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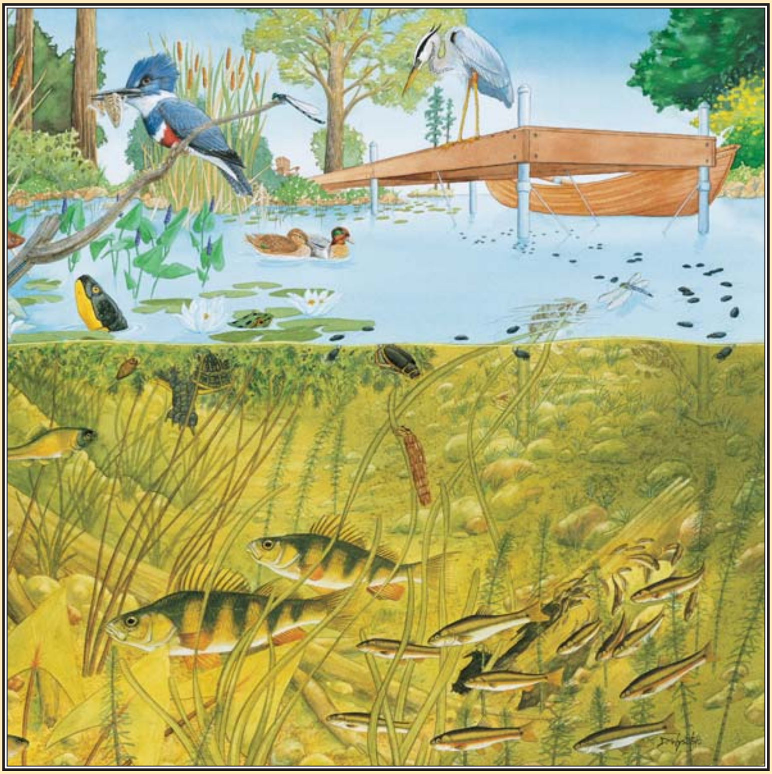
THE DOCK PRIMER



A COTTAGER'S GUIDE TO WATERFRONT FRIENDLY DOCKS

Cottage Life

Canada

Produced by
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FISHERIES AND OCEANS CANADA
Fish Habitat Management Program - Ontario-Great Lakes Area
867 Lakeshore Rd., Burlington, ON L7R 4A6
Web Site: www.dfo-mpo.gc.ca/oceans-habitat/

COTTAGE LIFE
54 St. Patrick Street, Toronto, ON M5T 1V1
Web Site: www.cottagelife.com

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GETTING STARTED

It is part of the waterfront experience…sitting on your dock watching the sun set and having a place to tie up your canoe or motor boat. Perhaps your shoreline already has a dock but it is badly in need of repair, or perhaps you do not have a dock and would like to add one to your waterfront. For whatever reason, you may be thinking of building or replacing a dock along your shoreline.

Building a residential dock is not a difficult process. In fact, constructing a dock can be easy when you know what factors to consider and you are prepared with some basic information. Fortunately, building a safe and stable dock is only a little more difficult than building a bad one, and with the right design, you can have a dock that meets your waterfront needs while minimizing impacts to fish habitat. This primer points both the confirmed do-it-yourselfer and the equally confirmed purchase-it-yourselfer in the direction of good docks and good dock-building practices. It also explains how to avoid some potentially damaging and costly errors. For the full scoop on docks - including plans and full construction techniques - check out additional references or consult experts to get you started.

The most important thing to know about dock construction is that no dock is a stand-alone structure. A dock has to work in harmony with that sometimes uneasy marriage of land and water known as your shoreline, and with the various uses you and your family envision for that shoreline. No two sites are alike so your dock should be designed to fit the characteristics of your shoreline. Is your site on a windy point with a lot of wave action? Or is it tucked away in a quiet bay? Is the shoreline mainly bedrock or do you have a sandy or mucky shoreline? The answers to these kinds of questions will help to determine the structural requirements for your dock. The best way to start is by taking note of your shoreline's prominent features and then making a detailed map of it all. Graph paper is the preferred media for map-making novices, as a scale can easily be assigned to the squares, such as one (1) centimetre square equals five (5) meters, or whatever is needed to fit your cottage shoreline onto paper.

A detailed map of your shoreline is your most valuable tool in building a dock. For one thing, you probably do not want to build your neighbours a dock, which can happen when your carefully constructed masterpiece ends up on the wrong side of a property line (it happens). Also, no matter where your waterfront is located, chances are you will need to get approval from at least one government department - probably several.

Having a map of your site with the proposed project neatly drawn out cuts down on the red tape (see "Building Your Dock: How To Do It Right," p. 20). Yet the best reason to map your shoreline is that it greatly eases the task of choosing the location, type, and size of dock best suited to your needs and budget, whether you are building it yourself or hiring a professional.

Begin the mapping process by locating lot lines and measuring any structures, such as the cottage or pumphouse. Mark your findings on the map. Do the same for the shape of the shoreline, the direction of prevailing winds and currents, the best views of the lake and shoreline, the topography and vegetation on the land rising from the water, and the water depth moving away from the land, noting the shoreline's makeup (rock, sand, mud) at 5, 10, and 15 metre intervals. Also mark the location of submerged navigational hazards such as rocks and sand bars. Note frequently used areas such as horseshoe pits or swimming areas, along with water-intake lines, power lines and telephone lines.

If you are aware of shoreline nesting sites for waterfowl (remember the ducklings that swam by in the spring?) and fish spawning areas or wetlands, mark these areas on the map but do not include any as-yet-to-be-constructed docks – yet. Do, however, take pictures of the shoreline area throughout the various seasons of the year. While your cottage may only be a summertime retreat, the shoreline is there all year and spring ice can tear apart anything that you might decide to add – even reinforced concrete bunkers. If you are new to the area, ask the neighbours about the ice; they will be able to tell you what to expect, which could save you time and money.

