6.0 ENVIRONMENTAL EFFECTS ANALYSIS

6.1 METHODOLOGY

The environmental assessment of the proposed flood control berm upgrades located along the shores of Fishing Lake, Saskatchewan was carried out based on: project information and results from field studies provided by the proponent, environmental information acquired from literature and internet searches, publications by Saskatchewan MOE, a screening by the Saskatchewan Heritage Resources Branch, contacts with federal and provincial government representatives, consultation with stakeholders, and a site visit by assessment team members.

Requirements of Saskatchewan's *Environment Act* and regulations and the *Canadian Environmental Assessment* Act and regulations, and relevant guides and operational policy statements were considered in the environmental assessment of the proposed berm upgrade project. Environmental assessment specifications outlined in the "Guidelines for the Preparation of a Project Proposal" were followed.

The environmental effects of the proposed berm upgrade project were identified using checklists, an interaction matrix (Appendix G), stakeholder input and professional judgment. Advice by government specialists, concerns expressed by the public and brainstorming among the assessment team, were also used to identify environmental issues and associated environmental effects. The adversity of environmental effects was determined based on the categories described in Table 6.

The cumulative effects of the proposed berm upgrade project in combination with the effects of other projects and activities in the study region were assessed following the methods prescribed by the Canadian Environmental Assessment Agency [(54)].

The significance of the residual environmental effects of the proposed berm upgrade project were evaluated following the procedures outlined in the Canadian Standards Association Final environmental assessment standard (Canadian Standard Association 1999). The degree of change from the existing conditions and the value of the environmental components being affected determine significance of an adverse effect. Criterion for this determination as

referenced in Table 7 include: a) Societal value of affected environmental components, b) Ecological value or sensitivity of affected environmental components, c) Duration, d) Frequency, e) Geographic extent, f) Magnitude, and g) Reversibility. For each criterion a particular level of significance rating (1, 2, or 3) is assigned. To judge overall significance of an effect, rating under the various criteria are considered together. An effect is determined significant when: (1) it rates a "3" for at least four criteria, at least one of which must be criteria "a" or "b"; or (2) it is rated "2" or "3" for all criteria.

6.2 ENVIRONMENTAL ISSUES

Environmental issues associated with the proposed berm upgrade project are summarized below. The assessment team identified issues that could have potential affects based on the nature of the project, the location and environmental effects typical of berm construction. Stakeholder consultations and professional judgment were also used to identify the issues.

6.2.1 Flooding

Since 1995, heavy precipitation years have increased the average water levels of Fishing Lake keeping the water levels between 528 and 530 masl. Local communities around the lake have been considering preventative measures since 1997 when water levels first breached 529.9 masl resulting in flooding of more than 100 residences. The lake levels have not significantly receded since the 1997 flooding and several hundred residences experienced or were at risk of flooding due to the high water levels in 2007. The 2007 flooding prompted the emergency actions that resulted in the construction of the existing temporary berms as described in Section 1.1.2. These two periods of flooding in a relatively short period of time have brought flood concerns to the forefront of issues in the region.

Local residents are concerned that if the temporary berms are removed the water will again encroach onto their properties putting the houses at risk once again. Diane Kreiser and Doreen McGuniagal, two local residents, are happy with the berms and hope they stay. McGunigal refers to the berms as "the perfect answer for us" [(55)]. Flooding is a concern as it results in damage to properties, as well as health issues associated with mould and mildew that results from standing water.

From an ecological perspective the flooding conditions can promote fish development and fecundity as the typically high salinity levels of Fishing Lake are currently diluted. Band councilor Wayne Desjarlais of the Fishing Lake First Nation stated that walleye (*Sander vitreus vitreus*) are more likely to develop when the saline levels are diluted [(55)]. Salinity, along with height of land separating watersheds and high summer temperatures are the three basic factors limiting on walleye lifecycles [(56)].

6.2.2 Impacts to Fish and Fish Habitat

Fishing Lake is a fish bearing lake, which supports an active sport fishery and local subsistence fishing by residents of the surrounding communities. Due to the high water levels, shorelines that typically would have been in the dry are now inundated with water. The result is that these areas have been deemed to be fish habitat in accordance with the policies of DFO Habitat Management Branch. Prior to construction of the berms in 2007, DFO issued an Authorization for the Harmful Alteration Disruption or Destruction (HADD) associated with installation of the temporary berms. This authorization stated that all berms located at or below an elevation of 529.57 masl will be removed by October 15, 2009. Fish habitat affected by the proposed work would as such include the area of shoreline that experienced infilling and any riparian vegetation that was removed for construction of the berms. Most of the berms were constructed in front of developed shorelines, which had minimal riparian zones, though no information was recorded as to the extent of riparian vegetation present prior to construction.

Potential effects on fish and fish habitat associated with the proposed berm upgrade work include some additional infilling along the toe of the berms, increased erosion of the banks along edges of existing berms during the construction phase, potential fish mortality during dewatering, and increased sedimentation during heavy precipitation events and while draining the Aqua Dams® after the construction phase at each lakeside berm. Whereas the infilling has a direct impact on fish habitat, increases in turbidity by introduction of fine particles into water bodies has both a direct and indirect effect on fish and fish habitat. Increased suspended sediment can have a direct negative effect on incubating fish eggs and fry [(57)] and can result in fish mortality if conditions persist [(58)]. Elevated turbidity can indirectly alter feeding behaviour of fish, as prey become less visible [(59)], or less abundant as is the case with insect larvae that can consume indigestible particles and die off [(57)]. Impacts to fish and fish habitat would be limited

to the duration of construction activities scheduled from June 2010 to October 2012, while avoiding the DFO timing windows for no in-water work. For southern Saskatchewan these periods are April 1-May 31 and Oct 1 - May31 of following year.

6.2.3 Drainage

Since construction of the temporary berms it has been identified that some areas between the berm and residents' properties accumulate standing water during snow melt, heavy precipitation and seepage from the lake. This accumulation of water is a result of blocked internal drainage or because drainage was left unfinished in combination with the areas between the berm and residents' properties requiring fill. To minimize water accumulation and further damages to the cabins this surface water is regularly pumped into Fishing Lake. Pumping has occurred, beginning in April 2008, at all the beaches where berms were constructed. It is anticipated that pumping will continue to be required during spring melt and following summer rains until the unfilled areas behind the temporary berms are properly finished as part of the long-term flood protection.

