-167
Max Hourly TDG, %	133	127	129

The regression equations used to predict TDG are based only on the spill level. The spill caps shown are also equation-predicted spill values that yield 120% TDG.

Table 4 summarizes periods with TDG in excess of the 120% saturation levels, assuming a 2002 runoff distribution similar to that of the 3 years analyzed.

Table 4. Projected Spill Periods with TDG > 120% TDG

Projects/ Characteristics	**High TDG Periods in 1934 (Early Runoff)**	**High TDG Periods in 1951 (Normal Runoff)**	**High TDG Periods in 1957 (Late High Runoff)**
ICE HARBOR			
Pwh Cap=94			
Night Cap = 95 kcfs			
Day Cap = 45 kcfs			
Days > 120%	0	0	0
Max Daily TDG, %	120	117	117
MCNARY	April 2 - May 27	April 25 - May 3	May 1-June 2
Pwh. Cap.=175 kcfs			
Spill Cap = 150 kcfs			
Days > 120%	36	9	33
Max Daily TDG, %	133	125	131
JOHN DAY	April 18-May19	April 28-May 1	May 1 - June 5
Pwh. Cap.=301 kcfs			
Spill Cap = 150 kcfs			
Days > 120%	16	3	31
Max Daily TDG, %	132	122	128

Based on these projections, TDG below McNary would exceed the 120% saturation level for extended periods (one to two months). Daily TDG below Ice Harbor stayed at a level of 120% or less.

The results shown above are for planning purposes and are not indicative of the limited extent and much smaller magnitude of the spill conditions that may be expected for 2003. More reliable flow projections will be made starting in late March, using the results of the SSARR run adjusted as needed to meet the seasonal flow objectives at Lower Granite, Priest Rapids, and McNary. The projected seasonal average flows derived from the weekly flow projection spreadsheet will be shown in the following format:

Lower Granite: 4/03 - 6/20: X1 kcfs; 6/21 - 7/31: X2 kcfs

Priest Rapids: 4/10 - 6/30: Y1 kcfs

McNary: 4/20 - 6/30: Z1 kcfs 7/01 - 7/31: Z2 kcfs

5.0 2003 TDG Management Plan

The 2002 TDG Management Plan is similar to previous years' plans. Storage reservoirs will be operated to flood control rule curves and are projected to provide some cushion that will minimize incidences of involuntary spill. No pre-emptive reservoir drafting below flood control elevation will be attempted, as the Salmon Managers are also concerned about reservoir refill. Flows will be regulated to maximize potential for voluntary spill. When project voluntary spill occurs, the projects will be operated to try to keep TDG at or below 120% as long as possible without jeopardizing flood control objectives. When TDG cannot be managed to 120%, the river will be managed in the best interest of listed and proposed salmon stocks. It is recognized that measures designed to physically reduce TDG could have significant impact on migrating salmon. Therefore, input from state and tribal salmon managers and TDG will be sought when attempting to use those TDG control measures.

The essence of the 2003 TDG Management Plan (see Figures 1 and 2), which may be modified in-season by the TMT if necessary, is as follows:

- Implement spill for fish passage at all mainstem Federal dams as specified in the 2000 NMFS BiOp up to the spill caps for 120% TDG given in Attachment. Adjust spill as needed, based on real-time TDG data, and fish movement and biological conditions in that order.

- Operate unit operation within 1% of peak efficiency.

- Limit daytime spill at Bonneville to avoid adult fallback.

- Accommodate special spill requirements/restrictions for research, adult passage, etc. that have the full endorsement of all concerned parties. Also, continue to implement fish transportation program as agreed to and using calculation method endorsed by NMFS (or an equivalent method agreed to at TMT).

- If systemwide TDG exceed 120%, update and implement the spill priority outlined in Attachment 1, with incremental system TDG control objectives. Unless and until a different reach priority is recommended by the TMT, spill will start from the lower river and work its way upstream.

