Alaska Department of Environmental Conservation

FISH WASTE MANAGEMENT PLAN:
KENAI PERSONAL USE DIPNET FISHERY

CITY OF KENAI

FINAL v2

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ACRONYMS AND ABBREVIATIONS

AAC ..... Alaska Administrative Code
ADEC..... Alaska Department of Environmental Conservation
ADF&G..... Alaska Department of Fish and Game
APDES..... Alaska Pollutant Discharge Elimination System
BMP ..... best management practices
°C..... degrees Celsius
CPL..... Central Peninsula Landfill
EPA..... United States Environmental Protection Agency
FDA..... United States Food and Drug Administration
KPB..... Kenai Peninsula Borough
NPDES..... National Pollutant Discharge Elimination System
OASIS..... OASIS Environmental, Inc.

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1. EXECUTIVE SUMMARY

The Kenai River personal use dipnet fishery, which occurs from July 10 to July 31 of each year, attracts large crowds of fishermen. Hundreds of thousands of sockeye salmon are harvested during this fishery and many of these fish are cleaned on the beaches at the mouth of the Kenai River where the majority of the fishery takes place. This land is owned by the City of Kenai. A considerable volume of fish waste is discarded on the beaches and has become a problem for the City of Kenai due to the volume and short period of time in which it is generated.

This fish waste management plan evaluated nine alternatives to simply discarding the cleaned fish carcasses on the beaches and into the river. The following alternatives were considered:

Grind and Discharge

Landfilling

Ocean Dumping

Fish Based Compost

Fish Fertilizer

Biomass Energy

Fish Oil (for human consumption)

Commercial Animal Food

Non-commercial Animal Food

The Landfilling option appears easiest to implement – if the Kenai Peninsula Borough will accept the waste at the Central Peninsula Landfill. Grind and Discharge, Ocean Dumping, and Fish Based Compost also appear to be viable for handling the fish waste by the 2013 season if the Borough will not allow the fish waste in their landfill.

Long term, creating a liquid fertilizer from the dipnet fish waste may provide enough income from the sale of the fertilizer to offset the cost of production. This is highly dependent on the local demand for the product which is currently unknown.

Three of the alternatives, Fish Oil, Commercial and Non-commercial Animal Food, were ruled out as viable alternates. Fish waste from the dipnet fishery is not suitable as a feedstock for products intended for human or animal consumption.

The relatively low volume of fish waste and the short time frame in which the waste is generated (3 weeks), coupled with the high cost of processing fish for energy purposes, makes Biomass Energy an unfeasible alternative.

Data on the amount of fish caught and cleaned on the beaches at the mouth of the Kenai River is lacking. Many assumptions had to be made to provide estimates of fish waste generated and discarded on the beaches. A survey of fish caught and cleaning practices would improve the accuracy of the fish waste estimates.

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2. INTRODUCTION

The Kenai River is the most productive sockeye salmon river in Upper Cook Inlet. Every summer it attracts large numbers of fishermen seeking to catch some of the returning salmon. The Alaska Board of Fisheries established "Personal Use" fisheries and in 1982, a personal use dipnet fishery was started near the mouth of the Kenai River (Figure 1). This fishery allows Alaska residents to harvest salmon from the Kenai River using dipnets. The season begins July 10th and runs through July 31st of each year. There are designated shoreline areas for shore based fishing and a section of river open to dipnetting from boats (Figure 2). The fishery has steadily grown in popularity and harvest amounts have also been increasing. Along with the increased harvest comes increased fish waste from fish cleaning in the fishery area.

2.1. Concerns Associated with Fish Waste

Although fish are a natural part of the environment and decompose in water bodies after they die, too much decomposing fish matter in one area can pose problems with water quality, odor, aesthetics, and nuisance or dangerous wildlife. A large volume of fish waste disposed of in a particular location can create accumulations of waste sludge and whole fish parts, cause the generation of toxic hydrogen sulfide gas, if discharged to surface water could cause dissolved oxygen concentrations to decrease below state water quality standards (WQS), increase the concentration of scavengers, and create noxious conditions caused by odors, bacteria and waste decomposition.

2.2. Regulatory Framework

Solid waste in Alaska is regulated under Title 18 of the Alaska Administrative Code, Chapter 60 (18 AAC 60). These regulations govern the storage, transportation, treatment, and disposal of solid waste and generally require a permit for disposal of solid waste in a landfill.

Wastewater is regulated by 18 AAC 72, Wastewater Disposal, and by 18 AAC 83, Alaska Pollutant Discharge Elimination System. 18 AAC 72 requires a permit for a person who disposes of nondomestic wastewater into or onto land, surface water, or groundwater in the state of Alaska. 18 AAC 83 implements the Alaska Pollutant Discharge Elimination System (APDES) in accordance with the Clean Water Act. The regulations in 18 AAC 83 govern point source wastewater discharges into waters of the United States within the state of Alaska.

Under the APDES program, ADEC is in the process of drafting a general permit for the disposal of fish waste in fresh water. ADEC intends for this permit to cover the disposal of fish waste from both seafood processing and non-seafood processing sources such as fish waste collected from the Kenai personal use fishery, dependent upon the method of discharge. (S. Stokes, personal communication, November 2011). In addition, ADEC is considering including general permit coverage for smaller discharges of fish waste not

currently covered under the APDES program. Appropriate permit limitations and controls for smaller dischargers are under development.

ADEC intends to have the permit in place in time for the 2013 Kenai personal use fishery. The future impact of this ADEC permit is dependent upon the volumes of waste allowed to be discharged, and acceptable methods of disposal allowed from the personal use fishery. Individual participants in the personal use fishery will not be required to seek coverage under this general permit, but instead coverage may be available for aggregated fish, for example, fish collected in totes. (Current ADEC permits only provide coverage for the disposal of fish waste from seafood processing.) Fish waste discharges that are not currently authorized under other permits will be a high priority for issuance.

Dumping material into the ocean is regulated by the Marine Protection, Research, and Sanctuaries Act, also known as the Ocean Dumping Act (40 CFR Parts 220 to 229). Ocean Dumping is only allowed in territorial waters. Although the Ocean Dumping Act regulations do not require a permit to dispose of fish waste in the ocean, EPA still has the discretion to set conditions and establish locations where the dumping of the fish waste occurs. (See section 5.4.)

18 AAC 70, Water Quality Standards, sets standards for surface water quality. The standards specify the degree of degradation that may not be exceeded in a water body as a result of human actions. A person may not conduct an operation that causes or contributes to a violation of the water quality standards set by these regulations.

2.3. Objectives of Fish Waste Management Plan

This management plan is designed to:

Document the impacts of fish waste caused by the personal use fishery.

Identify options for improving fish waste management.

Outline the feasibility of each disposal and beneficial use alternative.

Identify a preferred alternative and recommend associated actions.

3. DIPNET FISHERY AND FISH WASTE

The Kenai River dipnet fishery involves harvesting of salmon near the mouth of the Kenai River using a dipnet from either the shore or a boat. Many participants clean and fillet their fish in the fishery area and leave the carcass behind as waste.

3.1. Background

In 1981, four personal use fisheries in Cook Inlet were authorized by the Alaska Board of Fish. The four fisheries are open to all Alaska residents. One of these fisheries is the Kenai River dipnet. Participants are required to obtain a permit that allows members of a household to fish for sockeye salmon at the mouth of the Kenai River using a dipnet. Other salmon species and flounder are also harvested incidentally and may be retained.

The fishery runs from July 10 to July 31 of each year and the hours are 6:00 am to 11:00 pm unless extended by emergency order. The total annual limit is 25 salmon for the head of household and 10 salmon for each additional member of a household.

Dipnetting is allowed from shore from the commercial fishing markers located in Cook Inlet north and south of the river mouth, upstream to the downstream edge of the Warren Ames Bridge, except for a section of the north shore from an Alaska Department of Fish and Game (ADF&G) marker below the terminus of Main Street to ADF&G markers near the Kenai City Dock (Figure 2).

Both the north shore of the Kenai River mouth (North Beach) and the south shore (South Beach) of the dipnetting area are within the City of Kenai. Access to the North Beach is via Spruce Street and motor vehicles are not allowed on the beach itself at the mouth of the river. A day-use parking area is located at the end of Spruce Street and fishery participants walk from there to the shoreline. The City of Kenai charges fees for parking and for camping.

Access to the South Beach is off Cannery Road from Kalifornsky Beach Road. Vehicles are allowed on the beach between the high water mark and the sand dunes. Four-wheel-drive is required to avoid getting stuck in the soft sand. Camping is allowed on the beach and the City charges fees for parking and camping on the South Beach.

Dipnetting is also allowed from a boat but not at the river mouth. The open area for boats is from ADF&G markers near the Kenai City Dock upstream to the downstream edge of the Warren Ames Bridge. The closest public boat launch to the fishery is located at the City of Kenai Dock. Boats can also launch from a privately owned boat launch at Kenai Landing. The next closest public boat launch on the river is The Pillars located at river mile 12.5. Some smaller boats are launched from shore at the Warren Ames Bridge.

The fishery is scheduled to coincide with the late-run of sockeye salmon that occurs in July. The late run is the larger of the two sockeye salmon runs on the Kenai River with a return that typically exceeds one million fish. However, the number of returning fish varies substantially from year to year. In addition, the number of fish entering the river

each day varies. The peak of the return is mid to late July but this too varies. Graph 1 shows the average number sockeye salmon counted per day by ADF&G at their Kenai River Mile 19 sockeye salmon sonar site.

3.2. Participation and Harvest

The fishery draws residents primarily from the Kenai Peninsula, Anchorage, and the Matanuska-Susitna Valley (ADF&G, 2010). The run timing and sonar counts are well publicized and the number of people fishing each day tends to mirror the number of fish entering the river. The weekend that occurs nearest the peak of the run tends to be particularly crowded. The fishery can be divided up into several areas – North Beach, South Beach, City Dock (boats), other boats, and shore fishing upstream of the beach areas.

The City of Kenai (City) estimates the number of participants each year that access the fishery through the city owned assess points (City of Kenai, 2011). The estimate is based on fees collected and assuming that there are three participants per daily fee paid to access the beach and four participants per boat launch fee paid at the City Dock. The levels of participation in those areas have generally increased as shown in Graph 2. During 2011 approximately 64,000 participants accessed the fishery from the North Beach, South Beach, and City Dock.

