Request for Proposals (C3)
RFP E10-255

December 2010

SNOW MANAGEMENT ASSESSMENT & PLANNING

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Snow Management Assessment Plan

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December 2010

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

CHAPTER 1: PURPOSE OF STUDY

Background/History

Snow management is an important issue for the City and Borough of Juneau (CBJ). The CBJ is located in southeast Alaska in a mild, maritime climate. Annual precipitation averages 58 inches in Juneau with snowfall averaging 94 inches per year (Alaska Climate Research Center 2010). The CBJ Street Maintenance Division provides snow removal services for public roads. Snow collected from the downtown area is disposed of into the Gastineau Channel, while snow collected in the Mendenhall Valley is disposed of in the parking lot at the U.S. Forest Service (USFS) Mendenhall Glacier site. Recent and upcoming regulatory and land use management changes may curtail or eliminate the ability of the CBJ to continue to dispose of snow directly into the Channel and/or at the USFS site. This study evaluates potential snow management alternatives for the CBJ, to allow for the continuation of cost- and time-efficient snow removal services in a manner that addresses environmental concerns.

Regulatory Changes

Environmental regulation of snow disposal practices has increased over the years as research has identified possible water quality issues related to snow melt discharges for snow gathered from city streets. In 2006, the Alaska Department of Environmental Conservation (DEC) studied the potential impact of ocean disposal of snow from public roads and identified several potential water quality issues, including sediment, chlorides, hydrocarbons, and heavy metals (DEC 2006). Although DEC and the U.S. Environmental Protection Agency (EPA) have not currently adopted regulations specific to snow disposal in marine waters, it is likely that regulations will be adopted at some time in the future and steps will need to be taken to address the potential impacts associated with the discharges. Given these known concerns, the CBJ has begun to evaluate alternative measures for storing and disposing of snow from public roads.

In addition to the regulatory concerns that have been expressed by state and federal agencies, land use changes in Juneau are also affecting current snow removal operations. The CBJ has long used a portion of the USFS site at the Mendenhall Glacier for snow disposal from the Mendenhall Valley operations. There have been some indications from the USFS that this site may no longer be available to the CBJ in the future. The CBJ has a written agreement with the USFS to allow snow disposal for 2010-2011 season, but there is no long-term agreement currently in place. Similarly, the old Public Works downtown shop located near the Juneau-Douglas Bridge has served as a primary snow storage and disposal site for many years for the downtown area. The Public Works Department is in the process of closing the old Mendenhall Valley and downtown shops and consolidating all operations in a new facility in Lemon Creek. The old Public Works downtown shop is proposed for redevelopment as part of the CBJ's Long Range Downtown Waterfront Plan. This means that the old Public Works downtown shop site will likely not be available for snow storage or disposal in the future.

Private snow haulers (and occasionally the CBJ) have historically used an area at Norway Point at the Yacht Club for snow disposal. Recently concerns have been raised regarding snow disposal operations adversely affecting Yacht Club operations and there are long-term plans for additional development in this area, indicating that this area for private snow haulers may too be lost as a snow disposal option in the coming years.

Study Goals

The goals of this study are listed below.

- Identify potential alternative management strategies for snow management in Juneau.
- Evaluate the potential alternative management strategies in terms of cost, operational efficiency, environmental impacts, and social impacts.
- Provide recommendations for short-term and long-term improvements in snow management.
- Prepare a Snow Management Plan that includes a detailed action plan for implementing snow management improvements.

CHAPTER 2: EXISTING SNOW MANAGEMENT OPERATIONS

The goal of the Streets Division of the CBJ Public Works Department is to maintain public streets and related facilities for the safety of the general public, as illustrated by their mission statement below:

> *The Public Works Streets Division is committed to maintaining and repairing the complex network of streets, sidewalks, traffic control devices, stairways, storm drainage facilities, and street appurtenances throughout the City and Borough of Juneau. We are committed to constantly training our personnel to ensure that these systems are maintained in the best condition possible. The safety of the general public in the use of these systems is of paramount importance.*

Clearing CBJ roads and sidewalks of ice and snow is essential to safe transportation throughout the community. Priorities for snow removal are set according to public safety needs and traffic volumes, with major arteries and school routes receiving first priority. Depending on the conditions, crews plow, spread aggregate to help improve traction, and/or apply deicing material (magnesium chloride). The CBJ performs snow removal, sanding, and deicing around the clock and in the following order of priority, as shown on the figures in Appendix A.

- Main arteries and business district streets.
- Main feeder/collector streets that lead to arterial streets and highways.
- Neighborhood residential streets and rural subdivisions.
- All other low density streets.

Current Operations

The CBJ Public Works Department and the Alaska Department of Transportation and Public Facilities (DOT&PF) both provide snow removal services on the streets within the borough. DOT&PF plows all of the state roads, including Egan Drive, Glacier Highway, the Douglas and North Douglas Highways, Mendenhall Loop Road, Fritz Cove Road, Mendenhall Peninsula Road, Tee and Amalga Harbor Roads, Nine Mile Creek Road, Thane Road, and Eaglecrest Road. Most of these state roads have sufficient right-of-way (ROW) to allow for long-term snow storage along them, eliminating the need for DOT&PF to haul snow to disposal sites. The remaining publicly-maintained roads, which total over 250 lane-miles, are maintained by CBJ.

Snow removal activities include three separate phases. The first is plowing and clearing streets and sidewalks. Second is the hauling of snow from the areas where it is plowed. The final phase is the disposal of snow - either into a land-based disposal site or into the marine environment. Current operations are described in the following sections.

Plowing Operations

Initial plowing typically consists of moving snow to the side of the street. On narrow streets, this can include snow being temporarily stored on the sidewalk. In rare cases, snow is plowed to the center of the road. This practice is followed downtown primarily on Glacier Avenue between the Juneau Douglas High School and the Federal Building in order to accommodate heavy school bus, transit bus, and Federal Building traffic along the relatively narrow corridor. To a lesser extent, center plowing is done in the Mendenhall Valley area along north Riverside Drive. Center plowing is more time consuming than conventional side plowing because it involves moving the snow more than once and requires using multiple pieces of equipment (usually a plow and a grader). In the Mendenhall Valley area this practice has only recently been adopted as a result of public demands in certain neighborhoods. There is concern that if more center plowing is mandated in the Mendenhall Valley area, overall operational efficiency will decrease resulting in longer delays for initial plowing in lower traffic volume neighborhoods.

Depending on the intensity of the snow event, low-traffic-volume streets may not see snow removal operations until well after the storm. The operational goal of CBJ Public Works is that every neighborhood has at least one plow visit within three days of a significant snow event. The definition of a significant snow event varies between downtown and the Valley. Downtown, plowing often occurs with as little as an inch of snow accumulation. In the Mendenhall Valley, a significant snowfall is considered to be closer to three inches. As the busier streets are cleared, the street crews can turn their attention to lower traffic volume streets and to clearing sidewalks. Sidewalk clearing focuses mainly on clearing the sidewalks of the arterial and collector streets along walking routes to schools and in business areas (Appendix A).

Hauling

Once snow is plowed and the streets cleared, the snow is typically stored in the road ROW if there is sufficient room available. When the amount of snow begins to exceed the storage capacity of the ROWs, the snow must be hauled away. This is especially critical in the downtown area where the streets and ROWs are very narrow and property lines are often right up to the back of the sidewalk. Generally, after enough time has passed to clear all of the streets, the crews will use

graders and plows to move the snow from the sides of the streets into berms in the center of the street. From there, the snow is blown into dump trucks using a front-end loader mounted snow blower. Hauling snow is an equipment-intensive activity. In both the Mendenhall Valley and downtown areas, the hauling phase of snow removal generally consists of one or two plow trucks, two graders, one front-end loader, a safety observer, and as many as eight dump trucks. The dump trucks are operated by independent contractors under contract to the CBJ. The downtown area includes downtown Juneau and West Juneau, where snow is hauled to the old Public Works downtown shop site near the bridge; and downtown Douglas, where snow is hauled to Mayflower Island Causeway. North Douglas and Lemon Creek are also maintained from the downtown area, but rarely require snow hauling. Snow collected in the Mendenhall Valley area is taken to the USFS Mendenhall Glacier site. The need for snow hauling is more pronounced in the north-central portion of the Mendenhall Valley near Mendenhall Boulevard, where there is more dense residential development and more pedestrian activity. The demand for hauling is less near the airport and in areas north of the Mendenhall Valley, such as Auke Bay and Tee Harbor.

The cost of winter street maintenance operations has ranged from $1.2 to $1.9 million over the last four years (CBJ 2010a). Contractor costs, which are primarily related to hauling snow, are the most variable part of the winter operations budget and rise and fall based on the amount and timing of snowfall. Costs for contractors ranged from just over $37,000 last year to over $1.6 million during the record snow year in 2006-2007.

Disposal

As described above, snow is hauled from generation areas to disposal sites. In the Mendenhall Valley area, snow is stored in a parking area at the USFS Mendenhall Glacier site. In the downtown area, snow disposal is primarily to the marine environment. Snow from downtown Juneau and West Juneau is hauled to the old Public Works downtown shop near the bridge and from there is plowed into Gastineau Channel. Snow collected from Douglas is transported to the Mayflower Island Causeway for disposal into the Channel.

CBJ snow removal operations are carried out by the Streets Division of the Public Works Department. The responsibilities are divided into two primary areas; downtown and the Mendenhall Valley. These two areas are discussed further below.

Downtown/Douglas Operations

Downtown operations include service to a widely dispersed area including the downtown area from Mill Street, at the Thane Rock Dump, north to Lemon Creek (near Wal-Mart). Douglas, West Juneau, and North Douglas are also maintained from downtown Juneau. Downtown operations focus post-snowfall activities initially on the Flats area of downtown to ensure access to the Federal Building, multiple State office buildings, Harborview Elementary School, and Juneau Douglas High School. This effort includes clearing Glacier Avenue, West Twelfth Street, West Ninth Street, Willoughby Avenue, Whittier Street, Calhoun Avenue, and Main Street. Secondary efforts are usually focused on the downtown business and capital district streets of Fourth Street, Seward Street, North and South Franklin Streets, and Front Street. Ideally, these

areas are plowed during the night to be ready for the business day in the morning. With the exception of West Twelfth Street, parking is lighter during the night shift, allowing for more effective plowing.

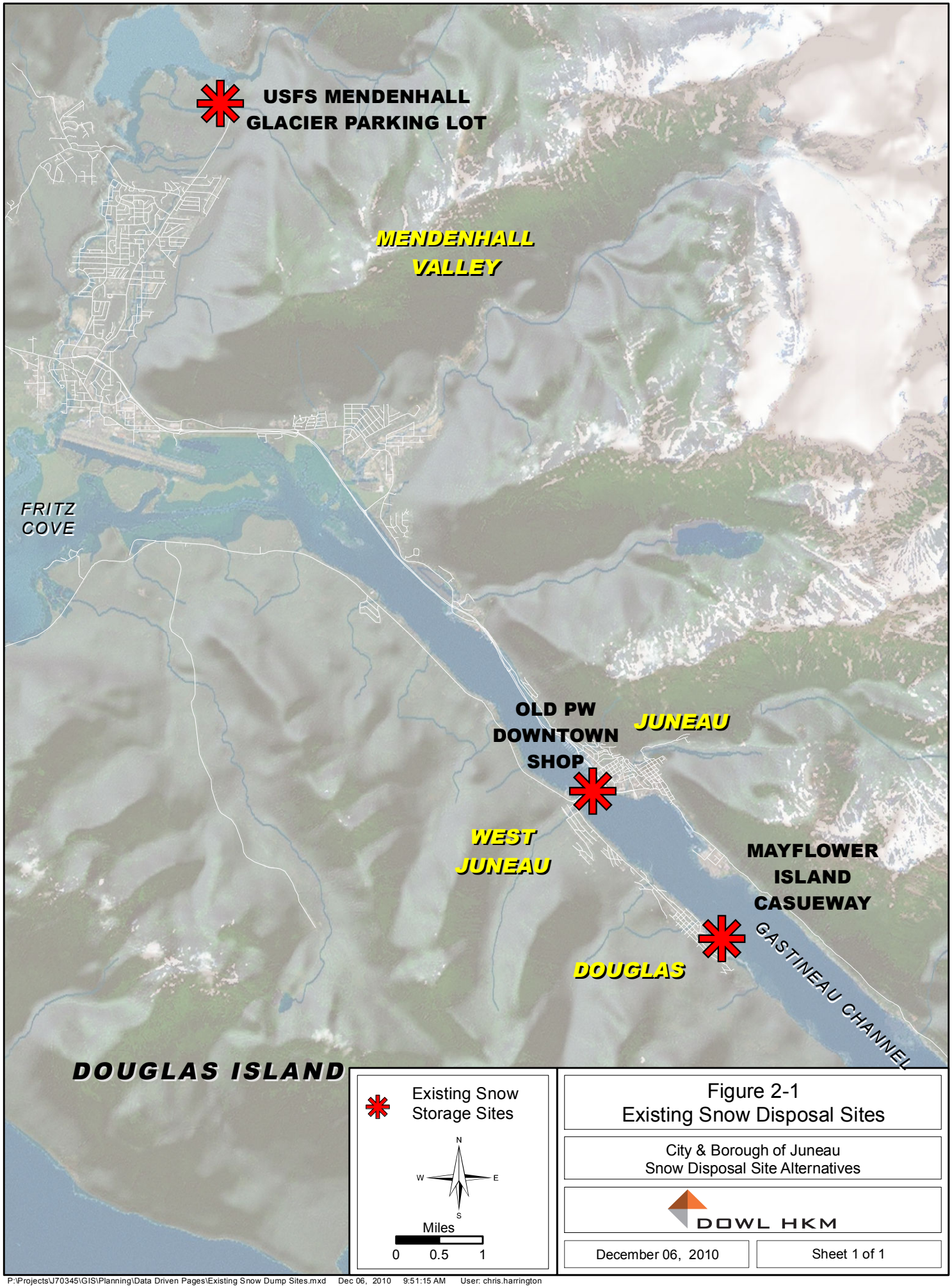
After clearing the downtown Juneau area, the downtown crews focus on the hillside neighborhoods of Starr Hill, the Highlands, West Juneau, and Twin Lakes. Ultimately, these crews will plow the Douglas and Lemon Creek neighborhoods and then work their way out to North Douglas. These areas are more efficiently plowed during the daytime after the residents have commuted to work with their vehicles, leaving more room to plow and remove snow.

Snow hauling priorities are similar to plowing priorities (see Appendix A). Hauling operations in the downtown area are generally conducted in the evening. In some areas, this requires temporary overnight parking bans to allow enough room for the equipment to operate. In the residential neighborhoods outside of the downtown core, hauling is generally conducted during the day while most residents are at work. When possible, hauling operations are coordinated to minimize impacts on other operations in the area; most notably, school bus and transit bus operations and garbage collection. Due to the narrow streets and limited maneuverability in downtown Juneau, 20-cubic yard capacity dump trucks are too large to be used for hauling operations. Hauling operations in the downtown area are limited to 10-cubic yard capacity dump trucks, resulting in the need for twice as many trucks for hauling snow.

The downtown Juneau and downtown Douglas areas require the most snow hauling. In downtown Juneau, the snow is hauled first to the old Public works downtown shop located at the base of the Juneau side of the Juneau–Douglas Bridge. Here, the snow is deposited on the south side of the lot and then bulldozed into the tidal area of the adjacent Gastineau Channel.

When this area reaches capacity, or the amount of snow arriving exceeds the dozer capacity, the snow is deposited at the Yacht Club parking lot at the northern end of Aurora Basin. In Douglas, snow is generally hauled to the Savikko Park area where it is dumped off of the causeway leading to Mayflower Island. Snow disposal areas in the downtown areas are shown on Figure 2-1.

