Great Slave Cruising Club - Moorings

Most boats operated from the Great Slave Cruising Club (GSCC) are moored offshore from the club during the summer months in an area referred to as the GSCC mooring field. Owners generally store small tenders/dinghies on land at the GSCC and row/motor out to their boats.

The GSCC does not have overnight or long-term docking facilities but the club does have a pier of approximately 160' in length used to help provision, load and service members' moored boats as required. Parking for vehicles is also available on site.

Moorings are constructed, maintained and owned by the individual boat owners (GSCC members).

The information provided below is not intended to be all inclusive but will hopefully act as a guide for those wanting to build and locate a mooring at the GSCC. **Do your homework**, talk to the mooring master and avoid the temptation of being minimalist when assembling the materials for your mooring.

Locating a Mooring at GSCC:

The mooring field changes year to year as boats and moorings are added and replaced. Space in the mooring field is limited and must be managed carefully. Geographic restrictions include a high traffic area used by the Giant Mine public boat ramps and wharf to the North, a shallow sand bar to the east, and the western shoreline that is home to GSCC.

As space is limited in the mooring field guidelines have been put in place to control the length of anchor rode used on moorings. Moorings are placed in such a manner as to adjust for radius swing between boats. Mooring radiuses must not overlap and must take into consideration boat length so that boats do not touch in any wind or becalmed condition.

Mooring locations are assigned by the club's Mooring Master. If you plan on relocating, servicing or adding a mooring to the mooring field please contact the Mooring Master.

Mooring Construction at GSCC:

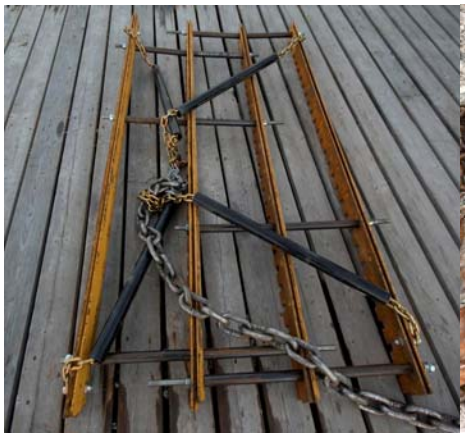
Over the years many styles and designs of moorings have been developed and used at the GSCC. The consensus remains that overall mass and quality of chain & hardware are of more concern than design and shape in the construction of new moorings.

All most all of the moorings at the GSCC are of the Dead-Weight variety. Mushroom and pyramid type anchors are too costly to ship. Temporary anchors such as a Plough, CQR, or Danforth consume too much anchor rode (space) to work effectively as a permanent mooring in a congested area.

The most commonly used material at the GSCC in mooring construction are used grader blades from road maintenance equipment. Used grader blades can be obtained for free from the City of Yellowknife Works Department. Most grader blades tend to be about six feet in length, 5/8" thick and 4-5" tall. These dimensions make for a piece of steel that weighs about 80lbs.

The mounting holes on the grader blades make it very easy to assemble a set of blades into a mooring without the need for any specialized tools or equipment. Blades can be assembled using threaded rod, schedule 40 pipe as spacers, washers, and stover nuts (similar to locknuts) or if the equipment is available; welded.

The photos below illustrates two moorings both of equal finished weight.



(Click on individual photos for more details)

The first mooring pictured was assembled using threaded rod and schedule 40 pipe. The pipe sections were used between the blades as spacers to increase the overall area of the mooring and a bridle was built between the four corners with 3/8" chain. The 3/8" chain is covered in ABS pipe to prevent ground tangles with the bridle.

Moorings have also been assembled with the blades on the flat and stacked and bolted in a triangular shape. Even more simple yet the blades have been assembled on edge without spacers and bolted into one simple block of blades.

The second mooring pictured above is of a stack of eight grader blades welded together with the 3/4" (heavy chain) welded directly to the grader blades. This is by far the most simple and quickest method to build a mooring out of grader blades if you have access to the equipment to do so.

Other materials that work for dead-weight moorings and that are available in Yellowknife are cast concrete blocks (See Renforth Boat Club) and scrap iron such as large boiler cores, man hole covers, or other. You must be careful when using scrap materials that you use materials that have enough integrity that they won't break under load and won't pollute the lake.

Mooring Weights:

A mooring must remain secure for long periods while unattended occasionally under adverse conditions **for peace of mind** it should be properly sized for the job. **Think heavy!!!**

If you intend on using material other than scrap grader blades remember when calculating the weight of your mooring that everything weighs less then it does in air. Immersed weight of a fully submerged object equals the weight of the object in air less the weight of the water displaced by the object. If the air weight of the object is less than the water displaced the object will want to come back to the surface. You must take this into consideration when you are comparing the submerged weights of other construction materials.

