ENVIRONMENT CANADA
CONSERVATION AND PROTECTION
ENVIRONMENTAL PROTECTION
PACIFIC AND YUKON REGION

COASTAL MARINAS:
AN ASSESSMENT OF FUEL HANDLING FACILITIES - METHODOLOGY DEVELOPMENT AND STUDY RESULTS

REGIONAL MANUSCRIPT REPORT: MS 90-01

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RESUME

Cette étude fut conduite pour évaluer l'application des lignes directrices de l'Association Pétrolière de la Colombie Britannique (BCPA) pour les facilités de storage et de manutention des utilisateurs de produits pétroliers en vrac, par les marinas cotières de Colombie Britannique. L'étude évaluait aussi le degré d'adoption des lignes directrices. L'évaluation fut constituée de propositions soumises au système d'orientation de Protection de l'Environnement d'Environnement Canada entre janvier 1984 et juin 1988. Soixante-dix sept applications furent reçues durant cette période; six de ces marinas comprenaient des facilités de manutention d'essence. Trois niveaux méthodologiques d'évaluation furent développés: une évaluation téléphonique (niveau 1), une inspection (niveau 2), et un échantillonage des sédiments (niveau 3). Vingt-deux marinas additionnelles furent inspectées.

Les point-clés de l'étude furent les suivants: plus de 50% des soumissions de marinas ne furent pas construites durant la période révisée; les résultats ont indiqué que le niveau 2 produit les informations les plus utiles quant au degré d'adoption; et en général il y avait un bas niveau d'application dans des domaines-clés des lignes directrices. Aucune différence significative ne fut détectée entre les marinas dont les lignes directrices furent fournies et celles dont le document ne fut pas fourni. Il fut remarqué que les inspections sur le terrain peuvent être utilisées pour s'assurer de l'application appropriée des lignes directrices du BCPA. Les lignes directrices du BCPA, en rapport aux facilités de pompage d'essence des marinas, peuvent être rendues plus utiles pour l'opérateur local de la marina.

ABSTRACT

The study was conducted to assess the implementation of the B.C. Petroleum Association's (BCPA) Guidelines for Consumer Bulk Petroleum Product Storing and Handling Facilities by B.C. coastal marinas, and the degree to which the guidelines were adopted. The assessment was made of proposals which were submitted to Environment Canada, Environmental Protection's referral system between January 1984 and June 1988. Seventy-five marina applications were reviewed over that period; six of the marinas included fuel handling facilities. Three levels of assessment methodologies were developed: a Level One telephone survey; a Level Two site inspection; and, a Level Three sediment survey. Inspections of 22 additional marinas were also undertaken. Key findings of the study were the following: that over 50% of the marina proposals had not been constructed over the period reviewed; that results indicated that the Level Two site inspections yielded the most useful information on degree of guidelines' implementation and, that overall there was a low level of implementation in key areas of the guidelines and no significant differences detected between those issued the guidelines and those without. In addition, it was found that site inspections could be used to ensure appropriate implementation of the BCPA Guidelines and that the BCPA Guidelines, with respect to marina fuelling facilities, could be made more useful to the local marina operator.

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INTRODUCTION

Environmental Protection, Pacific and Yukon Region and Environmental Impact Systems Division (EISD) Ottawa jointly undertook a review and test of the degree to which guidelines applicable to fuel handling facilities at marinas were utilized. EISD carried out a national review of relevant federal, provincial, industry and some U.S. guidelines. Pacific and Yukon Region developed and tested a series of methodologies to measure adherence or level of agreement to a particular set of guidelines.

Coastal British Columbia, which represents 10.5% (Owens, 1977) of the total Canadian marine shoreline, is a complex system of mountains, narrow coastal lowlands and fjords. A majority of this coastline is unsuitable for most forms of development because of limited access, steep topography and extremes of the environment. Settlement concentrations are found in the sheltered, low-lying coastal areas and on some deltas. The Strait of Georgia region supports over 70% of British Columbia's population, yet represents only about five percent of the total shoreline. Compounding this population pressure is the estimate that over 100,000 households own one or more boats (FEC 1978). That number continues to grow, though in recent years not as rapidly. Marina proposals to accommodate this growth and numbers of U.S. transient boats have also increased in the past decade. With these increases, concerns for the quality of the marine environment and the risk of spills grew. Environmental Protection, over this period, reviewed proposals and made recommendations on ways to reduce risks to the marine environment.

Environmental Protection, Pacific and Yukon Region undertook a study to measure the success of a particular set of guidelines at reducing the environmental effects of marinas; the study specifically addressed fuel handling facilities.

CONTEXT OF THE STUDY

Environmental Protection, Pacific and Yukon Region has three primary means to make recommendations and supply guidelines for fuel handling facilities. They are:

Navigable Waters Protection Act Referrals

Through interagency cooperation which has evolved over many years, Environmental Protection now can issue unilaterally, environmental conditions and suggested guidelines, through the NWPA permit process. This cooperation has been very successful and has allowed agencies (Department of Fisheries and Oceans, Canadian Wildlife Service, B.C. Fish and Wildlife, Environmental Protection) to make direct comments under their own mandates.

B.C. Ministry of Crown Lands Referrals

As the vast majority of the foreshores of British Columbia are vested in the Crown, all applications for developments on these foreshores must be approved by the Ministry of Crown Lands. The Ministry issues leases to applicants for the stated purposes. Prior to these leases being granted, a proposal to develop a marina on Crown foreshore is referred to Environmental Protection for coordination of a federal response. Environmental conditions and guidelines for fuel handling form part of that response.

Coordinated Project Review Process, Fraser River Estuary Management Program (FREMP)

All proposals for projects within the FREMP study area must be submitted to the coordinated project review process. The federal-provincial Environmental Review Committee coordinates the review of FREMP applications and is chaired by Environment Canada. Environmental terms and conditions based on agency mandates, ownership (federal Crown river bed), and FREMP designations and related to fuel handling facilities at marinas can be

directly attached to any approvals within the FREMP area.