- Discontinue or postpone field research and non-critical unit service and maintenance schedules that create (or have potential for creating) high localized TDG levels, especially when and where high numbers of listed fish are present.
- Operate turbines outside their respective 1% peak efficiency flow range at projects where measurable reduction in TDG (at least 3%, given the accuracy range of the instrumentation) and no intolerable adverse fish impacts can be expected.
- Store water at lower Snake reservoirs above MOP, if this would result in a measurable (3% or more, based on instrumentation accuracy) reduction in TDG levels.
- Experiment with promising new spill patterns.
- Implement other operations or measures recommended by the TMT or the IT. This may include appropriate changes in transportation targets when TDG exceeds levels that are universally recognized as lethal (130% more for 1 week or longer, per NMFS) or when obvious in-river lethal conditions exist.

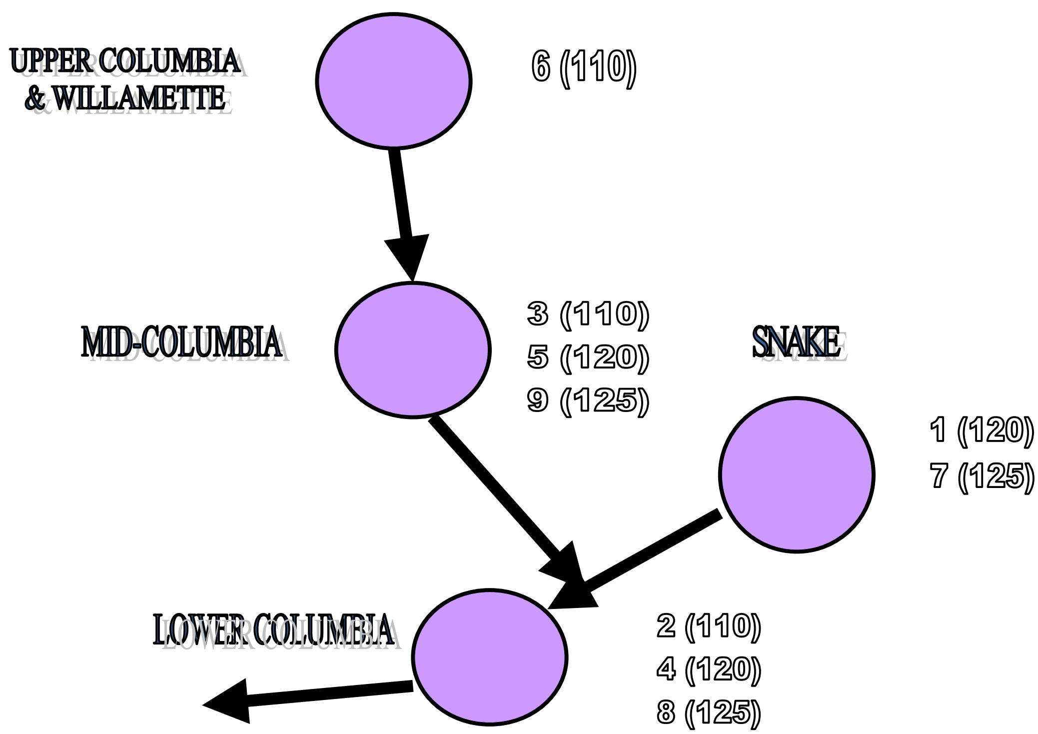

FIGURE 3

SPILL PRIORITY FOR APRIL 3 - APRIL 20

Priority (% TDG)