6.2.4 Surface Water Contamination

Temporary surface water contamination from construction activities adjacent water bodies can occur associated with increased erosion of shorelines leading to increases in sedimentation in the water. Although the work along the Lakeside berms will be conducted in the dry (via the use of Aqua Dams®) fine sediments can build up at the toe of the slope and enter the water once the dams are drained. Further, the process of draining the dams can potentially lead to additional erosion of fine particulate material into the water body. Potential surface water contamination from hazardous materials used during construction can also negatively impact the water quality.

6.2.5 Loss of Wetlands

Migratory birds and associated habitat is protected under the *Migratory Birds Convention Act* [60]. The concern is that wetlands in the ecoregion provide critical habitat for breeding, staging, and nesting grounds for 50% of North America's migratory waterfowl [61]. Already many wetland areas have been lost due to draining for agricultural land use and construction activities. There

are several potholes and wetland areas located adjacent to Fishing Lake and in the regional study area. To avoid disturbance of waterfowl use of wetlands/potholes, a minimum buffer zone will be established around these areas and construction activities will be limited in the spring and early summer in these areas to avoid the nesting/rearing period.

6.3 BIOPHYSICAL EFFECTS ASSESSMENT

6.3.1 Air Quality

Construction of the proposed berm upgrades will result in a short-term increase in fugitive dust levels in the project study area (Figure 2). Dust will be generated during excavation, transport and placement/shaping of soils, course gravel and rocks for the proposed upgrades of the existing berms. It is unlikely that this work will result in suspended particulates at levels that exceed the Saskatchewan MOE guidelines. The potential adverse effect on air quality was assessed to be negligible to minor. The effects may be mitigated by using an approved dust suppressant such as water, limiting and covering stockpiled materials, controlling construction vehicle speeds, covering loads being hauled to the site, limiting construction activities during high wind events, and re-establishing vegetation on disturbed areas. Proposed follow-up involves periodic observations for fugitive dust levels, inspections of the local area for accumulated dust, monitoring of complaints and adherence to contract specifications. The residual effect of fugitive dust on air quality was determined to be insignificant (Table 8).

Increased levels of NO_x, SO_2, and greenhouse gases may result from equipment and vehicle emissions used during construction of the proposed berm upgrades. Typical earth moving equipment will be used during construction of the proposed work as described in Section 3.6. It is unlikely that the emissions resulting from this project will produce levels that exceed the Saskatchewan MOE guidelines. The potential short-term adverse effects on air quality in the project study area were assessed to be negligible to minor. Proposed mitigation measures including; requiring a high standard of maintenance for construction equipment and vehicles, using low sulphur-containing fuels, and limiting unnecessary long-term idling will further reduce the emissions. Follow-up proposed involves periodic inspection during construction and monitoring for adherence to contract specifications and license terms and conditions. The

residual effect of NO_x, SO_2, and greenhouse gases on air quality was determined to be Insignificant (Table 8).

Increased volatile organic carbon (VOC) levels may result from use of fuels and other substances during construction. An equipment staging area will be established and all equipment fueling will be completed at this location, except for dewatering pumps that will be refuelled in a designated area on the top of the berm. The potential short-term adverse effects on air quality in the local area were assessed to be negligible to minor. However, proposed mitigation measures include using appropriate dispensing equipment and limiting fuelling of vehicles and equipment. Follow-up proposed includes requiring submission of MSDSs for all products used, periodic inspection for VOC sources and monitoring for adherence to contract specifications. The residual effect of VOCs on air quality was determined to be insignificant (Table 8).

6.3.2 Soils

Soils in the project area may be lost due to clearing and excavation activities during construction. Any potential soil loss will be restricted to the areas directly surrounding the borrow pits (Figure 2) and will only occur assuming the boundaries of the existing pits require expansion or if additional borrow sources are required. The potential adverse effects of soil loss were determined to be negligible. However, proposed mitigation includes minimizing soil loss or disturbance onsite, stockpiling surface soils for later use, reclamation and revegetation. Follow-up proposed includes periodic inspections of stockpiled soil and ensuring adherence to contract specifications. The residual effects of construction activities on soil loss were determined to be insignificant (Table 8).

Soils in the project area will be disturbed and compacted from excavating and berm shaping activities as well as from equipment and vehicle use during construction. Because the soils were previously disturbed during construction of the temporary berms the proposed berm upgrades would only potentially affect a small additional area. Transportation of borrow materials will follow the existing road system and the haul roads previously established during the temporary construction. The potential adverse effects of soil disturbance and compaction were determined to be negligible to minor. However, adverse effects may be mitigated by minimizing surface

disturbance and restricting activities to previously disturbed areas. Follow-up proposed includes periodic inspections of disturbed areas and ensuring adherence to contract specifications. The residual effect of construction activities on soil disturbance and compaction was determined to be insignificant (Table 8).

Soils in the project area may become contaminated during construction from leaks and accidental spills or releases of fuels or other hazardous substances. Existing soil quality in the project area has not been tested. The potential adverse effects on soil quality were assessed to be minor to moderate. Proposed mitigation includes preventing leaks, spills and releases by providing secondary containment for fuel/hazardous material storage, requiring drip trays for equipment, providing spill clean-up equipment and materials, excavation of soil contaminated by fuel or oil and transfer of contaminated soil to an approved disposal site, and preparing an emergency (spill) response plan. If a spill does occur the contractor will be responsible to notify the Saskatchewan MOE and the appropriate clean-up will be determined according to the size of spill and quantity of contamination. Follow-up proposed involves periodic inspection for leaks, spills and releases, ensuring adherence to contract specifications and license conditions, monitor soil quality as required during operation, and periodic updates of the emergency response plan. The residual effects of accidental leaks, spills and releases on soil quality were determined to be insignificant (Table 8).