THE BRITISH COLUMBIA PETROLEUM ASSOCIATION GUIDELINES

The "Guidelines for Consumers Bulk Petroleum product Storing and Handling Facilities" were developed in 1984 (see Appendix I). The guidelines represent a synthesis of salient requirements and proper procedures identified in various other codes and guidelines. They are not intended, however, to replace those codes and guidelines when seeking approvals. Their intent is to identify general actions, technical details and facility design that if incorporated not only reduce the risk of accidental spills and fires, but also ensure a safe operation. Environmental Protection, Pacific and Yukon Region encourage use of these guidelines as they also indirectly reduce the risk to the environment from the operation of the fuel handling facility. These guidelines formed the basis for this study of coastal marinas.

Early in the study, the guidelines were reviewed to identify specific provisions which applied to marina fuel handling facilities. In all, twenty-one were identified. Table One provides a summary list of these guidelines. For convenience they have been grouped into five general categories; unloading area, either land or marine; above ground storage tanks; dispensing and delivery systems, and operating safeguards and contingency plans. These 21 provisions were used as the basis to design the methodology and compare the results.

PURPOSE OF THE STUDY

Over the past several years Environmental Protection has become increasingly involved in looking at ways to measure how well its advice or guidelines protect the environment and how well they are followed by project proponents. The purpose of this assessment is as follows:

TABLE 1: SUMMARY GUIDELINES APPLICABLE TO MARINA FUEL FACILITIES (BCPA, 1984)

Unloading Area (Land)

1. Level off public land.
2. Graded to allow for drainage to impermeable collection point in case of spill.
3. Sufficient space for delivery vehicle.

Marine Delivery

4. Sufficient water depth for unloading.
5. Appropriate mooring structures.
6. Drip pan for drainage.
7. Accessible unloading connections.

Storage Tanks (Above ground)

8a. Dykes fully surround storage area.
8b. Dykes made of impervious materials.
9. Separator - sump provided.
10. Non-combustible walkover to storage area.

Dispensing and Delivery Systems

11. Meters on steel brackets with steel valve isolating from delivery system.
12. Dispensers bolted to deck or frame.
13. Hoses on reels or proper hanging brackets.
14. Drip pans.
15. Evidence of spillage or leakage.

Operating Safeguards

16. Fire extinguishers and notices.
17. Ignition sources.
18. Adequate spill clean-up equipment at site.
19. Emergency telephone contacts posted.
20. Good facility maintenance.
21. Flex hoses out of water and unobstructed from float movement.

1. To develop and test a range of methodologies, each requiring a different level of effort and resources, to assess agreement with the BCPA Guidelines.

2. To recommend the most appropriate methodology, based on the results, for future monitoring of coastal marinas.

3. To analyse the results of the preferred method.

4. To assess the nature of areas of non-agreement at fuel handling facilities and draw conclusions.

METHODOLOGY

A three level methodology was developed, each level represented a different intensity of effort, a more focussed information requirement and a higher cost. The levels developed for testing were:

Level One - A telephone survey using a questionnaire designed from the BCPA Guidelines and Environmental Protection operations requirements.

Level Two - A site inspection using a checklist designed from BCPA Guidelines and Environmental Protection operational requirements.

Level Three - A sediment sampling survey at fuel handling facilities to identify residual hydrocarbons which may be accumulating due to chronic spillages at the site. These values would be compared to values taken at two reference marinas which were developed without the guidelines.

Marina Applications Review

An initial requirement for the study was to identify the total number of marina development proposals which included plans for fuelling facilities. Referrals processed and reviewed by Environmental Protection for the period January 1984 to June 1988 were analysed. In all, 75 marina construction or approval applications were referred to Environmental Protection, Pacific and Yukon Region. Because of the mandates of the permitting agencies originating the referral, marina applicants are not required to include information on fuel facilities in their applications. Regardless, seven applicants did indicate that fuel dispensing was to be part of their operations. Each of these, as part of the federal response, were sent a copy of the BCPA Guidelines for implementation during the construction and operational phases of the marinas. The seven marinas identified were used to test the three levels developed for this study.

A valuable finding of this initial review of referrals was that greater than 50% of the marinas had not yet been built as of June 1988. On average, the delay between application and completion was found to be about three years. While several factors seemed to be responsible, economic climate primary among them, this lag time has ramifications to the environmental advice and recommendations provided to the marina proponent. This would be especially acute if during this lag period new regulations, requirements or codes came into effect such that construction of the marina would put it at variance to the new conditions. The question to be answered here is whether or not, after a predetermined amount of time, environmental agencies should have the opportunity to re-evaluate these applications before construction begins.

Level One Methodology Development - Telephone Survey

This level represents the broadest and least intensive method designed to compile information on the marinas through response to a