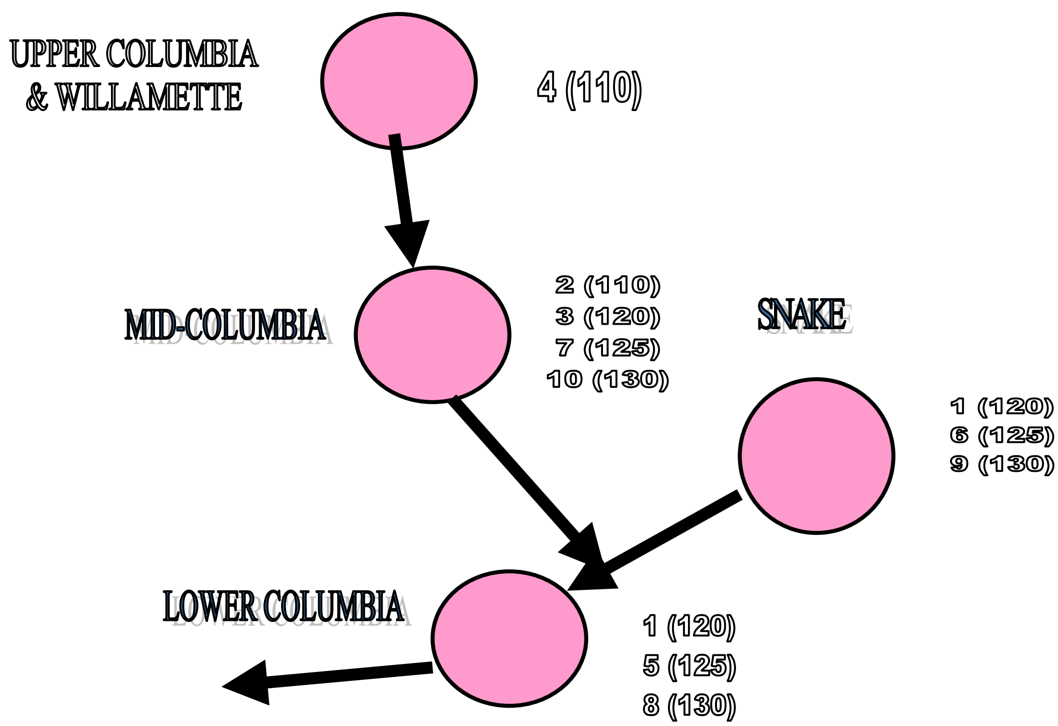

FIGURE 4. SPILL PRIORITY FOR APRIL 14-AUGUST 31

Priority (% TDG)

6.0 Water Quality Actions to Need 2000 Biological Opinions

One- and five-year water quality plans are to improve fish passage and survival through water quality improvement measures. The intent of the water quality plans is to recommend FCRPS facility and operational improvements related to water quality, total dissolved gas and water temperature monitoring, and related studies. All water quality RPAs listed in Appendix B, Table B-2 of the BiOp are not organized in separate Water Quality 1-year or 5-year plan, as defined in RPA 5 (NMFS BIOP Section 9.4.2.4 Page 9-29, Action 5).

All of the water quality RPAs listed in Table B-2 are divided into two categories. Operationally oriented water quality RPAs are addressed in the 1-year and the 5-year Water Management Plans. The other capital investment water quality RPAs related to facility improvements are addressed in the 1-year and the 5-year RM&E Plans.

6.1 TDG Monitoring

Too high a level of Total Dissolved Gas can be lethal to fish. Environmental monitoring at the dams is necessary to ensure that gas levels do not exceed TDG thresholds established in the BiOp and variance levels established by the state water quality agencies. According to the BiOp, the monitoring program is to include QA/QC components, including redundant and backup monitors at as many locations as the Water Quality Team determines necessary; calibration of monitoring equipment at least every 2 weeks; adequate funds for spot-checking monitoring equipment, error checking, correcting, and recording function for CROHMS data; and daily reporting. The QA/QC components are to be reviewed by the Action Agencies annually in coordination with the Water Quality Team.

RPA 131 will be addressed in the manner described in the paragraph above, except for the redundant monitoring. The Action Agencies will establish data Quality Objectives, in coordination with the Water Quality Team, to replace the redundancy identified in the BiOp. As part of the QA/QC component of the program, achievements of the Data Quality Objectives are to be evaluated by the Action Agencies annually, in coordination with the Water Quality Team (NMFS BIOP Section 9.6.1.7.2 Page 9-122, Action 131).