Table 1 lists the percentage of the total participants that access the fishery through the city owned assess points between 2003 and 2011. Based on these estimates, approximately 45 percent of the participants fish from the North Beach, 24 percent fish from the South Beach, and the remaining 31 percent fish from boats launching at the City Dock. Although potentially significant, no data is available on the number of participants that access the fishery from other areas.

The amount of salmon harvested varies by the strength of the return and the number of participants. ADF&G updates the sockeye sonar counts daily and this is also publicized widely and affects the amount of people that participate in the fishery. Stronger runs attract more people with the promise of greater catch rates and years with lower returns tend to see lower participation in the fishery. However, the overall trend has been for more participants and greater numbers of salmon harvested. This increasing trend can be seen in Graph 3, which shows the annual harvest for the fishery from 1996 through 2011 (ADF&G, 2012).

In 2011, ADF&G estimated that 548,583 salmon were harvested in the Kenai River dipnet fishery. This includes all species of salmon, although 98 percent of the total harvest was sockeye salmon. ADF&G's total includes the sum of the harvest reported on returned permits plus an estimated harvest from permits that were not returned.

3.3. Fish Waste Generation

Fish caught in the fishery are handled in a number of different ways. Some fishermen will remove the entire fish from the fishery area to be cleaned and processed elsewhere. Others will remove the head and guts near where the fish are caught and then process

the remaining carcass elsewhere. Many others will fillet the fish near where they are caught to minimize the amount of waste that needs to be transported and disposed of elsewhere.

ADF&G advises people cleaning fish riverside to chop up the waste into pieces and toss them into fast flowing water. The intent is to eliminate fish waste on land that can attract wildlife, particularly bears, and to return the nutrients provided by the fish remains back into the river system. This method of fish waste disposal is provided in the sport fishing regulations (ADF&G, 2011a) and most fishermen are aware of it. Cleaning fish can be a messy endeavor and many people prefer to perform this chore riverside to avoid creating a mess at home.

A challenge for this waste management plan was estimating the amount of fish that are cleaned on the beaches during the dipnet fishery. This bears directly on calculating the amount of fish waste that can be expected to be generated during the fishery. We assumed that none of the fish taken from a boat are cleaned on either the North or South Beaches.

For the South Beach, we surmise that since one can drive a vehicle nearly to the water's edge, a greater percentage of the people choose to clean their fish at some other location where there is access to clean water and no sand. A cooler full of whole fish, or gutted fish, is heavy but if it can be moved using a vehicle it is less of a problem to transport. We estimated that 80 percent of the fish harvested from the South Beach are cleaned at the beach and that the rest are cleaned elsewhere.

Access to the water's edge at the North Beach is more limited. Vehicles are prohibited on the beach in the area where most people fish and the distance to parked vehicles can be substantial on crowded days. Carrying a heavy cooler full of whole salmon across soft sand and then some distance to a car provides more incentive to clean fish near where they are caught. Fillets are approximately half as heavy as the whole fish. For the North Beach we estimated that 90 percent of the fish caught are cleaned on the beach.

To calculate the amount of fish waste generated, we took the total harvest and allocated a portion of the total to each of the three areas based on the number of estimated participants for each area. In other words, we assumed that 45 percent of the total harvest was taken at the North Beach since 45 percent of the total participants fished there. We assumed that the success rate was equal between the three areas since we do not have any data to suggest otherwise, although it is likely that boats are more successful. Table 2 shows the estimated harvest by beach area from 2003 to 2011.

The ADF&G Upper Cook Inlet commercial fishing report (ADF&G, 2010b) lists an average sockeye salmon weight of 6.3 pounds for upper Cook Inlet. We used this weight to calculate the amount of fish caught in pounds. The amount of waste generated from cleaning the fish varies depending on how it is cleaned. Approximately 15 percent of the fish is left as waste after just gutting the fish, approximately 25 percent if it is gutted and headed, and about 50 percent is left as waste if it is filleted. There is no data on how many fish are filleted versus headed and gutted, or just gutted, and an

average value of 30 percent of the fish is left as waste was used to calculate the amount of waste generated for the South Beach and 35 percent for the North Beach. Using these assumptions, we estimated the annual amount of fish waste that was generated on each beach from 2003 to 2011 (Table 3).

The estimated amount of fish waste ranged from approximately 170,000 pounds in 2006 to approximately 730,000 pounds in 2011. Converted into cubic yards (yd^3), the waste was approximately 98 yd^3 in 2006 and 422 yd^3 in 2011. Using the assumptions discussed above, roughly two to three times as much waste is generated on the North Beach as on the South Beach.

ADF&G also provided us with daily harvest amounts for 2008 through 2010. We used this data along with the assumptions above to estimate the amount of fish waste generated on each day of the fishery for each beach during these years (Tables 4 and 5). There are variations from year to year, but the general trend is for the amount of fish waste generated to remain relatively low and steady the first several days of the fishery and then to increase suddenly around the 15th or 16th of July and peaking between July 17th and 19th. There is a second, smaller, peak of waste generated occurring between July 24th and 26th. As one would expect, this pattern corresponds with the general pattern of the ADF&G sonar counts of returning sockeye salmon (Graph 1).

4. POTENTIAL IMPACTS OF FISH WASTE

The potential impacts of the fish waste generated on the North and South beaches during the Kenai personal use dipnet fishery are discussed in the following sections. Reducing the number of fish carcasses would reduce these impacts.

4.1. Human Health and Safety

Fish waste generated by the Kenai personal use dipnet fishery may attract disease vectors, birds, and other animals. A large colony of herring gulls utilizes the flats near the mouth of the Kenai River and feed on carcasses from the fishery and other food sources. The large numbers of birds attracted by the carcasses and other food sources defecate on the beaches and this may contribute to elevated levels of bacteria detected by ADEC and the City of Kenai during the personal use fishery. Recent microbial source tracking sample results found bird markers in 80% of the water samples collected in 2011.

ADEC has water quality standards (18 AAC 70.020(b)) for fecal coliform bacteria that apply to both fresh and marine water. Because of the extreme high tides in Cook Inlet the mouth of the Kenai River can be considered to have both fresh and marine depending on the tidal stage. The specific standard is based upon whether the receiving water is used for a water supply (e.g. drinking water or food processing), agriculture, aquaculture, industrial water, contact recreation, or secondary recreation. The most stringent standard is for water supply use. The water supply use standard for fresh and marine water (seafood processing) for fecal coliform state that in a 30-day period, the geometric mean of samples may not exceed 20 fecal coliforms/100 milliliters, and not more than 10% of the total samples may exceed 40 fecal coliforms/100 milliliters.

4.2. Nuisance Complaints

The large number of carcasses left on the North and South beaches contributes to excessive noise and feces from birds as well as strong odors from decay. They also degrade the aesthetics of an otherwise scenic area.

With a lack of fish cleaning stations and a clear location to dispose of fish waste, some amount of fish waste ends up being disposed of inappropriately. Waste is placed into dumpsters and trash cans that are not emptied daily causing noxious odors and attracting flies, pets, and wildlife. In addition, fish waste from the dipnet fishery has been discarded illegally in parks, roadside pullouts, and thrown into streams and rivers other than the Kenai River (ADF&G, 2011b).

This can create a dangerous situation if bears are drawn to discarded fish carcasses in areas frequented by people, particularly if bears are not normally expected in those locations. Moving fish carcasses from one drainage to another has the potential to introduce pathogens into stream systems, endangering local salmonids.

4.3. Violations of City or State Laws and Regulations

State law requires that fish waste disposal not cause any impairment to water. Water quality sampling conducted by ADEC and the City of Kenai during the personal use fishery indicated that elevated fecal coliform bacteria levels exist in the Kenai River during the fishery. These elevated levels may violate Alaska Water Quality Standards listed in 18 AAC 70.020(b).

Fish waste left along roadsides, parks, private property and other places is considered littering and is prohibited by AS 46.06.080.

5. DISPOSAL OPTIONS

Collection and disposal of the Kenai River dipnet fish waste is one method of reducing the impacts of a large amount of fish waste being placed in the river and beaches during the fishery. There are several different disposal options: Grinding the fish carcasses and disposing of the waste as wastewater, placing the fish carcasses in a landfill, and dumping the carcasses off shore.

5.1. Fish Cleaning Stations

Although fish cleaning stations are not a disposal option per se, the stationing of cleaning stations on the beaches would facilitate the collection of fish waste for disposal by creating localized spots where the waste is generated. The City of Kenai may choose to put fish cleaning stations on the North and South Kenai River beaches in order to increase compliance with placing fish carcasses in containers for disposal (e.g. landfilling, ocean dumping, beneficial use, etc). Suggested areas for placing cleaning stations and carcass collection containers are shown on Figure 3.

In 2010, an estimated 1,223 to 14,536 fish were caught per day on the South Beach. Assuming that active fishing occurred during 17 hours per day, there would be an average 72 to 855 fish caught per hour, although the fish tend to arrive in waves and peak catch rates likely exceed these averages. If the average angler took 1 minute per fillet, a fish cleaning station could be used to clean 30 fish per hour. If 50% of anglers used a fish cleaning station, there would be a need to fillet a minimum of 36 to a maximum of 428 fish per hour (based on the averages). When this value is divided by the rate of 30 fish cleaned per station per hour, a range of 2 to 14 fish cleaning stations could be necessary at the South Beach. There were a median of 2,652 fish caught per day on the South Beach. Applying the same formula, a total of 3 fish cleaning stations would be necessary.

Much larger numbers of fish are caught on the North Beach. In 2010, there were an estimated 2,280 to 27,108 fish caught per day. The median number of fish caught per day was 4,945. Following the same formula as listed above a range of 3 to 28 fish cleaning stations could be necessary at the North Beach. Five fish cleaning stations would accommodate the median number of fish caught per day.

If the City of Kenai chooses to install fish cleaning stations on the beaches during the dipnetting fishery, there will be some wastewater produced from wash water draining off the tables. We contacted the wastewater discharge permitting section of ADEC concerning this type of discharge (S. Stokes, personal communication, January 4, 2012). ADEC stated that fish cleaning station wastewater is not currently a regulated point of concern for ADEC. However, ADEC could require a discharge permit for an area due to water quality concerns or nuisance issues.

5.2 Grind and Discharge

Seafood processors in the Kenai area dispose of much of their fish waste by discharging it into the Kenai River or Cook Inlet under an APDES general permit for wastewater discharge. (EPA, 2001). The permit stipulates that the fish waste must be ground up to less than 0.5 inch particle size prior to discharge. We attempted to contact the processors to inquire about the possibility of disposing of the dipnet fish waste at their facility but only receive a response from one processor.