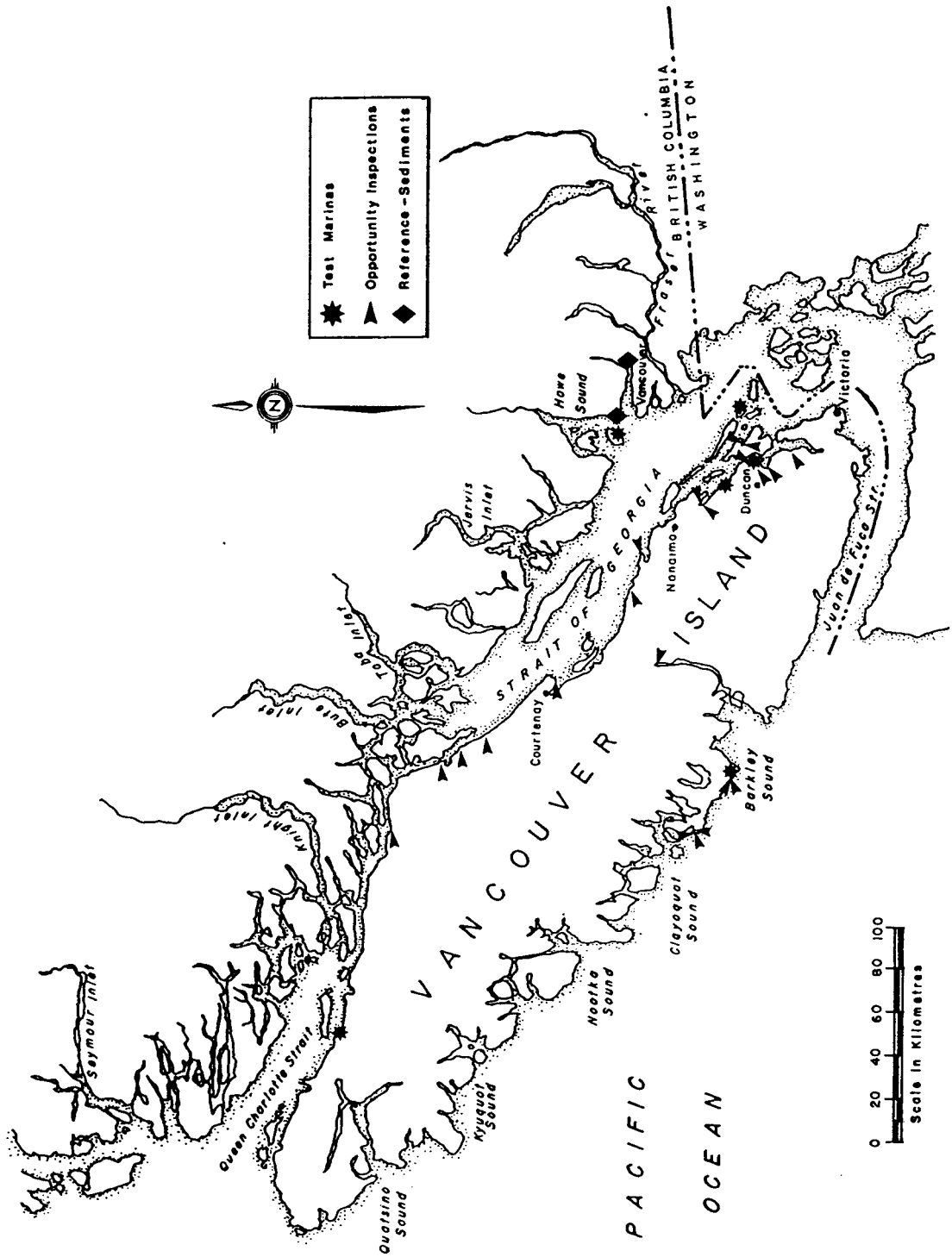
telephone questionnaire. The response would then be evaluated as to whether or not a clear picture of the condition and level of guideline implementation of the marina could be made. Using the BCPA Guidelines and input from the Environmental Protection Referrals Coordinator, a comprehensive telephone questionnaire was developed. Key to its design were questions on size and type of boat use; fuel delivery, handling and dispensing; fuel storage; contingency plans and countermeasures; and, inspections and approvals. (See Appendix II)

Level Two Methodology Development - Marina Inspections

Prior to the site inspections of the candidate marinas, a site inspection report was designed. This report, while repeating some of the information compiled from the telephone survey, also included guideline requirements on the nature and condition of storage tanks, bulk fuel unloading areas, delivery lines, and the dispensing station. All of which could only be adequately evaluated through a visual check of the site. An operational and overall maintenance evaluation was also carried out at this time. (See Appendix III) Six of the seven candidate marinas were included in the site inspections. The seventh marina was being phased out so was not visited. All marinas were visited in July 1988 and were located on Vancouver Island or some of the populated smaller, adjacent islands in the Strait of Georgia. (See Map)

Level Three Methodology Development - Sediment Sampling Survey

Prior to the site inspections of the six marinas, two existing marinas with long histories of fuel handling were sampled. The results of these samples were to be compared to the results of those marinas who had been issued the BCPA Guidelines. Differences in values would be used as a possible measure for how well the guidelines reduced chronic hydrocarbon releases to the marine environment.


Test Marinas
Opportunity Inspections
Reference-Sediments
N
BRITISH COLUMBIA
WASHINGTON
Fraser River
Vancouver
Victoria
Howe Sound
Jervis Inlet
Duncan
Nanaimo
STRAIT OF GEORGIA
Juan de Fuca Str.
VANCOUVER ISLAND
Toba Inlet
Bute Inlet
Courtenay
Kwatsi Inlet
Seymour Inlet
Queen Charlotte Strait
Barkley Sound
Clayoquot Sound
Nootka Sound
Kyuquot Sound
Quatsino Sound
PACIFIC OCEAN
0 20 40 60 80 100
Scale in Kilometres

STUDY AREA

Sediment samples were obtained using a 197 B15 Ekman Standard Dredge operated from the fuel dock. Subsequent samples were taken at increasing distances from the potential source. Information on sample locations and any other potential sources of hydrocarbon inputs to the marine waters were recorded on the site inspection reports. A total of 27 sediment grab samples were obtained in this survey. The sediments can be good indicators of the accumulation of residual hydrocarbons due to chronic discharges. Lighter ends of these fuels would volatilize while the residuals, which tend to adhere to particulates in the water column, would be deposited on the bottom. Analysis of the samples consisted of standard tests for oils and grease and total hydrocarbons. A Perkin-Elmer 882 Infrared Spectrophotometer was used to quantitatively determine the oils and greases and hydrocarbons by their similarity of solubility in a specific solvent. The infrared procedure has been found to have fewer interferences and is less 'technician dependent' than the gravimetric method.

Inspections of Opportunity Program

Incidental to the six marinas to be inspected, a total of 22 additional marinas with fuel facilities were visited and site inspections carried out. The site inspection report prepared for Level Two was used exclusively for these unannounced visits.

During these inspections incidences out of agreement with the 21 provisions were recorded. The facility operator/owner was then notified of the problem and recommendations for correction made. This was done both verbally and in writing at the time of inspection.