Almost all of the snow that is hauled from downtown is dumped or pushed directly into a marine environment. This practice is under increased regulatory agency scrutiny and regulatory changes may force the CBJ to eliminate the direct disposal of snow into the marine environment or to develop and implement treatment measures to reduce trash and pollutants discharged to the marine environment. Elimination of marine disposal would result in the need to acquire and/or develop new areas for land disposal of snow.



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Mendenhall Valley Operations

The Mendenhall Valley operations area covers the Airport area, all of the Mendenhall Valley and residential areas north of Auke Bay to Cohen Drive at the north end of Tee Harbor.

The Mendenhall Valley operations focus their primary efforts on the major arterials extending from the many residential neighborhoods in the Mendenhall Valley. This includes Riverside Drive, Stephen Richards Drive, Haloff Way, Tongass Boulevard, Trinity Drive, Nancy Street, and Montana Creek Road. Initial efforts also include the business district and roads surrounding the Juneau International Airport. Ideally, these areas are focused on during the night shift, when traffic volumes are relatively light.

The secondary efforts in the Mendenhall Valley focus on clearing the collector roads and allowing operations to move into the neighborhood local streets. Generally, this effort focuses on Radcliffe Road and Berners Avenue, Valley Boulevard, Threadneedle Street, Julep and Division Streets, and the University area. At this point, crews may also be freed up to send out to the residential areas north of Auke Bay. These crews will generally start at Tee Harbor and work their way back towards the Mendenhall Valley. It is more efficient to plow the residential areas during the day when the majority of the residents and vehicles are at work.

Operations in the Mendenhall Valley must pay particular attention to Juneau's microclimates. In many cases, it may be raining in portions of their area of operation and snowing in others. Snowfall intensity can vary widely as well, with areas of higher intensity near the Mendenhall Glacier and north of Auke Bay.

Road ROWs in the Mendenhall Valley area generally have wider ROWs than roads in the areas near downtown. Because of the wider ROWs, more snow can be stored along the edges of the streets. However, the Mendenhall Valley receives more snow than the downtown areas. Additionally, the Mendenhall Valley's flatter land is prone to flooding, so particular care must be given to keep the storm drainage system free of frozen piles of snow. Once the storage capacity of the road ROWs is met, hauling operations begin.

Hauling operations in the Mendenhall Valley are generally triggered by the need to provide room to store new snow in preparation for a forecasted new snow event. Snow hauling may also be started to clear sidewalks along main arterials and collector school walking routes, to remove center berms (which can be both a driving hazard and alluring play objects for children), to remove snow piles causing road icing from freeze-thaw cycles, and to clear cul-de-sacs where neighborhood snow has been stored. The wider streets in the Mendenhall Valley area allow enough maneuvering room for the use of both 10-yard and 20-yard dump trucks.

Currently, snow from the Mendenhall Valley area is hauled to the USFS Mendenhall Glacier site, which is located in the Mendenhall Glacier Visitor Center tour bus parking lot on Glacier Spur

Road (Figure 2-1). The parking lot covers an area of approximately 2.6 acres. At the parking lot, the snow is bulldozed into a large pile at the southern end of the lot. During heavy snow years, this snow pile can reach heights of 30-50 feet and not be completely melted until late June or early July.

The use of the USFS site has served the CBJ well, but some issues have been identified. The amount of snow stored can overwhelm maneuvering space at the site. Private contractors hauling snow from private parking lots sometimes make unauthorized snow dumps at this site, causing additional work for CBJ crews. Other USFS user groups have complained that snow storage activities at the site have adverse effects on summer activities at the site, as a result of the long melt time and the debris that is deposited as the snow melts. In 2009, the USFS asked the CBJ to find an alternative site for snow disposal and to vacate the parking area to allow for planned improvements to the area. The USFS has since agreed to allow the CBJ to store snow at the site for the winter of 2010-2011, while the CBJ evaluates long-term storage and disposal options.

Snow Storage Demand

Although the historic average for snowfall in Juneau is approximately 94 inches, the snowfall in recent years (2006 to 2009) has exceeded 160 inches per year (Alaska Climate Research Center 2010). Although some climate change studies project that the amount of snow in Juneau will decrease as the climate warms over the next century, actual weather patterns over the next several decades are uncertain and could well result in more variation with years of more snow than average and years with less snow than average as illustrated by the recent high snow years.

Snowfall amounts differ in areas near downtown versus the Mendenhall Valley area. The average snowfall in downtown averages 62 inches, but has varied from 25 inches to 171 inches. Average snowfall in the Mendenhall Valley was just over 98 inches with almost 200 inches in the peak year.

Based on a review of snowfall data per year and the amount of snow hauled to disposal sites per year, a correlation of inches of snowfall to cubic yards (cy) hauled was estimated. For downtown, one inch of snow correlates to 430 cy of snow being hauled to disposal. This equates to 26,660 cy of snow in an average year, and 67,510 cy of snow for the maximum year. For the Valley, one inch of snow correlates to 315 cy of snow hauled. This equates to 30,870 cy of snow for the average year and 62,370 cy of snow in the maximum year.

The planning estimate for evaluating disposal sites was based on one and one-half times the average year volume, or 40,300 cy for downtown and 46,000 cy for the Valley. The downtown volume was split with 80% for the downtown Juneau area (32,000 cy) and 20% for the Douglas area (8,300 cy). Assuming a fill height of 30 feet and side slopes of 2:1, a one acre site can hold approximately 28,000 cy. This must be reduced, however, for maneuvering room, buffer areas, and treatment facilities for melt-water. We estimate that a one-acre site has a usable capacity of 17,000 cy, a two-acre site has a capacity of 39,000 cy and a five-acre site has a capacity of 237,000 cy. Therefore, this study uses a two-acre site for downtown, a one-acre site for Douglas, and a three-acre site for the Mendenhall Valley.

CHAPTER 3: CBJ SNOW MANAGEMENT ISSUES

The primary issues facing the CBJ regarding snow management are the potential loss of existing snow disposal areas; potential water quality issues associated with snow melt; permitting issues associated with new disposal sites and/or methods; costs associated with implementing new snow management procedures, and impacts on the efficiency of snow removal operations.

Loss of Historic Storage/Disposal Sites

Snow generated from downtown Juneau is typically disposed of at the old Public Works downtown shop near the Juneau-Douglas Bridge. Snow from West Juneau is also hauled to this site. Snow from the Douglas area is disposed of off of the Mayflower Causeway near downtown Douglas. Other sites that are used occasionally include the Fish Creek parking area in North Douglas and the Yacht Club, northwest of downtown Juneau. The Lemon Creek gravel pit has also been used when snow levels in the Lemon Creek area have resulted in the need to haul snow in that area. Since snow hauling from North Douglas and Lemon Creek is only needed occasionally under high snowfall conditions, this study is focused on the snow hauled from downtown Juneau, West Juneau and Douglas for the downtown area analysis.

The CBJ has recently begun to consolidate all Public Works operations out of a new facility in Lemon Creek. The CBJ has also begun a planning and design project to look at redevelopment of the old Public Works downtown shop area near the Juneau-Douglas Bridge as part of the Long Range Downtown Waterfront Plan and seawalk. Redevelopment of the old Public Works downtown shop site will likely mean that the existing snow disposal area, which is ideally located for snow removal from downtown Juneau, will no longer be available for this use.

Although there are no immediate plans that would result in the loss of the Mayflower Causeway site, concerns regarding the potential for eventual restrictions on direct marine disposal of snow into the channel and impacts on current and proposed future operations in this areas may result in an eventual loss of these areas for disposal.

Snow generated in the Mendenhall Valley is disposed of in one disposal site, located in the tour bus parking area at the USFS Mendenhall Glacier Visitor Center. This site is owned by the USFS. The site is currently used for tour bus parking and for model aircraft events, both of which can be adversely affected during years when the snow is slow to melt. In addition, the USFS is considering plans to upgrade the parking area for tour buses and has expressed concerns about continued use of the area for snow disposal if the improvements are implemented.

Water Quality

Snow picked up from streets and parking areas often contains debris and a variety of pollutants. As snow melts, some pollutants can travel with the melt-water into the ground or surrounding water bodies. Snow samples were taken in Juneau in 2006 as part of a study conducted by the DEC. The samples indicated the presence of oil and grease, sediment, debris and heavy metals in the snow. Four of the metals tested for were found in levels exceeding the state standards: chromium, lead, zinc and mercury (DEC 2006). More recently, the CBJ has taken snow samples of snow melt-water in Juneau. These samples, taken in 2007 and 2008, indicate that lead and zinc levels exceeded state standards, but that no other metals did (CBJ 2010b).

Research has been conducted in Anchorage on snow melt pollutants and treatment measures for snow melt-water that is discharged to fresh water bodies (Wheaton and Rice 2003). The use of detention ponds for snow melt has been successful in allowing sediment to settle out of melt-water prior to discharge from the site. Since most metals adsorb to sediment, this also reduces the metal levels in the discharge. In Anchorage, chlorides have been found to peak in the first flush of melt from snow disposal sites. Retention of melt-water on the site allows this first flush of chlorides to be diluted with later melt-water, with lower chloride levels, prior to discharge. Vegetation is also integrated into the treatment system to allow for uptake of pollutants.

Snow melt characteristics may be different in Juneau than those found in Anchorage, as stored snow may melt continuously throughout the season as opposed to the later and more concentrated melting period in Anchorage. Many of the issues regarding pollutants in snow melt are the same, though. Treatment measures implemented in Juneau will need to remove debris, sediment and sediment-adsorbed pollutants from the melt-water. Other treatment measures that can be used for land disposal sites include oil-grit separators with absorbent booms to collect hydrocarbons and vegetated areas to allow for uptake of pollutants and nutrients in vegetation. Since marine receiving environments are not as sensitive to chlorides, treatment measures for marine disposal sites would focus on minimizing debris and sediment entering the marine environment.

Permitting Issues

Permitting issues for snow disposal sites may include wetland fill permits, water quality permits, anadromous stream permits, and land use permits, depending on the particular site and design features. Juneau's location between the mountains and the channel limits the availability of developable lands for snow disposal. This could result in the need to apply for a wetland fill permit for sites that contain wetlands. Although the CBJ does not currently have a municipal stormwater permit that requires permitting of stormwater discharges, measures such as snow melting with discharge to the storm drain system will likely interest the regulatory agencies and require some coordination and review.

Development of a snow disposal site will also likely require a rezone and/or a Conditional Use Permit (CUP) from the CBJ. The CBJ Land Use Code was amended in July 2010 (effective August 18) to identify the zoning districts in which snow disposal is an allowed use. The code identifies three different size snow disposal facilities, allowing smaller neighborhood-serving facilities in most zones and larger regional and area-wide snow disposal facilities in primarily commercial and industrial zones. Neighborhood snow disposal facilities (occupying less than one-half acre) would be allowed by right in industrial zones (Industrial and Waterfront Industrial) and in the General Commercial zoning district. In most other zoning districts, a neighborhood snow disposal facility would require a CUP to allow review of site-specific design and operations. Regional snow disposal facilities (occupying one half to one acre) would be prohibited in most residential zoning districts, but would be allowed by right in industrial zones, and with a CUP in other approved zones (residential and commercial). Area-wide snow disposal facilities (occupying more than one acre) would be prohibited in most residential zones and some commercial zones. Where allowed, an area-wide snow disposal facility would require a CUP. Most Conditional Use approvals for snow disposal sites would be limited to a five-year period and Street Maintenance would be required to reapply for the CUP every five years.

Prior to this code change, snow storage was not called out as a specific use, but was included under general outdoor storage and was allowed only in General Commercial, Industrial, Waterfront Industrial and Waterfront Commercial zones. The code provisions regarding snow disposal sites were broadened due to concerns about the potential loss of existing snow disposal sites and practices and concerns that there may be proposals to site snow disposal facilities in inappropriate areas. The discussion leading to approval of these new code provisions recognized that the issue of snow disposal facilities needed to be studied in more detail and that additional changes may be needed once the CBJ has completed its study of snow management practices and analysis of potential snow disposal facility sites.

Costs Associated with Snow Management

The total budget for the CBJ Street Maintenance operations is approximately $5 million per year. Winter costs for street maintenance over the last several years have ranged from $1 to $2 million depending on the level of snow. Although CBJ staff and equipment costs are relatively stable (other than possible changes in overtime hours), contractor costs can vary greatly - from less than $50,000 in low snow years to over $1 million in heavy snow years. Therefore, snow

management measures that reduce snow hauling are likely to reduce overall winter maintenance costs and make these costs more predictable. Snow management measures that increase the distance for hauling snow will result in higher costs and may reduce the efficiency of snow removal operations.

Costs associated with siting, permitting, and operating designed snow disposal sites with treatment systems are likely to result in a short-term increase in CBJ capital costs and a long-term increase in labor costs, due to the need to maintain the sites to maximize treatment efficiency and to reduce potential nuisance effects.

Efficiency of Snow Removal Operations

The timely and efficient removal of snow from streets and sidewalks is critical for public safety and for safe and efficient transportation of people and goods throughout the community. CBJ Street Maintenance staff attempt to concentrate their snow removal operations during time periods that have the least impact on residences and downtown business areas. Requiring longer haul times for disposal of snow may result in it taking more time to clear streets in some areas. Snow management measures that reduce the need for hauling snow, or shorten hauling distances, may result in increases in efficiency.

Regulatory Agency Input

CBJ staff met with regulatory agencies to discuss the issue on snow disposal in September 2010. The agencies expressed concerns regarding potential issues related to debris, hydrocarbons and metals in snow melt-water. The prevalence of anadromous streams in the Juneau area was noted and the need to keep snow disposal sites at least 50 feet away from these streams. There was discussion of potential treatment measures for both land and marine disposal sites to address these issues, including settling ponds, booms, oil and grit separators on storm drain outfalls, and other measures. Snow melting was also discussed and potential concerns noted were related to water temperatures as well as how water quality of snow melter discharge might differ from snow melt-water from land-based disposal sites. The agencies also noted that any permit application to develop a snow disposal site on wetlands would require a thorough analysis of practicable alternatives. Coordination with the regulatory agencies will continue as the CBJ evaluates, selects and implements any new snow management and disposal measures.

CHAPTER 4: SNOW MANAGEMENT ALTERNATIVES

Research was conducted in order to identify various snow management methods currently practiced in Alaska and other northern cities around the world. A variety of snow disposal measures have been and are being tried in various cities. Cities continue to deal with potential impacts of the various snow disposal measures. A summary of some of the methods being used in other areas is included in Appendix A.

Snow Management Outside Juneau

Most northern countries continue to rely on land disposal sites for snow disposal, but several countries are beginning to pursue options related to active snow melting. In Canada, which is home to one of the major manufacturers of snow melting equipment, mobile and portable snow melters are being used in some cities. In Japan, which is similar to Juneau in that many populated areas lie between mountains and ocean, a number of snow melting techniques have been investigated using heat sources such as wastewater flows. More information on snow melting programs in these countries is included in Appendix A.

In the United States outside Alaska, most winter cities use land disposal and marine or freshwater disposal is specifically prohibited by most states and/or cities. Some coastal communities do acknowledge the use of marine disposal for emergencies and a very few actually have permits to discharge snow to marine waters.

In Alaska, snow disposal methods vary depending on the topography of the area and restrictions in stormwater permits. Cities that have limited land between the mountains and the ocean tend to use marine disposal, while those with more land available use land disposal. The Municipality of Anchorage (MOA) is the only coastal city in Alaska that currently has a NPDES stormwater permit that restricts snow disposal in the adjacent marine waters. In the City of Valdez, little hauling of snow occurs as most snow is pushed to storage areas in ROW or other areas. Many snow storage sites use French drains to discharge melted water into local storm drain systems. Snow in areas close to the water are plowed and piled into the harbor and runoff flows directly into the ocean. The City of Whittier allows the plowed snow to melt into the ocean but does not dump directly into it. Snow is dumped into tidal pools where it stays until the tide melts it away. Although there is not much noticeable trash in the snow, trash or debris left in the tidal pools are cleaned up in the spring.

Based on this research, the following three snow removal and disposal measures were identified as having potential for use in the CBJ.

