Best Management Practice (BMP-010)
Drilling on Land

General Introduction

Drilling is one of the most definitive and common methods for surface exploration.

Background

A properly planned and managed drilling program reduces the risk of impacting the environment.

The following requirements apply to shield areas of the province. Drilling in the Western Sedimentary Basin requires additional precautions because of the potential of encountering oil and gas concentrations.

Clearing for drilling is dependent on the size of the drill rig used.

Authorization:

Mineral Industry Environmental Protection Regulations
Forest Resources Management Act and Regulations
The Oil and Gas Conservation Regulations, 1985

Requirements:

1. If drilling is required on ice-covered waters, see BMP-011 (Drilling on Ice).

2. The number of drill holes, locations, and drilling program details must be identified in the application.

3. Applicants wishing to conduct activities within 100 meters of a water body or watercourse must also contact *Fisheries and Oceans Canada* for their review.

4. Any program requiring water for drilling activities (except water from municipal or private sources) requires approval from the Saskatchewan Watershed Authority, Saskatchewan Environment and Fisheries and Oceans Canada. See BMP-008 (Water Crossings).

5. Clearing should be kept to a minimum size and constructed to facilitate drilling operations. A standard drill site should not exceed 20 meters by 20 meters (or 400 square meters) unless otherwise approved. See BMP-003 (Clearing) for further clearing requirements.

6. A minimum 100-meters must be maintained between the drill site clearing and any water body or watercourse unless previously authorized by Saskatchewan Environment (SE) and DFO. For drilling activities within 100m of a water body or watercourse, the applicant must follow the procedures outlined in BMP-011 (Drilling on Ice).

7. For drill sites that are not level, the first consideration should be given to leveling methods other than soil stripping (blocking, ice pads, etc.) and site relocation. If not possible, soil stripping should be minimized.

8. If soil stripping is required, soil horizons are to be removed and stored separately at the edge of the clearing.

9. Slash material is to be stockpiled at the edge of the clearing and utilized for reclamation of the site. See BMP-013 (Restoration).

10. For HQ (<2.5 inches or <63.5 mm) and smaller diameter drill holes in remote locations drilling effluent shall be contained, in sumps, containers, or natural depressions located as close to the drill site as possible, unless otherwise approved.

11. For larger diameter holes (> 2.5 inches or > 63.5mm) or areas of road access by trucks, sumps or tanks are required unless otherwise approved.

12. Where possible all efforts shall be used to prevent drill mud, return water, and cuttings (sludge) from running uncontrolled from the site or to within 100 meters of a water body or watercourse. Appropriate erosion control measures may need to be implemented.

13. The applicant must identify in the application any drilling additives that will be used in the program.

14. Wherever possible biodegradable mud and non-toxic additives should be used.

15. An adequate closed circuit system must be utilized for potentially harmful drilling mud and other additives.

16. Drill mud solids or cuttings with a uranium concentration greater than 0.05 per cent are to be collected and then disposed of down the drill hole and sealed.

17. Noise abatement devices including mufflers and shrouding are to be used near populated areas.

18. Upon completion of the program, exposed drill casings are to be removed or cut off at or below the surface of the ground, unless otherwise approved.

19. Any drill hole that encounters mineralization with a uranium content greater than 1.0% over a length > 1 meter, and with a meter-percent concentration > 5.0, will be sealed by grouting over the entire length of the mineralization zone and not less than 10 meters above or below each mineralization zone.

20. All artesian drill holes must be reported to the SE contact within 30 days of its discovery. All artesian drill holes must be sealed to prevent discharge to the environment.

21. Reclamation of the drill site must follow procedures outlined in BMP-013 (Restoration).

22. Companies wishing to drill in the Western Canada Sedimentary Basin are required to contact the Mines Branch of Saskatchewan Industry and Resources (SIR) prior to drilling. SIR will advise on any precautions that are required.