RESULTS

The Telephone Survey

All seven of the marina operators were familiar with the BCPA Guidelines. Significant findings of the survey can be summarized as follows:

Fuel Handling and Storage

Five of the marinas handled both diesel and gasoline, while the remaining two supplied gasoline only. All had their product supplied by major oil companies. This is, in itself indicative, as it is the policy of these companies, in B.C., not to supply product to unsafe operations. The seven marinas contacted collectively stored over 92,000 l gas and 355,000 l diesel. Four of the marinas had above-ground storage surrounded by dykes, two were underground, and one had tanks under its dock.

Maintenance and Inspection

Five of the marinas performed daily maintenance checks on fuel handling equipment. One performed checks every three weeks and the other did inspections when deemed necessary. Four of the facilities had some form of inspection prior to becoming operational. However, there was no consistent regulatory agency who gave final approval to the fuel handling facility. Table Two provides a summary of this observation:

TABLE 2: MARINA APPROVAL RECORD

MARINA*	INSPECTED BY
1	Fire Marshall
2	Fire Marshall
3	Oil Company, Municipality
4	Private Fuel Firm
5	Did not know
6	Did not know
7	No information

Environment Protection did not inspect any of these facilities prior to their becoming operational.

* Numbers used identify a specific marina and apply throughout the report

Oil Spill Contingency Plans

In the event of an oil spill, three marinas have emergency plans and access to oil spill clean-up equipment. The other four marinas would report a spill to a government agency (Environment Canada or Coast Guard) or to their product supplier who in turn would be expected to notify Environment Canada.

Satisfaction with the Marina Application Review Process

This section of the telephone questionnaire provided an opportunity for the respondents to indicate their views on the review process. Two of the test marinas were able to comment, while the others had changed ownership so could not respond. Comments received indicated satisfaction with the guidelines and response time to the application.

Marina Site Inspection

The site inspections of the marinas not only confirmed the results of parts of the telephone survey, they also helped to identify a range of problems that could not be readily identified through the telephone surveys alone. Six of the seven marinas were inspected for level of implementation of the B.C.P.A. Guidelines. Using the five general groupings discussed earlier, the results of the site inspections can be summarized as follows.

Unloading Area

All six marinas were supplied fuel via tanker truck and provided sufficient area to accommodate the delivery unit. However, five of the marinas, or 83%, do not provide for drainage to a safe, impermeable collection point in the event of a spill. In fact, two are situated such that any spilled fuel at delivery could drain to marine waters.

Storage Tanks

Three of the marinas stored product in above ground tanks; two marinas used buried tanks; and one had its tanks under its dock. Table Three summarizes the inspection results.

TABLE 3: STORAGE TANK INSPECTION SUMMARY TABLE

GUIDELINE/OBSERVATION	MARINA 1	2*	3	4	5	6
Above Ground:						
Surrounded by dyke	YES			YES		YES
Dyke impervious material	YES			NO		YES
Separator-sump	NO			YES		NO
Non-combustible walkover	YES			YES		YES
Evidence of spillage	NO			YES		YES
Below Ground:						
Locks on Tanks		NA	YES		NO	
Evidence of Spillage		NO	YES		NO	

* This marina stored fuel under dock.

Dispensing and Delivery Systems

Generally, all delivery lines and valves were in good condition as were the hoses at the dispensing station. All dispensing stations and hoses were appropriately mounted. This grouping accounted for seven incidences contrary to the provisions for the six marinas. Significant among them was that three marinas showed evidence of chronic minor spillages while dispensing fuel to boats. As these facilities are generally at water level (on floats) it represents a potential continuing source of hydrocarbons to the marine environment. While all marinas inspected had their meters in non-vulnerable locations, half could not isolate them from the overall fuel supply system.

This represents a potential risk should there be an accident at the meter and the flow of fuel could not be stopped immediately.

Operating Safeguards and Contingency Plans

All marinas provided fire extinguishers and appropriate notices. However, the highest number of incidences (11) contrary to the applicalble provisions were identified in this area of marina operation. Two marinas had identifiable ignition sources near key fuel delivery areas. None of the marinas had spill clean up equipment on-site, but three had access to equipment stored nearby. Fully five of the marinas did not have an emergency phone contact displayed and attendants at the fuel facility did not have a clear idea as to who to call. This is of interest because the telephone survey generally dealt with the owners who had a better knowledge of who to call. These last three findings become particularly significant when compounded with the lack of impermeable collection points for delivery spills or the inability to isolate meters from the overall system.

Figure One illustrates the percentage of non-agreement for the six marinas to the 21 applicable provisions.

