George Wuerch, Mayor

Bioassessment of Select Streams at Anchorage, Alaska: 2000 Data Report

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MUNICIPALITY OF ANCHORAGE
WATERSHED MANAGEMENT PROGRAM

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WATERSHED MANAGEMENT

Office of Planning, Development & Public Works

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1.0 Introduction

The Municipality of Anchorage (MOA) is currently studying the biotic community of storm water receiving waters within the Anchorage Bowl. The purpose of this assessment is to describe qualitatively the biological condition of waters with respect to human impacts and management practices over time. The overall Management Goal is to characterize Anchorage waterways in terms of potential and existing fish productivity. This task is referred to as the Bioassessment task (task 4.2.3.3 of the NPDES permit) and is one of the many tools being used for assessing the overall receiving water condition. The specific task collects information from specific streams to characterize the streams' potentialities. An attempt was made to evaluate specific habitat and chemical degradations. The causes of each specific degradation will be assessed and reported for use in the overall Watershed Management (WSM) goals as part of the Watershed Characterization task (task 4.2 of the NPDES permit).

The information collected under this bioassessment program will be used in developing a long term time series of biotic indices. This information will be used as one of the data sources for Task 4.2. The Watershed Analysis project (Section 4.14. of the NPDES Permit) will also use this data in conjunction with in-stream, near stream, and drainage basin mapping information to link stream impacts to watershed activities and conditions for use in cost/benefits analysis of watershed management enhancement alternatives.

Biological monitoring protocols using benthic macroinvertebrates are routinely used by federal, state, and local agencies for the assessment and tracking of water quality. Such protocols are based on the assumption that anthropogenic influences (e.g., sedimentation, nutrient enrichment, heavy metals, canopy removal, etc.) will yield a corresponding and somewhat predictable change in the biota. Therefore, by monitoring macroinvertebrate communities, a wide range of environmental perturbations can be detected that would otherwise be possible only by intensive chemical and physical monitoring.

To evaluate the water quality of Municipality of Anchorage (MOA) streams, ENRI used the rapid bioassessment methodology it developed for Alaska based on the U.S. Environmental Protection Agency's Rapid Bioassessment Protocols for wadeable streams and rivers (Major and Barbour 1997; Major and Barbour 1999; Barbour et al. 1999). The method incorporates seven biological metrics into a unitless index, the Alaska Stream Condition Index (ASCI), for a final assessment of water quality condition based upon biological information.

ASCI scores have been developed specifically for the Cook Inlet Basin, including the Anchorage Bowl. ASCI scores are based on seven factors subdivided into two categories: 1) richness measures [total number of taxa, number of Ephemeroptera (E), number of

Plecoptera(P), and number of Trichptera(T)] and, 2) composition measures (% EPT, % Chironomidae, and % Dominant taxon).

ASCI scores were developed by first normalizing the different numerical scores for each metric value into a unitless score (Gerritson 1995; Karr 1991 et al. 1986). The transformation to a score from an actual value allows all metrics with different scales (e.g., integer, percent, and ratio) to be expressed on the same scale. Values above the 95th percentile and below the 5th percentile were eliminated as outliers in accordance with USEPA RBPs (Barbour et al. 1999) The resulting value range below the 95th percentile was quadrisected and assigned scores of 6, 4, 2, and 0, where 6 is equivalent to the ASCI specific ecoregion expectations of unimpaired conditions (i.e. very good) and 4, 2, and 0 are progressively diminishing values (i.e. good, poor, and very poor) (DeShon 1995; Maxted et al 2000). Assessment results are based on ASCI scores for reference conditions by ecoregion (Major et al. 1998, Major and Houston 1999, Major et al. 2000).

Organizing streams into smaller classification units for biological assessment is important in order to reduce variation within the metrics caused by certain physical and chemical parameters (Barbour et al. 1995). Elevation above sea level has been identified as an influence to the benthic community (Major and Houston 1999) and was again used by ENRI as a classification variable. Sites were further classified into groups after sampling based on ecoregion (Cook Inlet); dominant stream type (such as glide/pool [GP] or riffle/run [RR]); and elevation defined as low for sites < 125 ft, moderate for those 125 - 749 ft, and high for those > 750 ft. Stream types for the Cook Inlet Ecoregion included the GP and RR categories, with RR further separated by elevation into low (RRL), moderate (RRM), and high (RRH).

ASCI scores developed for the Cook Inlet Ecoregion range from <10 to 42 for RRM and RRH streams and from <10 to 38 for GP and RRL streams (Table 1).

Habitat assessment were completed in accordance with AK SOP 003 (Appendix A). These habitat classifications can be related to WMS's habitat classifications per Appendix C.

