3.0 PROJECT DESCRIPTION

MDH Engineered Solutions (MDH) conducted a preliminary geotechnical investigation during July and August 2009 to evaluate the stability and permeability of the existing temporary berms in order to determine where reshaping and erosion protection will be implemented as part of the enhancement of the berms to permanent structures. They also completed an assessment of the existing erosion protection measures to develop a riprap design for the berms. The work was conducted as part of the feasibility design, the first phase in the Fishing Lake Flood Control Project Berm Upgrade [(7)]. The information provided in the following sections of the Project Description is based on the feasibility design prepared by MDH.

3.1 PROPONENT

The Saskatchewan Watershed Authority is the proponent for the proposed flood control berm upgrade project described in the following sections. As the proponent, SWA is representing the interests of the beach communities in the vicinity of the berms. The three primary stakeholders where the berms are located are as follows;

- Rural Municipality (R.M.) of Sasaman – berms at Murray, Ottman, Pavillion, Kuroki, Saskin and Buckhorn Bay beaches
- RM of Foam Lake – berms at KC and at Foam Lake Golf and Country Club
- Resort Village of Leslie Beach – berms at Leslie Beach

The project proponent retained KGS Group of Regina, Saskatchewan as their environmental consultant for the project.

3.2 OVERVIEW

Since 1964 (earliest recordings of water levels) the water level on Fishing Lake has typically ranged between 527 and 529 masl, which is below the natural outlet spill at El. 529.74 masl at which the majority of cabins are still above the water level. However, as previously noted, elevated water levels up to El. 529.92 masl in 1997 resulted in flooding of 149 cabins. Elevated water levels up to El. 530.6 masl in 2007 resulted in flooding of approximately 300 residences at which time the area was declared a disaster by local government emergency orders, making

funds available to assist with the response to the floodwater. Emergency actions were undertaken and temporary berms were constructed between September and December 2007 at eight locations along the shore of Fishing Lake with the floodwater behind the berms pumped back into the lake.

DFO issued an authorization for the HADD of fish and fish habitat, for the construction of the temporary berms. However, the authorization specified that all temporary berms at or below El. 529.57 masl be removed as of October 15, 2009 and that alternatives for long-term flood protection be investigated. The FLAC determined that the best course of action for the surrounding communities was to upgrade the existing berms to provide permanent flood protection. As construction of the temporary berms occurred within an area inundated with water, not all of the berms were built to the required height to provide sufficient long-term flood protection. Additionally, the 6H:1V design lakeside slope for the temporary berms was not achieved at all locations, the top of the temporary berms were generally flat without erosion control measures and were wider in places than the 8 m design width, and overlying riprap was placed in ridges in some locations.

The proposed project is defined as upgrading of the existing emergency flood protection berms to provide an effective and minimal maintenance long-term flood protection at Fishing Lake, Saskatchewan. Upgrading the existing temporary Fishing Lake berms will consist of reshaping so that they meet the design specifications of a lakeside slope of 6H:1V and increasing the height by 0.1 to 0.6 m so that the top of berm is at El. 531.6 masl to provide permanent protection to the 1:500 year EPWL. The back slope of the permanent berms will tie in with the lakeside lot property line elevations provided in the grading and drainage plans prepared by Crosby Hanna and Associates. The permanent berm disturbance area is generally defined between the lakeside lot property line and the edge of the lakeside toe of the berm and each end of the berm tying into high land (Figure 3).

Additional till material will be obtained from the existing borrow pits that were established during the emergency actions in 2007, or, if required, from additional borrow sources. Riprap will be removed from the existing temporary berms and combined with riprap from an off-site source to create riprap and coarse rock sufficient for meeting the design specifications for these materials. The typical cross section and riprap design of the proposed upgraded berms is illustrated in

Figure 4. Detailed geotechnical investigations will be conducted to assess and analyze the stability and permeability of the existing berms to confirm required reshaping and erosion protection of the existing berms. The addition of new berms or the removal of existing berms is not proposed as part of this project.