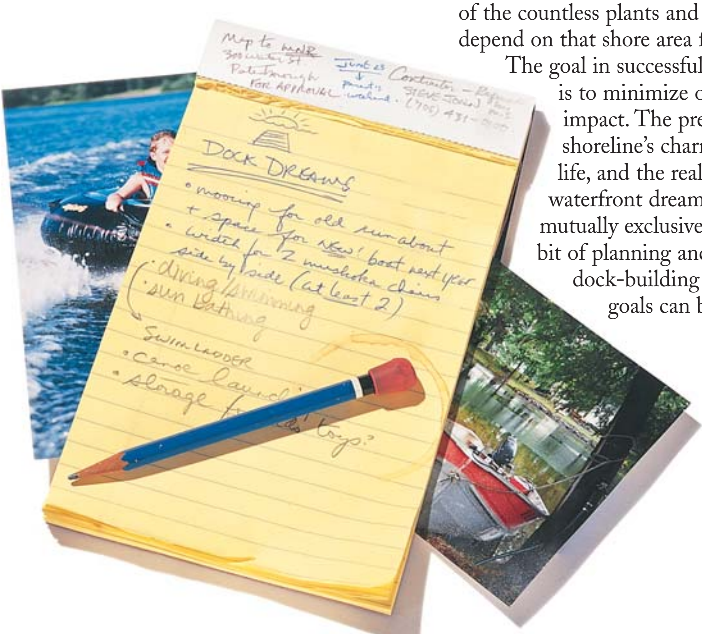
Before you pick up a hammer, pick up a pencil and make a detailed site plan of your waterfront.

WHAT ARE YOUR SHORELINE NEEDS?

At this stage, what you have is the "before" plan; the shoreline as it exists prior to any dock additions. Now, look into the future - not at structures, but at uses. Remember that the dock only facilitates your needs. Make a wish list of shoreline needs. Perhaps you need a place to moor the boat (how big is it?), or perhaps a place to swim, fish, launch a canoe, and sunbathe; maybe just a spot to sit and watch the world drift by, or any combination of the above and more. Your needs and what you have in the way of waterfront property should dictate the shape, size, and type of dock, not what the local lumberyard happens to have in stock. Obviously, finances also play a role, but as we will see, docks are usually modular devices, allowing you to add and rearrange dock sections over time. So rather than compromise your dreams with a substandard design that the kids love to use as a floating roller coaster and older members of the family refuse to board, complete your dream in stages as your finances permit.

A successful shoreline structure also pays homage to its surroundings. The body of water fronting your property exists because of a delicate balance in nature that has evolved over many millennia. That narrow band of earth known as the shoreline – an interdependent strip that includes the water and both exposed and submerged lands – is the most ecologically sensitive piece of the planet that many of us are ever likely to encounter. It is also the reason we have chosen to inhabit this small piece of planet earth. Unfortunately, anything we do at or near the shoreline will inevitably disrupt the balance, sometimes destroying not only the shoreline, but also water quality and many of the countless plants and animals that depend on that shore area for existence.

The goal in successful dock building is to minimize or even eliminate impact. The preservation of a shoreline's charm and abundant life, and the realization of our waterfront dreams, need not be mutually exclusive goals. With a bit of planning and use of proper dock-building practices, both goals can be achieved.



THE SHAPE OF THINGS TO COME

The most common dock shape is the rectangle. It is, after all, the simplest and most economical shape to build. But often there are better choices, both from the shoreline's perspective and that of our cottage wish list. Fortunately, most variations are based on the rectangle, often with one or more rectangular sections joined together to make a more stable, useful, and attractive dock.

In most cases, dock stability increases with size. It is simply a matter of percentages - the bigger the dock, the smaller the impact your visit, or nature's disturbances for that matter, will have on it. But it is also true that as dock size increases, so too does the risk of harming nature. Although they have a seemingly benign footprint, all docks possess the potential to harm aquatic ecosystems, disrupting currents enough to erode submerged lands and shorelines (including those belonging to your neighbours), blocking sunlight from the aquatic plants below, and disturbing submerged lands. These changes may be small, but they can result in harm to habitat for plants, invertebrates, fish and other aquatic species. Then there is the connection of dock to shoreline and dock to cottage, both of which can disrupt that delicate ecological balance. The bigger the dock, the greater the potential for mayhem. "Bigger" also costs more to construct and maintain. So big docks are bad, right? Maybe. The problem is, build a dock too small and not only is stability compromised, it might also fail to serve your needs. That is why that map of your shoreline is so important – it makes it easier for both you and the various regulatory authorities to choose and approve the dock best suited to both your needs and the shoreline's needs.

Make a list of the activities you have envisioned for the dock, as these often dictate minimum size requirements. For instance, while considered small craft, both sailboards and canoes can become serious dock hogs when out of water, demanding plenty of deck-acreage to swing around and launch. That

DOCK SHAPES

T-shape

U-shape

L-shape

said, if your shoreline includes a usable beach, some things – such as swimming zones and sailboard storage, may be best assigned to the beach, reducing demands on dock size. If the shoreline has no usable beach – where water and land meet at a steep cliff for example – the dock then takes on the role of a beach.

A smaller dock may be sufficient if you only need to accommodate a canoe and simply want a place for swimming or diving. If big boats are in the picture, there is little point in opting for a small dock. Should nature make waves, and the dock is not up to the task, it is goodbye to both dock and boat.

THE LIMITS TO THIN

With the exception of finger docks, 1 metre (approximately 3.3 feet) is the practical minimum width for any dock. You need that much room for two people to pass without risking one, or both, being bumped into the drink. Also, as you will see in our discussion of the various dock types, most docks have minimum size requirements and stability suffers if you try to go smaller.