Contacts:

Saskatchewan Environment
Fisheries and Oceans Canada
Saskatchewan Watershed Authority
Mines Branch, SIR

Best Management Practice (BMP-011)
Drilling on Ice

General Introduction:

Many exploration programs involve drilling on ice in the search for mineral deposits. Because potential risks increase from drilling on ice, special attention is given to all drilling phases to prevent or minimize adverse impacts to the environment. Operations may vary between drill rigs or even between holes as situations demand; however, decisions must reflect the requirements outlined in this guideline to reduce potential impacts to the aquatic ecosystem. This guideline does not apply to land-based drilling programs (see BMP-010).

Background:

The following information is provided to describe the various precautionary steps taken to protect the environment when drilling on ice.

Description of a Diamond Drill

Diamond drills come in a variety of shapes and sizes. Although there are a number of different sizes, manufacturers, and types of drills they generally adhere to a few simple rules. Diamond drills are almost always primarily powered by a diesel engine. All drills have at least some secondary drive mechanisms that are hydraulic. Typically drill rigs are small, about the size of a small recreational vehicle. The drill is transported to the site on a low bed tractor-trailer and is moved around the site using a dozer/skidder. The drill pipe or "rod " will have a diameter of anywhere from five inches to as small as two inches. Drills are capable of drilling to 300 meters or more, depending on the size of the drill and drill rod string used.

Drilling on ice goes through three basic phases: setting up, drilling, and tearing down.

All three of these operations are outlined in detail below:

Setting Up

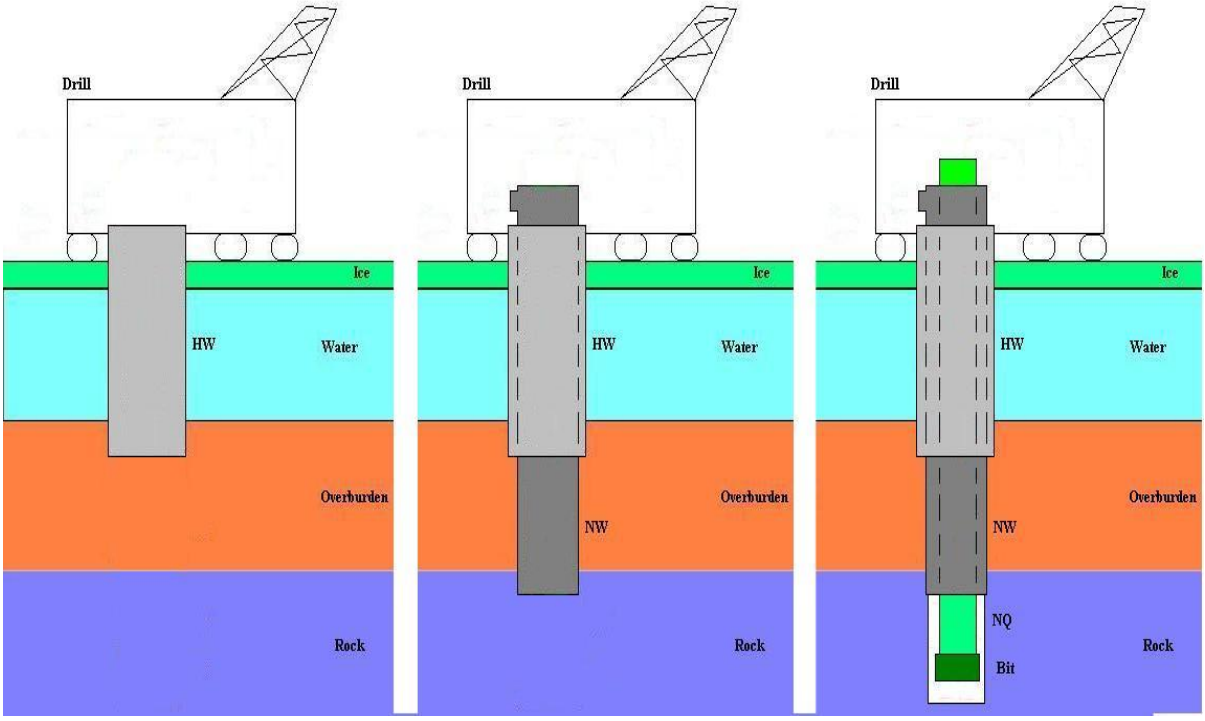
There must be sufficient ice to support the weight of the drill rig and associated equipment during transportation to the drilling location and when operating on the drill site. If insufficient ice is present, the ice is commonly built up with a series of local floods. The drill is supported on untreated timbers to distribute its weight over the ice and to help level the rig. Some drills are relatively light and need to be stabilized by using ice screws or freezing in anchors. Associated drilling equipment, which includes: drill rods, pumps, mixing tanks, and mechanical support equipment, is brought to the site and usually stored on sleds. Fuel and petroleum products necessary for maintenance and operation are temporarily brought to the drill site when required.

