# Turbidity Monitoring

# in

# Little Campbell Creek,

# Summer 2005


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**In cooperation with:**

**Anchorage Waterways Council**
**Alaska Department of Environmental Conservation**

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## Introduction

Little Campbell Creek is the largest tributary to Campbell Creek in Anchorage, Alaska (Figure 1). Little Campbell Creek supports large numbers of rearing and wintering juvenile Chinook and coho salmon (*Onchorynchus tshawytscha* and *O. kisutch*) and resident populations of rainbow trout (*Salmo gairdneri*), Dolly Varden (*Salvelinus malma*), slimy sculpin (*Cottus cognatus*), threespine stickleback (*Gasterosteus aculeatus*) and Ninespine stickleback (*Pungitius pungitius*). Limited numbers of adult salmon, primarily coho, spawn in lower Little Campbell Creek, but other important spawning areas for rainbow trout and Dolly Varden have not been documented. Adult escapement to Little Campbell Creek does not appear to account for the large number of juveniles wintering and rearing in Little Campbell Creek and, consequently, many juvenile salmon rearing in Little Campbell Creek are believed to be from spawning areas in Campbell Creek. As such, the juvenile salmon in Little Campbell Creek could represent a large proportion of the wild salmon reproduction for the entire Campbell Creek watershed.

Little Campbell Creek has been listed as impaired since 1990 for non-attainment of Alaska's fecal coliform bacteria standard (ADEC 2003). Schroeder (2005) documented elevated turbidity conditions in Little Campbell Creek. Suspended sediment, as indicated by turbidity, can impact fish and other aquatic resources (Bash et al. 2001). Elevated turbidity was associated with precipitation events. Fish kills involving juvenile Chinook and coho salmon, rainbow trout, Dolly Varden, slimy sculpin, threespine stickleback and ninespine stickleback were documented in late 2004 and early 2005 in separate forks of Little Campbell Creek (Schroeder 2005). The cause of these fish kills was not confirmed, but fish kills were coincident with elevated turbidity following precipitation events >0.10 inch (in) in certain reaches of Little Campbell Creek (ibid). These fish kills occurred in both forks of Little Campbell Creek. As many as 25 separate fish kills were documented to occur within the same reaches between 2 August and 26 September 2005 (Schroeder, in prep.).

## Study Area

Turbidity samples were collected from Little Campbell Creek downstream of Abbott Road and Abbott Loop Road (Figure 1). The Little Campbell Creek watershed is about 8,500 acres in size. Little Campbell Creek contains large portions of park areas with the Far North Bicentennial Park in the middle portion of the watershed and the upper watershed in Chugach State Park. The middle and upper reaches, east of Abbott Loop Road and south of Abbott Road, are relatively undisturbed land -- the result of a large drainage area within Bicentennial Park, the Bureau of Land Management Campbell Tract, and Ruth Arcand Park. The dominant landuse in the Little Campbell Creek watershed is residential. Overall, about 40% of the watershed is undeveloped.

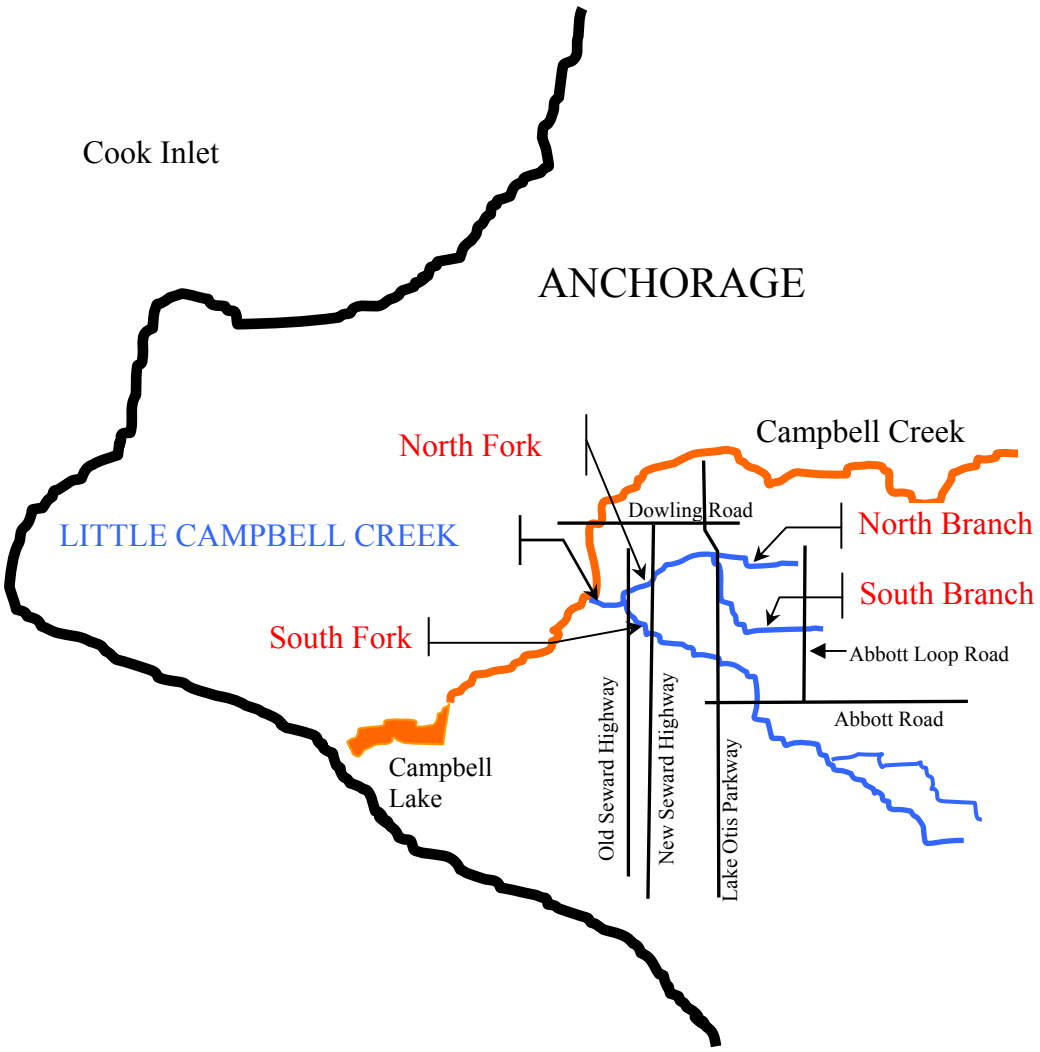


Figure 1: Campbell Creek (orange) and Little Campbell Creek (blue) in Anchorage, Alaska.

**Methods**

Four different people participated in collecting turbidity values from Little Campbell Creek. Two are currently employed for a state or federal agency. Two different people were employees of a non-profit organization, the Anchorage Waterways Council (AWC). The AWC monitors had completed a 12-hour Alaska Department of Environmental Conservation – approved training program to become Certified Water Quality Monitors under the Citizen's Monitoring Program prior to collecting turbidity values in Little Campbell Creek.

Starting on 20 April 2005, turbidity was measured at 15 different locations along Little Campbell Creek downstream of Abbott Road and Abbott Loop Road every Wednesday afternoon between

1200 and 1700 hrs (Figure 2). Regular sampling continued until 14 September 2005. For comparison purposes, a sample was routinely taken from within 1.0 m (3 ft) of the south bank of Campbell Creek about 25 m (77 ft) upstream of its confluence with Little Campbell Creek. Additional, opportunistic sampling was completed at these sites to document spatial or temporal changes in turbidity within the watershed. Sampling continued until 26 September 2005.

Turbidity measurements were made with a SM 2130 B Hach 2100P Turbidimeter or LaMotte Portable Turbidity Meter Model 2020 (ADEC 2005). Manufacturer's instructions were followed during the collection and processing of samples. Nephelometer batteries were replaced immediately after the instrument indicated low battery power. Units were calibrated using a 10 NTU standard on a weekly basis; the standard solution was replaced every month. A cotton-tipped swab was used to remove any residual sediment particles from the inside of the vial and the vials rinsed three times with distilled water before daily samples were collected. The same vial was used for each nephelometer for the duration of the sampling period.

Samples were collected from the top 0.3 m (12 in) of the water column, typically at the middle of a culvert or thalweg. The sample vial was filled and the contents discarded on the stream bank twice before the final sample was retained. Any sample water above the vial neck was discarded and the vial was sealed. The vial exterior was then dried with a lint-free cloth before being placed in the nephelometer for analysis. No samples required dilution for processing. Turbidity data were transcribed to an Excel spreadsheet database program and error-checked. Averages were calculated using the Excel Average command. Correlation ($R^2$) values were derived from the Excel Trend Line function.

Date, time, location, turbidity, water temperature, water depth (stage), and observations of oil sheen/foam were recorded at sampling points. In some cases, live or dead fish in the vicinity of the sampling point were noted. Water temperature, stage, and observations of oil/foam/fish are not included in this summary.

Precipitation data were obtained from the National Weather Service Forecast Office, Anchorage (http://pafc.arh.noaa.gov/). Precipitation data from 15 April – 26 September 2005 are in Appendix 1.

A Sampling Plan and Quality Assurance Project Plan for Little Campbell Creek Summer 2005 was prepared by the Alaska Department of Environmental Conservation. There were minor deviations from this plan that relate to this summary, including:

Section 2.3: The Sampling Manager was Mark Schroeder, USFWS.

Section 3.2: Flow velocity information was not collected 3 times between 1 July and 30 September. One flow measurement was recorded (two-dimension method due to channel asymmetry) for each sampling location during one flow stage. Flow depth information, collected in inches, has not been summarized. Some temperature data, collected in Fahrenheit, were converted to Celsius. Temperature data have not been summarized.

Section 4.2: Flow measurements were not collected three times for each station. Additional sampling would be required to meet this objective. This section also specifies that samples would be collected in a liter-sized glass container, but sampling containers were typically smaller than a liter, in some cases consisting of the vial that would be loaded directly into the nephelometer.

Section 4.4: The Sampling Manager compiled and error-checked field measurements. The Sampling Manager also prepared this summary of sampling activities. An interpretive data report is not anticipated.

**Results**:

From one to five measurements were made each month at each of 15 sampling sites from 20 April to 14 September 2005. The average turbidity values collected every Wednesday, by month at each sampling site are in Table 1 and are discussed below. Individual and opportunistic values are included in Appendix 2.

Table 1: Average Turbidity values (NTUs) (n) for Campbell Creek (CC, 1 site) and Little Campbell Creek (LCC, 14 sites) 20 April thru 14 September 2005. Turbidity values were obtained every Wednesday afternoon. Turbidity values collected on an opportunistic basis are detailed in Appendix 2.

| | CC | NORTH FORK | | | | | North Branch | South Branch | | | SOUTH FORK | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | | LCC | Nathan Drive | Old Seward Hwy | NF2 At 68th | NF1 Meadow Street | At Lake Otis | 68th at Lake Otis | Snowview Drive | Abbott Loop Road | Old Seward Hwy | Fire Stn 12 | Sandle-wood Drive | 84th Ave. | Abbott Road |
| April | 5.98 (1) | 13.09 (2) | 14.19 (2) | 11.46 (2) | 12.80 (2) | 6.20 (2) | 4.60 (2) | 8.9 (1) | 3.55 (2) | 11.45 (2) | 16.63 (2) | 15.46 (2) | 20.80 (2) | 14.05 (2) | 18.6 (2) |
| May | 4.87 (4) | 5.86 (4) | 6.01 (4) | 6.23 (4) | 6.92 (4) | 3.44 (4) | 4.18 (4) | 3.98 (4) | 2.53 (4) | 3.11 (4) | 6.11 (4) | 5.76 (4) | 4.87 (4) | 4.07 (4) | 4.94 (4) |
| June | 4.82 (5) | 4.43 (5) | 4.48 (5) | 4.83 (5) | 3.44 (5) | 3.78 (5) | 3.84 (5) | 4.21 (5) | 2.81 (5) | 5.90 (5) | 4.55 (5) | 5.16 (5) | 4.13 (5) | 2.74 (5) | 3.33 (5) |
| July | 5.11 (4) | 4.88 (4) | 5.78 (4) | 4.99 (4) | 2.99 (4) | 2.66 (4) | 5.11 (4) | 3.37 (4) | 6.46 (4) | 0.86 (4) | 5.22 (4) | 6.88 (4) | 2.79 (4) | 2.86 (4) | 3.50 (4) |
| August | 7.38 (4) | 20.30 (4) | 26.94 (4) | 29.75 (5) | 20.81 (5) | 29.57 (5) | 7.13 (5) | 17.32 (5) | 2.91 (5) | 1.07 (5) | 8.45 (5) | 5.29 (5) | 14.53 (5) | 4.29 (5) | 3.34 (5) |
| September | 5.84 (1) | 18.95 (1) | 14.02 (2) | 10.71 (2) | 16.86 (2) | 4.90 (2) | 7.64 (2) | 4.17 (2) | 5.64 (2) | 1.31 (2) | 16.34 (2) | 15.48 (2) | 7.70 (2) | 6.41 (2) | 5.31 (2) |

***Campbell Creek***: Turbidity measurements were taken along the bank of Campbell Creek about 75 ft upstream of its confluence with Little Campbell Creek. Average turbidity along the south bank of Campbell Creek remained between 4.82 and 7.78 NTUs for the entire sampling period (Table 1). Turbidity and precipitation for this site, by date, are on page 13.