TEST MARINAS WITH GUIDELINES

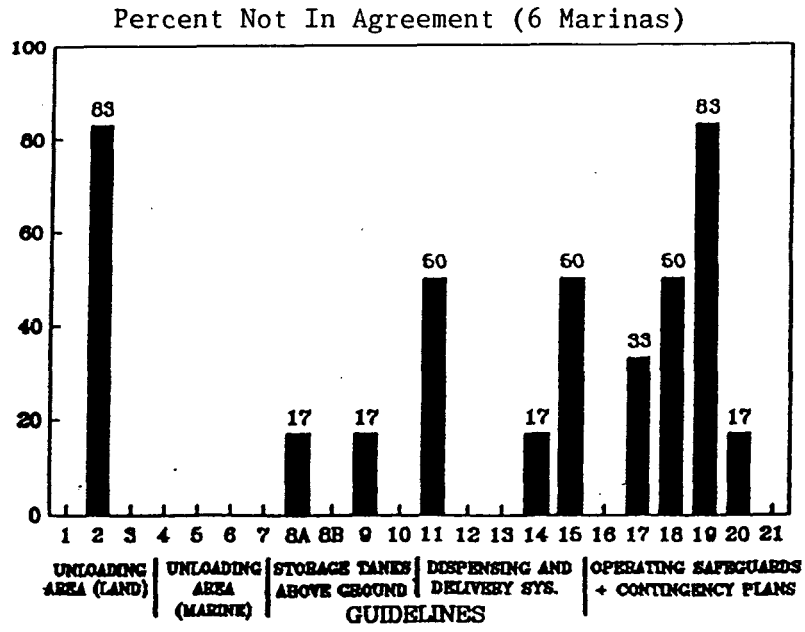


FIGURE 1 SITE INSPECTION RESULTS

Sediment Sampling Program

Analysis of the sediment samples was carried out by Environmental Protection's West Vancouver Laboratory (See Appendix IV). The two existing, long-established marinas sampled for reference purposes yielded total extractable oil and grease values of 364 µg/g and 497 µg/g in sediments immediately below their fueling stations. Subsequent samples taken at increased distances from the fuel dock displayed a range of values. In fact, higher values than the source site were found in sediments at several of the sampling points. For the six marinas sampled the total extractable oil and grease values obtained from the fuel dispensing areas ranged from 65 µg/g to an incredible 10900 µg/g. Comparing these values with the two reference stations identified three marinas in the same order of magnitude, one an order lower, and two an order higher or more. As with the reference marinas, there was no clear agreement between values and distance from the expected source. Comparisons between the reference marinas and the six marinas also showed no meaningful differences in values. These findings are further complicated by the number of marinas located in areas of other potential sources of hydrocarbons including boat yards, refineries, ferry terminals and fish processing plants. As well, the method of preparing the samples for analysis extracts all hydrocarbons, fatty acids, soaps, fats, waxes and oils which are soluble in a particular solvent, in this case Freon 113. Table Four summarizes these findings.

Using the infrared analysis, the extracted samples from the oils and grease were analysed for their hydrocarbon content. The process compares the chromatogram produced by a known synthetic 'standard oil' solution with the chromatograms of the extracted samples. In the case of all the marina sediments collected, hydrocarbon ranges between C17 and C32 were discernible. However, when compared to the standard no agreement could be found (See Appendix V). It was therefore not possible to identify whether or not these values represented petroleum-based hydrocarbons.

Inspections of Opportunity Survey

An additional twenty-two marinas were visited during the course of this survey (See Map). Site inspections and interviews were carried out at each. A total of 95 incidences contrary to the 21 provisions were identified at these marinas. Significant results among the five general groupings are summarized in Figure Two and described in the following.

Unloading Area

All 22 marinas had fuel delivered by tanker truck. Twenty or 91% however, did not provide for drainage to an impermeable collection point in the event of a spill.

Storage Tanks Above Ground

All marinas with above ground fuel storage generally complied with the provisions. Two did not have impermeable dykes enclosing the tanks, while three did not have separator-sumps to drain rainwater from within the dyked area.

Dispensing and Delivery System

A total of 33 incidences of non-agreement were identified in this grouping. Just under half (10) of the marinas could not isolate their meters and hoses from the rest of the delivery system. Forty-five percent did not provide drip pans at critical locations such as delivery and dispensing sites. Over one-third of the marinas had visible signs of chronic spillages at their delivery dispensing stations.

Operating Safeguards and Contingency Plans

Thirty-four incidences of non-agreement were identified in this grouping. Fifty percent of the marinas did not have spill response equipment on site, while 59% did not have an emergency number displayed or available should an accident occur. Five marinas were identified as not

TABLE 4: TOTAL OILS AND GREASE IN SEDIMENTS (µg/g) REFERENCE AND TEST MARINAS

MARINA	SAMPLES					OTHER SOURCES OF HYDROCARBONS
	FUEL DOCK	INCREASING DISTANCE FROM FUEL DOCK				
		A	B	C	D	
Reference A	364	666	285	-	-	Fishboats, B.C. Ferries, storm drains
Reference B	497	1180	1030	-	-	Refineries, oil transhipment, recreational boats
1	439	129	457	90	-	B.C. Ferry dock, recreational boats
2	1580	2850	1730	71500	1260	Fishboats, fish processing
3	303	312	205	-	-	Recreational boats
4	65	40	40	-	-	Recreational boats
5	634	166	255	-	-	Recreational boats
6	10900	1260	814	-	-	B.C. Ferry Dock, saw mill, recreational boats

having good facility maintenance, which included inspection routines, and general appearance of the fuel facility. Three marinas had to be told of product supply flex hoses trailing into the water between floats.

In all cases during these inspections of opportunity, the marina operator was made aware of the problems. Most showed a willingness to take the remedial action suggested. A written summary of the identified problems was also left at each marina inspected.

