Rick Mystrom, Mayor

Meltwater Runoff from Anchorage Streets and Snow Disposal: 1999 Data Report

Document No. WMP APr99003

MUNICIPALITY OF ANCHORAGE
WATERSHED MANAGEMENT PROGRAM

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Department of Public Works

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WATERSHED MANAGEMENT

Department of Public Works

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Abbreviations

µs/cm	microSiemen per centimeter
AKDOT/PF	Alaska Department of Transportation and Public Facilities
BMP(s)	best management practices
BOD	biochemical oxygen demand
CBD	Central Business District
cfs	cubic feet per second
CL	chloride (mg/L)
DHHS	Department of Health and Human Services
DPW	Department of Public Works
EC	specific conductivity (µS/cm)
EPA	United States Environmental Protection Agency
meq/L	millequivalent per liter
mg/L	milligram per liter
mmol	millimoles
MOA	Municipality of Anchorage
USGS	United States Geological Survey
WMP	Watershed Management Program
WMS	Watershed Management Section

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Summary

This 1999 data collection effort focused on two snow disposal sites (Tudor and North Mountain View) and three street sites (5th Avenue, Tikishla, Gambell/Ingra) to analyze the effect of street snowmelt runoff on receiving waters, and to verify and refine existing chloride runoff models. Temporal and spatial correlations were made at each site for chloride and flow. Spring melt commenced at the street sites in late March, and at the snow sites in late April. All sites indicated large diurnal trends in conductivity, chloride and flow, with peaks in the late afternoon, evening or early morning. Average daily conductivity and chloride events peaked weeks prior to flow peaks at snow disposal sites. Average daily conductivity and chloride events peaked the same day, just prior to flow peaks at street sites.

At the Tudor Snow Disposal Site, sampling was performed on site discharge meltwater, with corresponding receiving water stations upstream and downstream. Site discharge meltwater was first observed April 19. The bulk of the site discharge meltwater had flowed from the site by May 27, although low flows were noted through June. Peak chloride levels at downstream receiving water station CHS001 were calculated to be <1,000 mg/L during the entire melt period, with significant diurnal trends. Average daily flows of the site discharge meltwater peaked 18 days after peak chloride concentrations at CHS001. Sample analyses of site discharge meltwater and the receiving water creek indicated that between 58% – 80% of the chloride concentration in individual samples was from sodium chloride, and about 15% - 24% of the chloride concentration was from magnesium chloride. Comparison to 1998 data suggested a decrease in lag time for site discharge meltwater to reach the receiving water, from 8 days in 1998 to 4 days in 1999. Also, peak chloride levels recorded in 1999 were not as high as those sampled in 1998 meltwater.

At the North Mountain View Snow Disposal Site, sampling was performed on site discharge meltwater, with a corresponding downstream water station. Site discharge meltwater was first observed April 19. The bulk of the site discharge meltwater had flowed from the site by May 3, although low flows were noted through June. Peak chloride levels were observed at the initiation of site discharge. Peak chloride levels from samples taken at North Mountain View Snow Disposal Site site discharge station MTV01 (before meltwater entered the stormwater system) were calculated to be >1000 mg/L for 6 days during the recorded snowmelt period. For meltwater, between 42% – 50% of the chloride concentration in individual samples was from sodium chloride, and about 43% - 56% was from magnesium chloride. Receiving water chloride sampling at station NCH001, directly below the stormwater discharge point along the North Fork of Chester Creek, did not exceed 150 mg/L, and conductivity measurements did not exceed 350 µS/cm during the recorded

snowmelt period. Overall, less than 15% of the chloride in samples at creek station NCH001 could be accounted for by sodium and magnesium chloride. Although significant levels of chloride were discharged from the site, there was no documented exceedence of Alaska water quality standards for chloride (230 mg/L) at NCH001 during the site snowmelt.

The 5th Avenue Site discharges directly into Cook Inlet from the Central Business District (CBD). Meltwater from the 5th Avenue Site began to flow March 20, and the melting event ended March 31. Data from the 5th Avenue Site indicated strong diurnal trends, with conductivity and chloride peaks rising almost simultaneously just before flow peaks. The conductivity peak (995 mg/L) occurred a day before peak flow was recorded. Near the peak of the street melt period, meltwater analyses indicated that 29% of the chloride was from sodium chloride, and about 34% of the chloride concentration in samples was from magnesium chloride. Significant chloride peaks after March 30 are believed to be from additional deicing events.

Tikishla Site is located at Tikishla Park. The Tikishla Site spring melt event began later than the 5th Avenue Site, beginning March 26 and ended April 9. Large diurnal trends were noted in conductivity of the discharge to Chester Creek (TK01). Chloride in runoff increased during the spring melt, and small increases to downstream values were noted. The largest chloride grab sample difference for Chester Creek was approximately 21 mg/L, recorded between upstream (CHTK001) and downstream (CHTK002) sample stations at the height of the snowmelt runoff. The highest chloride value recorded at CHTK002 was 215 mg/L. Meltwater contained much higher concentrations of sodium than magnesium.

The Gambell/Ingra Site spring melt event began March 20 and ended March 29. Downstream (CHGI005) values in Chester Creek were low relative to street runoff outfall chloride values; 118 mg/L was the highest recorded chloride concentration (CHGI005). The largest difference between upstream (CHGI001) and downstream (CHGI005) values was 43.3 and 43.7 mg/L, recorded on March 14 and March 21, respectively. Analysis of street runoff flows indicated that they were significantly higher in sodium and magnesium than creek flows, and that sodium was the dominant cation. A wash experiment to analyze for entrained chloride on city streets was performed at the site after snowmelt had ended. This experiment indicated that 0.38 mg/L per square foot of magnesium chloride was entrained on the washed pavement, which equated to 0.02% of winter applied magnesium chloride.

Available lake data was also analyzed for chloride content over time, with specific conductivity used as a surrogate for chloride. The results of the data search did not indicate any apparent trend in time for data currently available.

Introduction

The information described in this data report was collected by Montgomery Watson under Department of Public Works (DPW) Watershed Management Section (WMS) Project No. 95004. The data collection effort was made to meet design parameters defined in Municipal Assessment Document No. WMP APd99002, *"Design for Assessment of Chloride Impacts From Snow Disposal Sites and Street Runoff"* (Brown and Rice, 1999). The following subsections summarize project background information, primary data collection objectives, important limitations of actual data collected, and report organization.

Project Purpose

The Municipality of Anchorage (MOA) and the Alaska Department of Transportation and Public Facilities (AKDOT/PF) are currently using aqueous solutions of magnesium chloride on streets throughout the city to enhance vehicle traction during winter months. In 1998, public concerns were raised about the potential for negative environmental impacts from deicer use.

To address these concerns, WMS designed and implemented, in spring of 1998, an exploratory assessment of deicer effects. This assessment was primarily concerned with the environmental effects of chloride. Other potential effects stemming from metals contained in the product and biochemical oxygen demand (BOD) were estimated using existing data, or considered, but not addressed, based on low toxicity, mobility, or concentration.

FOCUS OF THE 1998 PROJECT

- The 1998 project design and data collection effort focused on deicer contained in snow disposal sites. Sampling data from three sites included in the study were used to construct a model to predict receiving water impacts from all area snow disposal sites. Additionally, the project report also considered creek effects of deicer remaining on streets at the end of the winter, and creek effects of solid sodium chloride contained in vehicle-traction sand. The 1998 project was presented in the documents listed below.
- Assessment design, 1998: "*Magnesium Chloride Deicer in Snow Disposal Sites at Anchorage, Alaska: Assessment Design,*" WMS Document No. WMP APd98001 (Wheaton, 1998a)
- Data collection effort and results summary: "*Magnesium Chloride Deicer in Snow Disposal Sites at Anchorage, Alaska: Data Report,*" WMS Document No. WMP APr98001 (Wheaton & Bischofberger, 1998b)

- Findings and interpretations: "*Anchorage Street Deicer and Snow Disposal 1998 Best Management Practices Guidance,*" WMS Document No. WMP APg98001 (Wheaton & Bischofberger, 1998c)

CONCLUSIONS OF THE 1998 PROJECT

The general conclusion of the 1998 deicer project was that chloride from current levels of sand and deicer use (both AKDOT/PF and MOA) does not appear to be adversely impacting area receiving waters. The report also contained recommendations for further study of chloride sources and fates, and for implementation of snow disposal site best management practices (BMP). Based on the conclusions of the report, the United States Environmental Protection Agency (EPA) required MOA to conduct further studies on chloride impacts, including:

1. Spring break-up monitoring of several snow disposal sites in 1999 (including one site used in the 1998 study) to confirm 1998 modeling results demonstrating the effects of chloride contained in snow site runoff.
2. Spring break-up monitoring of several area creeks in 1999 to confirm 1998 modeling results demonstrating the effects of chloride contained in street runoff.

The continued monitoring of snow disposal sites and creeks was not only intended to confirm modeling results, but also to refine existing predictive models and assess the effectiveness of BMPs implemented as a result of the 1998 Deicer Assessment. Differentiation was also made between environmental impacts due to chloride derived from sodium chloride contained in street sand or from magnesium chloride deicer.

ADDITIONAL PROJECT CONCERNS

Although not specified in directives from the EPA, municipal watershed managers also wanted to address the effects of deicer used as a dust palliative. During the winter of 1998-99, the State Department of Transportation (AKDOT) used deicer exclusively for vehicle traction enhancement at the Gambell/Ingra Site between Fireweed Lane and 15th Avenue. This pilot study was designed to determine if substituting deicer for sand resulted in improved air quality. Consequently, chloride concentrations in street runoff from the study site, and associated impacts to Chester Creek, were studied to assess environmental implications of expanded deicer uses. Historic lake data was also analyzed to assess current levels of chloride and trends through time.

Problem Statements

Based on the above discussion, this data report is intended to present information critical to answering the following watershed management questions:

- Did 1998 magnesium chloride and sodium chloride modeling data accurately represent chloride impacts on Anchorage area creeks from snow disposal sites and city streets?
- What was the effectiveness of the BMP implemented at snow disposal sites for the winter of 1998/99?
- What were the relative concentrations of chloride derived from magnesium chloride (deicer) and sodium chloride (vehicle traction sand) contained in snow disposal site meltwater and street runoff?
- What are the probable consequences to area receiving water quality if magnesium chloride deicer is widely used as a dust palliative?

Data Limitations

Information acquired for this study is generally representative of 1999 Anchorage street deicer and snow disposal site systems. The study focuses primarily on the implications of chloride deicer use on receiving waters and does not address implications for traffic safety, or changes in current practices to alternative forms of street deicing.

This project was performed at the exploratory level, and was focused on the most important processes associated with deicer use. Assumptions used in considering the most important processes associated with deicer use may only be partly correct. Collected data represents the unique climatic and application processes present over the 1998-1999 winter season, and can only be approximately calibrated to average Anchorage conditions. Similarly, these results can only be extrapolated to other deicing practices where these practices are reasonably similar. Given the limitations of the study, however, it is believed that the results of the investigation are reasonably representative and useful in meeting the management needs of MOA.

This data report is meant to describe the quality and character of the collected data only, in context of the 1999 design document (Brown and Rice, 1999). It contains validated data (data that has been determined to be reasonably free of error) that can be used in later analysis to answer watershed management questions as appropriate.

Project Organization

This data report was preceded by a project design (Brown and Rice, 1999). The specific intent of the data report is to summarize the history of data collection and validation efforts, and graphically display principle data characteristics. The data report also makes available the collected, validated data.

This investigation was performed with participation and funding of the WMS Project Management and Engineering Division of DPW. WMS provided review and oversight of the collection process, and DPW provided construction and infrastructure support. Montgomery Watson performed the data collection effort.

Organization of Data Report

This document has been organized in the following manner:

Introduction. Summarizes the context of the 1999 Deicer Assessment, presents a statement of the information required by watershed managers, and describes the organization of this document.

Data Collection. Briefly describes the method and logic used in the 1999 data collection effort.

Data Summary. Describes the collected snow disposal sites, street runoff and lake data.

References. Contains the references cited in this report.

All figures and tables follow the written text. Selected field observations and data tabulations are appended.

Data Collection

This section documents how data were reported and used to represent street deicer use systems, processes and runoff from streets and snow disposal sites. It also describes how data were collected, and any significant variations from the original sampling design. Lastly, it summarizes data quality achievements and identifies collection problems and resolutions.

Data Purpose

MOA intends to use data collected for this project to confirm and refine 1998 interpretive results. Refinement of interpretive results responds to EPA and MOA requirements, as stated in Section 1.1. Project data will be used as a basis for continued development of BMP guidance, specifically for snow disposal and chloride street deicer application. Data collection design and parameters were specifically chosen to address critical system elements within the guidance development context. Based on the need to verify and refine interpretive models used in 1998, the identified critical system elements were:

- Peak and average concentrations of chloride in meltwater, treated meltwater, and receiving waters (lakes and streams).
- Meltwater (defined as snow site discharge before treatment).
- Stream flow.
- Major anions and cations (sodium, magnesium, potassium, calcium, chloride, sulfate, alkalinity).
- Area of drainage basins associated with study sites.
- Streets within each studied basin segregated by road type (residential, collector, minor arterial, major arterial).
- Mass of sodium chloride and magnesium chloride applied to each basin in the study.

These critical system elements are consistent with the 1998 Deicer Assessment (Wheaton, 1998a).

SPATIAL SITE SELECTION

Designers chose two snow disposal sites and three street sites for data collection. The two snow disposal sites chosen represented possible variations in street deicing and sanding conditions, and provided an opportunity to evaluate BMPs that were constructed during the 1998 summer season. To evaluate deicer runoff from streets, three sites were chosen to represent variations in land use and applications, and to differentiate between environmental effects of sodium and magnesium chloride deicer. At each of the snow disposal sites, and two of the street sites, samplers collected data on the quality of the meltwater, and the quality and volume of the receiving water. In accordance with the design, receiving water stations were chosen that roughly bracketed the extent of significant upstream and downstream effects. At the third street site, only data on the volume and quality of the meltwater was collected, as it discharged directly into Cook Inlet. Sampling this location allowed the direct measurement of chloride concentrations in street runoff that were unaffected by contributions from chloride derived from street sand, since traction sand was not applied on the contributing basin.

Temporal Change Sampling

In addition to sampling spatially, data were also collected to assess temporal changes in meltwater and receiving waters. Sampling occurred from beginning to end of the snowmelt period at each site, at frequencies that characterized changes in the critical system elements over the melt period time frame.

Data Collection

This section summarizes the history and performance of the data collection effort. Its primary focus is unusual events, or variations from the design document, which contains the original schedules and protocols followed in the data collection effort.

DATA COLLECTION HISTORY

Data collection at street sites began March 5, 1999, prior to discharge of street runoff into receiving waters. Generally, snow and ice from Anchorage urban streets and commercial parking lots had not yet melted within the street study basins. However, when data collection for snow disposal sites began March 18, generally snow and ice had started to melt from the urban streets and commercial parking lots surrounding the snow sites (significant accumulations of snow still remained in residential yards and vegetated areas). Data collection at all sites ended June 10, 1999. Table 1 lists the sampling stations and Table 2 tabulates sampling performed at each of the sites.

Data Collection Sites

The following snow disposal sites were selected for data collection and are depicted in Figure 1:

- Tudor Snow Disposal Site was chosen due to documented chloride concentrations above the state water quality criteria (250 mg/L) in a nearby tributary of Chester Creek in 1998.

- North Mountain View Snow Disposal Site, along with sampling station NCH001, was chosen because 1998 modeling results suggested that site meltwater discharging to the North Fork of Chester Creek may elevate chloride concentrations in the receiving water to levels that threaten the Alaska water quality standard of 250 mg/L (Wheaton et al., 1999c).

Locations of the three street sites are also depicted in Figure 1. The street sites chosen were:

- 5th Avenue Site, which drains the CBD and discharges into Cook Inlet, a basin where only deicer was used and no sanding was performed.
- Gambell/Ingra Site, which drains Gambell and Ingra streets as they merge into the Seward Highway and discharges into Chester Creek. Both sand and deicer were used in this basin.
- Tikishla Site, which drains a large residential neighborhood and discharges into Chester Creek. Both sand and deicer are used in this basin.

Sampling Methods

At each site, various meltwaters and receiving waters were sampled for flow, conductivity, calcium, sodium, potassium, magnesium, sulfate, chloride and bicarbonate ions. Observed trends in field electrical conductance measurements were used to guide the selection of samples for laboratory analysis, and samplers kept photographic documentation of the melt process at each site. Timing for sample collection consisted of spring sampling for the melt event one to two times per day, three times a week or more, depending on whether or not the melt event was at a peak at a selected site. Data loggers, conductivity measurements, and grab sample collection were all used to obtain data. Flow and conductivity measurements were collected by both grab samples and data loggers at selected sites.

Sample Handling and Analysis

At the end of a sampling day, samples were immediately cooled for best preservation. Every 2 weeks or less, samples were checked, and selected samples sent to a state-certified laboratory for chloride and other analyses. Samples were tracked by standard chain-of-custody protocols, and data were reviewed and compiled in a format that would allow refinement of sampling procedures based on updated information. All analytical and field data were compiled and validated, and derived values calculated at the end of the project.

VARIATIONS FROM DESIGN

Samplers only revised sampling locations at the Tudor Snow Disposal Site, through the addition of new stations. These new stations provided a more complete picture of the meltwater system at Tudor during the 1999 meltwater period. A complete list of sampling stations is shown in Table 1. Samplers mainly adhered to scheduled sampling times, although variation occurred as samplers attempted to reflect individual site melt rates. These changes were made to maintain good representation of site conditions and quality of data gathered.

Data Quality

Data collection activities conformed to data quality objectives, as established in the project design document (Brown and Rice, 1999). Standard methods and analytical procedures were used for quality control, including:

- field and quality control sampling, as prescribed in the design document;
- instrument calibration procedures;
- sample preservation;
- chain-of-custody and data tracking; and
- use of a certified laboratory.

Representative data and trends were also assessed in daily and weekly meetings, and frequent field visits to the study sites. The project data completeness goal of 90% was achieved.

SAMPLING SCHEDULES AND SAMPLE VARIABILITY

Sampling schedules were adjusted in an attempt to obtain representative grab sample data from different sites. However, data loggers, which were installed at selected sites to log water depth and conductivity data in half-hour increments, indicated large diurnal variability in conductivity and flow. This variability could only be estimated with grab samples. Some datalogger data could not be used due to freezing and flow fluctuations. Observed flows were difficult to measure accurately, as they also varied significantly based on daily and weekly climate changes. Some datalogger data was incomplete due to low flows that may have frozen at night and affected readings. Despite these variations, the collected data is thought to reasonably represent the critical system elements and events for purposes of making watershed management decisions.

DATA REVIEW

CT&E Environmental Services Inc., a local state-certified analytical testing laboratory, performed all sample analyses. All laboratory quality assurance protocols were met, with the exception of EPA holding times. Three samples exceeded EPA holding times for chloride and five samples exceeded EPA holding times for sulfate. These holding times were exceeded due to failures in scheduling. Time series analysis suggested the chloride samples did not reasonably represent actual chloride concentrations in sampled waters. Sulfate values appeared reasonable based on ionic balance determinations. The five sulfate values, therefore, have remained in the data set, but have been flagged as “suspect”. The chloride values were eliminated from the data set.

Twenty-five samples met all laboratory protocols except EPA holding times for alkalinity. Of these 25 samples, cation / anion balances indicated that 11 samples had an ionic difference greater than 5%. Since the analyzed samples did not include a full range of cation and anion analyses, it is unknown whether the large ionic balance is due to changes in alkalinity with time or a cation / anion that was not analyzed for. Therefore, all 25 samples that exceeded the holding time for alkalinity have remained in the data set, but have been flagged as “suspect”.

Lastly, six samples were analyzed in the laboratory for pH. EPA holding times for these samples were exceeded; however, their values were reasonable based on similar results in other studies (Rice, 1999). These values for pH, therefore, have remained in the data set, but have been flagged as “suspect”.

Other data have been flagged as “suspect” or have been eliminated from the data set. For all cation / anion balances with ionic differences of greater than 5%, alkalinity was flagged as “suspect”. One flow value from the Gambell / Ingra Site was eliminated due to measurement uncertainty when measuring very small amounts of flow. Two conductivity values from the Tikishla Site were eliminated due to measurement error. All “suspect” data are summarized in Table 3.

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DATA SUMMARY

The data summary presented in this section provides key site and data characteristics important for understanding the critical system elements at each site. Accompanying site descriptions include sampling station locations, why sampling stations were chosen, and location of relative receiving waters. Figure 1 illustrates site locations and basin areas of each site studied. Tables are presented for selected data. Tables 1 and 2 tabulate the stations and the sampling performed at each station, respectively. Data are also graphically summarized in relation to chloride, specific conductivity, and other cation and anions in the melt and receiving waters.

- Appendix A includes field observation summaries.
- Appendix B contains basin data sheets for the street sites.
- Appendix C contains a tabulated account of the data.
- Appendix D contains conductivity and chloride correlations and calculations.
- Appendix E contains cation/anion balance summaries of analyzed samples by station and date.
- Appendix F contains calculations used in a wash experiment at the Gambell/Ingra Site.

Snow Disposal Sites

Two snow disposal sites were chosen for the study. The relative locations of the sites and their contributing service areas are shown in Figure 1. Each snow disposal site is described below, along with the data collected at the site. Snow site meltwater began to flow off-site on approximately April 21.

TUDOR SNOW DISPOSAL SITE

The Tudor Snow Disposal Site is located at the intersection of Tudor Road and Campbell Airstrip Road (Figure 2). A Chester Creek tributary is the receiving water for this site. As indicated in Figure 2, three receiving water stations and seven sampling stations were used to characterize the spring melting event. Sampling stations CHS001, CHS002 and CHS003 were chosen to reflect downstream, intermediary, and upstream conditions of the Chester Creek tributary near the site during the spring runoff period. Sampling stations TU01, TU02, TU03 and TU07 were chosen to conduct measurements of meltwater flowing from the snow mass. Sampling stations TU04, TU05 and TU06 were chosen to measure meltwater flows after treatment as they passed through a detention pond, ditch and swamp from the various meltwater flow paths. Table 1 contains more detailed information on sampling station locations.

A datalogger was used at the downstream sampling station CHS001 to record conductivity and flow. These measurements were verified and correlated to chloride concentrations by grab samples of flow and conductivity readings, and chloride analyses. Cations and anions were also analyzed at the station. Field measurements were taken at upstream stations CHS002 and CHS003. Field and laboratory analyses were performed on samples from Stations TU01 through TU07. Table 2 contains more detailed information on the analyses performed at each of the sampling stations.

Site discharge meltwater was first observed April 19. The bulk of the site discharge meltwater had flowed from the site by May 27, although low flows were noted through June.

Chloride Data

Chloride data were taken intermittently at sample station CHS001 and from the primary meltwater streams at TU01, TU02, and TU07. Chloride data were compared to conductivity measurements and to trends noted in the 1998 Deicer Assessment Data Report (Wheaton & Bischofberger, 1998b).

The 1998 Deicer Assessment Data Report indicated a correlation between chloride and conductivity, and that this correlation neared zero at lower values (Wheaton & Bischofberger, 1998b). Based on the assumption that chloride concentrations are zero when there is no conductivity, two linear regressions of recorded conductivity measurements and chloride grab samples, with an intercept of zero, were formulated. The correlations were performed for both the downstream meltwater at station CHS001, and available chloride analysis of site discharge from stations TU01, TU02 and TU07 (Appendix D).

At downstream station CHS001, four 1999 chloride grab samples were related to field conductivity measurements taken concurrently with sampling. This linear regression gave an R-squared value of 0.79 and was

<u>Equation 1:</u>

$$[CL] = 0.3625\ [EC]$$

Using Equation 1 to convert other field conductivity values to chloride, and combining these values with chloride grab sample analyses, a time trend was created for receiving water stations (Figure 3). Upstream values, although significantly lower than intermediary and downstream values, were calculated to be approximately 35 mg/L higher than 1998 upstream results, which were below 2.5 mg/L for the 1998 period of record (Wheaton & Bischofberger 1998b). Upstream chloride results for 1999 were calculated using Equation 1 and may be highly influenced by the equation, as it was formed by using creek water data that were influenced by site discharge. Results indicated that chloride at the downstream station peaked between April 27 and April 29.

For site discharge stations, six chloride grab samples were related to field conductivity measurements taken concurrently with sampling. This linear regression gave an R-squared value of 0.84 and was

Equation 2:

$$[CL] = 0.506\ [EC]$$

Using Equation 2 to convert other field conductivity values to chloride, and combining these values with chloride grab sample analysis, a time trend was created for site discharge stations (Figure 4). The highest values of chloride emanated from TU02, which began to discharge on April 23. At all stations, chloride peaked at various dates between April 21 and April 23.

Using Equation 1, datalogger conductivity data was also converted to chloride for station CHS001 (Figures 5a, 5b, and 5c). Diurnal patterns are easily noted, with chloride rising to form a rough plateau that contains two chloride peaks on either side within a 24-hour time period. Peaks usually occurred in the morning and late afternoon or evening. Converted values indicated a chloride peak April 27 at 2130 of 984 mg/L. Chloride values were less than 100 mg/L after May 16. Prior to April 26, daily chloride peaks occurred in the mornings. After April 27, there was a relatively smooth downward trend in chloride data until May 11. From May 11, chloride values peaked during late night and mid-morning hours until May 25, when this pattern became indistinct. Figure 6 and Table 5 contain summaries of the datalogger data, and establish the daily peak, mean, and minimum chloride values compared to daily mean flow.

To further verify chloride results, chloride grab sample values were compared to their corresponding model values (Table 4). This analysis indicated that the model was within 15% of grab sample values for chloride. To further verify the model, observations during 1998 were analyzed (Wheaton & Bischofberger, 1998b). At CHS001, chloride in 1998 at the end of the snowmelt decreased to a range 30 to 50 mg/L. The datalogger time series indicated similar values towards the end of the melt period in 1999. Based on these observations, the 1999 conversion equation is considered a reasonable approximation and the best current assessment of chloride at station CHS001.

Ion Data

Chloride was the major ion analyzed in the data collection effort; however, other major cations and anions were analyzed for in selected samples. Samples of site discharge from TU01, TU02 and TU07, and one downstream sample from CHS001, were collected during peak chloride activity and as chloride activity decreased. Cation analytes included calcium, magnesium, potassium and sodium. Anion analytes included sulfate, chloride and bicarbonate. Cation/anion balances for analyzed samples are contained in Appendix E. Figure 7 presents stiff diagrams of Tudor Snow Disposal Site samples, which indicated that the highest portion of dissolved solids in all samples was from sodium, magnesium and chloride. The shape of individual meltwater samples through time changed only in the proportions of sodium and chloride present.

Analysis of the percentage of chloride contributed by sodium chloride or magnesium chloride was also performed, assuming that the total sodium and magnesium content in snowmelt derived from salts or deicer. As Figure 8 shows for all samples, between 58% – 80% of chloride concentration was from sodium chloride, and about 15% - 24% of chloride concentration was from magnesium chloride. Between 87% and 100% of the chloride in the samples analyzed was accounted for by sodium and magnesium salt and deicer during the snowmelt period. Deicers were the primary source of chloride in snowmelt runoff at the site. Results that indicated less than 100% of the chloride was accounted for may be due primarily to the flux and disequilibrium conditions present in snowmelt runoff, rather than another, unanalyzed source of chloride.

Flow Data

Samplers estimated flows at downstream station CHS001 based on the area-velocity method, and flow was correlated with datalogger flow depth measurements at the station (Appendix D). A "best fit" line was created using linear regression with an R-squared of 0.83, and was

Equation 3:

$$Q,\text{cfs} = 7.27\ [\text{depth,ft.}] - 2.1$$

The datalogger time series for flow is depicted with chloride values in Figures 5a, 5b and 5c. In general, large diurnal flows were noted at the beginning of the melt, and again towards the end of the melt, as large diurnal fluctuations increased noticeably, with a peak flow of 1.58 cfs on May 17. For the period of record until April 29, peak daily flows and peak conductivity/chloride values did not have a distinctive pattern. From April 29 to May 11 there was a distinct similar downward trend for both flow and conductivity/chloride values. After May 11, daily flows fluctuated distinctly and peaks were offset from conductivity/chloride peak values. This trend became less distinct after May 22. Observations of flow indicated significant variability in the timing of daily flow peaks; however, generally peaks appeared in the late afternoon or early evening.

Creek base flow was also determined for the receiving water at downstream station CHS001 using 1998 data, assuming that base flow is governed by groundwater, which is not expected to change significantly from year to year. Observations and measurements of creek flow during 1998 indicated significant base flow in the creek (Wheaton & Bischofberger, 1998b). In 1998, creek base flow ranged from 0.33 to 0.67 cfs during the snowmelt period, while at downstream station CHS001, flow consistently ranged from 1 to 2 cfs. Creek base flow in 1999 is illustrated in Figures 5a, 5b, and 5c in a step-function, assuming that creek base flow was similar to 1998, and trailed off to a base flow of 0.1 cfs during late spring. Low flow breaks in the datalogger record were used to initiate steps in the base flow record so that total flow equaled base flow plus site discharge.

Average daily flows at downstream station CHS001 were calculated and are shown in Table 5. Figure 6 contains average daily total flows from downstream station CHS001 and site discharge flows with base flow subtracted. The reader should be aware that baseflow was estimated to approximate the magnitude of effect site discharge had on water quality at downstream station CHS001; however, influences other than base flow may affect the amount of flow attributable to site discharge at CHS001.

Comparisons to 1998 Data

Data from 1999 was compared to 1998 data to analyze similarities or differences between data sets (Wheaton & Bischofberger, 1998b). Figure 9 compares 1998 and 1999 chloride data for meltwater flows and stream flows at CHS001 for chloride runoff and creek impacts. Lag time between the peak chloride value in the site discharge and the peak observed in the stream at CHS001 varied between 1998 and 1999, with 8 days in 1998 and 4 days in 1999, due to the emergence of site discharge at TU02. Chloride data in 1999 also recorded lower peak chloride levels in meltwater than in 1998.

NORTH MOUNTAIN VIEW SNOW DISPOSAL SITE

The North Mountain View Snow Disposal Site is located near the intersection of Boniface Road and the Glenn Highway; the receiving water for this site is the North Fork of Chester Creek (Figure 10). Sampling station NCH001 (Figure 1) was used to determine creek effects from meltwater. This station location relates to the point of discharge of the stormwater system to the North Fork of Chester Creek, which carries North Mountain View meltwater. There was no upstream sampling site, as only stormwater drains are available before stormwater reaches station NCH001 - there is no "creek". Sampling station MTV01 is located at the point where meltwater entered the stormwater system at the Glenn Highway. Station MTV02 was chosen to conduct measurements of meltwater directly from the snow mass, prior to discharge through a gravel detention berm.

Site discharge meltwater was first observed April 19. The bulk of the site discharge meltwater had flowed from the site by May 3, although low flows were noted through June.

Chloride Data

Chloride data were taken intermittently at downstream station NCH001 and from site discharge at MTV01 and ponded water at MTV02. Chloride data was compared to conductivity measurements and to trends noted in the 1998 Deicer Assessment guidance document (Wheaton et al., 1998b).

Graphical data from 1998 at Tudor Snow Disposal Site indicated a correlation between chloride and conductivity, and that this correlation neared zero at lower values (Wheaton & Bischofberger, 1998b). Based on the assumption that chloride concentrations were zero when there was no conductivity, a linear regression of recorded conductivity measurements and concurrent chloride grab samples, with an intercept of zero, was formulated for site discharge at MTV01 and BMP pond water at MTV02 (Appendix D). This linear regression, shown below, gave an R-squared value of 0.94 and was

Equation 4:

$$[CL] = 0.4245\ [EC]$$

Using Equation 4 to convert other field conductivity values to chloride, and combining these values with chloride grab sample analysis, a time trend was created for receiving water station data (Figure 11). Site discharge chloride values were initially two orders of magnitude higher than at the downstream receiving water at station NCH001. NCH001 also does not exhibit the same variations in chloride that site discharge at MTV01 or the pond discharge that MTV02 portrays.

During the study, only one documented chloride value above 230 mg/L (EPA chronic 4 day criteria) was recorded at station NCH001, and it was recorded prior to the snow site melt period. A chloride value of 348 mg/L was documented on March 21, 1999, at NCH001. Field notes indicated no melting occurred at the snow sites during this time; however, street site sampling was taking place, as temperatures rose to slightly above freezing during the day. Snow site runoff was first noted April 19, 1999.

Using Equation 4, datalogger conductivity data was also converted to chloride at station MTV01 (Figure 12). Table 6 shows daily peak, average, and minimum value calculations for meltwater at MTV01. Daily chloride peaks appeared in the mornings, with an overall decrease in value each day. Datalogger data did not cover the entire period of high chloride levels; results from April 19, 1999 grab samples indicated higher values for chloride, with a value of 1500 mg/L, as illustrated in Figure 11.

Figure 13 contains a summary of the datalogger data, and establishes daily peak, mean, and minimum chloride values compared to daily mean flow. A consistent downward trend is observed in chloride data, a continuation of the peak observed on April 19.

Ion Data

Chloride was the major ion analyzed in the data collection effort; however, other major cations and anions were analyzed for in selected samples. Three samples, site meltwater from MTV01 and MTV02, and downstream receiving water at NCH001, were collected during peak chloride concentrations and as chloride concentration decreased. Cation analytes included calcium, magnesium, potassium and sodium. Anion analytes included sulfate, chloride and bicarbonate. Cation / anion balances for the analyzed samples are given in Appendix D. Figure 14 contains stiff diagrams of NCH001, MTV01 and MTV02 samples. The shape of each individual sample through time changed only in the proportions of sodium, magnesium, and chloride present, which indicated that that the highest portion of dissolved solids in water were from sodium, magnesium, and chloride in site meltwater at MTV01 and MTV02.

Analysis of the percentage of chloride contributed by sodium chloride or magnesium chloride was also determined, assuming that total sodium and magnesium content in all samples would be from salts or deicer. As Figure 15a illustrates for site meltwater samples, between 42% – 50% of chloride concentration was from sodium chloride, and about 43% - 56% of chloride concentration was from magnesium chloride in meltwater. Results that indicate less than 100% of the chloride was accounted for may be due primarily to the flux and disequilibrium conditions present in snowmelt runoff, rather than another, unanalyzed source of chloride.

Figure 15b indicates that for downstream samples from NCH001, less than 10% of the chloride concentration in the samples was from sodium chloride, and less than 5% of the chloride concentration was from magnesium chloride. Overall, less than 15% of the chloride in downstream creek station NCH001 could be accounted for by sodium and magnesium chloride.

Flow Data

Samplers estimated flows at site discharge station MTV01 based on datalogger flow depth measurements at the station. Since the culvert was a 1-foot diameter circular corrugated pipe, the Manning equation (shown below) was used to correlate depth measurements to discharge.

$$Q = \frac{KAR^{2/3}S^{1/2}}{n}$$

Q = Flow
K = Unit constant
A = Cross-sectional area of flow

R = Hydraulic radius
S = Slope of the hydraulic radius
n = Manning roughness coefficient

Assuming a “k” of 1.49, slope of 0.5% and an “n” of 0.025 for an average corrugated pipe, flow was calculated from logger depth information related to “A” and “R”(Grant and Dawson, 1997).

The datalogger time series for flow is depicted with chloride concentrations in Figure 12. Note that the chloride peak was recorded on April 22, while peak flow values were recorded on April 29. Significant variability was indicated in the timing of daily peaks; however, Figure 14 illustrates that many flow peaks occurred in late evening. Figure 14 also indicates that chloride levels tended to peak just before flow peaks. The highest flow recorded was 0.067 cfs, on April 23, 1999.

Figure 13 illustrates daily average flow calculations from datalogger values of site discharge. As shown, the peak daily average flow, 0.06 cfs, occurred on May 30, 6 days after the peak recorded chloride event.

Comparisons to 1998 Modeling Data

Modeling data from 1998 suggested that snowmelt from the site may have yielded chloride levels high enough above the Alaska water quality standard of 250 mg/L to threaten receiving waters downstream (Wheaton et al., 1998c). Sampling at downstream station NCH001 indicated that although significant levels of chloride are discharged from the site, there was no documented exceedence of Alaska water quality standards at NCH001 during site snowmelt (Figure 11). Additionally, less than 15% of the chloride level in the discharge at NCH001 was calculated to have come from sodium and magnesium salts and deicers for the samples analyzed (Figure 15b).

STREET RUNOFF SITES

Three street runoff sites were chosen for the study. The relative location of the sites and their contributing areas are shown in Figure 1. Each street site is described below, along with the data collected at that site.

FIFTH AVENUE SITE

The 5th Avenue Site is located near Elderberry Park, west of the downtown area (Figure 16). Sampling station CH3301 was used to quantify the effects of street runoff during snowmelt. This station was located in a manhole near the outfall to Cook Inlet. Because this drainage discharges directly into Cook Inlet, no upstream or receiving water measurements were taken. The spring snowmelt began approximately March 20 and ended by March 30.

Chloride Data

Chloride data were taken intermittently at station CH3301 and compared to conductivity measurements (Appendix D). A linear regression of field conductivity measurements and concurrent chloride grab samples was created. This regression gave an R-squared value of 0.97 and was

Equation 5:

$$[CL] = 0.3\ [EC] - 14.92$$

Field conductivity measurements were taken in the morning and late afternoon, with late afternoon measurements consistently higher in conductivity (Appendix D). The highest afternoon values for field conductivity were converted to chloride using Equation 5, and these values were combined with chloride grab sample analysis to form a time trend (Figure 17). The maximum value obtained for chloride was 1426 mg/L on March 20, which decreased in value until a March 29 reading of 45 mg/L. A snowfall event with subsequent deicing applications occurred March 30-31, resulting in an additional peak.

Using Equation 5, datalogger conductivity data was also converted to chloride for station CH3301 (Figure 18). Table 6 and Figure 19 show daily peak, average, and minimum value calculations for station CH3301, although datalogger data did not cover the entire period of snowmelt, only the later portion. Diurnal trends were readily apparent, with daily chloride peaks appearing in the afternoon or early evening, and occurring for only a few hours during the day. These chloride peaks occurred slightly before peak flows, which also lasted only a few hours during the day. Both flow and chloride peaks indicated significant symmetry on a daily basis. After the snowmelt period, which was estimated to end March 30, some recorded events were due to deicer application during a snow fall event (March 30-31) or to other deicer applications, and were not representative of snowmelt runoff from the streets (April 2 and 5). These other events, however, did illustrate similar diurnal and symmetrical trends observed during the snowmelt period. For deicer applications after April 1, deicer inventory data suggests applications to the 5th Avenue basin one or two days prior to the observed peaks on April 2 and 5 (MOA, 1999).

Ion Data

Chloride was the major ion analyzed in the data collection effort; however, other major cations and anions were analyzed in selected samples. Three samples at station CH3301 were collected; one as base flow before the spring thaw, and two during spring thaw. Cation analytes included calcium, magnesium, potassium and sodium. Anion analytes included sulfate, chloride and bicarbonate. Cation/anion balances for analyzed samples are given in Appendix E. Figure 20 contains stiff diagrams of the samples. The shape of the base flow on March 18 changed significantly with regard to sodium, magnesium and chloride as the melt progressed; other parameters remained nearly the same.

An analysis of the percentage of chloride contributed by sodium chloride or magnesium chloride was made, assuming that the total sodium and magnesium content in the snowmelt would be from salts or deicer (Figure 21). This analysis for snowmelt flows indicated that on March 25, near the peak of the street melt period, 29% of the chloride came from sodium chloride, and approximately 34% of the chloride concentration in samples came from magnesium chloride. Sixty-three percent of the chloride could be accounted for by either sodium or magnesium chloride. Results that indicate less than 100% of the chloride was accounted for may be due to either the flux and disequilibrium conditions present in snowmelt runoff, or the presence of another source of chloride. On March 31, the end of the snowmelt flows had just occurred, but a snowfall event washed the streets. Analysis of this snowfall event for snowmelt flows indicated that 37% of the chloride came from sodium chloride, and about 67% of the chloride concentration in samples came from magnesium chloride. Base flow analysis indicated that there was more sodium and magnesium than could be accounted for by only considering deicer, suggesting these ions are present in base flow conditions.

Flow Data

Samplers estimated flows at CH3301 based on flow grab samples and datalogger flow depth measurements in the manhole at station CH3301, and datalogger flows were calculated by correlation to flow grab samples (Appendix D). A "best fit" line was formed using linear regression with an R-squared of 0.8879 and was

Equation 6:

$$Q,cfs - 5.036\ [depth,ft.]^2 - 2.15\ [depth,ft.] + 0.27$$

Figure 18 illustrates the datalogger chloride and flow trend with time. The figure shows that chloride peaks and flow peaks almost coincided through the entire period of record, both peaking in the late afternoon hours each day.

TIKISHLA SITE

The Tikishla Site is located near Tikishla Park (Figure 22). Sampling stations CHTK001 and CHTK002 were upstream and downstream stations chosen to quantify the effects of residential street snowmelt runoff to Chester Creek. Station TK01 was chosen as an easily sampled point along the outfall ditch to the creek. This ditch conveyed most of the runoff from the residential neighborhoods. Station TK02 was chosen as a location for performing intermittent measurements as a discharge point from a residential district into a lowland area near the ditch.

The spring melt event for this site began March 26 and ended April 9. The receiving water was the Middle Fork of Chester Creek.

Chloride Data

Chloride data were taken intermittently at stations CHTK001, CHTK002, and TK01 and compared to conductivity measurements (Appendix D). Two linear regressions of field conductivity measurements and concurrent chloride grab samples were created, one for the creek and one for the residential discharge. For the creek, at stations CHTK001 and CHTK002, this regression gave an R-squared value of 0.97 and was

Equation 7:

$$[CL] = 0.32\ [EC] - 59.3$$

For the residential discharge at TK01, this regression gave an R-squared value of 0.98 and was

Equation 8:

$$[CL] = 0.35\ [EC] - 92.96$$

Creek and residential runoff conductivity measurements were taken in the afternoon (Appendix D). These values for field conductivity were converted to chloride using Equations 7 and 8, and were combined with chloride grab sample analysis to form a time trend (Figure 23). The time trend indicates that the largest chloride difference between upstream and downstream stations was 20 mg/L for the times analyzed. Figure 23 also indicates that elevated creek runoff started March 21 and that residential discharge did not flow from Station TK01 until March 26. Figure 23 additionally indicates similar responses between upstream and downstream stations. Creek chloride values were between 175 and 200 mg/L on March 21 and March 26, both upstream and downstream of station TK01.

Using Equation 8, datalogger conductivity data was also converted to chloride at station TK01 (Figure 24). Table 6 and Figure 25 show daily peak, average, and minimum value calculations for station TK01, although datalogger data did not cover the entire period of snowmelt, only the later portion. Diurnal trends were readily apparent, with daily chloride peaks appearing in the afternoon or early evening, and occurring for only a few hours during the day. These chloride peaks occurred slightly before peak flows, which also lasted only a few hours during the day. Both flow and chloride peaks indicated significant symmetry on a daily basis, with flows initially large, and quickly losing their magnitude with time.

Ion Data

Other major cations and anions were analyzed in selected samples. Three samples of residential discharge at station TK01, and one sample each from upstream station CHTK001 and downstream station CHTK002 were collected. Cation analytes included calcium, magnesium, potassium and sodium. Anion analytes included sulfate, chloride and bicarbonate. Cation/anion balances for analyzed samples are given in Appendix E. Figure 26 contains stiff diagrams of the samples. The shape of base flow before snowmelt (A) indicated that the dominant ions in the creek are calcium and bicarbonate. During snowmelt, the creek and the residential discharge both contained sodium and chloride as the dominant ions.

Analysis of the percentage of chloride contributed by sodium chloride or magnesium chloride, assuming that total sodium and magnesium content in snowmelt derived from salts or deicer, was ambiguous at the Tikishla Site. This suggested that there were other significant contributors of sodium and magnesium during base flows and snowmelt events. However, for residential discharge, as Figure 27 illustrates, sodium values are much higher than magnesium during the peak snowmelt events (March 26), indicating that the contribution of chloride is much greater from sodium sources than from magnesium sources.

Flow Data

Samplers estimated flows for residential discharge at TK01 based on flow grab samples correlated to datalogger depth measurements in the discharge ditch. Significant error was encountered due to the presence of large amounts of snow in the ditch, which hindered flows, and the low ditch slope, which promoted pooling instead of flow at low flows. However, gross estimates of flow were calculated from field measurements using a best fit line between points (Appendix D). This relationship had an R-squared of 0.74 and was

Equation 9:

$$[Q,cfs] = 0.0016e^{3.86\,[depth,ft.]}$$

Figure 24 depicts datalogger flows, which illustrate the timing of peak chloride compared to flow. As shown, chloride peaks just before peak flow, then trails off daily in a near symmetrical pattern.

GAMBELL/INGRA SITE

The Gambell/Ingra Site is located on Chester Creek at the Gambell and Ingra Street couplet (Figure 28). Chester Creek sampling stations CHGI001 (upstream) and CHGI005 (downstream) were used to quantify the effects of street discharge from three outfalls that drained the surrounding streets. CHGI002, CHGI003, and CHGI004 are outfalls that collect street runoff. CHGI002 only flowed a couple of times during the spring melt, and most meltwater discharged from CHGI004. Initial spring melt was first observed March 12-13. The first continuous spring melt event began March 20 and ended March 29.

Chloride Data

Chloride data were taken intermittently at stations CHGI001, CHGI005, CHGI003, and CHGI004 and compared to conductivity measurements (Appendix D). Two linear regressions of recorded conductivity measurements and concurrent chloride grab samples were created, one for the creek and one for street outfall discharge. For the creek, at stations CHGI001 and CHGI002, this regression gave an R-squared value of 0.96 and was

Equation 10:

$$[CL] = 0.28\,[EC] - 57.3$$

For street outfall discharge, regressional analysis of data from CHGI004 and CHGI003 gave an R-squared value of 0.995 and was

Equation 11:

$$[CL] = 0.33\,[EC] - 53.3$$

Creek and street outfall runoff conductivity measurements were taken in the morning and afternoon (Appendix D). Higher values were consistently found during the afternoon sampling period, and these measurements were converted to chloride using Equations 10 and 11. The converted chloride values were then combined with chloride grab sample analysis to form a time trend (Figure 29). Downstream values in the creek were low relative to outfall chloride values, with 118 mg/L as the highest recorded chloride concentration. The time trend also indicated that the largest chloride difference between upstream and downstream stations was 43.4 mg/L on March 12, and 43.7 mg/L on March 21 for the times analyzed. These values represent the first observed snowmelt event (March 12-13) and the first continuous day of snowmelt (March 20). A continuous, downward trend is indicated until March 30, when values rise due to a snowfall event.

Ion Data

Other major cations and anions were analyzed in selected samples. Four samples were collected at CHGI001, six combined samples of meltwater at CHGI003 and CHGI004, and five samples at CHGI005. Cation analytes included calcium, magnesium, potassium and sodium. Anion analytes included sulfate, chloride and bicarbonate. Cation/anion balances for analyzed samples are given in Appendix E. Figures 30a, 30b, 30c, and 30d contain stiff diagrams of the samples. For comparisons between CHGI001 and CHGI005 (Figures 30a and 30b), calcium was the dominant cation except at CHGI005 on March 21. Relative chloride increases were evident at CHGI005 for March 14, 21, and 22. Street snowmelt runoff from CHGI003 and CHGI004 (Figures 30c and 30d) suggest that for the snowmelt period ending March 29, sodium and chloride were the dominant ions, except on March 21, when magnesium was dominant.

Concentrations of chloride, sodium and magnesium were compared in Figures 31a and 31b. These results indicated that meltwater flows from outfalls (Figure 31a) were significantly higher in sodium and magnesium than creek flows (Figure 31b), and that sodium was the dominant cation. Chloride concentration differences between upstream and downstream stations (Figure 31b) were apparent during spring melt. Figure 31b also indicated that sodium showed the largest increase during the spring melt period. Computation of relative percentages of sodium and chloride sources was ambiguous, and groundwater and other sources are assumed to have significantly contributed to sodium and magnesium concentrations, causing the ambiguity.

Flow Data

When interpreting street data, a limited amount of flow data was collected from upstream station CHGI001. These field flow values are tabulated in Appendix C. No street outfall discharge information was obtained during the study.

Site Wash

After the street snowmelt event was assessed and sampled, a one-time wash event was staged on April 21 along Gambell Street between Fireweed and Chester Creek, within the outfall runoff basin for station CHGI004. The purpose of this wash was to verify the assumption that the majority of magnesium chloride applied to streets during the winter was carried off within the spring melt period. The site wash found that approximately 0.02% of all deicer applied to the Gambell/Ingra couplet area during the winter was entrained in the pavement on April 21. This result equated to approximately 0.3 mg/sq. ft. magnesium chloride entrained in the wash area. Calculations and explanations of the methods used for the wash are located in Appendix E.

Variables that may have affected this wash experiment result relate to a spring snowfall event that occurred on March 30 and 31, just after street snowmelt events had returned to baseflow levels. At each of the three street sites, spikes in conductivity were recorded, suggesting that either the event washed a significant portion of the remaining deicer from the streets or that new deicer applications caused the new peaks. Current information suggests that at the 5th Avenue Site and Gambell/Ingra Site, the spikes were due to more deicer application; however, at the Tikishla Site the answer is more ambiguous, since it was indeterminate whether more deicer or sand had been applied to the basin (AK/DOT, 1999; MOA, 1999).

Lake Data

Existing data from Anchorage lakes was reviewed to assess the potential of chloride buildup through time. Increasing chloride levels in lakes would be expected if sufficient size and depth allowed density stratification that “trapped” waters high in chloride (saline waters). Sodium and magnesium chloride have long been used in the Anchorage Bowl, and these incremental, yearly chloride contributions could theoretically accumulate and lead to higher chloride levels at depth in lakes. Evidence of this trend could be observed on a gross scale by noting historic increases in chloride or conductivity with depth over time in area lakes. Consistent multiple-year data for any month were considered to discern a trend. Additionally, specific conductivity was used as a surrogate for chloride, as past data indicated a correlation between conductivity and chloride levels (Wheaton et al., 1998c).

Lastly, Lake Hood and Lake Spenard were not used in the study, as they collect stormwater from the International Airport and are not representative of most Anchorage area lakes.

DATA REVIEWED

Available conductivity and chloride data were reviewed with respect to finding data at depth in area lakes, specifically open basin lakes that would receive large amounts of spring runoff inflow. This inflow would carry the bulk of the chloride and would be the highest contributor to chloride load in the lake. Data reviewed included the following project reports:

- DHHS, 1992. *Water Quality Monitoring Program Annual Reports, 1988-1992* Department of Health and Human Services. Electronic Data.
- HDR Engineering, 1994. *Anchorage International Airport Water Quality Monitoring Report*.
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- Montgomery Watson, 1996. *Bayshore Lake Water Quality Improvements Study*, Municipality of Anchorage Department of Public Works.
- Montgomery Watson, 1998. *Cheney Lake 1998 Water Quality Monitoring Report*, Municipality of Anchorage, Department of Public Works.
- Montgomery Watson, 1999. *Landfill Water Quality Monitoring Program 1997/1998 Interpretive Report – Final*, Municipality of Anchorage Solid Waste Services.
- USGS, 1975. *Water Quality Data, 1948 – 1973 Anchorage and Vicinity, Alaska*, Open File Report.
- USGS, 1986. *Hydrologic Conditions in Connors Bog Area, Anchorage, Alaska*, Water Resources Investigations Report 86-4044.

DATA RESULTS

The best data available for comparison was a 5-year study of seven Anchorage lakes during 1988-1992 (DHHS, 1992). All specific conductivity data taken away from the lakeshore, towards the center of the lake, and with depth, are tabulated in Tables 7a and 7b and illustrated in

Figures 32a and 32b. These data were collected during September and October for all stations, during the fall lake turnover period. During fall lake turnover, it is assumed that the lake is homogenous in relation to temperature and that any stratification noted would be density stratification. Overall, each lake indicated specific conductivity peaks for different years and at various lake sampling stations with no apparent trend.

Other historic data were located for Sand Lake (USGS, 1975). Sand Lake data were analyzed quarterly and at five depth intervals during 1972. This data averaged between 2.5 and 3.1 mg/L chloride, with conductivities between 51-66 µS/cm (Table 8). Multi-year data were not available for this site.

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Table 1
Chloride Runoff from Anchorage Streets and Snow Disposal Sites
1999 Sampling Stations

Station_ID	Location	Water Type	Structure	Notes
CH3301	5th Avenue Site	meltwater	storm drain	Manhole above Cook Inlet outfall.
CHGI001	Gambell/Ingra Site	stream	------	Chester Creek approximately 30 feet upstream of Gambell/Ingra overpass.
CHGI002	Gambell/Ingra Site	meltwater	culvert	Outfall just east of Gambell/Ingra overpass.
CHGI003	Gambell/Ingra Site	meltwater	culvert	Outfall north side of creek, west of Gambell/Ingra overpass.
CHGI004	Gambell/Ingra Site	meltwater	culvert	Outfall south of creek, west of Gambell/Ingra overpass.
CHGI005	Gambell/Ingra Site	stream	------	Chester Creek approximately 50 feet downstream of Gambell/Ingra overpass.
CHTK001	Tikishla Site	stream	------	Chester Creek approximately 50 upstream from bridge by Tikishla Park.
CHTK002	Tikishla Site	stream	------	Chester Creek approximately 30 feet downstream from bridge by Tikishla Park.
TK01	Tikishla Site	meltwater	culvert	Culvert in ditch draining residential neighborhood on northeast side of Tikishla Park.
TK02	Tikishla Site	meltwater	culvert	Culvert draining residential neighborhood on northwest side of Tikishla Park.
CHS001	Tudor Snow Disposal Site	stream	culvert	Chester Creek tributary at culvert under Tudor Rd.
CHS002	Tudor Snow Disposal Site	stream	------	Chester Creek tributary approximately midway between CHS001and CHS002.
CHS003	Tudor Snow Disposal Site	stream	------	Chester Creek tributary upstream of observed Tudor Snow Disposal Site Influence.
TU01	Tudor Snow Disposal Site	meltwater	on-site drainage	Runoff through berm on access road (from Tudor Rd.), just north of snow mass.
TU02	Tudor Snow Disposal Site	meltwater	on-site drainage	Runoff through berm breach southwest of sedimentation pond.
TU03	Tudor Snow Disposal Site	meltwater	on-site drainage	Runoff entering southernmost end of sedimentation basin prior to straw bale dams.
TU04	Tudor Snow Disposal Site	meltwater	detention pond	Sampling point on northwest corner.
TU05	Tudor Snow Disposal Site	meltwater	ditch drainage	Location in ditch parallel to Tudor Rd. west of access road.
TU06	Tudor Snow Disposal Site	meltwater	------	Meltwater entering wetlands through mid-ramp armored channel.
TU07	Tudor Snow Disposal Site	meltwater	on-site drainage	Mid-ramp armored channel.
MV01	North Mountain View Snow Disposal Site	meltwater	culvert	Culvert under Glenn Highway.
MV02	North Mountain View Snow Disposal Site	meltwater	on-site drainage	Ponded meltwater runoff prior to discharge through gravel filtration berm.
CHN001	North Mountain View Snow Disposal Site	stream	North Fork	Stormwater system outfall at 15th Ave. and Lake Otis Parkway.