***Little Campbell Creek***: This site is located immediately upstream of the confluence with Campbell Creek (Figure 2). Average turbidity in Little Campbell Creek at this site was elevated during the break-up period in late April (Table 1, also see page 13). Average turbidity levels were consistently lower during May, June and July, when there was little precipitation. Turbidity increased dramatically during August and early September, when precipitation increased. Turbidity and precipitation for this site, by date, are on page 14.

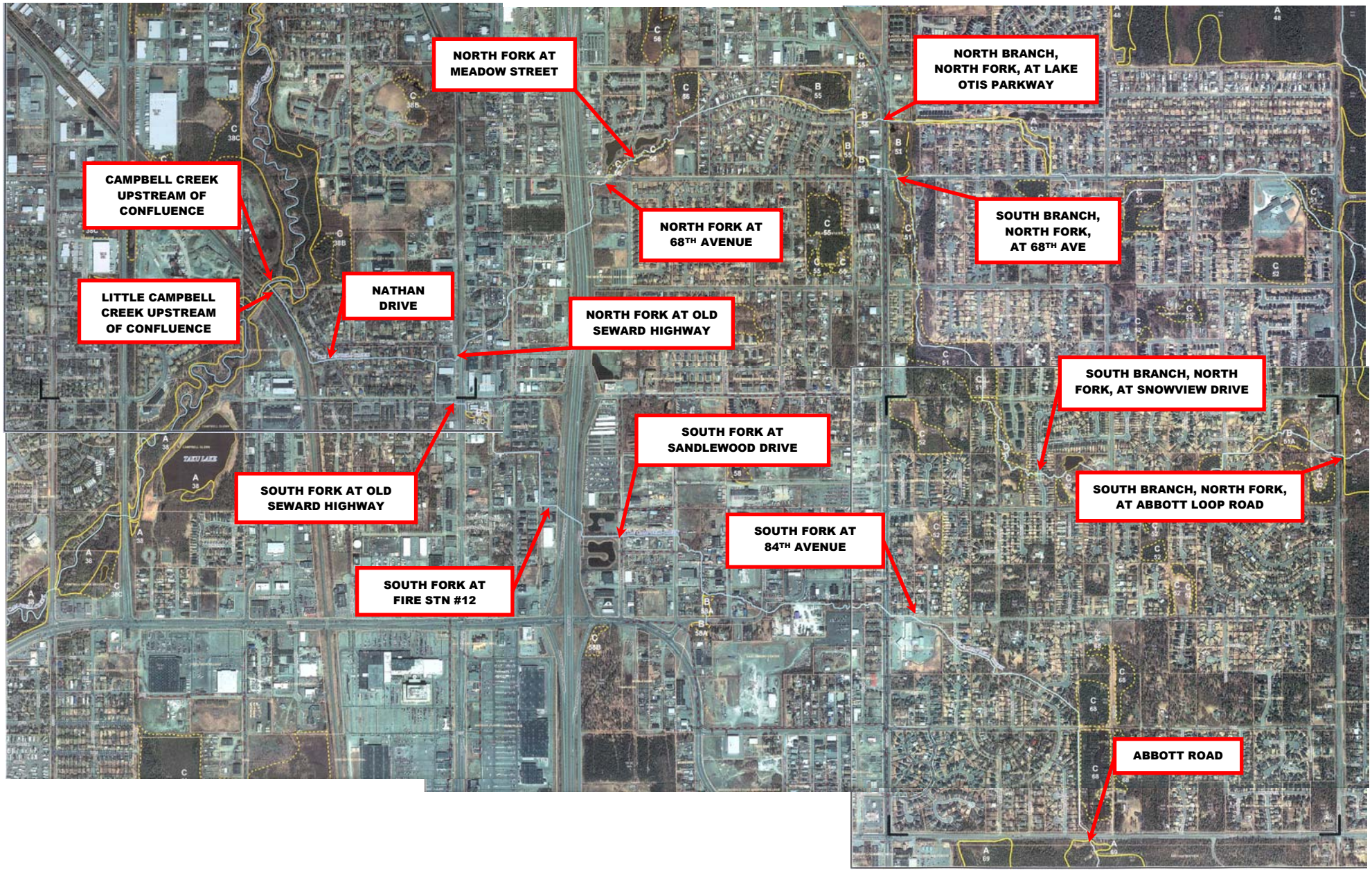


Figure 2: Turbidity sampling sites in Campbell and Little Campbell Creeks, 20 April through 26 September 2005.

***Nathan Drive***: Turbidity in Little Campbell Creek at the Nathan Drive crossing was elevated above baseline conditions during the break-up period in late April. Turbidity levels were consistently lower during May, June and July, when there was little precipitation. Turbidity increased dramatically during August and early September, when precipitation increased. Turbidity and precipitation for this site, by date, are on page 15.

Turbidity can increase and decrease to extremes over a short amount of time. For example, a 0.26in rain event on 3 August appeared to cause turbidity to increase from 6.47 NTUs on 2 August to 21.45 NTUs on 3 August. Turbidity decreased to 6.80 NTUs on 4 August. A 0.18 in rain event on 30 August appeared to cause turbidity to increase from 3.95 NTUs on 29 August to 33.60 NTUs on 31 August (Appendix 2)

Additional, opportunistic sampling indicated that elevated turbidity levels were sustained over several days during a series of precipitation events, particularly 31 July- 3 August, 17-26 August, 3-6 September, 9-12 September, 15-17 September, and 21-24 September.

***North Fork at Old Seward Highway***: The North Fork of Little Campbell Creek diverges from its confluence with the South Fork about 0.5 mi upstream of Campbell Creek.

Average turbidity at the North Fork, Old Seward Highway site was elevated during the break-up period in late April. Turbidity levels were consistently lower during May, June and July, when there was little precipitation. Turbidity increased dramatically during August and early September, when precipitation increased. Similar to the Nathan Drive site, a 0.26 in rain event on 3 August appeared to cause an increase in turbidity to 36.00 on 3 August. Turbidity decreased to 5.55 NTUs on 4 August. A 0.18 in rain event on 30 August appeared to cause turbidity to increase from 4.86 NTUs on 28 August to 43.88 NTUs on 31 August. Turbidity and precipitation for this site, by date, are on page 16.

Turbidity values at the North Fork, Old Seward Highway were more strongly correlated ($R^2 = 0.8648$) with downstream turbidity readings at Nathan Drive than the South Fork sampling site ($R^2 = 0.1708$), indicating that the North Fork exerted a greater downstream influence than the South Fork.

***North Fork at 68$^{th}$ Avenue***: This site is approximately 1.2 mi upstream of Campbell Creek Figure 2). Turbidity at this site was elevated during the break-up period in late April. Turbidity levels were consistently lower during May, June and July, when there was little precipitation. Turbidity increased dramatically during August and early September, when precipitation increased. Similar to the Nathan Drive site, a 0.26 in rain event on 3 August appeared to cause an increase in turbidity to 36.88 on 3 August at 1321 hrs. Turbidity decreased to 17.50 NTUs at 1555 hrs. A 0.18 in rain event on 30 August appeared to cause an increase in turbidity to at least 35.08 NTUs on 31 August. Turbidity and precipitation for this site, by date, are on page 17.

Elevated turbidity readings were documented on 10 August following a 6-day rain-free period. Subsequent upstream turbidity readings continued to increase up to a stormwater discharge point at Nadine Park. The stormwater system was followed to a new subdivision project in which an excavator was digging in a water-filled pit. Water pumps at the site were not operating at that

time, but it appeared that a turbid slurry was entering the stormdrain system from this construction site. As the stormwater system discharged pulses of untreated construction waters into the South Branch, these suspended sediments were transported to the downstream sampling points. Turbidity at the North Fork at 68th Avenue was 10.06 NTUs on 10 August and, following cessation of construction activities, was 20.00 NTUs on 11 August, which suggested that pulses of sediment were still being moved through the waterway.

***North Fork at Meadow Street***: This sampling site is about 445 ft further upstream of the 68th Avenue site, upstream of a sediment basin outfall. Turbidity at this site was elevated above baseline conditions during the break-up period in late April, but not as elevated as downstream sites. Turbidity levels were consistently lower during May, June and July, when there was little precipitation. Average turbidity increased over ten-fold during August when precipitation increased. Average turbidity did not increase as dramatically during early September. Similar to the Nathan Drive site, a 0.26 in rain event on 3 August appeared to raise turbidity to 22.30 on 3 August at 1321 hrs. Turbidity decreased to 16.75 NTUs at 1555 hrs. This turbidity value appeared inconsistent with mixing of the North and South branches at the upstream confluence. A 0.18 in rain event on 30 August appeared to raise turbidity to at least 91.30 NTUs on 31 August. This turbidity value appeared inconsistent with mixing of the North and South branches at the upstream confluence. Turbidity and precipitation for this site, by date, are on page 18.

This site is downstream of the Nadine Park outfall and the construction site described above. Turbidity at the North Fork at Meadow Street was 13.00 NTUs on 10 August and, following cessation of construction activities, was 10.75 NTUs on 11 August.

***North Branch, North Fork at Lake Otis Parkway***: The North Fork divides into the North and South branches shortly downstream of where both cross Lake Otis Parkway, about 1.2 mi upstream of the confluence of the North and South Forks. Turbidity at this site was elevated during the break-up period in late April, but not as elevated as sampling sites downstream of 68th Avenue. Turbidity levels were consistently lower during May, June and July, when there was little precipitation. Average turbidity increased a small amount when precipitation increased in August and early September. Similar to downstream sites, a 0.26 in rain event on 3 August appeared to elevate turbidity to 9.08 NTUS on 3 August. A 0.18in rain event on 30 August appeared to raise turbidity to at least 8.23 NTUs on 31 August. Turbidity and precipitation for this site, by date, are on page 19.

Turbidity at the North Branch, North Fork at Lake Otis Parkway site was not influenced by the previously described construction activities on 10 August, because it is separated from the South Branch.

***South Branch, North Fork at 68th Avenue***: The North Fork divides into the North and South branches shortly downstream of where both cross Lake Otis Parkway, about 1.2 miles upstream of the confluence of the North and South Forks. The first sampling site on the South Branch is south of 68th Avenue. Turbidity at this site was elevated above baseline conditions during the break-up period in late April, but not as elevated as sampling sites downstream of 68th Avenue. Turbidity levels were consistently lower during May, June and July, when there was little precipitation. Average turbidity increased dramatically when precipitation increased in August

and, less so, in early September. Similar to downstream sites, a 0.26 in rain event on 3 August appeared coincident with elevated turbidity to 6.68 NTUs on 3 August. A 0.18 in rain event on 30 August appeared coincident with a rise in turbidity to at least 6.11 NTUs on 31 August. Turbidity and precipitation for this site, by date, are on page 20.

Turbidity at the South Branch, North Fork site was strongly influenced by previously described construction activities on 10 August. Turbidity values increased to at least 392 NTUs at 1600 hrs on 10 August. Turbidity values decreased to 20.00 NTUs on 11 August, following cessation of construction activities.