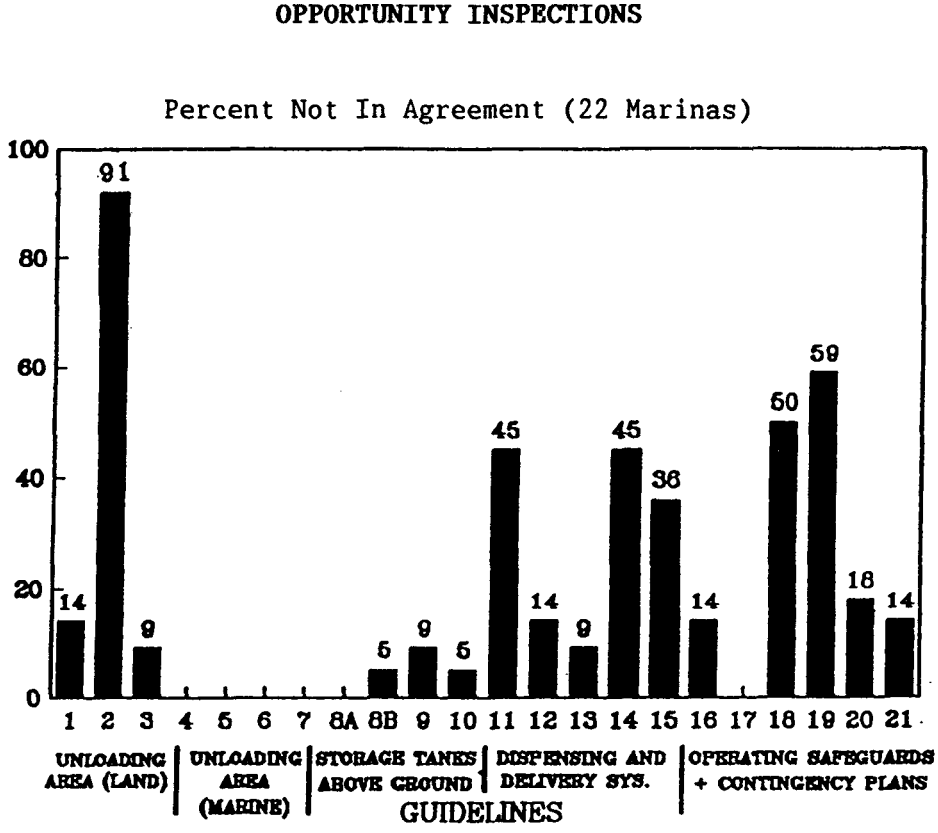


FIGURE 2 SITE INSPECTION RESULTS

Comparison of the Test Marina and Inspection of Opportunity Marina Results

Comparisons of the results of the inspections between the six marinas known to have had the guidelines and those of the opportunity

inspections were carried out. It was expected that there should be a discernible difference in the record of implementation between the two groups. Significantly, none could be found, in fact, the guideline groupings showing the highest levels of non-agreement were the same for both. Table Five provides a comparison of the level of agreement for individual guidelines which have significant implications to Environmental Protection's areas of interest.

Analysis of the table shows no significant differences between the test marinas with fuel facilities installed over the last five years and known to have had the BCPA Guidelines and the inspection of opportunity marinas.

TABLE 5: COMPARISON OF INDIVIDUAL GUIDELINES' AGREEMENT BETWEEN TEST AND OPPORTUNITY INSPECTION MARINAS WITH IMPLICATIONS TO ENVIRONMENTAL PROTECTION'S RESPONSIBILITIES

	PERCENT NOT IN AGREEMENT	
GUIDELINE	TEST	OPPORTUNITY INSPECTIONS
Loading area drained to impermeable collection point	83	91
Meters isolated from delivery system	50	45
Drip pans at critical locations	17	45
Evidence of spillage	50	36
Ignition sources near critical areas	33	0
Spill clean-up equipment	50	50
Emergency number	83	59

CONCLUSIONS

In conclusion, the analysis of the results indicates that:

1. The Level One Telephone Survey, while useful at compiling some information on guideline utilization did not give a good indication of the level of guidelines' implementation or an overall impression of the maintenance of a marina. It could not be used as the sole method of assessing agreement to the 21 guideline provisions studied.

2. The Level Two Marina Inspections provided the best comparable information on overall marina design and operational procedures. More valuable was the fact that problems could be identified and that the marina operators were willing to take remedial action immediately. This suggests that if the operators had a field manual or more specific document based on the BCPA Guidelines many of these problems could be reduced at the construction or early operational stages of new marinas.

3. The Level Three sediment surveys results could not conclusively identify the source of hydrocarbons in the sediments. More meaningful data could be obtained through more intensive analytical tools, such as mass spectrometry. However, this method was judged as cost-prohibitive for an extensive sediment survey of marinas.

4. The Inspections of Opportunity gave further support to the value of the site inspections for identifying and correcting problems. When compared to the Test marina results there were no discernible differences in the level of guidelines' implementation. In fact, the assessment revealed that the peak areas of non-agreement were almost identical.

5. The BCPA Guidelines did not appear to have an influence on the design and operation of marinas in this study. Though these Guidelines were developed to reduce the risk of accidents and fires, these conditions also protect the marine environment. However, the level of implementation of some of the most critical provisions was poor.

6. The site inspections identified high levels of non-agreement to some key provisions which, if a problem were to occur, all impact on Environmental Protection's areas of responsibility.

7. The BCPA Guidelines were produced to cover a range of consumer's fuel handling facilities and as such when used for a specific marina development may be too general to be specifically applied; thus contributing to the poor performance. It may be worthwhile for the guidelines to be broken down into specific groups or facilities, such as marina fuel handling facilities, and a field user manual prepared for each case.

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APPENDICES

APPENDIX I

GUIDELINES FOR CONSUMERS BULK PETROLEUM PRODUCT STORING AND HANDLING FACILITIES

BRITISH COLUMBIA PETROLEUM ASSOCIATION
1004 - Kapilano 100, 100 Park Royal, West Vancouver, B.C. V7T 1A2
(604) 926-7431

1 JULY 1984

GUIDELINES FOR CONSUMERS BULK PETROLEUM PRODUCT STORING AND HANDLING FACILITIES

CONSUMER

PETROLEUM FACILITY GUIDELINES

1. BASIC REQUIREMENT

All facilities must comply with applicable local, Provincial and Federal regulations (eg Provincial Fire Commissioner, Workers' Compensation Board, Canada Shipping Act, Canadian Electrical Code).

SCOPE

The following has been prepared as a guideline for examining and reviewing facilities used for the purpose of receiving and storing bulk petroleum at customer's premises.

The guidelines are not intended to supersede any local, Provincial or Federal regulations.

Technical assistance is available from the petroleum supplier to supplement these standards and to review any existing or proposed new facilities.

2. REFERENCE DRAWINGS

A) Above Ground Tank (Typical)
B) Jumper Hose Connections
C) Tank Farm Impounding Wall
D) Drainage System for Dyke Area

These drawings are for reference purposes only; for further information and assistance, contact the product supplier.

3. TRUCK UNLOADING AREA

An adequate truck unloading area is to be provided for deliveries. This would consist of:

* a level area sufficient in size to accommodate the delivery unit; (ie less than 2% grade) area should be graded to drain to a safe and impermeable collection point in the case of a spill.

* an unloading area off public property, located such that the truck is not required to back onto or off public property

* an area free of ignition sources (ie open flames, non-explosion proof motors, etc)

* a drip pan or a 5 gallon bucket to collect hose drainage drips. Customer to empty containers after each delivery. This required only where it is not a gravity dump.

