Protecting Karst in Coastal BC

Special Report

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Introduction

In the fall and winter of 2002, a forest company began to construct a road on the Queen Charlotte Islands to reach a timber sale issued by the BC Timber Sales, an independent organization within the B.C. Ministry of Forests and Range.[1] The company's contractor blasted roadside areas for road materials. Some of those materials came from "karst features", which had been previously marked with flagging by government staff and described to the licensee as being sensitive to damage from forest practices. The Ministry of Forests and Range imposed a fine of $45,000 for that damage, which was 90 percent of the maximum penalty.[2] Ultimately, the fine was set aside due to procedural errors, but this case drew the Board's interest because, in the Board's experience, fines that are near the maximum are rarely imposed. There had apparently been careful planning, so what had gone wrong in the Queen Charlotte Islands incident? It appeared as though the contractor that constructed the road had failed to recognize the value and sensitivity of karst in the field.

The problems with protecting karst during forest practices may have increased recently when the forest practices regulatory regime changed. Formerly, the government would not approve forest practices unless they would adequately manage and conserve these resource features. Under the *Forest and Range Practices Act*, government has shifted its approach.[3] It is now up to licensees and their forest professionals to plan, and carry out, their operations in ways that do not damage or render ineffective features that government has identified as sensitive. This shift puts most of the resource protection onus onto those who carry out or direct forest practices – licensees, professionals, contractors and equipment operators.

If those who carry out forest practices are to adequately conserve sensitive resource features such as karst, they must be informed about the resource, its sensitivity and its protection. Therefore, the Board has produced this special report to profile karst protection for those who plan and carry out forest practices. The Board utilized the services of Paul Griffiths, a karst specialist, to assist with the development of this report.

[1] The timber sale referred to in this report was issued by the Small Business Forest Enterprise Program of the Ministry of Forests. Since April 2003, such activities have been carried out by BC Timber Sales.

[2] The licensee's representative successfully appealed the penalty to the Forest Appeals Commission, which decided that the penalty should not have been imposed on the director of the licensee company; see http://www.fac.gov.bc.ca/DECISION/2005for015a.pdf.

[3] Most of the *Forest Practices Code of British Columbia Act* (the Code) was repealed on January 31, 2004, and replaced with the *Forest and Range Practices Act* (FRPA). The transitional provisions of FRPA state that the Code continues to apply to forest practices carried out under a forest development plan. This continues until there is an approved forest stewardship plan, at which point, the requirements of FRPA apply. Therefore, although FRPA is in effect, the legislated forest practices requirements of the Code concerning karst protection can still apply.

Background

Karst is a landscape that is created by water dissolving limestone over many thousands of years, forming an intricate three-dimensional topography with shafts, sinkholes, caves, disappearing streams and springs. About 10% of BC, primarily in mountainous parts of the coast and interior, has bedrock that is suitable for karst formation. The abundance of water in BC's coastal temperate rain forests causes karst to develop more rapidly there than in other karst areas. The worldwide scarcity of temperate rainforests such as those on Vancouver Island and the Queen Charlottes, combined with the rapid development of karst features in such forests, make BC's coastal karst landscapes among the most dynamic on earth.[4]

The most obvious public interest in karst is recreational interest in caving – BC's karst caves attract enthusiasts from around the world. Karst caves also have scientific value because they have dark, cool, alkaline conditions that tend to preserve archaeological and paleontological materials. They have related cultural values as well – karst caves were used by First Nations peoples for shelter, burial sites and ceremonial purposes.

However, caves are just a small component of karst terrain and karst is significant for many other reasons.[5] Biologically, coastal karst areas are very productive because dissolved nutrients, fractured bedrock and well-drained soils typical of karst landscape encourage deep rooting and vigorous growth of trees and other plants. That productivity also supports rare and diverse animal communities and aquatic systems. High productivity has also resulted in timber harvesting being directed toward karst areas.