1. Land Storage and Disposal
2. Freshwater/Marine Disposal
3. Active Snow Melting

Land Storage and Disposal

Land disposal of snow is the most common means of addressing snow in northern cities throughout the world. This method involves collecting snow and hauling it to a dedicated area for storage and disposal through naturally occurring melt off. Current best practices for land disposal of snow include sites designed to minimize the potential for site contamination, to provide a means for water quality treatment prior to melt-water discharge from the site, and to include regular maintenance of the site including ongoing trash collection.

In Alaska, the MOA is the leading operator of land storage and disposal. The MOA operates a small number of fairly large, centralized snow storage and disposal areas within its five maintenance districts. The MOA Project Management and Engineering, Watershed Management Services (WMS), division has developed several peer-reviewed and internationally recognized guidance documents and studies concerning snow storage and disposal. The MOA has developed site selection criteria, design criteria and best management practices (BMPs) for operations and maintenance of snow disposal sites based on studies conducted by WMS.

Land disposal can occur in a small number of larger sites or in a larger number of small sites. CBJ's current practice of storing snow at the USFS Mendenhall Glacier site on Glacier Spur Road falls under this category and would be considered a large, centralized site.

Costs associated with land disposal of snow can vary significantly. Capital costs associated with land acquisition (if required), design, and construction vary based on the site conditions and treatment requirements. Operating costs include maintenance costs to remove debris and sediment and to maintain the treatment system.

Juneau may be particularly challenged in implementing land disposal of snow given the lack of developable lands in the vicinity of snow generation areas. Even those areas currently used for disposal of snow into the channel have alternative and often higher value uses proposed or possible. Although it may make financial sense to develop a few larger snow disposal sites rather than a lot of smaller sites, the size and geography of the areas cleared downtown might require multiple smaller sites or other measures to address downtown Juneau, downtown Douglas and other specific generation areas.

Freshwater/Marine Disposal of Snow

This method involves collecting snow and hauling it to a specified location for direct disposal into the marine or freshwater environment. This method includes the subcategories of ocean

disposal, fluvial disposal (placing collected snow into flowing, channelized bodies of water), and lake or pond disposal. Information available on snow management systems in most U.S. cities outside Alaska indicate that most areas use land disposal for snow and allow marine or freshwater discharges only in extreme circumstances.

One of the primary contaminants of snow melt in urban areas is chlorides from road deicing. The high level of chlorides in snow melt-water has the potential to result in substantial changes in water quality in freshwater bodies. Given that most streams in the Juneau area support anadromous fish populations, fluvial deposit of snow is not likely to be feasible. Disposal of snow in other freshwater bodies, such as man-made lakes, may be feasible depending on the location and size of the lake and its relationship to local surface and groundwater resources.

Many maritime communities in Alaska have to manage more than 100 inches of snow per year. In addition, many larger Alaskan cities are located on coastlines with limited developable land between the mountains and the shoreline. These factors result in many of these Alaskan communities relying on the direct disposal of snow into the marine environment.

Over the last several years, the DEC has become increasingly concerned about the potential for water quality impacts from snow disposal into near-shore waters. The MOA, however, is the only maritime city in Alaska that has its own stormwater discharge permit that restricts this type of disposal. Other maritime cities, including Whittier, Kodiak, Valdez, and Petersburg continue to dispose of snow into the marine waters.

Although DEC's 2006 study recommended against marine disposal of snow, it did acknowledge that it might be possible for the State to develop a general permit for snow discharge into marine waters. The cost effectiveness of marine discharge, the constraints facing coastal cities that have limited developable lands available, and its frequent use by coastal cities in Alaska suggest that it may be worth working with DEC to evaluate the potential to allow for marine discharge of snow with incorporation of certain treatments or BMPs.

Active Snow Melting

This method involves collecting snow and using an energy source to melt the deposited snow. The practice of snow melting has gained prominence internationally and domestically, but is used primarily for airports and urban areas where storage space is limited or cost-prohibitive. Market research indicates that a wide variety of snow melters are available from various manufactures. Snow melters can be mobile or stationary. Mobile snow melting equipment generally uses some form of combustion as the energy source for melting snow. Stationary snow melting equipment may use combustion as the energy or incidental non-combustion sources such as industrial waste heat or domestic sewage. This study will evaluate the subcategories of Mobile and Stationary Combustion Snow melters and Stationary Incidental Fuel Snow melters.

Active snow melting has seen limited but growing use in Alaska to date. Elmendorf Air Force Base uses a mobile snow melter for runway clearing operations and some private businesses have been using snow melters in large parking lots. No municipalities in Alaska are currently

using active snow melting. In 2007, the MOA conducted a test of the SND900 mobile snow melter manufactured by Snow Dragon. The MOA test indicated that the cost of melting snow would be economically infeasible given the amount of snow generated in Anchorage each year. Potential water quality issues and permitting issues for the discharge of the snow melt were also cited as a concern. The results of that test are included in Appendix B. In Juneau, it is possible that mobile snow melting may be a reasonable alternative for specific areas, like downtown Juneau, where there are sufficient storm drains and little room for storage or for large snow hauling trucks.

Stationary snow melting using combustion is used on a small scale in parking areas, but may not have any advantages over land or marine disposal when used for regional snow management. Stationary snow melting using incidental heat sources may some potential to reduce the demand for land disposal sites or minimize the size of marine or land disposal sites.

CHAPTER 5: EVALUATION OF SNOW MANAGEMENT ALTERNATIVES

This section evaluates the various snow disposal options for use in the CBJ.

Evaluation Criteria

The evaluation criteria used in evaluation of snow management alternatives are listed below.

1. Capital Cost to Implement: Initial outlay of funds required for purchase of real property, facilities, and/or equipment.
2. Timeframe to Implement: Approximate time in months or fiscal years to develop a particular management alternative from the planning stage to initial operation.
3. Operating Costs: Year to year recurring costs for operations, maintenance, fuel, etc.
4. Impacts on Snow Removal Efficiency: Changes to the amount of hauling and the hauling distance may impact the efficiency of snow removal operations.
5. Natural Resource Impacts: Evaluation of environmental impacts on resources such as wetlands, tidelands, groundwater, and hydrology, and possible mitigation issues.
6. Permit Requirements: Permitting issues will be identified and the complexity of the permitting process will be evaluated.
7. Social Impacts: Evaluation of social impacts will include potential nuisance issues such as noise, traffic congestion, lighting changes, and visual impacts.
8. Opportunity Cost: Opportunity costs associated with using CBJ land for snow disposal as opposed to other potentially higher-value uses of lands will be evaluated.

Evaluation Results

An evaluation of each criterion for the various measures is presented below.

Capital Costs to Implement

Land Disposal: The primary capital cost to implement a land disposal site is land acquisition, if CBJ-owned lands are not available. Land prices on developable sites are high in the CBJ, with prices for sites ranging from $50,000 per acre to almost $600,000 per acre, depending on the size, location, topography, and environmental sensitivity of the site. A three-acre site is likely to cost anywhere from $150,000 to $1,500,000. Capital costs are likely to be higher for a number of small sites, versus a few large sites. This is because land tends to be more expensive at the small scale and each site would require a site-specific design and additional mobilization and construction costs. A rough estimate of design and construction costs for a one-acre snow disposal site is approximately $410,000. The cost for a two-acre site is $665,000 ($332,500 per acre) and for a three-acre site $800,000 - or $267,000 per acre. The total capital cost estimated to obtain land, design the facility and construct it, is likely to range from $500,000 for a one-acre site to $2.3 million for a three-acre site.

Freshwater/Marine Disposal: Costs to implement freshwater or marine disposal are minimal if disposal could be continued with no treatment measures. Since this is unlikely to be allowed in the long-term, the capital costs for implementing treatment measures would depend on the

measures required. Treatment could require acquisition and construction of a site or sites to place the snow to allow for removal of garbage or other pollutants prior to release of snow or melt-water into the environment. Sites for this measure would be limited to those adjacent to the marine environment or a freshwater site. A near-shore site could be modified with implementation of a silt curtain, containment boom, or dike to allow for the removal of sediment and debris prior to the discharge to the larger marine environment. Treatment for chlorides prior to discharge into freshwater would require an additional area adjacent to the freshwater site for detention and dilution of the chlorides prior to discharge to the freshwater.

Total capital costs for implementation of treatment systems for freshwater disposal would be similar to land disposal costs for land acquisition, design and construction. Since marine disposal treatment could be designed in the nearshore areas owned by the CBJ, capital costs for treatment systems for marine sites would likely be lower than for land sites.

Active Snow Melting: The primary capital costs for active snow melting differ between mobile snow melting and stationary snow melting. For mobile snow melting, the primary capital cost is the cost of the equipment itself. There could be additional capital costs associated with this alternative including improvements to storm drains for discharge of the snow melt-water. Discharge to the wastewater collection system is not feasible due to the chloride concentrations in the snow-melt. High chloride levels could disrupt the natural treatment processes, complicate combustion and increase maintenance. In addition, CBJ municipal code 75.02.080(g) prohibits stormwater discharge to the sewer system, so a permit or variance would be required. Most melting operations would be required to discharge directly to grass swales, storm drains or filtering systems prior to storm drain discharge. For example, Alaska Snow Removal in Anchorage has developed a mobile unit to remove a majority of the turbidity from the melt-water runoff so that they can discharge directly to the storm drain system. Mobile snow melting equipment costs range from $350,000 to $500,000. The cost of storm drain improvements could vary widely. Installation of oil and grit separators into the storm drain system cost approximately $100,000 per installation.

Capital costs for stationary snow melting systems would be higher, as they would include site acquisition, site preparation, site design, equipment purchase, and construction. The snow melting equipment cost is estimated at $500,000. Costs for land acquisition, site design and construction would be similar to that for land disposal sites, for a total capital cost of $1 to 2 million.

The capital costs for a snow melting site with an incidental heat source would likely be higher than those for the stationary combustion site. The incidental heat source melting operation would have all of the costs described for the stationary combustion site, but the process design and equipment are likely to be more costly.

A comparison of capital and operating costs for the various measures is provided in Table 5-1.

Table 5-1. Cost Comparison for Snow Management Measures

Measure	Capital Cost		Annual Operating Costs
Current Measures Downtown - haul to marine disposal Mendenhall Valley - haul to land disposal site	N/A		Labor - Currently ranges from $800K to $1.1M Hauling Cost - Currently ranges from $50K to $1.6M Fuel Cost - Currently ranges from $60K to $140K
Land Disposal (3 acre)	Land Acquisition Design/Permitting Site Prep/Construction Equipment	$0-$1.5M $150-300K $400-850K $0	Labor - Slightly higher than current operations for downtown; no change for Mendenhall Valley Hauling Cost - Depends on location; most new locations result in an increased cost Fuel Cost - Likely higher for most new locations
Land Disposal (2 acre)	Land Acquisition Design/Permitting Site Prep/Construction Equipment	$0-$1M $100-250K $300-500K $0	Labor - Slightly higher than current operations and than larger site option for both downtown and Mendenhall Valley Hauling Cost - Depends on location; multiple sites could reduce cost Fuel Cost - Downtown likely higher, Mendenhall Valley same or slightly lower
Land Disposal (1 acre)	Land Acquisition Design/Permitting Site Prep/Construction Equipment	$0-$500K $100-250K $200-400K $0	Labor - Slightly higher than current operations and than larger site option for both downtown and Mendenhall Valley Hauling Cost - Depends on location; multiple sites could reduce cost Fuel Cost - Downtown likely higher, Mendenhall Valley same or slightly lower
Marine Disposal (Downtown areas)	Land Acquisition Design/Permitting Site Prep/Construction Equipment	$0 $0 $0 $0	Labor - No change from current Hauling Cost - Depends on location; most locations result in an increased cost Fuel Cost –Likely higher for most new locations
Marine Disposal with treatment (Downtown areas)	Land Acquisition Design/Permitting Site Prep/Construction Equipment	$0 $100-200K $300-400K $0	Labor - Slightly higher than current downtown operations Hauling Cost - Depends on location; most locations result in an increased cost Fuel Cost - Likely higher for most new locations
Freshwater Disposal (Mendenhall Valley area)	Land Acquisition Design/Permitting Site Prep/Construction Equipment	$0 to $1M $0 $0 $0	Labor - Could decrease slightly compared to Mendenhall Valley operations Hauling Cost - Likely to increase somewhat Fuel Cost - Likely to increase somewhat

Measure	Capital Cost		Annual Operating Costs
Freshwater Disposal with treatment (Mendenhall Valley area)	Land Acquisition Design/Permitting Site Prep/Construction Equipment	$0 to $1M $100-200K $300-600K $0	Labor - Slightly higher than current Mendenhall Valley operations Hauling Cost - Likely to increase somewhat Fuel Cost - Likely to increase somewhat
Mobile Snow Melting	Land Acquisition Design/Permitting Site Prep/Construction Equipment	$0 $0 $0 $350-500K	Labor - Less labor related to snow hauling operations, more labor related to extra maintenance of storm drain outfalls Hauling Cost - None Fuel Costs - Could be same or lower
Stationary Combustion Snow Melting	Land Acquisition Design /Permitting Site Prep/Construction Equipment	$0 to $1M $100-200K $300-400K $500K	Labor - Likely higher due to additional of stationary melt equipment in addition to snow hauling Hauling Cost - Depends on location; most locations result in an increased cost Fuel Cost - Substantially higher (haul plus melt)
Stationary Incidental Snow Melting	Land Acquisition Design/Permitting Site Prep/Construction Equipment	$0 to $1M $100-250K $400-500K $500K+	Labor - Slightly higher than current operations Hauling Cost - Depends on location; most locations result in an increased cost Fuel Cost - Likely close to current

Operating Cost

Land Disposal: Operating costs for land disposal are primarily related to the hauling operations and the cost of personnel and equipment managing the snow on the site. Additional labor costs could be incurred with water quality monitoring and trash pickup during the melting period. Since hauling costs are the most variable expense for winter operations, reduced hauling could result in more consistency and certainty in budgeting winter operations. It is hard to quantify the exact cost and distance from the various generation areas to disposal sites; CBJ staff responsible for snow removal activities were asked to identify an area to be used as the midpoint of generation areas to calculate average haul distances. Average haul distances for the existing snow disposal sites are shown in Figures 5-1 through 5-4.

Freshwater/Marine Disposal: Operating costs for marine disposal would similarly be primarily related to hauling costs and the cost of managing the marine disposal sites. Although the CBJ currently disposes of snow directly into Gastineau Channel in downtown Juneau and at the Mayflower Island causeway near downtown Douglas, it is likely that use of marine disposal for a long-term solution will require some type of treatment prior to discharge. Implementation of a containment boom or dike may remove debris and sediment from the dumped snow before it enters the marine environment. This option would likely require on-going maintenance, such as periodic dredging, in terms of ongoing operating costs.

Freshwater disposal sites in the CBJ are extremely limited, since most freshwater resources are anadromous streams and/or impaired water bodies. As few sites are available, hauling distances and costs would likely be higher than for existing sites.

Active Snow Melting: Operating costs for a mobile snow melter are based on fuel consumption and a small amount of labor. Use of a mobile snow melter would eliminate hauling costs, but fuel costs associated with melting the snow may eliminate any savings. Based on a cost comparison calculation available from snow melting equipment manufacturers, the cost of fuel to melt the snow is expected to be lower than the cost to haul the snow to a disposal site, as shown in Table 5-2. Labor costs may possibly be decreased, as only a grader and a loader are necessary to feed the snow melter. Use of a stationary snow melter would result in both hauling costs and snow melting costs and would likely be the most expensive option in terms of annual operating costs. A stationary snow melter with an incidental heat source, such as from an adjacent incinerator or wastewater treatment plant, would still result in costs for hauling snow but could reduce the ongoing cost for operating the melting system.