TABLE 1

SCORING THRESHOLDS FOR CORE METRICS USED TO CALCULATE ASCI SCORES

		Index Score by Metric Value			
Stream Type	**Metric**	**6**	**4**	**2**	**0**
RRM	No. of Taxa	>16	12-16	7-11	<6
	No. of Ephemeroptera	>4	3-4	1-2	<1
	No. of Plecoptera	>4	3-4	1-2	<1
	No. of Trichoptera	>4	3-4	1-2	<1
	% EPT	>29	20-28	10-19	<10
	% Chironomidae	<39	39-59	60-79	>79
	% Dominant Taxon	<50	49-66	67-83	>83

		Index Score by Metric Value			
Stream Type	**Metric**	**6**	**4**	**2**	**0**
GP and RRL	No. of Taxa	>14	10-14	6-9	<6
	No. of Ephemeroptera		>2	1-2	0
	No. of Plecoptera		>2	1-2	0
	No. of Trichoptera	>7	5-7	2-4	<2
	% EPT	>12	7-11	4-6	<4
	% Chironomidae	<38	38-58	59-79	>79
	% Dominant Taxon	<81	81-87	88-93	>93

2.0 Explanation of Data Submittal Elements

This data submittal is divided into the following elements:

- Summary information about the field phase of the project are contained in Section 3.0, including a project summary, variations from the project design, notable field observations, and data validation summary.
- Tabular summaries of the data are presented in Section 4.0, with brief descriptions.
- References are contained in Section 5.0.
- Sample analysis results and other primary documentation are contained in Appendices A, B, and C. All project data have been entered into a project database. Appendix A includes the AK Methods 001, 002, 003, and 004. Additional documentation including field note forms (primary field data) are compiled in Appendix B. appendix C is a table relating the AK SOP Method 003 to MOA's habitat characterization method.

3.0 Project Summary

The following section presents a project summary, variations from the project design, and results of data validation. These sections are intended to:

- Provide context for the reported data by summarizing assumptions and methods underlying the data collection.
- List and explain variations from planning documents.
- Document field observations that may be helpful in understanding project data.
- Identify data that do not meet project objectives.

Detailed descriptions of the project approach and sampling methods, and other project requirements may be found in the project design document.

Sampling Description and Purpose:

The AK SOP 001 - 003 were selected to maintain consistency with data that is currently and has historically been collected within Anchorage and other regions of Alaska. These methods focus on a multi-habitat scheme. This methodology was designed to sample the variety of streams and stream habitats found in Alaska. The Alaska method was adapted from the U.S. Environmental Protection Agency Revised Rapid Bioassessment Protocols and has been modified for Alaska conditions as discussed in the AK SOP Method 001 protocol.

The Environmental and Natural Resources Institute (ENRI), of the University of Alaska Anchorage, assisted in the collection and sorting of the bioassessment work.

Biological monitoring and assessment at selected sites (not to exceed 25) was completed throughout the Ship, Chester, Campbell, and Rabbit Creek watersheds. In addition, Meadow Creek in Eagle River and one stream site in Girdwood were also be monitored and assessed. Monitoring included collecting composite benthic macroinvertebrate samples from multiple habitats within a 100m reach, physical characterization and assessment of the in-stream and riparian habitat, measurement of basic water quality parameters, and flow measurements.

The purpose of using biological monitoring in conjunction with completing grab sampling of physical and chemical assessments is to characterize the biological integrity of the waterbody, determine current biotic conditions, and generally associate the resulting information to critical stream and watershed impact factors. Sites were chosen with an attempt to reflect appropriate and discernable impact factors. Biological assessments are a useful tool to measure water quality and have demonstrated effectiveness for evaluating land use impacts, nonpoint source pollution, restoration techniques, etc.

The methods used for biological monitoring and assessment of suitable fish productivity are outlined in the Alaska Stream Condition Index (ASCI) (Major and Barbour 1997 and 1999, Major et al. 1998, Major and Houston 1999). These methods were developed and tested in 1997 with support from Alaska Department of Environmental Conservation. The methods are based on USEPA's Rapid Bioassessment Protocols for use in wadeable streams and rivers and were modified for Alaska conditions. These methods have been used to characterize reference conditions in the Cook Inlet Ecoregion since 1997. QA/QC procedures will follow those previously used and described in ASCI (Major et al. 1998). A Hydrolab Surveyor 4 Data Display unit with a MiniSonde multiprobe instrument equipped with pH, dissolved oxygen, conductivity, and water temperature sensors will be used to collect water chemistry information.

The ASCI approach uses an ecoregional reference condition to determine impacts to water bodies regarding fish productivity in Alaska based on physical stream characteristics. ENRI has already developed this reference condition information for the Cook Inlet Ecoregion and will use the existing regional reference condition information to assist with evaluating project results for Anchorage area streams.

Assessments following the ASCI methodology resulted in an index score that is based upon macroinvertebrate metrics. Physical habitat assessments and chemical water quality data were also collected on the day of sampling. It should be recognized that these grab samples only reflect the character of the site for a specific date and time. Continual monitoring for all parameters is necessary to identify chronic trends. The collected information will be used to support the information collected by the NPDES program to assess the present condition of the watershed and impacts of specific land use activities in the watershed. Sampling stations were selected to enhance coordination and collaboration with other ongoing efforts in the specified watersheds.

Monitoring Station Selection

Sampling sites were initially identified using topographic maps. Nonpoint source discharges documented through other programs were identified in order to locate the exact positions of point source discharges, so that sampling immediately downstream of these locations were avoided.