***South Branch, North Fork at Snowview Drive***: This sampling site is downstream of residential development but immediately upstream of a sediment basin and large, relatively undisturbed wetland complex. Turbidity at this site was not elevated above baseline conditions during the break-up period in late April. Average turbidity levels were consistently low during May and June, when there was little precipitation. The only turbidity values over about 5.00 NTUs were on 27 July (18.73) and 7 September (9.83). These two values were inconsistent with adjacent sampling sites, which suggested there was sediment input before the next upstream sampling site. Contrary to downstream sites, a 0.26 in rain event on 3 August did not appear to elevate turbidity. Similarly, a 0.18 in rain event on 30 August did not appear to influence turbidity values recorded on 31 August. Turbidity and precipitation for this site, by date, are on page 21.

***South Branch, North Fork at Abbott Loop Road***: This sampling site is next to a road, but is downstream of a large, undisturbed natural area. Average turbidity at this site was surprisingly elevated (11.45 NTUs) during the break-up period in late April. Average turbidity levels were consistently low throughout the remainder of the sampling period, even during periods of increased precipitation. The lowest turbidity values for the entire dataset were from this site. Contrary to most downstream sites, rain events of 0.26 in on 3 August and a 0.18 in rain event on 30 August did not appear to elevate turbidity above 1.50 NTUs. Turbidity and precipitation for this site, by date, are on page 22.

***South Fork at Old Seward Highway***: The South Fork of Little Campbell Creek diverges from its confluence with the North Fork about 0.5 miles upstream of Campbell Creek.

Average turbidity at the South Fork, Old Seward Highway site was elevated during the break-up period in late April. Average turbidity levels were consistently lower during May, June and July, when there was little precipitation. Average turbidity increased dramatically during August and early September, when precipitation increased. Contrary to the downstream Nathan Drive site, a 0.26 in rain event on 3 August did not appear to dramatically elevate turbidity that day. Turbidity and precipitation for this site, by date, are on page 23.

Average turbidity values at the South Fork, Old Seward Highway were weakly correlated ($R^2 = 0.1708$) with downstream turbidity readings at Nathan Drive. The North Fork sampling site was strongly correlated with the Nathan Drive site ($R^2 = 0.8648$), indicating that the North Fork exerted a greater downstream influence than the South Fork.

***South Fork at Fire Station 12***: Fire Station 12 is located at Homer Drive and 80th Avenue. The South Fork of Little Campbell Creek passes under the access driveway along 80th Avenue. Turbidity values from the Fire Station 12 site were strongly correlated ($R^2 = 0.9222$) with the downstream South Fork, Old Seward Highway site. As such, the same general patterns in average turbidity were exhibited at the Fire Station 12 site. Turbidity and precipitation for this site, by date, are on page 24.

A 0.26 in rain event on 3 August did not appear to influence turbidity at this site that day. A 0.18 in rain event on 30 August, however, preceded a near doubling of turbidity from 5.16 NTUs on 29 August to 11.18 NTUs on 31 August. The 31 August turbidity value was nearly one-third lower than the next upstream sampling site (Sandlewood Drive, 47.10 NTUs). Additional, opportunistic sampling indicated that elevated turbidity levels could be sustained over several days at this site, particularly 17-23 August (during a series of rainfall events) and 7-8 September (following a 1.18 in rainfall event).

***South Fork at Sandlewood Drive***: The South Fork of Little Campbell Creek passes under Sandlewood Drive on the east side of the New Seward Highway. Average turbidity at the South Fork, Old Seward Highway site was elevated above baseline conditions during the break-up period in late April. Average turbidity levels were consistently lower during May, June and July, when there was little precipitation. Turbidity and precipitation for this site, by date, are on page 25.

Average turbidity values increased nearly five-fold during August, the largest increases being closely associated with rain events on 17 August and 30 August. A 0.26 in rain event on 3 August did not appear to dramatically elevate turbidity at this site that day.

***South Fork at 84th Avenue***: This sampling site is located across from Abbott Loop Elementary School, upstream of Lake Otis Parkway. Average turbidity at the 84th Avenue was elevated during the break-up period in late April. Average turbidity levels were consistently lower during May, June and July, when there was little precipitation. Average turbidity did not increase dramatically (maximum value 10.06 NTUs) during August and early September, when precipitation increased. Average turbidities were 4.29 NTUs and 6.41 NTUs during the August and September regular sampling schedule. Turbidity and precipitation for this site, by date, are on page 26.

***South Fork at Abbott Road***: The South Fork of Little Campbell Creek crosses under Abbott Road from Ruth Arcand Park, a largely undisturbed area. As with most other sampling locations, there were elevated turbidity values at this site in late April. After April, however, no values exceeded 7.50 NTUs until monitoring ceased on 26 September. Turbidity and precipitation for this site, by date, are on page 27.

**Acknowledgements**:

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Appendix 1: Precipitation (inches) recorded at the Sand Lake Forecast Office of the National Weather Service, Anchorage. Rainfall exceeding 0.10 inches is in bold. Significant digits for zero and trace events are reported as 0 for clarity.

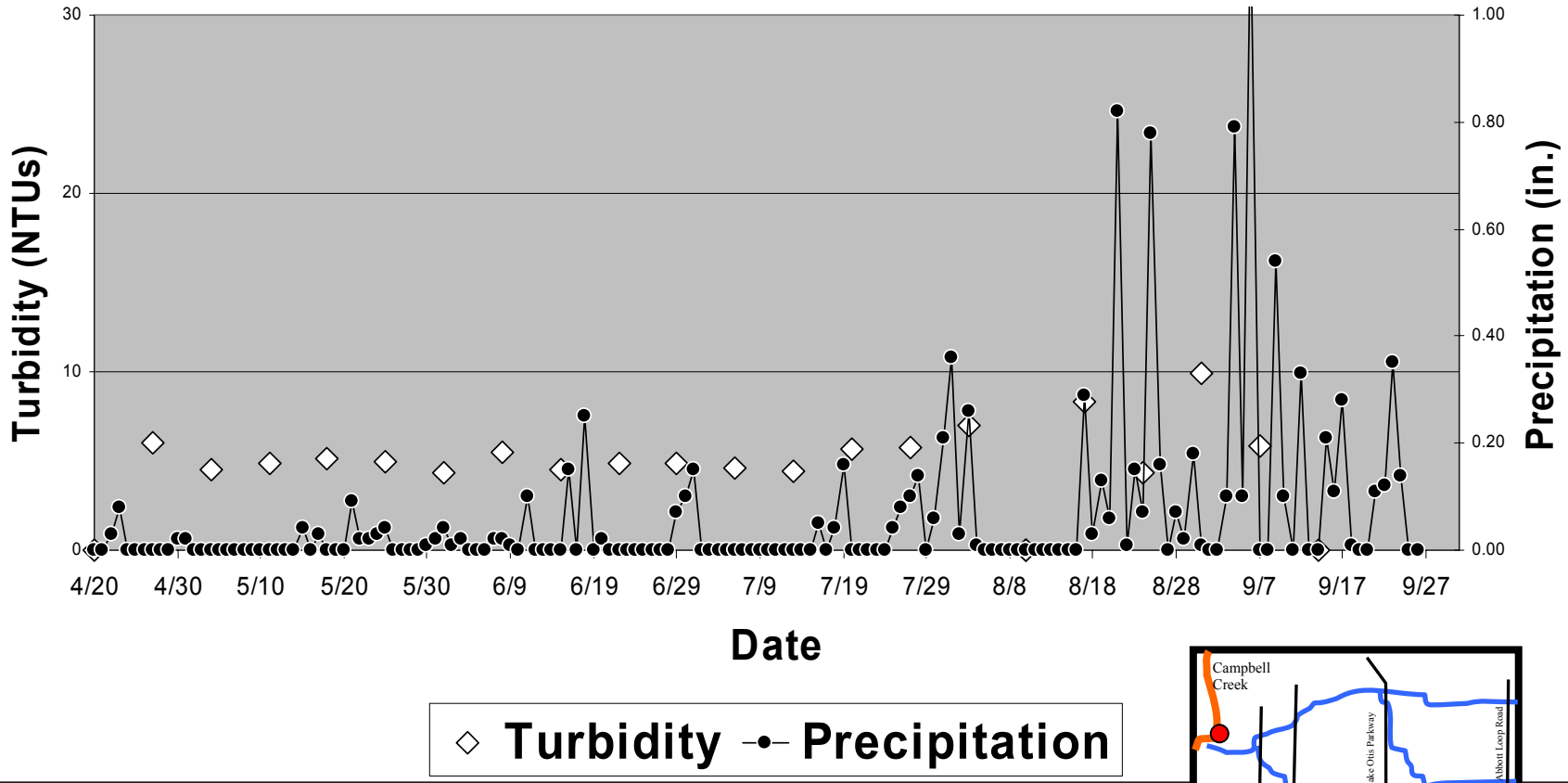
| DAY | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER |
|---|---|---|---|---|---|---|
| 1 | | 0.02 | 0.04 | **0.15** | **0.36** | 0 |
| 2 | | 0 | 0.01 | 0 | 0.03 | 0 |
| 3 | | 0 | 0.02 | 0 | **0.26** | 0.10 |
| 4 | | 0 | 0 | 0 | 0.01 | **0.79** |
| 5 | | 0 | 0 | 0 | 0 | 0.10 |
| 6 | | 0 | 0 | 0 | 0 | **1.18** |
| 7 | | 0 | 0.02 | 0 | 0 | 0 |
| 8 | | 0 | 0.02 | 0 | 0 | 0 |
| 9 | | 0 | 0.01 | 0 | 0 | **0.54** |
| 10 | | 0 | 0 | 0 | 0 | 0.10 |
| 11 | | 0 | 0.10 | 0 | 0 | 0 |
| 12 | | 0 | 0 | 0 | 0 | **0.33** |
| 13 | | 0 | 0 | 0 | 0 | 0 |
| 14 | | 0 | 0 | 0 | 0 | 0 |
| 15 | 0 | 0.04 | 0 | 0 | 0 | **0.21** |
| 16 | 0 | 0 | **0.15** | 0.05 | 0 | **0.11** |
| 17 | 0 | 0.03 | 0 | 0 | **0.29** | **0.28** |
| 18 | 0.01 | 0 | **0.25** | 0.04 | 0.03 | 0.01 |
| 19 | 0 | 0 | 0 | **0.16** | **0.13** | 0 |
| 20 | 0 | 0 | 0.02 | 0 | 0.06 | 0 |
| 21 | 0 | 0.09 | 0 | 0 | **0.82** | **0.11** |
| 22 | 0.03 | 0.02 | 0 | 0 | 0.01 | **0.12** |
| 23 | 0.08 | 0.02 | 0 | 0 | **0.15** | **0.35** |
| 24 | 0 | 0.03 | 0 | 0 | 0.07 | **0.14** |
| 25 | 0 | 0.04 | 0 | 0.04 | **0.78** | 0 |
| 26 | 0 | 0 | 0 | 0.08 | **0.16** | 0 |
| 27 | 0 | 0 | 0 | 0.10 | 0 | |
| 28 | 0 | 0 | 0 | **0.14** | 0.07 | |
| 29 | 0 | 0 | 0.07 | 0 | 0.02 | |
| 30 | 0.02 | 0.01 | 0.10 | 0.06 | **0.18** | |
| 31 | | 0.02 | | **0.21** | 0.01 | |

Appendix 2: Turbidity values (NTUs) for select sites within Little Campbell Creek, 20 April – 26 September 2005. Blue rows indicate regular sample taken on Wednesday afternoons. Blue rows also represent the North Fork for that day. Green rows represent samples taken on an opportunistic basis.