Timeframe to Implement

Land Disposal: Implementation of land disposal includes acquisition of the site, design of the site improvements, acquisition of permits, and development of the site. Since many developable sites in the CBJ include wetlands, it is likely that a wetland permit will be needed in addition to a CUP for any new site. Permit approval can be expected to take anywhere from three months to over a year, as illustrated by the CBJ's permit application for the proposed

Figure 5-1
Average Haul Distance for Downtown Juneau

City & Borough of Juneau
Snow Disposal Site Alternatives

DOWL HKM

November 12, 2010 | Sheet 1 of 1

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Figure 5-2

Average Haul Distance for West Juneau

City & Borough of Juneau
Snow Disposal Site Alternatives

DOWL HKM

November 12, 2010

Sheet 1 of 1

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Figure 5-3

Average Haul Distance for Douglas

City & Borough of Juneau
Snow Disposal Site Alternatives

DOWL HKM

November 12, 2010

Sheet 1 of 1

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Figure 5-4

Average Haul Distance for the Valley

City & Borough of Juneau
Snow Disposal Site Alternatives

DOWL HKM

November 12, 2010

Sheet 1 of 1

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Table 5-2. Snow Melting Cost Comparison

Snow Dragon Melting vs. Hauling

Melting

Snow Dragon: Based on melting 240 cubic yards of snow	Cost per hour for loader & operator	Cost per hour for second operator (optional)	SND900 average diesel consumption per hour	Diesel Fuel: Price per gallon	Total Cost for Diesel Fuel Consumed	Total Cost for SND 900 for one hour
	$153.00	**$58.00**	**40**	**$3.25**	**$130.00**	**$341.00**
	Enter Current $ in this cell	Enter Current $ in this cell		Enter Current $ in this cell		

Hauling

Based on hauling 240 cubic yards of snow using a 10 cubic yard truck	Cost per hour for blower & operator	Cost per hour for 10 cubic yard truck w/operator	Number of loads that can be hauled in one hour, portal to portal, per hour	Truck hours needed to haul 240 cubic yards of snow/hr	Cost to haul 240 cubic yards of snow/hr using 10 cubic yard truck	Total cost to haul 240 cubic yards of snow/hr	Savings to melt vs. haul
	$203.00	**$133.00**	**3.2**	**8**	**$997.50**	**$1,200.50**	**$859.50**
	Enter Current $ in this cell	Enter Current $ in this cell					

Based on hauling 240 cubic yards of snow using a 20 cubic yard truck	Cost per hour for blower & operator	Cost per hour for 20 cubic yard truck w/operator	Number of loads that can be hauled in one hour, portal to portal, per hour	Truck hours needed to haul 240 cubic yards of snow/hr	Cost to haul 240 cubic yards of snow/hr using 20 cubic yard truck	Total cost to haul 240 cubic yards of snow/hr	Savings to melt vs. haul
	$203.00	**$144.50**	**2.25**	**5**	**$770.67**	**$973.67**	**$632.67**
	Enter Current $ in this cell	Enter Current $ in this cell					

Source: Snow Dragon Website, 2010

Crazy Horse site in 2009. The timeframe for implementation of one large snow disposal site would likely range from a minimum of one year to a maximum of two years. Implementation of a number of smaller sites would like result in a slightly longer implementation time if multiple designs and permits are required.

Freshwater/Marine Disposal: Marine disposal is currently used by CBJ and will likely continue to be used unless an alternative management system is developed. Long-term use of marine disposal may require acquisition of a permit for the discharge. Acquisition of a permit is likely to require some type of treatment prior to discharge and thus, is likely to require development of shoreline or near-shore site improvements to accommodate the treatment process. In addition, there is a possibility that this would be considered the discharge of fill into the shoreline or near-shore environment, and could require a fill permit from the U.S. Army Corps of Engineers. Since land disposal is a more common disposal method in the U.S. than marine disposal, there is more uncertainty and less established treatment requirements for marine disposal. Therefore, the timeframe for implementation of permitted marine disposal may take longer than receiving a permit for land disposal.

Freshwater disposal is even rarer than marine disposal in the U.S. Permitting for freshwater disposal would be expected to take the longest of all options, due to the need to address the potential effects of chloride on the freshwater environment and to design and approve chloride treatment prior to discharge to freshwater environments. Since most of Juneau's freshwater streams are anadromous, permitting of direct discharge into these streams is unlikely to be feasible.

Active Snow Melting: Based on discussions with equipment manufacturers, acquisition of snow melting equipment is likely to take three to six months from ordering. For mobile equipment, it is possible that storm drain or sanitary sewer improvements may be required in some areas, including installation of oil and grit separators or other treatment devices. For a stationary site, additional time may be required to design the site and discharge treatment systems. Most communities are not requiring discharge permits to storm drain systems, although this may become a regulatory issue in the future as this would result in an indirect discharge to the marine environment. Discharge to the ground surface would not require any permit, but could result in problems with surface icing and blockages in existing drainage swales or storm drains. Although the acquisition of mobile snow melting equipment can occur in a short period of time, design, implementation and construction of needed storm drain improvements could take over a year. Therefore, the timeframe for implementation of mobile snow melting could be as short as six months to over a year.

The timeframe for a stationary combustion site would likely take longer, due to the need to acquire a site, design the facility, receive the equipment, and construct the site. Depending on the size of the stationary combustion equipment, an air quality review and/or permit could be required. The timeframe for a stationary combustion site is expected to take over a year and possibly two to three years.

The timeframe for a snow melting facility with incidental heat is likely to take even longer, as there would need to be a more detailed feasibility study of this option and a detailed process design prior to the beginning of any site preparation and construction. This option would like take more than two years and possibly up to five years.

Impacts on Snow Removal Efficiency

Land Disposal: The impact on operating efficiency from land disposal depends on the distance that the snow must be hauled from generation areas to the disposal area. Having several small sites located near generation areas would likely be more efficient than having a few large sites that require longer hauls from generation areas.

Marine/Freshwater Disposal: If pretreatment of snow is required prior to marine disposal, the impact on snow removal efficiency will be similar to that for land disposal. The impact will vary depending on how far the snow must be hauled to the disposal site. One efficiency advantage of marine disposal would be in the event of several large snowfalls in succession. Marine disposal provides for more rapid disposal of snow and would be less likely to ever result in a lack of capacity for snow disposal, which could become an issue with land disposal depending on the design and permit restrictions on the height of snow allowed at disposal sites. Freshwater disposal sites are limited and would likely result in longer hauls for disposal, reducing efficiency.

Active Snow Melting: Use of a mobile snow melter could improve snow removal efficiency as the haul component of snow removal could be eliminated and snow melted and disposed of at the site of generation. The impacts on efficiency for a stationary melting system would again depend on the distance snow would need to be hauled to the melting equipment.

Natural Resource Impacts

Land Disposal: Potential natural resource impacts from land disposal include some that are site specific and some that are more general in nature. Site specific impacts could include the loss of vegetation or wetlands on currently undeveloped sites. Other site-specific impacts could include changes in drainage patterns. More general impacts include the potential for water quality impacts to nearby waters or vegetation from the snow melt-water which is likely to contain sediment, hydrocarbons, heavy metals, and high levels of chlorides from road sanding and deicing. Water quality impacts can be minimized through appropriate design of melt-water treatment systems as part of the disposal site. Another potential issue with hauling snow to disposal sites is the emissions related to the trucks hauling snow. These emissions are lower with disposal sites that minimize haul distance.

The most problematic water quality issue associated with snow melt is chlorides from deicing operations. CBJ uses a magnesium chloride (CG-90) deicing formula with corrosion inhibitors. Approximately 200-300 tons of deicer is used per year. There are limited means to remove chlorides and therefore, the goal of treatment is to reduce the concentration in the discharge through dilution. Typically in a land disposal site, there is a "first flush" of melt-water in which the chloride concentrations are elevated. The concentration of chlorides in melt-water later in the season is much lower. Therefore, appropriate design measures need to be incorporated into the site drainage system to dilute the chlorides prior to discharge to reduce impacts to surrounding vegetation or freshwater streams or lakes.

Detention of melt-water on-site allows for sediment to settle out of the melt-water prior to discharge. Since heavy metals often adsorb onto the sediment, this can also reduce the heavy metals in the discharge from the site.

In terms of natural resource impacts, having fewer and larger sites would allow for fewer areas to be impacted by the water quality aspects of snow disposal sites.

Marine/Freshwater Disposal: Water quality impacts are assumed to be the main concern for marine and freshwater disposal options. Because the snow removed from streets is likely to contain hydrocarbons, heavy metals, sediment, debris and chlorides, we can assume that any approval for marine disposal would require that there be some type of pre-treatment to remove at a minimum sediment, debris and hydrocarbons (hydrocarbons and heavy metals levels in melt-water are decreased with decreased sediment.) Assuming that there will need to be sites developed for pre-treatment prior to disposal, there could again be some site specific impacts to natural resources from development of the sites. One advantage of marine disposal is that the marine environment would be less sensitive to the chlorides in the melt-water compared to the vegetated areas, freshwater streams or lakes, or groundwater. Since high chloride levels are a major issue with snow melt-water, the potential for adverse impacts to freshwater resources is high without adequate treatment prior to discharge to the freshwater source.

Active Snow Melting: Use of mobile snow melting equipment could eliminate the need to develop land disposal or treatment sites, reducing the impacts on existing vegetation, wetlands and freshwater streams and lakes. Use of a stationary site would likely require site development with similar impacts to the other measures. The major natural resource impact from active snow melting would again be related to the pollutants in the melt-water. Snow melters do not have a peak or "first flush" of chlorides; the chlorides are diluted by the melt-water as the process is performed. Entities using snow melting systems in the MOA are filtering the melt-water coming out of the snow melter to reduce sediment and hydrocarbons prior to discharge to the storm drain system. In general, the level of hydrocarbons is thought to be low in cases where high volumes of snow are being removed quickly from generation areas, which is most likely with mobile snow melting. Another possible pollutant associated with snow melting is diesel emissions from the melter. For mobile melters, the emissions would be dispersed throughout the area and may be similar to the emissions reduced from eliminating trucks hauling snow off-site. For stationary melters, there would be emissions from the stationary site

in addition to the emissions from trucks hauling the snow. Depending on the level of emissions, this could require an air quality permit or could be a concern in areas with existing air quality impacts. Use of an incidental heat source for a stationary melting site would reduce the concern regarding increased diesel emissions.

Social Impacts

Land Disposal: The impact of land disposal sites on social resources is related to the nuisance potential from operating these sites. Snow disposal sites generate substantial amounts of truck traffic during hauling operations, resulting in high noise levels and traffic congestion. Because disposal sites are often designed to store snow to 30 feet high or more, stored snow often contains dirt and debris, and debris accumulates as the snow melts; they can result in visual impacts on nearby residences. Finally, lighting and operation of equipment on the site can adversely impact nearby properties. Siting of disposal sites outside residential areas can reduce the potential for these impacts.

Theoretically, the use of a number of smaller sites would result in siting sites closer to the residential areas that are being cleared. Having a few larger sites allows for siting the disposal areas farther from residential areas.

Marine/Freshwater Disposal: If pre-treatment of snow is required prior to marine or freshwater disposal, the social resource impacts would depend on the areas identified for pre-treatment. The impact would be reduced for sites outside residential areas.

Active Snow Melting: Use of a mobile snow melter could reduce the social impacts associated with construction and operation of land disposal sites. The mobile snow melting system would likely produce similar noise and exhaust emissions to the trucks used to haul snow. Melt-water discharge would need to be managed to avoid creating icing problems on roads and drainage ditches to prevent safety hazards. Social impacts for a stationary melting system would be similar to land and marine disposal and would depend on the distance to residential or other sensitive land uses. Noise and exhaust from a stationary snow melter would likely require the site to be located away from residential areas.

Permitting Requirements

Land Disposal: Permitting requirements for land disposal include a CUP, possibly a zoning map amendment, and, if the site contains wetlands, a wetlands permit from the U.S. Army Corps of Engineers. The difficulty of obtaining these permits would depend on the location of the site and the amount and type of wetlands impacted. Although permit requirements for a land disposal site may be stringent, land disposal is a common disposal technique and with proper siting, design and treatment, permitting should be possible in six months to a year.

Marine/Freshwater Disposal: Although many coastal Alaskan communities use marine disposal for their snow disposal, this method is coming under increased regulatory scrutiny. Because marine disposal of snow has not been officially permitted to date, there is significant uncertainty about whether it would be permitted and if so, what types of pre-treatment may be required. Due to the uncertainties of the permitting process, it is likely that obtaining a permit for long-term marine discharge could take over a year. In addition, the likelihood that marine discharge would require pre-treatment could require development of a pre-treatment site, which again would likely require a CUP and possibly a fill permit.

Freshwater disposal would likely also require some type of discharge or fill permit. Since freshwater resources would be much more sensitive to high chloride levels than marine resources, permitting for freshwater disposal would be expected to be more rigorous and lengthy.

Active Snow Melting: Mobile snow melting would not likely require any permits for disposal to the CBJ storm drain system. Since discharge of melt-water into the storm drain system is essentially an indirect discharge to the marine environment and may be considered a point source discharge, it is likely that eventually the regulatory agencies will be interested in reviewing these discharges. A stationary combustion snow melter could possibly trigger a need for air quality permitting as well, depending on the amount of emissions estimated to be generated. This could be problematic in areas with air quality compliance issues, such as the smoke hazard area in the Valley.

Opportunity Cost

Land Disposal: The CBJ comprehensive plan notes that there is a shortage of suitable land for affordable residential development in Juneau. Land disposal of snow can require a significant amount of land, particularly to design and construct sites that provide the current standard of melt-water treatment. Use of a few larger sites outside residential areas may have a lower opportunity cost than using many smaller sites closer to residential areas, as developable residential lands are in short supply in Juneau and therefore, relatively valuable.

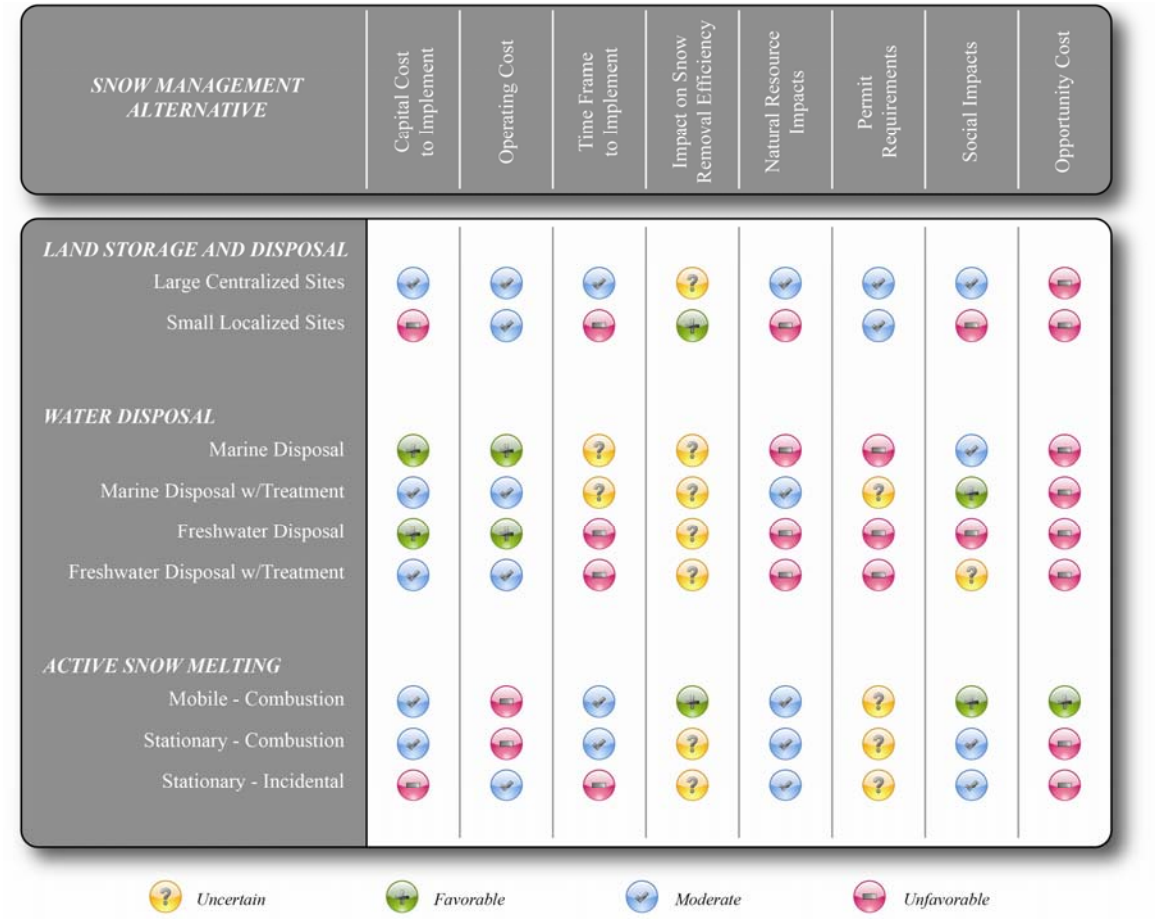
Marine Disposal: Opportunity costs for shoreline sites would include the potential for these sites to be used for other higher value uses, such as marine industrial uses.

