Little Campbell Creek Macroinvertebrate Analysis
prepared for
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Abstract
Benthic Macroinvertebrates (BMIs) were sampled at 11 sites in Little Campbell Creek in the summer of 2006 by the Municipality of Anchorage (MOA) using USGS National Water Quality Assessment (NAWQA) methods for both semi-quantitative and multi-habitat assessments. Samples were processed and identified by personnel at the University of Alaska Anchorage's Environment and Natural Resources Institute (ENRI) using NAQWA methods and then quantified using ENRI's Alaska Stream Condition Index (ASCI) for the Cook Inlet basin ecoregion and other appropriate biologically-based indices of ecological condition. In general, ecological condition based on macroinvertebrate scores decreased in a downstream direction, likely responding to increases in the intensity and aerial extent of watershed urbanization.

Introduction
Little Campbell Creek is the largest tributary to Campbell Creek in Anchorage, Alaska. Water quality in Little Campbell Creek has become a concern in the community after the report of several fish kills in the fall of 2004 and the spring of 2005 (Shroeder 2006). In response, the MOA has put considerable effort into identifying the causes of these fish kills and the apparent water quality degradation associated with them. Owing to their taxonomic and morphological diversity, BMIs have proven to be effective indicators of environmental conditions in waterbodies (Rosenberg and Resh 1993, Barbour et al. 1999).

Methods
As part of these efforts, the MOA collected BMIs from 11 sites throughout Little Campbell Creek and its tributaries (Figure 1) in the summer of 2006, using NAWQA methods for both semi-quantitative and multi-habitat assessments (Moulton et al. 2002). Semi-quantitative samples were collected using a 0.25 x 0.25 meter Slack sampler from five locations in the richest available habitat (i.e., the habitat expected to contain the most species of BMIs). At each of the 11 sites, the richest habitat was a riffle with stable gravel/cobble substrate. For each site these five samples were pooled into one sample, identified with an "R" designation, and preserved with 70% ethanol. Multi-habitat samples were collected from a variety of habitats proportionate to their occurrence in each of the sampling reaches. BMIs were collected with a variety of instruments,

including kick nets and brushes, for a total of one hour at each sampling reach. All multi-habitat samples from a given site were pooled into a composite sample, identified with a "Q" designation, and preserved in 70% ethanol.

Environment and Natural Resources Institute (ENRI) staff sorted and subsampled the 22 BMI samples and identified organisms using guidelines outlined in the USGS NAWQA protocols (Moulton et al. 2000). Each sample was subsampled to a standard count of ~300 organisms after which the remaining sample was scanned for 15 minutes for large/rare taxa that may not have been present in the subsample. Organisms were then identified to the lowest practical level of taxonomic resolution using widely accepted texts (Merritt and Cummins 1996, Thorp and Covich 2001, Stewart and Stark 2002, Wiggins 1996). Mollusks, crustaceans, and insects were identified to the genus or species level, where possible; other BMI groups were identified at higher taxonomic levels using the guidelines for Standard Taxonomic Assessment in the U.S.G.S. NAWQA protocols (Moulton et al. 2000). The family Chironomidae, which was often the dominant family in a sample, was identified to tribe, where possible, but was lumped back to family when calculating metric values, since the indices used were developed based on family level Chironomidae data. Ultimately, this process led to a list of all BMI taxa collected from each site plus corresponding (proportional) abundances.

Working with the BMI community data generated at each site, we applied several indices designed to quantify ecological conditions in streams. We used ASCI (Major et al. 2001), an index developed by ENRI for wadeable streams in the Cook Inlet basin ecoregion. We also used an index developed by the Institute of Arctic Biology (IAB) specifically for streams within the MOA (Milner and Oswood 1991). Finally, we calculated metrics identified by the USGS as being sensitive to the extent of impervious surface within the watershed: the percent of the BMIs belonging to the orders Ephemeroptera, Plecoptera, and Trichoptera (% EPT), the percent of the BMIs belonging to the order Ephemeroptera, and Ratio of EPT to Chironomidae (Ourso and Frenzel 2003).