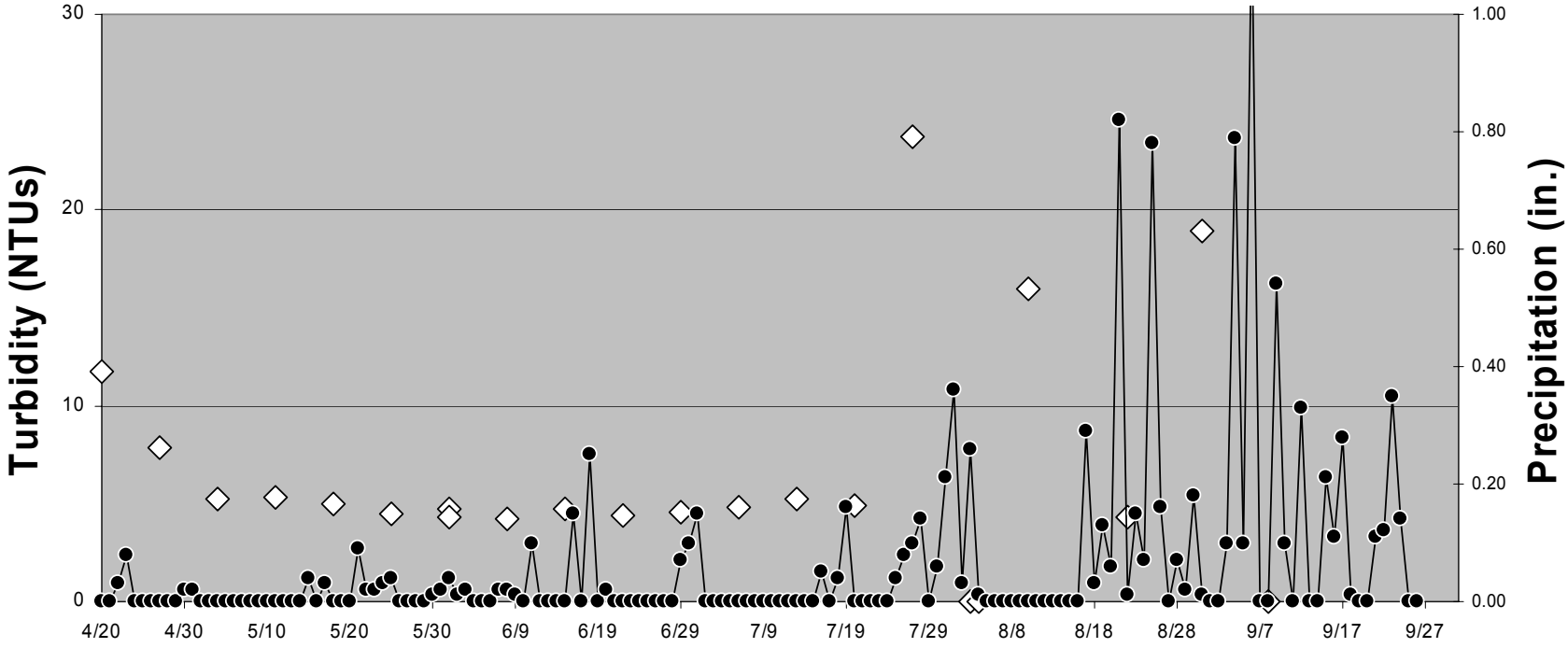
**Little Campbell Creek**

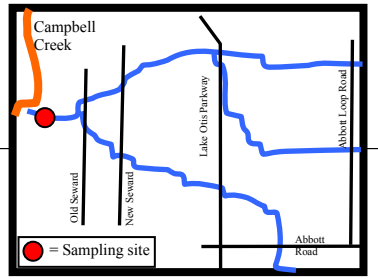
| | | | | NORTH FORK | | | | | North Branch | South Branch | | | SOUTH FORK | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date/Reach | | | CC | LCC@CC | Nathan Dr. | NFOSH | NF2 | NF1 | NBNF1 | SBNF3 | SBNF2 | SBNF1 | SFOSH | Fire Stn 12 | SF3 | SF2 | SF1 |
| | Day | time | | | | @ Old Seward | @68th Ave | @Meadow | @Lake Otis | 68th@L.O. | @Snowview | @Abbott Lp | @Old Seward | @80th | @Sandlewood | @84th Ave. | @Abbott Rd |
| 4/20/2005 | W | | | 14.43 | 16.63 | 10.95 | 12.10 | 8.20 | | | | | | | | | |
| South Fork | | | | | | | | | | | | | 21.63 | 19.93 | 24.00 | 14.90 | 29.00 |
| North Branch | | | | | | | | | 5.40 | | | | | | | | |
| South Branch | | | | | | | | | | | 4.00 | 18.00 | | | | | |
| 4/27/2005 | W | | 5.98 | 11.75 | 11.75 | 11.98 | 13.50 | 4.20 | | | | | | | | | |
| South Fork | | | | | | | | | | | | | 11.63 | 11.00 | 17.60 | 13.20 | 8.20 |
| North Branch | | | | | | | | | 3.80 | | | | | | | | |
| South Branch | | | | | | | | | | 8.90 | 3.10 | 4.90 | | | | | |
| 5/4/2005 | W | | 4.48 | 7.88 | 7.58 | 6.93 | 6.88 | 4.18 | | | | | | | | | |
| South Fork | | | | | | | | | | | | | 8.60 | 7.88 | 6.98 | 6.08 | 4.58 |
| North Branch | | | | | | | | | 5.13 | | | | | | | | |
| South Branch | | | | | | | | | | 4.63 | 3.53 | 3.65 | | | | | |
| 5/11/2005 | W | | 4.83 | 5.20 | 5.35 | 6.15 | 5.70 | 3.60 | | | | | | | | | |
| South Fork | | | | | | | | | | | | | 5.40 | 5.08 | 5.40 | 4.70 | 5.50 |
| North Branch | | | | | | | | | 3.70 | | | | | | | | |
| South Branch | | | | | | | | | | 3.10 | 1.60 | 3.00 | | | | | |
| 5/18/2005 | W | | 5.18 | 5.30 | 5.23 | 6.35 | 7.70 | 4.20 | | | | | | | | | |
| South Fork | | | | | | | | | | | | | 5.30 | 4.45 | 2.80 | 3.50 | 5.30 |
| North Branch | | | | | | | | | 4.30 | | | | | | | | |
| South Branch | | | | | | | | | | 3.80 | 2.10 | 2.70 | | | | | |
| 5/25/2005 | W | | 5.00 | 5.03 | 5.90 | 5.50 | 7.40 | 1.80 | | | | | | | | | |
| South Fork | | | | | | | | | | | | | 5.13 | 5.63 | 4.30 | 2.00 | 4.40 |
| North Branch | | | | | | | | | 3.60 | | | | | | | | |
| South Branch | | | | | | | | | | 4.40 | 2.90 | 3.10 | | | | | |
| 6/1/2005 | W | | 4.33 | 4.50 | 4.40 | 5.10 | 4.30 | 2.80 | | | | | | | | | |
| South Fork | | | | | | | | | | | | | 4.08 | 4.05 | 2.70 | 3.20 | 2.60 |
| North Branch | | | | | | | | | 4.10 | | | | | | | | |
| South Branch | | | | | | | | | | 2.70 | 1.20 | 1.90 | | | | | |
| 6/2/2005 | Th | | | 4.70 | | 5.20 | | | | | | | 4.40 | 5.38 | | | |
| 6/8/2005 | W | | 5.50 | 4.35 | 4.28 | 4.83 | 3.40 | 4.70 | | | | | | | | | |
| South Fork | | | | | | | | | | | | | 3.90 | 4.60 | 3.70 | 4.80 | 3.70 |
| North Branch | | | | | | | | | 3.28 | | | | | | | | |
| South Branch | | | | | | | | | | 4.13 | 5.20 | 14.50 | | | | | |
| 6/15/2005 | W | | 4.55 | 4.23 | 4.53 | 4.80 | 2.70 | 6.90 | | | | | | | | | |
| South Fork | | | | | | | | | | | | | 4.00 | 6.70 | 1.80 | 2.60 | 4.50 |
| North Branch | | | | | | | | | 3.80 | | | | | | | | |
| South Branch | | | | | | | | | | 10.20 | 4.20 | 11.10 | | | | | |
| 6/20/2005 | M | | | | 4.50 | 5.10 | | | | | | | 4.40 | 4.68 | | 1.10 | |
| 6/22/2005 | W | | 4.88 | 4.70 | 4.45 | 4.85 | 3.80 | 2.00 | | | | | | | | | |
| South Fork | | | | | | | | | | | | | 3.85 | 4.03 | 1.70 | 1.10 | 2.60 |
| North Branch | | | | | | | | | 4.00 | | | | | | | | |
| South Branch | | | | | | | | | | 2.00 | 1.20 | 1.00 | | | | | |
| 6/29/2005 | W | | 4.83 | 4.38 | 4.73 | 4.58 | 3.00 | 2.50 | | | | | | | | | |
| South Fork | | | | | | | | | | | | | 6.93 | 6.43 | 10.75 | 2.00 | 3.25 |
| North Branch | | | | | | | | | 4.00 | | | | | | | | |
| South Branch | | | | | | | | | | 2.00 | 2.25 | 1.00 | | | | | |
| 7/6/2005 | W | | 4.61 | 4.53 | 7.93 | 4.83 | 4.00 | 1.92 | | | | | | | | | |
| South Fork | | | | | | | | | | | | | 4.02 | 9.56 | 1.70 | 1.71 | 3.35 |
| North Branch | | | | | | | | | 6.00 | | | | | | | | |
| South Branch | | | | | | | | | | 3.25 | 1.89 | 1.27 | | | | | |
| 7/13/2005 | W | | 4.43 | 4.81 | 4.63 | 4.66 | 1.87 | 1.78 | | | | | | | | | |
| South Fork | | | | | | | | | | | | | 4.22 | 5.44 | 3.86 | 1.06 | 1.78 |
| North Branch | | | | | | | | | 3.58 | | | | | | | | |
| South Branch | | | | | | | | | | 2.55 | 2.62 | 0.62 | | | | | |
| 7/19/2005 | Tu | | | | | | | | | | | | 16.68 | 11.19 | | | |
| 7/20/2005 | W | | 5.64 | 5.27 | 5.36 | 5.13 | 2.63 | 3.09 | | | | | | | | | |
| South Fork | | | | | | | | | | | | | 8.29 | 7.98 | 4.27 | 7.08 | 6.71 |
| North Branch | | | | | | | | | 4.43 | | | | | | | | |
| South Branch | | | | | | | | | | 3.51 | 2.61 | 0.66 | | | | | |
| 7/27/2005 | W | | 5.77 | 4.91 | 5.20 | 5.33 | 3.45 | 3.86 | | | | | | | | | |
| South Fork | | | | | | | | | | | | | 4.36 | 4.54 | 1.33 | 1.58 | 2.18 |
| North Branch | | | | | | | | | 6.42 | | | | | | | | |
| South Branch | | | | | | | | | | 4.18 | 18.73 | 0.91 | | | | | |
| 8/2/2005 | Tu | | | | 6.47 | | | | | | | | | 5.01 | | | |
| 8/3/2005 | W | 1321pm | 7.00 | 23.75 | 21.25 | 36.00 | 36.88 | 22.30 | | | | | | | | | |
| South Fork | | | | | | | | | | | | | 8.08 | 4.78 | 4.72 | 3.92 | 3.72 |
| North Branch | | | | | | | | | 9.08 | | | | | | | | |
| South Branch | | | | | | | | | | 6.68 | 3.70 | 1.21 | | | | | |
| | | 1555pm | | | | | 17.50 | 16.75 | | | | | | | | | |
| 8/4/2005 | Th | | | | 6.80 | 5.55 | | | | | | | | | | | |
| 8/10/2005 | W | 1-5pm | | | | 8.88 | 10.06 | 13.00 | | | | | | | | | |
| South Fork | | | | | | | | | | | | | 1.70 | 1.55 | 2.26 | 2.17 | 2.80 |
| North Branch | | | | | | | | | 5.11 | 61.48 | | | | | | | |
| South Branch | | | | | | | | | | | 2.48 | 0.76 | | | | | |
| | | 1600pm | | | | | | | | 392.50 | | | | | | | |
| 8/11/2005 | Th | 1030am | | | | | | 10.75 | | 20.00 | | | | | | | |
| | | 4pm | | | | | | | | 16.75 | | | | | | | |
| 8/17/2005 | W | | 8.30 | 16.00 | 48.75 | 55.00 | 18.23 | 15.05 | | | | | | | | | |
| South Fork | | | | | | | | | | | | | 7.70 | 4.33 | 15.48 | 3.14 | 2.23 |
| North Branch | | | | | | | | | 10.32 | | | | | | | | |
| South Branch | | | | | | | | | | 9.32 | 1.98 | 1.03 | | | | | |
| 8/18/2005 | Th | | | | 8.33 | 9.88 | | | | | | | 5.48 | 7.15 | | | |
| 8/19/2005 | F | | | | | | | | | | | | | 24.30 | | | |
| 8/21/2005 | Su | | | | 48.13 | 40.70 | 49.35 | 40.75 | 21.70 | 23.35 | | | 58.58 | 41.20 | | | |
| 8/22/2005 | M | 0800am | | | 16.50 | 12.60 | | | | | | | 18.70 | | | | |
| | | 1530pm | | | 13.00 | 11.90 | | | | | | | | | | | |
| 8/23/2005 | Tu | | | | 15.10 | 10.46 | | | | | | | 15.28 | 12.75 | | | |
| 8/24/2005 | W | | 4.29 | 4.28 | 4.16 | 5.01 | 3.79 | 2.44 | | | | | | | | | |
| South Fork | | | | | | | | | | | | | 5.12 | 4.59 | 3.11 | 2.17 | 2.59 |
| North Branch | | | | | | | | | 2.89 | | | | | | | | |
| South Branch | | | | | | | | | | 3.01 | 3.14 | 0.87 | | | | | |
| 8/28/2005 | Su | | | | 3.82 | 4.86 | | | | | | | | | | | |
| 8/29/2005 | M | | | | 3.95 | | | | | | | | | 5.16 | | | |
| 8/30/2005 | Tu | | | | | | | | | | | | | | | | |
| 8/31/2005 | W | | 9.92 | 37.18 | 33.60 | 43.88 | 35.08 | 91.30 | | | | | | | | | |
| South Fork | | | | | | | | | | | | | 19.65 | 11.18 | 47.10 | 10.06 | 5.36 |
| North Branch | | | | | | | | | 8.23 | | | | | | | | |
| South Branch | | | | | | | | | | 6.11 | 3.24 | 1.47 | | | | | |
| 9/7/2005 | W | | 5.84 | 18.95 | 19.80 | 13.90 | 23.45 | 6.83 | | | | | | | | | |
| South Fork | | | | | | | | | | | | | 24.48 | 23.10 | 11.00 | 8.43 | 7.43 |
| North Branch | | | | | | | | | 11.35 | | | | | | | | |
| South Branch | | | | | | | | | | 6.11 | 9.83 | 1.45 | | | | | |
| 9/8/2005 | Th | | | | | | | 3.29 | | | | | | 19.43 | | | |
| 9/12/2005 | M | | | | | | | 9.78 | | | | | | | | | |
| 9/13/2005 | Tu | | | | | 9.77 | | 3.96 | | | | | 10.40 | | 4.12 | | |
| 9/14/2005 | W | | | | 8.23 | 7.53 | 10.28 | 2.98 | | | | | | | | | |
| South Fork | | | | | | | | | | | | | 8.21 | 7.86 | 4.40 | 4.40 | 3.20 |
| North Branch | | | | | | | | | 3.93 | | | | | | | | |
| South Branch | | | | | | | | | | 2.23 | 1.45 | 1.18 | | | | | |
| 9/16/2005 | F | | | | 8.60 | 8.97 | | | | | | | | | 2.32 | | |
| 9/17/2005 | Sa | | | | 19.78 | 20.85 | | | | | | | 13.85 | | | | |
| 9/18/2005 | Su | | | | 6.69 | 7.72 | | | | | | | 5.68 | | | | |
| 9/24/2005 | Sa | | | | 18.75 | 9.94 | | | | | | | 25.48 | 25.73 | 20.70 | 11.62 | |
| 9/26/2005 | M | | | | 6.48 | 6.04 | | 3.75 | | | | | 6.89 | | | | |