Active Snow Melting: Active snow melting using mobile snow melters would not have an opportunity cost for alternative uses of scarce lands. The opportunity costs for a stationary site would be the same as that for land or marine disposal sites.

Snow Management Recommendations

The figure below illustrates the relative advantages and disadvantages of the various snow management measures evaluated. As evidenced by the figure, there is a high level of uncertainty regarding operating costs, as these are heavily dependent on the specific sites evaluated. Similarly, the timeframe for implementation is related to the uncertainties regarding permitting requirements for some of the management options.

Table 5-2. Snow Melting Cost Comparison



Freshwater disposal without treatment is the least likely to be acceptable to regulatory agencies and the public. Although some land disposal sites are located near freshwater bodies, the intent would be for there to be detention on site to allow for sediment removal and dilution of chlorides prior to discharge from the site. Sites with more distance from freshwater bodies are preferred to sites close to freshwater bodies. Therefore, freshwater disposal measures are not considered feasible to carry forward.

Land disposal is a very common measure and is currently used for the Mendenhall Valley area. The benefits and drawbacks of land disposal are tied closely to the specific sites - whether land must be purchased and whether the site would require a longer haul distance from generation areas. In the Mendenhall Valley area, there are a number of land disposal site options that may be considered as discussed in Section 6. In the downtown areas, there are fewer land sites available - particularly in downtown Juneau.

Marine disposal is currently used in the downtown area. It is cost effective and provides for timely snow removal. Since treatment of snow discharged to the marine environment is likely to be required in the future, marine disposal with treatment should be evaluated further for the downtown area.

Although snow melting is used in various applications in Japan, snow melting is still a relatively new technology in the U.S., and there are significant uncertainties about the benefits and drawbacks of this technology for municipal operations. Mobile snow melting may have some benefits in areas with limited space and sufficient storm drain systems. In particular, mobile snow melting could address issues in downtown areas. The cost for operating the snow melters may be offset by the reduction in hauling costs in densely developed areas with no disposal sites nearby.

Stationary snow melting sites that use combustion are likely to result in significantly higher snow disposal costs, as the snow would still need to be hauled to the site and addition fuel burned to melt the snow. The use of incidental heating sources may make stationary snow melting feasible, for example near the Juneau-Douglas Wastewater Treatment Plant (J-D WWTP) and its sludge incinerator. The Fluidized-Bed Biosolids Incinerator located at the J-D WWTP is used to burn the solid waste matter produced in the wastewater treatment processes at both the Juneau-Douglas and Mendenhall facilities. High temperatures are used in the incinerator to ensure complete combustion of the waste material. The exhaust gases from the incineration process leave the incinerator at a temperature of approximately 1550 °F (Figure 5-5). The exhaust gas then passes through a pre-combustion heat exchanger that both cools the exhaust gas and pre-heats the air to be used in the combustion process in the incinerator. The exhaust gas leaving the pre-combustion heat exchanger is approximately 850 °F - 950 °F. It is then mixed with treatment plant effluent in a Venturi scrubber and filtered extensively allowing only water vapor to be released into the atmosphere. The resulting purified ash and water mix is sent to a holding pond where the ash is allowed to settle naturally. The water from these ponds is then redirected back into the wastewater treatment process.

The 850 °F - 950 °F exhaust gas between the pre-combustion heat exchanger and the scrubber presents an opportunity to capture more waste heat with the installation of a secondary heat exchanger prior to the exhaust gas entering the scrubber. The heat exchange medium could then be used to provide energy in the form of heat to an incidental snow melting process. This secondary heat exchanger would have the added benefit of increasing the efficiency of the Venturi scrubber by further cooling the exhaust gas prior to treatment in the scrubber. Two concepts for using this heat in the melting process are illustrated in Figures 5-6 and 5-7.

Section 6 looks at specific land and marine disposal sites for the downtown areas and the Mendenhall Valley areas in more detail.

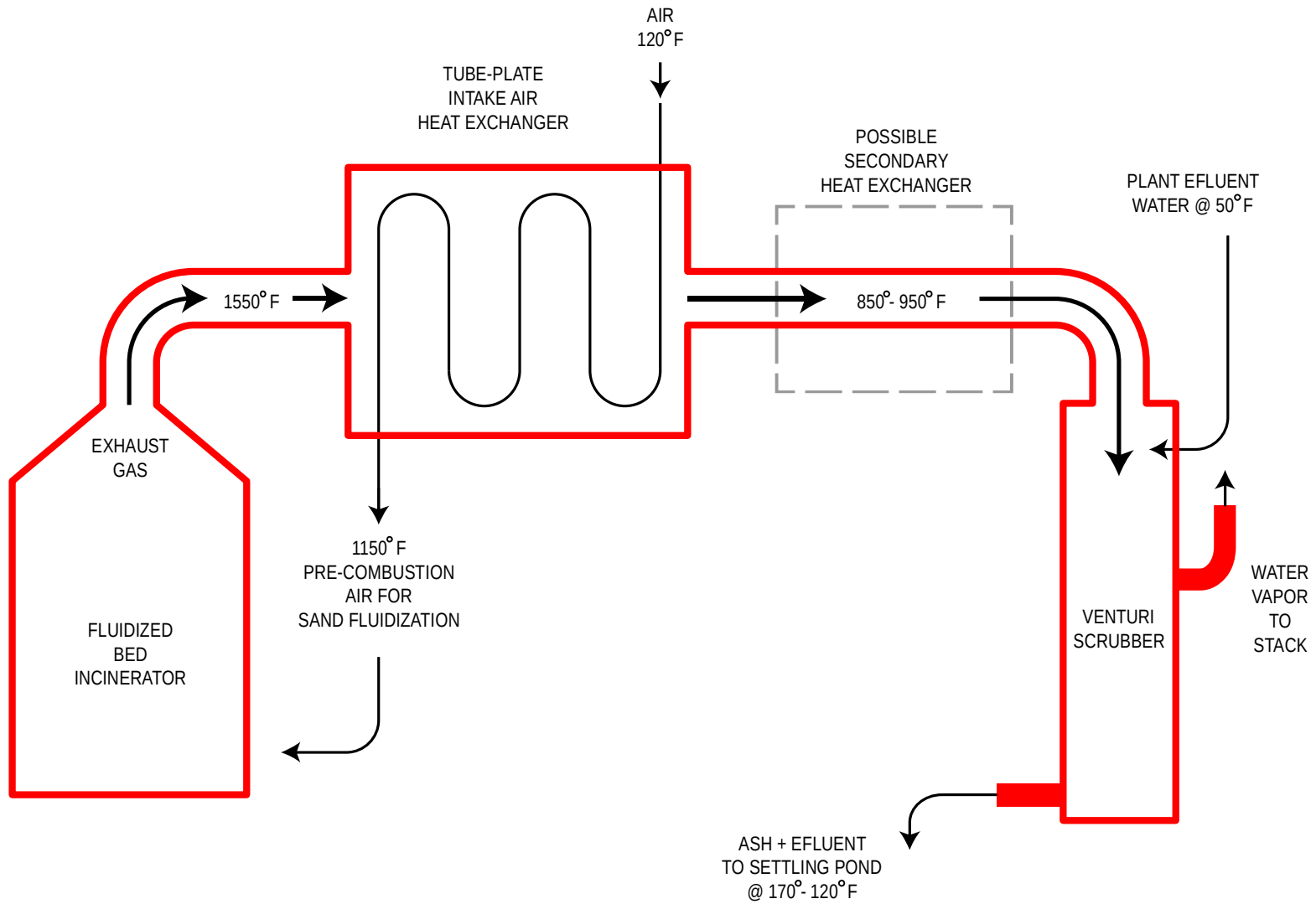


Figure 5-5
J-D WWTP Process

City & Borough of Juneau
Snow Disposal Site Alternatives

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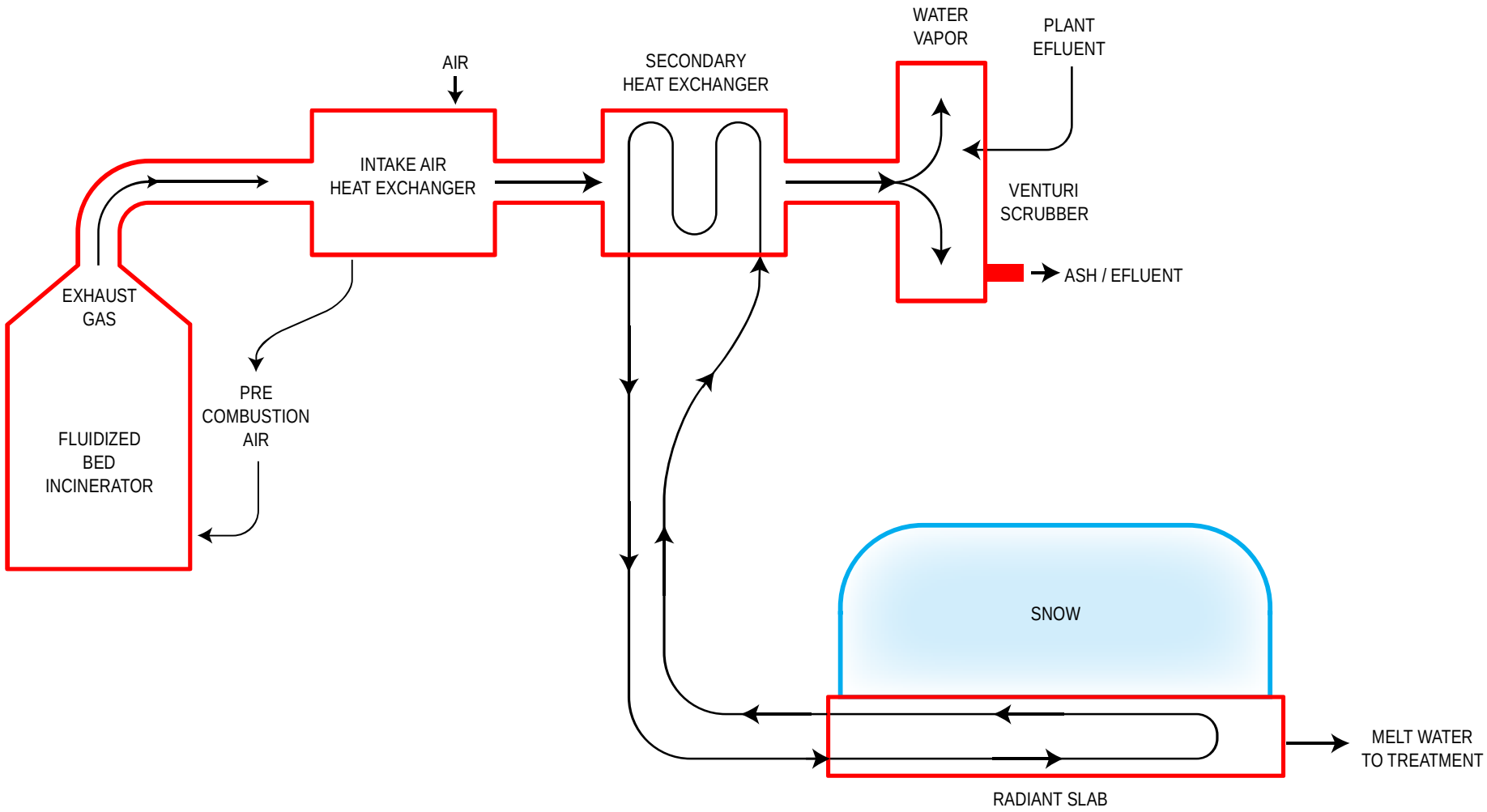

Figure 5-6
J-D WWTP Incidental Heat Concept - Radiant

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Snow Disposal Site Alternatives

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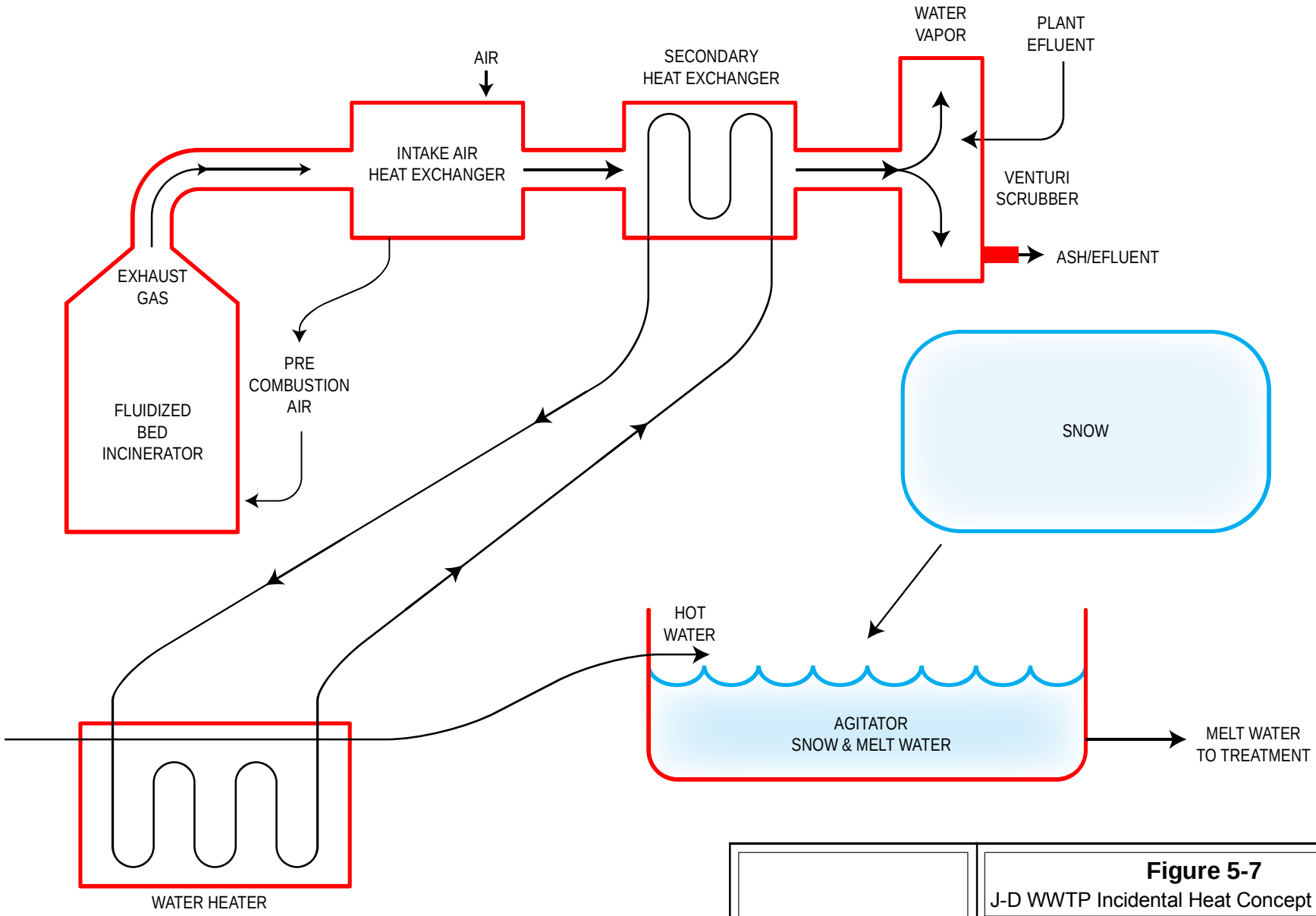

Figure 5-7
J-D WWTP Incidental Heat Concept - Hot Water

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CHAPTER 6: SNOW DISPOSAL SITE IDENTIFICATION AND ANALYSIS

Land and marine disposal of snow will likely continue to play some role in the CBJ's snow management strategy. Land disposal is particularly relevant in the Valley, where there is storage capacity in road ROWs and no existing marine disposal sites. In order to address the potential loss of the site currently used at the USFS Mendenhall Glacier Visitor Center and to address the potential for other land disposal or marine pre-treatment sites, an evaluation of potential sites was completed.