Steel weighs about 13% less in water. Concrete weighs about 44% less in water. A mooring constructed of eight grader blades has an approximate weight of 640lbs and a submerged weight of 557lbs. To obtain the same holding power (submerged weight) in concrete you will need to cast a block of 995lbs.

CONCRETE - 56 % of dry land weight
GRANITE - 64 % of dry land weight
IRON - 86 % of dry land weight
STEEL - 87 % of dry land weight

The table below has been put together as a guideline to calculate mooring weights for various sized boats.

Great Slave Cruising Club Mooring Systems (Guidelines)

Overall Boat Length (Feet)	Dead-Weight Mooring Weight (Pounds)	Suggested Number of Grader Blades	Primary Chain Length **(Feet)	Primary Chain Trade Size (Inches)	Riding Chain Length **(Feet)	Riding Chain Trade Size (Inches)	Pennant Length ***(Feet)	Pennant Line Diameter (Inches)	Min. Buoy Size (Diameter) **(Inches)	Anchor to Chock Length **(Feet)	Mooring System Weight **(Pounds)	Approximate Swing Radius **(Feet)
14-16	400	5	21	5/8	14	5/16	8	7/16	12	43	505	50
17-19	480	6	21	5/8	14	5/16	8	1/2	12	43	585	53
20-23	560	7	21	5/8	14	5/16	8	1/2	12	43	665	57
24-26	640	8	21	3/4	14	3/8	8	5/8	15	43	790	60
27-29	720	9	21	3/4	14	3/8	8	5/8	15	43	870	63
30-32	800	10	21	3/4	14	3/8	8	3/4	15	43	950	66
33-35	880	11	21	3/4	14	3/8	8	3/4	15	43	1030	69
36-39	960	12	21	7/8	14	7/16	8	7/8	18	43	1162	73
40-42	1040	13	21	7/8	14	7/16	8	7/8	18	43	1242	76

** Based on Mooring in 14' of Water

*** Based on Free Board of 3' 2" - Pennant Length is From Buoy Shackle to Bow Chock (Not Bow Cleat)

Mooring Chains:

Why Chain? Aside from it's strength, chain acts as a shock absorber: as the boat rides up a wave it uses energy to lift chain weight. This countered with force to submerge a large mooring buoy act like shocks, sapping the jolt before chain gets bar tight. This is especially apparent on a rough weather day.

When selecting chain, there are three basic considerations: grade (metal tensile strength), diameter (thickness of chain) and coil (opening size). A secondary concern is corrosion resistance. For moorings proof coil, preferably with hot dip galvanized finish, is the most common and most economical. Proof coil is also known as common coil chain. You may wish a long link coil (conveyor) chain for the riding chain to accommodate larger hardware. Long link chain is lighter (lb/ft) than proof coil and should not be used on primary chains.


5-1/4" Chain

Each mooring system contains two chains; the primary chain and the riding chain. Some refer to these as heavy and light chain or primary and secondary chain.

The primary chain lies on the bottom it should be 1-1/2 times the water depth in length. The primary chain is the key to how the whole mooring system works. The job of the primary chain is to change the direction of pull from vertical to horizontal. If this part of your mooring system remains parallel to the bottom for the most part there is very little chance that your mooring will ever move. When sizing the primary chain a chain 2-3 times the suggested chain on a regular anchor rode for your boat is a good place to start.

The riding chain should be 1/2 the size of the primary chain and equal to the water depth in length.

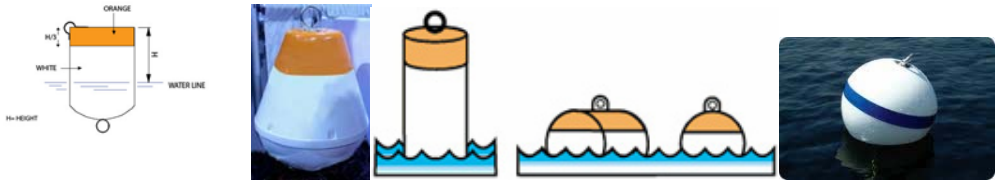
The primary chain and the riding chain are connected with shackles and a swivel. The boat will spend it's anchored life whirling around one point. A swivel prevents boat spin from twisting the mooring chain. A twisted chain looses breaking strength and will suffer from increased wear. When purchasing a swivel make sure the swivel's breaking strength is appropriate for the job. There are many swivels that will have the same trade size as your chain or shackles but will not come close in breaking strength. You will be able to purchase a swivel with the same stamped breaking strengths as your shackles if you shop around.

