# ABSTRACT

## TEMPORAL VARIABILITY OF RIVERBED HYDRAULIC CONDUCTIVITY AT AN INDUCED INFILTRATION SITE, SOUTHWEST OHIO

by Matthew David Birck

This study investigated the impact of high-stage events on riverbed scour and hydraulic conductivity ($K_v$). Seepage-meter measured riverbed $K_v$ averaged 0.092 m/d. Slug-test measured $K_v$ of the underlying sediment averaged 9.6 m/d. The low riverbed $K_v$ is probably due to a gravel and cobble layer clogged with fine sediment (colmation layer). $K_v$ of cores of transient material overlying the cobble layer averaged 5.3 m/d. Event-driven scour, measured with cross-sectional profiles, scour chains, and a load-cell pressure sensor, never exceeded 0.06 m, indicating that the colmation layer remained intact, despite even a 60-year event. A riverbed conceptual model of three distinct layers –transient sediment, an armor/colmation layer and a transitional bottom – had an overall $K_v$ of 4.6 m/d. Sensitivity analysis of layer thicknesses indicated that a) the transient layer has negligible impact on the overall $K_v$ and b) loss of the colmation layer, while not observed, could double the overall $K_v$.

# TEMPORAL VARIABILITY OF RIVERBED HYDRAULIC CONDUCTIVITY AT AN INDUCED INFILTRATION SITE, SOUTHWEST OHIO

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By

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# I. Introduction

Alluvial aquifers that are hydraulically connected to surface-water bodies are used as drinking-water production sites throughout the world due to the relative ease of shallow groundwater withdrawal (Hiscock and Grischek, 2002). Wells placed in such locations have generally high production capacities due to the high permeability of the aquifer sediment and high aquifer-recharge rates caused by induced infiltration from the surface-water body. As surface water travels through the riverbed and aquifer on its way to the production well, it undergoes riverbank filtration, a term that describes the attenuation of potential contamination that can occur due to physical filtration, sorption, or degradation (Ray et al., 2002). Contaminant attenuation can also occur due to dilution as water from a river mixes with water coming from farther away with longer aquifer residence times. All these processes can eliminate or lessen the concentrations of particulates (Wang et al., 1995), total and dissolved organic carbon (Miettinen et al., 1994; Sontheimer, 1991; Wang et al., 1995), turbidity (Mikels, 1992), bacteria (Miettinen et al., 1996), viruses (Havelaar et al., 1995) and synthetic organic compounds (Wilderer et al., 1985; Ray et al., 1998a,b; Ray et al., 2002).

In the U.S., riverbank filtration has recently received recognition as a viable treatment option for municipal treatment facilities which exploit a favorable hydrogeologic setting. In January of 2006, the USEPA promulgated the Long Term 2 Enhanced Surface Water Treatment Rule (USEPA, 2006) which awards a 1.0-log treatment credit for systems utilizing riverbank filtration if meeting certain criteria. Additional treatment credit may be obtained if a demonstration study can prove removal of pathogenic protozoa such as *Cryptosporidium,* as demonstrated in Casper, Wyoming where a 2.0-log credit was conditionally granted by USEPA (Gollnitz et al, 2005). The USEPA has been generally reluctant, however, to grant more than a 1.0-log credit despite studies indicating that 3.0-or 4.0-log credit is warranted (Gollnitz et al., 2004). Hesitance towards greater acceptance of riverbank filtration as an alternative treatment option has stemmed at least in part from concern over the stability of the infiltration rate and attenuation capacity of the system during high-stage events. The concern is that high-stage events can trigger scouring, or removal of riverbed layers that are critical to the natural attenuation of surface-water contaminants (Hiscock & Grischek, 2002; Ray et al., 2002; Wett et al., 2002).

The sediment layer that is potentially most at risk is the biologically-active colmation layer of the riverbed (Hiscock & Grischek, 2002). This layer is the product of deposition of fine particles into the interstitial spaces, often beneath a protective armor layer of larger-sized particles (Velickovic, 2005). This layer is sometimes referred to as the mechanical clogging layer (Schubert, 2002). Because it is composed of suspended solids deposited in the upper layer of a river-aquifer interface, it is often assumed to have a lower hydraulic conductivity and greater filtering capacity than the underlying sediments (Velickovic, 2005). The importance of the uppermost riverbed layers at the surface-water/groundwater interface has been demonstrated by research that has shown that the majority of particulate material is removed in the first two feet of the riverbed (Wang et al., 2002; Gollnitz et al., 2003). Loss of the colmation layer due to scour could potentially allow contaminates to reach production wells (Schubert, 2000).

Schalchli (1995) vertically divided the riverbed into three layers: the surface layer composed of mobile particles, a sub-surface layer composed of particles that are deposited beneath the mobile grains, and a more stable, compact bottom layer. In addition, Schalchli (1995) noted that a fourth layer of only coarse bed materials may be present between the surface and sub-surface layers, creating a low-permeability zone. This fourth layer may exist as an armor layer, which Lisle and Madej (1992) define as a coarse layer of particles mobile only in annual floods with size greater than 4 mm in diameter. Furthermore, Wilcock and DeTemple (2005) found laboratory evidence for the persistence of armor layers and the passage of mobile surface grains above this layer. It is this armor layer that is believed to prevent the sub-surface colmation layer from scour. Studies are needed that quantify the degree of riverbed scour and deposition during storm events and evaluate their potential impact on induced infiltration and riverbank filtration.

The goal of this study was to evaluate the impact of storms and high-stage events on the thickness and hydraulic conductivity of a riverbed at a site of induced infiltration. The working hypothesis of the research was that the riverbed generally has a lower hydraulic conductivity than the underlying aquifer (Walton et al., 1967) and that during storm events, scour takes place, removing sediment and cleansing the colmation layer of some of its clogging, thereby increasing its conductivity and decreasing its thickness. The net effect would therefore be to increase the amount of river water that infiltrates into the aquifer. This effect might be especially important because scouring can occur during the time of maximum hydraulic-head gradient and therefore during times with the greatest driving force of river-water infiltration. The hypothesis was tested at a specific location by addressing the following specific research objectives:

1) Estimate hydraulic conductivity of the riverbed and underlying sediments and characterize riverbed spatial and temporal variability under a variety of flow conditions using a variety of techniques

2) Estimate the degree of riverbed scouring during storm events using a variety of techniques

3) Assess the importance of the temporal variability of riverbed thickness and conductivity caused by storm events

## II. Description and Previous Studies of the Research Area

The field area was the Charles M. Bolton Municipal Well Field, located along the Great Miami River in southwest Ohio (Figure 1). Here the Greater Cincinnati Water Works operates a drinking-water production facility featuring ten wells pumping between 56 and 113 ML/d, roughly 10% of the city of Cincinnati's drinking water. As a result of this pumping, river water becomes induced infiltration into the aquifer. This research focused on one site within the well field associated with one of production wells, PW6, located about 0.3 km south of the river. The site (Site 6) is located along a meander and is characterized by a cobbled streambed. During baseflow conditions, the river at this point is nearly 120 meters in width and 3 meters at its greatest depth. Most of this investigation focused on the southern side (nearest PW6) on a migrating depositional bar, opposite the thalweg (Figure 2).


Figure 1. Riverbed research field area at Charles M. Bolton Water Plant in southwest Ohio.

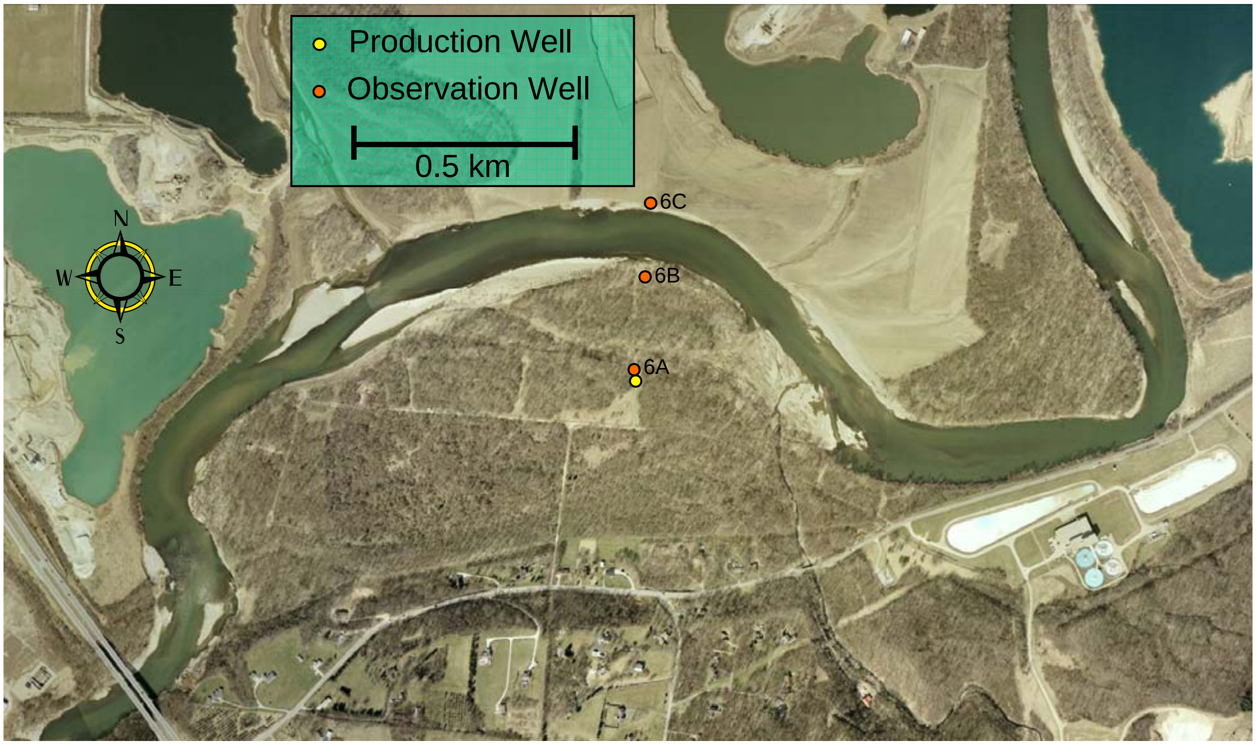


Figure 2. Location of research site (Site 6) along the Great Miami River

The Great Miami River is 273 kilometers in length, discharging into the Ohio River just west of Cincinnati (Figure 1). The Great Miami River watershed is dominated by agricultural which comprises over 80% of the land cover of the watershed's 10,196 square kilometers. Over 1.3 million people reside within the watershed, of which 97% are reliant upon groundwater for their primary drinking-water source (MCD, 2006). The bulk of this groundwater is procured from the Great Miami Buried Valley Aquifer, an alluvial outwash, mostly unconfined aquifer ranging from 3.2-to 4-km wide and 24-to 56-m deep. Hydraulic conductivities generally range from 60 to 120 m/d (Gollnitz et al, 2003). During the 18-month investigation of the riverbed, the mean daily discharge as recorded at the Hamilton, OH USGS station, located 9.5 kilometers northeast of the Bolton well field was 153 $m^3/s$. The region receives an annual precipitation total of about 1 m (Walton et al., 1967). The study period was characterized by numerous high-stage storm events. A high-stage event has been previously defined (Gollnitz et al, 2004) as rise and fall of river stage of at least 5 ft (1.52 m) within a 24 hour period (Figure 3).

Previous research on the interaction of the Great Miami River and the underlying aquifer (Walton et al., 1967) found that the infiltration rate was highly spatially variable and substantially influenced by river stage. This work is supported by Gollnitz (2002) who estimated infiltration rate variability using Darcy's law and seven input parameters (river stage, length of influenced reach, viscosity, and riverbed width, wetted area, thickness, and permeability). These calculations estimated that the infiltration rate could potentially range four orders of magnitude, with a likely scenario of the rate varying one order of magnitude throughout a year. More recently, a potential unit infiltration rate (PUIR) model was used in conjunction with a larger flowpath study examining water quality parameters at the Bolton wellfield (Gollnitz et al., 2004). The goal of this study was to test the impact of infiltration rate variability on natural filtration and water quality. Two production wells with the shortest and longest flowpaths from the river were monitored for surface water indicators such as *Giardia*, *Cryptosporidium*, turbidity, and aerobic spores. Out of more than 200 groundwater samples, *Giardia* and *Cryptosporidium* were not detected while turbidity remained well below 1.0-ntu and aerobic spores experienced a 4.0-log reduction compared to river water. The authors used particle counts in conjunction with the PUIR to relate the estimated infiltration rate with water quality data. The PUIR accounted for river stage, temperature, and groundwater elevation while assuming a constant riverbed thickness of 0.3 m and permeability of 0.46 m/d. The authors found no direct evidence that increased infiltration rates possibly caused scour or had any adverse effects on water quality. The authors also asserted, however, a need for further investigation into riverbed characteristics, particularly during high-stage events. Thus, without direct measurement of riverbed thickness and permeability, it is impossible to know for sure the temporal variability of riverbed infiltration rates.

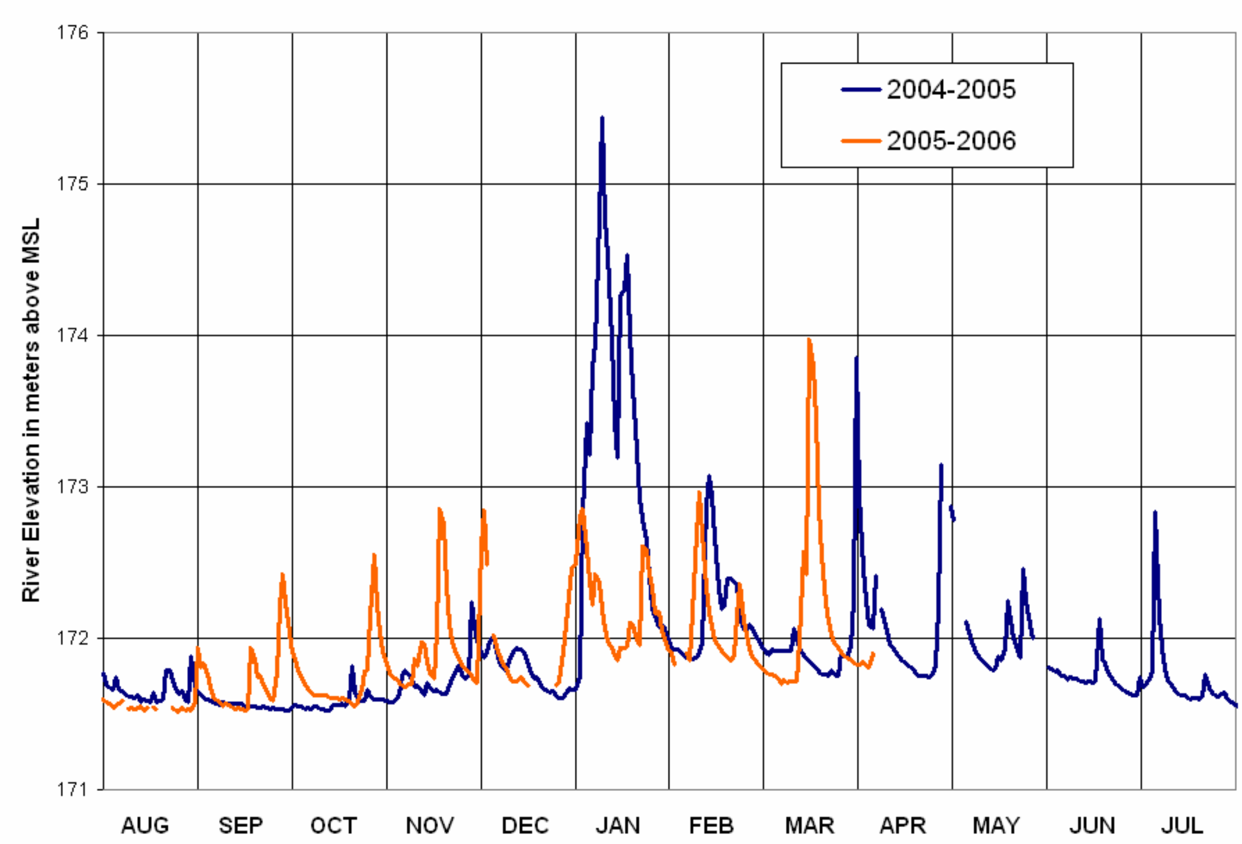


Figure 3. Hydrograph of Great Miami River elevation at USGS gaging station in Hamilton, Ohio during study period.

## III. Field Methods

### A. Measures of Riverbed Hydraulic Conductivity

#### *1. Seepage Meters*

Direct measurements of vertical riverbed hydraulic conductivity ($K_v$) were conducted using seepage meters modeled after Idaho seepage meters (ANCID.org, 2005) and fabricated at the Miami University Instrumentation Laboratory. These 30-cm diameter, stainless steel seepage meter cylinders had sharpened edges and were equipped with a detachable center rod with crossbar to enable forced penetration into the gravel and cobble riverbed. Seepage meters were placed in close proximity to mini-piezometers installed in accordance with techniques described by Lee & Cherry (1978). Because ours is a site with a downward hydraulic head gradient, a suction ball manometer was attached to the mini-piezometer as described by Woessner and Sullivan (1984) in order to obtain the vertical hydraulic gradient. Seepage meter experiments were performed throughout a variety of river stages and river temperatures, and were spatially distributed across the site (Figure 4).

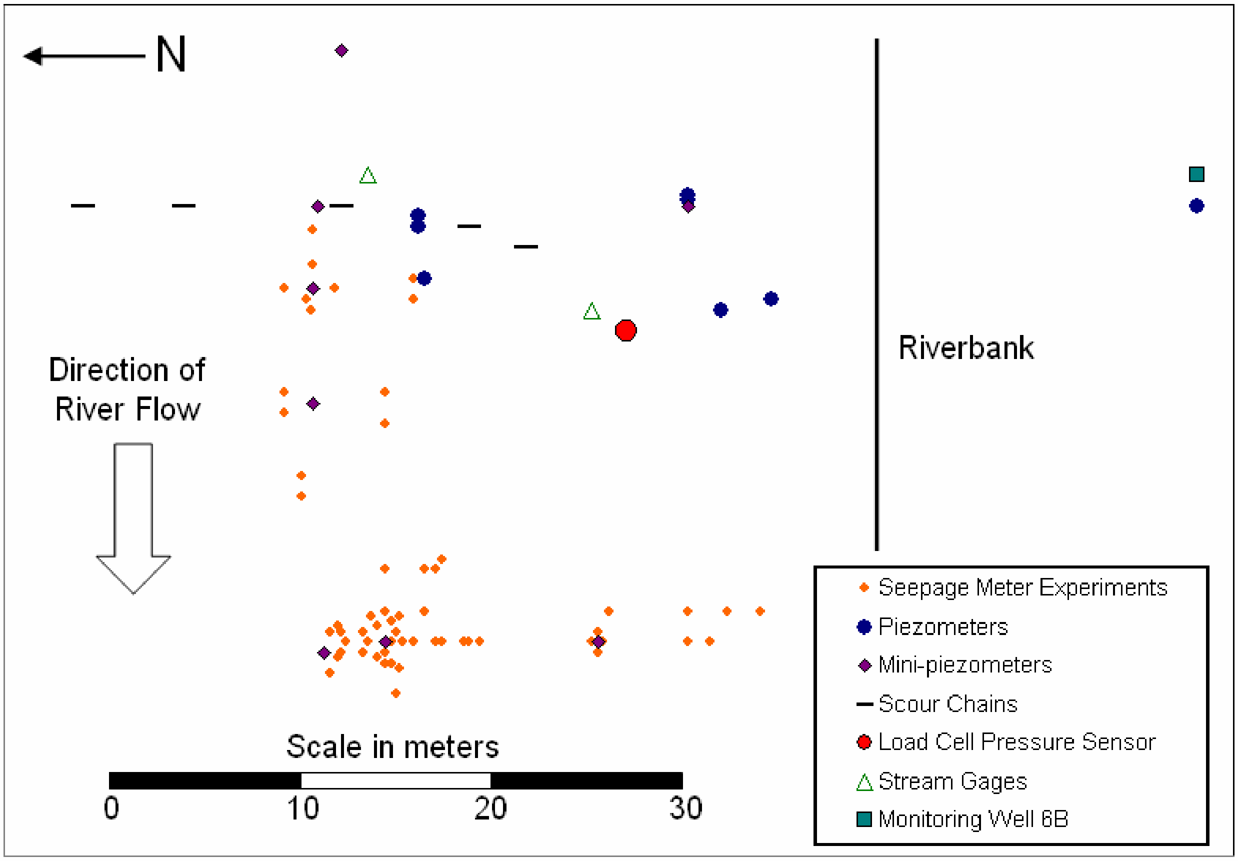


Figure 4. Spatial distribution of instrumentation and seepage meter experiments at Site 6.

Inherent error in seepage-meter experimentation often occurs as an artificial head loss or gain attributable to collection bag type or size, flow over a bag, or flow through tubing and fittings (Murdock and Kelly, 2003). Although Murdock and Kelly (2003) expressed concern regarding bag type and size, Isiorho and Meyer (1998) determined that the error associated with the collection bag was not significant if it were flexible, elastic and easy to use. For this reason, we chose 3-L Camelbak© bladders as seepage bags for their ease of connectibility and flexibility. The bags were filled in a manner to remove any air bubbles and measured for total volume prior to deployment to the field. To minimize the head loss caused from river current flowing over the bags (Murdock and Kelly, 2003; Libelo and MacIntyre, 1994) we housed the bladders in separate plastic bins sheltered from the river current but with openings large enough that the head in the bin was the same as in the river. Air bubbles within the system have also been found to cause anomalous seepage flux (Shaw and Prepas, 1998). The snap-connector design of the Camelbak© bladders allowed us to pre-attach the tubing to the seepage meter and remove all air from the system prior to attaching the bags to the tubing. Once the seepage meter was set in place, we adopted an experimentation scheme similar to that of Landon et al. (2001) by allowing the seepage meter to equilibrate for 10 to 15 minutes and then attached the bag for between two to four hours.

Longer-duration seepage meters such as remotely deployed seepage meters (Cherkauer and McBride, 1988), electromagnetic flowmeters (Rosenbury and Morin, 2004), and ultrasonic seepage meters (Paulsen et al., 2001) exist, but were not suitable for our objectives as they would not allow the natural riverbed processes of scour and deposition to occur. In addition, our study site proved impractical for devices left collecting data for long periods due to the river size and its proclivity to sudden rises in flow velocity and stage. Early on in the study, two meters were lost to a rise in river stage of less than 1 m.