If your needs are modest, the basic rectangle may be your best option. However, by adding a second rectangular section perpendicular to the first dock (at the deep end), the resulting T-shape or L-shape adds to dock stability – like training wheels on a bicycle – and the shape created helps to define designated activity areas. For example, one end of a T-shape could be set aside for sunbathing, while splashing and diving are moved to the other end. The shapes can also "capture" protected areas of water to moor boats or create a children's wading area.

Breaking away from the basic rectangle allows us to direct foot and boat traffic and activity patterns, reducing dock congestion. Therefore, less deck-acreage is required to accomplish the same goals. This means less cost, less impact on the environment, and usually, a more attractive shoreline. As a bonus, those additional rectangles can be added or subtracted over time as needs – and finances – change.

What should not be considered for budgetary reasons are finger docks. Finger docks are long and skinny rectangles that run out from a much larger main dock or breakwall. They are designed to provide the maximum number of slips (stalls to moor a boat) in a given area, not to save on construction costs. Because of the reduced width (sometimes down to half a metre), finger docks wiggle around just like fingers and provide wobbly access to boats, but not much else. If your activity list demands greater versatility, or if you do not relish that impending doom feeling of a tippy dock, stay away from finger docks.

BETWEEN A DOCK AND A HARD PLACE

The main problem docks experience is one shared with everything else in the universe: entropy, or the idea that a system (in this case the dock) will move towards increasing disorder (or in a dock's case, disrepair). Wood, metal, plastic, concrete, and even nature's own bedrock – all the basic ingredients of dock building – are all under continual assault from two very destructive forces – stress and decay. The effects of stress (the result of visiting boaters bashing into the dock, or nature hurling up huge waves, or spring ice pounding at your shoreline) can be reduced by evenly distributing the loads (weight or pressure). For a dock to survive to its maximum life expectancy, all loads must be shared by as much of the structure as possible. That is construction rule number one.

Decay is often a keen partner to stress when it comes to destruction. Wood rots, plastic degrades, concrete chips and cracks, metal corrodes, rock erodes – it is all part of nature's regenerative process.

Generally, decay thrives in an environment of warmth, a little moisture, and a little oxygen, all readily available at your local shoreline. Too much or not enough of any of these ingredients and decay moderates its attack. The secret to longevity therefore, is proper design and use of quality materials to discourage the onset and growth of decay. That is construction rule number two.

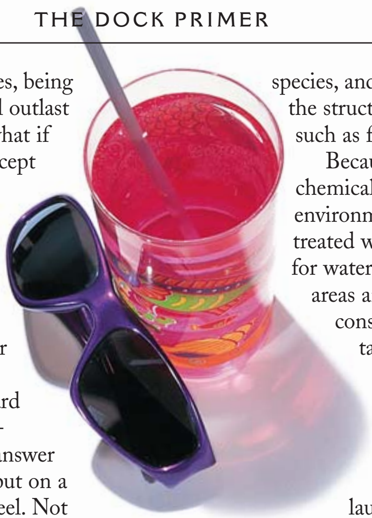
While real wood should be used for your dock's framing, plastic lumber can be an excellent choice for decking. When installed properly, it can offer a long working life.

DOCK MATERIALISM

Wood Wood is the most common material used in residential dock construction. It is relatively easy to work with, reasonably priced, and has some "give," allowing it to bend slightly under duress. It is also at its strongest under short-term loads (such as when your neighbour accidentally hits the dock with his new ski boat), a decided advantage to waterfront structures. As well, structures made of wood are usually easy to rebuild should nature prove its strength once again.

On the other hand, wood is at its worst down at the waterfront – wet and fat one moment, dry and skinny the next. Therefore, joining pieces of wood in dock building requires different techniques than the accepted practices of house carpentry.

The **preferred deck woods** for dock building are western red cedar, redwood, cypress, and eastern white cedar (in that order), all of which offer reasonable longevity and beauty. For most docks, that is also the preferred structural list, but for dock cribs and permanent piles, stronger woods, such as Douglas fir, hemlock, and tamarack (in that order) are a better choice. Unfortunately, this group is not as resistant to rot as the first. For permanent piles, western larch, pine, and even spruce can be used if fir is not available.



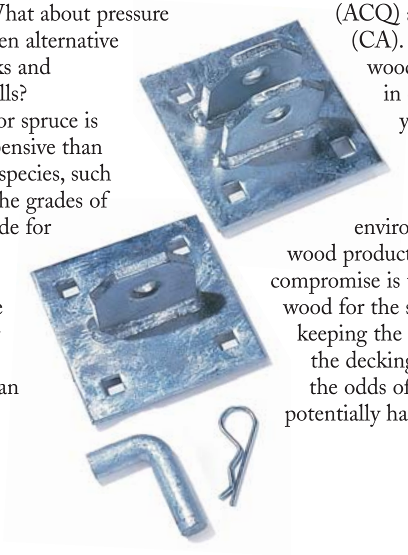
The better decking species, being naturally resistant to rot, will outlast species such as spruce, but what if the bank account will not accept that logic and it demands a cheaper solution? That is when we compromise. One way to do this – already mentioned – is to reduce the deck acreage or try to extend the life of lesser grades of wood.

Unfortunately, the standard route to wood preservation – paint and stain – is not the answer for docks. Any coating you put on a dock will fade, blister, and peel. Not only will this look terrible, but damaged coatings also trap water, creating an ideal spot for wood-destroying fungi to grow. To make matters worse, paint flakes can be toxic to many aquatic organisms, including fish. So you can either scrape and re-coat the dock every few years, or use preferred wood species and do as many dock builders advise – take the low maintenance option and let the wood go naturally grey.