We were able to contact Pat Simpson of Alaska Marine Nutrition (P. Simpson, personal communication, November 22, 2011) which takes fish heads and skins from the other processors and produces fish oil and fish meal. Mr. Simpson stated that his facility (relocating to the old Ocean Beauty facility in Nikiski) has the equipment and is permitted to discharge fish waste. The fish waste from the dipnet fishery would require washing prior to grinding to remove sand which would damage the grinding equipment. Mr. Simpson estimated that it would cost roughly $85,000 to $100,000 to collect the fish waste, transport it to their facility, clean, grind, and discharge under their wastewater discharge permit. This was based on 250,000 pounds of fish waste, whereas, our estimates suggest that it could be twice that amount.

It should be noted that in some areas of Alaska and the rest of the U.S., discharging fish waste into near shore surface waters is not permitted. The current general permit is expired (coverage prior to expiration has been extended) and ADEC, which now has primacy over this type of discharge, is drafting a new general permit. In addition, the EPA is currently reviewing whether or not to continue to allow the discharge of ground fish waste into near shore waters (EPA, 2010).

Another option could be to apply for coverage under the Alaska Offshore Seafood Processors General Permit, AKG523000, which can authorize the discharge of ground fish waste from a shore based facility via a barge or vessel to waters at least 0.5 nautical miles from shore (as delineated by mean lower low water). Although the transportation distance would be shorter than that what would be required for Ocean Dumping (see Section 5.4), the waste would have to be ground to 0.5 inch or smaller. A processor would still likely require that the fish waste be cleaned prior to being ground in order to protect their equipment.

5.3 Landfilling

Solid waste in the vicinity of Kenai is ultimately handled at the Central Peninsula Landfill (CPL), which is owned and operated by the Kenai Peninsula Borough (KPB). The landfill is situated at milepost 98.5 of the Sterling Highway in Soldotna, approximately 10 miles from the David Douthit Veteran's Memorial Bridge. The landfill is presently utilizing a lined cell (Cell 1) which occupies approximately 9.5 acres. A second lined cell (Cell 2) was completed in Fall 2011. Each cell, and subsequent cells, are designed with a service-life of five years. The CPL has a stated policy of accepting fish carcasses from individuals and requests notification at the time of disposal so that the operators can immediately cover the waste (KPB, 2011). Commercial fish waste is also accepted but

is limited to 1,000 pounds per week at the CPL. Disposal at transfer facilities is limited to two trash bags per day and requires double-bagging.

The ADEC Solid Waste Department was contacted about the possibility of fish carcass disposal at the CPL (E. Stergiou, personal communication, January 3, 2012). The Department anticipates that no new permitting would be required, but the existing permit would be amended to allow the activity. The concept of landfill disposal of the fish waste is viewed by ADEC as a short-term solution for the City. Technical and logistical issues that would require consideration include space availability, water quality and plans for waste treatment using lime to neutralize odors and disease vector attraction.

Disposal of dipnet fishery carcasses at the CPL has been considered in the past. CPL has not accepted the large quantity of waste in the lined cell due to operational hazards created by material of such consistency. The KPB Solid Waste Director was contacted to discuss the possibility of modifying waste handling procedures to allow disposal of fish carcasses at the CPL (J. Maryott, personal communication, January 5, 2012). He stated that it may be possible to accept and safely handle the fish waste but he could not commit to accepting the fish waste at this time.

5.4 Ocean Dumping

Collecting the fish waste, placing it in a barge, and towing the barge to a location in Cook Inlet for disposal is a potential disposal option. The fish waste would initially need to be stored in containers on the beach that could be loaded or emptied into a boat or barge. The barge would be towed to a location in Cook Inlet where the dumping of fish waste is allowed by EPA under the Ocean Dumping Act.

The Ocean Dumping Act (officially named the Marine Protection, Research, and Sanctuaries Act) prohibits the dumping of material into the ocean that would unreasonably degrade or endanger human health or the marine environment. Materials that are currently disposed of by ocean dumping include sediment, fish wastes, human remains, and vessels.

Ocean Dumping is only allowed in territorial waters. The National Oceanic and Atmospheric Administration (NOAA) nautical chart entitled “Cook Inlet – Anchor Point to Kalgin Island: Ninilchik Harbor” number 1661 displays the location of territorial water in Cook Inlet. The territorial sea boundary line is located roughly just north of Ninilchik and runs northwest through Kalgin Island and continues northwest to Harriet Point (Figure 4). The water seaward of this line is territorial water where Ocean Dumping may be allowed.

The regulations to implement the Ocean Dumping Act are found in 40 CFR Parts 220 to 229. In 40 CFR 220.1(c)(1), there is a provisional exclusion from requiring a permit to dispose of fish waste in the ocean. It states the following:

> (c) *Exclusions* — (1) *Fish wastes.* This subchapter H does not apply to, and no permit hereunder shall be required for, the transportation for the purpose of dumping or the dumping in ocean waters of fish wastes unless such dumping occurs in:
> (i) Harbors or other protected or enclosed coastal waters; or

(ii) Any other location where the Administrator finds that such dumping may reasonably be anticipated to endanger health, the environment or ecological systems.

This exclusion from requiring a permit is conditional and is based upon EPA making a finding that disposing of the fish waste in the ocean would not endanger health, the environment, or ecological systems. In order for EPA to make a determination that a permit is not necessary for fish waste disposal, a proposal would need to be submitted to EPA with the minimum of the following information: 1) responsible party for the waste; 2) the proposed disposal site(s); 3) disposal date(s); 4) type of fish waste; 5) quantity of fish waste; 6) whether fish are ground or whole; and 6) method of disposal. The proposal may include conditions on disposal site conditions, whether the discharge occurs while the vessel is stationary or underway (and at what speed), the distance of the disposal site from land, site depth, habitat at the disposal site and other pertinent factors. The EPA should be contacted during the proposal preparation process if this alternative is chosen. The proposal should be sent to:

Chris Meade
EPA Region 10
PO Box 20370
Juneau, AK 99802-0370
E-mail address: meade.chris@epa.gov
Phone #: (907) 586-7622
Fax #: (907) 586-7015

EPA will review the proposal and may provide the applicant with a letter that affirms that a permit is not required but imposes conditions or restrictions associated with disposing of the fish waste in the territorial seas. For example, EPA could require that the fish waste be disposed 3 to 12 nautical miles from shore in order for the discharge to occur outside of state waters, which would increase towing costs. In the worst case scenario for distance, EPA may require that the discharge of fish waste be disposed of 12 nautical miles from shore in addition to the requirement that the discharge be in territorial seas. The waste would then need to be disposed of south of South Kalgin Bay in the center portion of Cook Inlet (the line labeled “Territorial Sea and Contiguous Zone” on Figure 4). In addition to location restrictions, EPA may impose other conditions such as requiring that the fish waste be ground.

It is possible, although less likely, that EPA may determine that a permit is required for the disposal of fish waste in territorial waters. The permitting process for Ocean Dumping requires a federal rulemaking process.

6. BENEFICIAL USE OPTIONS

Ideally, the fish waste from the Kenai River dipnet fishery would be used for a beneficial purpose. There are a number of products that can be derived from fish waste, but the main impediment is the cost of producing these products on a small scale and within a short time frame.

6.1. Fish Based Compost

Composting is a process of speeding of the natural decomposition of organic matter. Compost makes a good soil amendment adding nutrients and organic matter to the soil aiding plant growth. Composting also reduces the volume of waste.

Organic waste will decompose on its own, but if attention is paid to three key areas the rate of decomposition is much faster. The three primary factors affecting the rate of decomposition are aeration, moisture content, and the proper carbon to nitrogen ratio. Of these, the factor that is of primary importance in composing fish is the carbon to nitrogen ratio. Bacteria and fungi use carbon as an energy source and nitrogen for protein synthesis. To promote rapid decomposition the organic matter should preferably be mixed using a ratio of 30 parts carbon to 1 part nitrogen by weight. Too much nitrogen can cause the generation of ammonia gas and unpleasant odors.

Since fish waste contains a higher nitrogen content than most organic matter used for compost, fish composting requires a slightly different technique from regular composting due to the potential for extreme odors. Wood residuals can be used as bulking agents to improve pile porosity and facilitate decomposition (Nicholls, 2002). If using wood waste for the carbon source, recommended ratios for fish compost vary substantially, from 2 parts wood to 1 part fish all the way up to 30 parts wood to 1 part fish.

Several communities compost primarily for waste reduction. The city of Bethel's Community Garden and Gustavus Community Compost both collect organic food waste and mix it with a bulking agent such as sawdust and wood chips. The finished compost is then used by gardeners in the community (Anderson, July 2011).

In the summer of 2009, Alaska Waste in Anchorage began a commercial composting pilot program (Alaska Waste, 2011). They use a composting machine that is 10 feet in diameter and is 32 feet long, with the capacity to process 16 cubic yards of material daily. The composter rotates slowly at the rate of one revolution every six minutes in order to move oxygen through the compost, speeding up the decomposition process. The composter is set at a 1 degree incline so that materials will very slowly tumble down towards the output. By the time material has travelled from one end of the composter to another over the course of four to six days, it has been completely converted from waste to quality soil amendment material.

The City of Gustavus composts food waste at their landfill with the primary objective of prolonging the life of their landfill (P. Berry, Manager/Operator City of Gustavus Disposal & Recycling Center, personal communication January 9, 2012). Burying food waste

requires significant landfill space and requires immediate and significant earthen cover to keep away birds and flies and to trap odors.

During 2008 and 2009, Gustavus accepted 57,907 lbs and 48,216 lbs of food waste per year. This volume of food waste was used to produce 10 to 12 yd^3 of compost per year. The composting yard is a raised and leveled 110' (front to back) by 60' (left to right), 6,600 square foot area adjacent to the original landfill. The composting yard includes a mixing station, Quonset shed (48' long x 30' wide x 16' high) wood chip storage pile, and an aeration blower.

The food waste is mixed with a bulking agent such as wood chips, typically local spruce or alder. The food waste, wood chips and any amendments are mixed and transported to the Quonset shed for composting using a static pile method. This means the food waste and wood chip mixture is not turned once it is placed in the Quonset shed. (The shed is used to protect the pile from excess moisture that contributes to anaerobic conditions and resulting odors.) Each pile holds about 10 to 12 yd^3 of waste. The mixture is capped with approximately 2 inches of wood chips to control odor and flies. There are aeration pipes under each static pile. Most of the time the static piles are passively ventilated, but they can be actively aerated with a blower if odor is a concern.