Site Evaluation Process and Criteria

The CBJ does not currently have adopted site selection, siting, or design criteria for snow disposal sites, or specific approval criteria for this use. The criteria used in this evaluation are based in large part on the criteria established by the MOA.

This site evaluation process included coordination with the CBJ Engineering Department, Planning Department, Public Works Department, and members of the private snow management industry. Each of these groups offered comment on the feasibility of acquiring and using these sites on a long term basis.

The evaluation criteria used in detailed site analysis are described below.

Ownership –In general, CBJ-owned property is preferable over privately owned sites.

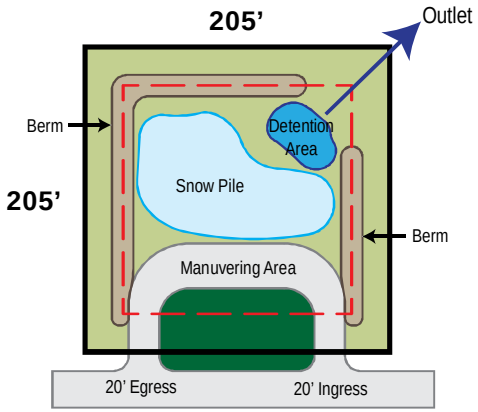
Assessed Value –The assessed value gives a general estimate of the cost for acquiring properties not owned by CBJ.

Zoning/CUP - Industrial or general commercial land use zoning for both the site and the surrounding area was more favorable than residential zoning. The site evaluation matrix shows the zoning classification for each site. Information is also provided on whether a CUP is required, any time limits on CUP approvals, and/or limits on the size of snow disposal facilities allowed.

Haul Distance - This criterion evaluates the average distance of hauling that would be required from an area roughly in the middle of the generation area and is used to compare hauling costs for proposed sites to the hauling costs for existing sites.

Accessibility - Accessibility considerations include accessibility, including whether the access is sufficient for the level of truck traffic and the maneuvering requirements for equipment and trucks used in snow disposal operations. Site proximity to arterial or collector roads was favored in the analysis, while use of residential streets to access disposal sites was unfavorable. Difficult left turns, roads with steep grades, and dangerous intersections were also unfavorable characteristics.

Size– The size of the site affects the volumetric storage potential of the site, the ability to design water quality treatment on-site, and the ability to maneuver trucks and equipment on the site. Small sites are very inefficient for designed snow disposal sites, as shown in Figure 6-1. For area-wide disposal sites, a minimum of one to three acres is likely to be needed depending on



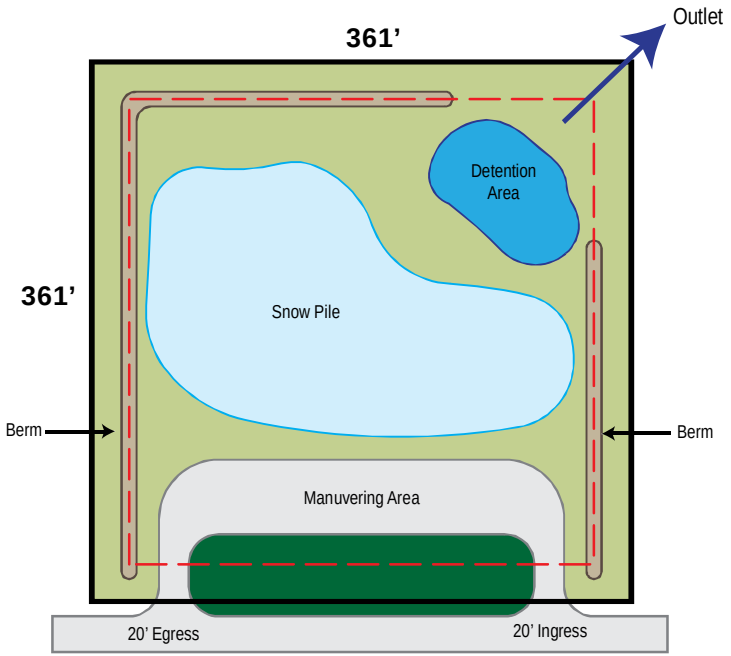
PARCEL 1

AREA = 42,025 s.f.

25’ BUFFER = 18,000 s.f. (43% of site)

= 24,025 s.f. SNOW STORAGE

(57% of site)



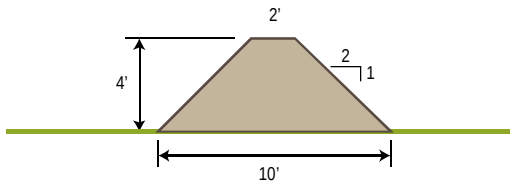
PARCEL 2

AREA = 130,682 s.f.

25’ BUFFER = 33,650 s.f. (26% of site)

= 97,032 s.f. SNOW STORAGE

(74% of site)



TYPICAL BERM SECTION

Figure 6-1
Usable Site Comparison

City & Borough of Juneau
Snow Disposal Site Alternatives

DOWL HKM

November 11, 2010

WO: J70345

the generation area being served. Larger sites provide more opportunities for designing a facility that operates efficiently and minimizes natural resource and social impacts.

Wetlands Impact - Sites containing high-value wetlands were less favorable than sites in upland areas or near lower-value wetlands. Sites that would reduce the functionality of any receiving wetlands or discharge into closed wetlands having few or no surface water outlets are not favorable. Snow sites may be able to supply surface water for wetland areas, both natural and manmade. Created wetlands would offer water quality improvements over sites without such BMP's.

Natural Resources - Sites adjacent to anadromous streams, and sites that discharge melt-water into potable water aquifers, closed lakes and wetlands, anadromous streams, impaired water bodies, or streams having low winter base flows are not favored. This category also includes impacts on upland habitats and other natural resource factors which may be site specific. Generally, upland areas that have already been affected by clearing and/or development are preferred to sites that contain wetlands and/or anadromous streams, or sites that are heavily vegetated and undisturbed.

Social/Nuisance Impact - Snow disposal sites may create nuisances for adjacent properties. These include noise, glare from lighting, dust, increased truck traffic, and trash. Nuisances can be mitigated, but not eliminated. Sites located away from residential areas were favored. Sites with existing natural buffers (vegetation or grade separation) were favored over sites requiring extensive improvements to mitigate nuisance problems.

Development Issues/Costs - This criteria evaluates the potential development issues associated with a site and the estimated costs for development.

Opportunity Costs - This criterion evaluates the potential for development and use of the site for other high value uses.

Site Evaluation

A total of 38 sites in the Juneau-Douglas area were evaluated. Figures showing each site are included in Appendix C. Table 6-1 is a site evaluation matrix summarizing the site evaluation process. For each site, the results of the analysis of each of the site evaluation criteria are summarized in Appendix C. A summary of the evaluation for each service area is provided.

There are no perfect sites for snow disposal as illustrated in the evaluation matrix. There are also few characteristics that absolutely eliminate potential sites, as most limitations can be addressed through site design, treatment systems, or changes in operations. The financial feasibility of addressing site limitations or of operational changes required may be significant, though, and this must be taken into consideration in selection of reasonable and feasible sites.

As discussed above, the site size required for the Mendenhall Valley area is a minimum of three acres, to allow for buffering, treatment, maneuvering, and storage. Therefore, the sites in the Mendenhall Valley area that are less than three acres were eliminated from consideration, unless there were multiple adjacent parcels that could be combined to meet the three-acre

Table 6-1. Potential Snow Disposal Sites

Site Number	Site Name	Ownership	Assessed Value	Zoning	Haul Distance (miles)	Accessibility	Size in Acres (Usable)	Wetlands Implact	Natural Resources	Social/Nuisance Impact	Development Cost	Opportunity Cost
	Mendenhall Valley Area											
1	AUKE BAY ELEMENTARY	CITY AND BOROUGH OF JUNEAU	NA	D3/GC	4.67	Poor - through school sites, would need to construct new	43 (32)	yes	wooded site	near schools	Requires new access road, steep topography	existing undeveloped recreation use
2	MONTANA CREEK PIT	W GLACIER DEV LLC / COOGAN GENERAL LLC	$1,165,900	D1/D3	2.45	Good	40	no	developed site	history of neighborhood complaints	Proximity to Mendenhall River would make challenging for treatment/drainage	none known
3	WREN DR/STEELHEAD ST	CITY AND BOROUGH OF JUNEAU	NA	D3	2.79	Poor - through residential area	4	yes - Class A	partially wooded and wetlands	Adjacent Residences	Likely poor soils and complicated drainage issues	conservation area
4	RIVERSIDE CHURCH	BETHANY BAPTIST CHURCH	$390,000	D15	1.7	Poor - through residential /school area	3	no	on Mendenhall River	Adjacent Residences, history of neighborhood complaints	Proximity to Mendenhall River would make challenging for treatment/drainage	Residential uses
5	MELVIN PARK	CITY AND BOROUGH OF JUNEAU	NA	D5	1.11	Good	8	no	developed site	recreation uses; close to residential	Proximity to Mendenhall River would make challenging for treatment/drainage	existing developed recreation use
6	THUNDER MTN	CITY AND BOROUGH OF JUNEAU	NA	D5	0.34	Poor - through residential areas	77	yes	wooded site, steep/slide area	close to residential areas	Requires new road access, proximity to residential and anadromous streams makes for complex drainage/treatment design	Residential uses
7	DIMOND PK	CITY AND BOROUGH OF JUNEAU	NA	D5	1.3	Poor - speed bumps; school area	68 (14)	yes	on Mendenhall River	Near school; recreation uses	May require new access road, likely poor soils, proximity to Mendenhall makes challenging for treatment/ drainage, small area undeveloped	Developed school and recreation uses
8	CINEMA DR #1	JKZ LLC	$1,100,000	D15	0.9	Moderate	20	no	Duck Creek, wooded site	residential uses to south	Few design challenges	affordable housing
9	CINEMA DR #2	GROSS ALASKA INC	$684,400	D15	0.9	Moderate	5	no	Duck Creek, wooded site	low	Few design challenges	affordable housing; commercial

Table 6-1. Potential Snow Disposal Sites

Site Number	Site Name	Ownership	Assessed Value	Zoning	Haul Distance (miles)	Accessibility	Size in Acres (Usable)	Wetlands Implact	Natural Resources	Social/Nuisance Impact	Development Cost	Opportunity Cost
10	ALLISON POND	ALLISON COMMUNITY PROPERTY TRUST	$150,000	D15	1	Very Poor - No existing access	2	yes	Adjacent to Duck Creek and pond	Access through residential area	site size makes design development difficult	residential/ creek buffer
11	NANCY ST WETLAND	KODZOFF ACRES LLC	NA	D5	1.3	Moderate	2	yes	Conservation wetlands and Duck Creek adjacent	Access at edge of residential area	site size makes design development difficult	residential/ creek buffer/ recreational trail
12	INDUSTRIAL BLVD 1	CITY AND BOROUGH OF JUNEAU	NA	I	2.7	Moderately Good	27	yes - Class B/C	disturbed site, Casa del Sol	in industrial area	some design challenges with wetland areas	conservation area
13	AT&T	AT&T	$1,937,000	I	2.6	Moderately Good	25 (23)	yes	partially developed	in industrial area	likely good soils and size allows for good treatment design, wetlands would need to be avoided	utility use
14	INDUSTRIAL BLVD 2	KEN WILLIAMSON	$580,000	I	2.6	Moderately Good	7	no	site is filled wetlands	in industrial area	Few design challenges	industrial development
15	WILLIAMSON PROPERTY	KEN WILLIAMSON	$100,000	I	2.6	Moderately Good	3	yes	disturbed site, Casa del Sol	low	soils likely poor, small size makes design development difficult	none known
16	BAHAI	SPIRITUAL ASSEMBLY OF THE BAHAIS	$930,000	LC	1.9	Moderately Good	3	yes	Class C wetlands; partially wooded	some residential nearby	may be difficult to avoid wetlands, may be complicated drainage design	residential/ commercial use
17	STATE DNR	DNR	NA	LC	1.9	Moderately Good	7	yes	Duck Creek, partially wooded site	commercial area along major streets	tight site size to avoid wetlands and creek and provide treatment prior to discharge	existing public use
18	FAITH LUTHERAN CHURCH	FAITH LUTHERAN CHURCH	$2,799,100	LC	2	Poor	6 (4)	no	partially developed	Access through residential area	difficult drainage design, site is partially developed, remainder would be xmall for treatment design	residential
19	SKATE PARK	CITY AND BOROUGH OF JUNEAU	NA	D5	1.9	Good	5 (4)	no	wooded site	recreation uses; close to residential	likely good soils but complex drainage design, likely to require stormdrain improvements	recreation, residential buffer
34	MILLER - HONSINGER POND	HONSINGER FAMILY LIMITED PARTNERSHIP	$642,900	RR	3.1	Moderately Good	50	yes	in coastal area, surrounded by wetlands	in industrial area	no uplands available for treatment	none known
31	USFS GLACIER PKG SITE	US FOREST SERVICE	NA	RR	1.41	Good	7	yes	developed site		possible poor soils, potentially room for treatment design	existing public use

Table 6-1. Potential Snow Disposal Sites

Site Number	Site Name	Ownership	Assessed Value	Zoning	Haul Distance (miles)	Accessibility	Size in Acres (Usable)	Wetlands Implact	Natural Resources	Social/Nuisance Impact	Development Cost	Opportunity Cost
	Downtown Area											
24	AJ MINE SITE	AJT MINING PROPERTIES INC	$608,800	MU	0.96	Moderately Poor - steep	17	no	disturbed site	in industrial area	steep site makes site and treatment design difficult	none identified
25	ROCK DUMP	B ROELAND & H FLAMEE	$1,016,900	I	1.75	Moderate	3	no	disturbed site	in industrial area	site size and location makes treatment design development difficult	marine industrial
26	JUNEAU - DOUGLAS WASTEWATER TREATMENT PLANT	CITY AND BOROUGH OF JUNEAU	NA	I/WI/RR	1.85	Good	67	tidal	disturbed site	in industrial area	No problems noted	marine industrial
35	COPE PARK	CITY AND BOROUGH OF JUNEAU	NA	RR/D10	1.12	Moderate	12 (8)	no	Adjacent to Gold Creek	recreation use, access along residential area	difficult drainage design, discharge to Gold Creek; poor sun exposure; other winter uses would make use difficult	recreation use
36	CITY SHOP	CITY AND BOROUGH OF JUNEAU	NA	LC	0.45-0.85 *	Moderately Good	1	tidal	developed site	in mixed use area with housing and offices; plans for future park and seawalk	site size and potential redevelopment plans make treatment design difficult	mixed use
	Lemon Creek Area											
20	MENTAL HEALTH TRUST	MENTAL HEALTH TRUST LAND	NA	D5	4.7-6.1**	Poor - would require new access	31	yes	wooded site		Site slope makes drainage design difficult	residential
21	PUBLIC WORKS FACILITY	CITY AND BOROUGH OF JUNEAU	NA	I	4.7-6.1**	Good	11	yes	wooded site	some residential nearby	Site slope makes drainage design difficult	public use
22	CBJ LANDFILL	CAPITAL DISPOSAL INC	$5,077,500	I	4.9-6.2**	Good	44	yes	developed site	industrial use	Drainage and treatment design would be difficult; would need to address leachate issues	public use
23	LEMON CK GRAVEL PIT	CITY AND BOROUGH OF JUNEAU	NA	I	5.7-6.9**	Good	42	no	disturbed site	industrial use	Infiltration to the river could be an issue given soils and proximity	industrial use