3.3 PROJECT LOCATION

Fishing Lake, Saskatchewan is located approximately 24 km north of Foam Lake and 170 km northeast of Regina, Saskatchewan (Figure 1). The previously constructed temporary berms are located along the shore at Leslie, Knights of Columbus (KC), Murray, Ottman, Pavillion, Kuroki, Saskin and Buckhorn Bay beaches and the Foam Lake Golf and Country Club (Figure 2). The previously established borrow pits are situated in the following locations (note: the land owner and current size of borrow pits are provided; Figure 2) [(2)]:

- NE-1-33-12 W2M (Melnychuk 188,621m^3);
- SW-5-33-11 W2M (F. Springer 15,140 m^3);
- NE-3-33-11 W2M (Dale Bindig 30,437 m^3);
- NW-11-33-11 W2M (Dale Bindig 114,588m^3):
- NE-16-33-11 W2M (Ken Van Os 11,990 m^3);
- SW-21-33-11 W2M (Bill Sowa 31,132 m^3);
- SW-11-33-11 W2M (John H. Murray 17,528 m^3);
- NE-4-33-11 W2M (F. Springer 36,126 m^3);
- SE-29-33-11 W2M (Ken Price 52,305 m^3)

3.4 NEED AND PURPOSE OF PROPOSED DEVELOPMENT

As described in Section 1.1.1, a series of water level increases occurred on Fishing Lake beginning in 1995 and in 1997 the water level peaked at El. 529.92 masl, which resulted in the flooding of 149 cabins. While the water levels decreased slightly during the subsequent low runoff years, water levels remained relatively high. In 2007, after heavy periods of precipitation and subsequent high runoff, Fishing Lake reached a water level of approximately El. 530.6 masl. Approximately 300 of the 550 cottages/residences were affected as well as several areas of the Fishing Lake Regional Park, the golf course, resort villages and numerous businesses. The area was declared a disaster by local government emergency orders, which made funds available to build temporary berms responding to the flooding impacts.

Preparation for berm construction began in September 2007 and approvals were received from regulators to construct the berms on a temporary basis [(2)]. The DFO approved the temporary berms, as discussed in Section 1.1.2, with the condition that they must be removed by October 15, 2009. As Fishing Lake water levels have not significantly decreased since 2007, there is a substantial need to establish long-term flood protective measures for Fishing Lake. The FLAC determined that the best course of action for the surrounding communities was to upgrade the existing berms to provide permanent flood protection.

Construction of the temporary berms under the emergency nature meant working in a difficult environment due to elevated water levels such that most of the berms are not a sufficient height or constructed to the design specifications. Additionally, the berms were constructed for a short-term emergency and were protected with minimal erosion armour that was intended to only last through that flood period. The temporary berms are in need of varying degrees of remedial measures, completion, and repairs, in particular to incorporate the temporary berms into a permanent shoreline, they need to have long-term permanent erosion protection. The most concerning issue of the existing berms is that of the temporary riprap on the lakeside slopes, which is almost entirely inadequate for permanent flood protection, leaving the berms vulnerable to wave erosion and increasing the risk of potential breaches. The concerns with the riprap include:

- The riprap coverage, at most beaches, was insufficient because the riprap did not extend up to the berm's crest (Photo 6);
- The riprap is poorly graded, too uniform and in places one sized and often segregated (Photo 7);
- The stone top size is generally too small, except at certain beaches (Photo 8);
- The riprap layer was generally too thin at most beaches and there were spots where the underlying bedding aggregate or geotextile was exposed (Photo 9); and
- The riprap was often observed to be damaged. It was pushed by ice in places (Photo 10), had slid, been eroded or removed/moved by human actions (Photo 11 and 12) at several locations.