Note:
1) Chester Creek is receiving water for all sites.
2) Meltwater refers to site discharge before treatment

Table 2
Chloride Runoff from Anchorage Streets and Snow Disposal Sites
1999 Sampling Performed

Station ID	Location	Sampling Performed
CH3301	5th Avenue Site	Conductivity, Major and Minor Ions, Flow, Datalogger Data
CHGI001	Gambell/Ingra Site	Conductivity, Major and Minor Ions, Flow
CHGI002	Gambell/Ingra Site	Conductivity
CHGI003	Gambell/Ingra Site	Conductivity, Major and Minor Ions
CHGI004	Gambell/Ingra Site	Conductivity, Major and Minor Ions
CHGI005	Gambell/Ingra Site	Conductivity, Major and Minor Ions, Flow
CHTK001	Tikishla Site	Conductivity, Major and Minor Ions, Flow
CHTK002	Tikishla Site	Conductivity, Major and Minor Ions
TK01	Tikishla Site	Conductivity, Major and Minor Ions, Flow, Datalogger Data
TK02	Tikishla Site	Conductivity
CHS001	Tudor Snow Disposal Site	Conductivity, Major and Minor Ions, Flow, Datalogger Data
CHS002	Tudor Snow Disposal Site	Conductivity
CHS003	Tudor Snow Disposal Site	Conductivity
TU01	Tudor Snow Disposal Site	Conductivity, Major and Minor Ions
TU02	Tudor Snow Disposal Site	Conductivity, Major and Minor Ions
TU03	Tudor Snow Disposal Site	Conductivity
TU04	Tudor Snow Disposal Site	Conductivity
TU05	Tudor Snow Disposal Site	Conductivity
TU06	Tudor Snow Disposal Site	Conductivity
TU07	Tudor Snow Disposal Site	Conductivity, Major and Minor Ions
MV01	North Mountain View Snow Disposal Site	Conductivity, Major and Minor Ions, Flow, Datalogger Data
MV02	North Mountain View Snow Disposal Site	Conductivity, Major and Minor Ions
CHN001	North Mountain View Snow Disposal Site	Conductivity, Major and Minor Ions, Flow

Table 3
Chloride Runoff from Anchorage Streets and Snow Disposal Sites
1999 Suspect Data

Station_ID	LogDate	LogTime	Samp_Type	Lab_SampID	Anal_Date	Par_Code	Par_Val	Units	Lab_RL
TU07	4/23/99	1400	1	*	*	EC	10500	3	*
CHGI002	3/26/99	1525	1	*	*	FLOW	0.001	5	*
CH3301	3/25/99	1600	1	991287027	4/5/99	HCO3	71.6	1	2
CH3301	3/31/99	1500	1	991605001	4/20/99	HCO3	74.5	1	2
CHGI001	3/14/99	1515	1	991034005	3/22/99	HCO3	87.3	1	2
CHGI001	3/18/99	1530	1	991287002	4/5/99	HCO3	85	1	2
CHGI001	3/21/99	1600	1	991287016	4/5/99	HCO3	77.3	1	2
CHGI003	3/21/99	1610	1	991287019	4/5/99	HCO3	57.3	1	2
CHGI004	3/14/99	1522	1	991034007	3/22/99	HCO3	57.9	1	2
CHGI004	3/18/99	1545	1	991287003	4/5/99	HCO3	56.3	1	2
CHGI004	3/21/99	1605	1	991287018	4/5/99	HCO3	59.2	1	2
CHGI004	3/22/99	1420	1	991287021	4/5/99	HCO3	63	1	2
CHGI004	3/25/99	1420	1	991287029	4/5/99	HCO3	66.8	1	2
CHGI004	4/21/99	1510	1	992093008	5/18/99	HCO3	82.3	1	2
CHGI004	4/21/99	1500	1	992093009	5/18/99	HCO3	60.1	1	2
CHGI004	4/21/99	1517	1	992093010	5/18/99	HCO3	79.4	1	2
CHGI005	3/5/99	1400	1	991034002	3/22/99	HCO3	91.4	1	2
CHGI005	3/18/99	1600	1	991287004	4/5/99	HCO3	81.1	1	2
CHGI005	3/21/99	1625	1	991287017	4/5/99	HCO3	72.5	1	2
CHGI005	3/22/99	1430	1	991287022	4/5/99	HCO3	80.2	1	2
CHN001	3/18/99	1230	1	991287001	4/5/99	HCO3	83	1	2
CHN001	3/26/99	1540	1	991287035	4/5/99	HCO3	52.5	1	2
CHS001	4/21/99	1455	1	992093007	05/18/99	HCO3	32	1	2
CHTK001	3/26/99	1800	1	991338003	4/8/99	HCO3	55.4	1	2
MTV01	4/19/99	1200	1	992093002	5/18/99	HCO3	121	1	2
MTV01	4/21/99	1730	1	992093004	5/18/99	HCO3	123	1	2
MTV02	4/19/99	1200	1	992093001	5/18/99	HCO3	159	1	2
MTV02	4/21/99	1730	1	992093003	5/18/99	HCO3	124	1	2
TK01	3/20/99	1255	1	991287006	4/5/99	HCO3	65.9	1	2
TK01	3/26/99	1800	1	991338002	4/8/99	HCO3	43	1	2
TK01	4/1/99	1520	1	992096003	5/14/99	HCO3	39.7	1	2
TU01	4/21/99	1455	1	992093006	5/18/99	HCO3	154	1	2
TU01	4/23/99	1400	1	992093015	05/18/99	HCO3	156	1	2
TU02	4/23/99	1400	1	992093016	05/19/99	HCO3	232	1	2
TU07	4/23/99	1400	1	992093017	05/19/99	HCO3	124	1	2
TU07	4/30/99	1500	1	992093022	05/19/99	HCO3	130	1	2
CH3301	3/18/99	1600	1	991034008	3/22/99	PH	7.68	4	*
CHGI001	3/14/99	1515	1	991034005	3/22/99	PH	7.78	4	*
CHGI004	3/14/99	1522	1	991034007	3/22/99	PH	6.84	4	*
CHGI005	3/5/99	1400	1	991034002	3/22/99	PH	7.7	4	*
CHGI005	3/14/99	1516	1	991034006	3/22/99	PH	7.9	4	*
CHTK002	3/9/99	1050	1	991034003	3/22/99	PH	7.67	4	*
CHGI004	3/29/99	1720	1	991338013	5/20/99	SO4	15.8	1	0.5
CHTK001	3/26/99	1800	1	991338003	5/20/99	SO4	12.7	1	0.5
MTV02	4/19/99	1200	1	992093001	5/18/99	SO4	4.31	1	0.5
TK01	3/26/99	1800	1	991338002	5/20/99	SO4	6.64	1	0.5
TK01	4/1/99	1520	1	992096003	5/14/99	SO4	17	1	5

* Field measurement
Note: Column headers correspond to tables in Appendix C.

Table 4
1999 Chloride at Anchorage Snow Disposal and Street Sites
Select Chloride, Conducitivity, and Flows

Date	Time	Analysis Type	Units	Measurement	Reading	Reading Type
Tudor Snow Disposal Site (Station CHS001)						
04/21/99	1455	EC	µS/cm	500	*	*
04/21/99	1455	CL	mg/L	249	*	*
04/23/99	1400	EC	µS/cm	1200	*	*
04/23/99	1400	CL	mg/L	487	578	(model calculation)
04/28/99	1145	EC	µS/cm	1700	*	*
04/28/99	1145	CL	mg/L	557	728	(model calculation)
04/30/99	1500	EC	µS/cm	1100	*	*
04/30/99	1500	CL	mg/L	403	538	(model calculation)
North Mountain View Snow Disposal Site (Station MTV01)						
04/19/99	1200	EC	µS/cm	3600	*	*
04/19/99	1200	CL	mg/L	1500	*	*
04/21/99	1730	EC	µS/cm	3050	*	*
04/21/99	1730	CL	mg/L	1360	*	*
04/23/99	1920	EC	µS/cm	2600	*	*
04/23/99	1920	CL	mg/L	1070	1022	(model calculation)
5th Avenue Site (Station CH3301)						
03/18/99	1600	EC	µS/cm	484	*	*
03/18/99	1600	CL	mg/L	75.7	*	*
03/24/99	1747	EC	µS/cm	3560	*	*
03/24/99	1747	CL	mg/L	995	*	*
03/25/99	1600	EC	µS/cm	2380	*	*
03/25/99	1600	CL	mg/L	766	*	*
03/26/99	1610	EC	µS/cm	1111	*	*
03/26/99	1610	CL	mg/L	343	*	(model calculation)
03/27/99	1145	EC	µS/cm	439	*	*
03/27/99	1145	CL	mg/L	80.3	122.4	(model calculation)
03/27/99	1656	EC	µS/cm	1061	*	*
03/27/99	1656	CL	mg/L	274	283.1	(model calculation)
03/29/99	1515	EC	µS/cm	348	*	*
03/29/99	1515	CL	mg/L	44.8	92.6	(model calculation)
03/31/99	1500	EC	µS/cm	2460	*	*
03/31/99	1500	CL	mg/L	736	755.7	(model calculation)

Note:

*	Data not available for these dates.
CL	chloride
EC	specific conductivity

Table 5
1999 Chloride at Anchorage Snow Disposal and Street Sites
1999 Selected Datalogger Daily Peak, Average, and Minimum Values
Station CHS001

Date 1999	Daily Peak Chloride Value (mg/L)	Daily Average Chloride Value (mg/L)	Daily Minimum Chloride Value (mg/L)	Daily Average Flow Value (cfs)
22-Apr	601	475	302	0.70
23-Apr	728	598	401	0.78
24-Apr	784	675	578	0.85
25-Apr	752	684	633	0.86
26-Apr	833	706	598	0.77
27-Apr	983	740	669	0.77
28-Apr	885	739	671	0.74
29-Apr	685	624	562	0.66
30-Apr	605	550	502	0.70
1-May	498	451	421	0.56
2-May	423	392	363	0.48
3-May	367	336	302	0.43
4-May	345	321	278	0.47
5-May	330	315	297	0.57
6-May	304	274	228	0.55
7-May	280	249	203	0.55
8-May	254	226	193	0.53
9-May	219	205	191	0.45
10-May	191	175	191	0.32
11-May	193	154	123	0.29
12-May	187	157	115	0.40
13-May	187	146	107	0.50
14-May	167	125	77	0.66
15-May	153	110	62	0.95
16-May	137	94	32	0.92
17-May	133	81	26	0.89
18-May	123	76	20	0.84
19-May	121	78	28	0.71
20-May	116.7	84.5	44.3	0.62
21-May	112.7	81.7	56.3	0.53
22-May	112.7	81.7	56.3	0.48
23-May	106.7	78	52.3	0.50
24-May	106.7	87.9	64.3	0.39
25-May	108.7	87.1	70.7	0.35
26-May	110.7	83	72.3	0.66
27-May	98.7	79.6	78.7	0.31
28-May	104.7	81.6	68.3	0.22

Table 6
1999 Chloride at Anchorage Snow Disposal and Street Sites
Datalogger Daily Peak, Average, and Minimum Values
Stations MTV01, CH3301, TK01

Date 1999	Daily Peak Chloride Value (mg/L)	Daily Average Chloride Value (mg/L)	Daily Minimum Chloride Value (mg/L)	Daily Average Flow (cfs)
Station MTV01				
24-Apr	1025	904	761	0.032
25-Apr	918	797	660	0.041
26-Apr	803	686	551	0.048
27-Apr	706	610	492	0.047
28-Apr	674	554	441	0.044
29-Apr	591	496	389	0.051
30-Apr	501	472	442	0.06
1-May	578	439	309	0.054
2-May	442	281	157	0.036
3-May	306	171	3	0.033
4-May	218	133	5	0.022
Station CH3301				
25-Mar	829	460	183	*
26-Mar	441	277	159	0.071
27-Mar	375	202	119	0.09
28-Mar	248	150	109	0.08
29-Mar	146	111	64	0.056
30-Mar	144	110	93	0.05
31-Mar	804	357	82	0.08
1-Apr	443	263	98	0.12
2-Apr	1145	386	87	0.12
3-Apr	341	178	94	0.051
4-Apr	133	117	103	0.05
5-Apr	188	118	98	0.11
Station TK01				
30-Mar	532	454	367	0.1
31-Mar	124	108	91	0.07
1-Apr	233	110	49	0.2
2-Apr	100	67	47	0.07
3-Apr	117	63	2.4	0.058
4-Apr	*	*	*	0.037
5-Apr	*	*	*	0.058
6-Apr	*	*	*	0.023
7-Apr	*	*	*	0.014

* Data not available or inconsistent for these dates.

Table 7a
1999 Chloride at Anchorage Snow Disposal and Street Sites
Depth Samples from Anchorage Area Lakes

Lake ID	Station Number	Date	Time	Sample Depth (feet)	Specific Conductance (μS/cm)
CAL	4000	10/11/88	11:30	3.00	125
CAL	4000	9/27/90	14:15	3.00	134
CAL	4000	9/26/91	13:00	3.00	128
CAL	5000	10/12/88	10:40	1.80	128
CAL	5000	9/27/90	14:45	5.10	133
CAL	5000	9/26/91	13:20	5.80	137
COL	2000	10/11/88	09:40	3.00	179
COL	2000	10/2/89	15:30	3.00	201
COL	2000	9/27/90	13:30	5.00	193
COL	2000	9/25/91	16:00	3.50	149
GOL	3000	10/10/88	10:00	3.00	100
GOL	3000	9/20/89	11:30	3.00	90
GOL	3000	9/28/90	12:30	3.00	84
GOL	3000	9/26/91	10:30	4.00	84
GOL	3000	10/6/92	10:00	5.25	94
GOL	4000	10/13/88	11:15	13.00	103
GOL	4000	9/20/89	11:30	10.30	90
GOL	4000	9/28/90	12:45	6.50	93
GOL	4000	9/26/91	10:30	8.00	84
JOL	2000	10/12/88	16:10	2.30	152
JOL	2000	10/3/89	15:00	3.50	111
JOL	2000	9/26/90	12:45	3.70	191
JOL	2000	9/25/91	15:00	3.20	172
JOL	2000	10/6/92	11:15	3.90	127
LFL	3000	10/11/88	14:15	3.00	192
LFL	3000	10/9/89	09:30	3.00	200
LFL	3000	9/28/90	10:30	3.00	177
LFL	3000	9/27/91	10:00	5.00	184
LFL	3000	10/1/92	10:55	5.00	188

Lake ID	
CAL 4000	CENTER OF CAMPBELL LAKE DUE NORTH OF END OF LAKESIDE DRIVE
CAL 5000	CAMPBELL LAKE NEAR INLET NEAR CURLEW DRIVE
CAL 6000	CENTER OF CAMPBELL LAKE DUE NORTH OF END OF LAKESIDE DRIVE
COL 2000	CENTER OF CONNORS LAKE
GOL 3000	CENTER OF GOOSE LAKE
GOL 4000	CENTER OF GOOSE LAKE
JOL 2000	SOUTHERN POINT OF JONES LAKE NEAR LAKE HOOD GRAVEL AIRSTRIP
LFL 3000	NORTHERN CENTER OF LOWER FIRE LAKE

* Taken from DHHS, 1992. Anchorage Area Wide Water Quality Monitoring Program, 1988 to 1992.

Table 7b
1999 Chloride at Anchorage Snow Disposal and Street Sites
Depth Samples from Anchorage Area Lakes

Lake ID	Station Number	Date	Time	Sample Depth (feet)	Specific Conductance (μS/cm)
LFL	4000	10/11/88	14:00	3.00	194
LFL	4000	10/9/89	10:00	3.00	198
LFL	4000	9/28/90	10:15	3.00	179
LFL	4000	9/27/91	09:30	5.50	191
LFL	4000	10/1/92	10:45	5.50	187
UNL	2000	10/13/88	10:00	10.80	246
UNL	2000	9/21/89	17:30	7.50	210
UNL	2000	9/28/90	13:30	10.10	222
UNL	2000	9/26/91	11:00	9.80	207
WEL	3000	10/10/88	14:40	3.00	249
WEL	3000	10/3/89	10:30	3.00	331
WEL	3000	9/26/90	14:15	3.50	278
WEL	3000	9/25/91	12:45	4.50	269
WEL	3000	9/29/92	12:15	2.50	302
WEL	4000	10/10/88	15:10	3.00	250
WEL	4000	10/3/89	11:30	2.00	322
WEL	4000	9/26/90	15:15	2.00	274
WEL	4000	9/25/91	13:00	2.00	277
WEL	4000	9/29/92	12:30	2.10	289
WEL	5000	10/12/88	13:35	3.00	337
WEL	5000	9/21/89	16:20	3.50	278
WEL	5000	9/26/90	13:45	3.00	289
WEL	5000	9/25/91	14:30	3.10	284
WEL	5000	9/29/92	11:00	2.50	323
WEL	6000	10/12/88	14:15	5.00	308
WEL	6000	9/20/89	16:10	3.50	284
WEL	6000	9/26/90	14:45	3.00	282
WEL	6000	9/25/91	13:45	3.90	283
WEL	6000	9/29/92	12:45	4.00	314

Lake ID	
LFL 4000	SOUTHERN CENTER OF LOWER FIRE LAKE
UNL 2000	UNIVERSITY LAKE
WEL 3000	NORTHERN CENTER OF WESTCHESTER LAGOON
WEL 4000	SOUTHERN CENTER OF WESTCHESTER LAGOON
WEL 5000	EASTERN CENTER OF WESTCHESTER LAGOON
WEL 6000	SOUTHERN COVE OF WESTCHESTER LAGOON

* Taken from DHHS, 1992. Anchorage Area Wide Water Quality Monitoring Program, 1988 to 1992.

Table 8
1999 Chloride at Anchorage Snow Disposal and Street Sites
Sand Lake Historic Data (USGS, 1978)

Station	Date	Depths (ft.)	Cond (uS/cm)	Cl (mg/L)
Middle Near Spenard	3/27/72	6.6	65	2.5
		9.9	62	2.5
		16	61	*
		21	60	3.1
		26		3.1
		29	61	2.5
Middle Near Spenard	6/27/72	6.6	61	3
		9.9	61	3
		16	61	3.2
		21	61	3.1
		26	61	3.3
		29	61	3.1
		33	61	*
Middle Near Spenard	8/23/72	6.6	52	2.9
		13	52	3
		19	52	3
		26	52	3.1
		33	55	3
Near Spenard	3/27/72	6.6	64	3.2
		13	61	3.1
		19	61	3
		26	60	3
		33	60	3.1
Near Spenard	6/27/72	6.6	51	2.9
		13	51	3
		19	51	3
		26	51	2.8
		33	52	2.9
Near Spenard	8/23/72	6.6	41	2.9
		13	52	3.1
		19	52	3
		26	51	2.9
		33	52	3
East End Near Spenard	3/27/72	3.3	66	3
		6.6	64	2.5
		9.9	61	2.5
		13	61	2.5
		16	60	2.5
		19	61	2.5
		23	60	2.5
East End Near Spenard	6/27/72	0	51	3
		6.6	51	2.5
		13	51	2.5
		18	51	3.1
		26	51	3.2
		29	51	2
East End Near Spenard	8/23/72	6.6	52	2.9
		13	52	3
		19	52	3.5
		26	52	3.5
		29	51	3.5

Note:
* Data not available or inconsistent for these dates.
Data from: USGS, 1975. Water-Quality Data, 1948-1973.
Anchorage and Vicinity, Alaska. Open File Report: 59 pp.
59 pp.

LEGEND

STREET SITE BASIN AREAS (SOURCE: ANCHORAGE BOWL OGS MODELING PROJECT, 9/4/88, MW)

SNOW DISPOSAL SITE SERVICE AREAS (SOURCE: GEORGE WATERS AND SHAWN McBRIDE, MOA STREET MAINTENANCE, 6/26/96 TO SRW)

JOB No. 1189090.020102

ANCHORAGE WATERSHED MANAGEMENT

FIGURE 1

MUNICIPALITY OF ANCHORAGE - DEPARTMENT OF PUBLIC WORKS
1999 CHLORIDE RUNOFF FROM ANCHORAGE STREETS
AND SNOW DISPOSAL SITES

SITE LOCATIONS

MONTGOMERY WATSON

JOB No. 1189090.020101

ANCHORAGE
WATERSHED
MANAGEMENT

FIGURE 2

MUNICIPALITY OF ANCHORAGE - DEPARTMENT OF PUBLIC WORKS
1999 CHLORIDE RUNOFF FROM ANCHORAGE STREETS
AND SNOW DISPOSAL SITES

TUDOR SNOW DISPOSAL SITE

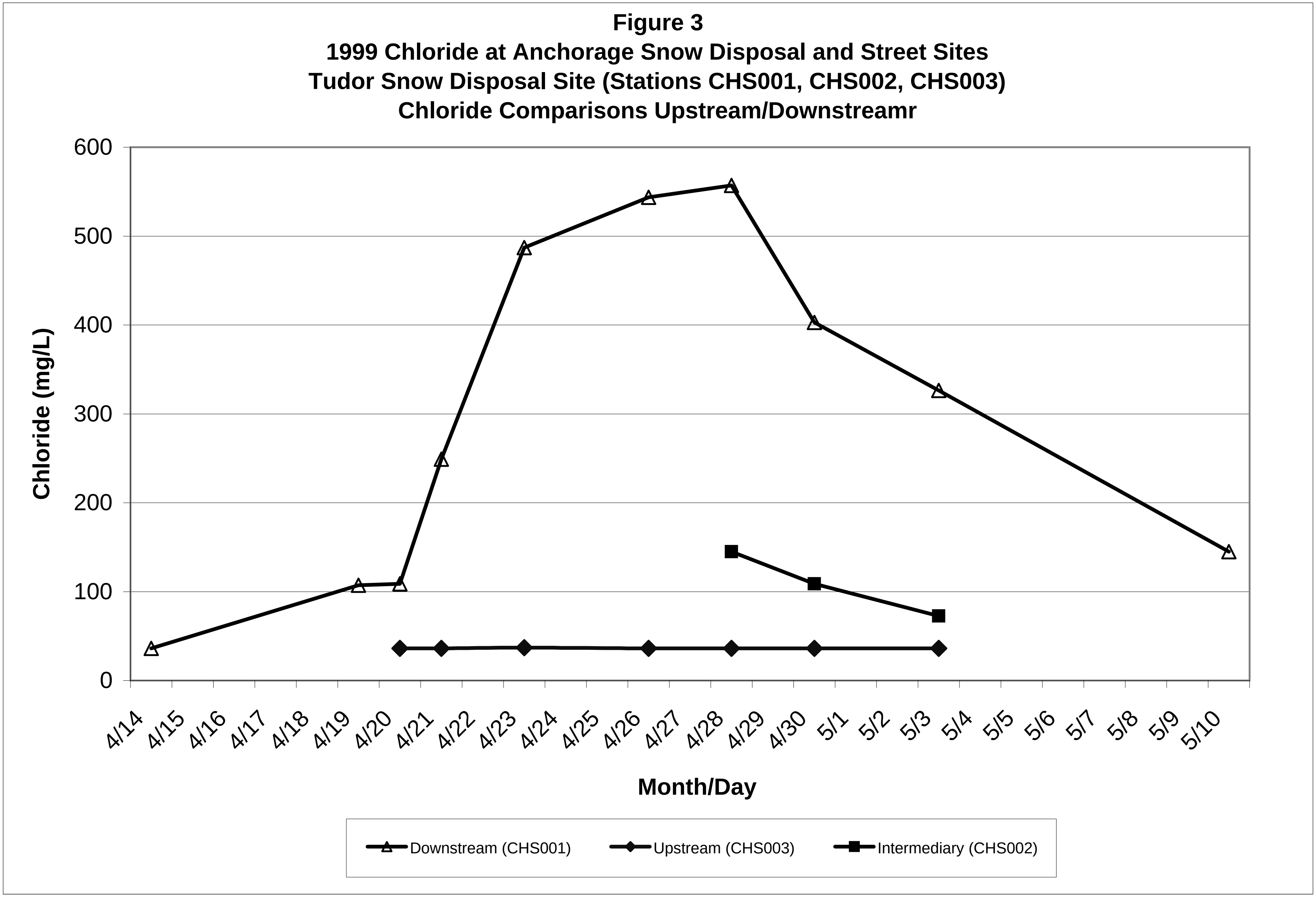


Figure 3
1999 Chloride at Anchorage Snow Disposal and Street Sites
Tudor Snow Disposal Site (Stations CHS001, CHS002, CHS003)
Chloride Comparisons Upstream/Downstreamr
Chloride (mg/L)
0
100
200
300
400
500
600
4/14
4/15
4/16
4/17
4/18
4/19
4/20
4/21
4/22
4/23
4/24
4/25
4/26
4/27
4/28
4/29
4/30
5/1
5/2
5/3
5/4
5/5
5/6
5/7
5/8
5/9
5/10
Month/Day
Downstream (CHS001)
Upstream (CHS003)
Intermediary (CHS002)

Figure 4
1999 Chloride at Anchorage Snow Disposal and Street Sites
Tudor Snow Disposal Site (Stations TU01, TU02 and TU07)
Chloride in Site Discharge Meltwater

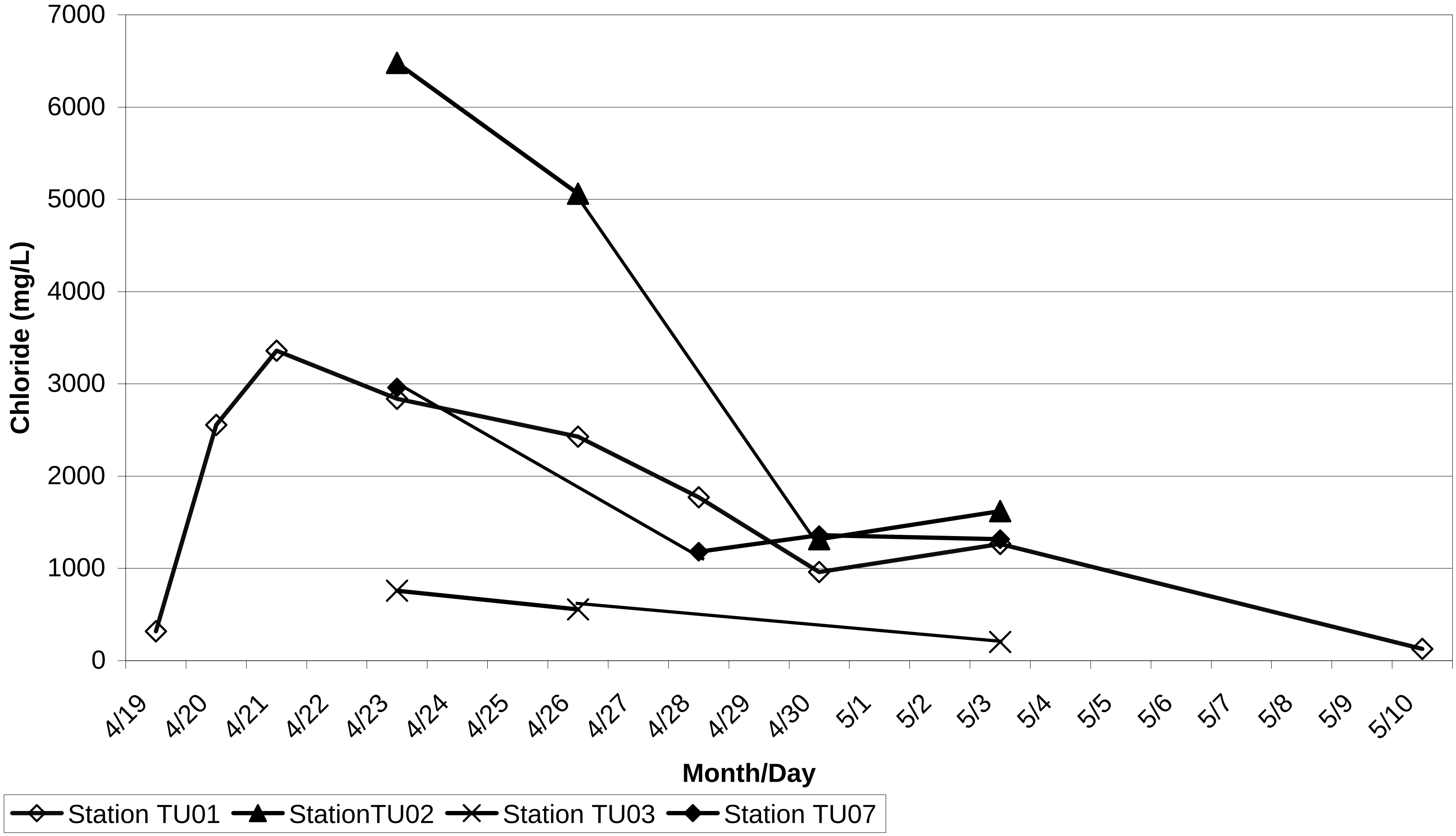
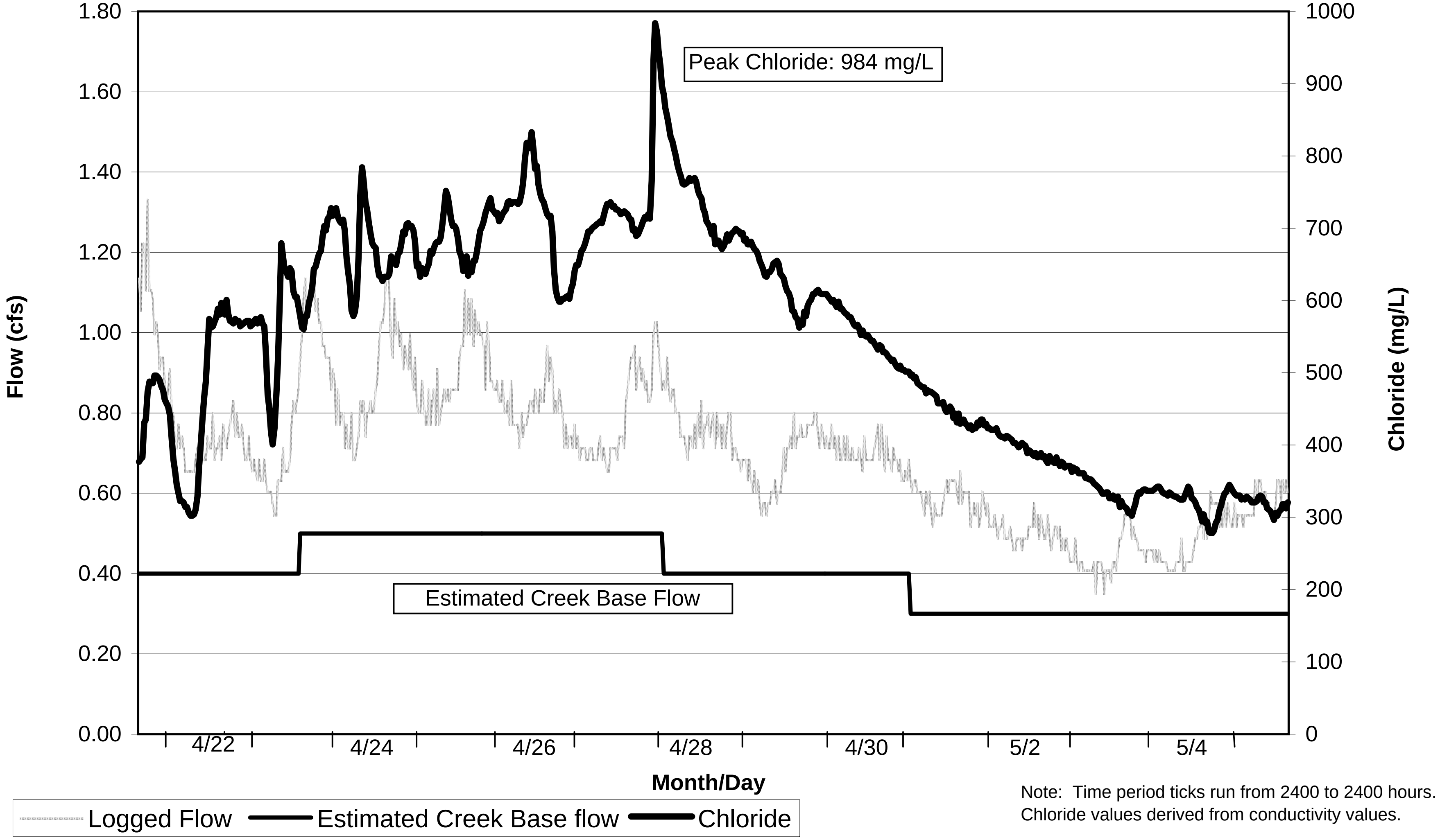


Figure 5a

1999 Chloride at Anchorage Snow Disposal and Street Sites

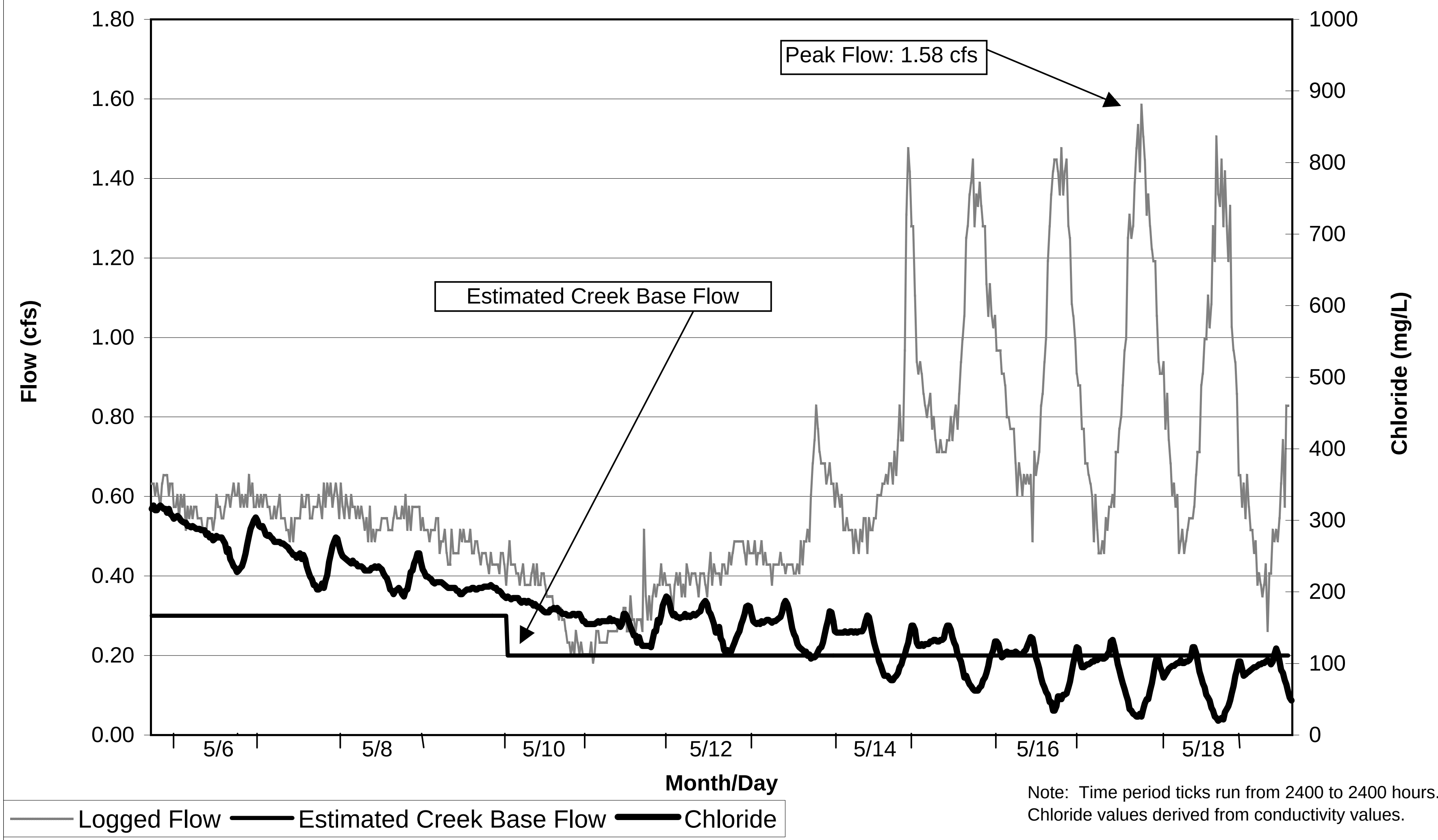
Tudor Snow Disposal Site - Downstream Receiving Water (Station CHS001)

Chloride Datalogger Time Series (4/21/99 to 5/5/99)



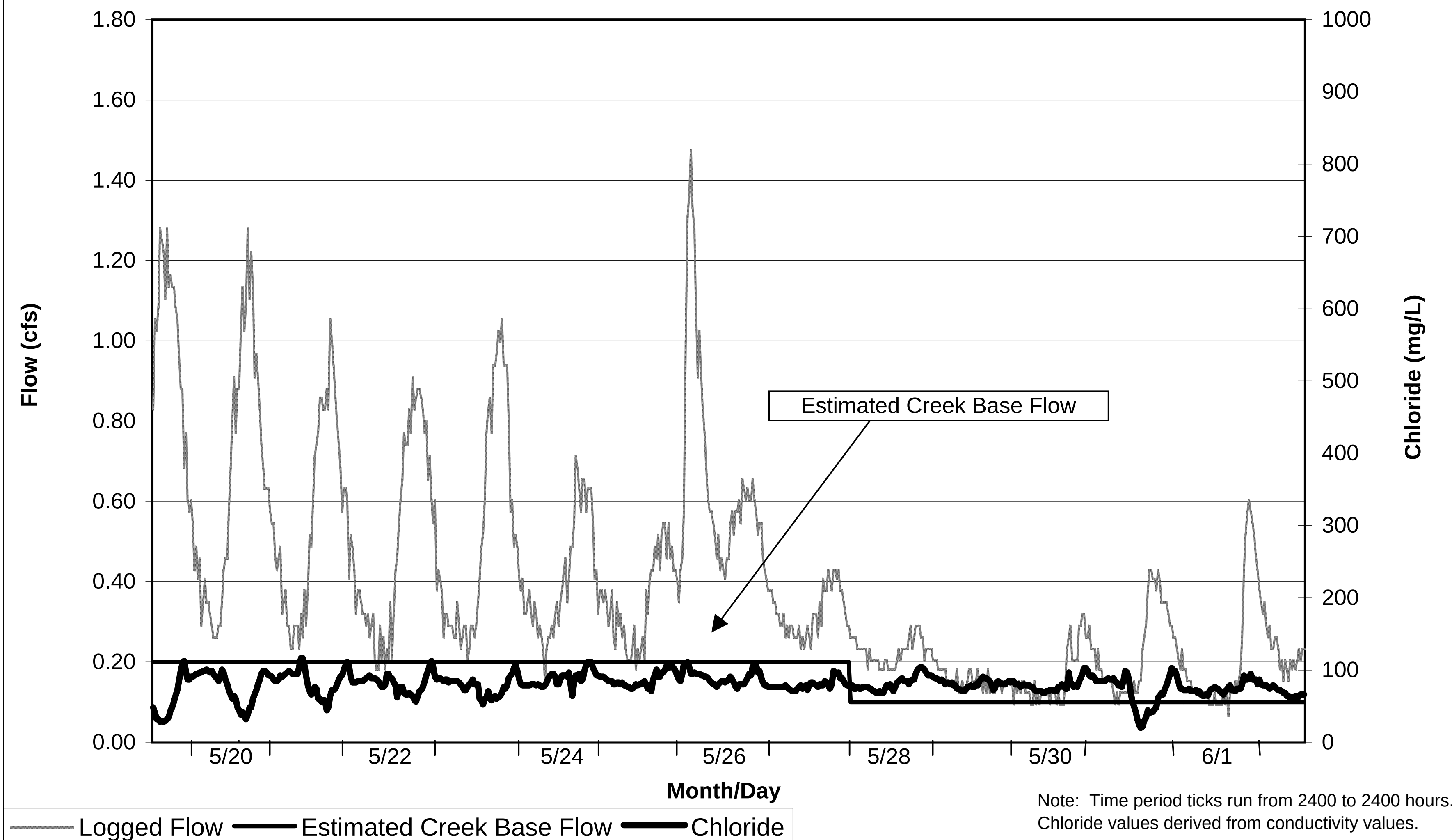
Note: Time period ticks run from 2400 to 2400 hours.
Chloride values derived from conductivity values.

Figure 5b
1999 Chloride at Anchorage Snow Disposal and Street Sites
Tudor Snow Disposal Site - Downstream Receiving Water (Station CHS001)
Chloride Datalogger Time Series (5/5/99 to 5/19/99)



Note: Time period ticks run from 2400 to 2400 hours.
Chloride values derived from conductivity values.

Figure 5c
1999 Chloride at Anchorage Snow Disposal and Street Sites
Tudor Snow Disposal Site - Downstream Receiving Water (Station CHS001)
Chloride Datalogger Time Series (5/19/99 to 6/2/99)



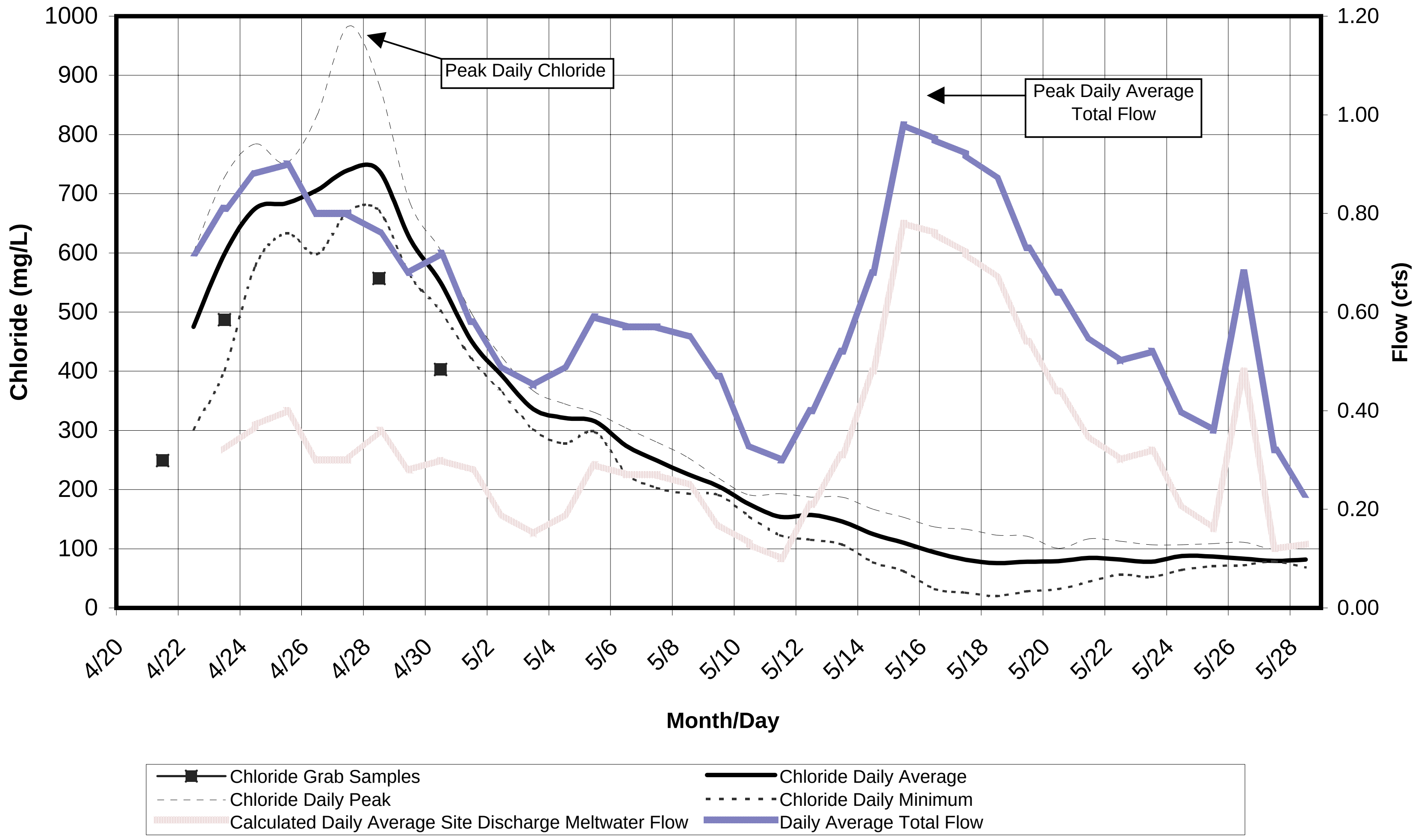
Note: Time period ticks run from 2400 to 2400 hours.
Chloride values derived from conductivity values.

Figure 6

1999 Chloride at Anchorage Snow Disposal and Street Sites

Tudor Snow Disposal Site - Downstream Receiving Water (Station CHS001)

Chloride Datalogger Summary



Note: Chloride values based on correlation to conductivity.

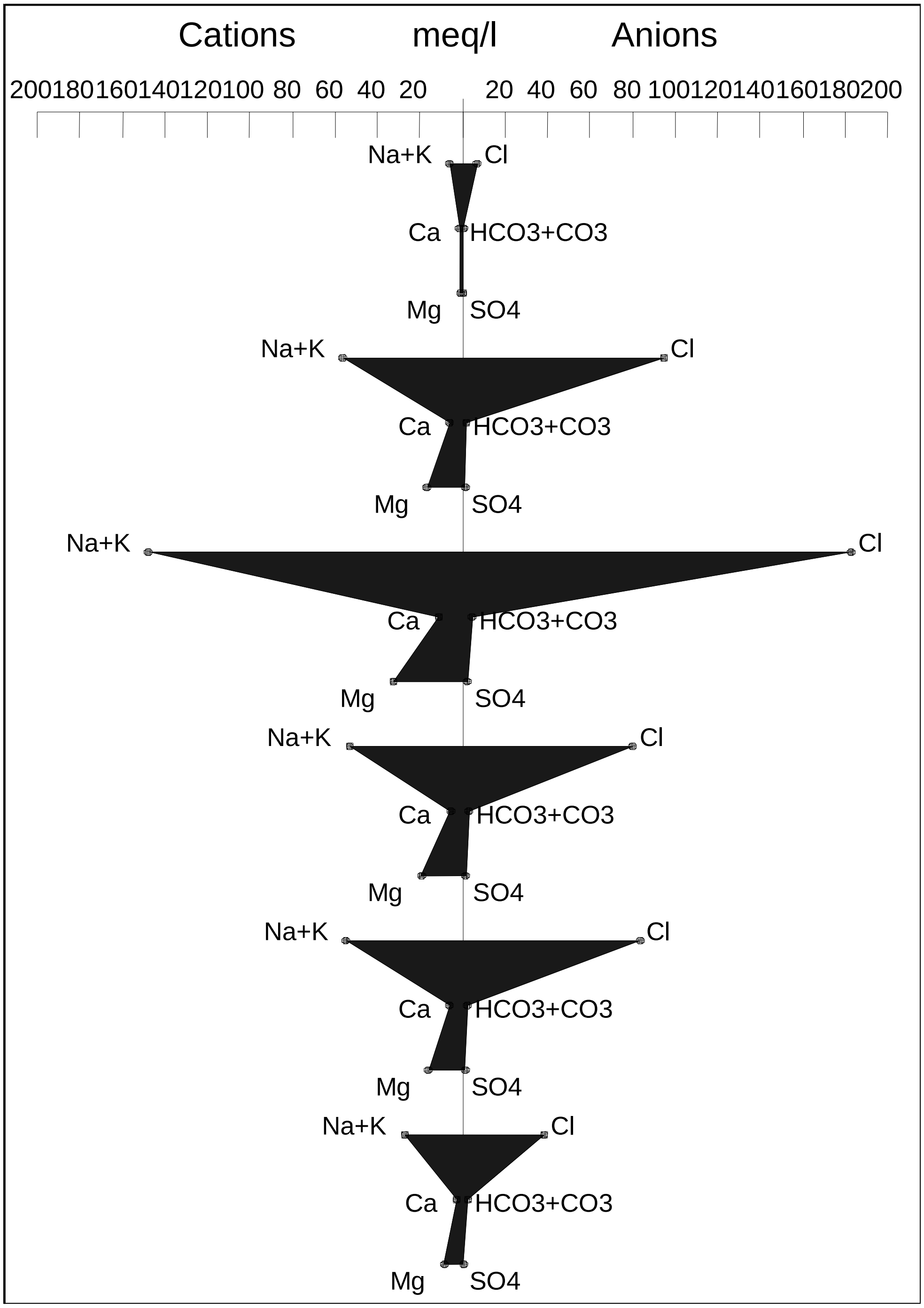


Figure 7 Stiff Diagrams of Tudor Snow Disposal Site Samples

Stiff diagrams, from top to bottom:

A) CHS001 (4/21/99)
B) TU01 (4/21/99)
C) TU02 (4/23/99)
D) TU01 (4/23/99)
E) TU07 (4/23/99)
F) TU07 (4/30/99)

Figure 8

1999 Chloride at Anchorage Snow Disposal and Street Sites

Tudor Snow Disposal Site

Chloride Source Percent Contributions

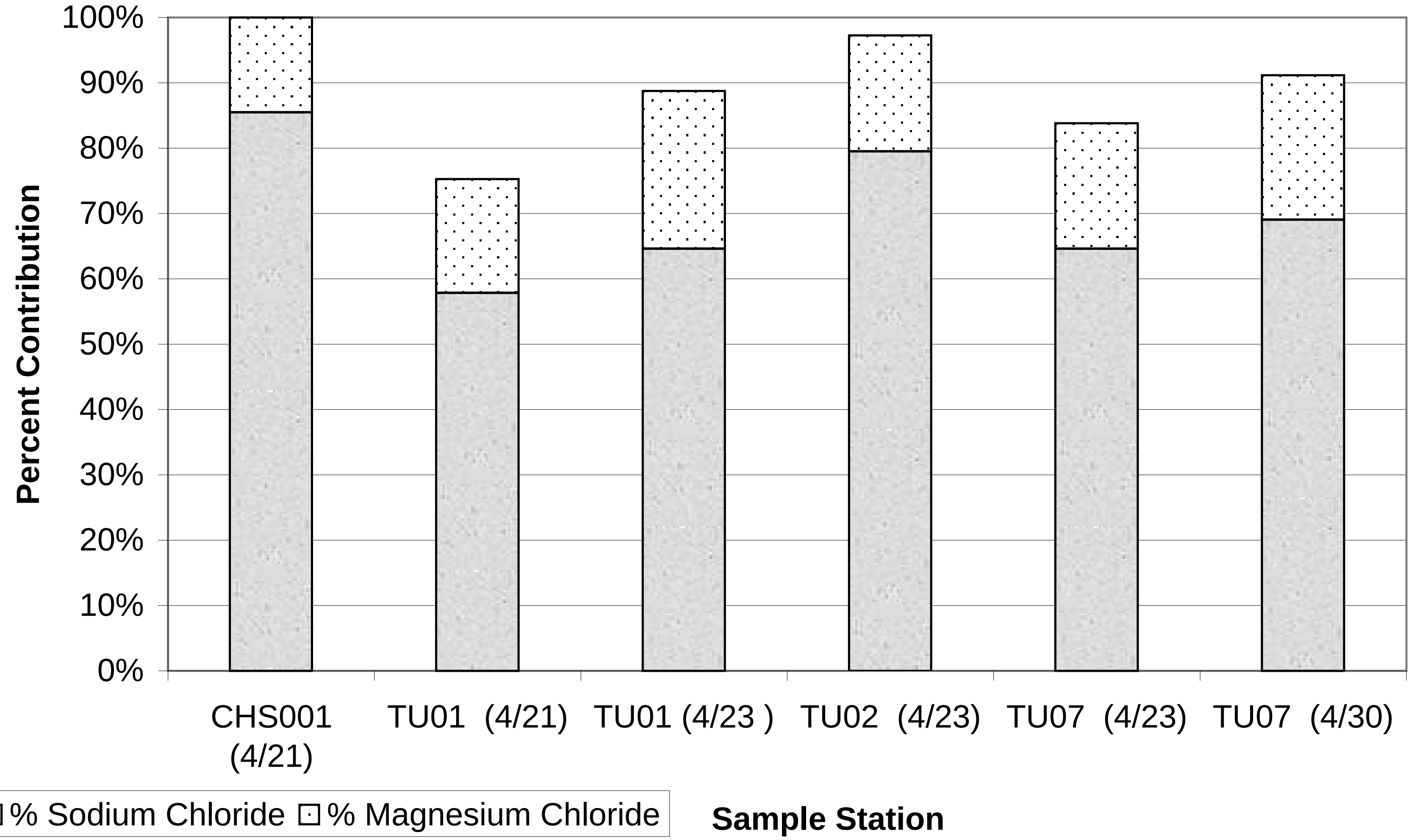
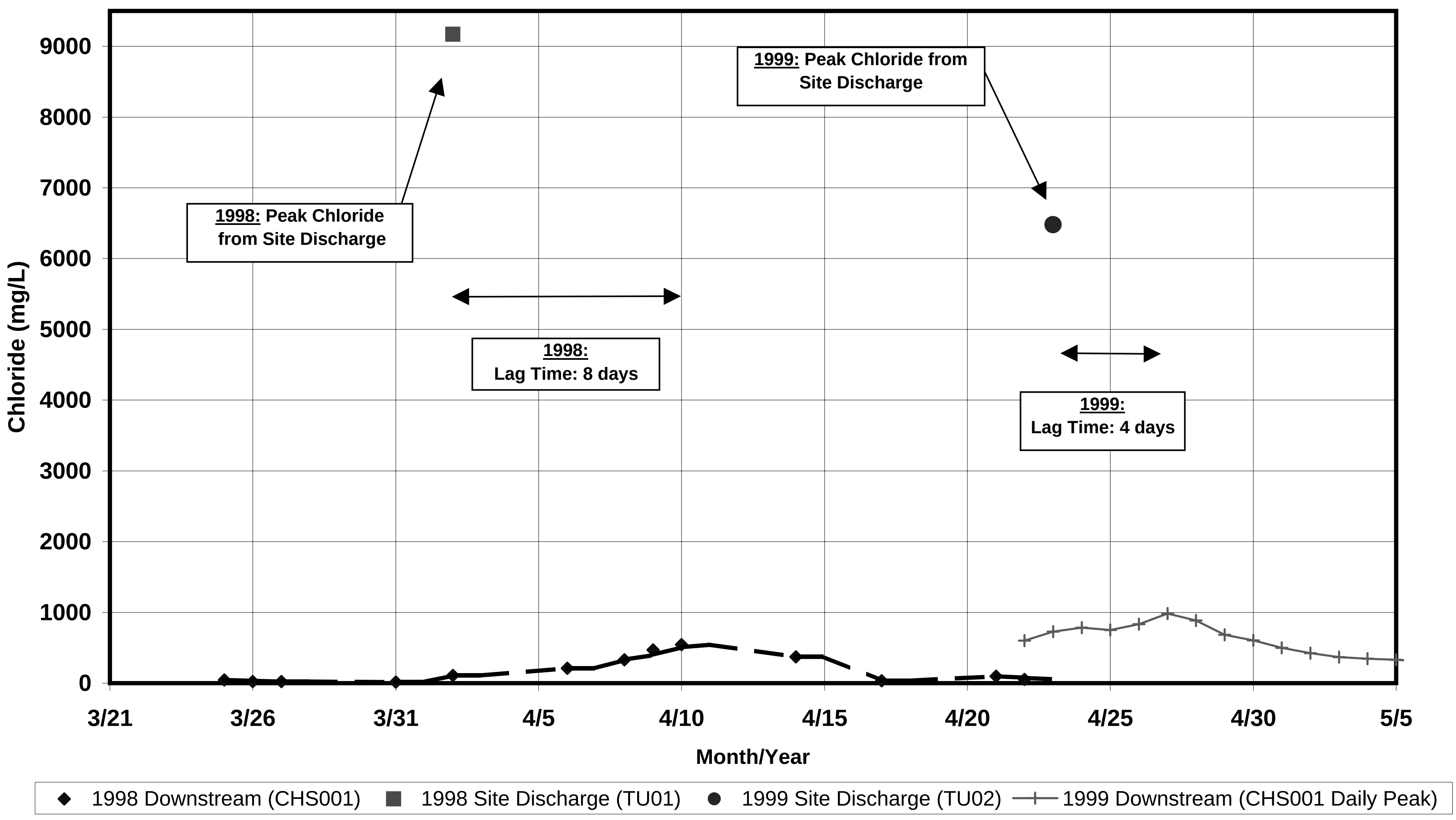


Figure 9

1999 Chloride at Anchorage Snow Disposal and Street Sites

Tudor Snow Disposal Site

1998 and 1999 Peak Chloride Comparisons Between Site Discharge and Downstream Receiving Water



MONTGOMERY WATSON

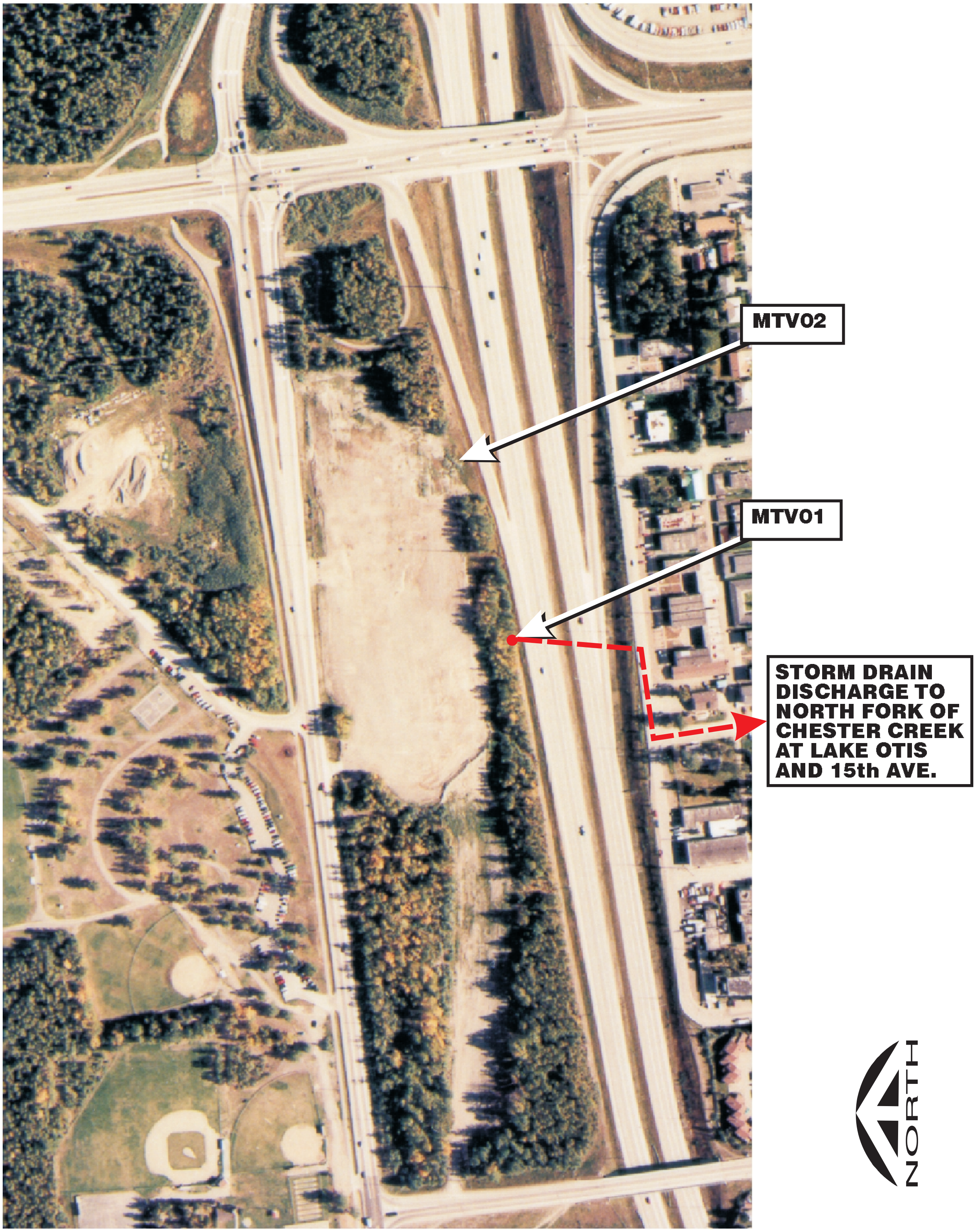


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FIGURE 10

MUNICIPALITY OF ANCHORAGE - DEPARTMENT OF PUBLIC WORKS
1999 CHLORIDE RUNOFF FROM ANCHORAGE STREETS AND SNOW DISPOSAL AREAS