Site selection and sampling involved collecting and analyzing a small portion of the total population and then extrapolating these results to describe the total population. Statistically valid sampling requires that the samples be randomly collected, representative of the larger population, and that the results of the sampling are repeatable.

Two types of sites were selected in the bioassessment survey. These were 1) impacted sites that were influenced by some land or pollution (impacts can be from both point source and nonpoint source), and 2) reference sites that reflected the least impacted conditions possible. An ideal reference site would be in pristine, natural condition. A realistic reference site usually represents the best attainable conditions and has not experienced human affect.

The chosen sampling sites attempted to be representative of 1) having different degrees of urbanization (pristine, low-density development, and high-density development), 2) having different stream types (land use, geology, and gradient), 3) providing a range of stream conditions from good to poor, and 4) having identifiable sources of biotic degradation.

Representative locations included sampling 25+/- sites along Rabbit Creek, Ship Creek, Chester Creek, Campbell Creeks, Eagle River and Meadow Creek.

Stream habitats have different macroinvertebrate communities, habitat conditions, and chemical water quality at different times of the year. Each site was sampled following established QA/QC procedures. Sampling was conducted during periods of low flow over a three week period beginning in mid-May, 2000.

Influencing Factors

There are a variety of anthropogenic factors that impact the quality of aquatic life. Site selection attempted to specifically test and assess the degree to which combinations of critical in-stream, near-stream and watershed impact factors may effect the quality of aquatic life *in the more general case* within similar stream regimes. That is, it was the intent of this project that *general* associations be established between sampled biotic parameters and impact factors which will allow later *prediction* of biotic conditions based on mapping of impact factors alone. Selected critical "pollutant" impact factors reflected those mapped by other WMS projects (including watershed, outfall, and stream mapping projects; pollutant generation projects; receiving water chemistry projects, and storm water runoff hydrology estimates). Stations were selected so that assessed impact qualities are reasonably reflective of the overall mapped character (as reported in other WMS projects) of the reach or subreach within which they are located. Sampling stations were selected to reflect the *chronic* overall impacts of factors along whole reaches or subreaches, and were not selected to unduly reflect acute point impacts alone.

The specific factors assessed to be most influential in the local degradation of streams were:

- Increased stream flow through increased impervious surface area,
- Channelization of streams,

- Increased sediment load into the streams from anthropogenic activities (such as construction and road sanding),
- Loss of the riparian or buffer zone, next to the streams.

Twenty-five sites were identified for study (Table 2 and Figures 1 through 6)). At each site, a composite sample of 20 kicks or jabs was collected from the predominant habitat(s) over a 100m reach. Instream and riparian habitat quality was characterized. Select water-quality parameters (dissolved oxygen, pH, conductivity, temperature) were measured, reflecting instantaneous conditions, not necessarily dominant conditions . The site characterization information (habitat assessment) was also collected to further evaluate with corresponding landscape conditions that may contribute to biological impairment observed at any site. Sample replicates were collected at three sites (approximately 10 percent) to evaluate sample precision. Subsampling precision was evaluated for two samples.

Sites were organized in a matrix by the MOA Watershed Management Section, CH2MHill, and ENRI to indicate possible stressors that potentially cause impairment to local streams. These included influences to flow from high impervious surface coverage or storm drains, stream channelization, sedimentation, and loss of riparian buffer zone. The sites, also classified by low or high elevation, were grouped into three categories of stressors: (1) impervious surface (2) sediment and associated chemistry, and (3) channelization and riparian habitat degradation. Sites were designated based on suspected presence of these stressors, but multiple stressors were present at most or all of the sites. Five reference sites were also sampled to provide a benchmark against which stressed sites were compared. The seven core metrics (taxa richness, % EPT, Ephemeroptera richness, Plecoptera richness, Trichoptera richness, % Chironomidae, and % dominant taxon) and a Cook Inlet Ecoregion ASCI score were calculated for both the original and replicated samples.

Sampling Procedures for Macroinvertebrates

METHOD OVERVIEW

The goal of the field sampling technique is to collect an unbiased, random, representative sample of macroinvertebrates from the stream. "Streams in Alaska vary from high-gradient, cobble-dominated, to low gradient streams with sandy or silty sediments. Surber samplers have historically been used for macroinvertebrate collection in some studies. However, some streams lack sufficient riffle structure to support this type of sampling and depth of water in many streams prevents the use of Surber samplers (AK SOP Method 001)." The modified Alaska method takes into account the multi-habitat structure of Alaska streams and is included as Appendix A.