In addition, the lakeside slope toe areas, which are of critical importance to the performance of the riprap slopes, are unprotected and vulnerable to undercutting especially as the water levels decrease. The entire length of temporary berm's lakeside slope is in a compromised state, which could significantly impact the berms' stability. There is also high risk of seepage under some berms, which creates a potential for piping failures. Surficial soil slumping with settlement

and slumping of the rip rap was observed along sections of the beaches (Photo 13). The slumping will destabilize the berm's slope over time, which creates some concern for the berm's stability.

The lakeside slopes generally ranged from as shallow as 8:1 to as steep as approximately 4:1. Extensive lengths of the lakeside slopes have a compound slope ratio, with a much steeper lower slope ratio. The lakeside and inside temporary design slopes were to be 6H:1V and 5H:1V, respectively. The tops of the temporary berms were generally flat, without erosion control measures and they were wider than the temporary berm design width (8 m) in some places. The backside temporary berms were also without erosion protection, too wide in some places and being used as roads.

Human activity is negatively affecting the temporary berms. This takes the form of traffic on the berms, alterations to the riprap, including complete removal and obstruction (docks, boating equipment, landscaping and piles of building supplies; Photo 14). The riprap alterations are allowing erosion to be initiated, while the obstructions will create hazards or hinder the reconstruction. Vehicle traffic on the lakeside berms should be prohibited for public safety and berm stability reasons.

A detailed summary of the condition of the existing berms at each of the beach locations and their deficiencies is provided in the MDH Phase 1 – Feasibility Design Study draft report [(7)]. Based on these problems and deficiencies the purpose of the proposed berm upgrades is to provide an effective and minimal maintenance long-term flood protection to the 1 in 500 year EPWL for the communities and public recreational areas surrounding Fishing Lake.

3.5 ALTERNATIVES TO THE PROJECT

Alternatives to upgrading the temporary berms as a part of long-term flood protection for Fishing Lake are:

- Remove the temporary berms so that Fishing Lake returns to its original state
- Leave temporary berms as they are to provide some degree of flood protection

- Remove temporary berms and construct a drainage ditch to control water levels in Fishing Lake

Removal of the temporary berms and returning Fishing Lake to its original state would again result in the disruption of fish habitat and remove any potential added benefit from the rock habitat they provide. More importantly, this alternative would eliminate the required flood protection for residents and businesses around Fishing Lake, against the wishes of the R.M. of Foam Lake, the R.M. of Sasman and the Resort Village of Leslie Beach. All three communities formally requested that the DFO allow the berms to remain as permanent structures and, therefore, this alternative would not be acceptable.

Leaving the temporary berms as they are to provide flood protection would avoid any further potential disruption to fish and fish habitat in Fishing Lake while still providing the required flood protection. However, leaving the berms would violate the DFO terms of authorization, and would not address unresolved issues such as poor drainage, inconsistent berm heights that do not provide protection to the 1 in 500 year EPWL and berm construction that does not meet the design specifications for slope and erosion protection. As such this alternative is not acceptable.

Removal of the temporary berms and construction of a drainage ditch to control water levels would provide the required flood protection. However, as noted removal of the berms would again result in the disruption of fish habitat and remove any potential added benefit provided by the rock habitat. Additionally, construction of a drainage ditch would result in greater disruption of fish habitat and affect drainage patterns in the surrounding area. The alternative of constructing a drainage ditch at Fishing Lake was previously investigated during the initial flood remediation planning [4, 5, 6]. The potential adverse environmental effects identified would be greater than the potential effects associated with the proposed berm upgrades. Additionally, as noted in Section 1.1.1, there was opposition from some local landowners and from the Fishing Lake First Nation, which stopped the drainage ditch alternative from progressing. Therefore this alternative would also not be acceptable.