In 2002 we established data quality objectives (DQO) at existing stations instead of establishing redundant stations.

Physical and biological monitoring described in RPA 131 includes QA/QC components to TDG data collection and includes redundant monitoring. The Corps presented suggested modifications to RPA 131 to the Water Quality Team at the March 12, 2002, meeting. The suggested modifications included a vigorous QA/QC program that would eliminate the need for redundant monitoring. The data quality criteria procedures are characterized in three parts: calibration protocols (data quality control), data review and corrections (data quality assurance), and completeness of data (a substitute quality assurance program for station redundancy). The Water Quality Team agreed with the suggested modifications.

The laboratory calibration protocols include use of National Institute of Standards and Technology (NIST) national standards to calibrate secondary standards in the laboratory; availability of two TDG probes dedicated to each site; lab calibration of the secondary instrument before the bi-monthly rotation; and calibration of barometric pressure, total gas pressure, and water temperature within +/-1 mm/Hg for gas and 0.2°C for water temperature of the primary standards. Primary and secondary standards criteria were developed for water temperature, barometric pressure, and total gas pressure. The primary standard for water temperature is a mercury thermometer and the secondary standard is a laboratory hydrolab unit. The primary standard for barometric pressure is a National Weather Service barometer, and the secondary standard is a hand-held barometer. The primary standard for total gas pressure is a digital pressure gauge calibrated to NIST standards. The secondary standard is a laboratory hydrolab unit that is checked to four pressures, and calibrated to a two-point curve. Field calibration protocols include bi-monthly TDG probe laboratory calibration of the secondary hydrolab unit, rotation to the field, and field calibration. Also, the barometric pressure, total gas pressure, and temperature sensors are field calibrated within 0.2 mm/Hg and 0.2°C of the secondary standard.

Data review and correction procedures include daily visual review of the numeric data, looking for signs of erroneous data or mechanical problems. Questions have been developed for a data checklist that is completed daily. For example: Are more than 25% of the hourly values for total dissolved gas missing or exhibiting intersite comparisons of greater than 20 mm Hg? or Are spill changes needed to explain any Pt values? Reviews of graphs of the data are also used to visually detect 1-hour anomalies. After the data is reviewed, two steps can be taken with data that has questionable quality. If there is a constant amount of shift or continual drift, the data can be corrected. If there is no justifiable means for correcting the data, the data is deleted from the database.

The data quality criteria for the completeness of the data include that 95% of the data that could have been collected during the defined monitoring period for each station is complete. The completeness evaluation is based on temperature and percent TDG, which encompasses barometric pressure and TDG pressure. Data completeness is based on an entire suite, not on the completeness of one parameter.

The data collected during the 2002 spill program will be evaluated in the fall of 2002, and will be presented to the Water Quality Team in early 2003, so that guidance for the 2003 program can be incorporated.

6.2 TDG Monitoring Review

Total Dissolved Gas (TDG) measurements in the forebays and tailwaters of the dams have been monitored as part of the NMFS spill program. In-season management to improve juvenile fish survival relies on the TDG monitoring program. Based on review of possible biases in the TDG data, NMFS believes that some forebay locations, such as the Camas site, have to be changed to provide a more representative measure of TDG in the water passing through the dams. It is possible that spill could be increased if current forebay locations over-represent the level of gas saturation in the water of the forebays.

RPA 132 addresses the development of a plan to systematically review and evaluate TDG fixed monitoring site forebays at all the mainstem Columbia and Snake dams, especially the Camas site.

The Water Quality Team created an RPA 132 subcommittee to address systematic review of the forebay TDG Fixed Monitoring Stations. The subcommittee reviewed the forebay station issues related to spill for fish passage in the fall of 2001, identified the highest priority locations, and recommended a detailed systematic review of many of the Columbia /Snake forebays at Corps projects.