TABLE 2
ANCHORAGE SAMPLING SITES FOR 2000

Stream Site	Location	Sample ID
California Creek 02	Girdwood, 150m upstream from school	MACAL02A
California Creek 04	Girdwood, 250m upstream from Crow Creek Rd.	MACAL04A
Campbell Creek 06	At park on Pearl Dr., 30m below footbridge	MACAM06A
Campbell Creek 08	At Wickersham Park	MACAM08A
Campbell Creek - North Fork 07	Near end of Bragaw	MANFC07A & B
Campbell Creek - North Fork 12	From end of Klutina Dr., follow gravel trail .75 mile to stream. Site is 50m upstream.	MANFC12A
Campbell Creek - South Fork	Off Campbell Airstrip Road, 100m above Bicentennial Park footbridge	MASFC11A
Chester Creek 08	Just below North Fork confluence, access from end of Maplewood St.	MACHE08A
Chester Creek - Middle Fork	Near end of Arca Dr.	MAMCH02A
Chester Creek - South Fork 01	Between North Fork confluence and Hilstrand Pond, access from end of Maplewood St.	MASCH01A
Chester Creek - South Fork 03	Above Middle Fork confluence, access from Lake Otis Park	MASCH03A
Chester Creek - South Fork 05	Near end of Dale St., 20m below footbridge	MASCH06A
Chester Creek - South Fork 06	Near end of Dale St., 20m above footbridge	MASCH05A
Chester Creek - South Fork 09	Corner of Northern Lights and Baxter, behind Baptist church parking lot	MASCH09A
Chester Creek - South Fork 13	Below Fort Richardson, end of Early View Drive	MASCH13A
Little Campbell Creek	Upstream from Nathan Cir., near 76th Av.	MALCA01A & B
Little Campbell Creek - North Fork	Downstream of Snowview Dr.	MANFLC04A
Little Campbell Creek - South Fork 01	50m above 76th Av., access from 76th Street near Old Seward Hwy.	MASFLC01A
Little Campbell Creek - South Fork 02	At Abbott Lp. Elementary	MASFLC02A
Little Campbell Creek - South Fork 04	Near end of Abbott Loop Rd., bottom of hill, site is up from horse path	MASFLC04A
Little Rabbit Creek	Above Old Seward Hwy., up from end of access road	MALR02A & B
Meadow Creek 02	Eagle River, 50m above confluence with Eagle River	MAMEA02 A
Meadow Creek 04	Eagle River, 20m above fire station on Eagle River Rd.	MAMEA04A
Meadow Creek 06	Eagle River, below culvert at Eagle River Loop Rd.	MAMEA06A
Ship Creek 03	Below Post Rd., above dam	MASHI03A

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figure 1, Bioassessment Stations Eagle River

FIGURE 2, BIOASSESSMENT STATIONS EAST ANCHORAGE

FIGURE 3, BIOASSESSMENT STATIONS NORTH ANCHORAGE

FIGURE 4, BIOASSESSMENT STATIONS SOUTH ANCHORAGE

FIGURE 5, BIOASSESSMENT STATION RABBIT CREEK, ANCHORAGE

FIGURE 6, BIOASSESSMENT STATIONS, GIRDWOOD

QUALITY ASSURANCE

Quality assurance procedures (QA) assess the environmental variability, sampling procedures validity, repeatability of the sample methods, and identification quality. The quality assurance procedures involve a system of following standard methods and protocols, duplicate sampling, and identification reviews.

FIELD QA SAMPLING

Ten percent of all stream sites sampled or one sample per survey (which ever is greater) have a duplicate set of field samples collected. The duplicate sample is from the same sample reach. This is called a field quality assurance sample (FQA). Field QA samples look at the natural variability within a riffle and ensures that the field sampling method is repeatable.

LABORATORY QA

Ten percent of all composite samples, or one sample per survey (which ever is greater) is resorted for an additional 300 specimen sub-sample from the original preserved composite sample. The result is duplicate samples from the same composite. This is a laboratory quality assurance sample (LQA). Lab QA samples look at the variability inherent in the sub-sampling method, and ensures that the sub-sampling method is repeatable. The sample is identified as described above.

TYPE COLLECTION

A macroinvertebrate type collection will be maintained for each major basin or ecoregion studied. This collection will have a representative of each taxon and will serve to act as a basin record and as a reference for checking identifications.

4.0 Project Data Summary

Results and Discussion

Fourteen sites were assessed as good or very good for fish productivity and 11 sites were assessed as poor or very poor (Table 3). Quality assurance replicates are also included. One reference site, North Fork Campbell 07, had ASCI scores of 18 and 22 for the field sample and the field quality assurance sample, respectively. These scores reflected assessments of both good and poor, an anomaly in the data set. Overall, half of the sites designated a priori as stressed were assessed as poor or very poor. Of the 10 designated stressed sites with ASCI assessments as poor or very poor, habitat scores were very low for 7 percent of those sites. The remaining 3 sites assessed as poor or very poor had habitat scores above the threshold level of 160/200 and one was an anomaly. No other consistent pattern emerged regarding the influence of the three dominant stressor categories (i.e. impervious surfaces, sediment/chemistry, channelization/habitat), to the assessment result. Habitat assessments and water chemistry analyses are presented in Table 4.