Photographs of the BMI assemblages at each sample location were taken with a digital camera using the multi-habitat (Q) sample. A voucher collection of representative taxa from this project was also assembled and is archived at ENRI.

Results and Discussion

A total of 54 benthic taxa were identified from the 22 samples enumerated (Table 1). We calculated BMI densities using the "R" samples that were collected semi-quantitatively from the richest (riffle cobble) habitat from each reach. BMI densities are reported in Table 2 and range from a high at Site 09 of 8,328 individuals/meter^2 to a low at Site 02 of 927 individuals/meter^2. While extremely high or low BMI densities can be indicative of ecological problems, BMI densities vary widely under natural conditions; as such, density is rarely used as an ecological indicator.

ASCI methods call for grouping sites into three classes based on channel slope and substrate size: low gradient-fine substrate, low gradient-coarse substrate, and high gradient stream reaches. The ASCI metrics required for each the three stream classifications can be seen on Tables 3-5. ASCI scores were calculated for all 22 samples, although we recommend that the multi-habitat (Q) sample for each reach be given more weight, as the collection procedures employed more closely reflect those outlined in the ASCI collection methods (Major et al. 2001).

Three of the 11 stream reaches were classified as low gradient-fine substrate streams: the most downstream reach on the South Fork (Site 02) and the two most upstream reaches on the North Fork (Sites 05 and 08). Site 02 had the lowest ASCI score for this stream class, with a corresponding ASCI rating of “poor.” Site 05 recieved an ASCI rating of “fair” while Site 08, located in Far North Bicentennial Park, scored a “good” ASCI rating. A breakdown of these ASCI scores can be found in Table 3.

The other eight stream reaches had predominantly coarse substrate. ASCI methods call for further dividing these reaches into two classes: low gradient-coarse substrate (i.e., <2% channel slope) and high gradient (i.e., >2% channel slope). The metrics for these two stream classes are quite different (Tables 4 and 5), with several metrics in the high gradient ASCI giving results that run counter to conventional metrics. This can present problems when streams are classified as high gradient but are structured biologically more like low gradient streams, and becomes especially problematic with streams of moderate (2-4%) gradient. For these reasons, we have calculated an ASCI score for the high gradient streams using both high gradient and low gradient-coarse substrate ASCI metrics. We are in the process of recalibrating the Cook Inlet ASCI in an attempt to resolve this contradiction; this work should be completed by July, 2007.

When all coarse substrate stream reaches are classified as low gradient-coarse substrate, all stream reaches score a rating of “poor” or “fair” (Table 4) and ASCI scores tend to decrease as you move downstream on the South Fork. All of the downstream reaches (and therefore, more urbanized reaches) scored a “poor” rating, while most of the upstream (and therefore less urbanized reaches) scored a “fair” rating, with the exception of the reach on Craig Creek, which scored a “poor”. When the four stream reaches above 2% gradient are analyzed with the high gradient ASCI metrics, Sites 03 and 09 receive “excellent” ratings, while sites 10 and 11 recieve “fair” ratings. It is our opinion that the low gradient metrics ASCI scores for these streams do a better job at depicting the ecological condition at these sites.

Both the ASCI and IAB rapid bioassessment indices showed similar basin-wide trends in ecological condition for Little Campbell Creek. For both the North and South forks, the dominant trend was that of decreasing ecological condition along a continuum from upstream to downstream (Figures 2 and 3). This trend is likely related to increasing intensity and aerial extent of watershed urbanization along the same continuum. The notable exception was the reach on Craig Creek (Site 10), which scored lower than other upstream sites.

The USGS metrics that are most sensitive to impervious surface coverage (i.e., % EPT, % Ephemeroptera, and EPT/Chironomidae) generally showed a similar longitudinal pattern, although the trend was not as clear-cut (Figures 4–6). As for the ASCI and IAB indices, these metrics further supported the poor condition of Sites 2 and 10.