Funding for the operational costs associated with the Gustavus food waste composting program is provided through user fees ($0.14 per pound), subsidy by the city, and the sale of finished compost. Funding of the capital costs associated with establishing the food waste composting program came from Federal, State, City and private grants (City of Gustavus, 2010).

GUSTAVUS COMPOSTING YARD

In 1998 E&A Environmental Consultants, Inc. prepared a "Fish Waste Composting Feasibility Study" for Sitka Tribal Enterprises (STE) based upon the results of multi-year pilot project composting 28 tons of fish waste (E&A Environmental Consultants, Inc., 1998). Fish waste was composted using the aerated static pile composting process. A total of three compost piles were constructed on city owned land with a total volume of approximately 300 cubic yards. The actual composting area was a quarter acre in size, with an additional quarter acre area for storing bulking material. An eight by twelve foot building was moved to the site for use as a field office and storing equipment. In addition to three compost piles with approximate dimensions of 33 feet long and 22 feet wide, the site also had a biofilter

made from a pile of wood debris with dimensions of 24 by 33 feet to prevent odor. Odor generation and control is a significant operational issue in the composting of organic wastes; biofilters (a pollution control technique using living material to capture and biologically degrade process pollutants) are used to control the odor.

The Sitka Fish Waste feasibility study looked at the capital and operational cost of scaling the 28 ton pilot project up to a 3,000 ton per year or a 10,000 ton per year fish waste compost facility. Depending on the composting scenario, the per ton composting costs ranged from $37 to $161 per ton of organics composted for the 10,000 ton per year compost facility. The 3,000 ton per year composting scenarios were more expensive than the 10,000 ton per year scenarios, and ranged from $66 to $207 per ton of organics processed.

Snug Harbor Seafoods in Kenai composts the fish waste from their fish processing plant. The ratio of fish to wood depends upon the condition of the chips. A ratio of 8 parts wood chips to 1 part fish waste is the ratio they generally use. Brenda Stoops of Snug Harbor Seafoods expressed interest in working with the City of Kenai to determine if the fish waste from the Kenai personal use fishery could be composted at Snug Harbor Seafoods. Ms. Stoops did not have a unit cost estimate at the time that OASIS contacted her for composting the fish waste, or the volume of fish waste that the facility has the capacity to accept. Ms. Stoops indicated that either whole fish or ground fish could be used for composting. Whole fish take longer to compost but it is possible. If fish waste from the personal use fishery were used, the sand level would be a concern (B. Stoops, personal communication, January 9, 2012).

According to ADEC Solid Waste regulations, composting facilities are exempt from permitting requirements if they accept less than 5 tons per day (18 AAC 60.200(10)). If ADEC deemed the facility to be a nuisance due to odor or animals, the facility would need plan review. If the facility accepted more than 5 tons per day, it would automatically require a plan review. The composted material could either be sold or used as landfill cover material.

The Kenai personal use fishery generates a median of 8 tons of fish waste from the combination of the North and South beaches per day. A plan review would be necessary if all fish waste were disposed at one composting facility. Per 18 AAC 60.700(i), ADEC does not charge a fee for permit or plan review activities related to a composting facility.

6.2. Biomass Energy

Salmon waste contains roughly 10% oil that can be used as energy for heating, electric power generation, or in vehicles. The primary issue is the cost of producing oil from fish waste and creating a useable product. There are two predominant ways of separating the oil from the rest of the fish waste, rendering and ensiling. Rendering involves heating the waste until the oil separates from the fish tissue and floats to the top of the container where it is recovered. Rendering is the most commonly used method to produce fish oil from fish waste, but it is an energy intensive process as the waste needs

to be heated to greater than 160^{o}F and keep there for period of time to breakdown the cellular structure of the fish. In the ensiling process, the fish waste is mixed with an acid (typically formic acid) and allowed to sit for days or weeks. The acid breaks down the fish tissue releasing the oil. It also kills pathogens, liquefies the fish waste, and allows for storage of the waste at ambient temperatures for up to several months. Ensiling results in a lower oil yield than rendering.

A number of studies have been performed to evaluate different methods of producing fish oil from fish waste and how to use the resulting product for energy. Generally, raw fish oil cannot be used as fuel in unmodified diesel systems due to high viscosity, polymerization which causes engine deposits, and high cloud point temperature (the oil gels at relatively high temperatures). However, UniSea has been successfully operating diesel generators using a blend of raw fish oil (mainly derived from pollock) and diesel fuel at their Dutch Harbor facilities (UniSea, 2009). Other studies have met with less success in using salmon oil in diesel engines, encountering problems with the fuel systems (Alaska Center for Energy and Power, 2010).

Studies have been conducted on converting salmon oil into biodiesel (Taku Renewable Resources, 2010; Sustainable Community Enterprises, 2007; Chiou, et al., 2008), a process known as transesterfication, to make it more suitable for use as a fuel in diesel engines. Once converted, the oil can be used in an unmodified diesel engine the same as diesel fuel. Disadvantages of biodiesel include cost to produce, a high cloud point (the temperature at which filter plugging wax crystals form), and for fish oil in particular, a short shelf life due to oxidation. In addition, one study (Taku Renewable Resources, 2010) determined that biodiesel produced from salmon oil does not meet ASTM D6751 standards and, therefore, could not be used as on on-road fuel, diminishing the value.

A significant obstacle to utilizing the fish waste from the Kenai dipnet fishery to produce fish oil, is the relatively low volume and the short time frame in which the waste is generated (3 weeks). In discussions with Pat Simpson of Alaska Marine Nutrition (P. Simpson, personal communication, November 22, 2011), the energy cost alone in the Kenai area of rendering salmon waste to separate the oil on a small scale exceeds the current price of diesel fuel. A feasibility study on biodiesel production in Juneau conducted by Taku Renewable Resources, Inc., concluded that the cost of producing biodiesel from fish processors on the Juneau road system could be as high as $37 per gallon.

According to an article in Fishermen's News (Fishermen's News, 2011), a researcher with the University of Alaska Fairbanks (Renewable-based Hydrocarbons Lab at the Palmer Center for Sustainable Living) is looking at the chemical conversion of biomass into an energy source. By combining fish waste and sawdust, he is developing pellets which can be placed in a gasifier to produce the equivalent of natural gas. The technology is still under investigation while further research is done to determine ash composition and emissions profiles.

6.3. Fish Oil

Section 5.2 discusses the production of fish oil from salmon waste to use as a fuel. In evaluating the feasibility of converting the salmon waste to fuel, the cost of production is compared to the value of the product. In this case, it is compared to heating oil and diesel fuel, roughly $3.50 - $4.50 per gallon at this time. However, fish oil produced for human consumption can be sold at a much higher price – up to several hundred dollars per gallon.

OASIS contacted Pat Simpson of Alaska Marine Nutrition to discuss the possibility of their using Kenai dipnet fish waste as feedstock for their products. In 2010 and 2011, the company took fish by-products from local processors to make food grade fish oil, fish meal, and pet treats. Fish heads were ground and rendered for oil. Frames (bones and fins) were ground and used to make meal for the pet food market, or disposed of by discharging via a permitted outfall.

To meet U.S. Food and Drug Administration (FDA) and their clients' quality standards, the fish accepted by Alaska Marine Nutrition requires a chain of custody. This allows the fish to be traced back to its origin. Placing containers on the beaches for individuals to throw their filleted carcasses into would not meet the chain of custody requirements and cannot be used to produce Alaska Marine Nutrition's products.

6.4. Commercial Animal Food/Treat

Arctic Paws is an Anchorage-based manufacturer of high protein pet treats. Their signature product, "Yummy Chummies ®" are made from various sources of food-grade fish. Based on a conversation with the owner/founder of the company (B. Gibson, personal communication, November 14, 2011) there are three challenges with the concept of using fish waste from the Kenai River dipnet fishery in their products:

Quality Control. Raw materials used for pet food products are sold commercially and must meet food grade standards. Issues of concern include decomposition (compromised quality if carcass is not iced), sand (affects both product quality and operability of grinding equipment) and potential for encountering lost tackle from sport-fishing hooks and other hardware (also affecting quality and equipment).

Cost/Logistics. Shipping cost per pound (primarily for fuel) from Kenai to Anchorage is prohibitive as it detracts from overall profitability. This is particularly true since approximately 79% of a whole fish is moisture that is ultimately driven off through processing.

Regulations. Potentially a problem, sport fish (and game) regulations prohibit the sale of any part of the animal.

It should also be noted that Alaska Marine Nutrition, based in Kenai, ceased making fish meal for use in pet food because it was not profitable.

6.5. Non-Commercial Animal Food

The potential use of Kenai River dipnet fish waste as a raw food source for animals was discussed with three non-profit organizations based in the Municipality of Anchorage: the Alaska Zoo, the Alaska Wildlife Conservation Center (AWCC) and the Bird Treatment and Learning Center (TLC). There are no known similar organizations located closer to Kenai.

Alaska Zoo. The director of the Alaska Zoo, (P. Lampi, personal communication, November 11, 2011), indicated that quality issues (potential for foreign objects such as hooks) are the primary concern with dip net waste as a food source. The zoo has a 20'x20' freezer used to store putrescible food, thus limiting the volume of carcasses that could be accepted at any one time. The zoo is located in Anchorage and receives a steady supply of donated whole-fish for use in feeding the animals.

Bird TLC. Bird TLC is an avian rescue, located in Anchorage. The organization rehabilitates injured, orphaned and sick wild birds. With regard to use of dipnet carcasses to feed the birds, identical issues were identified as those noted for the Alaska Zoo. In addition, there are a small number of birds that consume salmon carcasses such that their needs are essentially met through donations of higher quality whole fish.

Alaska Wildlife Conservation Center. The AWCC, located in Portage, cares for injured and orphaned Alaska wildlife. The Center is amenable to the idea of accepting carcasses as food for their animals, however they are limited in their capacity for long-term refrigerated storage. In addition, higher quality whole fish are generally available through donations.

6.6. Fertilizer

There are three main types of fertilizer made from fish waste, fish meal, fish emulsion, and fish hydrolyslate. Fish meal is made after heating the ground fish waste and removing the oil and much of the water. This process is energy intensive and not further considered under this section due to the expense. Fish emulsion is made from the water removed during the production of fish meal and also is not considered as a fertilizer product to be derived from the dipnet fish waste.