Protecting karst during forest practices

1. Recommended practices in karst areas

Karst landscape is particularly sensitive to damage from some forest practices because its fractured nature allows water to move rapidly through it. Sediments and pollutants can be moved large distances in a short time through subsurface routes. Forest practices need not avoid karst systems, but will often have to be modified to avoid damage. Planning forest practices on or near a karst landscape should consider the entire landscape as a functioning system.[6]

The first step is recognizing karst if it occurs in areas proposed for harvesting or road construction. Fortunately, karst indicators such as cave entrances, limestone bedrock, disappearing streams, springs and sinkholes are reasonably obvious, although they can be obscured by dense vegetation.

[4] Ministry of Forests. (2003). *Karst Management Handbook for British Columbia*, http:for.gov.bc.ca/hfp/fordev/karst/karstbmp.pdf [hereafter, *Karst Handbook*] at 5.

[5] *Karst Handbook* at 6 to 12.

[6] *Karst Handbook* at 13.

Once karst features are recognized, the sensitivity of the karst landscape associated with those features must be assessed. This can be quite complex, requiring field assessment by professionals. Sensitivity assessment in the field is a step that is often missed by those who are planning or carrying out forest practices. A field assessment will result in recommended management practices to avoid damaging not only the individual karst features but the entire local karst system. An assessment is likely to recommend reserving of timber near cave entrances, significant sinkholes and areas immediately above and adjacent to shallow caves. Such reserves will help to maintain the natural range of temperature, humidity, water infiltration and water chemistry. In addition, a buffer of additional trees may be needed to protect the reserved timber from being blown down.

Figure 1 – The sensitivity of karst areas to damage from forest practices is not immediately obvious

Road building can cause significant damage to karst features and landscapes. Heavy equipment and blasting can cause physical damage, soil erosion and sediment transfer; interrupt natural surface and subsurface drainage patterns; and collapse caves, especially those with thin ceilings. Detailed recommendations for forest practices such as harvesting, roads, landings and quarries, as explained in the government's Karst Management Handbook, can minimize such impacts.[7] However, it is important to recognize that these are simply suggested practices, not

[7] *Karst Handbook* at 36 to 42.

requirements. It remains for those who carry out the forest practices to decide how to prevent damage to karst terrain and features.

2. Regulation of forest practices in karst areas

a) Historical regulation of practices in karst areas

The evolution of management of karst in the BC forest practices context is quite recent. Fifty years ago, there was simply no management concern. However, as logging moved into more remote parts of northern Vancouver Island in the 1970's, cave protection became an issue. As most caves in BC are in provincial forests, the Ministry of Forests and Range was the agency that started doing cave inventories. It also developed policies and guidelines through the 1980's and early 1990's, but forest harvesting impacts on caves and other karst features continued to escalate.

By the mid-1990's, the Ministry had reviewed the management of cave and karst features and concluded the existing protection strategy, which focused only on caves, tended to dramatically underestimate the biological, hydrological and cultural importance of the entire karst resource.

Figure 2 – Road building has special risks for karst, such as this irreparable damage from blasting

The *Forest Practices Code of BC Act* (the Code) in 1995 required government to manage and

conserve many types of non-timber forest resources when approving forest practices. Cave and large sinkholes were included in the Code as recreation resources. If karst features were made "known" by government or by a higher-level plan, the Code allowed government to put seasonal or location restrictions on road construction. Also, licensees could be required to protect known karst features from disturbance or damage during harvesting, and from post-harvest silviculture treatments such as site preparation, planting and herbicide/pesticide application.

In 2003, the Ministry of Forests released the Karst Management Handbook for BC, with its recommendations for suitable forest practices on karst terrain. Those practices reflected the principle of managing karst as a complex ecosystem. Field procedures were also developed to determine the significance of specific karst features and vulnerability of karst terrain to potential damage from forest practices. As the vulnerability class increased, suggested management practices became more restrictive.