Especially mentioned in RPA 132 was the Camas/Washougal site in the lower Columbia River. To address the representativeness issues of the Camas/Washougal site (downstream of Bonneville Dam), which is used as a forebay index station for the estuary, the Portland District Corps performed data collection during the 2002 spill season at Corbett, Oregon. TDG data collection was from March through mid-September 2002. Sampling was at 15-minute intervals. A presentation concerning overview observations of TDG was made to the WQT on September 10, 2002. A report on the study, with conclusions and recommendations will be available in early 2003.

A remote water quality data sonde was installed at the west end of The Dalles powerhouse in April 2002. It was an auxiliary forebay monitor installed to evaluate the traditional fixed monitoring site (TDA) located at the east end of the powerhouse. The purpose of the study was to evaluate lateral variability of the TDG levels at the project. The instrument was removed in mid-September 2002. A presentation concerning overview observations was made to the WQT on September 10, 2002. A report on the study, with conclusions and recommendations, will be available in early 2003.

Studies were also initiated in 2002 to evaluate vertical thermal gradients in the forebays of the lower Columbia dams. A vertical string of water temperature loggers were placed in the forebays of Bonneville, The Dalles, and John Day dams from April to September 2002. Instruments in the Bonneville forebay were deployed at 1, 5, 10, 20, 50, and 80 feet at one station approximately 1,000 feet upstream of the dam. Two strings of water temperature loggers were installed approximately 1,000 feet upstream of The Dalles forebay. One string was at the shallow north side of the forebay at 1, 5, 10, 20, 40 and 60 feet. The deeper south side depth intervals were at 1, 5, 10, 20, 60 and 100 feet deep. The John Day forebay also had two strings of loggers about 1,000 feet upstream of the dam. The John Day instrument depths were at 1, 5, 10, 20 60, and 100 feet for both stations that have similar maximum depths. A report, with conclusions and recommendations, will be available in 2003.

The Corps Walla Walla District is preparing a 2003 contract to review and analyze exiting TDG and water temperature data for representativeness and anomalies. Site visits will be conducted to identify and investigate potential alternative forebay locations for Fixed Monitoring Stations. Automated data loggers will be installed at selected forebay locations at each project. Analyses for TDG and water temperature performance and representativeness will be prepared in report form, including conclusions and recommendations. The schedule includes:

Task	Description	Completion
1	Conduct review and analysis	31 December 2002
2	Site Visits	28 February 2003

3	Install instruments	31 March 2003
4	Collect and analyze data	30 June 2003
5	Draft Report	1 August 2003
6	Final Report	15 September 2003

6.3 TDG Model

Total Dissolved Gas caused by large volumes of water spilled over dams can result in injury and mortality of juvenile salmonids. Development and continued refinement of a systemwide TDG model would assist with in-season management of involuntary spill.

The Corps developed TDG models to be used as a river operations management tool. According to NOAA Fisheries RPA 133, the Corps was to develop the tool(s) by spring 2001. The Corps is to coordinate the systemwide management applications of the gas abatement model(s) with the annual planning process, the Transboundary Gas Group, the Mid-Columbia Public Utilities, and other interested parties (NMFS BIOP Section 9.6.1.7.2 Page 9-124, Action 133).

The Corps developed the SYSTDG model to assist with operational decisions related to TDG. Training in use of the model was provided by BPA to regional entities on February 27/28, 2001, and March 6/7, 2001. Model results for varying flow levels were used in 2002 to provide day-to-day guidance at the most difficult water quality monitoring site in the Columbia/Snake system to meet water quality standards, Camas/Washougal. Model development in 2002 included updating TDG production relationships, technical review, statistical summary of data, and update documentation.

6.3.1 Temperature model and Temperature Monitoring Needs

Water temperature caused by impoundment of pools behind dams can result in a change in the water temperature regime of the river, potentially causing injury and mortality of juvenile salmonids. NOAA Fisheries Biological Opinion RPA 143 identifies the need for development, and continued refinement of a Snake River water temperature model would assist with in-season management of voluntary spill. The model is to be used as a pre-season planning tool to provide predicted operations in real time to assist in the in-season water management decisions.