NORTH MOUNTAIN VIEW SNOW DISPOSAL SITE

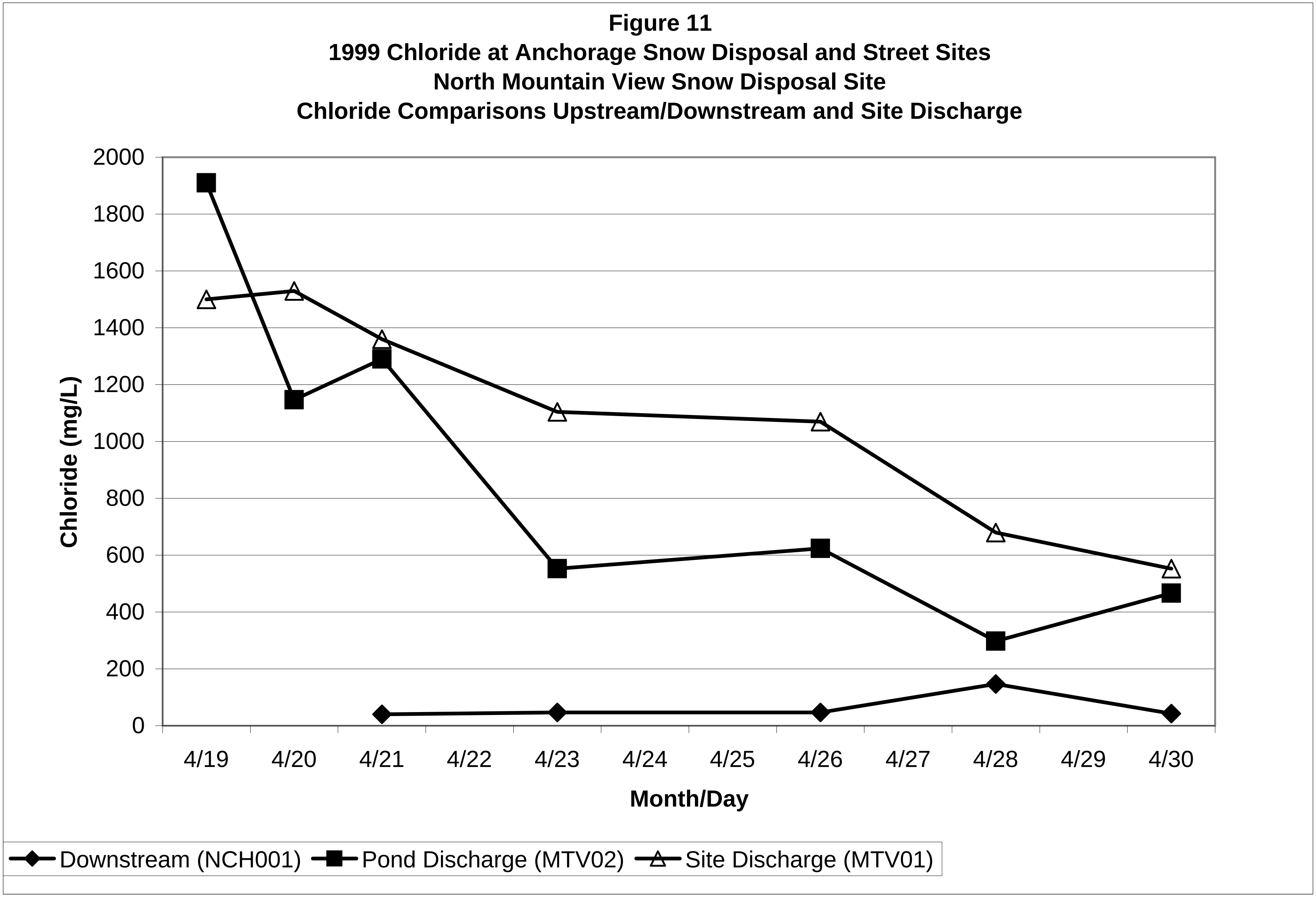


Figure 11
1999 Chloride at Anchorage Snow Disposal and Street Sites
North Mountain View Snow Disposal Site
Chloride Comparisons Upstream/Downstream and Site Discharge
Chloride (mg/L)
2000
1800
1600
1400
1200
1000
800
600
400
200
0
4/19
4/20
4/21
4/22
4/23
4/24
4/25
4/26
4/27
4/28
4/29
4/30
Month/Day
Downstream (NCH001)
Pond Discharge (MTV02)
Site Discharge (MTV01)

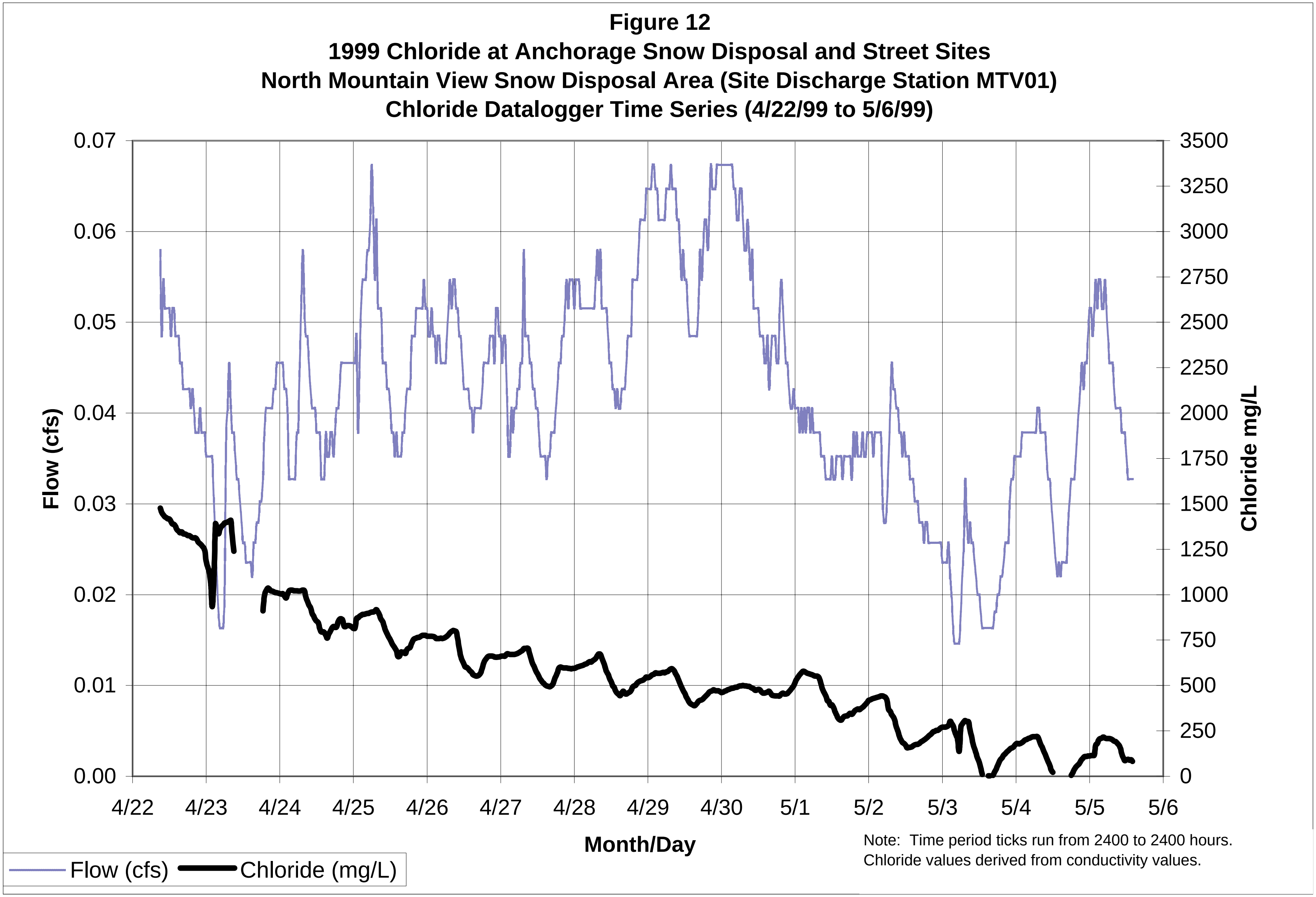
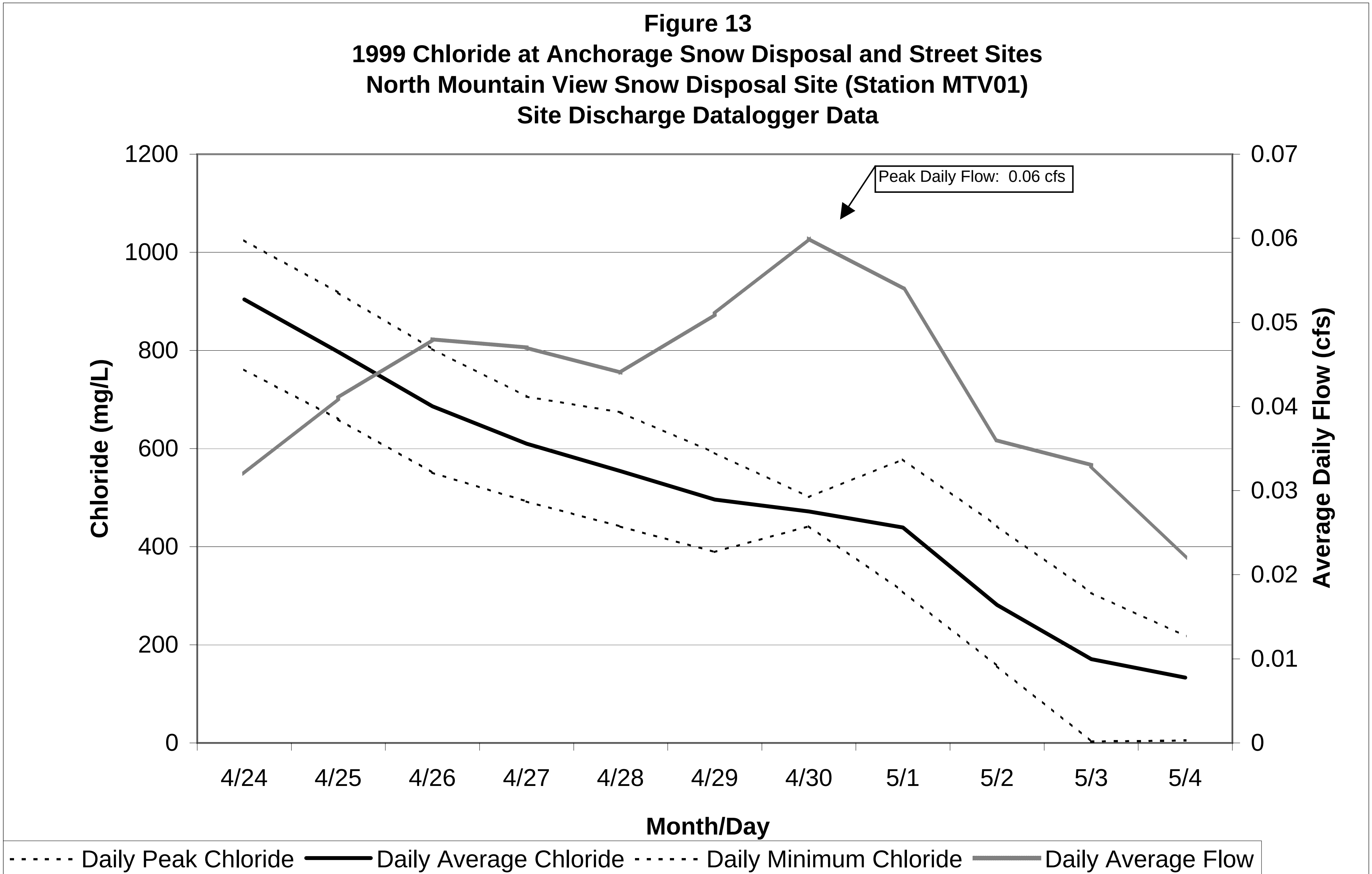


Figure 12
1999 Chloride at Anchorage Snow Disposal and Street Sites
North Mountain View Snow Disposal Area (Site Discharge Station MTV01)
Chloride Datalogger Time Series (4/22/99 to 5/6/99)
Flow (cfs)
Chloride mg/L
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
3500
3250
3000
2750
2500
2250
2000
1750
1500
1250
1000
750
500
250
0
4/22
4/23
4/24
4/25
4/26
4/27
4/28
4/29
4/30
5/1
5/2
5/3
5/4
5/5
5/6
Month/Day
Flow (cfs)
Chloride (mg/L)
Note: Time period ticks run from 2400 to 2400 hours.
Chloride values derived from conductivity values.



Note: Chloride determined from correlation to conductivity.

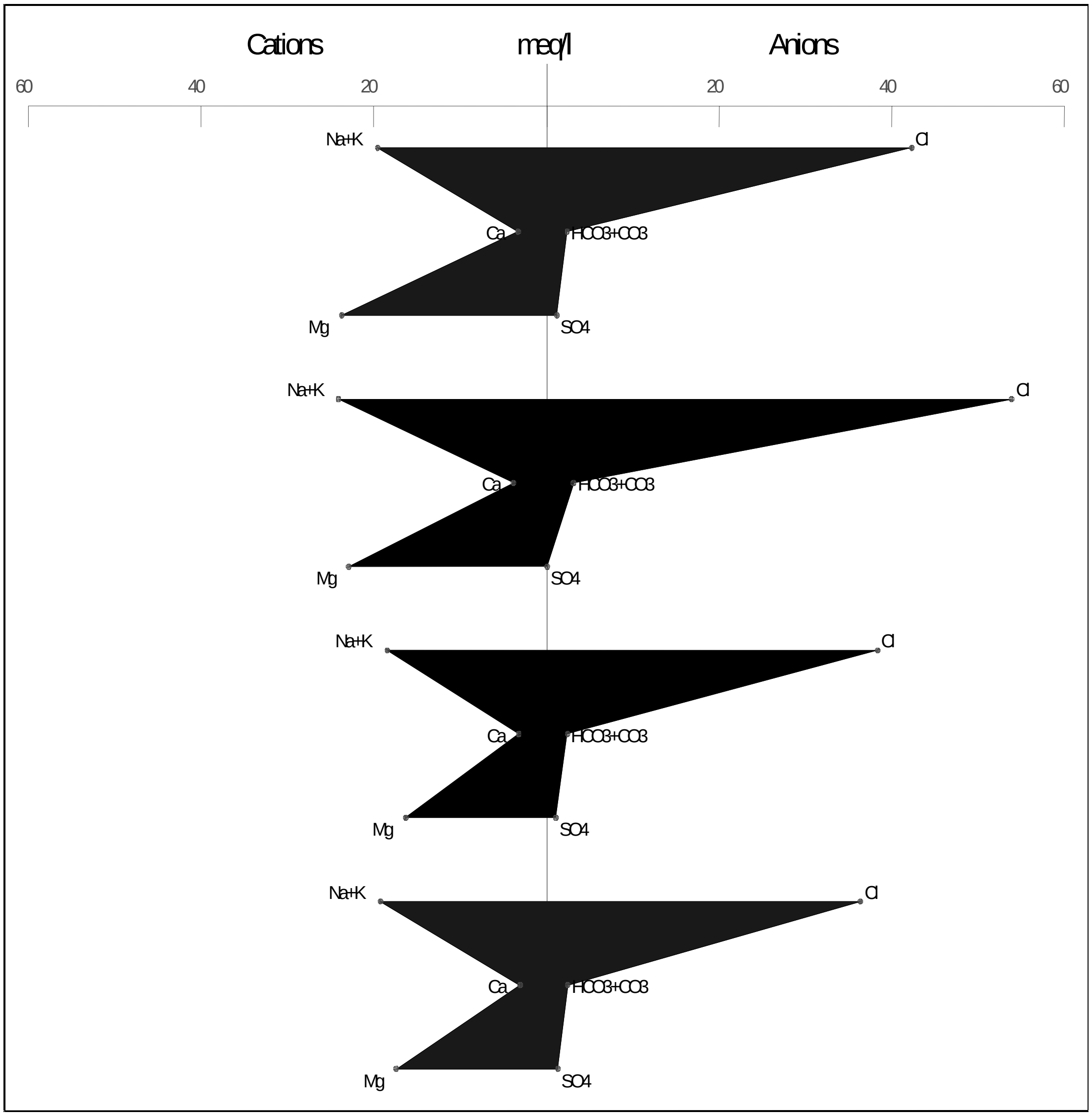


Figure 14 Stiff Diagrams of North Mountain View Snow Disposal Site Samples

Stiff diagrams, from top to bottom:

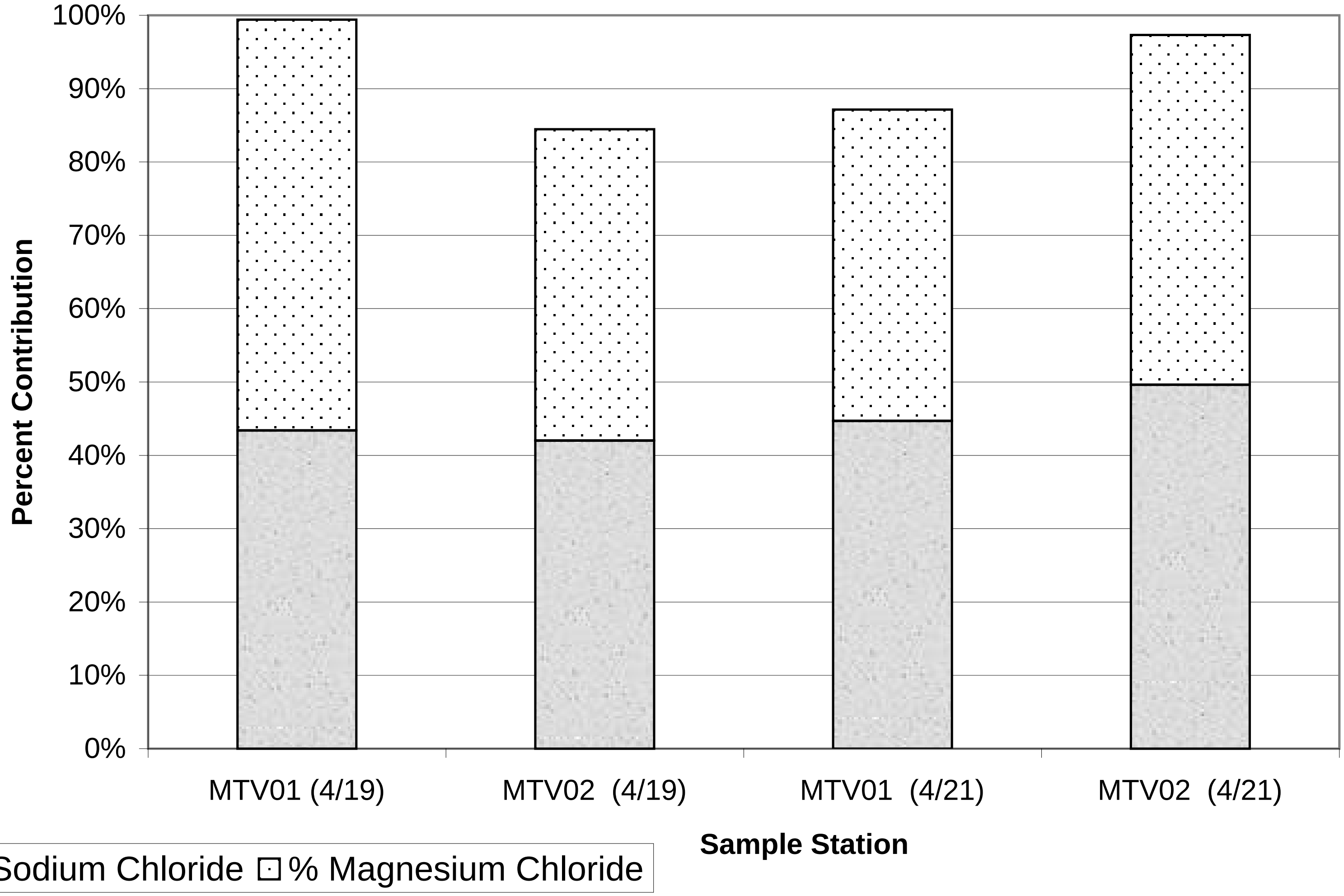
A) MTV01 (4/19/99)
B) MTV02 (4/19/99)
C) MTV01 (4/21/99)
D) MTV02 (4/21/99)

Figure 15a

1999 Chloride at Anchorage Snow Disposal and Street Sites

North Mountain View Snow Disposal Site

Site Discharge Chloride Source Percent Contributions



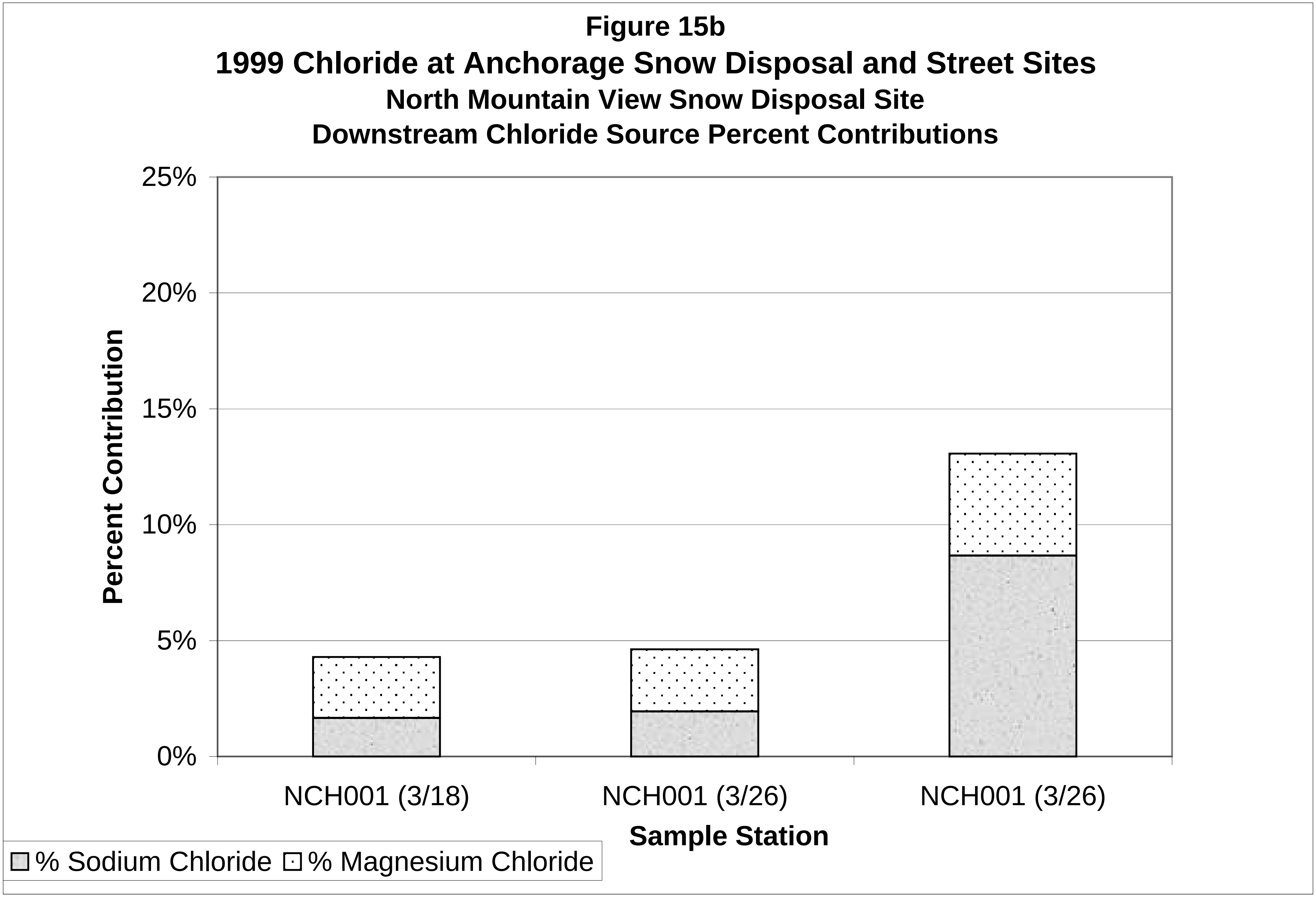


Figure 15b
1999 Chloride at Anchorage Snow Disposal and Street Sites
North Mountain View Snow Disposal Site
Downstream Chloride Source Percent Contributions
25%
20%
15%
10%
5%
0%
Percent Contribution
NCH001 (3/18)
NCH001 (3/26)
NCH001 (3/26)
Sample Station
% Sodium Chloride
% Magnesium Chloride

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FIGURE 16

MUNICIPALITY OF ANCHORAGE - DEPARTMENT OF PUBLIC WORKS
1999 CHLORIDE RUNOFF FROM ANCHORAGE STREETS
AND SNOW DISPOSAL SITES

5th AVENUE SITE

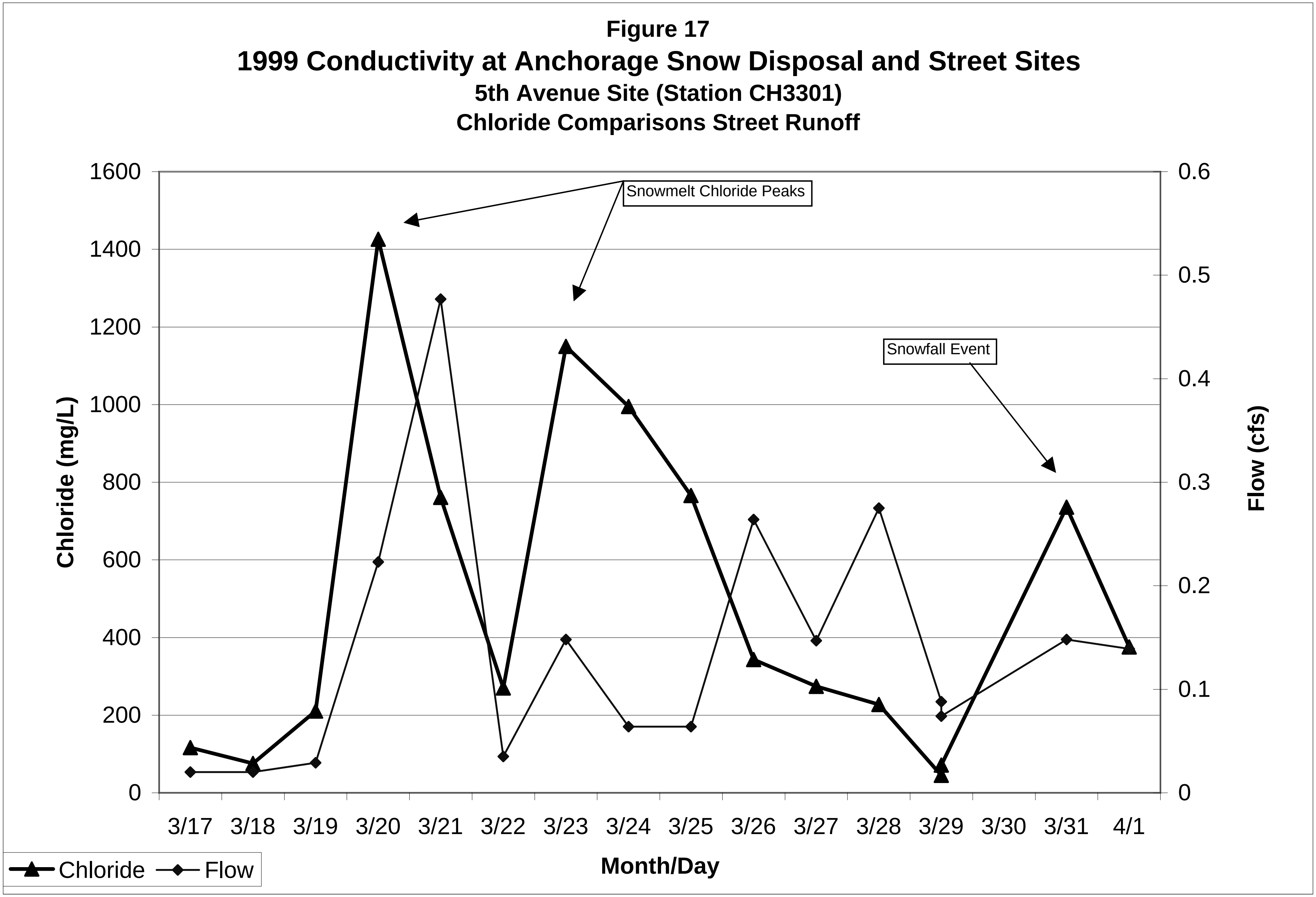


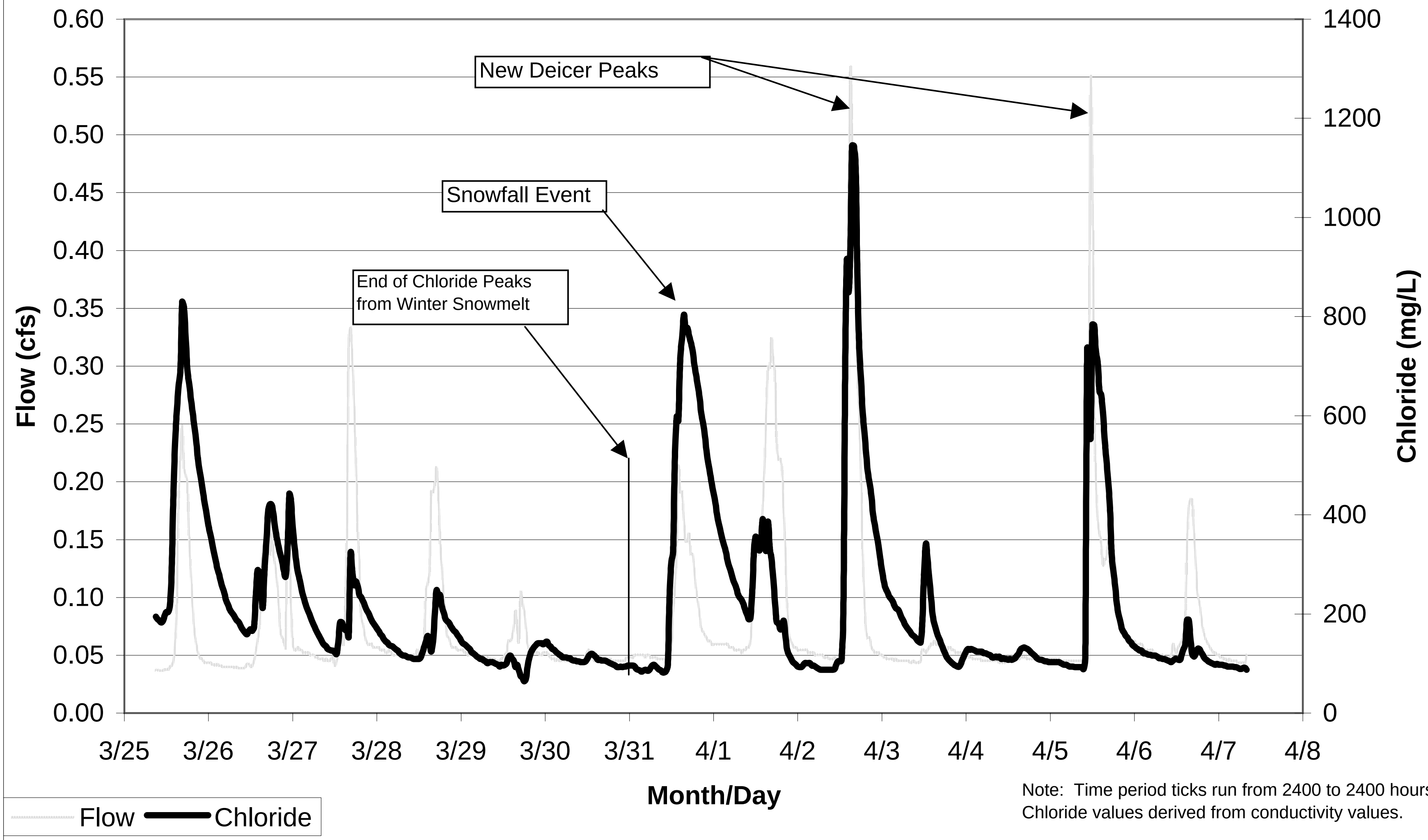
Figure 17
1999 Conductivity at Anchorage Snow Disposal and Street Sites
5th Avenue Site (Station CH3301)
Chloride Comparisons Street Runoff
Snowmelt Chloride Peaks
Snowfall Event
Chloride (mg/L)
Flow (cfs)
0
200
400
600
800
1000
1200
1400
1600
0
0.1
0.2
0.3
0.4
0.5
0.6
3/17
3/18
3/19
3/20
3/21
3/22
3/23
3/24
3/25
3/26
3/27
3/28
3/29
3/30
3/31
4/1
Month/Day
Chloride
Flow

Figure 18

1999 Chloride at Anchorage Snow Disposal and Street Sites

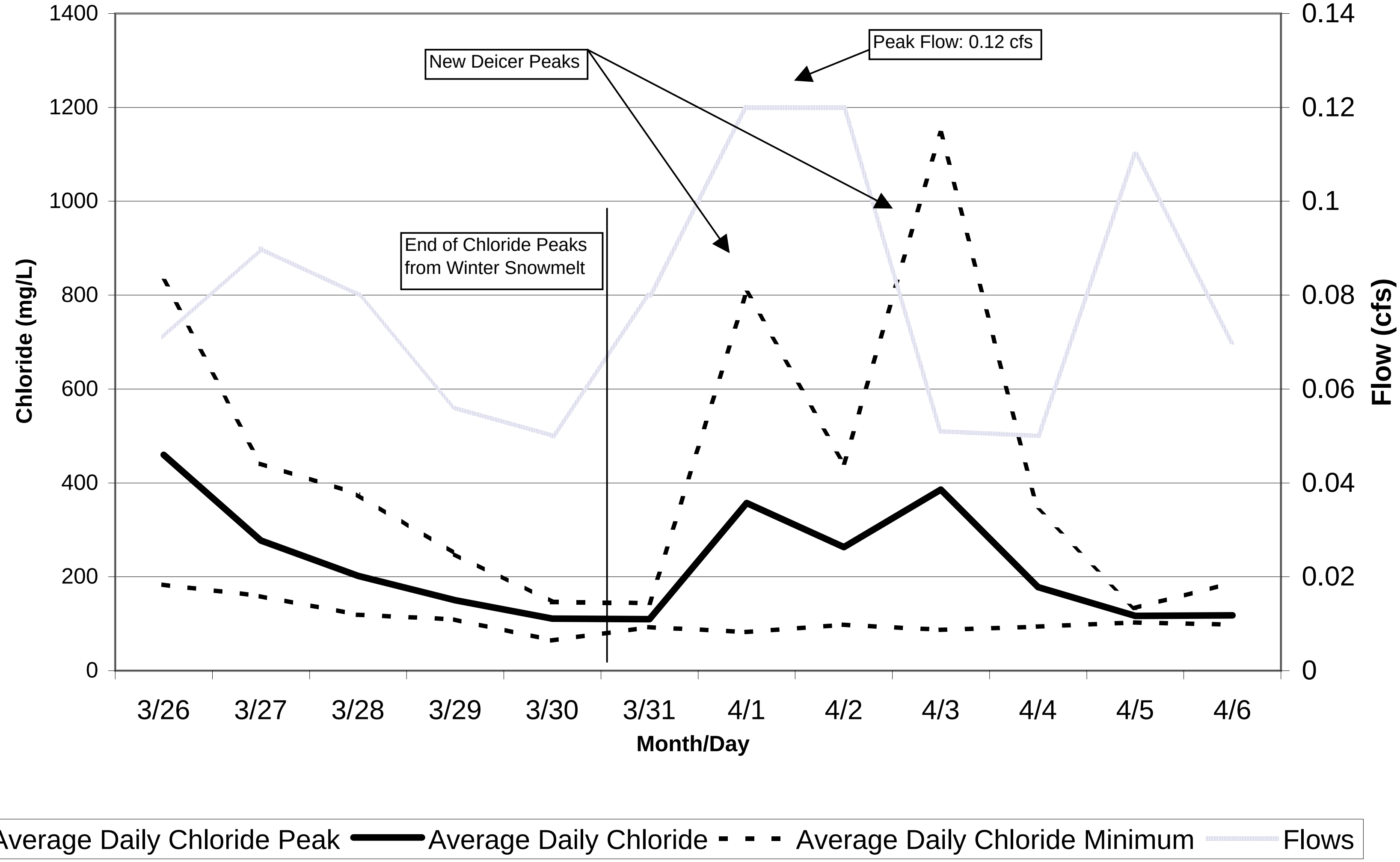
5th Avenue Site (Station CHS001)

Chloride Datalogger Series (3/25/99 to 4/7/99)



Note: Time period ticks run from 2400 to 2400 hours.
Chloride values derived from conductivity values.

Figure 19
1999 Chloride at Anchorage Snow Disposal and Street Sites
5th Avenue Site (Station CHS001)
Chloride Datalogger Summary



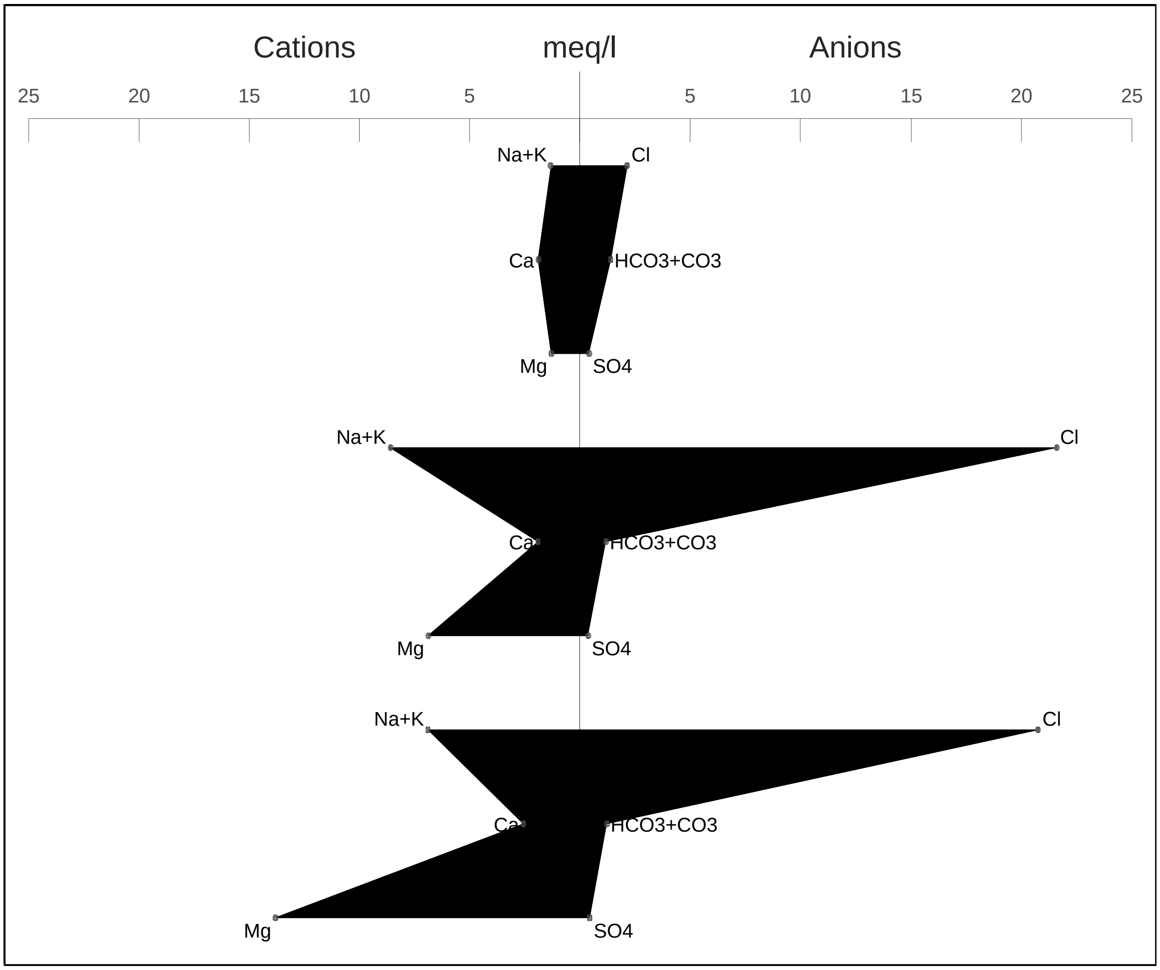


Figure 20 Stiff Diagrams of CH3301 Samples

Stiff diagrams, from top to bottom:

A) CHS3301 (3/18/99)
B) CHS3301 (3/25/99)
C) CHS3301 (3/31/99)

Figure 21

1999 Chloride at Anchorage Snow Disposal and Street Sites

5th Avenue Site

Chloride Source Percent Contributions During Snowmelt

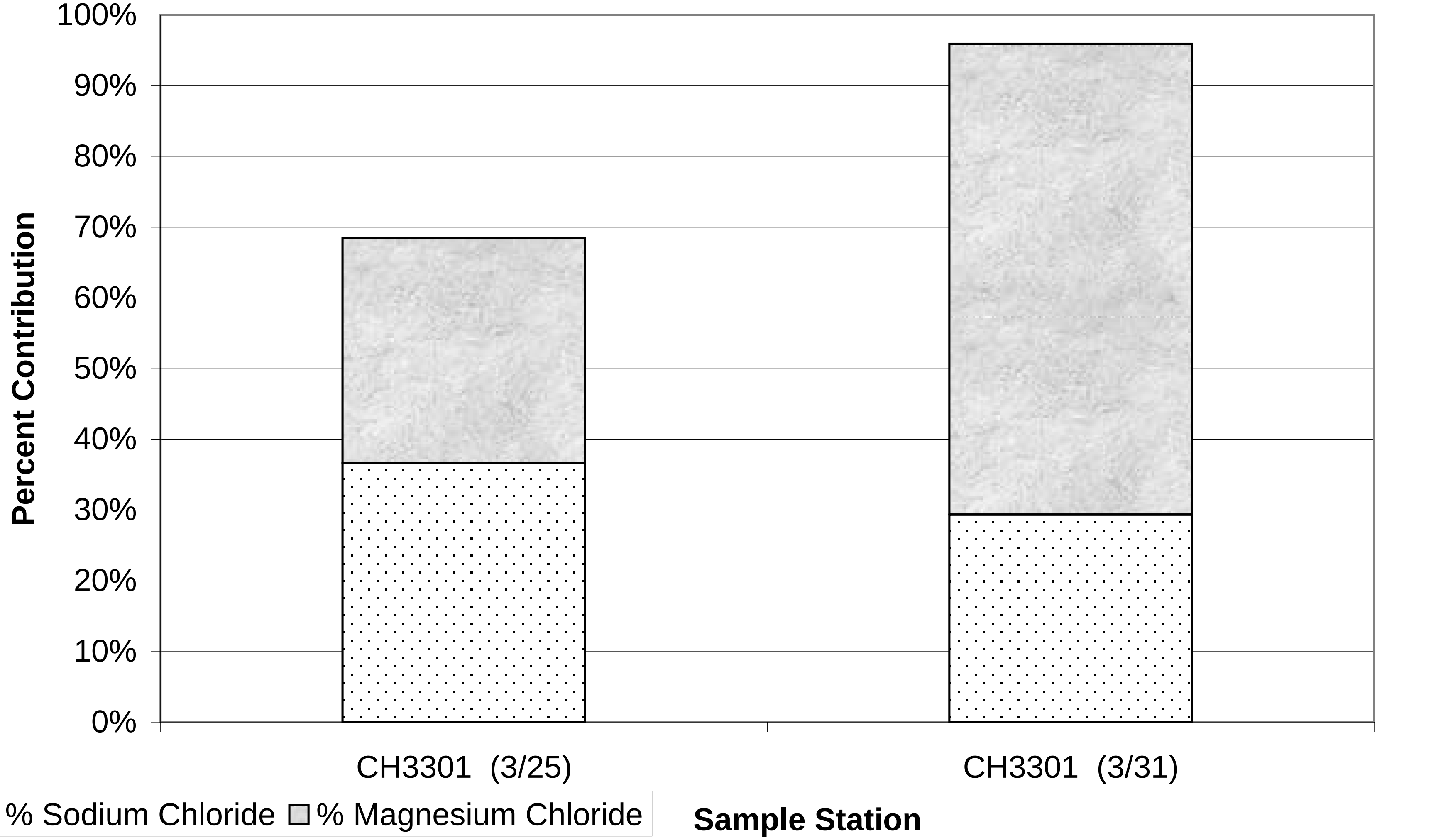


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FIGURE 22

MUNICIPALITY OF ANCHORAGE - DEPARTMENT OF PUBLIC WORKS
1999 CHLORIDE RUNOFF FROM ANCHORAGE STREETS
AND SNOW DISPOSAL SITES

TIKISHLA PARK SITE

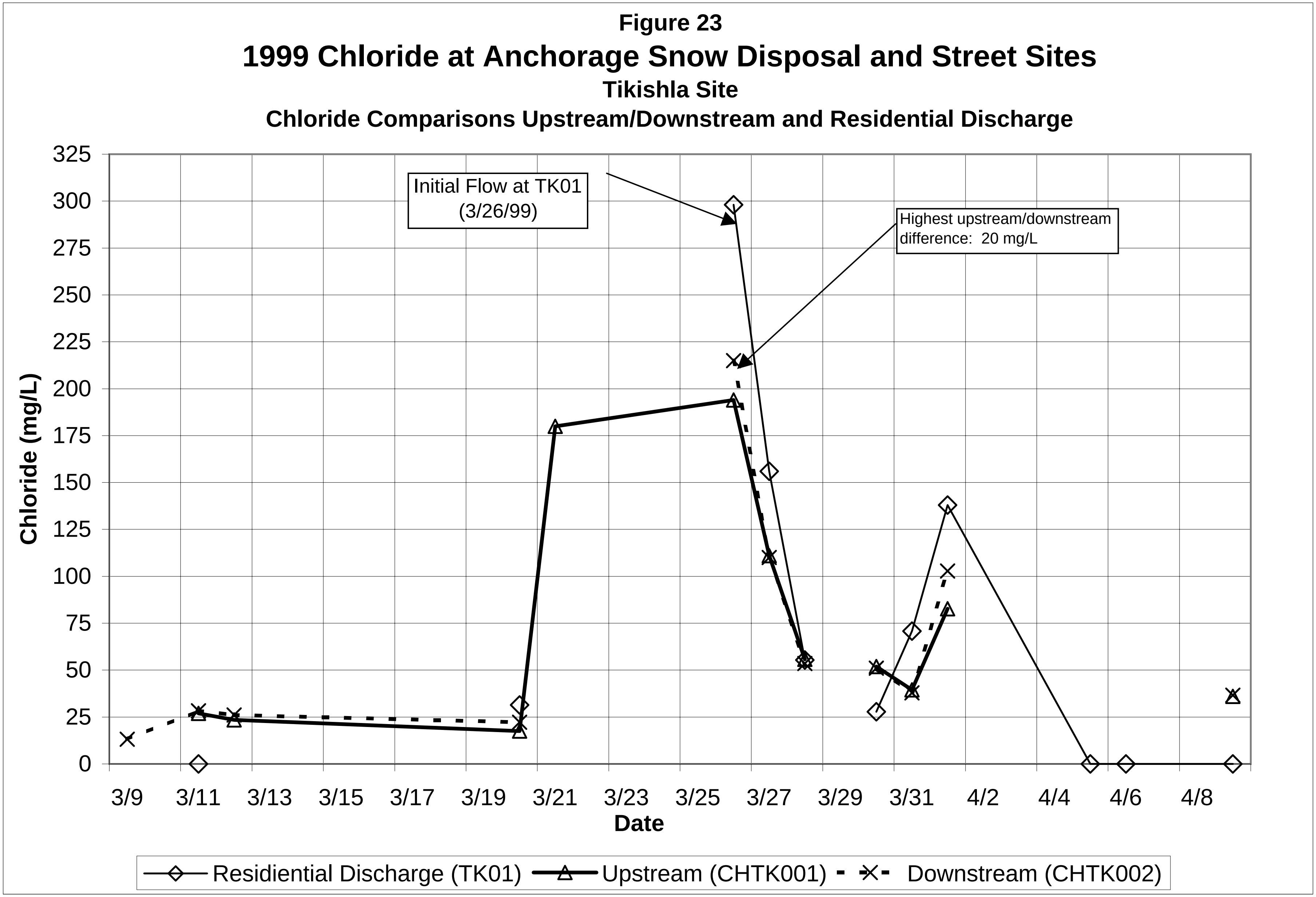
Figure 23
1999 Chloride at Anchorage Snow Disposal and Street Sites
Tikishla Site
Chloride Comparisons Upstream/Downstream and Residential Discharge
Initial Flow at TK01 (3/26/99)
Highest upstream/downstream difference: 20 mg/L
Chloride (mg/L)
325
300
275
250
225
200
175
150
125
100
75
50
25
0
3/9
3/11
3/13
3/15
3/17
3/19
3/21
3/23
3/25
3/27
3/29
3/31
4/2
4/4
4/6
4/8
Date
Resideintial Discharge (TK01)
Upstream (CHTK001)
Downstream (CHTK002)

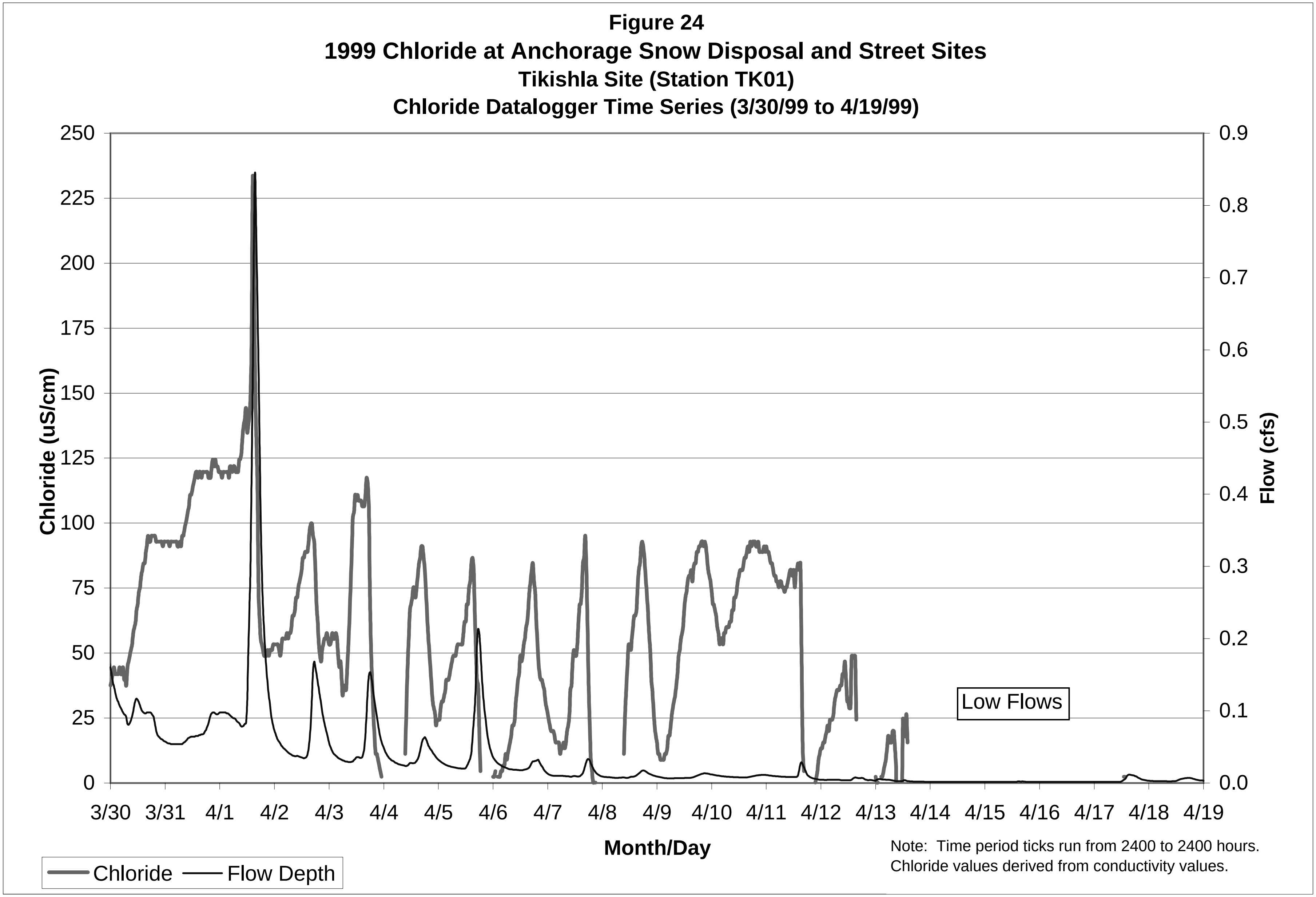

Figure 24
1999 Chloride at Anchorage Snow Disposal and Street Sites
Tikishla Site (Station TK01)
Chloride Datalogger Time Series (3/30/99 to 4/19/99)
Chloride (uS/cm)
Flow (cfs)
0
25
50
75
100
125
150
175
200
225
250
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
3/30
3/31
4/1
4/2
4/3
4/4
4/5
4/6
4/7
4/8
4/9
4/10
4/11
4/12
4/13
4/14
4/15
4/16
4/17
4/18
4/19
Low Flows
Month/Day
Note: Time period ticks run from 2400 to 2400 hours.
Chloride values derived from conductivity values.
Chloride
Flow Depth