Table 6-1. Potential Snow Disposal Sites

Site Number	Site Name	Ownership	Assessed Value	Zoning	Haul Distance (miles)	Accessibility	Size in Acres (Usable)	Wetlands Implact	Natural Resources	Social/Nuisance Impact	Development Cost	Opportunity Cost
	West Juneau/Douglas Area											
27	TLINGIT & HAIDA	TLINGIT & HAIDA REGIONAL HOUSING	$1,199,900	D18	1.2	Moderately Good	18	no	disturbed site	access along edge of residential area	drainage design complicated	residential
28	CROW HILL	CITY AND BOROUGH OF JUNEAU	NA	D5	1.2	Moderately Good	34	no	wooded site	access along edge of residential area	drainage design complicated	residential
29	GLACIER STATE PIT	JAMES B MASON	$442,000	RR(T)D15/LC	2	Good	15	no	disturbed site	None noted	No problems noted	None known
30	FISH CK PKG	CITY AND BOROUGH OF JUNEAU	NA	RR	6.1	Moderate	8	yes	developed site	recreation use	No problems noted	recreation use
32	J-D BRIDGE - NORTH	CITY AND BOROUGH OF JUNEAU	NA	WI	2.1-1.0*	Moderate	10	tidal	disturbed site	None noted	No problems noted	none identified
33	J-D BRIDGE - SOUTH	CITY AND BOROUGH OF JUNEAU	NA	D5	2.1-1.0*	Moderately Difficult	10	tidal	disturbed site	Access through residential area	No problems noted	none identified
37	MAYFLOWER CAUSEWAY	CITY AND BOROUGH OF JUNEAU	NA	WI	0.5	Moderately Good	NA	tidal	disturbed site	Near recreation area	Constrained site; difficult to implement treatment	none identified
38	DOCK STREET	CITY AND BOROUGH OF JUNEAU	NA	WI	0.5	Moderately Good	1	tidal	disturbed site	history of neighborhood complaints	would require safety improvements	none identified

* Haul Distances includes average distance in miles from Juneau and from West Juneau

** Haul Distances for Lemon Creek sites include average distance in miles from Juneau and from Mendenhall Valley.

minimum size. The sites were evaluated to determine if the sites had wetlands and whether or not the sites had sufficient uplands to allow for development. Other factors evaluated included the compatibility of the proposed use with other adjacent uses. Many sites were located adjacent to or very nearby residential areas. Siting heavily used facilities, such as a snow disposal site, in these areas is inconsistent with good land use planning and results in substantial nuisance impacts on residents. Therefore, a site like Thunder Mountain, which is large and allows for many opportunities for design solutions to buffering and water treatment, was eliminated since there is no way to access the site without impacting now-quiet residential areas. Although almost all of the potential sites would require rezoning to allow a snow disposal site greater than one acre in size, some of the larger sites have the potential to be designed to be compatible with adjacent uses and may therefore be eligible for a zoning map amendment. Finally, the costs for land acquisition, development and operations were considered. For example, the length of the haul to Auke Bay and the costs associated with development of a new road access into this site resulted in that site being eliminated.

Mendenhall Valley Evaluation

The evaluation process identified four potential land disposal sites with high potential to be used for snow disposal from Mendenhall Valley operations (Table 6-2). The highest ranked option is the continued use of the USFS site (Site #31). This site is currently developed and used as a snow disposal site, has good access, has no incompatible adjacent uses, and has room for the site to be redesigned to include water quality treatment prior to melt-water discharge. A proposed concept for this site is shown in Figure 6-2.

The second ranked site is a 20-acre parcel on Cinema Drive (Site #8). This site is well-located for the Mendenhall Valley operations and is large enough to allow for incorporation of design features to reduce social and environmental impacts. However, the site is privately owned and may have a higher value to be used for residential development, particularly to provide affordable housing. Use of the Cinema Drive site would require the site to be rezoned, as current zoning would limit the size of the snow disposal site to less than one-half acre.

The third-ranked site is a combination of the DOT&PF site (Site #17) located at the northwest corner of the intersection of Egan Drive and Mendenhall Loop Road, the adjacent Baha'i site (Site #16), and a portion of the Faith Lutheran Church parcel (Site #18). Together these sites provide over 10 acres, part of which is used by DOT&PF for road material storage. It is possible that these sites could be combined and designed to accommodate the existing use and snow disposal, along with water quality treatment and buffering from nearby residential uses. There

Table 6-2. Mendenhall Valley Recommended Sites

Site Number	Site Name	Ownership	Assessed Value	Zoning	Haul Distance (miles)	Accessibility	Size in Acres (Usable)	Wetlands Implact	Natural Resources	Social/Nuisance Impact	Development Cost	Opportunity Cost
	Mendenhall Valley Area											
8	CINEMA DR #1	JKZ LLC	$1,100,000	D15	0.9	Moderate	20	no	Duck Creek, wooded site	residential uses to south	Few design challenges	affordable housing
12	INDUSTRIAL BLVD 1	CITY AND BOROUGH OF JUNEAU	NA	I	2.7	Moderately Good	27	yes - Class B/C	disturbed site, Casa del Sol	in industrial area	some design challenges with wetland areas	conservation area
14	INDUSTRIAL BLVD 2	KEN WILLIAMSON	$580,000	I	2.6	Moderately Good	7	no	site is filled wetlands	in industrial area	Few design challenges	industrial development
16	BAHAI	SPIRITUAL ASSEMBLY OF THE BAHAIS	$930,000	LC	1.9	Moderately Good	3	yes	Class C wetlands; partially wooded	some residential nearby	may be difficult to avoid wetlands, may be complicated drainage design	residential/ commercial use
17	STATE DNR	DNR	NA	LC	1.9	Moderately Good	7	yes	Duck Creek, partially wooded site	commercial area along major streets	tight site size to avoid wetlands and creek and provide treatment prior to discharge	existing public use
18	FAITH LUTHERAN CHURCH	FAITH LUTHERAN CHURCH	$2,799,100	LC	2	Poor	6 (4)	no	partially developed	Access through residential area	difficult drainage design, site is partially developed, remainder would be xmall for treatment design	residential
31	USFS GLACIER PKG SITE	US FOREST SERVICE	NA	RR	1.41	Good		yes	developed site		possible poor soils, potentially room for treatment design	existing public use

Figure 6-2
Proposed Concept USFS Mendenhall Glacier

City & Borough of Juneau
Snow Disposal Site Alternatives

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November 11, 2010 | WO: J70345

are wetlands on this site, but they are classified as category C (low value) wetlands. Other drawbacks to this site include the potential costs for acquisition, the nearby residential uses, and the high traffic volumes on Egan Drive. As with the Cinema Drive site, this size would need to be rezoned, as current zoning would limit the size of the snow disposal site to less than one acre.

The last site would be a combination of the two Industrial Park sites (Sites #12 and 14). Combining these sites would provide sufficient area for both snow disposal and treatment and preservation of wetland buffers.

Snow melting and marine disposal options were not evaluated for the Mendenhall Valley area, as there are reasonable land disposal alternatives.

Downtown Evaluation

Evaluation of potential snow disposal sites for the downtown areas required looking at sites across the Channel from downtown, due to the lack of sites on the Juneau side (Table 6-3). The highest ranked site on the Juneau side is located at the J-D WWTP (Site #26). Although this site would increase the average haul distance for downtown operations by one and a half miles per truck trip, the site's advantages are its public ownership, the size, and the compatibility of the site with adjacent industrial uses. Drawbacks to the site in addition to the distance from downtown, include the possible need for a fill permit to develop a treatment area and use issues related to existing leases and mining rights. There are options for creating a land site or a marine site in this area. Proposed concepts for this site are shown in Figure 6-3 and 6-4 (6-3 through 6-6).

Another potential site for disposal of for snow from downtown Juneau is the shoreline area in Douglas north of the Juneau-Douglas Bridge (J-D Bridge North, Site #32). This parcel is again publicly owned and is not adjacent to residential or other sensitive land uses. The haul distance for this site would be less than that for the J-D WWTP. This site could also be designed as either a land site or a marine site. The drawback for this site is the potential need for a fill permit for treatment of the snow and snow-melt.

Evaluation of potential sites for snow disposal from Douglas indicated that the Mayflower Causeway (Site #37) remains a highly attractive marine disposal site. The Mayflower site is constrained in operations area, however, and it would be difficult to design or construct a treatment system for this area. An alternative marine disposal site is located at the end of Dock Street, north of the Douglas Harbor (Site #38). This site has occasionally been used for snow disposal in the past, but there were operational safety issues and the site was cited as a nuisance by neighbors. An alternative to the marine disposal sites was identified on Crow Hill. The Crow Hill/Tlingit Haida sites (Sites #27 and 28) provide opportunities for a site that is well-buffered from residential areas. Drawbacks to the site include acquisition costs, increased haul times, access through residential areas on steep roads, and complex hydrologic issues that would need to be addressed in the site and treatment design. In addition, this site would need

Table 6-3. Downtown Area Recommended Sites

Site Number	Site Name	Ownership	Assessed Value	Zoning	Haul Distance (miles)	Accessibility	Size in Acres (Usable)	Wetlands Implact	Natural Resources	Social/Nuisance Impact	Development Cost	Opportunity Cost
	Downtown Area											
26	JUNEAU - DOUGLAS WASTEWATER TREATMENT PLANT	CITY AND BOROUGH OF JUNEAU	NA	I/WI/RR	1.85	Good	67	tidal	disturbed site	in industrial area	No problems noted	marine industrial
	Lemon Creek Area											
23	LEMON CK GRAVEL PIT	CITY AND BOROUGH OF JUNEAU	NA	I	5.7-6.9	Good	42	no	disturbed site	industrial use	Infiltration to the river could be an issue given soils and proximity	industrial use
	West Juneau/Douglas Area											
27	TLINGIT & HAIDA	TLINGIT & HAIDA REGIONAL HOUSING	$1,199,900	D18	1.2	Moderately Good	18	no	disturbed site	access along edge of residential area	drainage design complicated	residential
28	CROW HILL	CITY AND BOROUGH OF JUNEAU	NA	D5	1.2	Moderately Good	34	no	wooded site	access along edge of residential area	drainage design complicated	residential
32	J-D BRIDGE - NORTH	CITY AND BOROUGH OF JUNEAU	NA	WI	2.1-1.0*	Moderate	10	tidal	disturbed site	None noted	No problems noted	none identified
37	MAYFLOWER CAUSEWAY	CITY AND BOROUGH OF JUNEAU	NA	WI	0.5	Moderately Good	NA	tidal	disturbed site	Near recreation area	Constrained site; difficult to implement treatment	none identified
38	DOCK STREET	CITY AND BOROUGH OF JUNEAU	NA	WI	0.5	Moderately Good	1	tidal	disturbed site	history of neighborhood complaints	would require safety improvements	none identified

* Haul Distances includes average distance in miles from Juneau and from West Juneau.

Figure 6-3
Proposed Concept J-D WWTP Land Option

City & Borough of Juneau
Snow Disposal Site Alternatives

DOWL HKM

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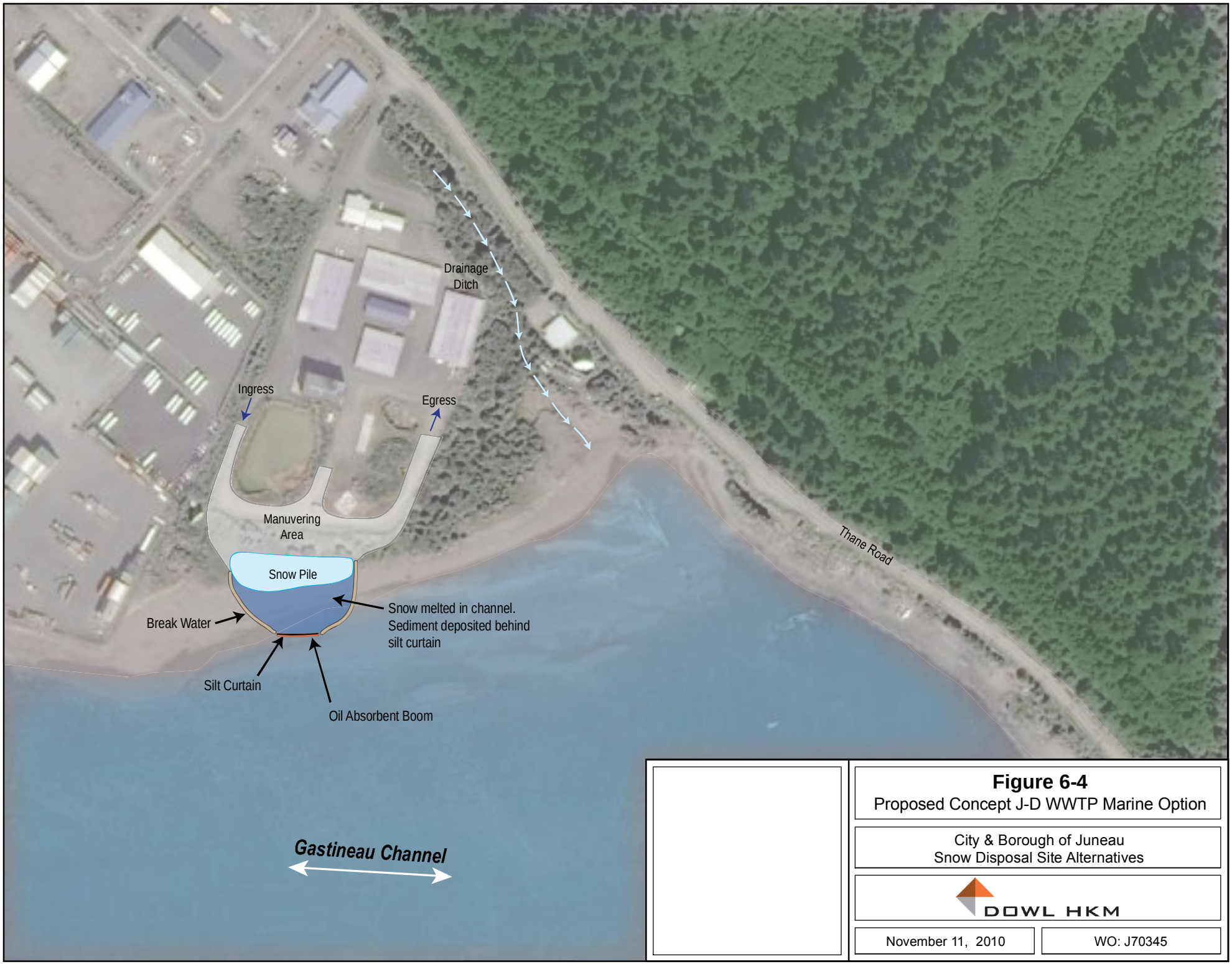

Figure 6-4
Proposed Concept J-D WWTP Marine Option

City & Borough of Juneau
Snow Disposal Site Alternatives

DOWL HKM

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Figure 6-5
Proposed Concept J-D WWTP Land Option 2