Fish hydrolyslate is a cold process where the fish waste is ground and then enzymatically digested into a liquid form. Acid is added to reduce the pH and stabilize the final product. For use as a plant fertilizer, phosphoric or sulfric acid is typically used to lower the pH of the hydrolysate. The fertilizer is applied to the soil by mixing with water and spraying, and is a key method of fertilizing fields for organic farmers.

In order to create hydrolysate fertilizer from dipnet fish waste, the waste would need to be transported to a site where it is ground, pumped into tanks for digestion and mixed with phosphoric or sulfuric acid to stabilize it. The product would then be stored in tanks until sold. Based on the estimates of the amount of fish waste generated during the dipnet fishery, approximately 80,000 gallons of liquid fish hydrolyslate could be produced. This alternative has the potential to be profitable if an adequate local market for the liquid fertilizer can be developed.

7. RECOMMENDATIONS

There are several potential solutions to the problem of excessive fish waste generated at the mouth of the Kenai River during the personal use dipnet fishery in July. Table 6 lists the alternatives evaluated and the advantages and disadvantages of each. Also listed in Table 6 is a rough estimate of the cost of each alternative (Appendix A). The alternatives were divided into two broad categories, disposal and beneficial use. Although either category is preferable to improperly discarded fish waste, the beneficial use alternatives are seen as more desirable since the fish waste would be turned into a useful product. However, the beneficial use alternatives can take longer to implement and the costs are more variable than the disposal alternatives as they depend on a market for the finished products. We have broken the recommendations down by expected time to implement which are discussed below.

2012 Season. It is unlikely that any of the alternatives can be executed by the City of Kenai for the 2012 season. Time is needed to review the alternatives, identify funding, solicit bids, and award a contract before the beginning of the season in July. In addition, the estimates of the amount of fish waste generated are based on incomplete data. Conducting a survey during the 2012 fishery would provide more accurate numbers on the quantity of fish waste left behind on the beach.

2013 season. Three of the alternatives appear to be implementable in the short term and similar in cost: Landfilling, Ocean Dumping, and Composting. The City of Kenai should discuss with the Kenai Peninsula Borough Solid Waste Department the option of landfilling the dipnet salmon waste and get a definitive response on acceptance of the fish waste at the CPL. If the borough will accept the waste, this appears to be the least risky alternative that can be implemented for the 2013 dipnet fishery. ADEC solid waste indicated that a modification to the CPL permit would not be difficult to execute.

Ocean Dumping will require EPA approval and they declined to give an estimate on how long the approval would take. Composing requires identifying a suitable location, source of wood waste to mix with the fish waste, and a plan review by ADEC. During our research, interest was expressed from one of the fish processors in disposing of the fish waste through grind and discharge but this appears to be a more expensive option.

Long term. One of the three viable beneficial use options should be explored further as a long term solution for the fish waste. It is unlikely that the borough will accept the dipnet fish waste at the CPL long term, and there is risk of regulatory changes affecting the grind and discharge and ocean dumping options. Using the fish waste to produce a liquid fish fertilizer may pay for itself, or even produce a profit, if there is sufficient local demand for the product.

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8. LIMITATIONS

This report was prepared, in accordance with generally accepted professional practices for the nature and conditions of the work completed in the same and similar localities, at the time that the work was performed. It is intended for the use of ADEC and the City of Kenai. This report is not meant to represent a legal opinion, and no other warranty, express or implied, is made.

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TABLES

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Table 1: Estimated Dipnet Participants by City of Kenai Area

Year	Average	2003	2004	2005	2006	2007	2008	2009	2010	2011
South Beach	24%	11%	25%	26%	23%	26%	26%	23%	24%	30%
North Beach	45%	51%	47%	46%	43%	43%	41%	43%	44%	44%
City Dock	31%	38%	28%	28%	35%	31%	33%	34%	32%	26%

Based on City of Kenai 2011 Dipnet Fishery Report

Table 2: Estimated Fish Harvest by Beach

Number of fish

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011
South Beach	25,063	67,867	79,157	32,509	77,744	65,781	80,295	94,691	164,944
North Beach	117,006	125,586	138,938	60,872	126,609	100,962	151,031	176,588	241,835
Total	142,070	193,453	218,096	93,381	204,353	166,743	231,326	271,279	406,779

Pounds

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011
South Beach	157,899	427,564	498,691	204,806	489,790	414,420	505,858	596,555	1,039,150
North Beach	737,139	791,190	875,312	383,492	797,634	636,060	951,493	1,112,504	1,523,559
Total	895,038	1,218,755	1,374,003	588,298	1,287,424	1,050,480	1,457,351	1,709,059	2,562,709

Assumptions

Average weight of each fish is 6.3 pounds.

Amount of harvest attributed to each beach is based on the total harvest and participant numbers estimated by the city of Kenai. This does not account for participants that access the fishery from non-city access points.

Table 3: Estimated Fish Waste Generated

Pounds

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011
South Beach	37,896	102,615	119,686	49,153	117,550	99,461	121,406	143,173	249,396
North Beach	232,199	249,225	275,723	120,800	251,255	200,359	299,720	350,439	479,921
Total	270,095	351,840	395,409	169,953	368,804	299,820	421,126	493,612	729,317

Cubic Yards

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011
South Beach	22	59	69	28	68	57	70	83	144
North Beach	134	144	159	70	145	116	173	203	277
Total	156	203	229	98	213	173	243	285	422

Assumptions

Average weight of each fish is 6.3 pounds.
The density of the fish waste is 1,730 pounds per cubic yard.
On the South Beach, 80% of the fish are cleaned on the beach and the rest are cleaned elsewhere.
On the North Beach, 90% of the fish are cleaned on the beach and the rest are cleaned elsewhere.
100% of the harvest from boats (City Dock) are cleaned elsewhere.
30% of each fish cleaned on the South Beach is left as waste.
35% of each fish cleaned on the North Beach is left as waste.
Amount of waste attributed to each beach is based on the total harvest and participant numbers estimated by the city of Kenai. This does not account for participants that access the fishery from non-city access points.

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Table 4: Estimated Fish Waste per Day - South Beach

Day	Pounds				Cubic Yards		
	2008	**2009**	**2010**		**2008**	**2009**	**2010**
10-Jul	288	1,125	1,859		0.2	0.7	1.1
11-Jul	364	2,345	1,702		0.2	1.4	1.0
12-Jul	732	1,732	1,998		0.4	1.0	1.2
13-Jul	577	2,213	2,883		0.3	1.3	1.7
14-Jul	1,939	7,557	4,080		1.1	4.4	2.4
15-Jul	5,697	9,299	10,547		3.3	5.4	6.1
16-Jul	7,644	6,030	17,812		4.4	3.5	10.3
17-Jul	5,978	10,544	**20,234**		3.5	6.1	**11.7**
18-Jul	9,613	13,903	13,286		5.6	8.0	7.7
19-Jul	11,615	11,526	8,873		6.7	6.7	5.1
20-Jul	7,605	9,226	9,293		4.4	5.3	5.4
21-Jul	8,221	4,021	8,190		4.8	2.3	4.7
22-Jul	4,373	4,298	6,980		2.5	2.5	4.0
23-Jul	4,743	3,299	7,440		2.7	1.9	4.3
24-Jul	2,491	2,958	9,930		1.4	1.7	5.7
25-Jul	4,913	5,443	3,019		2.8	3.1	1.7
26-Jul	6,622	5,373	1,806		3.8	3.1	1.0
27-Jul	3,801	5,581	3,302		2.2	3.2	1.9
28-Jul	2,911	5,193	3,176		1.7	3.0	1.8
29-Jul	3,110	3,611	1,903		1.8	2.1	1.1
30-Jul	3,536	3,823	2,822		2.0	2.2	1.6
31-Jul	2,690	2,307	2,039		1.6	1.3	1.2
Total	99,461	121,406	143,173		57	70	83

Table 5: Estimated Fish Waste per Day - North Beach

Day	Pounds				Cubic Yards		
	2008	2009	2010		2008	2009	2010
10-Jul	580	2,777	4,549		0.3	1.6	2.6
11-Jul	733	5,790	4,166		0.4	3.3	2.4
12-Jul	1,474	4,276	4,890		0.9	2.5	2.8
13-Jul	1,162	5,462	7,057		0.7	3.2	4.1
14-Jul	3,906	18,656	9,987		2.3	10.8	5.8
15-Jul	11,476	22,957	25,816		6.6	13.3	14.9
16-Jul	15,399	14,886	43,597		8.9	8.6	25.2
17-Jul	12,041	26,030	**49,526**		7.0	15.0	**28.6**
18-Jul	19,364	34,323	32,520		11.2	19.8	18.8
19-Jul	23,398	28,455	21,718		13.5	16.4	12.6
20-Jul	15,320	22,777	22,746		8.9	13.2	13.1
21-Jul	16,560	9,928	20,046		9.6	5.7	11.6
22-Jul	8,809	10,611	17,085		5.1	6.1	9.9
23-Jul	9,554	8,144	18,210		5.5	4.7	10.5
24-Jul	5,018	7,303	24,305		2.9	4.2	14.0
25-Jul	9,897	13,437	7,389		5.7	7.8	4.3
26-Jul	13,340	13,264	4,420		7.7	7.7	2.6
27-Jul	7,657	13,778	8,081		4.4	8.0	4.7
28-Jul	5,863	12,819	7,774		3.4	7.4	4.5
29-Jul	6,266	8,915	4,657		3.6	5.2	2.7
30-Jul	7,123	9,438	6,908		4.1	5.5	4.0
31-Jul	5,418	5,695	4,990		3.1	3.3	2.9
Totals	200,359	299,720	350,439		116	173	203

Table 6: Comparison of Alternatives

ALTERNATIVE	ADVANTAGES	DISADVANTAGES	ROUGH COST[1]
Disposal			
Status Quo	• Lowest cost • Easiest to implement	• Does not address problems associated with a large amount of fish waste in a concentrated area • Does not encourage proper disposal practices of fish carcasses	$1,500
Grind and Discharge	• Locally available (lower transportation costs) • Once discharged the waste is gone • Easy to implement	• Sand on carcasses increases costs • Not as ecologically desirable as beneficial use • Potential regulatory changes	$175,000
Landfilling	• No issues with cleanliness or quality of carcasses • Do not have to grind carcasses • Locally available (lower transportation costs)	• Reluctance by landfill operator to accept waste • May require a modification to the landfill's permit • Reduces landfill capacity • Not ecologically desirable	$125,000
Ocean Dumping	• No issues with cleanliness or quality of carcasses • Probably do not have to grind carcasses • Do not have to transport over road system	• Requires EPA approval with uncertain timeline • Uncertain distance to dump area until EPA reviews plan • Needed resources may already be committed during the dipnet season • Not as ecologically desirable as beneficial use	$138,000