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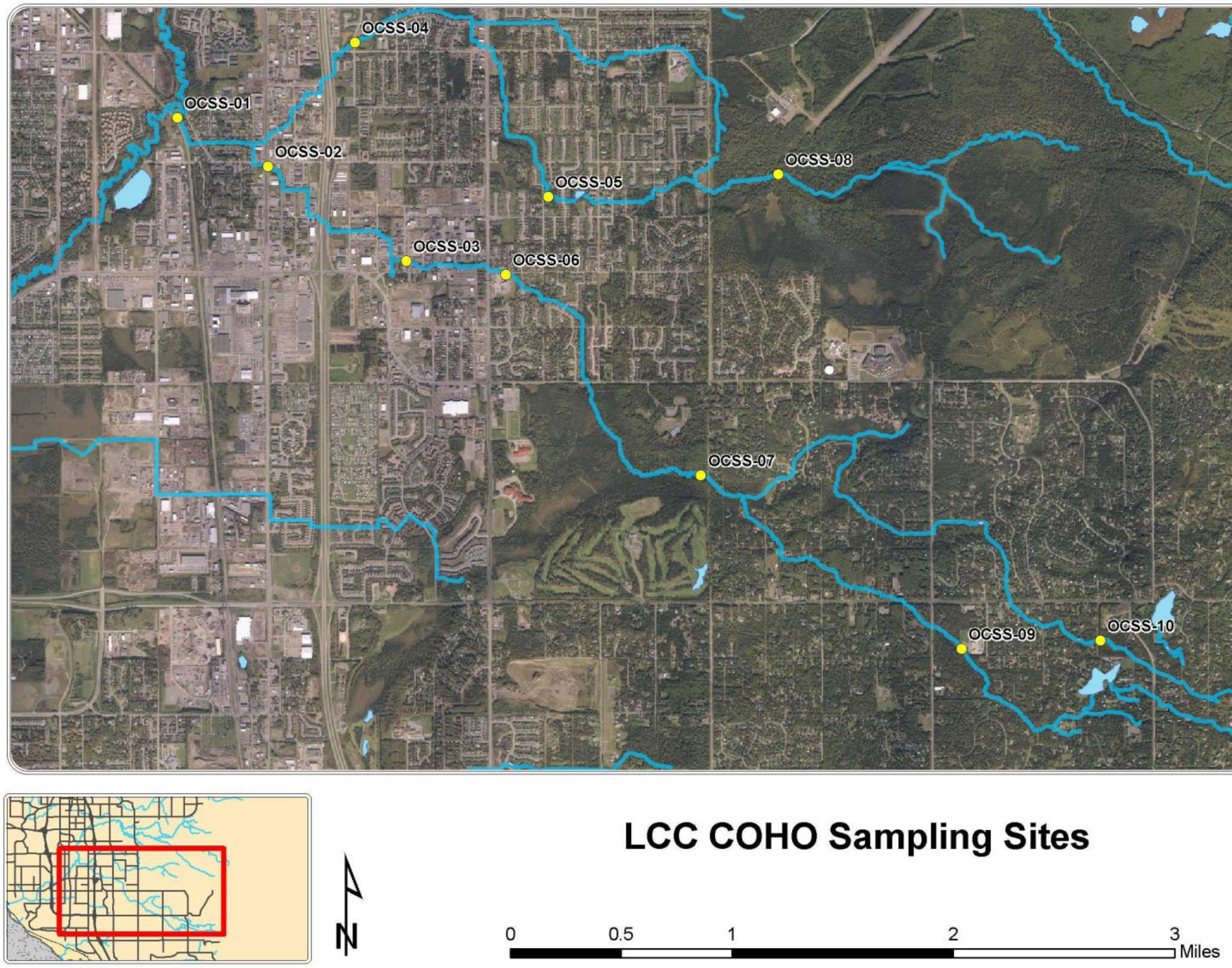

Figure 1. Little Campbell Creek COHO sampling sites.