To test our confidence in the measured seepage fluxes, we conducted a controlled laboratory test of our seepage meters. These tests were performed at the Ecology Research Center at Miami University where an artificial aquifer was constructed from a 2.5-m diameter tank filled to a depth of 1.8 m with a medium sand. The tank was instrumented with eleven piezometer nests to measure vertical gradients. The tank was first filled so that water was standing approximately 0.5-m above the top of the sand. Water was pumped at a constant rate from the bottom of the tank through a perforated plastic tube coiled into a circle at the center of the tank bottom. The perforated tube was connected to a side outlet so that pumping or injection into the outlet generates vertical flow. The pumped water from the side outlet was recharged to the water standing on top of the sand until a steady state was reached. Thus the entire tank was treated as a constant-head permeameter to determine the $K_v$ of the sand in the tank. The vertical gradients in each piezometer nest were measured and used in conjunction with Darcy's law to calculate $K_v$. Pumping was continued at the same rate and the seepage meters were employed following exactly the same procedure as was followed in the river. This allowed seepage-meter estimates of $K_v$ that could be compared to those derived from the constant-head vertical pumping tests.

*2. Slug Tests*

Horizontal riverbed hydraulic conductivity was also measured using slug tests on 4.4-cm diameter steel piezometers that were driven to depths between 1.5 and 3 m beneath the riverbed.

We used both 0.3- and 0.6-m long drive-point screens attached to piping extending no more than 0.5 meters above the riverbed. For piezometers near the shore, pneumatic rising-head slug tests were performed using an air compressor. In piezometers located further from the river shore, falling-head slug tests were conducted by pouring water into the piezometer. In both cases, heads were measured with a pressure transducer at very short sampling intervals starting at every 0.2 seconds. Data were then analyzed using the Bouwer and Rice method (Bouwer, 1989; Bouwer and Rice, 1976; Zlotnik 1994).

*3. Sediment Sampling, Laboratory Permeameter Tests, and Grain-Size Analyses*

Constant-head laboratory permeameter tests were also conducted on intact cores taken with a 5-cm diameter split-spoon sampler lined with polycarbonate tubing. The split spoon sampler was attached to a 45-kg hammer suspended from a manually operated pulley system. The pulley was anchored at the apex of a 3-m high tripod with legs driven into the riverbed for stability. Six cores were obtained from the top 0.12 meters of the riverbed during low-flow conditions in March of 2005. Cores were incorporated into a constant-head permeameter, and $K_v$ was determined using three different gradients (Fetter, 2001). Later, these cores were used for grain size analyses using wet sieve techniques.

*4. Temperature Modeling*

Indirect measurements of riverbed hydraulic conductivity were obtained using temperature modeling. Temperature data were collected from the river, the aquifer, and the riverbed. This was accomplished by instrumenting aquifer and shallow riverbed piezometers, and the river throughout the site with pressure transducers and thermistors. Five thermistors emplaced in wells were located in depths between 0.5 to 10 m relative to the river bottom. Additional thermistors were located in the river. Temperature data were collected at fifteen minute intervals from June of 2005 through May of 2006. Temperature modeling was performed by another student, Sam Mutiti, using the USGS program VS2DHI (Hsieh et al., 2000). By matching simulated groundwater temperatures to the observed temperatures, estimates of the overall riverbed hydraulic conductivity were obtained. This method was used by Su et al. (2004), where best fit lines were approximated to estimate the riverbed $K_v$.

B. Measures of Riverbed Thickness

*1. Cross-Sectional Profiles*

To characterize changes in the riverbed profile over time, cross-sectional profiles were conducted by surveying the riverbed elevation at 6-meter intervals along a bisect between monitoring wells 6B and 6C (Figure 2). This was accomplished by securing a static line between the two monitoring wells with 6-meter interval surface markings clearly visible on the line. A row-boat was then tethered to and moved along the static line. The river elevation was surveyed and the depth of the riverbed below the water surface was measured along the profile. Following the initial profile, comparison profiles were conducted after large events in order to quantify the total cumulative scour and deposition of the riverbed.

*2. Scour Chains*

Scour chains were installed at several locations and at different times on the southern side of the river to estimate total scour and re-deposition associated with individual events. These pre-measured chains were buried vertically into the riverbed through a pipe driven to a depth of up to 1 m. Upon removal of the pipe, sediment collapsed around the chain and the remaining length was measured and laid flat along the riverbed. To help locate the chain, a meter of string and a fishing bobber were tied to the end of the chain. During an event, any scour that occurred exposed more of the chain which will then lay flat. Subsequent deposition buried the horizontal portion of the chain. The length of chain that lay flat and the depth to which it was buried yielded estimates of scour and deposition.

*3. Load-Cell Pressure Sensor*

Beginning in November of 2005, measurements of riverbed thickness were taken with a vibrating-wire load-cell pressure sensor and thermistor (Roctest ®, St. Lampert, Quebec, Canada). This sensor was buried in a river trench approximately 0.7-m below the riverbed (Figure 5), covered on all sides by a layer of medium sand approximately 1.5-cm thick, filled over with riverbed sediment and smoothed out. The sensor cable was laid in a separate 0.15-m deep trench dug from the sensor through the riverbed, up the embankment to monitoring well 6B, where it was connected to a vibrating-wire interface adapter and data logger housed in a weather-proof box approximately 2.5 m above the land surface. The sensor measures total pressure comprising pressures of the saturated sediment load, the water-column height and air pressure. The data logger was programmed to take a reading of total pressure and temperature every hour. If the pressure exceeded a threshold corresponding to a 1-m rise in river stage, the sampling rate increased to a fifteen minute interval. A pressure transducer was installed at a known elevation in the river near the load-cell pressure sensor to give continuous measures of river stage combined with atmospheric pressure. These data can be subtracted from the load-cell pressure sensor data to isolate the pressure changes due to changes in sediment height above the sensor. To convert pressures into sediment height, we assumed a wet-bulk sediment density of 2.15 g/cm$^3$.

Figure 5. Placement of the vibrating-wire load-cell pressure sensor in a trench in the riverbed

## IV. Results and Discussion

### A. Seepage Meter Measurements of Sand Tank Hydraulic Conductivity

Controlled pumping tests in the sand tank artificial aquifer, designed to replicate a constant-head permeameter, yielded an average $K_v$ of 43 m/d for the medium sand. Experimentation with the seepage meters during pumping tests in the sand tank yielded an average $K_v$ of 28 m/d (Table 1). The seepage-meter derived average $K_v$ was approximately 67% of the average $K_v$ derived from the pumping test. The systemic cause for the difference was probably head loss due to the small diameter of tubing (0.6 cm) between the bladder and seepage meter. Previous findings by Belanger & Montgomery (1992) in comparing seepage-meter results from the field with those in a controlled environmental tank showed seepage meter-to-tank ratios between 0.55 and 0.77. Our seepage meter-to-tank ratio of 0.67 fell within this range.

The ratio of 0.67, or a tank-to-seepage meter ratio of 1.33, will be used from here on as a correction factor for seepage-meter results. $K_v$ values derived from seepage meter will be multiplied by a factor of 1.33 to correct for head-loss through tubing.

Table 1. Seepage meter results obtained during pumping tests in the sand tank.

| **Test #** | ***Experimental time (min)*** | ***Change in volume (ml)*** | ***Head gradient*** | ***K (m/d)*** |
|---|---|---|---|---|
| 1 | 30 | -1801 | -0.0505 | 25.2 |
| 2 | 28 | -2014 | -0.0505 | 30.2 |
| 3 | 26 | -1703 | -0.0505 | 27.5 |
| 4 | 26 | -1662 | -0.0505 | 26.8 |
| 5 | 12 | -1613 | -0.117 | 28.2 |
| 6 | 12 | -1885 | -0.117 | 32.9 |
| 7 | 12 | -1691 | -0.117 | 29.5 |
| 8 | 12 | -1694 | -0.117 | 29.6 |
| 9 | 11 | -671 | -0.117 | 12.8 |
| 10 | 11 | -1532 | -0.117 | 29.2 |
| 11 | 11 | -1758 | -0.117 | 33.5 |
| 12 | 10 | -1869 | -0.117 | 39.2 |
| | | | **Arithmetic Mean** | **28.7** |
| | | | **Geometric Mean** | **27.9** |

B. Seepage Meter Measurements of Riverbed Hydraulic Conductivity

Riverbed seepage-meter results over a five month period from September 2005 to January 2006 spanned two orders of magnitude with values ranging from 0.0076 m/d to 0.82 m/d (Table 2). The data were approximately log-normally distributed with a geometric mean of 0.092 m/d (Figure 6). Regression analysis performed on these data found no significant relationship of $K_v$ to river stage, distance from bank, or river temperature. Applying a tank-to-seepage meter correction factor of 1.33, the geometric mean adjusted riverbed $K_v$ value was 0.12 m/d. The 95% confidence interval for this mean (based on a geometric distribution) was 0.079 to 0.19 m/d.

Table 2. Riverbed seepage meter results with accompanying measured parameters.

| Test Number | River Stage Above Baseflow (m) | River Temperature (°C) | Distance from Bank (m) | Intrinsic Permeability (darcy) | $K_v$ (m/d) |
|---|---|---|---|---|---|
| 1 | 0.74 | 30.98 | 43 | 0.756 | 0.815 |
| 2 | 0.74 | 30.98 | 43 | 0.529 | 0.571 |
| 3 | 1.40 | 22.63 | 44 | 0.082 | 0.073 |
| 4 | 1.40 | 22.63 | 44 | 0.082 | 0.073 |
| 5 | 1.27 | 22.47 | 47 | 0.045 | 0.040 |
| 6 | 1.27 | 22.47 | 47 | 0.045 | 0.040 |
| 7 | 0.94 | 25.03 | 41 | 0.075 | 0.071 |
| 8 | 0.94 | 25.03 | 41 | 0.100 | 0.094 |
| 9 | 1.22 | 20.97 | 44 | 0.049 | 0.042 |
| 10 | 1.22 | 20.97 | 44 | 0.130 | 0.111 |
| 11 | 0.97 | 23.31 | 49 | 0.060 | 0.054 |
| 12 | 0.92 | 20.48 | 45 | 0.125 | 0.105 |
| 13 | 0.92 | 20.48 | 45 | 0.133 | 0.112 |
| 14 | 0.95 | 17.25 | 50 | 0.746 | 0.579 |
| 15 | 0.95 | 17.25 | 50 | 0.646 | 0.501 |
| 16 | 1.31 | 11.01 | 44 | 0.090 | 0.059 |
| 17 | 1.31 | 11.01 | 44 | 0.051 | 0.033 |
| 18 | 1.20 | 14.25 | 47 | 0.026 | 0.019 |
| 19 | 1.20 | 14.25 | 47 | 0.031 | 0.022 |
| 20 | 1.24 | 11.31 | 44 | 0.525 | 0.346 |
| 21 | 1.24 | 11.31 | 44 | 0.498 | 0.328 |
| 22 | 1.41 | 6.98 | 44 | 0.186 | 0.108 |
| 23 | 1.41 | 6.98 | 44 | 0.096 | 0.056 |
| 24 | 0.98 | 7.59 | 44 | 0.091 | 0.054 |
| 25 | 0.98 | 7.59 | 44 | 0.085 | 0.050 |
| 26 | 1.66 | 6.2 | 44 | 0.013 | 0.008 |

| | | | | | |
|---|---|---|---|---|---|
| 27 | 1.66 | 6.2 | 44 | 0.096 | 0.054 |
| 28 | 1.49 | 6.67 | 42 | 0.203 | 0.117 |
| 29 | 1.49 | 6.67 | 42 | 0.826 | 0.476 |
| Summary Statistics | | | | | |
| **arithmetic mean** | 1.19 | 16.24 | 44.69 | 0.221 | 0.173 |
| **geometric mean** | 1.16 | 14.27 | 44.64 | 0.122 | 0.092 |
| **max** | 1.66 | 30.98 | 49.70 | 0.826 | 0.815 |
| **min** | 0.74 | 6.20 | 41.16 | 0.013 | 0.008 |

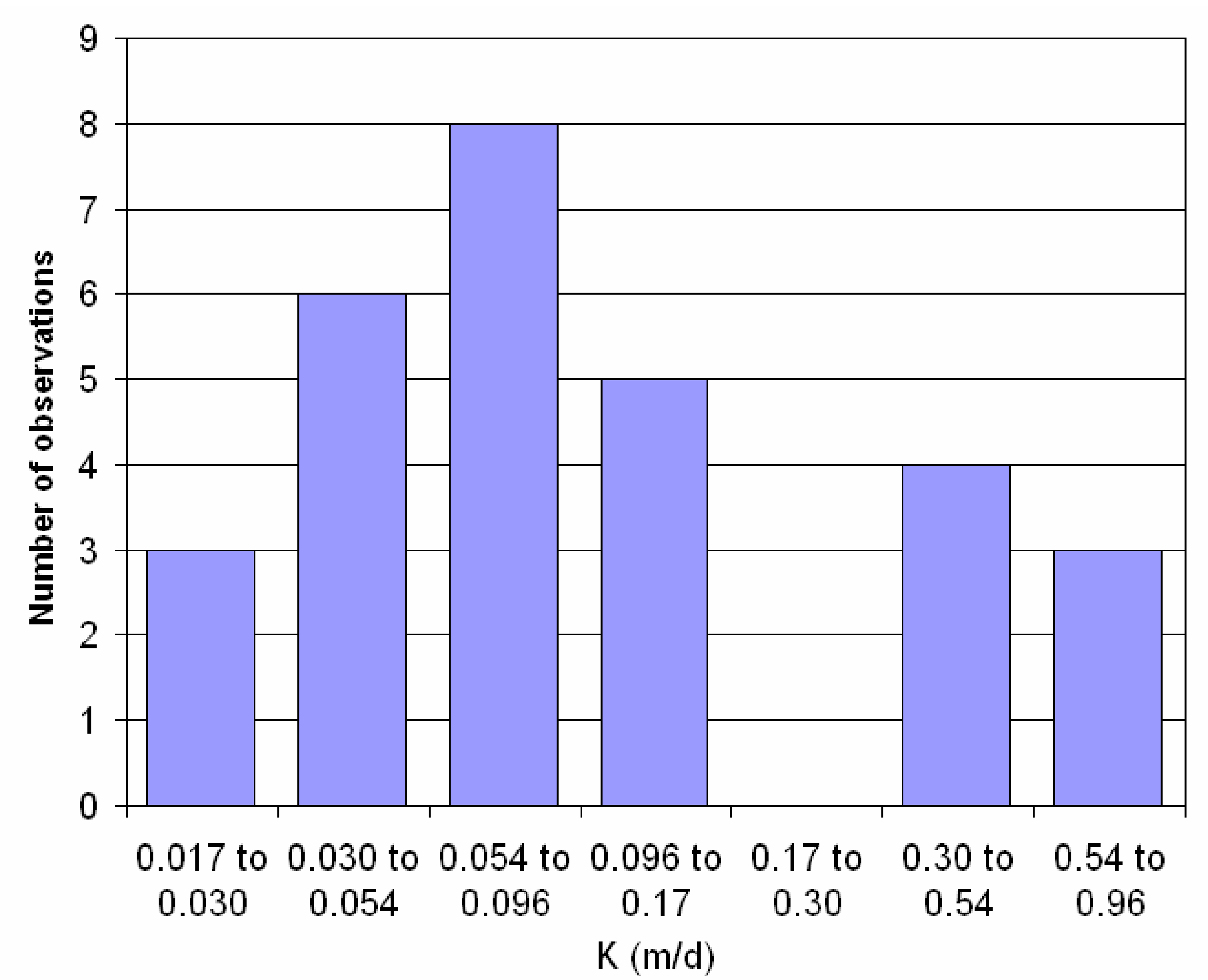


Figure 6. Riverbed seepage meter results, September through December 2005. Ranges used are based on a logarithmic distribution.

C. Slug Tests

Table 3 illustrates the results of slug tests using two different methods. The geometric mean value of horizontal hydraulic conductivity ($K_h$) obtained was 19.2 m/d, significantly less than the hydraulic conductivity of the underlying aquifer reported by Gollnitz et al. (2003). To obtain a $K_v$ for comparative purposes, we applied an anisotropic ratio of 0.5. This value was based on a Neuman analysis (Neuman, 1975) of an aquifer pumping test on a production well and four monitoring wells located approximately 1.2 kilometers from Site 6 (Levy, unpublished data). Using this anisotropic ratio yielded a slug test-derived $K_v$ value of about 9.6 m/d.

Table 3. Slug test results on two piezometers during July and October of 2005.

| **Screen depth (m)** | **Method** | **$K_h$ (m/d)** |
|---|---|---|
| 2.13 | Rising Head | **13.2** |
| 0.76 | Falling Head | **25.1** |
| | Average | **19.2** |

D. Laboratory Permeameter Tests and Grain Size Analyses

While sampling with the split-spoon, sample penetration did not exceed 0.12 meters due to contact with cobbles larger than the sampler diameter (5 cm) at this depth. We, therefore, infer that these samples represented sediments overlying a cobble layer. Of the six cores taken from the riverbed, three were suitable for the constant-head lab permeameter. Grain size analyses (Table 4, Figure 7) of these three cores indicated that two (cores 1 and 2) were poorly sorted gravels and one (core 3) was a well-sorted medium sand. The mean $K_v$ obtained through constant-head permeameter tests was 5.34 m/d.

Table 4. Analysis of three riverbed core samples

| Split Spoon Core | $d_{50}$ (mm) | $C_u$ | $K_v$ (m/d) |
|---|---|---|---|
| 1 | 8 | 31.58 | 3.52 |
| 2 | 6.3 | 30.3 | 4.3 |
| 3 | 0.5 | 2.15 | 10.05 |

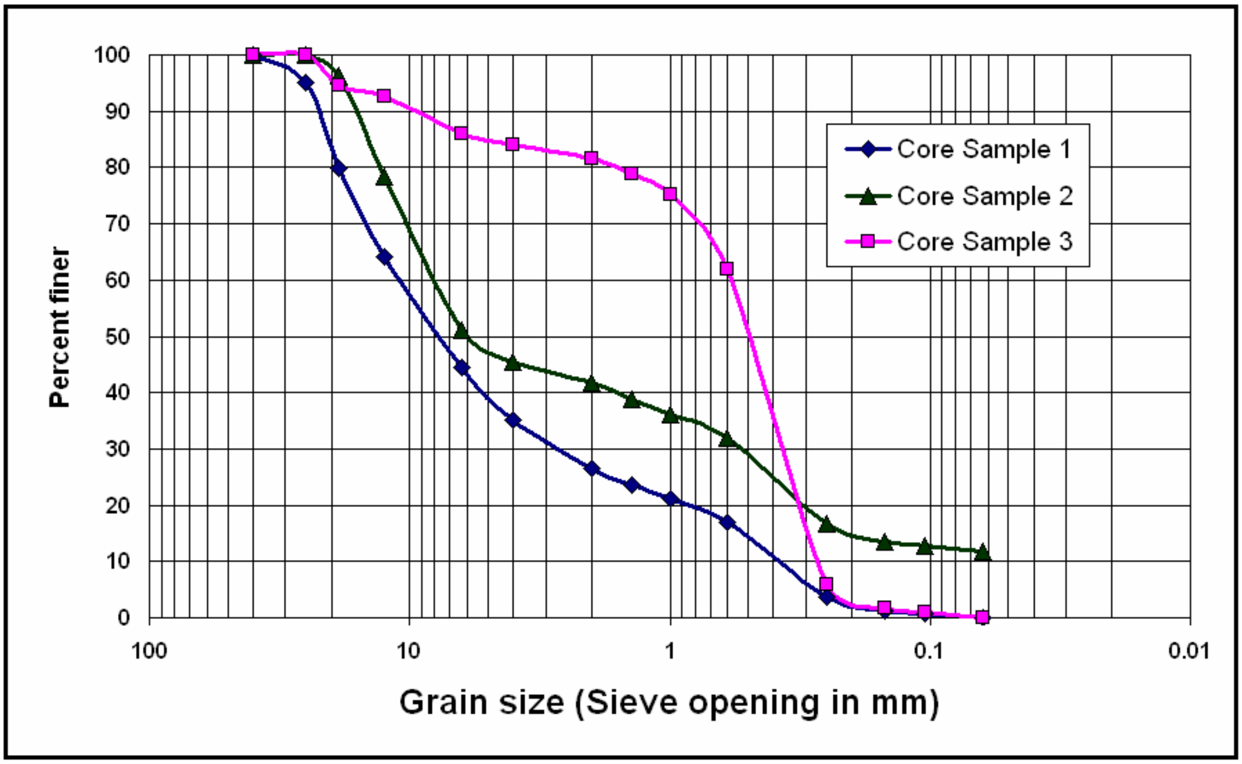


Figure 7. Grain size analyses obtained through wet sieving for three core samples of the upper 0.12 meters of riverbed.

E. Temperature Modeling

Best-fit simulations of temperature models used by Sam Mutiti yielded an overall riverbed $K_v$ of 3 m/d. Figure 8 shows three curves corresponding to simulated $K_v$ values spanning three orders of magnitude. The curve with a $K_v$ value of 3 m/d fits closest with actual recorded temperature data (Appendix A), and represents a rough estimate for overall riverbed $K_v$.