Table 6: Comparison of Alternatives

ALTERNATIVE	ADVANTAGES	DISADVANTAGES	ROUGH COST[1]
Beneficial Use			
Fish Based Compost	• Creates a usable product • Ecologically desirable • No issues with quality of carcasses	• Distance to potential markets for finish product • Must be mixed with a substantial volume of carbon based organic matter • Offensive odors and disease vector attractant if done improperly	$116,000
Liquid Fertilizer	• Creates a usable product • Ecologically desirable • Potentially profitable	• Operation would require ADEC approval • Requires grinding to promote rapid degradation • Must be cleaned of sand prior to grinding • Distance to potential markets for finish product • Cost of converting fish into liquid fertilizer	$0
Biomass Energy	• Creates a usable product • Ecologically desirable • Carbon neutral energy source	• Current cost of extracting oil from fish waste exceeds price of similar petroleum fuels • Requires carcasses to be in good condition (no spoilage) • Biodiesel made from salmon oil may not meet specifications for on-road use • Still have significant volume of waste to dispose of after oil extraction • Gasification of salmon waste is still in an experimental phase	$150,000

Table 6: Comparison of Alternatives

ALTERNATIVE	ADVANTAGES	DISADVANTAGES	ROUGH COST[1]
Fish Oil	• Creates a usable product • Fish oil for human consumption is a high value product • Ecologically desirable	• Fish waste from the dipnet fishery will not meet requirements for human consumption • Still have significant volume of waste to dispose of after oil extraction	Not a viable alternative
Commercial Animal Food	• Creates a usable product • Ecologically desirable	• Fish waste from the dipnet fishery will not meet requirements for pet food • Small scale and distance to markets reduces competiveness of final product	Not a viable alternative
Non-Commercial Animal Food	• Creates a usable product • Ecologically desirable	• Concerns with quality of fish carcasses • Higher quality food available at no cost • Limited volume of fish waste could be used	Not a viable alternative

[1] The rough cost for each alternative does not include the cost of fish cleaning stations and collection totes. The City of Kenai estimates these costs at $300,000 for cleaning stations, potable water, and totes.

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GRAPHS

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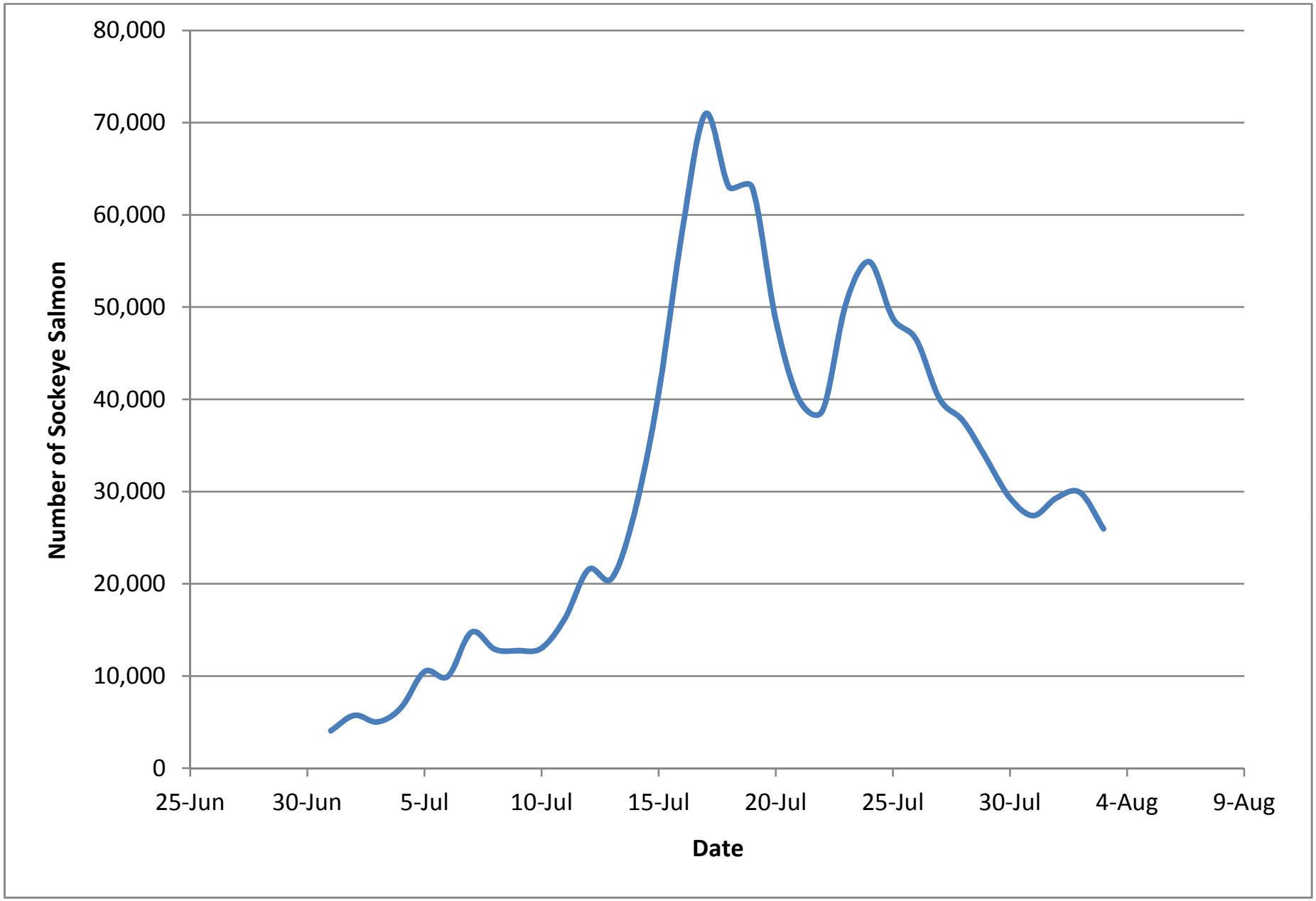
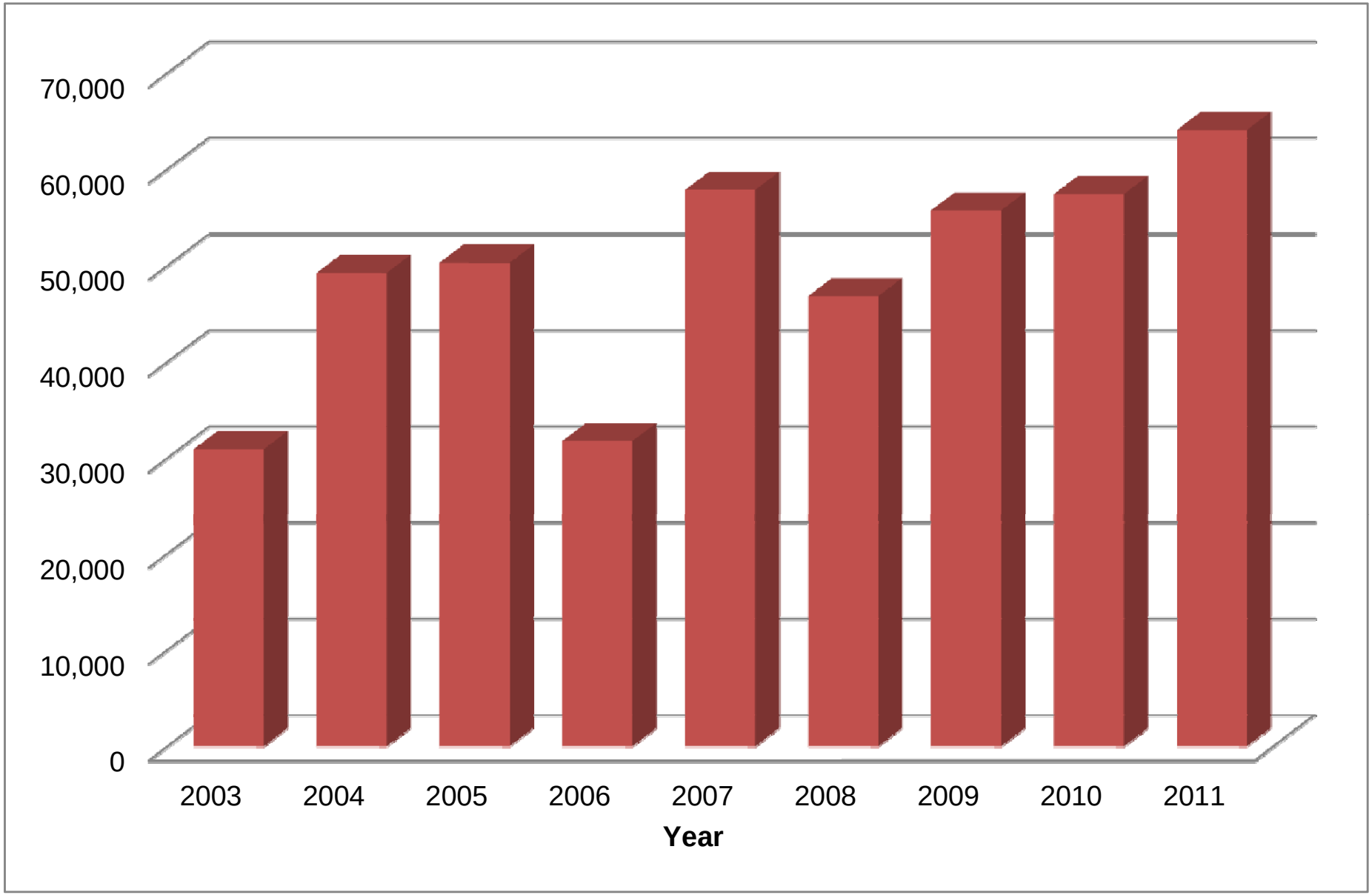
Graph 1: Kenai Sockeye Sonar Count Average 1996-2011

