Manitoba Floodway Authority

Red River Floodway Expansion Project
2009 Construction Surface Water Monitoring Report
.9905246 NM8

FINAL REV 0

March 2010

Prepared By

Katie Sinclair, B.Env.Sc.
Environmental Scientist

Approved By

Dave B. MacMillan, P.Eng.
Principal

KGS GROUP

CONSULTING ENGINEERS

Kontzamanis Graumann Smith MacMillan Inc.

KGS GROUP
CONSULTING ENGINEERS

3rd Floor
865 Waverley Street
Winnipeg,
Manitoba
R3T 5P4
204.896.1209
fax: 204.896.0754
www.kgsgroup.com

March 30, 2010

File No. 05-1100-01.19.06.03

Manitoba Floodway Authority
200 – 155 Carlton Street
Winnipeg, Manitoba
R3C 3H8

ATTENTION: Ms. Leanne Shewchuk
Manager of Environmental Services

Re: Red River Floodway Expansion Project
2009 Construction Surface Water Monitoring Report
Memo Reference: .9905246 NM8
Final Report – March 2010

Dear Ms. Shewchuk:

Please find enclosed twenty (20) paper copies and one (1) electronic copy of the Final Report for the 2009 Construction Surface Water Monitoring of the Red River Floodway Expansion. An electronic copy of each individual Final Monthly Monitoring Report from January to December 2009 is also provided, as supporting documents for the MFA web page.

This annual construction report describes the analysis results for samples collected from the Red River, Floodway Channel and the drains flowing into the Floodway and along the West Dyke during the 2009 construction time period. The data includes the monthly and event-based (Level I) monitoring.

We sincerely appreciate the opportunity to provide ongoing services on this project. If you have any questions regarding this report please contact Ms. Katie Sinclair, or the undersigned.

Yours truly,

for Dave MacMillan, P. Eng.
Principal

KS/dbm/mlb
Enclosure

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Docs\Reports\NM8\Yearly-Final\(L.Shewchuk-MFA)_NM8.2009ConstructionSWMonitoring_FNLRPT_KS_Mar3010.doc

EXECUTIVE SUMMARY

The Red River Floodway Expansion Project Screening Report prepared for Infrastructure Canada concluded that the effects of the project on surface water quality are not likely to be significant provided that the mitigation measures proposed are followed and that a monitoring and follow-up plan for surface water quality is submitted by the Manitoba Floodway Authority. A baseline surface water quality monitoring program was undertaken in the spring – summer of 2005, prior to the start of construction of the Floodway Expansion Project. Additionally a winter baseflow program was conducted in 2005 prior to construction, to monitor the groundwater discharge into the Floodway Channel when there was no surface water contribution. The data obtained during the baseline monitoring program forms the basis for comparison to this 2009 construction monitoring report and all future construction monitoring reports that will be compiled at the end of each construction year. Comparison of the 2009 construction monitoring to baseline data allows the effects of construction to be compared to the applicable compliance criteria and to predictions made in modelling effects.

The surface water quality monitoring program for the 2009 construction year was conducted from January to December 2009 in conjunction with the on-going construction activities. This 2009 construction report outlines the analysis results for samples collected from the Red River at the Inlet and Outlet, 11 locations along the Floodway Channel including the upstream and downstream ends of the construction and revegetation zones, 11 of the outfall drains flowing into the Floodway and 2 drains along the West Dyke. The 2009 construction monitoring data is summarized and compared to the data presented in the baseline surface water monitoring report.

There were twelve (12) monthly monitoring events, with one conducted each month following precipitation events, near the end of the month if a substantial precipitation event had not yet occurred or at the flood peak during the spring Red River flood condition. There were ten (10) Level I event-based monitoring events conducted between May and August, 2009 in response to precipitation levels greater than 10 mm.

On-going construction contracts for the Floodway at the start of January 2009 consisted of Channel Contracts; C-6C (Stn 33+670 – 35+060 west side), C-8B (Stn 40+900 – 50+430 east side), CE1 (Outlet Control Structure), CE2 (Erosion Protection at Red River), I2 (Inlet Control Structure) and I6 (Supply of Hydraulic Cylinders); Bridge Contracts for CPR Keewatin Bridge (T14; Stn 30+220) and CPR Emerson Bridge (T15; Stn 11+200); and West Dyke Contracts for W12 (Stn 19+300 – 23+500), W22 (Stn 19+300 – 23+500), W23 (Stn 33+300 – 35+600), W24 (Stn 35+600 – 23+500), W25 (Stn 2+500 – 4+500) and W26 (Stn 7+600 – 9+950).

Numerous Contracts were also started in 2009 and included T16 (Culvert replacement; Prairie Grove Road over Seine River) and W27 (West Dyke; Stn 23+900 – 25+000) in January; Contract W28 (West Dyke; Stn 40+300 – 43+100) in June; Contracts W19 (West Dyke; Stn 14+600; Glenlea Drain), W29 (West Dyke; Stn 43+100 – 45+380), T17 (PTH Hwy 44 Bridge; Stn 48+050,) and T18 (PTH Hwy 15 Bridge; Stn 25+700,) in July; Contracts S1 (Seine River Syphon), and ED1 (East Dyke; Stn 4+000 – 5 +300 Floodway Channel Stn Extents) in September; Contract W21 (West Dyke; Stn 37+360 – 40+300) in October and Contract W20 (West Dyke; Stn 33+300 – 37+050) in November.

Contracts Completed in 2009 included C6C, C8b, T14, T15, T16, CE1, CE2, ED1, W12, W20, W21, W22, W23, W24, W25, W26, W27, W28, and W29. Details of the construction contracts and activities that occurred during each month are summarized in each of the individual monthly monitoring reports, NM8.1 – January to NM8.12 – December, 2009.

Construction monitoring data for the key water quality parameters of interest, identified and discussed in the baseline surface water monitoring report, were compared to the baseline data under spring flood, non-flood/unfrozen and non-flood/frozen conditions. These parameters included total suspended solids, nutrients (total phosphorus, ammonia, nitrate plus nitrite and potassium), specific conductance, major ions (sodium and chloride), and *E.Coli* for bacterial concerns.

Benzene, toluene, ethylbenzene and xylenes (BTEX) and hydrocarbon fractions F1 to F4 were also analyzed when samples could be collected at the upstream and downstream of construction locations during each monthly monitoring. The April monthly monitoring (spring melt) laboratory analysis also included phenoxy acid herbicide screen (2,4-D, bromoxynil, dicamba, MCPA and picloram), AMPA and glyphosate, at the upstream and downstream of revegetation locations.

Results of the 10 Level I event-based monitoring events conducted between May and August have typically indicated very small changes in TSS concentration in the Red River during the 2009 construction year. The largest increase was on July 31, 2009, which resulted in a change of 0.28 mg/L or 4.29%. This increase in TSS concentration was within the CCME criteria of an allowable increase of 25 mg/L. Nearly all the other Level I event-based monitoring measured a change of less than 1.0% and over half of these were a decrease in TSS concentration, therefore, no Level II event-based monitoring was required during the 2009 construction year.

Several of the key water quality parameter concentrations, in particular specific conductivity, ammonia, potassium, sodium, chloride and *E.Coli* varied spatially throughout the Floodway Channel for a given monthly monitoring during the unfrozen and frozen non-flood conditions. Additionally they could vary temporally (with time) between the monthly monitoring events, at any given sample location.

During the spring flood condition in 2009, concentrations of most parameters measured in the Floodway Channel were typically below the spring flood baseline values, with the exception of *E.Coli* concentrations, which were measured throughout the Floodway Channel at concentrations at or above the spring baseline values. Within the Red River, the concentrations of these parameters were typically higher upstream of the Outlet when compared to sample locations downstream of the Outlet indicating that the input from the Floodway was not having a significant affect on the concentrations of these parameters in the Red River.

Within the non-flood unfrozen condition in 2009, concentrations of most parameters measured in the Floodway Channel were generally within the summer baseline concentrations. During June, several of the parameters including total phosphorus, ammonia, nitrate + nitrite-N, potassium and *E.Coli* concentrations were above summer baseline values; however, this was attributed to higher concentrations of these parameters entering the Floodway Channel via drains from run-off by agricultural fields. *E.Coli* concentrations were typically below or within baseline criteria, however, concentrations were elevated above criteria in the Floodway Channel for July and September. There were no construction activities occurring in the Floodway Channel that would release bacteria into the construction area, therefore the elevated concentrations are likely due to runoff from off-site. Iron concentrations were typically elevated above the CCME criteria, however these elevated concentrations are not a concern as elevated concentrations above CCME criteria were noted during baseline sampling in 2005. With the exception of samples collected in June, for many of the parameters measured with elevated concentrations within the Floodway Channel, the concentrations downstream of construction within the channel were typically lower than background conditions in the Red River. Therefore, the elevated concentrations in the Floodway Channel would have no effect on concentrations in the Red River or result in dilution if anything.

During the non-flood unfrozen condition monthly monitoring events, parameter concentrations measured in the Red River downstream of the Outlet were typically similar to the background concentrations upstream of the Outlet, ranging from slightly lower to slightly higher, although elevated concentrations downstream were measured for TSS, ammonia, total phosphorus, nitrate + nitrite-N, and *E.Coli* concentrations. The TSS concentration increases measured in the Red River downstream of the Outlet were all less than the CCME criteria of an allowable increase of 25 mg/L and therefore are within criteria. The TSS concentrations were likely the result of natural variation, as concentrations at the Outlet were lower than concentrations in the Red River and would have resulted in dilution if anything. As no nutrients were added during the 2009 construction season, the elevated concentrations of ammonia, total phosphorus and nitrate + nitrite-N were not related to construction activities. Elevated concentrations of *E.Coli* downstream of the Outlet compared to background concentration upstream of the Outlet were measured during May, September, October and November, however; were not attributed to construction activities, nor were they a concern as concentrations were typically within the range measured during baseline monitoring.

Concentrations of most parameters measured in the Floodway Channel were within the winter baseline concentrations (or the summer baseline if there was no winter baseline) with the exception of a few locations sampled in February where the concentration of several parameters (specific conductance, ammonia, sodium, chloride, and *E.Coli*) were elevated above baseline criteria. The elevations of parameter concentrations in February were likely influenced by a rain event carrying nutrients and road salts in the surface water run-off entering the Floodway Channel from agricultural drains and storm sewers. A few exceedances were recorded for concentrations of ammonia and *E.Coli* in January, however; the elevated concentrations of ammonia were not attributed to construction activities as no seeding would have occurred during the winter months and no nutrients were applied during the 2009 construction season. Further, the elevated ammonia concentrations did not result in an exceedance of the CCME un-ionized ammonia criteria. The elevated concentrations of *E.Coli* were not attributed to construction, as there were no construction activities that would release bacteria into the construction area. Further, there is no basis for an evaluation of *E.Coli*, as there are no applicable CCME criteria.

Parameter concentrations measured in the Red River downstream of the Outlet during the non-flood frozen condition were typically similar to or lower than the background concentrations upstream of the Outlet ranging from slightly lower to slightly higher. However, concentrations on the Red River approximately 2 km downstream of the Outlet resulted in elevated concentrations for several parameters (TSS, total phosphorus, chloride and *E.Coli*) compared to the background concentrations upstream of the Outlet. These elevations are likely due to natural variation as the Red River is ice-covered and the concentrations in the Floodway Channel at the Outlet are lower than the concentrations in the Red River. Concentrations of ammonia measured in the Red River downstream of the Outlet were elevated above the background concentration upstream of the Outlet, however, none of the ammonia concentrations in the Red River exceeded the CCME criteria for unionized ammonia. During the majority of the monthly monitoring events the concentrations at the downstream of construction location were lower than the background concentration upstream of the Outlet, and therefore would have resulted in dilution if anything.

Concentrations of most parameters measured in the Manness and Domain Drains along the West Dyke were elevated above the baseline concentrations during the monthly monitoring events that samples could be collected. Parameters that were within the baseline criteria included TSS and ammonia. All other parameters had at least one concentration elevated above baseline criteria for either the Manness or Domain Drains. Although construction activities were occurring adjacent to the Manness Drain in June and July 2009, the work consisted of rip rap application that was completed in August 2009. There were no construction activities that were occurring immediately adjacent to the Domain Drain in 2009, therefore elevated concentrations in the Manness and Domain Drains in 2009 were likely the result of natural variation.

Based on the results of the 2009 Construction monitoring events, recommendations and refinements for the ongoing monitoring should include the following;

- The 2010 Surface Water Sampling Program should consist of Event-based monitoring focusing on contract specific construction monitoring and assessing the surface water quality as it relates to potential groundwater impacts. In addition to conducting the Level I and II Rain and Spill Event-based monitoring as previously conducted, Event-based monitoring during 2010 should also be conducted in response to elevated water levels in the floodway channel when there is the greatest potential for surface water to affect the groundwater quality (Floodway Flow). This Floodway Flow Event-based monitoring should be conducted when the water level in the Floodway overtops the Low Flow Channel either from elevated Red River water levels (spring or summer flooding) or prolonged precipitation events.

- The Event-based monitoring should replace the regular Monthly monitoring, however, during the unfrozen conditions, typically from April to October, if there is no event-based monitoring triggered during a month then at a minimum samples should be collected in the Floodway Channel upstream and downstream of the overall construction area.

- To assess contract specific effects during the Event-based monitoring new sample locations should be established in the La Salle River upstream and downstream of where the new Glenlea Drain discharges and in the Seine River upstream and downstream of the new culvert on Prairie Grove road. Additionally, during the Level I Event-based monitoring samples should be collected from the Floodway Channel upstream and downstream of each contract area. Whereas, the sample locations in the Manness and Domain Drains adjacent the West Dyke are no longer required during 2010 as the construction activities in the vicinity of these locations was completed in 2009.

- The rain Event-based monitoring in 2010 should continue to follow the protocol used in 2009 with the additional sample locations noted above to identify contract specific effects. To assess potential effects of surface water on groundwater quality, samples collected during the rain Event-based monitoring should also be submitted for laboratory analysis of pH and conductivity. This revised protocol should be reviewed again during the 2010 monitoring program and revised if required as construction contracts near completion.

- With the introduction of the Nutrient Management Regulation (62/2008) no fertilizers have been applied to the Floodway Channel slopes since 2008. Therefore fewer nutrient parameters should be submitted for laboratory analysis and less frequently than previously.

- The reporting protocol for the 2010 surface water monitoring program should continue to follow the slight modifications made in 2008 to flag potential increases in TSS concentrations more rapidly. This included completing a Level I event-based worksheet for each of the monitoring events to provide an indication as to whether the sediment concentration in the Floodway will have a potential impact on the Red River downstream of the Floodway Outlet. If the worksheet indicates no potential impact then the results would be reported in the monthly monitoring report, whereas, if a potential impact is identified then MFA would be notified immediately and the laboratory would be contacted to request the TSS analysis results as soon as possible. Appropriate measures would then be developed with MFA based on the TSS laboratory results.

TABLE OF CONTENTS

PAGE

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Docs\Reports\NM8\Yearly-Final\(L.Shewchuk-MFA)_NM8.2009ConstructionSWMonitoring_FNLRPT_KS_Mar3010.doc

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1.0 INTRODUCTION

1.1 INTRODUCTION

The Environmental Impact Statement (EIS) prepared by TetrES Consultants Inc./Intergroup Consultants Ltd.[1] presented the assessment of potential effects on surface water quality resulting from the Floodway Expansion Project (Project). The EIS identified potential effects related to sedimentation associated with Project construction and the use of fertilizers (containing phosphorus, nitrogen and potassium), herbicides (glyphosate and 2,4-D amine) or spills of chemicals during Project construction or maintenance.

The EIS stated that potential effects on surface water quality would be mitigated through the use of appropriate construction management practices that would be specified in the Construction Phase Environmental Protection Plans (CPEPP) developed for each construction site. Additionally, as a component of the monitoring plans for the CPEPP, potential changes in surface water quality would be monitored during construction. Further, in the Red River Floodway Expansion Project Screening Report prepared for Infrastructure Canada [2] the responsible authorities concluded that the effects of the project on surface water quality are not likely to be significant provided that the mitigation measures proposed are followed and that a monitoring and follow-up plan for surface water quality is submitted by the Manitoba Floodway Authority (MFA).

A baseline surface water quality monitoring program [3] was undertaken in the spring – summer of 2005, prior to the start of construction of the Floodway Expansion Project. It consisted of sampling during early spring (April), the peak spring flow period (April), summer emergency operation (June) and during typical summer monthly (May to August) flow conditions. Additionally a winter baseflow program [4] was conducted in 2005 prior to construction, to monitor the groundwater discharge into the Floodway Channel when there was no surface water contribution. During the baseflow program, samples were collected on March 2, 2005 and these water quality results are considered representative of winter baseline data.

The data obtained during the baseline monitoring program forms the basis for comparison to this 2009 construction monitoring report and all future construction monitoring reports that will be compiled at the end of each construction year. Comparison of the 2009 monthly construction monitoring data (January to December) collected during typical monthly flow conditions, to baseline data will allow the effects of construction to be compared to the applicable compliance criteria and to predictions made in modelling effects. As well, the effectiveness of proposed mitigation measures will be assessed.

1.2 SCOPE OF WORK

The scope of work for the 2009 construction Surface Water Monitoring program conducted by KGS Group included the following:

- Collect **monthly** surface water quality data for the Red River, Floodway Channel, Drains that flow into the Floodway Channel and Drains that cross the West Dyke, preferably following a precipitation event or at the flood peak during Red River flood conditions;

- Collect **event-based** surface water quality data for compliance monitoring of applicable parameters (TSS, nutrients, herbicides or hydrocarbons) from the Floodway Channel upstream and downstream of the overall construction area, the Red River downstream of the Outlet and any additional required locations following precipitation events greater than 10 mm or a spill; and

- Provide an assessment of surface water quality comparing results of construction monthly and event-based compliance monitoring to baseline water quality and summarize in a 2009 construction monitoring report in order to;

  - compare predictions made in modelling effects
  - to assess the effectiveness of proposed mitigation measures and adapt if necessary
  - adapt the construction monitoring program in response to data and changes in mitigation measures

2.0 METHODOLOGY

2.1 OVERVIEW

The field investigation program for the 2009 construction year was conducted from January to December 2009 in conjunction with the on-going construction activities. There were twelve (12) monthly monitoring events, with one conducted each month following precipitation events, near the end of the month if a substantial precipitation event had not yet occurred or at the peak flood during the spring Red River flood condition. There were ten (10) Level I event-based monitoring events conducted between May and August, 2009 in response to precipitation levels greater than 10 mm. No Level II event-based monitoring was required during the 2009 construction year as the results of the Level I event-based monitoring indicated that the potential increase in sediment concentration in the Red River was within the Provincial Guidelines. No spill event-based monitoring was required because the spills that occurred during 2009 were typically small, contained and cleaned up with no potential run-off to the Floodway Channel.

The methodology used for the field program conducted by KGS Group followed the general methodology outlined in the Surface Water Monitoring – 2009 Sampling Program (Appendix A) that incorporated modifications made following the 2005 baseline and 2005 through 2008 construction monitoring programs. Deviations and changes from the general methodology used during the 2009 construction monitoring are described below.

2.2 SAMPLING LOCATIONS

The sample locations for the 2009 construction monitoring program are outlined on Figure NM8-1 and Figure NM8-2, listed in table NM8-1 and described as follows;

Red River at Inlet **–** Upstream of the Floodway Channel along the west shore of the river, with the exception of the Spring flood conditions in April, the 3 replicate samples (S-01, S-02 and S-03) were not sampled during the remainder of the 2009 monitoring program because there was no river water entering into the Floodway Channel at the Inlet during the monthly monitoring events.

***Red River at Outlet* –** Upstream of the Floodway Outlet along the east shore (S-34) and downstream of the Outlet at 4 locations along the east shore at 0.5, 1, 2 and 3 kilometers (S-30, S-31, S-32 and S-33, respectively) were sampled during each of the twelve (12) monthly monitoring events. S-31 and S-34 were also sampled during each of the ten (10) Level I event-based monitoring events. These 5 river locations were sampled from the shore for safety reasons, except during the months of January to March and December at which time the river was covered by at least 6 inches of ice that had to be augured through to collect the samples.

***Floodway Channel* –** The Floodway Channel downstream of the Inlet (S-04) was only sampled during the flood conditions in April; however, was not sampled during the remainder of the 2009 monitoring program because there was no river water entering into the Floodway Channel at the Inlet during any of the other monthly monitoring events. There are a total of 6 other locations in the Floodway Channel that included; downstream of the Grande Pointe Diversion drop structure (S-13), downstream of the North Bibeau Drain drop structure (S-14) and at the four weir locations; Keewatin Weir (S-21), Springfield Weir (S-23), Dunning Weir (S-25) and PTH# 44 Weir (S-28). Each of these locations was sampled during all twelve (12) of the monthly monitoring events with a few exceptions. Location S-13 was not sampled during the January monthly monitoring and S-28 was not sampled during the January, February, or March monthly monitoring because the water was frozen to the bottom of the channel.

***Outfall Sources* –** During the non-flood frozen condition from January to March, and December all 11 outfalls that drain into the Floodway Channel were not sampled because the frozen condition prevented any water from flowing into the Floodway Channel.

The Seine River Syphon Overflow (S-05) was not sampled in October because of construction activities occurring at the drain or in November due to lack of flow. During the flood unfrozen condition in April and the non-flood unfrozen condition from May to November the Deacon Reservoir Drain (S-08) was not sampled, as there was no flow at this location. Both the North Bibeau Drain Drop Structure (S-10) and Country Villa Estates Drain (S-11) were not sampled in September, October or November, as there was no flow. Kildare Trunk-Transcona Storm Sewer Outlet (S-12) was not sampled during the 2009 construction monitoring program as this location was inundated with water from April through September, and had no flow in October and November. Ashfield Drain Drop Structure (S-27) was not sampled in September, as there was no flow. The remaining five locations (S-06, S-07, S-09, S-22 and S-26) were sampled during each monthly monitoring event between April and November.

***West Dyke Drains* –** During the non-flood frozen condition from January to March, and December the Manness (S-35) and Domain (S-36) were not sampled as the samples were frozen to the bottom of the channel.

The Manness and Domain Drains were both sampled along the West Dyke during the April monthly monitoring that coincided with the spring melt and during the months of May, August, October and November. The Manness Drain was not sampled during April or May as the site was inaccessible due to construction activities and the Domain Drain was not sampled in September, as there was no flow. An upstream location of the Manness Drain was also sampled in April, May, August, September, October and November.

***Floodway Channel Construction Areas* –** In addition to the sample locations shown in figures NM8-1 and NM8-2, samples were also collected from the Floodway Channel upstream and downstream of construction activities (CON U/S and CON D/S, respectively) and upstream and downstream of re-vegetation activities (VEG U/S and VEG D/S, respectively). These sample locations were based on the construction contracts, the extent of the contracts along the Floodway Channel and the construction activities that occurred for each month as summarized in each of the monthly monitoring reports, NM8.1 – January to NM8.12 – December.

For the 2009 monitoring program the upstream end of construction was designated at Station 11+000, located approximately 200 m upstream of the construction activities in the Channel at the CPR Emerson Bridge Contract (T12, Station 11+200). Samples were not collected from the upstream of construction location during January through March and in December (frozen condition). The upstream of construction location was also sampled during each of the ten (10) Level I event-based monitoring events.

The location downstream of construction that was previously established at Station 50+500 during August 2007 was moved to Station 50+900 (downstream of the outlet structure) at the beginning of 2009 in order to measure any potential effects associated with construction activities at the Outlet structure. Samples were collected from this location for all of the monthly monitoring and Level I event-based monitoring events during 2009.

Seeding during the 2009 construction year began at the CNR Redditt Bridge contract (T11) in March with most of the seeding conducted during October and November at the CPR Emerson (T15), PTH Hwy 15 (T18), CPR Keewatin (T14) and PTH Hwy 44 (T17) bridges. Seeding during 2009 at the remaining Floodway Channel contracts was completed in July and August at C-6C, C-8B and the Outlet Structure (CE1). With the introduction of the Nutrient Management Regulation (62/2008) no fertilizers have been applied when seeding the Floodway Channel slopes since 2008. Regardless, there is potential for runoff of fertilizer because of snowmelt and rain from areas seeded previously during 2008. This included the area from the CPR Emerson bridge contract to the end of the Floodway Channel with contracts C-8A and C-8B. Therefore, the sample locations upstream and downstream of the revegetation zone were the same locations used for upstream and downstream of construction discussed above. No sample was collected in the Floodway Channel upstream of the revegetation zone during the January to March and December monthly monitoring because the water was frozen to the bottom on the Floodway Channel.

2.3 SAMPLING PROTOCOL

***Sample Frequency* –** The monthly monitoring events were conducted once per month from January to December, typically following a precipitation event. Ten (10) Level I event-based monitoring events were conducted between May and August in response to precipitation events greater than 10 mm as outlined in Appendix A.

***Sampling Protocol* –** The protocol followed the U.S. Environmental Protection Agency (EPA), Office of Water Quality (November, 1997, EPA 841-B-97-003) Monitoring Water Quality, Chapter 5 Water Quality Conditions [(5)] as outlined in Appendix A.

***Field Measurements* –** pH, temperature, conductivity, turbidity and water depth were obtained during each of the twelve monthly monitoring and ten Level I event-based monitoring events, as outlined in Appendix A.

Laboratory Analysis – The analysis package at all of the locations sampled during each of the monthly monitoring events included the following;

- Routine extractable (iron, manganese, fluoride, pH, total dissolved solids, sulphate, nitrate + nitrite-N, calcium, potassium magnesium, sodium, hardness, conductivity, chloride, total alkalinity, bicarbonate, carbonate and hydroxide)
- Total suspended solids (TSS) and turbidity
- Ammonia
- Ortho phosphorus, total phosphorus, total dissolved phosphorus
- Dissolved organic carbon (DOC), total organic carbon (TOC)
- Total Kjeldahl nitrogen (TKN)
- Total coliform and *E.Coli* by m-Coli Blue Membrane Filtration method

In addition to the above, at the upstream and downstream of construction locations, included in the analysis of the monthly monitoring samples, benzene, toluene, ethylbenzene and xylenes (BTEX) and hydrocarbon fractions F1 to F4 were also analyzed. During the April monthly monitoring (spring melt) laboratory analysis also included phenoxy acid herbicide screen (2,4-D, bromoxynil, dicamba, MCPA and picloram), AMPA and glyphosate, at the upstream and downstream of re-vegetation locations.

As part of the Level I event-based monitoring, laboratory analysis of TSS and nutrients (pH, nitrate+nitrite-N, ammonia, Total Kjeldahl Nitrogen, ortho-phosphorus and total dissolved phosphorus) was conducted for the samples collected in the Floodway Channel upstream and downstream of construction and on the Red River upstream (S-34) and downstream (S-31) of the Outlet. No laboratory analysis of herbicides (phenoxy acid herbicide screen, AMPA and glyphosate) was required during the event-based monitoring as there were no herbicides applied during the 2009 construction year.

Quality Assurance/Quality Control Program – Quality Assurance and Quality Control (QA/QC) methods have been adopted to ensure that all samples are representative of the site. In the field, quality was assured by using experienced field staff trained to follow the U.S. EPA sampling protocol and ensuring that all sampling equipment was sterilized and/or rinsed with the sampling media a minimum of three times to eliminate cross contamination of samples. Disposable latex gloves were used for every sample retrieved. Samples were placed into EPA approved sample containers provided by the laboratory and stored in cooler chests at 4°C for transport to ALS Laboratory Group, a Canadian Association for Laboratory Accreditation Inc. (CALA) certified laboratory for detailed analyses.

Implementation of one field duplicate sample per monthly monitoring event and laboratory quality control including; calibration verification standards, continuing calibration verification, certified reference material, matrix spikes, laboratory control samples, duplicates and method blanks, were also used to assure that the laboratory analyses of samples collected in the field were representative of conditions encountered in the investigation. The QA/QC program for the 2009 construction sampling included the following:

- Record keeping for all aspects of sample handling and analysis, including the description of methods/standards used to analyse samples, proper records of sampling and sample handling (chain of custody), analytical result records, and QC sample records.
- Field QC duplicated samples and laboratory QC including calibration verification standards, continuing calibration verification, certified reference material, matrix spikes, laboratory control samples, duplicates and method blanks.

2.4 FLOW CALCULATIONS

Estimates of the flow in the Red River, Floodway Channel, and agricultural drains that flow into the Channel are helpful for interpreting and comparing construction test results. Additionally, flow estimates are necessary to calculate approximate mass balances for the chemical analysis results to interpret the results in particular during event-based compliance monitoring.

The estimate of flow in the Red River was based on information provided in Manitoba Water Stewardship's weekly flow reports for the Red River near Selkirk (Appendix B) [(6)]. Estimates of the flow in the Floodway Channel and in each of the agricultural drains that flow into the channel were based on the recorded water levels at each location. Water levels were recorded using staff gauges installed at each of the sampling locations. The flow was then estimated using a relationship between flow and water level (rating curve), which was developed by KGS Group at each location. The rating curves developed for the agricultural drain drop structures were based on the physical characteristics of the drop structure and approach channel. Rating curves developed for the in-channel locations were based on the physical characteristics of the Floodway Channel.

3.0 RESULTS

3.1 HYDROLOGICAL CONDITIONS

Monthly Monitoring

The monthly monitoring events were generally conducted following a substantial precipitation event during the month or near the end of the month if a substantial precipitation event had not yet occurred. Full details of the hydrological conditions for each monthly monitoring are provided in each of the monthly monitoring reports, NM8.1 – January to NM8.12 – December. Details of precipitation recorded by Environment Canada at the Winnipeg International Airport, Manitoba [7] are provided in the Daily Data Report for January to December, 2009 in Appendix C. The precipitation levels during each of the monthly monitoring events and the percentage of the monthly precipitation total are summarized in the following table;

Summary of Precipitation Levels during the 2009 Monthly Monitoring

Sample Date	Amount of Precipitation (mm) for the Monitoring Event	Percent of Monthly Total	Monthly Total Precipitation (mm)	Historical Average Monthly Total Precipitation (mm) [8]
January 27-29	0.5	3%	16.5	19.7
February 19 & 20	0.0	0%	41.5	14.9
March 4 & 5	2.0	4%	54.0	21.5
April 20	1.5	4%	34.0	31.9
May 26	12.5	20%	63.5	58.8
June 29	1.0	1.6%	61.5	89.5
July 15	45.5	40%	114.5	70.6
August 25	6.0	11%	56.0	75.1
September 29	0.0	0%	22.5	52.3
October 28	4.0	11%	39.5	36.0
November 23	0.0	0%	1.5	25.0
December 16 & 17	0.5	3%	16.0	18.5
Annual Total			521.0	513.8

As evident by the table above, while 2009 had a relatively average overall amount of precipitation with an annual total precipitation of 521.0 mm compared to the historical average of 513.8 the conditions varied from month to month. June, August, September, and November all had total monthly precipitation amounts substantially lower than the historical average monthly precipitation. In comparison, February, March, and July had substantially higher monthly precipitation amounts compared to the historical average monthly precipitations.

Event-Based Monitoring

The Level I event-based monitoring events were conducted between May and August, 2009 following precipitation events of 10 mm or greater. The amount and duration of each precipitation event and the year storm categorization (based on the Atmospheric Environment Service, Rainfall Intensity – Duration Frequency (Rainfall IDF) Values for the Winnipeg International Airport [(9)]) which triggered each of the Level I event-based monitoring events are summarized in the following table;

Summary of Precipitation Levels during the 2009 Event-Based Monitoring

Sample Date	Amount of Precipitation (mm) for the Monitoring Event [1]	Approximate Duration (hours)	Year Storm [(9)]
May 26	6.6 – 14.5	3.5	<2
June 9	10.4 – 14.4	3.0	<2
June 27	8.4 –85.1	22.0	<2 - <5
July 9	22.8 – 55.1	12.0	<2 - <5
July 15	16.8 –37.1	9.5	<2
July 30	6.5 – 26.7	4.0	<2
July 31	9.8 – 34.3	6.0	<2
August 15	10.0 – 25.0	12.0	<2
August 21	0.5 – 16.0	13.0	<2
August 25	0.4 – 11.7	6.0	<2

1 - Amount of precipitation measured varied between the different weather stations.

3.2 WATER QUALITY

The field chemistry and turbidity measured in the surface water at each location during the monthly and event-based monitoring events are listed in Table NM8-1. The general water quality results for all of the analyzed parameters collected at each location during the monthly and event-based monitoring events are summarized in Table NM8-2. The petroleum hydrocarbons and bacteria results for samples collected during the monthly monitoring and the herbicides collected during the April monthly (spring melt run-off) are summarized in Table NM8-3, Table NM8-4 and Table NM8-5 respectively. Existing CCME Surface Water Quality Guideline values are given for any parameters that have established objectives.

Construction monitoring data for the key water quality parameters of interest, identified and discussed in the baseline surface water monitoring report, were compared to the baseline data under spring flood, non-flood/unfrozen and non-flood/frozen conditions. These parameters included total suspended solids, nutrients (total phosphorus, ammonia, nitrate plus nitrite and potassium), specific conductance, major ions (sodium and chloride), and *E.Coli* for bacterial concerns (Figures NM8-3 to NM8-34).

During April 2009, the Red River experienced flood conditions and, as such, there was water entering the Floodway Channel. Red River water began naturally flowing into the Floodway Channel on March 25 when the water levels rose above an elevation of 750 feet (228.6 m). The Floodway gates were put into operation on April 8 and remained in operation until the end of the month. The flood water levels crested on April 18 at an elevation of 766.75 feet. The samples analysed in April 2009 were compared to the samples collected during the flood conditions on April 12, 2005 during the baseline monitoring from the Red River, Floodway Channel, Drains that flow into the Floodway Channel, and Drains that cross the West Dyke.

During the May to November 2009 construction monitoring there was no Red River water entering the Floodway Channel, therefore, these monthly monitoring events represent the non-flood/unfrozen condition. As a result the range of baseline conditions for comparison shown on the figures for the Channel are represented by the minimum and maximum concentrations observed during the summer baseline monitoring when there was no Red River water diverted. This included data from the May 10, June 13 and August 19, 2005 baseline monthly events. For the upstream end of the Floodway Channel where there was insufficient baseline data to provide a range of baseline conditions, the range was extrapolated using the data immediately downstream and following the observed trends. The Floodway Channel summer baseline conditions are representative of surface water run-off from precipitation events and therefore are comparable to the non-flood/unfrozen condition. The baseline conditions used for comparison for the drains flowing into the Floodway Channel and for the Red River at the Outlet are from the corresponding sample events as above. In addition, for the Red River at the Outlet the baseline conditions from the emergency summer operation and the July monthly event are used for comparison because these dates represent the range of Red River flow conditions that could occur in any given year during construction.

During the January to March, and December 2009 construction monitoring there was no Red River water entering the Floodway Channel, therefore, these monthly monitoring events represent the non-flood/frozen condition. The Floodway Channel summer baseline conditions as discussed above are representative of surface water run-off from precipitation events and, therefore, for some parameters are not comparable to the frozen conditions. Under frozen conditions the surface water is primarily from groundwater discharge into the Channel, referred to as baseflow. As a result in addition to the summer baseline conditions, for applicable parameters, the monthly monitoring values during the non-flood/frozen condition are also compared to the winter baseline results from the baseflow monitoring conducted at the Floodway Channel weir locations in March 2005 (4).

3.2.1 Total Suspended Solids

Monthly Monitoring

The comparison of TSS concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flood condition, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM8–3, NM8–4, and NM8–5, respectively.

A major increase in total suspended solids (TSS) concentration was measured in the Floodway Channel downstream of construction (196 mg/L; Stn 50+900) compared to upstream of construction (80 mg/L; Stn 11+000; Figure NM8-3) during the spring flood conditions. These concentration increases were not attributed to construction as the concentration of these parameters in the Floodway Channel were generally lower than baseline Floodway concentrations, except for the location downstream of the North Bibeau Drain (292 mg/L). Additionally, the concentrations of these parameters in the Floodway Channel were generally similar to or lower than the Red River and would have resulted in dilution and not increases. The TSS concentration measured in the Floodway Channel at the Outlet (196 mg/L) was similar to the concentrations in the Red River. As such no increase in was measured in the Red River downstream of the Outlet (144 to 198 mg/L) compared to upstream of the Outlet (208 mg/L).

The TSS concentrations measured in the Floodway Channel were generally within or lower than the baseline concentrations during the monthly monitoring representing the non-flood/unfrozen condition, except during May and June (Figure NM8-4). The sample locations with elevated TSS concentrations included P.T.H #44 Weir (S-28) in May and the Dunning Weir (S-25), upstream of construction (CON U/S) location, and downstream of construction (CON D/S) location in June. However, during both of these months, all other TSS concentrations in the Floodway Channel were below the summer baseline conditions. There was a slight increase of TSS concentrations in May at the downstream of construction location (36 mg/L) compared to upstream of construction location (34 mg/L); however, the increase was well within the CCME criteria of an allowable increase of 25 mg/L. In June, the TSS concentration at the downstream of construction location (Stn 50+900; 78 mg/L) was well below the concentration at the upstream of construction location (Stn 11+000; 118 mg/L; Table NM8-2). In both May and June a major increase in TSS concentration was measured in the Red River approximately 2 km (S-32; 290 mg/L and 358 mg/L, respectively) and 3 km (S-33; 382 mg/L and 562 mg/L, respectively) downstream of the Outlet compared to the background concentration upstream of the Outlet (S-34; 200 mg/L and 466 mg/L, respectively). However, in both months, the samples 0.5 km (S-30) and 1 km (S-31) downstream of the Outlet had concentrations that were lower than the background concentration upstream of the Outlet. Additionally, in both May and June, the mass balance calculations indicated that the input from the Floodway Channel would result in a dilution of the TSS concentration in the Red River and was within the CCME criteria.

The TSS concentrations measured in the Floodway Channel were lower than the baseline concentrations during the monthly monitoring representing the non-flood/frozen condition (Figure NM8-5). During January, the Red River samples downstream of the outlet (S-30 to S32) had increases in TSS concentration compared to the background concentration upstream of the Outlet (S-34). In January, the samples collected at stations S-30, S-31 and S-32 had TSS concentrations of 240 mg/L, 72 mg/L and 820 mg/L, respectively, compared to the background concentration upstream of the Outlet (9 mg/L). In December the sample collected at the sample location 2 km downstream of the Outlet (S-32) had a TSS concentration of 596 mg/L compared to the background concentration upstream of the Outlet (11 mg/L). The elevated TSS concentrations in the Red River were not likely due to construction activities within the Floodway Channel because all TSS concentrations in the Floodway Channel were significantly lower than the Red River concentrations and were below summer baseline criteria. In particular the TSS concentrations measured in the Floodway Channel at the downstream of construction location (Stn 50+900; January (<5 mg/L); December (<5 mg/L)) were lower than the values in the Red River compared to January (9 to 820 mg/L) and December (10 to 596 mg/L). Elevated TSS concentrations in the Red River are likely due to the natural variation in the Red River. The mass balance calculations for each of the monthly non-flood/frozen monitoring reports (NM8.1 - NM8.3 and NM8.12) indicated that the input from the Floodway Channel would have resulted in a dilution of the TSS concentration in the Red River and were within the CCME criteria.

The TSS concentrations measured in the Red River at the Floodway Outlet during 2009 were compared to the 10th and 90th percentile range of monthly historical data collected once a month by Manitoba Water Stewardship from the Red River at Selkirk for the period of record available from 1970 to 2003. The TSS concentrations measured each month during 2009 were within the 10th to 90th percentile range in April, July through to September, and November (Figure NM8-6). In January the TSS concentrations at sample locations S-30 to S-32 in the Red River (72 to 820 mg/L) were much higher than the historical 90th percentile (19 mg/L) and the background concentration upstream of the Outlet (S-34; 9 mg/L). The TSS concentrations entering the Red River from the Floodway Channel would have resulted in a dilution during January as the concentrations in the Floodway Channel were lower and therefore, it is unlikely that the increased TSS is a result of construction activities occurring in the Floodway Channel. During February, although the TSS concentrations were elevated above the 10th and 90th percentile range the TSS concentration downstream of the Outlet (S30 - S33; 16-130 mg/L) were lower than the background concentration upstream of the Outlet (S-34; 200 mg/L). In March, the TSS concentrations measured in the Red River downstream of the Outlet were typically lower (25 to 43 mg/L) than the background concentration upstream of the Outlet (200 mg/L), with the exception of 2 km downstream of the Outlet that resulted in a minor elevation (S-32; 210 mg/L). In May the TSS concentration in the Red River 2 km (S-32; 290 mg/L) and 3 km downstream of the Outlet (S-33; 382 mg/L) were above the 90th percentile for the month (277 mg/L) and the background concentration upstream of the Outlet (S-34; 200 mg/L). In June, the concentration of TSS in the Red River at 2 km and 3 km downstream of the Outlet ((S-32; 358 mg/L) and (S-33; 562 mg/L), respectively), as well as the background concentration upstream of the Outlet (S-

34; 466 mg/L) were higher than the 90th percentile for the month (176 mg/L). Both May and June monthly samples were collected during or after periods of heavy precipitation. Therefore, the elevated TSS concentrations in the Red River may be associated with the higher than normal average monthly precipitation and in particular the 2-year to 2- to 5-year storm event as discussed above. Although October had concentrations elevated above the 10th and 90th percentile, the TSS concentrations downstream of the Outlet (35 to 49 mg/L) were below the background concentration upstream of the Outlet (60 mg/L). Lastly, in December the concentration of TSS at a single sample location 2 km downstream of the Outlet (S-32; 596 mg/L) was elevated above the 90th percentile for December (23 mg/L) and the background concentration upstream of the Outlet (S-34; 11 mg/L). In January, February, March, May, June, October and December the concentrations of TSS above the 90th percentile is likely a result of natural variation in the river and not related to construction, as all the mass balance worksheets for 2009 resulted in sediment loads in the Red River from the Floodway Channel below the CCME criteria of 25 mg/L.

The TSS concentrations measured in the Manness and Domain Drains along the West Dyke ranged from <5 to 31 mg/L and 5 to 86 mg/L, respectively, during the monthly monitoring in which samples could be collected (Table NM8-2). These concentrations were within or below the baseline range of concentrations measured in the Manness and Domain Drains (11 to 300 mg/L and <5 to 100 mg/L, respectively) during the previous sampling conducted prior to the start of construction.

Event-Based Monitoring

Results of the 10 Level I event-based monitoring events conducted between May and August indicated very small changes in TSS concentration in the Red River during the 2009 construction year (Table NM8-6). The Level I event-based worksheet and the follow-up lab results fax for each rain event are provided with the monthly monitoring reports, MN8.1 – January to NM8.12 December.

During the Level I event-based monitoring, the only measurable increases in TSS concentration in the Red River were following the July 9 (1.4% increase), July 15 (0.3% increase) and July 31 (4.29% increase) monitoring events, with nearly all the other events resulting in a negligible (<1.0%) decrease. The July 9 rainfall (23 to 55 mm in 12 hours) ranged from less than a 2-year storm to close to a 5-year storm based on the Atmospheric Environment Service, Rainfall Intensity – Duration Frequency (Rainfall IDF) Values for the Winnipeg International Airport [9]. The July 15 rainfall (17 to 37 mm in 10 hours) also ranged from less than a 2-year storm to close to a 5-year storm, with the July 31 rainfall (10 to 34 mm over 6 hours) being close to a 2-year storm. The mass balance calculations indicated that an estimated increase in the TSS concentration of 2.72 mg/L or 3.45% for July 9, 0.48 mg/L or 0.85 % for July 15, and –0.16 mg/L or –0.41% for July 31 which would result in the Red River from the Floodway Channel inputs. Likewise the mass balance using the flows provided by MWS and the laboratory TSS concentrations indicated an approximate increase in the TSS concentration of 1.48 mg/L or 1.42% for July 9, 0.12 mg/L or 0.24% for July 15 and 0.28 mg/L or 4.29% for July 31, 2009 (Table NM8-6). These increases in TSS concentrations are within the CCME criteria of an allowable increase of 25 mg/L based on the background concentration being <250 mg/L (clear flow). Nearly all the other Level I event-based monitoring events measured a change of less than 1.0% and resulted in a decrease in TSS concentration.

A review of the estimated and actual change in Red River sediment concentration measured during the Level I event-based monitoring is provided in Table NM8-6. This review indicates that the values estimated using the mass balancing based on field measurements of turbidity and water flows, and the site-specific relationships between TSS and field turbidity are comparable to the actual increases calculated from laboratory TSS analysis and reported flows. The review also clearly demonstrates that a TSS increase exceeding the CCME criteria of an allowable 10% or 25 mg/L is very unlikely for precipitation events less than 10 mm.

3.2.2 Specific Conductance

The comparison of specific conductance values between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flood, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM8-7, NM8-8 and NM8-9, respectively.

Specific conductance concentrations measured in the Floodway Channel were below the baseline values at all stations during the monthly monitoring representing the spring flood condition (Figure NM8-7). Likewise, specific conductance concentrations measured in the Red

River at all locations were also below baseline criteria, however; specific conductance concentrations measured in the Red River downstream of the Outlet (309 µS/cm to 320 µS/cm) resulted in minor elevations compared to the background concentration upstream of the Outlet 307 (µS/cm). However, these concentrations are likely due to the natural variation of the Red River.

Specific conductance concentrations measured in the Floodway Channel during the monthly monitoring representing the non-flood/unfrozen condition were all within or below the range of summer baseline criteria (Figure NM8-8). Typically all specific conductance concentrations measured in the Red River were below summer baseline criteria except during the months of October and November. The Red River specific conductance concentrations in October were slightly elevated above baseline criteria, however; concentrations downstream of the Outlet (899 to 938 µS/cm) were lower than the background concentration upstream of the Outlet (964 µS/cm). These elevated concentrations in the Red River are not likely due to construction activities in the Floodway Channel as the specific conductance concentration at the Outlet was 686 µS/cm and would have resulted in dilution. Although the Red River specific conductance concentrations in November were also slightly elevated above baseline criteria, the concentrations downstream of the Outlet (894 to 970 µS/cm) were lower than the background concentration upstream of the Outlet (1020 µS/cm). These elevated concentrations in the Red River are also not likely due to construction activities in the Floodway Channel as the specific conductance concentration at the Outlet was 415 µS/cm and would have resulted in dilution.

The specific conductance concentrations measured in the Floodway Channel were generally within or below the range of winter baseline values (1150 to 1730 µS/cm) during the monthly monitoring representing the non-flood/frozen condition, with the exception of February (Figure NM8-8). During the February monthly monitoring event, the Dunning Weir (S-25; 1890 µS/cm) and downstream of construction (Stn 50+900; 2040 µS/cm) locations were elevated above the winter baseline criteria. Although the specific conductance concentration at the Floodway Channel Outlet was higher than the values in the Red River, this may have resulted in a negligible change in the Red River at one sample location located 1 km downstream of the Outlet (1040 µS/cm) compared to the background concentration upstream of the Outlet (1020 µS/cm). Groundwater infiltration during the frozen months typically results in elevated specific conductance values in the Floodway Channel compared to non-frozen conditions when there is

KGS GROUP

a greater proportion of surface water contribution from the drains and precipitation, therefore; the elevated specific conductance concentrations in the Floodway Channel are likely due to groundwater infiltration. Also, the elevations of parameter concentrations in February may have been due to a rain event carrying nutrients and road salts in the surface water run-off entering the Floodway Channel from agricultural drains and storm sewers.

The specific conductance measured in the Manness and Domain Drains along the West Dyke ranged from 219 to 3320 µS/cm and 141 to 1180 µS/cm, respectively, during the monthly monitoring in which samples could be collected (Table NM8-2). The values measured in the Manness Drain were within the baseline range (177 to 1680 µS/cm), except during September, October and November where specific conductance concentrations ranged between 2010 to 3320 µS/cm. The elevated specific conductance levels were not a result of construction because the activities in the vicinity of the Manness Drain prior to September consisted of rip rap application that was completed in August 2009 and August resulted in a specific conductance concentration of 831 µS/cm, which was within the baseline criteria. The majority of values measured in the Domain Drain were within the baseline range (108 to 503 µS/cm), except for the elevated concentrations during May, July, October and November, which ranged between 537 to 1180 µS/cm. These elevated specific conductance concentrations were not a result of construction as there were no construction activities in the immediate vicinity of the Domain Drain in 2009.

3.2.3 Total Phosphorus

Monthly Monitoring

The comparison of total phosphorus concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flood, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM8-10, NM8-11 and NM8-12, respectively.

The total phosphorus concentrations measured in the Floodway Channel and Red River during the monthly monitoring representing the spring flood were below the spring flood baseline values (Figure NM8-10).

The total phosphorus concentrations measured in the Floodway Channel during the monthly monitoring representing the non-flood/unfrozen condition were generally lower than the summer baseline criteria, except during June and July (Figure NM8-11). Although the concentrations of total phosphorus were much higher in June, the concentration measured downstream of construction (Station 50+900; 0.563 mg/L) was below the background concentration upstream of construction (Station 11+000; 0.590). The elevated total phosphorus concentration in June at the Spring Hill Weir (S-23; 1.260 mg/L) may be due to natural variation as discharge into the Floodway Channel from the Cooks Creek Drain outlet structure, which had an elevated total phosphorus concentration (1.670 mg/L) did not elevate concentrations at the Keewatin Weir location (0.277 mg/L). Additionally, the samples collected in June from the Red River downstream of the Outlet (0.515 mg/L to 0.646 mg/L) resulted in concentrations that were lower than the background concentration upstream of the Outlet (0.711 mg/L). In July, one sampling location was elevated above the summer baseline criteria and included the Dunning Weir (S-25; 0.594 mg/L). The total phosphorus concentration in July measured downstream of construction (Station 50+900; 0.264 mg/L) was also moderately elevated above the upstream of construction location (Station 11+000; 0.212 mg/L), however; both concentrations were within the summer baseline criteria. Additionally, in July the total phosphorus concentrations measured in the Red River were moderately elevated downstream of the Outlet (0.284 mg/L to 0.340 mg/L) compared to the background concentration upstream of the Outlet (0.305 mg/L). The elevated total phosphorus in the Floodway Channel is not related to construction because no nutrients were applied in 2009; instead they may be in response to elevated total phosphorus concentrations flowing into the floodway from the agricultural drains. The elevated total phosphorus concentrations in the Red River downstream of the Outlet compared to the background concentration upstream of the Outlet were likely due to natural variation as the majority of the locations were within the summer baseline criteria and the concentrations downstream of construction are similar to or lower than the concentrations in the Red River upstream of the Outlet.

The total phosphorus concentrations measured in the Floodway Channel were within or lower than the baseline concentrations during the monthly monitoring representing the non-flood/frozen condition with the exception of the downstream of Grande Pointe Drain (S-13; 0.935 mg/L) location in February (Figure NM8-12). This elevated concentration was not a result of construction as there were no construction activities at the upstream end of the Floodway

Channel that would contribute to total phosphorus concentrations. Additionally, the concentration in the Floodway Channel was lower than the concentrations in the Red River such that there was no observed increase in Red River concentrations downstream of the Outlet. In January the range of total phosphorus concentrations in the Red River downstream of the Outlet (0.336 mg/L to 0.995 mg/L) were higher compared to the background condition upstream of the Outlet (0.266 mg/L). However, the elevated concentrations in the Red River are not likely the result of construction activities in the Floodway Channel as the concentration at the Outlet was 0.065 mg/L and would have resulted in dilution.

The total phosphorus concentration measured in the Red River at the Floodway Outlet during 2009 were compared to the 10th and 90th percentile range of monthly historical data collected once a month by Manitoba Water Stewardship from the Red River at Selkirk for the period of records available from 1970 to 2003. The total phosphorus concentrations measured each month during 2009, except for January, March and June monthly events were within the 10th and 90th percentile ranges (Figure NM8-13). Although one of the Red River samples collected downstream of the Outlet in March (S-32; 0.608 mg/L) and all of the downstream samples collected in June (0.515 mg/L to 0.646 mg/L) resulted in total phosphorus concentrations higher than the 90th percentile for their respective months (0.519 mg/L and 0.448 mg/L, respectively), none of the downstream concentrations were elevated above the background concentration upstream of the Outlet (0.638 mg/L (March); 0.711 (June), respectively). In January, the total phosphorus concentration measured at two locations downstream of the Outlet (S30; 0.591 mg/L and S32; 0.995 mg/L) were elevated above the historical January 90th percentile (0.515 mg/L). These elevated total phosphorus concentrations above historical concentrations in the Red River may be associated with nutrients from adjacent agricultural fields as no nutrients were applied to the Floodway Channel slopes in 2009.

The total phosphorus concentrations measured in the Manness and Domain Drains along the West Dyke ranged from 0.047 to 0.460 mg/L and 0.087 to 0.789 mg/L, respectively, during the monthly monitoring in which samples could be collected (Table NM8-2). The values measured in the Manness Drain were lower than the baseline range (0.329 to 0.710 mg/L). The values measured in the Domain Drain were generally lower than the baseline range (0.238 to 0.723 mg/L), except for the slightly elevated concentration measured during the June (0.789 mg/L) monthly monitoring. This elevated total phosphorus concentration above baseline may be associated with the higher TSS concentration measured during June and a not a result of construction activities as there were no activities in the immediate vicinity of the drain in 2009.

Event-Based Monitoring

Total phosphorus was analyzed during 3 of the 10 event-based monitoring events conducted in 2009, however all Level I event-based monitoring events were in conjunction with a monthly monitoring event and therefore were analyzed as part of the routine analysis. Therefore analyses of these results are described above in the discussion for non-flood/unfrozen conditions. There were no nutrients applied on the slopes of the Floodway Channel during the 2009 year, therefore only TSS was analyzed for all Level I event-based events that were not completed in conjunction with the monthly monitoring event.

3.2.4 Ammonia (NH3)

The water quality guidelines for ammonia vary depending on the temperature and pH concentrations of the water. For the 2009 construction monitoring program, the pH ranged from 7.29 to 8.73, which was within the CCME criteria for the protection of freshwater aquatic life (6.5 to 9.0; Table NM8-2). For the 2009 construction monitoring program the temperature ranged from 0°C to 23.3°C. The soluble ammonia (NH_3) values reported by the laboratory were converted by KGS Group into un-ionized ammonia values based on a pH temperature relationship (Table NM8-2). The un-ionized ammonia represents all the forms of ammonia in the water, with the exception of the ammonium ion (NH_4). The corresponding un-ionized ammonia CCME criteria for the protection of freshwater aquatic life is 0.019 mg/L.

Monthly Monitoring

The comparison of ammonia concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flood, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM8-14, NM8-15 and NM8-16, respectively.

The ammonia concentration measured in the Floodway Channel downstream of construction (Station 50+900; 0.091 mg/L) had a minor elevation compared to upstream of construction

KGS GROUP

(Station 11+000; 0.089 mg/L) during the spring flood condition (Figure NM8-14). However, the concentrations in the Floodway Channel were all below the spring flood baseline concentrations. Additionally, the ammonia concentrations in the Red River downstream of the Outlet (0.092 to 0.118 mg/L) were lower compared to the background concentration upstream of the Outlet (0.158 mg/L). The concentrations in the Red River were also below the baseline concentrations and resulted in un-ionized ammonia concentrations below the CCME criteria.

The ammonia concentrations measured in the Floodway Channel were generally below the range of summer baseline concentrations during the monthly monitoring representing the non-flood/unfrozen condition, with the exception of June and July (Figure NM8-15). In June the ammonia concentrations measured in the Floodway Channel locations downstream of the North Bibeau Drain (S-14; 0.737 mg/L), Spring Hill Weir (S-23; 0.304 mg/L), Dunning Weir (S-25; 0.366 mg/L), PTH Hwy 44 Weir (S-28; 0.405 mg/L) and at the downstream of construction location (Station 50+900; 0.478 mg/L) were elevated above the summer baseline criteria. These measured concentrations were more than twice the upper summer baseline range. However, of these elevated ammonia concentrations in the Floodway Channel only the ammonia concentration measured at the downstream of the North Bibeau Drain (0.031 mg/L), Spring Hill Weir (0.026 mg/L), and PTH #44 Weir (Duplicate; 0.021 mg/L) resulted in un-ionized ammonia concentrations exceeding the CCME criteria of 0.019 mg/L. These elevated concentrations and exceedance of the CCME criteria during June may be in response to elevated ammonia concentrations flowing into the Floodway Channel from the North Bibeau Drain (0.887 mg/L) and the Springfield Road Drain Drop Structure (0.332 mg/L). These drains flow into the Floodway Channel from agricultural fields in the surrounding areas. As no nutrients were applied during the 2009 season, the elevated ammonia concentrations in the Floodway Channel were not attributed to construction activities. A major increase in ammonia concentration was measured in the Red River approximately 0.5 km (S-30; 0.294 mg/L) downstream of the Outlet compared to the background concentration upstream of the Outlet (0.021 mg/L), however; all other Red River concentrations were below the background concentration upstream of the Outlet and below summer baseline concentrations. Additionally, none of the ammonia concentrations resulted in unionized ammonia exceeding the CCME criteria.

The ammonia concentrations measured in the Floodway Channel were typically within or below the range of winter baseline concentrations, with a few exceptions, during the monthly monitoring representing the non-flood/frozen condition (Figure NM8-16). The ammonia concentrations measured in the Floodway Channel at the Keewatin Weir (1.310 mg/L), Spring Hill Weir (1.600 mg/L), Dunning Weir (0.826 mg/L) and downstream of construction (Station 50+900; 0.305 mg/L) locations in January, and the Dunning Weir (0.666 mg/L) and downstream of construction (0.597 mg/L) locations in February were above the upper range for the winter baseline criteria. The elevated concentrations of ammonia in January were not attributed to construction activities as no seeding would have occurred during the winter months and no nutrients were applied during the 2009 construction season. The elevated concentrations in February, though not attributed to 2009 construction activities, may have been the result of nutrient run-off from the February 9th rain flowing over areas that were fertilized in November 2008 at the downstream end of the Floodway. Concentrations measured in the Red River downstream of the Outlet in January through March (ranges of 0.947 to 1.190 mg/L, 0.581 to 0.792 mg/L, and 0.443 to 0.712 mg/L, respectively) were higher than the background concentrations upstream of the Outlet (0.902 mg/L, 0.581 mg/L, 0.065 mg/L, respectively). There were no exceedances downstream of the Outlet compared to upstream for the Outlet for the month of December. Additionally, no ammonia concentrations measured in the Red River exceeded the CCME criteria for unionized ammonia.

The ammonia concentrations measured in the Red River at the Floodway Outlet during 2009 were compared to the 10th to 90th percentile range of monthly historical data collected once a month by Manitoba Water Stewardship from the Red River at Selkirk for the period of record available from 1970 to 2003. All of the ammonia concentrations measured each month during 2009 were within or lower than the 10th to 90th percentile ranges (Figure NM8-17).

The ammonia concentrations measured in the Manness and Domain Drains along the West Dyke ranged from <0.050 to 0.253 mg/L and <0.050 to 0.303 mg/L, respectively, during the monthly monitoring in which samples could be collected (Table NM8-2). These concentrations were within the baseline range of concentrations measured in the Manness and Domain Drains (0.050 to 1.57 mg/L and 0.070 to 2.03 mg/L, respectively). Additionally, all of the measured ammonia concentrations resulted in un-ionized ammonia concentrations below the CCME criteria.

Event-Based Monitoring

Ammonia was analyzed during 3 of the 10 event-based monitoring events conducted in 2009, however all Level I event-based monitoring events were in conjunction with a monthly monitoring event and therefore were analyzed as part of the routine analysis. Therefore analyses of these results are described above in the discussion for non-flood/unfrozen conditions. There were no nutrients applied on the slopes of the Floodway Channel during the 2009 year, therefore only TSS was analyzed for all Level I event-based events that were not completed in conjunction with the monthly monitoring event.

3.2.5 Nitrate + Nitrite-N

Monthly Monitoring

The comparison of nitrate + nitrite-N concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flood non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM8-18, NM8-19 and NM8-20, respectively.

The nitrate + nitrite-N concentrations measured in the Floodway Channel downstream of construction (Station 50+900; 0.422 mg/L) were moderately elevated compared to the upstream of construction location (Station 11+000; 0.268 mg/L) during the spring flood condition. However, the concentrations in the Floodway Channel were all below the spring flood baseline conditions. The elevated concentrations were not attributed to construction as no fertilizers were applied in the construction area. Further, the concentrations of nitrate + nitrite-N in the Red River downstream of the Outlet (0.376 mg/L to 0.423 mg/L) were lower compared to the background concentration in the Red River upstream of the Outlet (0.461mg/L; Figure NM8-18), and were well below the spring flood baseline concentrations.

The nitrate + nitrite-N concentrations measured in the Floodway Channel in June were all elevated above the range of the summer baseline criteria (Figure NM8-19). During the remaining months that represent the non-flood/unfrozen condition, the nitrate + nitrite-N concentrations measured were typically within the range of the summer baseline values with the exception of the Keewatin Weir in May (S-21; 0.989 mg/L), downstream of North Bibeau Drain in July (S-14; 1.100 mg/L) and downstream of Grande Pointe Drain in August (S-13; 0.766 mg/L). However, the nitrate + nitrite-N concentrations measured during these three months were within the range of summer baseline concentrations in the Floodway Channel at the Outlet and they were similar or lower than the concentrations in the Red River, except for June. When comparing the downstream of the Outlet locations on the Red River to the background concentration upstream of the Outlet, there were minor increases of nitrate + nitrite-N concentrations measured in July and October, and moderate increases in June. The elevated nitrate + nitrite-N concentrations in the Floodway Channel and subsequently in the Red River, are likely the result of elevated nitrate + nitrite-N concentrations in several of the drains flowing into the Floodway Channel from agricultural fields in the surrounding area and not due to construction activities as no nutrients have been applied in 2009.