Pressure Treating What about pressure treated wood; that green alternative seen on countless decks and suburban retaining walls? Pressure-treated pine or spruce is about 20-30% less expensive than the preferred decking species, such as cedar, but because the grades of lumber that are set aside for treatment are usually low, pressure-treated wood is typically more susceptible to warping and cracking when exposed to weather than the untreated decking species, and even some of the structural species, such as fir.

Because it can leach chemicals into the environment, pressure-treated wood is banned for waterfront use in some areas and, in all cases, construction should take place well back from the shoreline with the finished dock being left to thoroughly dry and "age" before being launched into the water. Working with pressure-treated wood is difficult; the sawdust is considered toxic, and each cut end must be sealed with an approved preservative, all of which exposes the builder (not to mention the flora and fauna living in the water) to some nasty chemicals.

Chemical wood preservatives most commonly used in pressure-treated lumber are alkaline copper quaternary (ACQ) and copper azole (CA). Creosote-treated wood should not be used in or near water. Before you buy, ask your local building supply outlet for more information about environmentally friendly wood products. A reasonable compromise is to use pressure-treated wood for the structure of the dock, keeping the preferred species for the decking, thereby lessening the odds of exposing skin to potentially harmful chemicals.



Plastic Plastic has become a common building material for docks. Compared with most woods, metals, or concrete, the types of plastic used in dock construction are relatively low in strength and lack hardness, which rules them out for structural duties. Plastic is however, the primary material for dock floats, and when supported by an appropriate structure - typically made from wood, metal, or concrete – plastic materials can be used for decking. Plastic is also waterproof and decay-resistant, a decided advantage when it comes to dock construction.

The cost of plastic decking usually fits somewhere between cedar and pressure-treated wood, although some variations are more expensive than even the preferred species of wood decking. Typically, plastic decking comes in traditional "planks" of solid polyethylene (PE), extrusions made from polyvinylchloride (PVC), and composites of recycled PE and wood byproducts. Unfortunately, all plastic decking has a propensity to sag, which means that decking cannot extend across the spans of traditional dock designs (check with the decking's manufacturer).

High quality hardware, like galvanized corner brackets, heavy-duty hinges, and corrosion resistant nuts, bolts, and screws is crucial if you want a long-lasting dock.

HARDWARE

The importance of good hardware in building docks cannot be stressed enough. Dock "hardware" is that bewildering array of metal brackets (usually steel) used to brace corners and joints, connect dock and ramp sections, hold the legs of pipe docks in place, and basically add strength to any dock connection under load. Technically, it does not fasten planks together; it leaves that task to the nails, screws, nuts, and bolts. Instead, once secured in place with nuts and bolts and the like, dock hardware shares and transfers loads, diminishing stress at crucial junctures. Joints that are nailed or screwed together without the benefit of dock hardware will inevitably pull apart.

It does not make sense to waste your time and money on second-rate hardware – whether it is your own creation (sorry), a piece of metal being used for a duty it was not designed for (such as barn-door hinges used to join sections of dock), or even most hardware sold from mass-merchandising outlets. Whether you are buying individual pieces or acquiring the hardware as part of a completed dock or in a kit, look for good-quality hardware designed specifically for dock building. It is an expense you will never regret.

As for fasteners, screws and bolts hold a dock together much better than nails. The extra cost is minimal, but the increase in strength is not.

DOCK TYPES

Although nature considers all docks to be removable, floating docks and pipe docks are the only ones cottagers usually consider removing, either for repairs or to protect the dock from the ravages of winter ice and spring breakup. Given Canada's climate, that means removable docks are extremely popular.

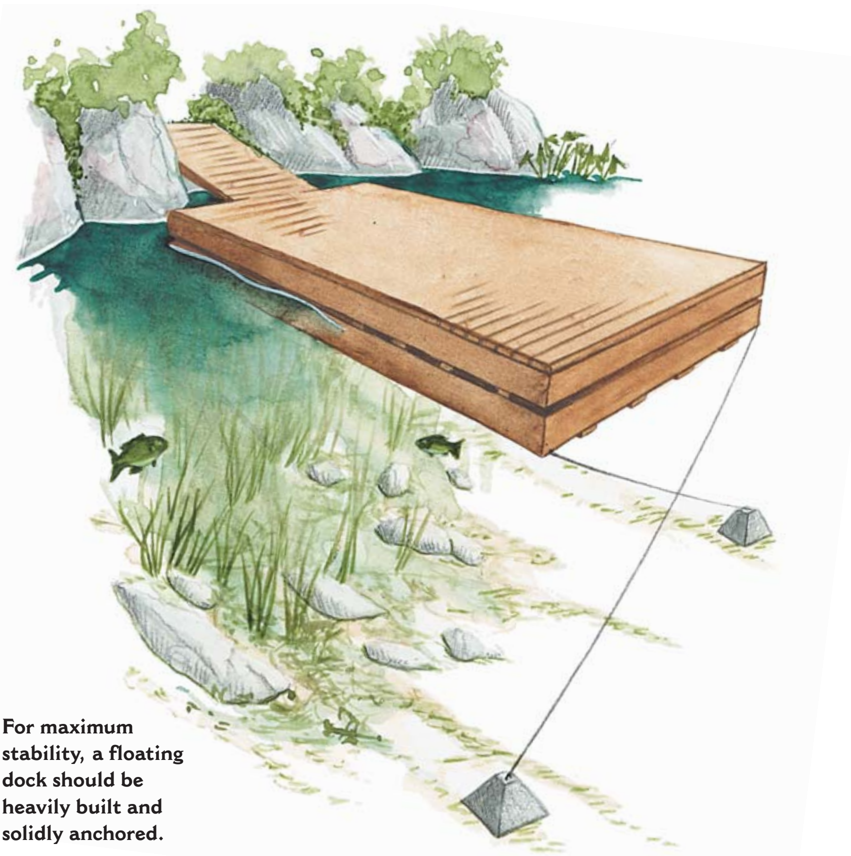
REMOVABLE DOCKS

Floating Docks Floating docks are relatively easy and economical to build, adaptable to most shorelines and, because they are held up by the water, the distance between the top of the dock's deck and the surface of the water – known as freeboard – remains fairly constant, varying only with dock load and high seas (being minimal on a well-designed and well-built floater). Since a floating dock is not dependent on submerged lands to hold it up, the added benefit is that there is no maximum water depth that prevents its use.