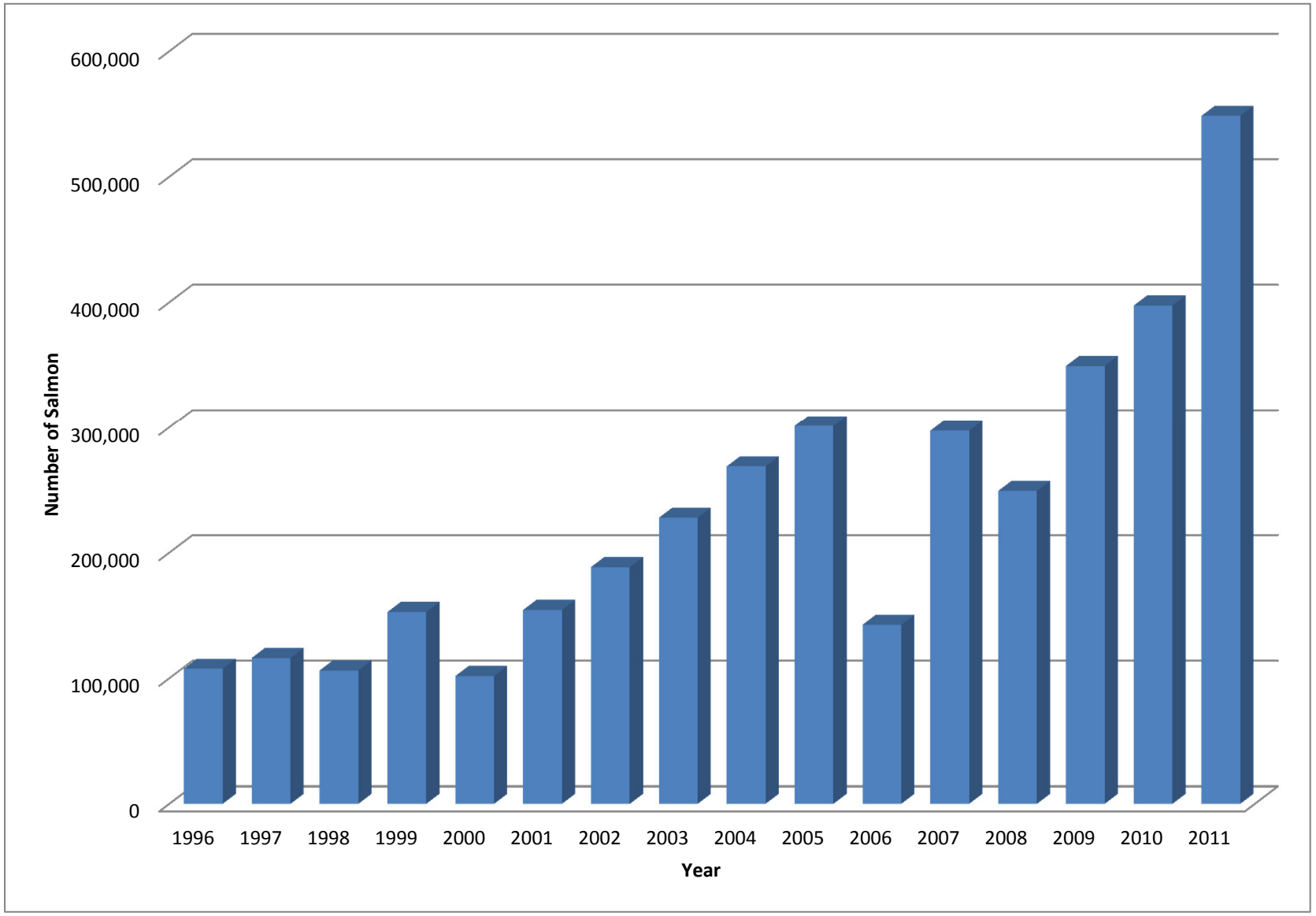


1/10/2012

Graph 2: Estimated Number of Dipnet Participants Utilizing City of Kenai Access



Graph 3: Kenai Dipnet Salmon Harvest



5/17/2012

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FIGURES

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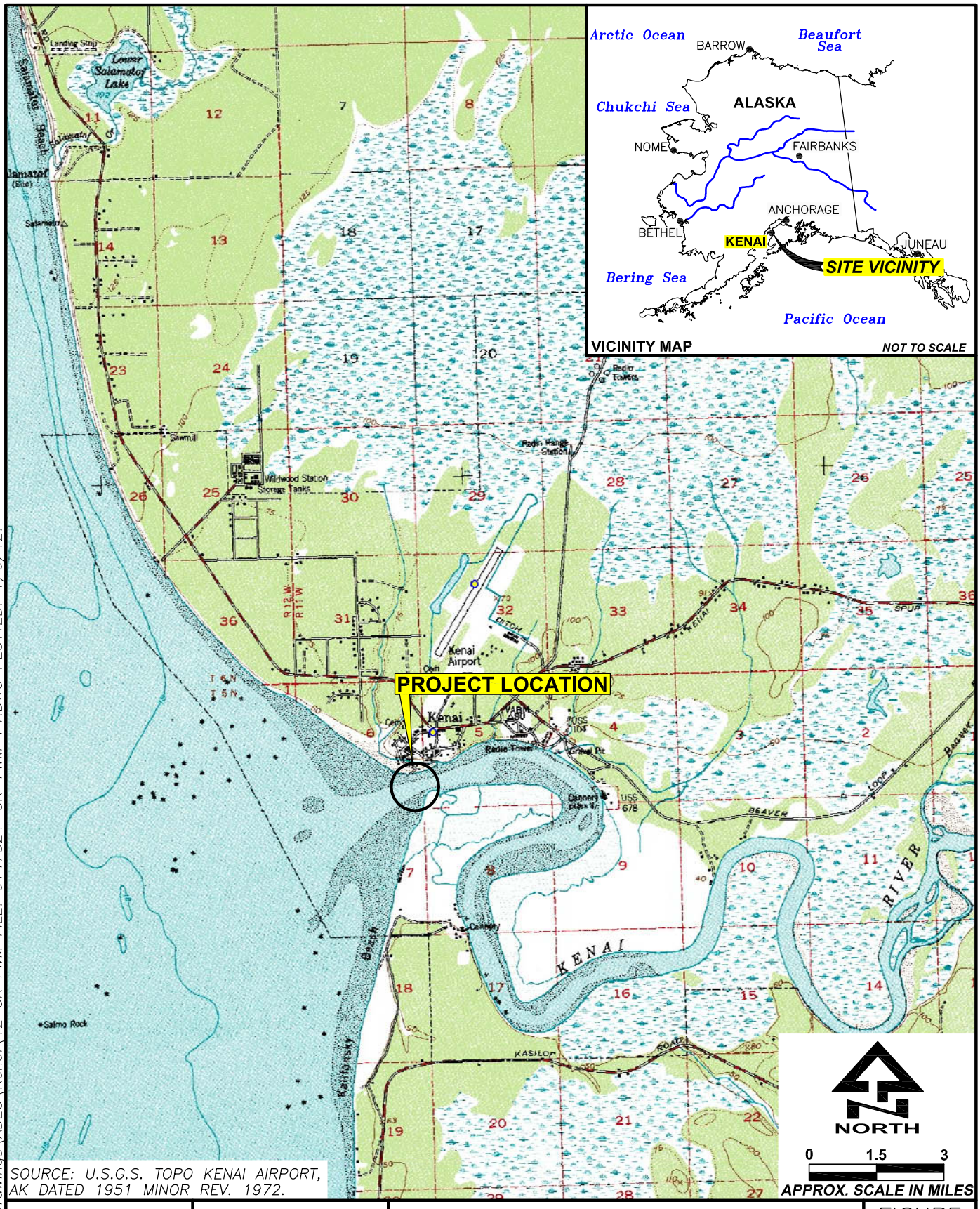

SOURCE: U.S.G.S. TOPO KENAI AIRPORT, AK DATED 1951 MINOR REV. 1972.

PATH: V:\Project Drawings\ADEC\Kenai\12 CK FWM FILE: 0147824-CK-FWM-F1.DWG PLOTTED: 1/6/12.

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SITE LOCATION MAP

CITY OF KENAI
KENAI FISH WASTE MANAGEMENT PLAN
Kenai, Alaska

FIGURE
1

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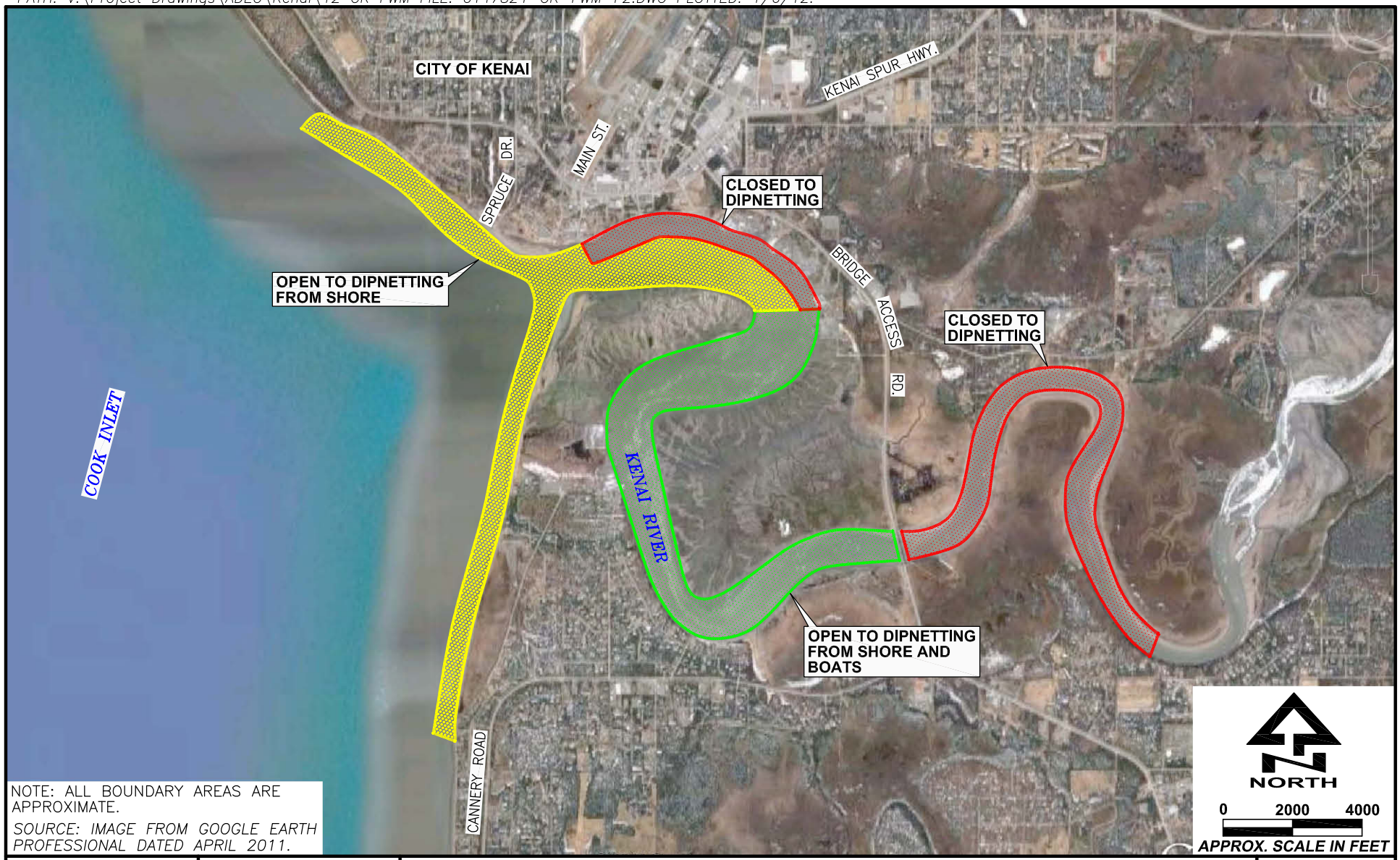

NOTE: ALL BOUNDARY AREAS ARE APPROXIMATE.