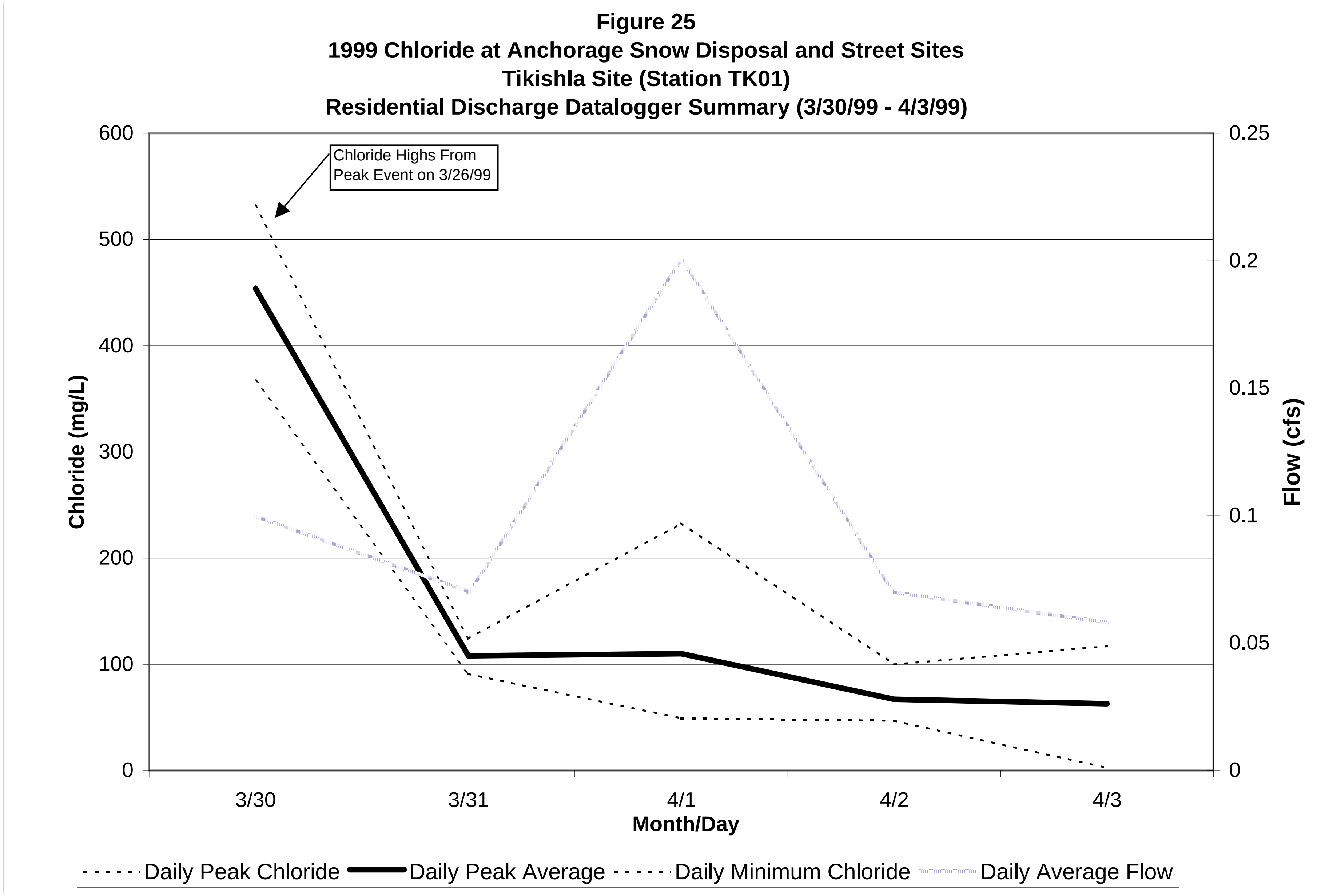

Figure 25
1999 Chloride at Anchorage Snow Disposal and Street Sites
Tikishla Site (Station TK01)
Residential Discharge Datalogger Summary (3/30/99 - 4/3/99)
Chloride Highs From Peak Event on 3/26/99
Chloride (mg/L)
600
500
400
300
200
100
0
Flow (cfs)
0.25
0.2
0.15
0.1
0.05
0
3/30
3/31
4/1
4/2
4/3
Month/Day
Daily Peak Chloride
Daily Peak Average
Daily Minimum Chloride
Daily Average Flow

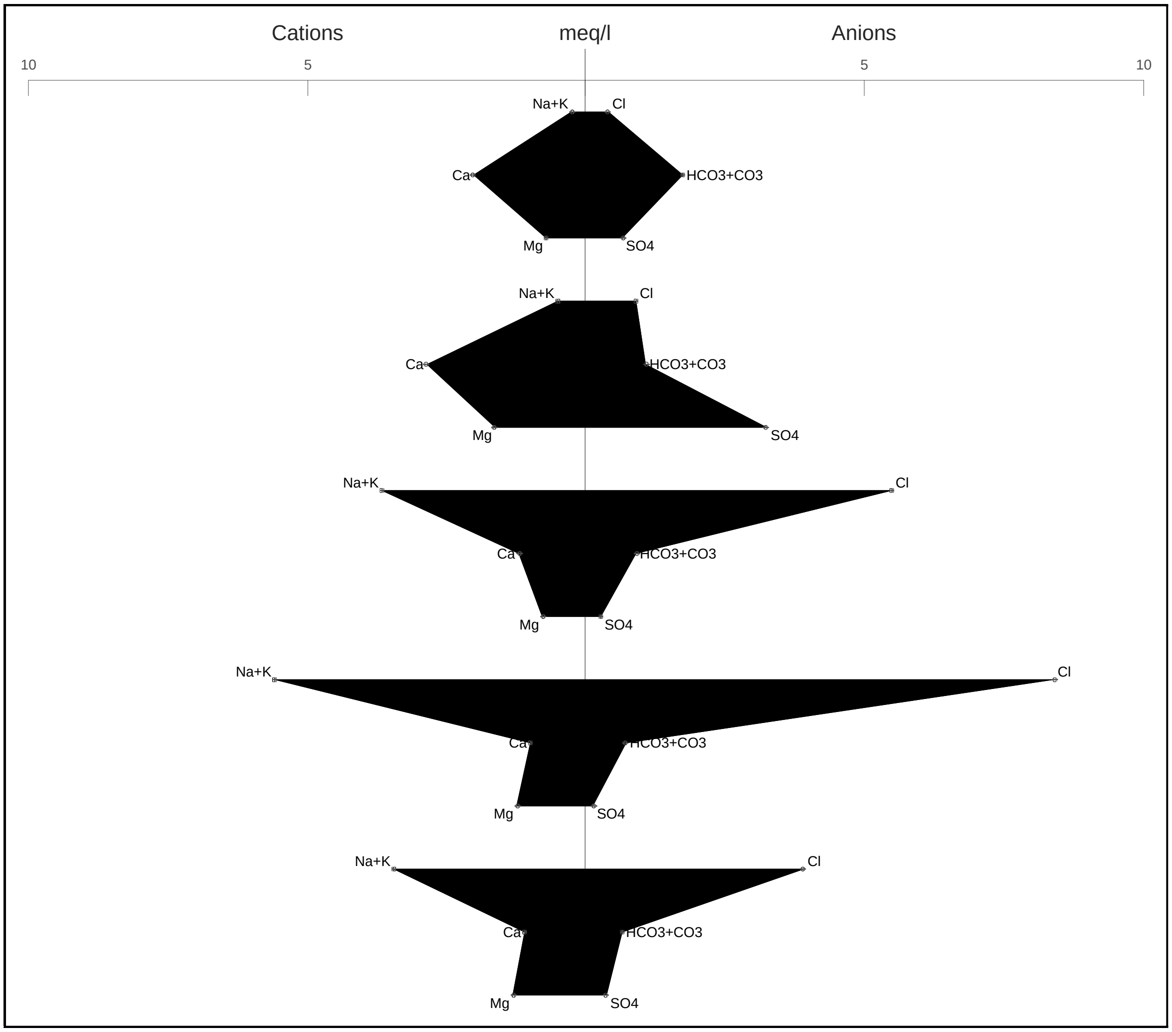

Figure 26 Stiff Diagrams of Tikishla Site Samples

Stiff diagrams, from top to bottom:

A) CHTK002 (3/09/99)
B) TK01 (3/20/99)
C) CHTK001 (3/26/99)
D) TK01 (3/26/99)
E) TK01 (4/01/99)

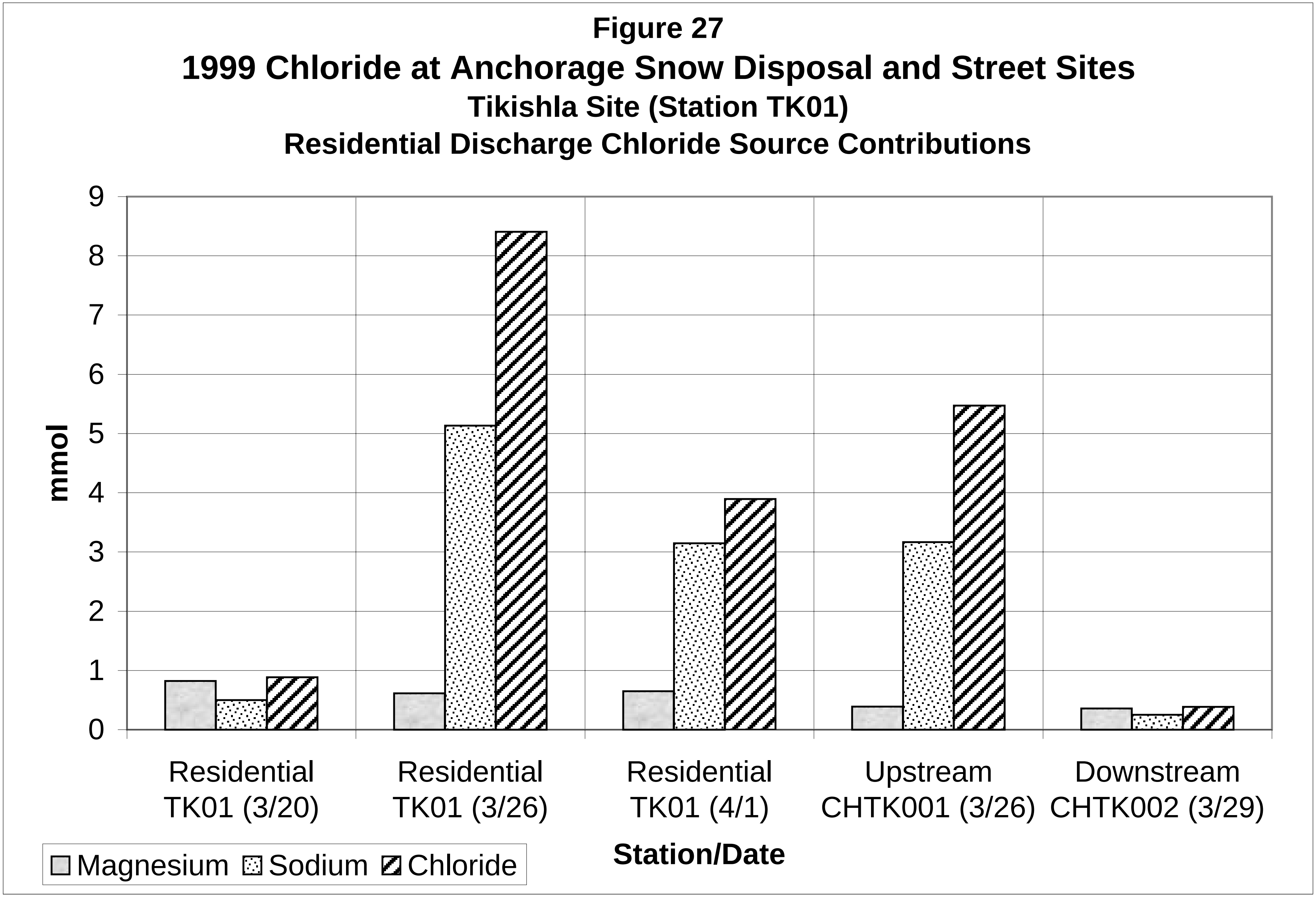

Figure 27
1999 Chloride at Anchorage Snow Disposal and Street Sites
Tikishla Site (Station TK01)
Residential Discharge Chloride Source Contributions
mmol
0
1
2
3
4
5
6
7
8
9
Residential TK01 (3/20)
Residential TK01 (3/26)
Residential TK01 (4/1)
Upstream CHTK001 (3/26)
Downstream CHTK002 (3/29)
Station/Date
Magnesium
Sodium
Chloride

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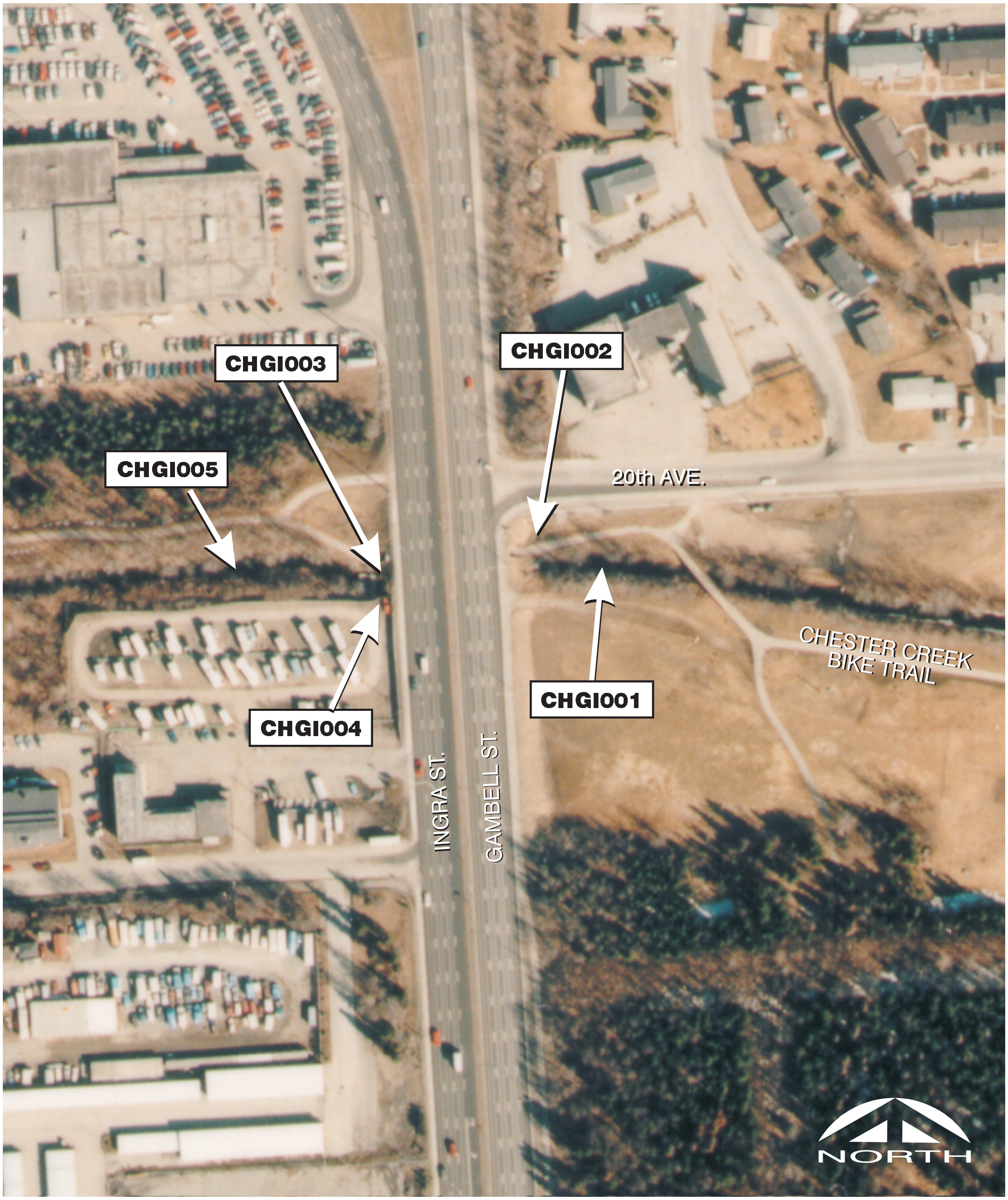

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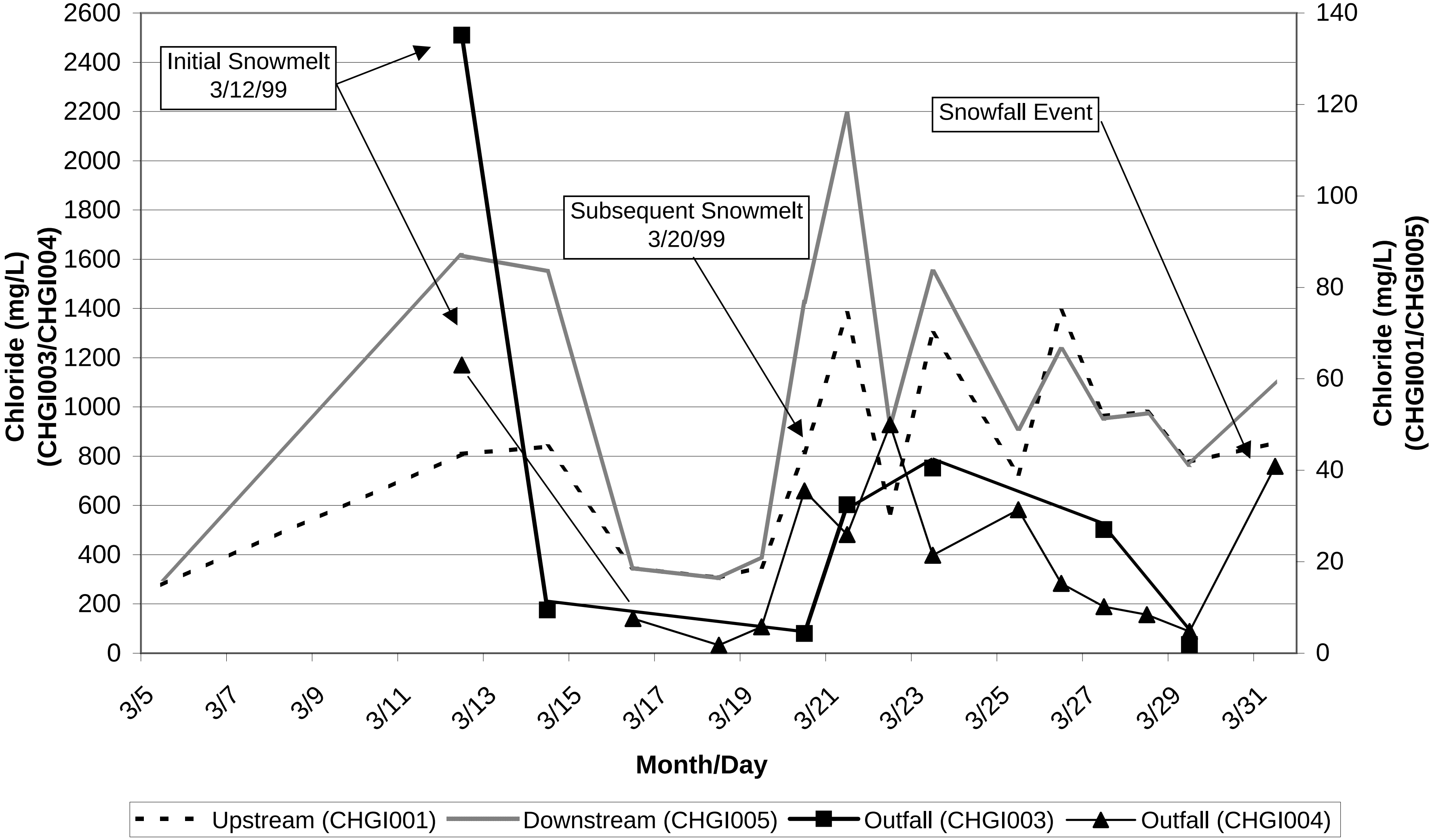
FIGURE 28

MUNICIPALITY OF ANCHORAGE - DEPARTMENT OF PUBLIC WORKS
1999 CHLORINE RUNOFF FROM ANCHORAGE STREETS
AND SNOW DISPOSAL SITES

GAMBELL/ INGRA SITE

Figure 29
1999 Chloride at Anchorage Snow Disposal and Street Sites
Gambell/Ingra Site
Chloride Comparisons Upstream/Downstream and Street Runoff



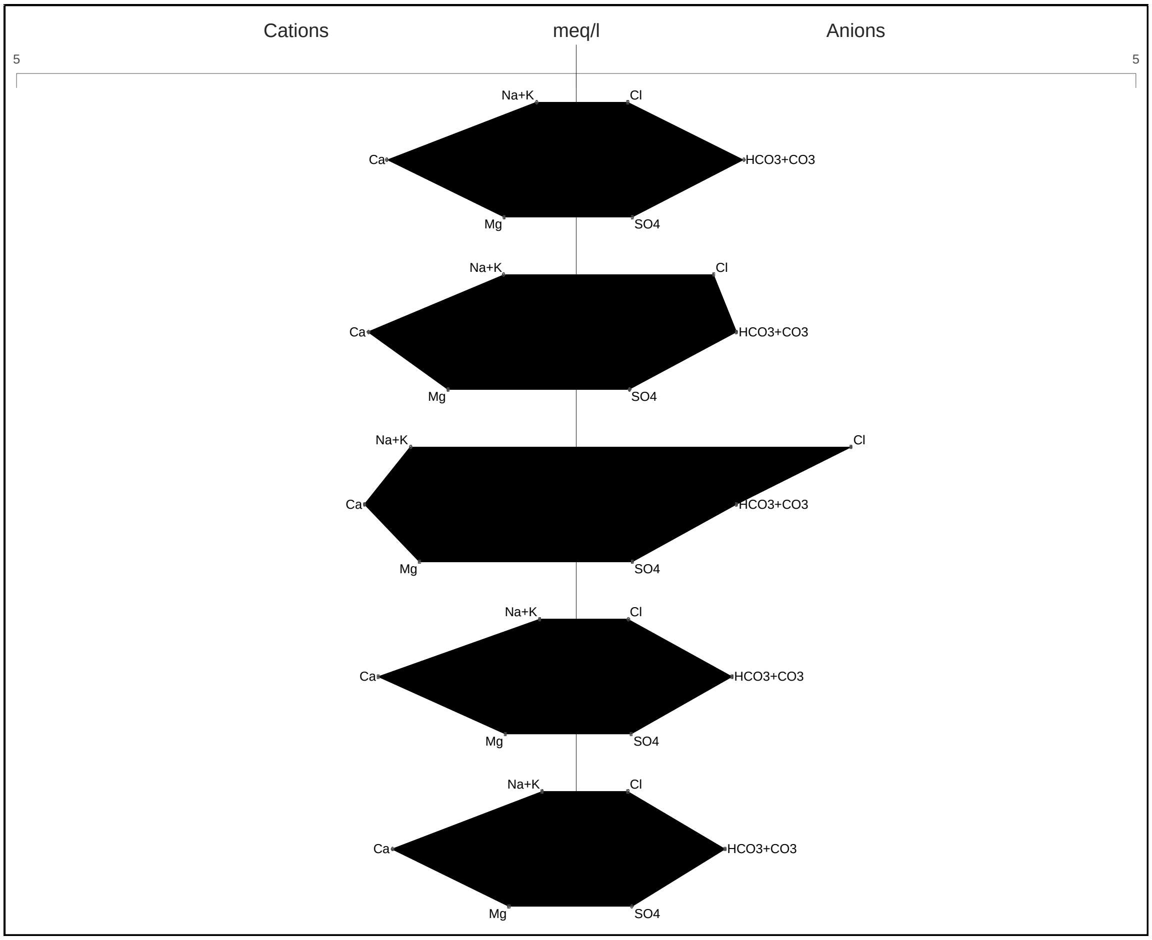


Figure 30a Stiff Diagrams of Gambell/Ingra Site Samples

Stiff diagrams, from top to bottom:

A) CHGI005 (3/05/99)
B) CHGI001 (3/14/99)
C) CHGI005 (3/14/99)
D) CHGI001 (3/18/99)
E) CHGI005 (3/18/99)

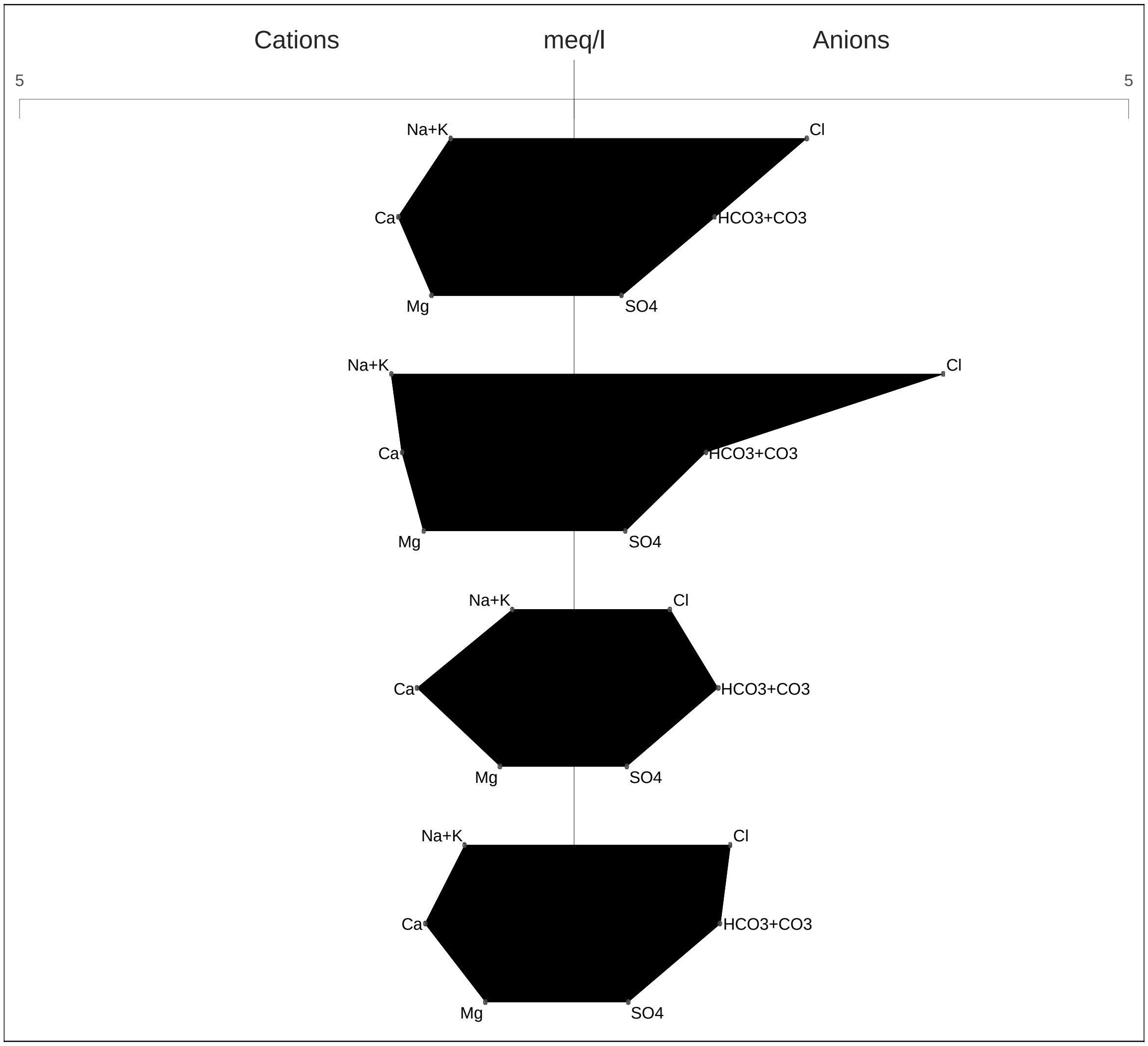


Figure 30b Stiff Diagrams of Gambell/Ingra Site Samples

Stiff diagrams, from top to bottom:

A) CHGI001 (3/21/99)
B) CHGI005 (3/21/99)
C) CHGI001 (3/22/99)
D) CHGI005 (3/22/99)

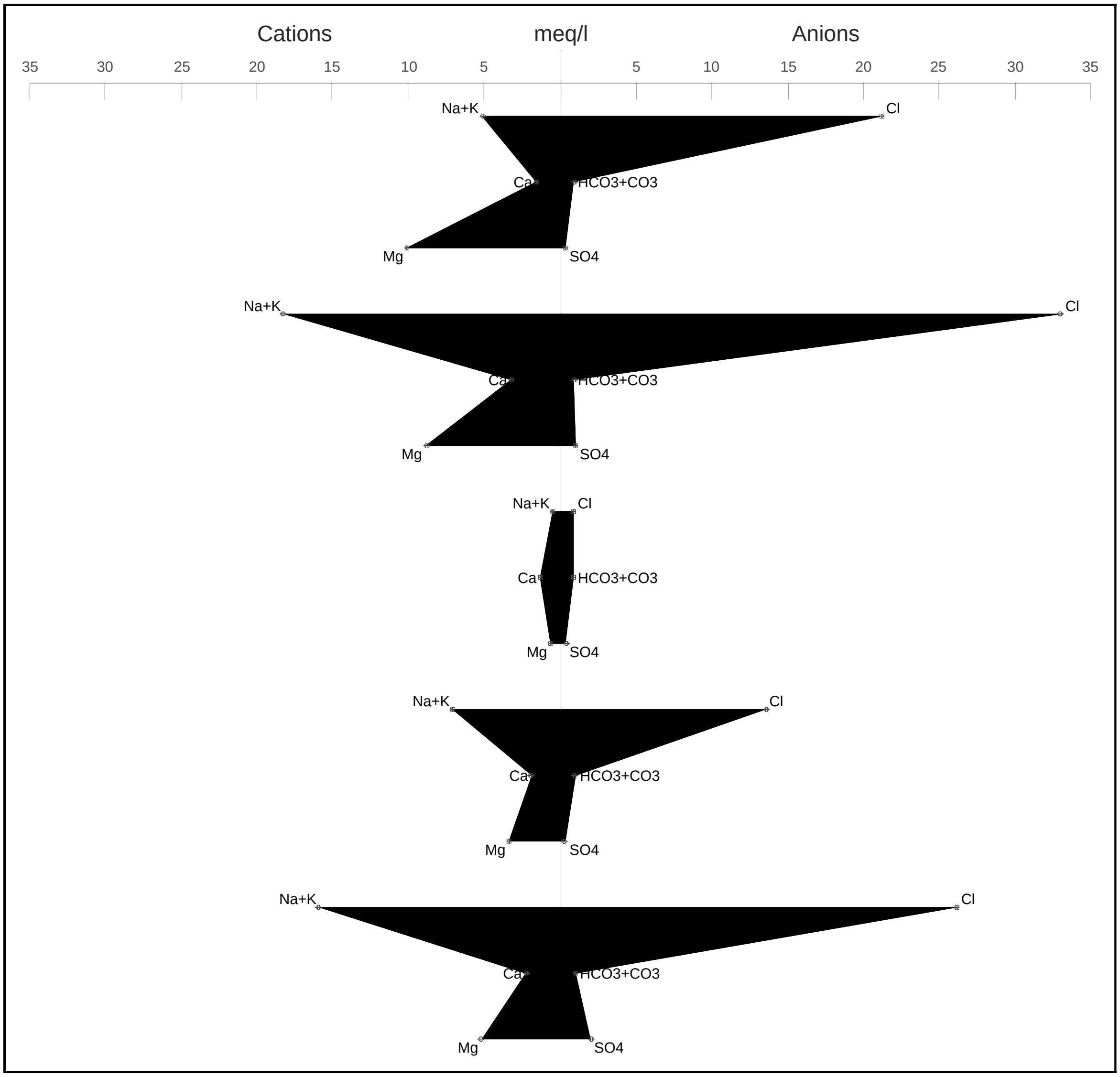


Figure 30c Stiff Diagrams of Gambell/Ingra Site Samples

Stiff diagrams, from top to bottom:

A) CHGI003 (3/21/99)
B) CHGI004 (3/14/99)
C) CHGI004 (3/18/99)
D) CHGI004 (3/21/99)
E) CHGI004 (3/22/99)

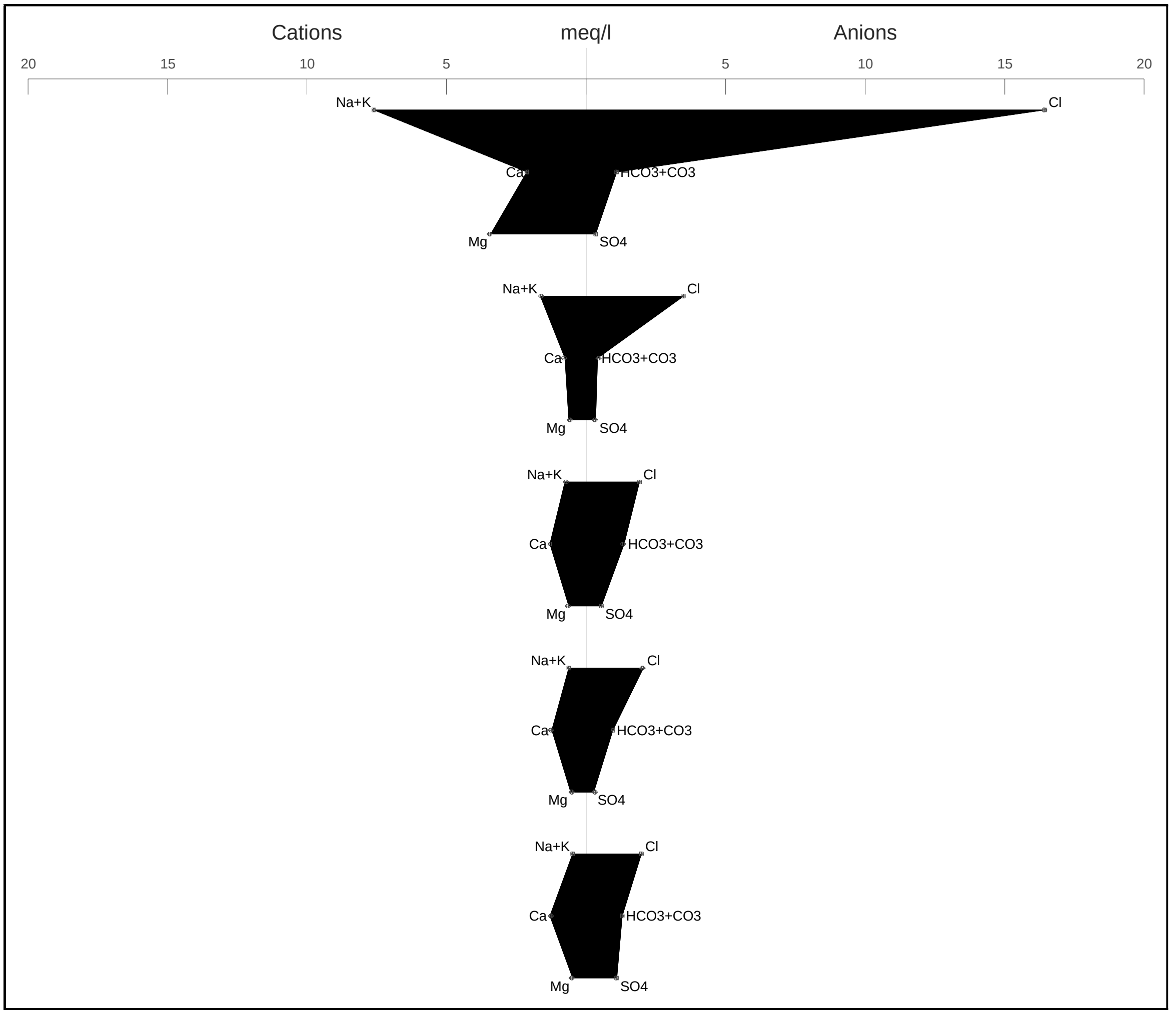


Figure 30d Stiff Diagrams of Gambell/Ingra Site Samples

Stiff diagrams, from top to bottom:

A) CHGI004 (3/25/99)
B) CHGI004 (3/29/99)
C) CHGI004 (4/21/99)*
D) CHGI004 (4/21/99)*
E) CHGI004 (4/21/99)*

* Note that 4/21/99 samples were from a wash experiment, analyzed as a baseflow (C) and two flushes (D and E).

Figure 31a

1999 Chloride at Anchorage Snow Disposal and Street Sites

Gambell/Ingra Site

Outfall Chloride Source Contributions

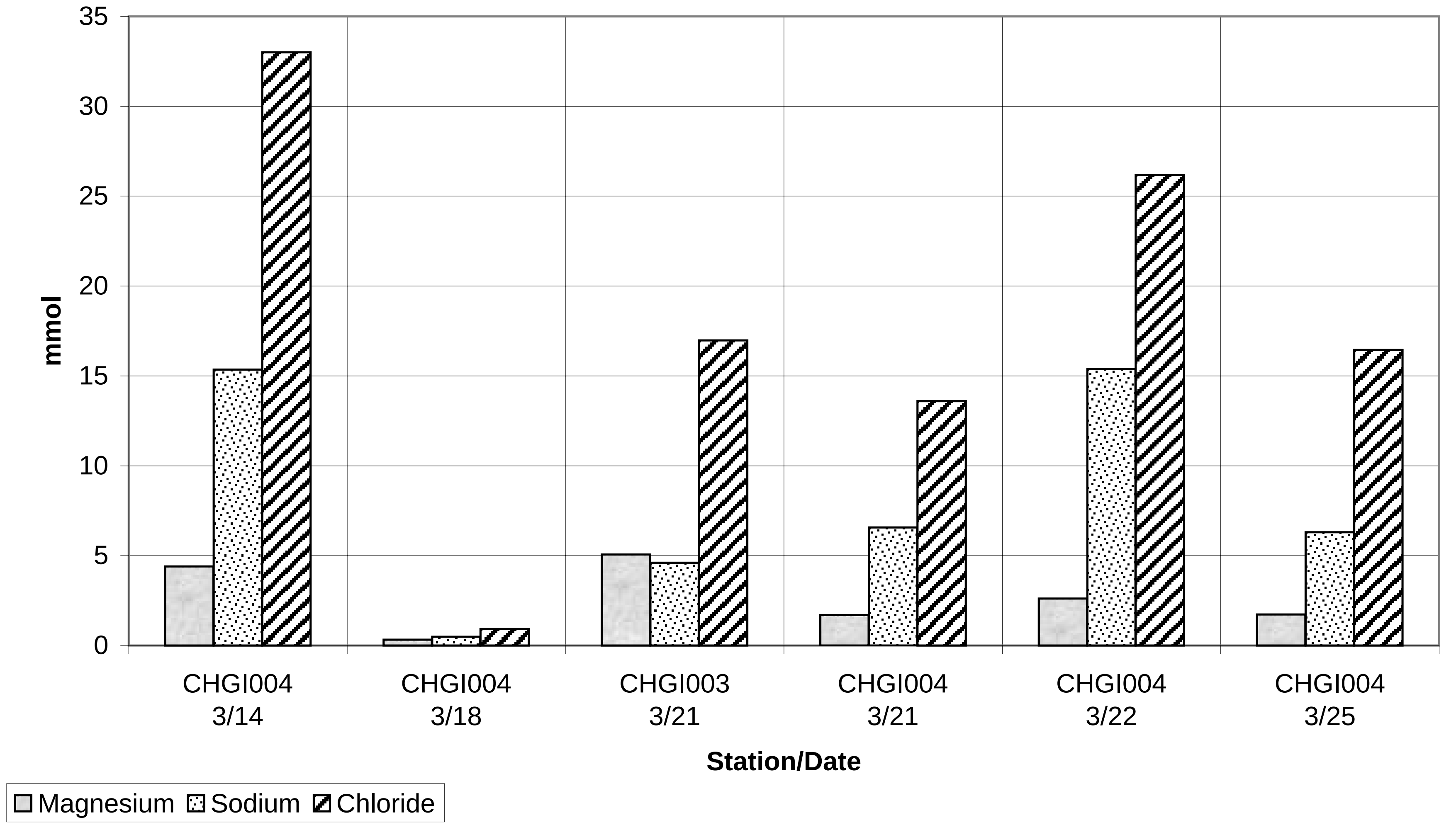
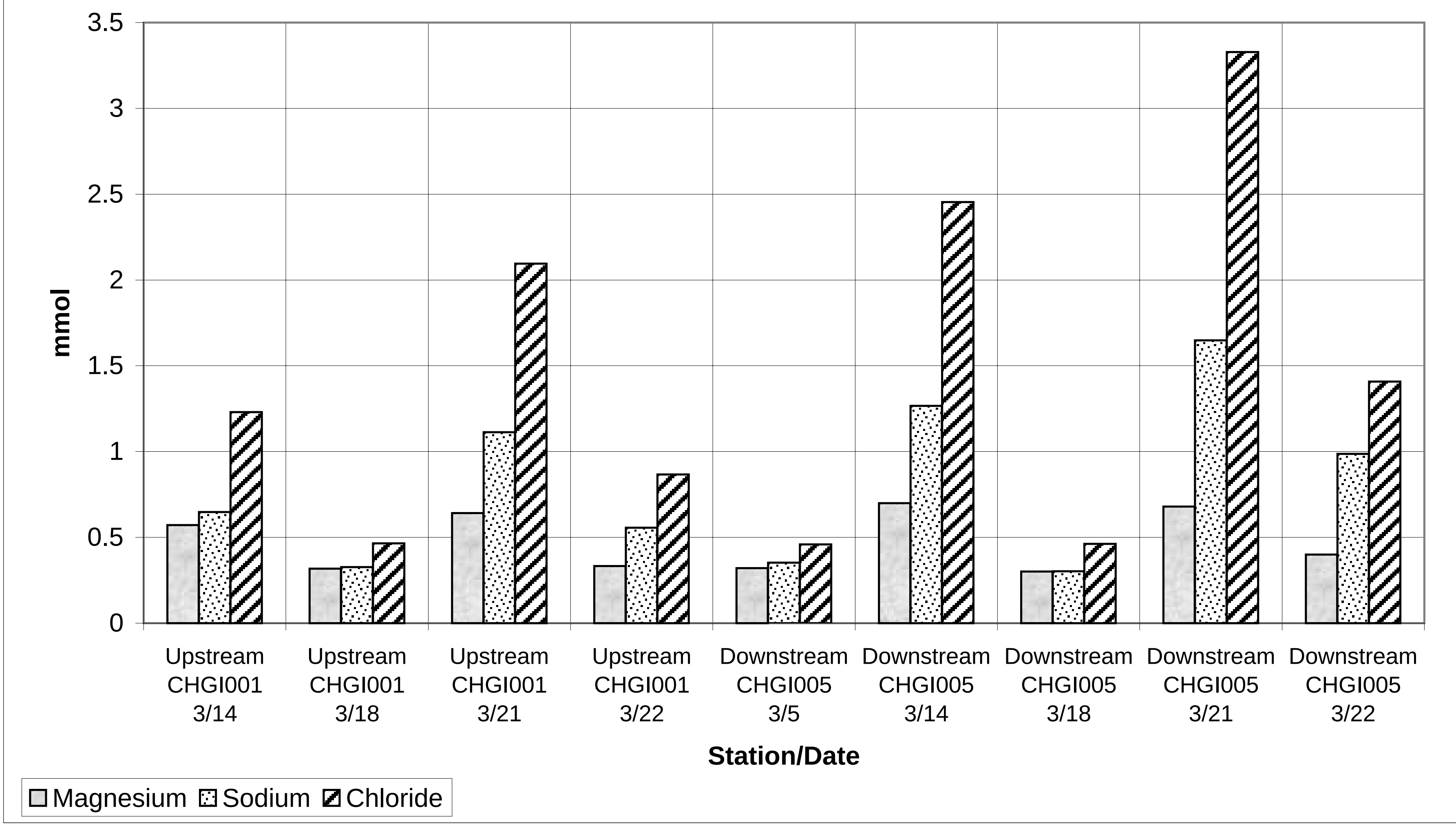


Figure 31b

1999 Chloride at Anchorage Snow Disposal and Street Sites

Gambell/Ingra Site

Upstream/Downstream Chloride Source Contributions



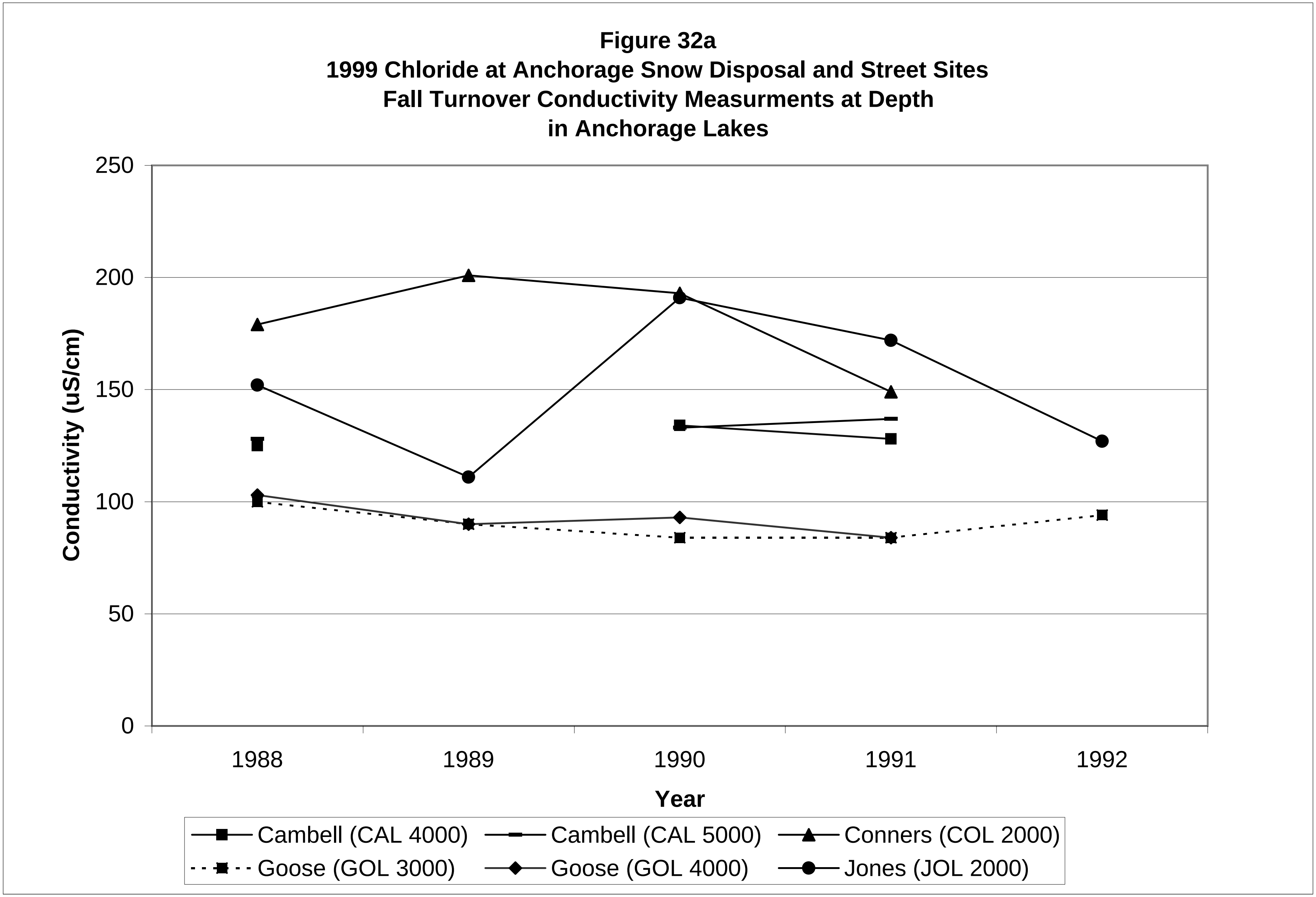


Figure 32a
1999 Chloride at Anchorage Snow Disposal and Street Sites
Fall Turnover Conductivity Measurments at Depth
in Anchorage Lakes
Conductivity (uS/cm)
250
200
150
100
50
0
1988
1989
1990
1991
1992
Year
Cambell (CAL 4000)
Cambell (CAL 5000)
Conners (COL 2000)
Goose (GOL 3000)
Goose (GOL 4000)
Jones (JOL 2000)

Figure 32b
1999 Chloride at Anchorage Snow Disposal and Street Sites
Fall Turnover Conductivity Measurments at Depth
in Anchorage Lakes
Conductivity (uS/cm)
400
350
300
250
200
150
100
50
0
1988
1989
1990
1991
1992
Year
Lower Fire (LFL 3000)
Lower Fire (LFL 4000)
University (UNL 2000)
Westchester (WEL 3000)
Westchester (WEL 4000)
Westchester (WEL 5000)
Westchester (WEL 6000)

Appendix A
Field Observation Summaries

Summary of Field Observations – Snow Sites

From approximately March 18 into June Montgomery Watson sampled and visually observed snow melt at two snow disposal areas: Tudor and North Mountain View. Major events are mentioned in the following paragraphs, as well as a pictorial of events following the summary.

Tudor Snow Disposal Site

Monitoring of the Tudor Snow Disposal Site began March 18. By March 22, meltwater had begun to runoff from the site. BMPs constructed in 1998 were noted not to have been constructed as per the 1998-guidance manual. Meltwater discharged directly into the Tudor ditch without passing through the infiltration area, and a armored ditch constructed halfway up the access ramp was discharging into the swamp below the site. Additionally, a channel had not been constructed south of the pond through the berm and meltwater was allowed to run down the access ramp.

Interim BMPs were initiated to divert flow and attempt to maximize infiltration prior to discharge into the Chester Creek tributary March 23. During this time, berm failure occurred in the area south of the detention pond, allowing meltwater to discharge as per the 1998 guidance document.

Turbidity increased through the melt period.

All berms were saturated with water during the melt and sloughing occurred along downstream berms where meltwater tended to pond.

North Mountain View Snow Disposal Site

Monitoring of the North Mountain View Snow site began March 18. Meltwater flow was noted March 19. BMPs berms were noted to have been constructed as per the 1998-guidance document.

During the meltwater flow, some overflow into an infiltration area was apparent in the southeast corner of the site, infiltration appears to work well there.

Berms were saturated with water during the bulk of the melt period.

Near the gravel berm discharge point, a steady meltwater flow was observed into the pond at waist height, emanating from the snow mass. This water was clear.

Meltwater flow along the berms to the pond discharge point gains a large amount of turbidity.

Meltwater flow basically ended at station MTV01 on June 17, 1999. Meltwater ponded near the discharge point through August.

Tudor Snow Disposal Site (Prior to BMP Revisions on 4/23/99)

Entrance Flow (TU01)

Entrance Flow into Ditch

Access Ramp Flow into Swamp (TU06)

Top of Access Ramp

Tudor Snow Disposal Site (4/28/99) - Various Meltwater Flows

V-ditch to Infiltration Area from TU01

Berm Directing all Flow to Ditch (TU07)

Top of Access Ramp Berm

Tudor Snow Disposal Site (5/7 - 5/10)

Entrance Gravel Dam

V-ditch Up Formed Up Access Ramp

V-Ditch Up Access Ramp

Armored Ditch Plug

Tudor Snow Disposal Site (5/20/99) - End of Melt, High Turbidity

Entrance Pond, Dry V-Ditch - TU01

Infiltration Area Overflow into Tudor Ditch

Overflow from Infiltration Area

High Melt, High Turbidity at CHS001

Tudor Snow Disposal Site -- Near Melt End (6/8/99) - Site After Spring Melt

Less Turbidity at Culvert - Station CHS001

Minor Ponding in Middle of Site

Pond Filled With Water

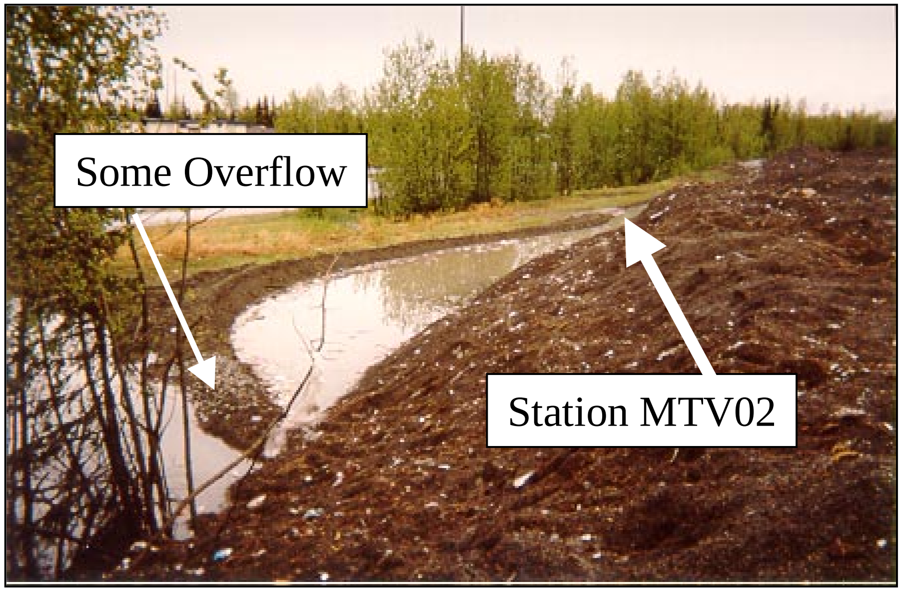
Tudor Snow Disposal Site

Berm Failure Above Pond (TU02) - (4/23/99)

Berm Above Pond (TU02) - (4/28/99)

Berm Failure above Pond (TU02) - (6/8/99)

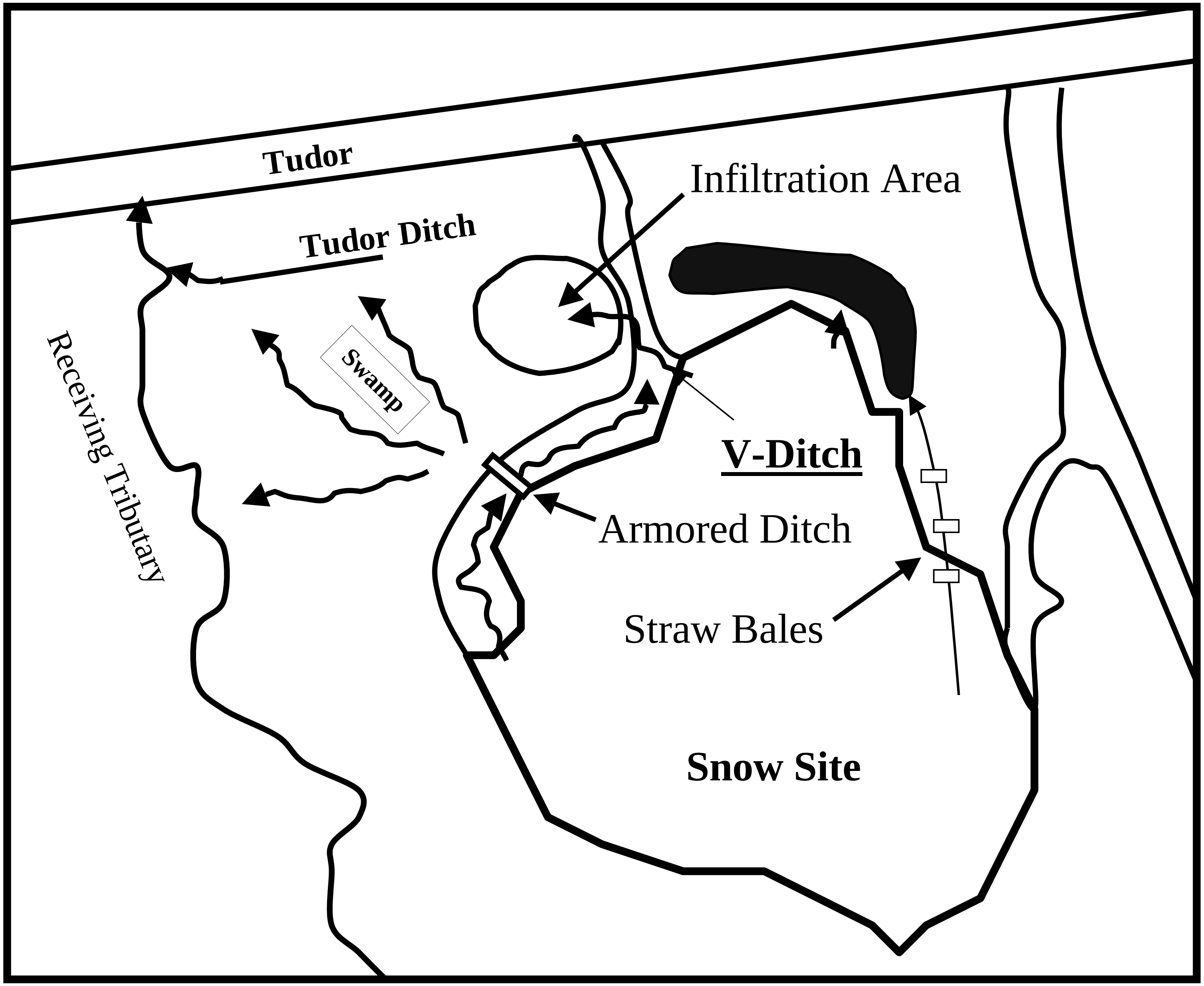
North Mountain View Snow Site - 5/26/99 - No berm failure, Some Overflow into Infiltration Areas - Pictures of Southeast Corner



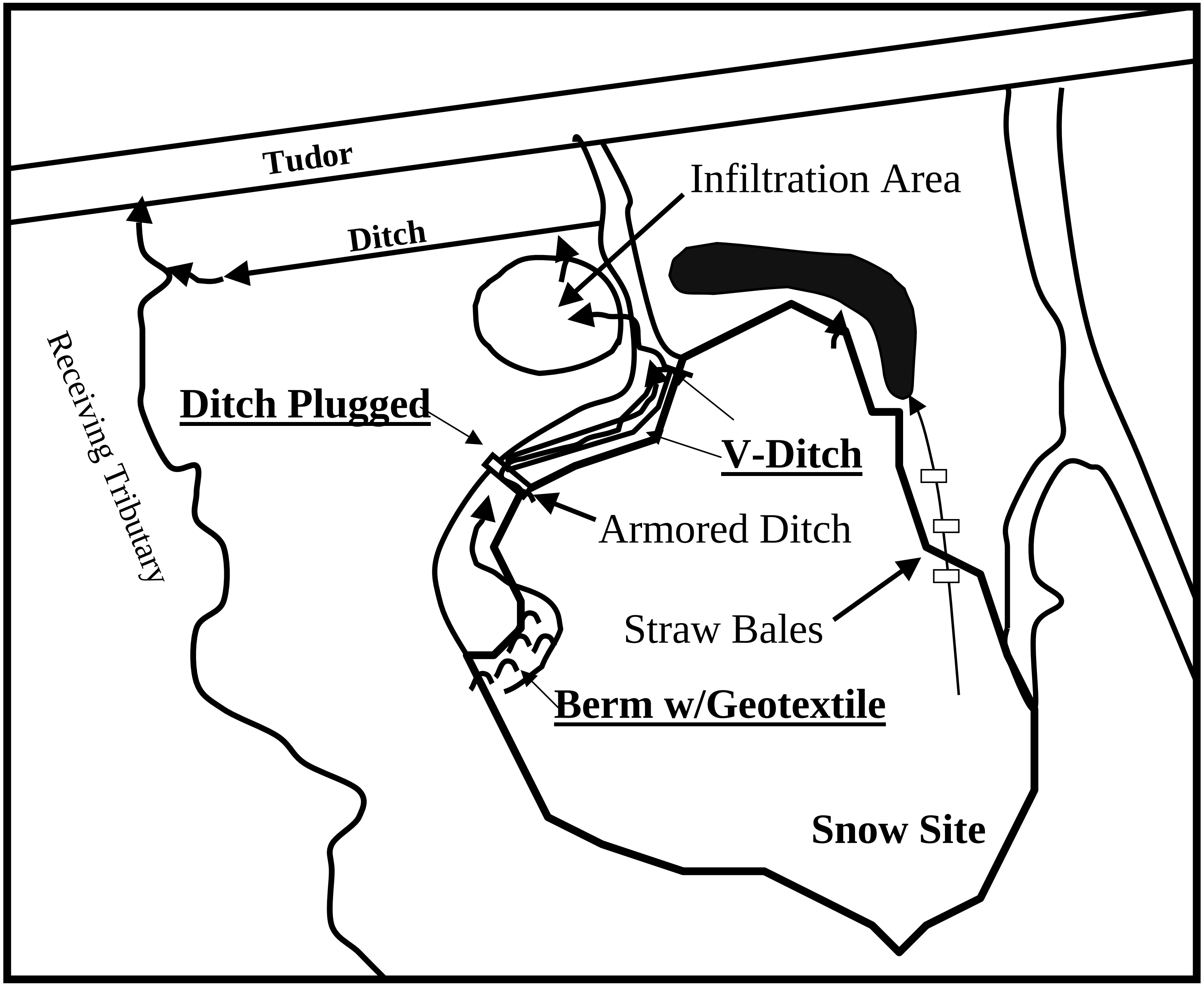
North Mountain View Snow Site - 5/26/99 - No berm failure, Some Overflow into Infiltration Areas - Turbid Runoff - Pictures of South Central Area

Turbid Flow to Culvert - Station MTV01

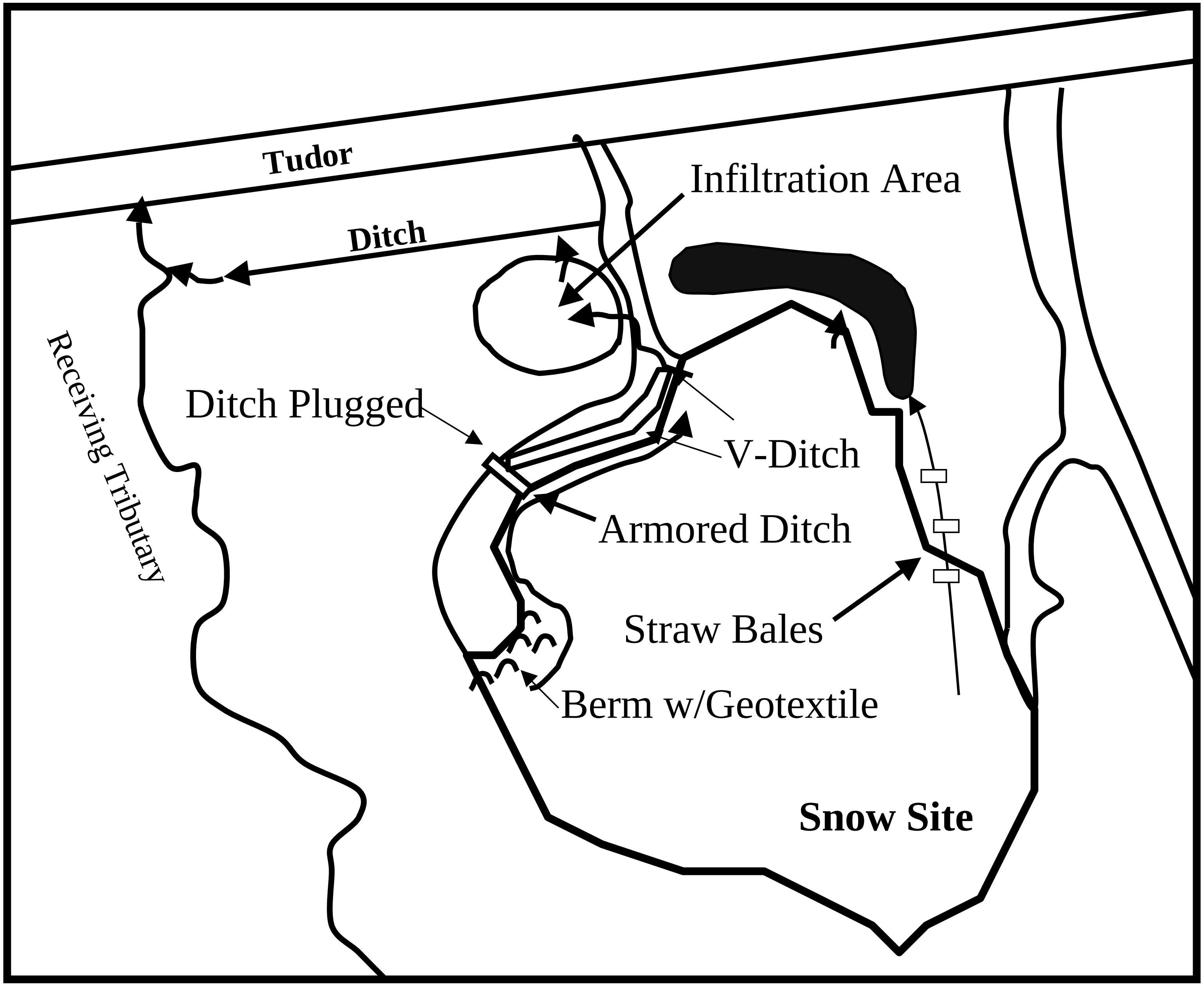
Tudor Snow Disposal Site (4/27/99) - Ditch Diverted Flow into Infiltration Area



Tudor Snow Disposal Site (5/7 - 5/10) - Armored Ditch Plugged, V-ditch Constructed



Tudor Snow Disposal Site (5/28/99) - Meltwater flows only from TU01 and TU02



Summary of Field Observations – Street Sites

From March 9 into June Montgomery Watson sampled and visually observed snow melt at study sites and contributing basin areas. The three street sites were 5th Avenue, Tikishla, and Gambell/Ingra. Major events are mentioned in the following paragraphs along with the high flow events of Chester Creek and Gambell/Ingra outfalls.