From an environmental perspective, floating docks cause minimal direct disruption to submerged lands; disruption typically caused by anchors, spuds, or pilings (the most popular ways to moor a floating dock in place).

In fact, if secured to the shore only, there may be no contact with submerged lands at all. However, floating docks can block sunlight to aquatic plants – altering fish habitat – and they may also cause the erosion of shorelines. This means that floating docks will not work everywhere. To minimize damage to the shoreline, a floating dock must have sufficient buoyancy to keep its floats resting on water, rather than bumping into submerged lands (which can harm both the dock and aquatic habitat). A depth of 1 metre (approximately 3.3 feet) (measured at the low-water mark) is the normal accepted minimum however, less depth may be possible if the water level never varies and the area is not subject to harsh wave action.

Floating docks often lack stability but it is not impossible to make a stable floater – hundreds of good designs exist; some so stable a user could mistake the dock underfoot for a waterfront boardwalk. Unfortunately, the number of unstable disasters out there is great due to poor construction practices. When it comes to stability, a floating dock works best when it is made long, wide, low, and heavy. Remember to



For maximum stability, a floating dock should be heavily built and solidly anchored.

look for a design that will achieve this stability without causing harm to fish habitat.

The consensus among dock builders is that 1.8 metres (approximately 6 feet) x 6.1 metres (approximately 20 feet) is the minimum size for a stable floater; this single section weighing in at about 450 kilograms (approximately 1000 lbs) minimum. And bigger is even better for stability.

As usual, the drawbacks to bigger are increased initial cost, increased labour for installation (and removal) and of course, greater impact on the shoreline's ecosystem. A pipe dock – which can be made smaller and still remain stable - may be a preferable choice in shallow water.

In areas where ice conditions prohibit a four-season solution, the floating dock offers the advantage that it can be removed from the water in the fall and replaced in the spring (albeit with no small effort in some cases). That said, many floaters are left in all year where wave action and ice conditions permit.

In addition to size and shape, float type and float location also contribute to

Because they have little contact with submerged lands, pipe docks are easy on the aquatic environment.

stability. A discussion of float types is beyond the scope of this booklet but as a general rule, installing floats towards the perimeter of the dock, rather than set back towards the dock's centre line, greatly enhances stability.

Pipe Docks If you can imagine a 1 metre wide wooden ramp sitting about a quarter of a metre above the water, supported by long skinny legs running from the ramp down to submerged land, you have just mentally built a pipe dock. Building one in reality is only a little more difficult, and not a lot more expensive (pipe docks are typically the least costly dock option). As most of the dock sits out of water, contact with the land and shading of aquatic vegetation is typically held to a minimum, making a simple pipe dock the least disruptive to the environment of all the dock types.

Unlike the floating dock, the pipe dock is stationary, therefore, the distance between the dock and the water varies as the water rises and falls. Should the lake or river at your shoreline do a gentle retreat through the season, the pipe dock's deck can usually be lowered on its legs to accommodate moderate fluctuations in water levels, and even more extreme fluctuations can sometimes be handled by relocating the dock further out on the shoreline. (The dock's light weight is a real advantage here). Some pipe dock legs can also be fitted with wheels to make moving the dock an even easier task. Be aware that the slightest amount of ice movement can fold up a pipe dock like an accordion, so plan on moving the dock at least twice a year (the more favourable option), or on buying a new one each spring.

Because a pipe dock's deck and framing remain elevated above the water, there is very little surface area exposed at the waterline for nature to damage. This makes the pipe dock a good candidate for situations where plenty of surface activity is experienced, such as on busy river channels where the wakes from passing boats may be a problem. However, with waves passing under the dock unobstructed, any boat moored to the opposite side will be exposed to the full brunt of wave action.

Severe wave action can put some of the lighter aluminum pipe docks at risk. However, lighter construction also means less labour to install and remove the dock, and less initial cost to purchase. And in the right situation – a protected bay for instance – a lightweight pipe dock is certainly up to the task of mooring smaller boats. For larger vessels and harsher wave

Where ice and currents permit, rock-filled cribs can make a solid dock foundation.

Concrete piers are expensive and environmentally destructive.

action, boat lifts or marine railways are a better choice. Because a pipe dock is propped up on legs, it can be built smaller than a floating dock yet still remain stable. The basic rule for pipe docks is that the width of the dock should be at least 1 metre (approximately 3.3 feet) and never less than the depth of the water. Because stability suffers as legs get longer, about 2 metres (6-7 feet) is considered the maximum water depth for pipe dock installations. Choose one of the other dock types – such as a floating dock – for deeper water.

PERMANENT DOCKS

Residential permanent docks (as opposed to commercial wharves) can be divided into three categories: crib docks, concrete piers, and permanent pile docks. The term "permanent dock" is more a reflection of objective than reality, because permanence is not a concept recognized by nature. Shifting ice can topple cribs, lift piles right out of submerged land, and push concrete piers up onto shore. However, blessed with sound construction techniques and the appropriate conditions, a permanent dock can serve faithfully, perhaps even for several generations.