6.3.3 Surface Water

Permanently retaining the berms for flood protection will result in a small-scale loss of wetland. There are a few intermittent water bodies adjacent the shores of Fishing Lake near Pavilion and KC beaches and the Foam Lake Golf and Country Club that provide wetland habitat during wet conditions and periods of high water (Figure 2). Permanently retaining the berms will prevent these ephemeral wetlands from being recharged during periodic flooding and therefore they will only be recharged by surface water run-off or seepage. In particular approximately 100 m of the temporary berm along the east side of the golf course bisects a small ephemeral wetland area. The potential adverse effects on wetlands were assessed to be minor. Proposed mitigation includes minimizing the area disturbed and avoiding further disturbance of the intermittent water bodies. Follow-up proposed includes periodic inspection of these areas during wet conditions.

The residual effects of permanently retaining the berms on wetland areas was determined to be insignificant (Table 8).

The proposed berm upgrades will result in a localized modified regime for surface water runoff. Tying the inside shoulder of the upgraded berms into the fill that many cottage owners have already placed and re-vegetating the backside of the berms will have a positive effect because the current drainage problems created by the temporary berms should be alleviated. However, by permanently retaining the compacted berms for flood protection less surface water will be absorbed into soils during the spring melt and precipitation events. Subsequently, more surface water run-off will flow overland into the lake, which may result in increased erosion. Additionally, because the compacted berms act as a barrier to surface water movement saturation of the soil backfill may occur and continue to result in ponding on the cottage side of the berms. The potential adverse effects of the modified surface water regime were assessed to be moderate. However, proposed mitigation includes limiting surface area disturbance and providing erosion control (e.g. riprap, vegetation, etc.) as required along water drainage routes, and monitoring surface water runoff. Follow-up proposed includes periodic inspection for ponding after the freshet and precipitation events. The residual effects of the project on surface waters were determined to be insignificant (Table 8).

Suspended sediment levels in the lake may become temporarily elevated when dewatering and when the water used in the Aqua Dams® is emptied or due to surface water runoff from the berms following major precipitation events during construction activities. During dewatering the water will be discharged onto either existing or newly constructed riprap at the shoulder of the lakeside slope adjacent to the dewatering area. Energy dissipation mats will be used to prevent erosion of the rock. This process would dissipate the pumped water's velocity and reduce its potential to create turbidity in Fishing Lake. The potential adverse effects on water quality were determined to be negligible to minor for most of the construction activities associated with the proposed project; however, the potential adverse effects associated with dewatering was assessed to be moderate. Proposed mitigation includes the use of sediment barriers and turbidity curtains during construction and removal of sediment collected by turbidity curtains. Follow-up proposed includes monitoring surface water runoff and suspended sediment levels, monitoring condition of turbidity curtains, periodic inspections for erosion, and ensuring

adherence to contract specifications and license terms and conditions. The residual effect of increased suspended sediments on water quality was determined to be insignificant (Table 8).

Surface water in the project area may become contaminated during construction from leaks and accidental spills or releases of fuels or other hazardous substances. The potential adverse effects on water quality were assessed to be minor to moderate. Proposed mitigation includes preventing leaks, spills and releases by providing secondary containment for fuel/hazardous material storage, requiring drip trays for equipment, equipment refueling or maintenance away from the water, providing spill clean-up equipment and materials, and preparing an emergency (spill) response plan. If a spill does occur the contractor will be responsible to notify the Saskatchewan MOE and the appropriate clean-up will be determined according to the size of spill and quantity of contamination. Follow-up proposed involves periodic inspection for leaks, spills and releases with daily inspections for equipment working on the lakeside slope or top of berms, ensuring adherence to contract specifications and license conditions, and periodic updates of the emergency response plan. The residual effects of accidental leaks, spills and releases on surface water quality were determined to be insignificant (Table 8).

6.3.4 Groundwater

Additional excavation at the existing borrow pits or establishing new borrow sources may result in increased infiltration and potentially affect the groundwater regime. Further, the enhancements of the berms may result in minor changes in the infiltration to groundwater reservoirs. The potential adverse effects on groundwater regime and levels were assessed to be negligible. No specific mitigation is proposed. Follow-up includes tracking and responding to any complaints from area residents related to groundwater well problems. The residual effects of the project on the groundwater regime and levels were determined to be insignificant (Table 8).

Groundwater in the project area may become contaminated during construction from leaks and accidental spills or releases of fuels or other hazardous substances. Groundwater quality in the project area has not been analyzed for contaminants; although the concentrations of many of the general water chemistry parameters measured in groundwater samples from Chorney Beach have been well above the HC-CDWQ drinking water guidelines. In particular, hardness,

sulphate, sodium, and total dissolved solids (TDS) consistently exceeded the HC-CDWQ objectives in each of the years sampled. The potential adverse effects on groundwater quality were assessed to be minor to moderate. Proposed mitigation includes preventing leaks, spills and releases by providing secondary containment for fuel/hazardous material storage, requiring drip trays for equipment, providing spill clean-up equipment and materials, and preparing an emergency (spill) response plan. If a spill does occur the contractor will be responsible to notify the Saskatchewan MOE and the appropriate clean-up will be determined according to the size of spill and quantity of contamination. Follow-up proposed involves periodic inspection for leaks, spills and releases, ensuring adherence to contract specifications and license conditions, and periodic updates of the emergency response plan. The residual effects of accidental leaks, spills and releases on groundwater quality were determined to be insignificant (Table 8).

6.3.5 Vegetation

Construction of the proposed berm upgrades will result in the loss and disturbance of terrestrial vegetation and possibly some aquatic vegetation if any has established since construction of the temporary berms. The vegetation at the existing berms and disturbed portions of the borrow pits if present will consist of early succession forbs and graminoids that tend to establish in disturbed areas. If the boundaries of the existing borrow pits require expansion then some additional agricultural vegetation would also need to be cleared (Figure 2). The potential adverse effects of vegetation loss were assessed to be negligible to minor. However, proposed mitigation includes minimizing loss and disturbance of vegetation, limiting construction activities to designated and previously disturbed areas, and re-vegetating disturbed or reclaimed areas after construction. Proposed follow-up involves periodic inspection during construction, maintenance of re-vegetated areas, and adherence to contract specifications and license terms and conditions. The residual effects of vegetation loss and disturbance were determined to be insignificant (Table 8).