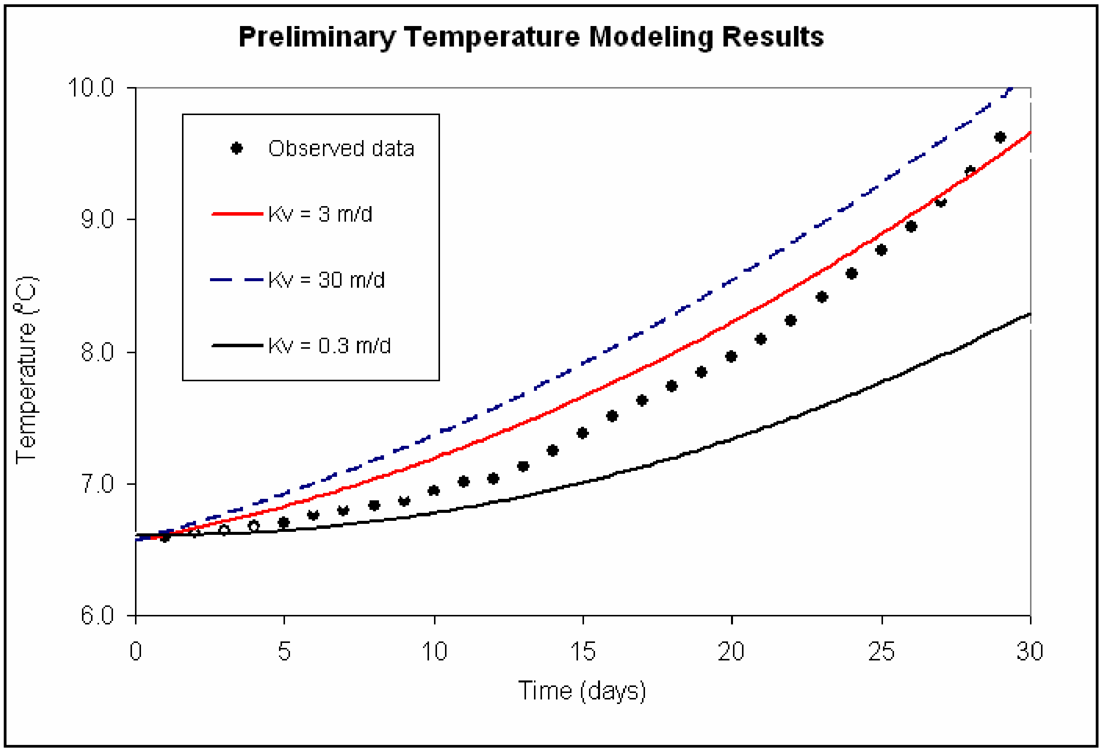


Figure 8. Best-fit lines of riverbed temperatures to estimate $K_v$ using USGS program VS2DHI

F. Cross-Sectional Profiles

Four profiles were performed during this investigation (Figure 9). The first two profiles, in December of 2004 and February of 2005, book-ended a 60-year recurrence interval flood event (Figure 3) that crested on January 6th, 2005 with a peak discharge of 2,016 $m^3/s$ and a maximum stage height of 175.47 m above sea level at the USGS Hamilton station. Due to this one event, the cutbank was eroded nearly 8 meters (Figure 9). Together, the four profiles indicate a gradual migration of the thalweg to the north and continuous erosion of the northern bank. Conversely, net deposition occurred out to approximately 70 meters from the southern shore, although there has been less change between the most recent profiles of September 2005 and May 2006.

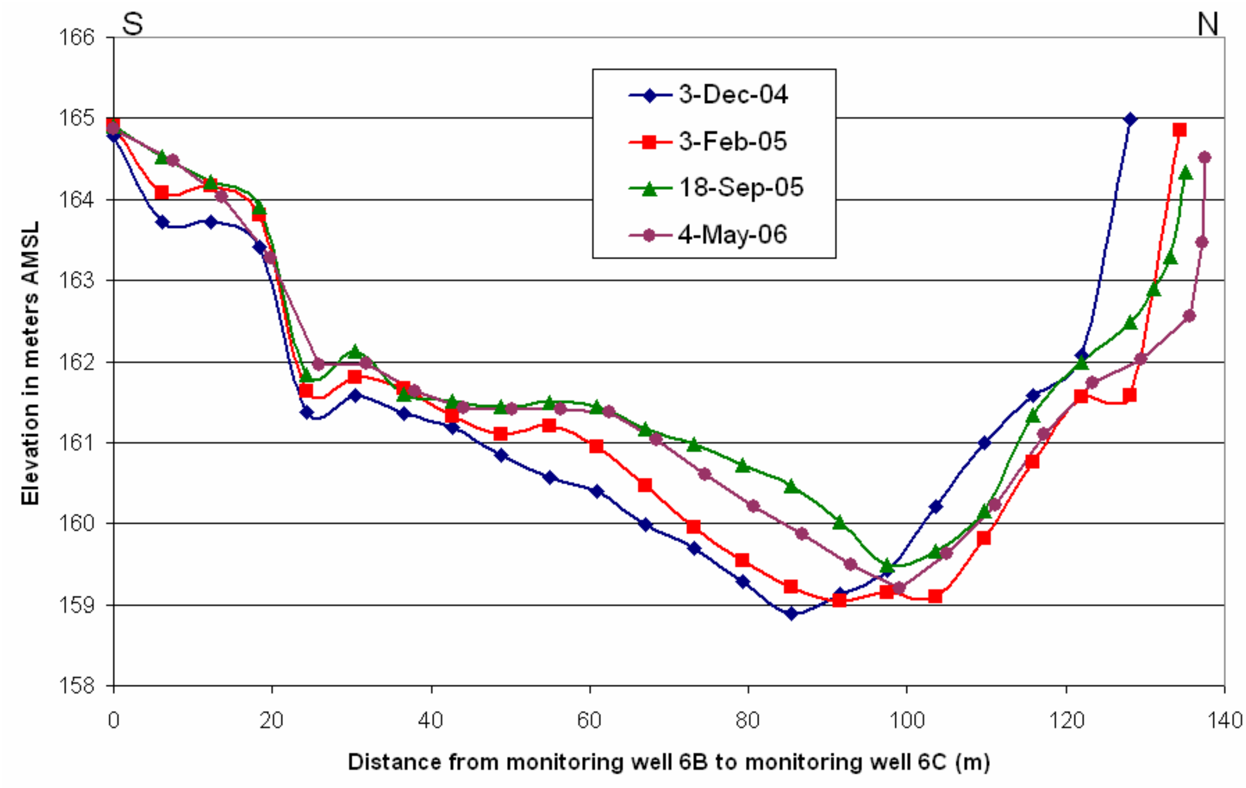


Figure 9. Four cross-sectional survey profiles of the riverbed taken at Site 6 looking downstream. Vertical exaggeration 10x.

G. Scour Chains

Cross-sectional profile data showed that within our study area, the southern half of the river was predominantly a depositional site; however, scour chain data confirmed that high-stage events were responsible for a small-quantity of temporary scouring. Table 5 illustrates scour chain data collected from eight high-stage events between November of 2004 and December of 2005. The dates shown in Table 5 represent the first opportunity available to record measurements following an event. Peak stage above baseflow is also shown, with event stages that ranged from 0.34 m to 7.05 m. The January 2005 flood (Figure 2) was the largest event recorded during this study period. Scour during this event, as measured on February 5$^{th}$, 2005 was 0.061 m. Event intensity, defined as peak stage above baseflow, was positively correlated to total scour ($R^2$ = 0.76, $p < 0.00001$) (Figure 10). Measures of deposition using scour chains yielded no significant relationships to event intensity. Measurements of deposition are less reliable than those of scour due to the possible disturbance of the horizontally laid chain during low-flow conditions. Disturbance of the chain under low flow can occur by floating debris or river wildlife such as fish and birds. These disturbances could help to explain the high number of zero values for measured deposition of a lightly covered chain.

Table 5. Scour chain measurements of scour and deposition for selected events occurring between November 2004 and December 2005.

| Date collected | Date of peak stage | Peak stage above baseflow (m) | Scour (m) | Deposition (m) |
|---|---|---|---|---|
| 11-Nov-04 | 6-Nov-04 | 0.33 | 0.01 | 0.00 |
| 11-Nov-04 | 6-Nov-04 | 0.33 | 0.00 | 0.00 |
| 18-Nov-05 | 12-Nov-04 | 0.42 | 0.00 | 0.00 |
| 6-Dec-05 | 26-Nov-04 | 1.28 | 0.01 | 0.00 |
| 21-Dec-04 | 26-Nov-04 | 1.28 | 0.02 | 0.00 |
| 3-Feb-05 | 6-Jan-05 | 7.05 | 0.06 | 0.43 |
| 17-Apr-05 | 28-Mar-05 | 4.19 | 0.03 | 0.00 |
| 17-Apr-05 | 28-Mar-05 | 4.19 | 0.05 | 0.00 |
| 18-Aug-05 | 1-Jul-05 | 2.35 | 0.02 | 0.57 |
| 18-Aug-05 | 1-Jul-05 | 2.35 | 0.02 | 0.00 |
| 15-Sep-05 | 31-Aug-05 | 0.75 | 0.01 | 0.10 |
| 15-Sep-05 | 31-Aug-05 | 0.75 | 0.00 | 0.81 |
| 22-Sep-05 | 31-Aug-05 | 0.75 | 0.03 | 0.02 |
| 22-Sep-05 | 31-Aug-05 | 0.75 | 0.02 | 0.12 |
| 6-Oct-05 | 27-Sep-05 | 1.61 | 0.02 | 0.75 |
| 31-Oct-05 | 26-Oct-05 | 2.74 | 0.03 | 0.12 |

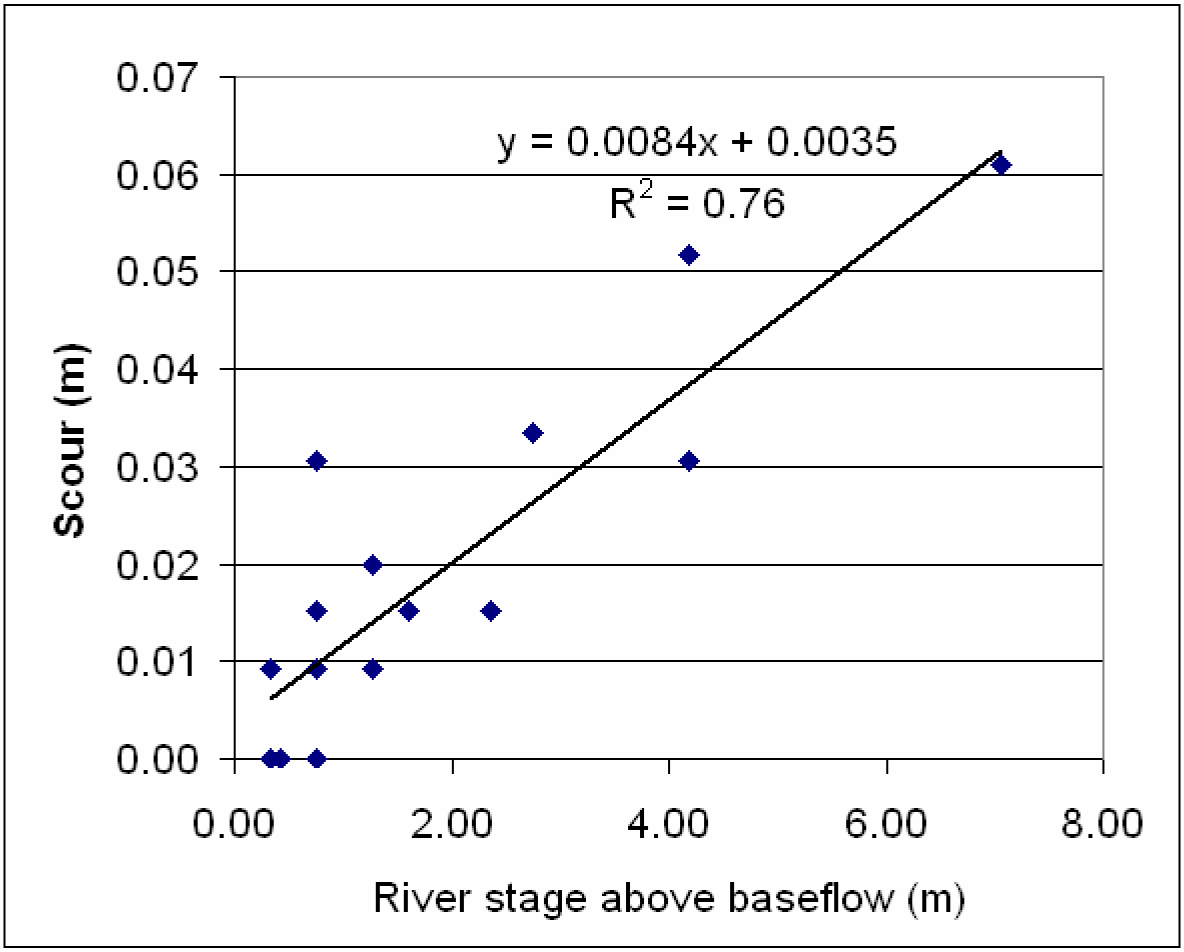


Figure 10. Graph showing linear relationship between event intensity (stage height in meters above base flow) and total scour.

H. Load-Cell Pressure Sensor

Continuous measurement of riverbed sediment height with the load-cell pressure sensor during the wet season (November 2005 through April 2006) revealed a fluctuation of the height of sediment above the load-cell sensor of 0.17 meters (0.71 m on February 5th, 2006 to 0.88 m on March 13th, 2006) (Appendix B). Maximum total scour due to a single event as measured by the load-cell sensor was 0.06 m, which occurred on December 27th, 2005. The largest event recorded during this season peaked on March 12th, 2006 at 4.5 m above baseflow with a maximum scour of only 0.03 m.

Examination of individual storm events revealed a complex pattern of scour and deposition compared to river stage (Figures 11 through 13). Figure 11 illustrates the period between December 25th, 2005 and January 10th, 2006 with three discrete river-stage peaks. Sediment scour began nearly simultaneously with the crest of the first peak, with a total measured scour of 0.06 m followed by a small amount of deposition as the stage fell. Sediment scour associated with the second peak corresponded with the second rise in stage and continued for two days until the stage dropped below 2 m. Deposition then occurred until the rising limb of the next event. During this third event, sediment scour occurred on the rising limb and deposition on the falling limb, after which net scour occurred for the next two days.

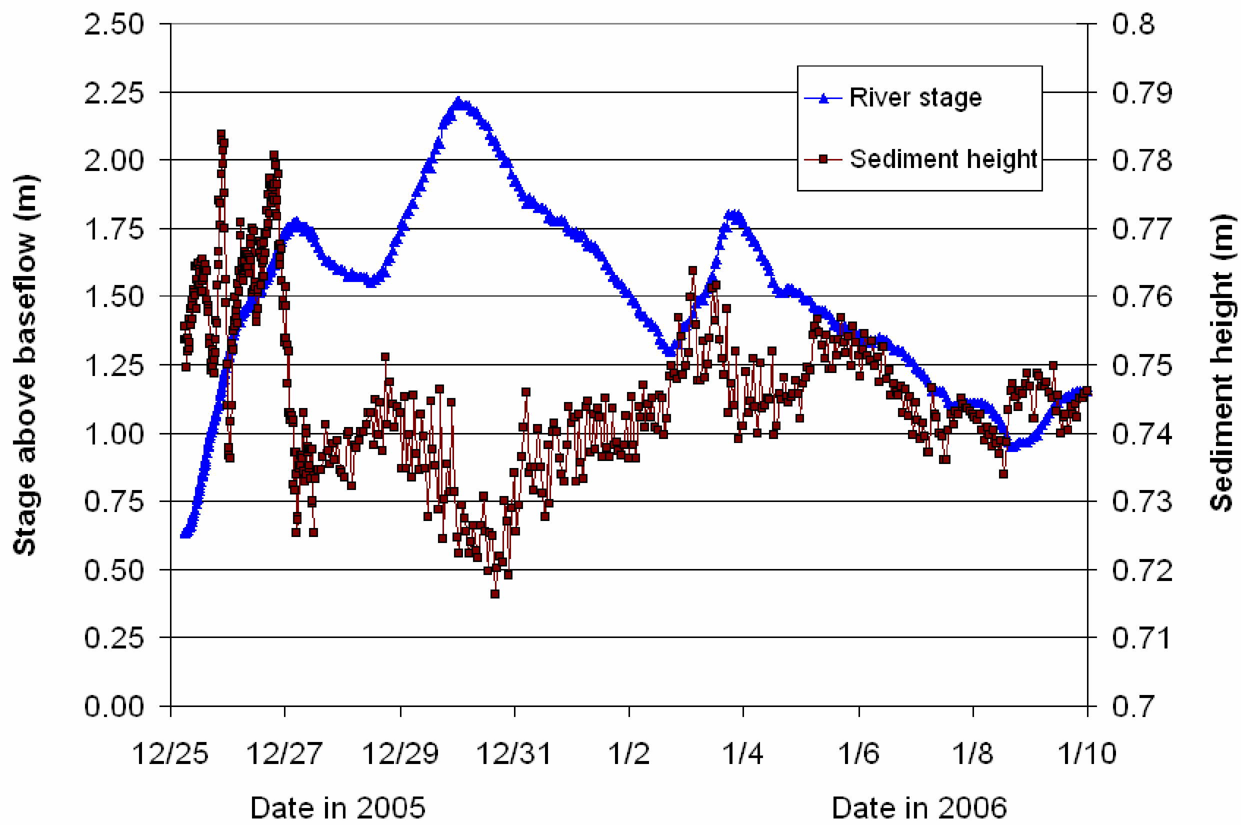


Figure 11. Sediment-height fluctuations over a high-stage event with multiple peaks.

Figure 12 shows two distinct high-stage events that occurred within two weeks of each other. Following the crest of the first event on February 6th, net sediment deposition occurred as the river stage dropped to baseflow conditions around February 12th. A rise in stage with the second event on February 18th immediately began the scouring of this sediment which continued over the next several days. Overall sediment fluctuation throughout this time period did not exceed 0.05 m.

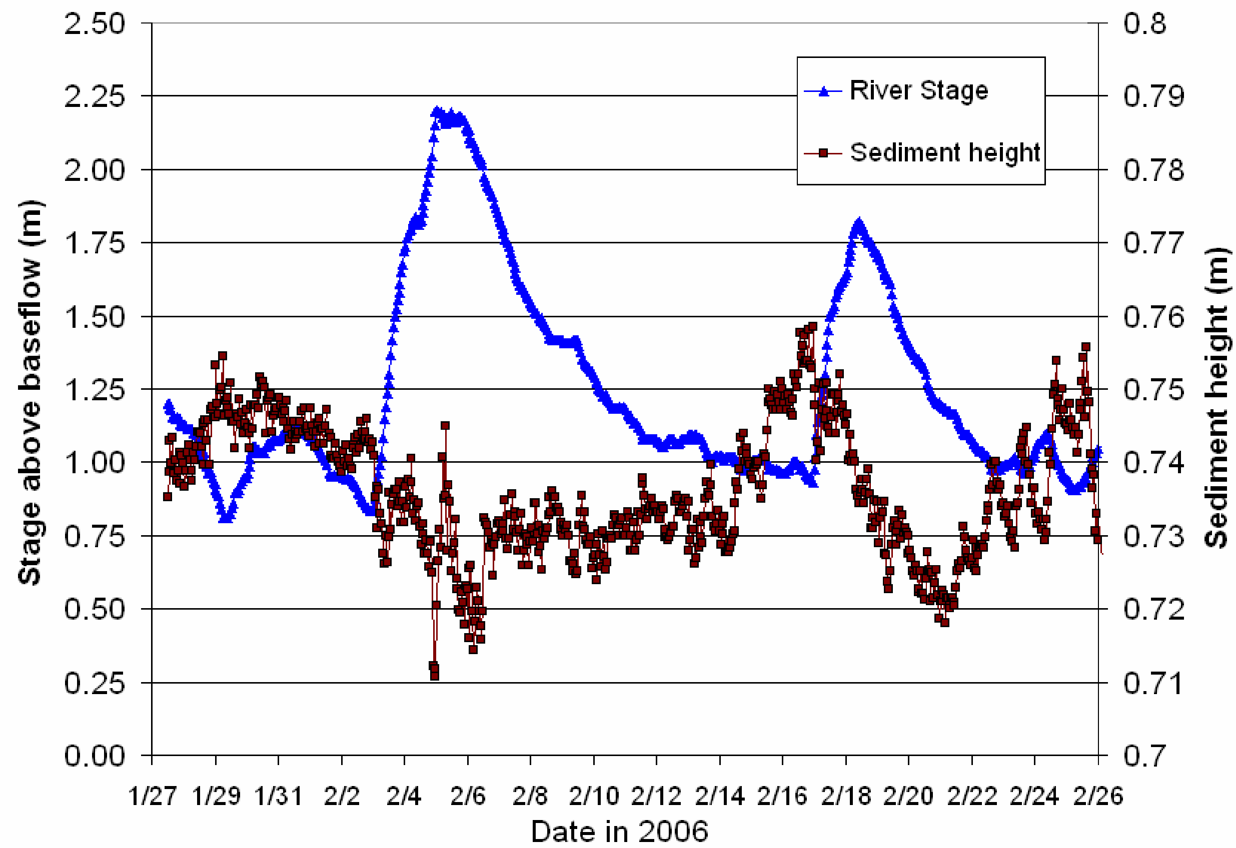


Figure 12. Sediment height fluctuations of two high-stage events in February 2006.

Figure 13 shows sediment height fluctuations from March 8th, 2006 to March 17th, 2006. This period captured the second largest high-stage event occurring during this investigation (Figure 3) and the largest event measured with the load-cell pressure sensor. This event, which crested on March 12th, 2006, reached a peak discharge of 1,140 $m^3/s$ as measured at the USGS Hamilton station. This flow had an approximate recurrence interval between 1 and 1.5 years. The sediment height fluctuation of 0.14 m during this time period was the largest observed of any of the three periods. Unlike during the events described previously (Figures 11 and 12), sediment deposition occurred during the rising limb of this event and continued for almost a day past the peak stage. Net scour then occurred until the stage dropped below 2.3 m. Reasons for the differences between this and previous events are not clear and will be explored in future research that goes beyond the scope of this study.