Drilling

The first step in drilling is "casing" the hole. This means sealing the hole from bedrock to surface using a large diameter pipe or "rod". This is a necessary step to ensure that the hole can be located again if any subsequent drill rods need to be removed during the operation. When casing the hole, one factor to contend with may be the depth of the water, or the distance between the drill and something solid. If the water is deep, the drillers will drop their largest rods first (rod size referred to as HW in *Figure 1*). The HW rod will be pushed and turned as far as it will go into the lake bottom manually and then anchored to the drill. Some disturbance of lake bottom sediments will result from this initial stage, however it is minimal and localized. If the lake bottom is bedrock there will be virtually no disturbance at all. If however consolidated sediments exist then some disturbance to organic matter at the bottom of the lake should be expected.

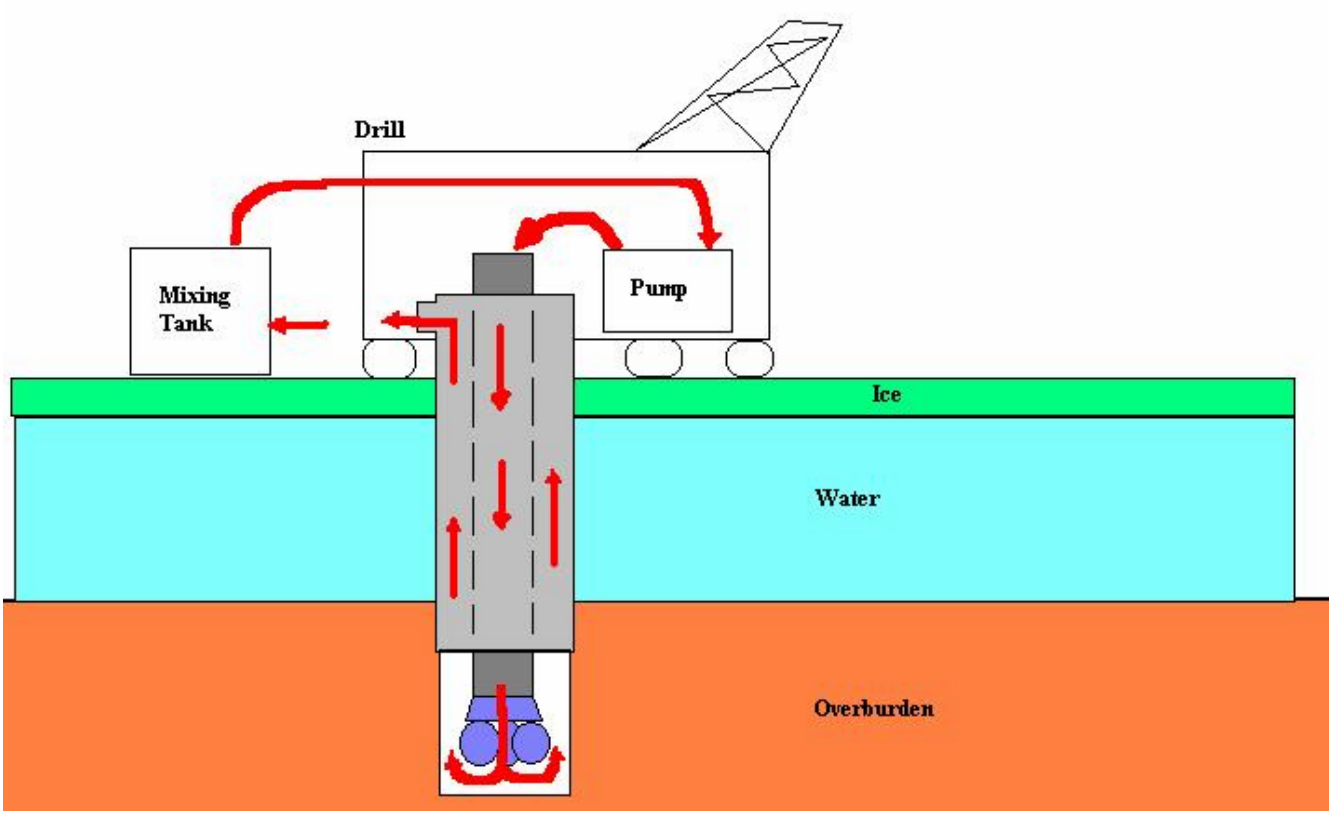
If the HW encounters bedrock then the next smallest size casing referred to as NW will be lowered inside the HW. The NW rod will be drilled into the rock to form a seal between the rock at the bottom of the lake and the drill at the surface. Once the NW rod is in place the next smaller "NQ" rods can be lowered into the hole.