A basin-by-basin perspective of the assessments conducted in 2000 is summarized below in Table 3. Several tributaries and sites were assessed within the Campbell Creek basin (mainstem, North Fork and South Fork Campbell, and North and South Fork Little Campbell). The two mainstem sites and Little Campbell Creek sites were a priori designated as stressed, while the North and South Fork Campbell Creek sites were a priori designated as reference sites. The upper Campbell Creek mainstem site (08) was assessed as poor with a habitat score of 111/200 while the lower mainstem Campbell Creek site (06) was assessed as good with a slightly improved habitat score of 146/200. Within the Little Campbell Creek basin, all sites displayed compromised assessments receiving poor or very poor ASCI assessments. Habitat scores were very low for most of these sites ranging from 89 to 127/200 with the exception of the upper site on South Fork Little Campbell Creek (04), which displayed a habitat score of 167/200. South Fork Campbell Creek was assessed as very good in 1999 and as good in 2000 with a habitat score of 186/200. North Fork Campbell Creek was assessed in good condition with the exception of one sample at the North Fork 07 that resulted in an assessment of poor. Habitat assessments for the North Fork Campbell Creek were consistently high in a previous 1999 study (ranging from 171/200 to 182/200) and remained consistent at 185/200 in 2000.

For the Chester Creek basin, most sites were located in the upper portion of the basin on the South Fork. One site each on the middle Fork and mainstem were also evaluated. Assessments of the South Fork Chester Creek sites ranged from poor (upstream) to very good (downstream). A longitudinal analysis of land use compared to bioassessment results

TABLE 3
CORE METRIC VALUES AND ASCI SCORES FOR 2000

Total Taxa	E Taxa	P Taxa	T Taxa	% EPT	% Chiro-nomidae	% Dom. Taxon	ASCI Score	Assessment	Primary Stressor
15	3	4	2	89	7	60	30	good	
14	4	3	2	88	8	47	32	good	
13	0	3	3	14	58	58	26	good	impervious surfaces
16	3	3	1	14	69	69	20	poor	impervious surfaces
13	2	3	1	15	72	72	18	poor	
19	3	2	3	12	74	74	22	good	
14	4	2	2	36	59	59	26	good	
18	5	3	3	33	61	61	32	good	
13	1	2	3	11	51	51	24	good	sediment/chemistry
8	1	1	2	2	20	76	20	good	impervious surfaces
16	1	4	3	15	57	57	30	very good	impervious surfaces
13	1	3	2	15	26	27	30	very good	sediment/chemistry
12	1	0	5	13	39	39	26	good	impervious surfaces
11	1	1	3	18	42	42	22	good	impervious surfaces
11	1	3	2	16	64	64	18	poor	channelization/habitat
13	1	1	3	12	75	75	18	poor	channelization/habitat
7	0	0	1	0	90	89	4	very poor	sediment/chemistry
4	0	0	1	0	93	93	2	very poor	sediment/chemistry
3	1	0	0	0	95	95	2	very poor	sediment/chemistry
7	0	0	1	0	94	94	4	very poor	impervious surfaces
8	0	0	2	1	90	90	6	very poor	sediment/chemistry
14	2	3	2	10	87	87	14	poor	channelization/habitat
11	1	1	2	9	76	76	12	poor	impervious surfaces
19	4	5	2	66	28	36	36	very good	impervious surfaces
14	4	3	2	64	26	30	32	good	impervious surfaces
13	2	3	2	63	16	45	30	good	channelization/habitat
11	2	4	2	78	18	56	26	good	channelization/habitat
18	3	4	3	56	15	30	36	very good	sediment/chemistry
13	3	3	2	68	19	43	32	good	sediment/chemistry
11	4	2	1	3	63	63	18	poor	sediment/chemistry

TABLE 4
HABITAT ASSESSMENT AND WATER CHEMISTRY DATA FOR 2000.

Stream Site	Date	Habitat Score	Water Temperature (c)	Conductivity (us/sec @ 25 C)	Dissolved Oxygen (mg/L)	pH	Total Dissolved Solids (mg/L)
California Creek 02	6/1/00	182	4.02	73.3	12.51	7.49	0.0467
California Creek 04	6/1/00	188	4.30	71.3	12.38	5.91	0.0459
Campbell Creek 06	5/23/00	147	6.16	92.5	11.53	7.42	0.0590
Campbell Creek 08	5/23/00	111	7.37	87.8	10.24	7.46	0.0556
Campbell Creek - North Fork 07	5/24/00	185	6.34	127.0	11.60	7.25	0.0814
Campbell Creek - North Fork 12	5/25/00	182	2.79	129.7	12.57	6.12	0.0827
Campbell Creek - South Fork	5/23/00	186	5.20	73.3	12.74	7.39	0.0470
Chester Creek 08	5/22/00	172	8.70	240.0	11.13	6.64	n.a.
Chester Creek - Middle Fork	5/22/00	174	7.24	343.7	11.00	7.05	0.2200
Chester Creek - South Fork 01	5/22/00	170	8.70	240.0	11.13	6.64	n.a.
Chester Creek - South Fork 03	5/22/00	161	9.87	201.7	11.07	6.65	0.1291
Chester Creek - South Fork 05	5/22/00	156	11.00	190.0	9.42	7.64	0.1200
Chester Creek - South Fork 06	5/22/00	165	11.00	190.0	9.42	7.64	0.1200
Chester Creek - South Fork 09	5/23/00	98	5.29	146.4	12.29	7.33	0.0940
Chester Creek - South Fork 13	5/23/00	95	3.88	116.7	11.83	6.72	0.0748
Little Campbell Creek	4/24/00	89	6.98	240.8	10.52	7.05	0.1546
Little Campbell Creek - North Fork	5/24/00	112	7.47	240.2	11.50	7.40	0.1542
Little Campbell Creek - South Fork 01	5/24/00	104	6.18	199.9	11.51	6.34	0.1282
Little Campbell Creek - South Fork 02	5/24/00	127	8.29	184.7	11.02	8.00	0.1131
Little Campbell Creek - South Fork 04	5/25/00	167	6.96	185.6	11.18	7.16	0.1190
Little Rabbit Creek	5/25/00	176	5.56	100.9	11.93	7.37	0.0652
Meadow Creek 02	5/26/00	169	3.79	208.1	12.39	7.77	0.1330