3.6 PROJECT COMPONENTS AND ACTIVITIES

Dewatering

Construction on the Lakeside berms will be conducted under dry conditions to mitigate the impact on aquatic habitat from the construction activities and to ensure the construction is completed to the proposed design specifications as illustrated in Figure 4. Where the water depth is less than 2.13 m (7 feet) Aqua Dams®, which consist of two polyethylene liners that are filled with water and contained in a single woven geo-tech outer tube to create a stable, non-rolling wall of water, will be used to separate the work area from the rest of the lake. A 3.05 m (10 feet) high Aqua Dam® would allow 0.91 m (3 feet) of freeboard and allow up to 2.13 m (7 feet) of water to be dewatered. The individual Aqua Dam® units can be combined to the desired length. The dewatered area should be as long as possible to maximize contractor productivity.

The Aqua Dams® will be floated into position approximately 5.0 m from the proposed berm toe. They will be filled with water pumped from the work area and the lake, if required, to create a barrier between the lake and work area. Navigational aids, such as flashing lights and buoys, will be placed on or near the Aqua Dams® to notify boaters that there is a temporary obstruction in Fishing Lake. The water will be pumped out of the work area into the Aqua Dams®. Once the Aqua Dams® are full any remaining water will be pumped 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. A floating turbidity curtain will be placed at the toe of the berm to allow any fine material to settle before the water is released into Fishing Lake. The water will be removed from the Aqua Dams® using these same methods to minimize the turbidity in Fishing Lake.

Fish screens will be installed on the pump intakes to protect any fish from being killed by the dewatering operation. Fish salvage will be completed as the water level in the work area is lowered and all salvaged fish will be returned to Fishing Lake. The water level needs to be drawn down slowly enough to allow all the fish to be salvaged. Where the water depth exceeds 2.13 m, a similar water barrier technology will need to be used that can be placed in the water from the shore and the same dewatering process will be used.

These water barriers will not create a complete watertight work area and they will also be placed on beach sand down slope from the existing riprap, so there will be some seepage into the work area. Pumps will likely need to operate while construction is underway to keep the area dewatered. The pumped water will be discharged using the same methods to minimize the turbidity in Fishing Lake as described above. The pumps will likely be powered by gasoline. To minimize the risk of fuel spilling into Fishing Lake the pumps will only be refuelled in a designated area on the top of the berm and the contractor(s) will need to have fuel spill kits on site. Any equipment working on the lakeside slope will be checked on a daily basis for fuel or oil leaks and any soil contaminated by fuel or oil will be excavated and hauled to an approved disposal site.

Lakeside Slopes

The feasibility design is based on establishing the lakeside top of berm elevation at 531.6 masl and intersecting the bottom of Fishing Lake at a 6H:1V slope (Figure 4). This is a conservative design, which will provide the worst-case scenario for the berm footprint and disturbance area in the lake. In this worst-case scenario, the toe of the berm will intersect the natural bottom of Fishing Lake at approximately 528.0 masl. The detailed design will adjust the lakeside berm's toe location and the berm's top width, while retaining a minimum 6 m top of berm width where possible, to minimize the berm footprint and disturbance area.

Once the work area is dewatered, the existing riprap will be picked up from the lakeside slope with a track hoe or front-end loader. The existing riprap will be hauled to the riprap stockpile site where it will be sorted to create riprap and coarse rock that meets the gradation specifications described in the MDH riprap design for the berms. The geotextile will then be removed and disposed of at an approved landfill. Once the riprap and geotextile are removed, the lakeside berms will be reshaped to a 6H:1V slope mainly by cutting back the existing berm material and in a few cases adding new fill material. Slope and grade stakes will be provided using real time kinematic (RTK) GPS survey equipment.

The cross sections obtained from the MDH topographic and bathymetric survey indicate that up to 1.2 m of fill could be required in some locations, so compacted till material would need to be used to build the lakeside slope to the desired slope ratio. However, the amount and/or depth of

fill can be mitigated by adjusting the berm top width, still maintaining a minimum 6.0 m design berm top width, and/or excavating the existing lakeside slopes to meet the design slope ratio. In most cases, the existing slopes will be excavated to the desired slope ratio rather than filled. A track hoe or hydraulic excavator would likely be used to excavate or "cut" the existing side slopes. Where additional till is required, the top 150 mm of the existing berm will be disked and re-compacted before the additional till material is placed. This will combine the existing granular bedding material with the existing till on the berm.