Enforcement of karst protection under the Code was effective if protection of karst features was identified in an operational plan and incorporated into a road layout and design. Such a design had to be approved by government, and failure to build the road as approved could result in significant fines.[8]

An Example – The Queen Charlotte Islands Experience

In 1999, logging on northwestern Moresby Island, Queen Charlotte Islands, exposed previously unidentified karst features. When the precursor to BC Timber Sales[9] planned another cutblock in the area in 2000, the district manager was advised by ministry staff to conduct a karst inventory. Karst specialists identified karst features in the proposed block, marking them in the field with ribbon and including recommendations in a report[10] to protect those features.

In late March 2001, the district manager issued a timber sale licence for the block to a small forestry company. The licence included a map that showed "special feature boundaries" around the locations of "swallets" – karst depressions where surface streams went underground. The map legend described management practices to minimize impacts on the swallets. A schedule to the licence stated that some saplings around karst features had been marked with orange and black flagging tape. The schedule to the licence also drew the licensee's attention to a silviculture prescription for the block, which stressed protecting and minimizing impact in the karst area. The prescription specifically mentioned karst features five times.

[8] Maximum fine of $50,000 for a contravention of section 62(1) of the *Code Act*, see Section 5 and Schedule of the *Administrative Remedies Regulation*.

[9] Before April 2003, the activities of BC Timber Sales, such as the planning of timber sales, was carried out by the Small Business Forest Enterprise Program of the Ministry of Forests.

[10] Cave Management Services. (2000). *Judgmental Karst Feature Search in the Vicinity of Kootenay Inlet on the Queen Charlotte Islands*. 19 pp. Report to the Ministry of Forests, Queen Charlotte Islands District.

Figure 3 – Damage occurred even though karst features had been previously marked in the field with black and yellow ribbons (MoFR Photo)

The district manager subsequently issued a road permit with a similar map to the timber sale licence map, again showing the special feature boundaries around swallets and outlining the management objectives for those swallets. Additionally, karst features were indicated at seven specific locations on the road plan attached to the permit. Finally, there was a pre-work meeting at the Ministry when government staff, the licensee's representative and the contractor went over the silviculture prescription.

In summary, government went to considerable effort to advise the licensee that the block had sensitive karst features, and directed the licensee to reports and maps that provided recommended forest practices to protect those features from damage.

Thus informed, the licensee's contractor began to construct the road in late 2002. Numerous problems arose. The road material used was so fine-textured that sediment was washed into karst features. Woody debris from the road clearing also went into previously-identified karst features. Road ditch material had been placed into a swallet. There were blasting holes drilled into identified karst features. In fact, by the end of March, most of the karst features that were to have been protected along the road had been either filled in or blown up.

In early 2003, as the harvesting proceeded, large and small logging debris was deposited along "sinking streams" - streams that disappear underground. As a result, stream channels eroded, sediment filled in some stream channel pools, and previously-stable debris was loosened and moved. The district manager concluded that the licensee had not constructed the road as

approved. In fact, there had been a total disregard for the karst. There was no way to repair or undo the damage. The district manager decided to impose a large fine. The maximum allowed for failing to construct the road in accordance with the approved road permit and the road layout and design was $50,000; the penalty imposed in this case was $45,000.[11]