Figure 1. Setting Casing



If the NW rod doesn't hit bedrock when it is initially lowered into the hole, it will commence hollow core drilling through the lake sediment or "overburden". If the overburden is deep, or the drilling is difficult, then the drillers will probably switch to a type of drill bit called a tricone. Tricones do not hollow core drill; instead they simply grind their way through everything they encounter. Triconing produces a lot of sand and silt and this abrasive material must be removed from the bottom of the hole or it will plug up the tricone and stop the drilling. Because this material is very coarse and heavy, drillers will commonly add a substance called bentonite to the drilling water to float the coarse sand away from the tricone and out the top of the hole. Mixing bentonite with water forms a thick slurry that is able to float out the coarse sand produced by the tricone, when pumped down with enough pressure. This drilling mixture is pumped down through the rods, out through the tricone, back up the outside of the hole into the HW rod, and thus back to the surface. When the bentonite reaches the surface it is contained in a large mixing tank, likely the same tank that was used to mix it in the first place, where the coarse sand can settle. The bentonite is then reused or re-circulated back down through the hole (*see Figure 2*). After the NW rods are sealed with the bedrock, the hole is considered "cased". Once the hole is cased the next step is the actual drilling. For this process, the drillers use the next smaller size rods called NQ.

Figure 2 Re-circulation During Triconing



"Coring" is the process by which rock is extracted using a hollow bit drill (s*ee Figure 3*) Coring is achieved by the drill supplying a great deal of pressure and a high speed rotation. This process generates heat so drilling fluid must be circulated through the bit to keep it from melting. In most cases water will suffice as a drill fluid, but in some cases additives must be used for additional reduction in friction and/or better cooling. If water is used it will be pumped directly from the lake down the hole. If additives are necessary, they are mixed and contained in tanks before pumping the mixture down the hole.

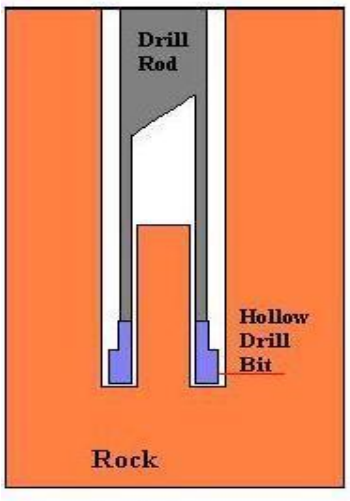


Figure 3. **Coring**

Water or drill fluid is pumped down the hole, through the bit, and back up the outside of the NQ rod, but because the hole is sealed it returns to the surface inside the NW casing (*see Figure 4*). While coring, the drill fluids are under

pressure forcing the “cuttings” (a gritty mud from the bit cutting the rock) away from the bit and out the top of the casing. This drill fluid full of cuttings coming out the top of the hole is called the “return”. When this return fluid reaches the surface it is run through a filter called a Polydrill filter. This filter separates out the cuttings and packs them in a cylindrical bag for disposal. The drill fluids are then pumped back down the hole or re-circulated (*see Figure 5*).