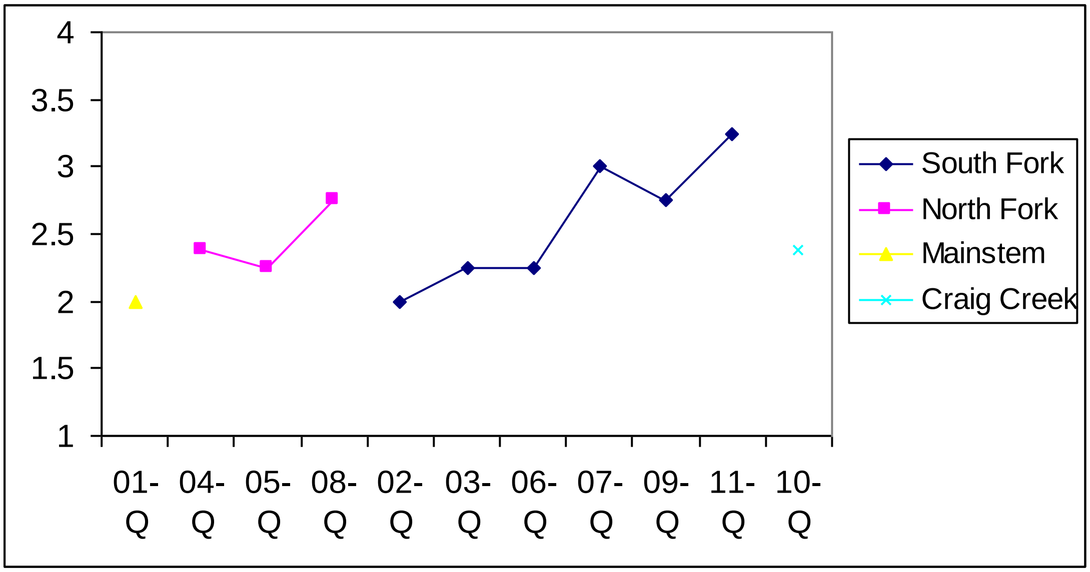

Figure 2. IAB rapid bioassessment scores for Little Campbell Creek. Scores are scaled 1-4.

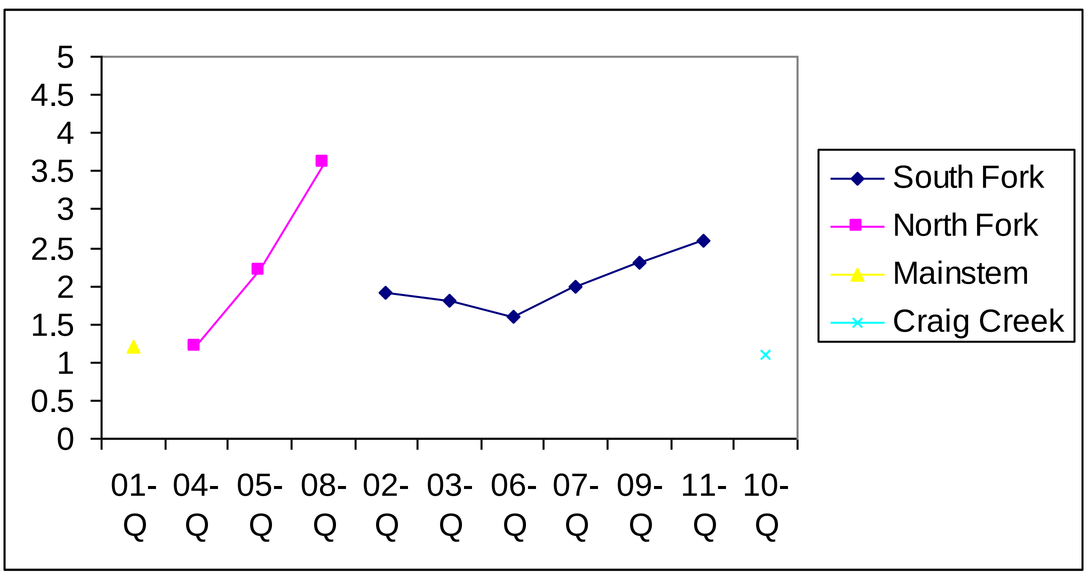

Figure 3. Scaled ASCI scores for Little Campbell Creek COHO sites. Low Gradient-fine substrate and low gradient-coarse substrate sites are scored on a common scale to allow direct comparison.