The nitrate + nitrite-N concentrations were not compared to winter baseline concentrations as there are none available, however, the concentrations measured in the Floodway Channel were typically within the range of summer baseline concentrations during the monthly monitoring representing the non-flood/frozen condition (Figure NM8-20). Exceptions included the sample collected from downstream of Grande Pointe Drain (S-13; 0.923 mg/L) and the downstream of construction (Station 50+900; 0.4380 mg/L) locations in February. As well, the concentrations at the Keewatin and Springhill Weir locations (<1 mg/L) appear to be elevated above baseline concentrations in December; however this is due to laboratory error as the lab used a higher detection limit of 1 mg/L instead of the previous detection limit of 0.005 mg/L. There was no seeding with fertilizer application during the winter months that would contribute to the elevated nitrate + nitrite-N concentrations. As previously noted, the increased nutrient levels in February could be attributed to run-off from the February 9th rain event flowing over the areas that were fertilized in November 2008. The concentrations of nitrate + nitrite-N sampled from the Red River downstream of the Outlet in January through March and in December were similar or lower than the background conditions sampled upstream. Further, with the exception of the sample collected in February, the concentrations measured at the downstream of construction location (Station 50+900) in the remaining months representing the non-flood/frozen condition were lower than the concentrations measured in the Red River.

The nitrate + nitrite-N concentrations measured in the Red River at the Floodway Outlet during 2009 were compared to the 10th to 90th percentile range of monthly historical data collected once a month by Manitoba Water Stewardship from the Red River at Selkirk for the period of record available from 1970 to 2003. The nitrate + nitrite-N concentrations measured during half of the 2009 monthly monitoring were within or below the 10^{th} to 90^{th} percentile ranges (Figure NM8-21). During the January, February, June, October, November, and December monthly monitoring events, the nitrate + nitrite-N concentrations in the Red River both upstream and downstream of the Outlet were higher than their respective historical 90^{th} percentiles. The elevated nitrate + nitrite-N concentrations above historical concentrations are not a result of construction however, as the concentrations downstream of the Outlet were very similar or lower compared to the background concentrations upstream of the Outlet, with the exception of moderate elevations in January, June and October. The moderate concentration increases measured in January and October (1.020 mg/L to 1.170 mg/L and 0.817 mg/L to 1.100 mg/L, respectively) compared to the background concentrations upstream of the Outlet (1.030 mg/L and 0.951 mg/L, respectively) were not likely due to construction activities within the Floodway Channel because the nitrate + nitrite-N concentrations within the Floodway were lower than the Red River concentrations. The higher than normal precipitation in June and subsequent run-off that would have occurred may have contributed to the extent of the increased concentrations measured in the Red River samples during this month.

The nitrate + nitrite-N concentrations measured in the Manness and Domain Drains along the West Dyke ranged from <0.005 to 5.310 mg/L and 0.033 to 7.410 mg/L, respectively, during the monthly monitoring in which samples could be collected (Table NM8-2). These concentrations were generally within the baseline range of concentrations measured in the Manness and Domain Drains (0.040 to 4.650 mg/L and 0.010 to 3.910 mg/L, respectively) except for the concentration at the Manness Drain during May (5.310 mg/L) and Domain Drain during June (7.41 mg/L). The elevated concentration at the Manness Drain may be due to the wet conditions after the spring flood and the drainage of agricultural fields. The elevated concentration at the Domain Drain may be associated with the higher TSS concentration measured during June and a not a result of construction activities as there were no activities in the immediate vicinity of the drain in 2009.

Event-Based Monitoring

Nitrate + nitrite-N was analyzed during 3 of the 10 event-based monitoring events conducted in 2009, however all Level I event-based monitoring events were in conjunction with a monthly monitoring event and therefore were analyzed as part of the routine analysis. Therefore analyses of these results are described above in the discussion for non-flood/unfrozen conditions. There were no nutrients applied on the slopes of the Floodway Channel during the 2009 year, therefore only TSS was analyzed for all Level I event-based events that were not completed in conjunction with the monthly monitoring event.

3.2.6 Potassium

The comparison of potassium concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flood, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM8-22, NM8-23, and NM8-24, respectively.

All of the potassium concentrations measured in the Floodway Channel during the spring flood condition were at or below the spring flood baseline values. The potassium value measured in the Floodway Channel downstream of construction (Station 50+900; 8.45 mg/L) was slightly elevated compared to the background potassium value upstream of construction (8.18 mg/L; Station 11+000; Figure NM8-22). However, the potassium concentrations measured in the Floodway Channel were all within the spring flood baseline concentrations. Additionally, the potassium concentrations measured in the Floodway Channel were lower than the concentrations in the Red River and would have resulted in dilution, however; minor concentrations increases were observed in the Red River downstream of the Outlet (8.84 to 9.10 mg/L) compared to upstream of the Outlet (8.79 mg/L). All Red River concentrations were within spring flood baseline criteria.

With the exception of the June monthly monitoring event and several locations in May, July and August, the potassium concentrations measured in the Floodway Channel during the monthly monitoring representing the non-flood/unfrozen condition were generally lower or within the range of summer baseline criteria (Figure NM8-23). The more notable exception included the upstream of construction station, which was elevated above the site-specific baseline value for all months (5.59 mg/L to 7.87mg/L), however; was below the overall summer baseline value, except for May and August. As well, the concentration of potassium in the Floodway Channel downstream of Grande Pointe Drain (S-13) was elevated above the site-specific baseline value from May through August (5.56 mg/L to 7.30 mg/L), however was below the overall summer baseline concentration. The concentration of potassium in the Floodway Channel was elevated above the summer baseline conditions for several locations, which included the Keewatin Weir in May (8.17 mg/L), the Spring Hill Weir in July (13.10 mg/L) and the upstream of construction location in May and August (7.63 mg/L and 7.87 mg/L, respectively). Additionally, potassium concentrations in May and August at PTH Hwy 44 Weir (7.19 mg/L and 6.89 mg/L, respectively) and the downstream of construction location (Station 50+900; 7.18 mg/L and 6.88 mg/L, respectively) were slightly elevated above the site specific summer baseline values, however; were below the overall baseline value. With the exception of June, the concentration of potassium for all months at the upstream of construction location was slightly elevated compared to the downstream of construction location, therefore; the increased potassium concentrations are not likely due to construction activities within the Floodway Channel. Further, the concentrations at the downstream of construction location (Station 50+900) were lower than the background concentration upstream of the Outlet on the Red River. Additionally, the Red River samples downstream of the Outlet had concentrations of potassium that were either less than the background conditions upstream or had negligible increases, and all of the samples were within the baseline range.

The potassium concentrations were not compared to winter baseline concentrations as there are none available, however, the concentrations measured in the Floodway Channel were typically within the range of summer baseline concentrations during the monthly monitoring representing the non-flood/frozen condition, with the exception of February (Figure NM8-24). Additionally, the concentrations of potassium in the Floodway Channel in January, March, and December were lower at the downstream of construction (Station 50+900) location and did not contribute to the elevated potassium concentrations in the Red River downstream of the Outlet compared to the background concentration upstream of the Outlet. Several of the potassium concentrations measured in February were well above the upper range of the summer baseline and included the Spring Hill Weir (S-23; 10.1 mg/L), Dunning Weir (S-25; 13.3 mg/L) and downstream of construction (Station 50+900; 13.2 mg/L) locations. The elevated potassium concentration at the downstream of construction location in February may have resulted in the minor concentration increase measured in the Red River 1 km downstream of the Outlet (8.86 mg/L) compared to the background concentration upstream of the Outlet (8.43 mg/L). However, all of the Red River potassium concentrations for the remaining months had concentrations downstream of the Outlet below the background concentration upstream of the Outlet.

The potassium concentrations measured in the Red River at the Floodway Outlet during 2009 were compared to the 10th to 90th percentile range of monthly historical data collected once a month by Manitoba Water Stewardship from the Red River at Selkirk for the period of record available from 1970 to 2003. The potassium concentrations measured 1 km downstream of the Outlet during February and upstream of the Outlet during October were higher than the 90th percentile, whereas all other months during 2009 were within or lower than the 10th to 90th percentile ranges (Figure NM8-25). The slight increase in concentration of potassium at the station 1 km downstream of the Outlet was negligible and was likely the result of natural variation in the Red River and not related to construction as the remaining downstream samples were below the background concentrations for potassium.

The potassium concentrations measured in the Manness and Domain Drains along the West Dyke ranged from 11.30 to 20 mg/L and 8.05 to 23 mg/L, respectively, during the monthly monitoring in which samples could be collected (Table NM8-2). These concentrations were generally within the baseline range of concentrations measured in the Manness and Domain Drains (8.4 to 17.8 mg/L and 7.99 to 18.9 mg/L, respectively) except for the concentration at the Manness Drain during September (20 mg/L) and Domain Drain during November (23 mg/L). The elevated concentrations at the Manness and Domain Drains may be associated with the elevated specific conductivity concentrations measured during September, however, there were no construction activities during September that would cause an increased potassium concentration.

3.2.7 Sodium

The comparison of sodium concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flood, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM8-26, and NM8-27, and NM8-28.

All of the sodium concentrations measured in the Floodway Channel in April were below the spring flood baseline concentrations (Figure NM8-26). There was a slight increase between concentrations at the upstream and downstream of construction locations; however, as all of the samples were below the baseline and, the increase was not likely related to construction activities. Additionally, all Red River concentrations downstream of the Outlet (8.16 to 8.62 mg/L) were lower than the sodium concentration upstream of the Outlet (8.81 mg/L).

The sodium concentrations measured in the Floodway Channel during the monthly monitoring representing the non-flood/unfrozen condition were within the range of summer baseline values (Figure NM8-27). The concentrations of sodium at the downstream of construction location (Station 50+900) were lower than the background conditions upstream of the Outlet on the Red River and therefore would have resulted in dilution for all months. However, all Red River concentrations during October were elevated above the summer baseline concentrations, but it was unlikely due to construction activities in the Floodway Channel as all Floodway Channel concentrations were below baseline. Additionally, all the months when compared to the non-flood/unfrozen baseline conditions, generally had lower concentrations of sodium at the downstream Red River locations compared to the background concentration upstream of the Outlet.

The sodium concentrations measured in the Floodway Channel were within or below the range of the winter baseline values (70.5 to 165 mg/L) during the monthly monitoring representing the non-flood/frozen condition with the exception of three sample locations in February (Figure NM8-28). In February several locations were elevated above the winter baseline concentrations and included the Spring Hill Weir (S-23; 170 mg/L), Dunning Weir (S-25; 215 mg/L) and the downstream of construction location (Station 50+900; 247 mg/L). There were no construction activities in February that would contribute to the elevated sodium concentrations, however; the elevated concentrations may be a result of the above freezing temperatures during February 9th through 11th and in conjunction with a heavy rainfall of 26.5 mm that occurred on February 9th. This may have resulted in road salts being flushed into the Floodway Channel via the Transcona Storm Sewer that were not diluted with typical spring melt water. The elevated sodium concentrations from the Floodway Outlet may have resulted in a minor concentration increase measured in the Red River 1 km downstream of the Outlet (66.4 mg/L) compared to the background concentration upstream of the Outlet (61.4 mg/L). However, all other Red River concentrations in February were lower than the background concentration upstream of the Outlet. In January, there was also a moderate increase in the sodium concentrations in the Red River downstream of the Outlet (59.5 to 70.3 mg/L) compared to the background concentration upstream of the Outlet (56.7 mg/L). The elevated concentrations in January were not likely due to construction activities within the Floodway Channel because the sodium concentrations measured in the Floodway Channel at the Outlet (67.2 mg/L) and all other channel locations (62.4 to 81.4 mg/L) were similar compared to the Red River concentrations. Additionally, as stated above, all Floodway Channel locations were below the winter baseline values. The minor sodium concentration in the Red River has no basis for evaluation, as there is no established CCME sodium criterion for the protection of freshwater aquatic life.

The sodium concentrations measured in the Manness and Domain Drains along the West Dyke ranged from 5.50 to 166 mg/L and 2.31 to 36.8 mg/L, respectively, during the monthly monitoring in which samples could be collected (Table NM8-2). The concentrations measured in the Manness and Domain Drains were generally elevated above baseline criteria 4.79 to 76 mg/L and 2.36 to 18.2 mg/L, respectively. Elevated sodium concentrations also coincide with elevated specific conductance concentrations, however, there were no construction activities occurring adjacent to the either of the drain locations that would release sodium concentrations into the drain locations during 2009.

3.2.8 Chloride

The comparison of chloride concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flood, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM8-29, NM8-30, and NM8-31.

The chloride concentration measured downstream of construction (15.5 mg/L) was slightly elevated above the upstream of construction location (12.6 mg/L; Figure NM8-29). However, all chloride concentrations in the Floodway Channel were below spring flood baseline data. Additionally, all Red River concentrations downstream of the Outlet (13.6 to 13.9 mg/L) were lower than the Chloride concentrations upstream of the Outlet (14.2 mg/L).

The chloride concentrations measured in the Floodway Channel during the monthly monitoring representing the non-flood/unfrozen condition were within the range of summer baseline criteria (Figure NM8-30). The concentration of chloride measured downstream of construction (Station 50+900) was slightly elevated in June, August, September, October and November (13.1 mg/L, 18.5 mg/L, 25.9 mg/L, 25.8 mg/L, 25.9 mg/L, respectively) compared to the background condition upstream of construction (Station 11+000; 12.7 mg/L, 17.6 mg/L, 21.3 mg/L, 23.7 mg/L, 23.4 mg/L, respectively). Although these minor concentration increases were observed in the Floodway Channel, the concentration at the Outlet was lower than the background condition upstream of the Outlet on the Red River and therefore; the chloride concentrations did not increase concentrations downstream of the Outlet in the Red River compared to the background conditions upstream of the Outlet.

The chloride concentrations measured in the Floodway Channel downstream of construction and at the other Floodway Channel locations were all within or below the range of winter baseline values (60 to 205 mg/L) during the monthly monitoring representing the non-flood/frozen condition with the exception of three stations in February (Figure NM8-31). In February the Spring Hill Weir (S-23; 256 mg/L), Dunning Weir (S-25; 368 mg/L), and the downstream of construction location (Station 50+900; 415 mg/L) resulted in concentrations above the upper range for the winter baseline criteria. There were no construction activities that would contribute to the elevated chloride concentrations, however, as discussed earlier in reference to sodium concentrations, the elevated concentrations of chloride may be in part a result of the above freezing temperatures and rain event in early February which may have resulted in road salts being flushed into the Floodway Channel by the Transcona Storm Sewer. The elevated chloride concentrations from the Floodway Outlet may have resulted in the minor concentration increase measured in the Red River 2 km downstream of the Outlet (65 mg/L) compared to the background concentration upstream of the Outlet (63 mg/L) in February. During the months of January, March and December there were slight elevations in chloride concentrations in the Red River downstream of the Outlet compared to the background condition upstream of the Outlet, however; as noted, all of the samples collected during these months were well within or below the winter baseline values. The minor chloride concentration increase in the Red River during February has no basis for evaluation, as there is no established CCME chloride criterion for the protection of freshwater aquatic life.

The chloride concentrations measured in the Manness and Domain Drains along the West Dyke ranged from 16.7 to 760 mg/L and 9.1 to 122 mg/L, respectively, during the monthly monitoring in which samples could be collected (Table NM8-2). The concentrations measured in the Manness and Domain Drains were elevated above baseline criteria 15 to 380 mg/L and 10 to 71 mg/L, respectively, for both drain locations. Elevated chloride concentrations also coincide with elevated specific conductance concentrations, however, there were no construction activities occurring adjacent to the either of the drain locations that would release chloride concentrations into the drains during 2009.

3.2.9 Iron

During the 2009 construction monitoring there were several occurrences of iron concentrations above the CCME criteria for the protection of freshwater aquatic life (0.30 mg/L; Table NM8-2), similar to what was observed during baseline and 2005 through 2008 construction monitoring. Iron concentrations are likely influenced, in part, by the presence of high levels of suspended sediment in the samples, which contributes to the iron when the samples are acidified for analysis.

During the spring flood condition, the concentration of iron measured in the Floodway Channel was elevated above the CCME criteria at all sample locations. Further, the downstream of construction location (Station 50+900; 1.99 mg/L) was elevated above the background condition sampled upstream of construction (Station 11+000; 1.53 mg/L). Additionally, the concentration of iron in the Red River samples collected 500 m, 2 km, and 3 km downstream of the Outlet (3.06 mg/L, 3.17 mg/L, and 3.21 mg/L) were elevated above the background concentration collected upstream of the Outlet (2.77 mg/L; Table NM8-2). Concentrations of iron above the CCME criteria were also measured in most of the drains entering the Floodway. The elevated concentrations of iron are neither attributed to construction nor are they of concern, as concentrations ranging from 0.32 to 3.34 mg/L were measured during the baseline sampling for the spring flood condition.

The iron concentrations measured in the Floodway Channel varied monthly during the monitoring representing the non-flood/unfrozen condition (Table NM8-2). There were exceedances of the CCME criteria during a majority of the months representing non-flood/unfrozen condition at every station in the Floodway Channel. The average elevated iron concentration in the Floodway Channel generally was 0.41 mg/L, which was similar to the exceedances measured during the baseline monitoring (0.31 to 0.81 mg/L); however, there were a few considerable exceedances as high as of 2.20 mg/L. In June, July and November the concentrations of iron at the downstream of construction location (1.86 mg/L, 0.383 mg/L, and 0.326 mg/L, respectively) were elevated compared to the concentration at the upstream of construction location (0.971 mg/L, 0.119 mg/L, and 0.326 mg/L, respectively). These elevated concentrations are within the range of concentrations measured during the baseline monitoring in the Red River (0.31 to 1.56 mg/L).

The iron concentrations measured in the Floodway Channel were generally below the CCME criteria during the monthly monitoring representing the non-flood/frozen condition (Table NM8-2). However, elevated iron concentrations above the CCME criteria were typically measured at a couple of locations in the Floodway Channel during each month (0.32 to 0.53 mg/L). These elevated iron concentrations are again, reflective of similar exceedances measured in the Floodway Channel (0.31 to 0.81 mg/L) during baseline monitoring. There were no elevated iron concentrations above the CCME criteria measured at the downstream of construction (Station 50+900) location compared to the upstream of construction (Station 11+000) location for any of the months representing the non-flood/frozen condition.

The iron concentrations measured in the Manness and Domain Drains along the West Dyke ranged from 0.038 to 1.970 mg/L and 0.222 to 3.780 mg/L, respectively, during the monthly monitoring in which samples could be collected (Table NM8-2). These iron concentrations typically exceeded the CCME criteria (0.30 mg/L), except for those measured in the Manness Drain during May, August, October and November and the Domain Drain during October. These elevated concentrations, also exceeded the baseline range of concentrations measured in the Manness and Domain Drains (0.21 to 0.93 mg/L and 0.15 to 1.06 mg/L, respectively). There were no construction activities in the immediate vicinity of the drains during 2009 that would release iron into the drains; therefore it is likely due to natural variation.

3.2.10 Petroleum Hydrocarbons

The concentration of petroleum hydrocarbons analyzed (Benzene, Toluene, Ethyl-benzene, Xylenes (-o,-m,-p), and hydrocarbon fractions F1 to F4) were below detection limits in the Floodway Channel downstream of the construction area during each of the monthly monitoring events (Table NM8-3). The concentrations of petroleum hydrocarbons were below detection limits in the Floodway Channel upstream of construction when samples could be collected during the April (spring melt), May June, July, August, September, October and November monthly monitoring. Although there was no water upstream of the construction area to sample as a background condition during January, February, March or December the concentration of petroleum hydrocarbons analyzed downstream of construction were below detection limits, therefore petroleum hydrocarbons were not considered an issue during the monthly monitoring in 2009.

3.2.11 Bacterial

The comparison of *E.Coli* concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flood, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM8-32, MM8-33, and NM8-34, respectively. The laboratory analysis method used for Total Coliform and *E.Coli* testing was the M-coli Blue membrane filtration analysis method, which has an upper detection limit of 1500 to 2000 CFU/100 mL. Samples in which the bacteria exceed the upper limit of 2000 CFU/100 mL are identified as overgrown.

E.Coli concentrations measured in the Floodway channel were very similar to the baseline values during the monthly monitoring representing the flood condition (Figure NM8-32; Table 8-4). However, moderate concentration increases in *E.Coli* were measured downstream of construction (Station 50+900; 30 CFU/100 mL) compared to upstream of construction (Station 11+000; 10 CFU/100 mL). The slightly elevated concentrations of *E.Coli* in the Floodway Channel included downstream of Grande Point Drain (S-13; 30 CFU/100mL), downstream of North Bibeau Drain (S-14; 30 CFU/100mL), and Spring Hill Weir (S-23; 40 CFU/100mL) and were not attributed to construction as there were no construction activities that would release bacteria into the Floodway Channel. Additionally, slightly elevated concentrations in the Floodway Channel did not result in increased *E.Coli* concentrations downstream of the Outlet (<10 to 40 CFU/100 mL) compared to upstream of the Outlet (150 CFU/100 mL).

The *E.Coli* concentrations measured in the Floodway Channel varied from month to month, during the monthly monitoring representing the non-flood/unfrozen condition (Figure NM8-33). The *E.Coli* concentrations were generally within the range of the summer baseline values with the exception of June, July and August that had exceedances at site-specific sample locations, however were within the overall summer baseline criteria. During the month of September, the majority of sample locations were elevated above site-specific summer baseline criteria, however; all locations were within the overall baseline range, except for at the Dunning Weir (S-25; 870 CFU/100 mL). *E.Coli* concentrations in the Floodway Channel at the downstream of construction location (Station 50+900) were elevated when compared to the upstream of construction location (Station 11+000) in May, July, August, September and October. Further, in May, September and October there were elevated concentrations of *E.Coli* in the Red River at several sample locations downstream of the Outlet when compared to the background concentration upstream of the Outlet. However; there were no construction activities occurring in the Floodway Channel that would have resulted in the release of bacteria into the construction area; therefore the elevated concentrations are likely due to runoff from off-site.

The *E.Coli* concentrations were not compared to winter baseline concentrations as there were none available, however, the concentrations measured in the Floodway Channel were generally below the detection limit of 10 CFU/100mL or within the summer baseline concentrations (16 to 630 CFU/100 mL) during the monthly monitoring representing the non-flood/frozen condition, with a few exceptions (Figure NM8-34). During January the concentrations measured in the Floodway Channel at the Keewatin weir, Spring Hill weir, and Dunning Weir locations were all overgrown. Additionally, the concentration measured at the Dunning Weir (560 CFU/100 mL) in February was also elevated above the summer baseline range. Further, in February, March, and December there were elevations in the concentrations of *E.Coli* on the Red River at several of the sample locations downstream of the Outlet when compared to the background concentration upstream of the Outlet. The elevated *E.Coli* concentrations, however, were not attributed to construction, as there were no construction activities in the Floodway Channel that would release bacteria into the construction area.

The *E.Coli* concentrations measured in the Manness and Domain Drains along the West Dyke ranged from <10 to 110 CFU/100 mL and <10 to 660 CFU/100 mL, respectively, during the monthly monitoring in which samples could be collected (Table NM8-2). These concentrations were typically within the baseline range of concentrations measured in the Manness and Domain Drains (11 CFU/100 mL to overgrown and <10 to 650 CFU/100 mL, respectively), except for the sample obtained from the Domain Drain in July (660 mg/L). There were no construction activities occurring immediately adjacent to the Domain Drain in 2009, therefore, the elevated concentration is likely due to natural variation.

3.2.12 Herbicides

The concentration of herbicides analyzed (2,4-D, AMPA, Bromoxynil, Dicamba, Glyphosate, MCPA and Picloram) were below the laboratory analysis detection limits for the samples collected in the Floodway Channel both upstream and downstream of the revegetation area during the spring melt represented by the April monthly monitoring (Table NM8-5). There were no herbicides applied during the 2009 construction year and therefore no other herbicide monitoring was conducted beyond the spring melt condition which was sampled to assess the run-off from agricultural fields. Based on these results herbicides were not a concern during the 2009 construction year.

4.0 SUMMARY AND CONCLUSIONS

1. The 2009 construction surface water quality monitoring program was conducted from January to December 2009 in conjunction with the on-going construction activities that occurred from Station 11+200 to 50+500. This consisted of;

   a. All the Channel contracts, except C-1, C-2, C3a, C3b, C3c, C4, C5, C6a, C6b, C7a, C7b, and C8a, that were completed prior to 2009;
   b. Bridge contracts for CNR Redditt (T11), CPR Keewatin (T14), CPR Emerson (T15), P.T.H Hwy 44 Bridge (T17) and P.T.H. Hwy 15 Bridge (T18);
   c. Culvert replacement at Prairie Grove Road over the Seine River (T16)
   d. The erosion protection on the Red River (CE2)
   e. The Inlet and Outlet structures;
   f. The East Dyke earthwork contract (ED1) and;
   g. The West Dyke earthworks contracts (W12, W19, W20, W21, W22, W23, W24, W25, W26, W27, W28, W29).

2. Samples were collected from the Red River at the Inlet and Outlet, at 11 locations along the Floodway Channel including the upstream and downstream ends of the construction and revegetation zones, at 11 of the outfall drains flowing into the Floodway and at 2 drains along the West Dyke, when there was a sufficient amount of water to collect a sample.

3. At each sampling location, field data was obtained (conductivity, pH, temperature, EC and turbidity) and water samples were submitted to an accredited laboratory for testing (including inorganic parameters, turbidity, TSS and bacteria). Benzene, toluene, ethylbenzene and xylenes (BTEX) and hydrocarbon fractions F1 to F4 were also analyzed when samples could be collected at the upstream and downstream of construction locations. During the April (spring melt) monitoring laboratory analysis also included phenoxy acid herbicide screen (2,4-D, bromoxynil, dicamba, MCPA and picloram), AMPA and glyphosate, at the upstream and downstream of revegetation locations. These results were compared to the floodway baseline surface water data, based on sampling in April to August, 2005 and applicable CCME criteria.

4. There were twelve (12) monthly monitoring events, with one conducted each month following precipitation events, near the end of the month if a substantial precipitation event had not yet occurred, or at the peak flood during Red River Flood conditions. There were ten (10) Level I event-based monitoring events conducted between May and August, 2009 in response to precipitation levels greater than 10 mm.

5. Results of the 10 Level I event-based monitoring events conducted between May and August have typically indicated very small changes in TSS concentration in the Red River during the 2009 construction year. The largest increase was on July 31, which resulted in a change of 0.28 mg/L or 4.29%. This increase in TSS concentration was within the CCME criteria of an allowable increase of 25 mg/L. Nearly all the other Level I event-based monitoring measured a change of less than 1.0% and over half of these were a decrease in TSS concentration, therefore, no Level II event-based monitoring was required during the 2009 construction year.

6. During the spring flood condition in 2009, concentrations of most parameters measured in the Floodway Channel were typically below the spring flood baseline values, with the exception of *E.Coli* concentrations, which were measured throughout the Floodway Channel at concentrations at or above the spring baseline values. Within the Red River, the concentrations of these parameters were typically higher upstream of the Outlet when compared to sample locations downstream of the Outlet indicating that the input from the Floodway was not having a significant affect on the concentrations of these parameters in the Red River.

7. Within the non-flood unfrozen condition in 2009, concentrations of most parameters measured in the Floodway Channel were generally within the summer baseline concentrations. During June, several of the parameters including total phosphorus, ammonia, nitrate + nitrite-N, potassium and *E.Coli* concentrations were above summer baseline values; however, this was attributed to higher concentrations of these parameters entering the Floodway Channel via drains from run-off by agricultural fields. *E.Coli* concentrations were typically below or within baseline criteria, however, concentrations were elevated above criteria in the Floodway Channel for July and September. There were no construction activities occurring in the Floodway Channel that would release bacteria into the construction area, therefore the elevated concentrations are likely due to runoff from off-site. Iron concentrations were typically elevated above the CCME criteria, however these elevated concentrations are not a concern as elevated concentrations above CCME criteria were noted during baseline sampling in 2005. With the exception of samples collected in June, for many of the parameters measured with elevated concentrations within the Floodway Channel, the concentrations downstream of construction within the channel were typically lower than background conditions in the Red River. Therefore, the elevated concentrations in the Floodway Channel would have no effect on concentrations in the Red River or result in dilution if anything.

8. During the non-flood unfrozen condition monthly monitoring events, parameter concentrations measured in the Red River downstream of the Outlet were typically similar to the background concentrations upstream of the Outlet, ranging from slightly lower to slightly higher, although elevated concentrations downstream were measured for TSS, ammonia, total phosphorus, nitrate + nitrite-N, and *E.Coli* concentrations. The TSS concentration increases measured in the Red River downstream of the Outlet were all less than the CCME criteria of an allowable increase of 25 mg/L and therefore are within criteria. The TSS concentrations were likely the result of natural variation, as concentrations at the Outlet were lower than concentrations in the Red River and would have resulted in dilution if anything. As no nutrients were added during the 2009 construction season, the elevated concentrations of ammonia, total phosphorus and nitrate + nitrite-N were not related to construction activities. Elevated concentrations of *E.Coli* downstream of the Outlet compared to background concentration upstream of the Outlet were measured during May, September, October and November, however; were not attributed to construction activities, nor were they a concern as concentrations were typically within the range measured during baseline monitoring.

9. Concentrations of most parameters measured in the Floodway Channel were within the winter baseline concentrations (or the summer baseline if there was no winter baseline) with the exception of a few locations sampled in February where the concentration of several parameters (specific conductance, ammonia, sodium, chloride, and *E.Coli*) were

elevated above baseline criteria. The elevations of parameter concentrations in February were likely influenced by a rain event carrying nutrients and road salts in the surface water run-off entering the Floodway Channel from agricultural drains and storm sewers. A few exceedances were recorded for concentrations of ammonia and *E.Coli* in January, however; the elevated concentrations of ammonia were not attributed to construction activities as no seeding would have occurred during the winter months and no nutrients were applied during the 2009 construction season. Further, the elevated ammonia concentrations did not result in an exceedance of the CCME un-ionized ammonia criteria. The elevated concentrations of *E.Coli* were not attributed to construction, as there were no construction activities that would release bacteria into the construction area. Further, there is no basis for an evaluation of *E.Coli*, as there are no applicable CCME criteria.

10. Parameter concentrations measured in the Red River downstream of the Outlet during the non-flood frozen condition were typically similar to or lower than the background concentrations upstream of the Outlet ranging from slightly lower to slightly higher. However, concentrations on the Red River approximately 2 km downstream of the Outlet resulted in elevated concentrations for several parameters (TSS, total phosphorus, chloride and *E.Coli*) compared to the background concentrations upstream of the Outlet. These elevations are likely due to natural variation as the Red River is ice-covered and the concentrations in the Floodway Channel at the Outlet are lower than the concentrations in the Red River. Concentrations of ammonia measured in the Red River downstream of the Outlet were elevated above the background concentration upstream of the Outlet, however, none of the ammonia concentrations in the Red River exceeded the CCME criteria for unionized ammonia. During the majority of the monthly monitoring events the concentrations at the downstream of construction location were lower than the background concentration upstream of the Outlet, and therefore would have resulted in dilution if anything.

11. Concentrations of most parameters measured in the Manness and Domain Drains along the West Dyke were elevated above the baseline concentrations during the monthly monitoring events that samples could be collected. Parameters that were within the baseline criteria included TSS and ammonia. All other parameters had at least one concentration elevated above baseline criteria for either the Manness or Domain Drains. Although construction activities were occurring adjacent to the Manness Drain in June and July 2009, the work consisted of rip rap application that was completed in August 2009. There were no construction activities that were occurring immediately adjacent to the Domain Drain in 2009, therefore elevated concentrations in the Manness and Domain Drains in 2009 were likely the result of natural variation.

5.0 RECOMMENDATIONS

Based on the results of the 2009 Construction monitoring events, recommendations and refinements for the ongoing monitoring should include the following;

- The 2010 Surface Water Sampling Program should consist of Event-based monitoring focusing on contract specific construction monitoring and assessing the surface water quality as it relates to potential groundwater impacts. In addition to conducting the Level I and II Rain and Spill Event-based monitoring as previously conducted, Event-based monitoring during 2010 should also be conducted in response to elevated water levels in the floodway channel when there is the greatest potential for surface water to affect the groundwater quality (Floodway Flow). This Floodway Flow Event-based monitoring should be conducted when the water level in the Floodway overtops the Low Flow Channel either from elevated Red River water levels (spring or summer flooding) or prolonged precipitation events.

- The Event-based monitoring should replace the regular Monthly monitoring, however, during the unfrozen conditions, typically from April to October, if there is no event-based monitoring triggered during a month then at a minimum samples should be collected in the Floodway Channel upstream and downstream of the overall construction area.

- To assess contract specific effects during the Event-based monitoring new sample locations should be established in the La Salle River upstream and downstream of where the new Glenlea Drain discharges and in the Seine River upstream and downstream of the new culvert on Prairie Grove road. Additionally, during the Level I Event-based monitoring samples should be collected from the Floodway Channel upstream and downstream of each contract area. Whereas, the sample locations in the Manness and Domain Drains adjacent the West Dyke are no longer required during 2010 as the construction activities in the vicinity of these locations was completed in 2009.

- The rain Event-based monitoring in 2010 should continue to follow the protocol used in 2009 with the additional sample locations noted above to identify contract specific effects. To assess potential effects of surface water on groundwater quality, samples collected during the rain Event-based monitoring should also be submitted for laboratory analysis of pH and conductivity. This revised protocol should be reviewed again during the 2010 monitoring program and revised if required as construction contracts near completion.

- With the introduction of the Nutrient Management Regulation (62/2008) no fertilizers have been applied to the Floodway Channel slopes since 2008. Therefore fewer nutrient parameters should be submitted for laboratory analysis and less frequently than previously.

- The reporting protocol for the 2010 surface water monitoring program should continue to follow the slight modifications made in 2008 to flag potential increases in TSS concentrations more rapidly. This included completing a Level I event-based worksheet for each of the monitoring events to provide an indication as to whether the sediment concentration in the Floodway will have a potential impact on the Red River downstream of the Floodway Outlet. If the worksheet indicates no potential impact then the results would be reported in the monthly monitoring report, whereas, if a potential impact is identified then MFA would be notified immediately and the laboratory would be contacted to request the TSS analysis results as soon as possible. Appropriate measures would then be developed with MFA based on the TSS laboratory results.

6.0 REFERENCES

1. TetrES Consultants Inc. / Intergroup Consultants Ltd. 2004. Proposed Floodway Expansion Project, Environmental Assessment, Environmental Impact Statement, Volumes 1 to 4. Submitted by the Manitoba Floodway Authority.

2. Gartner Lee Limited and Falk Environmental Inc. 2005. Screening Report – Red River Floodway Expansion Project. Prepared for Infrastructure Canada.

3. KGS Group. 2005. Red River Floodway Expansion Baseline Surface Water Monitoring, Final Report.

4. KGS Group. April 2005. February 2005 Pilot Channel Baseflow Program. Memorandum 05-1100-01.19.12.07.

5. U.S. Environmental Protection Agency (EPA), Office of Water Quality. November, 1997. Monitoring Water Quality, Chapter 5 Water Quality Conditions (EPA 841-B-97-003).

6. Province of Manitoba, Manitoba Water Stewardship. 2009. Water Information – Flood Forecasting Reports, Weekly River Flow Report Red River near Selkirk http://www.gov.mb.ca/waterstewardship/water_info/flood_forecasting/index.html.

7. Environment Canada. 2005. The Green Lane, Weather Office, Climate Data. http://www.climate.weatheroffice.ec.gc.ca/climateData/canada_e.html

8. Environment Canada. 2001. Canadian Climate Normals 1971 – 2000, Winnipeg Manitoba. http://www.climate.weatheroffice.ec.gc.ca/climate_normals/index_e.html

9. Atmospheric Environment Service. 1990. Rainfall Intensity - Duration Frequency Values, Table 2 – Winnipeg Int'l Airport, Manitoba

TABLES

TABLE NM8-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
Monthly							
CON D/S	Floodway Channel - Station 50+900	29-Jan-09	7.98	202	-1.5	105.0	
		19-Feb-09	7.76	444	-1.0	12.53	
		5-Mar-09	7.50	1183	0.3	10.55	
		20-Apr-09	7.90	376	6.5	170.2	
		26-May-09	7.85	588	14.1	39.00	
		29-Jun-09	7.23	357	16.0	145.0	
		15-Jul-09	7.32	491	17.2	102.5	
		25-Aug-09	7.50	454	18.3	23.97	
		29-Sep-09	6.55	629	10.8	35.63	
		28-Oct-09	7.60	719	6.2	13.40	
		23-Nov-09	7.00	344	3.5	25.36	
		16-Dec-09	7.09	856	0.6	7.580	
CON U/S	Floodway Channel - Station 11+000	29-Jan-09	-	-	-	-	CNM - Frozen
		20-Feb-09	-	-	-	-	CNM - Frozen
		4-Mar-09	-	-	-	-	CNM - Frozen
		20-Apr-09	7.32	448	6.2	102.3	
		26-May-09	7.21	472	17.5	82.99	
		29-Jun-09	7.32	269	17.5	196.7	
		15-Jul-09	8.17	556	16.8	10.15	
		25-Aug-09	7.17	461	18.9	5.66	
		28-Oct-09	8.24	554	8.4	7.24	
		23-Nov-09	7.59	658	3.2	4.65	
		17-Dec-09	-	-	-	-	CNM - Frozen
VEG D/S	Floodway Channel - Station 50+900	29-Jan-09	7.98	202	-1.5	105.0	
		19-Feb-09	7.76	444	-1.0	12.53	
		5-Mar-09	7.50	1183	0.3	10.55	
		20-Apr-09	7.90	376	6.5	170.2	
		26-May-09	7.85	588	14.1	39.00	
		29-Jun-09	7.23	357	16.0	145.0	
		15-Jul-09	7.32	491	17.2	102.5	
		25-Aug-09	7.50	454	18.3	23.97	
		29-Sep-09	6.55	629	10.8	35.63	
		28-Oct-09	7.60	719	6.2	13.40	
		23-Nov-09	7.00	344	3.5	25.36	
		16-Dec-09	7.09	856	0.6	7.58	

TABLE NM8-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
VEG U/S	Floodway Channel - Station 11+000	29-Jan-09	-	-	-	-	CNM - Frozen
		20-Feb-09	-	-	-	-	CNM - Frozen
		4-Mar-09	-	-	-	-	CNM - Frozen
		20-Apr-09	7.32	448	6.2	102.3	
		26-May-09	7.21	472	17.5	82.99	
		29-Jun-09	7.32	269	17.5	196.7	
		15-Jul-09	8.17	556	16.8	10.15	
		25-Aug-09	7.17	461	18.9	5.66	
		29-Sep-09	7.03	526	10.4	13.03	
		28-Oct-09	8.24	554	8.4	7.24	
		23-Nov-09	7.59	658	3.2	4.65	
		17-Dec-09	-	-	-	-	CNM - Frozen
S-01	Red River - Upstream of Inlet	28-Jan-09	-	-	-	-	CNM - No River Water Diverted
		20-Feb-09	-	-	-	-	CNM - No River Water Diverted
		4-Mar-09	-	-	-	-	CNM - No River Water Diverted
		20-Apr-09	7.04	414	5.4	107.1	25 m north from actual site off Turnbull Dr. (due to flooding)
		26-May-09	-	-	-	-	CNM - No River Water Diverted
		29-Jun-09	-	-	-	-	CNM - No River Water Diverted
		15-Jul-09	-	-	-	-	CNM - No River Water Diverted
		25-Aug-09	-	-	-	-	CNM - No River Water Diverted
		29-Sep-09	-	-	-	-	CNM - No River Water Diverted
		28-Oct-09	-	-	-	-	CNM - No River Water Diverted
		23-Nov-09	-	-	-	-	CNM - No River Water Diverted
		16-Dec-09	-	-	-	-	CNM - No River Water Diverted
S-02	Red River - Upstream of Inlet (replicate of 1)	28-Jan-09	-	-	-	-	CNM - No River Water Diverted
		20-Feb-09	-	-	-	-	CNM - No River Water Diverted
		4-Mar-09	-	-	-	-	CNM - No River Water Diverted
		20-Apr-09	7.47	400	5.4	104.1	
		26-May-09	-	-	-	-	CNM - No River Water Diverted
		29-Jun-09	-	-	-	-	CNM - No River Water Diverted
		15-Jul-09	-	-	-	-	CNM - No River Water Diverted
		25-Aug-09	-	-	-	-	CNM - No River Water Diverted
		29-Sep-09	-	-	-	-	CNM - No River Water Diverted
		28-Oct-09	-	-	-	-	CNM - No River Water Diverted
		23-Nov-09	-	-	-	-	CNM - No River Water Diverted
		16-Dec-09	-	-	-	-	CNM - No River Water Diverted
S-03	Red River - Upstream of Inlet (replicate of 1)	28-Jan-09	-	-	-	-	CNM - No River Water Diverted
		20-Feb-09	-	-	-	-	CNM - No River Water Diverted

TABLE NM8-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
S-03	Red River - Upstream of Inlet (replicate of 1)	4-Mar-09	-	-	-	-	CNM - No River Water Diverted
		20-Apr-09	7.58	395	6.1	100.2	
		26-May-09	-	-	-	-	CNM - No River Water Diverted
		29-Jun-09	-	-	-	-	CNM - No River Water Diverted
		15-Jul-09	-	-	-	-	CNM - No River Water Diverted
		25-Aug-09	-	-	-	-	CNM - No River Water Diverted
		29-Sep-09	-	-	-	-	CNM - No River Water Diverted
		28-Oct-09	-	-	-	-	CNM - No River Water Diverted
		23-Nov-09	-	-	-	-	CNM - No River Water Diverted
		16-Dec-09	-	-	-	-	CNM - No River Water Diverted
S-04	Floodway Channel - Downstream of Inlet	28-Jan-09	-	-	-	-	CNM - No River Water Diverted
		20-Feb-09	-	-	-	-	CNM - No River Water Diverted
		4-Mar-09	-	-	-	-	CNM - No River Water Diverted
		20-Apr-09	7.24	397	6.4	76.90	
		26-May-09	-	-	-	-	CNM - No River Water Diverted
		29-Jun-09	-	-	-	-	CNM - No River Water Diverted
		15-Jul-09	-	-	-	-	CNM - No River Water Diverted
		25-Aug-09	-	-	-	-	CNM - No River Water Diverted
		29-Sep-09	-	-	-	-	CNM - No River Water Diverted
		28-Oct-09	-	-	-	-	CNM - No River Water Diverted
		23-Nov-09	-	-	-	-	CNM - No River Water Diverted
		16-Dec-09	-	-	-	-	CNM - No River Water Diverted
S-05	Seine River Syphon Overflow	28-Jan-09	-	-	-	-	CNM - Frozen
U/S	- Upstream of Perimeter Ditches	28-Jan-09	-	-	-	-	CNM - Frozen
		20-Feb-09	-	-	-	-	CNM - Frozen
U/S		20-Feb-09	-	-	-	-	CNM - Frozen
		4-Mar-09	-	-	-	-	CNM - Frozen
U/S		4-Mar-09	-	-	-	-	CNM - Frozen
		20-Apr-09	6.96	330	6.2	68.05	
U/S		20-Apr-09	6.92	289	5.9	19.35	
		26-May-09	7.41	425	15.6	48.09	
U/S		26-May-09	7.51	390	15.9	32.05	
		29-Jun-09	7.19	272	15.8	197.9	
U/S		29-Jun-09	7.10	256	17.0	209.6	
		15-Jul-09	7.55	506	16.8	40.70	
U/S		15-Jul-09	7.74	502	17.0	55.00	
		25-Aug-09	7.19	512	17.9	71.72	
U/S		25-Aug-09	7.27	448	17.6	72.84	
		29-Sep-09	7.11	496	10.2	29.32	
U/S		29-Sep-09	7.12	526	10.3	30.04	
		28-Oct-09	-	-	-	-	CNM - Under Construction
U/S		28-Oct-09	-	-	-	-	CNM - Under Construction

TABLE NM8-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
S-05	Seine River Syphon Overflow	23-Nov-09	-	-	-	-	CNM - No Flow
U/S	- Upstream of Perimeter Ditches	23-Nov-09	-	-	-	-	CNM - No Flow
		17-Dec-09	-	-	-	-	CNM - Under Construction
U/S		17-Dec-09	-	-	-	-	CNM - Under Construction
S-06	Grande Pointe Diversion Drop Structure	28-Jan-09	-	-	-	-	CNM - Frozen
		20-Feb-09	-	-	-	-	CNM - Frozen
		4-Mar-09	-	-	-	-	CNM - Frozen
		20-Apr-09	7.39	369	6.3	50.96	
		26-May-09	7.46	592	18.2	12.50	
		29-Jun-09	6.97	270	17.6	152.1	
		15-Jul-09	7.57	558	17.5	10.67	
		25-Aug-09	7.27	522	19.5	45.33	
		29-Sep-09	7.40	643	10.6	23.91	
		28-Oct-09	8.11	653	6.2	11.82	
		23-Nov-09	7.73	724	2.1	16.68	
		17-Dec-09	-	-	-	-	CNM - Frozen
S-07	Centreline Drop Structure	28-Jan-09	-	-	-	-	CNM - Frozen
		20-Feb-09	-	-	-	-	CNM - Frozen
		4-Mar-09	-	-	-	-	CNM - Frozen
		20-Apr-09	7.46	324	7.5	27.78	
		26-May-09	7.45	660	19.2	8.72	
		29-Jun-09	7.11	217	18.4	158.3	
		15-Jul-09	7.67	584	16.2	30.72	
		25-Aug-09	7.32	440	20.6	20.56	
		29-Sep-09	8.44	1937	10.6	45.43	
		28-Oct-09	8.45	1491	7.2	6.55	
		23-Nov-09	7.50	1524	4.2	4.41	
		17-Dec-09	-	-	-	-	CNM - Frozen
S-08	Deacon Reservoir Drain	28-Jan-09	-	-	-	-	CNM - No Flow
		20-Feb-09	-	-	-	-	CNM - No Flow
		4-Mar-09	-	-	-	-	CNM - No Flow
		20-Apr-09	-	-	-	-	CNM - No Flow
		26-May-09	-	-	-	-	CNM - No Flow
		29-Jun-09	-	-	-	-	CNM - No Flow
		15-Jul-09	-	-	-	-	CNM - No Flow
		25-Aug-09	-	-	-	-	CNM - No Flow
		29-Sep-09	-	-	-	-	CNM - No Flow
		28-Oct-09	-	-	-	-	CNM - No Flow
		23-Nov-09	-	-	-	-	CNM - No Flow
		17-Dec-09	-	-	-	-	CNM - Frozen
S-09	Cooks Creek Diversion Drop Structure	28-Jan-09	-	-	-	-	CNM - Frozen
U/S	- Upstream of Perimeter Ditches	28-Jan-09	-	-	-	-	CNM - Frozen
		20-Feb-09	-	-	-	-	CNM - Frozen

TABLE NM8-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
U/S	- Upstream of Perimeter Ditches	20-Feb-09	-	-	-	-	CNM - Frozen
S-09	Cooks Creek Diversion Drop Structure	4-Mar-09	-	-	-	-	CNM - Frozen
U/S		4-Mar-09	-	-	-	-	CNM - Frozen
		20-Apr-09	7.78	367	7.7	99.90	
U/S		20-Apr-09	7.50	370	7.1	91.55	
		26-May-09	7.82	367	20.8	22.88	
U/S		26-May-09	7.83	369	17.2	20.96	
		29-Jun-09	7.30	345	20.3	106.6	
U/S		29-Jun-09	7.35	345	19.2	85.14	
		15-Jul-09	8.01	516	16.4	18.05	
U/S		15-Jul-09	7.84	500	16.0	16.43	
		25-Aug-09	7.45	626	20.7	55.70	
U/S		25-Aug-09	7.52	615	19.3	51.09	
		29-Sep-09	8.52	976	10.1	26.42	
U/S		29-Sep-09	8.73	956	10.3	30.64	
		28-Oct-09	8.86	2530	7.3	18.07	
U/S		28-Oct-09	8.90	2630	6.3	14.05	
		23-Nov-09	7.22	3498	3.6	18.72	
U/S		23-Nov-09	7.35	3335	3.3	27.21	
		17-Dec-09	-	-	-	-	CNM - Frozen
U/S		17-Dec-09	-	-	-	-	CNM - Frozen
S-10	North Bibeau Drain Drop Structure	28-Jan-09	-	-	-	-	CNM - Frozen
		20-Feb-09	-	-	-	-	CNM - Frozen
		4-Mar-09	-	-	-	-	CNM - Frozen
		20-Apr-09	7.71	404	9.4	9.77	
		26-May-09	7.71	1276	22.9	2.07	
		29-Jun-09	7.04	279	20.1	117.8	
		15-Jul-09	8.08	875	16.5	13.61	
		25-Aug-09	8.06	1027	21.4	8.83	
U/S	- Upstream of Perimeter Ditches	25-Aug-09	7.33	758	18.7	9.27	
		29-Sep-09	-	-	-	-	CNM - No Flow
U/S		29-Sep-09	-	-	-	-	CNM - No Flow
		28-Oct-09	-	-	-	-	CNM - No Flow
U/S		28-Oct-09	-	-	-	-	CNM - No Flow
		23-Nov-09	-	-	-	-	CNM - No Flow
U/S		23-Nov-09	-	-	-	-	CNM - No Flow
		17-Dec-09	-	-	-	-	CNM - Frozen
U/S		17-Dec-09	-	-	-	-	CNM - Frozen
S-11	Country Villa Estates Drain	29-Jan-09	-	-	-	-	CNM - No Flow
		19-Feb-09	-	-	-	-	CNM - No Flow
		4-Mar-09	-	-	-	-	CNM - Frozen
		20-Apr-09	8.00	546	10.3	1.42	
		26-May-09	8.27	1004	21.1	3.23	

TABLE NM8-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
S-11	Country Villa Estates Drain	29-Jun-09	7.64	451	23.1	21.91	
		15-Jul-09	7.77	567	16.2	16.03	
		25-Aug-09	7.07	547	20.4	3.76	
		29-Sep-09	-	-	-	-	CNM - No Flow
		28-Oct-09	-	-	-	-	CNM - No Flow
		23-Nov-09	-	-	-	-	CNM - No Flow
		17-Dec-09	-	-	-	-	CNM - Frozen
S-12	Kildare Trunk-Transcona Storm Sewer Outlet	29-Jan-09	-	-	-	-	CNM - Frozen
		20-Feb-09	-	-	-	-	CNM - Frozen
		4-Mar-09	-	-	-	-	CNM - Frozen
		20-Apr-09	-	-	-	-	CNM - Outlet Inundated
		26-May-09	-	-	-	-	CNM - Outlet Inundated
		29-Jun-09	-	-	-	-	CNM - Outlet Inundated
		15-Jul-09	-	-	-	-	CNM - Outlet Inundated
		25-Aug-09	-	-	-	-	CNM - Outlet Inundated
		29-Sep-09	-	-	-	-	CNM - Outlet Inundated
		28-Oct-09	-	-	-	-	CNM - No Flow
		23-Nov-09	-	-	-	-	CNM - No Flow
		17-Dec-09	-	-	-	-	CNM - Frozen
S-13	Floodway Channel - D/S of Grande Pointe Drain	28-Jan-09	-	-	-	-	CNM - Frozen
		20-Feb-09	7.80	763	0.2	17.06	
		4-Mar-09	7.40	621	0.1	12.98	
		20-Apr-09	7.45	372	6.2	93.61	
		26-May-09	7.58	431	18.7	75.96	
		29-Jun-09	7.20	263	18.0	125.5	
		15-Jul-09	7.87	487	17.2	26.50	
		25-Aug-09	7.51	506	19.3	53.48	
		29-Sep-09	7.17	523	10.2	41.06	
		28-Oct-09	8.17	649	6.8	15.94	
		23-Nov-09	7.53	678	2.5	19.30	
		17-Dec-09	6.44	920	1.0	11.35	
S-14	Floodway Channel - D/S of North Bibeau Drain	28-Jan-09	6.77	1134	0.0	11.99	
		20-Feb-09	7.80	482	0.6	7.61	
		4-Mar-09	8.13	891	0.2	35.36	
		20-Apr-09	7.68	368	7.8	257.7	
		26-May-09	8.06	504	20.3	94.56	
		29-Jun-09	7.61	289	19.9	133.3	
		15-Jul-09	7.87	478	17.4	28.19	
		25-Aug-09	8.09	496	20.5	29.72	
		29-Sep-09	8.19	589	11.5	44.07	
		28-Oct-09	8.52	678	7.8	28.36	
		23-Nov-09	7.71	449	4.0	5.54	
		17-Dec-09	7.19	819	0.7	10.50	

TABLE NM8-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
S-21	Floodway Channel - Keewatin Weir	28-Jan-09	6.78	1052	-0.1	5.65	
		20-Feb-09	8.00	629	2.9	0.83	
		4-Mar-09	8.11	598	0.9	2.61	
		20-Apr-09	7.80	384	8.8	137.7	
		26-May-09	7.73	483	21.8	60.92	
		29-Jun-09	8.00	416	22.0	52.87	
		15-Jul-09	7.98	511	16.3	23.5	
		25-Aug-09	7.22	500	21.4	10.87	
		29-Sep-09	8.46	692	11.8	42.47	
		28-Oct-09	7.72	733	6.0	27.04	
		23-Nov-09	7.97	588	3.3	7.96	
		17-Dec-09	8.32	1206	-0.1	10.11	
S-22	Springfield Road Drain Drop Structure	28-Jan-09	-	-	-	-	CNM - Frozen
U/S	- Upstream of Perimeter Ditches	28-Jan-09	-	-	-	-	CNM - Frozen
		20-Feb-09	-	-	-	-	CNM - Frozen
U/S		20-Feb-09	-	-	-	-	CNM - Frozen
		4-Mar-09	-	-	-	-	CNM - Frozen
U/S		4-Mar-09	-	-	-	-	CNM - Frozen
		20-Apr-09	8.00	434	8.6	6.54	
U/S		20-Apr-09	8.10	557	9.5	2.22	
		26-May-09	7.93	635	21.6	4.44	
U/S		26-May-09	7.99	682	21.6	1.33	
		29-Jun-09	7.31	432	19.8	16.78	
U/S		29-Jun-09	7.32	505	17.8	4.94	
		15-Jul-09	7.75	659	16.2	7.24	
U/S		15-Jul-09	7.85	846	15.7	2.99	
		25-Aug-09	7.78	679	20.3	2.09	
U/S		25-Aug-09	7.83	587	21.7	8.19	
		29-Sep-09	8.35	837	10.4	6.86	
U/S		29-Sep-09	-	-	-	-	CNM - No Flow
		28-Oct-09	7.91	891	7.0	6.52	
U/S		28-Oct-09	7.77	904	6.5	8.93	
		23-Nov-09	7.16	956	1.3	7.22	
U/S		23-Nov-09	6.94	852	1.3	15.84	
		17-Dec-09	-	-	-	-	CNM - Frozen
U/S		17-Dec-09	-	-	-	-	CNM - Frozen
S-23	Floodway Channel - Spring Hill Weir	28-Jan-09	6.53	1375	-1.2	8.49	
		19-Feb-09	7.21	513	-1.0	17.66	
		4-Mar-09	8.01	1183	0.1	33.97	
		20-Apr-09	7.80	366	7.6	126.8	
		26-May-09	7.78	462	20.4	50.69	
		29-Jun-09	7.69	430	19.8	15.20	
		15-Jul-09	6.99	465	15.8	27.10	

TABLE NM8-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
S-23	Floodway Channel - Spring Hill Weir	25-Aug-09	7.64	532	22.1	5.06	
		29-Sep-09	7.23	657	12.6	38.98	
		28-Oct-09	7.76	718	6.6	24.40	
		23-Nov-09	6.62	334	1.9	39.91	
		17-Dec-09	8.74	997	0.0	5.95	
S-25	Floodway Channel - Dunning Weir	28-Jan-09	6.75	1263	-0.3	9.98	
		19-Feb-09	7.52	168	-1.2	17.34	
		4-Mar-09	8.02	1202	0.1	22.75	
		20-Apr-09	7.90	369	7.1	133.2	
		26-May-09	8.04	589	16.6	54.63	
		29-Jun-09	7.25	331	17.3	220.8	
		15-Jul-09	7.23	468	16.6	69.05	
		25-Aug-09	7.66	449	20.5	21.86	
		29-Sep-09	6.89	605	11.6	54.38	
		28-Oct-09	7.42	722	5.3	25.79	
		23-Nov-09	6.78	319	2.6	27.44	
		16-Dec-09	7.61	850	-1.3	8.08	
S-26	Skholny Drain Drop Structure	28-Jan-09	-	-	-	-	CNM - Frozen
U/S	- Upstream of Perimeter Ditches	28-Jan-09	-	-	-	-	CNM - Frozen
		19-Feb-09	-	-	-	-	CNM - Frozen
U/S		19-Feb-09	-	-	-	-	CNM - Frozen
		4-Mar-09	-	-	-	-	CNM - Frozen
U/S		4-Mar-09	-	-	-	-	CNM - Frozen
		20-Apr-09	8.00	610	6.4	5.47	
U/S		20-Apr-09	7.80	517	5.7	3.89	
		26-May-09	8.01	674	16.2	1.51	
U/S		26-May-09	8.31	731	17.3	3.21	
		29-Jun-09	7.55	542	17.3	6.30	
U/S		29-Jun-09	7.19	478	16.8	3.71	
		15-Jul-09	7.24	668	15.7	15.06	
U/S		15-Jul-09	7.03	578	15.6	6.47	
		25-Aug-09	7.91	757	21.6	340.0	
U/S		25-Aug-09	7.54	615	18.9	2.12	
		29-Sep-09	6.47	421	10.9	8.81	
U/S		29-Sep-09	6.65	413	11.0	6.94	
		28-Oct-09	7.51	537	5.8	6.97	
U/S		28-Oct-09	7.66	535	5.8	9.75	
		23-Nov-09	7.45	475	2.3	13.01	
U/S		23-Nov-09	7.26	473	2.5	6.18	
		16-Dec-09	-	-	-	-	CNM - Frozen
U/S		16-Dec-09	-	-	-	-	CNM - Frozen
S-27	Ashfield Drain Drop Structure	28-Jan-09	-	-	-	-	CNM - Frozen
U/S	- Upstream of Perimeter Ditches	28-Jan-09	-	-	-	-	CNM - Frozen

TABLE NM8-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
S-27	Ashfield Drain Drop Structure	19-Feb-09	-	-	-	-	CNM - Frozen
U/S	- Upstream of Perimeter Ditches	19-Feb-09	-	-	-	-	CNM - Frozen
		5-Mar-09	-	-	-	-	CNM - Frozen
U/S		5-Mar-09	-	-	-	-	CNM - Frozen
		20-Apr-09	8.00	533	6.2	26.80	
U/S		20-Apr-09	8.00	502	5.6	7.08	
		26-May-09	8.25	678	18.7	29.52	
U/S		26-May-09	8.18	689	17.3	3.09	
		29-Jun-09	7.25	545	19.6	39.66	
U/S		29-Jun-09	7.29	549	17.8	14.38	
		15-Jul-09	7.38	527	16.7	64.66	
U/S		15-Jul-09	7.02	564	16.6	14.02	
		25-Aug-09	7.71	888	20.7	8.26	
U/S		25-Aug-09	7.38	884	17.5	3.07	
		29-Sep-09	-	-	-	-	CNM - No Flow
U/S		29-Sep-09	-	-	-	-	CNM - No Flow
		28-Oct-09	8.09	1555	6.7	5.06	
U/S		28-Oct-09	7.43	1706	5.8	2.79	
		23-Nov-09	7.29	1374	1.2	3.70	
U/S		23-Nov-09	-	-	-	-	CNM - No Flow
		16-Dec-09	-	-	-	-	CNM - Frozen
U/S		16-Dec-09	-	-	-	-	CNM - Frozen
S-28	Floodway Channel - PTH #44 Weir	29-Jan-09	-	-	-	-	CNM - Frozen
		19-Feb-09	-	-	-	-	CNM - Frozen
		5-Mar-09	-	-	-	-	CNM - Frozen
		20-Apr-09	7.90	375	8.6	178.2	
		26-May-09	7.90	593	14.8	96.83	
		29-Jun-09	7.29	428	16.7	107.1	
		15-Jul-09	7.55	501	17.6	50.51	
		25-Aug-09	7.21	460	18.2	9.56	
		29-Sep-09	6.98	636	10.7	35.84	
		28-Oct-09	7.66	723	6.0	15.06	
		23-Nov-09	6.86	303	3.0	25.48	
		16-Dec-09	7.00	848	-1.1	7.07	
S-30	Red River - Downstream of Outlet (500 m)	29-Jan-09	8.26	1022	-1.3	218.6	
		19-Feb-09	7.60	1091	-1.0	15.00	
		5-Mar-09	7.28	931	0.1	18.32	
		20-Apr-09	7.90	368	6.8	177.8	
		26-May-09	7.69	617	13.5	73.61	
		29-Jun-09	7.18	368	15.6	119.9	
		15-Jul-09	7.42	609	17.6	72.55	
		25-Aug-09	7.22	478	18.0	21.36	
		29-Sep-09	7.52	811	13.4	32.49	