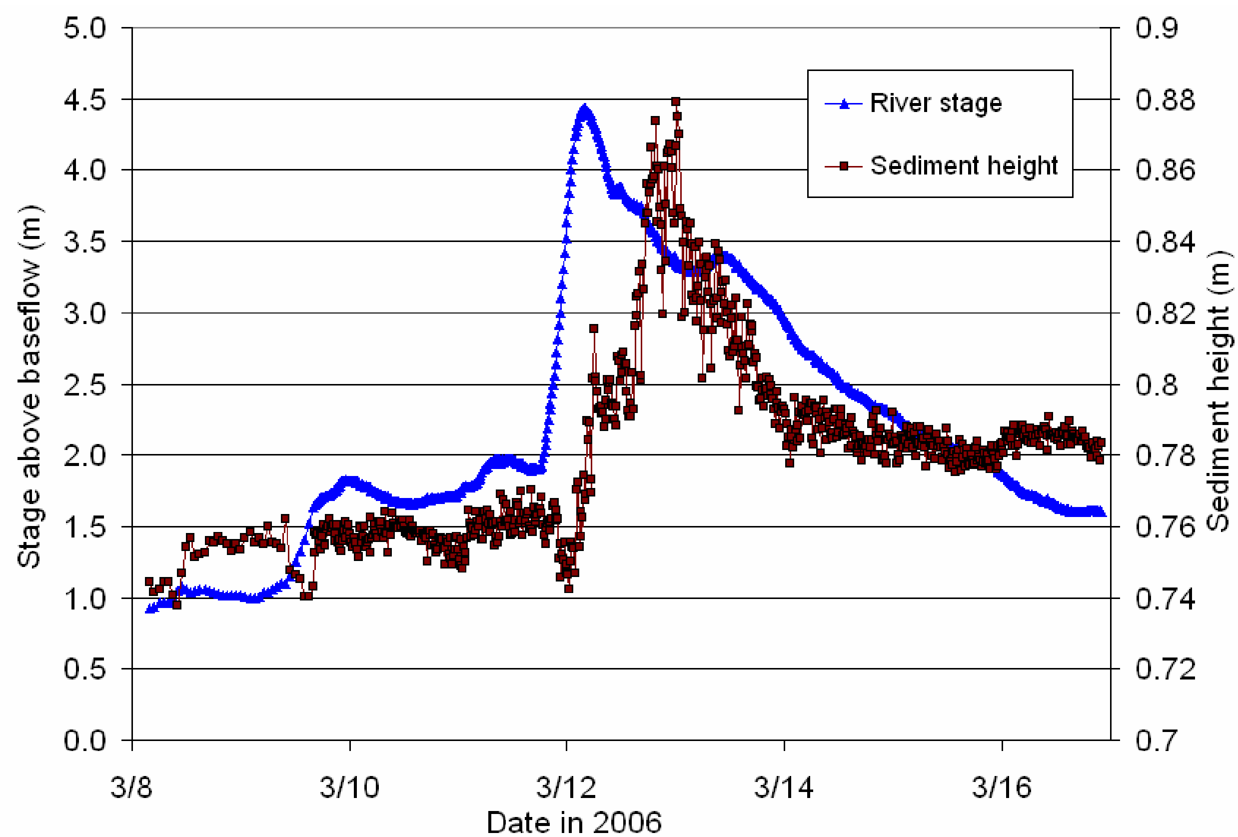


Figure 13. Sediment height fluctuations plotted with river stage for bankfull flow

# V. Riverbed Conceptual Model

## A. Model Description

Measurements of riverbed hydraulic conductivity and sediment-height fluctuations were used to develop a conceptual model of riverbed layers and their overall effective $K_v$. We hypothesized a riverbed divided into three distinct layers: a transient sediment layer, a stable armor and colmation layer, and a transitional bottom layer (Figure 14). The transient sediment layer comprises those top-most sands and gravels, sampled with the split-spoon core sampler, that are continuously scoured and deposited during high-stage events. As observed with the load-cell pressure sensor, the thickness of this layer has varied 0.17 meters during the study period. The estimated $K_v$ of these sediments of 5.3 m/d was based on the laboratory permeameter tests on the core samples.

Although never sampled directly, we inferred the presence of an immobile armor and colmation layer beneath the transient sediment. This armor layer explained why sediment samples obtained with a split-spoon sampler did not exceed 0.12 meters in length; the large sediment size prevented further penetration. It also explained why height fluctuations of the transient sediment, as measured by the load-cell sensor, did not exceed 0.17 m and why scour during high-stage events, as measured by scour chains, did not exceed 0.06 m. We believe that the consistently low $K_v$ (corrected mean of 0.12 m/d) obtained with seepage meters resulted from vertical flow through the low-conductivity colmation layer located within and immediately beneath the riverbed armor. The low hydraulic conductivity is consistent with fine sediment that has settled beneath and between the cobble armor layer. Maximum event-driven scour of 0.06 m indicated that the armor and colmation layer remained intact throughout the study period, apparently even during a 60-year flood event. This was further supported by the fact that no temporal variation was shown in seepage meter estimates of $K_v$ taken before and after large storm events.

Beneath the colmation layer lays the transitional bottom layer. This layer represents the interface between the deposited river sediments and the glacial outwash and its thickness is unknown. The $K_v$ of the transitional bottom layer was determined by slug tests and averaged 9.6 m/d.

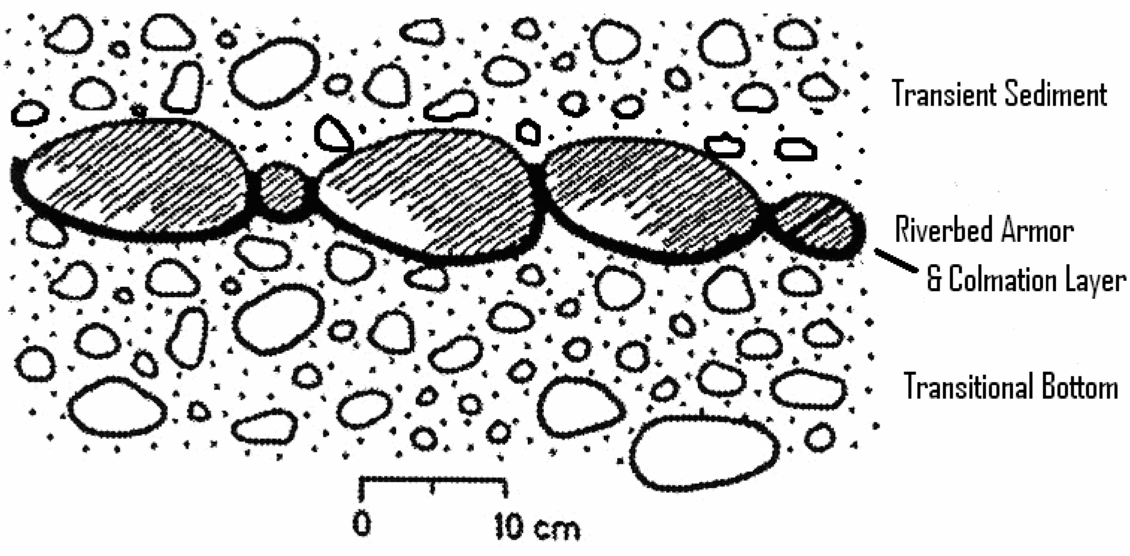


Figure 14. Conceptual diagram of three distinct riverbed layers. Adapted from Schubert, 2002.

Table 6 summarizes the conceptual model with the values of $K_v$ and thicknesses associated with each riverbed layer. The transient sediment was observed to fluctuate 0.17 m between what we believe corresponded to a thickness of between 0 and 0.17 m. We therefore selected the middle of this range (0.09 m) for its average thickness. For the armor/colmation layer we assumed that the thickness corresponded to just one layer of coarse-grained sediment. Therefore we estimated that its thickness was approximately 0.03 m, corresponding to the diameter of a large pebble. For the transitional bottom layer, we assumed that it extended at least to the depth of the deepest slug test or 2.1 m. We do not know at what depth this material transitions into glacial outwash with a higher average hydraulic conductivity. The importance of the uncertainty associated with all these assumptions was evaluated in a sensitivity analysis. The overall riverbed $K_v$ was obtained by using estimated layer thicknesses and $K_v$ values to calculate the harmonic mean, the mean appropriate when water flows through multiple layers in series (Fetter, 2001). The overall effective riverbed $K_v$ of this conceptual model was 4.6 m/d. This value is similar to effective riverbed $K_v$ values of 3 m/d estimated using temperature modeling.

Table 6. Riverbed layer sequence with measured vertical hydraulic conductivities establish an overall effective riverbed $K_v$.

| Layer | Mean $K_v$ (m/d) | Estimated thickness (m) |
|---|---|---|
| Transient sediment | 5.3 | 0.09 |
| Armor/colmation | 0.12 | 0.03 |
| Transitional bottom | 9.6 | 2.13 |
| Overall effective mean (for $K_v$) or total (for thickness) | 4.6 | 2.26 |

B. Sensitivity Analyses

Sensitivity analysis was first used to examine the effect on the overall $K_v$ of scour and deposition of the transient sediment (primary x-axis, Figure 15). In the analysis, the thickness of this layer was varied from 0 to 0.5 m, about three times the range observed during the study period. Given that this layer's estimated $K_v$ is close to the overall value for the entire system, changes to the thickness of the transient sediment have very little impact on the overall $K_v$ of the system.  Therefore, the scour and deposition of this layer observed during the study period probably had very little impact on the rate of induced infiltration or the capacity of the system for riverbank filtration.

Substantial uncertainty exists in the estimation of thicknesses of the armor/colmation and transitional bottom layers.  To address this uncertainty in the conceptual model, we conducted a sensitivity analysis by varying layer thickness and noting the effects of those changes on the overall effective $K_v$.  We varied the thickness of the armor/ colmation layer, from no clogging (thickness of 0 m) to substantial clogging of the layer through a thickness of 0.5 m, (primary x-axis, Figure 15).  The estimated overall riverbed $K_v$ is quite sensitive to the armor/colmation thickness estimate.  Overall $K_v$ increases to just over 9 m/d with the total loss of this low-conductivity layer (i.e., the removal of all clogging), representing an approximate doubling of the overall effective $K_v$ compared to the overall $K_v$ associated with the estimated layer thickness of 0.03 m.  Alternatively, if the layer thickness is 0.01 m, the overall effective $K_v$ of the system is approximately halved compared to the base-case estimate.  Further increases in layer thickness have relatively less impact on the estimated overall $K_v$.  If clogging actually occurs throughout a 0.5-m thickness, the overall $K_v$ drops to 0.6 m/d.  The overall effective $K_v$ is less sensitive to changes in the thickness of the transitional bottom.  Overall $K_v$ varies from only 3 to 6.5 m/d as the thickness varies from 1 to 5 m (secondary x-axis, Figure 15).  The sensitivity analysis demonstrates the need for further investigation of the site stratigraphy, especially the nature and thickness of the colmation layer.

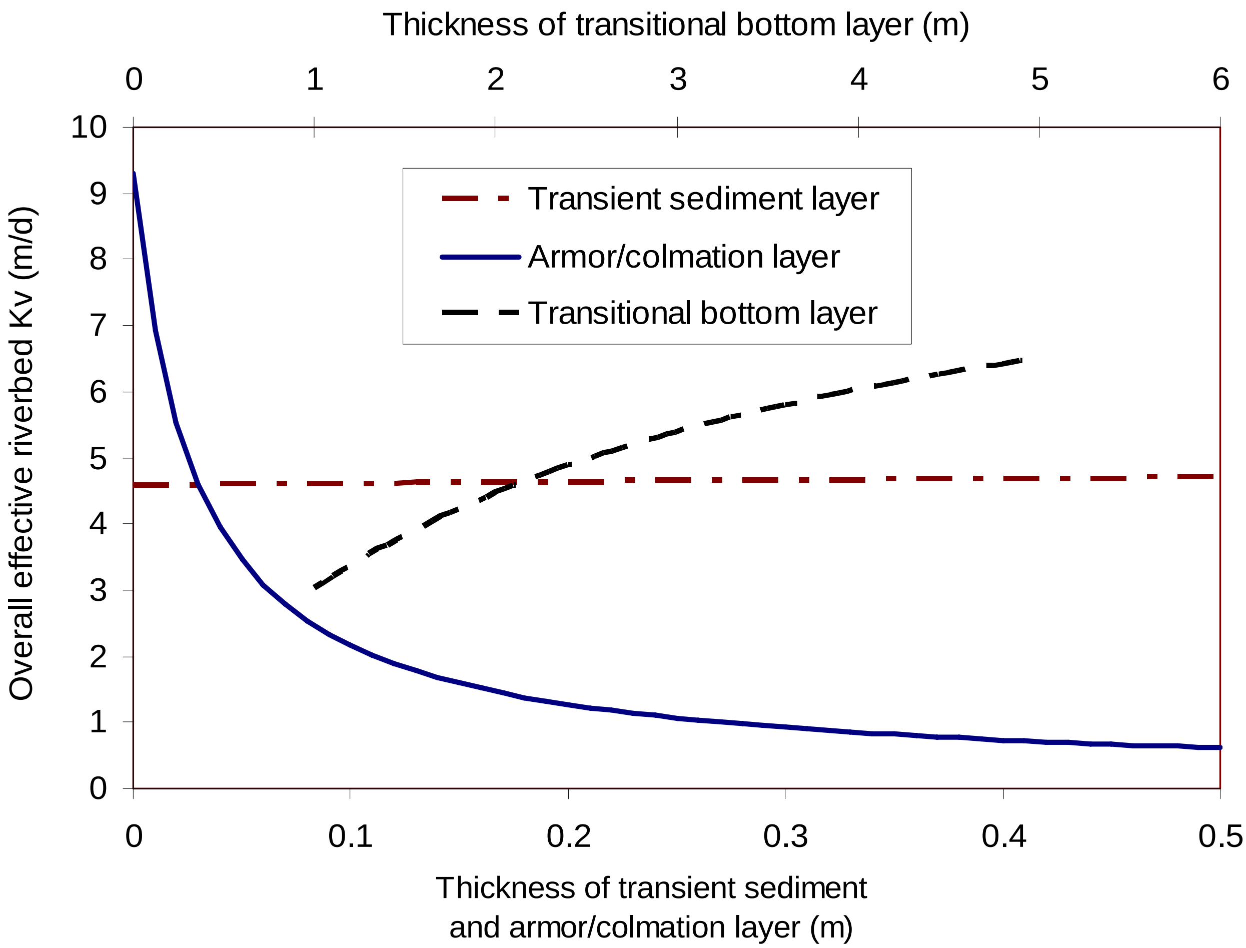


Figure 15. Sensitivity analysis of the effects of the thicknesses on the overall riverbed $K_v$.

Because the system is most sensitive to the armor/colmation layer, we also investigated the sensitivity of the overall $K_v$ estimate to the mean $K_v$ value used for this layer, thus investigating the importance of the observed spatial variability of this parameter. We varied the armor/colmation-layer $K_v$ through its observed range of 0.008 to 0.017 m/d. The estimated overall $K_v$ is very sensitive to this parameter varying by more than an order of magnitude from 0.56 to 8.2 m/d. On the other hand, varying the armor/colmation layer $K_v$ through the 95% confidence interval for the mean (0.079 to 0.19 m/d) results in relatively little change in the estimated overall $K_v$ only from 3.6 to 5.7 m/d (Figure 16).

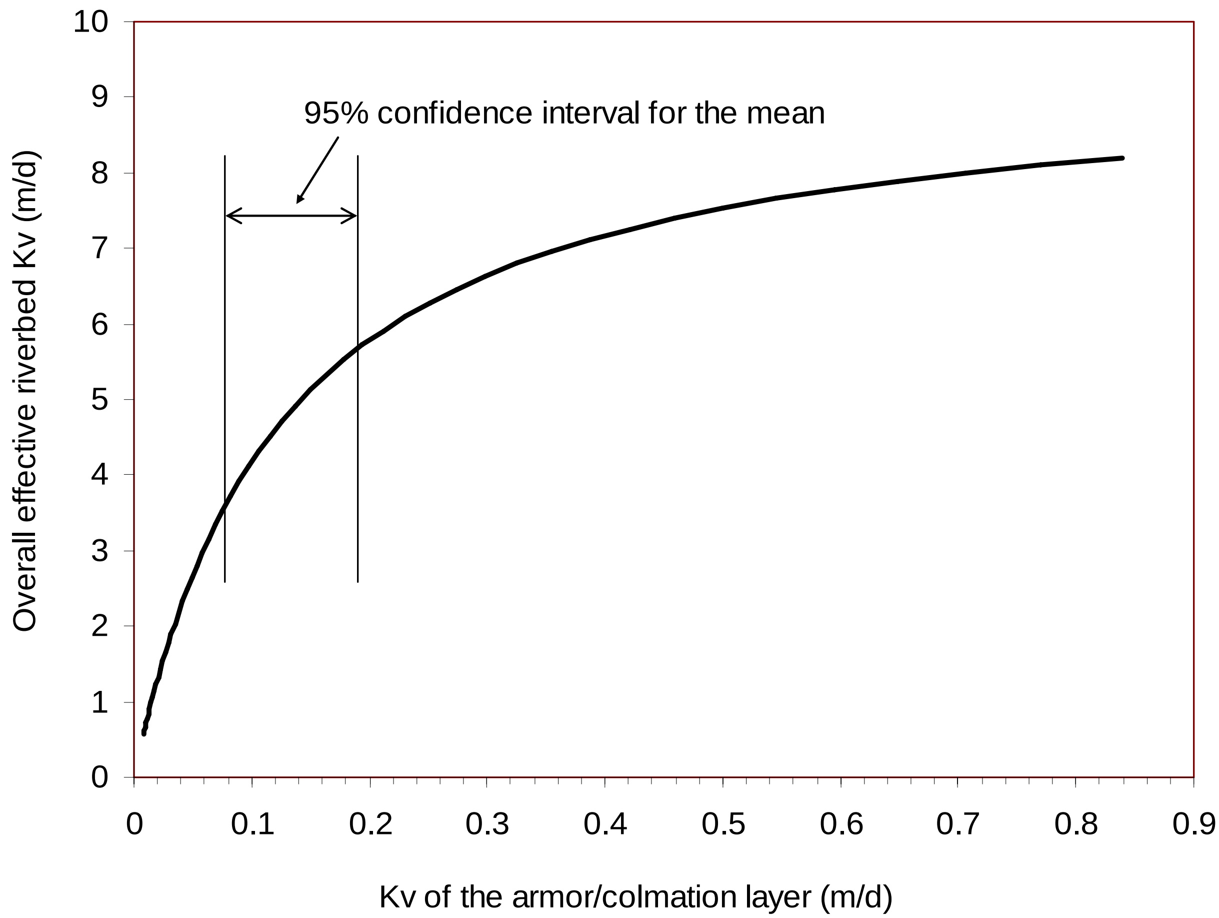


Figure 16. Sensitivity analysis of the effect of the $K_v$ of the armor/colmation layers on the overall riverbed $K_v$.

## VI. Regulatory Implications and Recommendations

Increased overall riverbed hydraulic conductivity as a result of scouring away riverbed layers is a concern of the USEPA with regards to providing treatment credit for riverbank filtration under LT2ESWTR. This study attempted to evaluate the impact of scour at one specific field site. Direct observations of riverbed sediment height fluctuations coupled with measurements of very low river $K_v$ indicated the presence of an armor/colmation layer that remained intact throughout the study period. The scour and deposition of sediment above this layer is minimal and its loss and gain has little impact on the overall $K_v$ of the system. For this field site, we believe that scour is not important and does not degrade the site's capacity for riverbank filtration. The study, however, was limited to one location on the depositional side of the river.

Greater-magnitude riverbed scour may occur at other locations, however, particularly in the thalweg where cross-sectional profiles have indicated loss of riverbed elevation of up to one meter during large storm events. Further research is needed in these low-accessibility areas of the river to assess the spatial variability of riverbed scour and hydraulic conductivity. It would be critical to identify whether scour in the thalweg moves a greater volume of transient sediment, or actually removes the critical armor/colmation layer. Increased overall riverbed hydraulic conductivity as a result of scouring away riverbed layers is a concern of the USEPA with regards to providing treatment credit for riverbank filtration under LT2ESWTR. Yet, in the context of the entire riverbank-filtration system, where underlying outwash has hydraulic conductivities that are several orders of magnitude greater than the riverbed and has a substantially greater thickness, the effect of increased riverbed $K_v$ due to scouring of riverbed layers seems insignificant.

The notion that scour at this site does result in loss of system's capacity for riverbank filtration is supported by the flowpath study (Gollnitz et al., 2004). During that study, no increases in concentrations of surface-water indicators were observed at monitoring wells during and after large storm events. Whole-profile estimation of riverbed scour used in conjunction with a flowpath study could provide a greater understanding of large-scale riverbank filtration processes. Until a full assessment of the temporal variability of riverbed hydraulic conductivity can be made for an entire river profile along an entire reach, scour will remain a concern for regulators. In the meantime, it is recommended that riverbank filtration continue to receive treatment credit, particularly enhanced credit in cases where demonstration studies have validated the consistent removal of surface water indicators at levels exceeding that of conventional treatment options.

## VII. Summary

Direct measurements of riverbed hydraulic conductivity were made using seepage meters and slug tests. Constant-head laboratory permeameter tests were also conducted on split-spoon core samples. Temperature modeling of river and groundwater temperatures throughout the site was used as a comparative method for obtaining overall riverbed hydraulic conductivity. Results of these measurements are summarized below.

- Sand-tank artificial aquifer seepage meter tests yielded a $K_v$ for the medium sand that was 67% of a $K_v$ derived from the pumping test. This provided a tank-to-meter ratio of 1.33 that could be used as a correction factor for other seepage meter experiments.
- Riverbed seepage meter experiments yielded a $K_v$ geometric mean of 0.092 m/d adjusted to 0.12 m/d applying a tank-to-meter correction factor of 1.33
- Sediment between 0.7 and 2.1 m below the river had a slug-test-derived geometric mean $K_h$ of 19.2 m/d. Applying an anisotropy ratio of 0.5 resulted in an estimated $K_v$ of 9.6 m/d
- Constant head permeameter tests of core samples taken from the top 0.12 m of the riverbed yielded a mean $K_v$ of 5.4 m/d
- Temperature modeling using the USGS program VS2DHI yielded an overall riverbed $K_v$ of 3 m/d

Riverbed scouring was estimated based on cross-sectional profiles, scour chains, and a load-cell pressure sensor. Results of these measurements are summarized below.

- Periodic profiling of the riverbed cross-section indicated a gradual migration of the thalweg to the north, characterized by 0.25 m to 1.25 m of deposition in the southern half of the river and scouring of the northern half (including the thalweg) by as much as 1.5 m. Profiling has also recorded erosion of the northern bank by 10 m.
- Scour chain data collected from eight high-stage events reveal a linear relationship between scour depth and event intensity, with the largest measurable scour of 0.06 m occurring during the January 2005 flood
- Load-cell pressure sensor data over a six month period yielded a total fluctuation of sediment height of 0.17 meters and a maximum total scour attributable to a single event of 0.06 m.

Together, measurements of riverbed hydraulic conductivity and riverbed scour were used in a conceptual model to estimate overall riverbed hydraulic conductivity. The conceptual model depicts a three-layer dynamic riverbed composed of a top transient layer underlain by a static armor and colmation layer, beneath which lies the transitional bottom layer. The transient layer represents sediment that is scoured and deposited during high-stage events and whose height fluctuated as much as 0.17 m as measured by the load-cell pressure sensor. $K_v$ for this layer was estimated by laboratory permeameter tests on intact core samples. Cores of only the top 0.12 m were obtained; the sampler was unable to penetrate further due to contact with the cobble armor layer. The armor/colmation layer is characterized by the low $K_v$ values measured by the seepage meters. There was no evidence for the removal of this layer at any time during the study. The transitional bottom layer represents sediment with hydraulic conductivities that are intermediate between the riverbed and the underlying outwash; the thickness of this layer is unknown. Estimates of $K_v$ for this layer were based on the slug tests on shallow piezometers.