# Turbidity in Campbell Creek upstream of confluence with Little Campbell Creek, April - September, 2005

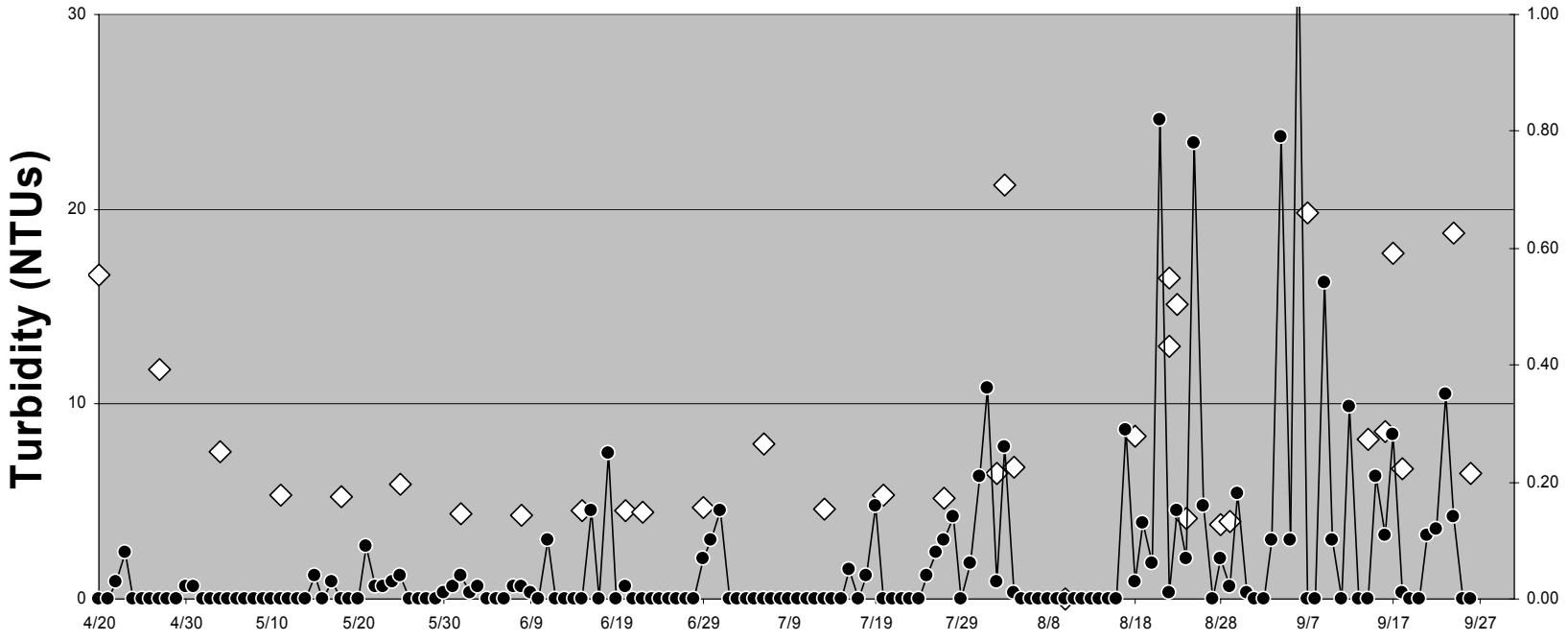


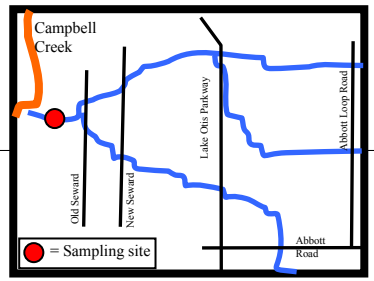
# Turbidity in Little Campbell Creek upstream of confluence with Campbell Creek, April - September, 2005