TABLE NM8-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
S-30	Red River - Downstream of Outlet (500 m)	28-Oct-09	7.09	929	6.0	31.73	
		23-Nov-09	6.52	725	2.4	46.54	
		16-Dec-09	8.45	701	-1.3	9.52	
S-31	Red River - Downstream of Outlet (1000 m)	27-Jan-09	8.05	287	-1.4	67.83	
		19-Feb-09	7.15	1141	-1.3	19.72	
		5-Mar-09	6.99	983	0.6	31.32	
		20-Apr-09	7.90	367	6.9	149.3	
		26-May-09	7.67	620	13.8	90.46	
		29-Jun-09	7.21	384	15.9	146.6	
		15-Jul-09	7.75	640	17.9	64.22	
		25-Aug-09	7.26	484	18.1	28.13	
		29-Sep-09	7.44	795	13.9	35.95	
		28-Oct-09	6.58	964	5.9	34.38	
		23-Nov-09	6.91	735	3.0	46.37	
		16-Dec-09	7.38	889	-1.3	15.36	
S-32	Red River - Downstream of Outlet (2000 m)	27-Jan-09	8.03	560	-1.4	394.5	
		19-Feb-09	7.51	1046	1.8	106.0	
		5-Mar-09	6.91	936	0.0	95.64	
		20-Apr-09	7.80	181	6.7	170.9	
		26-May-09	7.66	630	13.5	99.50	
		29-Jun-09	7.33	428	16.7	241.4	
		15-Jul-09	7.49	686	18.8	59.18	
		25-Aug-09	7.26	554	18.0	35.41	
		29-Sep-09	7.24	794	14.2	36.13	
		28-Oct-09	6.49	967	6.8	35.86	
		23-Nov-09	5.87	769	1.6	48.82	
		16-Dec-09	7.72	1113	-1.2	446.0	
S-33	Red River - Downstream of Outlet (3000 m)	27-Jan-09	6.83	1043	0.2	11.48	
		19-Feb-09	7.55	1087	0.5	18.96	
		5-Mar-09	6.65	944	0.0	18.90	
		20-Apr-09	8.00	388	6.8	166.6	
		26-May-09	7.59	635	13.6	110.2	
		29-Jun-09	7.29	468	17.3	302.1	
		15-Jul-09	7.64	717	19.7	59.01	
		25-Aug-09	7.47	599	18.5	44.28	
		29-Sep-09	7.27	789	13.8	36.61	
		28-Oct-09	7.09	960	7.6	39.47	
		23-Nov-09	6.85	775	1.8	48.98	
		16-Dec-09	5.75	1126	-0.4	13.72	
S-34	Red River - Upstream of Outlet	29-Jan-09	7.92	998	0.5	7.68	
		19-Feb-09	7.37	544	-1.2	125.9	
		5-Mar-09	7.54	995	0.1	107.5	
		20-Apr-09	7.90	366	6.4	165.4	

TABLE NM8-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
S-34	Red River - Upstream of Outlet	26-May-09	7.79	637	13.5	114.4	
		29-Jun-09	7.33	504	18.5	369.2	
		15-Jul-09	7.34	723	18.9	48.36	
		25-Aug-09	7.71	702	19.9	57.21	
		29-Sep-09	7.70	794	15.4	35.87	
		28-Oct-09	7.57	996	6.2	50.07	
		23-Nov-09	7.27	819	2.7	53.20	
		16-Dec-09	7.81	290	1.6	10.44	
S-35	West Dyke - Downstream of Manness Drain	29-Jan-09	-	-	-	-	CNM - Frozen
		20-Feb-09	-	-	-	-	CNM - Frozen
		4-Mar-09	-	-	-	-	CNM - Frozen
		20-Apr-09	7.01	274	4.5	65.73	
U/S	- Upstream of Manness Drain	20-Apr-09	7.08	259	4.1	65.06	
		26-May-09	7.37	1462	11.1	14.46	
U/S		26-May-09	6.21	1143	11.5	12.45	
		29-Jun-09	-	-	-	-	CNM - Location Inaccessible
U/S		29-Jun-09	-	-	-	-	CNM - Location Inaccessible
		15-Jul-09	-	-	-	-	CNM - Road Closed
U/S		15-Jul-09	-	-	-	-	CNM - Road Closed
		25-Aug-09	6.92	952	18.3	11.7	
		29-Sep-09	6.46	2.42	7.8	13.83	
U/S		29-Sep-09	7.03	1909	4.6	2.01	
		28-Oct-09	6.29	2310	6.7	5.53	
U/S		28-Oct-09	6.59	2430	5.3	0.99	
		23-Nov-09	7.19	4109	2.4	33.11	
U/S		23-Nov-09	6.90	4389	1.5	64.59	
		16-Dec-09	-	-	-	-	CNM - Frozen
U/S		16-Dec-09	-	-	-	-	CNM - Frozen
S-36	West Dyke - Downstream of Domain Drain	29-Jan-09	-	-	-	-	CNM - Frozen
		20-Feb-09	-	-	-	-	CNM - Frozen
		4-Mar-09	-	-	-	-	CNM - Frozen
		20-Apr-09	6.71	151	3.7	103.4	
		26-May-09	7.42	629	11.9	25.51	
		29-Jun-09	8.12	186	17.6	353.1	
		15-Jul-09	6.56	568	15.3	117.3	
		25-Aug-09	6.67	368	17.1	16.09	
		29-Sep-09	-	-	-	-	CNM - No Flow
		28-Oct-09	7.78	1081	5.8	14.72	
		23-Nov-09	7.08	1584	1.9	28.72	
		16-Dec-09	-	-	-	-	CNM - Frozen
Level 1							
CON D/S	Floodway Channel - Station 50+900	26-May-09	7.85	588	14.1	39.00	
		9-Jun-09	7.95	776	11.7	23.89	

TABLE NM8-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
CON D/S	Floodway Channel - Station 50+900	27-Jun-09	7.57	751	16.2	123.7	
		9-Jul-09	7.34	422	22.7	321.9	
		15-Jul-09	7.32	491	17.2	102.5	
		30-Jul-09	7.88	806	18.7	40.79	
		31-Jul-09	7.52	629	16.7	36.90	
		15-Aug-09	7.14	755	20.1	49.80	
		21-Aug-09	7.27	427	17.8	23.51	
		25-Aug-09	7.50	454	18.3	23.97	
CON U/S	Floodway Channel - Station 11+000	26-May-09	7.21	472	17.5	82.99	
		9-Jun-09	7.88	772	13.4	6.25	
		27-Jun-09	7.35	367	16.8	198.0	
		9-Jul-09	6.83	524	20.4	83.41	
		15-Jul-09	8.17	556	16.8	10.15	
		30-Jul-09	8.79	641	20.5	15.25	
		31-Jul-09	8.06	465	16.9	15.14	
		15-Aug-09	6.73	347	20.7	166.7	
		21-Aug-09	6.89	397	17.4	64.87	
		25-Aug-09	7.17	461	18.9	5.66	
S-31	Red River - Downstream of Outlet (1000 m)	26-May-09	7.67	620	13.8	90.46	
		9-Jun-09	7.82	710	13.4	82.35	
		27-Jun-09	7.57	683	18.8	120.6	
		9-Jul-09	7.90	588	22.3	106.7	
		15-Jul-09	7.75	640	17.9	64.22	
		30-Jul-09	8.11	940	20.7	39.13	
		31-Jul-09	7.71	710	18.7	33.6	
		15-Aug-09	7.36	776	21.2	44.48	
		21-Aug-09	7.47	571	17.8	27.88	
		25-Aug-09	7.26	484	18.1	28.13	
S-34	Red River - Upstream of Outlet	26-May-09	7.79	637	13.5	114.4	
		9-Jun-09	7.72	704	13.5	93.34	
		27-Jun-09	7.52	667	17.8	126.7	
		9-Jul-09	7.54	605	23.3	66.82	
		15-Jul-09	7.34	723	18.9	48.36	
		30-Jul-09	8.22	952	21.4	47.10	
		31-Jul-09	7.98	724	8.0	34.20	
		15-Aug-09	7.71	747	21.7	42.65	
		21-Aug-09	7.65	734	18.5	40.42	
		25-Aug-09	7.71	702	19.9	57.21	

Notes:
"-" = No Data
E.C. = Electrical Conductivity
CNM = Could Not Monitor

TABLE NM8-2
GENERAL WATER QUALITY
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No. [1]	Date	Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride - Soluble	Fluoride - Soluble	Sulphate - Soluble	Ortho-Phosphorus Soluble as P	Ammonia (NH_3) - Soluble	Unionized Ammonia [3]	Nitrate+ Nitrite-N Soluble	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese	D.O.C	Total Phosphorus	Total Dissolved Phosphorus	T.D.S. (Calc.)	T.S.S.	T.K.N.	T.O.C.	Ion Balance (%)
		Parameter [2]																												
Detection Limit		*0.05*	*0.01*	*0.4,1 0*	*1, 5*	*2, 5*	*0.6, 5*	*0.4, 5*	*0.2*	*9*	*0.1*	*9*	*0.001*	*0.003, 0.05*	*-*	*0.005, 0.2, 0.6, 1*	*0.05*	*0.01*	*0.05*	*0.02*	*0.01*	*0.0002*	*1*	*0.001, 0.030*	*0.001*	*5*	*5*	*0.2*	*1*	*-*
CCME [4]																														
Freshwater Aquatic Life		[5]	6.5-9.0	-	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	-	0.3	-	-	-	-	-	[6]	-	-	-
Monthly																														
CON D/S	27-Jan-09	7.7	7.74	1140	309	377	<0.6	<0.4	509	56.0	0.30	251	0.052	0.305	0.001	0.438	78.8	75.7	5.70	67.2	0.16	0.0504	2.0	0.065	0.048	722	<5	0.60	3.0	102
	19-Feb-09	8.5	8.13	2040	251	306	<0.6	<0.4	424	415.0	0.40	203	0.112	0.597	0.007	4.380	74.8	57.7	13.2	247	0.18	0.0588	8.0	0.150	0.112	1180	8	1.20	8.0	91.9
	5-Mar-09	8.1	7.97	1180	313	382	<0.6	<0.4	475	83.0	0.30	226	0.030	0.097	0.001	0.339	80.7	66.4	6.82	78.6	0.15	0.0331	5.0	0.052	0.031	730	7	0.30	5.0	98.0
	20-Apr-09	**185.0**	8.34	324	121	144	1.70	<0.4	153	15.5	0.12	29.5	0.412	0.091	0.003	0.422	37.6	14.4	8.45	8.83	**1.99**	0.0469	10.9	0.388	0.224	189	**196**	1.15	11.2	104
	26-May-09	30.0	7.63	590	210	256	<0.6	<0.4	281	22.3	0.25	104	0.154	0.037	0.000	0.146	62.3	30.6	7.18	24.4	0.26	0.0787	12.1	0.179	0.130	378	36	0.77	12.3	98.2
	29-Jun-09	120.0	8.10	337	104	127	<0.6	<0.4	152	13.1	0.36	43.8	0.018	0.478	0.018	5.710	31.1	18.1	7.18	10.50	**1.86**	0.0440	14.9	0.563	0.436	212	78	3.11	15.1	97.2
	15-Jul-09	**85.0**	8.39	483	188	224	2.88	<0.4	239	13.9	0.36	76.5	0.149	0.060	0.005	0.452	49.8	27.8	5.09	13.0	**0.38**	0.0503	16.0	0.264	0.181	301	**62**	1.10	16.0	94.2
	25-Aug-09	**16.0**	8.29	443	200	244	<0.6	<0.4	231	18.5	0.32	16.6	0.319	0.036	0.002	0.030	49.3	26.2	6.88	12.9	0.30	0.0167	15.5	0.376	0.337	251	15	1.25	15.8	110
	29-Sep-09	**40.0**	8.40	624	267	316	4.71	<0.4	296	25.9	0.35	45.3	0.190	0.020	0.001	0.181	64.3	33.0	4.38	22.1	0.29	0.0293	12.8	0.204	0.166	356	32	0.87	13.2	99.4
	28-Oct-09	12.0	8.47	686	265	307	7.79	<0.4	326	25.8	0.32	69.2	0.042	0.061	0.003	0.104	69.8	36.8	3.46	25.5	0.15	0.0157	8.6	0.068	0.046	390	12	0.51	8.8	103
	23-Nov-09	**22.0**	8.00	415	125	153	<5.0	<5.0	181	25.9	0.18	42.5	0.034	<0.05	0.001	<0.2	42.5	18.1	2.01	12.8	**0.33**	0.0264	4.6	0.038	0.019	219	11	0.29	5.0	102.0
	16-Dec-09	9.7	7.64	874	238	291	<5.0	<5.0	328	71.5	0.17	108	0.012	0.121	0.000	<0.2	66.1	39.6	3.79	40.3	0.22	0.031	7.3	0.035	0.015	473	<5	0.76	7.4	93.1
CON U/S	20-Apr-09	88.0	8.26	301	124	152	<0.6	<0.4	135	12.6	0.15	30	0.399	0.087	0.002	0.268	32.7	13.0	8.18	7.0	**1.53**	0.0337	12.7	0.466	0.354	179	80	1.26	13.2	91.9
	26-May-09	50.0	8.36	629	240	286	3.3	<0.4	295	22.5	0.25	102	0.154	0.082	0.006	0.177	68.0	30.3	7.63	23.6	**0.50**	0.5430	11.8	0.229	0.145	399	34	1.05	12.6	93.8
	29-Jun-09	200.0	7.95	269	96.7	118	<0.6	<0.4	121	12.7	0.40	34.8	0.492	0.111	0.003	4.450	27.5	12.8	6.86	6.42	**0.97**	0.0599	14.8	0.590	0.421	179	118	2.19	15.5	85.8
	15-Jul-09	40.0	8.60	525	172	193	8.58	<0.4	231	21.8	0.32	95.0	0.176	0.023	0.003	0.040	53.1	23.8	6.38	22.7	0.12	0.0470	10.3	0.212	0.207	326	5	0.94	10.5	95.0
	25-Aug-09	4.9	7.79	382	152	185	<0.6	<0.4	181	17.6	0.38	37.9	0.296	0.057	0.001	0.022	42.2	18.4	7.87	12.7	<0.01	0.1880	13.0	0.474	0.306	228	8	1.33	12.0	101
	29-Sep-09	12.0	8.27	497	202	246	<0.6	<0.4	212	21.3	0.32	34.0	0.172	0.030	0.001	0.069	48.0	22.4	6.26	16.7	0.21	0.0286	9.1	0.202	0.185	270	7	0.69	7.5	95.6
	28-Oct-09	7.2	8.68	471	147	162	8.44	<0.4	190	23.7	0.34	49.8	0.029	0.028	0.002	0.042	37.6	23.4	5.59	20.9	0.09	0.0137	4.8	0.043	0.031	249	5	0.57	4.9	104
	23-Nov-09	5.6	8.44	475	143	174	<5.0	<5.0	179	23.4	0.22	60.3	0.035	<0.05	0.002	<0.2	36.8	21.3	6.3	21.2	0.11	0.0125	8.3	0.052	0.044	255	<5	0.64	8.6	97.8
VEG D/S	27-Jan-09	7.7	7.74	1140	309	377	<0.6	<0.4	509	56.0	0.30	251	0.052	0.305	0.001	0.438	78.8	75.7	5.70	67.2	0.16	0.0504	2.0	0.065	0.048	722	<5	0.60	3.0	102
	19-Feb-09	8.5	8.13	2040	251	306	<0.6	<0.4	424	415.0	0.40	203	0.112	0.597	0.007	4.380	74.8	57.7	13.2	247	0.18	0.0588	8.0	0.150	0.112	1180	8	1.20	8.0	91.9
	5-Mar-09	8.1	7.97	1180	313	382	<0.6	<0.4	475	83.0	0.30	226	0.030	0.097	0.001	0.339	80.7	66.4	6.82	78.6	0.15	0.0331	5.0	0.052	0.031	730	7	0.30	5.0	98.0
	20-Apr-09	**185.0**	8.34	324	121	144	1.70	<0.4	153	15.5	0.12	29.5	0.412	0.091	0.003	0.422	37.6	14.4	8.45	8.83	**1.99**	0.0469	10.9	0.388	0.224	189	**196**	1.15	11.2	104
	26-May-09	30.0	7.63	590	210	256	<0.6	<0.4	281	22.3	0.25	104	0.154	0.037	0.000	0.146	62.3	30.6	7.18	24.4	0.26	0.0787	12.1	0.179	0.130	378	36	0.77	12.3	98.2
	29-Jun-09	120.0	8.10	337	104	127	<0.6	<0.4	152	13.1	0.36	43.8	0.018	0.478	0.018	5.710	31.1	18.1	7.18	10.50	**1.86**	0.0440	14.9	0.563	0.436	212	78	3.11	15.1	97.2
	15-Jul-09	**85.0**	8.39	483	188	224	2.88	<0.4	239	13.9	0.36	76.5	0.149	0.060	0.005	0.452	49.8	27.8	5.09	13.0	**0.38**	0.0503	16.0	0.264	0.181	301	**62**	1.10	16.0	94.2
	25-Aug-09	**16.0**	8.29	443	200	244	<0.6	<0.4	231	18.5	0.32	16.6	0.319	0.036	0.002	0.030	49.3	26.2	6.88	12.9	0.30	0.0167	15.5	0.376	0.337	251	15	1.25	15.8	110
	29-Sep-09	**40.0**	8.40	624	267	316	4.71	<0.4	296	25.9	0.35	45.3	0.190	0.020	0.001	0.181	64.3	33.0	4.38	22.1	0.29	0.0293	12.8	0.204	0.166	356	32	0.87	13.2	99.4
	28-Oct-09	12.0	8.47	686	265	307	7.79	<0.4	326	25.8	0.32	69.2	0.042	0.061	0.003	0.104	69.8	36.8	3.46	25.5	0.15	0.0157	8.6	0.068	0.046	390	12	0.51	8.8	103
	23-Nov-09	**22.0**	8.00	415	125	153	<5.0	<5.0	181	25.9	0.18	42.5	0.034	<0.05	0.001	<0.2	42.5	18.1	2.01	12.8	**0.33**	0.0264	4.6	0.038	0.019	219	11	0.29	5.0	102.0
	16-Dec-09	9.7	7.64	874	238	291	<5.0	<5.0	328	71.5	0.17	108.0	0.012	0.121	0.000	<0.2	66.1	39.6	3.79	40.3	0.22	0.0310	7.3	0.035	0.015	473	<5	0.76	7.4	93.1
VEG U/S	20-Apr-09	88.0	8.26	301	124	152	<0.6	<0.4	135	12.6	0.15	30.0	0.399	0.087	0.002	0.268	32.7	13.0	8.18	7.02	**1.53**	0.0337	12.7	0.466	0.354	179	80	1.26	13.2	91.9
	26-May-09	50.0	8.36	629	240	286	3.27	<0.4	295	22.5	0.25	102	0.154	0.082	0.006	0.177	68.0	30.3	7.63	23.6	**0.50**	0.5430	11.8	0.229	0.145	399	34	1.05	12.6	93.8
	29-Jun-09	200.0	7.95	269	96.7	118	<0.6	<0.4	121	12.7	0.40	34.8	0.492	0.111	0.003	4.450	27.5	12.8	6.86	6.42	**0.97**	0.0599	14.8	0.590	0.421	179	118	2.19	15.5	85.8
	15-Jul-09	40.0	8.60	525	172	193	8.58	<0.4	231	21.8	0.32	95.0	0.176	0.023	0.003	0.040	53.1	23.8	6.38	22.7	0.12	0.0470	10.3	0.212	0.207	326	5	0.94	10.5	95.0
	25-Aug-09	4.9	7.79	382	152	185	<0.6	<0.4	181	17.6	0.38	37.9	0.296	0.057	0.001	0.022	42.2	18.4	7.87	12.7	<0.01	0.1880	13.0	0.474	0.306	228	8	1.33	12.0	101
	29-Sep-09	12.0	8.27	497	202	246	<0.6	<0.4	212	21.3	0.32	34.0	0.172	0.030	0.001	0.069	48.0	22.4	6.26	16.7	0.21	0.0286	9.1	0.202	0.185	270	7	0.69	7.5	95.6
	28-Oct-09	7.2	8.68	471	147	162	8.44	<0.4	190	23.7	0.34	49.8	0.029	0.028	0.002	0.042	37.6	23.4	5.59	20.9	0.09	0.0137	4.8	0.043	0.031	249	5	0.57	4.9	104
	23-Nov-09	5.6	8.44	475	143	174	<5.0	<5.0	179	23.4	0.22	60.3	0.035	<0.05	0.002	<0.2	36.8	21.3	6.30	21.2	0.11	0.0125	8.3	0.052	0.044	255	<5	0.64	8.6	97.8
S-01	20-Apr-09	83.0	8.25	337	121	148	<0.6	<0.4	141	10.8	0.27	31.8	0.283	0.050	0.001	0.404	34.4	13.3	8.70	9.3	**1.53**	0.0435	10.6	0.318	0.187	183	92	0.94	11.6	100
S-02	20-Apr-09	88.0	8.26	339	122	149	<0.6	<0.4	143	10.7	0.26	41.8	0.279	0.046	0.001	0.405	34.9	13.5	8.55	9.4	**1.56**	0.043	10.9	0.314	0.181	194	96	0.99	11.6	95.1
S-03	20-Apr-09	86.0	8.27	340	122	149	<0.6	<0.4	144	13.7	0.19	48.4	0.287	0.040	0.001	0.405	35.3	13.6	8.69	9.24	**1.55**	0.0426	10.4	0.286	0.182	204	74	1.02	11.7	90.5
S-04	20-Apr-09	52.0	8.21	334	124	151	<0.6	<0.4	145	13.0	0.25	45.2	0.224	0.031	0.001	0.345	35.3	13.7	8.35	9.09	**1.25**	0.0325	10.9	0.251	0.176	201	32	0.85	11.6	-
S-05	20-Apr-09	**56.0**	8.20	285	121	147	<0.6	<0.4	123	14.5	0.20	18.1	0.369	0.154	0.004	0.163	28.5	12.5	8.63	6.80	**1.04**	0.0399	13.8	0.477	0.402	162	**57.3**	1.24	14.5	92.2
U/S	20-Apr-09	16.0	8.09	237	101	123	<0.6	<0.4	96.9	9.8	0.24	9.2	0.311	0.125	0.002	0.062	21.5	10.5	8.10	5.19	**0.34**	0.0170	14.0	0.407	0.350	125	17	1.17	14.1	94.8
	26-May-09	**30.0**	8.49	566	257	298	7.72	<0.4	292	24.6	0.25	24.8	0.114	0.023	0.002	0.025	60.9	33.9	4.33	16.2	0.30	0.0415	15.7	0.148	0.093	319	40	0.85	15.9	105.0
U/S	26-May-09	20.0	8.50	577	259	299	7.92	<0.4	274	24.5	0.31	33.4	0.102	0.031	0.003	0.022	58.6	31.1	4.36	15.0	0.27	0.0321	15.3	0.138	0.091	322	22	0.87	15.4	95.1
	29-Jun-09	200.0	7.87	266	98.7	120	<0.6	<0.4	126	12.8	0.38	23.5	0.531	0.062	0.001	4.640	29.2	13.0	7.26	5.82	**2.28**	0.0746	15.1	0.598	0.414	171	172	2.30	15.5	93.6
U/S	29-Jun-09	250.0	7.89	267	99	121	<0.6	<0.4	133	12.7	0.38	21.9	0.693	0.061	0.002	4.590	31.1	13.5	7.16	6.38	**2.58**	0.0875	15.4	0.616	0.410	173	224	2.42	15.7	99.3
	15-Jul-09	45.0	8.34	472	238	286	2.23	<0.4	242	16.5	0.32	19.9	0.195	0.048	0.003	0.153	56.8	24.4	4.44	11.3	**0.36**	0.0447	19.6	0.275	0.228	277	39	1.25	19.3	96.1
U/S	15-Jul-09	40.0	8.37	472	240	287	2.82	<0.4	260	16.1	0.33	18.7	0.204	0.044	0.003	0.148	60.1	26.7	4.74	11.6	**0.42**	0.0464	19.7	0.285	0.221	283	42	1.20	19.7	103.0
	25-Aug-09	70.0	8.00	433	211	258	<0.6	<0.4	233	17.4	0.33	22.3	0.363	0.089	0.003	0.052	50.9	25.6	6.24	9.82	**0.62**	0.0561	17.9	0.434	0.326	259	77	1.36	17.4	101
U/S	25-Aug-09	70.0	8.02	431	211	258	<0.6	<0.4	238	17.3	0.29	23.3	0.387	0.092	0.003	0.072	52.4	26.0	6.39	9.93	**0.64**	0.0595	18.1	0.430	0.337	262	80	1.31	17.6	102

X:\projects\2003\03-1100-01\General\(.19) SiteSurvnvest\(.06) Environmental\(.03) SW Monitoring\Temp\2009Construction\TablesNM8_SW_Tables.xls

TABLE NM8-2
GENERAL WATER QUALITY
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No. [1]	Date	Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride - Soluble	Fluoride - Soluble	Sulphate - Soluble	Ortho-Phosphorus Soluble as P	Ammonia (NH_3) - Soluble	Unionized Ammonia [3]	Nitrate+ Nitrite-N Soluble	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese	D.O.C	Total Phosphorus	Total Dissolved Phosphorus	T.D.S. (Calc.)	T.S.S.	T.K.N.	T.O.C.	Ion Balance (%)
		Parameter [2]																												
Detection Limit		*0.05*	*0.01*	*0.4,1 0*	*1, 5*	*2, 5*	*0.6, 5*	*0.4, 5*	*0.2*	*9*	*0.1*	*9*	*0.001*	*0.003, 0.05*	*-*	*0.005, 0.2, 0.6, 1*	*0.05*	*0.01*	*0.05*	*0.02*	*0.01*	*0.0002*	*1*	*0.001, 0.030*	*0.001*	*5*	*5*	*0.2*	*1*	*-*
CCME [4]																														
Freshwater Aquatic Life		[5]	6.5-9.0	-	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	-	0.3	-	-	-	-	-	[6]	-	-	-
S-05	29-Sep-09	27.0	8.28	499	271	330	<0.6	<0.4	255	11.3	0.33	11.2	0.146	0.026	0.001	0.040	65.9	22.0	2.97	6.6	**0.49**	0.0337	15.3	0.158	0.130	283	25	0.98	15.3	91.3
U/S	29-Sep-09	28.0	8.28	502	271	330	<0.6	<0.4	258	11.3	0.33	13.1	0.143	0.022	0.001	0.040	66.4	22.5	2.99	6.5	**0.51**	0.0340	15.4	0.161	0.133	285	25	0.91	15.6	91.8
S-06	20-Apr-09	25.0	8.36	297	142	169	2.03	<0.4	136	11.3	0.26	12.3	0.287	0.059	0.002	0.018	29.3	15.2	8.91	6.37	**0.48**	0.0122	14.7	0.341	0.315	169	41	3.05	15.2	93.9
	26-May-09	11.0	8.52	790	289	333	9.42	<0.4	394	31.9	0.28	139	0.091	0.013	0.001	<0.005	65.0	56.3	8.52	31.9	0.20	0.0549	16.0	0.125	0.093	506	9	0.92	16.0	99.1
	29-Jun-09	160.0	7.86	268	98.3	120	<0.6	<0.4	130	12.5	0.32	29.2	0.729	0.082	0.002	4.540	28.9	14.1	8.34	5.35	**3.17**	0.0527	16.3	1.110	0.429	177	114	2.58	17.1	93.3
	15-Jul-09	8.2	8.24	523	223	272	<0.6	<0.4	257	17.8	0.39	64.5	0.242	0.015	0.001	0.019	46.3	34.4	8.43	16.9	0.25	0.0545	18.4	0.303	0.311	322	5	1.62	18.2	96.3
	25-Aug-09	45.0	8.00	440	212	258	<0.6	<0.4	236	17.2	0.32	21.7	0.357	0.073	0.003	0.047	50.3	26.7	6.56	10.4	**0.42**	0.0320	18.0	0.410	0.332	260	44	1.51	17.6	103
	29-Sep-09	26.0	8.28	503	272	331	<0.6	<0.4	259	11.8	0.36	11.4	0.140	0.028	0.001	0.031	65.7	23.1	3.17	7.1	**0.48**	0.0445	14.9	0.163	0.135	285	22	0.98	15.5	92.6
	28-Oct-09	13.0	8.52	541	287	333	8.77	<0.4	286	12.9	0.28	10.9	0.039	0.043	0.002	0.013	74.6	24.3	3.00	7.6	0.25	0.0158	12.4	0.069	0.049	306	9	0.78	11.6	96.4
	23-Nov-09	16.0	8.21	522	278	339	<5.0	<5.0	276	9.1	0.26	16.1	0.043	<0.05	0.001	<0.2	72.5	23.1	2.29	6.8	**0.39**	0.0142	13.5	0.055	0.037	297	10	0.61	13.0	95.3
S-07	20-Apr-09	25.0	8.29	248	119	145	<0.6	<0.4	108	<9.0	0.25	17.3	0.500	0.121	0.004	0.098	21.2	13.3	10.60	4.40	**0.58**	0.0184	15.7	0.589	0.551	138	26	1.22	16.4	95.3
	26-May-09	5.0	8.54	882	293	335	11.00	<0.4	401	30.3	0.34	190	0.121	0.010	0.001	0.425	56.8	63.0	7.78	37.0	0.15	0.0423	16.2	0.159	0.130	563	8	1.03	16.1	91.9
	29-Jun-09	190.0	7.83	229	78.4	95.7	<0.6	<0.4	107	<9.0	0.35	24.4	0.401	0.214	0.005	6.910	21.9	12.8	7.65	3.83	**2.44**	0.0319	16.7	0.719	0.580	148	118	2.59	17.1	96.9
	15-Jul-09	23.0	7.87	551	197	240	<0.6	<0.4	254	20.8	0.36	99.6	0.296	0.061	0.001	0.374	40.3	37.2	7.44	23.1	**0.41**	0.0623	18.2	0.385	0.351	348	19	1.34	18.0	94.4
	25-Aug-09	19.0	7.95	382	177	217	<0.6	<0.4	195	12.7	0.40	21.1	0.696	0.026	0.001	0.008	34.9	26.2	8.24	10.8	**0.32**	0.0230	17.7	0.738	0.698	220	19	1.31	17.2	105
	29-Sep-09	40.0	8.48	1880	290	338	7.99	<0.4	374	339.0	0.53	180.0	0.949	0.552	**0.033**	0.007	52.5	59.0	15.40	252.0	**0.31**	0.0745	30.5	1.470	0.941	1070	51	5.24	37.6	98.4
	28-Oct-09	6.9	8.59	1280	371	420	16.4	<0.4	621	29.0	0.35	318.0	0.041	0.029	0.002	0.010	87.9	97.5	9.24	61.5	0.11	0.0236	10.5	0.069	0.048	826	9	0.94	11.2	103
	23-Nov-09	6.0	8.24	1120	426	499	9.8	<5.0	565	22.6	0.32	209.0	0.052	<0.05	0.001	<0.2	92.3	81.3	10.30	38.3	0.11	0.0191	13.4	0.073	0.062	709	<5	0.94	14.2	97.9
S-09	20-Apr-09	**90.0**	8.39	299	152	178	3.21	<0.4	157	9.4	0.23	26.5	0.227	0.081	0.003	0.019	36.8	15.9	6.23	4.15	**1.96**	0.0425	14.8	0.232	0.132	190	96	0.99	14.7	90.4
U/S	20-Apr-09	80.0	8.42	311	153	180	3.21	<0.4	159	9.8	0.24	24.9	0.138	0.076	0.003	0.018	36.9	16.3	5.76	4.44	**1.17**	0.0263	13.9	0.214	0.128	190	84	1.00	14.5	91.1
	26-May-09	20.0	8.57	502	246	280	9.69	<0.4	269	13.0	0.27	15.9	0.036	0.014	0.002	<0.005	61.6	28.0	2.69	9.0	0.26	0.0248	15.2	0.050	0.026	278	20	0.69	15.0	104.0
U/S	26-May-09	20.0	8.58	496	246	279	10.10	<0.4	269	12.9	0.25	15.8	0.034	0.019	0.002	<0.005	62.2	27.6	2.68	8.9	0.26	0.0303	15.2	0.057	0.024	277	25	1.21	15.4	104.0
	29-Jun-09	**80.0**	8.06	346	148	181	<0.6	<0.4	165	<9.0	0.33	18.0	0.662	0.295	0.014	3.080	33.4	19.8	5.87	7.13	**1.26**	0.0332	20.2	1.670	0.342	187	**80**	2.40	20.7	105.0
U/S	29-Jun-09	60.0	8.06	357	151	184	<0.6	<0.4	180	9.6	0.31	18.6	0.652	0.212	0.009	2.790	35.7	22.0	6.42	7.76	**0.94**	0.0286	20.2	0.785	0.304	203	48	2.30	20.9	105.0
	15-Jul-09	13.0	8.41	480	251	298	4.19	<0.4	271	10.0	0.31	19.6	0.086	0.078	0.006	0.008	62.7	27.9	2.87	8.6	0.26	0.0367	22.0	0.120	0.092	282	9	1.16	21.9	102.0
U/S	15-Jul-09	13.0	8.39	466	250	298	3.93	<0.4	275	9.4	0.31	19.3	0.080	0.078	0.006	<0.005	64.9	27.4	2.92	7.5	0.28	0.0296	21.3	0.121	0.089	282	8	1.16	21.5	103.0
	25-Aug-09	50.0	8.20	521	237	289	<0.6	<0.4	264	24.2	0.38	24.8	0.204	0.137	0.009	0.172	57.5	29.2	3.47	19.2	0.30	0.0385	19.1	0.265	0.198	302	34	1.30	18.1	104
U/S	25-Aug-09	45.0	8.21	515	237	289	<0.6	<0.4	267	24.0	0.33	22.9	0.202	0.134	0.008	0.127	58.8	29.1	3.46	19.3	**0.37**	0.0393	18.9	0.253	0.189	300	30	1.25	18.5	106
	29-Sep-09	25.0	8.55	919	307	351	11.50	<0.4	342	85.0	0.31	74.7	0.314	0.033	0.002	<0.0050	69.7	40.7	4.88	65.2	**0.34**	0.0280	16.1	0.333	0.340	524	22	1.18	16.8	96.9
U/S	29-Sep-09	24.0	8.62	909	305	342	15.10	<0.4	343	80.6	0.38	73.2	0.307	0.038	0.003	0.005	70.0	40.8	4.80	64.3	**0.37**	0.0271	17.1	0.355	0.341	517	19	1.09	16.6	98.4
	28-Oct-09	17.0	8.69	2460	447	487	28.7	<0.4	673	396.0	0.49	294.0	0.843	0.079	0.006	0.023	95.0	106.0	11.80	295.0	0.30	0.0357	16.8	0.913	0.921	1470	21	1.62	18.2	101
U/S	28-Oct-09	13.0	8.72	2450	440	476	29.7	<0.4	662	389.0	0.37	291.0	0.772	0.105	0.008	0.030	91.5	105.0	11.80	291.0	0.26	0.0335	17.8	0.869	0.834	1140	13	1.69	17.5	101
	23-Nov-09	21.0	8.16	2620	431	442	41.5	<5.0	715	429.0	0.46	368.0	0.367	0.084	0.001	<1	104.0	111.0	11.70	322.0	0.25	0.0467	17.2	0.397	0.381	1600	17	1.57	18.8	101.0
U/S	23-Nov-09	25.0	8.18	2570	433	467	30.2	<5.0	715	367.0	0.38	336.0	0.262	<0.05	0.001	<1	106.0	109.0	10.50	299.0	**0.35**	0.0790	16.9	0.312	0.256	1490	36	1.49	17.2	106.0
S-10	20-Apr-09	16.0	8.32	325	129	154	1.51	<0.4	137	15.3	0.33	34.1	0.481	0.064	0.002	0.014	24.9	18.2	12.10	7.73	0.22	0.0283	17.1	0.566	0.553	190	9	1.24	17.5	90.7
	26-May-09	1.0	8.66	1730	377	411	23.90	<0.4	887	87.0	0.99	518	0.080	0.007	0.001	<0.005	104.0	152.0	10.30	93.5	0.08	0.0191	17.1	0.111	0.097	1190	<5	1.02	17.2	106.0
	29-Jun-09	102.0	7.77	279	75	91.5	<0.6	<0.4	109	10.1	0.37	23.1	0.350	0.887	**0.022**	10.500	23.7	16.1	10.50	5.69	**1.12**	0.0144	20.5	0.785	0.682	174	42	3.59	21.1	99.7
	15-Jul-09	11.0	8.47	846	232	271	5.63	<0.4	395	36.1	0.34	214.0	0.201	0.059	0.005	0.141	54.5	62.9	9.10	40.7	0.28	0.0236	21.1	0.288	0.297	557	16	1.33	21.2	97.7
	25-Aug-09	7.9	8.38	876	258	308	3.67	<0.4	435	36.0	0.42	209	0.224	0.014	0.001	0.040	58.6	70.2	8.40	45.5	0.09	0.0068	16.4	0.289	0.261	583	6	1.16	16.0	103
U/S	25-Aug-09	8.3	8.02	655	220	268	<0.6	<0.4	302	32.6	0.32	111	0.460	0.019	0.001	0.230	44.8	46.1	8.82	28.6	0.13	0.0087	20.7	0.496	0.472	405	<5	1.54	20.6	98.0
S-11	20-Apr-09	0.9	8.53	491	165	190	5.63	<0.4	172	45.1	0.33	<9.0	0.219	0.026	0.002	<0.005	36.1	19.8	8.65	26.70	<0.01	0.0058	14.9	0.274	0.268	235	<5	0.87	15.0	105
	26-May-09	3.0	8.48	1020	277	322	7.92	<0.4	414	124.0	0.37	106	0.031	0.004	0.001	<0.005	66.2	60.4	9.56	68.7	0.07	0.0064	18.2	0.054	0.052	601	5	0.82	17.8	102.0
	29-Jun-09	19.0	8.45	435	158	185	3.99	<0.4	183	26.0	0.31	41.0	0.561	0.033	0.004	<0.005	34.2	23.7	8.66	17.10	**0.54**	0.0068	25.2	0.077	0.045	-	5	1.59	25.4	96.9
	15-Jul-09	12.0	8.35	561	196	235	2.03	<0.4	242	47.6	0.29	50.8	0.037	0.058	0.004	<0.005	45.3	31.3	7.40	27.5	0.29	0.0147	21.6	0.086	0.063	327	7	1.24	21.7	98.2
	25-Aug-09	3.1	8.22	538	221	270	<0.6	<0.4	248	24.7	0.38	40.3	0.260	0.023	0.002	<0.005	49.3	30.2	6.13	21.5	0.10	0.0211	14.5	0.306	0.284	305	<5	1.05	15.6	101
S-13	20-Feb-09	13.0	8.28	685	315	384	<0.6	<0.4	311	30.0	0.40	10	0.104	0.101	0.002	0.923	77.4	28.5	4.85	20.5	**0.39**	0.0454	11.0	0.935	0.102	365	8	0.70	11.0	97.2
	4-Mar-09	11.0	8.07	628	329	402	<0.6	<0.4	338	18.0	0.20	9	0.063	0.075	0.001	0.595	83.7	31.2	5.29	13.3	**0.42**	0.0447	7.0	0.098	0.063	361	<5	0.60	8.0	102
	20-Apr-09	70.0	8.32	298	129	154	1.44	<0.4	135	10.9	0.25	21.0	0.353	0.083	0.003	0.252	32.3	13.3	8.46	6.99	**1.93**	0.0582	12.3	0.407	0.323	171	85.3	1.36	12.8	96.4
	26-May-09	50.0	8.45	581	252	295	6.15	<0.4	289	23.7	0.23	62.6	0.135	0.041	0.004	0.091	62.9	31.9	5.56	18.6	**0.41**	0.2810	14.0	0.233	0.124	357	52	1.18	14.5	95.7
	29-Jun-09	105.0	7.96	284	106	129	<0.6	<0.4	134	10.4	0.34	14.3	0.661	0.194	0.006	3.940	32.1	13.2	7.30	6.17	**1.71**	0.0420	15.8	0.991	0.388	164	42	2.05	16.4	105.0
	15-Jul-09	20.0	8.39	459	218	259	3.21	<0.4	229	15.8	0.35	19.5	0.210	0.082	0.006	0.172	49.6	25.6	6.19	12.3	0.27	0.0352	18.5	0.294	0.277	260	11	1.20	18.7	101.0
	25-Aug-09	**55.0**	8.11	429	209	255	<0.6	<0.4	230	16.9	0.33	21.6	0.364	0.073	0.004	0.766	50.6	25.2	6.39	9.59	**0.54**	0.0331	18.3	0.400	0.320	259	**49**	1.33	17.5	100
	29-Sep-09	**40.0**	8.31	502	271	328	1.51	<0.4	263	11.9	0.31	14.2	0.159	0.019	0.001	0.046	67.0	23.2	3.22	6.9	**0.63**	0.0468	15.0	0.168	0.135	289	**39**	0.90	15.6	92.8
	28-Oct-09	15.0	8.54	538	287	330	9.88	<0.4	285	12.8	0.32	11.8	0.042	0.042	0.002	0.018	74.2	24.3	2.99	7.6	0.27	0.0181	10.9	0.072	0.046	306	16	0.80	12.0	96.0
	23-Nov-09	**17.0**	8.09	532	273	333	<5.0	<5.0	279	9.0	0.28	15.3	0.044	<0.05	0.001	<0.2	73.3	23.3	2.34	6.9	**0.40**	0.0146	12.8	0.054	0.037	294	11	0.66	13.4	98.2
	17-Dec-09	12.0	7.82	936	504	615	<5.0	<5.0	492	16.9	0.28	9.8	0.031	<0.05	0.000	<0.2	129.0	41.6	3.29	12.1	0.29	0.0511	19.8	0.055	0.046	514	10	2.38	17.9	97.2

X:\projects\2003\03-1100-01\General\(.19) SiteSurvnvest\(.06) Environmental\(.03) SW Monitoring\Temp\2009Construction\TablesNM8_SW_Tables.xls

TABLE NM8-2
GENERAL WATER QUALITY
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No. (1)	Date	Parameter (2) Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride - Soluble	Fluoride - Soluble	Sulphate - Soluble	Ortho-Phosphorus Soluble as P	Ammonia (NH_3) - Soluble	Unionized Ammonia (3)	Nitrate+ Nitrite-N Soluble	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese	D.O.C	Total Phosphorus	Total Dissolved Phosphorus	T.D.S. (Calc.)	T.S.S.	T.K.N.	T.O.C.	Ion Balance (%)
Detection Limit		*0.05*	*0.01*	*0.4,1 0*	*1, 5*	*2, 5*	*0.6, 5*	*0.4, 5*	*0.2*	*9*	*0.1*	*9*	*0.001*	*0.003, 0.05*	*-*	*0.005, 0.2, 0.6, 1*	*0.05*	*0.01*	*0.05*	*0.02*	*0.01*	*0.0002*	*1*	*0.001, 0.030*	*0.001*	*5*	*5*	*0.2*	*1*	*-*
CCME (4)																														
Freshwater Aquatic Life		(5)	6.5-9.0	-	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	-	0.3	-	-	-	-	-	(6)	-	-	-
S-14	28-Jan-09	7.5	8.04	1100	238	290	<0.6	<0.4	389	49.0	0.40	269	0.024	0.227	0.002	0.032	64.8	55.2	4.60	73.3	0.22	0.2040	7.0	0.033	0.026	659	12	0.50	6.0	94.3
	20-Feb-09	7.0	8.24	919	260	317	<0.6	<0.4	355	64.0	0.30	147	0.079	0.047	0.001	0.312	72.7	42.1	6.95	59.3	0.18	0.0744	12.0	0.123	0.089	549	5	0.80	13.0	97.5
	4-Mar-09	22.0	8.13	888	302	369	<0.6	<0.4	387	40.0	0.20	145	0.021	0.068	0.001	0.243	78.8	46.2	5.82	46.7	**0.53**	0.0652	7.0	0.089	0.013	545	35	0.80	7.0	97.0
	20-Apr-09	**240.0**	8.22	301	120	146	<0.6	<0.4	158	14.4	0.26	53.3	0.367	0.093	0.003	0.327	37.9	15.4	8.76	7.81	**2.44**	0.0434	11.5	0.449	0.288	211	**292**	1.55	12.8	94.3
	26-May-09	**75.0**	8.40	622	216	255	3.99	<0.4	277	20.8	0.34	116	0.152	0.053	0.005	0.172	62.6	29.3	7.45	23.5	**0.48**	0.3610	12.4	0.226	0.137	390	**60**	1.00	12.9	91.9
	29-Jun-09	100.0	8.01	293	79.2	96.7	<0.6	<0.4	134	9.1	0.42	30.0	0.270	0.737	**0.031**	9.900	28.3	15.4	9.69	6.38	**2.17**	0.0294	18.9	0.717	0.600	190	60	3.35	19.8	100.0
	15-Jul-09	22.0	8.33	446	174	209	1.64	<0.4	222	15.0	0.29	61.7	0.296	0.088	0.006	1.100	42.9	28.0	7.75	14.3	**0.31**	0.0198	17.9	0.376	0.355	279	12	1.29	17.5	99.7
	25-Aug-09	**19.0**	8.13	423	199	243	<0.6	<0.4	223	16.3	0.31	15.1	0.360	0.044	0.002	0.030	47.1	25.5	6.77	10.6	**0.32**	0.0199	17.4	0.412	0.385	241	16	1.27	16.9	106
	29-Sep-09	**40.0**	8.39	554	260	308	4.06	<0.4	260	20.8	0.34	14.2	0.183	0.038	0.002	0.092	62.7	25.0	3.77	15.6	**0.55**	0.0355	15.1	0.198	0.159	298	32	1.01	15.1	97.9
	28-Oct-09	**27.0**	8.53	556	281	322	9.88	<0.4	292	14.6	0.33	14.0	0.051	0.071	0.004	0.027	73.8	26.1	2.89	10.5	**0.32**	0.0259	11.1	0.083	0.045	311	26	0.81	11.1	101
	23-Nov-09	4.9	7.88	318	97.6	119	<5.0	<5.0	131	22.7	0.17	21.3	0.016	<0.05	0.000	<0.2	34.6	10.9	1.52	8.3	0.17	0.0265	4.1	0.016	0.011	158	<5	<0.20	3.6	99.4
	17-Dec-09	9.1	7.99	816	385	470	<5.0	<5.0	402	21.2	0.28	47.4	0.021	<0.05	0.000	<0.2	102.0	36.0	2.95	18.6	0.29	0.0187	14.7	0.042	0.036	459	6	0.84	14.2	96.1
S-21	28-Jan-09	5.2	8.16	976	259	316	<0.6	<0.4	395	59.0	0.40	224	0.133	1.310	0.016	0.026	64.2	57.1	4.84	62.4	0.16	0.1070	2.0	0.174	0.128	628	10	1.60	3.0	93.2
	20-Feb-09	0.8	8.27	710	239	292	<0.6	<0.4	265	33.0	0.40	38	0.003	0.029	0.001	0.012	51.1	33.5	3.78	23.4	0.02	0.0055	2.0	0.022	0.007	326	<5	<0.2	3.0	98.4
	4-Mar-09	1.1	8.20	575	240	293	<0.6	<0.4	261	27.0	0.30	37	0.002	0.007	0.000	<0.005	51.5	32.1	3.49	19.4	0.05	0.0073	<1	0.014	0.005	315	<5	<0.2	<1	96.8
	20-Apr-09	**130.0**	8.14	329	123	150	<0.6	<0.4	150	16.4	0.22	43.3	0.343	0.070	0.002	0.409	36.7	14.1	8.27	10.30	**1.39**	0.0397	10.7	0.380	0.215	205	**142**	1.10	11.3	94.5
	26-May-09	50.0	8.43	647	238	280	5.04	<0.4	315	20.6	0.29	96.3	0.234	0.044	0.005	0.989	71.4	33.2	8.17	25.1	**0.41**	0.5030	13.5	0.324	0.207	402	33	1.28	13.5	102.0
	29-Jun-09	55.0	8.49	420	113	128	4.58	<0.4	165	24.4	0.37	62.0	0.677	0.127	0.017	3.870	35.9	18.3	7.23	20.60	**0.53**	0.0145	13.8	0.277	0.213	253	16	1.65	14.1	96.8
	15-Jul-09	20.0	8.33	476	183	220	1.38	<0.4	221	25.0	0.31	49.7	0.155	0.100	0.006	0.419	46.8	25.4	4.98	20.7	0.28	0.0545	15.7	0.216	0.167	284	8	1.25	16.0	100.0
	25-Aug-09	**14.0**	8.06	438	203	248	<0.6	<0.4	219	17.6	0.31	15.7	0.300	0.011	0.001	<0.005	47.0	24.7	6.41	12.1	0.14	0.0510	18.2	0.374	0.341	245	28	2.50	17.7	103
	29-Sep-09	**40.0**	8.41	677	274	324	5.04	<0.4	298	32.1	0.31	50.1	0.206	0.037	0.002	0.098	66.4	32.2	4.31	28.8	**0.56**	0.0366	15.0	0.215	0.206	379	**36**	1.11	15.6	98.3
	28-Oct-09	**24.0**	8.55	703	288	330	10.4	<0.4	336	24.3	0.36	68.3	0.059	0.058	0.003	0.032	75.5	35.8	3.42	25.6	0.28	0.0237	11.2	0.095	0.055	406	26	0.77	11.2	100
	23-Nov-09	8.5	7.74	391	117	142	<5.0	<5.0	160	24.6	0.16	33.5	0.017	<0.05	0.000	<0.2	39.7	14.8	1.86	11.2	0.24	0.0187	4.7	0.024	0.014	196	7	0.26	4.8	100.0
	17-Dec-09	9.7	7.86	1120	350	427	<5.0	<5.0	509	42.3	0.28	191.0	0.011	<0.05	0.000	<1	101.0	62.1	4.55	52.3	0.18	0.0219	9.6	0.024	0.022	664	10	0.82	9.4	103
S-22	20-Apr-09	7.0	8.49	379	164	191	4.65	<0.4	170	16.8	0.23	18.9	0.267	0.089	0.005	0.241	32.9	21.4	8.59	6.02	0.08	0.0137	16.2	0.349	0.331	204	6	1.15	16.3	92.9
U/S	20-Apr-09	2.0	8.57	488	213	243	8.44	<0.4	231	21.4	0.32	34.9	0.160	0.064	0.004	0.012	46.2	28.2	7.17	8.12	<0.01	0.0103	15.4	0.241	0.229	274	<5	0.94	15.6	92.0
	26-May-09	1.5	8.73	845	341	369	23.00	<0.4	448	38.0	0.30	105	0.135	0.004	0.001	<0.005	74.1	64.0	6.26	24.2	0.03	0.0089	17.6	0.169	0.151	516	<5	1.01	17.8	101.0
U/S	26-May-09	1.1	8.72	910	353	384	23.10	<0.4	479	51.2	0.19	107	0.049	<0.003	0.001	0.019	82.2	66.6	4.45	27.5	0.02	0.0068	16.1	0.073	0.065	551	<5	0.84	15.6	101.0
	29-Jun-09	11.0	8.23	408	140	171	<0.6	<0.4	190	12.6	0.47	25.6	0.777	0.322	**0.021**	8.480	37.3	23.7	9.25	6.92	**0.37**	0.0099	20.8	0.414	0.359	237	12	2.71	20.7	101.0
U/S	29-Jun-09	5.0	8.31	480	174	209	1.64	<0.4	238	16.0	0.31	40.7	0.039	0.550	**0.038**	6.720	48.1	28.6	7.46	9.09	0.13	0.0045	21.5	0.238	0.252	284	<5	2.63	21.9	101.0
	15-Jul-09	**23.0**	8.41	456	179	212	2.94	<0.4	226	20.0	0.28	45.6	0.150	0.078	0.006	0.383	46.0	27.1	5.24	16.1	**0.36**	0.0488	15.6	1.710	0.222	269	17	1.03	16.0	105.0
U/S	15-Jul-09	2.7	8.41	803	309	366	5.70	<0.4	416	52.6	0.30	99.0	0.181	0.171	0.013	<0.005	71.3	57.8	11.50	30.1	0.03	0.0063	23.5	0.245	0.223	508	<5	1.51	23.2	102.0
	25-Aug-09	8.2	8.51	581	252	293	7.20	<0.4	296	21.6	0.27	54.6	0.343	0.027	0.003	0.052	50.9	41.1	8.29	13.2	0.17	0.0124	18.5	0.394	0.372	341	<5	1.49	18.9	98.6
U/S	25-Aug-09	2.0	8.48	671	289	338	7.46	<0.4	353	26.1	0.28	63.6	0.141	0.023	0.003	0.008	62.7	47.7	5.71	16.4	0.05	0.0042	17.1	0.204	0.168	396	<5	1.29	18.1	101
	29-Sep-09	8.1	8.66	847	344	381	19.00	<0.4	420	45.4	0.40	94.0	0.027	0.012	0.001	<0.0050	53.7	69.4	5.72	26.9	0.10	0.0099	17.8	0.045	0.038	502	8	1.09	17.3	95.8
	28-Oct-09	6.8	8.60	876	366	413	16.4	<0.4	464	28.9	0.31	93.8	0.011	0.010	0.001	0.006	73.5	68.1	4.48	20.3	0.12	0.0125	9.1	0.028	0.017	509	6	0.58	7.6	102
U/S	28-Oct-09	8.0	8.55	888	393	447	15.6	<0.4	473	28.7	0.36	73.2	0.033	0.016	0.001	0.014	81.3	65.5	4.18	18.6	0.06	0.0170	8.5	0.045	0.034	507	8	0.58	8.6	102
	23-Nov-09	7.3	8.17	1150	500	610	<5.0	<5.0	640	40.0	0.29	125.0	0.028	<0.05	0.001	<0.2	114.0	86.3	4.46	23.6	0.06	0.0086	9.9	0.043	0.037	693	5	0.44	10.7	101.0
U/S	23-Nov-09	14.0	7.98	1060	463	565	<5.0	<5.0	597	37.1	0.27	92.9	0.051	<0.05	0.000	<0.2	110.0	78.3	3.90	20.8	0.10	0.0270	9.8	0.063	0.050	621	12	0.43	9.9	106.0
S-23	28-Jan-09	7.8	8.03	1300	287	350	<0.6	<0.4	471	69.0	0.30	311	0.175	1.600	0.014	0.034	72.2	70.6	5.47	81.4	0.22	0.1530	4.0	0.214	0.158	782	12	2.10	5.0	92.4
	19-Feb-09	11.0	8.25	1530	256	312	<0.6	<0.4	388	256.0	0.30	141	0.047	0.233	0.003	0.202	71.5	51.0	10.1	170	0.17	0.0891	7.0	0.095	0.052	854	17	0.60	7.0	101.0
	4-Mar-09	17.0	8.11	1180	328	400	<0.6	<0.4	488	75.0	0.30	228	0.034	0.115	0.001	0.158	88.2	65.2	6.95	75.7	**0.38**	0.0550	5.0	0.093	0.035	736	19	0.50	5.0	98.5
	20-Apr-09	**120.0**	8.36	316	124	147	1.83	<0.4	136	14.0	0.32	25.6	0.373	0.097	0.004	0.342	33.1	13.0	8.70	7.82	**2.32**	0.0697	11.2	0.415	0.278	178	**118**	1.10	12.1	95.5
	26-May-09	40.0	8.48	631	227	264	6.42	<0.4	298	20.8	0.28	97.9	0.168	0.040	0.005	0.116	64.5	33.2	7.06	24.4	0.29	0.1850	12.5	0.222	0.148	385	26	0.99	13.3	100.0
	29-Jun-09	16.0	8.35	406	138	164	1.96	<0.4	184	12.5	0.37	26.1	0.478	0.304	**0.026**	8.800	35.9	22.8	8.94	6.81	0.30	0.0078	21.3	1.260	0.336	235	8	2.74	21.6	97.6
	15-Jul-09	6.4	8.56	672	256	293	9.29	<0.4	328	29.4	0.27	100.0	0.230	0.049	0.005	0.065	53.2	47.3	13.10	18.0	0.21	0.0096	25.0	0.320	0.270	415	<5	1.72	25.5	95.3
	25-Aug-09	4.8	8.47	518	225	264	5.50	<0.4	262	20.3	0.34	40.6	0.279	0.021	0.003	<0.005	51.2	32.5	7.26	13.7	0.12	0.0089	17.1	0.347	0.300	301	<5	1.25	18.0	101
	29-Sep-09	**60.0**	8.46	674	272	318	7.20	<0.4	304	31.8	0.37	50.6	0.187	0.104	0.007	0.086	67.2	33.0	4.24	28.3	**0.34**	0.0354	15.0	0.206	0.180	379	**41**	1.19	15.3	99.7
	28-Oct-09	**24.0**	8.53	697	287	331	9.88	<0.4	338	23.7	0.36	66.4	0.054	0.043	0.002	0.034	76.1	35.8	3.38	24.0	0.24	0.0215	10.4	0.087	0.051	402	23	0.72	11.8	101
	23-Nov-09	**34.0**	7.59	392	115	141	<5.0	<5.0	173	28.6	0.18	39.3	0.041	<0.05	0.000	<0.2	42.0	16.5	1.78	12.1	**0.34**	0.0385	4.6	0.043	0.014	209	**34**	0.28	4.5	102.0
	17-Dec-09	6.6	7.96	1030	341	416	<5.0	<5.0	462	37.5	0.31	182.0	0.006	<0.05	0.000	<1	94.2	55.1	4.35	40.5	0.15	0.0154	8.2	0.019	0.016	618	5	0.54	7.3	95.1
Field Dup.	17-Dec-09	7.1	8.00	1030	337	411	<5.0	<5.0	466	37.0	0.31	180.0	0.006	<0.05	0.000	<1	94.7	55.7	4.43	40.5	0.15	0.0147	7.3	0.018	0.015	615	5	0.49	7.7	96.9
S-25	28-Jan-09	10.0	8.09	1210	277	338	<0.6	<0.4	453	64.0	0.30	251	0.084	0.826	0.009	0.081	72.4	66.1	5.49	72.6	0.22	0.1110	3.0	0.108	0.079	699	14	1.20	3.0	98.1
	19-Feb-09	12.0	8.20	1890	265	323	<0.6	<0.4	456	368.0	0.40	219	0.096	0.666	0.008	0.277	80.6	62.0	13.3	215	0.26	0.1580	9.0	0.164	0.100	1120	16	1.30	9.0	92.8
Field Dup.	19-Feb-09	13.0	8.22	1890	264	322	<0.6	<0.4	466	368.0	0.40	220	0.105	0.637	0.008	0.512	83.5	62.6	13.1	213	0.27	0.1530	9.0	0.166	0.097	1120	20	1.30	10.0	93.2
	4-Mar-09	25.0	8.14	1220	320	391	<0.6	<0.4	523	82.0	0.20	204	0.031	0.102	0.001	0.114	91.7	71.4	7.07	75.6	**0.41**	0.0584	5.0	0.066	0.026	725	34	0.40	5.0	107
Field Dup.	4-Mar-09	18.0	8.14	1210	314	383	<0.6	<0.4	516	80.0	0.20	218	0.029	0.101	0.001	0.111	89.1	71.4	7.13	75.2	**0.39**	0.0695	5.0	0.063	0.025	730	21	0.40	5.0	105