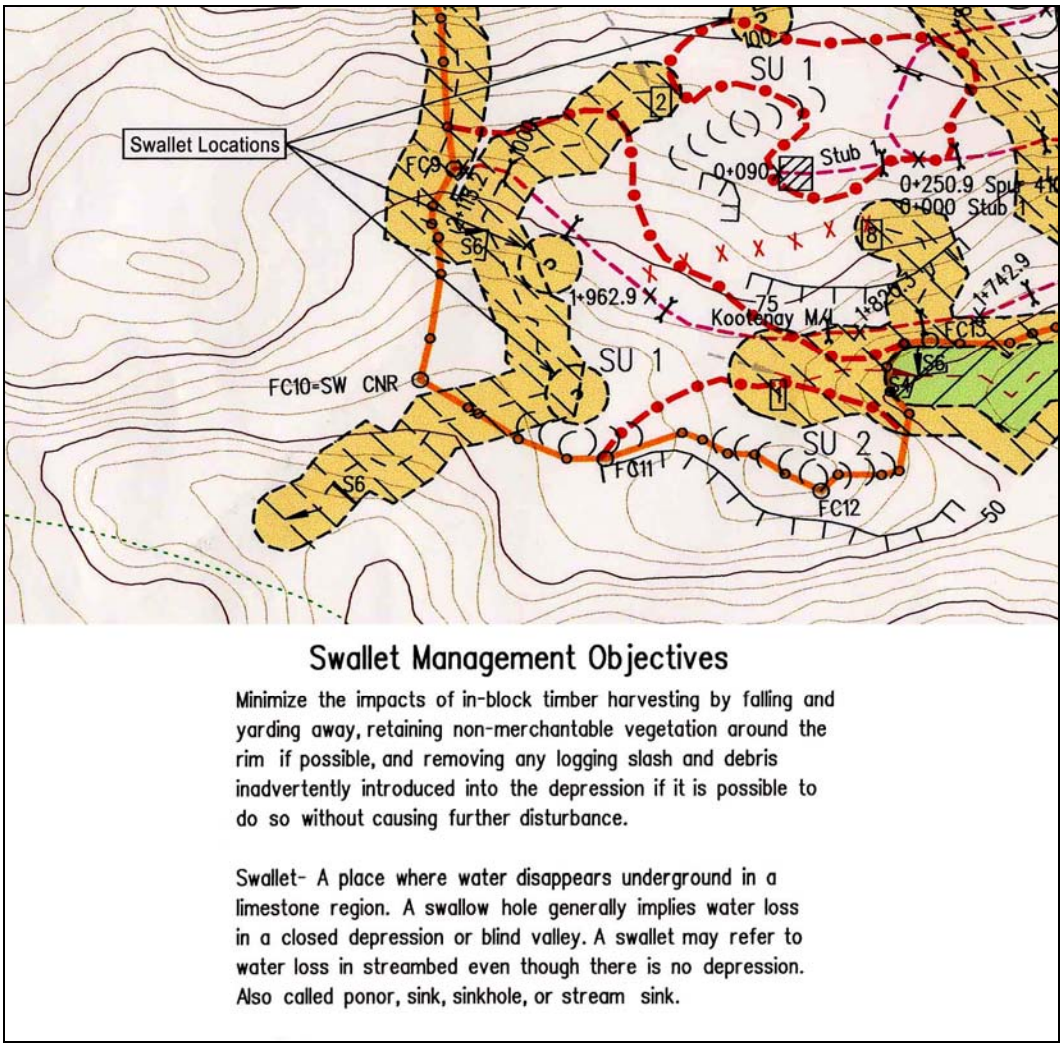

Figure 4 – The road permit and timber sale licence maps highlighted karst features to be protected (MoFR Photo)

In summary, there had been good planning and preparation, but it still failed to prevent damage by poor practices because the contractor and equipment operators did not realize the sensitivity of the identified karst features. This unfortunate result occurred under the Code's highly prescriptive regulatory regime, where government had ensured that assessments and planning occurred, and where government had imposed terms and conditions as part of a series of approvals. What are the karst protection prospects under the non-prescriptive *Forest and*

[11] The licensee's representative successfully appealed the penalty to the Forest Appeals Commission, which decided that the penalty should not have been imposed on the director of the licensee company; see http://www.fac.gov.bc.ca/DECISION/2005for015a.pdf.