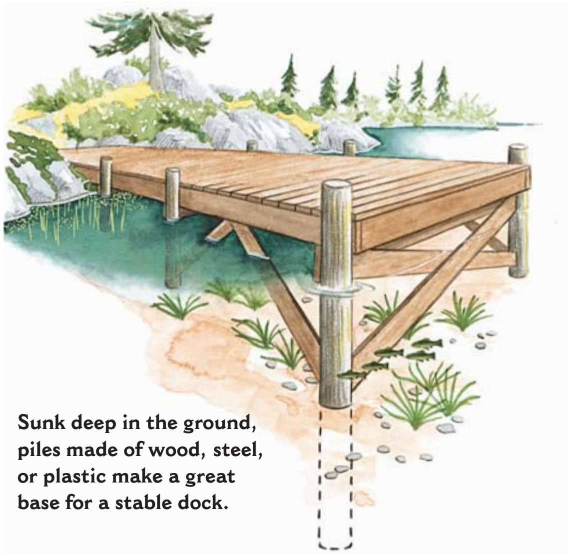
Because freeboard will vary with fluctuations in water level, permanent docks are often used in conjunction with floating docks, the floaters attached to the more permanent structure in a manner that permits the floater to move up and down in concert with changing water levels.

Crib Docks A "crib" is a container. In the context of waterfront construction, a crib holds a few tons of rock and stone. Cribs should not be confused with gabions. Gabions are inexpensive wire or plastic mesh baskets designed to hold stones, rock, or concrete; the baskets wired together to serve as unattractive retaining walls. At first glance, they may seem like a good idea for dock building, but time has proven gabions to be better at tearing skin than retaining rock under siege by strong currents, waves, and ice, all of which will distort the basket's shape, causing the gabion to sag and flatten.

A proper crib is built from new, square-cut timber, not wire or driftwood or round logs tacked together with small nails and hope. (Occasionally, steel or concrete castings are used in lieu of wood). The timbers are assembled in opposing pairs, one pair laid out on top of the next, creating a slatted, box-like affair with an integral floor. Threaded rods run the full height in each corner to secure the timbers in place. The box is then filled with rock.

Maximum water depth for a crib is about 2.5 metres (approximately 8 feet). For optimum stability, a crib's total height should at least equal its total width. Obviously, this can make for a very large container, which in turn needs a ton or more of rock to fill it, and all of this rock must be taken from onshore sources, not from close-at-hand submerged lands (which would disrupt fish habitat). For this reason, and from an environmental standpoint, cribs should be placed above the ordinary high water mark, using the strength of the crib as an anchor or attachment point for other structures such as floating docks, cantilever docks or pipe docks. (On a lakeshore, the ordinary high water mark is the highest point to which water customarily rises, and where the vegetation changes from mostly aquatic species to terrestrial). If however, cribs must be placed in the water, leave at least 2 metres (6-7 feet) between them, and locate them at least 2 metres from the ordinary high water mark. This will allow near-shore water to circulate around the structures.

From an environmental perspective, floating and pipe docks are preferred to crib docks, since crib docks can cover over sensitive spawning habitat and result in the removal of rocks and logs that provide shelter.



Sunk deep in the ground, piles made of wood, steel, or plastic make a great base for a stable dock.

Concrete Piers The concrete pier is basically a big block of cement and aggregate, bound together, often with an integral boat ramp. Most often, they are found in commercial or municipal settings. As with crib-based docks, practical water depths are limited to about 2.5 metres (approximately 8 feet), and the piers can be merged into shorelines to provide a shoreline interface for other types of docks.

However, concrete piers are expensive to construct, and no dock does a better job of disrupting the environment. Erosion of submerged lands at the base of the pier can often be a problem too, and unlike the slatted sides of the crib, the concrete pier provides no substitute home for refugee aquatic life. Because they take over the areas where fish feed, rest, and hide from predators, you should only consider designing a concrete pier when no other alternative is feasible.

In most cases, there are better solutions for residential docks.

Cantilever docks do not disturb the water or submerged lands.

Permanent Pile Docks The permanent pile dock is a heavyweight, long-term version of the pipe dock – still a ramp on long legs, but definitely not portable. Instead of resting on the surface of submerged lands (as the legs of pipe docks do), long poles of wood or tubes of steel or plastic – all referred to as piles – are sunk into the earth, either by force or by being set in pre-drilled holes. Either way, because of the heavy-duty equipment required, a pile dock is not the stuff of home workshop projects.

Piles should always be braced to prevent sway, and although there are no theoretical limits to depth, if the exposed portion of the pile extends 7.5 metres (approximately 25 feet) or more above supportive soil, construction costs will skyrocket.

The permanent pile dock shares many of the environmental advantages of the pipe dock – minimal contact with submerged lands, free flow of water underneath, and the ability to build a relatively narrow dock that is still quite stable.

SPECIALTY DOCKS

Specialty docks include cantilever docks, suspension docks, and lift docks.

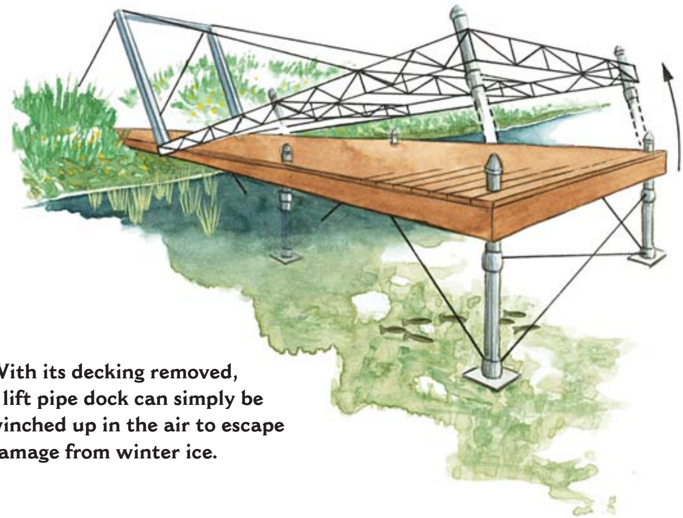
A tower and thick cables keep a suspension dock up in the air.