Estimates of layer thicknesses were paired with corresponding values of $K_v$ to calculate a harmonic mean, overall $K_v$ of the three-layer system. The resulting overall $K_v$ of 4.6 m/d compared well with temperature modeling estimates of 3 m/d. Sensitivity analysis demonstrated even the total removal of the transient sediment would have little impact on the overall $K_v$. Alternatively, loss of the armor/colmation layer would result in a doubling of the overall $K_v$ compared to the value based on an armor/colmation-layer thickness of 0.03 m. Therefore, estimates of the overall $K_v$ were most sensitive to the armor/colmation layer. The importance of the spatial variability of the armor/colmation layer $K_v$ was also explored using sensitivity analysis. When the $K_v$ of the armor/colmation layer was varied through the 95% confidence interval for its mean (0.079 to 0.19 m/d), the overall riverbed $K_v$ did not vary considerably (3.6 to 5.7 m/d). Our data show that scour has been minimal (maximum measured scour of 0.06 m) throughout many high-stage events, even during a 60-year event. We believe that the armor/colmation layer has remained intact throughout the study period. The sensitivity analysis indicated that scour of the armor/colmation layer could result in an approximate doubling of the overall $K_v$ of the system, but based on the observations during the study period, it would take a very unusual storm event (> 60-year recurrence interval) to remove this layer. The sensitivity analysis also showed that total scour of the transient sediment has minimal impact on overall riverbed hydraulic conductivity. Thus, our observations of riverbed scour show that the depositional side of this river site is not readily subject to large fluctuations of temporal variability in riverbed hydraulic conductivity. Scour, however, occurs with greater magnitude along other sectors of the river profile, particularly in the thalweg, where our cross-sectional profiles have indicated scouring as great as one meter with large events. In order for a full assessment of the temporal variability of riverbed hydraulic conductivity to be reached, instrumentation of entire profiles, along many other reaches, must be accomplished.

A need also exists for a method of continuous monitoring of riverbed hydraulic conductivity that does not hinder the natural scour and deposition processes of the riverbed and is durable enough to withstand river flow over a wide variety of environmental changes.

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# APPENDIX A: TEMPERATURE DATA

| Date / Time | Temperatures in degrees Celsius | | | | | |
|---|---|---|---|---|---|---|
| | River | Load Cell | P6-4 | P6-5 | 6B | 6B-1 |
| 11/21/05 6:00 PM | 6.98 | 7.62 | 13.07 | 11.38 | 20.82 | 16.78 |
| 11/22/05 12:00 AM | 6.82 | 7.61 | 13.08 | 11.23 | 20.84 | 16.83 |
| 11/22/05 6:00 AM | 6.98 | 7.58 | 13.09 | 11.07 | 20.82 | 16.85 |
| 11/22/05 12:00 PM | 6.98 | 7.59 | 13.09 | 11.07 | 20.84 | 16.87 |
| 11/22/05 6:00 PM | 7.13 | 7.66 | 13.09 | 10.92 | 20.88 | 16.89 |
| 11/23/05 12:00 AM | 6.67 | 7.42 | 13.08 | 10.77 | 20.92 | 16.91 |
| 11/23/05 6:00 AM | 6.20 | 7.12 | 13.07 | 10.61 | 20.91 | 16.91 |
| 11/23/05 12:00 PM | 6.04 | 6.88 | 13.06 | 10.46 | 20.95 | 16.91 |
| 11/23/05 6:00 PM | 6.36 | 6.94 | 13.02 | 10.46 | 20.97 | 16.89 |
| 11/24/05 12:00 AM | 6.36 | 6.86 | 12.99 | 10.30 | 20.96 | 16.87 |
| 11/24/05 6:00 AM | 6.20 | 6.76 | 12.96 | 10.14 | 20.97 | 16.82 |
| 11/24/05 12:00 PM | 5.73 | 6.43 | 12.91 | 9.99 | 20.98 | 16.79 |
| 11/24/05 6:00 PM | 5.73 | 6.04 | 12.87 | 9.83 | 20.98 | 16.75 |
| 11/25/05 12:00 AM | 5.27 | 5.47 | 12.82 | 9.68 | 20.96 | 16.70 |
| 11/25/05 6:00 AM | 4.48 | 5.04 | 12.76 | 9.53 | 21.01 | 16.65 |
| 11/25/05 12:00 PM | 4.02 | 4.54 | 12.68 | 9.37 | 20.97 | 16.59 |
| 11/25/05 6:00 PM | 4.33 | 4.83 | 12.60 | 9.22 | 20.99 | 16.58 |
| 11/26/05 12:00 AM | 3.86 | 3.69 | 12.54 | 9.06 | 20.96 | 16.53 |
| 11/26/05 6:00 AM | 3.38 | 2.58 | 12.48 | 8.91 | 20.96 | 16.50 |
| 11/26/05 12:00 PM | 3.54 | 2.75 | 12.40 | 8.75 | 20.96 | 16.48 |
| 11/26/05 6:00 PM | 4.17 | 4.67 | 12.32 | 8.75 | 20.94 | 16.45 |
| 11/27/05 12:00 AM | 4.33 | 5.00 | 12.25 | 8.59 | 20.94 | 16.41 |
| 11/27/05 6:00 AM | 4.48 | 5.31 | 12.16 | 8.44 | 20.94 | 16.40 |
| 11/27/05 12:00 PM | 4.64 | 5.63 | 12.08 | 8.44 | 20.95 | 16.36 |
| 11/27/05 6:00 PM | 5.11 | 7.00 | 12.01 | 8.44 | 20.94 | 16.38 |
| 11/28/05 12:00 AM | 5.42 | 7.42 | 11.96 | 8.44 | 20.94 | 16.38 |
| 11/28/05 6:00 AM | 5.73 | 7.41 | 11.89 | 8.44 | 20.95 | 16.34 |
| 11/28/05 12:00 PM | 6.67 | 8.94 | 11.84 | 8.44 | 20.92 | 16.34 |
| 11/28/05 6:00 PM | 8.06 | 11.64 | 11.79 | 8.59 | 20.91 | 16.33 |
| 11/29/05 12:00 AM | 9.92 | 10.57 | 11.76 | 8.44 | 21.00 | 16.28 |
| 11/29/05 6:00 AM | 8.83 | 9.69 | 11.73 | 8.28 | 21.19 | 16.15 |
| 11/29/05 12:00 PM | 9.29 | 9.57 | 11.63 | 8.28 | 21.19 | 15.87 |
| 11/29/05 6:00 PM | 8.98 | 9.19 | 11.46 | 8.44 | 21.09 | 15.77 |
| 11/30/05 12:00 AM | 8.83 | 9.07 | 11.29 | 8.59 | 21.06 | 15.77 |
| 11/30/05 6:00 AM | 8.22 | 8.66 | 11.12 | 8.59 | 20.91 | 15.68 |
| 11/30/05 12:00 PM | 7.91 | 8.31 | 10.97 | 8.75 | 20.79 | 15.67 |

| Date / Time | Temperatures in degrees Celsius | | | | | |
|---|---|---|---|---|---|---|
| | River | Load Cell | P6-4 | P6-5 | 6B | 6B-1 |
| 11/30/05 6:00 PM | 7.75 | 8.11 | 10.84 | 8.75 | 20.66 | 15.62 |
| 12/1/05 12:00 AM | 7.29 | 7.81 | 10.74 | 8.91 | 20.57 | 15.54 |
| 12/1/05 6:00 AM | 6.82 | 7.43 | 10.67 | 8.91 | 20.44 | 15.47 |
| 12/1/05 12:00 PM | 6.36 | 7.07 | 10.61 | 8.91 | 20.34 | 15.36 |
| 12/1/05 6:00 PM | 6.04 | 6.79 | 10.56 | 8.91 | 20.24 | 15.29 |
| 12/2/05 12:00 AM | 5.73 | 6.54 | 10.52 | 8.91 | 20.18 | 15.23 |
| 12/2/05 6:00 AM | 5.27 | 6.22 | 10.51 | 8.75 | 20.08 | 15.19 |
| 12/2/05 12:00 PM | 4.80 | 5.80 | 10.48 | 8.75 | 20.04 | 15.21 |
| 12/2/05 6:00 PM | 4.64 | 5.62 | 10.47 | 8.59 | 19.98 | 15.19 |
| 12/3/05 12:00 AM | 4.17 | 5.24 | 10.46 | 8.59 | 19.97 | 15.18 |
| 12/3/05 6:00 AM | 4.17 | 5.02 | 10.46 | 8.59 | 19.94 | 15.18 |
| 12/3/05 12:00 PM | 4.02 | 4.84 | 10.44 | 8.44 | 19.91 | 15.18 |
| 12/3/05 6:00 PM | 4.02 | 4.73 | 10.43 | 8.44 | 19.91 | 15.17 |
| 12/4/05 12:00 AM | 3.86 | 4.63 | 10.42 | 8.44 | 19.91 | 15.14 |
| 12/4/05 6:00 AM | 3.70 | 4.48 | 10.41 | 8.28 | 19.86 | 15.13 |
| 12/4/05 12:00 PM | 3.70 | 4.37 | 10.41 | 8.28 | 19.85 | 15.13 |
| 12/4/05 6:00 PM | 3.86 | 4.37 | 10.38 | 8.28 | 19.88 | 15.11 |
| 12/5/05 12:00 AM | 3.86 | 4.32 | 10.38 | 8.13 | 19.83 | 15.09 |
| 12/5/05 6:00 AM | 3.38 | 4.17 | 10.36 | 8.13 | 19.83 | 15.06 |
| 12/5/05 12:00 PM | 3.23 | 3.95 | 10.34 | 7.98 | 19.84 | 15.03 |
| 12/5/05 6:00 PM | | 3.97 | 10.33 | 7.98 | 19.82 | 15.01 |
| 12/6/05 12:00 AM | | 3.84 | 10.31 | 7.98 | 19.83 | 14.99 |
| 12/6/05 6:00 AM | | 3.60 | 10.28 | 7.82 | 19.82 | 14.96 |
| 12/6/05 12:00 PM | | 3.38 | 10.27 | 7.82 | 19.80 | 14.92 |
| 12/6/05 6:00 PM | 3.38 | 3.61 | 10.24 | 7.82 | 19.79 | 14.89 |
| 12/7/05 12:00 AM | 3.07 | 3.49 | 10.22 | 7.67 | 19.77 | 14.87 |
| 12/7/05 6:00 AM | 2.91 | 3.15 | 10.19 | 7.67 | 19.77 | 14.86 |
| 12/7/05 12:00 PM | 3.07 | 3.04 | 10.17 | 7.67 | 19.77 | 14.83 |
| 12/7/05 6:00 PM | 3.38 | 3.20 | 10.14 | 7.67 | 19.79 | 14.79 |
| 12/8/05 12:00 AM | 3.07 | 2.56 | 10.12 | 7.51 | 19.74 | 14.77 |
| 12/8/05 6:00 AM | 2.59 | 1.83 | 10.09 | 7.51 | 19.74 | 14.69 |
| 12/8/05 12:00 PM | 2.59 | 1.67 | 10.07 | 7.36 | 19.76 | 14.68 |
| 12/8/05 6:00 PM | 2.12 | 1.99 | 10.04 | 7.36 | 19.71 | 14.68 |
| 12/9/05 12:00 AM | 2.12 | 1.49 | 10.02 | 7.21 | 19.72 | 14.67 |
| 12/9/05 6:00 AM | 1.64 | 1.32 | 9.99 | 7.21 | 19.70 | 14.64 |
| 12/9/05 12:00 PM | 1.33 | 1.27 | 9.95 | 7.21 | 19.71 | 14.57 |
| 12/9/05 6:00 PM | 1.64 | 1.24 | 9.93 | 7.05 | 19.69 | 14.62 |
| 12/10/05 12:00 AM | 1.48 | 1.19 | 9.90 | 7.05 | 19.64 | 14.58 |

| Date / Time | River | Load Cell | P6-4 | P6-5 | 6B | 6B-1 |
|---|---|---|---|---|---|---|
| | Temperatures in degrees Celsius | | | | | |
| 12/10/05 6:00 AM | 1.33 | 1.17 | 9.88 | 6.89 | 19.64 | 14.56 |
| 12/10/05 12:00 PM | 1.64 | 1.10 | 9.85 | 6.74 | 19.63 | 14.54 |
| 12/10/05 6:00 PM | 1.96 | 1.02 | 9.81 | 6.74 | 19.59 | 14.52 |
| 12/11/05 12:00 AM | 1.81 | 0.97 | 9.79 | 6.58 | 19.58 | 14.52 |
| 12/11/05 6:00 AM | 1.96 | 0.92 | 9.76 | 6.58 | 19.53 | 14.48 |
| 12/11/05 12:00 PM | 2.44 | 0.86 | 9.72 | 6.43 | 19.54 | 14.46 |
| 12/11/05 6:00 PM | 2.44 | 0.78 | 9.70 | 6.43 | 19.51 | 14.43 |
| 12/12/05 12:00 AM | 2.12 | 0.76 | 9.66 | 6.27 | 19.53 | 14.42 |
| 12/12/05 6:00 AM | 2.12 | 0.71 | 9.62 | 6.12 | 19.51 | 14.38 |
| 12/12/05 12:00 PM | 2.28 | 0.68 | 9.58 | 6.12 | 19.48 | 14.36 |
| 12/12/05 6:00 PM | 2.44 | 0.63 | 9.53 | 5.96 | 19.46 | 14.32 |
| 12/13/05 12:00 AM | 1.81 | 0.52 | 9.49 | 5.96 | 19.44 | 14.29 |
| 12/13/05 6:00 AM | 1.48 | 0.46 | 9.44 | 5.81 | 19.42 | 14.28 |
| 12/13/05 12:00 PM | 1.96 | 0.42 | 9.41 | 5.81 | 19.38 | 14.26 |
| 12/13/05 6:00 PM | 2.44 | 0.40 | 9.37 | 5.81 | 19.35 | 14.24 |
| 12/14/05 12:00 AM | 2.28 | 0.39 | 9.33 | 5.81 | 19.32 | 14.23 |
| 12/14/05 6:00 AM | 2.28 | 0.37 | 9.29 | 5.81 | 19.31 | 14.23 |
| 12/14/05 12:00 PM | 2.76 | 0.37 | 9.26 | 5.81 | 19.25 | 14.22 |
| 12/14/05 6:00 PM | 3.07 | 0.37 | 9.23 | 5.81 | 19.25 | 14.20 |
| 12/15/05 12:00 AM | 3.23 | 0.36 | 9.19 | 5.81 | 19.19 | 14.19 |
| 12/15/05 6:00 AM | 3.38 | 0.34 | 9.15 | 5.81 | 19.19 | 14.17 |
| 12/15/05 12:00 PM | 2.76 | 0.29 | 9.13 | 5.65 | 19.19 | 14.13 |
| 12/15/05 6:00 PM | 2.91 | 0.29 | 9.09 | 5.49 | 19.12 | 14.08 |
| 12/16/05 12:00 AM | 3.07 | 0.22 | 9.03 | 5.18 | 19.16 | 14.02 |
| 12/16/05 6:00 AM | 3.38 | 0.36 | 8.96 | 5.02 | 19.15 | 13.95 |
| 12/16/05 12:00 PM | 3.54 | 1.59 | 8.88 | 4.71 | 19.09 | 13.88 |
| 12/16/05 6:00 PM | 3.54 | 2.41 | 8.82 | 4.55 | 19.07 | 13.81 |
| 12/17/05 12:00 AM | 3.54 | 1.90 | 8.73 | 4.23 | 19.00 | 13.76 |
| 12/17/05 6:00 AM | 3.38 | 1.07 | 8.66 | 4.08 | 18.98 | 13.74 |
| 12/17/05 12:00 PM | 3.54 | 0.81 | 8.59 | 3.92 | 18.92 | 13.70 |
| 12/17/05 6:00 PM | 3.86 | 1.10 | 8.53 | 3.77 | 18.91 | 13.67 |
| 12/18/05 12:00 AM | 3.38 | 0.54 | 8.44 | 3.61 | 18.86 | 13.64 |
| 12/18/05 6:00 AM | 3.23 | 0.35 | 8.38 | 3.61 | 18.82 | 13.60 |
| 12/18/05 12:00 PM | 3.70 | 0.21 | 8.32 | 3.61 | 18.77 | 13.57 |
| 12/18/05 6:00 PM | 4.02 | 0.18 | 8.26 | 3.77 | 18.71 | 13.54 |
| 12/19/05 12:00 AM | 3.38 | 0.17 | 8.21 | 3.77 | 18.67 | 13.54 |
| 12/19/05 6:00 AM | 2.76 | 0.10 | 8.17 | 3.92 | 18.66 | 13.51 |
| 12/19/05 12:00 PM | 2.59 | -0.01 | 8.14 | 3.92 | 18.62 | 13.50 |

| Date / Time | River | Load Cell | P6-4 | P6-5 | 6B | 6B-1 |
|---|---|---|---|---|---|---|
| | Temperatures in degrees Celsius | | | | | |
| 12/19/05 6:00 PM | 2.76 | -0.06 | 8.10 | 4.08 | 18.58 | 13.47 |
| 12/20/05 12:00 AM | 2.12 | -0.15 | 8.05 | 4.08 | 18.56 | 13.45 |
| 12/20/05 6:00 AM | 1.17 | -0.53 | 8.01 | 4.08 | 18.52 | 13.46 |
| 12/20/05 12:00 PM | 1.33 | -0.75 | 7.97 | 4.23 | 18.48 | 13.42 |
| 12/20/05 6:00 PM | 1.48 | -0.41 | 7.94 | 4.23 | 18.48 | 13.41 |
| 12/21/05 12:00 AM | 1.33 | -0.69 | 7.91 | 4.23 | 18.44 | 13.41 |
| 12/21/05 6:00 AM | 1.01 | -1.16 | 7.89 | 4.23 | 18.43 | 13.42 |
| 12/21/05 12:00 PM | 1.64 | -0.94 | 7.87 | 4.23 | 18.42 | 13.42 |
| 12/21/05 6:00 PM | 2.12 | -0.43 | 7.87 | 4.23 | 18.40 | 13.41 |
| 12/22/05 12:00 AM | 1.96 | -1.06 | 7.84 | 4.39 | 18.41 | 13.40 |
| 12/22/05 6:00 AM | 2.12 | -0.96 | 7.83 | 4.39 | 18.35 | 13.38 |
| 12/22/05 12:00 PM | 2.59 | -0.75 | 7.82 | 4.39 | 18.35 | 13.37 |
| 12/22/05 6:00 PM | 2.91 | -0.43 | 7.81 | 4.39 | 18.33 | 13.37 |
| 12/23/05 12:00 AM | 2.91 | -0.38 | 7.79 | 4.39 | 18.31 | 13.37 |
| 12/23/05 6:00 AM | 2.76 | -0.57 | 7.78 | 4.39 | 18.32 | 13.36 |
| 12/23/05 12:00 PM | 3.38 | -0.50 | 7.76 | 4.39 | 18.31 | 13.36 |
| 12/23/05 6:00 PM | 4.17 | -0.40 | 7.76 | 4.39 | 18.30 | 13.35 |
| 12/24/05 12:00 AM | 4.02 | -0.36 | 7.74 | 4.39 | 18.27 | 13.35 |
| 12/24/05 6:00 AM | 3.70 | -0.34 | 7.73 | 4.39 | 18.29 | 13.33 |
| 12/24/05 12:00 PM | 4.17 | -0.33 | 7.72 | 4.39 | 18.28 | 13.32 |
| 12/24/05 6:00 PM | 4.80 | -0.32 | 7.71 | 4.39 | 18.25 | 13.32 |
| 12/25/05 12:00 AM | 4.64 | -0.29 | 7.71 | 4.39 | 18.23 | 13.31 |
| 12/25/05 6:00 AM | 4.17 | -0.29 | 7.69 | 4.39 | 18.24 | 13.30 |
| 12/25/05 12:00 PM | 4.02 | -0.30 | 7.68 | 4.23 | 18.28 | 13.21 |
| 12/25/05 6:00 PM | 3.86 | -0.26 | 7.64 | 3.77 | 18.30 | 13.12 |
| 12/26/05 12:00 AM | 3.23 | -0.13 | 7.59 | 3.46 | 18.35 | 13.01 |
| 12/26/05 6:00 AM | 3.23 | 0.13 | 7.50 | 3.29 | 18.34 | 12.83 |
| 12/26/05 12:00 PM | 3.07 | 0.36 | 7.39 | 3.29 | 18.29 | 12.73 |
| 12/26/05 6:00 PM | 3.23 | 0.66 | 7.27 | 3.14 | 18.19 | 12.62 |
| 12/27/05 12:00 AM | 3.38 | 1.24 | 7.14 | 3.14 | 18.18 | 12.57 |
| 12/27/05 6:00 AM | 3.23 | 2.20 | 7.02 | 3.14 | 18.10 | 12.57 |
| 12/27/05 12:00 PM | 3.07 | | 6.87 | 3.14 | 18.04 | |
| 12/27/05 6:00 PM | 3.38 | 2.97 | 6.73 | 3.14 | | |
| 12/28/05 12:00 AM | 3.38 | 3.13 | 6.60 | 3.29 | | |
| 12/28/05 6:00 AM | 3.86 | 3.41 | 6.50 | 3.29 | | |
| 12/28/05 12:00 PM | 4.48 | 3.83 | 6.39 | 3.29 | | |
| 12/28/05 6:00 PM | 5.11 | 4.43 | 6.31 | 3.46 | | |
| 12/29/05 12:00 AM | 5.27 | 4.85 | 6.22 | 3.46 | | |