4. MARINE UNLOADING AREA

An adequate marine unloading area is to be provided for deliveries. This would consist of:

* sufficient depth of water to prevent grounding of marine vessel at any time
* structures to safely moor the marine vessel
* a safe working area on all sides of unloading connections
* easy access from the marine vessel to the unloading connections (eg traversing log booms are not acceptable)
* an area free of ignition sources (eg open flames, non-explosion proof motors, etc)
* a 5 gallon bucket or a drip pan to collect hose drainage and drips. Customer to empty containers after each delivery.

5. UNLOADING ASSEMBLY

The unloading assembly should be located so that a minimum of unloading hose is required.

Where unloading into storage tanks, the size of the fill pipe should be large enough to accommodate the offloading equipment without restriction.

Land: The following items should be reviewed with the carrier/ supplier and specifications agreed upon:

- underground tanks
  * minimum tank(s) capacity
  * minimum fill pipe size
  * tight fill connections
  * drop tubes
- above ground tanks
  * minimum tank(s) eapacity
  * minimum size of unloading line
  * tight fill connections
  * hose/drain valves
  * spill preventer
  * check valve (to prevent back flow)

Marine: A typical unloading assembly would consist of a blanked off flange or male quick coupler with dust cap, a gate valve, and a drain hose which may be required by the supplier's carrier. Check valves at a wharf to shorepoint are mandatory. All valving and fittings are to be steel.

6. UNLOADING PIPELINES

It is desirable to provide flanged unloading pipelines with a minimum of 75 mm (3") diameter. Larger sizes may be required by the carrier. It is strongly recommended that all lines be welded.

Above ground unloading lines should have both steel gate valve and steel unloading assembly with incombustible pipe supports at intervals consistent with good design. Buried lines under roadways should have a minimum 1 metre (3') cover, or be encased in a steel culvert at a depth of bury consistent with culvert design.

If the unloading pipeline is also connected to dispensing facilities, such lines should be isolated with positive steel valving as a precaution against high unloading line pressures.

All gate valves used in the unloading system should be rising stem type (to visually identify whether valve is open or closed).

7. DYKES FOR ABOVE GROUND TANKS

Above ground tanks are to be completely surrounded by a dyke. The dyke and the enclosed area are to be impervious and should retain water for a minimum period of 24 hours. The dyke may be constructed of concrete or impervious earthen material sized to meet all applicable government regulations. This will usually require a holding capacity of the largest tank plus 10% of the balance of the tanks, or 110% of the largest tank, whichever is greater.

A separator-sump shall be provided inside the dyked area. This may be drained by a manual start syphon or pumped over it.

All dykes shall have a suitable non-combustible walkover for safe access into the tank farm.

8. VERTICAL AND HORIZONTAL ABOVE GROUND TANKS

All above ground tanks should be made to ULC specifications S 601-1975 and API-650-1973, or latest revisions, of welded construction and mounted on non-combustible solid footings, with tanks at least 1 metre (3') apart.

* All new tanks must have an attached steel tank valve and steel fittings from this valve to the tank. Steel water draw-off valves should also be provided on vertical tanks.

* Tank venting is necessary and should be sized (minimum size 75 mm (3") to accept the carrier's tank filling rate. Normally, gasoline tanks use vacuum pressure vents, and distillate tanks use vents with a return bend.

* Emergency venting is also required to relieve excessive internal pressure caused by exposure to fires. For tanks up to 4 metres (12') diameter, this can be provided by using a 150 mm (6") diameter hinged non-locking gauge hatch. For larger tanks engineering advice is recommended.

* Individual or interconnected tanks require ladders, walkways and/or catwalks of non-combustible material, for tank gauging and emergency access.

* Individual hatches are necessary for proper gauging of product levels.

* The pipelines to above ground tanks are to have relief in order that thermal pressure in the line may be relieved to the tank.

9. UNDERGROUND TANKS

Underground tanks should be made to ULC specifications S603-1975 or S603.1-1975 (steel corrosion non-protected and protected tanks respectively) or S615-1977 (fibreglass tanks), or latest revisions, if welded construction, or to ULC approval (specification pending) if constructed of fibreglass re-inforced plastic, with fittings to meet regulations and filling rates. (ie 100 mm (4") fill pipe and suitable vent rising 4 metres (12') above ground level).

Tanks should be installed in well drained ground at least 0.9 m (3') apart and backfilled with compacted sand, or pea gravel (if fibreglass tank).

Tanks should be installed with a re-inforced concrete slab over top if subjected to vehicular traffic. This may not be necessary for steel tanks buried to a depth greater than 1 metre.

Installation must be inspected and approved by the Provincial Fire Commissioner or his designated alternate.

10. INTERCONNECTION OF ABOVE GROUND TANKS

Where two or more above - ground tanks of different top of tank elevations are interconnected, they should have positive valving to prevent the possibility of gravity flow from one tank to another, and a resultant oil spill.

11. DISPENSING FACILITIES

* Dispensing areas should be off public property, free from congestion and traffic, and designed to contain petroleum products in the event of a spill.

* As precautions against explosion and fire, all dispensing areas should be free of ignition sources, have static grounding wires, display no smoking signs, and clearly identify fire extinguisher positions.

* Marine dispensing equipment should be mounted such that

    * meters are on steel brackets with the meter and hose isolated from the system by a steel valve.

    * Service station dispensers are bolted to the deck or frame.

    * hoses are on reels or proper hanging brackets.

Note: Automotive lock open nozzles are illegal for dispensing gasoline at marine facilities.

* The facility should provide adequate clean-up materials for petroleum product spills in a designated location.

12. OPERATING SAFEGUARDS

* Grounding

All above-ground tanks and unloading connections from these tanks must be grounded. All tank car unloading connections must be grounded and bonded to the tracks as specified in C.T.C. regulations.

* Product Identification

All tanks and unloading connections require identification by product, consistent with

B.C.P.A. coding standards (2½" diameter ABS plastic tags:

- distillate products - round black tags
- gasoline products - octagonal red tags)

* Fire Extinguishers

Inspected dry chemical fire extinguishers (minimum 10 BC rating size) should be provided in well designated locations, consistent with Code requirements. The carrier will provide his own fire extinguisher for his use during unloading.