These docks can be dramatic to behold and expensive to purchase. Some design and construction similarities exist between specialty docks and the docks discussed above, but specialty docks are more complex, typically making their construction and installation beyond the skills of even many professional dock builders. These are not docks that lend themselves well to the average tinkerer.

Cantilever and Suspension Docks
The cantilever dock works in the same manner as an overhanging apartment building balcony: the dock's frame stretches from shore, over the fulcrum point, and then out over the water. The maximum length of the dock, and the proportion of the length that is land-based, is determined by how well the land-based end – the end that supports the load – is tagged to the shore. Customarily, a cantilevered dock requires 0.5 metres (approximately 2 feet) of onshore dock for every 0.25 metres (approximately 1 foot) hanging beyond the fulcrum, although cantilever docks can be incorporated into wood bulkheads (walls built parallel to, and usually at, the shoreline) using a leverage ratio as little as 0.25 metres (approximately 1 foot) on shore for every 0.25 metres of overhang, and even less when the land-based end is embedded into a concrete bulkhead or solid bedrock.

The suspension dock, on the other hand, has more in common with a massive suspension bridge than an apartment balcony. Picture half a Golden Gate Bridge but instead of connecting two bits of land together, it connects one bit of land to water and your boat. Think of it as the "Golden Gate Dock".

Unlike the cantilever dock, a suspension dock's deck does not rely on large chunks of shoreline for support. Instead, a rectangular tower holds up a pair of cables



With its decking removed, a lift pipe dock can simply be winched up in the air to escape damage from winter ice.

anchored well back on shore to keep the deck suspended over the water (just like the entrance to the aforementioned bridge). Both cantilever and suspension docks sit completely out of the water, so neither dock demands a minimum depth of water for installation. Since freeboard will vary with water level fluctuations, cantilever and suspension docks are not the answer for locations that experience extreme water level fluctuations.

Both dock types have practical limits to the length of overhang: About 2.5 metres (approximately 8 feet) for cantilever docks (which normally equates to a minimum of 5 metres (approximately 16 feet) of onshore decking), and about 15 metres (approximately 50 feet) for the suspension dock. Greater distances are not considered cost effective.

A short cantilevered overhang of about 0.25 - 0.5 metres (approximately 1-2 feet) can work very well along bulkheads, cribs, and the like. When a large, shore-based deck is desirable (such as over a boulder-strewn shoreline), the cantilever dock again becomes a reasonable option.

Cantilever and suspension docks cause the least disruption to the water or submerged lands – it is difficult to disrupt what you do not touch. However, as with floating docks, the resulting shading of the aquatic environment could alter aquatic life. Also, both dock types will disturb the shoreline, particularly the cantilever dock, which in turn has the potential to disrupt both aquatic and land-based life.

Lift Docks Lift docks come in three styles – lift pipe docks, lift floating docks, and lift suspension docks – each based on the style of dock being lifted. The freeboard of each is the same as for non-lifting versions.

In concept, the lift dock appears to function much like the classic drawbridge. Yet while the drawbridge was historically raised to protect the castle from unwanted weekend guests, the lift dock gets raised for its own protection, hoisting it up out of reach of winter ice.

Size restrictions and environmental impact for the three versions of lift docks are the same as for their non-lifting counterparts.

BUILDING YOUR DOCK: HOW TO DO IT RIGHT

The approval process begins with you. With the map of your shoreline and your wish list of shoreline needs spread out on the kitchen table, use what you have learned about dock shapes and types to look for solutions. How will a dock work here? Perhaps it would be better at the opposite end of the shoreline? Based on the terrain - both submerged and above-water - what type of dock is best for both you and the environment?

What shape of dock will best accommodate your wish list of activities? Make copies of your original site map and let members of the family explore different solutions. When consensus is reached, your next task is to find out if approvals are required.

GETTING APPROVALS, MAKING AMENDS

Fisheries and Oceans Canada (DFO) has streamlined its review and approval process by identifying certain dock-building activities that have a low risk to fish habitat. The first step is to check whether your project meets the criteria of an Operational Statement - DFO's guidelines for work around water that pose a low risk to fish habitat. If your plan for a dock or boathouse meets the conditions laid out in an Operational Statement, and it incorporates the measures it advises to protect fish habitat, then your project does not require review under the *Fisheries Act*. To see if your plans are lake-friendly (or to find out how to make them better), visit the DFO web site at www.dfo-mpo.gc.ca/oceans-habitat/.

Once you are there, click on "Operational Statements" (for dock and boathouse construction, beach creation, and so on). You may be pleasantly surprised to learn that your project can pass "go" without acquiring DFO's formal blessing.

If your project does not meet the standards of an Operational Statement, you will need to submit your plans for review to ensure that your dock project does not adversely affect fish habitat. In Ontario, your first stop for approval should be the local Conservation Authority, or Parks Canada office, then the Ontario Ministry of Natural Resources (MNR), and finally DFO. You may not have to talk to each of these agencies separately. For instance, some Conservation Authorities or Parks Canada offices may handle the entire process on behalf of the other government departments, or the MNR may do it all, but the only surefire way to find out is to ask (see Contact information on p. 23).

Here is another stop you should make on the approvals journey: If your project is in an area where there are aquatic species at risk, as defined by the *Species at Risk Act* (SARA), get in touch with your local Conservation Authority, DFO or Parks Canada office to make sure that what you have in mind is in compliance with SARA. A visit to www.sararegistry.gc.ca will help. Also, some municipalities now require building permits for dock construction, so you will need to check there as well.

Keep in mind that gaining approval from one government department does not guarantee that you will be able to obtain approval from another government department. It is important that you obtain all approvals before starting the work.

The size, shape, and location of your dock - or perhaps even whether you can have one at all - will all come under review so do not be surprised if you are asked to make some changes. However, making adjustments in the early stages - when your dock is still in erasable pencil on paper - is much easier and more economical than altering the finished work.