TABLE NM8-2
GENERAL WATER QUALITY
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No. [1]	Date	Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride - Soluble	Fluoride - Soluble	Sulphate - Soluble	Ortho-Phosphorus Soluble as P	Ammonia (NH_3) - Soluble	Unionized Ammonia [3]	Nitrate+ Nitrite-N Soluble	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese	D.O.C	Total Phosphorus	Total Dissolved Phosphorus	T.D.S. (Calc.)	T.S.S.	T.K.N.	T.O.C.	Ion Balance (%)
		Parameter [2]																												
Detection Limit		0.05	0.01	0.4,1 0	1, 5	2, 5	0.6, 5	0.4, 5	0.2	9	0.1	9	0.001	0.003, 0.05	-	0.005, 0.2, 0.6, 1	0.05	0.01	0.05	0.02	0.01	0.0002	1	0.001, 0.030	0.001	5	5	0.2	1	-
CCME [4]																														
Freshwater Aquatic Life		[5]	6.5-9.0	-	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	-	0.3	-	-	-	-	-	[6]	-	-	-
S-25	20-Apr-09	**130.0**	8.35	315	124	148	1.44	<0.4	144	14.1	0.35	15.7	0.371	0.101	0.003	0.356	35.0	13.8	8.63	8.12	**2.32**	0.0670	11.3	0.413	0.271	171	**134**	0.99	11.6	107
	26-May-09	50.0	8.41	593	213	250	4.38	<0.4	282	23.1	0.25	102	0.166	0.053	0.004	0.116	62.6	30.4	6.89	24.0	**0.39**	0.1320	12.0	0.198	0.123	377	52	0.85	12.6	97.2
	29-Jun-09	210.0	8.14	301	106	129	<0.6	<0.4	180	10.4	0.42	23.9	0.495	0.366	0.017	5.310	40.7	19.1	7.48	7.81	**2.20**	0.0778	16.1	0.622	0.407	196	100	2.74	16.1	125.0
	15-Jul-09	**60.0**	8.45	465	199	234	4.38	<0.4	230	14.2	0.37	46.6	0.164	0.055	0.005	0.434	49.6	25.7	4.99	11.0	**0.37**	0.0466	17.2	0.594	0.265	274	**46**	1.21	17.2	96.2
	25-Aug-09	**20.0**	8.41	447	199	236	3.34	<0.4	214	18.5	0.31	16.4	0.322	0.042	0.004	0.064	45.9	24.2	6.02	12.0	0.28	0.0167	15.7	0.357	0.304	243	25	1.19	16.7	102
	29-Sep-09	**65.0**	8.43	615	242	283	5.56	<0.4	272	32.0	0.38	55.8	0.196	0.024	0.001	0.140	60.6	29.4	3.95	23.3	**0.41**	0.0398	12.1	0.200	0.154	351	**56**	1.00	12.4	94.8
	28-Oct-09	**22.0**	8.53	691	286	329	9.88	<0.4	339	23.5	0.39	62.4	0.052	0.044	0.002	0.023	76.4	36.0	3.44	24.1	0.24	0.0242	10.8	0.090	0.052	398	20	0.75	11.2	103
	23-Nov-09	**24.0**	7.43	378	106	129	<5.0	<5.0	161	26.2	0.18	39.0	0.037	<0.05	0.000	<0.2	39.6	15.0	1.84	11.3	0.25	0.0270	4.2	0.036	0.013	197	17	<0.20	4.3	102.0
	16-Dec-09	9.6	7.88	971	352	429	<5.0	<5.0	419	39.3	0.25	129.0	0.009	0.051	0.000	<0.2	89.8	47.2	3.69	35.1	**0.32**	0.0211	10.6	<0.030	0.015	556	5	0.67	10.9	92.2
S-26	20-Apr-09	5.0	8.56	514	228	260	8.70	<0.4	247	19.9	0.36	34.5	0.052	0.055	0.003	0.119	51.7	28.6	4.59	10.10	0.09	0.0178	13.9	0.106	0.086	287	<5	0.97	13.2	93.7
U/S	20-Apr-09	4.5	8.55	435	215	247	7.53	<0.4	220	14.1	0.15	10.4	0.034	0.054	0.003	0.124	49.1	23.6	3.26	5.82	0.06	0.0190	12.4	0.086	0.062	236	<5	0.71	12.5	95.9
	26-May-09	4.0	7.80	734	334	407	<0.6	<0.4	400	26.2	0.35	61.3	0.027	0.347	0.007	0.461	79.5	48.9	3.79	20.3	0.08	0.0110	15.9	0.329	0.337	442	5	1.15	15.5	103.0
U/S	26-May-09	1.5	7.56	670	333	406	<0.6	<0.4	354	22.1	0.23	20.5	0.316	0.589	0.007	0.275	74.8	40.6	3.36	15.2	0.04	0.0089	14.0	0.508	0.526	377	<5	1.42	14.6	101.0
	29-Jun-09	5.5	8.32	513	228	275	1.90	<0.4	262	17.9	0.36	36.6	0.548	0.038	0.003	0.210	52.1	32.1	4.57	12.30	0.22	0.0101	18.5	0.091	0.069	293	5	1.22	18.6	100.0
U/S	29-Jun-09	5.5	8.25	447	224	274	<0.6	<0.4	250	12.6	0.31	<9.0	0.582	0.060	0.003	0.116	53.2	28.5	3.71	7.13	0.21	0.0114	17.5	0.107	0.096	240	<5	1.18	18.0	111.0
	15-Jul-09	10.0	8.39	665	233	277	3.21	<0.4	296	34.4	0.29	102.0	0.118	0.068	0.005	0.113	52.5	40.1	5.09	25.9	0.24	0.0118	22.2	0.235	0.235	400	12	1.32	21.4	92.4
U/S	15-Jul-09	4.9	8.38	557	241	288	3.21	<0.4	290	18.5	0.26	55.8	0.272	0.201	0.014	0.311	56.8	36.0	5.12	17.0	0.16	0.0143	19.6	1.630	0.363	335	6	1.38	19.8	102.0
	25-Aug-09	2.5	8.52	761	313	363	9.36	<0.4	385	31.0	0.36	90.7	0.086	0.019	0.003	<0.005	67.3	52.8	4.72	26.0	0.08	0.0079	17.5	0.122	0.108	460	<5	1.28	18.4	99.0
U/S	25-Aug-09	1.9	8.42	607	299	353	5.43	<0.4	342	19.4	0.40	28.2	0.128	0.019	0.002	0.007	67.6	42.2	2.94	12.7	0.10	0.0124	15.2	0.162	0.159	352	<5	1.05	15.9	105
	29-Sep-09	9.9	8.44	428	219	257	5.10	<0.4	211	11.9	0.36	10.0	0.071	0.013	0.001	<0.0050	38.8	27.8	2.68	8.1	0.11	0.0155	7.8	0.086	0.073	231	13	0.52	8.4	93.9
U/S	29-Sep-09	9.2	8.44	410	216	254	4.91	<0.4	207	10.3	0.35	<9.0	0.058	0.017	0.001	<0.0050	38.2	27.2	2.56	7.1	0.11	0.0157	8.3	0.069	0.058	215	9	0.54	9.4	97.5
	28-Oct-09	5.2	8.54	511	258	296	8.84	<0.4	258	14.6	0.32	9.4	0.184	0.071	0.003	0.061	50.0	32.5	3.88	9.5	0.10	0.0102	9.5	0.224	0.205	275	8	0.86	9.7	98.4
U/S	28-Oct-09	9.4	8.52	501	256	295	8.11	<0.4	263	13.7	0.25	9.7	0.135	0.061	0.003	0.057	51.1	33.0	3.85	8.8	0.16	0.0154	9.1	0.188	0.149	274	10	0.82	10.8	101
	23-Nov-09	12.0	8.19	574	290	354	<5.0	<5.0	297	11.5	0.29	14.3	0.228	<0.05	0.001	0.220	59.1	36.2	3.02	9.4	0.08	0.0181	14.6	0.262	0.222	308	13	1.28	15.6	99.4
U/S	23-Nov-09	5.0	8.19	557	283	345	<5.0	<5.0	322	9.7	0.21	9.0	0.098	0.102	0.002	<0.2	57.6	35.5	2.59	7.7	0.13	0.0114	14.6	0.130	0.110	303	<5	0.97	15.4	101.0
S-27	20-Apr-09	**18.0**	8.54	454	221	254	7.26	<0.4	229	11.7	0.28	19.2	0.029	0.042	0.002	0.028	43.3	29.5	3.21	6.06	0.29	0.0076	16.9	0.072	0.047	245	24	0.80	16.6	95.8
U/S	20-Apr-09	6.0	8.54	446	216	249	7.33	<0.4	227	12.4	0.26	14.2	0.016	0.036	0.002	0.009	41.3	30.1	3.08	6.12	0.04	0.0038	17.4	0.059	0.045	237	10	0.80	17.7	98.0
	26-May-09	**20.0**	8.43	683	320	376	6.94	<0.4	389	21.3	0.32	77.1	0.215	0.020	0.002	<0.005	68.6	52.9	2.47	14.1	0.23	0.0104	17.5	0.035	0.015	428	30	0.70	16.7	98.3
U/S	26-May-09	2.0	8.50	690	321	371	10.10	<0.4	395	22.0	0.30	60.2	0.007	<0.003	0.000	<0.005	65.8	56.1	2.46	15.0	0.03	0.0046	18.0	0.022	0.015	414	6	0.69	17.7	104.0
	29-Jun-09	**30.0**	8.29	529	259	316	<0.6	<0.4	291	11.5	0.46	12.3	0.229	0.025	0.002	<0.005	55.1	37.3	2.77	9.48	**0.58**	0.0160	21.2	0.060	0.033	284	**45**	1.19	22.2	109.0
U/S	29-Jun-09	15.0	8.27	529	257	314	<0.6	<0.4	275	12.7	0.40	10.8	0.505	0.030	0.002	<0.005	52.1	35.2	2.61	8.88	0.17	0.0112	22.2	0.047	0.034	277	16	1.17	22.3	103.0
	15-Jul-09	4.1	8.37	541	228	272	2.55	<0.4	273	16.4	0.29	72.1	0.015	0.030	0.002	<0.005	48.3	37.1	3.41	13.3	**0.41**	0.0209	20.4	0.317	0.077	327	**71**	1.02	19.7	94.0
U/S	15-Jul-09	14.0	8.35	563	230	276	2.29	<0.4	277	19.9	0.36	71.4	0.012	0.045	0.003	<0.005	45.3	39.7	3.25	13.8	0.13	0.0117	21.0	1.910	0.045	332	16	1.01	21.3	93.2
	25-Aug-09	7.6	8.41	874	363	430	6.42	<0.4	503	25.3	0.40	151	0.008	0.023	0.002	0.017	81.2	73.0	2.96	26.0	0.12	0.0105	18.8	0.029	0.029	577	8	1.14	19.9	101
U/S	25-Aug-09	2.4	8.33	879	369	445	2.23	<0.4	559	27.8	0.40	144	0.006	0.022	0.002	0.050	101.0	74.5	2.44	25.2	0.13	0.0117	20.7	0.026	0.026	597	<5	1.11	21.7	110
	28-Oct-09	4.5	8.58	1530	514	577	24.4	<0.4	830	53.5	0.49	324.0	0.008	0.028	0.002	0.015	98.2	142.0	7.03	53.9	0.06	0.0178	16.7	0.025	0.017	987	6	0.85	17.9	103
U/S	28-Oct-09	3.3	8.43	1680	536	629	12.1	<0.4	920	65.0	0.64	356.0	0.009	0.027	0.001	0.017	121.0	150.0	9.00	52.4	0.03	0.0147	19.0	0.030	0.026	1070	<5	0.87	19.5	105
	23-Nov-09	2.2	8.11	1720	545	664	<5.0	<5.0	1050	49.9	0.41	435.0	0.010	<0.05	0.001	<1	152.0	163.0	4.48	52.4	0.05	0.0133	20.8	0.031	0.028	1180	<5	0.91	19.5	109.0
S-28	20-Apr-09	**160.0**	8.34	326	122	146	1.57	<0.4	154	13.8	0.18	53.7	0.381	0.059	0.002	0.425	37.8	14.5	8.90	8.94	**2.90**	0.0987	10.6	0.405	0.224	213	**196**	1.13	11.2	92.6
Field Dup.	20-Apr-09	**190.0**	8.35	325	122	145	1.64	<0.4	160	13.8	0.30	55.0	0.364	0.067	0.003	0.423	39.1	15.1	9.08	9.25	**3.29**	0.1060	10.7	0.392	0.222	216	**228**	1.16	11.2	95.4
	26-May-09	**75.0**	8.42	591	210	247	4.65	<0.4	285	22.4	0.27	105	0.205	0.063	0.004	0.131	63.1	31.0	7.19	24.5	**0.45**	0.1630	12.1	0.205	0.122	381	**140**	0.86	12.4	98.9
Field Dup.	26-May-09	**70.0**	8.52	610	212	244	7.07	<0.4	278	20.0	0.25	102	0.133	0.027	0.002	0.124	62.3	29.7	7.13	23.6	**0.79**	0.1690	11.7	0.233	0.126	373	**86**	1.06	12.4	97.4
	29-Jun-09	80.0	8.14	406	110	135	<0.6	<0.4	168	18.5	0.49	66.9	0.378	0.395	0.017	6.000	35.2	19.4	6.60	15.90	**1.19**	0.0316	14.1	0.465	0.331	255	44	2.59	14.4	92.0
Field Dup.	29-Jun-09	90.0	8.21	397	108	132	<0.6	<0.4	177	17.6	0.50	64.7	0.022	0.405	**0.021**	6.170	35.6	21.3	7.66	14.50	**1.67**	0.0366	14.4	0.475	0.356	254	40	2.84	14.7	97.4
	15-Jul-09	45.0	8.55	497	202	232	7.20	<0.4	239	15.7	0.33	64.4	0.134	0.070	0.008	0.281	48.8	28.5	4.88	13.0	**0.35**	0.0451	16.4	0.420	0.220	298	**32**	1.12	16.5	93.3
Field Dup.	15-Jul-09	45.0	8.57	497	202	231	7.53	<0.4	240	15.6	0.32	64.4	0.135	0.040	0.005	0.287	49.0	28.5	4.92	13.1	**0.32**	0.0452	16.3	1.330	0.211	298	**36**	1.08	16.4	93.7
	25-Aug-09	9.0	8.26	442	197	240	<0.6	<0.4	225	18.8	0.33	18.8	0.296	0.049	0.003	0.011	48.0	25.6	6.89	13.4	0.20	0.0123	15.3	0.358	0.321	249	5	1.12	16.0	108
Field Dup.	25-Aug-09	6.1	8.24	444	197	240	<0.6	<0.4	222	18.7	0.35	17.8	0.313	0.076	0.005	0.009	46.7	25.5	6.79	13.1	0.16	0.0113	15.1	0.354	0.326	247	<5	1.19	16.6	107
	29-Sep-09	**50.0**	8.41	634	269	317	5.30	<0.4	295	26.7	0.39	45.4	0.195	0.025	0.001	0.138	65.3	32.1	4.35	23.4	0.28	0.0309	13.9	0.213	0.180	359	**41**	0.99	14.2	99.0
Field Dup.	29-Sep-09	**40.0**	8.45	642	269	315	6.67	<0.4	294	26.9	0.40	46.6	0.195	0.020	0.001	0.161	64.7	32.2	4.34	23.1	0.27	0.0317	14.3	0.195	0.176	360	**34**	0.94	14.4	97.9
	28-Oct-09	15.0	8.51	688	282	327	8.58	<0.4	331	24.0	0.38	66.0	0.045	0.034	0.002	0.010	74.0	35.5	3.46	25.1	0.20	0.0179	9.8	0.074	0.047	397	12	0.67	9.9	101
Field Dup.	28-Oct-09	**16.0**	8.49	693	282	326	8.77	<0.4	334	24.0	0.36	65.3	0.044	0.031	0.001	0.008	74.8	35.9	3.48	25.0	0.02	0.0172	10.3	0.076	0.048	398	10	0.70	10.7	102
	23-Nov-09	**24.0**	8.09	357	89.9	110	<5.0	<5.0	149	28.0	0.17	41.2	0.035	<0.05	0.001	<0.2	36.2	14.2	1.81	11.7	**0.52**	0.0227	5.7	0.037	0.014	187	15	0.23	6.4	102.0
Field Dup.	23-Nov-09	**23.0**	8.13	355	89.7	109	<5.0	<5.0	147	30.0	0.22	38.7	0.028	<0.05	0.001	<0.2	35.7	14.1	1.82	11.5	0.26	0.0284	3.0	0.035	0.012	186	17	<0.20	3.4	101.0
	16-Dec-09	9.2	7.69	840	290	354	<5.0	<5.0	350	40.7	0.22	101.0	0.006	0.054	0.000	<0.2	76.6	38.6	3.31	27.7	0.22	0.0237	9.5	<0.030	0.013	462	<5	0.63	9.9	91.5

X:\projects\2003\03-1100-01\General\(.19) SiteSurvnvest\(.06) Environmental\(.03) SW Monitoring\Temp\2009Construction\TablesNM8_SW_Tables.xls

TABLE NM8-2
GENERAL WATER QUALITY
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No. (1)	Date	Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride - Soluble	Fluoride - Soluble	Sulphate - Soluble	Ortho-Phosphorus Soluble as P	Ammonia (NH_3) - Soluble	Unionized Ammonia (3)	Nitrate+ Nitrite-N Soluble	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese	D.O.C	Total Phosphorus	Total Dissolved Phosphorus	T.D.S. (Calc.)	T.S.S.	T.K.N.	T.O.C.	Ion Balance (%)
		Parameter (2)																												
Detection Limit		*0.05*	*0.01*	*0.4,1 0*	*1, 5*	*2, 5*	*0.6, 5*	*0.4, 5*	*0.2*	*9*	*0.1*	*9*	*0.001*	*0.003, 0.05*	*-*	*0.005, 0.2, 0.6, 1*	*0.05*	*0.01*	*0.05*	*0.02*	*0.01*	*0.0002*	*1*	*0.001, 0.030*	*0.001*	*5*	*5*	*0.2*	*1*	*-*
CCME (4)																														
Freshwater Aquatic Life		(5)	6.5-9.0	-	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	-	0.3	-	-	-	-	-	(6)	-	-	-
S-30	29-Jan-09	**190.0**	8.10	1000	309	376	<0.6	<0.4	408	51.0	0.40	167	0.298	1.190	0.012	1.170	87.3	46.1	8.22	60.0	**1.08**	0.3620	10.0	0.591	0.302	610	**240**	2.60	10.0	98.1
	19-Feb-09	15.0	8.31	953	291	350	2.2	<0.4	374	43.0	0.40	174	0.255	0.785	0.013	1.150	80.4	42.2	8.18	55.2	0.18	0.0414	7.0	0.290	0.267	583	17	1.50	8.0	93.9
	5-Mar-09	17.0	7.96	927	271	330	<0.6	<0.4	364	50.0	0.20	167	0.254	0.712	0.006	1.100	76.3	42.2	8.95	57.1	0.25	0.0450	9.0	0.313	0.250	568	25	1.50	9.0	96.2
	20-Apr-09	155.0	8.33	320	126	151	1.44	<0.4	155	13.9	0.11	48.0	0.408	0.101	0.003	0.379	38.0	14.7	9.01	8.39	**3.06**	0.0886	11.3	0.420	0.249	209	198	1.22	11.8	93.8
	26-May-09	75.0	8.32	612	209	251	1.90	<0.4	284	23.0	0.33	114	0.212	0.097	0.005	0.176	63.0	30.8	7.53	27.0	**0.62**	0.1860	11.4	0.233	0.135	391	176	0.95	11.9	97.7
	29-Jun-09	200.0	8.13	352	115	141	<0.6	<0.4	173	13.0	0.42	40.2	0.052	0.294	0.012	5.450	35.6	20.4	7.28	10.80	**1.83**	0.0567	14.4	0.515	0.363	221	100	2.83	15.8	105.0
	15-Jul-09	**50.0**	8.38	588	200	238	2.88	<0.4	263	23.1	0.37	106.0	0.188	0.068	0.005	0.533	57.3	29.3	6.22	23.7	**0.34**	0.0735	14.7	0.284	0.215	368	56	1.16	14.9	93.5
	25-Aug-09	25.0	8.30	472	207	253	<0.6	<0.4	241	18.9	0.41	24.1	0.301	0.033	0.002	0.119	50.6	27.9	6.75	13.6	**0.31**	0.0229	15.0	0.355	0.305	267	24	1.19	15.1	107
	29-Sep-09	28.0	8.40	830	262	310	4.84	<0.4	322	37.4	0.46	139.0	0.227	0.029	0.002	0.763	65.7	38.3	8.11	50.0	0.22	0.0847	10.3	0.254	0.204	499	32	1.23	10.3	95.1
	28-Oct-09	26.0	8.41	899	261	309	4.84	<0.4	379	34.0	0.40	167.0	0.166	0.147	0.005	0.901	75.9	46.0	7.83	53.0	0.25	0.0549	8.9	0.220	0.167	545	35	1.10	8.7	103
	23-Nov-09	45.0	8.13	894	232	283	<5.0	<5.0	374	31.6	0.29	198.0	0.175	<0.05	0.001	0.980	76.4	44.6	7.46	47.2	**1.65**	0.0480	10.4	0.219	0.162	549	47	<0.20	10.9	99.9
	16-Dec-09	14.0	8.11	1130	301	367	<5.0	<5.0	437	40.4	0.27	246.0	0.211	0.620	0.006	0.760	88.8	52.3	10.40	59.5	0.19	0.0356	11.7	0.226	0.183	677	10	1.72	11.5	94.2
S-31	27-Jan-09	**55.0**	7.82	1060	316	386	<0.6	<0.4	444	45.0	0.40	232	0.331	0.947	0.005	1.020	90.9	52.8	8.69	70.3	**0.40**	0.1130	10.0	0.358	0.266	693	**72**	1.80	10.0	97.3
	19-Feb-09	15.0	8.30	1040	296	362	<0.6	<0.4	396	49.0	0.50	176	0.276	0.792	0.012	1.180	83.0	45.9	8.86	66.4	0.18	0.0462	7.0	0.308	0.278	613	26	1.50	8.0	99.5
	5-Mar-09	32.0	7.95	961	288	351	<0.6	<0.4	406	52.0	0.20	184	0.245	0.443	0.004	1.280	84.7	47.4	9.13	61.5	**0.36**	0.0768	8.0	0.328	0.239	617	43	1.40	9.0	99.0
	20-Apr-09	130.0	8.33	320	125	149	1.44	<0.4	146	13.6	0.25	16.3	0.406	0.092	0.003	0.376	36.1	13.6	8.84	8.16	**2.73**	0.0816	10.7	0.409	0.261	173	144	1.12	11.6	108
	26-May-09	85.0	8.32	615	209	251	1.83	<0.4	281	23.0	0.32	120	0.212	0.118	0.006	0.184	62.6	30.3	7.44	27.2	**0.73**	0.2090	11.3	0.258	0.138	396	142	1.01	11.7	95.3
	29-Jun-09	200.0	8.13	363	115	141	<0.6	<0.4	167	13.7	0.56	48.2	0.624	0.022	0.001	5.840	35.1	19.2	6.47	11.60	**2.13**	0.0862	14.8	0.549	0.360	229	170	2.82	14.9	96.5
	15-Jul-09	**50.0**	8.39	641	206	245	3.14	<0.4	288	26.8	0.37	124.0	0.208	0.075	0.006	0.610	62.0	32.3	6.89	30.6	**0.37**	0.0829	14.8	0.306	0.228	409	49	1.17	14.8	96.5
	25-Aug-09	34.0	8.31	464	203	245	1.37	<0.4	237	19.4	0.32	29.5	0.311	0.040	0.003	0.087	50.0	27.2	6.74	14.9	**0.32**	0.0279	15.1	0.353	0.333	270	20	1.20	15.9	106
	29-Sep-09	40.0	8.47	802	247	287	7.07	<0.4	308	38.1	0.42	141.0	0.248	0.013	0.001	0.530	64.4	35.9	8.32	52.0	0.28	0.0929	10.1	0.303	0.220	490	54	1.28	10.7	95.9
	28-Oct-09	35.0	8.47	925	251	293	6.42	<0.4	381	36.1	0.33	187.0	0.195	0.146	0.006	0.817	77.3	45.6	8.64	58.4	**0.32**	0.0639	9.3	0.258	0.195	567	37	1.24	9.5	104
	23-Nov-09	40.0	8.06	918	246	300	<5.0	<5.0	385	32.2	0.30	205.0	0.188	<0.05	0.001	1.030	78.7	45.9	7.74	49.0	**1.26**	0.0622	10.7	0.215	0.162	571	49	0.22	12.0	98.5
	16-Dec-09	14.0	8.13	1130	301	367	<5.0	<5.0	447	39.5	0.22	240.0	0.212	0.607	0.007	0.780	91.1	53.3	10.70	60.5	0.19	0.0391	10.8	0.200	0.161	676	16	1.72	11.4	97.4
S-32	27-Jan-09	**430.0**	7.79	970	301	367	<0.6	<0.4	444	53.0	0.40	172	0.606	0.995	0.005	1.070	94.5	50.6	8.10	61.7	**1.35**	0.5470	10.0	0.995	0.277	626	**820**	3.30	11.0	105
	19-Feb-09	75.0	8.30	965	295	360	<0.6	<0.4	396	65.0	0.40	176	0.256	0.697	0.014	1.140	85.1	44.5	8.40	56.5	**0.62**	0.1760	11.0	0.418	0.254	618	130	1.80	11.0	92.0
	5-Mar-09	130.0	7.95	930	269	328	<0.6	<0.4	393	53.0	0.20	173	0.285	0.595	0.005	1.120	84.5	44.2	9.05	58.6	**1.47**	0.2750	8.0	0.608	0.239	588	210	2.20	8.0	101
	20-Apr-09	120.0	8.30	311	123	148	1.05	<0.4	154	13.8	0.29	53.9	0.385	0.118	0.004	0.423	37.8	14.6	9.07	8.49	**3.17**	0.0996	10.7	0.424	0.247	213	180	1.17	11.3	91.8
	26-May-09	110.0	8.30	623	208	252	1.31	<0.4	304	23.3	0.25	130	0.225	0.122	0.006	0.191	67.4	32.9	7.95	30.0	**0.87**	0.2680	11.7	0.318	0.134	418	**290**	1.08	11.8	100.0
	29-Jun-09	150.0	8.14	409	126	154	<0.6	<0.4	200	15.0	0.37	62.6	0.074	0.023	0.001	5.390	43.5	22.1	6.84	15.30	**2.56**	0.1880	13.2	0.619	0.341	265	358	2.67	13.9	104.0
	15-Jul-09	**45.0**	8.37	680	211	252	2.55	<0.4	300	29.6	0.35	140.0	0.201	0.079	0.007	0.690	66.0	32.8	7.08	36.0	0.25	0.1000	14.2	0.333	0.253	441	58	1.28	15.1	96.4
	25-Aug-09	33.0	8.31	537	211	255	1.18	<0.4	260	23.4	0.38	64	0.306	0.079	0.006	0.265	54.8	29.8	7.12	22.6	**0.34**	0.0453	13.3	0.347	0.305	330	28	1.16	14.6	102
	29-Sep-09	31.0	8.44	803	249	292	6.02	<0.4	307	37.8	0.46	143.0	0.251	0.040	0.003	0.674	63.8	35.8	8.33	51.6	0.24	0.0935	10.3	0.273	0.217	493	36	1.34	10.6	94.3
	28-Oct-09	33.0	8.41	942	261	308	4.78	<0.4	383	35.7	0.40	187.0	0.203	0.049	0.002	1.100	75.6	47.3	8.65	58.5	0.28	0.0668	9.5	0.266	0.194	574	50	1.16	9.8	102
	23-Nov-09	45.0	8.10	944	248	303	<5.0	<5.0	399	31.7	0.32	212.0	0.194	<0.05	0.001	1.130	80.8	47.9	8.02	49.8	**0.72**	0.0524	10.8	0.231	0.170	584	52	0.57	11.3	99.8
	16-Dec-09	**320.0**	8.10	1140	301	367	<5.0	<5.0	481	50.8	0.26	256.0	0.234	0.603	0.006	0.780	100.0	55.9	10.80	61.0	**1.00**	0.4080	11.6	0.229	0.174	715	**596**	3.26	12.8	97.8
S-33	27-Jan-09	9.2	7.75	974	294	358	<0.6	<0.4	377	48.0	0.40	167	0.290	1.070	0.005	1.030	78.2	44.2	7.88	59.5	0.18	0.0422	10.0	0.336	0.300	585	15	1.80	9.0	95.7
	19-Feb-09	12.0	8.30	970	293	357	<0.6	<0.4	371	48.0	0.40	168	0.238	0.581	0.011	1.150	79.8	41.8	8.11	57.0	0.25	0.0444	11.0	0.263	0.238	584	16	1.40	11.0	93.6
	5-Mar-09	22.0	7.90	936	269	328	<0.6	<0.4	376	52.0	0.30	170	0.231	0.549	0.004	1.070	79.3	43.3	8.99	59.6	**0.34**	0.0578	8.0	0.288	0.225	579	40	1.30	8.0	98.8
	20-Apr-09	120.0	8.28	309	122	149	<0.6	<0.4	151	13.8	0.24	53.1	0.384	0.102	0.003	0.417	36.9	14.3	9.10	8.62	**3.21**	0.0961	10.7	0.409	0.240	211	168	1.16	11.6	91.1
	26-May-09	120.0	8.31	625	208	251	1.24	<0.4	294	23.7	0.25	132	0.241	0.156	0.008	0.192	65.4	31.7	7.83	29.5	**0.99**	0.2870	11.5	0.304	0.202	416	**382**	1.11	11.7	97.0
	29-Jun-09	250.0	8.15	444	134	164	<0.6	<0.4	237	16.7	0.38	76.2	0.555	0.040	0.002	5.030	52.9	25.5	8.03	17.50	**3.80**	0.3110	11.5	0.646	0.310	299	**562**	2.58	12.6	111.0
	15-Jul-09	2.7	8.38	701	215	256	3.14	<0.4	312	30.9	0.34	143.0	0.223	0.053	0.005	0.736	69.5	33.7	7.60	39.3	**0.36**	0.1120	14.8	0.340	0.260	456	65	1.30	14.8	99.1
	25-Aug-09	40.0	8.33	584	212	255	1.83	<0.4	275	26.5	0.42	82.9	0.305	0.106	0.008	0.340	58.6	31.3	7.51	29.0	**0.36**	0.0606	12.7	0.360	0.285	365	42	1.24	13.7	103
	29-Sep-09	37.0	8.48	810	246	285	7.07	<0.4	314	37.6	0.43	142.0	0.264	0.025	0.002	0.646	65.2	36.7	8.81	54.0	**0.50**	0.1030	10.6	0.300	0.236	495	37	1.36	11.3	98.4
	28-Oct-09	36.0	8.45	948	245	287	6.09	<0.4	375	37.3	0.39	199.0	0.230	0.159	0.007	0.899	75.5	45.4	9.24	62.9	**0.34**	0.0771	9.4	0.296	0.232	580	49	1.23	10.0	103
	23-Nov-09	45.0	7.99	970	258	315	<5.0	<5.0	410	32.4	0.26	218.0	0.207	<0.05	0.001	1.190	81.6	50.0	8.38	53.7	**0.80**	0.0573	10.8	0.232	0.181	605	48	0.28	11.9	100.0
	16-Dec-09	**29.0**	8.13	1130	299	364	<5.0	<5.0	443	41.5	0.21	243.0	0.215	0.630	0.007	0.830	90.2	52.8	10.30	59.2	0.21	0.0392	11.4	0.221	0.203	677	17	1.70	11.5	95.6
S-34	29-Jan-09	6.4	8.14	972	294	358	<0.6	<0.4	369	46.0	0.30	161	0.246	0.902	0.011	1.030	76.7	43.1	7.69	56.7	0.19	0.0356	9.0	0.266	0.246	572	9	1.50	9.0	94.6
	19-Feb-09	120.0	8.28	1020	295	360	<0.6	<0.4	393	63.0	0.30	179	0.300	0.581	0.009	1.660	84.5	44.3	8.43	61.4	**0.58**	0.2150	11.0	0.490	0.296	625	200	1.70	11.0	93.2
	5-Mar-09	170.0	7.89	985	303	370	<0.6	<0.4	451	49.0	0.30	185	0.318	0.065	0.000	2.060	95.9	51.5	9.29	62.2	**0.78**	0.2130	9.0	0.638	0.317	643	200	1.50	9.0	104
	20-Apr-09	160.0	8.31	307	115	138	1.11	<0.4	143	14.2	0.33	42.0	0.409	0.158	0.005	0.461	34.8	13.7	8.79	8.81	**2.77**	0.1010	11.0	0.465	0.254	193	208	1.39	11.5	95.8
	26-May-09	115.0	7.53	632	208	254	<0.6	<0.4	301	23.6	0.21	125	0.255	0.156	0.001	0.184	66.8	32.7	8.14	31.1	**0.97**	0.2840	11.9	0.296	0.146	413	200	1.08	12.4	102.0
	29-Jun-09	230.0	8.19	487	146	178	<0.6	<0.4	247	16.9	0.50	82.3	0.367	0.021	0.001	4.400	56.5	25.8	7.94	20.70	**4.70**	0.3670	10.1	0.711	0.287	317	466	2.25	11.0	111.0
	15-Jul-09	36.0	8.40	728	214	254	3.40	<0.4	304	32.5	0.36	149.0	0.211	0.100	0.009	0.663	67.9	32.8	7.43	38.6	0.28	0.0984	13.8	0.305	0.266	460	47	1.26	14.4	95.2
	25-Aug-09	60.0	8.37	694	221	264	2.69	<0.4	300	34.1	0.45	120	0.282	0.141	0.013	0.541	64.2	34.0	7.96	39.5	**0.44**	0.0855	9.8	0.373	0.273	435	66	1.21	11.8	99.8
	29-Sep-09	40.0	8.52	805	245	281	8.70	<0.4	308	40.0	0.43	147.0	0.246	0.043	0.004	0.458	64.6	35.7	8.56	53.7	0.28	0.0980	10.5	0.268	0.219	498	50	1.20	11.4	95.4

X:\projects\2003\03-1100-01\General\(.19) SiteSurvnvest\(.06) Environmental\(.03) SW Monitoring\Temp\2009Construction\TablesNM8_SW_Tables.xls

TABLE NM8-2
GENERAL WATER QUALITY
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No. [1]	Date	Parameter [2]																												
		Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride - Soluble	Fluoride - Soluble	Sulphate - Soluble	Ortho-Phosphorus Soluble as P	Ammonia (NH_3) - Soluble	Unionized Ammonia [3]	Nitrate+ Nitrite-N Soluble	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese	D.O.C	Total Phosphorus	Total Dissolved Phosphorus	T.D.S. (Calc.)	T.S.S.	T.K.N.	T.O.C.	Ion Balance (%)
Detection Limit		*0.05*	*0.01*	*0.4,1 0*	*1, 5*	*2, 5*	*0.6, 5*	*0.4, 5*	*0.2*	*9*	*0.1*	*9*	*0.001*	*0.003, 0.05*	-	*0.005, 0.2, 0.6, 1*	*0.05*	*0.01*	*0.05*	*0.02*	*0.01*	*0.0002*	*1*	*0.001, 0.030*	*0.001*	*5*	*5*	*0.2*	*1*	-
CCME [4]																														
Freshwater Aquatic Life		(5)	6.5-9.0	-	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	-	0.3	-	-	-	-	-	(6)	-	-	-
S-34	28-Oct-09	45.0	8.47	964	244	284	6.54	<0.4	379	38.3	0.41	204.0	0.255	0.237	0.010	0.951	77.7	45.1	9.73	65.2	**0.42**	0.0940	9.2	0.312	0.236	590	60	1.38	10.4	104
	23-Nov-09	45.0	8.14	1020	254	310	<5.0	<5.0	464	35.9	0.28	240.0	0.217	<0.05	0.001	1.240	93.0	56.3	9.54	62.6	**0.48**	0.0872	11.5	0.255	0.197	650	54	1.31	12.0	109.0
	16-Dec-09	13.0	8.13	1130	295	360	<5.0	<5.0	450	39.9	0.26	241.0	0.221	0.664	0.009	0.820	91.4	53.9	10.80	62.0	0.23	0.0384	11.1	0.230	0.206	676	11	1.75	11.2	99.2
S-35	20-Apr-09	53.0	8.02	219	78	95.4	<0.6	<0.4	79.5	16.7	0.23	16.2	0.367	0.068	0.001	0.015	17.3	8.8	12.80	5.50	**1.97**	0.0128	15.2	0.460	0.385	124	31	1.35	16.5	90.4
U/S	20-Apr-09	53.0	7.98	215	78	95.6	<0.6	<0.4	80.0	16.8	0.16	18.6	0.360	0.064	0.001	0.017	17.4	8.9	12.70	5.54	**1.94**	0.0128	15.0	0.458	0.370	127	28	1.29	16.9	88.9
	26-May-09	9.0	8.22	1630	196	240	<0.6	<0.4	658	325.0	0.68	167	0.390	0.253	0.009	5.310	126.0	83.7	14.50	82.0	0.28	0.1210	17.3	0.452	0.430	940	11	2.14	17.5	101.0
U/S	26-May-09	10.0	8.21	1510	201	245	<0.6	<0.4	616	342.0	0.61	129	0.428	0.258	0.009	5.840	119.0	77.3	15.70	76.7	**0.32**	0.1220	17.3	0.474	0.449	906	10	2.14	18.3	95.5
	25-Aug-09	11.0	7.43	831	128	156	<0.6	<0.4	317	159.0	0.38	79.4	0.405	0.025	0.000	<0.005	64.5	38.0	11.30	42.6	0.27	0.0142	14.8	0.456	0.413	472	5	1.04	14.4	97.4
	29-Sep-09	10.0	8.16	2010	182	221	<0.6	<0.4	808	376.0	0.50	325.0	0.152	0.047	0.001	0.062	158.0	100.0	20.00	104.0	0.30	0.0213	14.1	0.226	0.229	1190	8.1	0.99	11.1	101.0
U/S	29-Sep-09	2.1	7.97	1740	207	252	<0.6	<0.4	663	367.0	0.41	132.0	0.235	0.015	0.000	<0.005	127.0	83.9	23.50	93.1	0.21	0.0188	13.5	0.311	0.339	950	<5	0.96	12.2	104.0
	28-Oct-09	2.0	8.33	2280	201	241	2.09	<0.4	812	491.0	0.32	168.0	0.014	0.031	0.001	0.008	149.0	107.0	15.30	116.0	0.04	0.0060	8.7	0.047	0.037	1170	<5	0.82	8.5	101
U/S	28-Oct-09	6.0	8.38	2210	200	236	3.93	<0.4	796	447.0	0.25	180.0	0.018	0.030	0.001	0.078	148.0	104.0	15.60	112.0	0.07	0.0078	8.4	0.052	0.040	1130	8	0.81	8.5	104
	23-Nov-09	15.0	7.89	3320	248	302	<5.0	<5.0	1270	760.0	0.27	319.0	0.021	<0.05	0.000	<1	242.0	161.0	16.80	166.0	0.27	0.0207	12.4	0.055	0.029	1810	20	0.82	12.3	99.8
U/S	23-Nov-09	26.0	7.93	3380	278	339	<5.0	<5.0	1230	830.0	0.26	294.0	0.046	<0.05	0.000	<1	236.0	156.0	17.70	165.0	**0.33**	0.0174	13.3	0.103	0.039	1870	33	0.39	13.0	91.9
S-36	20-Apr-09	75.0	7.89	141	53	64.5	<0.6	<0.4	53.5	9.1	0.26	30.2	0.293	0.089	0.001	0.033	11.2	6.2	12.20	2.31	**3.00**	0.0129	15.3	0.367	0.270	103	39	1.32	17.2	-
	26-May-09	19.0	8.20	773	172	209	<0.6	<0.4	321	59.2	0.43	152	0.384	0.032	0.001	0.382	67.6	36.9	12.10	32.7	**0.76**	0.0849	17.4	0.432	0.383	465	21	1.40	17.3	98.3
	29-Jun-09	350.0	7.48	187	48	58.1	<0.6	<0.4	80.6	12.1	0.30	62.5	0.838	0.303	0.003	7.410	17.9	8.7	10.70	3.42	**3.78**	0.0407	16.7	0.789	0.484	177	60	3.05	20.8	64.8
	15-Jul-09	100.0	7.87	537	87	106	<0.6	<0.4	205	28.2	0.66	150.0	0.158	0.054	0.001	1.370	44.3	22.9	8.05	29.7	**0.42**	0.0237	8.4	0.281	0.162	342	86	0.95	8.5	96.6
	25-Aug-09	15.0	7.29	299	110	135	<0.6	<0.4	128	22.3	0.37	22.1	0.552	0.064	0.000	0.117	28.0	14.0	11.70	7.2	**0.55**	0.0376	17.6	0.625	0.556	172	5	1.41	17.4	95.0
	28-Oct-09	20.0	8.50	903	241	280	7.33	<0.4	387	62.3	0.42	120.0	0.052	0.158	0.007	0.647	84.9	42.5	18.10	29.5	0.22	0.0352	9.4	0.087	0.060	505	15	1.20	9.6	104
	23-Nov-09	37.0	8.17	1180	253	309	<5.0	<5.0	492	122.0	0.26	211.0	0.072	<0.05	0.001	0.760	106.0	54.9	23.00	36.8	**0.51**	0.0295	10.8	0.093	0.041	706	34	1.07	11.3	92.5
Level 1																														
CON D/S	26-May-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36	-	-	-
	9-Jun-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	-	-	-
	27-Jun-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	112	-	-	-
	9-Jul-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**223**	-	-	-
	15-Jul-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**62**			
	30-Jul-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	-	-	-
	31-Jul-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	-	-	-
	15-Aug-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27	-	-	-
	21-Aug-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	-	-	-
	25-Aug-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	-	-	-
CON U/S	26-May-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34	-	-	-
	9-Jun-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	-	-	-
	27-Jun-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	156	-	-	-
	9-Jul-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28	-	-	-
	15-Jul-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-
	30-Jul-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-	-	-
	31-Jul-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-
	15-Aug-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	110	-	-	-
	21-Aug-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48	-	-	-
	25-Aug-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-
S-31	26-May-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	142	-	-	-
	9-Jun-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	122	-	-	-
	27-Jun-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	140	-	-	-
	9-Jul-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	105	-	-	-
	15-Jul-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	49			
	30-Jul-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33	-	-	-
	31-Jul-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-
	15-Aug-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	47	-	-	-
	21-Aug-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	-	-	-
	25-Aug-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-
S-34	26-May-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	200	-	-	-
	9-Jun-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	146	-	-	-
	27-Jun-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	156	-	-	-
	9-Jul-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	86	-	-	-

TABLE NM8-2
GENERAL WATER QUALITY
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No. [1]	Date	Parameter [2] Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride - Soluble	Fluoride - Soluble	Sulphate - Soluble	Ortho-Phosphorus Soluble as P	Ammonia (NH_3) - Soluble	Unionized Ammonia [3]	Nitrate+ Nitrite-N Soluble	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese	D.O.C	Total Phosphorus	Total Dissolved Phosphorus	T.D.S. (Calc.)	T.S.S.	T.K.N.	T.O.C.	Ion Balance (%)
Detection Limit		*0.05*	*0.01*	*0.4,1 0*	*1, 5*	*2, 5*	*0.6, 5*	*0.4, 5*	*0.2*	*9*	*0.1*	*9*	*0.001*	*0.003, 0.05*	*-*	*0.005, 0.2, 0.6, 1*	*0.05*	*0.01*	*0.05*	*0.02*	*0.01*	*0.0002*	*1*	*0.001, 0.030*	*0.001*	*5*	*5*	*0.2*	*1*	*-*
CCME [4]																														
Freshwater Aquatic Life		[5]	6.5-9.0	-	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	-	0.3	-	-	-	-	-	[6]	-	-	-
S-34	15-Jul-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	47			
	30-Jul-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	53	-	-	-
	31-Jul-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	31	-	-	-
	15-Aug-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	47	-	-	-
	21-Aug-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	-	-	-
	25-Aug-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	66	-	-	-

Notes:

"-" = No Data

E.C. = Electrical Conductivity
T.K.N. = Total Kjeldahl Nitrogen

D.O.C. = Dissolved Organic Carbon
T.D.S. = Total Dissolved Solids

T.O.C. = Total Organic Carbon
T.S.S. = Total Suspended Solids

1. See Table NM8-1 for sample location descriptions
2. All values are expressed in milligrams per litre (mg/L) unless indicated otherwise.
3. Guideline for un-ionized ammonia is 0.019 mg/L. Un-ionized ammonia is pH and Temperature dependant. See Factsheet for details.
   Unionized Ammonia = (f) x (Ammonia), f = 1/(10(pKa - pH) + 1), pKa = 0.09018+2729.92/T, where T = Temperature in Kelvins
4. CCME 2007 - Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines, 1999. Update 7.0 - 2007.
   Chapter 4 -Aquatic Life
5. Turbidity Guidelines Narrative (see fact sheet for complete details):
   Clear Flow:
      Maximum increase of 8 NTUs from background levels for a short-term exposure (e.g. 24 hr period).
      Maximum average increase of 2 NTUs from background levels for a longer exposure (e.g. 30 d period).
   High Flow or Turbid Waters:
      Maximum increase of 8 NTUs from background levels at any one time when background levels are between 8 and 80 NTUs.
      Should not increase more than 10% of background levels when background is >80 NTUs.
6. Suspended Sediments Guidelines (see fact sheet for complete details):

Clear Flow:
   Maximum increase of 25 mg/L from background levels for any short-term exposure (eg. 24 hr period).
   Maximum average increase of 5 mg/L from background levels for longer term exposures (eg. Inputs lasting between 24 hrs and 30 days).

High Flow:
   Maximum increase of 25 mg/L from background levels at any time when background levels are between 25 and 250 mg/L.
   Should not increase more than 10% of background levels when background is >250 mg/L.

BOLD - Exceedance of Criteria

TABLE NM8-3
PETROLEUM HYDROCARBONS IN SURFACE WATER
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No. [1]	Date	Parameter [2]								
		Benzene	Toluene	Ethyl-benzene	Xylenes (-o,-m,-p)	F1 (C_6 - C_{10})	F2 (C_{10} - C_{16})	F3 (C_{16} - C_{34})	F4 (C_{34} - C_{50})	Total Hydrocarbons (C_6 - C_{50})
Detection Limit		*0.5*	*0.5*	*0.5*	*1.5*	*100*	*100*	*250*	*250*	*250*
CCME [3]										
Recreation and Aesthetics		-	-	-	-	-	-	-	-	-
Freshwater Aquatic Life		370 (MAC)	2 (MAC)	90 (MAC)	-	-	-	-	-	-
Monthly										
CON D/S (Stn 50+900)	28-Jan-09	<0.5	<0.5	<0.5	<1.5	<100	<100	<250	<250	<250
	19-Feb-09	<0.5	<0.5	<0.5	<1.5	<100	<100	<250	<250	<250
	5-Mar-09	<0.5	<0.5	<0.5	<1.5	<100	<100	<250	<250	<250
	20-Apr-09	<0.5	<0.5	<0.5	<1.5	<100	<100	<250	<250	<250
	26-May-09	<0.5	<0.5	<0.5	<1.5	<100	<100	<250	<250	<250
	29-Jun-09	<0.5	<0.5	<0.5	<1.5	<100	<100	<250	<250	<250
	15-Jul-09	<0.5	<0.5	<0.5	<1.5	<100	<100	<250	<250	<250
	25-Aug-09	<0.5	<0.5	<0.5	<1.5	<100	<100	<250	<250	<250
	29-Sep-09	<0.5	<0.5	<0.5	<1.5	<100	<100	<250	<250	<250
	28-Oct-09	<0.5	<0.5	<0.5	<1.5	<100	<100	<250	<250	<250
	23-Nov-09	<0.5	<0.5	<0.5	<1.5	<100	<100	<250	<250	<250
	16-Dec-09	<0.5	<0.5	<0.5	<1.5	<100	<100	<250	<250	<250
CON U/S (Stn 11+000)	20-Apr-09	<0.5	<0.5	<0.5	<1.5	<100	<100	<250	<250	<250
	26-May-09	<0.5	<0.5	<0.5	<1.5	<100	<100	<250	<250	<250
	29-Jun-09	<0.5	<0.5	<0.5	<1.5	<100	<100	<250	<250	<250
	15-Jul-09	<0.5	<0.5	<0.5	<1.5	<100	<100	<250	<250	<250
	25-Aug-09	<0.5	<0.5	<0.5	<1.0	<100	<100	<250	<250	<250
	29-Sep-09	<0.5	<0.5	<0.5	<1.5	<100	<100	<250	<250	<250
	28-Oct-09	<0.5	<0.5	<0.5	<1.5	<100	<100	<250	<250	<250
	23-Nov-09	<0.5	<0.5	<0.5	<1.5	<100	<100	<250	<250	<250

Notes:
"-" = No Data

1. See Table NM8-1 for sample location descriptions
2. All concentrations in micrograms per litre (µg/L).
3. CCME 2005 - Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines
   Chapter 3 - Canadian Water Quality Guidelines for Recreation and Aesthetics (Update October 2005) - Fact Sheets
   Chapter 4 - Canadian Water Quality Guidelines for the Protection of Aquatic Life (Update October 2005) - Fact Sheets
   MAC - Maximum Acceptable Concentration
4. Oil or petrochemicals should not be present in concentrations that:
   - Can be detected as a visible film, sheen, or discoloration on the surface;
   - Can be detected by odour; or
   - Can form deposits on shorelines and bottom deposits that are detectable by sight and colour
   Chapter 5 - Agricultural Water (1999, Updated 2003.)

BOLD	- Parameter Detected
BOLD & Shaded	- Exceedance of Health Related Criteria (MAC)

TABLE NM8-4
BACTERIA IN SURFACE WATER
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No. [1]	Date	Parameter	
		Total Coliform CFU/100mL	E.Coli CFU/100mL
Detection Limit		*10*	*10*
CCME [2]			
Freshwater Aquatic Life		-	-
Monthly			
CON D/S (Stn 50+900)	27-Jan-09	1310	490
	19-Feb-09	380	10
	5-Mar-09	90	10
	20-Apr-09	120	30
	26-May-09	OVERGROWN	<10
	29-Jun-09	OVERGROWN	320
	15-Jul-09	OVERGROWN	400
	25-Aug-09	1210	80
	29-Sep-09	950	470
	28-Oct-09	460	100
	23-Nov-09	460	<10
	16-Dec-09	70	10
CON U/S	20-Apr-09	170	10
	26-May-09	OVERGROWN	<10
	29-Jun-09	OVERGROWN	610
	15-Jul-09	190	20
	25-Aug-09	2060	20
	29-Sep-09	250	<10
	28-Oct-09	160	<10
	23-Nov-09	40	<10
VEG D/S (Stn 50+900)	27-Jan-09	1310	490
	19-Feb-09	380	10
	5-Mar-09	90	10
	20-Apr-09	120	30
	26-May-09	OVERGROWN	<10
	29-Jun-09	OVERGROWN	320
	15-Jul-09	OVERGROWN	400
	25-Aug-09	1210	80
	29-Sep-09	950	470
	28-Oct-09	460	100
	23-Nov-09	460	<10
	16-Dec-09	70	10
VEG U/S	20-Apr-09	170	10
	26-May-09	OVERGROWN	<10
	29-Jun-09	OVERGROWN	610
	15-Jul-09	190	20
	25-Aug-09	2060	20
	29-Sep-09	250	<10
	28-Oct-09	160	<10
	23-Nov-09	40	<10
S-01	20-Apr-09	140	10
S-02	20-Apr-09	120	50
S-03	20-Apr-09	160	10
S-04	20-Apr-09	80	<10
S-05	20-Apr-09	120	<10
U/S	20-Apr-09	40	<10
	26-May-09	OVERGROWN	60
U/S	26-May-09	OVERGROWN	60
	29-Jun-09	OVERGROWN	560
U/S	29-Jun-09	OVERGROWN	460
	15-Jul-09	OVERGROWN	80
U/S	15-Jul-09	OVERGROWN	120
	25-Aug-09	OVERGROWN	70
U/S	25-Aug-09	OVERGROWN	100
	29-Sep-09	OVERGROWN	210
U/S	29-Sep-09	OVERGROWN	80

TABLE NM8-4
BACTERIA IN SURFACE WATER
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No. (1)	Date	Parameter	
		Total Coliform CFU/100mL	E.Coli CFU/100mL
Detection Limit		*10*	*10*
CCME (2)			
Freshwater Aquatic Life		-	-
S-06	20-Apr-09	340	40
	26-May-09	OVERGROWN	40
	29-Jun-09	OVERGROWN	350
	15-Jul-09	OVERGROWN	40
	25-Aug-09	OVERGROWN	80
	29-Sep-09	OVERGROWN	100
	28-Oct-09	230	10
	23-Nov-09	520	<10
S-07	20-Apr-09	100	30
	26-May-09	OVERGROWN	10
	29-Jun-09	OVERGROWN	190
	15-Jul-09	OVERGROWN	40
	25-Aug-09	OVERGROWN	70
	29-Sep-09	OVERGROWN	390
	28-Oct-09	110	<10
	23-Nov-09	50	<10
S-09	20-Apr-09	100	<10
U/S	20-Apr-09	110	20
	26-May-09	OVERGROWN	10
U/S	26-May-09	OVERGROWN	<10
	29-Jun-09	OVERGROWN	350
U/S	29-Jun-09	OVERGROWN	230
	15-Jul-09	OVERGROWN	30
U/S	15-Jul-09	OVERGROWN	10
	25-Aug-09	OVERGROWN	170
U/S	25-Aug-09	OVERGROWN	140
	29-Sep-09	OVERGROWN	40
U/S	29-Sep-09	OVERGROWN	80
	28-Oct-09	180	<10
U/S	28-Oct-09	370	10
	23-Nov-09	40	<10
U/S	23-Nov-09	740	<10
S-10	20-Apr-09	100	<10
	26-May-09	OVERGROWN	20
	29-Jun-09	OVERGROWN	140
	15-Jul-09	OVERGROWN	<10
	25-Aug-09	OVERGROWN	400
U/S	25-Aug-09	OVERGROWN	80
S-11	20-Apr-09	110	<10
	26-May-09	OVERGROWN	20
	29-Jun-09	1250	100
	15-Jul-09	OVERGROWN	40
	25-Aug-09	OVERGROWN	30
S-13	20-Feb-09	510	60
	4-Mar-09	200	<10
	20-Apr-09	140	50
	26-May-09	OVERGROWN	30
	29-Jun-09	OVERGROWN	530
	15-Jul-09	OVERGROWN	60
	25-Aug-09	OVERGROWN	130
	29-Sep-09	OVERGROWN	70
	28-Oct-09	140	<10
	23-Nov-09	350	<10
	17-Dec-09	210	30
S-14	28-Jan-09	90	<10
	20-Feb-09	380	<10
	4-Mar-09	1080	<10
	20-Apr-09	80	30

TABLE NM8-4
BACTERIA IN SURFACE WATER
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No. [1]	Date	Parameter: Total Coliform CFU/100mL	Parameter: E.Coli CFU/100mL
Detection Limit		*10*	*10*
CCME [2]			
Freshwater Aquatic Life		-	-
S-14	26-May-09	OVERGROWN	<10
	29-Jun-09	OVERGROWN	290
	15-Jul-09	OVERGROWN	50
	25-Aug-09	OVERGROWN	20
	29-Sep-09	OVERGROWN	350
	28-Oct-09	340	<10
	23-Nov-09	50	<10
	17-Dec-09	10	<10
S-21	28-Jan-09	OVERGROWN	OVERGROWN
	20-Feb-09	10	<10
	4-Mar-09	10	<10
	20-Apr-09	200	20
	26-May-09	OVERGROWN	40
	29-Jun-09	OVERGROWN	160
	15-Jul-09	OVERGROWN	470
	25-Aug-09	1800	60
	29-Sep-09	OVERGROWN	500
	28-Oct-09	700	30
	23-Nov-09	140	<10
	17-Dec-09	160	20
S-22	20-Apr-09	50	<10
U/S	20-Apr-09	60	<10
	26-May-09	OVERGROWN	<10
U/S	26-May-09	OVERGROWN	<10
	29-Jun-09	1070	10
U/S	29-Jun-09	980	10
	15-Jul-09	OVERGROWN	280
U/S	15-Jul-09	OVERGROWN	320
	25-Aug-09	OVERGROWN	190
U/S	25-Aug-09	1570	50
	29-Sep-09	OVERGROWN	30
	28-Oct-09	520	10
U/S	28-Oct-09	210	10
	23-Nov-09	170	<10
U/S	23-Nov-09	430	<10
S-23	28-Jan-09	OVERGROWN	OVERGROWN
	19-Feb-09	700	<10
	4-Mar-09	OVERGROWN	30
	20-Apr-09	110	40
	26-May-09	OVERGROWN	10
	29-Jun-09	1230	80
	15-Jul-09	OVERGROWN	120
	25-Aug-09	1490	30
	29-Sep-09	1150	370
	28-Oct-09	630	10
	23-Nov-09	880	<10
	17-Dec-09	30	10
Field Dup.	17-Dec-09	40	20
S-25	28-Jan-09	OVERGROWN	OVERGROWN
	19-Feb-09	1470	560
Field Dup.	19-Feb-09	1950	690
	4-Mar-09	OVERGROWN	<10
Field Dup.	4-Mar-09	OVERGROWN	<10
	20-Apr-09	60	10
	26-May-09	OVERGROWN	10
	29-Jun-09	OVERGROWN	400
	15-Jul-09	OVERGROWN	290
	25-Aug-09	OVERGROWN	170
	29-Sep-09	OVERGROWN	870

TABLE NM8-4
BACTERIA IN SURFACE WATER
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No. [1]	Date	Parameter	
		Total Coliform CFU/100mL	E.Coli CFU/100mL
Detection Limit		*10*	*10*
CCME [2]			
Freshwater Aquatic Life		-	-
S-25	28-Oct-09	OVERGROWN	100
	23-Nov-09	390	10
	17-Dec-09	130	<10
S-26	20-Apr-09	10	<10
U/S	20-Apr-09	50	<10
	26-May-09	OVERGROWN	60
U/S	26-May-09	OVERGROWN	110
	29-Jun-09	910	20
U/S	29-Jun-09	1340	60
	15-Jul-09	OVERGROWN	100
U/S	15-Jul-09	OVERGROWN	120
	25-Aug-09	OVERGROWN	110
U/S	25-Aug-09	2130	120
	29-Sep-09	360	50
U/S	29-Sep-09	1850	390
	28-Oct-09	230	10
U/S	28-Oct-09	280	20
	23-Nov-09	560	<10
U/S	23-Nov-09	210	<10
S-27	20-Apr-09	50	10
U/S	20-Apr-09	30	<10
	26-May-09	OVERGROWN	20
U/S	26-May-09	OVERGROWN	<10
	29-Jun-09	1030	70
U/S	29-Jun-09	1130	10
	15-Jul-09	OVERGROWN	220
U/S	15-Jul-09	OVERGROWN	110
	25-Aug-09	1670	120
U/S	25-Aug-09	400	80
	28-Oct-09	300	30
U/S	28-Oct-09	410	10
	23-Nov-09	590	<10
S-28	20-Apr-09	100	10
Field Dup.	20-Apr-09	190	<10
	26-May-09	OVERGROWN	10
Field Dup.	26-May-09	OVERGROWN	<10
	29-Jun-09	1240	120
Field Dup.	29-Jun-09	OVERGROWN	220
	15-Jul-09	OVERGROWN	350
Field Dup.	15-Jul-09	OVERGROWN	540
	25-Aug-09	710	10
Field Dup.	25-Aug-09	280	<10
	29-Sep-09	1080	390
Field Dup.	29-Sep-09	920	350
	28-Oct-09	390	20
Field Dup.	28-Oct-09	310	40
	23-Nov-09	440	<10
Field Dup.	23-Nov-09	240	<10
	16-Dec-09	30	<10
S-30	29-Jan-09	1560	380
	19-Feb-09	840	130
	5-Mar-09	420	60
	20-Apr-09	140	20
	26-May-09	OVERGROWN	100
	29-Jun-09	OVERGROWN	310
	15-Jul-09	OVERGROWN	1660
	25-Aug-09	1590	90
	29-Sep-09	860	240
	28-Oct-09	OVERGROWN	350

TABLE NM8-4
BACTERIA IN SURFACE WATER
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No. (1)	Date	Parameter	
		Total Coliform CFU/100mL	E.Coli CFU/100mL
Detection Limit		*10*	*10*
CCME (2)			
Freshwater Aquatic Life		-	-
S-30	23-Nov-09	630	320
	16-Dec-09	1840	880
S-31	27-Jan-09	280	<10
	19-Feb-09	80	<10
	5-Mar-09	160	50
	20-Apr-09	160	20
	26-May-09	220	150
	29-Jun-09	OVERGROWN	450
	15-Jul-09	OVERGROWN	1980
	25-Aug-09	OVERGROWN	190
	29-Sep-09	900	90
	28-Oct-09	OVERGROWN	270
	23-Nov-09	380	110
	16-Dec-09	1630	830
S-32	27-Jan-09	620	100
	19-Feb-09	820	190
	5-Mar-09	570	190
	20-Apr-09	240	<10
	26-May-09	270	140
	29-Jun-09	OVERGROWN	350
	15-Jul-09	OVERGROWN	2020
	25-Aug-09	2040	290
	29-Sep-09	940	60
	28-Oct-09	OVERGROWN	400
	23-Nov-09	550	170
	16-Dec-09	OVERGROWN	OVERGROWN
S-33	27-Jan-09	1220	340
	19-Feb-09	760	90
	5-Mar-09	310	50
	20-Apr-09	300	40
	26-May-09	OVERGROWN	210
	29-Jun-09	OVERGROWN	440
	15-Jul-09	OVERGROWN	1290
	25-Aug-09	2090	410
	29-Sep-09	800	70
	28-Oct-09	OVERGROWN	490
	23-Nov-09	430	210
	16-Dec-09	1880	980
S-34	29-Jan-09	1630	570
	19-Feb-09	600	<10
	5-Mar-09	320	<10
	20-Apr-09	480	150
	26-May-09	OVERGROWN	130
	29-Jun-09	OVERGROWN	450
	15-Jul-09	OVERGROWN	2040
	25-Aug-09	OVERGROWN	860
	29-Sep-09	830	100
	28-Oct-09	1060	220
	23-Nov-09	540	230
	16-Dec-09	1680	1040
S-35	20-Apr-09	230	<10
U/S	20-Apr-09	310	<10
	26-May-09	OVERGROWN	110
U/S	26-May-09	OVERGROWN	70
	25-Aug-09	1430	20
	29-Sep-09	OVERGROWN	20
U/S	29-Sep-09	OVERGROWN	10

TABLE NM8-4
BACTERIA IN SURFACE WATER
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample No. [1]	Date	Parameter	
		Total Coliform CFU/100mL	E.Coli CFU/100mL
Detection Limit		*10*	*10*
CCME [2]			
Freshwater Aquatic Life		-	-
S-35	28-Oct-09	370	<10
U/S	28-Oct-09	230	<10
	23-Nov-09	1120	<10
U/S	23-Nov-09	440	<10
S-36	20-Apr-09	100	<10
	26-May-09	OVERGROWN	<10
	29-Jun-09	OVERGROWN	240
	15-Jul-09	OVERGROWN	660
	25-Aug-09	1920	30
	28-Oct-09	820	<10
	23-Nov-09	550	<10

Notes:

"-" = No Data

1. See Table NM8-1 for sample location descriptions
2. CCME 2007 - Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines, 1999.
   Update 7.0 - 2007.
   Chapter 4 -Aquatic Life

Overgorwn: Exceeded maximum detection limit of approximately 2000 CFU/100 mL using Mcoli Blue MF Method

BOLD - Exceedance of Criteria

TABLE NM8-5
HERBICIDES IN SURFACE WATER
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Location	Date	Parameter [1]						
		2,4-D	AMPA	Bromoxynil	Dicamba	Glyphosate	MCPA	Picloram
EQL		*0.1*	*1*	*0.1*	*0.1*	*1*	*0.1*	*0.1*
CCME [2]								
Freshwater Aquatic Life		4	-	5	10	65	2.6	29
VEG U/S (Stn 11+000)	20-Apr-09	<0.10	<1.0	<0.10	<0.10	<1.0	<0.10	<0.10
VEG D/S (Stn 50+900)	20-Apr-09	<0.10	<1.0	<0.10	<0.10	<1.0	<0.10	<0.10

Notes:

"-" = No Data

EQL = Estimated Quantitation Limit = The lowest level of the parameter that can be quantified with confidence

1. All values are expressed in micrograms per lite (µg/L).
2. CCME 2007 - Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines, 1999.
   Update 7.0 - 2007.
   Chapter 4 -Aquatic Life

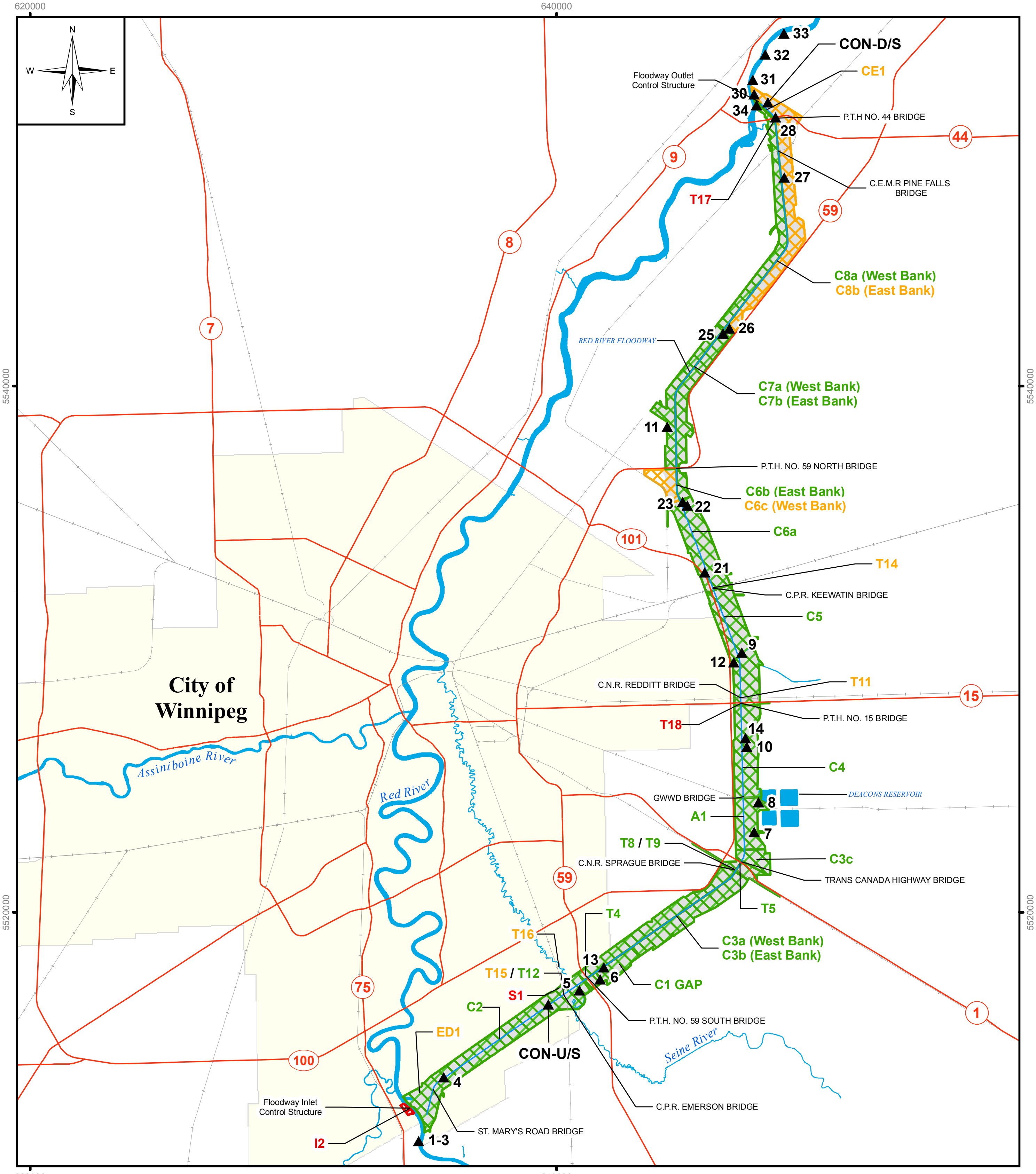
BOLD	- Parameter Detected
BOLD	- Exceedance of Criteria

TABLE NM8-6
LEVEL I EVENT BASED TSS MONITORING REVIEW
RED RIVER FLOODWAY - 2009 SURFACE WATER MONITORING

Sample Date	Amount of Precipitation (mm) for the Monitoring Event [1]	Approximate Duration (hrs)	Year Storm [2]	Estimated							Actual						
				Floodway - Downstream of Construction			Red River - Upstream of Outlet			Change in Red River Sediment Concentration (%)	Floodway - Downstream of Construction			Red River - Upstream of Outlet			Change in Red River Sediment Concentration (%)
				Flow (cms)	TSS (mg/L)	Sediment Load (tonne/day)	Flow (cms)	TSS (mg/L)	Sediment Load (tonne/day)		Flow (cms)	TSS (mg/L)	Sediment Load (tonne/day)	Flow (cms)	TSS (mg/L)	Sediment Load (tonne/day)	
26-May-09	6.6 – 14.5	3.5	<2	819.0	33.8	2391.7	1197.8	135.4	14,015	**-30.47%**	819.0	36	2547.4	1263.0	142	15,495	**-29.36%**
9-Jun-09	10.4 – 14.4	3.0	<2	11.5	21.0	20.9	820.0	110.3	7,813	**-1.12%**	11.5	30	29.8	754.3	122	7,950	**-1.13%**
27-Jun-09	8.4 – 85.1	22.0	<2 - 25	151.0	123.2	1608.0	942.5	439.7	35,802	**-9.94%**	151.0	112	1461.6	677.6	140	8,196	**-3.65%**
9-Jul-09	22.8 – 55.1	12.0	<2 - <5	12.6	272.5	296.0	885.0	78.6	6,011	**3.45%**	12.6	223	242.2	979.8	105	8,888	**1.42%**
15-Jul-09	16.8 – 37.1	9.5	<2	4.9	87.4	37.3	312.5	56.6	1,527	**0.85%**	4.9	62	26.5	550.0	49	2,328	**0.24%**
30-Jul-09	6.5 – 26.7	4.0	<2	3.1	35.3	9.4	175.0	55.1	833	**-0.63%**	3.1	18	4.8	169.9	33	484	**-0.82%**
31-Jul-09	9.8 – 34.3	6.0	<2	3.5	32.0	9.6	160.0	39.7	548	**-0.41%**	3.5	19	5.7	171.1	6	89	**4.29%**
15-Aug-09	10.0 – 25.0	12.0	<2	112.9	42.9	418.0	175.0	49.8	752	**-5.42%**	112.9	27	263.3	161.8	47	657	**-17.49%**
21-Aug-09	0.5 – 16.0	13.0	<2	112.9	20.2	196.5	205.0	48.8	863	**-20.83%**	112.9	13	127.7	188.1	18	293	**-10.21%**
25-Aug-09	0.4 – 11.7	6.0	<2	112.9	20.5	200.1	260.0	68.6	1,541	**-21.21%**	112.9	15	146.3	264.0	20	456	**-7.49%**

Notes:
1 - Amount of precipitation measured varied between the different weather stations
2 - Year Storm is an approximate calculation based on the Atmospheric Environment Service, Rainfall Intensity - Duration Frequency Values for the Winnipeg Int'l Airport and recorded precipitation at the unofficial rain gauge sites

FIGURES



MEMO REFERENCE ....05-1100-01.9905246-NM8.............