SOURCE: IMAGE FROM GOOGLE EARTH PROFESSIONAL DATED APRIL 2011.

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KENAI RIVER DIPNET AREAS

CITY OF KENAI
KENAI FISH WASTE MANAGEMENT PLAN
Kenai, Alaska

FIGURE

2

PATH: V:\Project Drawings\ADEC\Kenai\12 CK FWM FILE: 0147824-CK-FWM-F3.DWG PLOTTED: 1/6/12.

SOURCE: IMAGE FROM GOOGLE EARTH PROFESSIONAL DATED APRIL 2011.

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PROPOSED FISH CARCASS COLLECTION CONTAINER LOCATIONS

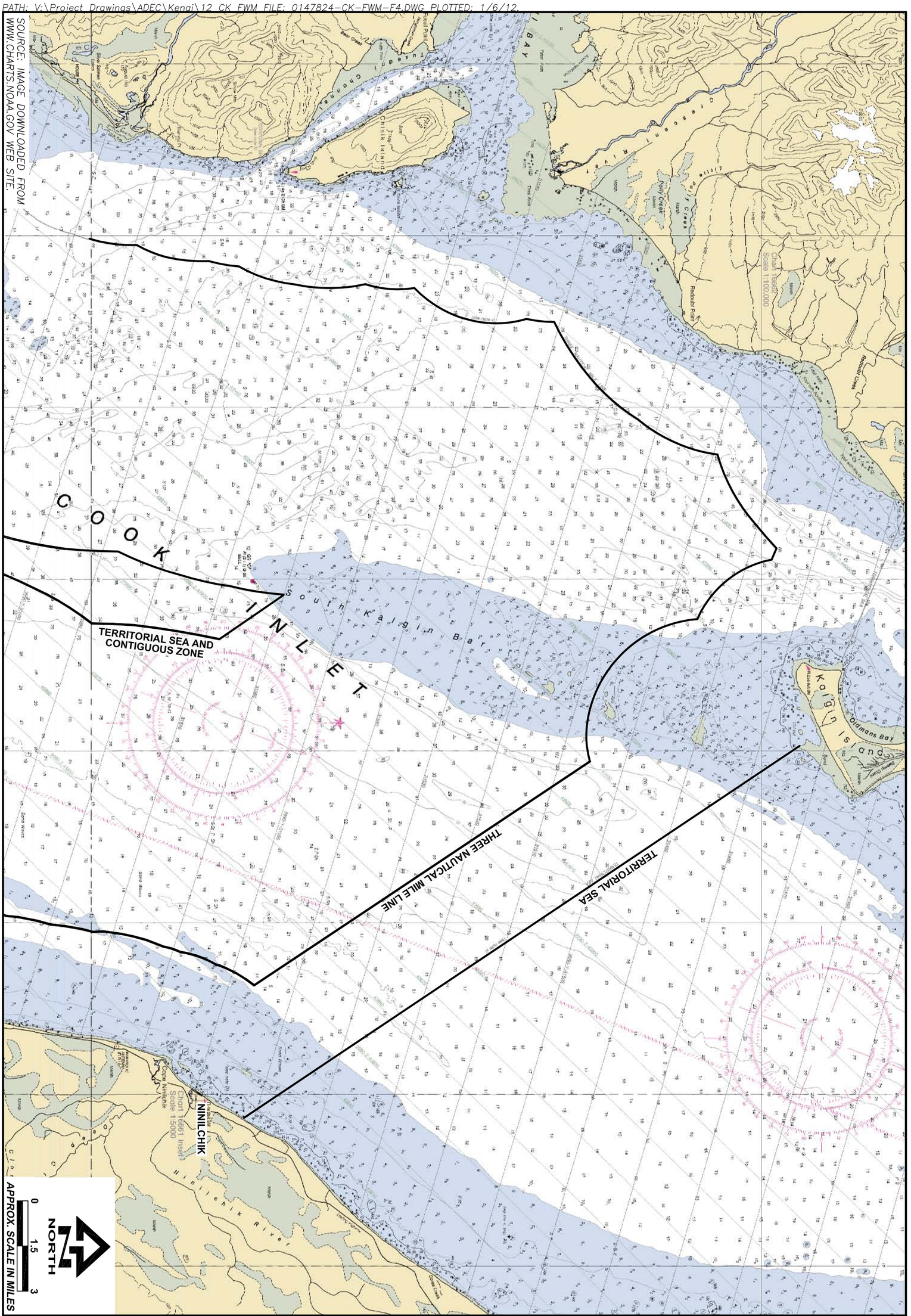
CITY OF KENAI
KENAI FISH WASTE MANAGEMENT PLAN
Kenai, Alaska

FIGURE

3

PATH: V:\Project Drawings\ADEC\Kenai\12_CK_FWM FILE: 0147824-CK-FWM-F4.DWG PLOTTED: 1/6/12

SOURCE: IMAGE DOWNLOADED FROM WWW.CHARTS.NOAA.GOV WEB SITE.



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OCEAN DUMPING BOUNDARIES

CITY OF KENAI
KENAI FISH WASTE MANAGEMENT PLAN
Kenai, Alaska

FIGURE

4

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APPENDICIES

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Rough Order of Magnitude Cost Estimates

Kenai Fish Waste Management Plan

Alternative	Assumptions	Costs
Status Quo	111 hours of labor @ $11.83 per hour for "Fish Removal and Raking" from City 2011 Report (rounded up).	$ 1,500
	Total Estimate for Alternative:	**$ 1,500**
Grind and Discharge	Alaska Marine Nutrition rought estimate of $85K-$100K for 250,000 lbs (transport, clean, grind, and discharge). Estimated $175K for larger volume likely to be produced by fishery.	$ 175,000
	Total Estimate for Alternative:	**$ 175,000**
Landfilling	Fish handling at beach: Loader & Operator $150/hr x 8 hrs/day x 21 days	$ 25,200
	Fish transport: Dump truck and driver $120/hr x 8hrs/day x 21 days	$ 20,160
	Landfill tipping fee of $85/ton x 350 tons	$ 29,750
	Miscellaneous expenses (management, admin, etc.)	$ 50,000
	Total Estimate for Alternative:	**$ 125,110**
Ocean Dumping	Fish barge cost of $20K divided by 5yrs	$ 4,000
	Boat to tow barge: $3,500 per day x 21 days	$ 73,500
	Fuel cost: 16 gph x $4.50/gal x 7hrs/day x 21 days	$ 10,584
	Miscellaneous expenses (management, admin, etc.)	$ 50,000
	Total Estimate for Alternative:	**$ 138,084**
Fish Based Compost	Assuming a ratio of 8 parts wood waste to 1 part fish waste requires about 2,500 cubic yards of wood waste.	
	Assume lot for compost is city or borough property at no cost.	$ -
	Assume wood waste sourced for free, transportation is $10/yd.	$ 25,000
	Fish handling at beach: Loader & Operator $150/hr x 8 hrs/day x 21 days	$ 25,200
	Fish transport: Dump truck and driver $120/hr x 8hrs/day x 21 days	$ 20,160
	Compost tillage: Loader & Operator $150/hr x 8 hrs/day x 6 events.	$ 7,200
	Miscellaneous expenses (management, admin, etc.)	$ 50,000
	Sale of finished compost: Finished volume 40%, sell for $10/yard.	$ (11,200)
	Total Estimate for Alternative:	**$ 116,360**
Fish Fertilizer	300 cubic yards of fish at 200 gallons/yard = 60,000 gallons of fish waste.	
	Chemical cost: 500,000 lbs fish mixed with 1% phosphoric acid, assume phosphoric acid is $1,000/ton.	$ 2,500
	Storage containers: 40 ft ISO tanks 13,500 gal each, 5 tanks needed @ $4,000/yr each.	$ 20,000
	Fish handling at beach: Loader & Operator $150/hr x 8 hrs/day x 21 days	$ 25,200
	Fish transport: Dump truck and driver $120/hr x 8hrs/day x 21 days	$ 20,160
	Mixing and pumping.	$ 80,000
	Miscellaneous expenses (management, admin, etc.)	$ 50,000
	Sale of fertilizer at $4/gallon. (Unsure if market exists, sells for $4/gallon or more in NW US).	$ (228,000)
	Total Estimate for Alternative:	**$ (30,140)**
Biomass Energy	60,000 gallons of waste with 7% oil recovery = 4,200 gallons of oil produced.	
	Fish handling at beach: Loader & Operator $150/hr x 8 hrs/day x 21 days	$ 25,200
	Fish transport: Dump truck and driver $120/hr x 8hrs/day x 21 days	$ 20,160
	Assume cost to render, process oil, and dispose of remaining waste is $12 per gallon of produced oil.	$ 67,200
	Miscellaneous expenses (management, admin, etc.)	$ 50,000
	Sale of produced oil is $3/gal	$ (12,600)
	Total Estimate for Alternative:	**$ 149,960**
Fish Oil for Human Consumption	Not viable - cannot use dipnet fish waste for this alternative.	
Commercial Animal Food	Not viable - cannot use dipnet fish waste for this alternative.	
Non-commercial Animal Food	Not viable - insufficient volume can be disposed of by this alternative.	