| Date / Time | Temperatures in degrees Celsius River | Load Cell | P6-4 | P6-5 | 6B | 6B-1 |
|---|---|---|---|---|---|---|
| 12/29/05 6:00 AM | 5.42 | 5.06 | 6.13 | 3.61 | | |
| 12/29/05 12:00 PM | 5.27 | 5.19 | 6.03 | 3.77 | | |
| 12/29/05 6:00 PM | 5.11 | 5.14 | 5.94 | 3.92 | | |
| 12/30/05 12:00 AM | 4.96 | 5.07 | 5.84 | 4.08 | | |
| 12/30/05 6:00 AM | 4.96 | 4.99 | 5.75 | 4.23 | | |
| 12/30/05 12:00 PM | 4.80 | 4.90 | 5.68 | 4.39 | | |
| 12/30/05 6:00 PM | 4.80 | 4.84 | 5.64 | 4.39 | | |
| 12/31/05 12:00 AM | 4.64 | 4.78 | 5.62 | 4.55 | | |
| 12/31/05 6:00 AM | 4.64 | 4.70 | 5.61 | 4.55 | | |
| 12/31/05 12:00 PM | 4.64 | 4.67 | 5.61 | 4.71 | | |
| 12/31/05 6:00 PM | 4.64 | 4.65 | 5.62 | 4.71 | | |
| 1/1/06 12:00 AM | 4.48 | 4.61 | 5.64 | 4.71 | | |
| 1/1/06 6:00 AM | 4.33 | 4.50 | 5.66 | 4.71 | | |
| 1/1/06 12:00 PM | 4.33 | 4.40 | 5.68 | 4.86 | | |
| 1/1/06 6:00 PM | 4.64 | 4.52 | 5.71 | 4.86 | | |
| 1/2/06 12:00 AM | 4.96 | 4.68 | 5.73 | 4.86 | | |
| 1/2/06 6:00 AM | 5.11 | 4.90 | 5.76 | 4.86 | | |
| 1/2/06 12:00 PM | 5.42 | 5.05 | 5.78 | 4.86 | | |
| 1/2/06 6:00 PM | 5.89 | 5.38 | 5.81 | 4.86 | | |
| 1/3/06 12:00 AM | 6.36 | 5.82 | 5.84 | 4.86 | | |
| 1/3/06 6:00 AM | 6.51 | 6.10 | 5.86 | 5.02 | | |
| 1/3/06 12:00 PM | 6.67 | 6.26 | 5.88 | 5.02 | | |
| 1/3/06 6:00 PM | 6.82 | 6.46 | 5.89 | 5.02 | | |
| 1/4/06 12:00 AM | 6.98 | 6.61 | 5.89 | 5.18 | | |
| 1/4/06 6:00 AM | 6.98 | 6.69 | 5.89 | 5.18 | | |
| 1/4/06 12:00 PM | 7.13 | 6.72 | 5.90 | 5.33 | | |
| 1/4/06 6:00 PM | 7.44 | 6.97 | 5.91 | 5.33 | | |
| 1/5/06 12:00 AM | 7.44 | 7.04 | 5.94 | 5.49 | | |
| 1/5/06 6:00 AM | 7.13 | 7.02 | 5.97 | 5.49 | | |
| 1/5/06 12:00 PM | 6.98 | 6.86 | 5.99 | 5.65 | | |
| 1/5/06 6:00 PM | 6.82 | 6.74 | 6.02 | 5.65 | | |
| 1/6/06 12:00 AM | 6.51 | 6.61 | 6.04 | 5.65 | | |
| 1/6/06 6:00 AM | 6.20 | 6.41 | 6.07 | 5.81 | | |
| 1/6/06 12:00 PM | 5.89 | 6.14 | 6.09 | 5.81 | | |
| 1/6/06 6:00 PM | 5.73 | 5.98 | 6.13 | 5.96 | | |
| 1/7/06 12:00 AM | 5.42 | 5.75 | 6.16 | 5.96 | | |
| 1/7/06 6:00 AM | 5.11 | 5.50 | 6.18 | 5.96 | | |
| 1/7/06 12:00 PM | 4.96 | 5.24 | 6.22 | 5.96 | | |

| Date / Time | Temperatures in degrees Celsius River | Load Cell | P6-4 | P6-5 | 6B | 6B-1 |
|---|---|---|---|---|---|---|
| 1/7/06 6:00 PM | 4.96 | 5.29 | 6.24 | 5.96 | | |
| 1/8/06 12:00 AM | 4.64 | 5.12 | 6.28 | 5.96 | | |
| 1/8/06 6:00 AM | 4.48 | 4.90 | 6.31 | 5.96 | | |
| 1/8/06 12:00 PM | 4.48 | 4.73 | 6.33 | 5.96 | | |
| 1/8/06 6:00 PM | 4.80 | 4.89 | 6.36 | 5.96 | | |
| 1/9/06 12:00 AM | 4.96 | 4.95 | 6.38 | 5.96 | | |
| 1/9/06 6:00 AM | 5.11 | 5.03 | 6.41 | 5.96 | | |
| 1/9/06 12:00 PM | 5.42 | 5.14 | 6.43 | 5.81 | | |
| 1/9/06 6:00 PM | 5.42 | 5.33 | 6.44 | 5.81 | | |
| 1/10/06 12:00 AM | 5.27 | 5.32 | 6.46 | 5.81 | | |
| 1/10/06 6:00 AM | 5.27 | 5.30 | 6.47 | 5.81 | | |
| 1/10/06 12:00 PM | 5.42 | 5.30 | 6.48 | 5.81 | | |
| 1/10/06 6:00 PM | 5.73 | 5.46 | 6.48 | 5.81 | | |
| 1/11/06 12:00 AM | 5.73 | 5.57 | 6.50 | 5.81 | | |
| 1/11/06 6:00 AM | 5.89 | 5.71 | 6.48 | 5.81 | 15.15 | |
| 1/11/06 12:00 PM | 6.20 | 5.87 | 6.48 | 5.81 | 15.10 | |
| 1/11/06 6:00 PM | 6.04 | 6.01 | 6.47 | 5.81 | 15.03 | |
| 1/12/06 12:00 AM | 6.04 | 5.98 | 6.46 | 5.81 | 15.01 | |
| 1/12/06 6:00 AM | 5.73 | 5.85 | 6.44 | 5.81 | 14.95 | |
| 1/12/06 12:00 PM | 5.73 | 5.66 | 6.42 | 5.81 | 14.88 | |
| 1/12/06 6:00 PM | 6.20 | 6.01 | 6.41 | 5.81 | 14.92 | |
| 1/13/06 12:00 AM | 6.20 | 6.03 | 6.39 | 5.81 | 14.84 | |
| 1/13/06 6:00 AM | 6.36 | 6.13 | 6.38 | 5.96 | 14.81 | |
| 1/13/06 12:00 PM | 6.67 | 6.34 | 6.37 | 5.96 | 14.77 | |
| 1/13/06 6:00 PM | 6.98 | 6.64 | 6.36 | 5.96 | 14.74 | |
| 1/14/06 12:00 AM | 6.98 | 6.79 | 6.34 | 5.96 | 14.69 | |
| 1/14/06 6:00 AM | 6.82 | 6.79 | 6.33 | 5.96 | 14.70 | |
| 1/14/06 12:00 PM | 6.51 | 6.63 | 6.32 | 6.12 | 14.60 | |
| 1/14/06 6:00 PM | 6.36 | 6.53 | 6.31 | 6.12 | 14.57 | |
| 1/15/06 12:00 AM | 5.89 | 6.27 | 6.29 | 6.27 | 14.50 | |
| 1/15/06 6:00 AM | 5.58 | 5.99 | 6.28 | 6.27 | 14.38 | |
| 1/15/06 12:00 PM | 5.42 | 5.71 | 6.27 | 6.27 | 14.32 | |
| 1/15/06 6:00 PM | 5.58 | 5.76 | 6.27 | 6.27 | 14.27 | |
| 1/16/06 12:00 AM | 5.42 | 5.64 | 6.27 | 6.27 | 14.22 | |
| 1/16/06 6:00 AM | 5.27 | 5.53 | 6.27 | 6.27 | 14.12 | |
| 1/16/06 12:00 PM | 5.27 | 5.40 | 6.27 | 6.27 | 14.10 | |
| 1/16/06 6:00 PM | 5.73 | 5.69 | 6.28 | 6.27 | 14.08 | |
| 1/17/06 12:00 AM | 5.89 | 5.78 | 6.29 | 6.27 | 14.03 | |

| Date / Time | River | Load Cell | P6-4 | P6-5 | 6B | 6B-1 |
|---|---|---|---|---|---|---|
| | Temperatures in degrees Celsius | | | | | |
| 1/17/06 6:00 AM | 6.20 | 5.94 | 6.31 | 6.27 | 14.00 | |
| 1/17/06 12:00 PM | 6.67 | 6.18 | 6.31 | 6.12 | 14.13 | |
| 1/17/06 6:00 PM | 6.82 | 6.60 | 6.32 | 6.12 | 14.18 | |
| 1/18/06 12:00 AM | 6.67 | 6.57 | 6.32 | 6.12 | 14.07 | |
| 1/18/06 6:00 AM | 6.04 | 6.34 | 6.32 | 6.12 | 13.98 | |
| 1/18/06 12:00 PM | 5.42 | 5.88 | 6.32 | 6.12 | 13.96 | |
| 1/18/06 6:00 PM | 5.27 | 5.60 | 6.31 | 6.12 | 13.86 | |
| 1/19/06 12:00 AM | 5.11 | 5.38 | 6.29 | 6.27 | 13.78 | |
| 1/19/06 6:00 AM | 4.48 | 5.06 | 6.28 | 6.27 | 13.64 | |
| 1/19/06 12:00 PM | 4.48 | 4.75 | 6.27 | 6.27 | 13.61 | |
| 1/19/06 6:00 PM | 4.96 | 4.91 | 6.27 | 6.12 | 13.56 | |
| 1/20/06 12:00 AM | 5.27 | 5.08 | 6.27 | 6.12 | 13.51 | |
| 1/20/06 6:00 AM | 5.27 | 5.24 | 6.27 | 6.12 | 13.42 | |
| 1/20/06 12:00 PM | 5.73 | 5.41 | 6.27 | 6.12 | 13.40 | |
| 1/20/06 6:00 PM | 6.36 | 5.82 | 6.27 | 6.12 | 13.40 | |
| 1/21/06 12:00 AM | 6.51 | 6.10 | 6.27 | 6.12 | 13.33 | |
| 1/21/06 6:00 AM | 6.82 | 6.32 | 6.28 | 5.96 | 13.30 | |
| 1/21/06 12:00 PM | 6.98 | 6.52 | 6.28 | 5.96 | 13.29 | |
| 1/21/06 6:00 PM | 7.44 | 6.80 | 6.28 | 5.96 | 13.27 | |
| 1/22/06 12:00 AM | 6.98 | 6.86 | 6.28 | 5.96 | 13.19 | |
| 1/22/06 6:00 AM | 6.67 | 6.73 | 6.28 | 6.12 | 13.16 | |
| 1/22/06 12:00 PM | 6.36 | 6.48 | 6.28 | 6.12 | 13.19 | |
| 1/22/06 6:00 PM | 6.36 | 6.40 | 6.29 | 6.12 | 13.13 | |
| 1/23/06 12:00 AM | 6.36 | 6.35 | 6.29 | 6.12 | 13.16 | |
| 1/23/06 6:00 AM | 5.89 | 6.15 | 6.29 | 6.12 | 13.18 | |
| 1/23/06 12:00 PM | 6.04 | 5.96 | 6.29 | 6.12 | 13.16 | |
| 1/23/06 6:00 PM | 6.20 | 6.15 | 6.29 | 6.12 | 13.11 | |
| 1/24/06 12:00 AM | 5.89 | 6.11 | 6.29 | 6.27 | 13.10 | |
| 1/24/06 6:00 AM | 5.58 | 5.90 | 6.29 | 6.27 | 13.07 | |
| 1/24/06 12:00 PM | 5.27 | 5.61 | 6.31 | 6.27 | 13.10 | |
| 1/24/06 6:00 PM | 5.42 | 5.70 | 6.31 | 6.27 | 13.10 | |
| 1/25/06 12:00 AM | 5.42 | 5.58 | 6.31 | 6.27 | 13.10 | |
| 1/25/06 6:00 AM | 5.27 | 5.50 | 6.31 | 6.27 | 13.08 | |
| 1/25/06 12:00 PM | 5.11 | 5.38 | 6.32 | 6.27 | 13.05 | |
| 1/25/06 6:00 PM | 4.96 | 5.30 | 6.32 | 6.27 | 13.08 | |
| 1/26/06 12:00 AM | 4.64 | 5.13 | 6.32 | 6.12 | 13.04 | |
| 1/26/06 6:00 AM | 4.48 | 4.93 | 6.33 | 6.12 | 13.04 | |
| 1/26/06 12:00 PM | 4.48 | 4.71 | 6.33 | 6.12 | 13.03 | |

| Date / Time | Temperatures in degrees Celsius | | | | | |
|---|---|---|---|---|---|---|
| | River | Load Cell | P6-4 | P6-5 | 6B | 6B-1 |
| 1/26/06 6:00 PM | 4.80 | 4.93 | 6.33 | 6.12 | 13.03 | |
| 1/27/06 12:00 AM | 4.33 | 4.79 | 6.34 | 6.12 | 13.04 | |
| 1/27/06 6:00 AM | 4.17 | 4.58 | 6.34 | 6.12 | 13.04 | |
| 1/27/06 12:00 PM | 4.48 | 4.48 | 6.34 | 5.96 | 13.10 | |
| 1/27/06 6:00 PM | 4.96 | 4.87 | 6.34 | 5.96 | 13.04 | |
| 1/28/06 12:00 AM | 4.64 | 4.82 | 6.34 | 5.96 | 13.02 | |
| 1/28/06 6:00 AM | 4.80 | 4.78 | 6.33 | 5.81 | 13.01 | |
| 1/28/06 12:00 PM | 5.42 | 4.92 | 6.33 | 5.81 | 13.03 | |
| 1/28/06 6:00 PM | 6.36 | 5.67 | 6.32 | 5.81 | 13.03 | |
| 1/29/06 12:00 AM | 6.04 | 5.81 | 6.31 | 5.65 | 13.01 | |
| 1/29/06 6:00 AM | 6.36 | 5.91 | 6.29 | 5.65 | 13.03 | |
| 1/29/06 12:00 PM | 6.98 | 6.28 | 6.28 | 5.65 | 13.06 | |
| 1/29/06 6:00 PM | 7.91 | 6.95 | 6.27 | 5.65 | 13.03 | |
| 1/30/06 12:00 AM | 7.59 | 7.16 | 6.24 | 5.65 | 13.03 | |
| 1/30/06 6:00 AM | 7.59 | 7.21 | 6.23 | 5.81 | 13.06 | |
| 1/30/06 12:00 PM | 7.75 | 7.24 | 6.21 | 5.81 | 13.00 | |
| 1/30/06 6:00 PM | 7.75 | 7.50 | 6.18 | 5.96 | 12.97 | |
| 1/31/06 12:00 AM | 7.44 | 7.41 | 6.17 | 5.96 | 12.97 | |
| 1/31/06 6:00 AM | 7.44 | 7.29 | 6.16 | 6.12 | 12.89 | |
| 1/31/06 12:00 PM | 7.29 | 7.20 | 6.14 | 6.12 | 12.90 | |
| 1/31/06 6:00 PM | 7.13 | 7.15 | 6.13 | 6.27 | 12.91 | |
| 2/1/06 12:00 AM | 6.67 | 6.92 | 6.13 | 6.27 | 12.85 | |
| 2/1/06 6:00 AM | 6.36 | 6.68 | 6.13 | 6.27 | | |
| 2/1/06 12:00 PM | 6.51 | 6.55 | 6.13 | 6.27 | | |
| 2/1/06 6:00 PM | 7.08 | 6.81 | 6.14 | 6.43 | | |
| 2/2/06 12:00 AM | 6.77 | 6.74 | 6.15 | 6.43 | | |
| 2/2/06 6:00 AM | 6.61 | 6.62 | 6.17 | 6.43 | | |
| 2/2/06 12:00 PM | 6.77 | 6.55 | 6.17 | 6.43 | | |
| 2/2/06 6:00 PM | 6.77 | 6.63 | 6.18 | 6.43 | | |
| 2/3/06 12:00 AM | 6.61 | 6.53 | 6.19 | 6.43 | | |
| 2/3/06 6:00 AM | 6.46 | 6.46 | 6.22 | 6.43 | | |
| 2/3/06 12:00 PM | 6.77 | 6.42 | 6.23 | 6.43 | | |
| 2/3/06 6:00 PM | 7.08 | 6.61 | 6.23 | 6.58 | | |
| 2/4/06 12:00 AM | 6.77 | 6.66 | 6.24 | 6.58 | | |
| 2/4/06 6:00 AM | 6.61 | 6.57 | 6.24 | 6.58 | | |
| 2/4/06 12:00 PM | 6.30 | 6.39 | 6.26 | 6.58 | | |
| 2/4/06 6:00 PM | 5.83 | 6.13 | 6.26 | 6.58 | | |
| 2/5/06 12:00 AM | 5.36 | 5.73 | 6.27 | 6.58 | | |

| Date / Time | River | Load Cell | P6-4 | P6-5 | 6B | 6B-1 |
|---|---|---|---|---|---|---|
| | Temperatures in degrees Celsius | | | | | |
| 2/5/06 6:00 AM | 4.89 | 5.31 | 6.28 | 6.58 | | |
| 2/5/06 12:00 PM | 4.27 | 4.87 | 6.29 | 6.58 | | |
| 2/5/06 6:00 PM | 3.96 | 4.49 | 6.31 | 6.58 | | |
| 2/6/06 12:00 AM | 3.64 | 4.14 | 6.32 | 6.43 | | |
| 2/6/06 6:00 AM | 3.18 | 3.76 | 6.33 | 6.43 | | |
| 2/6/06 12:00 PM | 3.02 | 3.43 | 6.33 | 6.43 | | |
| 2/6/06 6:00 PM | 3.49 | 3.53 | 6.35 | 6.27 | | |
| 2/7/06 12:00 AM | 3.33 | 3.54 | 6.35 | 6.27 | | |
| 2/7/06 6:00 AM | 2.86 | 3.37 | 6.35 | 6.12 | | |
| 2/7/06 12:00 PM | 2.86 | 3.14 | 6.36 | 6.12 | | |
| 2/7/06 6:00 PM | 3.33 | 3.34 | 6.35 | 6.12 | | |
| 2/8/06 12:00 AM | 3.18 | 3.35 | 6.35 | 5.96 | | |
| 2/8/06 6:00 AM | 3.18 | 3.36 | 6.35 | 5.96 | | |
| 2/8/06 12:00 PM | 3.18 | 3.24 | 6.33 | 5.81 | | |
| 2/8/06 6:00 PM | 3.64 | 3.49 | 6.33 | 5.81 | | |
| 2/9/06 12:00 AM | 3.33 | 3.51 | 6.32 | 5.81 | | |
| 2/9/06 6:00 AM | 3.02 | 3.41 | 6.31 | 5.65 | | |
| 2/9/06 12:00 PM | 3.18 | 3.19 | 6.29 | 5.65 | | |
| 2/9/06 6:00 PM | 3.33 | 3.45 | 6.28 | 5.49 | | |
| 2/10/06 12:00 AM | 3.18 | 3.36 | 6.27 | 5.49 | | |
| 2/10/06 6:00 AM | 3.33 | 3.36 | 6.24 | 5.49 | | |
| 2/10/06 12:00 PM | 3.64 | 3.38 | 6.23 | 5.33 | | |
| 2/10/06 6:00 PM | 3.80 | 3.65 | 6.22 | 5.33 | | |
| 2/11/06 12:00 AM | 3.64 | 3.65 | 6.19 | 5.18 | | |
| 2/11/06 6:00 AM | 3.49 | 3.58 | 6.17 | 5.18 | | |
| 2/11/06 12:00 PM | 4.11 | 3.62 | 6.14 | 5.18 | | |
| 2/11/06 6:00 PM | 4.27 | 4.03 | 6.13 | 5.02 | | |
| 2/12/06 12:00 AM | 4.11 | 3.99 | 6.10 | 5.02 | | |
| 2/12/06 6:00 AM | 3.96 | 3.91 | 6.08 | 5.02 | | |
| 2/12/06 12:00 PM | 4.42 | 3.92 | 6.05 | 5.02 | | |
| 2/12/06 6:00 PM | 4.42 | 4.17 | 6.03 | 5.02 | | |
| 2/13/06 12:00 AM | 3.80 | 4.05 | 6.00 | 4.86 | | |
| 2/13/06 6:00 AM | 3.64 | 3.82 | 5.98 | 4.86 | | |
| 2/13/06 12:00 PM | 4.11 | 3.72 | 5.94 | 4.86 | | |
| 2/13/06 6:00 PM | 4.27 | 4.09 | 5.91 | 4.86 | | |
| 2/14/06 12:00 AM | 3.64 | 3.87 | 5.89 | 4.86 | | |
| 2/14/06 6:00 AM | 3.33 | 3.65 | 5.86 | 4.86 | | |
| 2/14/06 12:00 PM | 4.58 | 3.62 | 5.84 | 4.86 | | |

| Date / Time | Temperatures in degrees Celsius | | | | | |
|---|---|---|---|---|---|---|
| | River | Load Cell | P6-4 | P6-5 | 6B | 6B-1 |
| 2/14/06 6:00 PM | 5.36 | 4.50 | 5.81 | 4.86 | | |
| 2/15/06 12:00 AM | 5.05 | 4.67 | 5.79 | 4.71 | | |
| 2/15/06 6:00 AM | 4.89 | 4.68 | 5.76 | 4.71 | | |
| 2/15/06 12:00 PM | 5.99 | 4.72 | 5.75 | 4.71 | | |
| 2/15/06 6:00 PM | 6.14 | 5.46 | 5.72 | 4.71 | | |
| 2/16/06 12:00 AM | 5.99 | 5.48 | 5.70 | 4.71 | | |
| 2/16/06 6:00 AM | 6.30 | 5.61 | 5.67 | 4.71 | | |
| 2/16/06 12:00 PM | 7.23 | 5.96 | 5.65 | 4.86 | | |
| 2/16/06 6:00 PM | 7.69 | 6.60 | 5.62 | 4.86 | | |
| 2/17/06 12:00 AM | 8.16 | 6.99 | 5.61 | 4.86 | | |
| 2/17/06 6:00 AM | 7.85 | 7.24 | 5.58 | 5.02 | | |
| 2/17/06 12:00 PM | 7.69 | 7.21 | 5.56 | 5.18 | | |
| 2/17/06 6:00 PM | 7.54 | 7.31 | 5.53 | 5.33 | | |
| 2/18/06 12:00 AM | 7.08 | 7.06 | 5.51 | 5.65 | | |
| 2/18/06 6:00 AM | 6.46 | 6.77 | 5.51 | 5.81 | | |
| 2/18/06 12:00 PM | 5.83 | 6.26 | 5.49 | 5.96 | | |
| 2/18/06 6:00 PM | 5.52 | 5.98 | 5.49 | 6.12 | | |
| 2/19/06 12:00 AM | 4.73 | 5.45 | 5.49 | 6.27 | | |
| 2/19/06 6:00 AM | 3.80 | 4.85 | 5.52 | 6.27 | | |
| 2/19/06 12:00 PM | 3.33 | 4.15 | 5.54 | 6.27 | | |
| 2/19/06 6:00 PM | 3.49 | 4.01 | 5.57 | 6.27 | | |
| 2/20/06 12:00 AM | 3.02 | 3.76 | 5.60 | 6.27 | | |
| 2/20/06 6:00 AM | 2.71 | 3.43 | 5.63 | 6.12 | | |
| 2/20/06 12:00 PM | 2.54 | 3.07 | 5.67 | 6.12 | | |
| 2/20/06 6:00 PM | 2.86 | 3.14 | 5.70 | 6.12 | | |
| 2/21/06 12:00 AM | 2.71 | 3.03 | 5.72 | 5.96 | | |
| 2/21/06 6:00 AM | 2.54 | 2.94 | 5.76 | 5.81 | | |
| 2/21/06 12:00 PM | 3.02 | 2.88 | 5.77 | 5.81 | | |
| 2/21/06 6:00 PM | 3.49 | 3.32 | 5.80 | 5.65 | | |
| 2/22/06 12:00 AM | 3.33 | 3.31 | 5.81 | 5.49 | | |
| 2/22/06 6:00 AM | 3.33 | 3.32 | 5.82 | 5.49 | | |
| 2/22/06 12:00 PM | 4.11 | 3.50 | 5.84 | 5.33 | | |
| 2/22/06 6:00 PM | 4.58 | 4.00 | 5.85 | 5.33 | | |
| 2/23/06 12:00 AM | 4.11 | 4.08 | 5.84 | 5.18 | | |
| 2/23/06 6:00 AM | 3.64 | 3.90 | 5.85 | 5.18 | | |
| 2/23/06 12:00 PM | 4.89 | 3.87 | 5.84 | 5.02 | | |
| 2/23/06 6:00 PM | 5.52 | 4.76 | 5.82 | 5.02 | | |
| 2/24/06 12:00 AM | 4.89 | 4.75 | 5.82 | 5.02 | | |