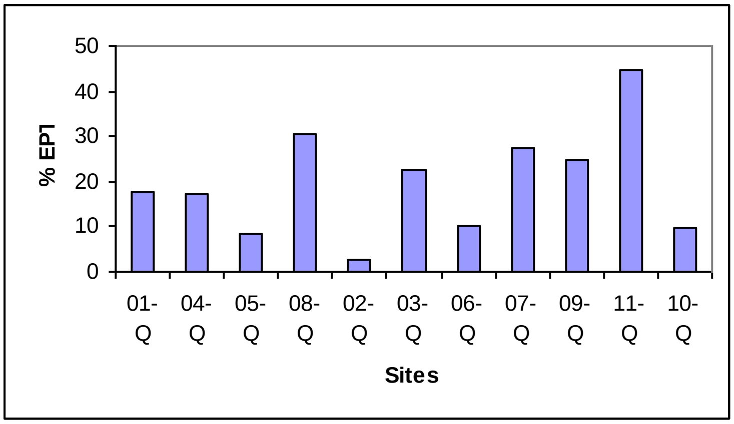

Figure 4. % EPT for Little Campbell Creek COHO Sites.

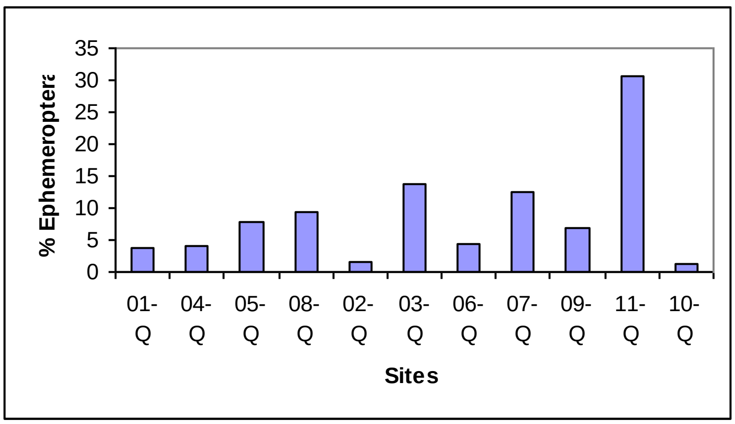

Figure 5. % Ephemeroptera for Little Campbell Creek COHO sites.

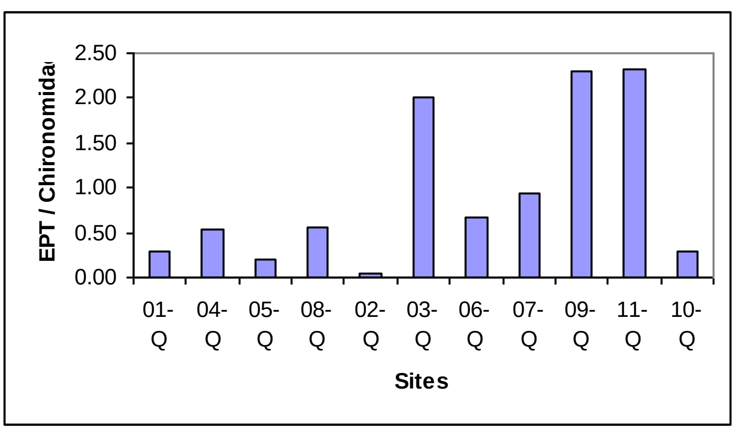

Figure 6. EPT/Chironomidae for Little Campbell Creek COHO sites.