5TH AVENUE SITE

March 19
First day of street melt. Streets are very wet with significant runoff. Temperature is 36° F.

March 20-24
Discharge very turbid, significantly more flow in the afternoon than the morning. Afternoon high flows are associated with gas smell from the outlet pipe into the manhole. Flows appear to return to base flow by the morning, as the nights are below freezing, hindering snowmelt. Most of the snow directly on streets and sidewalks is gone by March 24.

March 25
Parking lots and snow berms on the sides of streets are noticeably melting in the afternoon. Puddles begin forming on the streets.

March 27
Parking lots fairly clear of snow and no ice noted. Only berms of snow left along streets. Residential streets are beginning to noticeably melt. Parking lanes on streets still melting, but rest of streets are dry.

March 29
Snow still present in parking lots and snow berms. Streets are completely dry. Most of the snow is gone except where the sun does not directly hit the snow.

March 31
Nighttime snow flurries melting. Snow flurries still occurring throughout the day, contributing to snow runoff.

April 1-5
Snow is still present in parking lots. Snow that has fallen is mainly gone from the streets. Stormwater inlet washing has been observed at various times.

TIKISHLA PARK

March 26
First flow at study area. Residential area streets melting. Flow in ditch that outfalls into Creek began about 3pm. Water was very turbid and moving slowly as it went through the accumulated snow in the ditch.

March 28-29
Ditch still flowing, although ice forms overnight and water overflows the ice during the afternoon. Significant amount of street puddles on residential streets. Datalogger installed on-site March 29.

April 6
Residential roads are free of snow, but extremely dirty. Significant amounts of snow berms are present and melting.

April 15
Streets are bare and most of the snow in the residential neighborhood is gone.

GAMBELL/INGRA

March 14
First observed day of melt. Some flow from outflows. Temperatures just above freezing.

March 16-18
Streets fairly dry, Chester Creek covered with snow. Below freezing weather present.

March 19
First continuous day of snowmelt. Significant increase in flow at CHGI004 with evidence of significant late afternoon discharge from March 18. CHGI002 overflowed the bike path and froze overnight. Most of the snow on the creek has melted. Streets are dry but significant snow berms exist along the highways.

March 20
A lot of runoff on the street and a significant amount of snow left on the sides of the streets. The CHGI004 has quite a bit of sediment flowing through it and there is no flow from CHGI002 or CHGI003.

March 28
Streets have no gutter ice and flow still occurs from snow berms along the highway.

March 29
High flows from all stations.

April 21
No significant precipitation in April, streets dry.

March 22, 1999. Streets wet. Sidewalks becoming bare (5th Ave.)

March 25, 1999. Streets wet. Sidewalks becoming bare (5th Ave.)

March 25, 1999. Streets wet. Sidewalks almost all bare (5th Ave.)

March 25, 1999. Parking lot with melting snow. (South of 5th Ave. looking west)

March 25, 1999. Streets and sidewalks
are bare, some ponding along curbs (5th Ave.)

March 26, 1999. Streets and sidewalks are
bare, ponding along curbs. (5th Ave.)

March 27, 1999. Sidewalks are wet from parking
lots, some ponding along curbs (5th Ave.)

March 28, 1999. Parking Lots are melting
(5th Ave.)

March 29, 1999. Streets and sidewalks dry (5th Ave.)

March 31, 1999. Snowmelt from recent snow storm. (5th Ave.)

March 31, 1999. Snowmelt from recent snowstorm (5th Ave.)

March 12, 1999. Upstream Sampling Location Station CHGI001 (Tikishla Site)

March 12, 1999. Downstream Sampling Location Station CHGI002 (Tikishla Site)

March 29, 1999. Tikishla Ditch near TK01. (Tikishla Site)

March 27, 1999. Tikishla Neighborhood .Streets wet, sand and ice along edges, snowbanks prevalent.

April 6, 1999. Tikishla Neighborhood. Streets semi-wet, dirt and snowbanks on edges. (Tikishla Site)

April 15, 1999. Tikishla Neighborhood. Streets dry, edges dirty and wet, no snowbanks on edges. (Tikishla Site)

April 19, 1999. CHGI004 and Chester Creek (Gambell/Ingra Site)

April 19, 1999. Downstream Site CHGI005 (Gambell/Ingra Site)

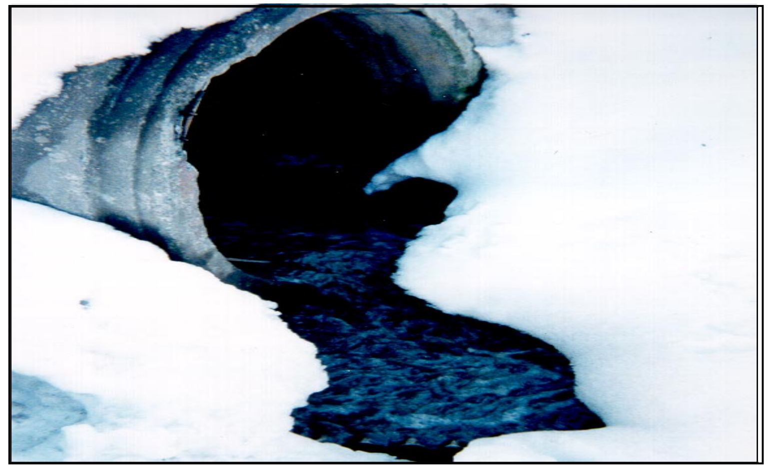
April 19, 1999. Station CHGI002 - Frozen Meltwater. (Gambell/Ingra Site)

April 19, 1999. Gambell & Ingra Streets - Dirty gutters, some snowbanks. (Gambell/Ingra Site)

April 19, 1999. Gambell & Ingra Streets - Dirty gutters, some snowbanks. (Gambell/Ingra Site)

April 29, 1999. Downstream CHGI005 (Gambell/Ingra Site)

April 29, 1999. Downstream Station CHGI005 - (Gambell/Ingra Site)



April 29, 1999. Station CHGI004 - Street Runoff (Gambell/Ingra Site)

April 29, 1999. Station CHGI003 - Street Runoff (Gambell/Ingra Site)

April 29, 1999. Gambell/Ingra Streets - Dirty gutters, snowbanks almost gone.

Appendix B
Basin Data Sheets

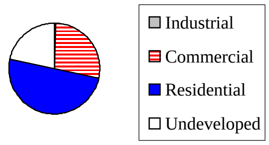
TUDOR SNOW DISPOSAL SITE

ANCHORAGE BOWL OGS PERFORMANCE MODELING

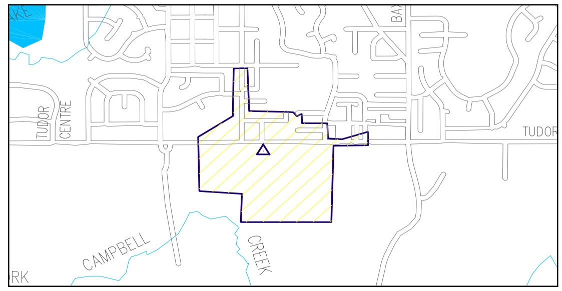
Basin: South Fork Chester Creek Non-NPDES 35

Basin Area	86	acres

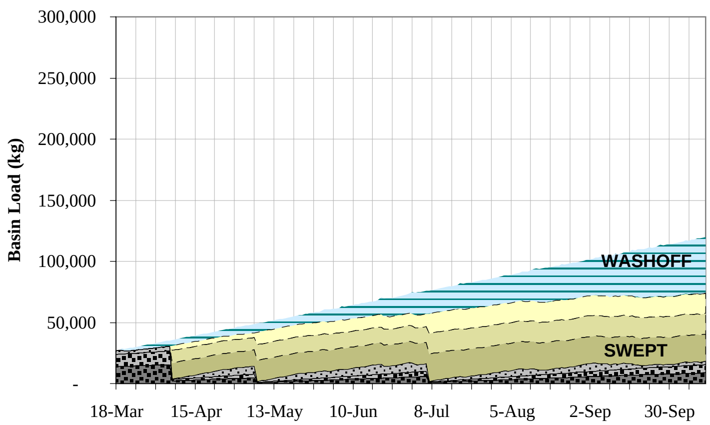
Land Use	
Industrial	1%
Commercial	28%
Residential	50%
Undeveloped	22%



Road Areas		
Local	1.16	acres
Collector	-	acres
Minor Arterial	-	acres
Major Arterial	7.53	acres

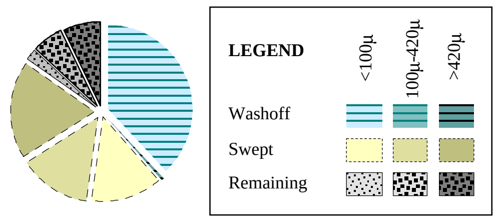


SEDIMENT FATE

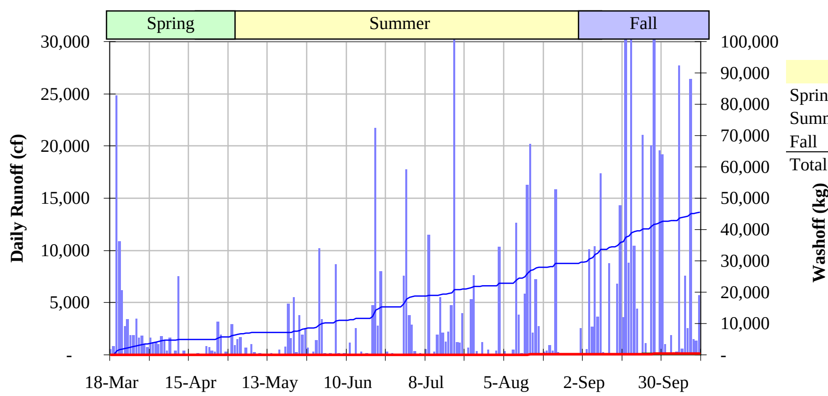


Sediment Fates (kg)

	<100µ	100µ - 420µ	>420µ	Total
Remaining	2,587	6,770	8,790	18,147
Swept	16,266	16,870	22,361	55,497
Washed Off	45,528	197	452	46,178
Total	64,381	23,837	31,603	119,821

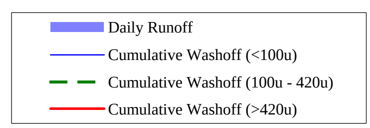


RUNOFF AND CUMULATIVE WASHOFF

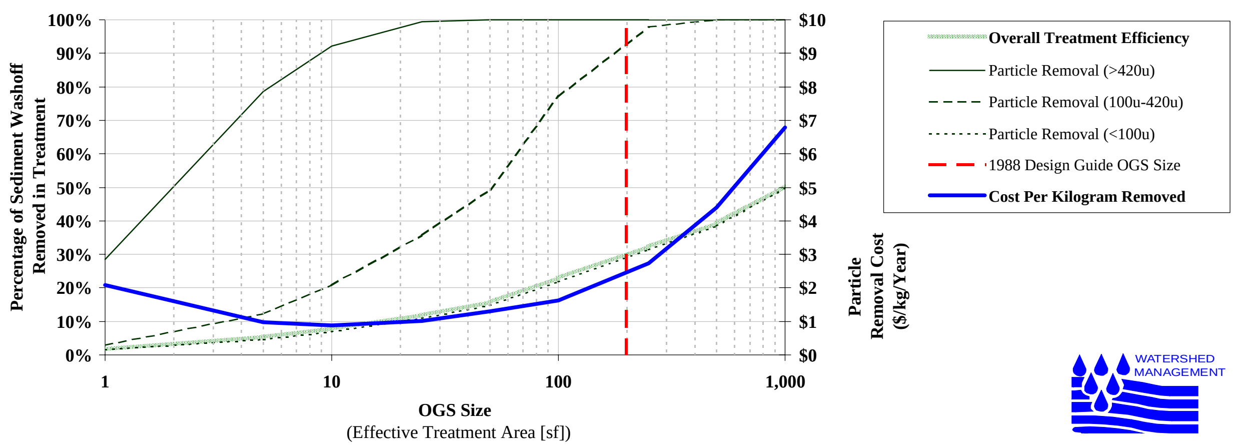


Sediment Washoff (kg)

	<100µ	100µ - 420µ	>420µ	Total
Spring	4,959	10	19	4,988
Summer	24,289	42	98	24,428
Fall	16,280	146	335	16,761
Total	45,528	197	452	46,178



OGS TREATMENT EFFICIENCY



WATERSHED MANAGEMENT

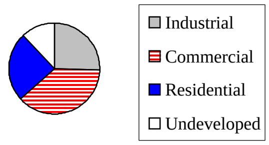
NORTH MOUNTAIN VIEW SNOW DISPOSAL SITE

ANCHORAGE BOWL OGS PERFORMANCE MODELING

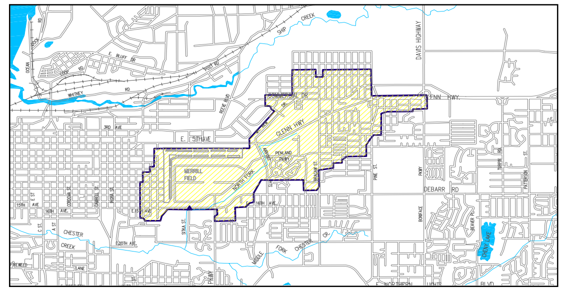
Basin: North Fork Chester Creek NPDES 84

Basin Area	1,207	acres

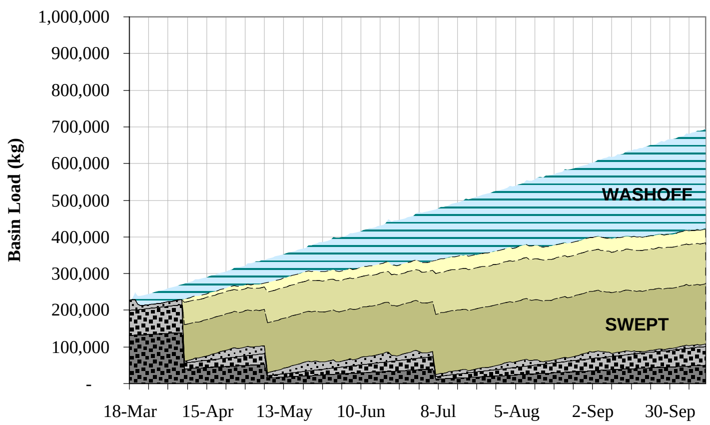
Land Use	
Industrial	26%
Commercial	38%
Residential	25%
Undeveloped	12%



Road Areas		
Local	78.24	acres
Collector	13.09	acres
Minor Arterial	10.55	acres
Major Arterial	26.87	acres

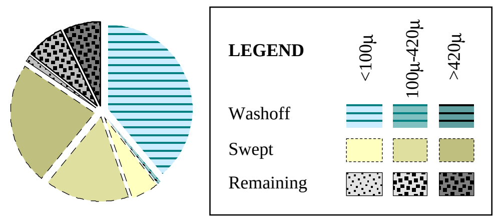


SEDIMENT FATE

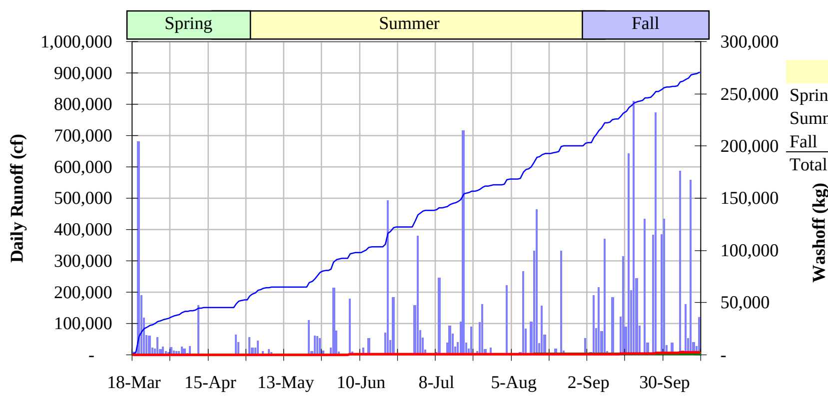


Sediment Fates (kg)

	<100µ	100µ - 420µ	>420µ	Total
Remaining	6,828	51,077	50,115	108,020
Swept	35,718	111,406	164,775	311,899
Washed Off	270,758	1,331	2,465	274,554
Total	313,304	163,815	217,355	694,473

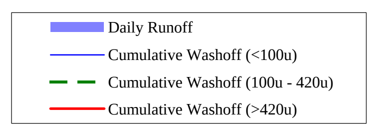


RUNOFF AND CUMULATIVE WASHOFF

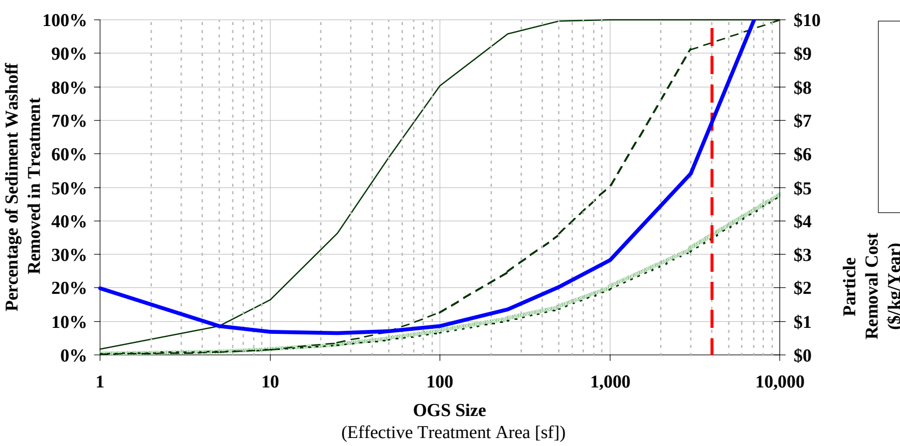


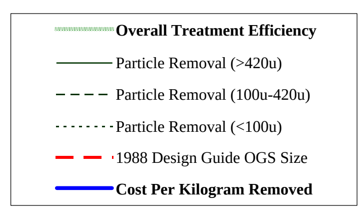
Sediment Washoff (kg)

	<100µ	100µ - 420µ	>420µ	Total
Spring	45,131	99	281	45,511
Summer	155,061	281	553	155,895
Fall	70,566	952	1,631	73,148
Total	270,758	1,331	2,465	274,554



OGS TREATMENT EFFICIENCY





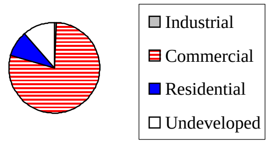
5TH AVENUE SITE

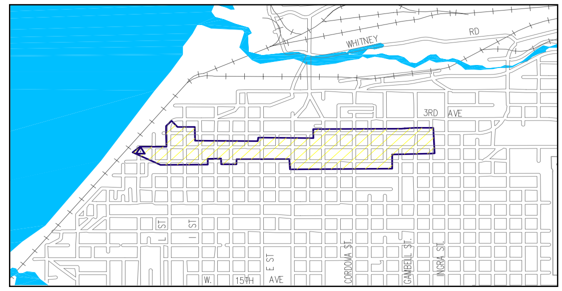
ANCHORAGE BOWL OGS PERFORMANCE MODELING

Basin: Chester Creek NPDES 41

Basin Area	117	acres

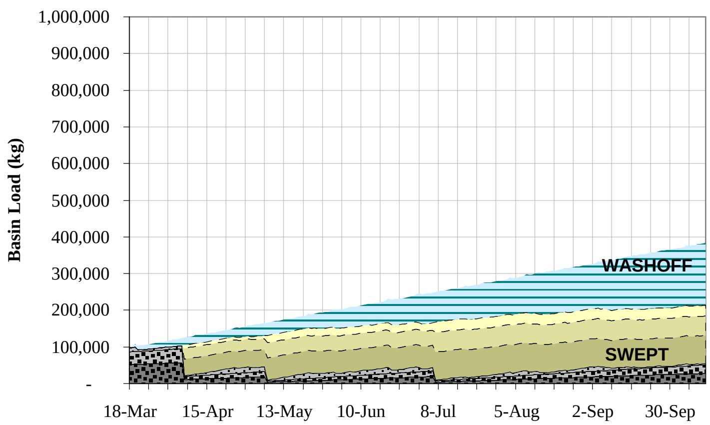
Land Use	
Industrial	1%
Commercial	79%
Residential	9%
Undeveloped	11%





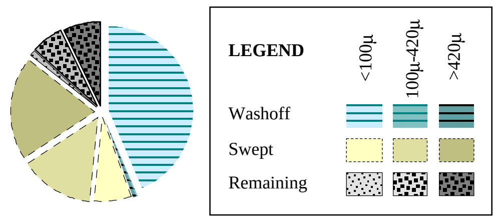
Road Areas		
Local	2.18	acres
Collector	8.02	acres
Minor Arterial	5.74	acres
Major Arterial	21.13	acres

SEDIMENT FATE

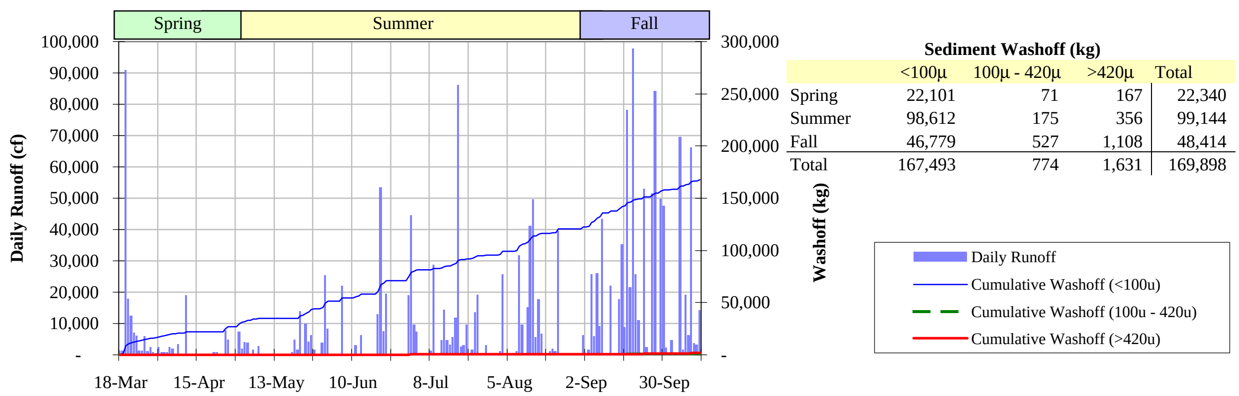


Sediment Fates (kg)

	<100µ	100µ - 420µ	>420µ	Total
Remaining	4,140	23,115	27,676	54,931
Swept	28,383	53,677	76,472	158,533
Washed Off	167,493	774	1,631	169,898
Total	200,017	77,566	105,779	383,362



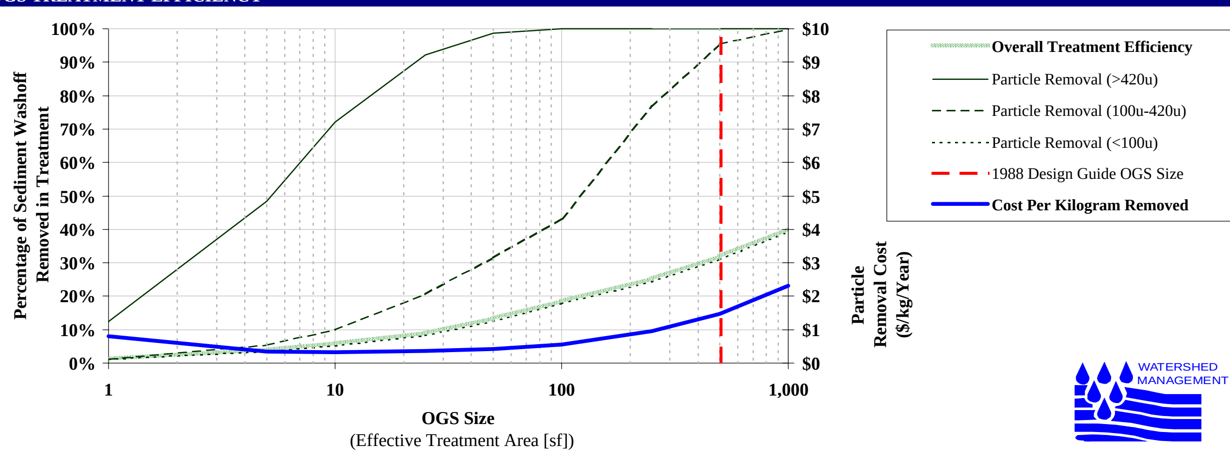
RUNOFF AND CUMULATIVE WASHOFF



Sediment Washoff (kg)

	<100µ	100µ - 420µ	>420µ	Total
Spring	22,101	71	167	22,340
Summer	98,612	175	356	99,144
Fall	46,779	527	1,108	48,414
Total	167,493	774	1,631	169,898

OGS TREATMENT EFFICIENCY



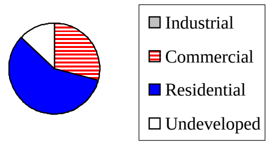
TIKISHLA SITE

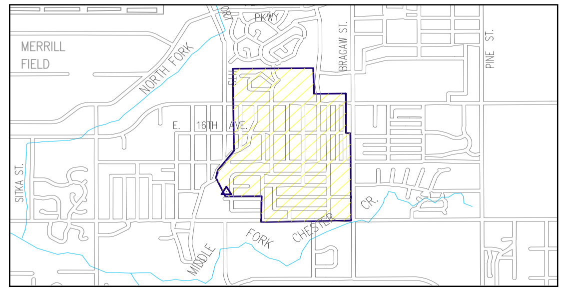
ANCHORAGE BOWL OGS PERFORMANCE MODELING

Basin: Middle Fork Chester Creek NPDES 87

Basin Area	177	acres

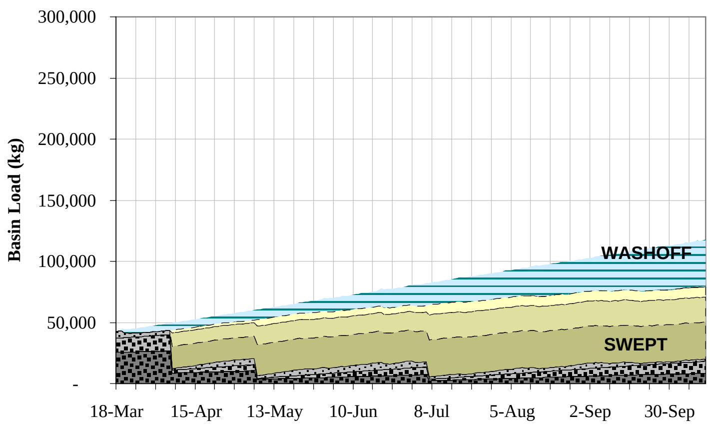
Land Use	
Industrial	0%
Commercial	29%
Residential	58%
Undeveloped	13%





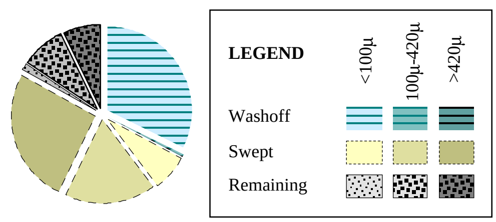
Road Areas		
Local	24.10	acres
Collector	-	acres
Minor Arterial	-	acres
Major Arterial	3.82	acres

SEDIMENT FATE

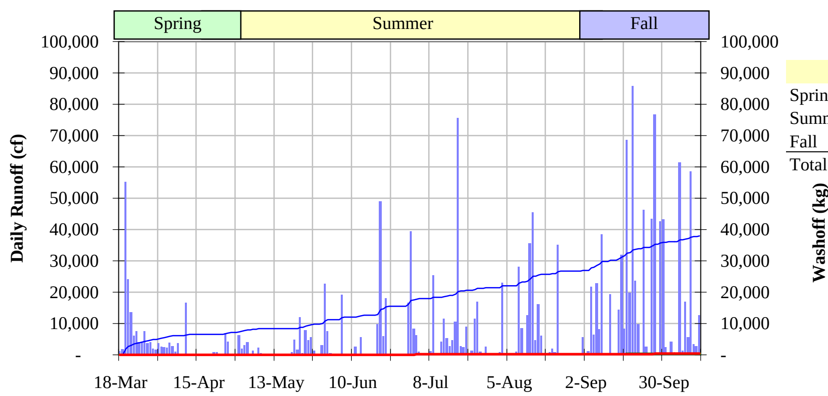


Sediment Fates (kg)

	<100µ	100µ - 420µ	>420µ	Total
Remaining	1,751	9,812	8,425	19,988
Swept	8,161	20,496	30,325	58,982
Washed Off	37,950	280	482	38,712
Total	47,862	30,588	39,232	117,682

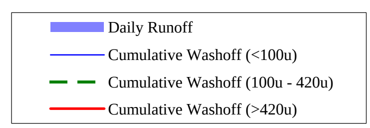


RUNOFF AND CUMULATIVE WASHOFF

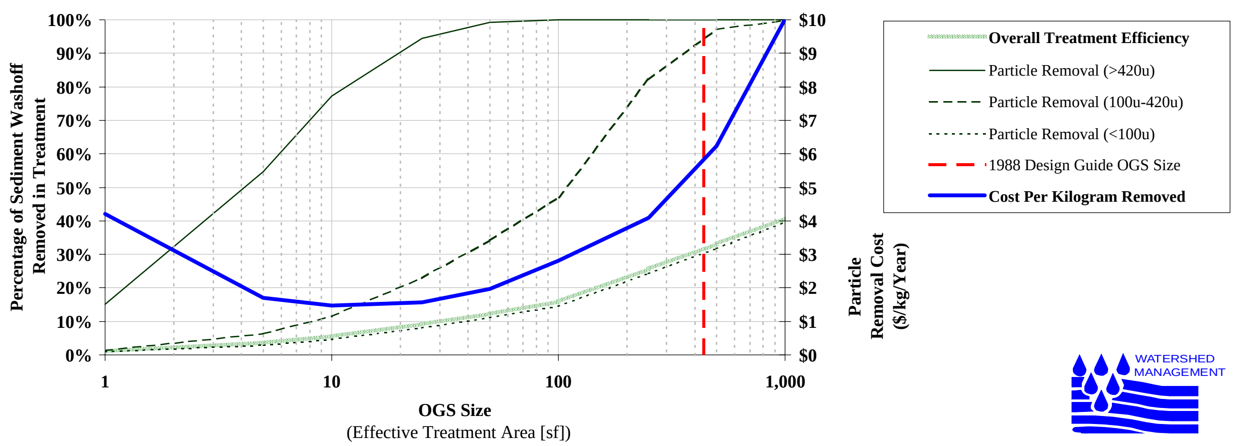


Sediment Washoff (kg)

	<100µ	100µ - 420µ	>420µ	Total
Spring	6,447	11	35	6,493
Summer	20,229	63	127	20,419
Fall	11,275	206	320	11,801
Total	37,950	280	482	38,712



OGS TREATMENT EFFICIENCY



WATERSHED MANAGEMENT

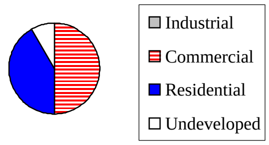
ANCHORAGE BOWL OGS PERFORMANCE MODELING

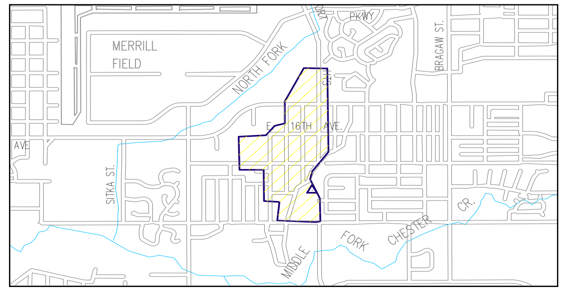
Basin: Middle Fork Chester Creek NPDES 86

Basin Area 83 acres

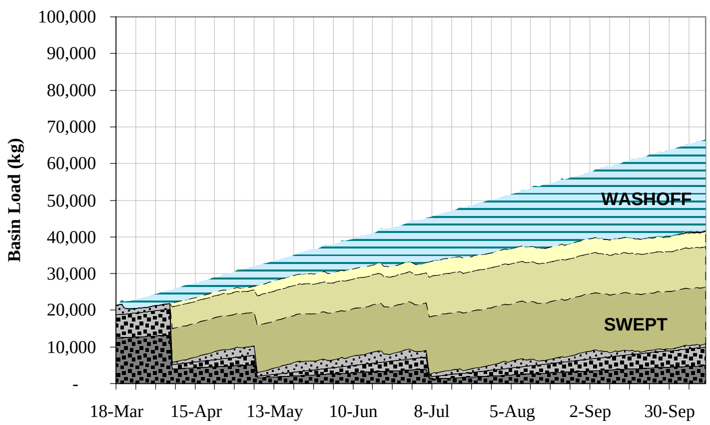
Land Use	
Industrial	0%
Commercial	50%
Residential	42%
Undeveloped	8%

Road Areas		
Local	9.83	acres
Collector	-	acres
Minor Arterial	-	acres
Major Arterial	2.75	acres



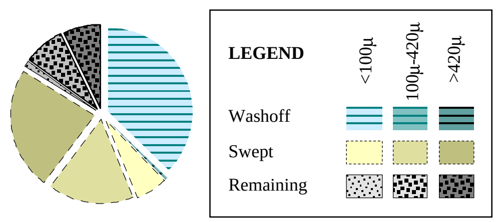


SEDIMENT FATE

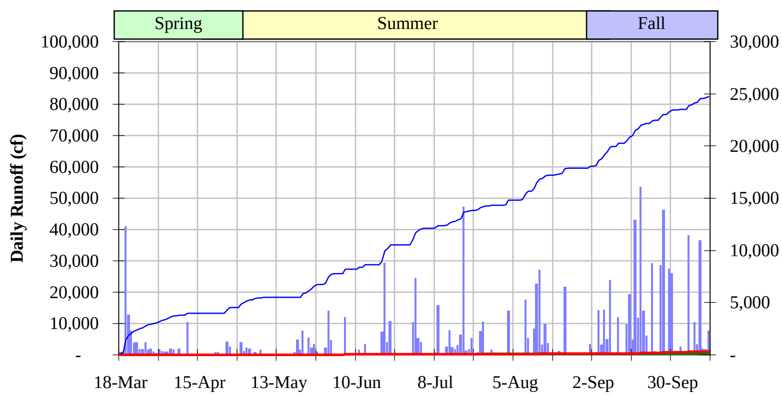


Sediment Fates (kg)

	<100µ	100µ - 420µ	>420µ	Total
Remaining	813	5,051	4,891	10,755
Swept	4,069	10,907	15,642	30,618
Washed Off	24,742	159	306	25,207
Total	29,624	16,117	20,839	66,580

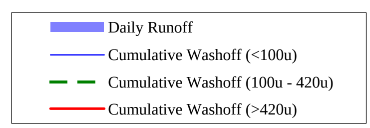


RUNOFF AND CUMULATIVE WASHOFF

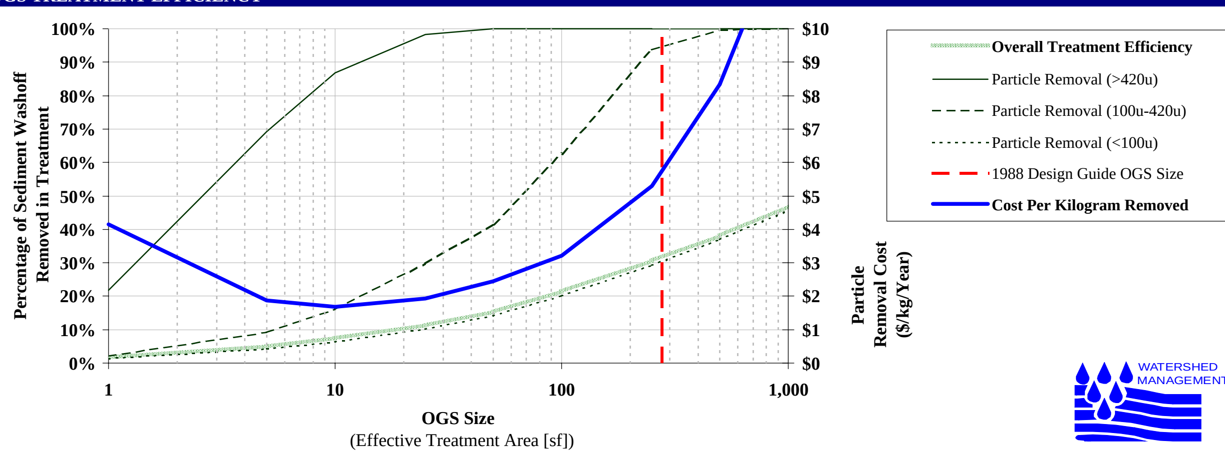


Sediment Washoff (kg)

	<100µ	100µ - 420µ	>420µ	Total
Spring	3,999	9	25	4,033
Summer	13,864	36	79	13,978
Fall	6,879	115	201	7,195
Total	24,742	159	306	25,207



OGS TREATMENT EFFICIENCY



WATERSHED MANAGEMENT

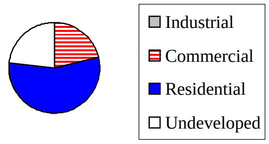
GAMBELL/INGRA SITE

ANCHORAGE BOWL OGS PERFORMANCE MODELING

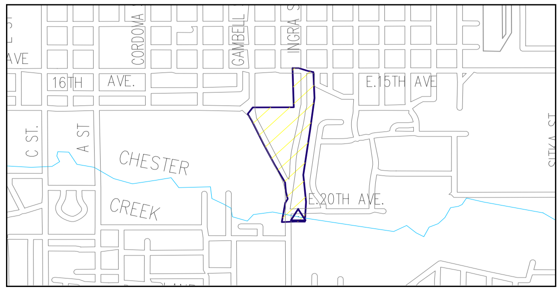
Basin: Chester Creek NPDES 69

Basin Area	24	acres

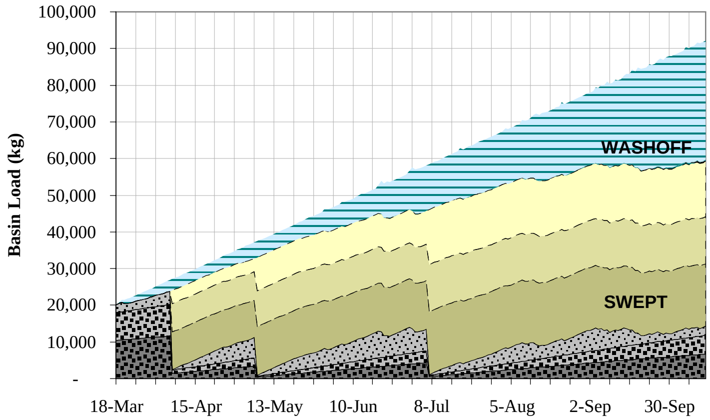
Land Use	
Industrial	0%
Commercial	21%
Residential	56%
Undeveloped	23%



Road Areas		
Local	-	acres
Collector	0.20	acres
Minor Arterial	-	acres
Major Arterial	5.91	acres

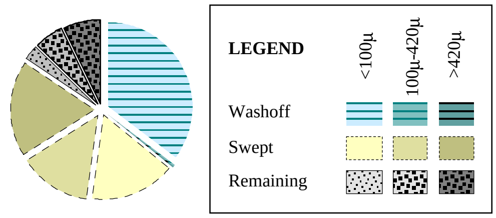


SEDIMENT FATE

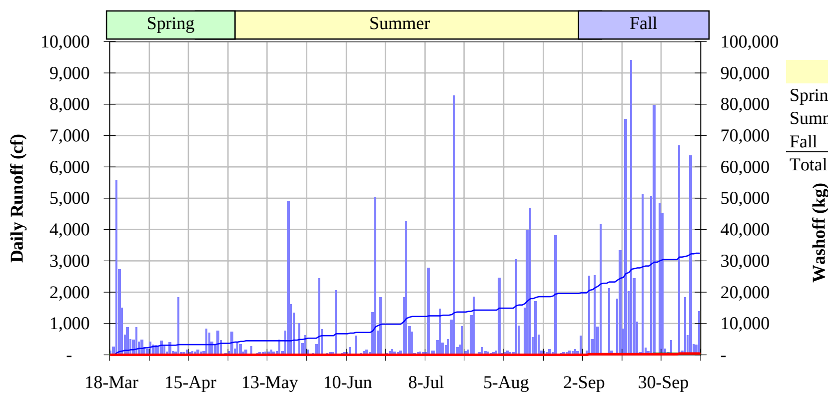


Sediment Fates (kg)

	<100µ	100µ - 420µ	>420µ	Total
Remaining	2,456	5,106	6,678	14,240
Swept	15,005	12,810	17,085	44,900
Washed Off	32,540	161	373	33,074
Total	50,001	18,077	24,136	92,214

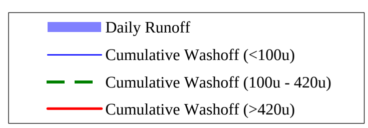


RUNOFF AND CUMULATIVE WASHOFF

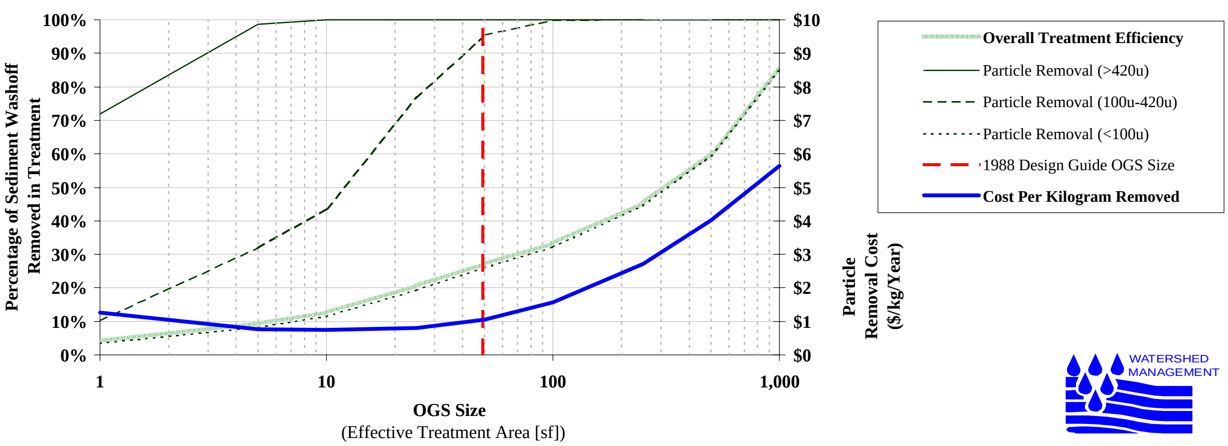


Sediment Washoff (kg)

	<100µ	100µ - 420µ	>420µ	Total
Spring	3,232	7	14	3,253
Summer	16,276	35	83	16,395
Fall	13,032	119	276	13,427
Total	32,540	161	373	33,074



OGS TREATMENT EFFICIENCY



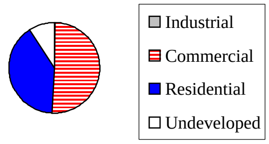
WATERSHED MANAGEMENT

ANCHORAGE BOWL OGS PERFORMANCE MODELING

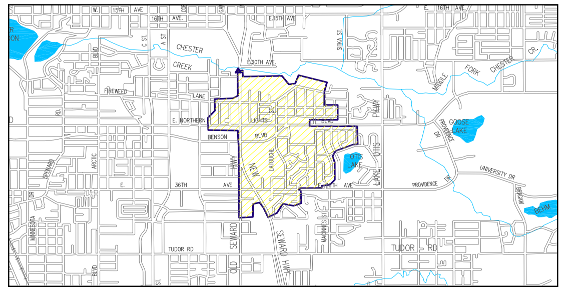
Basin: Chester Creek NPDES 68

Basin Area	450	acres

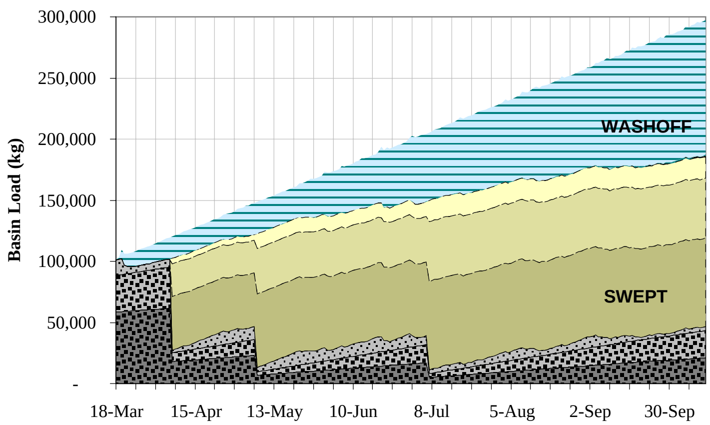
Land Use	
Industrial	0%
Commercial	51%
Residential	40%
Undeveloped	9%



Road Areas		
Local	37.31	acres
Collector	5.62	acres
Minor Arterial	6.07	acres
Major Arterial	10.38	acres

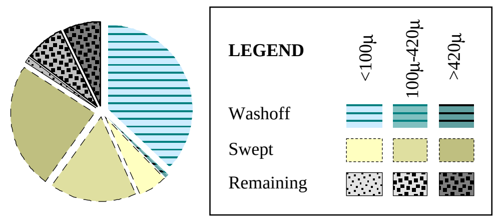


SEDIMENT FATE

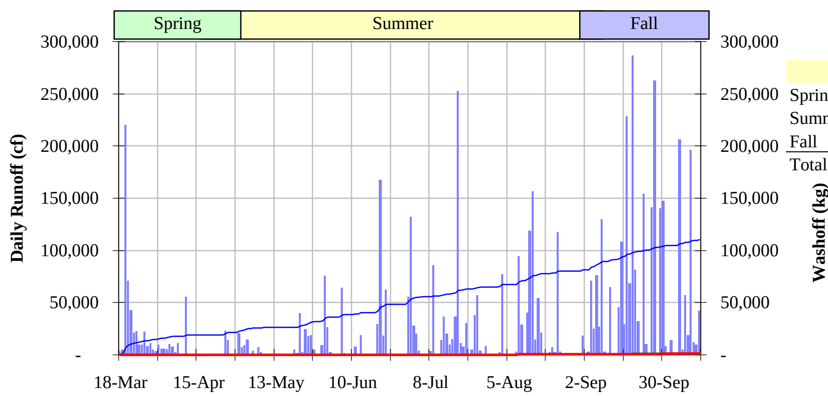


Sediment Fates (kg)

	<100µ	100µ - 420µ	>420µ	Total
Remaining	3,366	22,307	21,071	46,744
Swept	17,290	48,938	72,459	138,687
Washed Off	110,236	627	1,133	111,996
Total	130,892	71,872	94,663	297,428

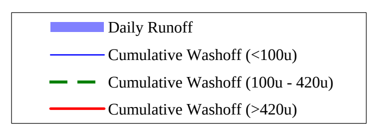


RUNOFF AND CUMULATIVE WASHOFF

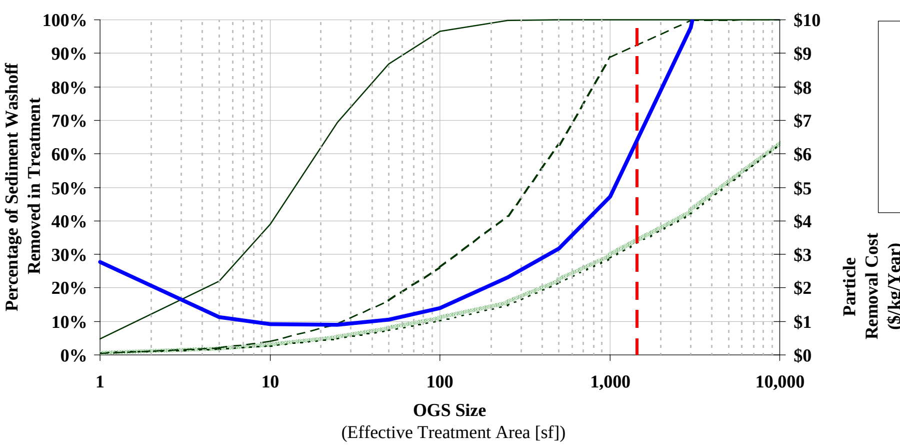


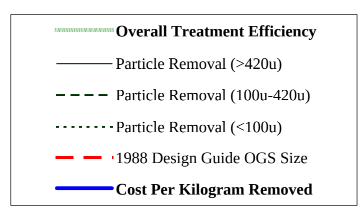
Sediment Washoff (kg)

	<100µ	100µ - 420µ	>420µ	Total
Spring	18,935	39	109	19,083
Summer	61,531	138	272	61,941
Fall	29,770	450	752	30,973
Total	110,236	627	1,133	111,996



OGS TREATMENT EFFICIENCY





WATERSHED MANAGEMENT

Appendix C
Tabulated Data

1999 VALIDATED DATA
Explanation of Table Values

Samp_Type	
1	Primary
2	Field Replicate

Samp_Meth	
G	Grab
S	Field Probe
V	Visual

Lab_Code	
1	CT&E

Anal_Meth	
1	EPA 300.0
2	EPA 200.7
3	EPA 150.1
4	SM 18
5	SM16 205
100	EC*0.3625
101	EC*0.5061
102	(EC-1290)/-23.49
103	EC*0.4248
104	(EC*0.3)-14.32
105	(0.81*EC)-409.6
106	(0.32*EC)-67.4
107	(0.28*EC)-57.3
108	(0.33*EC)-53.3

Par_Code	
BA	Barium
CL	Chloride
EC	Conductivity
MG	Magnesium
NA	Sodium
CA	Calcium
K	Potassium
FE	Iron
MN	Manganese
NO3N	Nirate-N
SO4	Sulfate
SI	Silicon
SR	Strontium
OP	Orthophosphate
HCO3	Bicarbonate Alkalinity
CO3	Carbonate Alkalinity
OH	Hydroxide Alkalnity
RV	Resistivity
PH	PH
FLOW	Flow
TEMP	Temperature