Construction activities including excavation and transportation of materials may result in increased fugitive dust, which can settle on vegetation in the project study area. The potential adverse effects of dust on vegetation were assessed to be negligible. However, the effects may be mitigated by controlling dust and restricting construction activities during high wind events. Proposed follow-up involves periodic inspections of the local area for accumulated dust on

vegetation and monitoring of complaints during and after construction. The residual effects of dust on vegetation were determined to be insignificant (Table 8).

6.3.6 Wildlife

Localized loss and disturbance of wildlife habitat may occur associated with the construction of the proposed berm upgrades. The land-side of the existing berms that may be extended during the upgrades, and the excavation of the borrow pits (Figure 2) could potentially impact existing habitat for small burrowing mammals and rodents. The potential adverse effects of the habitat loss were assessed to be minor. However, proposed mitigation includes minimizing loss and disturbance of vegetation, limiting construction activities to designated and previously disturbed areas, and re-vegetating disturbed or reclaimed areas during and after construction. Proposed follow-up involves periodic inspection during and after construction, maintenance of re-vegetated areas, and adherence to contract specifications and license terms and conditions. The residual effects of wildlife habitat loss and disturbance were determined to be insignificant (Table 8).

Construction activities and equipment and vehicle use may have adverse effects on small and burrowing mammals in the project area. The potential adverse effects were assessed to be minor. However, proposed mitigation includes minimizing the area of disturbance and confining construction activities to previously disturbed areas. Follow-up proposed includes keeping records of small and burrowing mammals killed by construction activities and vehicles. The residual effects of the project on small and burrowing mammals were determined to be insignificant (Table 8).

Vehicle traffic associated with construction, in particular transporting borrow material may result in increased vehicle – wildlife interactions and associated wildlife mortalities, vehicle damage, and human injury or death. No local data are available on wildlife mortalities, vehicle damage or human injury/deaths. The potential adverse effect of the proposed project on wildlife mortalities was assessed to be minor. Mitigation measures proposed to address the effects on wildlife-vehicle interactions include operating transport trucks during daylight hours, providing wildlife awareness information to drivers and adhering to existing speed limits. Proposed follow-up

includes maintaining records of vehicle-wildlife interactions. The residual effect of the proposed project on wildlife mortalities was determined to be insignificant (Table 8).

Waterfowl and shorebirds and their habitat will be temporarily disturbed in the project area during construction of the proposed berm upgrades, in particular associated with dewatering of the work areas to allow construction of the lakeside berms in the dry. The areas to be dewatered are adjacent to the existing temporary berms approximately 5.0 m from the proposed berm toe. The potential adverse effects were assessed to be minor. Proposed mitigation includes minimizing disturbance to aquatic vegetation and limiting construction activities to designated and previously disturbed areas. The residual effects of disturbance to waterfowl and shorebirds were determined to be insignificant (Table 8).

Migratory and other birds may be disturbed during nesting and rearing from construction of the proposed berm upgrades. Spring and early summer are the most critical times for these bird species. The Saskatchewan Conservation Data Center has records of five bird species with rare-uncommon status and one species with rare status in terms of breeding for the rural municipalities associated with this project. Saskatchewan Environment recommends a one km buffer around areas with species of high conservation concern. The work to be conducted as part of the berm upgrading will not impact existing nesting/breeding habitat for any of the species of conservation concern listed by the SKCDC. Therefore, the potential adverse effects of construction on migratory birds were assessed to be negligible and no specific mitigation or follow-up is proposed. Additionally, re-vegetation the berms will, over time, create perching areas providing a positive effect for migratory birds. The residual effects of the proposed project on migratory bird nesting and rearing were determined to be insignificant (Table 8).

6.3.7 Aquatic Biota/Habitat

The impacts on aquatic biota in relation to specific conditions associated with the proposed construction of the permanent berms were assessed in detail by NorthSouth Consultants (Appendix H). The primary concern in terms of aquatic biota pertains to fish and fish habitat. All of the proposed permanent berms encroach into fish habitat, specifically below El. 529.74 masl, which is the defined upper limit of fish habitat by DFO (See Section 4.1.9). The value of the habitat being disturbed was determined, in part, based on the substrate present and the

duration for which the substrate is inundated with water. Construction of the proposed berm upgrades will result in localized loss and disturbance of primarily forage fish habitat and subsequently on future utilization by sport fish. Construction activities such as placing of soils and aggregates, and shaping of the berm will have adverse effects to fish habitat. The adverse affects were assessed to be minor even though there is a clear alteration to fish habitat. The assessment determined that the value of the substrate/fish habitat that will be impacted was deemed to be low when compared to surrounding shorelines and the overall quality of the permanent berm habitat that will be created was assessed as equal or exceeding the quality of the pre-development habitat. Further, as the permanent berms are being cut back (i.e. the toe of the proposed berms typically reside within the footprint of the existing temporary berms) there is a potential recovery of approximately 0.4 Ha of fish habitat (Appendix H). These effects will be considered by the SWA and DFO when determining the compensation required for replacing the loss of fish and fish habitat resulting from the construction of the temporary berms. However, proposed mitigation includes conducting most of the work from the berm to prevent further disturbance to fish habitat, limiting activities in areas with higher valued habitat, adhering to DFO no in-water work timeframes, and the use of sediment barriers and turbidity curtains during construction and removal of sediment collected by turbidity curtains. Follow-up includes bio-monitoring of Fishing Lake, which involves studies that compare and contrast the use of natural and permanent berm habitat by macroinvertebrates which are a primary food source for many fish species. The residual effects on fish habitat resulting from construction activities required to upgrade the temporary berms to permanent structures were determined to be insignificant (Table 8).