The additional till material will be hauled from the designated borrow source along a designated haul route and placed on the berms to the design elevation in compacted 150 mm lifts. The till material will be placed on the berm and spread with graders or front-end loaders. The till material will then be compacted with sheep's foot rollers to achieve 100% Standard Proctor density at the optimum moisture content.

Granular, Coarse Rock and Riprap Material

An erosion protection design for the lakeside slope of the permanent berm was completed and considered protecting the berms from three potential attacks; wave action, ice action and human action. The recommended 400 mm riprap size (D_{50} = 400 mm) is conservative for waves, but desirable to protect the shore from ice action. The material will be well graded, so that there are smaller rocks to fill the voids and create a dense surface to prevent ice penetration. The erosion protection design includes three distinct layers with the large rock (riprap) on the outside of the berm, coarse rock in the center and granular bedding material on the bottom (Figure 4). The riprap, coarse rock and granular bedding material specification is for clean materials with less than 5 per cent passing the 80 μm sieve to ensure that minimal fine sediment is discharged into Fishing Lake.

The 200 mm layer of granular bedding material will be placed in one lift on the compacted till material with a front-end loader or bobcat. The bedding material does not need to be compacted, but it needs to be smooth and free of dips or mounds. Then the 200 mm layer of coarse rock will be placed in one lift on the bedding material. The 600 mm layer of riprap will be placed on the coarse rock to the full coarse thickness in one operation. The riprap and coarse rock can be placed with equipment, but the underlying material should not be disturbed and the

fine material in the granular bedding material should not be mixed with the coarse rock or riprap. The riprap will be relatively homogenous with the large rocks uniformly distributed and firmly in contact with each other to prevent coarse rock from being washed through the voids in the riprap. The coarse rock material will be placed below the riprap to prevent wave action from removing the granular bedding material or embankment till material. The riprap and coarse rock will likely be hauled to the work area in a rock truck and dumped on the top of the berm. The riprap and coarse rock will be placed with a track hoe or loader; it should not be dumped on the bedding material from trucks.

The lakeside toe of the berm will intersect the bottom of Fishing Lake at a point where there is a shallow natural slope and the shore is protected from erosion by the shallow water of the beach. At some future time, it is expected that the lake will follow its historic pattern and the water level will drop. The intersection of the 6H:1V berm slope and the natural beach will be subject to attack by wave action when the level is a slightly above the beach elevation. As a result, the erosion control on the berm slope cannot simply end at this intersection and a transition is required. MDH recommends that a 2.0 m apron of riprap extending from the toe of the 6H:1V slope (Figure 4). If the toe erodes the apron will settle and protect the toe of the slope from further attack. The flat slope will break the waves, so aggressive erosion is not expected. Depending on future lake levels, this apron may or may not actually be subject to erosion. It is desirable to bury the toe protection slightly below natural ground, so it is not actually exposed unless there is some erosion.

Riprap toe armour protection will be excavated into the bottom of Fishing Lake. The 2.0 m wide and 1.0 m thick apron will be excavated with a track hoe. Most of the excavated material will likely be beach sand, but there may be some fine grained soils (till) or organic material. Any fine grained till soils will be removed from the work area and used in the top of berm if suitable material or inside berm construction. Some organic material may be suitable for use as topsoil on the top of the berm or the inside berm slope. The excavated area will be filled with 200 mm of granular bedding material, 200 mm of coarse rock material and 600 mm of riprap as per the erosion design described above. Any excavated beach sand material will be placed over the riprap toe armour with a nominal 600 mm thickness at the toe of the slope tapering to no beach sand at the Aqua Dam® (5.0 m from the berm's toe), which produces an 8:1 slope. This will eliminate the need to haul the beach sand, hide the riprap toe armour unless it is needed, and

provide additional beach area as the water levels decrease. The beach sand would only be placed on the toe armour in areas where beach sand is the native material on the bottom of Fishing Lake. Sand would not be imported to cover the toe armour in areas where the native soil on the bottom of Fishing Lake was not sand.