Range Practices Act? Are licensees, contractors and equipment operators more likely to be aware of the damage that they can cause?

b) Regulation of practices in karst areas under the *Forest and Range Practices Act*

The regulation of forest practices has changed recently to place more responsibility on licensees, their contractors and equipment operators to deal with karst features and karst terrains. Under the *Forest and Range Practices Act* (FRPA), government officials no longer have the authority they formerly had under the Code to withhold approval of plans if they do not adequately manage and conserve forest features.[12] Instead, government can make orders that protect karst features as "resource features" via FRPA's *Government Actions Regulation*.[13] Once identified in such orders, the *Forest Planning and Practices Regulation* requires that a person carrying out harvesting, silviculture or road construction or maintenance ensure that those practices do not "damage or render ineffective" resource features.[14] Therefore, it is now up to licensees, their contractors and equipment operators to determine how to ensure that their field practices do not damage or render ineffective karst caves, significant surface karst features and higher-vulnerability karst terrains.

Several coastal forest districts (Campbell River, Queen Charlotte Islands and South Island) considered draft orders in 2005. In September 2006, the Queen Charlotte Islands district manager made the first order that formally identified three types of karst features as "resource features" wherever they occurred in that district:[15]

- karst caves,
- "significant" surface karst features, and
- "very high or high vulnerability" karst terrain

On the Charlottes, those features now must not be damaged or rendered ineffective. Other coastal districts will likely make similar orders. (Although the Queen Charlottes' identifying order does not do so, such an order can also require a licensee to annually report newly-found resource features, that are next to roads or cutblocks, to government.[16])

It is up to government to decide which karst features and terrains warrant protection. Under the Queen Charlotte order, non-significant surface features and karst terrains that are only rated as low or moderate vulnerability remain unprotected. This raises questions about which features are significant and how to determine vulnerability. There are established procedures for

[12] There was such authority under section 41 of the Code Act until early 2004, but no such provision exists in FRPA. Instead, plan approval can be withheld if results or strategies are not consistent with specified government objectives.

[13] Section 5(1)(a) of the *Government Action Regulation* allows the minister of forests to make an order that identifies "a surface or subsurface element of a karst system" as a resource feature.

[14] Section 70(1) of the *Forest Planning and Practices Regulation*.

[15] Ministry of Forests and Range, (2006). *Order to Identify Karst Resource Features for the Queen Charlotte Islands Forest District*. 1 p. The order, signed on September 1, took effect on September 15, 2006.

[16] Section 86(3)(b) of the *Forest Planning and Practices Regulation*.

determining both, and those are known to karst specialists. Examples of significant surface features include sinkholes large enough to create a localized microclimate and karst springs that have unique plants or animals associated with them.

Overall, government appears to be making reasonable efforts to implement protective measures for karst on the Queen Charlottes. Similar karst orders are likely to follow in other coastal districts. Once karst orders have been issued, licensees are responsible and accountable for damage to karst features from their operations. How they avoid causing such damage is up to them.

If karst features are damaged, licensees can avoid a penalty if they can prove "due diligence".[17] Due diligence means taking all reasonable care not to damage identified karst resource features. Licensees can show such diligence in a couple of ways. Licensees could retain a professional to go on site and identify significant and vulnerable karst features and terrain. This can be somewhat difficult when dealing with karst because this is a multi-disciplinary field, where geoscientists, engineers, biologists, hydrologists, foresters and archaeologists may need to work together. Reliance on a professional's opinion, or recommendations on how to protect karst during operations, would be a strong factor to show due diligence. Another, less reliable, way for licensees to demonstrate diligence is to train contractors and equipment operators to recognize karst and its sensitivity. Regardless of who is likely liable for damage to karst, the suggested management practices in the Karst Management Handbook provide useful and practical guidance to avoid doing damage in the first place. The Ministry of Forests and Range also has advice on how to inventory karst.[18]

If insufficient diligence was applied and karst is damaged by a licensee, the available penalty becomes important. Although not directly comparable, FRPA's penalty regime appears to be both weaker and stronger than what existed under the Code. It is weaker because the maximum administrative penalty that a district manager can impose for damaging a resource feature has decreased from $50,000 (as applied in the Queen Charlotte Islands example described previously) to just $20,000.[19] On the other hand, it is stronger because FRPA, unlike the Code, allows government the alternative of using court prosecution in cases of serious damage to a resource feature. A court can impose a fine up to $100,000 for such damage.[20]

How effective will licensees be at protecting karst in coastal BC from damage due to forest practices? It is too early to be certain. There is a resource evaluation program currently under way, involving input from industry, government and karst experts to develop karst indicators.[21] However, the emphasis is still on developing evaluation methods.