The use of the Aqua Dams® will prevent fish from being directly affected by the construction activities as the construction at each lakeside location will be conducted in the dry. However, the use of the Aqua Dams® themselves will result in potential adverse effects to fish. First, by dewatering areas of shoreline there is the potential for fish to be killed. Second, the pumps used for dewatering and filling of the Aqua Dams® potentially suck up small bodied fish species. Third, during the draining of the Aqua Dams®, the resulting flow of water can disturb the sediment creating plumes in the water that can be deleterious to fish. The potential adverse effects associated with the dewatering process were assessed to be moderate. Proposed mitigation includes use of screened intakes suspended in the water column when filling the Aqua Dams® and while dewatering and refilling the work areas bound by the Aqua Dams®, and

conducting fish salvage of enclosed shorelines prior to dewatering once the Aqua Dams® are in place. Further, the excess water remaining after filling the Aqua Dams®, and water drained from the Aqua Dams® after construction activities will be discharged onto either existing or newly constructed riprap at the shoulder of the lakeside slope adjacent to the dewatering area. Energy dissipation mats will be used to prevent erosion of the rock. This process would dissipate the pumped water's velocity and reduce its potential to adversely impact aquatic biota and habitat in Fishing Lake. Sediment barriers and turbidity curtains will be used during construction and sediment collected by turbidity curtains will be removed. Follow-up proposed includes periodic inspections of the Aqua Dams® during construction, monitoring the enclosed water during the dewatering process to recover any fish discovered that were not relocated during fish salvage, and recording any fish kills that occur during the dewatering process. The residual effects on fish from dewatering the construction area were determined to be insignificant (Table 8).

Fish and fish habitat in the project area may be adversely affected by contamination during construction resulting from leaks and accidental spills or releases of fuels or other hazardous substances. The potential adverse effects were assessed to be minor to moderate. Proposed mitigation includes preventing leaks, spills and releases by providing secondary containment for fuel/hazardous material storage, requiring drip trays for equipment, equipment refueling or maintenance away from the lake, providing spill clean-up equipment and materials, and preparing an emergency (spill) response plan. If a spill does occur the contractor will be responsible to notify the Saskatchewan MOE and the appropriate clean-up will be determined according to the size of spill and quantity of contamination. Follow-up proposed involves periodic inspection for leaks, spills and releases, with daily inspections for equipment working on the lakeside slope or top of berms, ensuring adherence to contract specifications and license conditions, and periodic updates of the emergency response plan. The residual effects of accidental leaks, spills and releases on fish and fish habitat were determined to be insignificant (Table 8).

6.4 SOCIO-ECONOMIC EFFECTS ASSESSMENT

6.4.1 Economic Conditions

The economy of the project study area and surrounding regional study area is dependent on agriculture as well as government operations and some tourism and recreational related activities. While there may be a short-term reduction in tourist activities during the construction period for the proposed berm upgrades, overall there will likely be a positive effect on the economy in the project study area. During the construction phase of the project the contractors and their employees will need to purchase food, gas and other basic necessities. Additionally, by retaining the berms permanently the proposed project will have a long-term positive effect in the project study area by providing security from future flooding to the communities surrounding Fishing Lake; thus removing the financial burden associated with flood protection and post flooding rehabilitation. No mitigation or follow-up has been proposed. The residual effect was determined to be insignificant (Table 8).

6.4.2 Employment

Although contractors will likely be acquired from the surrounding rural municipalities of Foam Lake and/or Sasman, there will likely be no additional employment in the regional study area resulting from this project. Providing long-term flood protection for the project area may result in increased tourism as the threat of flooding will be removed. This may indirectly increase employment in the project area for services to support increased tourist visits. No mitigation or follow-up has been proposed because the potential effects are positive. The residual effect was determined to be insignificant (Table 8).

6.4.3 Land-Use/Zoning

Land occupied by the beach communities adjacent to the proposed berm upgrades include residential, as well as a variety of commercial and recreational uses, whereas the land use surrounding the borrow pits is primarily agriculture. The construction activities associated with the proposed berm upgrades will have minimal impacts on the surrounding residential land use, except for the storage of hazardous materials, which can result in potential changes if a spill or

release occurs. If the boundaries of the existing borrow pits require expansion or new borrow sources are developed to provide the fill materials then additional agricultural land will be lost. The potential adverse effects of the project on land use were assessed to be moderate. In comparison, the flood protection provided by retaining the berms permanently will result in a positive effect as the residential land use is now being protected from future damages. Mitigation measures proposed to address the adverse effects of the project on land use include limiting construction activities to designated and previously disturbed areas, reclamation and re-vegetation after construction activities are completed and the measures to prevent leaks, spills and releases. Follow-up proposed includes periodic inspections of disturbed areas and ensuring adherence to contract specifications. The residual effect of the project on land use was determined to be insignificant (Table 8).

6.4.4 Human Health and Safety

Noise and vibration levels will be temporarily increased in the local area associated with construction activities and in particular the use of heavy equipment. These increased noise and vibration levels can result in increased public concern. The potential adverse effects of the project on noise concerns were generally assessed to be minor, although the effect associated with use of heavy equipment was assessed to be moderate. Mitigation measures proposed to address the adverse effects include limiting noise-creating activities including heavy equipment operation and truck movements to normal working hours, muffling vehicles and equipment, limiting unnecessary long-term idling and requiring a high standard of maintenance for heavy equipment. Follow-up proposed involves monitoring and periodic inspection of the site for noise levels, monitoring public complaints, and ensuring adherence to contract specifications and license terms and conditions. The residual effects of construction on concerns related to noise and vibration were determined to be insignificant (Table 8).

Living near a construction site can increase resident's stress levels affecting their well being and the public attitude towards a project. The intrusion of the workers and equipment into peoples' daily schedules along with the increased noises and vibrations as discussed can result in short-term frustration and loss of sleep, and a general reduction in quality of life. However, the resulting long-term flood protection from the proposed berm upgrades will have a positive affect on the attitudes of the residents that are directly affected by the construction. The peace of

mind that comes from knowing that water levels will no longer encroach onto and into houses will likely outweigh any negative attitudes towards the proposed project. The potential adverse effects of the project on public attitudes and well-being were assessed to be negligible to minor. Proposed mitigation measures include: limiting access of construction vehicles and equipment to designated areas, limiting noise-creating activities including heavy equipment operation and truck movements to normal working hours, muffling vehicles and equipment, limiting unnecessary long-term idling and requiring a high standard of maintenance for heavy equipment. Follow-up proposed includes monitoring adherence to license terms and conditions and tracking complaints from area residents. The residual effect of the project on public attitudes and well-being was determined to be insignificant (Table 8).