▲10 Surface Water Sampling Locations

C0 Completed Prior to 2008

C0 Completed During 2008

C0 Still Active at End of 2008

Completed Prior to 2009

Completed During 2009

Still Active at End of 2009

1:200,000

2 0 2 4 6 8 10

Kilometres

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

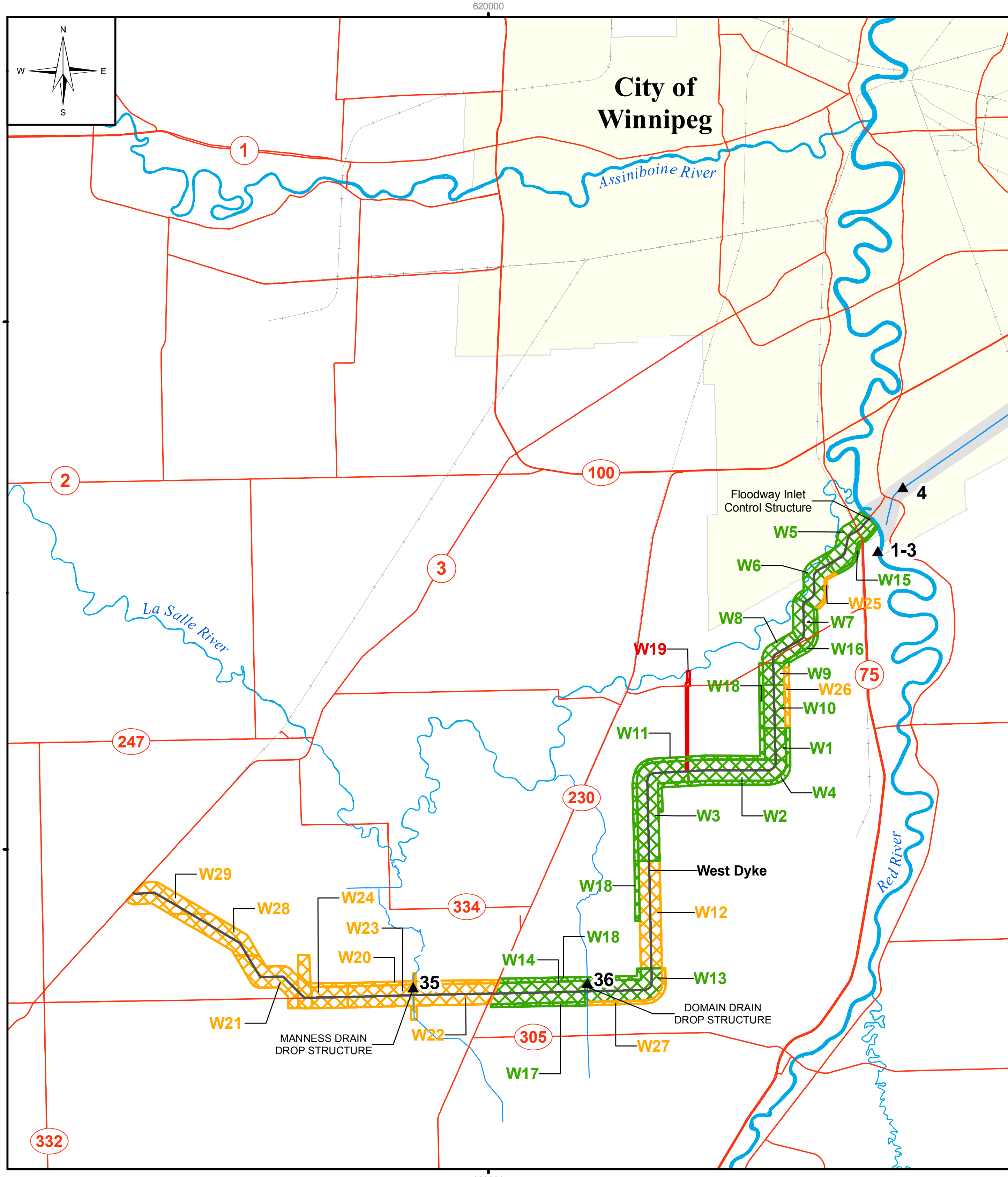
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

FLOODWAY CHANNEL SAMPLE LOCATIONS

JANUARY 2009	FIGURE NM8-1	REV 0

X:\projects\2003\03-1100-01\GIS\Archive\Contract_General\9905241\MXDs\NM7-1.mxd



▲35 Surface Water Sampling Locations

W0	Completed Prior to 2008		Completed Prior to 2009
W0	Completed During 2008		Completed During 2009
W0	Still Active at End of 2008		Still Active at End of 2009

1:200,000

2 0 2 4 6 8 10

Kilometres

X:\projects\2003\03-1100-01\GIS\Archive\Contract_General\9905241\MXDs\NM7-2.mxd

MEMO REFERENCE 05-1100-01.9905246-NM8

KGS GROUP

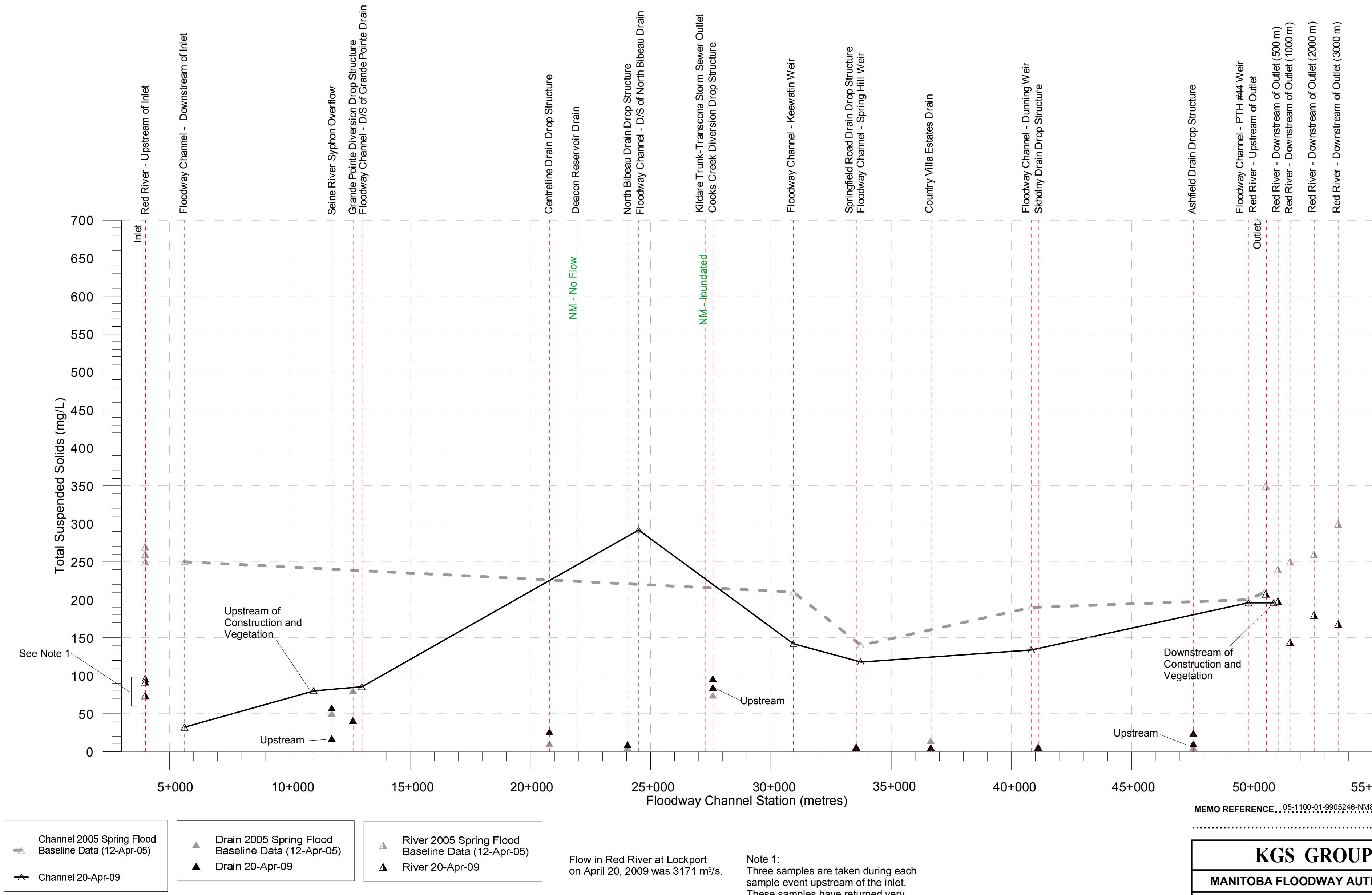
MANITOBA FLOODWAY AUTHORITY

RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

FLOODWAY CHANNEL SAMPLE LOCATIONS

JANUARY 2009	FIGURE NM8-2	REV 0



Flow in Red River at Lockport on April 20, 2009 was 3171 m³/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905246-NM8

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

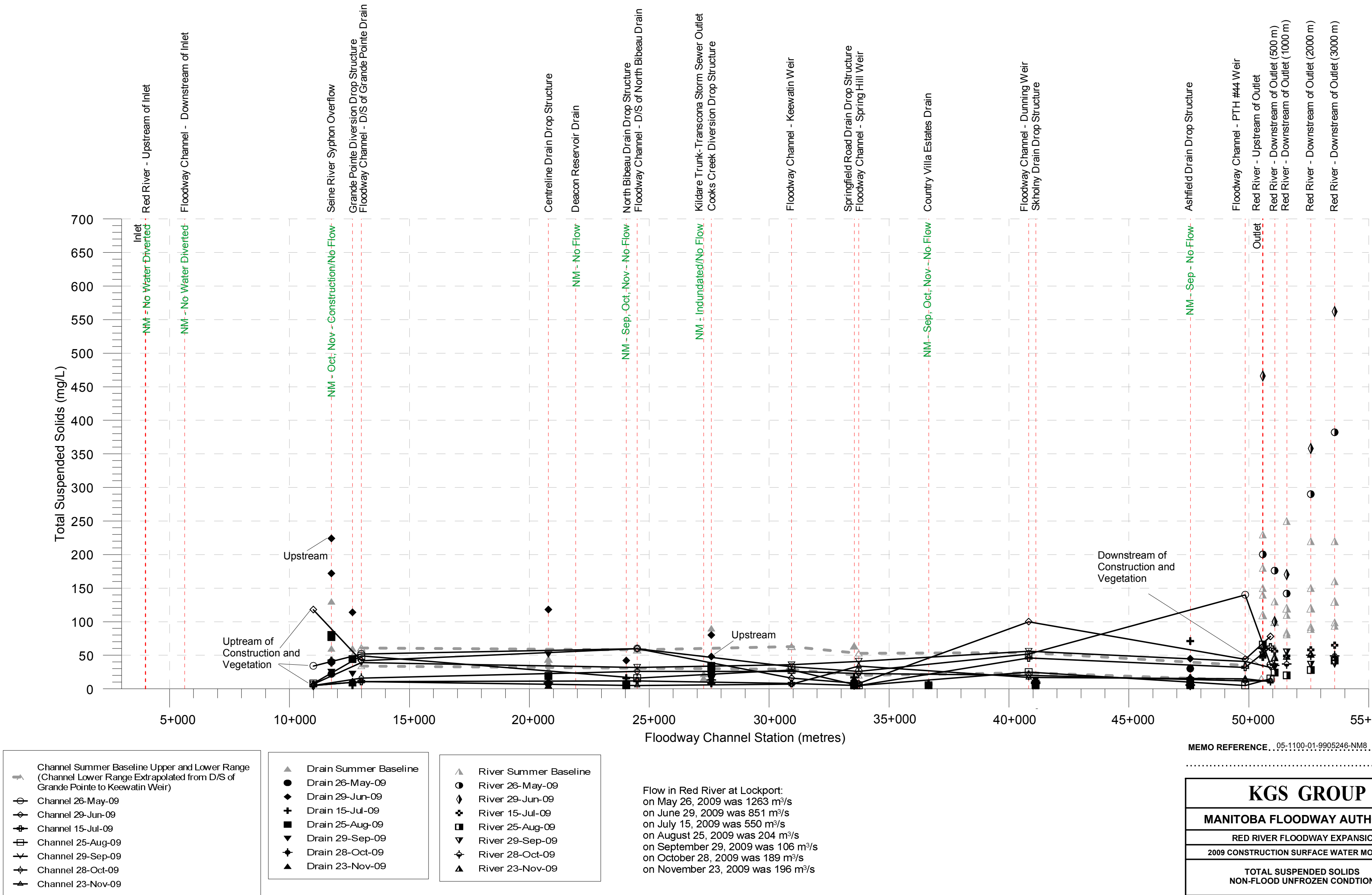
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

TOTAL SUSPENDED SOLIDS
SPRING FLOOD CONDITION

MARCH 2010	FIGURE NM8-3	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\TSS\Fig8-3_TSS construction_Spring Flood.grf



MEMO REFERENCE 05-1100-01-9905246-NM8

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

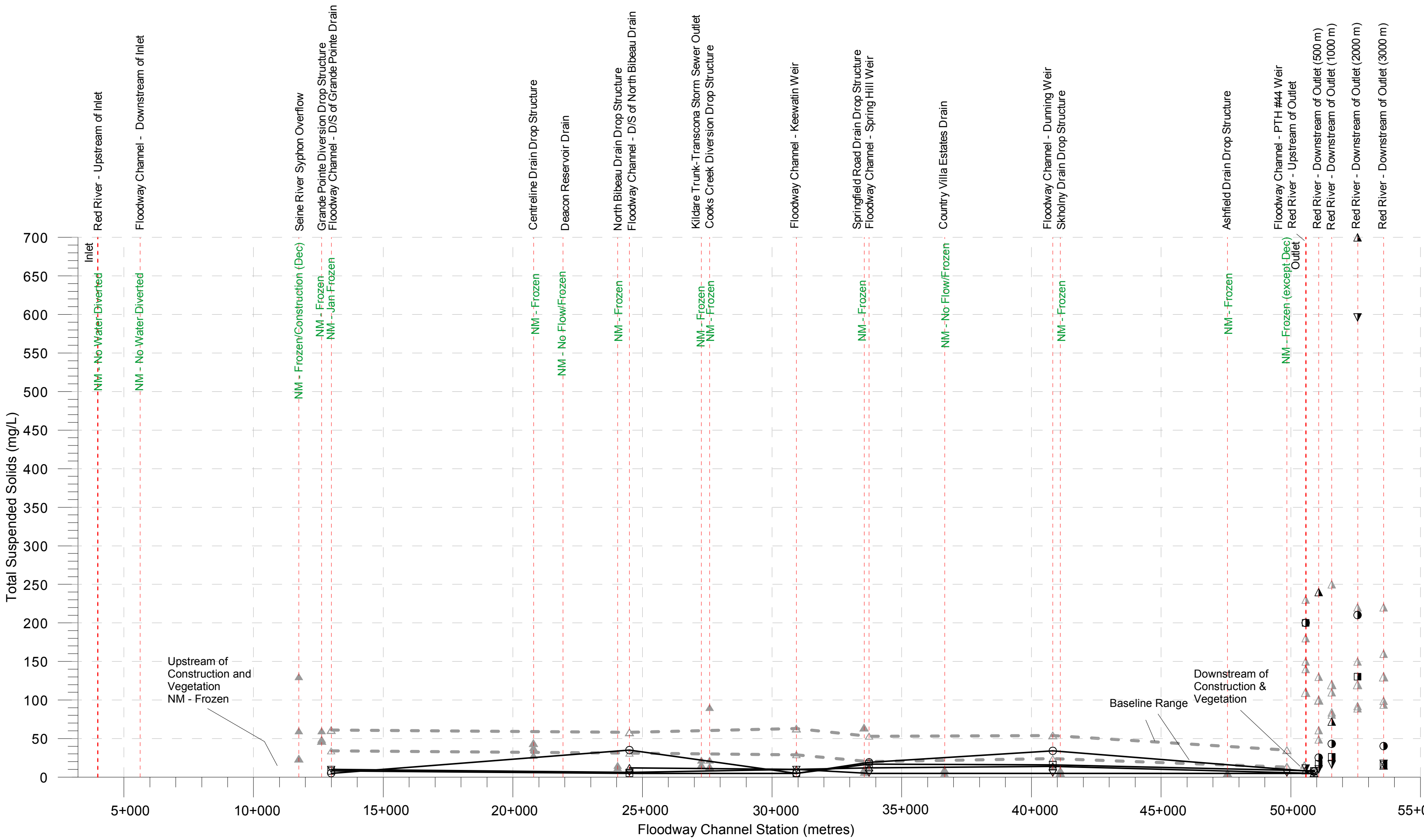
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

TOTAL SUSPENDED SOLIDS
NON-FLOOD UNFROZEN CONDITION

MARCH 2010	FIGURE NM8-4	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANUUAL\TSS\FigNM8-4_TSS construction_Non-flood unfrozen.grf



Channel Baseline Upper and Lower Range (Channel Lower Range Extrapolated from D/S of Grande Pointe to Keewatin Weir)
Channel 27-29-Jan-09
Channel 19/20-Feb-09
Channel 4/5-Mar-09
Channel 16/17-Dec-09

Drain Baseline
Drain 27-29-Jan-09
Drain 19/20-Feb-09
Drain 4/5-Mar-09
Drain 16/17-Dec-09

River Baseline
River 27-29-Jan-09
River 19/20-Feb-09
River 4/5-Mar-09
River 16/17-Dec-09

Flow in the Red River at Lockport on
- January 29, 2009 was 74.2 m³/s,
- February 19, 2009 was 83.5 m³/s, and
- March 5, 2009 was 111.9 m³/s
- December 16, 2009 was 119.8 m³/s.

MEMO REFERENCE 05-1100-01-9905246-NM8

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

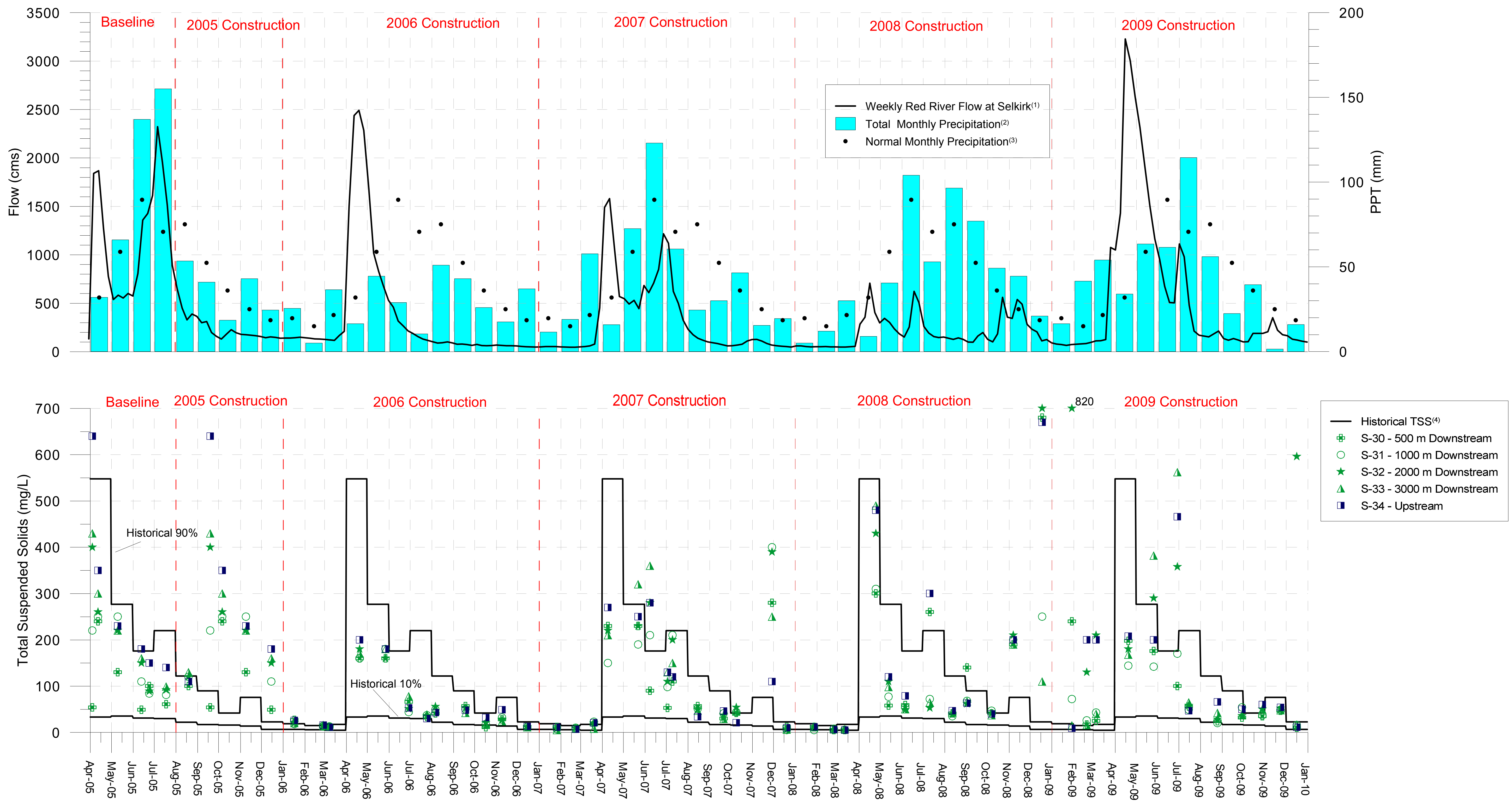
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

TOTAL SUSPENDED SOLIDS
NON-FLOOD FROZEN CONDITION

MARCH 2010	FIGURE NM8-5	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\TSS\FigNM8-5_TSS construction_Non-flood frozen.grf



MEMO REFERENCE 05-1100-01-9905246-NM8

Notes

1 - Province of Manitoba, Manitoba Water Stewardship, Hydrologic Forecast Centre; Weekly River Flow Reports.
2 - Environment Canada. 2005. The Green Lane Weather Office, Climate Data Winnipeg International Airport.
3 - Environment Canada. 2001. Canadian Climate Normals 1971-200, Winnipeg International Airport, Manitoba.
4 - Historical Data obtained from the Proposed Floodway Expansion Project Environmental Assessment Report
Completed by Tetres (August 2004).Surface water quality parameters were summarized to the 10th and 90th percentile.
Monthly range based on data collected once a month by Manitoba Water Stewardship from 1970 to 2003 in the Red River at Selkirk (downstream of the Floodway Outlet).

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

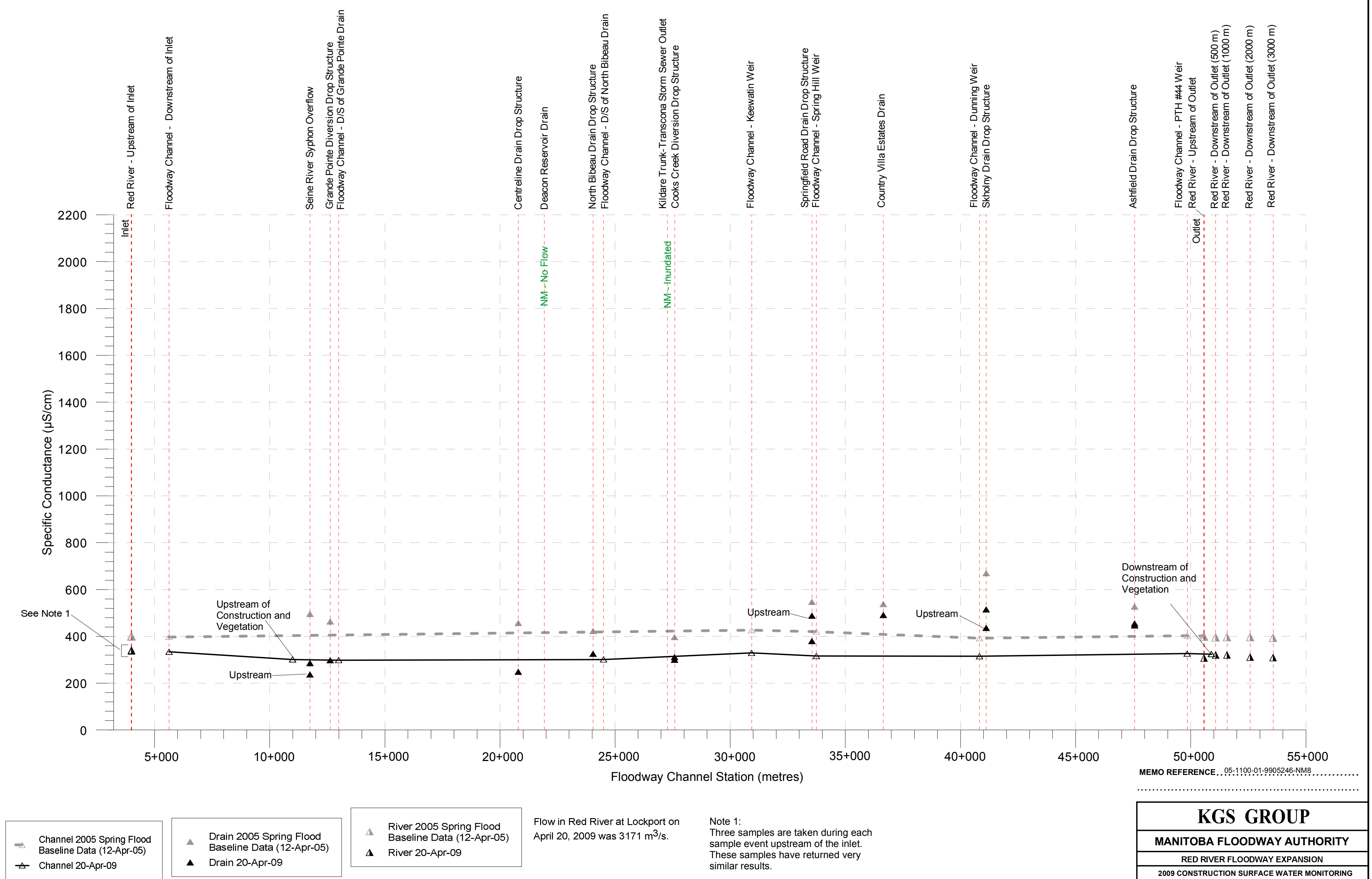
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

HISTORICAL WATER QUALITY COMPARISON
RED RIVER AT FLOODWAY OUTLET
TOTAL SUSPENDED SOLIDS

MARCH 2010	FIGURE NM8-6	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\Historical data\Worksheet\NM8-6_Historical Water Quality Comparisons TSS.grf



Flow in Red River at Lockport on April 20, 2009 was 3171 m^3/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905246-NM8

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

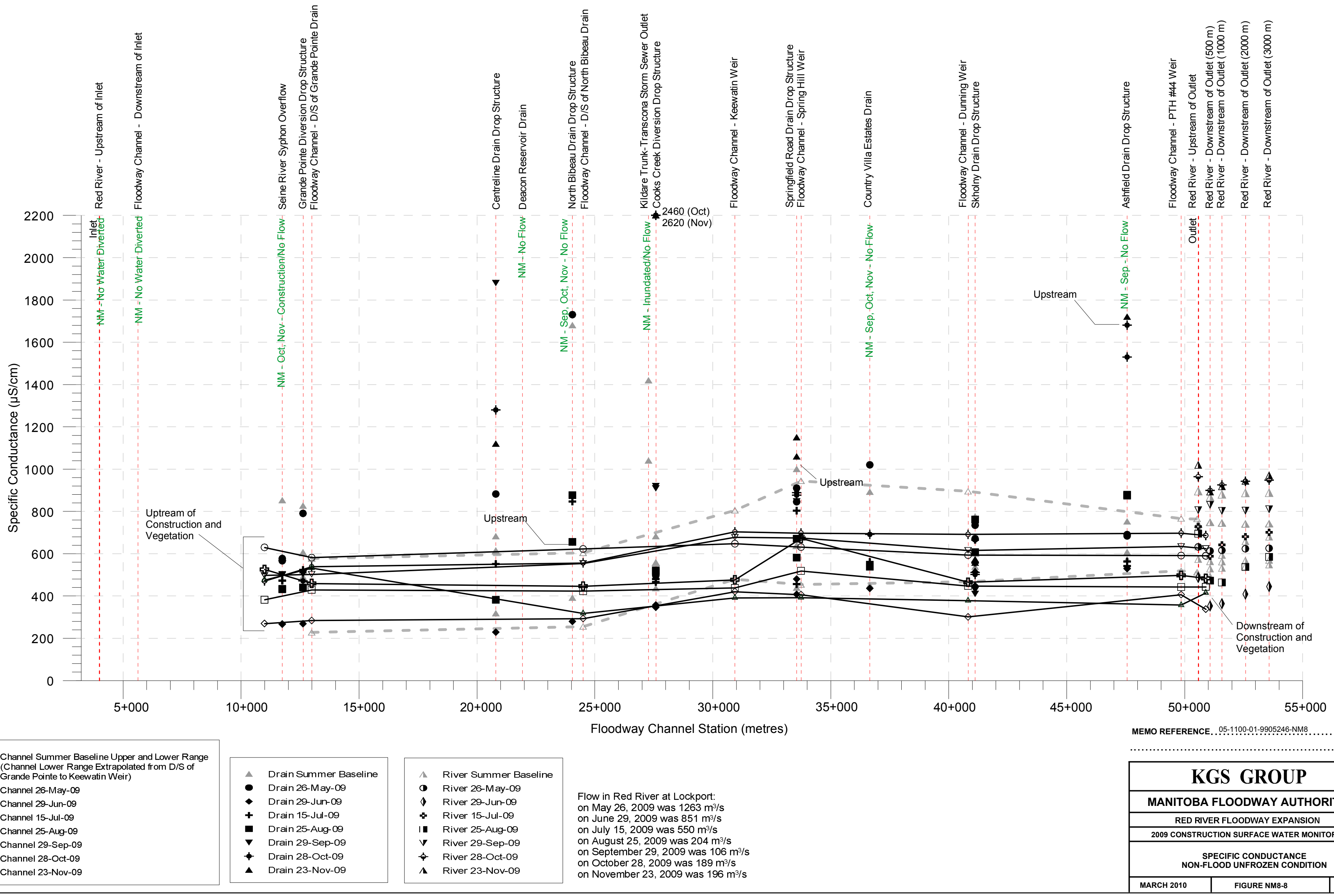
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

SPECIFIC CONDUCTANCE
SPRING FLOOD CONDITION

MARCH 2010 | FIGURE NM8-7 | REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\EC\FigNM8-7_EC construction_Spring flood.grf



MEMO REFERENCE: 05-1100-01-9905246-NM8

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

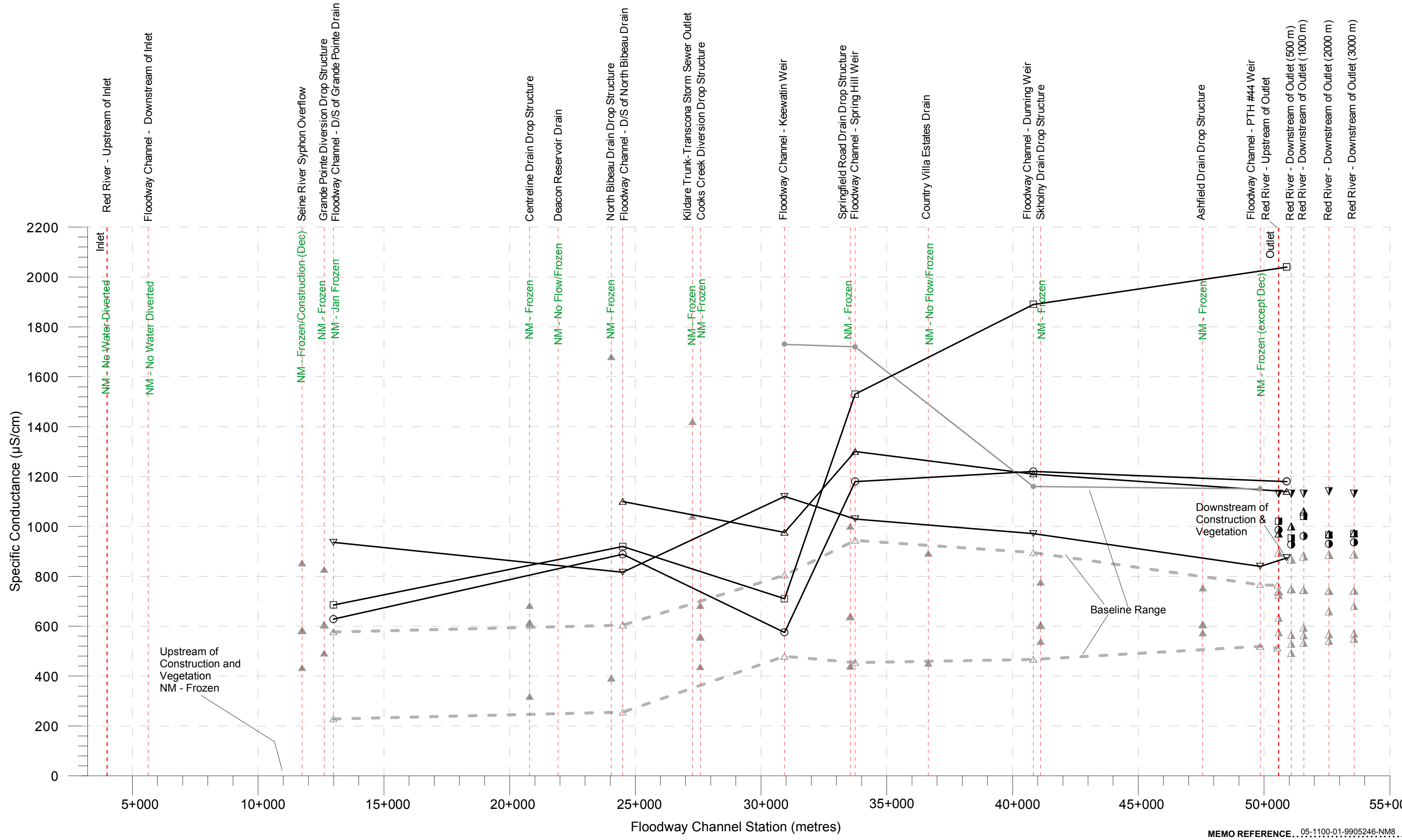
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

SPECIFIC CONDUCTANCE
NON-FLOOD UNFROZEN CONDITION

MARCH 2010	FIGURE NM8-8	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\EC\FigNM8-8_EC construction_Non-flood unfrozen.grf



- Channel Baseline Upper and Lower Range (Channel Lower Range Extrapolated from D/S of Grande Pointe to Keewatin Weir)
- Channel Winter Baseline (Baseflow, Groundwater Discharge Conditions Sampled March 2005)
- Channel 27-29-Jan-09
- Channel 19-20-Feb-09
- Channel 4/5-Mar-09
- Channel 16/17-Dec-09

- Drain Baseline
- Drain 27-29-Jan-09
- Drain 19/20-Feb-09
- Drain 4/5-Mar-09
- Drain 16/17-Dec-09

- River Baseline
- River 27-29-Jan-09
- River 19/20-Feb-09
- Channel 4/5-Mar-09
- River 16/17-Dec-09

Flow in the Red River at Lockport on
- January 29, 2009 was 74.2 m³/s,
- February 19, 2009 was 83.5 m³/s, and
- March 5, 2009 was 111.9 m³/s.
- December 16, 2009 was 119.8 m³/s.

MEMO REFERENCE 05-1100-01-9905246-NM8

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

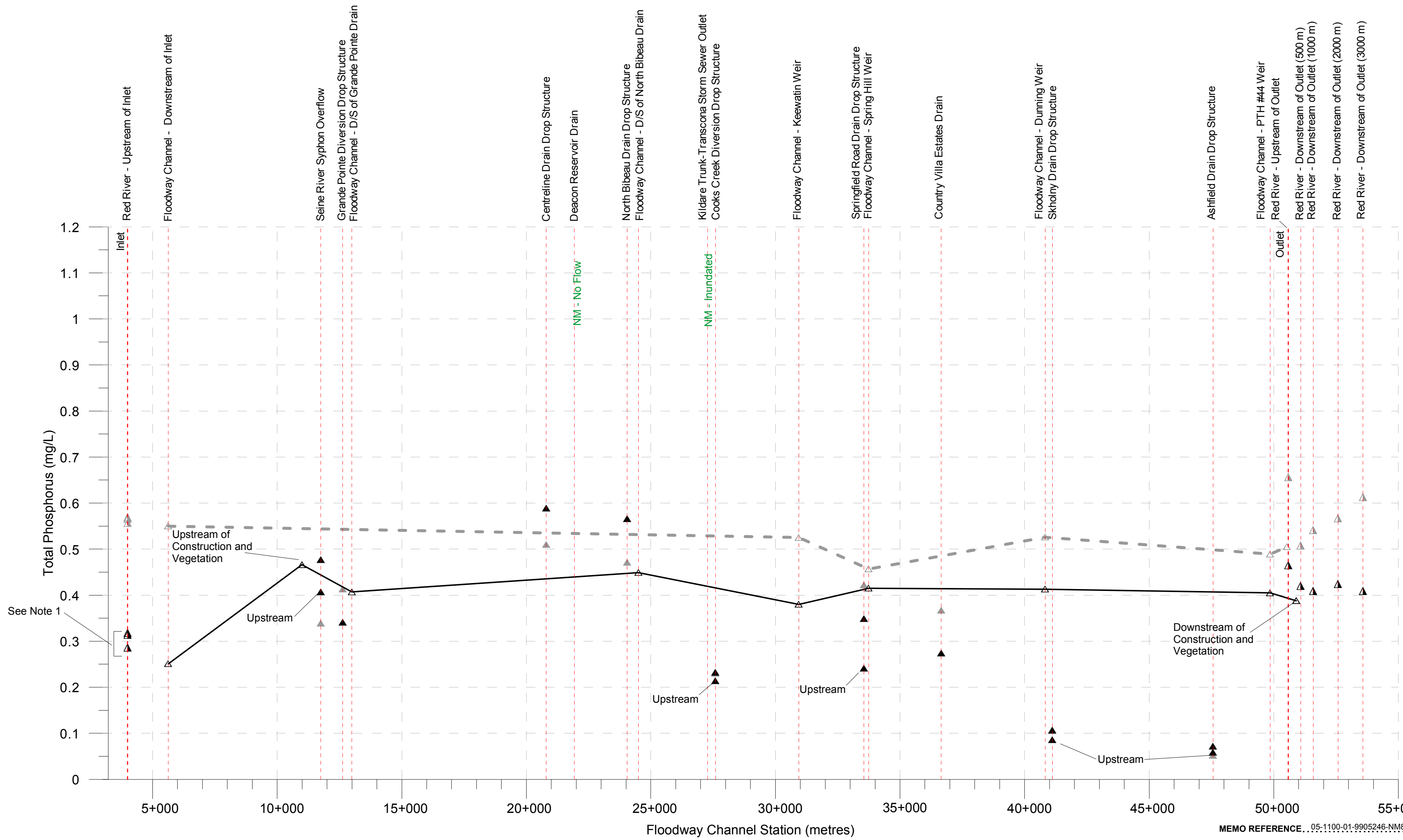
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

SPECIFIC CONDUCTANCE
NON-FLOOD FROZEN CONDITION

MARCH 2010	FIGURE NM8-9	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\EC\FigNM8-9_EC construction_Non-flood frozen.grf



MEMO REFERENCE 05-1100-01-9905246-NM8

Legend	
Channel 2005 Spring Flood Baseline Data (12-Apr-05)	Channel 20-Apr-09
Drain 2005 Spring Flood Baseline Data (12-Apr-05)	Drain 20-Apr-09
River 2005 Spring Flood Baseline Data (12-Apr-05)	River 20-Apr-09

Flow in Red River at Lockport on April 20, 2009 was 3171 m^3/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

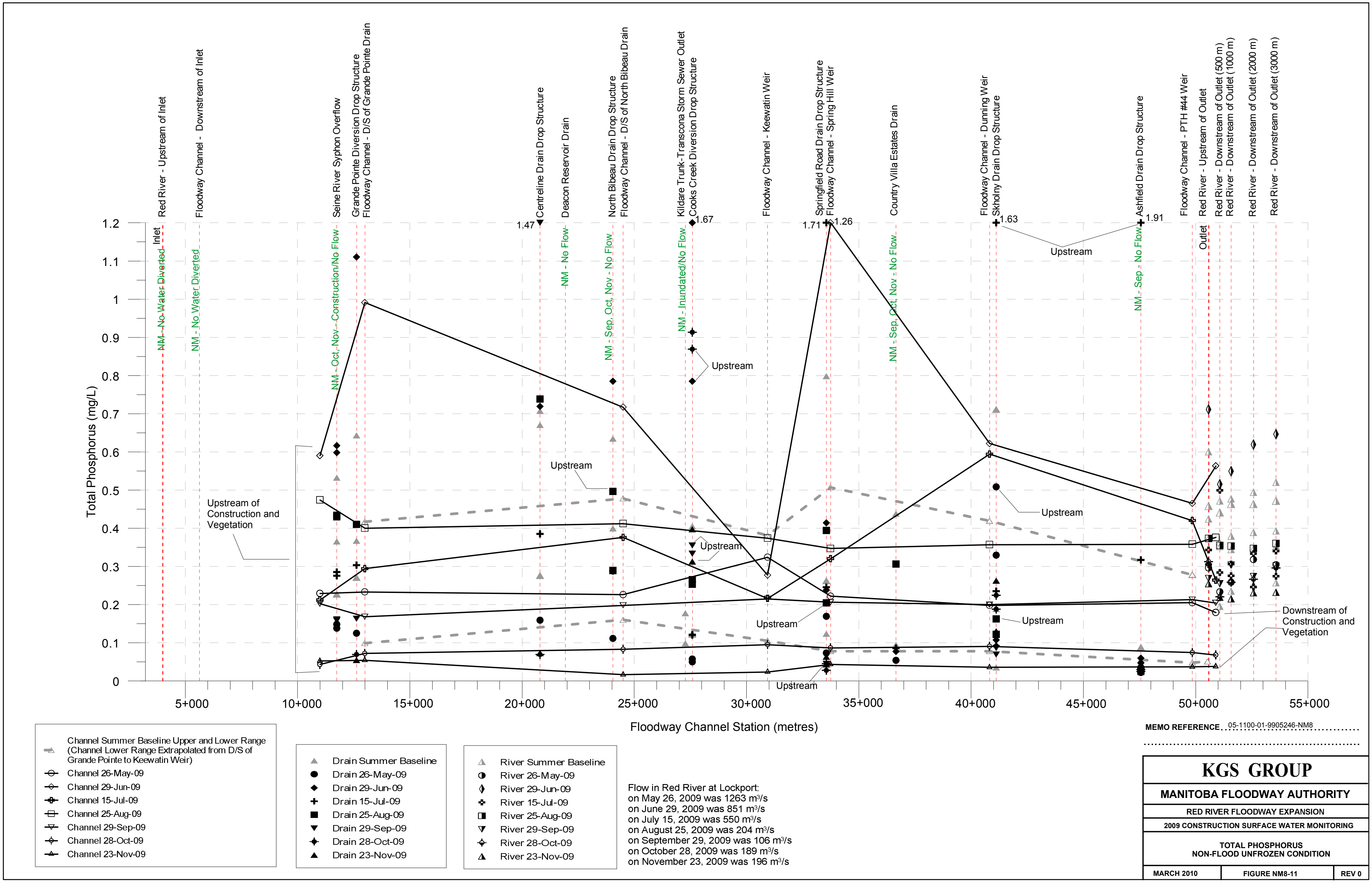
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

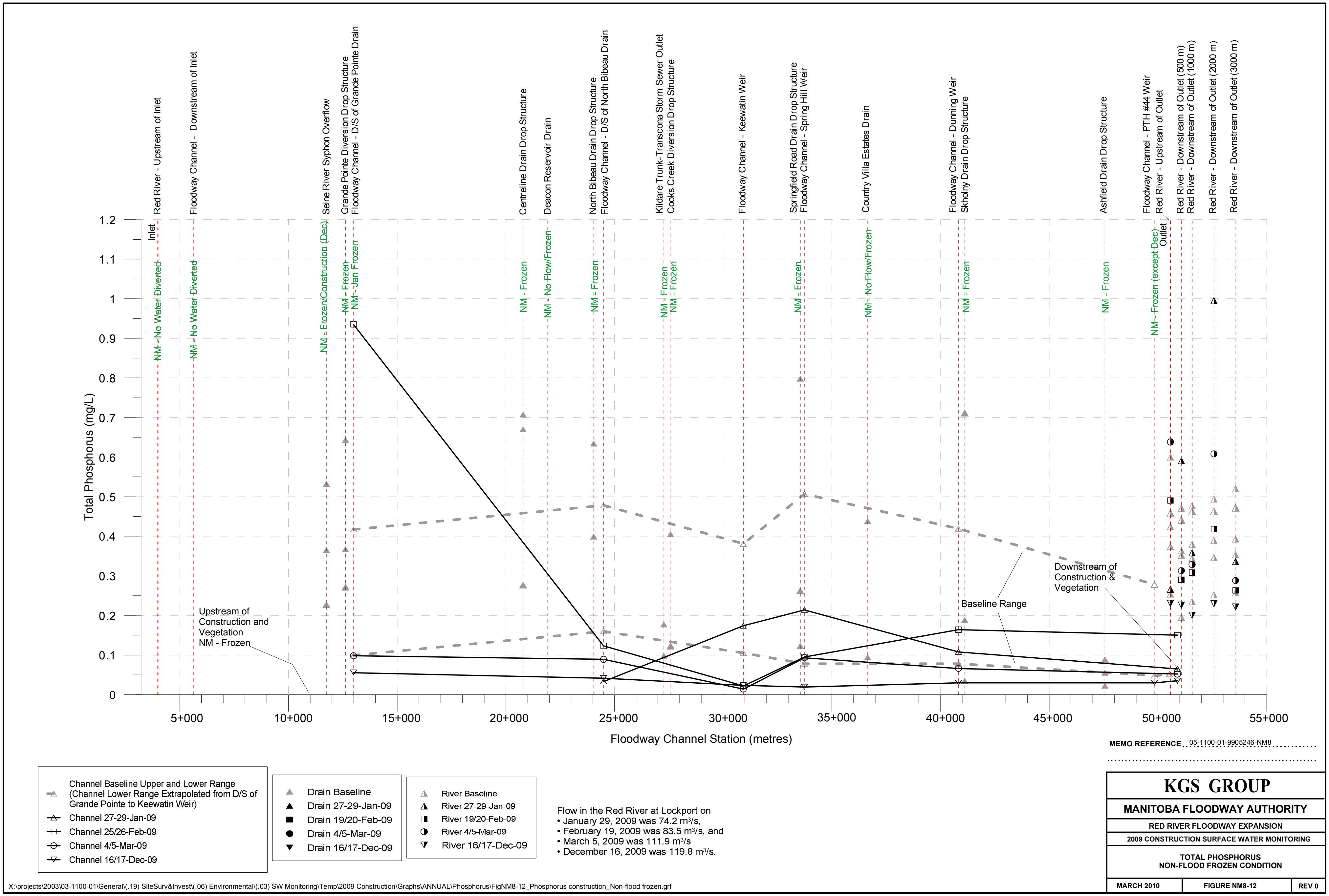
TOTAL PHOSPHORUS
SPRING FLOOD CONDITION

MARCH 2010	FIGURE NM8-10	REV 0

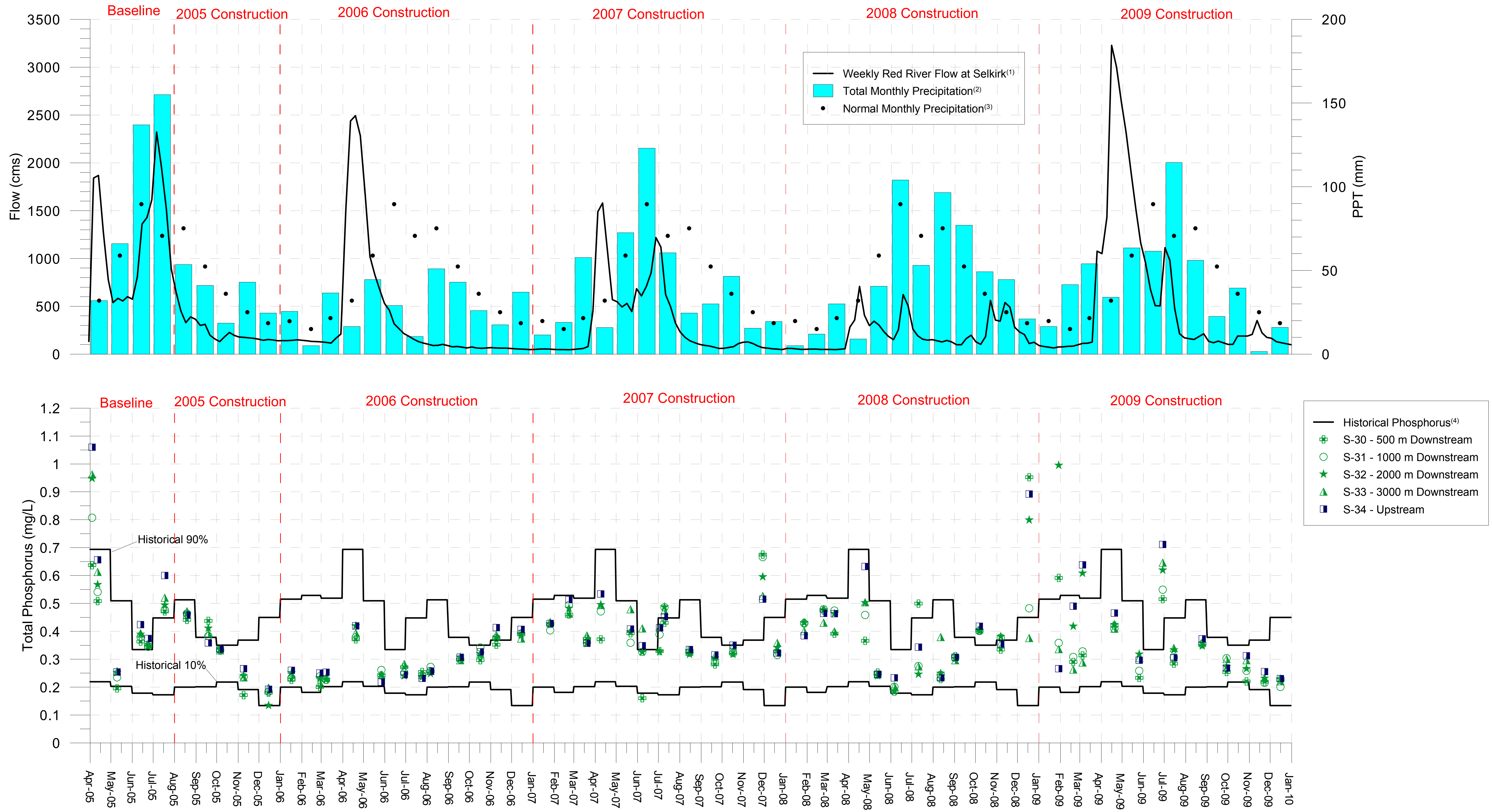
X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2006 Construction\GraphsANNUAL\Phosphorus\FigNM8-10_Phosphorus construction_Spring flood.grf



X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\Phosphorus\FigNM8-11_Phosphorus construction_Non-flood unfrozen.grf



Inlet
Red River - Upstream of Inlet
Floodway Channel - Downstream of Inlet
Seine River Syphon Overflow
Grande Pointe Diversion Drop Structure
Floodway Channel - D/S of Grande Pointe Drain
Centreline Drain Drop Structure
Deacon Reservoir Drain
North Bibeau Drain Drop Structure
Floodway Channel - D/S of North Bibeau Drain
Kildare Trunk-Transcona Storm Sewer Outlet
Cooks Creek Diversion Drop Structure
Floodway Channel - Keewatin Weir
Springfield Road Drain Drop Structure
Floodway Channel - Spring Hill Weir
Country Villa Estates Drain
Floodway Channel - Dunning Weir
Skholny Drain Drop Structure
Ashfield Drain Drop Structure
Floodway Channel - PTH #44 Weir
Red River - Upstream of Outlet
Outlet
Red River - Downstream of Outlet (500 m)
Red River - Downstream of Outlet (1000 m)
Red River - Downstream of Outlet (2000 m)
Red River - Downstream of Outlet (3000 m)
NM - No Water Diverted
NM - No Water Diverted
NM - Frozen/Construction (Dec)
NM - Frozen
NM - Jan Frozen
NM - Frozen
NM - No Flow/Frozen
NM - Frozen
NM - Frozen
NM - Frozen
NM - Frozen
NM - No Flow/Frozen
NM - Frozen
NM - Frozen
NM - Frozen (except Dec)
Total Phosphorus (mg/L)
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5+000
10+000
15+000
20+000
25+000
30+000
35+000
40+000
45+000
50+000
55+000
Floodway Channel Station (metres)
Upstream of Construction and Vegetation NM - Frozen
Baseline Range
Downstream of Construction & Vegetation
Channel Baseline Upper and Lower Range (Channel Lower Range Extrapolated from D/S of Grande Pointe to Keewatin Weir)
Channel 27-29-Jan-09
Channel 25/26-Feb-09
Channel 4/5-Mar-09
Channel 16/17-Dec-09
Drain Baseline
Drain 27-29-Jan-09
Drain 19/20-Feb-09
Drain 4/5-Mar-09
Drain 16/17-Dec-09
River Baseline
River 27-29-Jan-09
River 19/20-Feb-09
River 4/5-Mar-09
River 16/17-Dec-09
Flow in the Red River at Lockport on
• January 29, 2009 was 74.2 m³/s,
• February 19, 2009 was 83.5 m³/s, and
• March 5, 2009 was 111.9 m³/s
• December 16, 2009 was 119.8 m³/s.
MEMO REFERENCE 05-1100-01-9905246-NM8
KGS GROUP
MANITOBA FLOODWAY AUTHORITY
RED RIVER FLOODWAY EXPANSION
2009 CONSTRUCTION SURFACE WATER MONITORING
TOTAL PHOSPHORUS
NON-FLOOD FROZEN CONDITION
MARCH 2010
FIGURE NM8-12
REV 0
X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\Phosphorus\FigNM8-12_Phosphorus construction_Non-flood frozen.grf



MEMO REFERENCE 05-1100-01-9905246-NM8

Notes

1 - Province of Manitoba, Manitoba Water Stewardship, Hydrologic Forecast Centre; Weekly River Flow Reports.
2 - Environment Canada. 2005. The Green Lane Weather Office, Climate Data Winnipeg International Airport.
3 - Environment Canada. 2001. Canadian Climate Normals 1971-200, Winnipeg International Airport, Manitoba.
4 - Historical Data obtained from the Proposed Floodway Expansion Project Environmental Assessment Report
Completed by Tetres (August 2004).Surface water quality parameters were summarized to the 10^{th} and 90^{th} percentile.
Monthly range based on data collected once a month by Manitoba Water Stewardship from 1970 to 2003 in the Red River at Selkirk (downstream of the Floodway Outlet).