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[17] The maximum administrative penalty for contravention is $20,000.

[18] Ministry of Forests. (2000). *A Preliminary Discussion of Karst Inventory Systems and Principles for BC*, Working Paper No. 51 at http://www.for.gov.bc.ca/hfd/pubs/docs/wp/wp51.htm.

[19] Section 14(c) of the *Administrative Orders and Remedies Regulation*.

[20] Section 102(2) of the *Forest Planning and Practices Regulation*.

[21] More information on the government's "Forest and Range Evaluation Program" (FREP), go to http://www.for.gov.bc.ca/hfp/frep.

Conclusions

1. Karst is a resource that, particularly on the BC coast, is sensitive to damage from forest practices, but that sensitivity is often not recognized.

2. Government no longer protects karst features or terrain by approving only non-damaging forest practices. Instead, government can identify karst that needs protection in an order. Once so identified, it is up to those who carry out forest practices to determine how best to carry out forest practices in a way that avoids damaging identified karst features.

3. There has been a shift of responsibility for karst stewardship from government to those who carry out forest practices. This shift puts the onus on licencees, contractors and equipment operators to recognize karst and be aware of its significance and sensitivity. It also leaves it to licensees, and their resource professionals, to determine when expertise is required to plan and to carry out appropriate forest practices.

NEWS RELEASE

For Immediate Release
January 11, 2007

Op-ed: Protecting Karst in Coastal BC

Figure 1 Paddlers cautiously approach a cave in Barclay Sound, Vancouver Island. http://www.wavelengthmagazine.com/1994/ma94destination2.php

There is something special, and especially sensitive, in BC's coastal forests – karst. Karst is formed by water dissolving limestone over many thousands of years, creating shafts, sinkholes, caves, disappearing streams and springs. About 10% of BC has bedrock that is suitable for karst formation, largely concentrated on Vancouver Island and Haida Gwaii. The abundant rainfall of BC's coastal rainforest makes our karst features among the most dynamic on earth. That's why the Forest Practices Board has recently published a special report on protecting karst in coastal British Columbia.

The most obvious public interest in karst is recreational - BC's karst caves attract caving enthusiasts from around the world to marvel at the stalactites, stalagmites, "moon milk" and "cave pearls" that are deposited during the cave formation. Karst caves also have scientific value because they preserve fossil records from prehistoric times. They have cultural values as well – karst caves were used by First Nations peoples for shelter, burial sites and ceremonial purposes. However, karst is significant for many other reasons. Dissolved nutrients, fractured bedrock and well-drained soils make karst terrain highly productive for growing forests, as well as supporting rare and diverse animal and plant communities. Overall, karst is a valuable resource with direct economic and environmental values.

Protecting Karst in Coastal BC

Karst is created by water dissolving limestone over many thousands of years. Those who carry out forest practices are supposed to conserve karst features. This special report profiles karst protection for those who plan and carry out forest practices.

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Figure 2 Small sinking stream fails to indicate the fragile nature of this karst ecosystem. Photo courtesy of MoFR.

Karst terrain is particularly sensitive to damage from forest practices because its fractured nature allows water to move rapidly through it. Logging debris, sediments and pollutants introduced into karst by water flows, as well as road building, can all damage karst features. Heavy equipment and blasting can cause physical damage, soil erosion and sediment transfer, interrupt natural surface and subsurface drainage patterns, and collapse caves, especially those with thin ceilings. To avoid damage, forest practices do not necessarily have to avoid karst areas, but will often have to be modified.