Construction activities of the proposed berm upgrades may result in decreased air quality (NO_x, SO_2, particulates) as discussed previously. This may potentially increase the incidences of health problems such as acute and chronic respiratory conditions for workers and surrounding residents. It is unlikely that the Saskatchewan MOE air quality guidelines will be exceeded during construction and the activities will be short-term. Therefore, the potential adverse effects of the project on human health associated with air quality were assessed to be negligible, with the exception of excavating soils that were assessed as minor. Mitigation measures proposed to address the adverse effects include using an approved dust suppressant such as water, covering loads being hauled to and from site, controlling construction vehicle speeds, limiting construction in high wind events, requiring a high standard of maintenance for construction equipment and vehicles, limiting unnecessary long-term idling, using low sulphur-containing fuels and re-establishing vegetation on disturbed areas. Proposed follow-up involves periodic inspections of the local area for accumulated dust, adherence to contract specifications and monitoring of health complaints. The residual effect of fugitive dust on human health was determined to be insignificant (Table 8).

Soils, surface water and groundwater in the project area may become contaminated during construction associated with the use and storage of hazardous materials and fuels. The potential adverse effects of the project on human health were assessed to be moderate. Proposed mitigation measures include preventing leaks, spills and releases, providing secondary containment for fuel storage, requiring drip trays for equipment, providing spill clean-up equipment and materials, complying with provincial fuel storage and dispensing regulations,

storing hazardous materials in approved containers, and providing an emergency (spill) response plan. Follow-up proposed involves periodic inspection of equipment and storage container for leaks, spills and releases, remediate and record fuel spills and releases, periodic updates of the emergency response plan, ensuring adherence to contract specifications and license terms and conditions. The residual effects of soil, surface water and groundwater contamination on human health were determined to be insignificant (Table 8).

Interaction with the public is likely to occur both on site and along roadways leading to the site because the construction activities associated with the proposed berm upgrades are located in direct contact with existing public residences/properties. The initial construction of the temporary berms drew substantial attention from the public [(2)] and given the continuing media attention with the proposed berm upgrades public interest is anticipated to continue. Problems encountered during the initial construction included the public traveling and taking pictures in close proximity to heavy equipment and attempting to drive on the haul roads and constructed berm [(2)]. Construction activities associated with the berm upgrades will again result in short-term disturbance to traffic flow pattern, which can increase the possibility of vehicle accidents. Once construction is completed the long-term flood protection provided by the berms being permanently retained will have a positive effect on public safety by reducing the impacts of flooding. The adverse effects associated with construction of the proposed project on public safety was assessed as negligible to minor. Proposed mitigation includes informing community members of construction activities and timetables through community announcements, signage indicating the dangers leading to and associated with the site, traffic control signs and flag persons at intersections to control public traffic and prevent unauthorized vehicle access, and instructing workers to be aware of members of the public. Follow-up proposed includes recording any issues associated with the public. The residual effects of construction activities on public safety were determined to be insignificant (Table 8).

Construction activities for the proposed berm upgrades also pose a risk to worker safety. Particular issues previously identified during construction of the temporary berms included: haul trucks having to work in inclement weather and in close proximity to public vehicles and construction equipment having to work near or pass by low overhanging power lines. Additionally, the handling and storage of fuels and hazardous materials poses a threat to worker health and safety. The adverse effect of construction activities associated with the proposed

project on worker safety was assessed as minor. However, the proposed mitigation includes compliance with Saskatchewan occupational health and safety regulations, conduct safety briefings with workers, enforcement of standard operation procedure guidelines, and provision of training to employees. Follow-up proposed includes recording the occurrence of workplace accidents and updating training and safety guidelines as required. The residual effects of construction activities on worker safety were determined to be insignificant (Table 8).

6.4.5 Aesthetic Values

Retaining the berms permanently as proposed will have a long-term positive effect on aesthetic values as the area will be protected from future flood damages that are unsightly. However, the construction activities for the proposed berm upgrades will result in a short-term decrease in the aesthetic values. Excavating soil at the borrow pit locations, if required, transporting soil and aggregate material and stockpiling, placing and shaping materials on the berms will potentially decrease the aesthetic values. The potential adverse effects of the project on aesthetic values were assessed as negligible to minor. However, the proposed mitigation includes minimizing the loss and disturbance of vegetation, limiting construction activities to designated and previously disturbed areas, re-vegetating disturbed areas after construction, implementing dust control methods and covering loads during transport to and from the site. Proposed follow-up involves observing dust levels and debris during construction, maintenance of re-vegetated areas, recording public complaints, and adherence to contract specifications and license terms and conditions. The residual effects of aesthetic values were determined to be insignificant (Table 8).

6.4.6 Cultural Resources

The Heritage Resources Branch of Saskatchewan has no concerns with the proposed project at the potential site as a search of records indicated low potential to impact significant heritage resources (Appendix E). The potential for adverse effects of the project on cultural resources is unlikely.

6.4.7 First Nations

The Fishing Lake First Nation is located on the West shore of Fishing Lake. Although construction activities associated with the proposed berm upgrades will not occur directly on reserve land, the border of the reserve land is within approximately 1 km of the berms at Leslie Beach. The potential for adverse effects of the project on First Nation lands and resources is unlikely. However, retaining the berms permanently has the potential to affect the fish and fish habitat in Fishing Lake as previously described. These changes may indirectly affect the subsistence fishing for Fishing Lake First Nation. As previously noted the SWA has consulted with the Fishing Lake First Nation by letters, telephone conversations and meetings with the Chief and Council to discuss the proposed project. The Fishing Lake First Nation wish to create some positive momentum and early success on this project. The main concerns expressed by the Fishing Lake First Nation include ensuring a healthy environment able to support their peoples' lives and ensuring that their opinions are heard and their concerns and interests are respected and meaningfully considered.