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\Historical data\Worksheet\NM8-13_Historical Water Quality Comparisons Total Phosphorus.grf

KGS GROUP

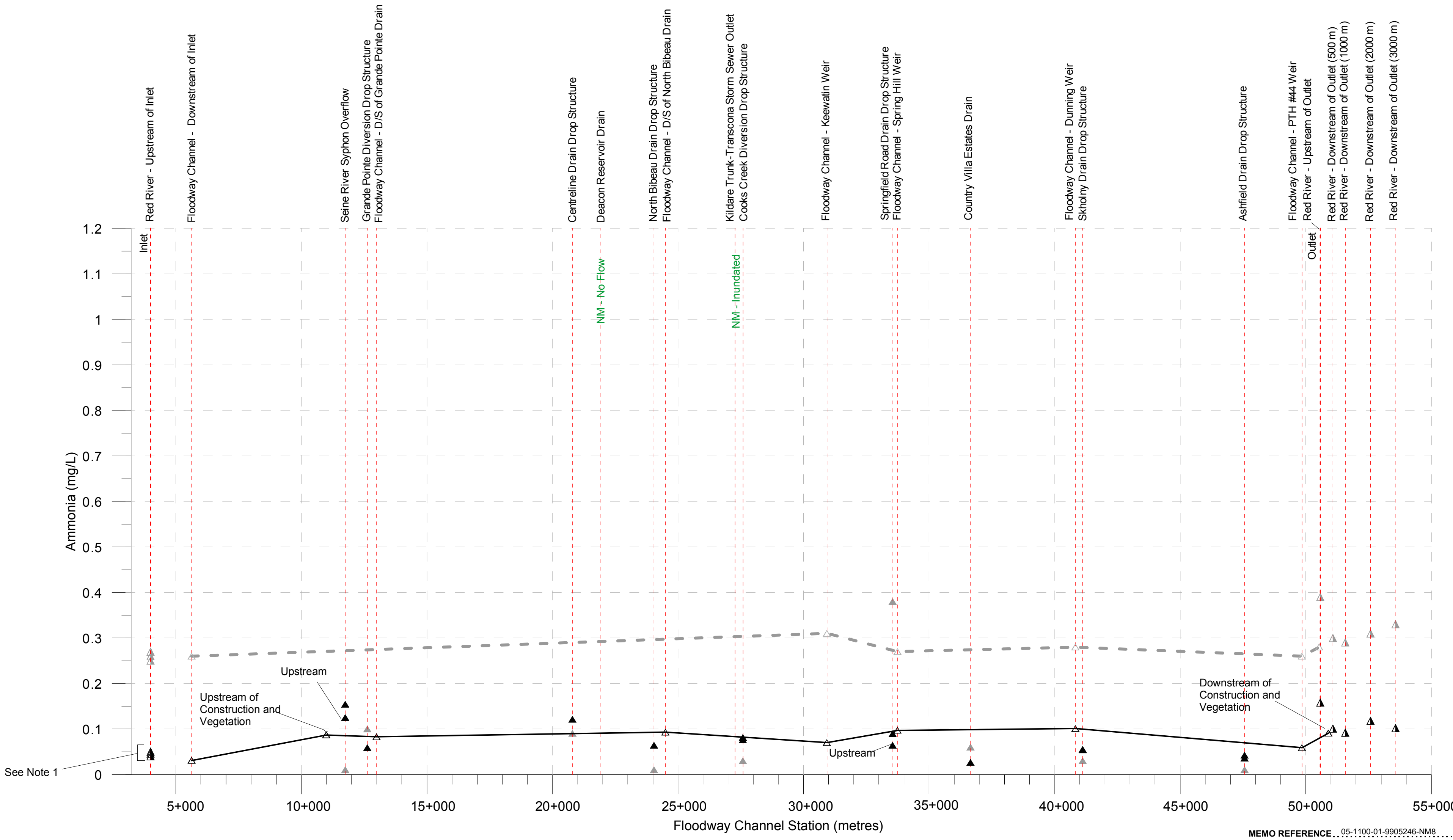
MANITOBA FLOODWAY AUTHORITY

RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

HISTORICAL WATER QUALITY COMPARISON
RED RIVER AT FLOODWAY OUTLET
TOTAL PHOSPHORUS

MARCH 2010	FIGURE NM8-13	REV 0



Channel 2005 Spring Flood Baseline Data (12-Apr-05)
Channel 20-Apr-09

Drain 2005 Spring Flood Baseline Data (12-Apr-05)
Drain 20-Apr-09

River 2005 Spring Flood Baseline Data (12-Apr-05)
River 20-Apr-09

Flow in Red River at Lockport on April 20, 2009 was 3171 m³/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905246-NM8

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

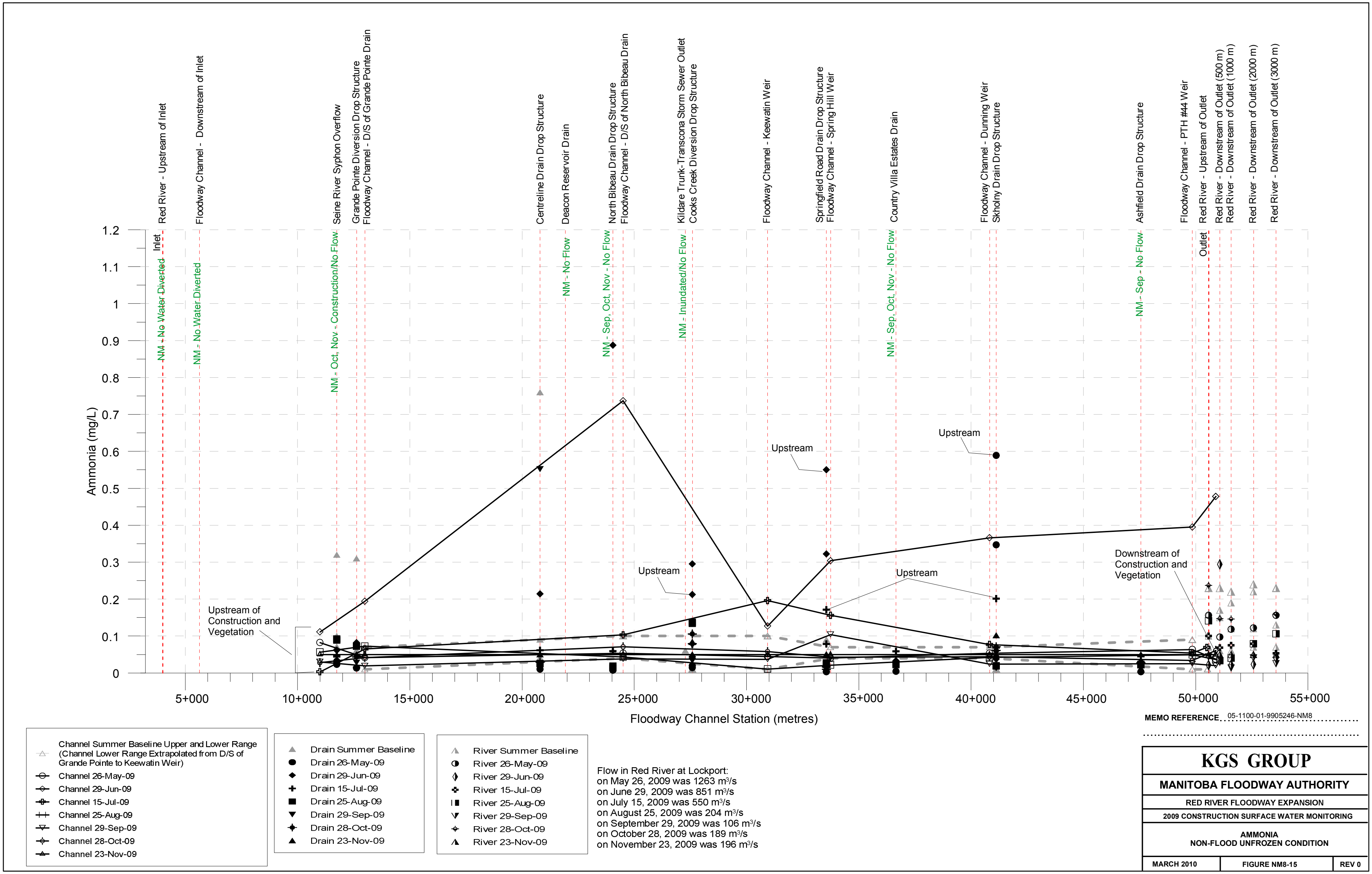
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

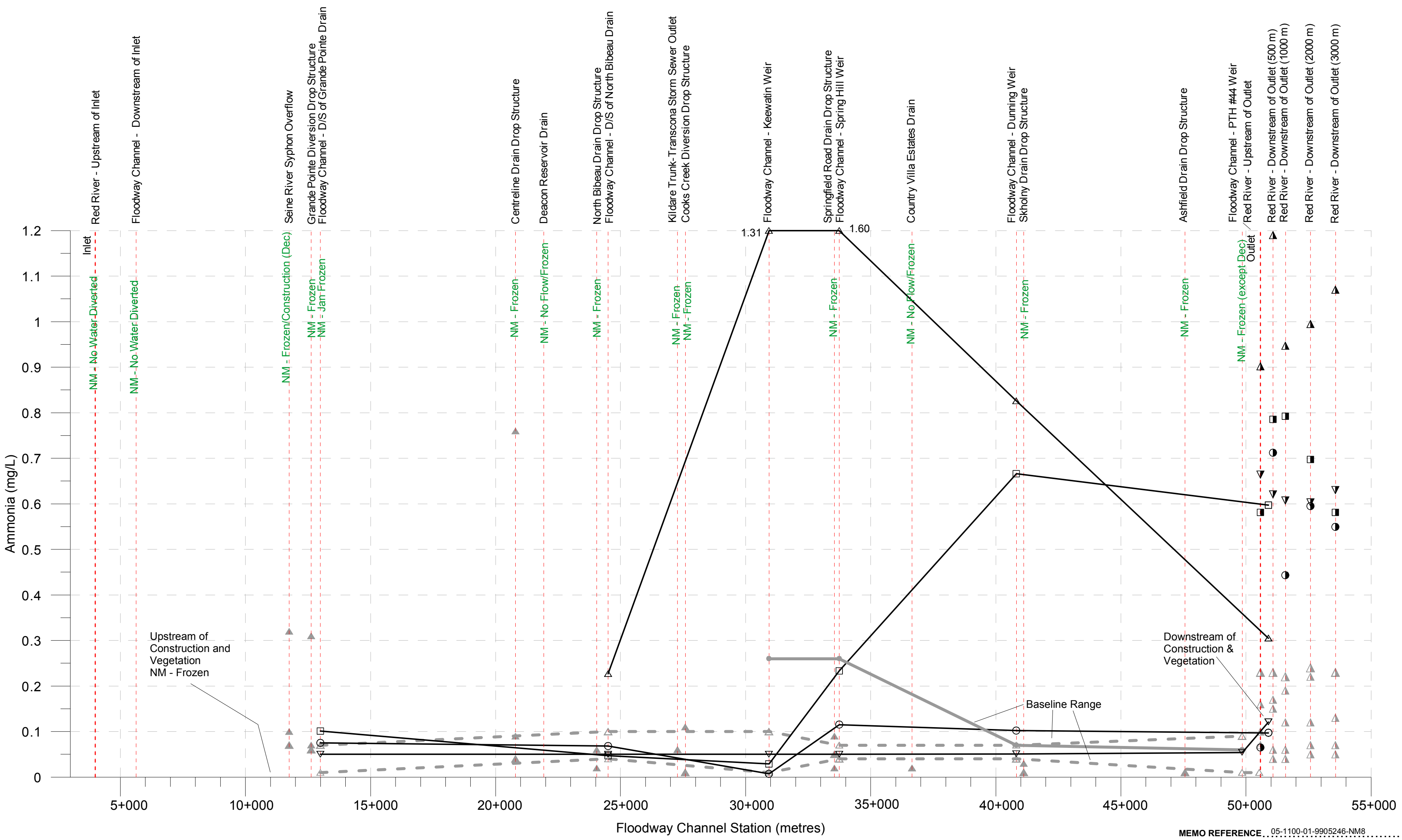
AMMONIA
SPRING FLOOD CONDITION

MARCH 2010	FIGURE NM8-14	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\Ammonia\FigNM8-14_Ammonia construction_Spring flood.grf



X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\Ammonia\FigNM8-15_Ammonia construction_Non-flood unfrozen.grf



- Channel Baseline Upper and Lower Range (Channel Lower Range Extrapolated from D/S of Grande Pointe to Keewatin Weir)
- Channel Winter Baseline (Baseflow, Groundwater Discharge Conditions Sampled March 2005)
- Channel 27-29-Jan-09
- Channel 19/20-Feb-09
- Channel 4/5-Mar-09
- Channel 16/17-Dec-09

- Drain Baseline
- Drain 27-29-Jan-09
- Drain 19/20-Feb-09
- Drain 4/5-Mar-09
- Drain 16/17-Dec-09

- River Baseline
- River 27-29-Jan-09
- River 19-20-Feb-09
- River 4/5-Mar-09
- River 16/17-Dec-09

Flow in the Red River at Lockport on
- January 29, 2009 was 74.2 m³/s,
- February 19, 2009 was 83.5 m³/s, and
- March 5, 2009 was 111.9 m³/s
- December 16, 2009 was 119.8 m³/s.

MEMO REFERENCE 05-1100-01-9905246-NM8

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

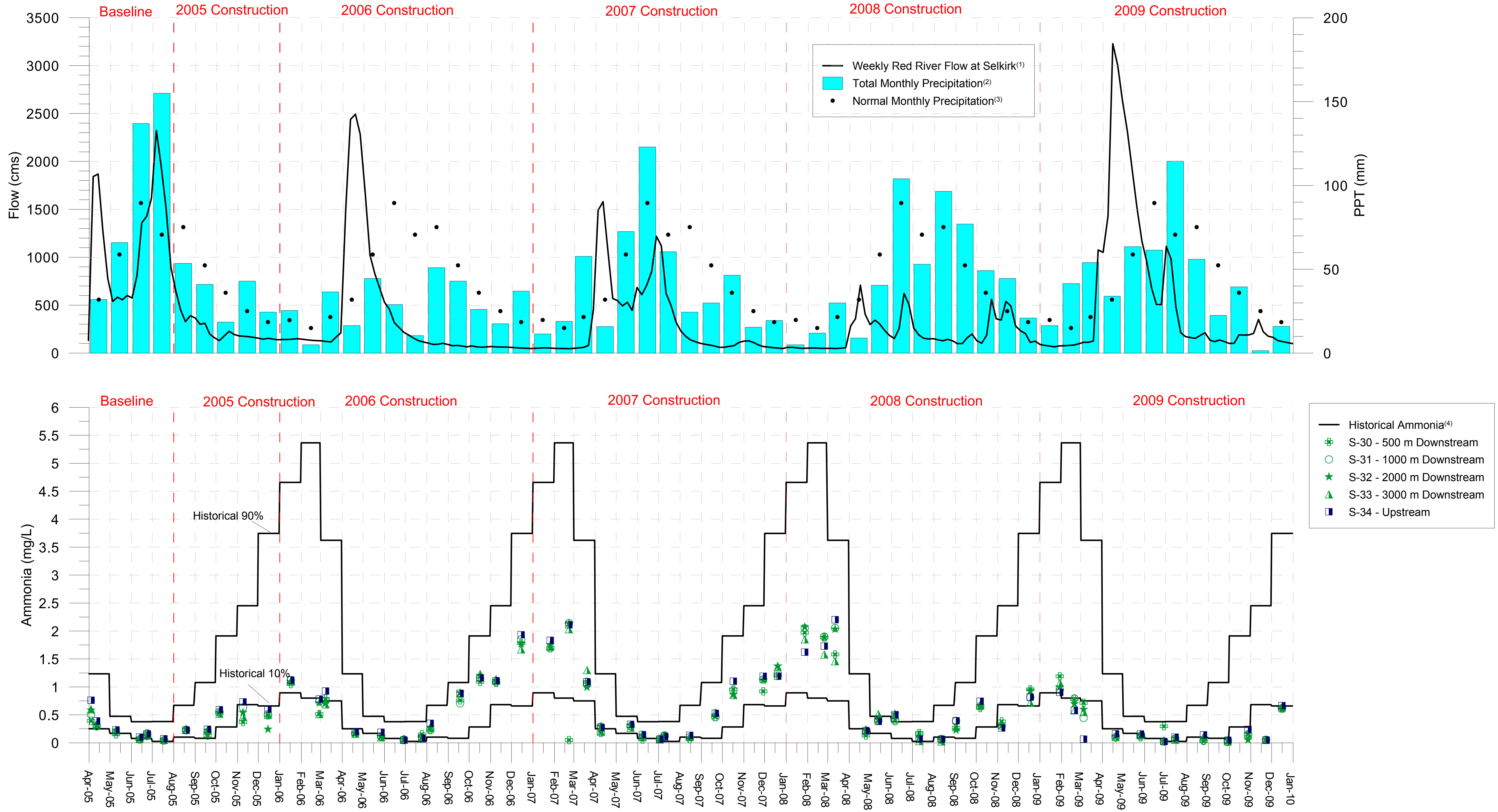
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

AMMONIA
NON-FLOOD FROZEN CONDITION

MARCH 2010	FIGURE NM8-16	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\Ammonia\FigNM8-16_Ammonia construction_Non-flood frozen.grf



MEMO REFERENCE 05-1100-01-9905246-NM8

Notes

1 - Province of Manitoba, Manitoba Water Stewardship, Hydrologic Forecast Centre; Weekly River Flow Reports.
2 - Environment Canada. 2005. The Green Lane Weather Office, Climate Data Winnipeg International Airport.
3 - Environment Canada. 2001. Canadian Climate Normals 1971-200, Winnipeg International Airport, Manitoba.
4 - Historical Data obtained from the Proposed Floodway Expansion Project Environmental Assessment Report
Completed by Tetres (August 2004).Surface water quality parameters were summarized to the 10th and 90th percentile.
Monthly range based on data collected once a month by Manitoba Water Stewardship from 1970 to 2003 in the Red River at Selkirk (downstream of the Floodway Outlet).

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

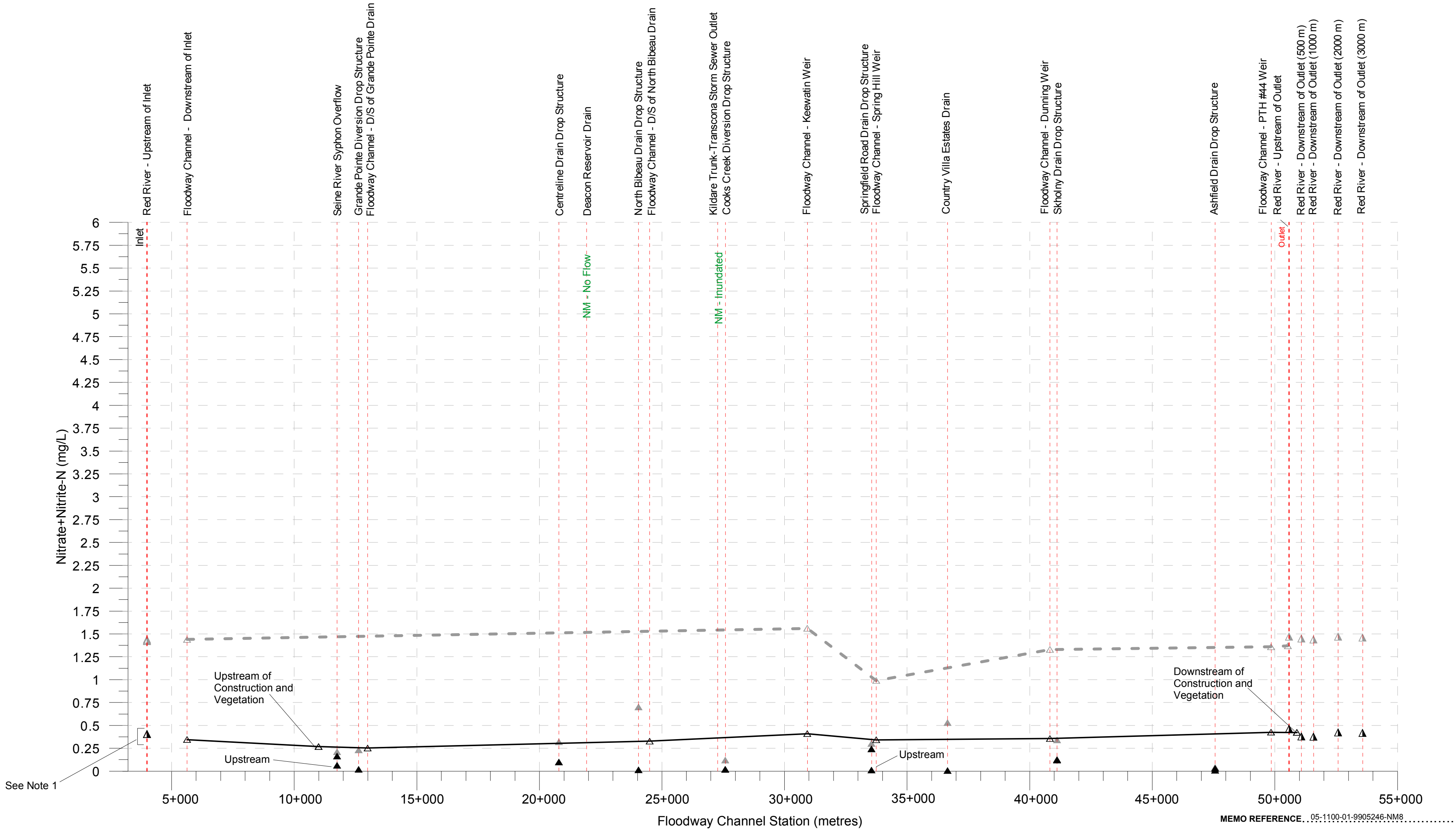
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

HISTORICAL WATER QUALITY COMPARISON
RED RIVER AT FLOODWAY OUTLET
AMMONIA

MARCH 2010	FIGURE NM8-17	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\Historical data\Worksheet\NM8-17_Historical Water Quality Comparisons Ammonia.grf



MEMO REFERENCE 05-1100-01-9905246-NM8

Channel 2005 Spring Flood Baseline Data (12-Apr-05)
Channel 20-Apr-09

Drain 2005 Spring Flood Baseline Data (12-Apr-05)
Drain 20-Apr-09

River 2005 Spring Flood Baseline Data (12-Apr-05)
River 20-Apr-09

Flow in Red River at Lockport on April 20, 2009 was 3171 m^3/s

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

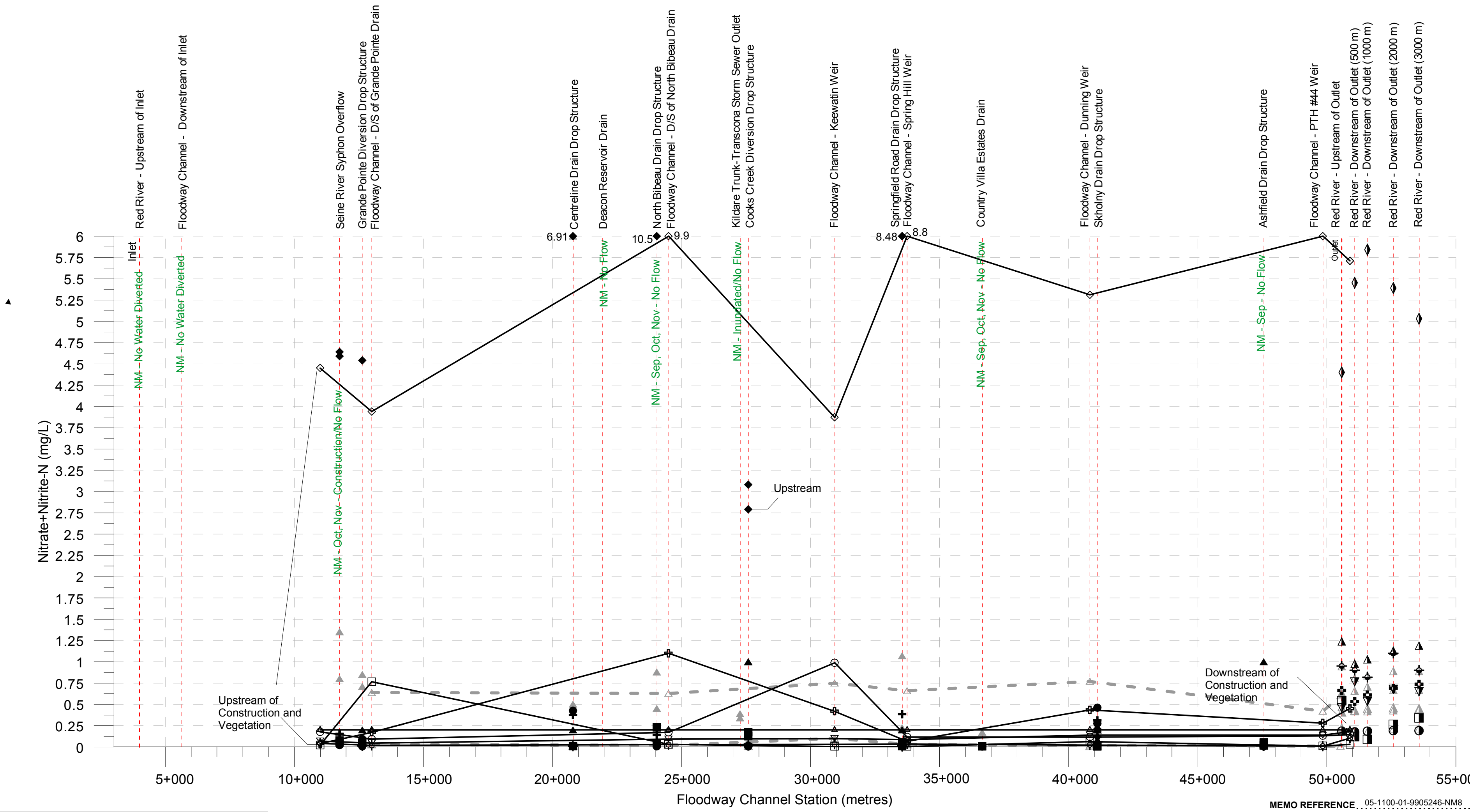
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

NITRATE + NITRITE - N
SPRING FLOOD CONDITION

MARCH 2010	FIGURE NM8-18	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\N&N\FigNM8-18_Nitrate+Nitrite construction_Spring flood.grf



Channel Summer Baseline Upper and Lower Range (Channel Lower Range Extrapolated from D/S of Grande Pointe to Keewatin Weir)
Channel 26-May-09
Channel 29-Jun-09
Channel 15-Jul-09
Channel 25-Aug-09
Channel 29-Sep-09
Channel 28-Oct-09
Channel 23-Nov-09

Drain Summer Baseline
Drain 26-May-09
Drain 29-Jun-09
Drain 15-Jul-09
Drain 25-Aug-09
Drain 29-Sep-09
Drain 28-Oct-09
Drain 23-Nov-09

River Summer Baseline
River 26-May-09
River 29-Jun-09
River 15-Jul-09
River 25-Aug-09
River 29-Sep-09
River 28-Oct-09
River 23-Nov-09

Flow in Red River at Lockport:
on May 26, 2009 was 1263 m³/s
on June 29, 2009 was 851 m³/s
on July 15, 2009 was 550 m³/s
on August 25, 2009 was 204 m³/s
on September 29, 2009 was 106 m³/s
on October 28, 2009 was 189 m³/s
on November 23, 2009 was 196 m³/s

MEMO REFERENCE 05-1100-01-9905246-NM8

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

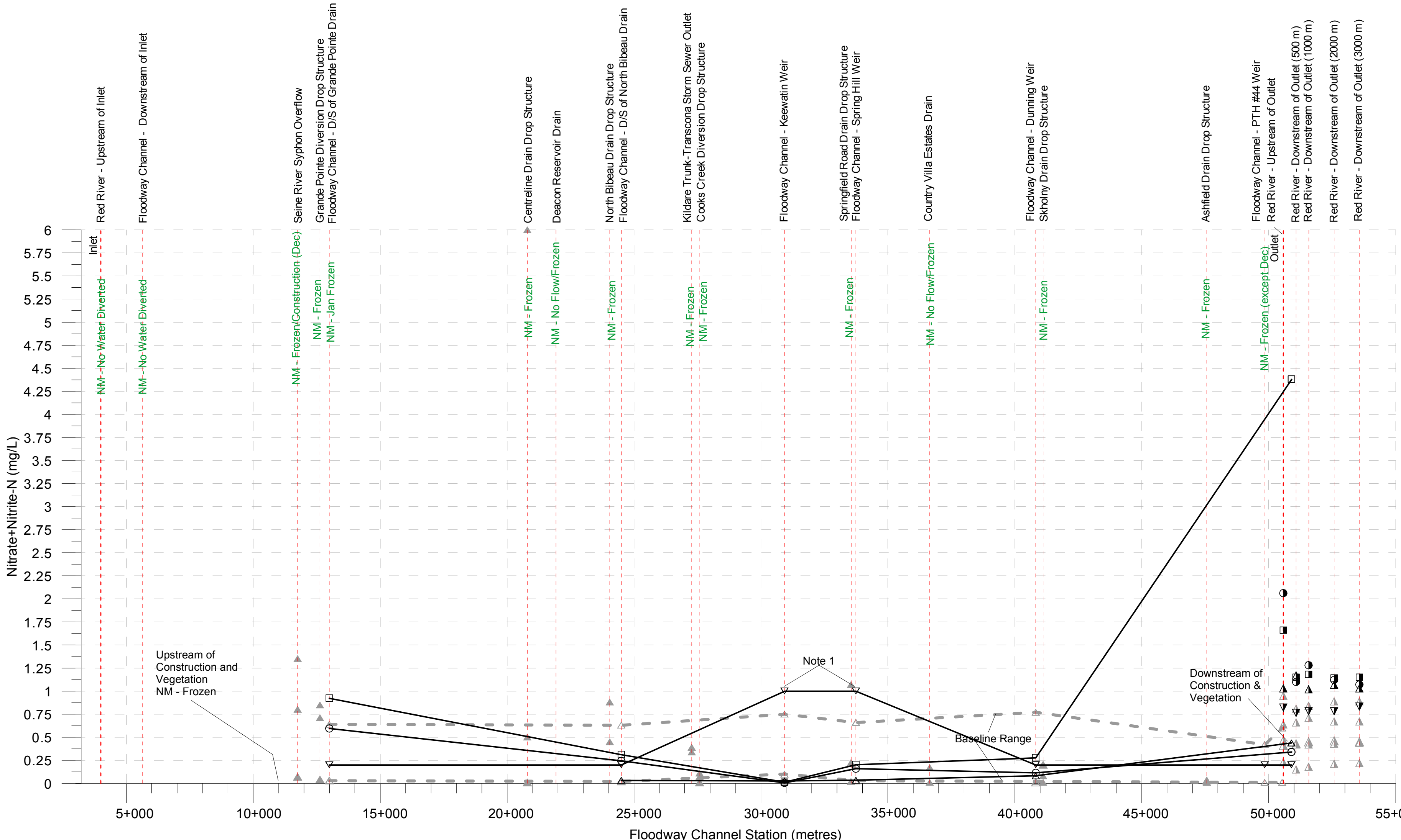
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

NITRATE+NITRITE-N
NON-FLOOD UNFROZEN CONDITION

MARCH 2010	FIGURE NM8-19	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\N&N\FigNM8-19_Nitrate+Nitrite construction_Non-flood unfrozen.grf



Flow in the Red River at Lockport on
- January 29, 2009 was 74.2 m³/s,
- February 19, 2009 was 83.5 m³/s, and
- March 5, 2009 was 111.9 m³/s
- December 16, 2009 was 119.8 m³/s.

Note 1: Results were below detection limits, however a higher than normal detection limit was used by the laboratory.

MEMO REFERENCE 05-1100-01-9905246-NM8

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

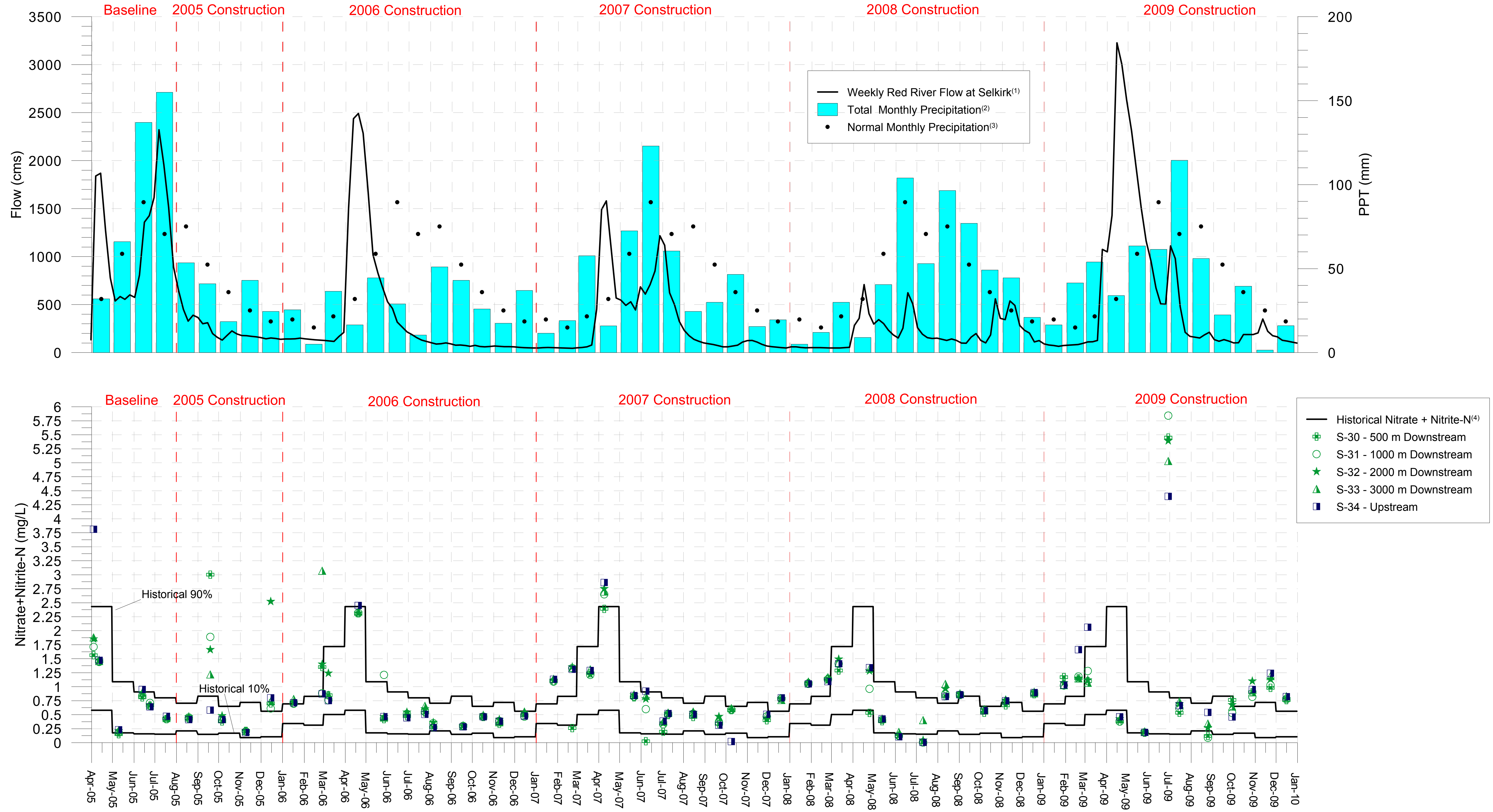
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

NITRATE + NITRITE - N
NON-FLOOD FROZEN CONDITION

MARCH 2010	FIGURE NM8-20	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\N&N\FigNM8-20_Nitrate+Nitrite construction_Non-flood frozen.grf



Notes

1 - Province of Manitoba, Manitoba Water Stewardship, Hydrologic Forecast Centre; Weekly River Flow Reports.
2 - Environment Canada. 2005. The Green Lane Weather Office, Climate Data Winnipeg International Airport.
3 - Environment Canada. 2001. Canadian Climate Normals 1971-200, Winnipeg International Airport, Manitoba.
4 - Historical Data obtained from the Proposed Floodway Expansion Project Environmental Assessment Report
Completed by Tetres (August 2004).Surface water quality parameters were summarized to the 10th and 90th percentile.
Monthly range based on data collected once a month by Manitoba Water Stewardship from 1970 to 2003 in the Red River at Selkirk (downstream of the Floodway Outlet).

MEMO REFERENCE 05-1100-01-9905246-NM8

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

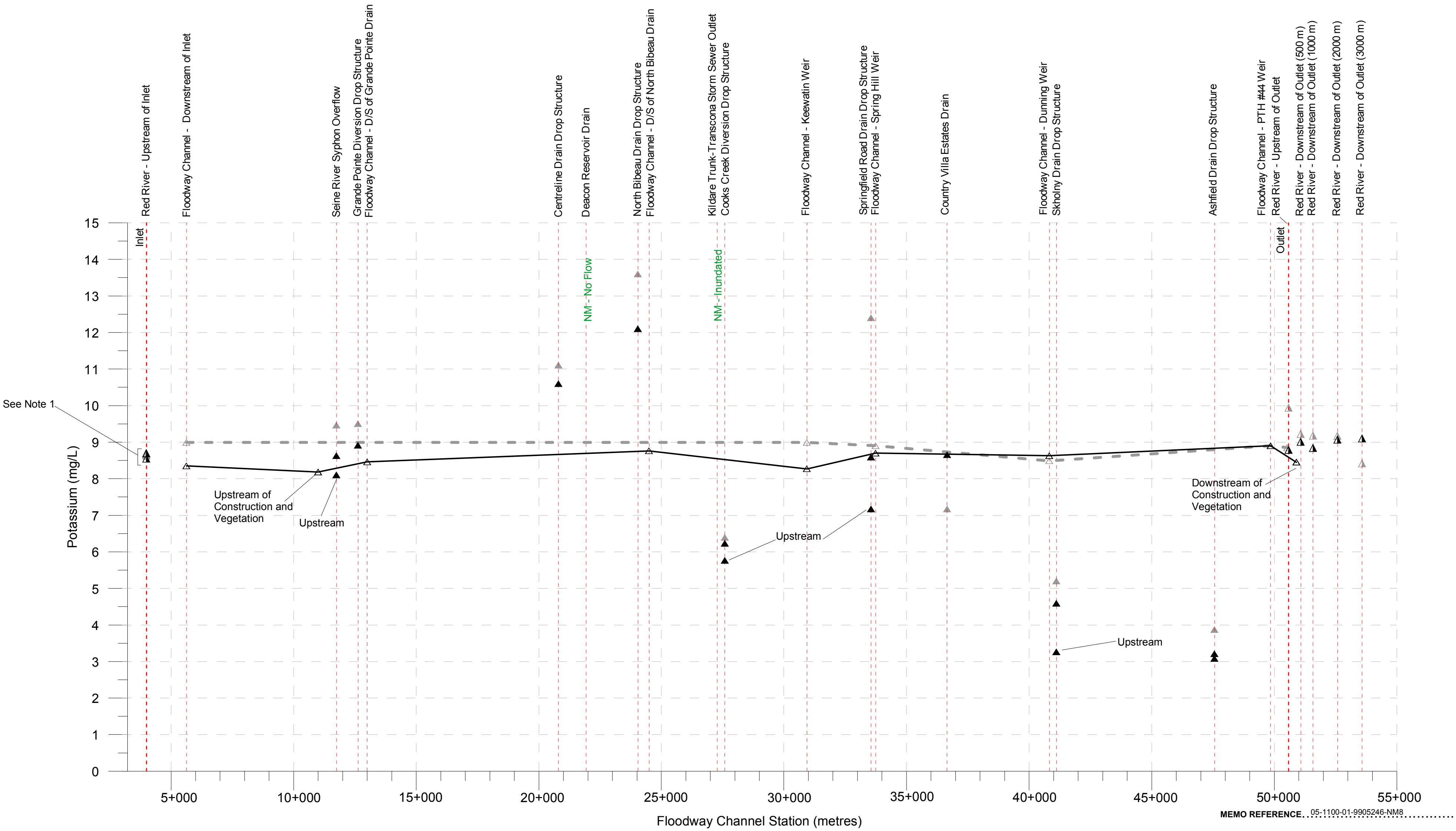
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

HISTORICAL WATER QUALITY COMPARISON
RED RIVER AT FLOODWAY OUTLET
NITRATE + NITRITE-N

MARCH 2010	FIGURE NM8-21	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\Historical data\Worksheet\NM8-21_Historical Water Quality Comparisons Total Nitrate and Nitrite-n.grf



MEMO REFERENCE. 05-1100-01-9905246-NM8

Channel 2005 Spring Flood Baseline Data (12-Apr-05)
Channel 20-Apr-09

Drain 2005 Spring Flood Baseline Data (12-Apr-05)
Drain 20-Apr-09

River 2005 Spring Flood Baseline Data (12-Apr-05)
River 20-Apr-09

Flow in Red River at Lockport on April 20, 2009 was 3171 m^3/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

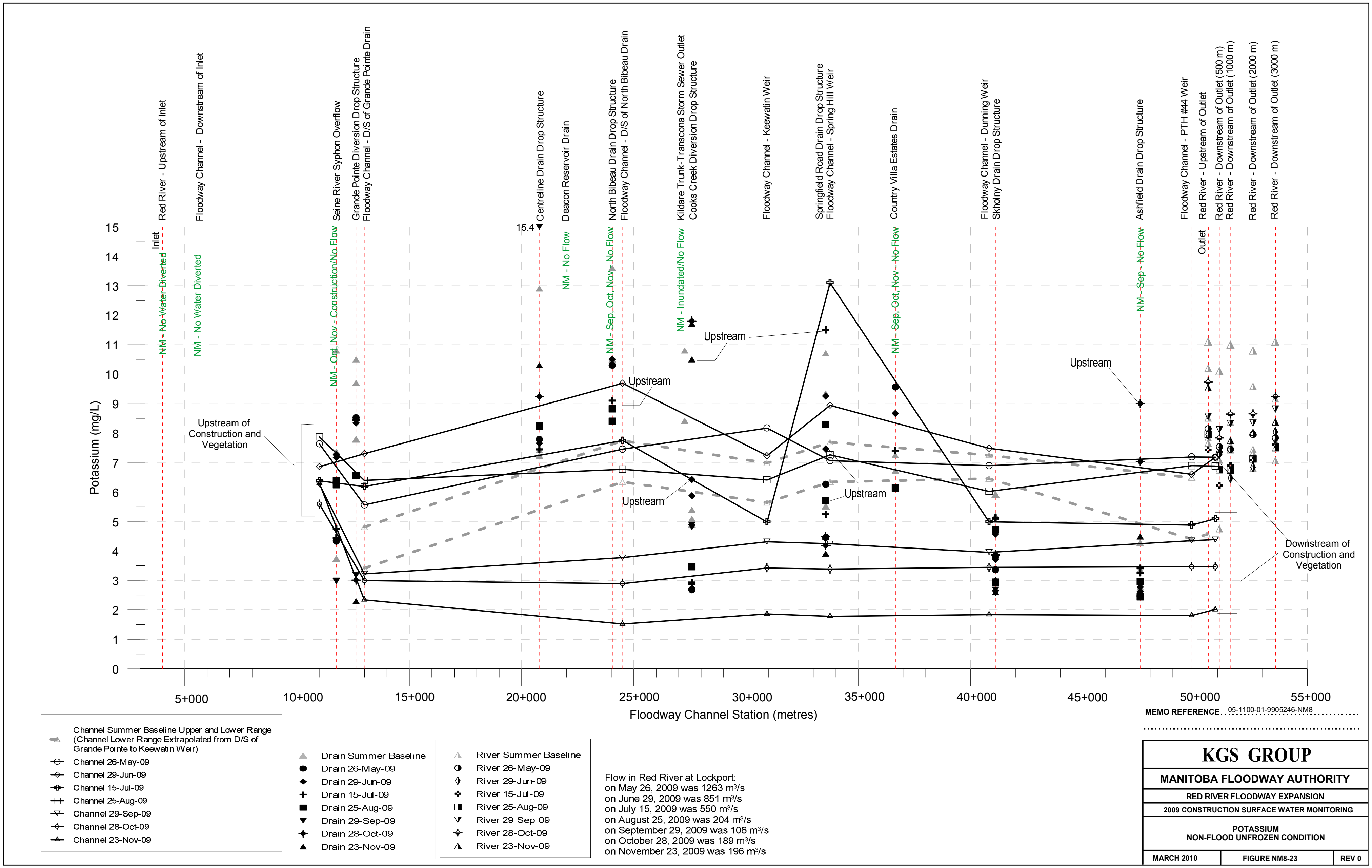
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

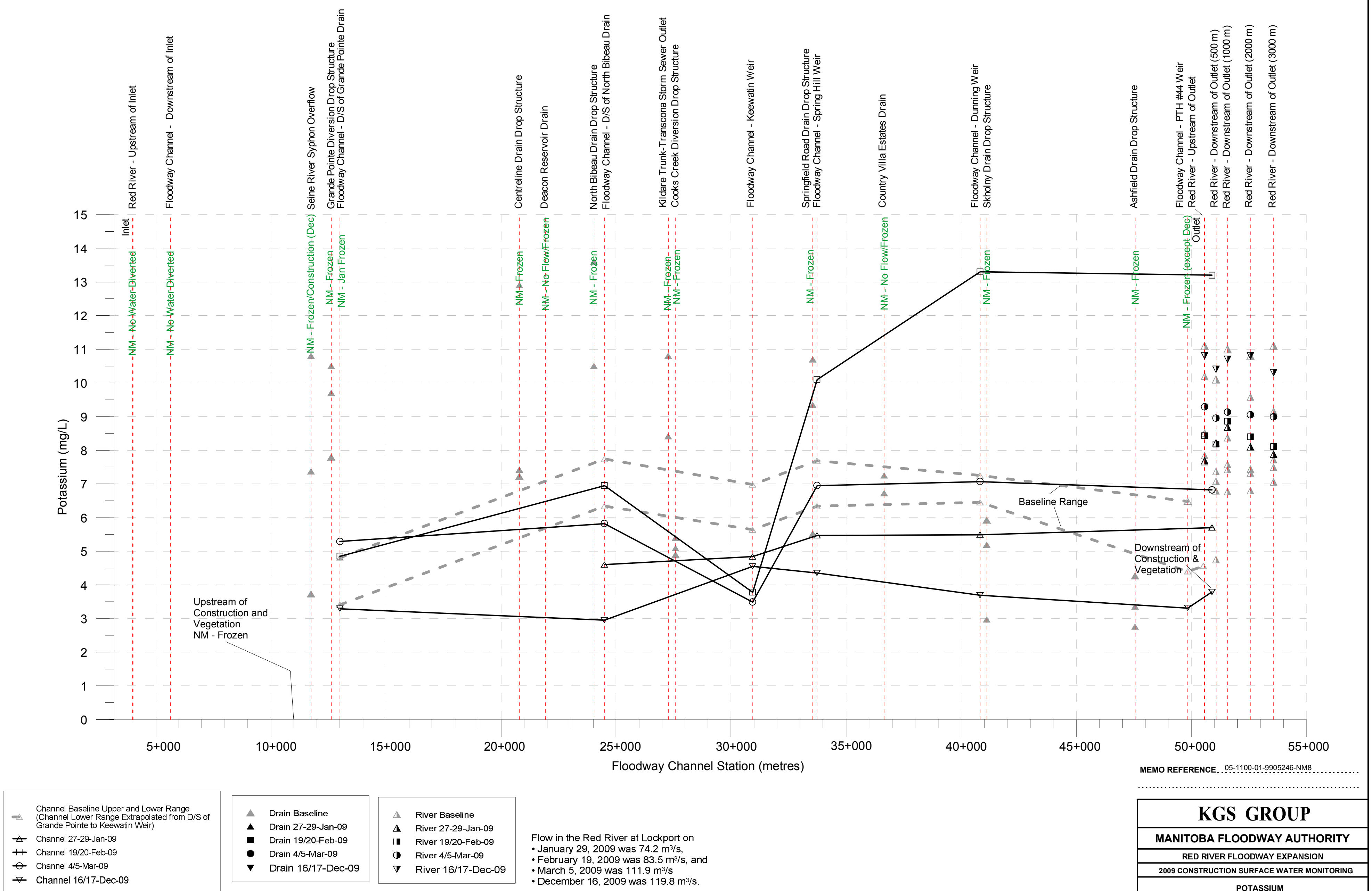
POTASSIUM
SPRING FLOOD CONDITION

MARCH 2010	FIGURE NM8-22	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\Potassium\FigNM8-22_Potassium construction_Spring flood.grf



X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\FigNM8.11 Nov\FigNM8.11-08_Potassium construction_Nov.grf



Flow in the Red River at Lockport on
- January 29, 2009 was 74.2 m³/s,
- February 19, 2009 was 83.5 m³/s, and
- March 5, 2009 was 111.9 m³/s
- December 16, 2009 was 119.8 m³/s.

MEMO REFERENCE 05-1100-01-9905246-NM8

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

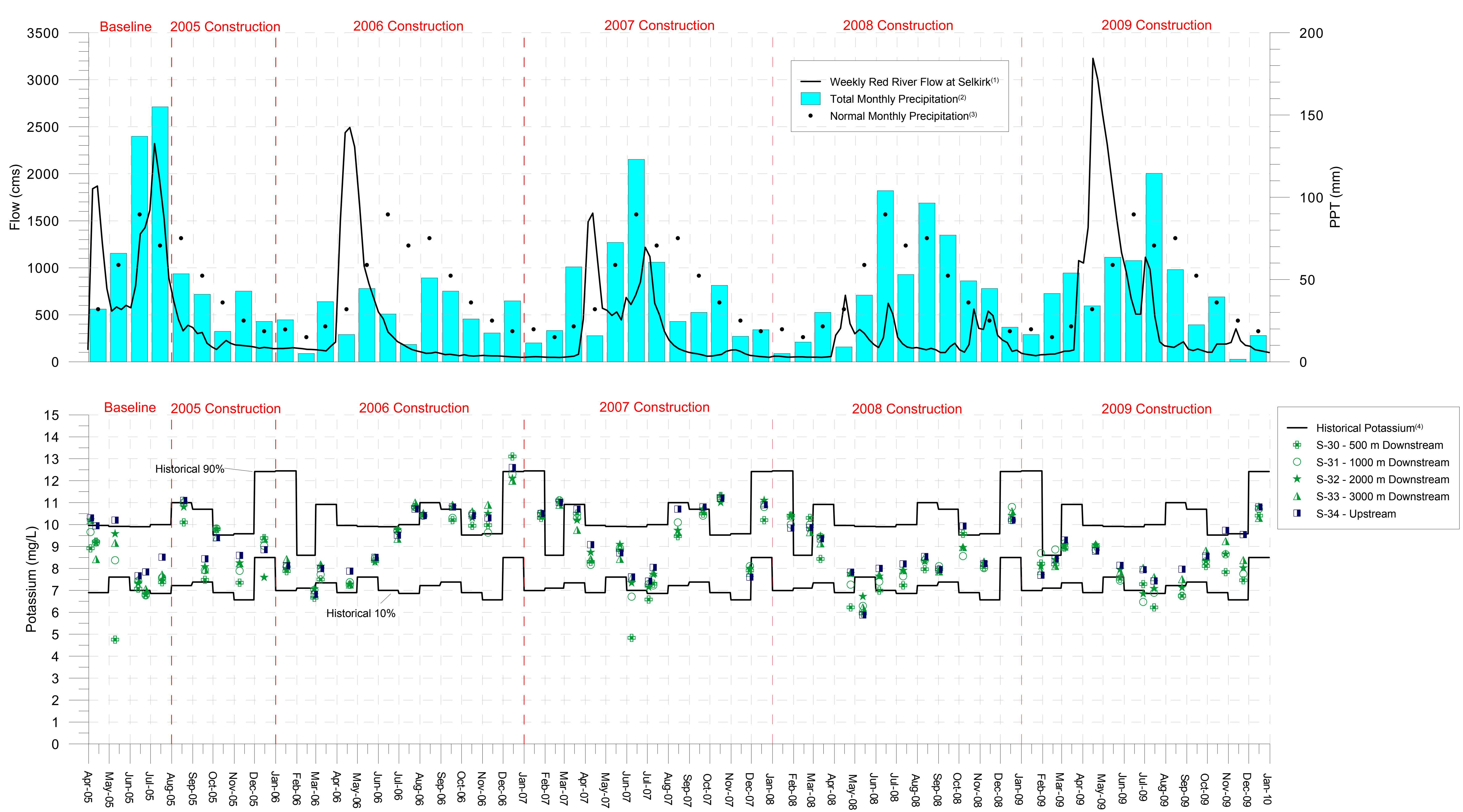
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

POTASSIUM
NON-FLOOD FROZEN CONDITION

MARCH 2010	FIGURE NM8-24	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\Potassium\FigNM8-24_Potassium construction_Non-flood frozen.grf



MEMO REFERENCE 05-1100-01-9905246-NM8

Notes

1 - Province of Manitoba, Manitoba Water Stewardship, Hydrologic Forecast Centre; Weekly River Flow Reports.
2 - Environment Canada. 2005. The Green Lane Weather Office, Climate Data Winnipeg International Airport.
3 - Environment Canada. 2001. Canadian Climate Normals 1971-200, Winnipeg International Airport, Manitoba.
4 - Historical Data obtained from the Proposed Floodway Expansion Project Environmental Assessment Report
Completed by Tetres (August 2004).Surface water quality parameters were summarized to the 10th and 90th percentile.
Monthly range based on data collected once a month by Manitoba Water Stewardship from 1970 to 2003 in the Red River
at Selkirk (downstream of the Floodway Outlet).