Figure 4. Circulation of Drill Fluids

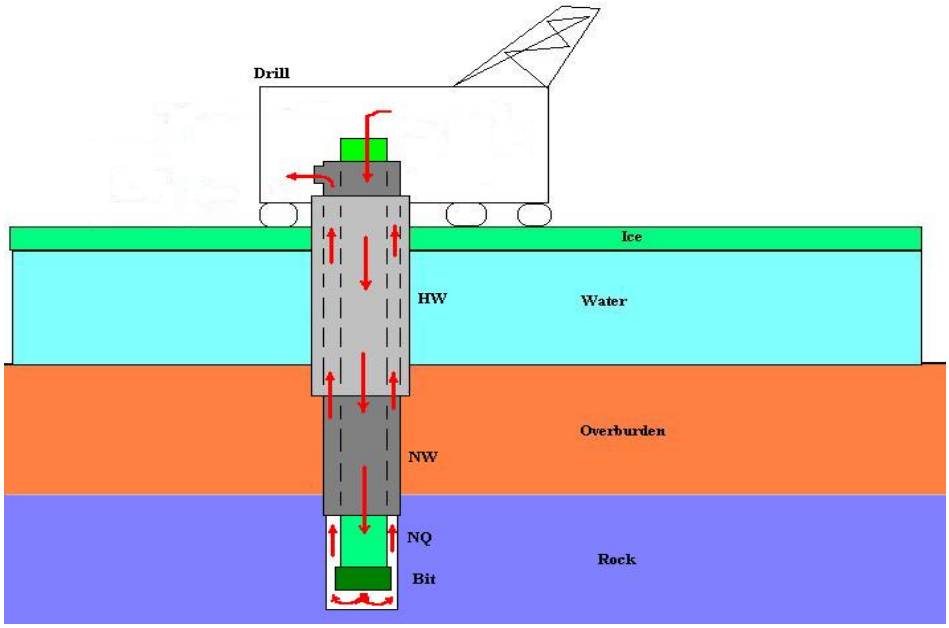
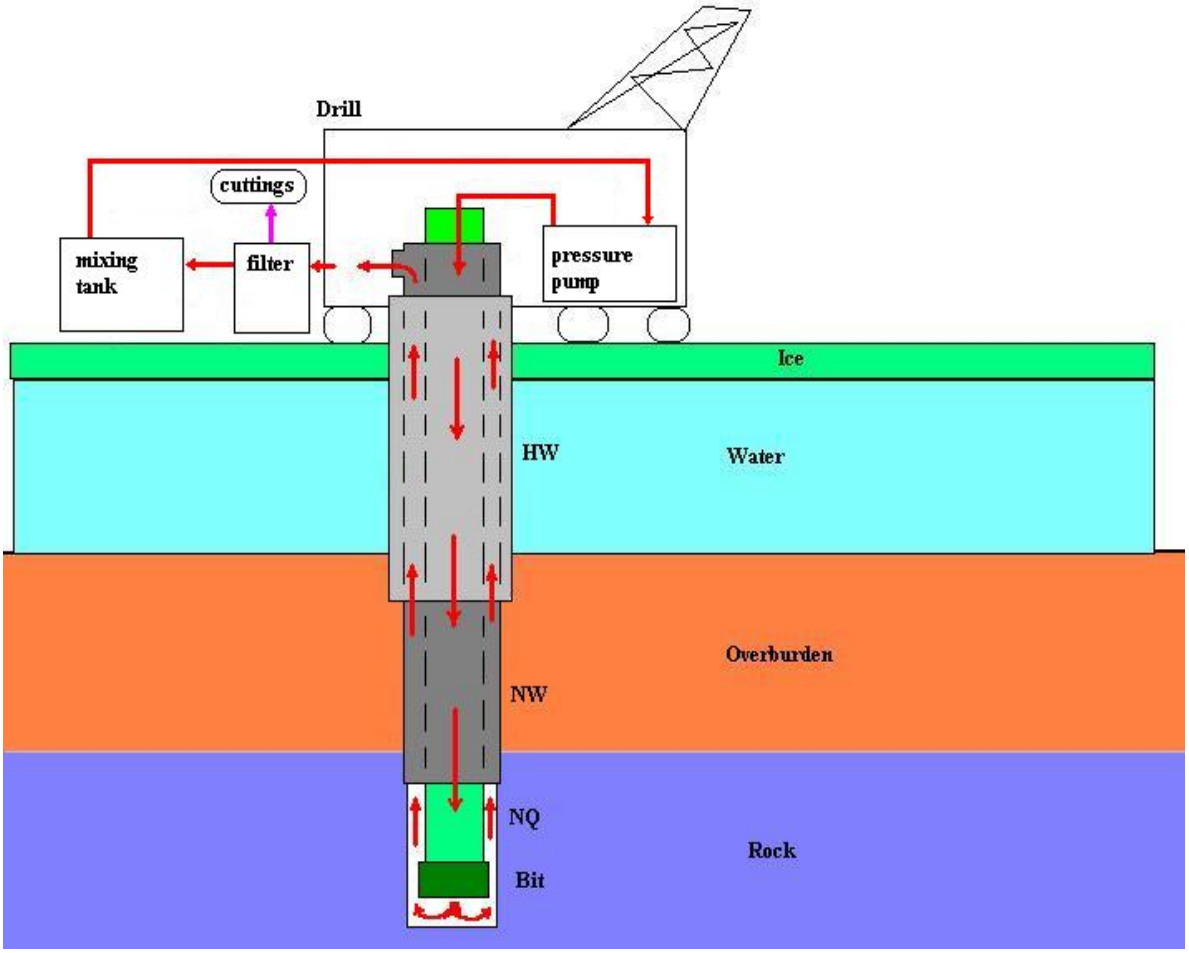