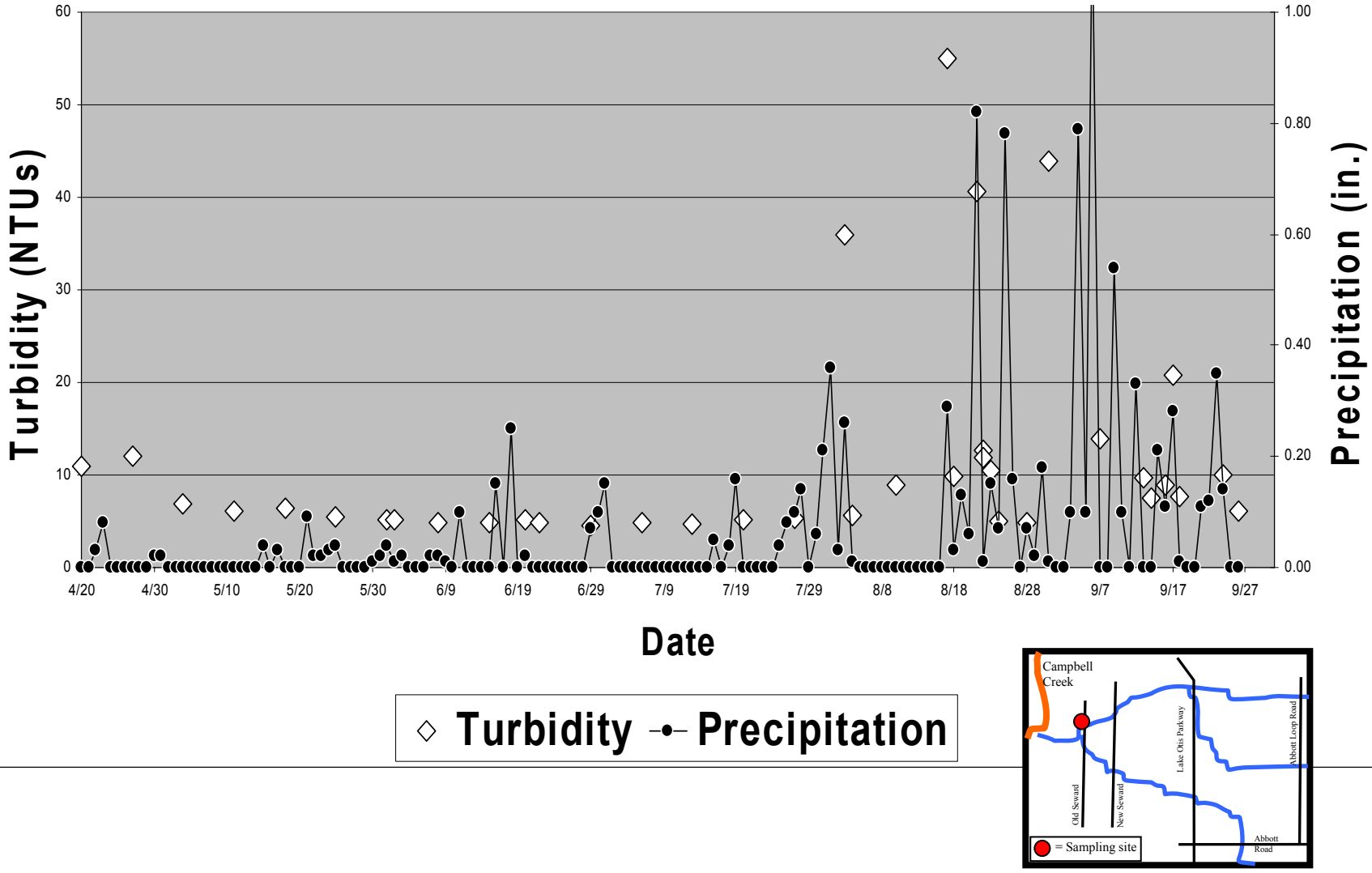



# Turbidity in Little Campbell Creek, at Nathan Drive, April - September, 2005

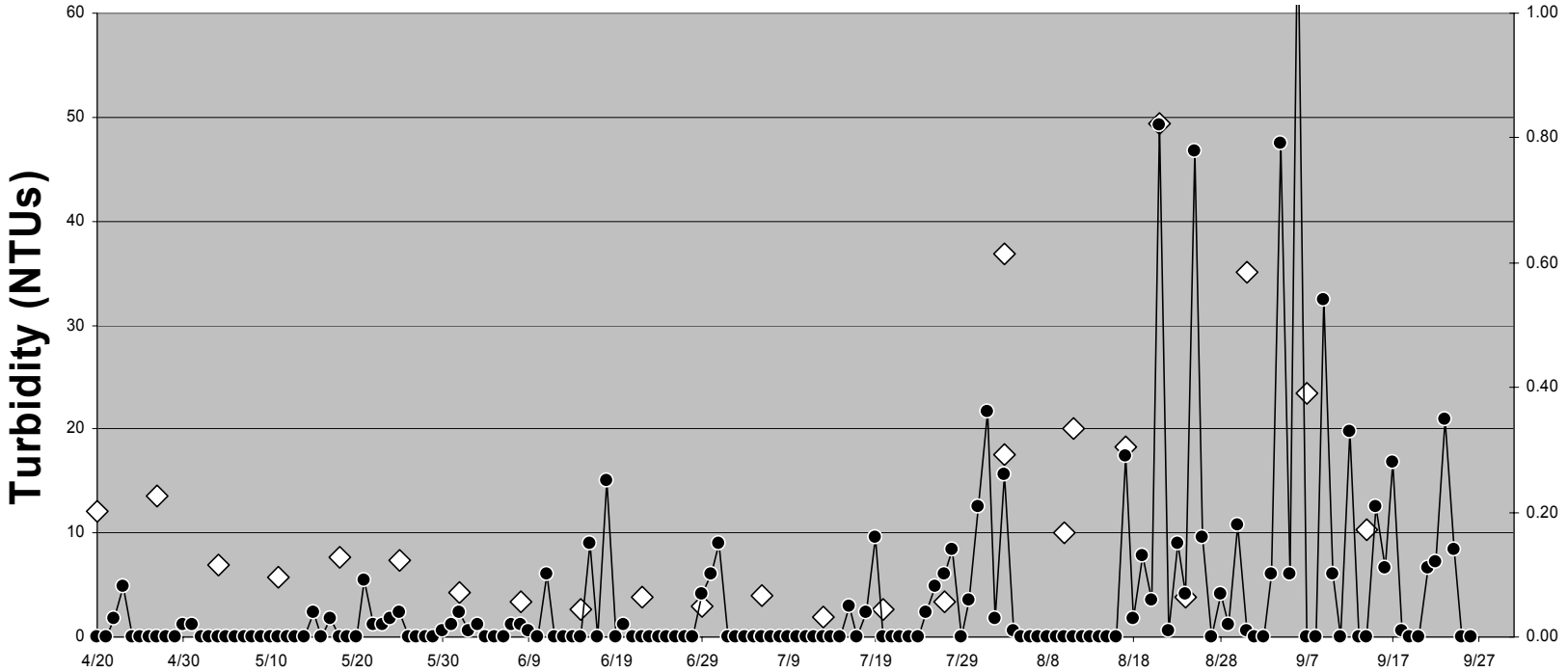


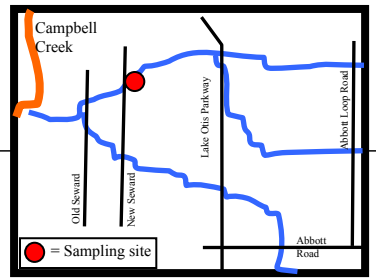



# Turbidity in North Fork of Little Campbell Creek at the Old Seward Highway crossing, April - September, 2005

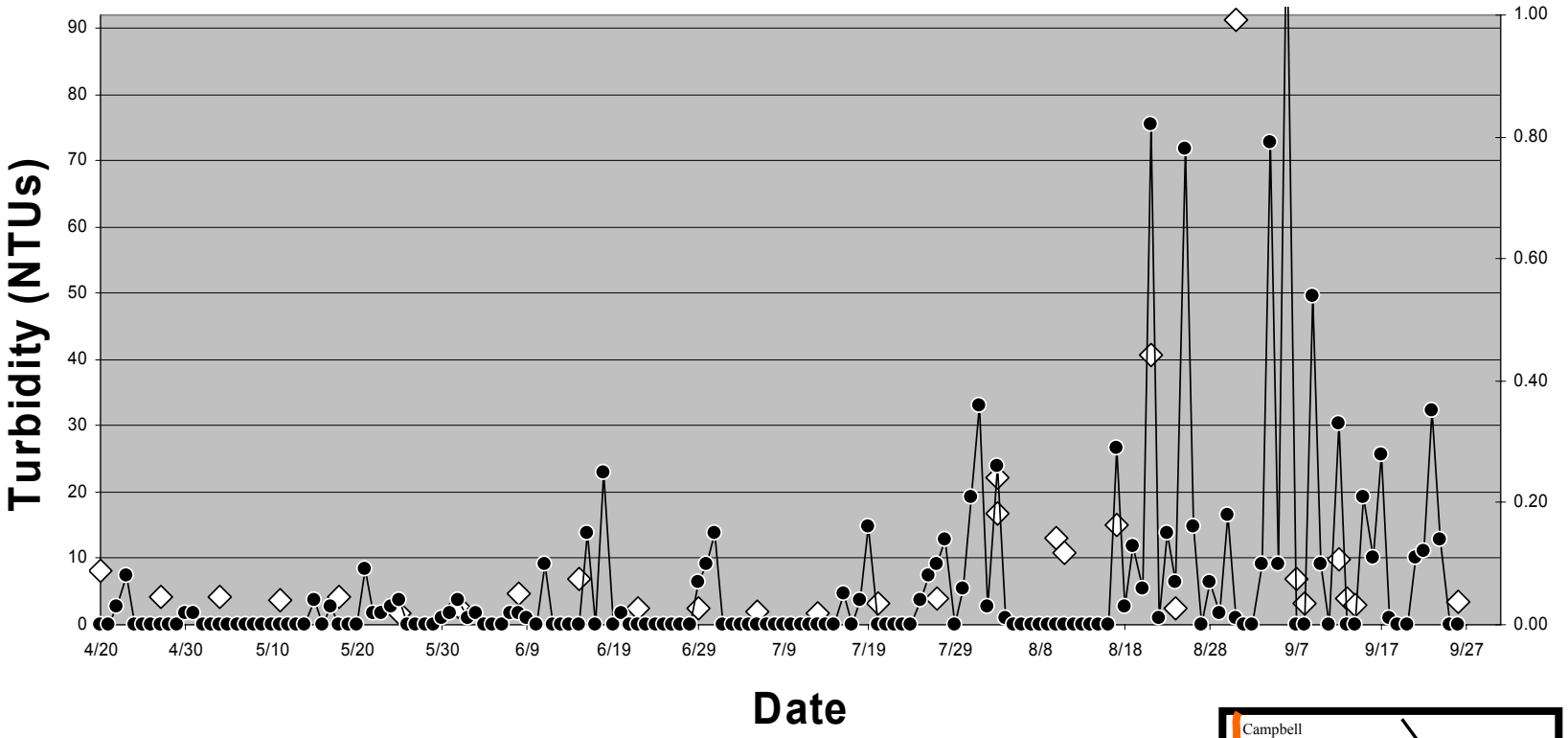


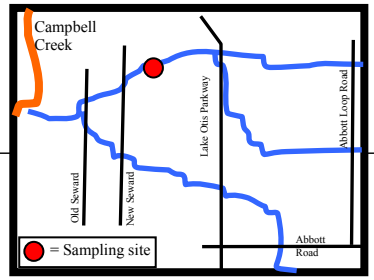
# Turbidity in North Fork, Little Campbell Creek at 68th Avenue crossing, April - September, 2005



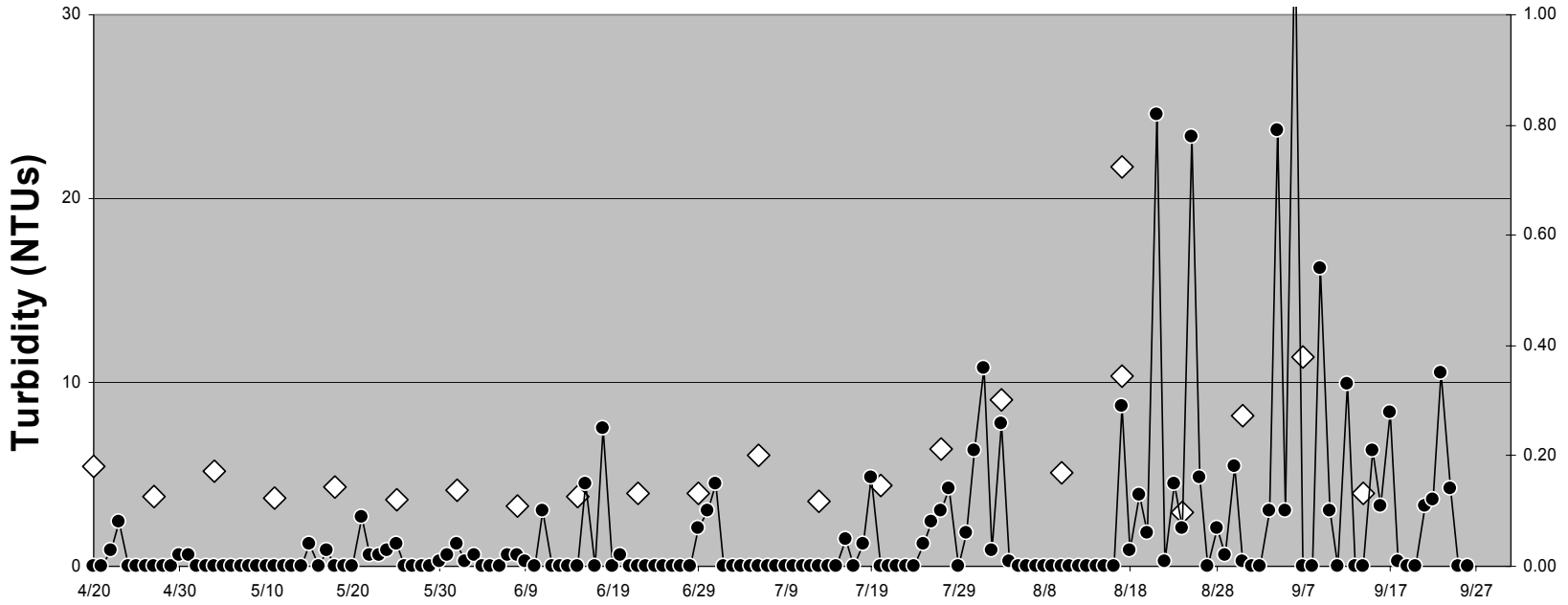



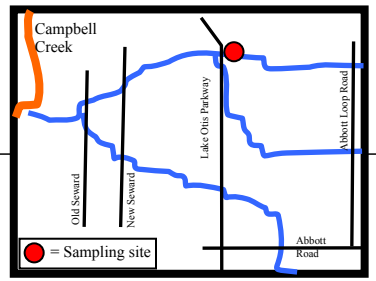
# Turbidity in North Fork, Little Campbell Creek at Meadow Street crossing, April - September, 2005



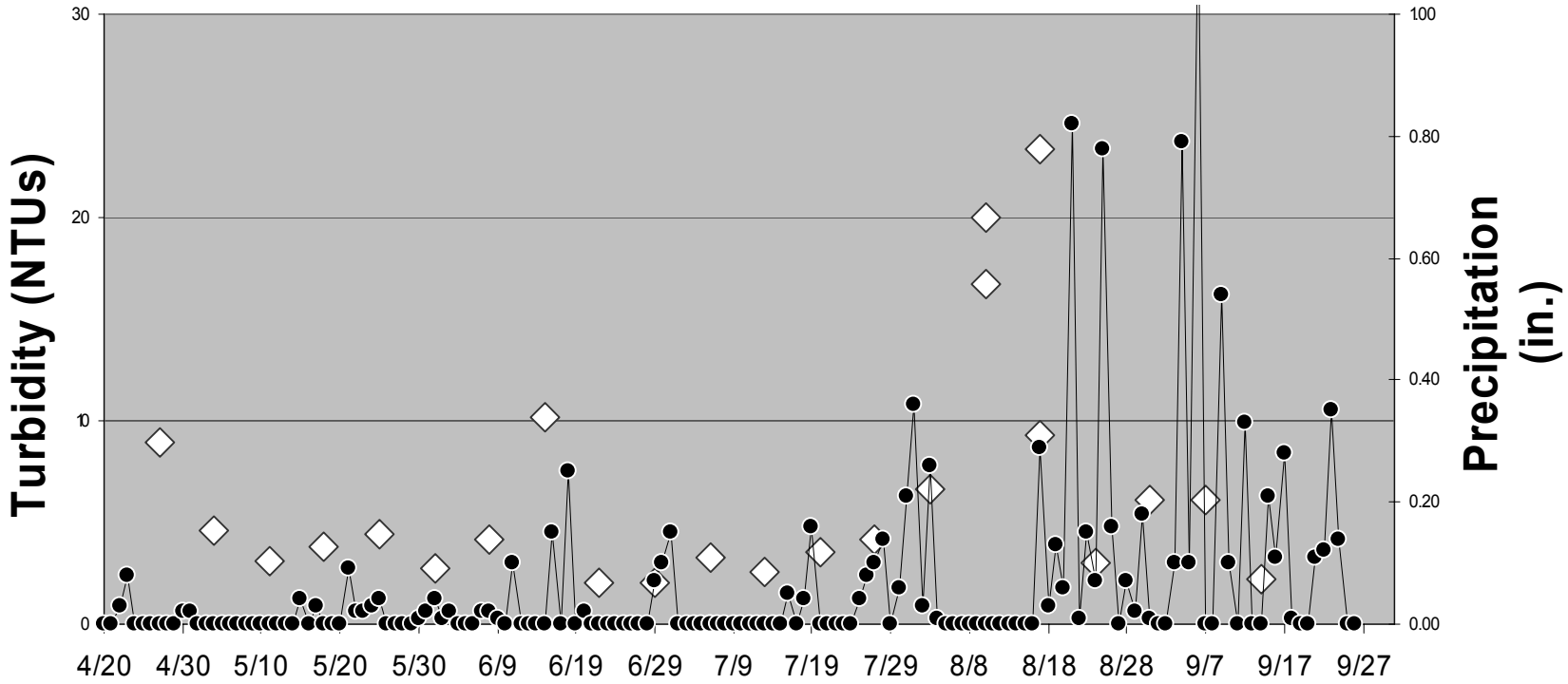



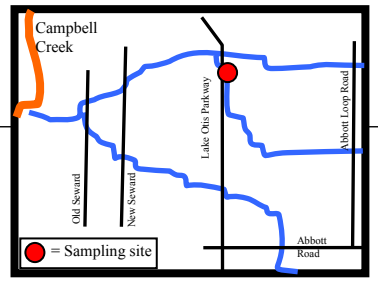
# Turbidity in the North Branch, North Fork of Little Campbell Creek at Lake Otis crossing, April - September, 2005