Top of Berm and Inside Slopes

There will be a one per cent (1%) cross slope on the top of the berm from the inside berm shoulder to the lakeside berm shoulder to provide surface water drainage towards Fishing Lake (Figure 4). MDH recommends maintaining a minimum 6.0 m design berm top width and raising the berms to the 531.6 masl design lakeside shoulder elevation. If any berms need to be extended to meet the minimum 6.0 m top width, the extension will be away from Fishing Lake where possible to minimize the disturbance area in the lake.

The interior side slopes of the lakeside temporary berms are in relatively good condition. The inside slopes will not be steeper than a 5H:1V slope ratio (Figure 4). Based on the preliminary seepage analysis, this provides an adequate seepage path length to mitigate the potential for seepage and piping failures at higher water levels. In most cases the inside slope will be variable because it will tie the inside shoulder elevation to the inside alignment. In most cases, cottage owners have already placed fill against the berm outside their property line. In these situations the existing fill material will be maintained, as long as the inside slope ratio is not steeper than 5H:1V.

The existing lakeside berm shoulder elevations are between 0.1 m and 0.6 m below the design elevation (531.6 masl) and will therefore need to be raised. Compacted till material will be used to extend the top of the berm and build the inside slopes to the design slope ratio in areas where there are cottages behind the berms. The compacted till material would come from previously used till borrow sources. In areas where there is a marsh or wetland behind the berm the granular bedding material used under the riprap can be used to build the inside slope. This will mitigate the impact on the aquatic habitat because it is to be very clean (less than 5 per cent of the material passes the 80 μm sieve).

Before any work is completed, a sediment barrier will be installed along the top of berm lakeside shoulder and at the bottom of any inside slopes that are adjacent to water to prevent any sediment from entering Fishing Lake. Slope and grade stakes will be provided using real time kinematic (RTK) GPS survey equipment. The top 150 mm of the existing berm top and side slopes will be disked and re-compacted before placing any additional till material. The additional till material will be hauled from the designated borrow source along a designated haul route and placed on the berms to the design elevation in compacted 150 mm lifts. In the borrow pit, the till material will be loaded and hauled with a track hoe and rock trucks or it will be loaded/hauled with rock trucks. The till material will be dumped on the berm and spread with graders. The till material will be compacted with sheep's foot rollers to achieve 100% Standard Proctor density at the optimum moisture content.

A 1.0 m wide riprap area on the lakeside top of the berm is recommended to transition the riprap from the lakeside slopes into the top of the berm and protect the berm from water splash caused by wave action when Fishing Lake is at EPWL (Figure 4). Additionally, topsoil and grass seed will be placed on the top of the berm and the inside berm slope to promote vegetation growth and reduce the risk of erosion from surface water runoff. The topsoil will be loaded in designated top soil borrow areas with either a track hoe and rock truck or a self propelled scraper. The topsoil will be hauled along the designated haul route to the berms. The topsoil will be dumped and spread with a grader and bobcat to create a 50 mm layer of topsoil. The grass seed will be applied at the specified application rate using either a broadcast spreader or an air seeder. If a broadcast spreader is used the application rate would need to be increased and the grass seed will need to be raked into the topsoil.

Although the berms are built out of till, which can be an erodible material, once the top and inside slopes of the berm are vegetated with grass there should minimal deleterious material or sediment entering the lake from the surface water runoff. It will take some time to establish the vegetation so there is the potential for localized erosion on the inside of the berms before the vegetation is established, however, there is little risk to the berm's integrity. If erosion occurs in localized areas before the vegetation is established and/or there are any concerns with topsoil entering the lake from surface water runoff sedimentation barriers should remain installed to manage the erosion at these localized areas. However, there is a risk that any sedimentation control may be removed or damaged by cottage owners before the vegetation is well

established, reducing the sedimentation control's effectiveness and creating an ongoing maintenance concern.