Preventing damage to karst features is easier said than done. Karst tends to be visible because indicators such as cave entrances, limestone outcrops, disappearing streams and sinkholes are reasonably obvious. However, the sensitivity of those karst features is not easy to assess. Protection of shafts , sinkholes, small disappearing streams and springs requires field assessment by professionals.

However, contractors and equipment operators can help by recognizing these features in the field and either modifying their activities to avoid damage or alerting a licensee to bring in specialized professionals.

A government Karst Management Handbook, available at http://www.for.gov.bc.ca/hfp/publications/00189/Karst-Mgmt-Handbook-web.pdf, has many suggestions to assist equipment operators and contractors to minimize impacts of forest practices on karst. For example, it is often better to use existing roads, landings and quarries near karst features rather than building new ones. Operators should try to maintain natural drainage patterns as much as possible in karst areas. Drilling and blasting should be minimized but if these practices are necessary, minimum charges, blasting mats and other techniques should be used to prevent rock fragments from damaging surface karst features or blocking streams flowing into karst areas.

Figure 3 The surface and subsurface components of forested karst ecosystems.
Photo courtesy of http://www.island.net/~subterra/FAQ.htm

The regulation of forest practices has changed recently to place more responsibility on licensees, their contractors and equipment operators to deal with karst features and karst terrains. Under the Forest Practices Code of BC Act, government was responsible for managing and conserving karst. Now, under the Forest and Range Practices Act (FRPA), individual forest districts can simply make orders that designate karst features as “resource features” via FRPA’s Government Actions Regulation [1] . If so designated, the Forest Planning and

Practices Regulation requires that a person carrying out harvesting, silviculture or road construction or maintenance ensure that those practices do not “damage or render ineffective” resource features. That leaves it is up to licensees and their employees and contractors to decide how to ensure that their field practices meet this test.

Recently, the Queen Charlotte Islands Forest District manager implemented the first karst identification order in B.C. Similar karst orders are likely to follow in other coastal districts. The order identified three types of karst features as “resource features” wherever they occur in that district:

karst caves,

“significant” surface karst features, and

“very high or high vulnerability” karst terrain.

Figure 4 Surface karst features include karst springs. Photo courtesy of MoFR.

Those orders rely on forest companies and machine operators to recognize and avoid damage to karst. If karst is damaged by inattentive or uninformed licensees or operators, it is not yet clear what level of damage would trigger a penalty . Physical damage such as blowing up karst formations during road building may be fairly obvious, but what test will district managers apply to determine if forest practices “render” a significant karst feature “ineffective”?

FRPA encourages, but does not require, licensees to use professionals to design and carry out forest practices that protect karst. The main incentive for licensees to employ professionals is to be able to use the defence of due diligence.

If identified karst resource features are damaged, a licensee can avoid a fine by proving due diligence, which means taking all reasonable care to avoid doing the damage. Reasonable reliance upon a professional’s opinion or recommendations would be a strong indicator of such care. Still, reasonable reliance may be difficult for karst because no single professional body has the necessary expertise. This is a complex subject, where geoscientists, engineers, biologists, hydrologists, foresters and archaeologists may need to work together. Nevertheless, there are karst experts available in B.C. and the suggested management practices in the Karst Management Handbook can also help inform forest workers.

How effective will licensees be at protecting karst in coastal BC from damage due to forest practices? The answer remains unknown. We know that karst is a resource that, particularly on the BC coast, is sensitive to damage from forest practices. Government no longer protects karst by checking and approving forest practices. Instead, those who carry out forest practices must themselves determine how best to carry out forest practices in a way that avoids damaging identified karst features.

This shift of responsibility for karst stewardship, from government to industry, requires that licensees, their professionals, contractors and equipment operators all learn about karst, its identification, its sensitivity and its protection. More information on karst can be found in an on-line training course on the Ministry of Forests and Range website at http://www.for.gov.bc.ca/hfp/training/00008.

Dr. Bruce Fraser, Chair

Forest Practices Board