Figure 5. Recirculating Drill Fluids



Tearing Down

Once drilling has been completed, clean water is circulated through the hole to remove any drill additives and remaining cuttings. The hole is then sealed as per requirements to prevent any of the lake water from being inadvertently drained into any aquifer or mine workings (past or future) and to prevent any impure water (salty, mineralized) from entering the lake through underground sources. The hole is sealed for cementing by pumping down a properly sized safety plug and regular Portland cement is pumped down the hole to form a watertight seal.

As the hole is being cemented, all the rods are extracted from the hole in the reverse order they went in. As they are withdrawn any remaining cement will settle to the bottom of the hole. The amount of cement deposited on the lake bottom will be minor as the drillers follow a formula to determine the exact amount of cement they will require to seal a hole. All drill and support equipment is then removed from the lake. The goal is to leave the ice surface in the same condition as it was prior to moving onto the site.

Authority:

Fisheries Act
Mineral Industry Environmental Protection Regulations
The Oil and Gas Conservation Regulations, 1985

Requirements:

1. Applicants conducting activities on or near a water body or watercourse must also contact Fisheries and Oceans Canada for their review.

2. Any program requiring water for drilling activities (except water from municipal or private sources) requires approval from the Saskatchewan Watershed Authority, Saskatchewan Environment and Fisheries and Oceans Canada and must be identified in the original application.

3. All access routes onto the water body must follow the requirements outlined in BMP-008 “Water Crossings”.

4. The ice needs to be of sufficient thickness to support the drill and associated equipment both during transportation and drill setup.