Units	
1	mg/L
2	*u*g/L
3	*u*S/cm
4	units
5	CFS
6	Celcius
7	ohm-m

Par_VQ	
1	ND
2	Entry

QC_Note	
1	valid
2	suspect

1999 Validated Data
Chloride at Anchorage Snow Disposal Sites

Station_ID	LogDate	LogTime	Samp_Type	Samp_Meth	Lab_Code	Lab_SampID	Anal_Date	Anal_Meth	Par_Code	Par_Val	Units	Par_VQ	Lab_RL	QC_Note
CH3301	3/17/99	1530	1	S				104	CL	116	1	2		1
CH3301	3/17/99	1530	1	S					EC	435	3	2		1
CH3301	3/17/99	1530	1	V					FLOW	0.02	5	2		1
CH3301	3/17/99	1530	1	S					TEMP	9.8	6	2		1
CH3301	3/18/99	1600	1	G	1	991034008	3/30/99	2	BA	0.0189	1	2	0.01	1
CH3301	3/18/99	1600	1	G	1	991034008	3/30/99	2	CA	38	1	2	1	1
CH3301	3/18/99	1600	1	G	1	991034008	3/19/99	1	CL	75.7	1	2	5	1
CH3301	3/18/99	1600	1	S					EC	484	3	2		1
CH3301	3/18/99	1600	1	G	1	991034008	3/30/99	2	FE	0	1	1	0.05	1
CH3301	3/18/99	1600	1	V					FLOW	0.02	5	2		1
CH3301	3/18/99	1600	1	G	1	991034008	3/22/99	4	HCO3	84.2	1	2	2	1
CH3301	3/18/99	1600	1	G	1	991034008	3/30/99	2	K	6.03	1	2	4.5	1
CH3301	3/18/99	1600	1	G	1	991034008	3/30/99	2	MG	15.9	1	2	0.1	1
CH3301	3/18/99	1600	1	G	1	991034008	3/30/99	2	NA	27.2	1	2	1	1
CH3301	3/18/99	1600	1	G	1	991034008	3/22/99	3	PH	7.68	4	2		2
CH3301	3/18/99	1600	1	G	1	991034008	3/30/99	5	RV	20.6	7	2		1
CH3301	3/18/99	1600	1	G	1	991034008	3/19/99	1	SO4	19.1	1	2	1	1
CH3301	3/18/99	1600	1	G	1	991034008	3/30/99	2	SR	0.181	1	2	0.03	1
CH3301	3/18/99	1600	1	S					TEMP	9.6	6	2		1
CH3301	3/19/99	1445	1	S				104	CL	211	1	2		1
CH3301	3/19/99	1445	1	S					EC	750	3	2		1
CH3301	3/19/99	1445	1	V					FLOW	0.03	5	2		1
CH3301	3/19/99	1445	1	S					TEMP	2.9	6	2		1
CH3301	3/20/99	1800	1	S				104	CL	1426	1	2		1
CH3301	3/20/99	1130	1	S					EC	1370	3	2		1
CH3301	3/20/99	1500	1	S					EC	3880	3	2		1
CH3301	3/20/99	1800	1	S					EC	4800	3	2		1
CH3301	3/20/99	1130	1	V					FLOW	0.03	5	2		1
CH3301	3/20/99	1500	1	V					FLOW	0.19	5	2		1
CH3301	3/20/99	1800	1	V					FLOW	0.22	5	2		1
CH3301	3/20/99	1130	1	S					TEMP	8.5	6	2		1
CH3301	3/20/99	1500	1	S					TEMP	9	6	2		1
CH3301	3/20/99	1800	1	S					TEMP	4.8	6	2		1
CH3301	3/21/99	1528	1	S				104	CL	761	1	2		1
CH3301	3/21/99	845	1	S					EC	1825	3	2		1
CH3301	3/21/99	1305	1	S					EC	1470	3	2		1

1999 Validated Data
Chloride at Anchorage Snow Disposal Sites

Station_ID	LogDate	LogTime	Samp_Type	Samp_Meth	Lab_Code	Lab_SampID	Anal_Date	Anal_Meth	Par_Code	Par_Val	Units	Par_VQ	Lab_RL	QC_Note
CH3301	3/21/99	1528	1	S					EC	1770	3	2		1
CH3301	3/21/99	1657	1	S					EC	1400	3	2		1
CH3301	3/21/99	845	1	V					FLOW	0.03	5	2		1
CH3301	3/21/99	1305	1	V					FLOW	0.12	5	2		1
CH3301	3/21/99	1528	1	V					FLOW	0.47	5	2		1
CH3301	3/21/99	1657	1	V					FLOW	0.47	5	2		1
CH3301	3/21/99	845	1	S					TEMP	2.2	6	2		1
CH3301	3/21/99	1305	1	S					TEMP	2.8	6	2		1
CH3301	3/21/99	1528	1	S					TEMP	2	6	2		1
CH3301	3/21/99	1657	1	S					TEMP	2.1	6	2		1
CH3301	3/22/99	1407	1	S				104	CL	270	1	2		1
CH3301	3/22/99	900	1	S					EC	1202	3	2		1
CH3301	3/22/99	1407	1	S					EC	948	3	2		1
CH3301	3/22/99	900	1	V					FLOW	0.024	5	2		1
CH3301	3/22/99	1407	1	V					FLOW	0.035	5	2		1
CH3301	3/22/99	900	1	S					TEMP	2.8	6	2		1
CH3301	3/22/99	1407	1	S					TEMP	3.7	6	2		1
CH3301	3/23/99	1540	1	S				104	CL	1150	1	2		1
CH3301	3/23/99	810	1	S					EC	1072	3	2		1
CH3301	3/23/99	1540	1	S					EC	3880	3	2		1
CH3301	3/23/99	1803	1	S					EC	2730	3	2		1
CH3301	3/23/99	810	1	V					FLOW	0.022	5	2		1
CH3301	3/23/99	1540	1	V					FLOW	0.147	5	2		1
CH3301	3/23/99	1803	1	V					FLOW	0.165	5	2		1
CH3301	3/23/99	810	1	S					TEMP	4	6	2		1
CH3301	3/23/99	1540	1	S					TEMP	3.7	6	2		1
CH3301	3/23/99	1803	1	S					TEMP	2.5	6	2		1
CH3301	3/24/99	1547	1	G	1	991338001	4/1/99	1	CL	995	1	2	50	1
CH3301	3/24/99	920	1	S					EC	670	3	2		1
CH3301	3/24/99	1300	1	S					EC	730	3	2		1
CH3301	3/24/99	1747	1	S					EC	3560	3	2		1
CH3301	3/24/99	920	1	V					FLOW	0.024	5	2		1
CH3301	3/24/99	1300	1	V					FLOW	0.041	5	2		1
CH3301	3/24/99	1747	1	V					FLOW	0.064	5	2		1
CH3301	3/24/99	920	1	S					TEMP	3.2	6	2		1
CH3301	3/24/99	1300	1	S					TEMP	3.7	6	2		1

1999 Validated Data
Chloride at Anchorage Snow Disposal Sites

Station_ID	LogDate	LogTime	Samp_Type	Samp_Meth	Lab_Code	Lab_SampID	Anal_Date	Anal_Meth	Par_Code	Par_Val	Units	Par_VQ	Lab_RL	QC_Note
CH3301	3/24/99	1747	1	S					TEMP	1.8	6	2		1
CH3301	3/25/99	1600	1	G	1	991287027	4/5/99	2	CA	38.2	1	2	1	1
CH3301	3/25/99	1600	1	G	1	991287027	4/6/99	1	CL	766	1	2	50	1
CH3301	3/25/99	0840	1	S					EC	695	3	2		1
CH3301	3/25/99	1110	1	S					EC	675	3	2		1
CH3301	3/25/99	1400	1	S					EC	1420	3	2		1
CH3301	3/25/99	1600	1	S					EC	2380	3	2		1
CH3301	3/25/99	1810	1	S					EC	2160	3	2		1
CH3301	3/25/99	0840	1	V					FLOW	0.083	5	2		1
CH3301	3/25/99	1110	1	V					FLOW	0.033	5	2		1
CH3301	3/25/99	1400	1	V					FLOW	0.083	5	2		1
CH3301	3/25/99	1600	1	V					FLOW	0.264	5	2		1
CH3301	3/25/99	1810	1	V					FLOW	0.189	5	2		1
CH3301	3/25/99	1600	1	G	1	991287027	4/5/99	4	HCO3	71.6	1	2	2	2
CH3301	3/25/99	1600	1	G	1	991287027	4/5/99	2	K	26.4	1	2	4.5	1
CH3301	3/25/99	1600	1	G	1	991287027	4/5/99	2	MG	83.7	1	2	0.1	1
CH3301	3/25/99	1600	1	G	1	991287027	4/5/99	2	NA	182	1	2	1	1
CH3301	3/25/99	1600	1	G	1	991287027	4/5/99	2	SI	1.71	1	2	0.5	1
CH3301	3/25/99	1600	1	G	1	991287027	3/31/99	1	SO4	17.3	1	2	5	1
CH3301	3/25/99	0840	1	S					TEMP	7.4	6	2		1
CH3301	3/25/99	1110	1	S					TEMP	8.2	6	2		1
CH3301	3/25/99	1400	1	S					TEMP	8.3	6	2		1
CH3301	3/25/99	1600	1	S					TEMP	3	6	2		1
CH3301	3/25/99	1810	1	S					TEMP	9.3	6	2		1
CH3301	3/26/99	1610	1	G	1	991287031	3/31/99	1	CL	343	1	2	5	1
CH3301	3/26/99	1200	1	S					EC	637	3	2		1
CH3301	3/26/99	1410	1	S					EC	940	3	2		1
CH3301	3/26/99	1610	1	S					EC	1111	3	2		1
CH3301	3/26/99	1200	1	V					FLOW	0.024	5	2		1
CH3301	3/26/99	1410	1	V					FLOW	0.087	5	2		1
CH3301	3/26/99	1610	1	V					FLOW	0.147	5	2		1
CH3301	3/26/99	1200	1	S					TEMP	3.4	6	2		1
CH3301	3/26/99	1410	1	S					TEMP	7.6	6	2		1
CH3301	3/26/99	1610	1	S					TEMP	9.5	6	2		1
CH3301	3/27/99	1145	1	G	1	991338005	4/1/99	1	CL	80.3	1	2	5	1
CH3301	3/27/99	1656	1	G	1	991338006	4/1/99	1	CL	274	1	2	50	1

1999 Validated Data
Chloride at Anchorage Snow Disposal Sites

Station_ID	LogDate	LogTime	Samp_Type	Samp_Meth	Lab_Code	Lab_SampID	Anal_Date	Anal_Meth	Par_Code	Par_Val	Units	Par_VQ	Lab_RL	QC_Note
CH3301	3/27/99	1145	1	S					EC	439	3	2		1
CH3301	3/27/99	1400	1	S					EC	636	3	2		1
CH3301	3/27/99	1656	1	S					EC	1061	3	2		1
CH3301	3/27/99	1145	1	V					FLOW	0.025	5	2		1
CH3301	3/27/99	1400	1	V					FLOW	0.075	5	2		1
CH3301	3/27/99	1656	1	V					FLOW	0.275	5	2		1
CH3301	3/27/99	1145	1	S					TEMP	3.5	6	2		1
CH3301	3/27/99	1400	1	S					TEMP	2.7	6	2		1
CH3301	3/27/99	1656	1	S					TEMP	3.2	6	2		1
CH3301	3/28/99	1600	1	S				104	CL	227	1	2		1
CH3301	3/28/99	1155	1	S					EC	416	3	2		1
CH3301	3/28/99	1600	1	S					EC	806	3	2		1
CH3301	3/28/99	1155	1	V					FLOW	0.025	5	2		1
CH3301	3/28/99	1600	1	V					FLOW	0.066	5	2		1
CH3301	3/29/99	1729	1	G	1	991338011	4/1/99	1	CL	44.8	1	2	5	1
CH3301	3/29/99	1730	1	S				104	CL	71	1	2		1
CH3301	3/29/99	1215	1	S					EC	397	3	2		1
CH3301	3/29/99	1515	1	S					EC	348	3	2		1
CH3301	3/29/99	1729	1	S					EC	285	3	2		1
CH3301	3/29/99	1215	1	V					FLOW	0.022	5	2		1
CH3301	3/29/99	1515	1	V					FLOW	0.074	5	2		1
CH3301	3/29/99	1729	1	V					FLOW	0.087	5	2		1
CH3301	3/29/99	1215	1	S					TEMP	4.2	6	2		1
CH3301	3/29/99	1515	1	S					TEMP	9.5	6	2		1
CH3301	3/29/99	1729	1	S					TEMP	10	6	2		1
CH3301	3/31/99	1500	1	G	1	991605001	4/22/99	2	CA	51.8	1	2	10	1
CH3301	3/31/99	1500	1	G	1	991605001	4/19/99	1	CL	736	1	2	50	1
CH3301	3/31/99	1300	1	S					EC	1710	3	2		1
CH3301	3/31/99	1500	1	S					EC	2460	3	2		1
CH3301	3/31/99	1700	1	S					EC	2350	3	2		1
CH3301	3/31/99	1300	1	V					FLOW	0.084	5	2		1
CH3301	3/31/99	1500	1	V					FLOW	0.139	5	2		1
CH3301	3/31/99	1700	1	V					FLOW	0.11	5	2		1
CH3301	3/31/99	1500	1	G	1	991605001	4/20/99	4	HCO3	74.5	1	2	2	2
CH3301	3/31/99	1500	1	G	1	991605001	4/26/99	2	K	31.6	1	2	4.5	1
CH3301	3/31/99	1500	1	G	1	991605001	4/22/99	2	MG	168	1	2	1	1

1999 Validated Data
Chloride at Anchorage Snow Disposal Sites

Station_ID	LogDate	LogTime	Samp_Type	Samp_Meth	Lab_Code	Lab_SampID	Anal_Date	Anal_Meth	Par_Code	Par_Val	Units	Par_VQ	Lab_RL	QC_Note
CH3301	3/31/99	1500	1	G	1	991605001	4/22/99	2	NA	140	1	2	10	1
CH3301	3/31/99	1500	1	G	1	991605001	4/16/99	1	SO4	20.9	1	2	5	1
CH3301	4/1/99	1454	1	S				104	CL	376	1	2		1
CH3301	4/1/99	926	1	S					EC	626	3	2		1
CH3301	4/1/99	1454	1	S					EC	1300	3	2		1
CH3301	4/1/99	926	1	V					FLOW	0.02	5	2		1
CH3301	4/1/99	1454	1	V					FLOW	0.13	5	2		1
CHGI001	3/5/99	1401	1	G	1	991034001	3/19/99	1	CL	14.9	1	2	5	1
CHGI001	3/5/99	1401	1	S					EC	278	3	2		1
CHGI001	3/5/99	1401	1	S					TEMP	6.7	6	2		1
CHGI001	3/12/99	930	1	S					EC	277	3	2		1
CHGI001	3/12/99	1400	1	S					EC	264	3	2		1
CHGI001	3/12/99	930	1	V					FLOW	1.3	5	2		1
CHGI001	3/12/99	1400	1	V					FLOW	8	5	2		1
CHGI001	3/12/99	930	1	S					TEMP	1	6	2		1
CHGI001	3/12/99	1400	1	S					TEMP	8.7	6	2		1
CHGI001	3/14/99	1515	1	G	1	991034005	3/30/99	2	BA	0.0238	1	2	0.01	1
CHGI001	3/14/99	1515	1	G	1	991034005	3/30/99	2	CA	37.2	1	2	1	1
CHGI001	3/14/99	1515	1	G	1	991034005	3/19/99	1	CL	43.6	1	2	5	1
CHGI001	3/14/99	1515	1	S				107	CL	45.2	1	2		1
CHGI001	3/14/99	1515	1	S					EC	366	3	2		1
CHGI001	3/14/99	1515	1	G	1	991034005	3/30/99	2	FE	0	1	1	0.05	1
CHGI001	3/14/99	1515	1	G	1	991034005	3/22/99	4	HCO3	87.3	1	2	2	2
CHGI001	3/14/99	1515	1	G	1	991034005	3/30/99	2	K	0	1	1	4.5	1
CHGI001	3/14/99	1515	1	G	1	991034005	3/30/99	2	MG	13.9	1	2	0.1	1
CHGI001	3/14/99	1515	1	G	1	991034005	3/30/99	2	NA	14.9	1	2	1	1
CHGI001	3/14/99	1515	1	G	1	991034005	3/22/99	3	PH	7.78	4	2		2
CHGI001	3/14/99	1515	1	G	1	991034005	3/30/99	5	RV	29	7	2		1
CHGI001	3/14/99	1515	1	G	1	991034005	3/19/99	1	SO4	22.8	1	2	1	1
CHGI001	3/14/99	1515	1	G	1	991034005	3/30/99	2	SR	0.226	1	2	0.03	1
CHGI001	3/14/99	1515	1	S					TEMP	8.2	6	2		1
CHGI001	3/16/99	1445	1	S				107	CL	18.6	1	2		1
CHGI001	3/16/99	1445	1	S					EC	271	3	2		1
CHGI001	3/16/99	1445	1	V					FLOW	4.7	5	2		1
CHGI001	3/16/99	1445	1	S					TEMP	6.7	6	2		1
CHGI001	3/18/99	1530	1	G	1	991287002	4/5/99	2	CA	35.5	1	2	1	1

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CHGI001	3/18/99	1530	1	G	1	991287002	3/30/99	1	Cl	16.5	1	2	5	1
CHGI001	3/18/99	1530	1	S					EC	268	3	2		1
CHGI001	3/18/99	1530	1	V					FLOW	8.6	5	2		1
CHGI001	3/18/99	1530	1	G	1	991287002	4/5/99	4	HCO3	85	1	2	2	2
CHGI001	3/18/99	1530	1	G	1	991287002	4/5/99	2	K	0	1	1	4.5	1
CHGI001	3/18/99	1530	1	G	1	991287002	4/5/99	2	MG	7.73	1	2	0.1	1
CHGI001	3/18/99	1530	1	G	1	991287002	4/5/99	2	NA	7.52	1	2	1	1
CHGI001	3/18/99	1530	1	G	1	991287002	4/5/99	2	SI	5.69	1	2	0.5	1
CHGI001	3/18/99	1530	1	G	1	991287002	3/30/99	1	SO4	23.7	1	2	5	1
CHGI001	3/18/99	1530	1	S					TEMP	6	6	2		1
CHGI001	3/19/99	1320	1	S				107	CL	18.9	1	2		1
CHGI001	3/19/99	1320	1	S					EC	272	3	2		1
CHGI001	3/19/99	1320	1	V					FLOW	18.6	5	2		1
CHGI001	3/19/99	1320	1	S					TEMP	2.2	6	2		1
CHGI001	3/20/99	1217	1	G	1	991287007	3/30/99	1	CL	24	1	2	5	1
CHGI001	3/20/99	1530	1	G	1	991287008	3/30/99	1	CL	43.9	1	2	5	1
CHGI001	3/20/99	1217	1	S					EC	270	3	2		1
CHGI001	3/20/99	1630	1	S					EC	345	3	2		1
CHGI001	3/20/99	1217	1	S					TEMP	9.4	6	2		1
CHGI001	3/21/99	1600	1	G	1	991287016	4/5/99	2	CA	31.8	1	2	1	1
CHGI001	3/21/99	1600	1	G	1	991287016	3/30/99	1	CL	74.3	1	2	5	1
CHGI001	3/21/99	1600	1	S					EC	488	3	2		1
CHGI001	3/21/99	1600	1	G	1	991287016	4/5/99	4	HCO3	77.3	1	2	2	2
CHGI001	3/21/99	1600	1	G	1	991287016	4/5/99	2	K	0	1	1	4.5	1
CHGI001	3/21/99	1600	1	G	1	991287016	4/5/99	2	MG	15.6	1	2	0.1	1
CHGI001	3/21/99	1600	1	G	1	991287016	4/5/99	2	NA	25.6	1	2	1	1
CHGI001	3/21/99	1600	1	G	1	991287016	4/5/99	2	SI	4.82	1	2	0.5	1
CHGI001	3/21/99	1600	1	G	1	991287016	3/30/99	1	SO4	20.6	1	2	5	1
CHGI001	3/21/99	1600	1	S					TEMP	0.8	6	2		1
CHGI001	3/22/99	1410	1	G	1	991287020	4/5/99	2	CA	28.4	1	2	1	1
CHGI001	3/22/99	1410	1	G	1	991287020	3/31/99	1	CL	30.7	1	2	5	1
CHGI001	3/22/99	1000	1	S					EC	339	3	2		1
CHGI001	3/22/99	1410	1	S					EC	311	3	2		1
CHGI001	3/22/99	1000	1	V					FLOW	10.9	5	2		1
CHGI001	3/22/99	1410	1	V					FLOW	10.1	5	2		1
CHGI001	3/22/99	1410	1	G	1	991287020	4/5/99	4	HCO3	79.2	1	2	2	1

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CHGI001	3/22/99	1410	1	G	1	991287020	4/5/99	2	K	0	1	1	4.5	1
CHGI001	3/22/99	1410	1	G	1	991287020	4/5/99	2	MG	8.1	1	2	0.1	1
CHGI001	3/22/99	1410	1	G	1	991287020	4/5/99	2	NA	12.8	1	2	1	1
CHGI001	3/22/99	1410	1	G	1	991287020	4/5/99	2	SI	4.75	1	2	0.5	1
CHGI001	3/22/99	1410	1	G	1	991287020	3/31/99	1	SO4	22.8	1	2	5	1
CHGI001	3/22/99	1000	1	S					TEMP	0.8	6	2		1
CHGI001	3/22/99	1410	1	S					TEMP	9.5	6	2		1
CHGI001	3/23/99	1410	1	G	1	991287023	3/31/99	1	CL	69.9	1	2	5	1
CHGI001	3/23/99	925	1	S					EC	294	3	2		1
CHGI001	3/23/99	1315	1	S					EC	471	3	2		1
CHGI001	3/23/99	925	1	V					FLOW	10.1	5	2		1
CHGI001	3/23/99	1315	1	V					FLOW	8.9	5	2		1
CHGI001	3/23/99	925	1	S					TEMP	9.4	6	2		1
CHGI001	3/23/99	1315	1	S					TEMP	3.3	6	2		1
CHGI001	3/25/99	1410	1	G	1	991287028	3/31/99	1	CL	39.2	1	2	5	1
CHGI001	3/25/99	905	1	S					EC	327	3	2		1
CHGI001	3/25/99	1405	1	S					EC	365	3	2		1
CHGI001	3/25/99	905	1	V					FLOW	4.4	5	2		1
CHGI001	3/25/99	1405	1	V					FLOW	5.3	5	2		1
CHGI001	3/25/99	905	1	S					TEMP	1.7	6	2		1
CHGI001	3/25/99	1405	1	S					TEMP	2.7	6	2		1
CHGI001	3/26/99	1500	1	S				107	CL	74.9	1	2		1
CHGI001	3/26/99	1000	1	S					EC	320	3	2		1
CHGI001	3/26/99	1500	1	S					EC	472	3	2		1
CHGI001	3/26/99	1000	1	V					FLOW	7.8	5	2		1
CHGI001	3/26/99	1500	1	V					FLOW	10.4	5	2		1
CHGI001	3/26/99	1000	1	S					TEMP	8.8	6	2		1
CHGI001	3/26/99	1500	1	S					TEMP	3.9	6	2		1
CHGI001	3/27/99	1457	1	S				107	CL	51.9	1	2		1
CHGI001	3/27/99	1040	1	S					EC	330	3	2		1
CHGI001	3/27/99	1457	1	S					EC	390	3	2		1
CHGI001	3/27/99	1040	1	S					TEMP	2.4	6	2		1
CHGI001	3/27/99	1457	1	S					TEMP	3.2	6	2		1
CHGI001	3/28/99	1620	1	S				107	CL	52.7	1	2		1
CHGI001	3/28/99	1310	1	S					EC	359	3	2		1
CHGI001	3/28/99	1620	1	S					EC	393	3	2		1

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CHGI001	3/29/99	1705	1	G	1	991338012	4/1/99	1	CL	41.8	1	2	5	1
CHGI001	3/29/99	850	1	S					EC	309	3	2		1
CHGI001	3/29/99	1705	1	S					EC	362	3	2		1
CHGI001	3/29/99	850	1	V					FLOW	0.17	5	2		1
CHGI001	3/29/99	1705	1	V					FLOW	3.2	5	2		1
CHGI001	3/29/99	850	1	S					TEMP	7.1	6	2		1
CHGI001	3/29/99	1705	1	S					TEMP	3.5	6	2		1
CHGI001	3/31/99	1505	1	S				107	CL	46	1	2		1
CHGI001	3/31/99	1045	1	S					EC	338	3	2		1
CHGI001	3/31/99	1505	1	S					EC	369	3	2		1
CHGI001	3/31/99	1045	1	V					FLOW	3.8	5	2		1
CHGI001	3/31/99	1505	1	V					FLOW	6.3	5	2		1
CHGI001	3/31/99	1045	1	S					TEMP	2.2	6	2		1
CHGI001	3/31/99	1505	1	S					TEMP	2.1	6	2		1
CHGI002	3/26/99	1525	1	S					EC	835	3	2		1
CHGI002	3/26/99	1525	1	S					TEMP	0.4	6	2		1
CHGI002	3/27/99	1457	1	S					EC	434	3	2		1
CHGI002	3/27/99	1457	1	S					TEMP	1.3	6	2		1
CHGI003	3/14/99	1520	1	G	1	991034004	3/29/99	1	CL	2510	1	2	50	1
CHGI003	3/14/99	1515	1	S				108	CL	176	1	2		1
CHGI003	3/14/99	1520	1	S					EC	694	3	2		1
CHGI003	3/14/99	1520	1	S					TEMP	7.7	6	2		1
CHGI003	3/20/99	1540	1	G	1	991287011	3/30/99	1	CL	79.9	1	2	5	1
CHGI003	3/21/99	1610	1	G	1	991287019	4/5/99	2	CA	31.8	1	2	1	1
CHGI003	3/21/99	1610	1	G	1	991287019	4/6/99	1	CL	602	1	2	50	1
CHGI003	3/21/99	1610	1	S					EC	2220	3	2		1
CHGI003	3/21/99	1610	1	G	1	991287019	4/5/99	4	HCO3	57.3	1	2	2	2
CHGI003	3/21/99	1610	1	G	1	991287019	4/5/99	2	K	18.9	1	2	4.5	1
CHGI003	3/21/99	1610	1	G	1	991287019	4/5/99	2	MG	123	1	2	0.1	1
CHGI003	3/21/99	1610	1	G	1	991287019	4/5/99	2	NA	106	1	2	1	1
CHGI003	3/21/99	1610	1	G	1	991287019	4/5/99	2	SI	0.676	1	2	0.5	1
CHGI003	3/21/99	1610	1	G	1	991287019	3/31/99	1	SO4	16.6	1	2	5	1
CHGI003	3/21/99	1610	1	S					TEMP	0.2	6	2		1
CHGI003	3/23/99	1325	1	G	1	991287024	4/6/99	1	CL	752	1	2	50	1
CHGI003	3/23/99	1325	1	S					EC	2630	3	2		1
CHGI003	3/23/99	1325	1	S					TEMP	1.1	6	2		1

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CHGI003	3/27/99	1457	1	S				108	CL	502	1	2		1
CHGI003	3/27/99	1500	1	S					EC	1683	3	2		1
CHGI003	3/27/99	1500	1	S					TEMP	0.5	6	2		1
CHGI003	3/29/99	1705	1	S				108	CL	35	1	2		1
CHGI003	3/29/99	1715	1	S					EC	267	3	2		1
CHGI003	3/29/99	1715	1	S					TEMP	0.3	6	2		1
CHGI004	3/12/99	1000	1	S					EC	466	3	2		1
CHGI004	3/12/99	1420	1	S					EC	1557	3	2		1
CHGI004	3/12/99	1000	1	S					TEMP	2.7	6	2		1
CHGI004	3/12/99	1420	1	S					TEMP	8.2	6	2		1
CHGI004	3/14/99	1522	1	G	1	991034007	3/30/99	2	BA	0.18	1	2	0.01	1
CHGI004	3/14/99	1522	1	G	1	991034007	3/30/99	2	CA	64.3	1	2	1	1
CHGI004	3/14/99	1522	1	G	1	991034007	3/26/99	1	CL	1170	1	2	50	1
CHGI004	3/14/99	1522	1	G	1	991034007	3/30/99	2	FE	0	1	1	0.05	1
CHGI004	3/14/99	1522	1	G	1	991034007	3/22/99	4	HCO3	57.9	1	2	2	2
CHGI004	3/14/99	1522	1	G	1	991034007	3/30/99	2	K	114	1	2	4.5	1
CHGI004	3/14/99	1522	1	G	1	991034007	3/30/99	2	MG	107	1	2	0.1	1
CHGI004	3/14/99	1522	1	G	1	991034007	3/30/99	2	NA	353	1	2	1	1
CHGI004	3/14/99	1522	1	G	1	991034007	3/22/99	3	PH	6.84	4	2		2
CHGI004	3/14/99	1522	1	G	1	991034007	3/30/99	5	RV	2.74	7	2		1
CHGI004	3/14/99	1522	1	G	1	991034007	3/26/99	1	SO4	50.1	1	2	10	1
CHGI004	3/14/99	1522	1	G	1	991034007	3/30/99	2	SR	0.694	1	2	0.03	1
CHGI004	3/14/99	1522	1	S					TEMP	7.7	6	2		1
CHGI004	3/16/99	1445	1	S				108	CL	140	1	2		1
CHGI004	3/16/99	1455	1	S					EC	587	3	2		1
CHGI004	3/16/99	1455	1	S					TEMP	5.8	6	2		1
CHGI004	3/18/99	1545	1	G	1	991287003	4/5/99	2	CA	26.5	1	2	1	1
CHGI004	3/18/99	1545	1	G	1	991287003	3/30/99	1	CL	32.6	1	2	5	1
CHGI004	3/18/99	1545	1	S					EC	271	3	2		1
CHGI004	3/18/99	1545	1	G	1	991287003	4/5/99	4	HCO3	56.3	1	2	2	2
CHGI004	3/18/99	1545	1	G	1	991287003	4/5/99	2	K	0	1	1	4.5	1
CHGI004	3/18/99	1545	1	G	1	991287003	4/5/99	2	MG	7.77	1	2	0.1	1
CHGI004	3/18/99	1545	1	G	1	991287003	4/5/99	2	NA	11.2	1	2	1	1
CHGI004	3/18/99	1545	1	G	1	991287003	4/5/99	2	SI	5.32	1	2	0.5	1
CHGI004	3/18/99	1545	1	G	1	991287003	3/30/99	1	SO4	19.3	1	2	5	1
CHGI004	3/18/99	1545	1	S					TEMP	6.6	6	2		1

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CHGI004	3/19/99	1320	1	S				108	CL	107	1	2		1
CHGI004	3/19/99	1335	1	S					EC	486	3	2		1
CHGI004	3/19/99	1335	1	S					TEMP	3	6	2		1
CHGI004	3/20/99	1219	1	G	1	991287012	4/6/99	1	CL	463	1	2	50	1
CHGI004	3/20/99	1534	1	G	1	991287013	4/6/99	1	CL	659	1	2	50	1
CHGI004	3/20/99	1219	1	S					EC	1596	3	2		1
CHGI004	3/20/99	1534	1	S					EC	2040	3	2		1
CHGI004	3/20/99	1219	1	S					TEMP	10.5	6	2		1
CHGI004	3/20/99	1534	1	S					TEMP	10.5	6	2		1
CHGI004	3/21/99	1605	1	G	1	991287018	4/5/99	2	CA	38.5	1	2	1	1
CHGI004	3/21/99	1605	1	G	1	991287018	4/7/99	1	CL	482	1	2	50	1
CHGI004	3/21/99	1605	1	S					EC	1655	3	2		1
CHGI004	3/21/99	1605	1	G	1	991287018	4/5/99	4	HCO3	59.2	1	2	2	2
CHGI004	3/21/99	1605	1	G	1	991287018	4/5/99	2	K	19	1	2	4.5	1
CHGI004	3/21/99	1605	1	G	1	991287018	4/5/99	2	MG	41.1	1	2	0.1	1
CHGI004	3/21/99	1605	1	G	1	991287018	4/5/99	2	NA	151	1	2	1	1
CHGI004	3/21/99	1605	1	G	1	991287018	4/5/99	2	SI	1	1	2	0.5	1
CHGI004	3/21/99	1605	1	G	1	991287018	3/31/99	1	SO4	13.9	1	2	5	1
CHGI004	3/21/99	1605	1	S					TEMP	1.4	6	2		1
CHGI004	3/22/99	1420	1	G	1	991287021	4/5/99	2	CA	44.2	1	2	1	1
CHGI004	3/22/99	1420	1	G	1	991287021	4/6/99	1	CL	928	1	2	50	1
CHGI004	3/22/99	1020	1	S					EC	756	3	2		1
CHGI004	3/22/99	1420	1	S					EC	3000	3	2		1
CHGI004	3/22/99	1420	1	G	1	991287021	4/5/99	4	HCO3	63	1	2	2	2
CHGI004	3/22/99	1420	1	G	1	991287021	4/5/99	2	K	21.6	1	2	4.5	1
CHGI004	3/22/99	1420	1	G	1	991287021	4/5/99	2	MG	63.4	1	2	0.1	1
CHGI004	3/22/99	1420	1	G	1	991287021	4/5/99	2	NA	354	1	2	1	1
CHGI004	3/22/99	1420	1	G	1	991287021	4/5/99	2	SI	2.8	1	2	0.5	1
CHGI004	3/22/99	1420	1	G	1	991287021	3/31/99	1	SO4	98	1	2	5	1
CHGI004	3/22/99	1020	1	S					TEMP	9.8	6	2		1
CHGI004	3/22/99	1420	1	S					TEMP	9.1	6	2		1
CHGI004	3/23/99	1330	1	G	1	991287025	3/31/99	1	CL	398	1	2	5	1
CHGI004	3/23/99	930	1	S					EC	1138	3	2		1
CHGI004	3/23/99	1330	1	S					EC	1309	3	2		1
CHGI004	3/23/99	930	1	S					TEMP	10.1	6	2		1
CHGI004	3/23/99	1330	1	S					TEMP	2.1	6	2		1

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CHGI004	3/25/99	1420	1	G	1	991287029	4/5/99	2	CA	42.1	1	2	1	1
CHGI004	3/25/99	1420	1	G	1	991287029	3/31/99	1	CL	583	1	2	5	1
CHGI004	3/25/99	900	1	S					EC	1004	3	2		1
CHGI004	3/25/99	1420	1	S					EC	1883	3	2		1
CHGI004	3/25/99	1420	1	G	1	991287029	4/5/99	4	HCO3	66.8	1	2	2	2
CHGI004	3/25/99	1420	1	G	1	991287029	4/5/99	2	K	50.4	1	2	4.5	1
CHGI004	3/25/99	1420	1	G	1	991287029	4/5/99	2	MG	41.8	1	2	0.1	1
CHGI004	3/25/99	1420	1	G	1	991287029	4/5/99	2	NA	145	1	2	1	1
CHGI004	3/25/99	1420	1	G	1	991287029	4/5/99	2	SI	1.81	1	2	0.5	1
CHGI004	3/25/99	1420	1	G	1	991287029	3/31/99	1	SO4	17.7	1	2	5	1
CHGI004	3/25/99	900	1	S					TEMP	2.4	6	2		1
CHGI004	3/25/99	1420	1	S					TEMP	2.6	6	2		1
CHGI004	3/26/99	1510	1	G	1	991287033	3/31/99	1	CL	283	1	2	5	1
CHGI004	3/26/99	1015	1	S					EC	867	3	2		1
CHGI004	3/26/99	1510	1	S					EC	1039	3	2		1
CHGI004	3/26/99	1015	1	S					TEMP	9	6	2		1
CHGI004	3/26/99	1510	1	S					TEMP	2.8	6	2		1
CHGI004	3/27/99	1457	1	S				108	CL	189	1	2		1
CHGI004	3/27/99	1040	1	S					EC	662	3	2		1
CHGI004	3/27/99	1500	1	S					EC	733	3	2		1
CHGI004	3/27/99	1040	1	S					TEMP	1.7	6	2		1
CHGI004	3/27/99	1500	1	S					TEMP	2.7	6	2		1
CHGI004	3/28/99	1620	1	S				108	CL	157	1	2		1
CHGI004	3/28/99	1315	1	S					EC	637	3	2		1
CHGI004	3/29/99	1720	1	G	1	991338013	4/5/99	2	CA	15.4	1	2	1	1
CHGI004	3/29/99	1720	1	G	1	991338013	4/1/99	1	CL	88.2	1	2	50	1
CHGI004	3/29/99	1705	1	S				108	CL	88	1	2		1
CHGI004	3/29/99	855	1	S					EC	506	3	2		1
CHGI004	3/29/99	1720	1	S					EC	429	3	2		1
CHGI004	3/29/99	1720	1	G	1	991338013	4/8/99	4	HCO3	27.7	1	2	2	1
CHGI004	3/29/99	1720	1	G	1	991338013	4/5/99	2	K	8.37	1	2	4.5	1
CHGI004	3/29/99	1720	1	G	1	991338013	4/5/99	2	MG	7.02	1	2	0.1	1
CHGI004	3/29/99	1720	1	G	1	991338013	4/5/99	2	NA	32.1	1	2	1	1
CHGI004	3/29/99	1720	1	G	1	991338013	4/5/99	2	SI	1.26	1	2	0.5	1
CHGI004	3/29/99	1720	1	G	1	991338013	5/20/99	1	SO4	15.8	1	2	0.5	2
CHGI004	3/29/99	855	1	S					TEMP	7.2	6	2		1

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CHGI004	3/29/99	1720	1	S					TEMP	2.1	6	2		1
CHGI004	3/31/99	1505	1	S				108	CL	759	1	2		1
CHGI004	3/31/99	1100	1	S					EC	552	3	2		1
CHGI004	3/31/99	1510	1	S					EC	2460	3	2		1
CHGI004	3/31/99	1100	1	S					TEMP	2.2	6	2		1
CHGI004	3/31/99	1510	1	S					TEMP	1.5	6	2		1
CHGI004	4/21/99	1510	1	G	1	992093008	5/14/99	2	CA	25.5	1	2	10	1
CHGI004	4/21/99	1500	1	G	1	992093009	5/14/99	2	CA	25	1	2	10	1
CHGI004	4/21/99	1517	1	G	1	992093010	5/14/99	2	CA	25.4	1	2	10	1
CHGI004	4/21/99	1510	1	G	1	992093008	5/14/99	1	CL	68.2	1	2	50	1
CHGI004	4/21/99	1500	1	G	1	992093009	5/14/99	1	CL	72.2	1	2	50	1
CHGI004	4/21/99	1517	1	G	1	992093010	5/14/99	1	CL	70.3	1	2	50	1
CHGI004	4/21/99	1500	1	G					EC	100	3	2		1
CHGI004	4/21/99	1503	1	G					EC	200	3	2		1
CHGI004	4/21/99	1509	1	G					EC	200	3	2		1
CHGI004	4/21/99	1510	1	G					EC	200	3	2		1
CHGI004	4/21/99	1513	1	G					EC	200	3	2		1
CHGI004	4/21/99	1517	1	G					EC	150	3	2		1
CHGI004	4/21/99	1510	1	G	1	992093008	5/18/99	4	HCO3	82.3	1	2	2	2
CHGI004	4/21/99	1500	1	G	1	992093009	5/18/99	4	HCO3	60.1	1	2	2	2
CHGI004	4/21/99	1517	1	G	1	992093010	5/18/99	4	HCO3	79.4	1	2	2	2
CHGI004	4/21/99	1510	1	G	1	992093008	5/20/99	2	K	4.85	1	2	4.5	1
CHGI004	4/21/99	1500	1	G	1	992093009	5/20/99	2	K	5.75	1	2	4.5	1
CHGI004	4/21/99	1517	1	G	1	992093010	5/20/99	2	K	0	1	1	4.5	1
CHGI004	4/21/99	1510	1	G	1	992093008	5/14/99	2	MG	7.64	1	2	1	1
CHGI004	4/21/99	1500	1	G	1	992093009	5/14/99	2	MG	6.26	1	2	1	1
CHGI004	4/21/99	1517	1	G	1	992093010	5/14/99	2	MG	6.07	1	2	1	1
CHGI004	4/21/99	1510	1	G	1	992093008	5/14/99	2	NA	13.6	1	2	10	1
CHGI004	4/21/99	1500	1	G	1	992093009	5/14/99	2	NA	10.6	1	2	10	1
CHGI004	4/21/99	1517	1	G	1	992093010	5/14/99	2	NA	10.8	1	2	10	1
CHGI004	4/21/99	1510	1	G	1	992093008	5/18/99	1	SO4	26	1	2	5	1
CHGI004	4/21/99	1500	1	G	1	992093009	5/18/99	1	SO4	14.8	1	2	5	1
CHGI004	4/21/99	1517	1	G	1	992093010	5/14/99	1	SO4	52.4	1	2	50	1
CHGI005	3/5/99	1400	1	G	1	991034002	3/30/99	2	BA	0.0163	1	2	0.01	1
CHGI005	3/5/99	1400	1	G	1	991034002	3/30/99	2	BA	33.9	1	2	1	1
CHGI005	3/5/99	1400	1	G	1	991034002	3/30/99	2	CA	33.9	1	2	1	1

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CHGI005	3/5/99	1400	1	G	1	991034002	3/19/99	1	CL	16.3	1	2	5	1
CHGI005	3/5/99	1400	1	S					EC	268	3	2		1
CHGI005	3/5/99	1400	1	G	1	991034002	3/30/99	2	FE	0	1	1	0.05	1
CHGI005	3/5/99	1400	1	G	1	991034002	3/22/99	4	HCO3	91.4	1	2	2	2
CHGI005	3/5/99	1400	1	G	1	991034002	3/30/99	2	K	0	1	1	4.5	1
CHGI005	3/5/99	1400	1	G	1	991034002	3/30/99	2	MG	7.81	1	2	0.1	1
CHGI005	3/5/99	1400	1	G	1	991034002	3/30/99	2	NA	8.11	1	2	1	1
CHGI005	3/5/99	1400	1	G	1	991034002	3/22/99	3	PH	7.7	4	2		2
CHGI005	3/5/99	1400	1	G	1	991034002	3/30/99	5	RV	5.71	7	2		1
CHGI005	3/5/99	1400	1	G	1	991034002	3/19/99	1	SO4	24	1	2	1	1
CHGI005	3/5/99	1400	1	G	1	991034002	3/30/99	2	SR	0.192	1	2	0.03	1
CHGI005	3/5/99	1400	1	S					TEMP	6.7	6	2		1
CHGI005	3/12/99	1010	1	S					EC	278	3	2		1
CHGI005	3/12/99	1425	1	S					EC	272	3	2		1
CHGI005	3/12/99	1010	1	S					TEMP	1.4	6	2		1
CHGI005	3/12/99	1425	1	S					TEMP	8.1	6	2		1
CHGI005	3/14/99	1516	1	G	1	991034006	3/30/99	2	BA	0.0296	1	2	0.01	1
CHGI005	3/14/99	1516	1	G	1	991034006	3/30/99	2	CA	37.9	1	2	1	1
CHGI005	3/14/99	1516	1	G	1	991034006	3/19/99	1	CL	87	1	2	5	1
CHGI005	3/14/99	1515	1	S				107	CL	83.5	1	2		1
CHGI005	3/14/99	1516	1	S					EC	503	3	2		1
CHGI005	3/14/99	1516	1	G	1	991034006	3/30/99	2	FE	0	1	1	0.05	1
CHGI005	3/14/99	1516	1	G	1	991034006	3/22/99	4	HCO3	87.3	1	2	2	1
CHGI005	3/14/99	1516	1	G	1	991034006	3/30/99	2	K	8.28	1	2	4.5	1
CHGI005	3/14/99	1516	1	G	1	991034006	3/30/99	2	MG	17	1	2	0.1	1
CHGI005	3/14/99	1516	1	G	1	991034006	3/30/99	2	NA	29.1	1	2	1	1
CHGI005	3/14/99	1516	1	G	1	991034006	3/22/99	3	PH	7.9	4	2		2
CHGI005	3/14/99	1516	1	G	1	991034006	3/30/99	5	RV	20	7	2		1
CHGI005	3/14/99	1516	1	G	1	991034006	3/19/99	1	SO4	24.1	1	2	1	1
CHGI005	3/14/99	1516	1	G	1	991034006	3/30/99	2	SR	0.239	1	2	0.03	1
CHGI005	3/14/99	1516	1	S					TEMP	8.9	6	2		1
CHGI005	3/16/99	1445	1	S				107	CL	18.6	1	2		1
CHGI005	3/16/99	1500	1	S					EC	271	3	2		1
CHGI005	3/16/99	1500	1	S					TEMP	5.8	6	2		1
CHGI005	3/18/99	1600	1	G	1	991287004	4/5/99	2	CA	32.9	1	2	1	1
CHGI005	3/18/99	1600	1	G	1	991287004	3/30/99	1	CL	16.4	1	2	5	1

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CHGI005	3/18/99	1600	1	S					EC	264	3	2		1
CHGI005	3/18/99	1600	1	G	1	991287004	4/5/99	4	HCO3	81.1	1	2	2	2
CHGI005	3/18/99	1600	1	G	1	991287004	4/5/99	2	K	0	1	1	4.5	1
CHGI005	3/18/99	1600	1	G	1	991287004	4/5/99	2	MG	7.31	1	2	0.1	1
CHGI005	3/18/99	1600	1	G	1	991287004	4/5/99	2	NA	6.97	1	2	1	1
CHGI005	3/18/99	1600	1	G	1	991287004	4/5/99	2	SI	5.41	1	2	0.5	1
CHGI005	3/18/99	1600	1	G	1	991287004	3/30/99	1	SO4	23.9	1	2	5	1
CHGI005	3/18/99	1600	1	S					TEMP	7.9	6	2		1
CHGI005	3/19/99	1320	1	S				107	CL	21.1	1	2		1
CHGI005	3/19/99	1340	1	S					EC	280	3	2		1
CHGI005	3/19/99	1340	1	S					TEMP	1.7	6	2		1
CHGI005	3/20/99	1215	1	G	1	991287009	3/30/99	1	CL	27.9	1	2	5	1
CHGI005	3/20/99	1532	1	G	1	991287010	3/30/99	1	CL	76.8	1	2	5	1
CHGI005	3/20/99	1215	1	S					EC	290	3	2		1
CHGI005	3/20/99	1532	1	S					EC	435	3	2		1
CHGI005	3/20/99	1540	1	S					EC	450	3	2		1
CHGI005	3/20/99	1215	1	S					TEMP	9.5	6	2		1
CHGI005	3/21/99	1625	1	G	1	991287017	4/5/99	2	CA	31.1	1	2	1	1
CHGI005	3/21/99	1625	1	G	1	991287017	3/31/99	1	CL	118	1	2	5	1
CHGI005	3/21/99	1625	1	S					EC	598	3	2		1
CHGI005	3/21/99	1625	1	G	1	991287017	4/5/99	4	HCO3	72.5	1	2	2	2
CHGI005	3/21/99	1625	1	G	1	991287017	4/5/99	2	K	0	1	1	4.5	1
CHGI005	3/21/99	1625	1	G	1	991287017	4/5/99	2	MG	16.5	1	2	0.1	1
CHGI005	3/21/99	1625	1	G	1	991287017	4/5/99	2	NA	37.9	1	2	1	1
CHGI005	3/21/99	1625	1	G	1	991287017	4/5/99	2	SI	4.32	1	2	0.5	1
CHGI005	3/21/99	1625	1	G	1	991287017	3/31/99	1	SO4	22.2	1	2	5	1
CHGI005	3/21/99	1625	1	S					TEMP	0.3	6	2		1
CHGI005	3/22/99	1430	1	G	1	991287022	4/5/99	2	CA	26.9	1	2	2	1
CHGI005	3/22/99	1430	1	G	1	991287022	3/31/99	1	CL	49.9	1	2	5	1
CHGI005	3/22/99	1030	1	S					EC	343	3	2		1
CHGI005	3/22/99	1430	1	S					EC	370	3	2		1
CHGI005	3/22/99	1430	1	G	1	991287022	4/5/99	4	HCO3	80.2	1	2	2	2
CHGI005	3/22/99	1430	1	G	1	991287022	4/5/99	2	K	0	1	1	9	1
CHGI005	3/22/99	1430	1	G	1	991287022	4/5/99	2	MG	9.71	1	2	0.1	1
CHGI005	3/22/99	1430	1	G	1	991287022	4/5/99	2	NA	22.7	1	2	2	1
CHGI005	3/22/99	1430	1	G	1	991287022	4/5/99	2	SI	4.87	1	2	0.5	1

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CHGI005	3/22/99	1430	1	G	1	991287022	3/31/99	1	SO4	23.4	1	2	5	1
CHGI005	3/22/99	1030	1	S					TEMP	0.9	6	2		1
CHGI005	3/22/99	1430	1	S					TEMP	8.4	6	2		1
CHGI005	3/23/99	1340	1	G	1	991287026	3/31/99	1	CL	83.4	1	2	5	1
CHGI005	3/23/99	940	1	S					EC	295	3	2		1
CHGI005	3/23/99	1340	1	S					EC	511	3	2		1
CHGI005	3/23/99	940	1	S					TEMP	9.4	6	2		1
CHGI005	3/23/99	1340	1	S					TEMP	2.2	6	2		1
CHGI005	3/25/99	1425	1	G	1	991287030	3/31/99	1	CL	49.1	1	2	5	1
CHGI005	3/25/99	845	1	S					EC	341	3	2		1
CHGI005	3/25/99	1425	1	S					EC	408	3	2		1
CHGI005	3/25/99	845	1	S					TEMP	2.4	6	2		1
CHGI005	3/25/99	1425	1	S					TEMP	2.3	6	2		1
CHGI005	3/26/99	1515	1	G	1	991287034	3/31/99	1	CL	66.4	1	2	5	1
CHGI005	3/26/99	1020	1	S					EC	327	3	2		1
CHGI005	3/26/99	1515	1	S					EC	449	3	2		1
CHGI005	3/26/99	1020	1	S					TEMP	8.8	6	2		1
CHGI005	3/26/99	1515	1	S					TEMP	2.4	6	2		1
CHGI005	3/27/99	1457	1	S				107	CL	51.3	1	2		1
CHGI005	3/27/99	1517	1	S					EC	388	3	2		1
CHGI005	3/27/99	1040	1	S					EC	327	3	2		1
CHGI005	3/27/99	1517	1	S					TEMP	2.3	6	2		1
CHGI005	3/27/99	1040	1	S					TEMP	1.4	6	2		1
CHGI005	3/28/99	1620	1	S				107	CL	52.5	1	2		1
CHGI005	3/28/99	1312	1	S					EC	361	3	2		1
CHGI005	3/28/99	1620	1	S					EC	392	3	2		1
CHGI005	3/29/99	1725	1	G	1	991338014	4/1/99	1	CL	41.2	1	2	5	1
CHGI005	3/29/99	900	1	S					EC	309	3	2		1
CHGI005	3/29/99	1725	1	S					EC	354	3	2		1
CHGI005	3/29/99	900	1	S					TEMP	7.7	6	2		1
CHGI005	3/29/99	1725	1	S					TEMP	2.2	6	2		1
CHGI005	3/31/99	1505	1	S				107	CL	59.5	1	2		1
CHGI005	3/31/99	1105	1	S					EC	326	3	2		1
CHGI005	3/31/99	1515	1	S					EC	417	3	2		1
CHGI005	3/31/99	1105	1	S					TEMP	1.6	6	2		1
CHGI005	3/31/99	1515	1	S					TEMP	1.8	6	2		1

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CHS001	3/31/99	1300	1	S					EC	226	3	2		1
CHS001	3/31/99	1300	1	V					FLOW	0.1	5	2		1
CHS001	3/31/99	1300	1	S					TEMP	2.4	6	2		1
CHS001	4/5/99	1400	1	S					EC	273	3	2		1
CHS001	4/5/99	1400	1	V					FLOW	0.1	5	2		1
CHS001	4/5/99	1400	1	S					TEMP	2.3	6	2		1
CHS001	4/14/99	1330	1	S				100	CL	36	1	2		1
CHS001	4/14/99	1330	1	S					EC	100	3	2		1
CHS001	4/19/99	1100	1	S				100	CL	107	1	2		1
CHS001	4/19/99	1100	1	S					EC	296	3	2		1
CHS001	4/20/99	1130	1	S				100	CL	109	1	2		1
CHS001	4/20/99	1130	1	S					EC	300	3	2		1
CHS001	4/21/99	1455	1	G	1	992093007	05/14/99	2	CA	26.6	1	2	10	1
CHS001	4/21/99	1455	1	G	1	992093007	05/14/99	1	CL	249	1	2	50	1
CHS001	4/21/99	1455	1	S					EC	500	3	2		1
CHS001	4/21/99	1715	1	S					EC	1100	3	2		1
CHS001	4/21/99	1455	1	G	1	992093007	05/18/99	4	HCO3	32	1	2	2	2
CHS001	4/21/99	1455	1	G	1	992093007	05/21/99	2	K	0	1	1	4.5	1
CHS001	4/21/99	1455	1	G	1	992093007	05/14/99	2	MG	12.4	1	2	1	1
CHS001	4/21/99	1455	1	G	1	992093007	05/14/99	2	NA	138	1	2	10	1
CHS001	4/21/99	1455	1	G	1	992093007	05/18/99	1	SO4	12.8	1	2	5	1
CHS001	4/21/99	1715	1	S					TEMP	2.3	6	2		1
CHS001	4/23/99	1400	1	G	1	992093014	05/14/99	1	CL	487	1	2	50	1
CHS001	4/23/99	1400	1	S					EC	1200	3	2		1
CHS001	4/26/99	1430	1	S				100	CL	544	1	2		1
CHS001	4/26/99	1430	1	S					EC	1500	3	2		1
CHS001	4/26/99	1430	1	V					FLOW	0.92	5	2		1
CHS001	4/28/99	1145	1	G	1	992093018	05/14/99	1	CL	557	1	2	50	1
CHS001	4/28/99	1145	1	S					EC	1700	3	2		1
CHS001	4/28/99	1145	1	V					FLOW	0.7	5	2		1
CHS001	4/30/99	1500	1	G	1	992093021	05/14/99	1	CL	403	1	2	50	1
CHS001	4/30/99	1500	1	S					EC	1100	3	2		1
CHS001	4/30/99	1500	1	V					FLOW	0.6	5	2		1
CHS001	5/3/99	1530	1	S				100	CL	326	1	2		1
CHS001	5/3/99	1530	1	S					EC	900	3	2		1
CHS001	5/3/99	1530	1	V					FLOW	0.6	5	2		1

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Station_ID	LogDate	LogTime	Samp_Type	Samp_Meth	Lab_Code	Lab_SampID	Anal_Date	Anal_Meth	Par_Code	Par_Val	Units	Par_VQ	Lab_RL	QC_Note
CHS001	5/10/99	1200	1	S				100	CL	145	1	2		1
CHS001	5/10/99	1200	1	S					EC	400	3	2		1
CHS002	4/28/99	1200	1	S				100	CL	145	1	2		1
CHS002	4/28/99	1200	1	S					EC	400	3	2		1
CHS002	4/30/99	1500	1	S				100	CL	109	1	2		1
CHS002	4/30/99	1500	1	S					EC	300	3	2		1
CHS002	5/3/99	1530	1	S				100	CL	73	1	2		1
CHS002	5/3/99	1530	1	S					EC	200	3	2		1
CHS003	3/18/99	1138	1	S					EC	113	3	2		1
CHS003	3/18/99	1138	1	S					TEMP	9.7	6	2		1
CHS003	4/20/99	1130	1	S				100	CL	36	1	2		1
CHS003	4/20/99	1130	1	S					EC	100	3	2		1
CHS003	4/21/99	1455	1	S				100	CL	36	1	2		1
CHS003	4/21/99	1455	1	S					EC	100	3	2		1
CHS003	4/26/99	1430	1	S				100	CL	36	1	2		1
CHS003	4/26/99	1430	1	S					EC	100	3	2		1
CHS003	4/28/99	1145	1	S				100	CL	36	1	2		1
CHS003	4/28/99	1145	1	S					EC	100	3	2		1
CHS003	4/30/99	1500	1	S				100	CL	36	1	2		1
CHS003	4/30/99	1500	1	S					EC	100	3	2		1
CHS003	5/3/99	1530	1	S				100	CL	36	1	2		1
CHS003	5/3/99	1530	1	S					EC	100	3	2		1
CHTK001	3/9/99	1100	1	S					EC	308	3	2		1
CHTK001	3/9/99	1100	1	S					TEMP	5.2	6	2		1
CHTK001	3/11/99	1420	1	S				106	CL	27	1	2		1
CHTK001	3/11/99	1420	1	S					EC	295	3	2		1
CHTK001	3/11/99	1420	1	S					TEMP	9.2	6	2		1
CHTK001	3/12/99	1445	1	S				106	CL	23	1	2		1
CHTK001	3/12/99	1100	1	S					EC	306	3	2		1
CHTK001	3/12/99	1450	1	S					EC	284	3	2		1
CHTK001	3/12/99	1100	1	V					FLOW	1.6	5	2		1
CHTK001	3/12/99	1450	1	V					FLOW	2.8	5	2		1
CHTK001	3/12/99	1100	1	S					TEMP	2.7	6	2		1
CHTK001	3/12/99	1450	1	S					TEMP	7.9	6	2		1
CHTK001	3/20/99	1245	1	G	1	991287005	3/30/99	1	CL	17.5	1	2	5	1
CHTK001	3/20/99	1245	1	S					EC	285	3	2		1