TABLE 4
HABITAT ASSESSMENT AND WATER CHEMISTRY DATA FOR 2000.

Stream Site	Date	Habitat Score	Water Temperature (c)	Conductivity (us/sec @ 25 C)	Dissolved Oxygen (mg/L)	pH	Total Dissolved Solids (mg/L)
Meadow Creek 04	5/26/00	176	4.36	205.1	12.14	7.79	0.1325
Meadow Creek 06	5/26/00	164	2.24	202.8	12.83	7.42	0.1301
Ship Creek	5/23/00	162	5.54	137.1	11.68	6.39	0.0890

should result in an explanation of this pattern. Upper South Fork Chester Creek, located near Fort Richardson and Chugach State Park, drains undeveloped land. The stream, flowing generally westward, then transects roughly 6 km of heavy suburban development in eastern Anchorage, where the channel has been straightened and habitat altered for much of its length. South Fork Chester Creek sites 13 and 9, both located within this reach, were assessed as poor (Tables 3 and 4) with habitat scores of 95/200 and 98/200 that reflected the anthropogenic impacts. This is consistent with documented influences of development on streams (Garie and McIntosh 1986).

The stream is then impounded for ~0.5 km at University Lake, below which it flows through about 2.5 km of less developed areas marked by somewhat intact riparian zones near Providence Hospital and the University of Alaska Anchorage. South Fork Chester Creek sites 06 and 05, both located within this reach, were assessed as good, where the stream flows through buffered areas. Similar observations were made in New Zealand by Storey and Cowley (1997) as streams passed from pasture into small segments of forest. Habitat scores were 156/200 for site 06 and 165/200 for Site 05.

Below these sites, South Fork Chester Creek flows through the Chester Creek Greenbelt, with relatively intact riparian zones and limited road crossings. Sites within the greenbelt were assessed as very good (South Fork Chester Creek 3 and 1) with habitat scores of 161/200 and 170/200 respectively or good (Chester Creek 8) with a habitat score of 172/200. Middle Fork Chester Creek was also sampled just below the beginning of the greenbelt area and was assessed as good with wide buffered areas and good habitat (174/200).

All sites in the Chester Creek basin below Fort Richardson were a priori designated as stressed for one or more factors. Results of this study suggest that urban streams with intact riparian areas do not display compromised macroinvertebrate communities. Habitat quality appears to have the most pronounced impact on the biota. Further macroinvertebrate assessments, basic water chemistry, fish surveys, in-depth habitat characterization, and periphyton parameters may yield more information regarding the influence of riparian areas to the biota of Anchorage streams.

The California Creek (n = 2) and Meadow Creek (n = 3) sites were assessed as good or very good consistent with a priori designations. Habitat scores were 182/200 and 188/200 for California Creek and 169/200 and 176/200 for Meadow Creek. Little Rabbit Creek (1 site) was assessed as very good in both 1999 and 2000, counter to its a priori stressed designation with a habitat score of 176/200. Lower Ship Creek (n = 1) was assessed as poor and is consistent with its a priori designation. The habitat score for lower Ship Creek is just above the threshold value at 162/200. A USEPA superfund site is located in this basin between the lower (Ship03) and the upper site (Ship10). The upper site was assessed as very good in 1999 by ENRI with a habitat score of 177/200.

Recommendations

Sufficient analysis has not been performed to allow associations of the 2000 field observations with any particular stressor (i.e. impervious surfaces, sediment/chemistry, channelization/habitat). Establishing definitive conclusions regarding the influence of these stressors were not part of this project. This information along with data on land use and riparian habitat patterns, currently being collected, is intended to establish these relationships. The absence of any pattern may be due to the imprecise quantification of stressors within each watershed, where sites were classified based on the presence and not the extent of a stressor. Multiple stressors were present in most watersheds, confounding the ability to detect specific cause and effect patterns.

Precision

An estimate of the variability in sampling techniques is important to evaluate the reliability of results. Three replicate field samples were collected (representing approximately 10 percent of the sites). The core metrics were calculated and ASCI scores were assigned for both the original and replicated samples. The replicate scores were then used to calculate precision (100 percent minus coefficient of variation [CV]) for each core metric and the ASCI score (Table 5).

Using similar methodology, the precision of laboratory subsampling techniques was also assessed. Laboratory subsamples were replicated for two sites by collecting and evaluating duplicate subsamples of 300 organisms. Precision was calculated for each core metric and the ASCI score (Table 5).