5. Flooding is permitted to build the ice up to sufficient thickness if required provided that the intake for the pump is screened and the fuel source for the pump has secondary containment.

6. Unless otherwise approved, drilling shall occur in water depth greater than 2 meters, including ice thickness. Additional site assessment and mitigation information will be required if the applicant plans to drill in a water depth less than 2 meters. Contact Fisheries and Oceans Canada and Saskatchewan Environment for information requirements.

7. Untreated timber or local cut timber can be used to support the drill. If local timber is used, a Forest Products permit authorizing this use is required before any timber harvesting is permitted. All timbers must be removed on completion of drilling operations.

8. The use of ice screws or freezing in anchors is permitted but must be removed once the drilling operation is completed.

9. Fuel shall be stored at a shore cache a minimum100 meters from the high water mark. A limited supply of fuel can be temporarily brought to the site to support the drill. Fuel stored on site must be stored in a secondary containment system; either a large tray or an ice/snow bermed containment area lined with an impervious liner to the product being stored.

10. Absorbent matting or drip trays must be used where accidental spills may occur during fueling. Contaminated material is to be removed from the site for proper disposal immediately after cleanup has been completed. Refer to BMP-005 "HSWDG" for further requirements regarding fuel handling, storage and spills.

11. The drilling crew is to be trained to respond to a spill should the need arise.

12. External pumps or motorized equipment used in the drill operation and sitting on the ice shall have secondary containment (e.g. impermeable liner resistant to the product being used, plastic drip trays).

13. Any water intake shall be covered with 2.5 mm or less screening material. The water velocity at the screened face of the intake shall not exceed 3.8 cm/second.

14. Noise abatement devices including mufflers and shrouding are to be used near populated areas.

15. The applicant must identify in the application any drilling additives that will be used down the hole during drilling. All drilling additives must be biodegradable and accompanied by an MSDS sheet. Drill additives should only be used if required and in minimal amounts.

16. If mixing tanks for drill muds are being used, they must be placed on an impervious liner and any spills are to be cleaned up with absorbent material and contained.

17. All drilling operations shall use a "closed loop" recycling system with no discharge to the water or ice. In some cases, approval may be given to allow the return fluid to be pumped back to shore and into a natural or constructed sump located 100 meters or greater from the water (in these cases re-circulating drill fluids would not be required).

18. Drill cuttings must be collected through a filter system and disposed of in a SE approved landfill or alternatively the drill mud, return fluid and cuttings can be disposed of in a land-based sump placed 100 meters above the high water mark. Any requirements in BMP-010 (Drilling) addressing operation and handling of the land-based sump must be followed.

19. The drill area is to be kept orderly and any garbage is to be removed daily from the area to an approved disposal site. The ice surface is to be kept clean at all times. Once drilling is complete, all material is to be removed from the ice and the site left in a safe and clean state.

20. Once drilling is completed, clean water must be circulated through the hole to remove any remaining drill fluids and cuttings.

21. Drill holes must have all rods and casing removed prior to abandoning the hole.

22. Drill mud solids or cuttings with a uranium concentration greater than 0.05 % are to be disposed of down the drill hole and sealed.

23. Any drill hole that encounters uranium mineralization with a content greater than 1.0% over a length of more than 1 meter with a meter-percent concentration greater than 5.0 will be sealed by cementing (grouting) over the entire length of the mineralization zone and not less than 10 meters above or below each mineralization zone.

24. Drill holes are to be sealed by cementing (grouting) the upper 30 meters of bedrock or the entire depth of the hole, whichever is less.

25. Companies wishing to drill in the Western Canada Sedimentary Basin are required to contact the Mines Branch of Saskatchewan Industry and Resources (SIR) prior to drilling. SIR will advise of any precautions that are required.

26. The closure report must provide site assessment, drilling operation, and abandonment information for each drill hole. See the "Closure Report" document for further information.

Contacts:

Saskatchewan Environment
Fisheries and Oceans Canada
Saskatchewan Watershed Authority
Saskatchewan Industry and Resources, Mines Branch