Sediment Control

Sedimentation control measures will be employed in several locations, as previously described, to protect against sediment entering Fishing Lake. Installation of sediment barriers on the top of the berm along the lakeside shoulder and at the bottom of any inside slopes that are adjacent to water will protect against run-off of topsoil from the berm top until vegetation is well established. When emptying the Aqua Dam® equipment a floating turbidity curtain will be placed at the toe of the berm to allow any fine material to settle before the water is released into Fishing Lake. Sediment barriers can also be placed around the till borrow source areas and top soil borrow source areas if there is a potential for erosion or sediment movement by wind or water impacting any water bodies.

Haul Road Locations

A network of haul roads was constructed for the emergency berm construction. Where possible, the same haul roads/routes will be used for the berm upgrading. Haul roads for the riprap and granular bedding material would include the provincial highway and municipal grid road network. Near Fishing Lake, local roads and the temporary berms will be part of the haul road system.

The contractor(s) will repair damage to the municipal roads, local roads and berms caused by the haul. Any temporary haul roads will be decommissioned after this project is completed. The decommissioning would involve regrading the road, so that it matches the adjacent topography and placing topsoil on the disturbed area adjacent the roads to make it easier for the native vegetation to be established.

Equipment

The berm construction activities will be completed with traditional earth moving equipment along with supplemental equipment required for dewatering. The type of equipment used to complete this project will include:

- Track hoes;
- Rock trucks;
- Graders;
- Front end loaders;
- Bobcats;
- Scrapers;
- Sheep's foot roller;
- Pumps;
- Dissipation mats; and
- Aqua Dams®.

Fuelling and Fuel Spills

An equipment staging area will be established and all equipment fuelling will be completed at this location, except for pumps. To minimize the risk of fuel spilling into Fishing Lake the pumps will be refuelled in a designated area on the top of the berm and the contractor(s) will be required to have fuel spill kits on site. Any equipment working on the lakeside slope or top of berms will be checked on a daily basis or as appropriate for fuel or oil leaks and any soil contaminated by fuel or oil will be excavated and hauled to an approved disposal site.

3.7 RESOURCES

The materials required to upgrade the existing temporary berms include till, granular bedding, coarse rock and riprap, topsoil or organic material, grass seed that is native to the area and able to withstand periods without water and sedimentation control measures. The till, granular and rock materials will be obtained from existing borrow pits which were previously established during the emergency work in 2007, as well as from off-site stockpiled material that may be brought in by rail.

Potential Till and Topsoil Sources

The embankment materials specified will be native soils that are free from organic materials, deleterious materials and frozen materials. The materials will be low to medium plasticity clay till with the following characteristics, a maximum size of 150 mm, a minimum of 50% passing the 80 μm sieve and a minimum plasticity index of 7%. The existing borrow sources contain a silty till, which is suitable for the embankment fill material.

To minimize the area impacted at the borrow pits, it is recommended that the additional required material be excavated from the bottom and sides of the existing pits maintaining a 3:1 slope ratio along the sides of the pits. If the borrow pits are already storing water, the water will need to be pumped out to the adjacent agricultural drainage ditches or marsh/forested areas before the borrow pit can be used. It may also be possible to use the same borrow sources as the Saskatchewan Ministry of Highways and Infrastructure when Highway No. 310 is upgraded.

If additional borrow sources are required beyond the capacity or those described above, landscape borrow sources will be developed where possible rather than deep type borrow pits. It is important to note that landscape borrow is only possible if there are knolls or hills that could be excavated in the Fishing Lake area. The advantage of a landscape borrow source is that the landowner can continue to use the disturbed area for the same purpose. Before any potential new borrow sources are used, a heritage and biology assessment will be completed. Developing and decommissioning a landscape borrow source involves the following process:

- Topsoil is stripped and stockpiled;
- The borrow material is excavated to create a slight swale ditch or match the adjacent topography; and
- The stockpiled topsoil is placed back on the disturbed area.