The Water Quality Team created an RPA 143 subcommittee in the spring of 2002. Participants include representatives from NOAA Fisheries, CRITFC, EPA, Idaho Power Company, IDEQ, NMFS, ODEQ, Fish Passage Center, Battelle, BPA, USACE and WDOE. The workgroup first met March 8, 2002, and met monthly in the remainder of 2002. Meeting minutes are available from the subcommittee chair, Rick Emmert, of the Walla Walla District COE.

Objectives of the subcommittee are:

- To gain an understanding of causes and effects and controlling processes in relation to stream flows, temperatures, and fish response;

- To understand how best to use Dworshak reservoir water to affect flow and temperature conditions in the Snake River for the fish; and

- To document and describe this understanding for management of temperature conditions.

The team posed and ranked relevant questions that needed to be answered to adequately address the measure. The questions were organized in a matrix. The next step included developing a list of existing data (1970s to present), models and reports done by others to avoid repeating work that was already in progress or had already been completed. While developing a list of existing data, the team noted that data collection efforts in the river during the 2002 summer could benefit from a supplemental data collection effort to support the RPA measure 143 work and moved ahead with additional data collection in the river for the summer/fall months of 2002. This work is in progress and will be completed this next year (March 2003).

Once data efforts are completed, responses will be written for as many identified questions as possible**.** Questions that have not been addressed and new questions that have been identified will then determine the model selection. Following model selection, a data collection strategy to support modeling efforts will be prepared. A second year of field data collection may be implemented based on model selection and the data collection strategy. Finally, draft and final reports will be prepared, with recommendations.

The workgroup determined that there is an extra effort by agencies and organizations to collect temperature and other data in the Lower Snake River during the 2002 summer. A table of temperature and other data sets that relate to temperature conditions has been compiled; this table shows the site name, location, agency or organization collecting the data, type of data, months the data were collected, frequency of data collection, specifics on how or where the data were collected and who to contact to get the data.

The Idaho Power Company addressed the workgroup on July 22 regarding their water-quality monitoring and modeling results of the Snake River from Farewell Bend to Asotin, Washington.

Mike Schneider of the COE presented to the workgroup a summary of existing and potential temperature models that are or could be used on the Lower Snake River at the April 12 meeting of the workgroup.

Findings associated with the Idaho/Oregon TMDL, EPA TMDL, fish ladder temperatures, flow and temperature operations at Snake River dams operated by the COE, and how spilling potentially could affect temperatures have not been completed as of September 2002.

The following schedule is proposed for completion of the plan. This schedule assumes we can get all data collected in 2002 organized by March 2003.

Task	**Target Completion Date**
Complete review of existing data and reports	May 2003
Complete data collection/analysis and reporting	July 2003

Task	Target Completion Date
Selection of model(s)	August 2003
Development of data collection strategy	September 2003
Implement data collection strategy (optional)	June – Nov 2003
Prepare draft report or plan	November 2003
Review (subgroup team and WQT)	December 2003
Prepare final report	January 2004
Model development (optional)	To Be Determined

6.3.2 Water Quality Database

As part of Cumulative Risk Initiative evaluations, NMFS has focused on the need for a single comprehensive data management system to ensure integration of monitoring and evaluation information with information from other sources. The application of performance standards and measures will require additional data collection and analysis. Validation of the approach, and of specific actions taken, will require continual confirmation that the measures are sufficient to avoid jeopardy and facilitate recovery of listed salmonids (NMFS BiOp Section 9.6.5.4 Page 9-127, Action 198).

The Action Agencies, in coordination with NMFS, USFWS, and other Federal agencies, NWPPC, states, and Tribes, have been designated to develop a common data management system for fish populations, water quality, and habitat data.

In order to comply with RPA 198 of the NOAA Fisheries 2000 Biological Opinion, the Corps began reviewing commercial databases in 2000 and 2001. The Corps developed database selection criteria that would most effectively meet each of the three Corps Districts and the Northwestern Division needs. Staffing changes delayed completion of the review of the commercial database until 2002. Public sector databases were also reviewed in 2002.