Sampling precision for core metrics ranged from 71 percent to 96 percent, with ASCI sampling precision at 77 percent. Subsampling precision for core metrics ranged from

TABLE 5
SAMPLING AND SUBSAMPLING PRECISION (%) FOR SEVEN CORE METRICS AND ASCI SCORE IN 2000

Metric	Sampling Precision (n=3)	Subsampling Precision (n=2)
Total Taxa	71	66
E Taxa	91	75
P Taxa	79	90
T Taxa	76	75
% EPT	95	91
% Chironomidae	96	94
% Dominant Taxon	94	90
ASCI Score	77	71

66 percent to 91 percent. Subsampling ASCI precision was 71 percent. In some cases, precision was below the 80 percent recommended by Barbour (2000), but precision estimates with such small sample sizes are not entirely reliable. Overall, these precision estimates indicate no gross violation of repeatability in sampling and subsampling techniques.

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Appendix A
Alaska SOP Methods 001, 002, 003, and 004

Appendix B
Primary Field Data

Appendix C
Comparison of MOA Stream Habitat Classification with Alaska Stream Habitat Classification

COMPARISON OF MOA STREAM HABITAT CLASSIFICATION WITH AK STREAM HABITAT CLASSIFICATION

Attribute	MOA	Description	AK	Description	Comparison
1	Site ID	As per MOA Standard	Site ID	As per AK Standard	Use MOA Standard
2	Channel Profile Class	Modified Rosgen Classification: Classic, Flat, Run, Cascade, Braided, Bog, Piped, Irregular, Rivulet, Continuity	Rosgen Classification	Indicated on Field Data Sheet	Use MOA Standard (Modified Rosgen) on Field data sheet
3	Channel Modification	Unmodified (1), Slightly Modified (2), Modified (3), Highly Modified (4)	Channel Alteration	Optimal (16 - 20) = Channelization or dredging absent or minimal, stream normal. Suboptimal (11 -15) = Some channelization present, usually in areas of bridge abutments, evidence of past channelization (i.e. dredging, greater than past 20 yr.) Marginal (6 - 10) = Channelization may be extensive; embankments or shoring structures present on both banks; 40-80% of stream reach channelized and disrupted. Poor (0 - 5) = Banks shored with gabion or cement; over 80% of reach channelized and disrupted. Instream habitat greatly altered or removed entirely.	Unmodified (1)= Optimal (16-20) Slightly Modified (2) = Suboptimal (11-15) Modified (3) = Marginal (6-10) Highly Modified (4) = Poor (0-5)
4	Channel Evolution Class	Equilibrium, Degradation, Widening, Aggregation	Not collected		Do Not Collect
5	Bankfull Width (BFW)	Mean annual flood stage	High water mark denoted	Estimated from deepest point in stream	Do Not Collect
6	Flood Prone Width (FPW)	2 times the maximum depth at bankfull stage.	Not collected		Do Not Collect
7	Entrenchment	Ratio of the FPW to BFW, 1 to 1.4 = entrenched streams, 1.41 to 2.2 = moderately entrenched, >2.2 = slightly entrenched	Not collected		Do Not Collect

COMPARISON OF MOA STREAM HABITAT CLASSIFICATION WITH AK STREAM HABITAT CLASSIFICATION

Attribute	MOA	Description	AK	Description	Comparison
8	Maximum and Mean Bankfull Width	Direct Measurement	Not collected		Do Not Collect
9	Slope	Direct Measurement	Gradient % drop over a 25 m distance	Direct Measurement	Follow MOA Standard
10	BFW:Bankfull Depth (BFD) Ratio	Direct Measurement	Not collected		Do Not Collect
11	Sinuosity Class	Ratio of stream length to down valley distance. 1 to 1.2 = low sinuosity, 1.2 to 1.5 = medium sinuosity, >1.5 = high sinuosity	Channel Sinuosity	Optimal (16 - 20) = Bends in stream increase the length 3-4 times longer than straight line. Suboptimal (11 -15) = Bends in stream increase the length 2-3 times longer than straight line. Marginal (6 - 10) = Bends in stream increase the length 2-1 times longer than straight line. Poor (0 - 5) = Channel straight, waterway has been channelized.	Follow MOA Standard Low sinuosity = Poor Medium = Suboptimal and Marginal High Sinuosity = Optimal
12	Bed Material	1 = silt/clay, 2 = silt/sand, 3= sand/gravel, 4 = gravel/cobble, 5 = cobble/boulders, 6 = peat/roots, 7 = bedrock	Inorganic/Organic Substrate Components	Data Collected on the field data sheet	Data sheets have direct measurement of substrate types, can convert or record as per MOA standard.
13	Bank Material	1 = silt/clay, 2 = silt/sand, 3= sand/gravel, 4 = gravel/cobble, 5 = cobble/boulders, 6 = peat/roots, 7 = bedrock	Not collected		Do Not Collect
14	Canopy	Percentage of stream shaded by canopy.	Percent Canopy Cover	Circled Value <20 % open	Use MOA Standard.