Below is a chart with the standard sizing for proof coil chain.

Industry Standards - Proof Coil (Common) Chain

Trade Size (inches)	Material Size (inches)	Inside Length of Link (inches)	Inside Width of Link (inches)	Outside Length of Link (inches)	Outside Width of Link (inches)	Links Per Foot	Weight Per 100 ' (pounds)	Weight Per Foot (pounds)	Working Load Limit (pounds)
5/16	13/32	1.10	0.50	1.79	1.18	11.00	115	**1.2**	**1750**
3/8	15/32	1.23	0.62	2.04	1.43	9 3/4	166	**1.7**	**2450**
7/16	17/32	1.37	0.75	2.31	1.68	8 3/4	225	**2.3**	**3250**
1/2	19/32	1.50	0.81	2.56	1.87	8.00	286	**2.9**	**4250**
9/16	21/32	1.75	0.87	2.94	2.06	6 3/4	355	**3.6**	**5250**
5/8	23/32	1.87	1.00	3.18	2.31	6 3/8	425	**4.3**	**6375**
3/4	25/32	2.12	1.12	3.68	2.68	5 3/8	605	**6.1**	**9125**
7/8	29/32	2.50	1.37	4.31	3.18	4 3/4	811	**8.1**	**10750**

The Buoy:



The buoy's job is to float the riding chain to the surface. Buoys are classified and sold by their buoyancy. In general the buoy should be able to support at least twice the weight of the suspended chain (riding chain) so that the buoy floats high enough to be easily seen. Transport Canada Regulations require a minimum height above water of 12".

There are no permits required for the placement of a single mooring buoy under the Navigable Waters Protection Program of Transport Canada providing the buoy (mooring) is located as follows:

- The buoy is secured by a single anchor line.
- The mooring buoy including swing area is placed no less than 20m from any existing structure located within the limits of the waterway; placed at least 50m from any public launch ramp, marina, known navigation channel; and it must allow for a **clear circular radius equal to three times the length of the vessel**.
- Moored vessels must comply with the Collision Regulations of the Canada Shipping Act 2001 (which have to do with having an anchor light)

- The buoy is sized and marked as per the Private Buoy Regulations (summarized below)

Private Buoy Regulations and Canadian Aids to Navigation (TP 968) publication state that a mooring buoy should meet the following criteria.

- **SIZE**: minimum above water dimensions of 15.25 cm (6 inches) in width and 30.5 cm (12 inches) in height. This should be regarded as the absolute minimum.
- **COLOUR**: The mooring must be white with the top third of the area above the waterline coloured international orange. If reflective materials are to be used they should be yellow.
- **MARKINGS**: The markings "PRIV" must be as large as practical for the size of the buoy and printed on opposite sides
- **IDENTIFICATION**: The buoy must have the owner's name, address, and telephone number displayed in a conspicuous location
- **CONSTRUCTION**: constructed of materials and in a manner that ensure that it remains in position and retains the characteristics specified above

Mooring buoys are difficult to find locally. Manufactures such as Taylor Made Products make white buoys that conform to the US Coast Guard criteria of a mooring buoy. Mooring Buoys in the US are also required to be white but must have a 2" horizontal blue stripe. This stripe can easily be covered with white tape or removed and the top of the top 1/3 of the buoy painted international orange to meet Transport Canada standards.

Quality mooring buoys are made with a hard plastic shell filled with closed cell foam. This ensures sufficient buoyancy even if the shell becomes damaged. Buoys do not need to be of the manufactured variety. They may be home made if they meet the criteria listed above. Ideally a buoy should be rugged enough to withstand the elements, should possess and maintain a good visual signal, and yet be `soft` enough to absorb vessel impacts and reduce collision damage.

Pennant:

The pennants are the lines that tie the boat to the mooring. You should choose the largest diameter of line that fits reasonably through the bow chocks (if installed on your boat) and around the bow cleats.

Nylon 3 strand is the most common and easy to splice. The Nylon also has good dynamic characteristics and absorbing stretch. The equivalent diameter polyester line

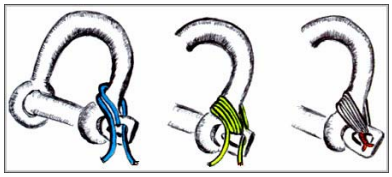
will offer more strength but are more difficult to splice and cost more. Polypropylene lines are not well suited for this application.

Regardless of line choice you should use some sort of chafe gear sleeving in the areas around the chocks (Gunnels) to prevent abrasion wear. Most chandleries sell leather kits for this purpose but canvas or rubber hosing can also be used and purchased locally.