City & Borough of Juneau
Snow Disposal Site Alternatives

DOWL HKM

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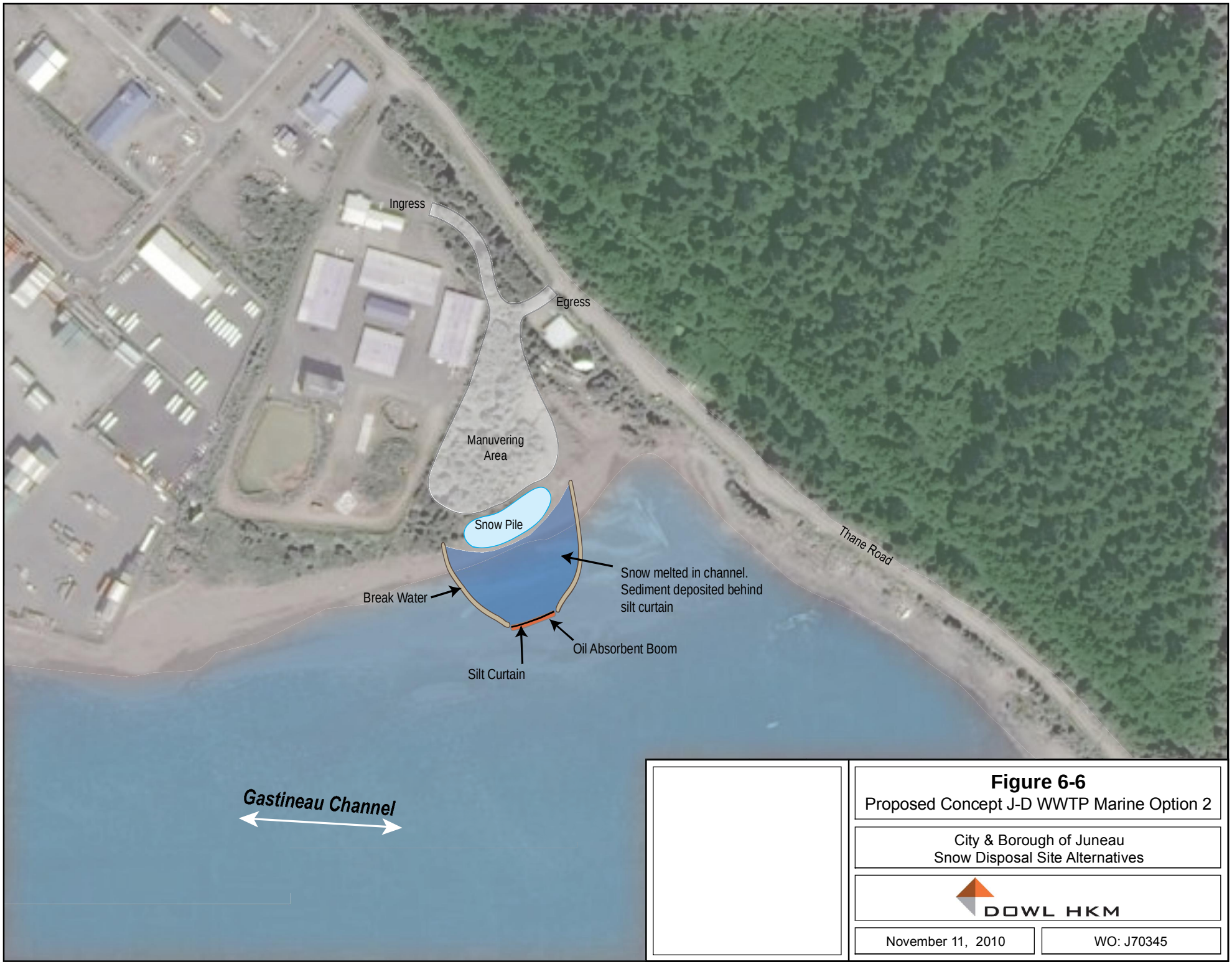

Figure 6-6
Proposed Concept J-D WWTP Marine Option 2

City & Borough of Juneau
Snow Disposal Site Alternatives

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to be rezoned, as current zoning would limit the size of the snow disposal site to less than one-half acre.

Due to the shortage of feasible land-based sites in the downtown areas, and the density of development, it may be reasonable to consider snow melting options in some areas. The downtown Juneau and downtown Douglas areas in particular may have potential for mobile snow melting, given the storm drain systems available in these areas. Snow melting using incidental heat may also be an option for snow disposal near the J-D WWTP, where exhaust from the incinerator or wastewater effluent may be available. These options are discussed further in Section 7.

Site Evaluation Summary

As discussed above, the evaluation of potential snow disposal sites resulted in the following sites being recommended for further study (Table 6-4). Relative costs for developing and operations these costs are shown in Table 6-5. These costs are very rough estimates, with land acquisition costs based on properties assessed value. Actual acquisition costs may differ from these assessed values.

Table 6-4. Summary of Preferred Sites

Mendenhall Valley	Advantages	Disadvantages
USFS Site	Existing use, large size allows design for treatment and buffering, good zoning	Would require negotiation of a long-term agreement with USFS
Cinema Site	Central location, size allows for design for treatment and buffering	Requires acquisition, would require a rezone to allow a larger snow disposal site, high opportunity cost (loss of land for affordable housing), nearby impaired creek
State/Baha'i/FLC Site	Fair location and size	Requires acquisition, , would require a rezone to allow a larger snow disposal site, nearby residential areas, high traffic, nearby impaired creek
Industrial Park 1/AT&T	Large size, industrial area, good zoning	Primarily wetlands, nearby impaired creek, longest haul distance
Downtown	Advantages	Disadvantages
J-D WWTP Site (land or marine)	Compatible with near uses, publicly owned, large size allows for treatment design, good zoning	Longer haul distance, fill permit may be needed
J-D Bridge North Site (land or marine)	Centrally located, large size allows for treatment design, good zoning	Fill permit likely needed
Mayflower Causeway Site (marine)	Short haul distance, publicly owned, no zoning issues	Limited space for operations or treatment design
Dock Street Site (marine)	Good location and size, good zoning	Residential uses nearby
Crow Hill/Tlingit Haida Site (land)	Fair location and size	Longer haul distance, steep access through residential area, complicated hydrology, would require a rezone to allow for a larger snow disposal site

Table 6-5. Relative Costs for Preferred Sites

Potential Site	Capital Cost		Annual Operating Costs
Mendenhall Valley Area Sites			
USFS Site	Land Acquisition Design/Permitting Site Prep/Construction	$0 $170K $400K	Labor - Might increase slightly for maintenance of site Hauling Cost – No change from current operations Fuel Cost – No change from current operations
Cinema Site	Land Acquisition Design/Permitting Site Prep/Construction	$1.1M $250K $850K	Labor – Might increase slightly for maintenance of site Hauling Cost – Decreases (average half-mile per haul) from current operations Fuel Cost – Decreases from current operations
State/Baha'i/FLC Site	Land Acquisition Design/Permitting Site Prep/Construction	$1M+ $300K $825K	Labor – Might increase slightly for maintenance of site Hauling Cost – Increases costs for distance (extra average half-mile per haul) and traffic impacts Fuel Cost – Likely somewhat higher
Industrial Park 1/AT&T	Land Acquisition Design/Permitting Site Prep/Construction	$580K $170K $700K	Labor – Might increase slightly for maintenance of site Hauling Cost – Likely to increase by 100% (almost double the hauling distance) Fuel Cost –Likely to be twice as much as current
Downtown Area Sites			
J-D WWTP Site (land or marine)	Land Acquisition Design/Permitting Site Prep/Construction	$0 $150-200K $300-400K	Labor – Would increase somewhat with a land-based site Hauling Cost – Likely to increase by 100% (double the haul distance) Fuel Cost – Likely to be twice as much as current
J-D Bridge North Site (land or marine)	Land Acquisition Design/Permitting Site Prep/Construction	$0 $150-200K $300-400K	Labor – Would increase somewhat with a land-based site Hauling Cost – Likely to increase by 100% (double the haul distance) Fuel Cost – Likely to be twice as much as current
Douglas Area Sites			
Mayflower Causeway Site (marine)	Land Acquisition Design/Permitting Site Prep/Construction	$0 $150-200K $400K	Labor – Slightly higher for maintenance Hauling Cost – Same as current operations Fuel Costs – Same as current operations
Dock Street Site (land or marine)	Land Acquisition Design /Permitting Site Prep/Construction	$0 $200K $300-400K	Labor – Would increase somewhat with a land-based site Hauling Cost – Same as current operations Fuel Costs – Same as current operations
Crow Hill/Tlingit Haida Site (land)	Land Acquisition Design/Permitting Site Prep/Construction	$1.2M $250K $250K	Labor – Likely to increase for operation and maintenance of site Hauling Cost – Likely to increase by more than 100% Fuel Cost – Likely to increase by more than 100%

CHAPTER 7: SNOW MANAGEMENT PLAN

Current CBJ snow removal operations provide residents with fast and cost-effective snow removal services. With increasing demand for development of areas being used for snow disposal and the potential for increased regulation of snow disposal operations, the goal of this study was to identify measures that could be implemented to improve existing operations and to provide alternatives to existing snow disposal practices. The recommendations provided below outline short-term, medium-term and long-term measures that will move the CBJ forward toward the most efficient and environmentally-sustainable snow disposal practices.

Snow Management Measures

As discussed previously, the Mendenhall Valley and downtown areas have different needs and different opportunities for snow management. The Mendenhall Valley has historically used a centralized land disposal site which is well-located for Mendenhall Valley operations and has minimal social and nuisance impacts. There are a few other land disposal sites in the Mendenhall Valley area that may have some potential for use, but each of these has drawbacks that would need to be addressed. Although snow melting could potentially be used in some areas of the Valley, snow melting is potentially expensive. The existing snow removal and disposal process appears to work efficiently and may be improved with design of treatment system for the existing USFS Mendenhall Glacier site. The CBJ may want to do a more detailed study of the alternative sites to select one to be designated and retained as a snow disposal site for future use in the event that the existing site becomes unavailable or future demands exceed the capacity of the site. Based on this evaluation, land disposal appears to be a reasonable long-term solution for the Mendenhall Valley area.

The downtown areas have much more limited options for land-based snow disposal. Most developable land in the downtown Juneau, West Juneau and Douglas areas has been developed. The old Public works downtown shop site is ideally located, but has been designated for redevelopment as a park and seawalk. Given the limits on land disposal sites in a reasonable distance from generation areas, the sites identified for downtown areas are primarily located along the shoreline. Some of these areas could be filled and designed as land disposal sites, or designed to allow for discharge of snow into marine areas with minimal fill for creating safe operating areas. The J-D WWTP site appears to be the most promising site for the downtown area, given its size, zoning and lack of non-compatible uses in the area. The J-D Bridge North site is also located away from non-compatible uses, but the site is more constrained. The existing Mayflower Causeway site is also constrained in operations area and in treatment potential. The CBJ may want to evaluate replacing this with a designed site on Dock Street. One non-shoreline site was identified at Crow Hill in Douglas. The drawbacks related to this site include a steep access route that would pass through residential areas.

Mobile snow melting options may have potential for reducing hauling operations in some of the more densely developed areas in Juneau and Douglas. The feasibility of mobile snow melting may be further evaluated through rental of snow melting equipment to conduct a test operation in downtown Douglas or Juneau. The costs for fueling the mobile snow melter can then be compared to the cost of hauling snow to a disposal site. Similarly, snow melting using incidental heat could be further evaluated using the J-D WWTP. Although an incidental heat source would reduce the cost of melting snow, it would not eliminate the snow

hauling cost and may not provide many benefits beyond designing a marine disposal site with treatment at the site. A feasibility study could identify whether this option is worth pursuing any further.

Finally, the CBJ Lemon Creek pit site is not ideally located for disposal of snow from either the Mendenhall Valley or the downtown. However, the site has been used during periods of heavy snow. Given the variation in the amount of snow received in the CBJ over time, it may be prudent to preserve an area in the upper Lemon Creek valley area for use in extreme snow years.

Recommendations

The following recommendations were identified, based on the evaluation described in this report. Short-term recommendations are those that could be undertaken within one year. Medium-term recommendations are those that should be accomplished within one to five years. Long-term recommendations may take five years or more to implement.

Short-term Recommendations (within one year)

1. Continue to use the USFS snow disposal site and the old Public Works downtown shop near the J-D Bridge for winter 2010-2011 snow disposal operations.
2. Review BMPs identified in the following sources to determine those best suited to the CBJ environment: the Synthesis of Best Management Practices for Snow Storage Areas (DOT&PF 2003), Guidelines for the Selection of Snow and Ice Control Materials to Mitigate Environmental Impacts (NCHRP 2007), and Environmental Stewardship Practices, Procedures and Policies for Highway Construction and Maintenance (NCHRP, no date). These would include:

    a. Maximize street sweeping pre-snowfall to minimize dirt and debris entrainment in snow.
    b. Evaluate measures for reducing the amount of sand and deicing chemicals used.
    c. Evaluate the potential to use non-chloride deicing agents.
    d. Reduce salt requirements by using coarser, angular materials that is kept warm and dry prior to application.

3. Negotiate a long-term agreement with the USFS to allow continued use of the tour bus parking area in exchange for design and construction of a snow disposal site with specific operation boundaries and water quality treatment.
4. Begin site analysis and planning for recommended snow disposal sites and approach land owners regarding interest in acquisition. Treatment system design should incorporate analysis of currents at proposed marine sites to ensure design addresses direction and force of currents.
5. Consider a test evaluation of a mobile snow melter through a rental agreement with equipment providers. Track the amount of snow melted and operations costs to compare with typical costs for hauling that amount of snow.
6. Develop and implement a water quality monitoring program to be implemented to document baseline water quality at existing and potential snow disposal sites and storm drain outfalls to provide baseline data to compare to future data.
7. Begin discussions with regulatory agencies regarding treatment design and permitting requirements for preferred sites.

8. Conduct a feasibility study to evaluate the potential for use of the J-D WWTP and/or incinerator as part of a stationary incidental snow melting system to be located at the J-D WWTP site.
9. Evaluate the potential to store downtown snow removal equipment at the J-D WWTP site, at least during winter operations periods.
10. Evaluate the potential for indoor storage of material for street sanding.
11. Maintain an area near the Lemon Creek pit as an emergency snow disposal site.

Medium-term Recommendations (one to five years)

1. Complete acquisition of any private lands needed for preferred snow disposal sites.
2. Complete 95% design for recommended snow disposal sites and begin permitting process for any required regulatory approvals.
3. Design and construct a storage area for downtown snow removal equipment at the J-D WWTP site.
4. Develop a site-specific Operations Plan for each snow disposal site to document the operating and maintenance procedures to be used to reduce environmental and social impacts from site operations.
5. Continue to collect water quality samples to provide both baseline and site-specific data on water quality.
6. Evaluate the potential for the addition of oil/grit separators on street storm drains to provide for treatment of snow-melt from snow stored in street rights-of-way.
7. If mobile snow melting appears to be financially feasible, budget for purchase of snow melter.
8. If stationary incidental snow melting appears to be financially feasible, implement a scaled test of the concept.
9. Review and revise CBJ subdivision regulations and design criteria manual guidance to ensure that snow storage and removal are addressed for new development. Consider requiring subdivisions to designate sufficient space for local snow disposal with adequate treatment of melt-water. Ensure that design of public facilities, including roads, incorporate snow storage areas and adequate melt-water treatment.
10. Develop a long-term plan for snow disposal by private snow disposal operators.

Long-term Recommendations (five or more years)

1. Complete design, permitting and construction of preferred snow disposal sites.
2. Continue to monitor operations to identify potential natural and social resource impacts and to evaluate potential mitigation measures.
3. If stationary incidental snow melting appears to be feasible, continue with design, permitting and construction of the system.
4. Consider acquisition of secondary snow disposal sites to provide for potential future needs.
5. Continue to evaluate new methods for reducing sand and deicer use and new treatment measures for snow melt-water.
6. Maintain an area near the Lemon Creek pit as an emergency snow disposal site.

CHAPTER 8: REFERENCES

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