COMPARISON OF MOA STREAM HABITAT CLASSIFICATION WITH AK STREAM HABITAT CLASSIFICATION

Attribute	MOA	Description	AK	Description	Comparison
		1 = <10% 2 = 10 - 30% 3 = 31 - 50% 4 = 51 -75% 5 = >75%		20 - 40% open 40 - 60% open >80% open	
15	Bank Under Cut	Percentage of Bank that is undercut. 1 = <10% 2 = 10 - 30% 3 = 31 - 50% 4 = 51 -75% 5 = >75%	Not collected		Do Not Collect
16	Invertebrate Habitat	Leaf packs, gravel, cobble/boulders, fine woody debris, submerged logs, undercut bank	Substrate Characteristics	Optimal (16 - 20) = Mixture of substrate materials, gravel and firm sand may be prevalent; root mats and submerged vegetation common. Suboptimal (11 -15) = Mixture of soft sand, mud, or clay, some root mats and submerged vegetation present. Marginal (6 - 10) = all mud clay or sand, little or no root mat, no submerged vegetation. Poor (0 - 5) = Hard pan clay or bedrock	Can convert or report as MOA standard

COMPARISON OF MOA STREAM HABITAT CLASSIFICATION WITH AK STREAM HABITAT CLASSIFICATION

Attribute	MOA	Description	AK	Description	Comparison
17	Fish Cover	Logs and large woody debris, root mats/wads, deep pools, undercut banks, cobble/boulders, dense macrophyte beds, riffles, isolated backwater pools, overhanging vegetation	Epifaunal Substrate/Available Instream Cover	Optimal (16 - 20) = >70% of substrate favorable for colonization, mix of snags, submerged logs, undercut banks, cobble or other stable habitat. Suboptimal (11 -15) = 40 - 70% mix of stable habitat Marginal (6 - 10) = 20 - 40% mix of stable habitat, substrate frequently disturbed or removed. Poor (0 - 5) = <20% stable habitat available	Data is reported on Field data sheets, can report or convert to MOA standard, with each type adding a point to the score. Scores can vary from 0 to 9. 6-9 = Optimal 4-5 = Suboptimal 2-3 = Marginal 0-2 = Poor
18	Not Collected		Velocity-Depth Combinations	Optimal (16 - 20) = All four velocity-depth combinations present (slow-deep, slow-shallow, fast-deep, fast-shallow). Suboptimal (11 -15) = Only 3 of the 4 combinations present. Marginal (6 - 10) = Only 2 of the combinations present. Poor (0 - 5) = Dominated by 1 velocity-depth combination (usually slow-deep)	Remain to collect as part of bioassessment, not reported on MOA format.
19	Not Collected		Channel Flow Status	Optimal (16 - 20) = Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. Suboptimal (11 -15) = Water fills >75% of the available channel; or <25% of channel substrate is exposed. Marginal (6 - 10) = Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed. Poor (0 - 5) = Very little water in channel and mostly present as standing pools.	Remain to collect as part of bioassessment, not reported on MOA format.
20	Not Collected		Bank Stability	Optimal (16 - 20) = More than 90% of the streambank & immediate riparian zone surfaces	Remain to collect as part of bioassessment, not

COMPARISON OF MOA STREAM HABITAT CLASSIFICATION WITH AK STREAM HABITAT CLASSIFICATION

Attribute	MOA	Description	AK	Description	Comparison
				covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruptions through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. Suboptimal (11 -15) = 70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. Marginal (6 - 10) = 50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation. Poor (0 - 5) = Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.	reported on MOA format

COMPARISON OF MOA STREAM HABITAT CLASSIFICATION WITH AK STREAM HABITAT CLASSIFICATION

Attribute	MOA	Description	AK	Description	Comparison
21	Not Collected		Riparian Vegetative Zone Width (Each Bank Scored)	Optimal (16 - 20) = Width of riparian zone >18 meters; human activities (i.e. parking lots, roadbeds, clear cuts, lawns, or crops) have not impacted zone.	Remain to collect as part of bioassessment, not reported on MOA format
				Suboptimal (11 -15) = Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	
				Marginal (6 - 10) = width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	
				Poor (0 - 5) = Width of riparian zone <6 meters; human activities have impacted zone a great deal.	
		Estimated Stream Depth	Measured as Stream Depth	Three depth measurements collected over the 100 m distance for Riffle, Run. Pool, with % length for each along the 100-m distance as well.	Remain to collect as part of bioassessment, not reported on MOA format
22	Not Collected		Sediment Deposition	Optimal (16 - 20) = Little or no enlargements of islands or point bars and <5% of bottom affected by sediment deposition.	Remain to collect as part of bioassessment, not reported on MOA format
				Suboptimal (11 -15) = Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of bottom is affected; slight deposition in pools	
				Marginal (6 - 10) = Moderate deposition of new gravel, sand on old and new bars; 30-50% of bottom affected; deposits at obstructions, bends and constrictions; moderate deposition of pools prevalent.	
				Poor (0 - 5) = Heavy deposits of fine material, increasing bar development; >50% of bottom changing frequently; pools almost absent due to major sediment deposition.	