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

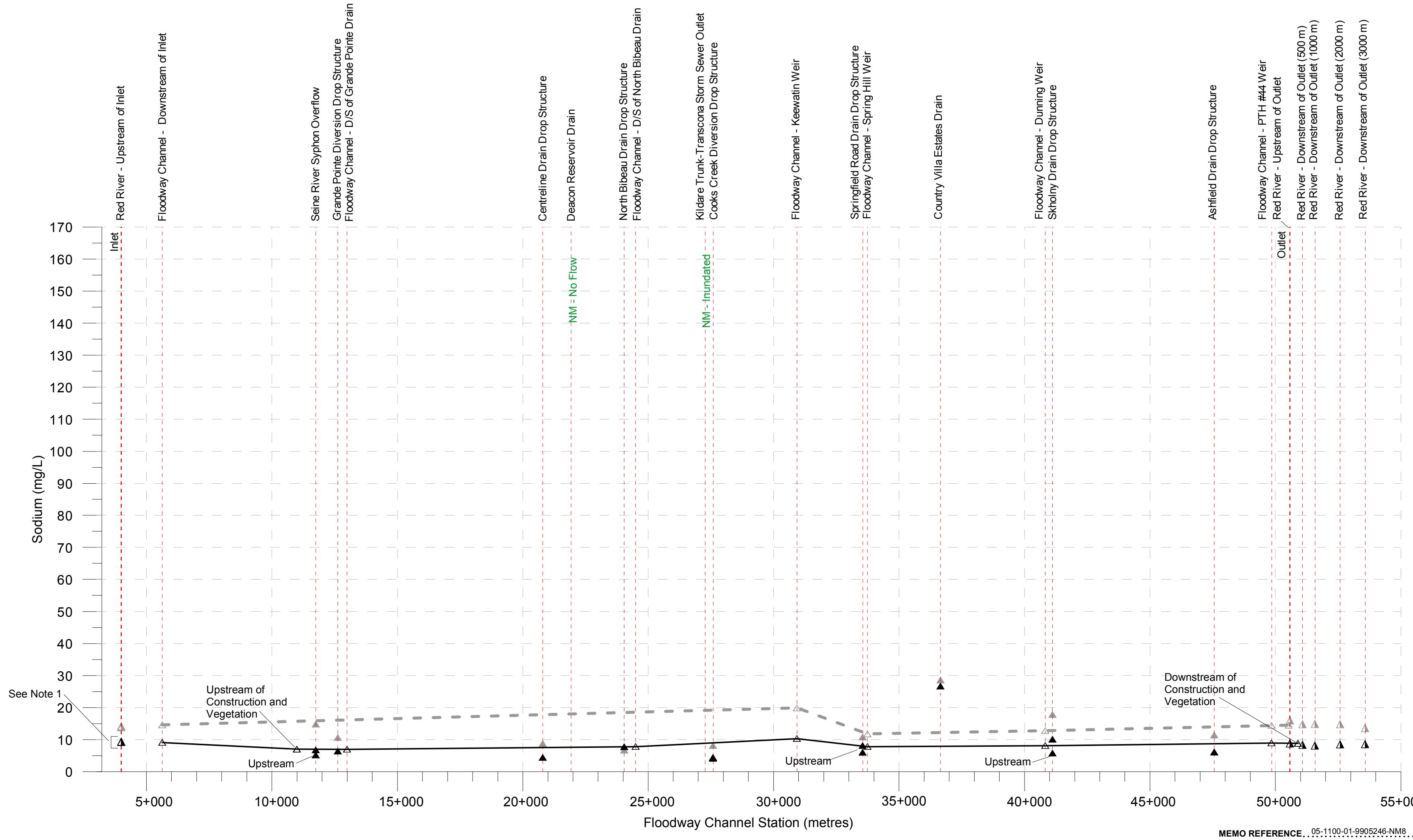
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

HISTORICAL WATER QUALITY COMPARISON
RED RIVER AT FLOODWAY OUTLET
POTASSIUM

MARCH 2010	FIGURE NM8-25	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\Historical data\Worksheet\NM8-25_Historical Water Quality Comparisons Potassium.grf



Channel 2005 Spring Flood Baseline Data (12-Apr-05)
Channel 20-Apr-09

Drain 2005 Spring Flood Baseline Data (12-Apr-05)
Drain 20-Apr-09

River 2005 Spring Flood Baseline Data (12-Apr-05)
River 20-Apr-09

Flow in Red River at Lockport on April 20, 2009 was 3171 m^3/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905246-NM8

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

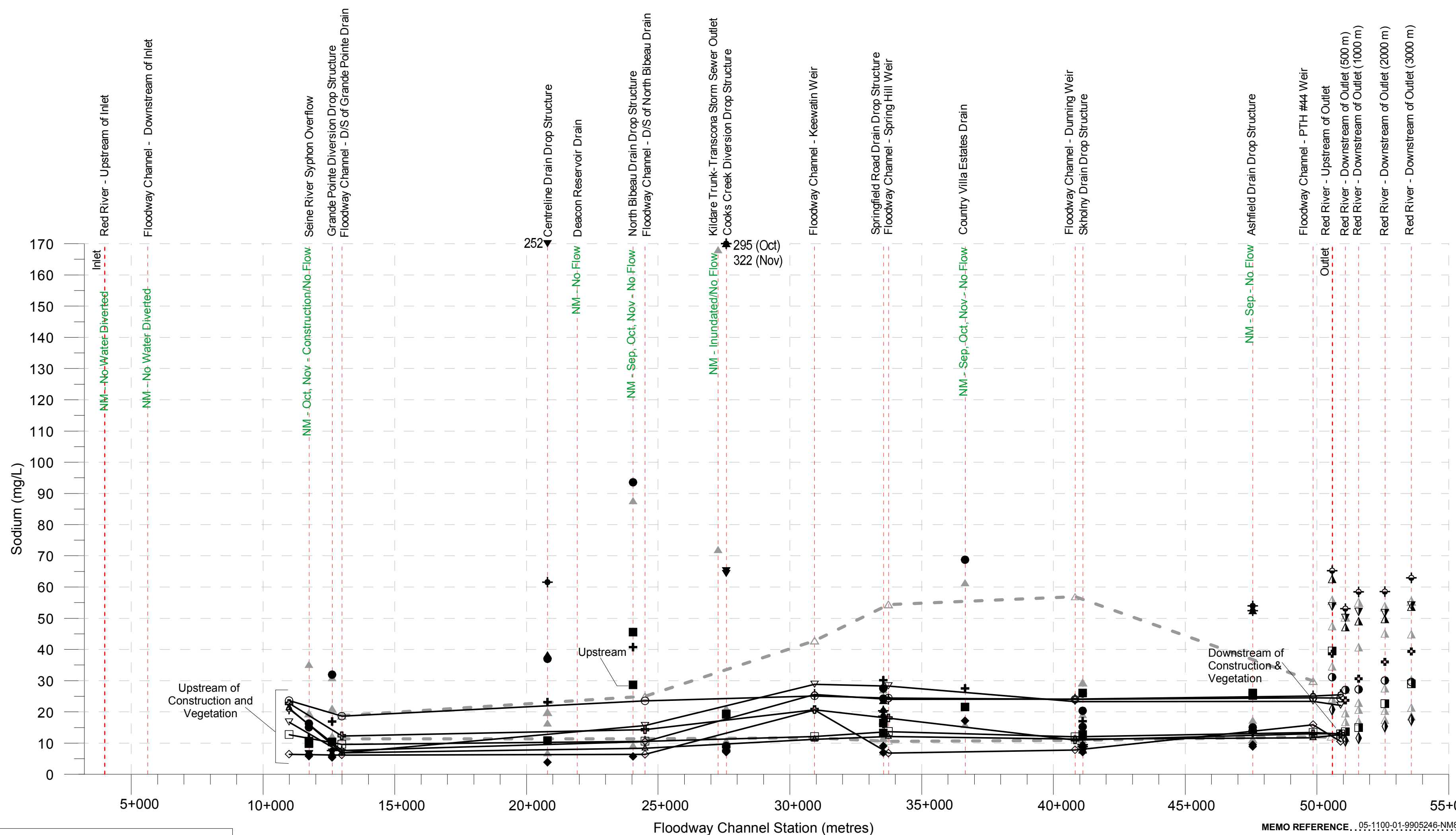
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

SODIUM
SPRING FLOOD CONDITION

MARCH 2010	FIGURE NM8-26	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\Sodium\FigNM8-26_Sodium construction_Spring Flood.grf



Channel Summer Baseline Upper and Lower Range (Channel Lower Range Extrapolated from D/S of Grande Pointe to Keewatin Weir)
Channel 26-May-09
Channel 29-Jun-09
Channel 15-Jul-09
Channel 25-Aug-09
Channel 29-Sep-09
Channel 28-Oct-09
Channel 23-Nov-09

Drain Summer Baseline
Drain 26-May-09
Drain 29-Jun-09
Drain 15-Jul-09
Drain 25-Aug-09
Drain 29-Sep-09
Drain 28-Oct-09
Drain 23-Nov-09

River Summer Basline
River 26-May-09
River 29-Jun-09
River 15-Jul-09
River 25-Aug-09
River 29 Sep-09
River 28-Oct-09
River 23-Nov-09

Flow in Red River at Lockport:
on May 26, 2009 was 1263 m^3/s
on June 29, 2009 was 851 m^3/s
on July 15, 2009 was 550 m^3/s
on August 25, 2009 was 204 m^3/s
on September 29, 2009 was 106 m^3/s
on October 28, 2009 was 189 m^3/s
on November 23, 2009 was 196 m^3/s

MEMO REFERENCE 05-1100-01-9905246-NM8

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

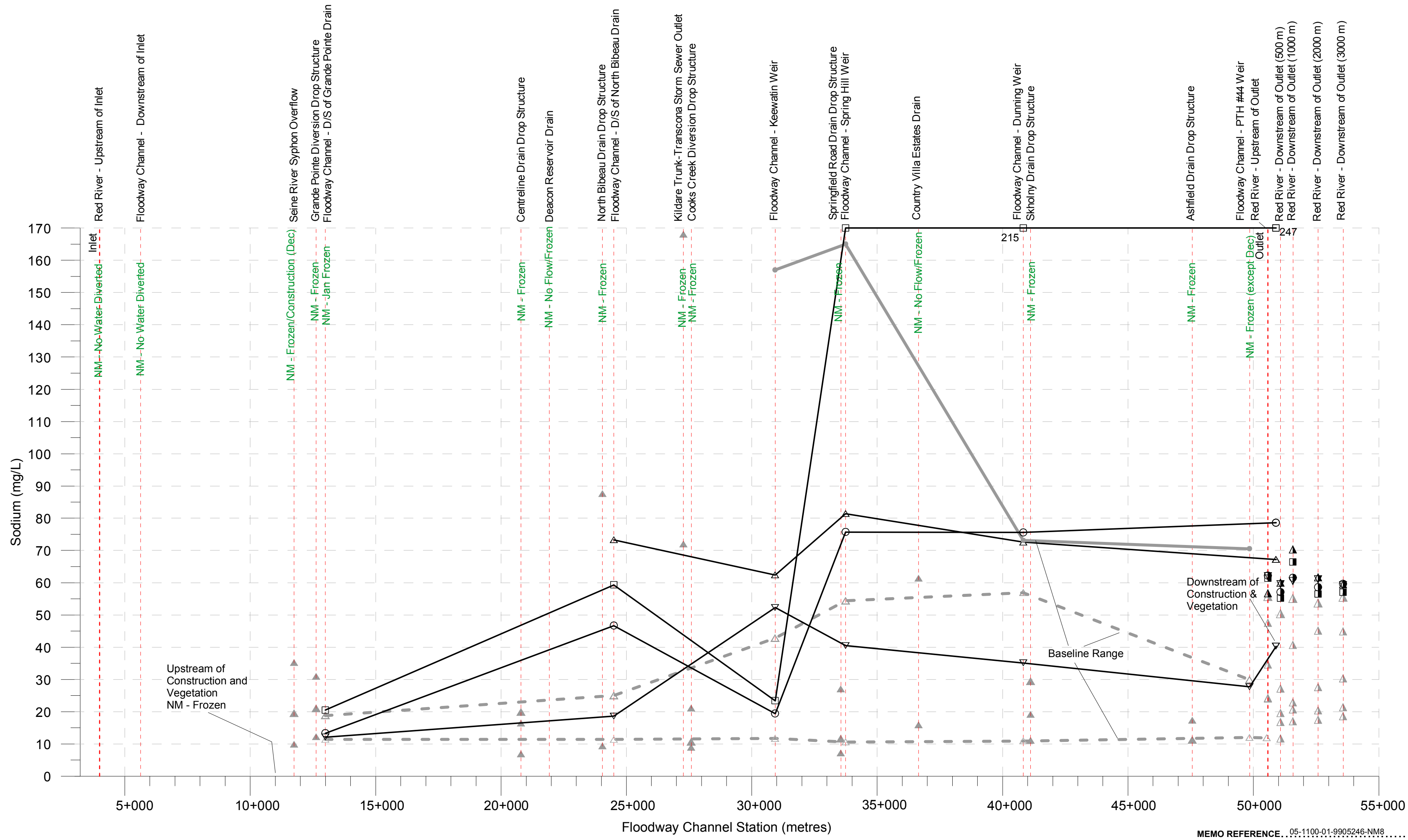
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

SODIUM
NON-FLOOD UNFROZEN CONDITION

MARCH 2010	FIGURE NM8-27	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\Sodium\FigNM8-27_Sodium construction_Non-flood unfrozen.grf



MEMO REFERENCE 05-1100-01-9905246-NM8

- Channel Baseline Upper and Lower Range (Channel Lower Range Extrapolated from D/S of Grande Pointe to Keewatin Weir)
- Channel Winter Baseline (Baseflow, Groundwater Discharge Conditions Sampled March 2005)
- Channel 27-29-Jan-09
- Channel 19/20-Feb-09
- Channel 4/5-Mar-09
- Channel 16/17-Dec-09

- Drain Baseline
- Drain 27-29-Jan-09
- Drain 19/20-Feb-09
- Drain 4/5-Mar-09
- Drain 16/17-Dec-09

- River Baseline
- River 27-29-Jan-09
- River 19/20-Feb-09
- River 4/5-Mar-09
- River 16/17-Dec-09

Flow in the Red River at Lockport on
- January 29, 2009 was 74.2 m³/s,
- February 19, 2009 was 83.5 m³/s, and
- March 5, 2009 was 111.9 m³/s
- December 16, 2009 was 119.8 m³/s.

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

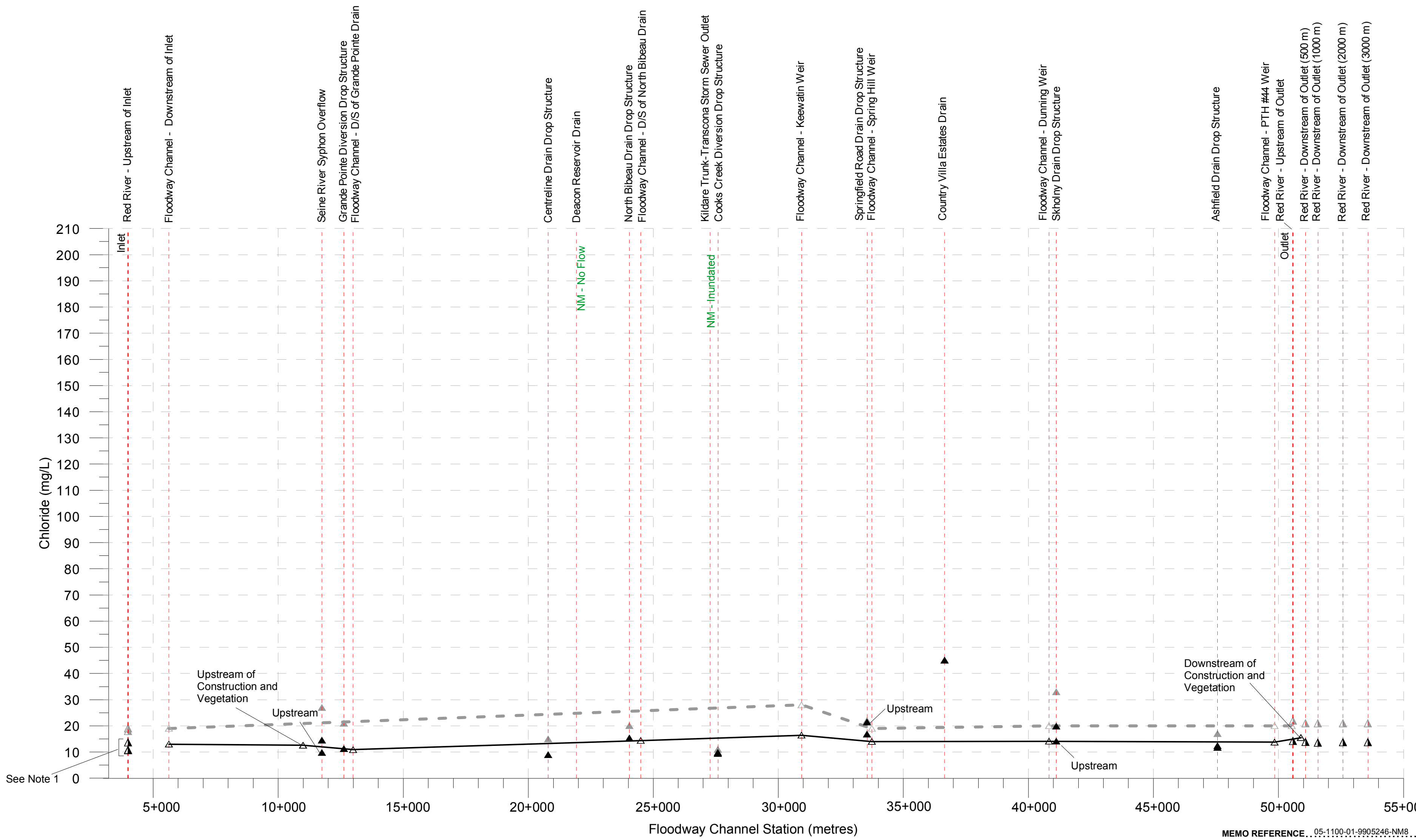
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

SODIUM
NON-FLOOD FROZEN CONDITION

MARCH 2010	FIGURE NM8-28	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\Sodium\FigNM8-28_Sodium construction_Non-flood frozen.grf



MEMO REFERENCE 05-1100-01-9905246-NM8

Channel 2005 Spring Flood Baseline Data (12-Apr-05)	Drain 2005 Spring Flood Baseline Data (12-Apr-05)	River 2005 Spring Flood Baseline Data (12-Apr-05)
Channel 20-Apr-09	Drain 20-Apr-09	River 20-Apr-09

Flow in Red River at Lockport on April 20, 2009 was 3171 m^3/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

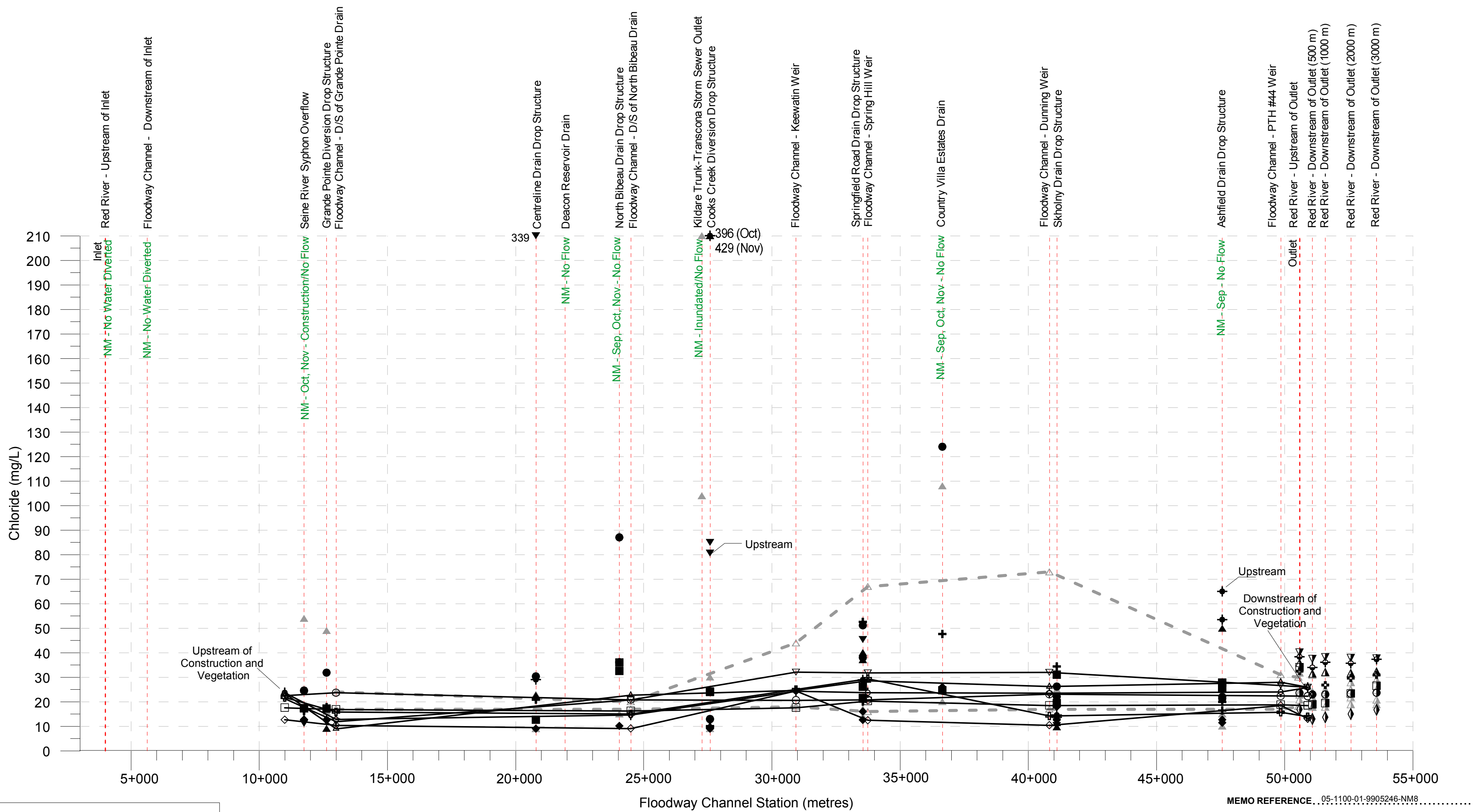
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

CHLORIDE
SPRING FLOOD CONDITION

MARCH 2010	FIGURE NM8-29	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\Chloride\FigNM8-29_Chloride construction_Spring flood.grf



Channel Summer Baseline Upper and Lower Range (Channel Lower Range Extrapolated from D/S of Grande Pointe to Keewatin Weir)
Channel 26-May-09
Channel 29-Jun-09
Channel 15-Jul-09
Channel 25-Aug-09
Channel 29-Sep-09
Channel 28-Oct-09
Channel 23-Nov-09

Drain Summer Baseline
Drain 26-May-09
Drain 29-Jun-09
Drain 15-Jul-09
Drain 25-Aug-09
Drain 29-Sep-09
Drain 28-Oct-09
Drain 23-Nov-09

River Summer Baseline
River 26-May-09
River 29-Jun-09
River 15-Jul-09
River 25-Aug-09
River 29-Sep-09
River 28-Oct-09
River 23-Nov-09

Flow in Red River at Lockport:
on May 26, 2009 was 1263 m^3/s
on June 29, 2009 was 851 m^3/s
on July 15, 2009 was 550 m^3/s
on August 25, 2009 was 204 m^3/s
on September 29, 2009 was 106 m^3/s
on October 28, 2009 was 189 m^3/s
on November 23, 2009 was 196 m^3/s

MEMO REFERENCE 05-1100-01-9905246-NM8

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

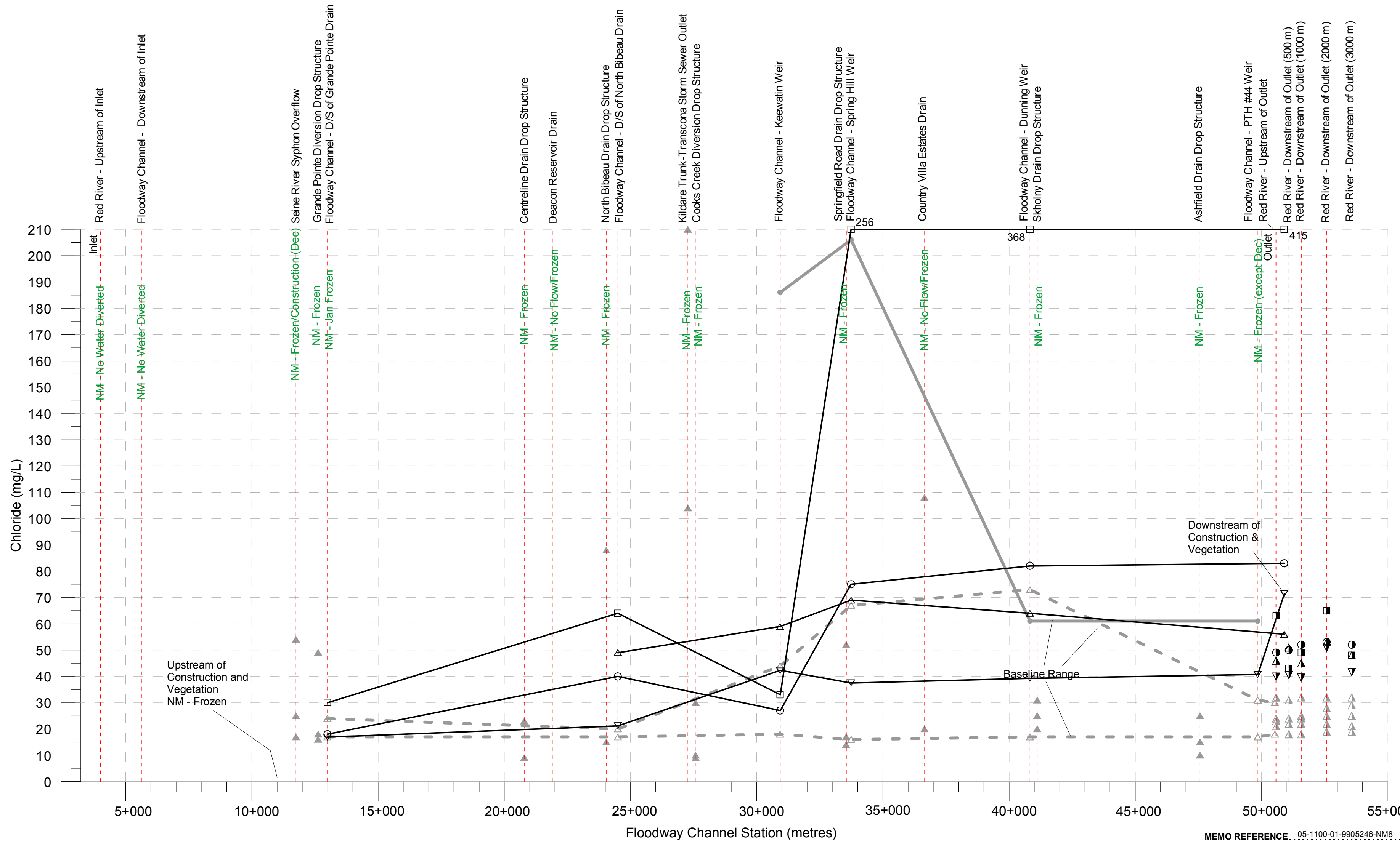
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

CHLORIDE
NON-FLOOD UNFROZEN CONDITION

MARCH 2010	FIGURE NM8-30	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\Chloride\FigNM8-30_Chloride construction_Non-flood unfrozen.grf



MEMO REFERENCE 05-1100-01-9905246-NM8

Channel Baseline Upper and Lower Range (Channel Lower Range Extrapolated from D/S of Grande Pointe to Keewatin Weir)
Channel Winter Baseline (Baseflow, Groundwater Discharge Conditions Sampled March 2005)
Channel 27-29-Jan-09
Channel 19/20-Feb-09
Channel 4/5-Mar-09
Channel 16/17-Dec-09

Drain Baseline
Drain 27-29-Jan-09
Drain 19/20-Feb-09
Drain 4/5-Mar-09
Drain 16/17-Dec-09

River Baseline
River 27-29-Jan-09
River 19/20-Feb-09
River 4/5-Mar-09
River 16/17-Dec-09

Flow in the Red River at Lockport on
- January 29, 2009 was 74.2 m^3/s,
- February 19, 2009 was 83.5 m^3/s, and
- March 5, 2009 was 111.9 m^3/s
- December 16, 2009 was 119.8 m^3/s.

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

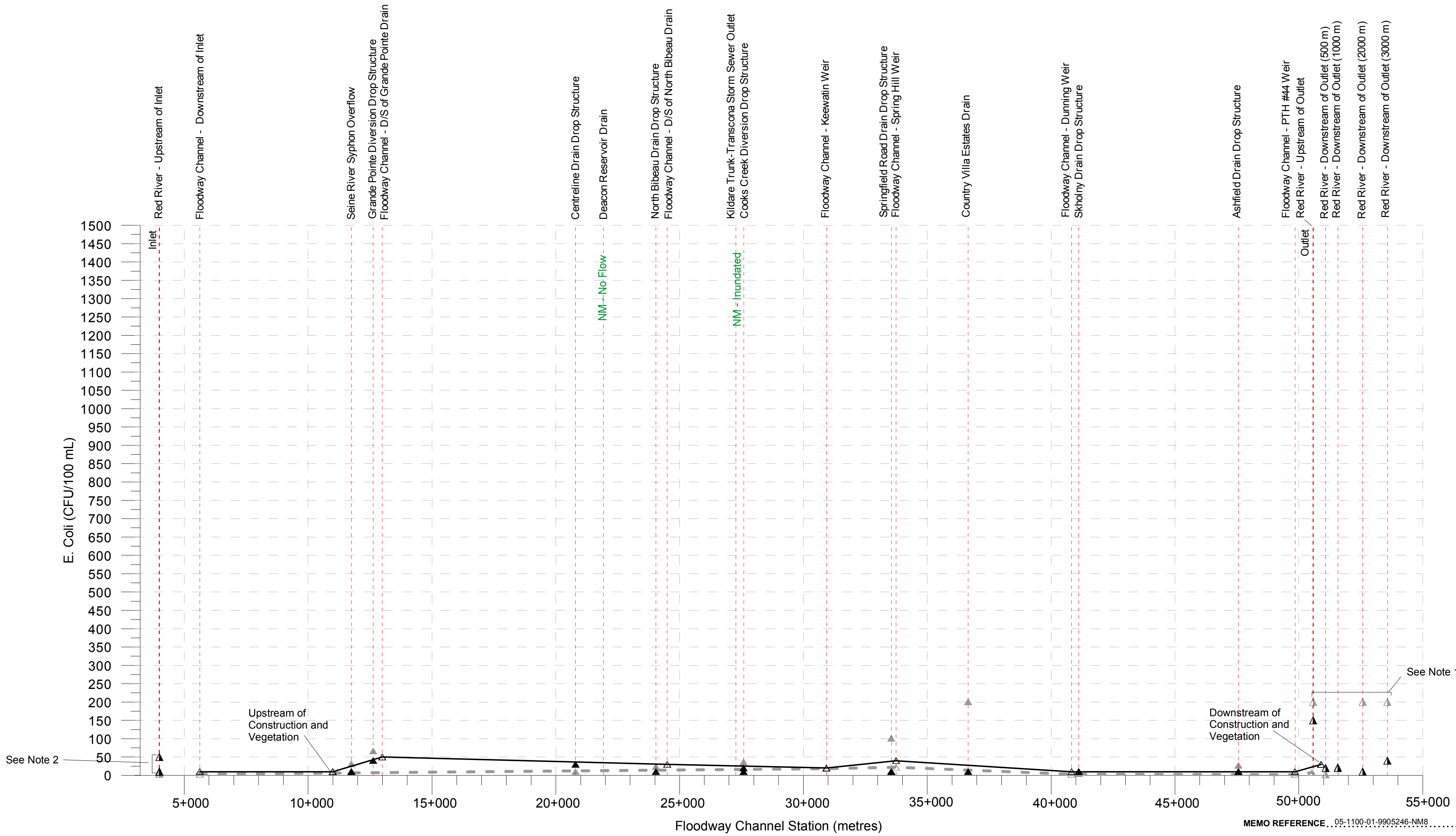
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

CHLORIDE
NON-FLOOD FROZEN CONDITION

MARCH 2010	FIGURE NM8-31	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\Chloride\FigNM8-31_Chloride construction_Non-flood frozen.grf



MEMO REFERENCE 05-1100-01-9905246-NM8

Channel	Drain	River
Channel 2005 Spring Flood Baseline Data (12-Apr-05)	Drain 2005 Spring Flood Baseline Data (12-Apr-05)	River 2005 Spring Flood Baseline Data (12-Apr-05)
Channel 20-Apr-09	Drain 20-Apr-09	River 20-Apr-09

Flow in Red River at Lockport on April 20, 2009 was 3171 m³/s.

Note 1:
The lab Quanti Tray method used during some baseline monitoring had a maximum detection limit of 200 CFU/100 mL. For all other samples, the EColi by MColi Blue MF method was used.

Note 2:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

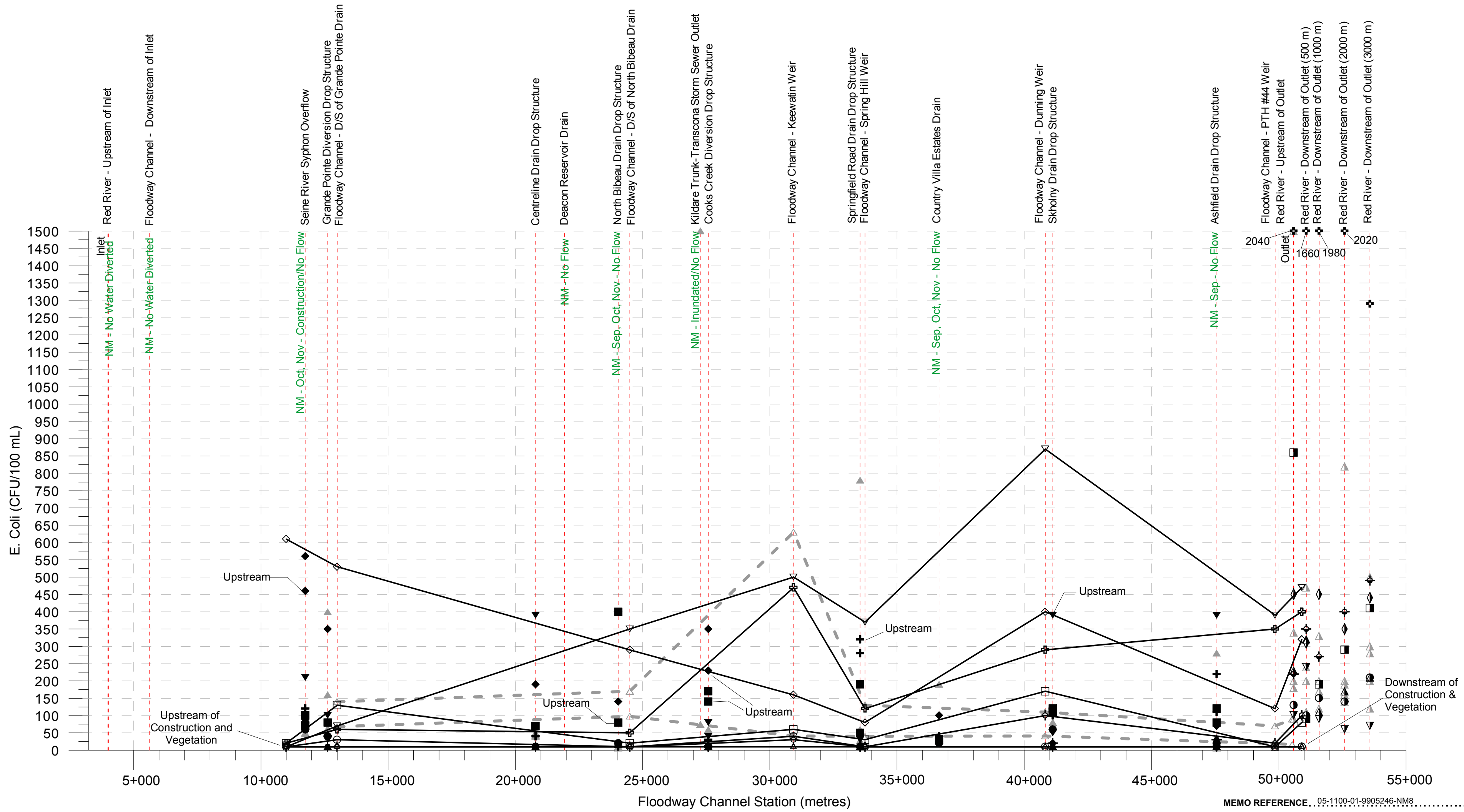
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

E.COLI
SPRING FLOOD CONDITION

MARCH 2010	FIGURE NM8-32	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\E-Coli\FigNM8-32_EColi construction_Spring flood.grf



MEMO REFERENCE 05-1100-01-9905246-NM8

Channel Summer Baseline Upper and Lower Range (Channel Lower Range Extrapolated from D/S of Grande Pointe to Keewatin Weir)
Channel 26-May-09
Channel 29-Jun-09
Channel 15-Jul-09
Channel 25-Aug-09
Channel 29-Sep-09
Channel 28-Oct-09
Channel 23-Nov-09

Drain Summer Baseline
Drain 26-May-09
Drain 29-Jun-09
Drain 15-Jul-09
Drain 25-Aug-09
Drain 29-Sep-09
Drain 28-Oct-09
Drain 23-Nov-09

River Summer Baseline
River 26-May-09
River 29-Jun-09
River 15-Jul-09
River 25-Aug-09
River 29-Sep-09
River 28-Oct-09
River 23-Nov-09

Flow in Red River at Lockport:
on May 26, 2009 was 1263 m³/s
on June 29, 2009 was 851 m³/s
on July 15, 2009 was 550 m³/s
on August 25, 2009 was 204 m³/s
on September 29, 2009 was 106 m³/s
on October 28, 2009 was 189 m³/s
on November 23, 2009 was 196 m³/s

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

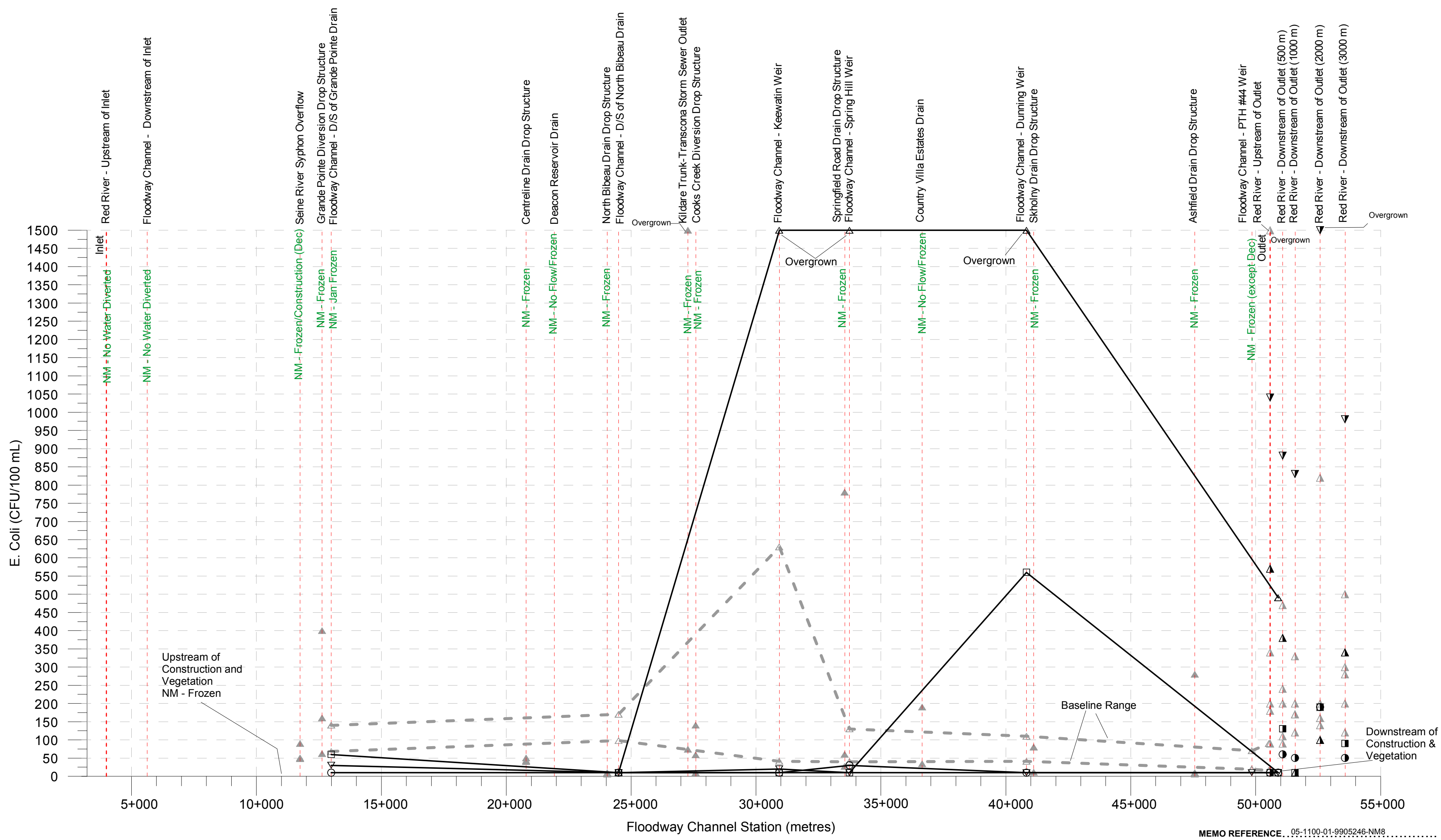
RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

E.COLI
NON-FLOOD UNFROZEN CONDITION

MARCH 2010	FIGURE NM8-33	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\E-Coli\FigNM8-33_EColi construction_Non-flood unfrozen.grf



Channel Baseline Upper and Lower Range (Channel Lower Range Extrapolated from D/S of Grande Pointe to Keewatin Weir)
Channel 27-29-Jan-09
Channel 19/20-Feb-09
Channel 4/5-Mar-09
Channel 16/17-Dec-09

Drain Baseline
Drain 27-29-Jan-09
Drain 19-20-Feb-09
Drain 4/5-Mar-09
Drain 16/17-Dec-09

River Baseline
River 27-29-Jan-09
River 19/20-Feb-09
River 4/5-Mar-09
River 16/17-Dec-09

Flow in the Red River at Lockport on
- January 29, 2009 was 74.2 m^3/s,
- February 19, 2009 was 83.5 m^3/s, and
- March 5, 2009 was 111.9 m^3/s.
- December 16, 2009 was 119.8 m^3/s.

Overgrown:
Exceeded maximum detection limit of approximately 2000 CFU/100ml using MColi Blue MF Method.

MEMO REFERENCE 05-1100-01-9905246-NM8

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

E.COLI
NON-FLOOD FROZEN CONDITION

MARCH 2010	FIGURE NM8-34	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2009 Construction\Graphs\ANNUAL\E-Coli\FigNM8-34_EColi construction_Non-flood frozen.grf

APPENDICES

APPENDIX A

SURFACE WATER MONITORING – 2009 SAMPLING PROGRAM

1.0 INTRODUCTION

This provides details and a description of the sampling events, sampling protocol, data reduction, reporting and summary tables for the 2009 Surface Water Sampling Program prepared by KGS Group.

The surface water quality monitoring program consists of Monthly monitoring during the 2009 construction year from January to December 2009 in conjunction with the on-going construction activities. It also consists of Event-based monitoring during 2009 in response to potential erosion causing precipitation and spill events.

The scope of work for the 2009 construction Surface Water Monitoring program conducted by KGS Group includes the following:

- Collect **monthly** surface water quality data for the Red River, Floodway Channel, Drains that flow into the Floodway Channel and Drains that cross the West Dyke, preferably following a precipitation event or at the flood peak during Red River flood conditions;

- Collect **event-based** surface water quality data for compliance monitoring of applicable parameters (TSS, nutrients, herbicides or hydrocarbons) from the Floodway Channel upstream and downstream of the overall construction area, the Red River upstream and downstream of the Outlet and any additional required locations following precipitation events greater than 10 mm or a spill; and

- Provide an assessment of surface water quality comparing results of construction monthly and event-based compliance monitoring to baseline water quality and summarized in an 2009 construction monitoring report in order to;

    - compare predictions made in modelling effects
    - assess the effectiveness of proposed mitigation measures and adapt if necessary
    - adapt the construction monitoring program in response to data and changes in mitigation measures.

2.0 SAMPLING LOCATIONS

The sample locations are similar to those used during the past sampling programs incorporating minor alterations as recommended in the Baseline and 2005, 2006, 2007 and 2008 Construction Surface Water Monitoring reports. These sample locations are outlined on Figure NM8-1 and Figure NM8-2 and described as follows;

Red River at Inlet

- Upstream of the Floodway channel along the west shore of the river, 3 replicate samples collected consecutively at the same location (S-01) to capture the natural variation within the Red River. During a sample event when there is no river water entering into the Floodway channel at the inlet, then these samples will not be collected during that event.

Red River at Outlet

- Upstream of the Floodway Outlet along the east shore (S-34) and downstream of the Outlet along the east shore at 500, 1000, 2000 and 3000 m (S-30, S-31, S-32 and S-33, respectively).

Floodway Channel

- Floodway Channel downstream of the Inlet (S-04), downstream of the Grande Pointe Diversion drop structure (S-13), downstream of the North Bibeau Drain drop structure (S-14) and at the four weir locations within the low flow channel used to calculate the channel base flow during the winter; Keewatin Weir (S-21), Springfield Weir (S-23), Dunning Weir (S-25) and PTH# 44 Weir (S-28). For quality control one replicate sample is collected during each sample event from one of the channel locations. Note during a sampling event if no Red River water is entering into the Floodway Channel, sample location S-04 in the channel downstream of the inlet will not be collected during that event. Likewise, during a sample event if there is less than 0.1 m water depth in the low flow channel at a sample location then that location will not be collected during that event.

Outfall Sources

- At the 11 outfalls immediately upstream of where they drain into the Floodway channel. These include; Seine River Syphon Overflow (S-05), Grande Point Diversion Drop Structure (S-06), Centreline Drain Drop Structure (S-07), Deacon Reservoir Drain (S-08), Cooks Creek Diversion Drop Structure (S-09), North Bibeau Drain Drop Structure (S-10), Country Villa Estates Drain (S-11), Kildare Trunk-Transcona Storm Sewer Outlet (S-12), Springfield

Road Drain Drop Structure (S-22), Skholny Drain Drop Structure (S-26) and Ashfield Drain Drop Structure (S-27). During a sample event if there is low flow or the water is frozen such that no water is entering into the Floodway from any of the above drains or there is insufficient amounts of water in the drain to collect a sample (< 0.10 m flow depth) then, that drain will not be sampled during that event. Additionally, during a sample event if a drain is within an area of on-going construction activities, to eliminate a potential confounding effect and in order to assess the effects from the perimeter ditches an additional sample will be collected from the drain upstream of the perimeter ditching.

West Dyke

- Downstream of the West Dyke in the Manness (S-35) and Domain (S-36) Drains. During a sample event if there is insufficient amounts of water in either of the drains to collect a sample (< 0.10 m flow depth) or the water is frozen then, that drain will not be sampled during that event. Additionally, if there is on-going construction activities in the vicinity of either drain during a sample event, in order to assess the construction effects, an additional sample will be collected from the drain upstream of the West Dyke.

Construction Areas

- Sample locations will be located in the Floodway Channel, upstream and downstream of the overall construction limits for all contracts (CON U/S and CON D/S) and upstream and downstream of the limits of the entire re-vegetation area for all contracts (VEG U/S and VEG D/S). Note these sample locations will change as work proceeds and the limits of construction change. During a sample event if there is less than 0.1 m water depth in the low flow channel at a sample location then that location will not be collected during that event.

The potential maximum number of sample locations, likely only for monthly sampling events in late fall, is 42, whereas on average there will likely be 30 sample locations. The sample locations used for any given sampling event will depend on the time of year, flow conditions and construction progress to date. For example, during the winter construction period no river water will be flowing into the Floodway Channel and most or all of the drains will likely be frozen and therefore samples will likely only be collected from the Floodway Channel and the Red River at the Outlet. Likewise, during the spring to fall construction period when drier conditions occur such as in 2006, if any of the source flows of water into the Floodway Channel (i.e. Red River and the 11 outfalls) are not flowing into the channel or have an insufficient amount of water to sample, then they will not be sampled.

3.0 SAMPLING PROTOCOL

As in the previous years sampling programs, the protocol follows the U.S. Environmental Protection Agency (EPA), Office of Water Quality, Monitoring Water Quality, Chapter 5 Water Quality Conditions (November, 1997, EPA 841-B-97-003). Samples are collected by wading into the water source and/or using a 3 metre sample extension rod to sample as close to the centre of the flow as possible. For safety considerations, the Red River samples are collected from the shoreline using the sample extension rod. Samples are collected by dipping a sample collector into the water to a depth of approximately 30 cm, or half the depth if there is less than 60 cm of water, and scooping the sample collector upstream into the water flow. If there is an insufficient depth of water, 10 cm or less, then sampling is not conducted as the bottom would likely be disturbed during sampling and spoil the sample. Before each sample, the collection jar is rinsed a minimum of three times with the sample water to ensure representative readings of the existing surface water conditions.

During winter when the surface water has an ice cover, an auger or other tools will be used to provide access to sample the water. The sampling health and safety plan includes: two person sampling; flotation suits during cold weather and/or high flows; Personal Floatation Devices (PFD's) during other times; use of a harness and rope to anchor personnel to a fixed object and specifications for working on ice.

4.0 PARAMETERS

While sampling during monthly monitoring, field measurements of pH, temperature, conductivity and turbidity will be obtained. Water depth is also recorded from staff gauges installed at Floodway Channel locations and in the outfalls. Staff gauges are not installed at Kildare Trunk-Transcona Storm Sewer Outlet, Country Villa Estates Drain and Deacon Reservoir Drain as it is not feasible to record the depth of water at these drains. No depth of water is recorded for any of the samples collected from the Red River or the West Dyke drains. The water depth is recorded to estimate the water discharge at each site using rating curves developed for each of the drains and the Floodway Channel at the sample locations. Estimates of the water discharge are necessary to calculate approximate mass balances for the chemical analysis results to interpret the results in particular during event-based compliance monitoring. Discharge estimates for the Red River are based on upstream and downstream measurements from Water Survey of Canada Metering Stations.

The analysis package for the monthly sampling events includes various combinations of the following;

- Routine extractable (iron, manganese, fluoride, pH, total dissolved solids, sulphate, nitrate-nitrite, calcium, potassium magnesium, sodium, hardness, conductivity, chloride, total alkalinity, bicarbonate, carbonate and hydroxide)
- Total suspended solids (TSS) and turbidity
- Ammonia
- Ortho phosphorus, total phosphorus, total dissolved phosphorus
- Dissolved organic carbon (DOC), total organic carbon (TOC)
- Total Kjeldahl nitrogen (TKN)
- Phenoxy acid herbicide screen (2,4-D, Bromoxynil, Dicamba, MCPA, Picloram), AMPA and Glyphosate
- Benzene, toluene, ethylbenzene and xylenes (BTEX)
- Hydrocarbon fractions F1 to F4
- Total coliform and *E.Coli* by m-Coli Blue Membrane Filtration method

The specific parameters assessed during monthly monitoring at each sampling location are similar to the previous sampling programs and are detailed in Table 1. Additional parameters can be added, if required and approved by MFA.

5.0 EVENT-BASED COMPLIANCE MONITORING

Event-based compliance monitoring will be conducted in response to rain events and spill events with samples analyzed for the following parameters of interest:

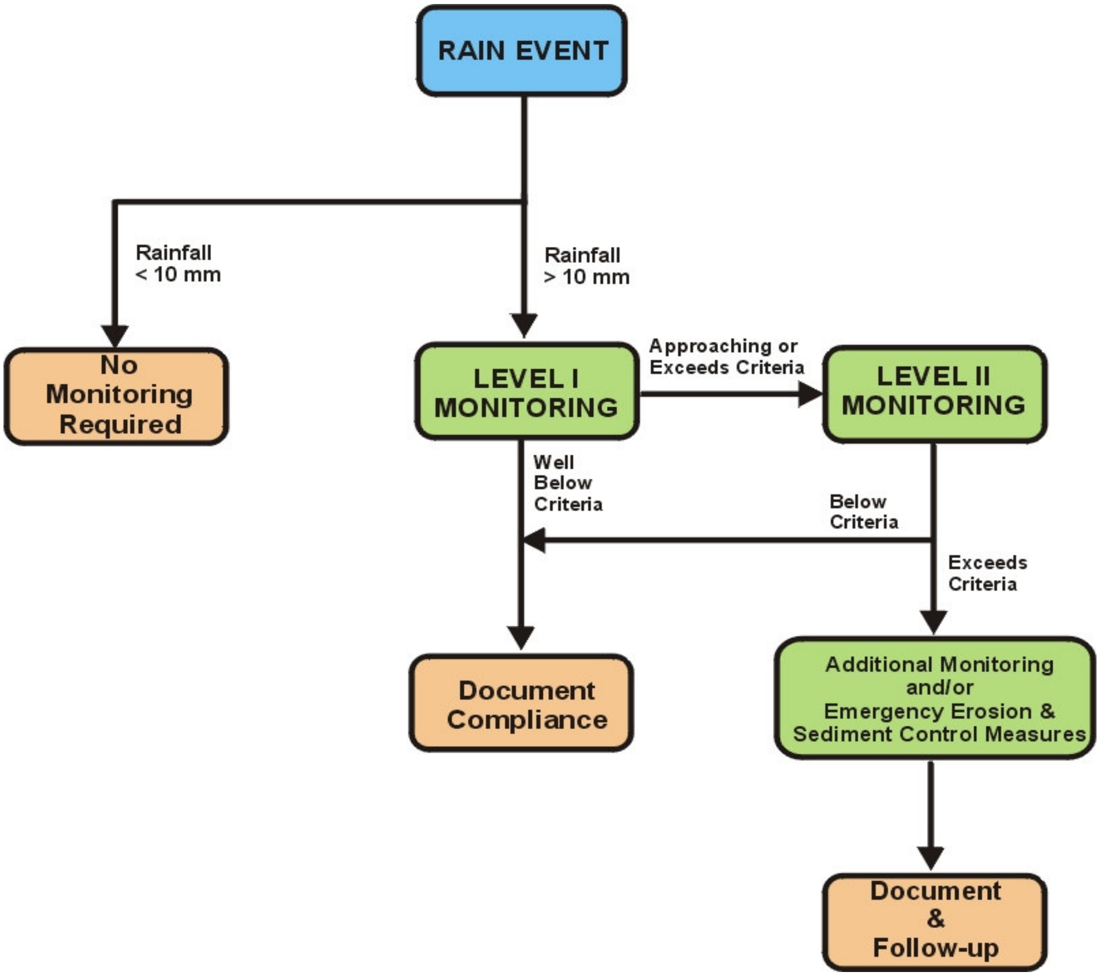
- Total Suspended Solids (as detailed in the KGS Group Memorandum 03-1100-01.37.10 Erosion and Sediment Control Plan, Event-Based Compliance Monitoring Program)
- Nutrients - field temperature, pH, nitrate-nitrite+N, ammonia, total Kjeldahl nitrogen, ortho phosphorus, total phosphorus and total dissolved phosphorus

- Herbicides - Phenoxy acid herbicide screen, AMPA and Glyphosate
- Hydrocarbons - BTEX and fraction F1 to F4

Rain Event

As outlined in the flow chart below, the event-based monitoring program will be structured so that the level of effort associated with the monitoring is consistent with the level of potential concern. The structure for the 2009 sampling program represents the modifications made during the 2006 sampling program as discussed in the 2006 Construction Surface Water Monitoring Report (March 2007) and detailed in the October 3, 2006 KGS Group Memorandum (05-1100-01.19.06.03) Red River Floodway Expansion Project; 2006 Surface Water Sampling Program – Precipitation Review.

When a rainfall is less than 10 mm no monitoring is required. When rainfall exceeds 10 mm, a relatively simple monitoring approach ("Level I") will be carried out to indicate whether the downstream conditions are approaching the CCME and Provincial limits or whether the concentration inflow to the Red River is within accepted limits. If the "Level I" downstream conditions approach the CCME and Provincial limits, more rigorous monitoring ("Level II") will be carried out to determine whether additional mitigation control measures are required.



Monitoring Program Flow Chart

Real-time precipitation data will be used to trigger the initiation of the Level I monitoring program. This real-time data will be monitored regularly whenever there are precipitation events to allow for the monitoring team to mobilize in order to carry out the surface water sampling without delay following or during rain events.

There are a couple of Environment Canada rainfall gauges within the City of Winnipeg that can be used as a source of real-time rainfall data. This data will not be accessible directly by the monitoring team and is provided by the owners of the rainfall gauge network on a daily basis. As such a network of unofficial rainfall gauges within the City of Winnipeg are used as a source of real-time rainfall data.

The rainfall/monitoring criteria have been formulated based on experience during the 2006, 2007 and 2008 sampling programs, assuming an adaptive management approach will be followed throughout the Project to ensure that the level of monitoring is consistent with the potential concern. That is, if it is regularly determined that parameter concentrations are well below the CCME and Provincial criterion for rain events greater than 10 mm even with the increased area of open excavations, the criterion for "Level I" monitoring will be revised accordingly.

Level I – The "Level I" monitoring program will consist of sampling in the Floodway Channel upstream and downstream of the construction area and in the Red River upstream and downstream of the Outlet. Field turbidity, using a hand-held turbidity meter, and the water level will be measured and used to estimate the TSS and the flow.

TSS will be estimated using the site-specific relationships between TSS and field turbidity. These were defined as part of the Baseline Surface Water Monitoring Program and updated following each monthly sampling event during the 2005, 2006, 2007 and 2008 Construction Surface Water Monitoring. Two relationships were developed, one for Red River water and a second for non-Red River water. The Red River water relationship is based on data collected from the Red River as well as data collected from the Floodway during operation of the Floodway. The non-Red River water relationship is based on data collected from the Floodway when it was not in operation and from the inflowing drains. The TSS and field turbidity relationships will continue to be updated on a monthly basis, allowing the quality of the relationships to improve as more samples are collected.

The estimated TSS and flows will be used in conjunction with a simple mass balance (see attached "Level I Compliance Monitoring Worksheet") to provide an indication as to whether an increase in sediment concentration in the Floodway will have an impact on the Red River downstream of the Floodway Outlet. Additionally, as phosphorus fertilizer and glyphosate-based herbicides readily bind to soil particles the estimated TSS will give an indication of potential nutrient and herbicide concentration increases. It should be noted that the estimate of flows and TSS values are considered to be approximate and are to be used in the mass balance to provide a best estimate of the impacts of construction. The factor that has the most sensitivity to the percent increase in sediment concentration in the Red River is the Red River flow, that is, if the Red River flow is quite low, there is a greater risk of exceeding the Provincial Criterion. The effect of the magnitude of the river flow is discussed in the Erosion and Sediment Control Plan.

In addition to measuring field turbidity, samples will be collected at the four locations for laboratory confirmation analysis of TSS. If fertilizer has been applied or if herbicides have been used within two weeks prior to the rain event, then samples will also be collected and submitted for laboratory analysis of nutrients and herbicides, respectively.

Level II – The "Level II" monitoring program considers more sample locations that allow for both the assessment of the dilution effect of the Floodway channel downstream of the construction zone and of where the potential contaminant source(s) originate. It will consist of collecting samples at all of the sample locations that would be monitored during a monthly monitoring event, however only the applicable parameters will be analyzed. These include TSS, and if used within two weeks prior to the rain event, nutrients and herbicides.

Spill Event

The event-based monitoring program in response to spills will consist of sampling in the Floodway Channel and in the Red River with samples analyzed for nutrients, herbicides or hydrocarbons as dictated by the material spilled. Samples will be collected in the Floodway Channel upstream and downstream of the spill point source, at two more locations further downstream in the Floodway Channel and in the Red River upstream and 1000 m downstream of the Outlet immediately following notification of the spill. In order to track the status of the contaminant plume as it moves downstream, these six sample locations will also be sampled at regular time intervals (based on the flow magnitude during the spill event) for a total of up to three days of monitoring following the spill event.

6.0 REPORTING

The data collected during the monthly monitoring and event-based compliance monitoring will be summarized in table format outlining the surface water quality. This information will be compared to the 2005 baseline data on a monthly and event basis to assess the accuracy of predictions made and the effectiveness of mitigation measures. It will also be summarized in a separate 2009 Annual Construction Monitoring Report. In addition to the annual report, documentation will be provided to MFA after each Level I, Level II, and spill monitoring events.

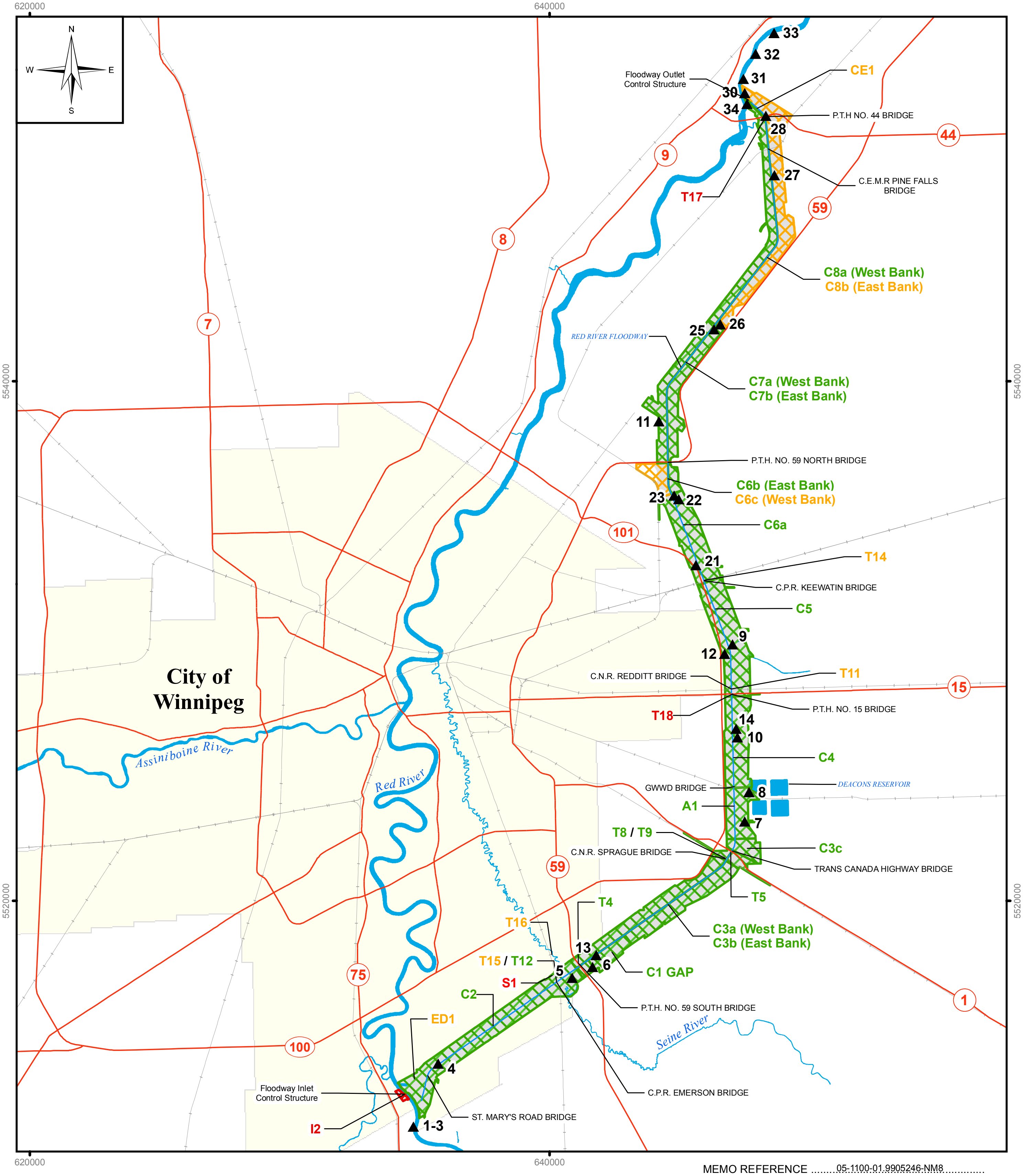
TABLE 1: SAMPLE PARAMETERS FOR EACH SAMPLE LOCATION DURING THE 2009 CONSTRUCTION MONTHLY MONITORING (JANUARY 2009 - DECEMBER 2009

Sample Location	Sample Number	Parameters												
		Routine Extractable	TSS	Ammonia	Ortho - P	Total P	Total Dissolved P	DOC	TOC	TKN	Phenoxy Acid Herbicide Screen	Glyphosate	BTEX, F1 to F4	Total Coliform / E. Coli
Red River														
Upstream of Inlet (3 replicates) [1]	1 - 3	X	X	X	X	X	X	X	X	X				X
Upstream of Outlet	34	X	X	X	X	X	X	X	X	X				X
Downstream of Outlet (500, 1000, 2000 and 3000 m)	30 - 33	X	X	X	X	X	X	X	X	X				X
Floodway Channel														
Downstream of Inlet [1]	4	X	X	X	X	X	X	X	X	X				X
Downstream of Grande Pointe DS	13	X	X	X	X	X	X	X	X	X				X
Downstream of North Bibeau DS	14	X	X	X	X	X	X	X	X	X				X
Keewatin Weir	21	X	X	X	X	X	X	X	X	X				X
Spring Hill Weir	23	X	X	X	X	X	X	X	X	X				X
Dunning Weir	25	X	X	X	X	X	X	X	X	X				X
Hwy #44 Weir	28	X	X	X	X	X	X	X	X	X				X
Field Duplicate of one Channel location	99	X	X	X	X	X	X	X	X	X				X
Upstream of Construction Area	CON-U/S	X	X	X	X	X	X	X	X	X			X	X
Downstream of Construction Area	CON-D/S	X	X	X	X	X	X	X	X	X			X	X
Upstream of Revegetation Area	VEG-U/S	X	X	X	X	X	X	X	X	X	X	X		X
Downstream of Revegetation Area	VEG-D/S	X	X	X	X	X	X	X	X	X	X	X		X
Drains [1]														
Seine River Syphon Overflow	5	X	X	X	X	X	X	X	X	X				X
Grande Pointe Diversion Drop Structure	6	X	X	X	X	X	X	X	X	X				X
Centreline Drain Drop Structure	7	X	X	X	X	X	X	X	X	X				X
Deacon Reservoir Drain	8	X	X	X	X	X	X	X	X	X				X
Cooks Creek Diversion Drop Structure	9	X	X	X	X	X	X	X	X	X				X
North Bibeau Drain Drop Structure	10	X	X	X	X	X	X	X	X	X				X
Country Villa Estates Drain	11	X	X	X	X	X	X	X	X	X				X
Kildare Trunk–Transcona Storm Sewer Outlet	12	X	X	X	X	X	X	X	X	X				X
Spring Field Road Drain Drop Structure	22	X	X	X	X	X	X	X	X	X				X
Skholny Drain Drop Structure	26	X	X	X	X	X	X	X	X	X				X
Ashfield Drain Drop Structure	27	X	X	X	X	X	X	X	X	X				X
Upstream of perimeter ditch in active construction areas		X	X	X	X	X	X	X	X	X				X
West Dyke														
Downstream of Manness Drain	35	X	X	X	X	X	X	X	X	X				X
Downstream of Domain Drain	36	X	X	X	X	X	X	X	X	X				X
Upstream of drains in active construction areas		X	X	X	X	X	X	X	X	X				X
Estimated Average Number of Samples/Month [2]		30	30	30	30	30	30	30	30	30	2	2	2	30

Notes:

1 - During the sampling events if there is no water flowing into the floodway channel from the Red River or a drain due to frozen or low flow conditions then sampling that location is not required.