Pennants should be tied directly to the riding chain not to the buoy. Depending on the buoy there might be a bar through the middle that permits a direct link (check the breaking strength), the chain may pass up through the middle of the buoy, or you may have to attach the pennants to the chain beneath the buoy.

The end of the pennant to be connected to the chain should have tight eye-splices made around a galvanized thimble. A heavy duty galvanized shackle should then be used to attach the two pennants to the chain. In most cases you will need two `Bow` shackles to make this connection. The first shackle will be large enough to contain both thimbles (eye-splices) but will be two large for the pin to fit through a link on the riding chain. The second smaller shackle will be the same trade size (dia.) as the chain and connect the chain and larger shackle together.

Make sure that you secure or mouse all shackle connections with lock tight wire (seizing wire). This will prevent the shackle pins from working their way loose,



Other additions that can be made to you pennants are foam covers (pool noodles work best) or a light pick-up buoy.

The foam covers help in a few ways. If you are unable to tidy your lines when you leave your mooring or your lines get knocked into the water the foam covers make your lines more visible, make them easier to pick up, and help prevent them from becoming tangled around the base of the mooring.

A small pick-up buoy with a whip tied to the boat end of the pennant allow you to easily pick up your pennants without need of a boathook.

The length of your pennants should not be more than 2-1/2 times the freeboard of your boat. This recommended length is the length from the buoy to the chocks (gunnels) on your boat. Pennants that are any longer increase the required swing radiuses needed and increase the potential for your lines to become fouled on the mooring or a passing boat.

Seasonal Considerations and Maintenance:

Winter Buoys May be made of Styrofoam, plastic bottles or plastic material. The Great Slave Cruising Club organises their lift-out mid to late September and most sailboats are out of the mooring field by the first of October. That said their is still a lot of activity by power boaters using the public ramps to the north all the way through to freeze up. If winter Buoys are to be used they should still conform to Transport Canada standards.

During past winters some members have left their complete mooring system in the water (ice) all winter. Others have removed their pennants and replaced the buoy with painted propane tanks; or removed buoy & pennants, tied a polypropylene line with small float to their riding chain, and let the chain sit on the bottom all winter. Those with lots of ambition have gone as far as removing their whole mooring system for the winter.

At the very least boat owners should pull their primary chains to the surface each season to inspect the condition of the links for wear and the connections between the primary and rider chain. Make sure that all connections are still solid and replace shackles and/or mousing where necessary. This is also a good opportunity to clean and lubricate the swivel. This work can all be done easily from a tender as the primary chain should be 1-1/2 times the water depth.

If on inspection of your primary chain the amount of wear leads you to believe that their might be wear on your connection to the mooring or the mooring it's self you can use the club's "Anchor-Yanker" to pull the mooring to the surface for inspection or hire a diver to make an inspection of your mooring.

Moving Your Mooring and the Anchor-Yanker:

The Mooring Master will provide you with direction on the use of the club's Anchor-Yanker. The Anchor-Yanker is a lifting tripod (raft) used to lift and float moorings around the mooring field. The most difficult part to launching a new mooring is getting the mooring from the place of construction into the shallow water by the club's ramps. Some members in the past have built their moorings shore side then flipped them into the water. Others have built their moorings on flat deck trailers and backed the mooring down into the water. You may have to get creative.

All moorings, chains, pennants and their placement must be approved by the Mooring Master before their initial installation.

Links to helpful resources and suppliers:

- Acklands Grainger
- All-Steel Mooring Fabrication and Placement
- Chapmans Piloting, Seamanship and Small Boat Handling
- Coastal Cruising in BC
- Go Deep International
- Good Old Boat & Sailnet
- Handbook of Ocean and Underwater Engineering - Myers, Holm and McAllister
- Jamestown Distributers
- Jim Buoy
- Manhasset Yacht Club of Long Island New York
- Northern Industrial Sales
- Oceans Limited
- Pride Marine
- Rainbow Net & Rigging Limited
- Renforth Boat Club - How to Build Yourself a Mooring
- Rockport Harbour Master's Mooring Regulations
- Rolyan Buoys
- Save Ontario Shipwrecks Online Store
- Taylor Made Products - Catalog
- Tideland Signal Canada Limited
- Town of Chatham, MA Mooring Regulations
- Transport Canada - An Owners Guide to Private Buoys
- Transport Canada - Canada Shipping Act
- Transport Canada - Mooring Buoys
- Transport Canada - Navigable Waters Protection Programs
- West Marine
- Zepoli Inc