In order to work toward a "common regional database system" concept described in RPA 198, a database review team was formed consisting of the following representatives:

- John Piccininni - Bonneville Power Administration
- Bruce Schmidt - Pacific States Marine Fisheries Commission
- Bruce Sutherland - Lower Columbia Estuary Program
- Laura Hamilton - U.S. Army Corps of Engineers
- Jim Versteeg – U.S. Army Corps of Engineers

A total of 12 databases were reviewed, four commercial and eight public sector databases. Each database was reviewed against the selection criteria. A general overall evaluation was performed which includes the history, description, advantages, and disadvantages of each database being considered, and the cost to remedy any of their deficiencies. Only federal and state agency databases being used in the Pacific Northwest were recommended in the final review process.

The Washington Department of Ecology's (WDOE) SEDQUAL database was considered to be the best database to meet Corps water quality needs, with the capability for multi-agency regional use. In August 2002, the Corps Reservoir Control Center recommended that SEDQUAL be selected and modified to become the Corps regional water quality database. On September 18, 2002, Washington Department of Ecology (WDOE) preliminarily recommended specific actions to adopt and convert a copy of SEDQUAL into a Corps water and sediment quality database. One of the conditions was that the name be changed to reflect its conversion to include being a water quality database. WDOE also recommended other conditions of use of the public sector database. The Corps is currently working with the WDOE concerning conditions of transfer of a copy of the SEDQUAL programming code to the Corps so that it can be expanded to include being a water quality database.

The advantages of modifying the SEDQUAL database to also include being a regional water quality database were:

Advantages:

1. Because the EPA, Region 10 is promoting SEDQUAL as the sediment database for this region, there is a level of interagency support for it.

2. In 1999, the Portland and Walla Walla Districts of the Corps adopted SEDQUAL as their sediment quality database. Many other agencies have adopted SEDQUAL too, such as ODEQ; Corps; USGS; US EPA, Region 10; Washington Department of Natural Resources and King County. Several agencies in California and Alaska are considering adopting SEDQUAL.

3. SEDQUAL was originally designed to handle both water and sediment samples, so it has the database structure to handle the upgrade to include, once again, water quality data.

4. Because SEDQUAL was originally designed to handle only water and sediment samples, it was designed to store more detailed information on water and sediment samples than large databases that store all media data.

5. SEDQUAL is GIS compatible with easy to use tools.

6. There is a complete set of GIS map data that meets the Corps' needs that the Portland District developed after they adopted SEDQUAL

7. The Corps Walla Walla and Portland Districts have entered data and are familiar with the database.

8. To establish a standardized database, the Portland District of the Corps developed a SEDQUAL data entry manual that described how to enter Corps data. The Corps and EPA jointly published the SEDQUAL Data Entry Manual.

9. SEDQUAL was designed with an "agency name" field, which documents which agency generated the data. This feature gives the database a "regional focus," which is necessary for a regional common database system as described in the NOAA Fisheries 2000 BiOp.

10. SEDQUAL has analytical tools to analyze the data and generate reports and graphs.

11. SEDQUAL has the capability to compare the data against any standard you want to compare against. You enter your standard or choose a regional standard.

12. Data can be entered through Excel spreadsheets.

13. SEDQUAL has tools that check data as it is entered and provides an error file identifying the mistakes in data entry.

14. It is easy to update the lookup tables to match the Pacific Northwest.

15. SEDQUAL is free if used as it is.

16. SEDQUAL has a field for listing the QA/QC qualifier code for the data. Puget Sound Estuary Program (PSEP) developed the standards for evaluating the data, which WDOE and the Corps, Portland District adopted.

There will be ongoing negotiation during the fall of 2002 with WDOE on expanding the use of SEDQUAL as a Corps, and potentially, a regional interagency water quality database. If the database is adopted as the Corps sediment and water quality database, its name will be changed to Sediment and Water Quality System (SAWQS).