Do your planning the summer before you want to begin the work, and file your applications (where required) in the fall. That way, you will have all of the paperwork taken care of in time for the spring thaw.

What happens if you ignore all of this good advice? Not taking the proper precautions to ensure that your project meets provincial and federal requirements may result in a violation under the *Fisheries Act* and related legislation. First time offenders under the *Fisheries Act* can receive a maximum fine of $300,000 and possible jail time for subsequent conviction. As well, the courts often order restoration of the property to its original state.

TIPS FOR EASING THE PROCESS

Begin the mapping and design process in the summer when you can accurately assess current and proposed waterfront activities. Present your plan to government departments in the winter or late fall. This will allow adequate time for those in charge of approvals to look at your proposal and suggest alternatives should there be a problem. By getting all of the paperwork taken care of when the lake is frozen, you could be building your dock in the spring and sipping lemonade on its deck by summer. And no lemonade tastes sweeter than that sipped from a deck chair on your own dock, as you take in the quiet beauty of your waterfront.

FURTHER READING

The Shore Primer
Fisheries and Oceans Canada and Cottage Life

The Shore Primer is an essential guide to healthy waterfronts, showing cottagers and other landowners how to protect and restore their shorelines. A good compliment to *The Dock Primer*.

The Drain Primer
Cliff Evanitski

Fisheries and Oceans Canada, Ontario Federation of Agriculture and Drain Superintendents Association of Ontario

The Drain Primer is a helpful guide to maintaining and conserving agricultural drains and fish habitat.

The Baitfish Primer
Becky Cudmore and Nicholas E. Mandrak

Fisheries and Oceans Canada and Bait Association of Ontario

The Baitfish Primer is an informative guide for identifying and protecting Ontario's baitfishes.

The Fish Habitat Primer
Fisheries and Oceans Canada

The Fish Habitat Primer is an essential guide to recognizing and respecting the environment on which fish depend to keep their - and our - waterways vibrant with life.

"Working Around Water?" – a series of fact sheets.

Operational Statements – a series of documents developed to streamline DFO's regulatory review of low risk activities.

These publications, and more, are available electronically on the Fisheries and Oceans Canada (DFO) Web site at www.dfo-mpo.gc.ca/oceans-habitat/. For a copy of any of these DFO publications, please contact your local DFO office (see "Contacts," p. 23).

Aussi disponible en français.

CONTACTS

Fisheries and Oceans Canada - Ontario-Great Lakes Area Offices

SOUTHERN ONTARIO DISTRICT

Burlington
304-3027 Harvester Road
P.O. Box 85060
Burlington, ON L7R 4K3
Tel: 905-639-0188
Fax: 905-639-3549
E-mail: referralsburlington@dfo-mpo.gc.ca

London
73 Meg Drive
London, ON N6E 2V2
Tel: 519-668-2722
Fax: 519-668-1772
E-mail: referralslondon@dfo-mpo.gc.ca

EASTERN ONTARIO DISTRICT

Peterborough
501 Towerhill Road, Unit 102
Peterborough, ON K9H 7S3
Tel: 705-750-0269
Fax: 705-750-4016
E-mail: referralspeterborough@dfo-mpo.gc.ca

Prescott
401 King Street West
Prescott, ON K0E 1T0
Tel: 613-925-2865
Fax: 613-925-2245
E-mail: referralsprescott@dfo-mpo.gc.ca

NORTHERN ONTARIO DISTRICT

Parry Sound
28 Waubeek Street
Parry Sound, ON P2A 1B9
Tel: 705-746-2196
Fax: 705-746-4820
E-mail: referralsparrysound@dfo-mpo.gc.ca

Thunder Bay and Kenora
425-100 Main Street
Thunder Bay, ON P7B 6R9
Tel: 807-346-8118
Fax: 807-346-8545
E-mail: referralsthunderbay@dfo-mpo.gc.ca

Sudbury and Sault Ste. Marie
1500 Paris Street, Unit 11
Sudbury, ON P3E 3B8
Tel: 705-522-2816
Fax: 705-522-6421
E-mail: referralssudbury@dfo-mpo.gc.ca

COTTAGE LIFE
54 St. Patrick Street
Toronto, ON M5T 1V1
Tel: 416-599-2000
Fax: 416-599-0500
E-mail: clmag@cottagelife.com
Web Site: www.cottagelife.com

PARKS CANADA
25 Eddy Street
Gatineau, QC K1A 0M5
Tel: 1-888-773-8888
E-mail: information@pc.gc.ca
Web Site: www.parkscanada.gc.ca

MINISTRY OF NATURAL RESOURCES
Natural Resources Information Centre
P.O. Box 7000
300 Water Street
Peterborough, ON K9J 8M5
Tel: 1-800-667-1940
Fax: 705-755-1677
E-mail: mnr.nric@ontario.ca
Web Site: www.mnr.gov.on.ca

FEDERATION OF ONTARIO COTTAGERS' ASSOCIATIONS (FOCA)
201 - 159 King Street
Peterborough, ON K9J 2R8
Phone: 705-749-FOCA (3622)
Fax: 705-749-6522
E-mail: info@foca.on.ca
Web Site: www.foca.on.ca

CONSERVATION ONTARIO
120 Bayview Parkway, Box 11
Newmarket, ON L3Y 4W3
Tel: 905-895-0716
Fax: 905-895-0751
E-mail: info@conservationontario.ca
Web Site: www.conservationontario.ca

THE LIVING BY WATER PROJECT
Centre for Sustainable Watersheds
14 Water Street, Box 280
Portland, ON K0G 1V0
Tel: 613-272-5136
E-mail: lbw@watersheds.ca
Web Site: www.watersheds.ca

See inside back cover for complete listing of DFO Offices.

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