| Date / Time | River | Load Cell | P6-4 | P6-5 | 6B | 6B-1 |
|---|---|---|---|---|---|---|
| | Temperatures in degrees Celsius | | | | | |
| 2/24/06 6:00 AM | 4.58 | 4.58 | 5.81 | 5.02 | | |
| 2/24/06 12:00 PM | 6.14 | 4.71 | 5.79 | 4.86 | | |
| 2/24/06 6:00 PM | 6.30 | 5.60 | 5.77 | 4.86 | | |
| 2/25/06 12:00 AM | 5.67 | 5.46 | 5.75 | 5.02 | | |
| 2/25/06 6:00 AM | 5.67 | 5.36 | 5.74 | 5.02 | | |
| 2/25/06 12:00 PM | 8.00 | 5.62 | 5.72 | 5.02 | | |
| 2/25/06 6:00 PM | 5.99 | 6.41 | 5.71 | 5.02 | | |
| 2/26/06 12:00 AM | 3.80 | 5.55 | 5.70 | 5.02 | | |
| 2/26/06 6:00 AM | 3.18 | 4.64 | 5.67 | 5.18 | | |
| 2/26/06 12:00 PM | 7.08 | 4.80 | 5.66 | 5.18 | | |
| 2/26/06 6:00 PM | 3.18 | 6.39 | 5.66 | 5.18 | | |
| 2/27/06 12:00 AM | -0.48 | 4.48 | 5.65 | 5.18 | | |
| 2/27/06 6:00 AM | -0.48 | 3.23 | 5.65 | 5.18 | | |
| 2/27/06 12:00 PM | 4.58 | 3.20 | 5.63 | 5.18 | | |
| 2/27/06 6:00 PM | 6.30 | 7.33 | 5.63 | 5.18 | | |
| 2/28/06 12:00 AM | 2.54 | 5.94 | 5.62 | 5.18 | | |
| 2/28/06 6:00 AM | 1.12 | 4.45 | 5.62 | 5.18 | | |
| 2/28/06 12:00 PM | 8.92 | 5.02 | 5.62 | 5.18 | | |
| 2/28/06 6:00 PM | 8.77 | 9.91 | 5.62 | 5.18 | | |
| 3/1/06 12:00 AM | 5.83 | 7.79 | 5.62 | 5.18 | | |
| 3/1/06 6:00 AM | 2.71 | 6.44 | 5.62 | 5.33 | | |
| 3/1/06 12:00 PM | 5.83 | 6.02 | 5.62 | 5.33 | | |
| 3/1/06 6:00 PM | 7.23 | 7.91 | 5.62 | 5.33 | | |
| 3/2/06 12:00 AM | 5.83 | 6.66 | 5.62 | 5.49 | | |
| 3/2/06 6:00 AM | 6.77 | 6.59 | 5.62 | 5.49 | | |
| 3/2/06 12:00 PM | 12.80 | 7.73 | 5.62 | 5.65 | | |
| 3/2/06 6:00 PM | 4.73 | 7.97 | 5.62 | 5.65 | | |
| 3/3/06 12:00 AM | 2.86 | 5.75 | 5.63 | 5.81 | | |
| 3/3/06 6:00 AM | 1.43 | 4.46 | 5.63 | 5.81 | | |
| 3/3/06 12:00 PM | 5.36 | 4.34 | 5.65 | 5.96 | | |
| 3/3/06 6:00 PM | 3.49 | 6.13 | 5.65 | 5.96 | | |
| 3/4/06 12:00 AM | -1.29 | 3.34 | 5.67 | 5.96 | | |
| 3/4/06 6:00 AM | -3.94 | 1.97 | 5.68 | 5.96 | | |
| 3/4/06 12:00 PM | 3.64 | 1.35 | 5.70 | 5.96 | | |
| 3/4/06 6:00 PM | 5.21 | 6.18 | 5.71 | 5.96 | | |
| 3/5/06 12:00 AM | -1.62 | 3.16 | 5.74 | 5.81 | | |
| 3/5/06 6:00 AM | -3.11 | 1.71 | 5.75 | 5.81 | | |
| 3/5/06 12:00 PM | 6.14 | 1.35 | 5.77 | 5.65 | | |

| Date / Time | River | Load Cell | P6-4 | P6-5 | 6B | 6B-1 |
|---|---|---|---|---|---|---|
| | Temperatures in degrees Celsius | | | | | |
| 3/5/06 6:00 PM | 6.98 | 4.10 | 5.79 | 5.65 | | |
| 3/6/06 12:00 AM | 6.82 | 3.26 | 5.81 | 5.49 | | |
| 3/6/06 6:00 AM | 6.51 | 3.10 | 5.82 | 5.49 | | |
| 3/6/06 12:00 PM | 6.67 | 3.46 | 5.84 | 5.33 | | |
| 3/6/06 6:00 PM | 6.51 | 4.07 | 5.85 | 5.33 | | |
| 3/7/06 12:00 AM | 6.36 | 3.39 | 5.85 | 5.33 | | |
| 3/7/06 6:00 AM | 5.73 | 1.89 | 5.85 | 5.18 | | |
| 3/7/06 12:00 PM | 6.67 | 2.04 | 5.85 | 5.18 | | |
| 3/7/06 6:00 PM | 7.44 | 7.26 | 5.85 | 5.18 | | |
| 3/8/06 12:00 AM | 7.13 | 4.82 | 5.85 | 5.18 | | |
| 3/8/06 6:00 AM | 7.13 | 3.84 | 5.84 | 5.02 | | |
| 3/8/06 12:00 PM | 7.29 | 3.90 | 5.84 | 5.02 | | |
| 3/8/06 6:00 PM | 6.04 | 5.11 | 5.82 | 5.02 | | |
| 3/9/06 12:00 AM | 7.44 | 5.90 | 5.81 | 4.86 | | |
| 3/9/06 6:00 AM | 6.98 | 6.44 | 5.80 | 4.86 | | |
| 3/9/06 12:00 PM | 7.29 | 6.62 | 5.77 | 4.86 | | |
| 3/9/06 6:00 PM | 8.06 | 7.09 | 5.75 | 4.86 | | |
| 3/10/06 12:00 AM | 8.06 | 7.46 | 5.72 | 5.02 | | |
| 3/10/06 6:00 AM | 7.91 | 7.65 | 5.70 | 5.02 | | |
| 3/10/06 12:00 PM | 7.91 | 7.75 | 5.66 | 5.18 | | |
| 3/10/06 6:00 PM | 8.22 | 7.88 | 5.62 | 5.33 | | |
| 3/11/06 12:00 AM | 8.06 | 7.92 | 5.60 | 5.33 | | |
| 3/11/06 6:00 AM | 7.75 | 7.82 | 5.57 | 5.49 | | |
| 3/11/06 12:00 PM | 7.59 | 7.70 | 5.56 | 5.65 | | |
| 3/11/06 6:00 PM | 8.06 | 7.78 | 5.54 | 5.81 | | |
| 3/12/06 12:00 AM | 8.22 | 7.91 | 5.54 | 5.96 | | |
| 3/12/06 6:00 AM | 8.06 | 8.04 | 5.54 | 5.96 | | |
| 3/12/06 12:00 PM | 8.68 | 8.32 | 5.54 | 6.12 | | |
| 3/12/06 6:00 PM | 9.45 | 8.65 | 8.58 | 6.27 | | |
| 3/13/06 12:00 AM | 10.07 | 8.94 | 9.42 | 6.27 | | |
| 3/13/06 6:00 AM | 10.23 | 9.25 | 9.85 | 6.43 | | |
| 3/13/06 12:00 PM | 10.69 | 9.43 | 10.78 | 6.43 | | |
| 3/13/06 6:00 PM | 11.46 | 9.69 | 11.66 | 6.43 | | |
| 3/14/06 12:00 AM | 11.31 | 10.04 | 11.21 | 6.43 | | |
| 3/14/06 6:00 AM | 10.69 | 10.13 | 10.99 | 6.58 | | |
| 3/14/06 12:00 PM | 10.23 | 9.95 | 10.56 | 6.58 | | |
| 3/14/06 6:00 PM | 10.38 | 9.83 | 10.54 | 6.58 | | |
| 3/15/06 12:00 AM | 9.76 | 9.69 | 9.99 | 6.43 | | |

| Date / Time | River | Load Cell | P6-4 | P6-5 | 6B | 6B-1 |
|---|---|---|---|---|---|---|
| | Temperatures in degrees Celsius | | | | | |
| 3/15/06 6:00 AM | 9.14 | 9.35 | 9.34 | 6.43 | | |
| 3/15/06 12:00 PM | 8.98 | 9.01 | 9.22 | 6.43 | | |
| 3/15/06 6:00 PM | 9.45 | 9.00 | 9.57 | 6.58 | | |
| 3/16/06 12:00 AM | 9.29 | 9.01 | 9.44 | 6.58 | | |
| 3/16/06 6:00 AM | 8.83 | 8.86 | 8.95 | 6.58 | | |
| 3/16/06 12:00 PM | 8.83 | 8.66 | 9.05 | 6.58 | | |
| 3/16/06 6:00 PM | 8.68 | 8.66 | 9.06 | 6.58 | | |
| 3/17/06 12:00 AM | 8.52 | 8.59 | 8.77 | 6.58 | | |
| 3/17/06 6:00 AM | 7.91 | 8.39 | 8.23 | 6.58 | | |

APPENDIX B: LOAD-CELL PRESSURE SENSOR DATA

| Date / Time | Stage Data (m of H2O) | Sediment pressure (g/cm$^2$) | Sediment Height (m) |
|---|---|---|---|
| 11/21/05 6:00 PM | 11792.00 | 169.46 | 0.79 |
| 11/22/05 12:00 AM | 11792.07 | 170.79 | 0.79 |
| 11/22/05 6:00 AM | 11792.15 | 171.49 | 0.80 |
| 11/22/05 12:00 PM | 11792.23 | 171.29 | 0.80 |
| 11/22/05 6:00 PM | 11792.30 | 171.49 | 0.80 |
| 11/23/05 12:00 AM | 11792.38 | 170.47 | 0.79 |
| 11/23/05 6:00 AM | 11792.45 | 169.23 | 0.79 |
| 11/23/05 12:00 PM | 11792.53 | 168.68 | 0.78 |
| 11/23/05 6:00 PM | 11792.61 | 170.79 | 0.79 |
| 11/24/05 12:00 AM | 11792.68 | 170.60 | 0.79 |
| 11/24/05 6:00 AM | 11792.76 | 171.83 | 0.80 |
| 11/24/05 12:00 PM | 11792.84 | 172.57 | 0.80 |
| 11/24/05 6:00 PM | 11792.91 | 171.68 | 0.80 |
| 11/25/05 12:00 AM | 11792.99 | 168.85 | 0.79 |
| 11/25/05 6:00 AM | 11793.06 | 168.55 | 0.78 |
| 11/25/05 12:00 PM | 11793.14 | 166.81 | 0.78 |
| 11/25/05 6:00 PM | 11793.22 | 168.33 | 0.78 |
| 11/26/05 12:00 AM | 11793.29 | 168.51 | 0.78 |
| 11/26/05 6:00 AM | 11793.37 | 168.71 | 0.78 |
| 11/26/05 12:00 PM | 11793.45 | 168.30 | 0.78 |
| 11/26/05 6:00 PM | 11793.52 | 171.05 | 0.80 |
| 11/27/05 12:00 AM | 11793.60 | 174.00 | 0.81 |
| 11/27/05 6:00 AM | 11793.67 | 175.53 | 0.82 |
| 11/27/05 12:00 PM | 11793.75 | 177.05 | 0.82 |
| 11/27/05 6:00 PM | 11793.83 | 180.30 | 0.84 |
| 11/28/05 12:00 AM | 11793.90 | 181.01 | 0.84 |
| 11/28/05 6:00 AM | 11793.98 | 181.71 | 0.85 |
| 11/28/05 12:00 PM | 11794.05 | 182.62 | 0.85 |
| 11/28/05 6:00 PM | 11794.13 | 182.30 | 0.85 |
| 11/29/05 12:00 AM | 11794.21 | 175.08 | 0.81 |
| 11/29/05 6:00 AM | 11794.28 | 175.14 | 0.81 |
| 11/29/05 12:00 PM | 11794.36 | 174.17 | 0.81 |
| 11/29/05 6:00 PM | 11794.44 | 177.56 | 0.83 |
| 11/30/05 12:00 AM | 11794.51 | 176.12 | 0.82 |
| 11/30/05 6:00 AM | 11794.59 | 173.09 | 0.81 |

| Date / Time | Stage Data (m of H2O) | Sediment pressure ($g/cm^2$) | Sediment Height (m) |
|---|---|---|---|
| 11/30/05 12:00 PM | 11794.66 | 167.99 | 0.78 |
| 11/30/05 6:00 PM | 11794.74 | 175.08 | 0.81 |
| 12/1/05 12:00 AM | 11794.82 | 169.03 | 0.79 |
| 12/1/05 6:00 AM | 11794.89 | 171.23 | 0.80 |
| 12/1/05 12:00 PM | 11794.97 | 169.04 | 0.79 |
| 12/1/05 6:00 PM | 11795.05 | 169.21 | 0.79 |
| 12/2/05 12:00 AM | 11795.12 | 169.59 | 0.79 |
| 12/2/05 6:00 AM | 11795.20 | 168.54 | 0.78 |
| 12/2/05 12:00 PM | 11795.27 | 171.19 | 0.80 |
| 12/2/05 6:00 PM | 11795.35 | 169.83 | 0.79 |
| 12/3/05 12:00 AM | 11795.43 | 169.51 | 0.79 |
| 12/3/05 6:00 AM | 11795.50 | 168.17 | 0.78 |
| 12/3/05 12:00 PM | 11795.58 | 167.32 | 0.78 |
| 12/3/05 6:00 PM | 11795.66 | 166.87 | 0.78 |
| 12/4/05 12:00 AM | 11795.73 | 166.94 | 0.78 |
| 12/4/05 6:00 AM | 11795.81 | 168.38 | 0.78 |
| 12/4/05 12:00 PM | 11795.88 | 167.28 | 0.78 |
| 12/4/05 6:00 PM | 11795.96 | 167.18 | 0.78 |
| 12/5/05 12:00 AM | 11796.04 | 166.06 | 0.77 |
| 12/5/05 6:00 AM | 11796.11 | 166.46 | 0.77 |
| 12/5/05 12:00 PM | 11796.19 | 165.74 | 0.77 |
| 12/5/05 6:00 PM | 11796.27 | | |
| 12/6/05 12:00 AM | 11796.34 | | |
| 12/6/05 6:00 AM | 11796.42 | | |
| 12/6/05 12:00 PM | 11796.49 | | |
| 12/6/05 6:00 PM | 11796.57 | 158.99 | 0.74 |
| 12/7/05 12:00 AM | 11796.65 | 159.40 | 0.74 |
| 12/7/05 6:00 AM | 11796.72 | 159.61 | 0.74 |
| 12/7/05 12:00 PM | 11796.80 | 159.33 | 0.74 |
| 12/7/05 6:00 PM | 11796.88 | 158.40 | 0.74 |
| 12/8/05 12:00 AM | 11796.95 | 157.99 | 0.74 |
| 12/8/05 6:00 AM | 11797.03 | 156.65 | 0.73 |
| 12/8/05 12:00 PM | 11797.10 | 157.55 | 0.73 |
| 12/8/05 6:00 PM | 11797.18 | 161.59 | 0.75 |
| 12/9/05 12:00 AM | 11797.26 | 163.42 | 0.76 |
| 12/9/05 6:00 AM | 11797.33 | 163.24 | 0.76 |
| 12/9/05 12:00 PM | 11797.41 | 163.97 | 0.76 |

| Date / Time | Stage Data (m of H2O) | Sediment pressure ($g/cm^2$) | Sediment Height (m) |
|---|---|---|---|
| 12/9/05 6:00 PM | 11797.48 | 166.51 | 0.77 |
| 12/10/05 12:00 AM | 11797.56 | 166.09 | 0.77 |
| 12/10/05 6:00 AM | 11797.64 | 164.85 | 0.77 |
| 12/10/05 12:00 PM | 11797.71 | 165.64 | 0.77 |
| 12/10/05 6:00 PM | 11797.79 | 166.13 | 0.77 |
| 12/11/05 12:00 AM | 11797.87 | 169.28 | 0.79 |
| 12/11/05 6:00 AM | 11797.94 | 165.40 | 0.77 |
| 12/11/05 12:00 PM | 11798.02 | 165.91 | 0.77 |
| 12/11/05 6:00 PM | 11798.09 | 165.31 | 0.77 |
| 12/12/05 12:00 AM | 11798.17 | 163.18 | 0.76 |
| 12/12/05 6:00 AM | 11798.25 | 163.89 | 0.76 |
| 12/12/05 12:00 PM | 11798.32 | 163.09 | 0.76 |
| 12/12/05 6:00 PM | 11798.40 | 164.22 | 0.76 |
| 12/13/05 12:00 AM | 11798.48 | 163.62 | 0.76 |
| 12/13/05 6:00 AM | 11798.55 | 166.48 | 0.77 |
| 12/13/05 12:00 PM | 11798.63 | 169.14 | 0.79 |
| 12/13/05 6:00 PM | 11798.70 | 170.87 | 0.79 |
| 12/14/05 12:00 AM | 11798.78 | 172.19 | 0.80 |
| 12/14/05 6:00 AM | 11798.86 | 171.78 | 0.80 |
| 12/14/05 12:00 PM | 11798.93 | 172.79 | 0.80 |
| 12/14/05 6:00 PM | 11799.01 | 173.69 | 0.81 |
| 12/15/05 12:00 AM | 11799.09 | 171.75 | 0.80 |
| 12/15/05 6:00 AM | 11799.16 | 171.33 | 0.80 |
| 12/15/05 12:00 PM | 11799.24 | 165.20 | 0.77 |
| 12/15/05 6:00 PM | 11799.31 | 164.29 | 0.76 |
| 12/16/05 12:00 AM | 11799.39 | 160.44 | 0.75 |
| 12/16/05 6:00 AM | 11799.47 | 161.16 | 0.75 |
| 12/16/05 12:00 PM | 11799.54 | 162.30 | 0.76 |
| 12/16/05 6:00 PM | 11799.62 | 161.90 | 0.75 |
| 12/17/05 12:00 AM | 11799.70 | 162.01 | 0.75 |
| 12/17/05 6:00 AM | 11799.77 | 161.11 | 0.75 |
| 12/17/05 12:00 PM | 11799.85 | 160.51 | 0.75 |
| 12/17/05 6:00 PM | 11799.92 | 164.18 | 0.76 |
| 12/18/05 12:00 AM | 11800.00 | 165.20 | 0.77 |
| 12/18/05 6:00 AM | 11800.08 | 166.83 | 0.78 |
| 12/18/05 12:00 PM | 11800.15 | 168.77 | 0.79 |
| 12/18/05 6:00 PM | 11800.23 | 170.39 | 0.79 |

| Date / Time | Stage Data (m of H2O) | Sediment pressure (g/cm$^2$) | Sediment Height (m) |
|---|---|---|---|
| 12/19/05 12:00 AM | 11800.30 | 172.74 | 0.80 |
| 12/19/05 6:00 AM | 11800.38 | 170.80 | 0.79 |
| 12/19/05 12:00 PM | 11800.46 | 141.88 | 0.66 |
| 12/19/05 6:00 PM | 11800.53 | 140.32 | 0.65 |
| 12/20/05 12:00 AM | 11800.61 | 133.27 | 0.62 |
| 12/20/05 6:00 AM | 11800.69 | 76.04 | 0.35 |
| 12/20/05 12:00 PM | 11800.76 | 100.35 | 0.47 |
| 12/20/05 6:00 PM | 11800.84 | 105.23 | 0.49 |
| 12/21/05 12:00 AM | 11800.91 | 113.31 | 0.53 |
| 12/21/05 6:00 AM | 11800.99 | 132.01 | 0.61 |
| 12/21/05 12:00 PM | 11801.07 | 168.40 | 0.78 |
| 12/21/05 6:00 PM | 11801.14 | 158.08 | 0.74 |
| 12/22/05 12:00 AM | 11801.22 | 164.11 | 0.76 |
| 12/22/05 6:00 AM | 11801.30 | 190.47 | 0.89 |
| 12/22/05 12:00 PM | 11801.37 | 199.37 | 0.93 |
| 12/22/05 6:00 PM | 11801.45 | 186.27 | 0.87 |
| 12/23/05 12:00 AM | 11801.52 | 152.43 | 0.71 |
| 12/23/05 6:00 AM | 11801.60 | 131.89 | 0.61 |
| 12/23/05 12:00 PM | 11801.68 | 173.98 | 0.81 |
| 12/23/05 6:00 PM | 11801.75 | 179.58 | 0.84 |
| 12/24/05 12:00 AM | 11801.83 | 175.50 | 0.82 |
| 12/24/05 6:00 AM | 11801.91 | 172.96 | 0.80 |
| 12/24/05 12:00 PM | 11801.98 | 167.84 | 0.78 |
| 12/24/05 6:00 PM | 11802.06 | 174.37 | 0.81 |
| 12/25/05 12:00 AM | 11802.13 | 171.00 | 0.80 |
| 12/25/05 6:00 AM | 11802.21 | 162.42 | 0.76 |
| 12/25/05 12:00 PM | 11802.29 | 164.22 | 0.76 |
| 12/25/05 6:00 PM | 11802.36 | 161.55 | 0.75 |
| 12/26/05 12:00 AM | 11802.44 | 159.90 | 0.74 |
| 12/26/05 6:00 AM | 11802.52 | 164.46 | 0.77 |
| 12/26/05 12:00 PM | 11802.59 | 162.76 | 0.76 |
| 12/26/05 6:00 PM | 11802.67 | 167.07 | 0.78 |
| 12/27/05 12:00 AM | 11802.74 | 161.92 | 0.75 |
| 12/27/05 6:00 AM | 11802.82 | 158.04 | 0.74 |
| 12/27/05 6:00 PM | 11802.97 | 158.50 | 0.74 |
| 12/28/05 12:00 AM | 11803.05 | 157.78 | 0.73 |
| 12/28/05 6:00 AM | 11803.13 | 158.58 | 0.74 |