Attachment
SPILL PRIORITY LIST and SPILL CAPS (April 20 - August 31)

1. This attachment provides project priority for spill and allowable spill levels to be used in an attempt to control total dissolved gas (TDG) to 120%, 125%, 130% and 135%. Projects are listed in a sequential order, placing first priority on spilling at mainstem Columbia projects before spilling at projects outside the fish migration corridor (HGH, Willamette, etc). See also Figure 1.

2. When systemwide TDG is at or below 120%, provide the spill for fish passage up to the 120% TDG spill caps in the following order:

   - Spill up to the 120% TDG spill caps at McNary (MCN), John Day (JDA, The Dalles (TDA), Bonneville (BON), Lower Monumental (LMN), Little Goose (LGS), and Lower Granite (LWG);

   - Spill up to the 110% TDG spill caps at projects outside the lower river fish migration corridor: Priest Rapids (PRD), Rocky Reach (RRH), Wells (WEL), Rock Island (RIS), Wanapum (WAN), Chief Joseph (CHJ), Grand Coulee (GCL), and Dworshak (DWR) in that order. The priority order for the mid-Columbia projects is as recommended for the period beyond April 15 by the Mid-Columbia Coordinating Committee;

   - Spill up to the 120% TDG spill caps at projects where State standards waivers have been granted: PRD, RRH, WEL, RIS, and WAN in that order;

   - Spill up to the 120% TDG spill caps at DWR if release from DWR is for use in maintaining 100 kcfs flow at LWG;

   - Spill up to the 110% TDG spill caps at Hungry Horse (HGH) and Willamette Projects.

3. When systemwide TDG exceeds 120% TDG, then try to control systemwide TDG to 125%, then to 130% and so on by spilling up to the spill caps indicated for those TDG levels, at lower Columbia, Snake, mid-Columbia, HGH, and Willamette Projects in that order. To accommodate the 64/30 tests, the spill priority for The Dalles will be such that spill at this project can follow the 64/30 alternating percent requirement as much as possible. The spill level at John Day may also be dictated by the test at The Dalles.

4. Spill caps for various applicable TDG levels are provided below. They will be updated as needed, based on real-time TDG information.

Table A-1. Spill caps (in kcfs) corresponding to 110 to 135 % TDG Levels

PROJECT	TDG%	TDG%	TDG%	TDG%	TDG%	TDG%	REMARKS
	110	115	120	125	130	135	
MCN	20	80	170	250	340	410	(NEW DATA)
JDA	40	90	160	300	400	450	(NEW DATA)
TDA	50	100	200				(NEW DATA)
BON	70	120	170	250	300	370	(NEW DATA)
IHR	20	45	85	120	145	160	(NEW DATA)
LMN	35	40	45	70	170	250	(NEW DATA)
LGS	30	35	50	80	200	250	(NEW DATA)
CHJ	05	27	30	33	50	70	(NEW DATA)
LWG	20	40	60	90	130	190	(NEW DATA)
DWR	03	07	12	15	15	15	(NEW DATE)
WAN	10	15	20	50	100	200	
PRD	25	30	40	100	210	350	
RIS	05	10	20	30	150(1)	300	(LIMITED DATA)
RRH	05	10	20	30	150(1)	300	(LIMITED DATA)
WEL	10	15	25	45	130(1)	250	(LIMITED DATA)
GCL(2)	0 20	5 25	10 30	20 75	35 120	55 170	
HGH	03	3	3	3	3	3	
HCR	04	4	6	6	6	6	
LOP/DEX	05	5	5	5	5	5	

PROJECT	TDG%	TDG%	TDG%	TDG%	TDG%	TDG%	REMARKS
GPR	02	2	2	2	2	2	
DET/BCL	07	7	7	7	7	7	
TDG %	110	115	120	125	130	130	

1. Limit daytime spill to 100 kcfs
2. Assume forebay TDG at 120% (1st row=outlet El<1260'), 2nd row=spillway (El>1260')
3. HGH spill to 3 kcfs (110% TDG) until further notice