During the construction in 2007 topsoil was previously stripped from the existing borrow pits and stockpiled on the landowners' property. The topsoil remained the property of the landowner, however, if the landowners have not used this topsoil material there may be an opportunity to use it as the material on the top and inside of the permanent berms. The topsoil from any additional borrow sources should also be stockpiled for use on the permanent berms or decommissioning the borrow sources.

The borrow sources will be decommissioned once the permanent berms are completed. Depending on the location, size and depth, the decommissioning plan could include leaving it as a dugout for the landowner or working with Ducks Unlimited to turn the area into a marsh/wetland as part of the compensation for the Fishing Lake Flood Control project.

Potential Granular Bedding Material Sources

MDH recommends acquiring the granular bedding material from an existing local gravel pit or aggregate supplier. This option would have minimal environmental impacts, primarily associated with transportation effects. If a suitable existing aggregate source is not available, MDH would complete a geological aggregate search during the detailed design phase. Before any potential gravel source was mined, a heritage and biology assessment will be completed. If any selected gravel sources are high quality they could continue to operate as a gravel pit until the resource is depleted if there is interest. Any new gravel sources will be decommissioned after the gravel was removed. Depending on the location, size and depth, the decommissioning plan could include leaving it as a dugout for the landowner or working with Ducks Unlimited to turn the area into a marsh/wetland as part of the compensation for the Fishing Lake project.

Potential Riprap and Coarse Rock Sources

The riprap and coarse rock will be well graded fieldstone that is sound, hard, dense, durable and free from silt, clay, shale, sandstone, flaky particles, topsoil, organic matter and other deleterious materials Most of the riprap and coarse rock material used in the temporary berms will not meet the design requirements, in particular size, for the permanent berms. There are a limited number of riprap and coarse rock sources in the Fishing Lake area and it will be difficult to find material that meets the design criteria. In order to minimize the amount of riprap that is required, it was recommended that the existing riprap be removed and hauling it to a designated stockpile location. The existing riprap will be screened and combined with new rock material to create riprap and coarse rock that meets the design gradation requirements.

MDH has identified a potential rock source that could be used for the riprap and coarse rock. The rock is already stockpiled and an analysis would need to be completed to determine if it is feasible to haul the rock to Fishing Lake by rail. The rock would then need to be hauled by truck

from the rail line to the riprap stockpile. There may also be some rock available from gravel pits that are already operating in the area or local farmers that have stockpiled rock from their fields.

The options listed above have minimal environmental impacts, because the rock is already stockpiled. If these sources do not provide enough rock, MDH would complete a geological aggregate/rock search during the detailed design phase. Before any potential rock source was mined, a heritage and biology assessment will be completed. The rock source will be decommissioned once all of the rock was removed. Depending on the location, size and depth, the decommissioning plan could include leaving it as a dugout for the landowner or working with Ducks Unlimited to turn the area into a marsh/wetland as part of the compensation for the Fishing Lake project.

3.8 CONSTRUCTION SCHEDULE

The permanent berm construction activities are proposed to take place between the beginning of May 2010 and the end of September 2010. There may be fish spawning or bird nesting requirements that restrict construction activity in certain areas in the late spring or early summer. The contractor(s) will be instructed to manage their work schedule around these environmental requirements.

The work in Fishing Lake should be completed later in the summer when there is a higher chance that the water levels will be reduced. The till placement and compaction is proposed to be completed by the middle of September 2010. It is more difficult to moisture condition (dry) the till material as the temperatures decreases and the till material should not be compacted in freezing conditions.

The grass seed should be placed early enough that it has a chance to become established before winter. If the grass seed is not placed before 15 August 2010, it will be placed after 15 October 2010 (according to the Alberta Agriculture and Rural Development) and before freeze up, as long as the night temperatures are consistently below zero. The grass seed could also be placed in the spring of 2011.