| Date / Time | Stage Data (m of H2O) | Sediment pressure ($g/cm^2$) | Sediment Height (m) |
|---|---|---|---|
| 12/28/05 12:00 PM | 11803.20 | 159.70 | 0.74 |
| 12/28/05 6:00 PM | 11803.28 | 161.45 | 0.75 |
| 12/29/05 12:00 AM | 11803.35 | 159.67 | 0.74 |
| 12/29/05 6:00 AM | 11803.43 | 160.22 | 0.75 |
| 12/29/05 12:00 PM | 11803.51 | 156.39 | 0.73 |
| 12/29/05 6:00 PM | 11803.58 | 155.73 | 0.72 |
| 12/30/05 12:00 AM | 11803.66 | 155.76 | 0.72 |
| 12/30/05 6:00 AM | 11803.73 | 155.65 | 0.72 |
| 12/30/05 12:00 PM | 11803.81 | 155.93 | 0.73 |
| 12/30/05 6:00 PM | 11803.89 | 155.18 | 0.72 |
| 12/31/05 12:00 AM | 11803.96 | 157.80 | 0.73 |
| 12/31/05 6:00 AM | 11804.04 | 157.77 | 0.73 |
| 12/31/05 12:00 PM | 11804.12 | 157.15 | 0.73 |
| 12/31/05 6:00 PM | 11804.19 | 159.07 | 0.74 |
| 1/1/06 12:00 AM | 11804.27 | 159.36 | 0.74 |
| 1/1/06 6:00 AM | 11804.34 | 159.86 | 0.74 |
| 1/1/06 12:00 PM | 11804.42 | 159.54 | 0.74 |
| 1/1/06 6:00 PM | 11804.50 | 158.69 | 0.74 |
| 1/2/06 12:00 AM | 11804.57 | 158.26 | 0.74 |
| 1/2/06 6:00 AM | 11804.65 | 160.57 | 0.75 |
| 1/2/06 12:00 PM | 11804.73 | 159.12 | 0.74 |
| 1/2/06 6:00 PM | 11804.80 | 161.14 | 0.75 |
| 1/3/06 12:00 AM | 11804.88 | 161.18 | 0.75 |
| 1/3/06 6:00 AM | 11804.95 | 160.70 | 0.75 |
| 1/3/06 12:00 PM | 11805.03 | 162.59 | 0.76 |
| 1/3/06 6:00 PM | 11805.11 | 159.69 | 0.74 |
| 1/4/06 12:00 AM | 11805.18 | 159.27 | 0.74 |
| 1/4/06 6:00 AM | 11805.26 | 159.04 | 0.74 |
| 1/4/06 12:00 PM | 11805.34 | 161.64 | 0.75 |
| 1/4/06 6:00 PM | 11805.41 | 160.20 | 0.75 |
| 1/5/06 12:00 AM | 11805.49 | 159.48 | 0.74 |
| 1/5/06 6:00 AM | 11805.56 | 162.42 | 0.76 |
| 1/5/06 12:00 PM | 11805.64 | 161.09 | 0.75 |
| 1/5/06 6:00 PM | 11805.72 | 161.89 | 0.75 |
| 1/6/06 12:00 AM | 11805.79 | 161.47 | 0.75 |
| 1/6/06 6:00 AM | 11805.87 | 161.97 | 0.75 |
| 1/6/06 12:00 PM | 11805.95 | 160.75 | 0.75 |

| Date / Time | Stage Data (m of H2O) | Sediment pressure (g/cm$^2$) | Sediment Height (m) |
|---|---|---|---|
| 1/6/06 6:00 PM | 11806.02 | 160.52 | 0.75 |
| 1/7/06 12:00 AM | 11806.10 | 159.99 | 0.74 |
| 1/7/06 6:00 AM | 11806.17 | 158.44 | 0.74 |
| 1/7/06 12:00 PM | 11806.25 | 158.22 | 0.74 |
| 1/7/06 6:00 PM | 11806.33 | 159.63 | 0.74 |
| 1/8/06 12:00 AM | 11806.40 | 159.64 | 0.74 |
| 1/8/06 6:00 AM | 11806.48 | 159.22 | 0.74 |
| 1/8/06 12:00 PM | 11806.55 | 158.79 | 0.74 |
| 1/8/06 6:00 PM | 11806.63 | 160.19 | 0.75 |
| 1/9/06 12:00 AM | 11806.71 | 160.51 | 0.75 |
| 1/9/06 6:00 AM | 11806.78 | 160.53 | 0.75 |
| 1/9/06 12:00 PM | 11806.86 | 160.25 | 0.75 |
| 1/9/06 6:00 PM | 11806.94 | 159.65 | 0.74 |
| 1/10/06 12:00 AM | 11807.01 | 160.37 | 0.75 |
| 1/10/06 6:00 AM | | | |
| 1/10/06 12:00 PM | | | |
| 1/27/06 12:00 AM | | | |
| 1/27/06 6:00 AM | | | |
| 1/27/06 12:00 PM | 11812.35 | 158.04 | 0.74 |
| 1/27/06 6:00 PM | 11812.42 | 159.14 | 0.74 |
| 1/28/06 12:00 AM | 11812.50 | 159.03 | 0.74 |
| 1/28/06 6:00 AM | 11812.58 | 158.82 | 0.74 |
| 1/28/06 12:00 PM | 11812.65 | 159.93 | 0.74 |
| 1/28/06 6:00 PM | 11812.73 | 159.69 | 0.74 |
| 1/29/06 12:00 AM | 11812.80 | 160.39 | 0.75 |
| 1/29/06 6:00 AM | 11812.88 | 162.18 | 0.75 |
| 1/29/06 12:00 PM | 11812.96 | 161.37 | 0.75 |
| 1/29/06 6:00 PM | 11813.03 | 160.37 | 0.75 |
| 1/30/06 12:00 AM | 11813.11 | 160.60 | 0.75 |
| 1/30/06 6:00 AM | 11813.19 | 160.74 | 0.75 |
| 1/30/06 12:00 PM | 11813.26 | 161.34 | 0.75 |
| 1/30/06 6:00 PM | 11813.34 | 161.05 | 0.75 |
| 1/31/06 12:00 AM | 11813.41 | 160.95 | 0.75 |
| 1/31/06 6:00 AM | 11813.49 | 160.55 | 0.75 |
| 1/31/06 12:00 PM | 11813.57 | 160.25 | 0.75 |
| 1/31/06 6:00 PM | 11813.64 | 160.55 | 0.75 |
| 2/1/06 12:00 AM | 11813.72 | 159.83 | 0.74 |

| Date / Time | Stage Data (m of H2O) | Sediment pressure ($g/cm^2$) | Sediment Height (m) |
|---|---|---|---|
| 2/1/06 6:00 AM | 11813.80 | 160.23 | 0.75 |
| 2/1/06 12:00 PM | 11813.87 | 160.11 | 0.74 |
| 2/1/06 6:00 PM | 11813.95 | 159.17 | 0.74 |
| 2/2/06 12:00 AM | 11814.02 | 158.76 | 0.74 |
| 2/2/06 6:00 AM | 11814.10 | 159.16 | 0.74 |
| 2/2/06 12:00 PM | 11814.18 | 159.36 | 0.74 |
| 2/2/06 6:00 PM | 11814.25 | 159.95 | 0.74 |
| 2/3/06 12:00 AM | 11814.33 | 159.64 | 0.74 |
| 2/3/06 6:00 AM | 11814.41 | 157.55 | 0.73 |
| 2/3/06 12:00 PM | 11814.48 | 156.84 | 0.73 |
| 2/3/06 6:00 PM | 11814.56 | 158.26 | 0.74 |
| 2/4/06 12:00 AM | 11814.63 | 157.31 | 0.73 |
| 2/4/06 6:00 AM | 11814.71 | 159.18 | 0.74 |
| 2/4/06 12:00 PM | 11814.79 | 157.14 | 0.73 |
| 2/4/06 6:00 PM | 11814.86 | 156.38 | 0.73 |
| 2/5/06 12:00 AM | 11814.94 | 152.79 | 0.71 |
| 2/5/06 6:00 AM | 11815.02 | 158.00 | 0.74 |
| 2/5/06 12:00 PM | 11815.09 | 155.85 | 0.73 |
| 2/5/06 6:00 PM | 11815.17 | 154.73 | 0.72 |
| 2/6/06 12:00 AM | 11815.24 | 155.32 | 0.72 |
| 2/6/06 6:00 AM | 11815.32 | 154.38 | 0.72 |
| 2/6/06 12:00 PM | 11815.40 | 154.66 | 0.72 |
| 2/6/06 6:00 PM | 11815.47 | 156.77 | 0.73 |
| 2/7/06 12:00 AM | 11815.55 | 157.35 | 0.73 |
| 2/7/06 6:00 AM | 11815.63 | 156.82 | 0.73 |
| 2/7/06 12:00 PM | 11815.70 | 157.60 | 0.73 |
| 2/7/06 6:00 PM | 11815.78 | 156.04 | 0.73 |
| 2/8/06 12:00 AM | 11815.85 | 156.74 | 0.73 |
| 2/8/06 6:00 AM | 11815.93 | 157.23 | 0.73 |
| 2/8/06 12:00 PM | 11816.01 | 157.01 | 0.73 |
| 2/8/06 6:00 PM | 11816.08 | 158.01 | 0.74 |
| 2/9/06 12:00 AM | 11816.16 | 157.09 | 0.73 |
| 2/9/06 6:00 AM | 11816.23 | 156.17 | 0.73 |
| 2/9/06 12:00 PM | 11816.31 | 155.87 | 0.73 |
| 2/9/06 6:00 PM | 11816.39 | 157.06 | 0.73 |
| 2/10/06 12:00 AM | 11816.46 | 156.23 | 0.73 |
| 2/10/06 6:00 AM | 11816.54 | 156.01 | 0.73 |

| Date / Time | Stage Data (m of H2O) | Sediment pressure (g/cm$^2$) | Sediment Height (m) |
|---|---|---|---|
| 2/10/06 12:00 PM | 11816.62 | 156.81 | 0.73 |
| 2/10/06 6:00 PM | 11816.69 | 157.21 | 0.73 |
| 2/11/06 12:00 AM | 11816.77 | 156.91 | 0.73 |
| 2/11/06 6:00 AM | 11816.84 | 156.48 | 0.73 |
| 2/11/06 12:00 PM | 11816.92 | 157.49 | 0.73 |
| 2/11/06 6:00 PM | 11817.00 | 157.68 | 0.73 |
| 2/12/06 12:00 AM | 11817.07 | 157.58 | 0.73 |
| 2/12/06 6:00 AM | 11817.15 | 156.86 | 0.73 |
| 2/12/06 12:00 PM | 11817.23 | 157.17 | 0.73 |
| 2/12/06 6:00 PM | 11817.30 | 157.58 | 0.73 |
| 2/13/06 12:00 AM | 11817.38 | 157.89 | 0.73 |
| 2/13/06 6:00 AM | 11817.45 | 156.26 | 0.73 |
| 2/13/06 12:00 PM | 11817.53 | 157.47 | 0.73 |
| 2/13/06 6:00 PM | 11817.61 | 158.37 | 0.74 |
| 2/14/06 12:00 AM | 11817.68 | 157.05 | 0.73 |
| 2/14/06 6:00 AM | 11817.76 | 156.43 | 0.73 |
| 2/14/06 12:00 PM | 11817.84 | 157.86 | 0.73 |
| 2/14/06 6:00 PM | 11817.91 | 159.89 | 0.74 |
| 2/15/06 12:00 AM | 11817.99 | 158.68 | 0.74 |
| 2/15/06 6:00 AM | 11818.06 | 159.09 | 0.74 |
| 2/15/06 12:00 PM | 11818.14 | 160.01 | 0.74 |
| 2/15/06 6:00 PM | 11818.22 | 161.12 | 0.75 |
| 2/16/06 12:00 AM | 11818.29 | 161.22 | 0.75 |
| 2/16/06 6:00 AM | 11818.37 | 160.51 | 0.75 |
| 2/16/06 12:00 PM | 11818.45 | 161.64 | 0.75 |
| 2/16/06 6:00 PM | 11818.52 | 162.03 | 0.75 |
| 2/17/06 12:00 AM | 11818.60 | 161.22 | 0.75 |
| 2/17/06 6:00 AM | 11818.67 | 160.60 | 0.75 |
| 2/17/06 12:00 PM | 11818.75 | 159.89 | 0.74 |
| 2/17/06 6:00 PM | 11818.83 | 160.84 | 0.75 |
| 2/18/06 12:00 AM | 11818.90 | 160.14 | 0.75 |
| 2/18/06 6:00 AM | 11818.98 | 159.28 | 0.74 |
| 2/18/06 12:00 PM | 11819.05 | 158.26 | 0.74 |
| 2/18/06 6:00 PM | 11819.13 | 158.14 | 0.74 |
| 2/19/06 12:00 AM | 11819.21 | 157.92 | 0.73 |
| 2/19/06 6:00 AM | 11819.28 | 156.36 | 0.73 |
| 2/19/06 12:00 PM | 11819.36 | 157.14 | 0.73 |

| Date / Time | Stage Data (m of H2O) | Sediment pressure ($g/cm^2$) | Sediment Height (m) |
|---|---|---|---|
| 2/19/06 6:00 PM | 11819.44 | 156.81 | 0.73 |
| 2/20/06 12:00 AM | 11819.51 | 156.37 | 0.73 |
| 2/20/06 6:00 AM | 11819.59 | 155.84 | 0.73 |
| 2/20/06 12:00 PM | 11819.66 | 155.02 | 0.72 |
| 2/20/06 6:00 PM | 11819.74 | 155.80 | 0.72 |
| 2/21/06 12:00 AM | 11819.82 | 154.97 | 0.72 |
| 2/21/06 6:00 AM | 11819.89 | 155.06 | 0.72 |
| 2/21/06 12:00 PM | 11819.97 | 155.37 | 0.72 |
| 2/21/06 6:00 PM | 11820.05 | 156.87 | 0.73 |
| 2/22/06 12:00 AM | 11820.12 | 156.25 | 0.73 |
| 2/22/06 6:00 AM | 11820.20 | 156.54 | 0.73 |
| 2/22/06 12:00 PM | 11820.27 | 157.76 | 0.73 |
| 2/22/06 6:00 PM | 11820.35 | 159.07 | 0.74 |
| 2/23/06 12:00 AM | 11820.43 | 157.85 | 0.73 |
| 2/23/06 6:00 AM | 11820.50 | 156.74 | 0.73 |
| 2/23/06 12:00 PM | 11820.58 | 158.27 | 0.74 |
| 2/23/06 6:00 PM | 11820.66 | 160.09 | 0.74 |
| 2/24/06 12:00 AM | 11820.73 | 158.28 | 0.74 |
| 2/24/06 6:00 AM | 11820.81 | 157.38 | 0.73 |
| 2/24/06 12:00 PM | 11820.88 | 159.01 | 0.74 |
| 2/24/06 6:00 PM | 11820.96 | 160.72 | 0.75 |
| 2/25/06 12:00 AM | 11821.04 | 160.19 | 0.75 |
| 2/25/06 6:00 AM | 11821.11 | 159.87 | 0.74 |
| 2/25/06 12:00 PM | 11821.19 | 161.41 | 0.75 |
| 2/25/06 6:00 PM | 11821.27 | 159.29 | 0.74 |
| 2/26/06 12:00 AM | 11821.34 | 156.75 | 0.73 |
| 2/26/06 6:00 AM | 11821.42 | 155.43 | 0.72 |
| 2/26/06 12:00 PM | 11821.49 | 158.89 | 0.74 |
| 2/26/06 6:00 PM | 11821.57 | 159.08 | 0.74 |
| 2/27/06 12:00 AM | 11821.65 | 155.60 | 0.72 |
| 2/27/06 6:00 AM | 11821.72 | 155.08 | 0.72 |
| 2/27/06 12:00 PM | 11821.80 | 158.22 | 0.74 |
| 2/27/06 6:00 PM | 11821.88 | 162.07 | 0.75 |
| 2/28/06 12:00 AM | 11821.95 | 158.41 | 0.74 |
| 2/28/06 6:00 AM | 11822.03 | 156.17 | 0.73 |
| 2/28/06 12:00 PM | 11822.10 | 160.76 | 0.75 |
| 2/28/06 6:00 PM | 11822.18 | 164.11 | 0.76 |

| Date / Time | Stage Data (m of H2O) | Sediment pressure (g/cm$^2$) | Sediment Height (m) |
|---|---|---|---|
| 3/1/06 12:00 AM | 11822.26 | 161.25 | 0.75 |
| 3/1/06 6:00 AM | 11822.33 | 156.97 | 0.73 |
| 3/1/06 12:00 PM | 11822.41 | 159.11 | 0.74 |
| 3/1/06 6:00 PM | 11822.48 | 161.34 | 0.75 |
| 3/2/06 12:00 AM | 11822.56 | 158.47 | 0.74 |
| 3/2/06 6:00 AM | 11822.64 | 158.86 | 0.74 |
| 3/2/06 12:00 PM | 11822.71 | 161.33 | 0.75 |
| 3/2/06 6:00 PM | 11822.79 | 158.20 | 0.74 |
| 3/3/06 12:00 AM | 11822.87 | 154.35 | 0.72 |
| 3/3/06 6:00 AM | 11822.94 | 152.62 | 0.71 |
| 3/3/06 12:00 PM | 11823.02 | 155.18 | 0.72 |
| 3/3/06 6:00 PM | 11823.09 | 156.72 | 0.73 |
| 3/4/06 12:00 AM | 11823.17 | 151.42 | 0.70 |
| 3/4/06 6:00 AM | 11823.25 | 154.89 | 0.72 |
| 3/4/06 12:00 PM | 11823.32 | 153.77 | 0.72 |
| 3/4/06 6:00 PM | 11823.40 | 158.66 | 0.74 |
| 3/5/06 12:00 AM | 11823.48 | 153.26 | 0.71 |
| 3/5/06 6:00 AM | 11823.55 | 156.21 | 0.73 |
| 3/5/06 12:00 PM | 11823.63 | 157.95 | 0.73 |
| 3/5/06 6:00 PM | 11823.70 | | |
| 3/6/06 12:00 AM | 11823.78 | | |
| 3/6/06 6:00 AM | 11823.86 | | |
| 3/6/06 12:00 PM | 11823.93 | | |
| 3/6/06 6:00 PM | 11824.01 | | |
| 3/7/06 12:00 AM | 11824.09 | | |
| 3/7/06 6:00 AM | 11824.16 | | |
| 3/7/06 12:00 PM | 11824.24 | | |
| 3/7/06 6:00 PM | 11824.31 | | |
| 3/8/06 12:00 AM | 11824.39 | | |
| 3/8/06 6:00 AM | 11824.47 | | |
| 3/8/06 12:00 PM | 11824.54 | | |
| 3/8/06 6:00 PM | 11824.62 | 159.58 | 0.74 |
| 3/9/06 12:00 AM | 11824.70 | 162.07 | 0.75 |
| 3/9/06 6:00 AM | 11824.77 | 162.37 | 0.76 |
| 3/9/06 12:00 PM | 11824.85 | 161.95 | 0.75 |
| 3/9/06 6:00 PM | 11824.92 | 163.39 | 0.76 |
| 3/10/06 12:00 AM | 11825.00 | 160.41 | 0.75 |

| Date / Time | Stage Data (m of H2O) | Sediment pressure (g/cm$^2$) | Sediment Height (m) |
|---|---|---|---|
| 3/10/06 6:00 AM | 11825.08 | 162.01 | 0.75 |
| 3/10/06 12:00 PM | 11825.15 | 163.17 | 0.76 |
| 3/10/06 6:00 PM | 11825.23 | 163.86 | 0.76 |
| 3/11/06 12:00 AM | 11825.30 | 163.83 | 0.76 |
| 3/11/06 6:00 AM | 11825.38 | 162.82 | 0.76 |
| 3/11/06 12:00 PM | 11825.46 | 160.79 | 0.75 |
| 3/11/06 6:00 PM | 11825.53 | 161.37 | 0.75 |
| 3/12/06 12:00 AM | 11825.61 | 163.33 | 0.76 |
| 3/12/06 6:00 AM | 11825.69 | 163.51 | 0.76 |
| 3/12/06 12:00 PM | 11825.76 | 145.15 | 0.68 |
| 3/12/06 6:00 PM | 11825.84 | 172.70 | 0.80 |
| 3/13/06 12:00 AM | 11825.91 | 173.14 | 0.81 |
| 3/13/06 6:00 AM | 11825.99 | 184.19 | 0.86 |
| 3/13/06 12:00 PM | 11826.07 | 184.40 | 0.86 |
| 3/13/06 6:00 PM | 11826.14 | 174.88 | 0.81 |
| 3/14/06 12:00 AM | 11826.22 | 175.72 | 0.82 |
| 3/14/06 6:00 AM | 11826.30 | 175.23 | 0.82 |
| 3/14/06 12:00 PM | 11826.37 | 172.60 | 0.80 |
| 3/14/06 6:00 PM | 11826.45 | 171.27 | 0.80 |
| 3/15/06 12:00 AM | 11826.52 | 170.19 | 0.79 |
| 3/15/06 6:00 AM | 11826.60 | 168.80 | 0.79 |
| 3/15/06 12:00 PM | 11826.68 | 169.28 | 0.79 |
| 3/15/06 6:00 PM | 11826.75 | 169.63 | 0.79 |
| 3/16/06 12:00 AM | 11826.83 | 169.60 | 0.79 |
| 3/16/06 6:00 AM | 11826.91 | 167.94 | 0.78 |
| 3/16/06 12:00 PM | 11826.98 | 168.61 | 0.78 |
| 3/16/06 6:00 PM | 11827.06 | 168.76 | 0.79 |
| 3/17/06 12:00 AM | 11827.13 | 169.75 | 0.79 |
| 3/17/06 6:00 AM | 11827.21 | 168.61 | 0.78 |