6.5 EFFECTS OF THE ENVIRONMENT ON THE PROJECT

6.5.1 Flooding

By the nature of the project, as flood protection berms, the berms will be exposed to periodic flooding and therefore need to be designed to withstand flood conditions. The design specification for the berms includes a slope of 6H:1V for the lakeside of the berm with the compacted silt covered with granular bedding material followed by course rock and then riprap. As discussed in Section 3.6, under the worst-case scenario the toe of the berm will intersect the natural bottom of Fishing Lake at approximately 528.0 masl. Based on this conservative design elevation and the hydraulic analysis of water levels on Fishing Lake (Appendix A) the lake water will be in direct contact with the berms approximately 70% of the time, during which, wave action can potentially erode the berms. Therefore it is proposed that following completion of the upgrades periodic maintenance inspections will be conducted with any damaged areas repaired as required. Any erosion damage and repairs should also be recorded to identify any long-term problem areas.

6.5.2 Wind/Wave Action

High wind velocities during construction can cause increased dust and blow loose materials from the borrow pits, haul trucks, and berms. During the original construction of the temporary berms high winds resulted in wave action causing erosion problems on the earthen berms prior to placement of erosion control measures. Additionally, the wave action caused problems with the floating turbidity curtains installed for sedimentation control. The erosion control measures that are currently in place, though not sufficient for long-term protection from wave action will provide some protection during the construction phase. Further, when the current erosion control material is removed during reshaping of the lakeside berms, wave action will not be an issue as the Aqua Dams® would separate the work area from the rest of the lake so that work can be conducted in the dry. Wave action from sustained wind speed will generate waves of various heights based on the fetch distance, which varies from 4 to 7 km at fishing lake. Based on the maximum 7 km fetch and the 6H:1V design slope the required rock size will be 400 mm (D_{50} = 400 mm). However, at Fishing Lake the fetch is often shorter than 7 km and the water will be 1.5 m deep or less at the berms so waves will be weakened as they approach. Therefore the 400 mm rock sizes will provide conservative performance and shoreline erosion from wave action will not be a concern once construction is completed. Mitigation measures to minimize adverse effects from wind during construction include securing loose materials, covering any soil stockpiles, and suspending construction activities during high wind events and conducting lakeside work in the dry. The residual effect of wind and waves on the project was determined to be insignificant.

6.5.3 Ice Action

Ice impacts the shore differently in the winter and spring. In winter the ice is frozen solid, but it shrinks and expands as the air temperature varies. A drop in temperature of 10°C can shrink the ice resulting in cracks that fill with water and freeze. Later as the temperature increases, the expansion of the ice results in ice ridges on the edges of lakes and pressure at the shore that can cause substantial forces against the shore. In spring, the early runoff can raise the lake level and float the ice on an enlarged surface area leaving open water around the shore. Wind can then push the floating ice against the shore. The ice is weakened in the spring, so it flexes and the forces are not as severe as winter ice movement, but the ice movements often extend a

greater distance up the shoreline. Both types of ice movement can shift shoreline materials up slope (in most cases) and disrupt planned shoreline shapes [7]. Although there is no way to prevent ice damage to shoreline without the use of massive structural works, mitigation measures to be implemented in order to minimize the adverse effects include building flat slopes to allow ice to slide, installing large rocks to resist movement, providing a compacted smooth surface to expose less surface of an individual rock to ice, and regular maintenance of the lakeside berm slope which would included replacing any lost materials. The residual effect of ice on the project was determined to be insignificant.

6.5.4 Human Action

As the berms are situated in populated areas they can be negatively impacted by human activity. These include traffic on the berms, alterations to the riprap, including complete removal and obstruction (docks, boating equipment, landscaping and piles of building supplies). The riprap alterations are initiating erosion, while the obstructions will create hazards or hinder the reconstruction. Vehicle traffic on the lakeside berms should be stopped for public safety and berm stability reasons. The changes to the riprap erosion control on the berms can be extreme, such as using machinery to change the shore to suit desirable purposes such as improved access to water, or subtle impacts which included casually picking up stones and throwing them into the lake or on the ice. Although a few casual stones thrown off the riprap slope may seem insignificant, the overall protection can be hampered over years of casual human disturbance. As with ice impacts it is not practical to eliminate human impacts; however, many of the same design features will help reduce impacts [7]. Mitigation measures to minimize adverse effects from human activity include preventing vehicle access to the berms, constructing a flat slope that allows easy access to the shore to reduce the desire to modify berm for personal use, and the use of large rocks over most of the surface embedded in a well graded mix with the voids filled with smaller rocks making it more difficult to remove individual stones to casually toss aside. Regular maintenance of the lakeside berm slope, which would include replacing any lost materials, will also be required. The residual effect of human action on the project was determined to be insignificant.

6.6 CUMULATIVE ENVIRONMENTAL EFFECTS

Cumulative environmental effects are defined as effects that are likely to result from the proposed project in combination with the effects of other projects or activities that have been or will be carried out in the foreseeable future [(62)]. The Canadian Environmental Assessment Agency advocates a 5-step approach for assessing cumulative environmental effects [(54)]. The methodology involves five sequential steps: 1) scoping, 2) analysis of effects, 3) identification of mitigation, 4) evaluation of significance, and 5) follow-up.

6.6.1 Scoping

Scoping for a cumulative effects assessment involves determining regional issues, selecting appropriate regional Valued Ecosystem Components (VECs), defining spatial and temporal boundaries, describing other actions that may affect the VECs and identifying environmental effects of actions on VECs.