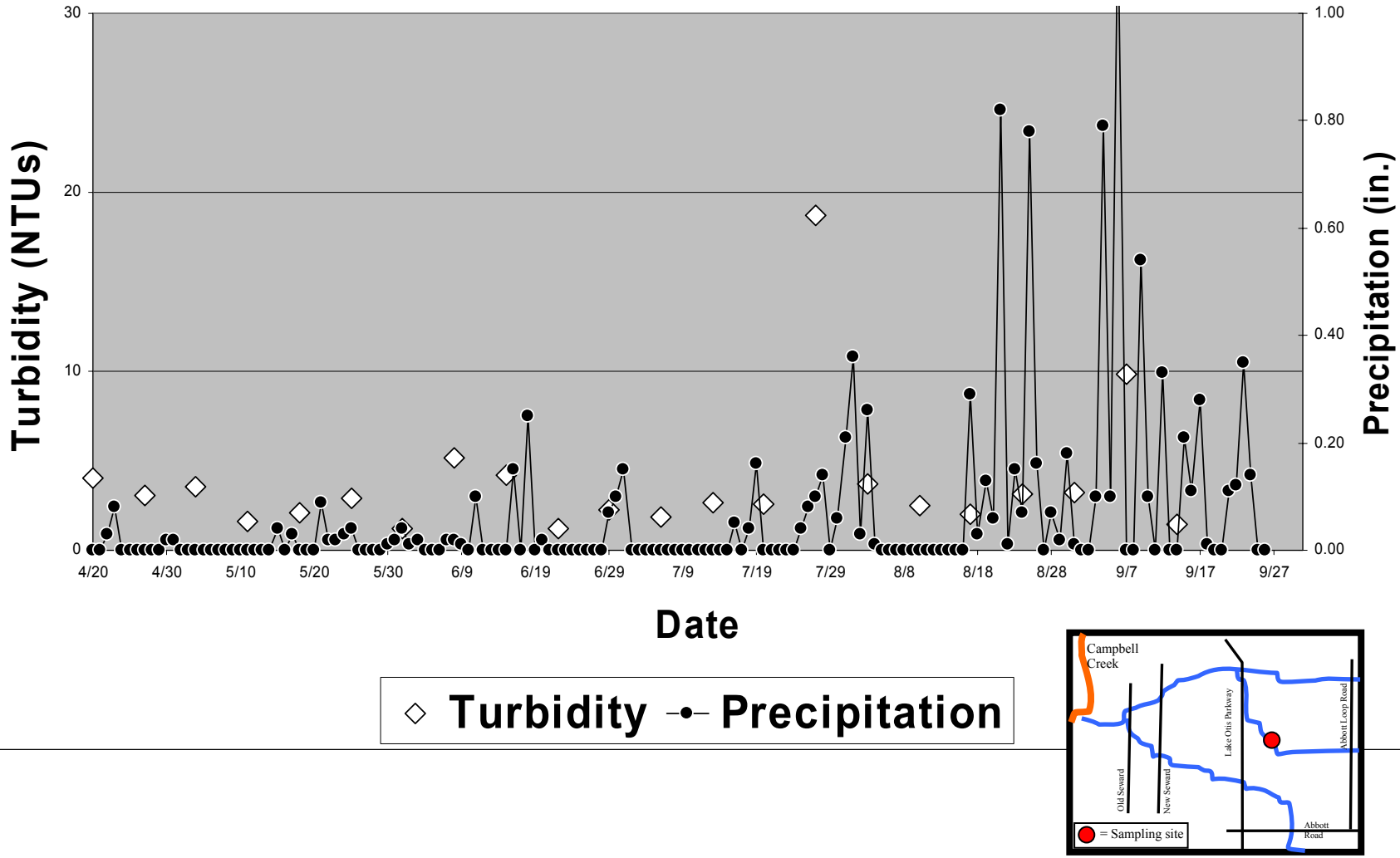



# Turbidity in South Branch, North Fork of Little Campbell Creek, April - September, 2005

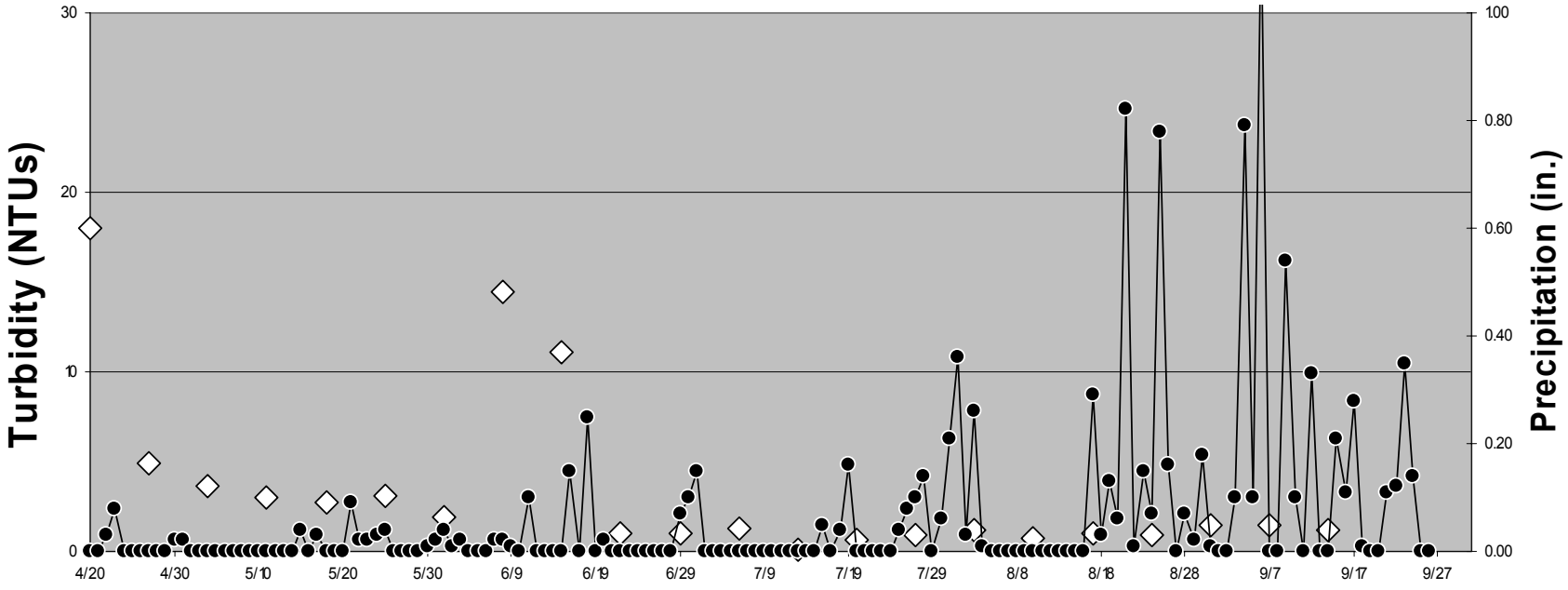


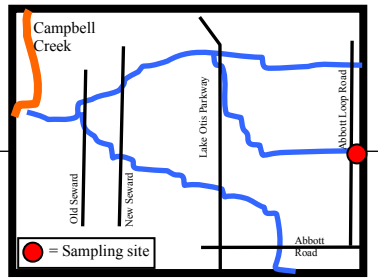



# Turbidity in South Branch, North Fork, Little Campbell Creek at Snowview crossing, April - September, 2005

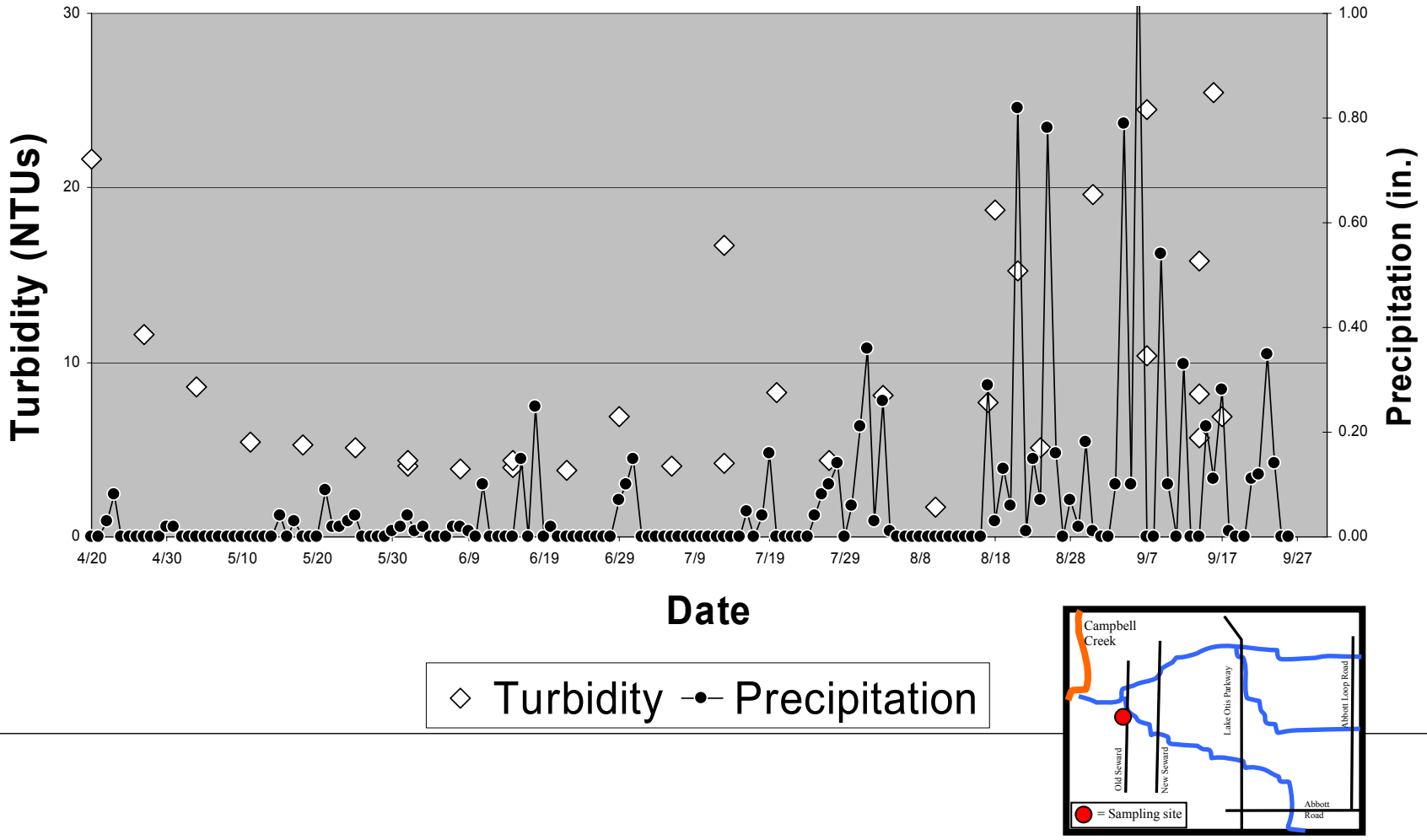


## Turbidity in South Branch, North Fork, Little Campbell Creek at Abbott Loop Road crossing, April - September, 2005

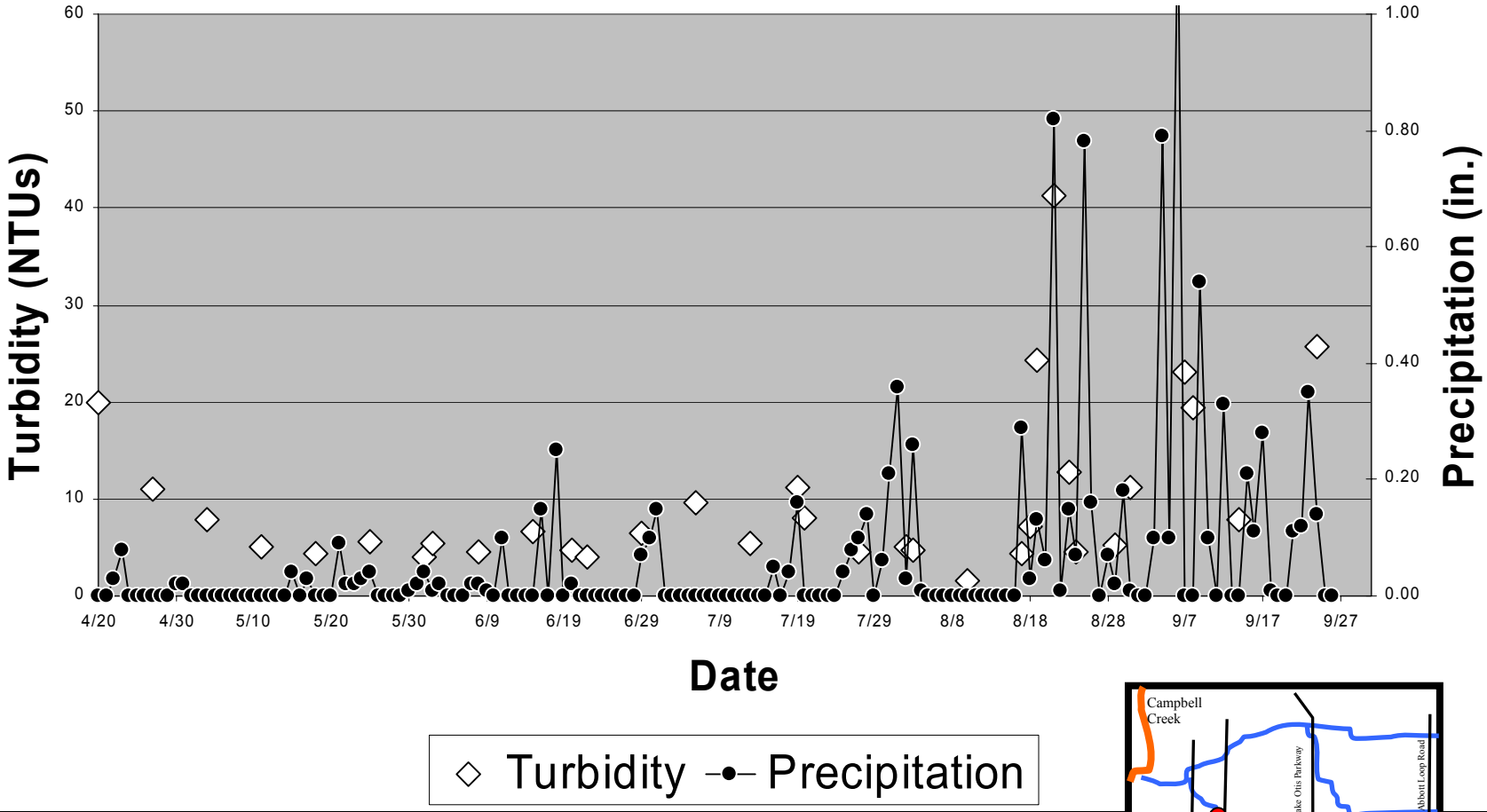


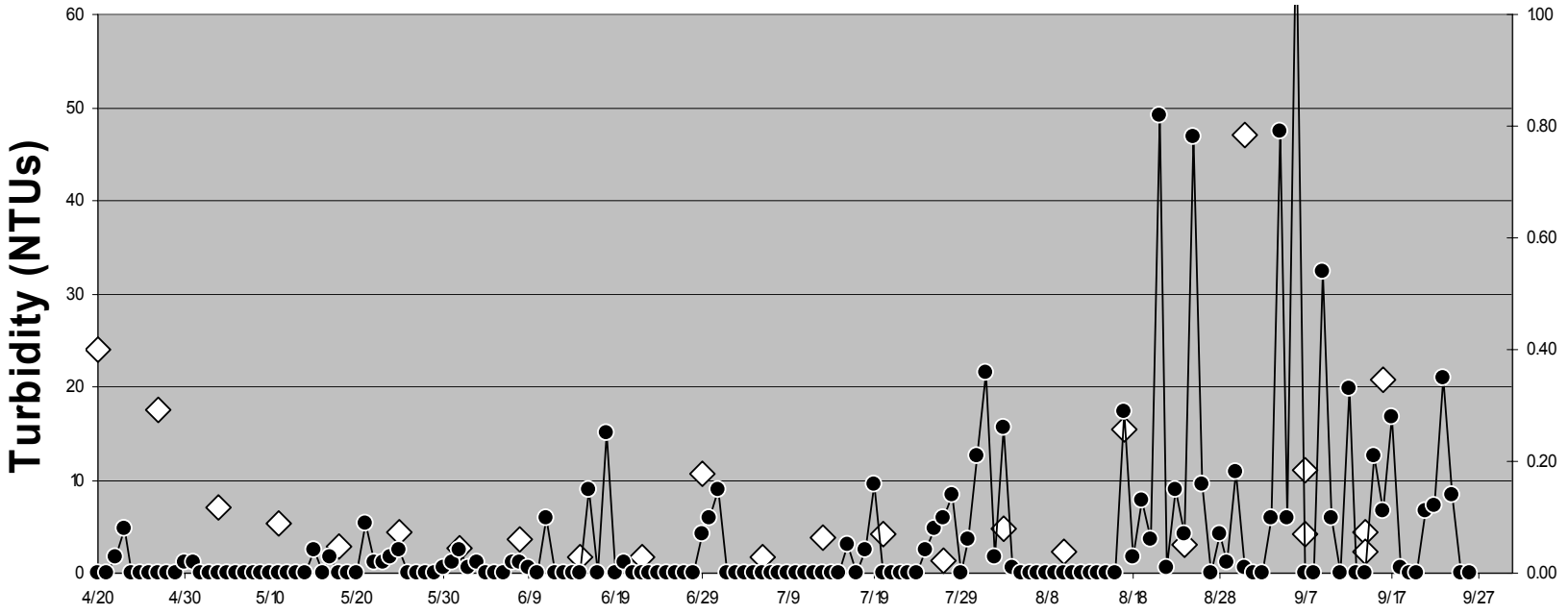