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CHTK001	3/21/99	1500	1	G	1	991287014	3/30/99	1	CL	180	1	2	5	1
CHTK001	3/21/99	1000	1	S					EC	356	3	2		1
CHTK001	3/21/99	1500	1	S					EC	828	3	2		1
CHTK001	3/21/99	1000	1	S					TEMP	2.5	6	2		1
CHTK001	3/21/99	1500	1	S					TEMP	3.3	6	2		1
CHTK001	3/22/99	1120	1	S					EC	360	3	2		1
CHTK001	3/22/99	1120	1	V					FLOW	3.5	5	2		1
CHTK001	3/22/99	1120	1	S					TEMP	2.6	6	2		1
CHTK001	3/25/99	945	1	S					EC	375	3	2		1
CHTK001	3/25/99	945	1	V					FLOW	4.6	5	2		1
CHTK001	3/25/99	945	1	S					TEMP	3.2	6	2		1
CHTK001	3/26/99	1800	1	G	1	991338003	4/5/99	2	CA	23.9	1	2	1	1
CHTK001	3/26/99	1800	1	G	1	991338003	4/5/99	1	CL	194	1	2	5	1
CHTK001	3/26/99	1800	1	S					EC	801	3	2		1
CHTK001	3/26/99	1800	1	V					FLOW	4.6	5	2		1
CHTK001	3/26/99	1800	1	G	1	991338003	4/8/99	4	HCO3	55.4	1	2	2	2
CHTK001	3/26/99	1800	1	G	1	991338003	4/5/99	2	K	19.6	1	2	4.5	1
CHTK001	3/26/99	1800	1	G	1	991338003	4/5/99	2	MG	9.44	1	2	0.1	1
CHTK001	3/26/99	1800	1	G	1	991338003	4/5/99	2	NA	72.8	1	2	1	1
CHTK001	3/26/99	1800	1	G	1	991338003	4/5/99	2	SI	2.37	1	2	0.5	1
CHTK001	3/26/99	1800	1	G	1	991338003	5/20/99	1	SO4	12.7	1	2	0.5	2
CHTK001	3/26/99	1800	1	S					TEMP	2.1	6	2		1
CHTK001	3/27/99	1557	1	G	1	991338008	4/1/99	1	CL	111	1	2	50	1
CHTK001	3/27/99	1245	1	S					EC	355	3	2		1
CHTK001	3/27/99	1557	1	S					EC	485	3	2		1
CHTK001	3/27/99	1245	1	V					FLOW	0.7	5	2		1
CHTK001	3/27/99	1557	1	V					FLOW	3	5	2		1
CHTK001	3/27/99	1245	1	S					TEMP	4	6	2		1
CHTK001	3/27/99	1557	1	S					TEMP	4.5	6	2		1
CHTK001	3/28/99	1245	1	S				106	CL	56	1	2		1
CHTK001	3/28/99	1245	1	S					EC	385	3	2		1
CHTK001	3/30/99	1545	1	S				106	CL	52	1	2		1
CHTK001	3/30/99	1610	1	S					EC	373	3	2		1
CHTK001	3/30/99	1610	1	V					FLOW	3.0	5	2		1
CHTK001	3/30/99	1610	1	S					TEMP	3.2	6	2		1
CHTK001	3/31/99	1550	1	S				106	CL	39	1	2		1

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CHTK001	3/31/99	1155	1	S					EC	334	3	2		1
CHTK001	3/31/99	1155	1	V					FLOW	1.1	5	2		1
CHTK001	3/31/99	1155	1	S					TEMP	2.7	6	2		1
CHTK001	4/1/99	1535	1	S				106	CL	83	1	2		1
CHTK001	4/1/99	940	1	S					EC	354	3	2		1
CHTK001	4/1/99	1535	1	S					EC	469	3	2		1
CHTK001	4/1/99	940	1	V					FLOW	0.2	5	2		1
CHTK001	4/1/99	1535	1	V					FLOW	9.3	5	2		1
CHTK001	4/1/99	940	1	S					TEMP	3.3	6	2		1
CHTK001	4/1/99	1535	1	S					TEMP	3.9	6	2		1
CHTK001	4/9/99	1515	1	S				106	CL	36	1	2		1
CHTK001	4/9/99	1520	1	S					EC	323	3	2		1
CHTK001	4/9/99	1520	1	S					TEMP	3.3	6	2		1
CHTK002	3/9/99	1100	1	G	1	991034003	3/30/99	2	BA	0.0245	1	2	0.01	1
CHTK002	3/9/99	1100	1	G	1	991034003	3/30/99	2	CA	40.7	1	2	1	1
CHTK002	3/9/99	1100	1	G	1	991034003	3/19/99	1	CL	13.7	1	2	5	1
CHTK002	3/9/99	1050	1	S					EC	306	3	2		1
CHTK002	3/9/99	1100	1	G	1	991034003	3/30/99	2	FE	0	1	1	0.05	1
CHTK002	3/9/99	1100	1	G	1	991034003	3/22/99	4	HCO3	106	1	2	2	1
CHTK002	3/9/99	1100	1	G	1	991034003	3/30/99	2	K	0	1	1	9	1
CHTK002	3/9/99	1100	1	G	1	991034003	3/30/99	2	MG	8.68	1	2	0.1	1
CHTK002	3/9/99	1100	1	G	1	991034003	3/30/99	2	NA	5.79	1	2	1	1
CHTK002	3/9/99	1050	1	G	1	991034003	3/22/99	3	PH	7.67	4	2		2
CHTK002	3/9/99	1100	1	G	1	991034003	3/30/99	5	RV	32.3	7	2		1
CHTK002	3/9/99	1100	1	G	1	991034003	3/19/99	1	SO4	31.8	1	2	1	1
CHTK002	3/9/99	1100	1	G	1	991034003	3/30/99	2	SR	0.23	1	2	0.03	1
CHTK002	3/9/99	1050	1	S					TEMP	7.6	6	2		1
CHTK002	3/11/99	1420	1	S				106	CL	28	1	2		1
CHTK002	3/11/99	1420	1	S					EC	299	3	2		1
CHTK002	3/11/99	1420	1	S					TEMP	10.2	6	2		1
CHTK002	3/12/99	1445	1	S				106	CL	26	1	2		1
CHTK002	3/12/99	1045	1	S					EC	306	3	2		1
CHTK002	3/12/99	1445	1	S					EC	292	3	2		1
CHTK002	3/12/99	1045	1	V					FLOW	3.2	5	2		1
CHTK002	3/12/99	1445	1	V					FLOW	3.7	5	2		1
CHTK002	3/12/99	1045	1	S					TEMP	2.9	6	2		1

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CHTK002	3/12/99	1445	1	S					TEMP	6.8	6	2		1
CHTK002	3/20/99	1245	1	S				106	CL	22	1	2		1
CHTK002	3/20/99	1243	1	S					EC	280	3	2		1
CHTK002	3/26/99	1800	1	G	1	991338004	4/1/99	1	CL	215	1	2	50	1
CHTK002	3/26/99	1800	1	S					EC	860	3	2		1
CHTK002	3/26/99	1800	1	S					TEMP	2.4	6	2		1
CHTK002	3/27/99	1600	1	G	1	991338009	4/1/99	1	CL	110	1	2	50	1
CHTK002	3/27/99	1257	1	S					EC	360	3	2		1
CHTK002	3/27/99	1600	1	S					EC	490	3	2		1
CHTK002	3/27/99	1257	1	S					TEMP	3.5	6	2		1
CHTK002	3/27/99	1600	1	S					TEMP	3.7	6	2		1
CHTK002	3/28/99	1245	1	S				106	CL	54	1	2		1
CHTK002	3/28/99	1245	1	S					EC	378	3	2		1
CHTK002	3/30/99	1545	1	S				106	CL	51	1	2		1
CHTK002	3/30/99	1600	1	S					EC	370	3	2		1
CHTK002	3/30/99	1600	1	V					FLOW	3.2	5	2		1
CHTK002	3/30/99	1600	1	S					TEMP	3	6	2		1
CHTK002	3/31/99	1550	1	S				106	CL	38	1	2		1
CHTK002	3/31/99	1150	1	S					EC	329	3	2		1
CHTK002	3/31/99	1150	1	V					FLOW	4.2	5	2		1
CHTK002	3/31/99	1150	1	S					TEMP	2.4	6	2		1
CHTK002	4/1/99	1535	1	S				106	CL	103	1	2		1
CHTK002	4/1/99	930	1	S					EC	360	3	2		1
CHTK002	4/1/99	1530	1	S					EC	532	3	2		1
CHTK002	4/1/99	930	1	V					FLOW	2.0	5	2		1
CHTK002	4/1/99	1530	1	V					FLOW	9.0	5	2		1
CHTK002	4/1/99	930	1	S					TEMP	2.9	6	2		1
CHTK002	4/1/99	1530	1	S					TEMP	3.6	6	2		1
CHTK002	4/9/99	1515	1	S				106	CL	37	1	2		1
CHTK002	4/9/99	1530	1	S					EC	325	3	2		1
CHTK002	4/9/99	1530	1	S					TEMP	3.2	6	2		1
MTV01	4/19/99	1200	1	G	1	992093002	5/14/99	2	CA	66.1	1	2	10	1
MTV01	4/19/99	1200	1	G	1	992093002	5/14/99	1	CL	1500	1	2	50	1
MTV01	4/19/99	1200	1	S					EC	3600	3	2		1
MTV01	4/19/99	1200	1	V					FLOW	1	5	2		1
MTV01	4/19/99	1200	1	G	1	992093002	5/18/99	4	HCO3	121	1	2	2	2

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MTV01	4/19/99	1200	1	G	1	992093002	5/20/99	2	K	46.8	1	2	4.5	1
MTV01	4/19/99	1200	1	G	1	992093002	5/14/99	2	MG	208	1	2	1	1
MTV01	4/19/99	1200	1	G	1	992093002	5/14/99	2	NA	422	1	2	10	1
MTV01	4/19/99	1200	1	G	1	992093002	5/14/99	1	SO4	58.7	1	2	50	1
MTV01	4/20/99	1030	1	S				103	CL	1147	1	2		1
MTV01	4/20/99	1030	1	S					EC	3600	3	2		1
MTV01	4/20/99	1030	1	V					FLOW	8.5	5	2		1
MTV01	4/21/99	1730	1	G	1	992093004	5/14/99	2	CA	64.3	1	2	10	1
MTV01	4/21/99	1730	1	G	1	992093004	5/14/99	1	CL	1360	1	2	50	1
MTV01	4/21/99	1730	1	S					EC	3050	3	2		1
MTV01	4/21/99	1730	1	V					FLOW	12	5	2		1
MTV01	4/21/99	1730	1	G	1	992093004	5/18/99	4	HCO3	123	1	2	2	2
MTV01	4/21/99	1730	1	G	1	992093004	5/14/99	2	K	50.9	1	2	45	1
MTV01	4/21/99	1730	1	G	1	992093004	5/14/99	2	MG	198	1	2	1	1
MTV01	4/21/99	1730	1	G	1	992093004	5/14/99	2	NA	394	1	2	10	1
MTV01	4/21/99	1730	1	G	1	992093004	5/14/99	1	SO4	52.7	1	2	50	1
MTV01	4/21/99	1730	1	S					TEMP	9.7	6	2		1
MTV01	4/23/99	1920	1	G	1	992093012	5/14/99	1	CL	1070	1	2	50	1
MTV01	4/23/99	1920	1	S				103	CL	552	1	2		1
MTV01	4/23/99	1920	1	S					EC	2600	3	2		1
MTV01	4/26/99	2140	1	S					EC	1500	3	2		1
MTV01	4/28/99	1645	1	S				103	CL	297	1	2		1
MTV01	4/28/99	1645	1	S					EC	1600	3	2		1
MTV01	4/30/99	1325	1	S				103	CL	466	1	2		1
MTV01	4/30/99	1325	1	S					EC	1300	3	2		1
MTV02	4/19/99	1200	1	G	1	992093001	5/14/99	2	CA	76.3	1	2	10	1
MTV02	4/19/99	1200	1	G	1	992093001	5/14/99	1	CL	1910	1	2	50	1
MTV02	4/19/99	1200	1	S					EC	2600	3	2		1
MTV02	4/19/99	1200	1	G	1	992093001	5/18/99	4	HCO3	159	1	2	2	2
MTV02	4/19/99	1200	1	G	1	992093001	5/14/99	2	K	56.8	1	2	45	1
MTV02	4/19/99	1200	1	G	1	992093001	5/14/99	2	MG	278	1	2	1	1
MTV02	4/19/99	1200	1	G	1	992093001	5/14/99	2	NA	520	1	2	10	1
MTV02	4/19/99	1200	1	G	1	992093001	5/18/99	1	SO4	4.31	1	2	0.5	2
MTV02	4/20/99	1030	1	S				104	CL	1529	1	2		1
MTV02	4/20/99	1030	1	S					EC	2700	3	2		1
MTV02	4/21/99	1730	1	G	1	992093003	5/14/99	2	CA	61	1	2	10	1

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MTV02	4/21/99	1730	1	G	1	992093003	5/14/99	1	CL	1290	1	2	50	1
MTV02	4/21/99	1730	1	S					EC	4420	3	2		1
MTV02	4/21/99	1730	1	G	1	992093003	5/18/99	4	HCO3	124	1	2	2	2
MTV02	4/21/99	1730	1	G	1	992093003	5/20/99	2	K	45.3	1	2	4.5	1
MTV02	4/21/99	1730	1	G	1	992093003	5/14/99	2	MG	211	1	2	1	1
MTV02	4/21/99	1730	1	G	1	992093003	5/14/99	2	NA	415	1	2	10	1
MTV02	4/21/99	1730	1	G	1	992093003	5/14/99	1	SO4	62.7	1	2	50	1
MTV02	4/21/99	1730	1	S					TEMP	1.1	6	2		1
MTV02	4/23/99	1925	1	G	1	992093011	5/14/99	1	CL	624	1	2	50	1
MTV02	4/23/99	1925	1	S				104	CL	1104	1	2		1
MTV02	4/23/99	1925	1	S					EC	1300	3	2		1
MTV02	4/26/99	2135	1	S					EC	1000	3	2		1
MTV02	4/28/99	1640	1	S				104	CL	680	1	2		1
MTV02	4/28/99	1640	1	S					EC	700	3	2		1
MTV02	4/30/99	1320	1	G	1	992093020	5/14/99	1	CL	466	1	2	50	1
MTV02	4/30/99	1320	1	S				104	CL	552	1	2		1
MTV02	4/30/99	1320	1	S					EC	300	3	2		1
NCH001	3/18/99	1230	1	G	1	991287001	4/5/99	2	CA	37.8	1	2	10	1
NCH001	3/18/99	1230	1	G	1	991287001	3/30/99	1	CL	43.6	1	2	5	1
NCH001	3/18/99	1230	1	S					EC	375	3	2		1
NCH001	3/18/99	1230	1	G	1	991287001	4/5/99	4	HCO3	83	1	2	2	2
NCH001	3/18/99	1230	1	G	1	991287001	4/5/99	2	K	0	1	1	9	1
NCH001	3/18/99	1230	1	G	1	991287001	4/5/99	2	MG	12.1	1	2	0.1	1
NCH001	3/18/99	1230	1	G	1	991287001	4/5/99	2	NA	14.4	1	2	1	1
NCH001	3/18/99	1230	1	G	1	991287001	4/5/99	2	SI	6.68	1	2	0.5	1
NCH001	3/18/99	1230	1	G	1	991287001	3/30/99	1	SO4	23.9	1	2	5	1
NCH001	3/18/99	1230	1	S					TEMP	9.7	6	2		1
NCH001	3/19/99	1350	1	S					EC	464	3	2		1
NCH001	3/19/99	1350	1	V					FLOW	4	5	2		1
NCH001	3/19/99	1350	1	S					TEMP	4	6	2		1
NCH001	3/20/99	1235	1	S					EC	670	3	2		1
NCH001	3/21/99	1535	1	G	1	991287015	3/30/99	1	CL	348	1	2	5	1
NCH001	3/21/99	1025	1	S					EC	421	3	2		1
NCH001	3/21/99	1535	1	S					EC	1249	3	2		1
NCH001	3/21/99	1025	1	S					TEMP	3.8	6	2		1
NCH001	3/21/99	1535	1	S					TEMP	3.1	6	2		1

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NCH001	3/22/99	1100	1	S					EC	442	3	2		1
NCH001	3/22/99	1100	1	V					FLOW	1.1	5	2		1
NCH001	3/22/99	1100	1	S					TEMP	4	6	2		1
NCH001	3/25/99	925	1	S					EC	422	3	2		1
NCH001	3/25/99	925	1	S					TEMP	4.3	6	2		1
NCH001	3/26/99	1035	1	G	1	991287032	4/5/99	2	CA	35.9	1	2	1	1
NCH001	3/26/99	1540	1	G	1	991287035	4/5/99	2	CA	23	1	2	1	1
NCH001	3/26/99	1035	1	G	1	991287032	3/31/99	1	CL	49.6	1	2	5	1
NCH001	3/26/99	1540	1	G	1	991287035	3/31/99	1	CL	135	1	2	5	1
NCH001	3/26/99	1035	1	S					EC	418	3	2		1
NCH001	3/26/99	1540	1	S					EC	620	3	2		1
NCH001	3/26/99	1035	1	V					FLOW	0.53	5	2		1
NCH001	3/26/99	1540	1	V					FLOW	4.8	5	2		1
NCH001	3/26/99	1035	1	G	1	991287032	4/5/99	4	HCO3	85	1	2	2	1
NCH001	3/26/99	1540	1	G	1	991287035	4/5/99	4	HCO3	52.5	1	2	2	2
NCH001	3/26/99	1035	1	G	1	991287032	4/5/99	2	K	0	1	1	4.5	1
NCH001	3/26/99	1540	1	G	1	991287035	4/5/99	2	K	9.68	1	2	4.5	1
NCH001	3/26/99	1035	1	G	1	991287032	4/5/99	2	MG	11.7	1	2	0.1	1
NCH001	3/26/99	1540	1	G	1	991287035	4/5/99	2	MG	12.3	1	2	0.1	1
NCH001	3/26/99	1035	1	G	1	991287032	4/5/99	2	NA	16	1	2	1	1
NCH001	3/26/99	1540	1	G	1	991287035	4/5/99	2	NA	45.8	1	2	1	1
NCH001	3/26/99	1035	1	G	1	991287032	4/5/99	2	SI	6.13	1	2	0.5	1
NCH001	3/26/99	1540	1	G	1	991287035	4/5/99	2	SI	2.41	1	2	0.5	1
NCH001	3/26/99	1035	1	G	1	991287032	3/31/99	1	SO4	24.1	1	2	5	1
NCH001	3/26/99	1540	1	G	1	991287035	3/31/99	1	SO4	13.1	1	2	5	1
NCH001	3/26/99	1035	1	S					TEMP	10.1	6	2		1
NCH001	3/26/99	1540	1	S					TEMP	3.8	6	2		1
NCH001	3/27/99	1200	1	S					EC	467	3	2		1
NCH001	3/27/99	1536	1	S					EC	563	3	2		1
NCH001	3/27/99	1536	1	V					FLOW	1.5	5	2		1
NCH001	3/27/99	1200	1	S					TEMP	5.4	6	2		1
NCH001	3/27/99	1536	1	S					TEMP	5.1	6	2		1
NCH001	3/28/99	1230	1	S					EC	457	3	2		1
NCH001	3/29/99	830	1	S					EC	414	3	2		1
NCH001	3/29/99	1735	1	S					EC	366	3	2		1
NCH001	3/29/99	1735	1	V					FLOW	2.1	5	2		1

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NCH001	3/29/99	830	1	S					TEMP	7.2	6	2		1
NCH001	3/29/99	1735	1	S					TEMP	3.6	6	2		1
NCH001	3/31/99	1130	1	S					EC	590	3	2		1
NCH001	3/31/99	1530	1	S					EC	898	3	2		1
NCH001	3/31/99	1130	1	V					FLOW	1.4	5	2		1
NCH001	3/31/99	1130	1	S					TEMP	4.1	6	2		1
NCH001	3/31/99	1530	1	S					TEMP	3	6	2		1
NCH001	4/1/99	910	1	S					EC	440	3	2		1
NCH001	4/1/99	1505	1	S					EC	366	3	2		1
NCH001	4/1/99	910	1	S					TEMP	5.3	6	2		1
NCH001	4/1/99	1505	1	S					TEMP	6.9	6	2		1
NCH001	4/21/99	1800	1	G	1	992093005	5/13/99	1	CL	40.1	1	2	5	1
NCH001	4/21/99	1800	1	S					EC	348	3	2		1
NCH001	4/21/99	1800	1	V					FLOW	3.6	5	2		1
NCH001	4/21/99	1800	1	S					TEMP	4.7	6	2		1
NCH001	4/23/99	1935	1	G	1	992093013	5/13/99	1	CL	46.4	1	2	5	1
NCH001	4/23/99	1935	1	S				102	CL	46.4	1	2		1
NCH001	4/23/99	1935	1	S					EC	200	3	2		1
NCH001	4/26/99	2200	1	S					EC	200	3	2		1
NCH001	4/27/99	1536	1	G	1	991338007	4/1/99	1	CL	147	1	2	50	1
NCH001	4/28/99	1625	1	S					EC	200	3	2		1
NCH001	4/30/99	1335	1	S				102	CL	42.4	1	2		1
NCH001	4/30/99	1335	1	S					EC	300	3	2		1
TK01	3/11/99	1420	1	S					EC	458	3	2		1
TK01	3/11/99	1420	1	S					TEMP	8.9	6	2		1
TK01	3/20/99	1255	1	G	1	991287006	4/5/99	2	CA	57.5	1	2	1	1
TK01	3/20/99	1255	1	G	1	991287006	3/30/99	1	CL	31.4	1	2	5	1
TK01	3/20/99	1255	1	G	1	991287006	4/5/99	4	HCO3	65.9	1	2	2	2
TK01	3/20/99	1255	1	G	1	991287006	4/5/99	2	K	0	1	1	4.5	1
TK01	3/20/99	1255	1	G	1	991287006	4/5/99	2	MG	20	1	2	0.1	1
TK01	3/20/99	1255	1	G	1	991287006	4/5/99	2	NA	11.5	1	2	1	1
TK01	3/20/99	1255	1	G	1	991287006	4/5/99	2	SI	8.07	1	2	0.5	1
TK01	3/20/99	1255	1	G	1	991287006	3/30/99	1	SO4	155	1	2	5	1
TK01	3/26/99	1800	1	G	1	991338002	4/5/99	2	CA	20.2	1	2	1	1
TK01	3/26/99	1800	1	G	1	991338002	4/5/99	1	CL	298	1	2	50	1
TK01	3/26/99	1800	1	S					EC	1104	3	2		1

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TK01	3/26/99	1800	1	V					FLOW	0.89	5	2		1
TK01	3/26/99	1800	1	G	1	991338002	4/8/99	4	HCO3	43	1	2	2	2
TK01	3/26/99	1800	1	G	1	991338002	4/5/99	2	K	17.9	1	2	4.5	1
TK01	3/26/99	1800	1	G	1	991338002	4/5/99	2	MG	14.9	1	2	0.1	1
TK01	3/26/99	1800	1	G	1	991338002	4/5/99	2	NA	118	1	2	1	1
TK01	3/26/99	1800	1	G	1	991338002	4/5/99	2	SI	1.34	1	2	0.5	1
TK01	3/26/99	1800	1	G	1	991338002	5/20/99	1	SO4	6.64	1	2	0.5	2
TK01	3/26/99	1800	1	S					TEMP	2.3	6	2		1
TK01	3/26/99	1800	1	S					TEMP	2.1	6	2		1
TK01	3/27/99	1600	1	G	1	91338010	4/1/99	1	CL	158	1	2	50	1
TK01	3/27/99	1600	1	G	1	991338010	4/1/99	1	Cl	156	1	2	5	1
TK01	3/27/99	1600	1	S					EC	715	3	2		1
TK01	3/27/99	1600	1	S					EC	671	3	2		1
TK01	3/27/99	1600	1	V					FLOW	1.32	5	2		1
TK01	3/27/99	1600	1	S					TEMP	0.1	6	2		1
TK01	3/27/99	1600	1	S					TEMP	1.6	6	2		1
TK01	3/28/99	1245	1	S				105	CL	55	1	2		1
TK01	3/28/99	1245	1	S					EC	574	3	2		1
TK01	3/29/99	0820	1	S					EC	475	3	2		1
TK01	3/29/99	1750	1	S					EC	460	3	2		1
TK01	3/29/99	1500	1	S					EC	536	3	2		1
TK01	3/29/99	0820	1	V					FLOW	0.01	5	2		1
TK01	3/29/99	1750	1	V					FLOW	0.49	5	2		1
TK01	3/29/99	1500	1	V					FLOW	0.48	5	2		1
TK01	3/29/99	0820	1	S					TEMP	0.1	6	2		1
TK01	3/29/99	1750	1	S					TEMP	0.2	6	2		1
TK01	3/30/99	1545	1	S				105	CL	28	1	2		1
TK01	3/30/99	1545	1	S					EC	540	3	2		1
TK01	3/30/99	1545	1	V					FLOW	0.02	5	2		1
TK01	3/30/99	1545	1	S					TEMP	0.9	6	2		1
TK01	3/31/99	1550	1	S				105	CL	71	1	2		1
TK01	3/31/99	1145	1	S					EC	593	3	2		1
TK01	3/31/99	1550	1	S					EC	594	3	2		1
TK01	3/31/99	1145	1	S					TEMP	0.2	6	2		1
TK01	3/31/99	1550	1	S					TEMP	0.2	6	2		1
TK01	4/1/99	1520	1	G	1	992096003	5/20/99	2	CA	22.2	1	2	0.5	1

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TK01	4/1/99	1520	1	G	1	992096003	5/14/99	1	CL	138	1	2	5	1
TK01	4/1/99	920	1	S					EC	601	3	2		1
TK01	4/1/99	1520	1	S					EC	687	3	2		1
TK01	4/1/99	1520	1	V					FLOW	1.49	5	2		1
TK01	4/1/99	1520	1	G	1	992096003	5/14/99	4	HCO3	39.7	1	2	2	2
TK01	4/1/99	1520	1	G	1	992096003	5/20/99	2	K	11.7	1	1	2.25	1
TK01	4/1/99	1520	1	G	1	992096003	5/20/99	2	MG	15.8	1	2	0.05	1
TK01	4/1/99	1520	1	G	1	992096003	5/20/99	2	NA	72.3	1	2	50	1
TK01	4/1/99	1520	1	G	1	992096003	5/14/99	1	SO4	17	1	2	5	2
TK01	4/1/99	920	1	S					TEMP	0.7	6	2		1
TK01	4/1/99	1520	1	S					TEMP	1.9	6	2		1
TK01	4/5/99	1500	1	S					EC	501	3	2		1
TK01	4/5/99	1500	1	V					FLOW	0.14	5	2		1
TK01	4/6/99	1440	1	S					EC	334	3	2		1
TK01	4/6/99	1440	1	V					FLOW	0.03	5	2		1
TK01	4/6/99	1440	1	S					TEMP	1.1	6	2		1
TK01	4/9/99	1515	1	S					EC	455	3	2		1
TK01	4/9/99	1515	1	S					TEMP	0.6	6	2		1
TK01	4/15/99	1330	1	S					EC	300	3	2		1
TK02	3/26/99	1800	1	S					EC	1090	3	2		1
TK02	3/26/99	1800	1	S					TEMP	0.6	6	2		1
TK02	3/27/99	1600	1	S					EC	953	3	2		1
TK02	3/27/99	1600	1	S					TEMP	0.8	6	2		1
TU01	4/19/99	1100	1	S				101	CL	219	1	2		1
TU01	4/19/99	1100	1	S					EC	630	3	2		1
TU01	4/19/99	1100	1	S					TEMP	2.7	6	2		1
TU01	4/20/99	1100	1	S				101	CL	2556	1	2		1
TU01	4/20/99	1130	1	S					EC	5050	3	2		1
TU01	4/21/99	1455	1	G	1	992093006	5/14/99	2	CA	118	1	2	10	1
TU01	4/21/99	1455	1	G	1	992093006	5/18/99	1	CL	3360	1	2	500	1
TU01	4/21/99	1455	1	S					EC	5000	3	2		1
TU01	4/21/99	1455	1	G	1	992093006	5/18/99	4	HCO3	154	1	2	2	2
TU01	4/21/99	1455	1	G	1	992093006	5/14/99	2	K	57	1	2	45	1
TU01	4/21/99	1455	1	G	1	992093006	5/14/99	2	MG	201	1	2	1	1
TU01	4/21/99	1455	1	G	1	992093006	5/20/99	2	NA	1260	1	2	100	1
TU01	4/21/99	1455	1	G	1	992093006	5/14/99	1	SO4	64.2	1	2	50	1

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TU01	4/21/99	1455	1	S					TEMP	8.5	6	2		1
TU01	4/23/99	1400	1	G	1	992093015	05/14/99	2	CA	113	1	2	10	1
TU01	4/23/99	1400	1	G	1	992093015	05/18/99	1	CL	2840	1	2	500	1
TU01	4/23/99	1400	1	S					EC	6500	3	2		1
TU01	4/23/99	1400	1	G	1	992093015	05/18/99	4	HCO3	156	1	2	2	2
TU01	4/23/99	1400	1	G	1	992093015	05/14/99	2	K	47.9	1	2	45	1
TU01	4/23/99	1400	1	G	1	992093015	05/14/99	2	MG	235	1	2	1	1
TU01	4/23/99	1400	1	G	1	992093015	05/20/99	2	NA	1190	1	2	100	1
TU01	4/23/99	1400	1	G	1	992093015	05/14/99	1	SO4	70.7	1	2	50	1
TU01	4/26/99	1430	1	S				101	CL	2429	1	2		1
TU01	4/26/99	1430	1	S					EC	4800	3	2		1
TU01	4/26/99	1430	1	V					FLOW	0.1	5	2		1
TU01	4/28/99	1200	1	S				101	CL	1771	1	2		1
TU01	4/28/99	1200	1	S					EC	3500	3	2		1
TU01	4/30/99	1500	1	S				101	CL	962	1	2		1
TU01	4/30/99	1500	1	S					EC	1900	3	2		1
TU01	5/3/99	1615	1	S				101	CL	1265	1	2		1
TU01	5/3/99	1615	1	S					EC	2500	3	2		1
TU01	5/10/99	1200	1	S				101	CL	127	1	2		1
TU01	5/10/99	1200	1	S					EC	250	3	2		1
TU02	4/23/99	1400	1	G	1	992093016	05/14/99	2	CA	223	1	2	10	1
TU02	4/23/99	1400	1	G	1	992093016	05/18/99	1	CL	6480	1	2	500	1
TU02	4/23/99	1400	1	S					EC	11500	3	2		1
TU02	4/23/99	1400	1	G	1	992093016	05/19/99	4	HCO3	232	1	2	2	2
TU02	4/23/99	1400	1	G	1	992093016	05/14/99	2	K	91.3	1	2	45	1
TU02	4/23/99	1400	1	G	1	992093016	05/14/99	2	MG	395	1	2	1	1
TU02	4/23/99	1400	1	G	1	992093016	05/20/99	2	NA	3340	1	2	1000	1
TU02	4/23/99	1400	1	G	1	992093016	05/14/99	1	SO4	111	1	2	50	1
TU02	4/26/99	1430	1	S				101	CL	5061	1	2		1
TU02	4/26/99	1430	1	S					EC	10000	3	2		1
TU02	4/30/99	1500	1	S				101	CL	1316	1	2		1
TU02	4/30/99	1500	1	S					EC	2600	3	2		1
TU02	5/3/99	1530	1	S				101	CL	1620	1	2		1
TU02	5/3/99	1530	1	S					EC	3200	3	2		1
TU03	4/23/99	1400	1	S				101	CL	759	1	2		1
TU03	4/23/99	1400	1	S					EC	1500	3	2		1

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TU03	4/26/99	1430	1	S				101	CL	557	1	2		1
TU03	4/26/99	1430	1	S					EC	1100	3	2		1
TU03	4/26/99	1430	1	V					FLOW	0.06	5	2		1
TU03	5/3/99	1530	1	S				101	CL	202	1	2		1
TU03	5/3/99	1530	1	S					EC	400	3	2		1
TU04	4/20/99	1130	1	S					EC	100	3	2		1
TU04	4/20/99	1130	1	V					FLOW	0	5	1		1
TU04	4/21/99	1455	1	S					EC	233	3	2		1
TU04	4/21/99	1455	1	V					FLOW	0	5	1		1
TU04	4/23/99	1400	1	V					FLOW	0	5	1		1
TU04	4/26/99	1430	1	V					FLOW	0	5	1		1
TU04	4/28/99	1130	1	V					FLOW	0	5	1		1
TU04	4/30/99	1500	1	V					FLOW	0	5	1		1
TU04	5/3/99	1530	1	V					FLOW	0	5	1		1
TU04	5/10/99	1200	1	S					EC	1700	3	2		1
TU04	5/10/99	1200	1	V					FLOW	0	5	1		1
TU05	4/23/99	1400	1	S					EC	4500	3	2		1
TU05	4/28/99	1130	1	S					EC	4300	3	2		1
TU05	4/30/99	1500	1	S					EC	3300	3	2		1
TU05	5/3/99	1530	1	S					EC	2600	3	2		1
TU05	5/10/99	1200	1	S					EC	800	3	2		1
TU06	4/23/99	1400	1	S					EC	7100	3	2		1
TU06	4/23/99	1400	1	S					EC	4300	3	2		1
TU06	4/26/99	1430	1	S					EC	4800	3	2		1
TU06	4/28/99	1130	1	S					EC	2500	3	2		1
TU07	4/23/99	1400	1	G	1	992093017	05/14/99	2	CA	123	1	2	10	1
TU07	4/23/99	1400	1	G	1	992093017	05/14/99	1	CL	2960	1	2	50	1
TU07	4/23/99	1400	1	S					EC	6600	3	2		2
TU07	4/23/99	1400	1	G	1	992093017	05/19/99	4	HCO3	124	1	2	2	2
TU07	4/23/99	1400	1	G	1	992093017	05/20/99	2	K	34.5	1	2	4.5	1
TU07	4/23/99	1400	1	G	1	992093017	05/14/99	2	MG	195	1	2	1	1
TU07	4/23/99	1400	1	G	1	992093017	05/20/99	2	NA	1240	1	2	100	1
TU07	4/23/99	1400	1	G	1	992093017	05/14/99	1	SO4	62.4	1	2	50	1
TU07	4/28/99	1145	1	G	1	992093019	05/14/99	1	CL	1180	1	2	50	1
TU07	4/28/99	1145	1	S					EC	4600	3	2		1
TU07	4/30/99	1500	1	G	1	992093022	05/14/99	2	CA	55.3	1	2	10	1

1999 Validated Data
Chloride at Anchorage Snow Disposal Sites

Station_ID	LogDate	LogTime	Samp_Type	Samp_Meth	Lab_Code	Lab_SampID	Anal_Date	Anal_Meth	Par_Code	Par_Val	Units	Par_VQ	Lab_RL	QC_Note
TU07	4/30/99	1500	1	G	1	992093022	05/14/99	1	CL	1360	1	2	50	1
TU07	4/30/99	1500	1	S					EC	3300	3	2		1
TU07	4/30/99	1500	1	G	1	992093022	05/19/99	4	HCO3	130	1	2	2	2
TU07	4/30/99	1500	1	G	1	992093022	05/20/99	2	K	21.7	1	2	4.5	1
TU07	4/30/99	1500	1	G	1	992093022	05/14/99	2	MG	103	1	2	1	1
TU07	4/30/99	1500	1	G	1	992093022	05/14/99	2	NA	609	1	2	10	1
TU07	4/30/99	1500	1	G	1	992093022	05/18/99	1	SO4	22.4	1	2	5	1
TU07	5/3/99	1615	1	S				101	CL	1316	1	2		1
TU07	5/3/99	1615	1	S					EC	2600	3	2		1

Appendix D
Conductivity, Chloride and Flow Correlations

TUDOR SNOW DISPOSAL SITE

Tudor Snow Disposal Site - 1999

Figure 1 - Conductivity Comparisons

Date	Time	CHS003	CHS002	CHS001
4/20/99	1130	100		300
4/21/99	1455	100		500
4/26/99	1430	100		1500
4/28/99	1145	100	400	1700
4/30/99	1500	100	300	1100
5/3/99	1530	100	200	900
05/10/99	1200			400

Figure 2 & 3 - Conductivity vs. Chloride

Date	Time	Station	Cond. uS/cm	Chloride (mg/L)
4/21/99	1455	CHS001	**500**	**249**
4/23/99	1400	CHS001	**1200**	**487**
4/28/99	1145	CHS001	**1700**	**557**
4/30/99	1500	CHS001	**1100**	**403**
4/21/99	1455	TU01	**5000**	**3360**
4/23/99	1400	TU02	**11500**	**6480**
4/23/99	1400	TU01	**6500**	**2840**
4/23/99	1400	TU07	**6600**	**2960**
4/28/99	1145	TU07	**4600**	**1180**
4/30/99	1500	TU07	**3300**	**1360**

Figure 1

1999 Chloride at Anchorage Snow Disposal and Street Sites

Tudor Snow Disposal Site

Conductivity Comparisons of the Receiving Water

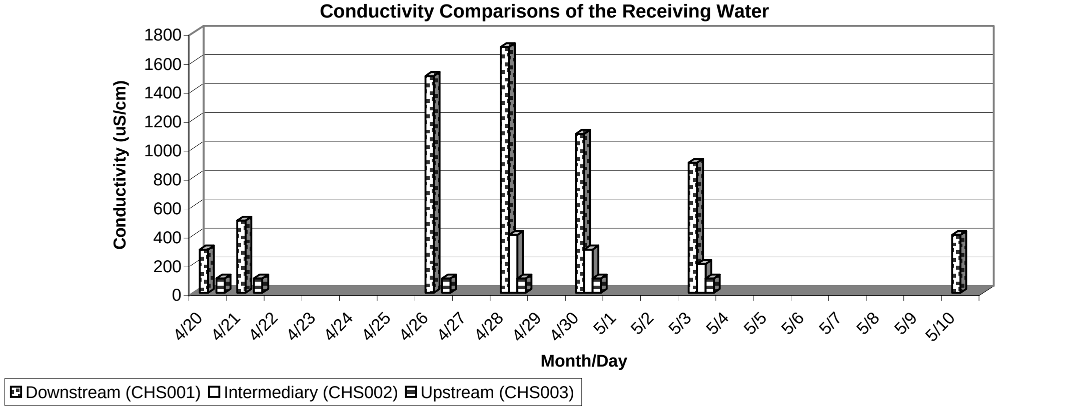


Figure 2

1999 Chloride at Anchorage Snow Disposal and Street Sites

Tudor Snow Disposal Site - Receiving Water (Station CHS001)

Chloride vs. Conductivity

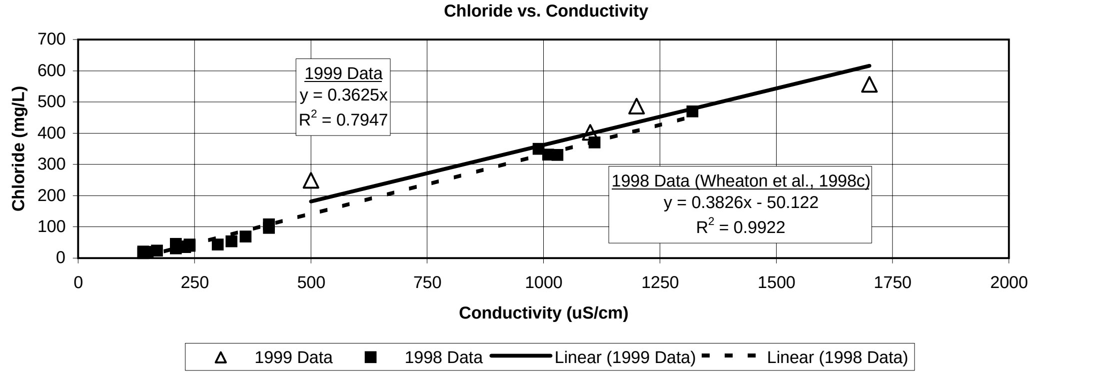


Figure 3

1999 Chloride at Anchorage Snow Disposal and Street Sites

Tudor Snow Disposal Site - Site Discharge Meltwater (Stations TU01, TU02 and TU07)

Chloride vs. Conductivity

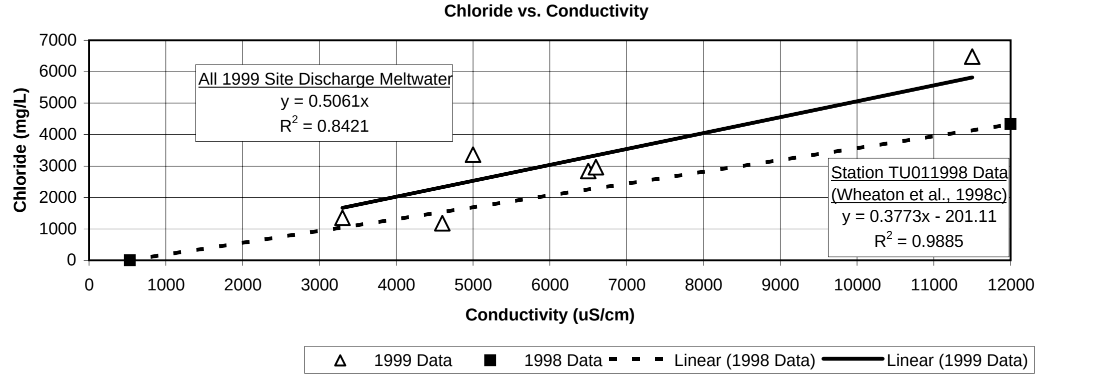


Figure 4a

1999 Chloride at Anchorage Snow Disposal and Street Sites

Tudor Snow Disposal Site - Downstream Receiving Water (Station CHS001)

Conductivity Data Logger Time Series (4/21/99 to 5/5/99)

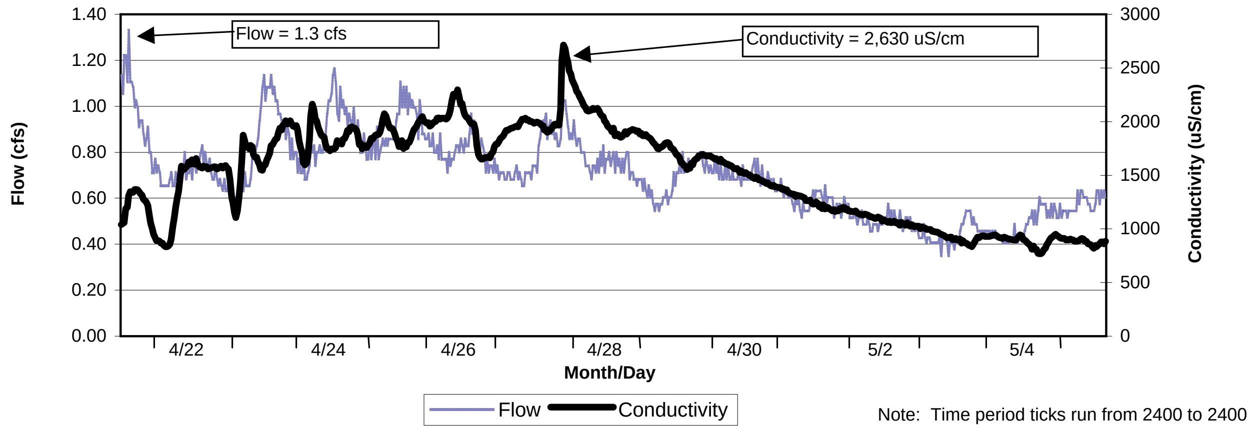


Figure 4b

1999 Chloride at Anchorage Snow Disposal and Street Sites

Tudor Snow Disposal Site - Downstream Receiving Water (Station CHS001)

Conductivity Data Logger Time Series (5/5/99 to 5/19/99)

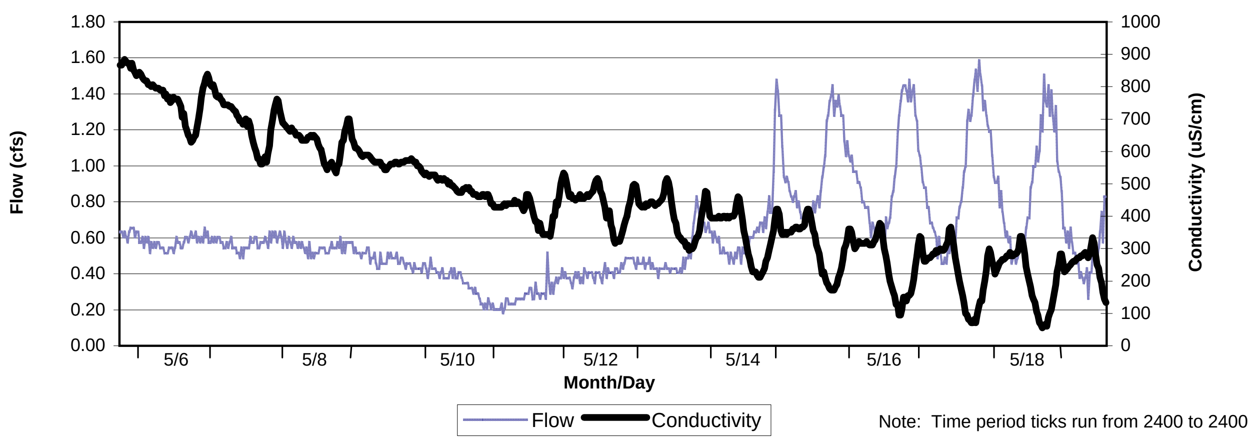
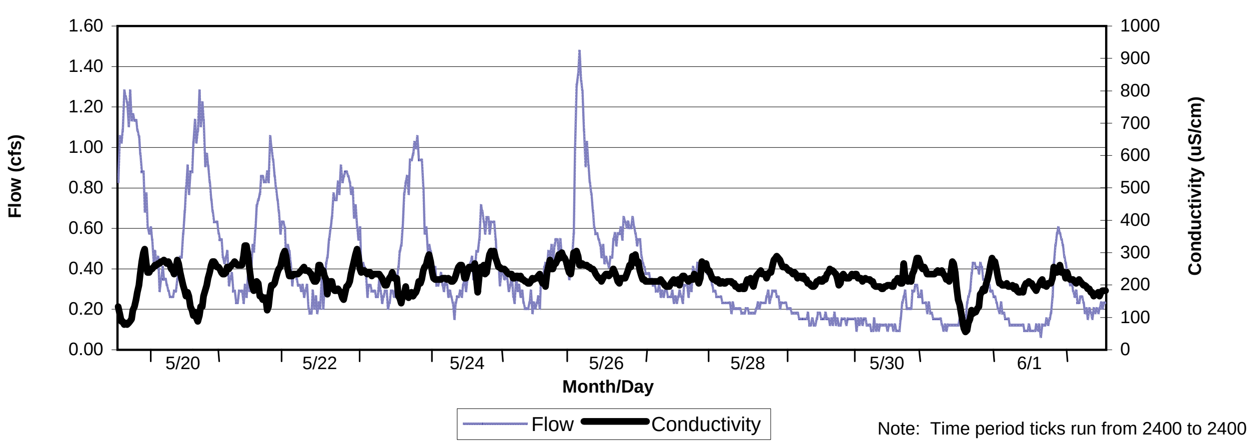


Figure 4c

1999 Chloride at Anchorage Snow Disposal and Street Sites

Tudor Snow Disposal Site - Downstream Receiving Water (Station CHS001)

Conductivity Data Logger Time Series (5/19/99 to 6/2/99)



Tudor Snow Disposal Site

Converted Conductivity to Chloride
and Grab-Sample Chloride

Equation: 0.3625*EC = CL

Date	CHS003	CHS002	CHS001
	CL	CL	CL
4/14			36.25
4/19			107.3
4/20	36.25		108.75
4/21	36.25		**249**
4/26	36.25		543.75
4/28	36.25	145	**557**
4/30	36.25	108.75	**403**
5/3	36.25	72.5	326.25
5/10			145

Equation: 0.5061*EC = CL

ID	DATE	EC	CL
TU01	4/19	630	319
TU01	4/20	5050	2556
TU01	4/21	5000	**3360**
TU01	4/23	6500	**2840**
TU01	4/26	4800	2429
TU01	4/28	3500	1771
TU01	4/30	1900	962
TU01	5/3	2500	1265
TU01	5/10	250	127
TU02	4/19		
TU02	4/20		
TU02	4/21		
TU02	4/23	11500	**6480**
TU02	4/26	10000	5061
TU02	4/28		
TU02	4/30	2600	1316
TU02	5/3	3200	1620
TU02	5/10		
TU03	4/19		
TU03	4/20		
TU03	4/21		
TU03	4/23	1500	759
TU03	4/26	1100	557
TU03	4/28		
TU03	4/30		
TU03	5/3	400	202
TU03	5/10		
TU07	4/19		
TU07	4/20		
TU07	4/21		
TU07	4/23	6600	**2960**
TU07	4/26		
TU07	4/28	4600	**1180**
TU07	4/30	3300	**1360**
TU07	5/3	2600	1316
TU07	5/10		

Note: Bold values are actual grab chloride values.

NORTH MOUNTAIN VIEW SNOW DISPOSAL SITE

North Mountain View Snow Disposal Site - Spring 1999 Deicer Assessment
Conductivity Correlations to Chloride

	Conductivity (uS/cm)			Chloride (mg/L)		
	MTV01	MTV02	NCH001	MTV01	MTV02	NCH001
3/18/99			375			**43.6**
3/21/99			1249			**348**
3/26/99			418			**49.6**
3/26/99			620			**135**
4/19	3600	2600		**1500**	**1910**	
4/20	3600	2700		1529	1147	
4/21	3050	4420	348	**1360**	**1290**	**40.1**
4/23	2600	1300	200	1104	552	46.4 *
4/26	1500	1000	200	**1070**	**624**	**46.4**
4/28	1600	700		680	297	**147.0**
4/30	1300	300	300	552	466	42.0 *

* Note: NCH001 values determined by using linear line between 4/21 and 4/26 NCH001 values.
Bold values are grab sample analysis, other numbers were calculated from conductivity by 0.4248 * Conductivity.

Figure 13
1999 Chloride at Anchorage Snow Disposal and Street Sites
North Mountain View Snow Disposal Site
Conductivity Comparisons

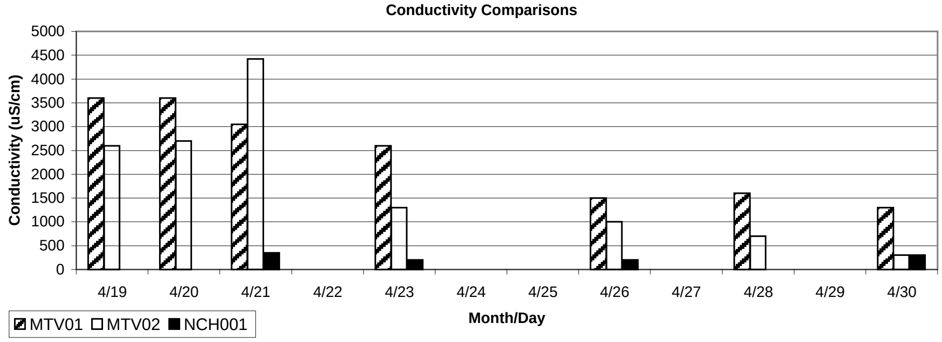


Figure 16
1999 Chloride at Anchorage Snow Disposal and Street Sites
North Mountain View Snow Disposal Site - Station MTV01
Chloride vs. Conductivity

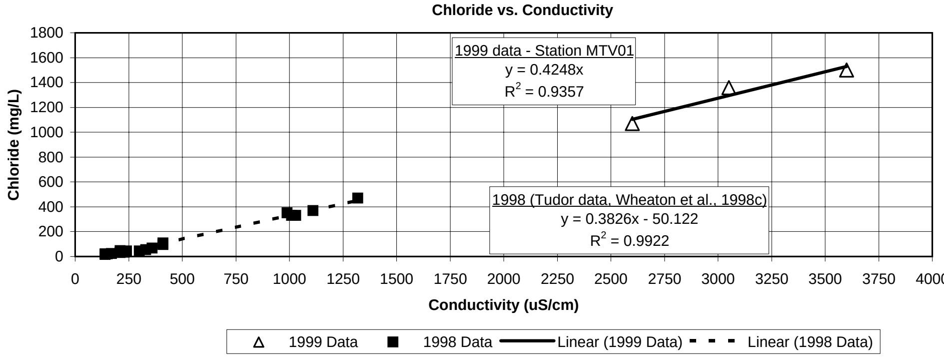
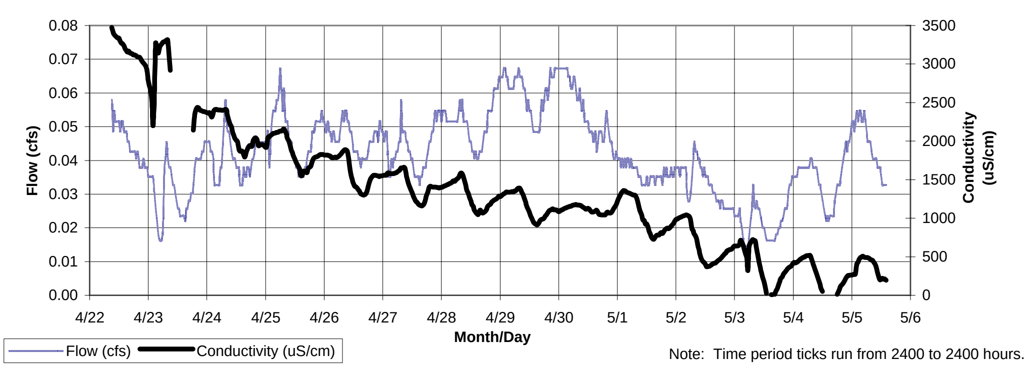


Figure 14
1999 Chloride at Anchorage Snow Disposal and Street Sites
North Mountain View Snow Disposal Site - Station MTV01
Conductivity Datalogger Time Series (4/22/99 to 5/6/99)



Note: Time period ticks run from 2400 to 2400 hours.

For Chloride:

Bold are actual grab chloride samples

Other are converted by 0.4248 * EC. 4/23 and 4/30 NCH001 samples are converted from EC by linear interpolation from 4/21 and 4/26 values.