Regional Issues

The main regional issues identified in relation to the proposed Fishing Lake berm upgrades are as follows:

- Flooding
- Land/property values
- Loss of fish and fish habitat
- Surface water contamination
- Loss of wildlife habitat
- Disruption of migratory/waterfowl habitat
- Loss of rare-uncommon plant species
- Truck traffic
- Access to lake over rock on lakeside slope
- Control of human activity on berms

Valued Environmental Components

Valued Environmental Components (VECs) are components of the natural and human world that are considered to be valuable and should receive specific consideration in an

environmental assessment. Value may be attributed for ecological, economic, social, cultural, aesthetic or ethical reasons. VECs in the regional study area for the proposed berm upgrade project include the following:

Air Quality

Air quality in this region is good and there are no industrial sources of emissions. Particulate matter from fields and roads is the major source of air contamination. There are no known exceedences of the Saskatchewan Environment ambient air quality guidelines. Rural communities such as those situated around Fishing Lake value pristine air quality for health and aesthetic reasons.

Surface Water Quality

Surface water quality in Fishing Lake is generally good although it is classified as saline because of elevated TDS concentrations. There are no industrial sources of contamination in the regional study area. The closest industry to the project study area is Milligan Biotech which is situated in Foam Lake, approximately 20 km from the south shore of Fishing Lake. Good surface water quality is valued in Saskatchewan for consumption, agriculture and recreation, and is important for migratory birds and aquatic biota.

Soil

Soils in the region are rich providing good production for forestry and agriculture. Rich productive soils are valued in Saskatchewan for the agricultural capabilities.

Agriculture Economy

The agriculture economy is of significant value to residents of rural Saskatchewan. Crops grown in the regional study area include cereals, oilseeds, and forages. There is also some livestock production in the region.

Recreation/Tourism Economy

The recreation/tourism economy in the regional study area is continuing to grow in importance since the Fishing Lake Regional Park was established in 1967. The populations at Chorney and Leslie beaches doubled from 2001 to 2006 as noted in Section 4.2.2. The industry depends upon a pristine environment with abundant and diverse natural resources and a general absence of industrial or other commercial development.

Migratory Birds

Migratory bird species are abundant in the prairie pothole region of southeast Saskatchewan. Many migratory birds pass through the region in the spring and fall, and significant numbers nest in the regional study area. The SKCDC lists Fishing Lake as a migratory bird concentration site. Migratory birds are protected under the *Migratory Birds Convention Act*. These areas also attract hunters during the fall from all over North America.

Quality of Life

The rural quality of life is of value to residents of Saskatchewan. An agricultural base with open spaces, peace and quiet, clean air, water and soil, and a general absence of industrial or other commercial development characterize the quality of life.

Spatial and Temporal Boundaries

Spatial and temporal boundaries for the proposed Fishing Lake berm upgrade project cumulative effects assessment are as follows:

Spatial Boundary

The spatial boundary for the cumulative effects assessment is the regional study area, which has a radius of 10 km extending from approximately the center of Fishing Lake (Figure 1). The regional study area covers an area of 314 km^2 and is contained within the rural municipalities of Foam Lake and Sasman.

Temporal Boundary

The temporal boundary for the cumulative effects assessment covers a period of 40 years to allow for an assessment of the effects of retaining the berms permanently through a full hydraulic cycle from wet to dry years.

Other Projects and Activities

Existing Projects and Activities

Other existing and proposed projects in the regional study area as well as communities that have ongoing activities are listed in Table 9. There are numerous small scale projects that are still on-going along the waters edge at each of the existing berm locations as a result of the several hundred residences affected by the floodwaters in 1997. These include repairs to houses and replacement of small sheds damaged from flooding as well as houses being temporarily shifted so that the foundation can be raised.

Proposed (Known) Projects and Activities

Upgrades to HWY 310 are projected for implementation between 2009-2010. The proposed work would occur in sections and will include grade widening and asphalt surfacing of the existing highway. The first section of highway upgrades is approximately 17 km north of the Town of Foam Lake to just south of Fishing Lake. Construction is anticipated to start in August 2009 and is proposed to be completed by July 2010. The section of Highway 310 at Fishing Lake is proposed to start in spring 2010 pending acquiring appropriate permitting. There are no other known projects and activities proposed for the regional study area for the immediate future.

Potential (Rumored) Projects and Activities

There are no rumored projects and activities in the regional study area for the foreseeable future.

Environmental Effects

Environmental effects of the proposed Fishing Lake berm upgrades are summarized in Table 8 and described in Sections 6.3 and 6.4 of this report. The adverse environmental effects used in the cumulative effects assessment are listed below:

- Increased particulates
- Increased greenhouse gases
- Increased SO_2, NOx, etc.
- Loss of soil
- Contamination of soils
- Loss of wetlands
- Modifications in surface water flow
- Contamination of surface water
- Contamination of groundwater
- Loss and disturbance of terrestrial vegetation
- Increased wildlife mortalities
- Disturbance to shore and migratory bird habitat
- Loss of fish and fish habitat
- Increased noise
- Impacts to human health
- Loss of agricultural land
- Impaired aesthetic values

6.6.2 Analysis

Environmental Effects

Environmental effects associated with project activities for the proposed Fishing Lake berm upgrades are identified in Table 8. Effects are identified for the site preparation, construction, and operation stages of the project. Environmental effects of other projects and activities in the regional study area are also shown in Table 9.

Cumulative Environmental Effects

Adverse environmental effects of the proposed berm upgrade project and adverse environmental effects of other projects and activities occur within the regional study area. Most of the adverse effects identified are localized to the source and therefore do not overlap in

space. However, if berm upgrade construction is conducted at the same time or immediately after the upgrades to Hwy 310 are completed, then the effects will overlap in time and space. As such, there is some potential for the effects of the proposed project to be cumulative with the effects of other projects and activities within this area. Potential Cumulative effects include the following:

- Impaired air quality (increased dust, greenhouse gases, NO_x, SO_2);
- Loss and contamination of soil;
- Contamination of the groundwater and surface water;
- Increased wildlife mortalities;
- Increased noise;
- Impacts to human health; and
- Impaired aesthetic values

6.6.3 Mitigation

No additional mitigation measures are required as a result of the cumulative effects assessment.

6.6.4 Significance

Potential cumulative effects associated with the proposed project were determined to be insignificant.

6.6.5 Follow-up

No additional follow-up is required as a result of the cumulative effects assessment.