# Turbidity in South Fork, Little Campbell Creek at Old Seward Highway crossing, April - September, 2005

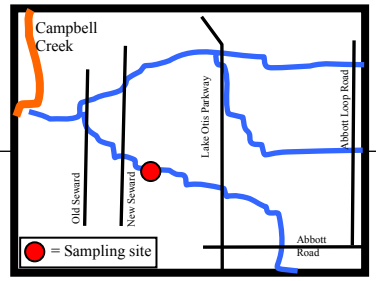


# Turbidity in South Fork, Little Campbell Creek at Fire Station 12 (80th/Homer Drive), April - September, 2005

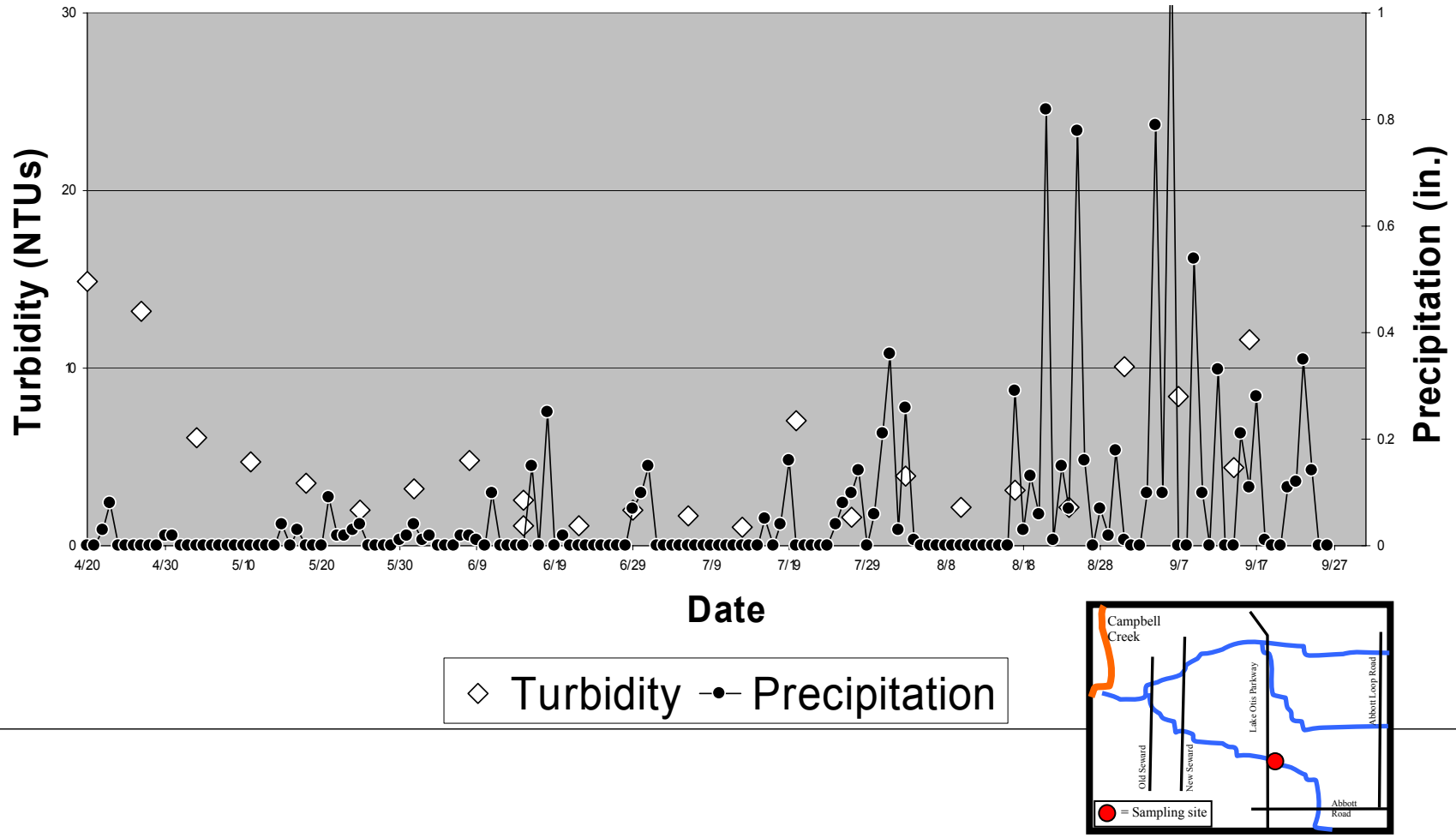


# Turbidity in South Fork, Little Campbell Creek at Sandlewood Drive crossing, April - September, 2005



# Turbidity in South Fork of Little Campbell Creek at 84th Ave crossing, April - September, 2005



# Turbidity in South Fork, Little Campbell Creek at Abbott Road crossing, April - September, 2005