	Conductivity (uS/cm)			Chloride (mg/L)		
	MTV01	MTV02	NCH001	MTV01	MTV02	NCH001
3/18/99			375			**43.6**
3/21/99			1249			**348**
3/26/99			418			**49.6**
3/26/99			620			**135**
4/19	3600	2600		**1500**	**1910**	
4/20	3600	2700		1529	1147	
4/21	3050	4420	348	**1360**	**1290**	**40.1**
4/23	2600	1300	200	1104	552	46.4
4/26	1500	1000	200	**1070**	**624**	**46.4**
4/28	1600	700		680	297	**147.0**
4/30	1300	300	300	552	466	42.0

Date	Time	CL	EC
		MTV01	MTV01
4/19	1200	1500	3600
4/21	1730	1360	3050
4/23	1920	1070	2600

5TH AVENUE SITE

5th Avenue Field Data
Field Data

Site	Date	Time	Flow (cfs)	Cond. 25C	Logger	Air Temp	Comments
1	3/17/99	1530	0.02	435		<32	Cold day, not much free water on streets
2	3/18/99	1600	0.02	484		<32	No free water in streets
3	3/19/99	1445	0.029	750		36	Streets wet, lots of free water and runoff
4	3/20/99	1130	0.029	1370		34	wet streets, runoff (EC measured 3/23/99)
5	3/20/99	1500	0.191	3880		40	Lots of runoff (EC measured 3/23/99)
6	3/20/99	1800	0.223	4800		36	Lots of runoff (EC measured 3/23/99)
7	3/21/99	845	0.028	2657		32	Streets are starting to melt
8	3/21/99	1305	0.121	2123		42	Lots of runoff, diesel smell, VERY turbid
9	3/21/99	1528	0.477	2584		42	Lots of runoff, diesel smell, VERY turbid
10	3/21/99	1657	0.477	2041		42	Lots of runoff, diesel smell, VERY turbid
11	3/22/99	900	0.025	1202		27	Clear, with floating debris, streets froze
12	3/22/99	1407	0.035	948		35	Slightly turbid, streets running
13	3/23/99	810	0.022	1072	1595	34	Clear, little water on streets
14	3/23/99	1540	0.148	3880	4262	45	Very turbid, diesel smell, streets running
15	3/23/99	1803	0.167	2730	2971	35	Very turbid, diesel smell, streets running
16	3/24/99	920	0.024	670	1171	31	Clear, little water on streets
17	3/24/99	1300	0.041	730		35	Clear, little water on streets, pking lots have snow
18	3/24/99	1747	0.065	3560		35	Turbid, foaming, slight flows on street sides and over sidewalks
19	3/25/99	840	0.027	695	1206	32	Clear, little water on streets, small puddles beginning to form
20	3/25/99	1110	0.033	675	1176	38	Slightly turbid, foaming, streets wet, little flow on sides, sidewalks bare
21	3/25/99	1400	0.084	1420	1968	40	Slightly turbid, foaming, slight gas smell, streets dry, parking lots/snow berms melting
22	3/25/99	1600	0.267	2380	2725	40	Very turbid, foam, streets running from parking lots melting over sidewalks
22	3/25/99	1810	0.191	2160	2674	38	
23	3/26/99	1200	0.025	637	1125	44	
24	3/26/99	1410	0.088	940	1478	44	
25	3/26/99	1610	0.148	1111	1559	40	
26	3/27/99	1145	0.026	439	990		
27	3/27/99	1400	0.076	636	1166		
28	3/27/99	1656	0.278	1061	1470		
29	3/28/99	1155	0.025	416	944		
30	3/28/99	1600	0.067	806	1050		
31	3/29/99	1215	0.022	397	906		
32	3/29/99	1515	0.075	348	902		
33	3/29/99	1730	0.088	285	833		
34	3/31/99	1300	0.083	1710	2205	>32	4" of snow last night, melting on streets - more deicer on streets
35	3/31/99	1500	0.148	2460	2488	35	Lots of melting
36	3/31/99	1700	0.111	2350	2503	35	Same
37	4/1/99	920	0.025	626	723		
38	4/1/99	1454	0.129	1300	1131		

Figure 1
1999 Chloride at Anchorage Snow Disposal and Street Sites
5th Avenue Site
Conductivity and Flow Comparisons

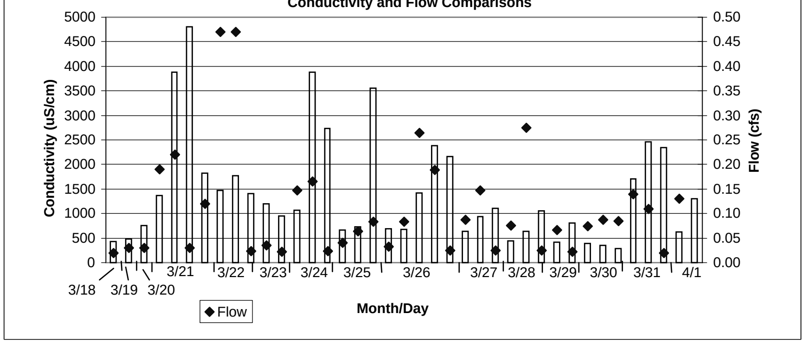
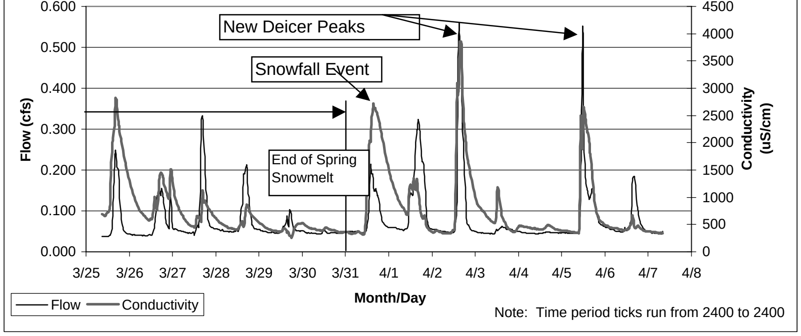


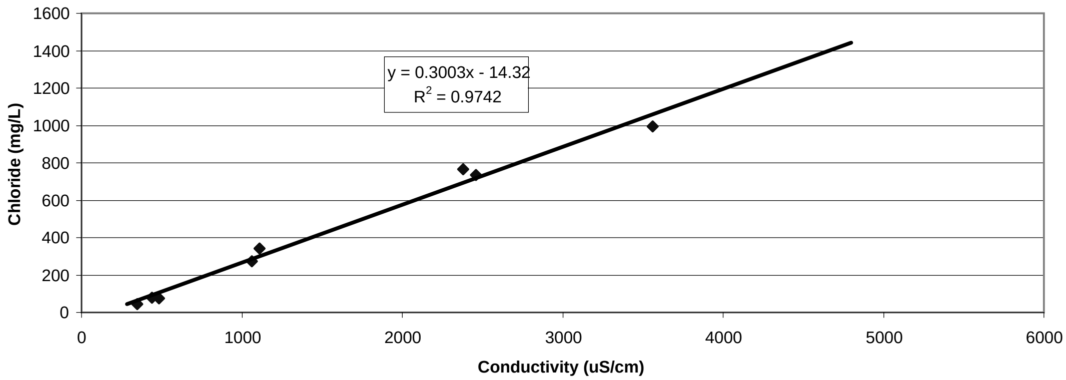
Figure 2
1999 Conductivity at Anchorage Snow Disposal and Street Sites
5th Avenue Site - Station CH3301
Conductivity Datalogger Time Series (3/25/99 to 4/7/99)



5th Avenue Site
Conductivity to Chloride

ID	Date	Time	EC	Flow	Cl
CH3301	3/18 (1600)	1600	484	0.02	75.7
CH3301	3/24 (1747)	1747	3560	0.064	995
CH3301	3/25 (1600)	1600	2380	0.264	766
CH3301	3/26 (1610)	1610	1111	0.147	343
CH3301	3/27 (1145)	1145	439	0.025	80.3
CH3301	3/27 (1656)	1656	1061	0.275	274
CH3301	3/29 (1515)	1515	348	0.074	44.8
CH3301	3/31 (1500)	1500	2460	0.139	736

Figure 3
1999 Chloride at Anchorage Snow Disposal and Street Sites
5th Avenue Site
Chloride vs. Conductivity



Bold numbers are grab chloride samples, other chloride values are determined by equation shown

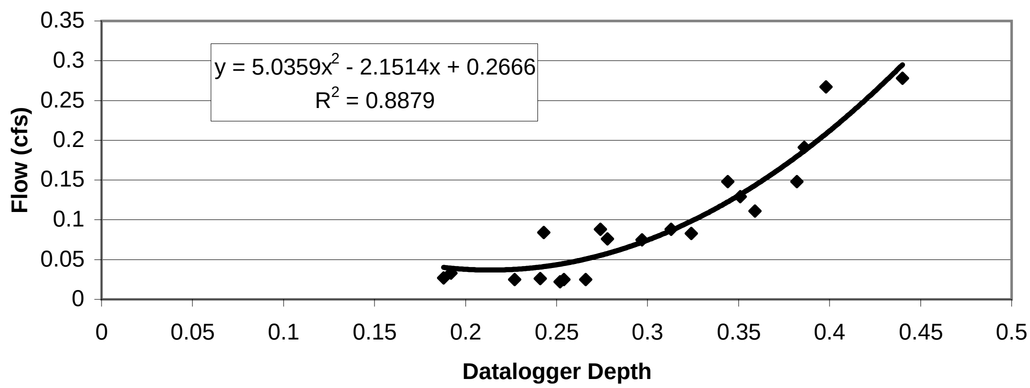
Station CH3301			EC to Cl by equation	Grab
	Time	EC	0.3*EC-14.32	Flow (cfs)
3/17/99	1530	435	116	0.02
3/18/99	1600	484	**75.7**	0.02
3/19/99	1445	750	211	0.029
3/20/99	1800	4800	1426	0.223
3/21/99	1528	2584	761	0.477
3/22/99	1407	948	270	0.035
3/23/99	1540	3880	1150	0.148
3/24/99	1747	3560	**995**	0.064
3/25/99	1600	2380	**766**	0.064
3/26/99	1610	1111	**343**	0.264
3/27/99	1656	1061	**274**	0.147
3/28/99	1600	806	227	0.275
3/29/99	1515	348	**45**	0.088
3/29/99	1730	285	71	0.074
3/31/99	1500	2460	**736**	0.148
4/1/99	1454	1300	376	0.139

5th Avenue Site
Flow Verification for Datalogger

Grab flow values correlated to datalogger depth readings

Date	Time	Flow (cfs)	Depth	
3/25/99	840	0.027	0.188	
3/25/99	1110	0.033	0.192	
3/25/99	1400	0.084	0.243	
3/25/99	1600	0.267	0.398	
3/25/99	1810	0.191	0.386	
3/26/99	1200	0.025	0.227	
3/26/99	1410	0.088	0.274	
3/26/99	1610	0.148	0.344	
3/27/99	1145	0.026	0.241	
3/27/99	1400	0.076	0.278	
3/27/99	1656	0.278	0.44	
3/28/99	1155	0.025	0.254	
3/28/99	1600	0.067		0.384 (Outlier)
3/29/99	1215	0.022	0.252	
3/29/99	1515	0.075	0.297	
3/29/99	1730	0.088	0.313	
3/31/99	1300	0.083	0.324	
3/31/99	1500	0.148	0.382	
3/31/99	1700	0.111	0.359	
4/1/99	926	0.025	0.266	
4/1/99	1354	0.129	0.351	

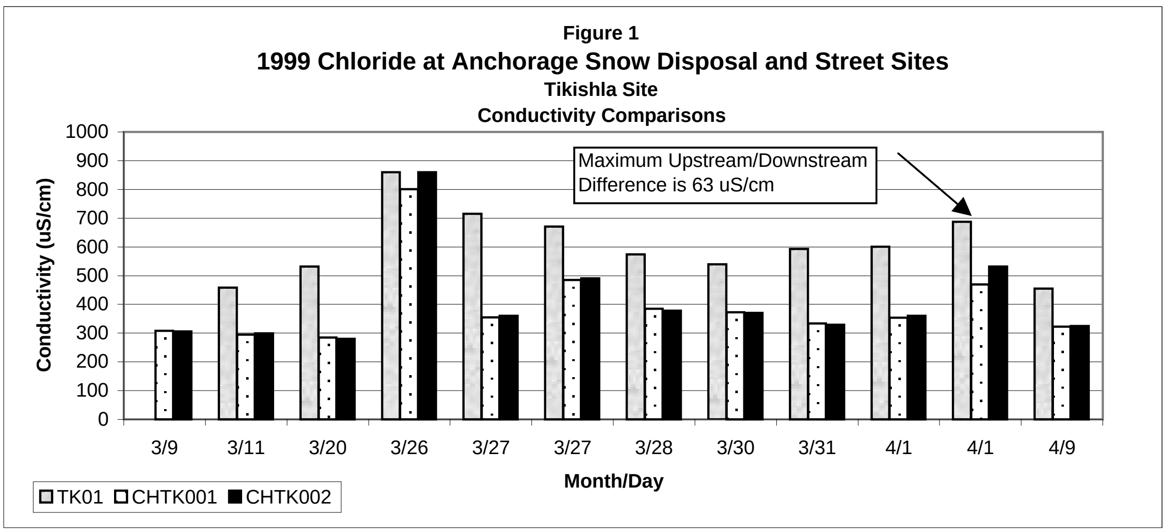
Figure 29
1999 Chloride at Anchorage Snow Disposal and Street Sites
5th Avenue Site
Flow versus Depth

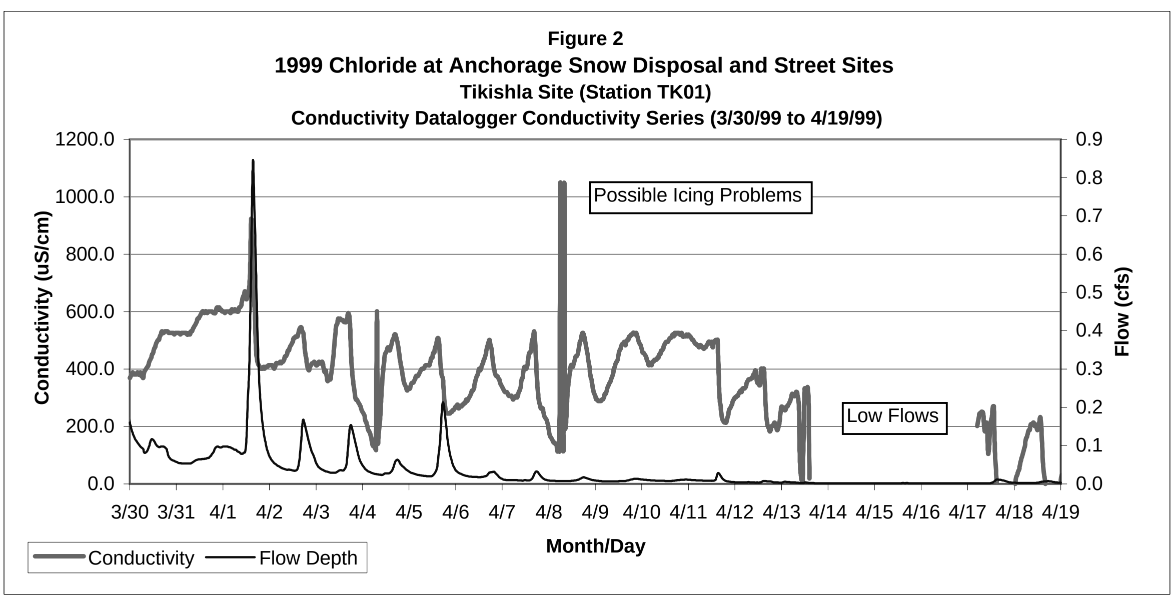


TIKISHLA SITE

Tikishla Site
Conductivity and Chloride Correlations

Date	TK01	CHTK01	CHTK02	Difference
3/9		308	306	-2
3/11	458	295	299	4
3/20	532	285	280	-5
3/26	860	801	860	59
3/27	715	355	360	5
3/27	671	485	490	5
3/28	574	385	378	-7
3/30	540	373	370	-3
3/31	593	334	329	-5
4/1	601	354	360	6
4/1	687	469	532	63
4/9	455	323	325	2





Tikishla Site
Conductivity and Chloride Correlations

(Analytical Results)

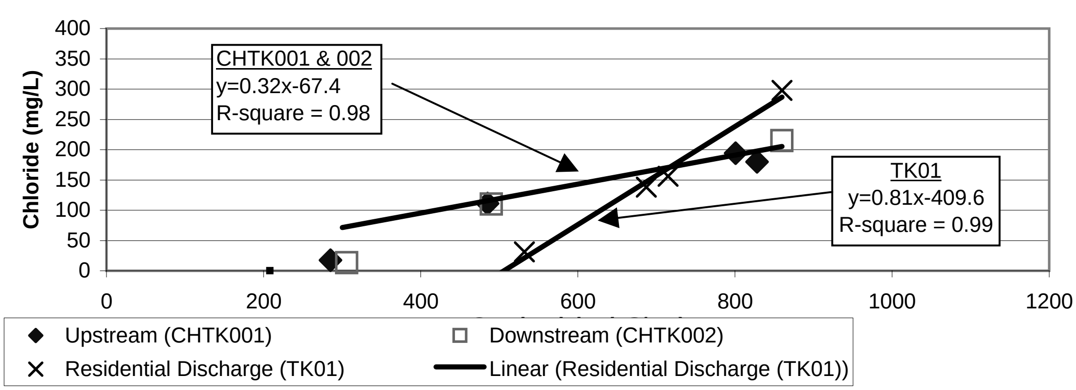
		Conductivity			Chloride		
Date	Time	TK01	CHTK001	CHTK002	TK01	CHTK001	CHTK002
3/9	1100		308	306			**13.2**
3/11	1420	458	295	299			
3/12	1445		284	292			
3/20	1245	532	285	280	**31.4**	**17.5**	
3/21	1500		828			**180**	
3/26	1800	860	801	860	**298**	**194**	**215**
3/27	1557	715	485	490	**156**	**111**	**110**
3/28	1245	574	385	378			
3/30	1545	540	373	370			
3/31	1550	593	334	329			
4/1	1535	687	469	532	**138**		
4/5	1500	501					
4/6	1440	334					
4/9	1515	455	323	325			
4/15	1330	300					

**** (CHTK001 & CHTK002) combined**

285	**17.5**
801	**194**
828	180
485	111
306	**13.2**
860	**215**
490	**110**

Line from combination	
208.22	0
3500.062	1200

Figure 3
1999 Chloride at Anchorage Snow Disposal and Street Sites
Tikishla Site (Stations CHTK001 and CHTK002)
Chloride vs. Conductivity

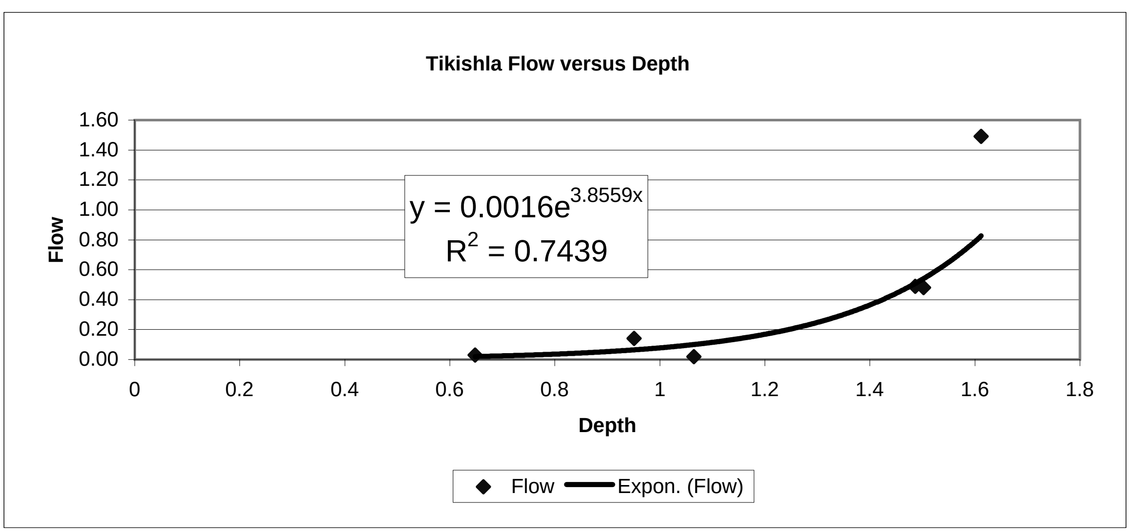


Tikishla Site
Calc'd Chloride and Flow Verification

		Conductivity			Chloride		
Date	Time	TK01	CHTK001	CHTK002	TK01	CHTK001	CHTK002
3/9	1100		308	306			**13.2**
3/11	1420	458	295	299	0	27	28
3/12	1445		284	292		23	26
3/20	1245	532	285	280	**31**	**17.5**	22
3/21	1500		828			**180**	
3/26	1800	860	801	860	**298**	**194**	**215**
3/27	1557	715	355	360	**156**	**111**	**110**
3/28	1245	574	385	378	55	56	54
3/30	1545	540	373	370	28	52	51
3/31	1550	593	334	329	71	39	38
4/1	1535	687	469	532	**138**	83	103
4/5	1500	501			0		
4/6	1440	334			0		
4/9	1515	455	323	325	0	36	37
4/15	1330	300			0		

Bold are grab chloride analytical results
Normal type are calculated results based on :
1) TK01: (0.81*EC-409.6)
2) CHTK001 and CHTK002: (0.32*EC-67.4)

Flow Verification			Flow	Flow Depth (ft.)
			cfs	Data Logger
TK01	03/29/99	0820	0.01	
TK01	03/29/99	1750	0.49	1.486
TK01	03/29/99	1500	0.48	1.502
TK01	03/30/99	1545	0.02	1.065
TK01	04/01/99	1520	1.49	1.612
TK01	04/05/99	1500	0.14	0.951
TK01	04/06/99	1440	0.03	0.648



GAMBELL/INGRA SITE

Gambell/Ingra Site
EC Measurements at the Stations

Date (1999)	Time	CHGI001	CHGI002	CHGI003	CHGI004	CHGI005
3/12	930	277			466	278
3/12	1400	264			1557	272
3/14	1515	366		694		503
3/16	1445	271			587	271
3/18	1530	268			271	264
3/19	1320	272			486	280
3/20	1217	270			1596	290
3/20	1630	345			2040	435
3/21	1600	488		2220	1655	598
3/22	1000	339			756	343
3/22	1410	311			3000	370
3/23	925	294			1138	295
3/23	1315	471		2630	1309	511
3/25	905	327			1004	341
3/25	1405	365			1883	408
3/26	1000	320			867	327
3/26	1500	472	835		1039	449
3/27	1040	330	434		662	327
3/27	1457	390		1683	733	388
3/28	1310	359			637	361
3/28	1620	393				392
3/29	850	309			506	309
3/29	1705	362		267	429	354
3/31	1045	338			552	326
3/31	1505	369			2460	417

Figure 1a
1999 Chloride at Anchorage Snow Disposal and Street Sites
Gambell/Ingra Site
Conductivity Comparisons

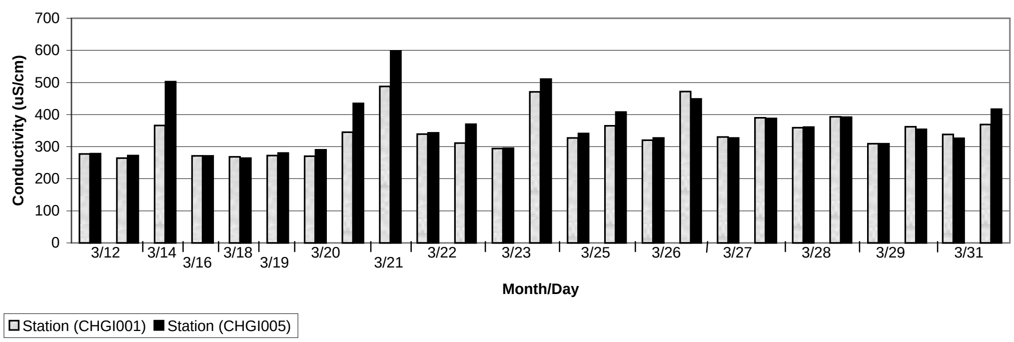
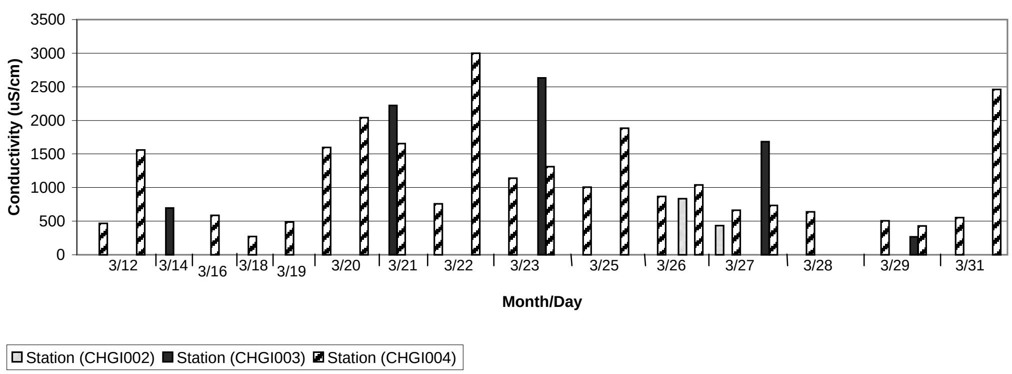


Figure 1b
1999 Chloride at Anchorage Snow Disposal and Street Sites
Gambell/Ingra Site
Conductivity Comparisons



Gambell/Ingra Site
Conductivity and Chloride Correlations

CHGI001				CHGI004				CHGI005			
Date	**Time**	**EC**	**Cl**	**Date**	**Time**	**EC**	**Cl**	**Date**	**Time**	**EC**	**Cl**
3/14	1515	366	43.6	3/14	1515		1170	3/14	1515	503	87
3/18	1530	268	16.5	3/18	1530	271	32.6	3/18	1530	264	16.4
3/20	1217	270	24	3/20	1217	1596	463	3/20	1217	290	27.9
3/20	1630	345	43.9	3/20	1630	2040	659	3/20	1630	435	76.8
3/21	1600	488	74.3	3/21	1600	1655	482	3/21	1600	598	118
3/22	1410	311	30.7	3/22	1410	3000	928	3/22	1410	370	49.9
3/23	1315	471	69.9	3/23	1315	1309	398	3/23	1315	511	83.4
3/25	1405	365	39.2	3/25	1405	1883	583	3/25	1405	408	49.1
3/29	1705	362	41.8	3/26	1500	1039	283	3/26	1500	449	66.4
				3/22	1000	756		3/29	1705	354	41.2
					CHGI003	2220	**602**				
					CHGI003	2630	**752**				

366	43.6	47.68	0
268	16.5	196	700
270	24	700	139.5
345	43.9	203.7	0
488	74.3		
311	30.7		
471	69.9		
365	39.2		
362	41.8		
503	87		
264	16.4		
290	27.9		
435	76.8		
598	118		
370	49.9		
511	83.4		
408	49.1		
449	66.4		
354	41.2		

Figure 38a
1999 Chloride at Anchorage Snow Disposal and Street Sites
Gambell/Ingra Site (Stations CHGI001 and CHGI005)
Creek Chloride vs. Conductivity

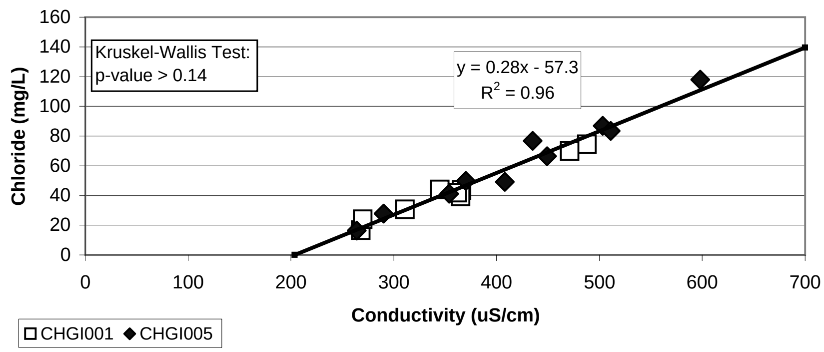
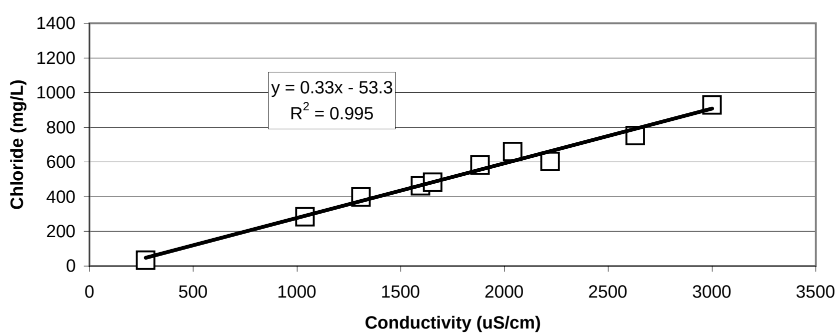


Figure 38b
1999 Chloride at Anchorage Snow Disposal and Street Sites
Gambell/Ingra Site (Station CHGI003 and CHGI004)
Outfall Chloride vs. Conductivity



Gambell/Ingra Site
Conductivity and Chloride Correlations

Date (1999)	Time	CONDUCTIVITY				CHLORIDE			
		CHGI001	CHGI003	CHGI004	CHGI005	CHGI001	CHGI003	CHGI004	CHGI005
3/5						**14.9**			**16.3**
3/12	1400	264		1557	272	**43.6**	**2510**	**1170**	**87**
3/14	1515	366	694		503	45.2	176		83.5
3/16	1445	271		587	271	18.6		140	18.6
3/18	1530	268		271	264	**16.5**		**32.6**	**16.4**
3/19	1320	272		486	280	18.9		107	21.1
3/20	1630	345		2040	435	**43.9**	**79.9**	**659**	**76.8**
3/21	1600	488	2220	1655	598	**74.3**	**602**	**482**	**118**
3/22	1410	311		3000	370	**30.7**		**928**	**49.9**
3/23	1315	471	2630	1309	511	**69.9**	**752**	**398**	**83.4**
3/25	1405	365		1883	408	**39.2**		**583**	**49.1**
3/26	1500	472		1039	449	74.9		**283**	**66.4**
3/27	1457	390	1683	733	388	51.9	502	189	51.3
3/28	1620	393		637	392	52.7		157	52.5
3/29	1705	362	267	429	354	**41.8**	35	88	**41.2**
3/31	1505	369		2460	417	46.0		759	59.5

Bold are grab chloride analytical results

Normal type are calculated results based on :

1) CHGI001, CHGI005: (0.28*EC-57.3)

2) CHGI003. CHGI004: (0.33*EC-53.3)

Appendix E
Cation/Anion Balance Summaries

Tudor Snow Disposal Site Samples
Cation/Anion Balances

Sample: CHS001 04/21/99 1455

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	26.6	20	1.33	Sulfate	12.8	47.8	0.27
Potassium	0	39.1	0.00	Chloride	249	35.45	7.02
Magnesium	12.4	12.22	1.01	Bicarbonate	32	60	0.53
Sodium	138	23	6.00				
Total Cations, meq/L			8.34	Total Anions, meq/L			7.83
Ionic Balance:			3.2%				

Sample: TU01 04/21/99 1455

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	118	20	5.90	Sulfate	64.2	47.8	1.34
Potassium	57	39.1	1.46	Chloride	3360	35.45	94.78
Magnesium	201	12.22	16.45	Bicarbonate	154	60	2.57
Sodium	1260	23	54.78				
Total Cations, meq/L			78.59	Total Anions, meq/L			98.69
Ionic Balance:			11.3%				

Sample: TU01 04/23/99 1400

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	113	20	5.65	Sulfate	70.7	47.8	1.48
Potassium	47.9	39.1	1.23	Chloride	2840	35.45	80.11
Magnesium	235	12.22	19.23	Bicarbonate	156	60	2.60
Sodium	1190	23	51.74				
Total Cations, meq/L			77.84	Total Anions, meq/L			84.19
Ionic Balance:			3.9%				

Sample: TU02 04/23/99 1400

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	223	20	11.15	Sulfate	111	47.8	2.32
Potassium	91.3	39.1	2.34	Chloride	6480	35.45	182.79
Magnesium	395	12.22	32.32	Bicarbonate	232	60	3.87
Sodium	3340	23	145.22				
Total Cations, meq/L			191.03	Total Anions, meq/L			188.98
Ionic Balance:			0.5%				

Sample: TU07 04/23/99 1400

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	123	20	6.15	Sulfate	62.4	47.8	1.31
Potassium	34.5	39.1	0.88	Chloride	2960	35.45	83.50
Magnesium	195	12.22	15.96	Bicarbonate	124	60	2.07
Sodium	1240	23	53.91				
Total Cations, meq/L			76.90	Total Anions, meq/L			86.87
Ionic Balance:			6.1%				

Sample: TU07 04/30/99 1500

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	55.3	20	2.77	Sulfate	22.4	47.8	0.47
Potassium	21.7	39.1	0.55	Chloride	1360	35.45	38.36
Magnesium	103	12.22	8.43	Bicarbonate	130	60	2.17
Sodium	609	23	26.48				
Total Cations, meq/L			38.23	Total Anions, meq/L			41.00
Ionic Balance:			3.5%				

North Mountain View Snow Disposal Site
Cation/Anion Balances

Sample: MTV01 04/19/99 1200

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	66.1	20	3.31	Sulfate	58.7	47.8	1.23
Potassium	46.8	39.1	1.20	Chloride	1500	35.45	42.31
Magnesium	208	12.22	17.02	Bicarbonate	121	60	2.02
Sodium	422	23	18.35				
Total Cations, meq/L			39.87	Total Anions, meq/L			45.56
Ionic Balance:			6.7%				

Sample: MTV01 04/21/99 1730

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	64.3	20	3.22	Sulfate	52.7	47.8	1.10
Potassium	50.9	39.1	1.30	Chloride	1360	35.45	38.36
Magnesium	198	12.22	16.20	Bicarbonate	123	60	2.05
Sodium	394	23	17.13				
Total Cations, meq/L			37.85	Total Anions, meq/L			41.52
Ionic Balance:			4.6%				

Sample: MTV02 04/19/99 1200

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	76.3	20	3.82	Sulfate	4.31	47.8	0.09
Potassium	56.8	39.1	1.45	Chloride	1910	35.45	53.88
Magnesium	278	12.22	22.75	Bicarbonate	159	60	2.65
Sodium	520	23	22.61				
Total Cations, meq/L			50.63	Total Anions, meq/L			56.62
Ionic Balance:			5.6%				

Sample: MTV02 04/21/99 1730

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	61	20	3.05	Sulfate	62.7	47.8	1.31
Potassium	45.3	39.1	1.16	Chloride	1290	35.45	36.39
Magnesium	211	12.22	17.27	Bicarbonate	124	60	2.07
Sodium	415	23	18.04				
Total Cations, meq/L			39.52	Total Anions, meq/L			39.77
Ionic Balance:			0.3%				

Sample: NCH001 03/18/99 1230

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	37.8	20	1.89	Sulfate	23.9	47.8	0.50
Potassium	0	39.1	0.00	Chloride	43.6	35.45	1.23
Magnesium	12.1	12.22	0.99	Bicarbonate	83	60	1.38
Sodium	14.4	23	0.63				
Total Cations, meq/L			3.51	Total Anions, meq/L			3.11
Ionic Balance:			5.9%				

Sample: NCH001 03/26/99 1035

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	35.9	20	1.80	Sulfate	24.1	47.8	0.50
Potassium	0	39.1	0.00	Chloride	49.6	35.45	1.40
Magnesium	11.7	12.22	0.96	Bicarbonate	85	60	1.42
Sodium	16	23	0.70				
Total Cations, meq/L			3.45	Total Anions, meq/L			3.32
Ionic Balance:			1.9%				

Sample: NCH001 03/26/99 1540

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	23	20	1.15	Sulfate	13.1	47.8	0.27
Potassium	9.68	39.1	0.25	Chloride	135	35.45	3.81
Magnesium	12.3	12.3	1.00	Bicarbonate	52.5	60	0.88
Sodium	45.8	23	1.99				
Total Cations, meq/L			4.39	Total Anions, meq/L			4.96
Ionic Balance:			6.1%				

5th Avenue Site
Cation/Anion Balances

Sample: CH3301 03/18/99

Cations					Anions			
	mg/L	**Eq. Wt.**	**meq/L**			**mg/L**	**Eq. Wt.**	**meq/L**
Calcium	37.99	20	1.90		Sulfate	19.1	47.8	0.40
Potassium	6.035	39.1	0.15		Chloride	75.6	35.45	2.13
Magnesium	15.9	12.22	1.30		Bicarbonate	84.24	60	1.40
Sodium	27.24	23	1.18					
Total Cations, meq/L			4.54		Total Anions, meq/L			3.94
Ionic Balance:			7.1%					

Sample: CH3301 03/25/99 1600

Cations					Anions			
	mg/L	**Eq. Wt.**	**meq/L**			**mg/L**	**Eq. Wt.**	**meq/L**
Calcium	38.2	20	1.91		Sulfate	17.3	47.8	0.36
Potassium	26.4	39.1	0.68		Chloride	766	35.45	21.61
Magnesium	83.7	12.22	6.85		Bicarbonate	71.6	60	1.19
Sodium	182	23	7.91		Silicon	1.71	14	0.12
Total Cations, meq/L			17.35		Total Anions, meq/L			23.29
Ionic Balance:			14.6%					

Sample: CH3301 03/31/99 1500

Cations					Anions			
	mg/L	**Eq. Wt.**	**meq/L**			**mg/L**	**Eq. Wt.**	**meq/L**
Calcium	51.8	20	2.59		Sulfate	20.9	47.8	0.44
Potassium	31.6	39.1	0.81		Chloride	736	35.45	20.76
Magnesium	168	12.22	13.75		Bicarbonate	74.5	60	1.24
Sodium	140	23	6.09					
Total Cations, meq/L			23.23		Total Anions, meq/L			22.44
Ionic Balance:			1.7%					

Gambell/Ingra Site
Cation/Anion Balances

Sample: CHGI001 03/14/99 1515

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	37.2	20	1.86	Sulfate	22.8	47.8	0.48
Potassium	0	39.1	0.00	Chloride	43.6	35.45	1.23
Magnesium	13.9	12.22	1.14	Bicarbonate	87.3	60	1.46
Sodium	14.9	23	0.65				
Total Cations, meq/L			3.65	Total Anions, meq/L			3.16
Ionic Balance:			7.1%				

Sample: CHGI001 03/18/99 1530

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	35.5	20	1.78	Sulfate	23.7	47.8	0.50
Potassium	0	39.1	0.00	Chloride	16.5	35.45	0.47
Magnesium	7.73	12.22	0.63	Bicarbonate	85	60	1.42
Sodium	7.52	23	0.33				
Total Cations, meq/L			2.73	Total Anions, meq/L			2.38
Ionic Balance:			7.0%				

Sample: CHGI001 03/21/99 1600

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	31.8	20	1.59	Sulfate	20.6	47.8	0.43
Potassium	0	39.1	0.00	Chloride	74.3	35.45	2.10
Magnesium	15.6	12.22	1.28	Bicarbonate	77.3	60	1.29
Sodium	25.6	23	1.11				
Total Cations, meq/L			3.98	Total Anions, meq/L			3.82
Ionic Balance:			2.1%				

Sample: CHGI001 03/22/99 1410

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	28.4	20	1.42	Sulfate	22.8	47.8	0.48
Potassium	0	39.1	0.00	Chloride	30.7	35.45	0.87
Magnesium	8.1	12.22	0.66	Bicarbonate	79.2	60	1.32
Sodium	12.8	23	0.56				
Total Cations, meq/L			2.64	Total Anions, meq/L			2.66
Ionic Balance:			0.4%				

Sample: CHGI003 03/21/99 1610

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	31.8	20	1.59	Sulfate	16.6	47.8	0.35
Potassium	18.9	39.1	0.48	Chloride	602	35.45	16.98
Magnesium	123	12.22	10.07	Bicarbonate	57.3	60	0.96
Sodium	106	23	4.61				
Total Cations, meq/L			16.75	Total Anions, meq/L			18.28
Ionic Balance:			4.4%				

Sample: CHGI004 03/14/99 1522

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	64.3	20	3.22	Sulfate	50.1	47.8	1.05
Potassium	114	39.1	2.92	Chloride	1170	35.45	33.00
Magnesium	107	12.22	8.76	Bicarbonate	57.9	60	0.97
Sodium	353	23	15.35				
Total Cations, meq/L			30.23	Total Anions, meq/L			35.02
Ionic Balance:			7.3%				

Gambell/Ingra Site
Cation/Anion Balances

Sample:	CHGI004	03/18/99	1545				
	Cations				Anions		
	mg/L	Eq. Wt.	meq/L		mg/L	Eq. Wt.	meq/L
Calcium	26.5	20	1.33	Sulfate	19.3	47.8	0.40
Potassium	0	39.1	0.00	Chloride	32.6	35.45	0.92
Magnesium	7.77	12.22	0.64	Bicarbonate	56.3	60	0.94
Sodium	11.2	23	0.49				
Total Cations, meq/L			2.45	Total Anions, meq/L			2.26
Ionic Balance:			4.0%				

Sample:	CHGI004	03/21/99	1605				
	Cations				Anions		
	mg/L	Eq. Wt.	meq/L		mg/L	Eq. Wt.	meq/L
Calcium	38.5	20	1.93	Sulfate	13.9	47.8	0.29
Potassium	19	39.1	0.49	Chloride	482	35.45	13.60
Magnesium	41.1	12.22	3.36	Bicarbonate	59.2	60	0.99
Sodium	151	23	6.57				
Total Cations, meq/L			12.34	Total Anions, meq/L			14.87
Ionic Balance:			9.3%				

Sample:	CHGI004	03/22/99	1420				
	Cations				Anions		
	mg/L	Eq. Wt.	meq/L		mg/L	Eq. Wt.	meq/L
Calcium	44.2	20	2.21	Sulfate	98	47.8	2.05
Potassium	21.6	39.1	0.55	Chloride	928	35.45	26.18
Magnesium	63.4	12.22	5.19	Bicarbonate	63	60.7	1.04
Sodium	354	23	15.39				
Total Cations, meq/L			23.34	Total Anions, meq/L			29.27
Ionic Balance:			11.3%				

Sample:	CHGI004	03/25/99	1420				
	Cations				Anions		
	mg/L	Eq. Wt.	meq/L		mg/L	Eq. Wt.	meq/L
Calcium	42.1	20	2.11	Sulfate	17.7	47.8	0.37
Potassium	50.4	39.1	1.29	Chloride	583	35.45	16.45
Magnesium	41.8	12.22	3.42	Bicarbonate	66.8	60.7	1.10
Sodium	145	23	6.30				
Total Cations, meq/L			13.12	Total Anions, meq/L			17.92
Ionic Balance:			15.5%				

Sample:	CHGI004	03/29/99	1720				
	Cations				Anions		
	mg/L	Eq. Wt.	meq/L		mg/L	Eq. Wt.	meq/L
Calcium	15.4	20	0.77	Sulfate	15.8	47.8	0.33
Potassium	8.37	39.1	0.21	Chloride	88.2	35.45	2.49
Magnesium	7.02	12.22	0.57	Bicarbonate	27.7	60	0.46
Sodium	32.1	23	1.40				
Total Cations, meq/L			2.95	Total Anions, meq/L			3.28
Ionic Balance:			5.2%				

Sample:	CHGI005	03/05/99	1400				
	Cations				Anions		
	mg/L	Eq. Wt.	meq/L		mg/L	Eq. Wt.	meq/L
Calcium	33.9	20	1.70	Sulfate	24	47.8	0.50
Potassium	0	39.1	0.00	Chloride	16.3	35.45	0.46
Magnesium	7.81	12.22	0.64	Bicarbonate	91.4	60	1.52
Sodium	8.11	23	0.35				
Total Cations, meq/L			2.69	Total Anions, meq/L			2.49
Ionic Balance:			3.9%				

Gambell/Ingra Site
Cation/Anion Balances

Sample: CHGI005 03/14/99 1516

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	37.9	20	1.90	Sulfate	24.1	47.8	0.50
Potassium	8.28	39.1	0.21	Chloride	87	35.45	2.45
Magnesium	17	12.22	1.39	Bicarbonate	87.3	60	1.46
Sodium	29.1	23	1.27				
Total Cations, meq/L			4.76	Total Anions, meq/L			4.41
Ionic Balance:			3.8%				

Sample: CHGI005 03/18/99 1600

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	32.9	20	1.65	Sulfate	23.9	47.8	0.50
Potassium	0	39.1	0.00	Chloride	16.4	35.45	0.46
Magnesium	7.31	12.22	0.60	Bicarbonate	81.1	60	1.35
Sodium	6.97	23	0.30	Silicon	5.41	14	0.39
Total Cations, meq/L			2.55	Total Anions, meq/L			2.70
Ionic Balance:			2.9%				

Sample: CHGI005 03/21/99 1625

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	31.1	20	1.56	Sulfate	22.2	47.8	0.46
Potassium	0	39.1	0.00	Chloride	118	35.45	3.33
Magnesium	16.5	12.22	1.35	Bicarbonate	72.5	60	1.21
Sodium	37.9	23	1.65	Silicon	4.32	14	0.31
Total Cations, meq/L			4.55	Total Anions, meq/L			5.31
Ionic Balance:			7.7%				

Sample: CHGI005 03/22/99 1430

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	26.9	20	1.35	Sulfate	23.4	47.8	0.49
Potassium	0	39.1	0.00	Chloride	49.9	35.45	1.41
Magnesium	9.71	12.22	0.79	Bicarbonate	80.2	60	1.34
Sodium	22.7	23	0.99	Silicon	4.87	14	0.35
Total Cations, meq/L			3.13	Total Anions, meq/L			3.58
Ionic Balance:			6.8%				

Sample: CHGI004 04/21/99 1510 WASH

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	25.5	20	1.28	Sulfate	26	47.8	0.54
Potassium	4.85	39.1	0.12	Chloride	68.2	35.45	1.92
Magnesium	7.64	12.22	0.63	Bicarbonate	82.3	60	1.37
Sodium	13.6	23	0.59				
Total Cations, meq/L			2.62	Total Anions, meq/L			3.84
Ionic Balance:			19.0%				

Sample: CHGI004 04/21/99 1500 WASH

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	25	20	1.25	Sulfate	14.8	47.8	0.31
Potassium	5.8	39.1	0.15	Chloride	72.2	35.45	2.04
Magnesium	6.3	12.22	0.52	Bicarbonate	60.1	60	1.00
Sodium	10.6	23	0.46				
Total Cations, meq/L			2.37	Total Anions, meq/L			3.35
Ionic Balance:			17.0%				

Sample: CHGI004 04/21/99 1517 WASH

Cations	mg/L	Eq. Wt.	meq/L	Anions	mg/L	Eq. Wt.	meq/L
Calcium	25.4	20	1.27	Sulfate	52.4	47.8	1.10
Potassium	0	39.1	0.00	Chloride	70.3	35.45	1.98
Magnesium	6.07	12.22	0.50	Bicarbonate	79.4	60	1.32
Sodium	10.8	23	0.47				
Total Cations, meq/L			2.24	Total Anions, meq/L			4.40
Ionic Balance:			32.6%				

Tikishla Site
Cation/Anion Balances

Sample:	CHTK001	03/26/99	1800				
Cations				**Anions**			
	mg/L	**Eq. Wt.**	**meq/L**		**mg/L**	**Eq. Wt.**	**meq/L**
Calcium	23.9	20	1.20	Sulfate	12.7	47.8	0.27
Potassium	19.6	39.1	0.50	Chloride	194	35.45	5.47
Magnesium	9.44	12.22	0.77	Bicarbonate	55.4	60	0.92
Sodium	72.8	23	3.17				
Total Cations, meq/L			5.63	Total Anions, meq/L			6.66
Ionic Balance:			8.4%				

Sample:	CHTK002	03/09/99	1100				
Cations				**Anions**			
	mg/L	**Eq. Wt.**	**meq/L**		**mg/L**	**Eq. Wt.**	**meq/L**
Calcium	40.7	20	2.04	Sulfate	31.8	47.8	0.67
Potassium	0	39.1	0.00	Chloride	13.7	35.45	0.39
Magnesium	8.68	12.22	0.71	Bicarbonate	106	60	1.77
Sodium	5.79	23	0.25				
Total Cations, meq/L			3.00	Total Anions, meq/L			2.82
Ionic Balance:			3.1%				

Sample:	TK01	03/26/99	1800				
Cations				**Anions**			
	mg/L	**Eq. Wt.**	**meq/L**		**mg/L**	**Eq. Wt.**	**meq/L**
Calcium	20.2	20	1.01	Sulfate	6.64	47.8	0.14
Potassium	17.9	39.1	0.46	Chloride	298	35.45	8.41
Magnesium	14.9	12.22	1.22	Bicarbonate	43	60	0.72
Sodium	118	23	5.13				
Total Cations, meq/L			7.82	Total Anions, meq/L			9.26
Ionic Balance:			8.5%				

Sample:	TK01	4/1/99	1520				
Cations				**Anions**			
	mg/L	**Eq. Wt.**	**meq/L**		**mg/L**	**Eq. Wt.**	**meq/L**
Calcium	22.2	20	1.11	Sulfate	17	47.8	0.36
Potassium	11.7	39.1	0.30	Chloride	138	35.45	3.89
Magnesium	15.8	12.22	1.29	Bicarbonate	39.7	60	0.66
Sodium	72.3	23	3.14				
Total Cations, meq/L			5.85	Total Anions, meq/L			4.91
Ionic Balance:			8.7%				

Sample:	TK01	03/20/99	1255				
Cations				**Anions**			
	mg/L	**Eq. Wt.**	**meq/L**		**mg/L**	**Eq. Wt.**	**meq/L**
Calcium	57.5	20	2.88	Sulfate	155	47.8	3.24
Potassium	0	39.1	0.00	Chloride	31.4	35.45	0.89
Magnesium	20	12.22	1.64	Bicarbonate	65.9	60	1.10
Sodium	11.5	23	0.50				
Total Cations,	0		5.01	Total Anions, meq/L			5.23
Ionic Balance:			2.1%				

Appendix F
Wash Experiment Method and Calculations

STREET WASH AT GAMBELL/INGRA SITE

After the street snowmelt event was assessed and sampled, a one-time wash event was staged on April 21 along Gambell Street between Fireweed and Chester Creek, within the basin for station CHGI004. The purpose of this wash was to verify the assumption that the majority of magnesium chloride applied to streets during the winter was carried off within the spring melt period. The estimated amount of magnesium chloride used on the Gambell/Ingra couplet area between Fireweed and 15th Street, a total street area of approximately 740,000 square feet, totaled 15,445 gallons during the 1998 winter (AKDOT/PF, 1999).

Field notes indicated that the streets had been dry and free of snow since April 1, and field notes indicate that much of the snow adjacent to the highway was gone. Site wash methods involved using two water trucks that washed approximately 2,200 gallons of water onto approximately 350 feet by 65 feet of road. The water was discharged in ten passes, as the trucks moved side-by-side and sprayed water for the 350-foot length of discharge, and then turned around and came back to discharge more water. Table 1 documents the flushes, and conductivity readings obtained. Cations and anions were also analyzed for selected samples.

Station CHGI004 has a continuous groundwater flow, which was analyzed prior to the test. Conductivity of the groundwater flow was 100 uS/cm, and this conductivity level was used during testing to determine when the washing had washed all of the chloride into the stormdrain system.

Station CHGI004 has a continuous groundwater flow, which was recorded as baseflow. Two other samples were analyzed, one during the initial wash, and one at mid-wash, when conductivity levels indicated that the flow had reverted to base flow conductivity levels. Figure 1 illustrates the composition of selected samples in stiff diagrams During the wash, sodium and magnusium ion concentrations increased, and then reverted to near baseflow levels during mid-wash. As graphically indicated, the amount of ions present was very small relative to the amount of ions from CHGI004 during the melt period. Calcium was the dominant cation, while chloride was the dominant anion. Figure 2 depicts relative percentages of chloride from magnesium and sodium chloride, assuming that all the magnesium and sodium was from deicing sources. As Figure 2 illustrates, although there was not a great change in base flow due to the street washing, an increase did occur during the initial wash and then neared base flow values at mid-wash. The percent increases in Figure 2 between base flow and the initial wash resulted in a 15.1% increase in sodium chloride and a 12.7% increase in magnesium chloride contributions during the wash period.

Calculations were made to determine the amount of sodium and magnesium chloride that remained on the streets, based on the increases in magnesium observed in the analysis.

Table 1
SITE WASH DEICER EXPERIMENT
Start Time: 3:13 a.m., April 21, 1999

Elapsed Time (Min)	Flow (gpm)	Conductivity (µS/cm)	Comments
0	0.5	100	Base flow
1:00	0.7	*	*
3:10	1.3	*	1st Flush
3:30	1.3	200	*
4:30	0.8	*	*
5:10	1	*	Sample
6:30	2	200	*
7:00	2	200	*
9:30		200	2nd Flush
10:00	5	200	*
10:40	5	200	3rd Flush
13:30		200	4th Flush
14:51	1.3	*	*
15:10	5	*	*
17:00	5	150	5th Flush - Sample
18:00		100	*

* Data not available for these times.A1

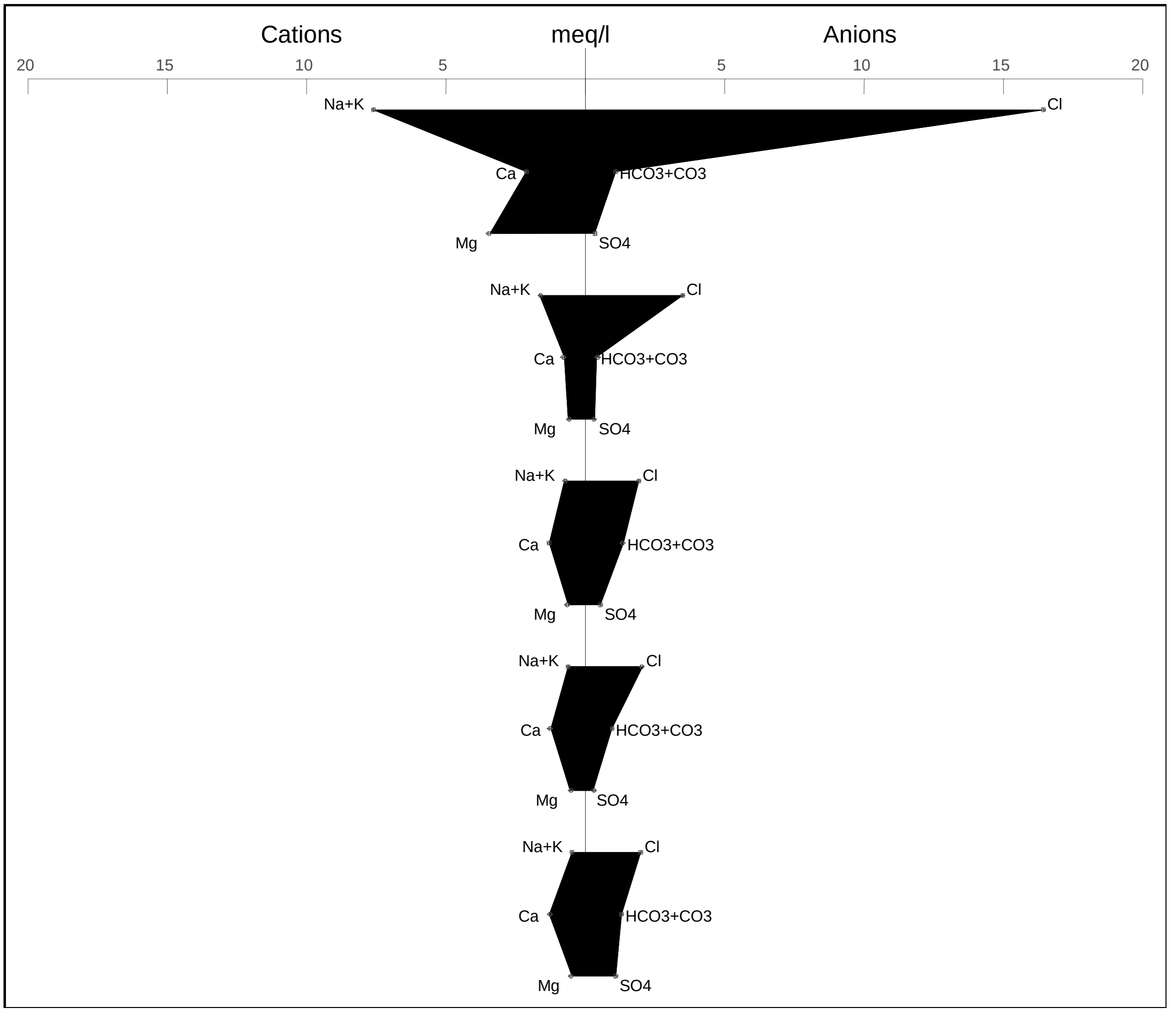


Figure 1 Stiff Diagrams of Gambell/Ingra Site Samples

Stiff diagrams depicted, from top to bottom:

A) CHGI004 (3/25/99)
B) CHGI004 (3/29/99)
C) CHGI004 (4/21/99)*
D) CHGI004 (4/21/99)*
E) CHGI004 (4/21/99)*

* Note that 4/21/99 samples were from a wash experiment, analyzed as a baseflow (C) and two flushes (D and E).

Wash Experiment Analysis
Calculation for the amount of DeicerLeft on Streets after Snowmelt

Event	Analysis at CHGI004								Source Contributions		Total
	Cl (mg/L)	K (mg/L)	Na (mg/L)	Mg (mg/L)	Cl (mmol)	Mg (mmol)	Na (mmol)	K (mmol)	NaCl	MgCl2	Contibution
Baseflow	72.2	5.75	10.6	6.26	2.037	0.258	0.461	0.147	22.6%	25.3%	47.9%
Initial Wash	68.2	4.85	13.6	7.64	1.924	0.314	0.592	0.124	30.8%	32.7%	63.4%
Mid-Wash	70.3	0	10.8	6.07	1.983	0.250	0.470	0.000	23.7%	25.2%	48.9%
CALCULATIONS											
1) Percent Difference of Base Flow and Initial Wash									15.2%	12.7%	13.9%

2) Total water discharged: 2,200 gallons.
3) Amount of water per flush (Table 6). 2,200 gallons/5 flushes = 440 gallons.
4) Four effective flushes as per Table 6 conductivities, so 440 * 4 = 1760 gallons or 6,662 Liters
5) Sodium Chloride sources: Initial Wash was 13.6 mg/L * 15.2% = 2.07 mg/L
6) Magnesium Chloride sources: Initial Wash was 7.64 mg/L * 12.7% = 0.97 mg/L
7) Amount of sodium chloride in wash: 6,662 liters * 2.07 mg/L = 13.79 grams
8) Amount of magnesium chloride in wash: 6,662 liters * 0.97 mg/L = 6.46 grams
9) Amount of sodium chloride per square foot: 13.79 grams/22,750 square feet of wash = 0.6 mg/square foot
10) Amount of magnesium chloride per square foot: 6.46 grams/22,750 square feet of wash = 0.3 mg/square foot
11) Total area between Fireweed and 15th Street on streets: 740,000 sq.ft., with 15,445 gallons deicer applied or 3,861 gallons undiluted deicer applied.
12) 3,861 gal or 14,615 liters deicer/740,000 sq.ft. = 0.0198 liters/sq.ft.
13) From FreezeGard Sample composition (Brown, 1999), magnesium is 93,200 mg/L
14) 0.198 * 93,200 = 1,841 mg magnesium/sq.ft.

15) 0.3/1841 = 0.02% deicer left on streets from application

Figure 2
1999 Chloride at Anchorage Snow Disposal and Street Sites
Gambell/Ingra Site (Station CHGI004)
April 21 Wash - Chloride Sources