2 - Average based on experience obtained during previous years that realizes that not every sample location visited each month will have a sample collected



▲10 Surface Water Sampling Locations

C0 Completed Prior to 2008

C0 Completed During 2008

C0 Still Active at End of 2008

Completed Prior to 2009

Completed During 2009

Still Active at End of 2009

1:200,000

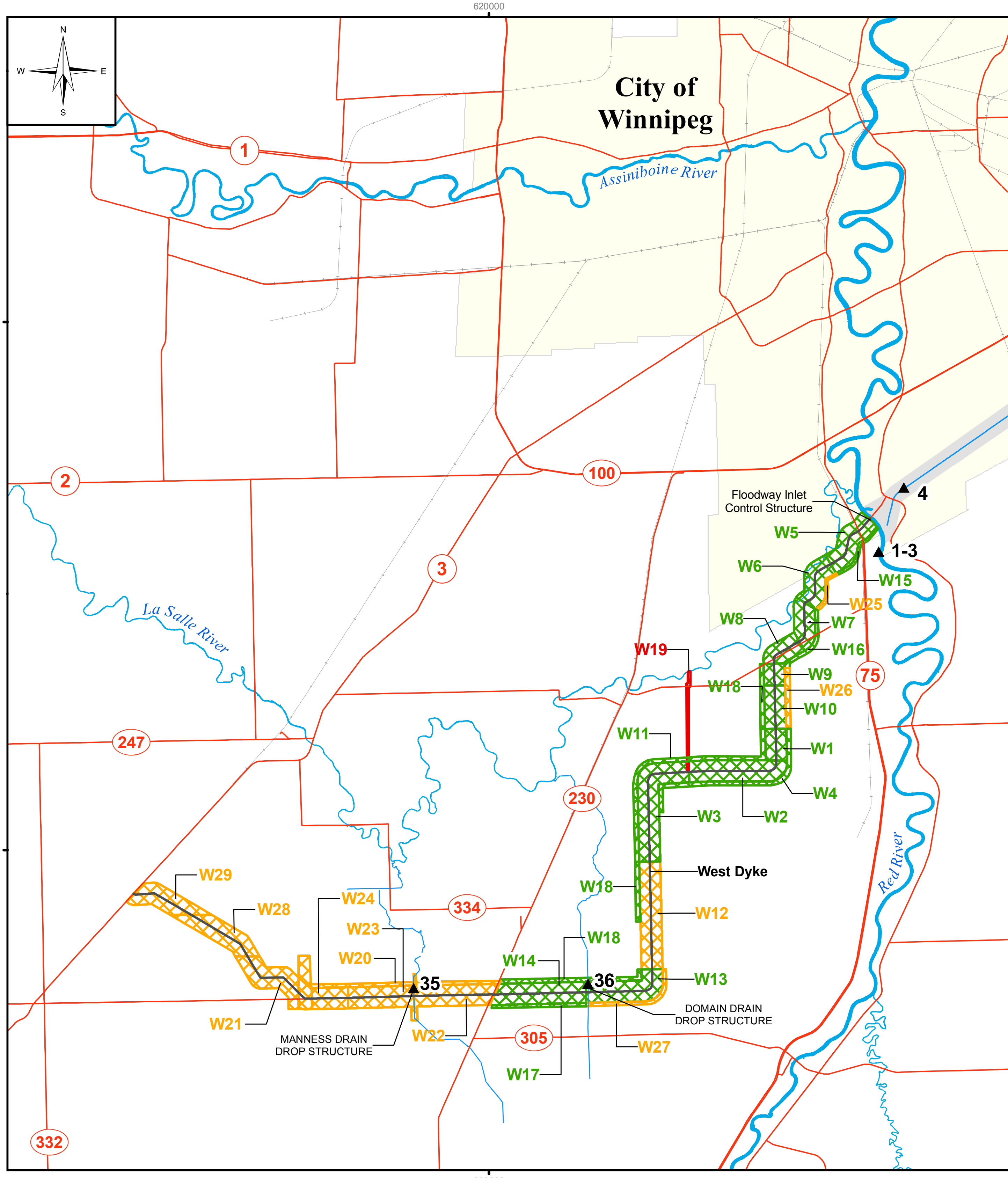
2 0 2 4 6 8 10

Kilometres

X:\projects\2003\03-1100-01\GIS\Archive\Contract_General\9905241\MXDs\NM7-1.mxd

MEMO REFERENCE ....05-1100-01.9905246-NM8.............

KGS GROUP		
MANITOBA FLOODWAY AUTHORITY		
RED RIVER FLOODWAY EXPANSION		
2009 CONSTRUCTION SURFACE WATER MONITORING		
FLOODWAY CHANNEL SAMPLE LOCATIONS		
JANUARY 2009	FIGURE NM8-1	REV 0



▲35 Surface Water Sampling Locations

W0 Completed Prior to 2008

W0 Completed During 2008

W0 Still Active at End of 2008

Completed Prior to 2009

Completed During 2009

Still Active at End of 2009

1:200,000

2 0 2 4 6 8 10

Kilometres

X:\projects\2003\03-1100-01\GIS\Archive\Contract_General\9905241\MXDs\NM7-2.mxd

MEMO REFERENCE 05-1100-01.9905246-NM8

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

RED RIVER FLOODWAY EXPANSION

2009 CONSTRUCTION SURFACE WATER MONITORING

FLOODWAY CHANNEL SAMPLE LOCATIONS

JANUARY 2009 | FIGURE NM8-2 | REV 0

Manitoba
Floodway Expansion Authority

KGS GROUP

FLOODWAY EXPANSION PROJECT
SURFACE WATER MONITORING PROGRAM

LEVEL I SURFACE WATER MONITORING WORKSHEET
LEVEL I SURFACE WATER MONITORING EVENT – XXXX, 2009

Recorded Flows and Turbidity Values

Note: Recorded flows and turbidity values based on field measurements

Floodway Channel – Upstream of Construction	Flow =		m^3/s **Box 1**	Turbidity =	-	NTU	**Box 2**
Floodway Channel – Downstream of Construction	Flow =		m^3/s **Box 3**	Turbidity =		NTU	**Box 4**
Red River – Upstream of Floodway Outlet	Flow =		m^3/s **Box 5**	Turbidity =		NTU	**Box 6**

Sediment Concentration Values

Note: Based on recorded turbidity and appropriate regression relationship

Floodway Channel – Upstream of Construction	TSS =	-	mg/L	**Box 7**	**[Use Box 2 in Regression Equation]**
Floodway Channel – Downstream of Construction	TSS =		mg/L	**Box 8**	**[Use Box 4 in Regression Equation]**
Red River – Upstream of Floodway Outlet	TSS =		mg/L	**Box 9**	**[Use Box 6 in Regression Equation]**

Regression Relationships

Red River Water (ie Red River, FW Operation)

TSS = 1.181 x Turbidity + 1.012

Non – Red River Water (ie. FW non-operation, Drains)

TSS = 0.807 x Turbidity + 1.175

Sediment Load

Upstream of Construction Area	Sediment Load =		tonne/day	**Box 10 =**	**[0.0864 × Box 1 × Box 7]**
Downstream of Construction Area	Sediment Load =		tonne/day	**Box 11 =**	**[0.0864 × Box 3 × Box 8]**
Red River – Upstream of Floodway Outlet	Sediment Load =		tonne/day	**Box 12 =**	**[0.0864 × Box 5 × Box 9]**

Calculated Effect of Construction Works After Mixing in the Red River

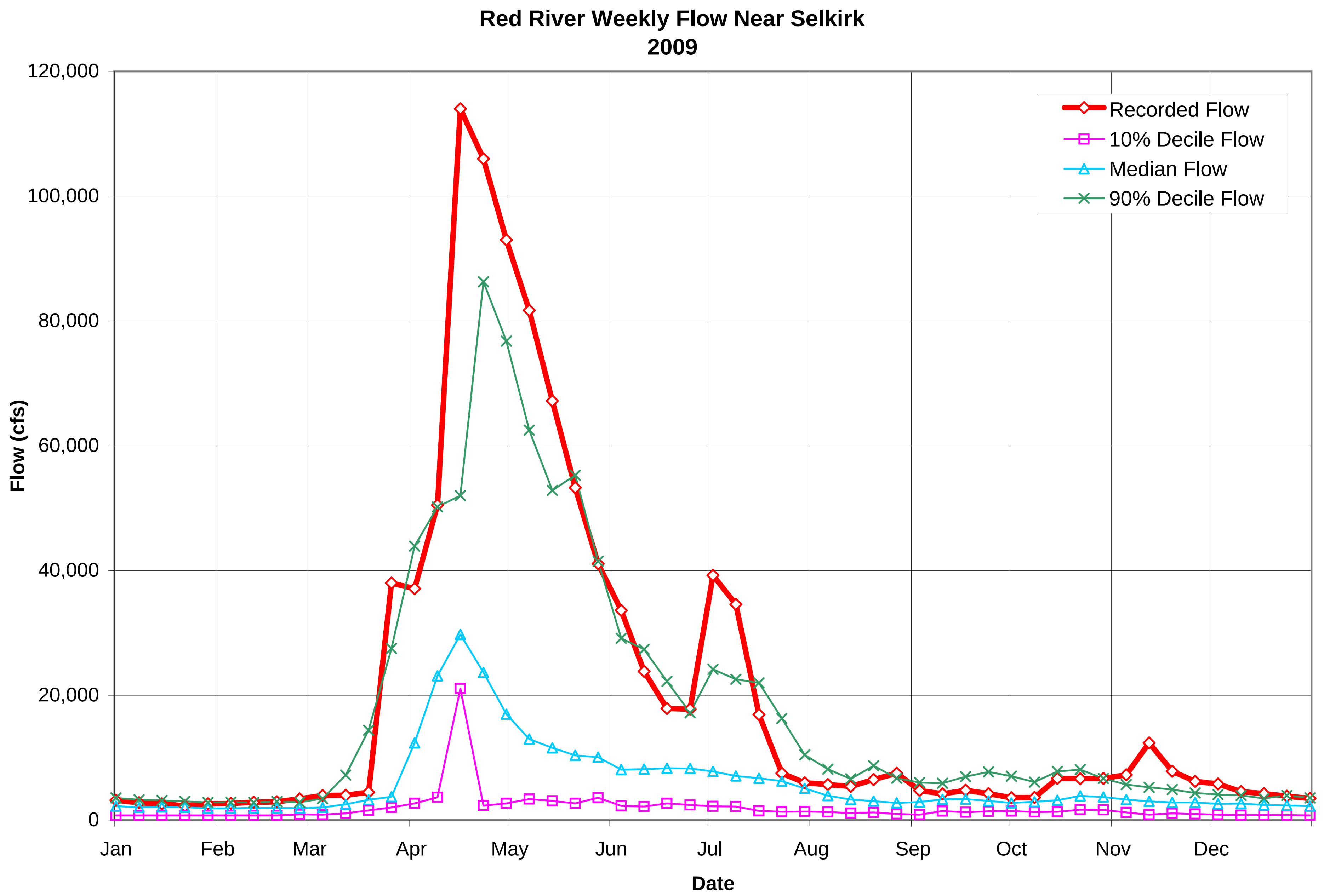
Note: Assumes no other inflows to channel except those at the downstream end of construction

Flow in Red River		m^3/s	**Box 13 =**	**[Box 3 + Box 5]**
Sediment Load in Red River		tonne/day	**Box 14 =**	**[Box 11 + Box 12]**
Sediment Concentration in Red River		mg/L	**Box 15 =**	**[11.574 × Box 14 ÷ Box 13]**
Change in Sediment Concentration in Red River		mg/L	**Box 16 =**	**[Box 15 – Box 9]**
Percent Change in Sediment Concentration in Red River		%	**Box 17 =**	**[(Box 15 – Box 9) ÷ Box 9 x 100]**

Prepared By: ____________ **Date Prepared:** ____________

APPENDIX B

MANITOBA WATER STEWARDSHIP, WEEKLY RIVER FLOW REPORT RED RIVER NEAR SELKIRK


Red River Weekly Flow Near Selkirk
2009
120,000
100,000
80,000
60,000
40,000
20,000
0
Flow (cfs)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Date
Recorded Flow
10% Decile Flow
Median Flow
90% Decile Flow

APPENDIX C

ENVIRONMENT CANADA
WINNIPEG INT'L A, MANITOBA – DAILY DATA REPORTS
JANUARY - DECEMBER 2009

Environment Canada Environnement Canada Canada

Notices:

As of July 24, 2008 changes were made in how data are accessed at 25 stations. Please click here for further details.

Daily Data Report for January 2009

Notes on Data Quality.

WINNIPEG RICHARDSON AWOS
MANITOBA

Latitude: 49° 55.200' N **Longitude:** 97° 13.800' W **Elevation:** 238.70 m
Climate ID: 5023226 **WMO ID:** 71852 **TC ID:** YWG

Previous Month January 2009 Go Next Month

Daily Data Report for January 2009

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days °C	Cool Deg Days °C	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
01†	-14.1	-27.5	-20.8	38.8	0.0	M	M	2.0		1	33
02†	-17.4	-34.4	-25.9	43.9	0.0	M	M	0.0			<31
03†	-14.2	-17.7	-16.0	34.0	0.0	M	M	5.0		10	35
04†	-17.7	-30.1	-23.9	41.9	0.0	M	M	1.0		28	35
05†	-21.1	-33.7	-27.4	45.4	0.0	M	M	0.0			<31
06†	-16.7	-21.7	-19.2	37.2	0.0	M	M	1.0			<31
07†	-18.6	-27.8	-23.2	41.2	0.0	M	M	0.0			<31
08†	-21.2	-30.4	-25.8	43.8	0.0	M	M	0.0			<31
09†	-17.3	-30.2	-23.8	41.8	0.0	M	M	0.0			<31
10†	-13.4	-18.8	-16.1	34.1	0.0	M	M	1.0		19	33
11†	-14.8	-26.0	-20.4	38.4	0.0	M	M	0.5			<31
12†	-16.5	-34.4	-25.5	43.5	0.0	M	M	0.0		3	39
13†	-24.9	-37.6	-31.3	49.3	0.0	M	M	0.0			<31
14†	-26.8	-37.2	-32.0	50.0	0.0	M	M	0.0		29	32
15†	-23.5	-32.4	-28.0	46.0	0.0	M	M	0.0			<31
16†	-14.9	-31.5	-23.2	41.2	0.0	M	M	1.5		18	52
17†	-6.8	-15.0	-10.9	28.9	0.0	M	M	0.0		34	44
18†	-3.5	-18.6	-11.1	29.1	0.0	M	M	0.0		3	32
19†	-2.0	-18.2	-10.1	28.1	0.0	M	M	0.0		35	44
20†	-3.9	-12.8	-8.4	26.4	0.0	M	M	0.5		19	44
21†	-5.1	-14.9	-10.0	28.0	0.0	M	M	0.0			<31
22†	-4.3	-16.7	-10.5	28.5	0.0	M	M	0.5			<31

23†	-16.7	-25.9	-21.3	39.3	0.0	M	M	0.0		36	50
24†	-20.0	-26.5	-23.3	41.3	0.0	M	M	0.0		28	41
25†	-22.1	-28.5	-25.3	43.3	0.0	M	M	0.0			<31
26†	-20.2	-30.1	-25.2	43.2	0.0	M	M	0.0			<31
27†	-18.0	-25.1	-21.6	39.6	0.0	M	M	0.5		18	56
28†	-10.4	-23.3	-16.9	34.9	0.0	M	M	0.0		18	52
29†	-18.2	-26.0	-22.1	40.1	0.0	M	M	0.0			<31
30†	-6.5	-23.5	-15.0	33.0	0.0	M	M	0.0		2	33
31†	2.8	-10.9	-4.1	22.1	0.0	M	M	3.0		31	100
Sum				**1176.3**	**0.0**	**M**	**M**	**16.5**			
Avg	**-14.5**	**-25.4**	**-19.93**								
Xtrm	**2.8**	**-37.6**								**31**	**100**

Previous Month | January 2009 Go | Next Month

Legend

[empty] = No data available
M = Missing
E = Estimated
A = Accumulated
C = Precipitation occurred, amount uncertain
L = Precipitation may or may not have occurred
F = Accumulated and estimated
N = Temperature missing but known to be > 0
Y = Temperature missing but known to be < 0
S = More than one occurrence
T = Trace
* = The value displayed is based on incomplete data
† = Data for this day has undergone only preliminary quality checking

Navigation Options

Canada Map
Manitoba Map
Customized Search
Nearby Stations with Data
Customizable Chart
Bulk Data (2009) [CSV] [XML]

Date Modified: 2008-10-09

Environment Canada Environnement Canada Canada

Notices:

As of July 24, 2008 changes were made in how data are accessed at 25 stations. Please click here for further details.

Daily Data Report for February 2009

Notes on Data Quality.

WINNIPEG RICHARDSON AWOS
MANITOBA

Latitude: 49° 55.200' N **Longitude**: 97° 13.800' W **Elevation**: 238.70 m

Climate ID: 5023226 **WMO ID**: 71852 **TC ID**: YWG

Previous Month February 2009 Go Next Month

Daily Data Report for February 2009

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days °C	Cool Deg Days °C	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
01†	-5.2	-23.0	-14.1	32.1	0.0	M	M	0.5		33	63
02†	-17.6	-28.5	-23.1	41.1	0.0	M	M	0.0		34	37
03†	-17.4	-32.4	-24.9	42.9	0.0	M	M	0.0			<31
04†	-10.2	-21.5	-15.9	33.9	0.0	M	M	2.0		18	76
05†	-3.3	-17.2	-10.3	28.3	0.0	M	M	0.0		18	44
06†	-3.1	-10.3	-6.7	24.7	0.0	M	M	0.0		19	37
07†	-3.0	-9.6	-6.3	24.3	0.0	M	M	0.0		2	57
08†	-2.3	-10.6	-6.5	24.5	0.0	M	M	0.0		22	32
09†	1.9	-6.7	-2.4	20.4	0.0	M	M	26.5		12	35
10†	1.9	0.5	1.2	16.8	0.0	M	M	2.5			<31
11†	0.5	-5.5	-2.5	20.5	0.0	M	M	1.0		3	37
12†	-5.4	-14.4	-9.9	27.9	0.0	M	M	0.5		31	44
13†	-10.0	-17.7	-13.9	31.9	0.0	M	M	0.0			<31
14†	-15.1	-22.3	-18.7	36.7	0.0	M	M	0.0			<31
15†	-13.7	-24.2	-19.0	37.0	0.0	M	M	0.0			<31
16†	-13.8	-23.6	-18.7	36.7	0.0	M	M	0.0			<31
17†	-11.1	-17.8	-14.5	32.5	0.0	M	M	1.0		4	35
18†	-16.2	-22.8	-19.5	37.5	0.0	M	M	0.0			<31
19†	-13.8	-24.1	-19.0	37.0	0.0	M	M	0.0			<31
20†	-11.5	-19.0	-15.3	33.3	0.0	M	M	0.0			<31
21†	-11.3	-20.7	-16.0	34.0	0.0	M	M	0.0			<31
22†	-11.8	-20.9	-16.4	34.4	0.0	M	M	0.0			<31

23†	-7.3	-22.7	-15.0	33.0	0.0	M	M	0.5	18	59
24†	-6.5	-12.9	-9.7	27.7	0.0	M	M	6.0	4	37
25†	-12.8	-22.3	-17.6	35.6	0.0	M	M	0.5		<31
26†	-21.7	-30.8	-26.3	44.3	0.0	M	M	0.0	2	39
27†	-19.9	-33.5	-26.7	44.7	0.0	M	M	0.0	20	33
28†	-15.0	-27.4	-21.2	39.2	0.0	M	M	0.5	33	41
Sum				**912.9**	**0.0**	**M**	**M**	**41.5**		
Avg	**-9.8**	**-19.4**	**-14.58**							
Xtrm	**1.9**	**-33.5**							**18**	**76**

Previous Month February 2009 Go Next Month

Legend

[empty] = No data available
M = Missing
E = Estimated
A = Accumulated
C = Precipitation occurred, amount uncertain
L = Precipitation may or may not have occurred
F = Accumulated and estimated
N = Temperature missing but known to be > 0
Y = Temperature missing but known to be < 0
S = More than one occurrence
T = Trace
* = The value displayed is based on incomplete data
† = Data for this day has undergone only preliminary quality checking

Navigation Options

Canada Map
Manitoba Map
Customized Search
Nearby Stations with Data
Customizable Chart
Bulk Data (2009) [CSV] [XML]

Date Modified: 2008-10-09

Environment Canada Environnement Canada Canada

Notices:

As of July 24, 2008 changes were made in how data are accessed at 25 stations. Please click here for further details.

Daily Data Report for March 2009

Notes on Data Quality.

WINNIPEG RICHARDSON AWOS
MANITOBA

Latitude: 49° 55.200' N **Longitude:** 97° 13.800' W **Elevation:** 238.70 m

Climate ID: 5023226 **WMO ID:** 71852 **TC ID:** YWG

Previous Month March 2009 Go Next Month

Daily Data Report for March 2009

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days °C	Cool Deg Days °C	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
01†	-14.8	-29.4	-22.1	40.1	0.0	M	M	0.0		19	35
02†	-7.4	-19.5	-13.5	31.5	0.0	M	M	0.0		19	48
03†	-1.3	-7.8	-4.6	22.6	0.0	M	M	0.5		18	57
04†	-1.9	-6.0	-4.0	22.0	0.0	M	M	0.0		17	50
05†	1.1	-5.4	-2.2	20.2	0.0	M	M	1.5			<31
06†	-1.3	-17.7	-9.5	27.5	0.0	M	M	1.0		28	44
07†	-12.1	-22.3	-17.2	35.2	0.0	M	M	0.0			<31
08†	-5.5	-15.4	-10.5	28.5	0.0	M	M	0.0		18	39
09†	-5.4	-21.6	-13.5	31.5	0.0	M	M	1.5		32	46
10†	-20.5	-24.2	-22.4	40.4	0.0	M	M	0.5		1	57
11†	-18.8	-25.0	-21.9	39.9	0.0	M	M	0.0		34	39
12†	-9.1	-23.8	-16.5	34.5	0.0	M	M	0.0		21	39
13†	-0.2	-17.3	-8.8	26.8	0.0	M	M	0.0		2	37
14†	2.4	-7.6	-2.6	20.6	0.0	M	M	0.0		21	41
15†	6.8	-9.1	-1.2	19.2	0.0	M	M	0.0		16	39
16†	6.5	-4.8	0.9	17.1	0.0	M	M	0.0		20	46
17†	3.0	-7.2	-2.1	20.1	0.0	M	M	0.0		28	46
18†	-7.1	-14.0	-10.6	28.6	0.0	M	M	0.0		33	44
19†	-4.3	-16.0	-10.2	28.2	0.0	M	M	0.0		18	39
20†	3.2	-4.7	-0.8	18.8	0.0	M	M	1.5		19	44
21†	5.7	-2.4	1.7	16.3	0.0	M	M	0.0		16	37
22†	7.2	1.7	4.5	13.5	0.0	M	M	9.5		13	70

23†	4.3	1.3	2.8	15.2	0.0	M	M	8.0		14	56
24†	1.8	-6.2	-2.2	20.2	0.0	M	M	19.0		36	57
25†	-6.0	-10.3	-8.2	26.2	0.0	M	M	7.0		2	59
26†	-7.6	-12.4	-10.0	28.0	0.0	M	M	1.5		2	56
27†	-10.6	-18.1	-14.4	32.4	0.0	M	M	0.0			<31
28†	-4.7	-16.5	-10.6	28.6	0.0	M	M	0.0			<31
29†	1.5	-13.1	-5.8	23.8	0.0	M	M	0.0			<31
30†	0.4	-9.9	-4.8	22.8	0.0	M	M	0.0			<31
31†	2.5	-6.6	-2.1	20.1	0.0	M	M	2.5		6	56
Sum				**800.4**	**0.0**	**M**	**M**	**54.0**			
Avg	**-3**	**-12.6**	**-7.8**								
Xtrm	**7.2**	**-29.4**								**13**	**70**

Previous Month March 2009 Go Next Month

Legend

[empty] = No data available
M = Missing
E = Estimated
A = Accumulated
C = Precipitation occurred, amount uncertain
L = Precipitation may or may not have occurred
F = Accumulated and estimated
N = Temperature missing but known to be > 0
Y = Temperature missing but known to be < 0
S = More than one occurrence
T = Trace
* = The value displayed is based on incomplete data
† = Data for this day has undergone only preliminary quality checking

Navigation Options

Canada Map
Manitoba Map
Customized Search
Nearby Stations with Data
Customizable Chart
Bulk Data (2009) [CSV] [XML]

Date Modified: 2008-10-09

Notices:

As of July 24, 2008 changes were made in how data are accessed at 25 stations. Please click here for further details.

Daily Data Report for April 2009

Notes on Data Quality.

WINNIPEG RICHARDSON AWOS
MANITOBA

Latitude: 49° 55.200' N **Longitude:** 97° 13.800' W **Elevation:** 238.70 m

Climate ID: 5023226 **WMO ID:** 71852 **TC ID:** YWG

Daily Data Report for April 2009

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days °C	Cool Deg Days °C	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
01†	-0.2	-2.4	-1.3	19.3	0.0	M	M	4.0		2	39
02†	0.4	-3.9	-1.8	19.8	0.0	M	M	0.5			<31
03†	-0.1	-2.8	-1.5	19.5	0.0	M	M	0.0			<31
04†	-0.1	-9.9	-5.0	23.0	0.0	M	M	0.5			<31
05†	-1.2	-11.6	-6.4	24.4	0.0	M	M	0.0		1	44
06†	1.8	-9.8	-4.0	22.0	0.0	M	M	0.0			<31
07†	2.0	-6.7	-2.4	20.4	0.0	M	M	0.0		20	32
08†	3.7	-5.7	-1.0	19.0	0.0	M	M	0.0		31	33
09†	1.7	-4.6	-1.5	19.5	0.0	M	M	0.0			<31
10†	4.1	-5.2	-0.6	18.6	0.0	M	M	0.0			<31
11†	10.4	-2.8	3.8	14.2	0.0	M	M	0.0		19	50
12†	10.8	4.8	7.8	10.2	0.0	M	M	12.5		16	59
13†	8.1	5.6	6.9	11.1	0.0	M	M	6.0		19	52
14†	16.8	3.4	10.1	7.9	0.0	M	M	0.0		19	35
15†	18.1	6.3	12.2	5.8	0.0	M	M	0.5		19	56
16†	15.9	7.8	11.9	6.1	0.0	M	M	0.0		17	50
17†	10.2	0.2	5.2	12.8	0.0	M	M	0.0		30	44
18†	2.7	-1.6	0.6	17.4	0.0	M	M	0.0		3	37
19†	5.5	0.0	2.8	15.2	0.0	M	M	1.0			<31
20†	11.3	-0.1	5.6	12.4	0.0	M	M	0.5		34	39
21†	15.9	-1.7	7.1	10.9	0.0	M	M	0.5		1	54
22†	10.8	-4.8	3.0	15.0	0.0	M	M	0.0		16	35
23†	14.3	2.6	8.5	9.5	0.0	M	M	0.0		2	59
24†	5.4	-3.7	0.9	17.1	0.0	M	M	0.0		2	46
25†	11.4	-4.6	3.4	14.6	0.0	M	M	0.0		27	46
26†	11.5	-0.8	5.4	12.6	0.0	M	M	0.0		13	44

27†	12.8	-2.0	5.4	12.6	0.0	M	M	0.0		2	52
28†	14.3	-3.9	5.2	12.8	0.0	M	M	0.5		17E	37E
29†	16.3	5.7	11.0	7.0	0.0	M	M	2.0		9	48
30†	12.1	2.4	7.3	10.7	0.0	M	M	5.5		36	57
Sum				**441.4**	**0.0**	**M**	**M**	**34.0**			
Avg	**8.2**	**-1.7**	**3.28**								
Xtrm	**18.1**	**-11.6**								**16**	**59**

Legend
[empty] = No data available
M = Missing
E = Estimated
A = Accumulated
C = Precipitation occurred, amount uncertain
L = Precipitation may or may not have occurred
F = Accumulated and estimated
N = Temperature missing but known to be > 0
Y = Temperature missing but known to be < 0
S = More than one occurrence
T = Trace
* = The value displayed is based on incomplete data
† = Data for this day has undergone only preliminary quality checking

Date Modified: 2008-10-09

Environment Canada Environnement Canada Canada

Notices:

As of July 24, 2008 changes were made in how data are accessed at 25 stations. Please click here for further details.

Popular historical Environment Canada publications, studies, and reports from the National Climate Archive library are now available for download as electronic files. They can be accessed by clicking the "Products and Services" link on the left menu bar.

Daily Data Report for May 2009

Notes on Data Quality.

WINNIPEG RICHARDSON AWOS
MANITOBA

Latitude: 49° 55.000' N **Longitude**: 97° 14.000' W **Elevation**: 238.70 m
Climate ID: 5023226 **WMO ID**: 71852 **TC ID**: YWG

Daily Data Report for May 2009

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days °C	Cool Deg Days °C	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
01†	10.1	-2.2	4.0	14.0	0.0	M	M	0.0		32	41
02†	11.3	-3.0	4.2	13.8	0.0	M	M	0.0		30	48
03†	15.7	-3.6	6.1	11.9	0.0	M	M	0.0		33	39
04†	20.2	5.7	13.0	5.0	0.0	M	M	0.0		17	56
05†	18.6	8.7	13.7	4.3	0.0	M	M	0.0		16	44
06†	21.2	4.8	13.0	5.0	0.0	M	M	0.0		30	52
07†	10.6	0.3	5.5	12.5	0.0	M	M	2.5		30	52
08†	5.1	0.0	2.6	15.4	0.0	M	M	0.5		4	37
09†	10.2	-2.6	3.8	14.2	0.0	M	M	0.5		7	32
10†	14.9	-6.2	4.4	13.6	0.0	M	M	0.0		34	32
11†	19.5	1.1	10.3	7.7	0.0	M	M	0.0		23	46
12†	19.0	6.6	12.8	5.2	0.0	M	M	0.0		16	50
13†	12.4	-2.2	5.1	12.9	0.0	M	M	38.0		30	70
14†	5.9	-3.6	1.2	16.8	0.0	M	M	0.5		33	54
15†	3.7	-0.4	1.7	16.3	0.0	M	M	3.0		36	57
16†	14.2	-3.2	5.5	12.5	0.0	M	M	0.0		33	48
17†	19.7	0.7	10.2	7.8	0.0	M	M	0.5		20	57
18†	13.5	1.6	7.6	10.4	0.0	M	M	0.0		36	59
19†	10.7	-0.6	5.1	12.9	0.0	M	M	0.5		10	54
20†	14.3	3.9	9.1	8.9	0.0	M	M	1.0		9	35

21†	16.0	1.0	8.5	9.5	0.0	M	M	0.5		29	48
22†	18.8	-0.6	9.1	8.9	0.0	M	M	2.0		30	63
23†	17.1	-2.4	7.4	10.6	0.0	M	M	0.0		24	33
24†	22.2	5.7	14.0	4.0	0.0	M	M	0.0			<31
25†	14.9	9.0	12.0	6.0	0.0	M	M	12.5		20	50
26†	19.1	6.4	12.8	5.2	0.0	M	M	0.0		2	52
27†	20.2	4.1	12.2	5.8	0.0	M	M	0.0		18	48
28†	15.5	3.6	9.6	8.4	0.0	M	M	0.0		21	39
29†	22.2	3.7	13.0	5.0	0.0	M	M	0.0		1	76
30†	15.6	0.9	8.3	9.7	0.0	M	M	0.0		1	35
31†	15.3	6.9	11.1	6.9	0.0	M	M	1.5		12	44
Sum				**301.1**	**0.0**	**M**	**M**	**63.5**			
Avg	**15.1**	**1.4**	**8.25**								
Xtrm	**22.2**	**-6.2**								**1**	**76**

Legend
[empty] = No data available
M = Missing
E = Estimated
A = Accumulated
C = Precipitation occurred, amount uncertain
L = Precipitation may or may not have occurred
F = Accumulated and estimated
N = Temperature missing but known to be > 0
Y = Temperature missing but known to be < 0
S = More than one occurrence
T = Trace
* = The value displayed is based on incomplete data
† = Data for this day has undergone only preliminary quality checking

Date Modified: 2008-10-09

Environment Canada Environnement Canada Canada

Home » Climate Data Online » Daily Data

Notices:

As of July 24, 2008 changes were made in how data are accessed at 25 stations. Please click here for further details.

Popular historical Environment Canada publications, studies, and reports from the National Climate Archive library are now available for download as electronic files. They can be accessed by clicking the "Products and Services" link on the left menu bar.

Daily Data Report for June 2009

Notes on Data Quality.

WINNIPEG RICHARDSON AWOS MANITOBA

Latitude: 49° 55.000' N **Longitude**: 97° 14.000' W **Elevation**: 238.70 m

Climate ID: 5023226 **WMO ID**: 71852 **TC ID**: YWG

Daily Data Report for June 2009

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days °C	Cool Deg Days °C	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
01†	20.0	4.5	12.3	5.7	0.0	M	M	3.0		31E	69E
02†	14.9	3.0	9.0	9.0	0.0	M	M	0.0		32	37
03†	22.5	3.6	13.1	4.9	0.0	M	M	0.0		28	50
04†	16.2	6.5	11.4	6.6	0.0	M	M	5.5		33	44
05†	11.3	-1.6	4.9	13.1	0.0	M	M	0.5		34	54
06†	13.8	-4.6	4.6	13.4	0.0	M	M	0.0		4	35
07†	16.2	7.2	11.7	6.3	0.0	M	M	0.0		6	32
08†	11.4	8.1	9.8	8.2	0.0	M	M	11.0		5	33
09†	15.1	5.2	10.2	7.8	0.0	M	M	3.0		33	35
10†	15.7	3.0	9.4	8.6	0.0	M	M	1.0			<31
11†	18.8	3.5	11.2	6.8	0.0	M	M	0.5		28	39
12†	23.9	5.0	14.5	3.5	0.0	M	M	0.0		33	50
13†	20.7	7.1	13.9	4.1	0.0	M	M	0.0		33	37
14†	25.6	3.2	14.4	3.6	0.0	M	M	0.0			<31
15†	29.0	13.5	21.3	0.0	3.3	M	M	0.0		20E	41E
16†	28.2	15.8	22.0	0.0	4.0	M	M	0.5		15	50
17†	26.2	15.9	21.1	0.0	3.1	M	M	0.0		18	32
18†	30.0	15.6	22.8	0.0	4.8	M	M	0.0		18	44
19†	27.5	14.7	21.1	0.0	3.1	M	M	0.0		33	37
20†	28.2	10.7	19.5	0.0	1.5	M	M	0.5			<31

21†	29.7	16.0	22.9	0.0	4.9	M	M	0.5		17	46
22†	28.0	17.9	23.0	0.0	5.0	M	M	0.0			<31
23†	26.0	16.3	21.2	0.0	3.2	M	M	1.5		27	44
24†	29.6	15.1	22.4	0.0	4.4	M	M	1.5		31	69
25†	26.2	11.7	19.0	0.0	1.0	M	M	0.5		33	37
26†	25.9	16.2	21.1	0.0	3.1	M	M	11.0		16	48
27†	17.4	14.0	15.7	2.3	0.0	M	M	20.0		34	69
28†	20.8	12.1	16.5	1.5	0.0	M	M	0.5		32	72
29†	20.0	11.8	15.9	2.1	0.0	M	M	0.5		3	44
30†	20.6	5.5	13.1	4.9	0.0	M	M	0.0		2	44
Sum				**112.4**	**41.4**	**M**	**M**	**61.5**			
Avg	**22**	**9.2**	**15.6**								
Xtrm	**30.0**	**-4.6**								**32**	**72**

Legend
[empty] = No data available
M = Missing
E = Estimated
A = Accumulated
C = Precipitation occurred, amount uncertain
L = Precipitation may or may not have occurred
F = Accumulated and estimated
N = Temperature missing but known to be > 0
Y = Temperature missing but known to be < 0
S = More than one occurrence
T = Trace
* = The value displayed is based on incomplete data
† = Data for this day has undergone only preliminary quality checking

Date Modified: 2008-10-09

Environment Canada Environnement Canada

Canada

Notices:

As of July 24, 2008 changes were made in how data are accessed at 25 stations. Please click here for further details.

Popular historical Environment Canada publications, studies, and reports from the National Climate Archive library are now available for download as electronic files. They can be accessed by clicking the "Products and Services" link on the left menu bar.

Daily Data Report for July 2009

Notes on Data Quality.

WINNIPEG RICHARDSON AWOS
MANITOBA

Latitude: 49° 55.000' N **Longitude**: 97° 14.000' W **Elevation**: 238.70 m

Climate ID: 5023226 **WMO ID**: 71852 **TC ID**: YWG

Daily Data Report for July 2009

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days °C	Cool Deg Days °C	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
01†	22.3	6.7	14.5	3.5	0.0	M	M	0.0		2	32
02†	22.0	9.6	15.8	2.2	0.0	M	M	0.0		3	32
03†	23.9	6.7	15.3	2.7	0.0	M	M	0.0		4	32
04†	24.0	10.4	17.2	0.8	0.0	M	M	0.0		31	33
05†	24.4	8.5	16.5	1.5	0.0	M	M	0.0		3	35
06†	25.4	9.5	17.5	0.5	0.0	M	M	0.0		36	61
07†	22.4	9.3	15.9	2.1	0.0	M	M	0.0		8E	32E
08†	26.2	9.3	17.8	0.2	0.0	M	M	M			<31
09†	26.4	13.8	20.1	0.0	2.1	M	M	33.5		28	70
10†	20.0	9.1	14.6	3.4	0.0	M	M	0.0		29	48
11†	19.1	5.8	12.5	5.5	0.0	M	M	0.0		31	44
12†	21.9	5.0	13.5	4.5	0.0	M	M	0.0			<31
13†	23.7	6.3	15.0	3.0	0.0	M	M	0.0			<31
14†	22.0	13.8	17.9	0.1	0.0	M	M	45.0		27	41
15†	17.4	9.9	13.7	4.3	0.0	M	M	0.5		28	54
16†	16.7	8.6	12.7	5.3	0.0	M	M	2.0		33	67
17†	20.0	8.6	14.3	3.7	0.0	M	M	0.0		34	35
18†	20.8	6.7	13.8	4.2	0.0	M	M	0.0			<31
19†	26.2	9.8	18.0	0.0	0.0	M	M	0.5		18	54
20†	25.6	15.7	20.7	0.0	2.7	M	M	2.5		16	54

21†	25.0	13.8	19.4	0.0	1.4	M	M	0.0		29	39
22†	27.5	13.5	20.5	0.0	2.5	M	M	0.0		28	54
23†	25.8	14.4	20.1	0.0	2.1	M	M	1.0		19	50
24†	23.5	11.7	17.6	0.4	0.0	M	M	0.5		32	48
25†	25.1	13.4	19.3	0.0	1.3	M	M	0.0		33	37
26†	26.5	11.2	18.9	0.0	0.9	M	M	0.0			<31
27†	23.1	12.3	17.7	0.3	0.0	M	M	1.5		34	65
28†	22.0	10.5	16.3	1.7	0.0	M	M	0.0		33	50
29†	21.5	9.4	15.5	2.5	0.0	M	M	7.5		32	44
30†	20.9	11.9	16.4	1.6	0.0	M	M	6.5		29	41
31†	16.9	11.0	14.0	4.0	0.0	M	M	13.5		1	41
Sum				**58.0**	**13.0**	**M**	**M**	**114.5***			
Avg	**22.8**	**10.2**	**16.52**								
Xtrm	**27.5**	**5.0**								**28**	**70**

Legend
[empty] = No data available
M = Missing
E = Estimated
A = Accumulated
C = Precipitation occurred, amount uncertain
L = Precipitation may or may not have occurred
F = Accumulated and estimated
N = Temperature missing but known to be > 0
Y = Temperature missing but known to be < 0
S = More than one occurrence
T = Trace
* = The value displayed is based on incomplete data
† = Data for this day has undergone only preliminary quality checking

Date Modified: 2008-10-09

Environment Canada Environnement Canada Canada

Notices:

As of July 24, 2008 changes were made in how data are accessed at 25 stations. Please click here for further details.

Popular historical Environment Canada publications, studies, and reports from the National Climate Archive library are now available for download as electronic files. They can be accessed by clicking the "Products and Services" link on the left menu bar.

Daily Data Report for August 2009

Notes on Data Quality.

WINNIPEG RICHARDSON AWOS
MANITOBA

Latitude: 49° 55.000' N **Longitude**: 97° 14.000' W **Elevation**: 238.70 m
Climate ID: 5023226 **WMO ID**: 71852 **TC ID**: YWG

Daily Data Report for August 2009

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days °C	Cool Deg Days °C	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
01†	19.8	8.2	14.0	4.0	0.0	M	M	0.0		30	50
02†	22.7	12.0	17.4	0.6	0.0	M	M	0.0			<31
03†	21.0	9.3	15.2	2.8	0.0	M	M	3.0		32	63
04†	21.1	7.3	14.2	3.8	0.0	M	M	0.0		32	46
05†	22.2	10.4	16.3	1.7	0.0	M	M	0.0		30	41
06†	22.5	7.2	14.9	3.1	0.0	M	M	0.0			<31
07†	19.7	15.6	17.7	0.3	0.0	M	M	0.5		12	32
08†	20.3	16.4	18.4	0.0	0.4	M	M	0.5			<31
09†	24.2	11.4	17.8	0.2	0.0	M	M	0.0		1	32
10†	27.4	10.6	19.0	0.0	1.0	M	M	0.0			<31
11†	30.6	17.0	23.8	0.0	5.8	M	M	0.0		21	44
12†	30.7	17.0	23.9	0.0	5.9	M	M	0.0			<31
13†	28.7	17.8	23.3	0.0	5.3	M	M	2.0		17	54
14†	22.6	16.6	19.6	0.0	1.6	M	M	6.0		3	44
15†	21.4	14.5	18.0	0.0	0.0	M	M	18.5		5	32
16†	21.6	13.6	17.6	0.4	0.0	M	M	4.0		24	35
17†	16.9	10.4	13.7	4.3	0.0	M	M	3.0		31	37
18†	22.5	9.6	16.1	1.9	0.0	M	M	0.5			<31
19†	21.3	14.7	18.0	0.0	0.0	M	M	2.5		17	33
20†	22.7	12.2	17.5	0.5	0.0	M	M	5.5		1	37

21†	20.7	9.3	15.0	3.0	0.0	M	M	0.5		36	35
22†	21.2	6.1	13.7	4.3	0.0	M	M	0.0		17	44
23†	25.3	14.6	20.0	0.0	2.0	M	M	0.0		18	35
24†	21.6	12.3	17.0	1.0	0.0	M	M	6.0		11E	59E
25†	24.7	11.3	18.0	0.0	0.0	M	M	0.0		30	33
26†	27.9	10.7	19.3	0.0	1.3	M	M	0.0		19	54
27†	20.2	15.0	17.6	0.4	0.0	M	M	0.0		20	39
28†	20.2	11.0	15.6	2.4	0.0	M	M	0.0			<31
29†	19.3	6.9	13.1	4.9	0.0	M	M	3.5		29	35
30†	21.8	4.3	13.1	4.9	0.0	M	M	0.0			<31
31†	23.4	9.6	16.5	1.5	0.0	M	M	0.0			<31
Sum				**46.0**	**23.3**	**M**	**M**	**56.0**			
Avg	**22.8**	**11.7**	**17.24**								
Xtrm	**30.7**	**4.3**								**32**	**63**

Legend
[empty] = No data available
M = Missing
E = Estimated
A = Accumulated
C = Precipitation occurred, amount uncertain
L = Precipitation may or may not have occurred
F = Accumulated and estimated
N = Temperature missing but known to be > 0
Y = Temperature missing but known to be < 0
S = More than one occurrence
T = Trace
* = The value displayed is based on incomplete data
† = Data for this day has undergone only preliminary quality checking

Date Modified: 2008-10-09

Environment Canada Environnement Canada

Canada

Daily Data Report for September 2009

Notes on Data Quality.

WINNIPEG RICHARDSON AWOS
MANITOBA

Latitude: 49° 55.200' N **Longitude**: 97° 13.800' W **Elevation**: 238.70 m

Climate ID: 5023226 **WMO ID**: 71852 **TC ID**: YWG

Daily Data Report for September 2009

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days °C	Cool Deg Days °C	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
01†	24.7	12.1	18.4	0.0	0.4	M	M	0.0		17	37
02†	25.4	13.1	19.3	0.0	1.3	M	M	0.0			<31
03†	27.0	12.4	19.7	0.0	1.7	M	M	0.0			<31
04†	25.9	15.2	20.6	0.0	2.6	M	M	0.0		20	48
05†	28.3	15.3	21.8	0.0	3.8	M	M	0.0		19	44
06†	28.5	14.2	21.4	0.0	3.4	M	M	0.0			<31
07†	27.1	16.7	21.9	0.0	3.9	M	M	0.0		18	57
08†	22.1	14.8	18.5	0.0	0.5	M	M	11.0		17	54
09†	25.8	11.4	18.6	0.0	0.6	M	M	0.5		19	52
10†	27.3	10.4	18.9	0.0	0.9	M	M	0.0		18	41
11†	19.4	14.9	17.2	0.8	0.0	M	M	10.0		3	35
12†	21.6	14.8	18.2	0.0	0.2	M	M	0.0			<31
13†	25.2	14.0	19.6	0.0	1.6	M	M	0.0			<31
14†	27.0	12.8	19.9	0.0	1.9	M	M	0.0			<31
15†	26.7	16.0	21.4	0.0	3.4	M	M	0.0		17	32
16†	27.0	13.7	20.4	0.0	2.4	M	M	0.0			<31
17†	27.1	10.8	19.0	0.0	1.0	M	M	0.0			<31
18†	27.6	13.9	20.8	0.0	2.8	M	M	0.0		16	44
19†	30.3	15.2	22.8	0.0	4.8	M	M	0.0		21	39
20†	25.5	15.0	20.3	0.0	2.3	M	M	0.0		17	63
21†	18.8	13.8	16.3	1.7	0.0	M	M	1.0		35	39
22†	22.3	6.0	14.2	3.8	0.0	M	M	0.0			<31
23†	26.0	5.7	15.9	2.1	0.0	M	M	0.0		22	33
24†	26.9	7.5	17.2	0.8	0.0	M	M	0.0			<31
25†	26.8	12.0	19.4	0.0	1.4	M	M	0.0		21	35
26†	20.4	7.6	14.0	4.0	0.0	M	M	0.0			<31
27†	15.1	8.6	11.9	6.1	0.0	M	M	0.0		32	61
28†	14.5	3.5	9.0	9.0	0.0	M	M	0.0		32	63
29†	11.9	-2.4	4.8	13.2	0.0	M	M	0.0		12	37
30†	16.8	4.2	10.5	7.5	0.0	M	M	0.0		13	54
Sum				**49.0**	**40.9**	**M**	**M**	**22.5**			

Avg	**24**	**11.4**	**17.7**		
Xtrm	**30.3**	**-2.4**		**17**	**63**

Legend
[empty] = No data available
M = Missing
E = Estimated
A = Accumulated
C = Precipitation occurred, amount uncertain
L = Precipitation may or may not have occurred
F = Accumulated and estimated
N = Temperature missing but known to be > 0
Y = Temperature missing but known to be < 0
S = More than one occurrence
T = Trace
* = The value displayed is based on incomplete data
† = Data for this day has undergone only preliminary quality checking

Date Modified: 2008-10-09

Environment Canada Environnement Canada Canada

Home » Climate Data Online » Daily Data

Daily Data Report for October 2009

Notes on Data Quality.

WINNIPEG RICHARDSON AWOS
MANITOBA

Latitude: 49° 55.200' N **Longitude**: 97° 13.800' W **Elevation**: 238.70 m

Climate ID: 5023226 **WMO ID**: 71852 **TC ID**: YWG

Daily Data Report for October 2009

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days °C	Cool Deg Days °C	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
01†	11.5	6.5	9.0	9.0	0.0	M	M	2.0		13	48
02†	8.9	-0.2	4.4	13.6	0.0	M	M	0.0			<31
03†	11.2	5.7	8.5	9.5	0.0	M	M	0.0			<31
04†	9.4	-0.1	4.7	13.3	0.0	M	M	0.5			<31
05†	9.7	-2.9	3.4	14.6	0.0	M	M	0.0			<31
06†	7.7	-0.3	3.7	14.3	0.0	M	M	0.0			<31
07†	9.3	4.2	6.8	11.2	0.0	M	M	2.0		28	63
08†	5.0	-4.5	0.3	17.7	0.0	M	M	1.5		30	48
09†	3.9	-6.4	-1.3	19.3	0.0	M	M	1.5		27	56
10†	1.2	-3.3	-1.1	19.1	0.0	M	M	0.5		28E	46E
11†	2.9	-1.9	0.5	17.5	0.0	M	M	0.0			<31
12†	4.1	-6.9	-1.4	19.4	0.0	M	M	0.0			<31
13†	5.1	-9.4	-2.2	20.2	0.0	M	M	0.0			<31
14†	3.7	-3.6	0.1	17.9	0.0	M	M	1.0			<31
15†	4.9	0.1	2.5	15.5	0.0	M	M	1.0			<31
16†	5.7	-0.5	2.6	15.4	0.0	M	M	0.0			<31
17†	8.2	1.9	5.1	12.9	0.0	M	M	0.5		17	59
18†	16.6	2.7	9.7	8.3	0.0	M	M	0.0		18	41
19†	9.2	4.8	7.0	11.0	0.0	M	M	0.0		35	50
20†	7.6	-2.8	2.4	15.6	0.0	M	M	0.0			<31
21†	7.8	-5.3	1.3	16.7	0.0	M	M	0.0			<31
22†	9.3	-7.0	1.2	16.8	0.0	M	M	0.0			<31
23†	6.7	-3.9	1.4	16.6	0.0	M	M	0.0		18	37
24†	7.3	-2.0	2.7	15.3	0.0	M	M	0.0			<31
25†	7.2	2.7	5.0	13.0	0.0	M	M	0.0			<31
26†	8.2	2.8	5.5	12.5	0.0	M	M	0.5		17	50
27†	10.2	5.6	7.9	10.1	0.0	M	M	0.0		17	59
28†	10.2	3.2	6.7	11.3	0.0	M	M	4.0		17	44
29†	5.5	1.3	3.4	14.6	0.0	M	M	24.0			<31
30†	4.0	0.4	2.2	15.8	0.0	M	M	0.5		33	56
31†	4.6	-0.9	1.9	16.1	0.0	M	M	0.0		32	52

Sum				**454.1**	**0.0**	**M**	**M**	**39.5**		
Avg	**7.3**	**-0.6**	**3.34**							
Xtrm	**16.6**	**-9.4**							**28**	**63**

Legend
[empty] = No data available
M = Missing
E = Estimated
A = Accumulated
C = Precipitation occurred, amount uncertain
L = Precipitation may or may not have occurred
F = Accumulated and estimated
N = Temperature missing but known to be > 0
Y = Temperature missing but known to be < 0
S = More than one occurrence
T = Trace
* = The value displayed is based on incomplete data
† = Data for this day has undergone only preliminary quality checking

Date Modified: 2008-10-09

Environment Canada Environnement Canada Canada

Notices:

As of November 19 2009, changes have been made to how Wind Chill and Humidex values are calculated. Please click here for further details. A detailed outline of these calculations can be found in the Glossary.

The Notice Inventory contains a record of all past and current Notices.

Daily Data Report for November 2009

Notes on Data Quality.

WINNIPEG RICHARDSON AWOS
MANITOBA

Latitude: 49° 55.200' N **Longitude**: 97° 13.800' W **Elevation**: 238.70 m

Climate ID: 5023226 **WMO ID**: 71852 **TC ID**: YWG

Daily Data Report for November 2009

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days °C	Cool Deg Days °C	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
01†	3.5	-1.3	1.1	16.9	0.0	M	M	0.5		12	33
02†	0.7	-7.4	-3.4	21.4	0.0	M	M	0.0		30	50
03†	4.3	-6.5	-1.1	19.1	0.0	M	M	0.0		14	35
04†	6.4	-8.0	-0.8	18.8	0.0	M	M	0.0		29	37
05†	3.6	-10.8	-3.6	21.6	0.0	M	M	0.0		16	46
06†	12.7	1.5	7.1	10.9	0.0	M	M	0.0		17	57
07†	12.8	1.1	7.0	11.0	0.0	M	M	0.0		28	48
08†	13.8	-1.2	6.3	11.7	0.0	M	M	0.0		19	32
09†	10.7	-3.8	3.5	14.5	0.0	M	M	0.0		28	35
10†	12.4	-4.6	3.9	14.1	0.0	M	M	0.0		18	59
11†	12.5	1.4	7.0	11.0	0.0	M	M	0.0		19	48
12†	10.9	3.3	7.1	10.9	0.0	M	M	0.0		16	37
13†	6.8	-8.9	-1.1	19.1	0.0	M	M	0.0			<31
14†	6.9	-10.3	-1.7	19.7	0.0	M	M	0.0			<31
15†	5.3	-8.5	-1.6	19.6	0.0	M	M	0.0			<31
16†	10.2	-4.7	2.8	15.2	0.0	M	M	0.0			<31
17†	11.4	-0.4	5.5	12.5	0.0	M	M	0.0		19	57
18†	9.6	-0.8	4.4	13.6	0.0	M	M	0.0		18	48
19†	7.9	-7.1	0.4	17.6	0.0	M	M	0.0		18	33
20†	9.8	-9.4	0.2	17.8	0.0	M	M	0.0		17	39
21†	13.4	0.5	7.0	11.0	0.0	M	M	0.0		17	76
22†	6.9	-4.7	1.1	16.9	0.0	M	M	0.0		28	32

23†	7.0	-9.6	-1.3	19.3	0.0	M	M	0.0			<31
24†	6.2	-8.5	-1.2	19.2	0.0	M	M	0.0			<31
25†	1.3	-12.2	-5.5	23.5	0.0	M	M	0.0		34	46
26†	-0.4	-11.4	-5.9	23.9	0.0	M	M	0.0			<31
27†	1.1	-9.3	-4.1	22.1	0.0	M	M	0.0		14	33
28†	1.1	-10.2	-4.6	22.6	0.0	M	M	0.5			<31
29†	-0.1	-7.5	-3.8	21.8	0.0	M	M	0.0			<31
30†	4.5	-7.6	-1.6	19.6	0.0	M	M	0.5		32	46
Sum				**516.9**	**0.0**	**M**	**M**	**1.5**			
Avg	**7.1**	**-5.6**	**0.77**								
Xtrm	**13.8**	**-12.2**								**17**	**76**

Legend
[empty] = No data available
M = Missing
E = Estimated
A = Accumulated
C = Precipitation occurred, amount uncertain
L = Precipitation may or may not have occurred
F = Accumulated and estimated
N = Temperature missing but known to be > 0
Y = Temperature missing but known to be < 0
S = More than one occurrence
T = Trace
* = The value displayed is based on incomplete data
† = Data for this day has undergone only preliminary quality checking

Date Modified: 2008-10-09

Environment Canada Environnement Canada Canada

Notices:

As of November 19 2009, changes have been made to how Wind Chill and Humidex values are calculated. Please click here for further details. A detailed outline of these calculations can be found in the Glossary.

The Notice Inventory contains a record of all past and current Notices.

Daily Data Report for December 2009

Notes on Data Quality.

WINNIPEG RICHARDSON AWOS
MANITOBA

Latitude: 49° 55.200' N **Longitude**: 97° 13.800' W **Elevation**: 238.70 m

Climate ID: 5023226 **WMO ID**: 71852 **TC ID**: YWG

Daily Data Report for December 2009

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days °C	Cool Deg Days °C	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
01†	-0.7	-3.6	-2.2	20.2	0.0	M	M	0.0			<31
02†	-3.1	-10.4	-6.8	24.8	0.0	M	M	0.0		35	33
03†	-7.1	-14.2	-10.7	28.7	0.0	M	M	0.0		33	39
04†	-9.1	-16.5	-12.8	30.8	0.0	M	M	0.0		32	33
05†	-7.1	-20.4	-13.8	31.8	0.0	M	M	0.5			<31
06†	-7.2	-16.4	-11.8	29.8	0.0	M	M	0.0			<31
07†	-13.8	-20.5	-17.2	35.2	0.0	M	M	0.0			<31
08†	-18.2	-25.9	-22.1	40.1	0.0	M	M	0.0			<31
09†	-19.8	-28.8	-24.3	42.3	0.0	M	M	0.0			<31
10†	-17.7	-27.2	-22.5	40.5	0.0	M	M	0.0			<31
11†	-15.0	-25.9	-20.5	38.5	0.0	M	M	0.0			<31
12†	-18.4	-28.0	-23.2	41.2	0.0	M	M	0.0		3	35
13†	-22.7	-29.2	-26.0	44.0	0.0	M	M	0.0		28	33
14†	-18.9	-27.7	-23.3	41.3	0.0	M	M	0.0		27	35
15†	-20.4	-27.1	-23.8	41.8	0.0	M	M	0.0			<31
16†	-11.6	-22.6	-17.1	35.1	0.0	M	M	0.5		18	46
17†	-7.0	-17.6	-12.3	30.3	0.0	M	M	0.0		17	50
18†	-7.7	-16.7	-12.2	30.2	0.0	M	M	0.0			<31
19†	-7.6	-13.2	-10.4	28.4	0.0	M	M	0.5			<31
20†	-5.4	-12.9	-9.2	27.2	0.0	M	M	0.5			<31
21†	-11.7	-22.6	-17.2	35.2	0.0	M	M	0.0			<31
22†	-8.1	-23.2	-15.7	33.7	0.0	M	M	0.5			<31

23†	-3.4	-9.1	-6.3	24.3	0.0	M	M	0.0			<31
24†	-3.8	-6.7	-5.3	23.3	0.0	M	M	3.5			<31
25†	-5.3	-7.6	-6.5	24.5	0.0	M	M	8.0		2	65
26†	-3.9	-8.4	-6.2	24.2	0.0	M	M	1.5		1	61
27†	-6.6	-12.4	-9.5	27.5	0.0	M	M	0.0		4	52
28†	-9.0	-23.6	-16.3	34.3	0.0	M	M	0.0		35	44
29†	-13.2	-21.9	-17.6	35.6	0.0	M	M	0.5		18	50
30†	-12.3	-18.8	-15.6	33.6	0.0	M	M	0.0		34	39
31†	-18.7	-28.2	-23.5	41.5	0.0	M	M	0.0		32	35
Sum				**1019.9**	**0.0**	**M**	**M**	**16.0**			
Avg	**-10.8**	**-18.9**	**-14.87**								
Xtrm	**-0.7**	**-29.2**								**2**	**65**

Legend
[empty] = No data available
M = Missing
E = Estimated
A = Accumulated
C = Precipitation occurred, amount uncertain
L = Precipitation may or may not have occurred
F = Accumulated and estimated
N = Temperature missing but known to be > 0
Y = Temperature missing but known to be < 0
S = More than one occurrence
T = Trace
* = The value displayed is based on incomplete data
† = Data for this day has undergone only preliminary quality checking

Date Modified: 2008-10-09