* Lighting

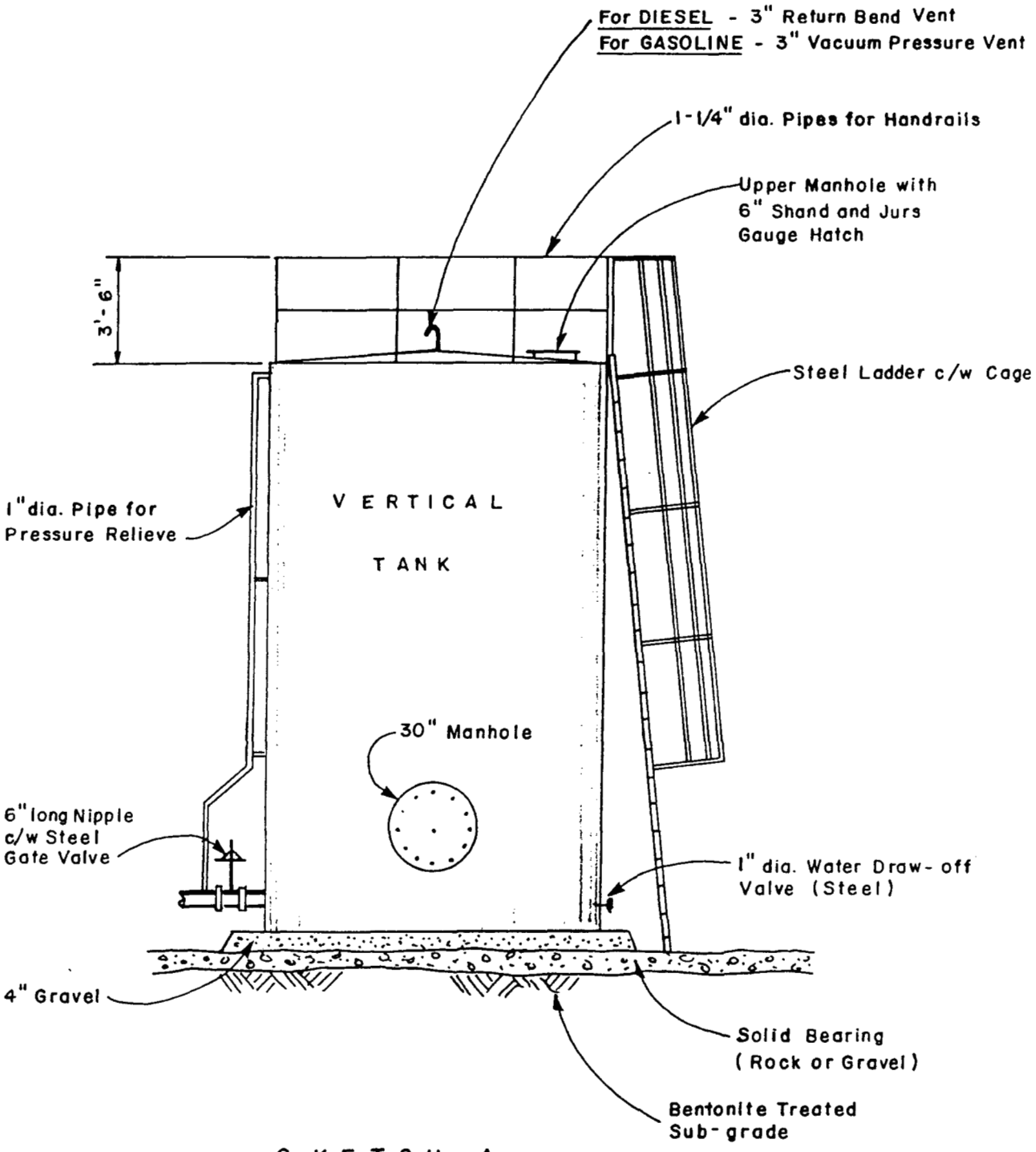
Facilities need adequate lighting to ensure a safe operation, and explosion proof fixtures are required in a hazardous area.

• Maintenance

All facilities must be maintained in good condition.

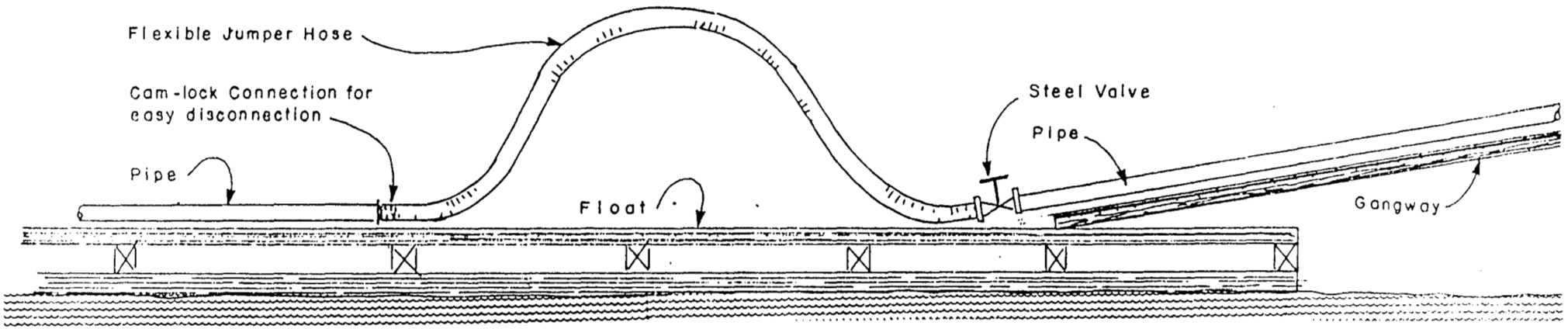
• Daily Inspection

All lines, valves should be inspected daily for possible leaks.



SKETCH A

ABOVE GROUND TANK - TYPICAL

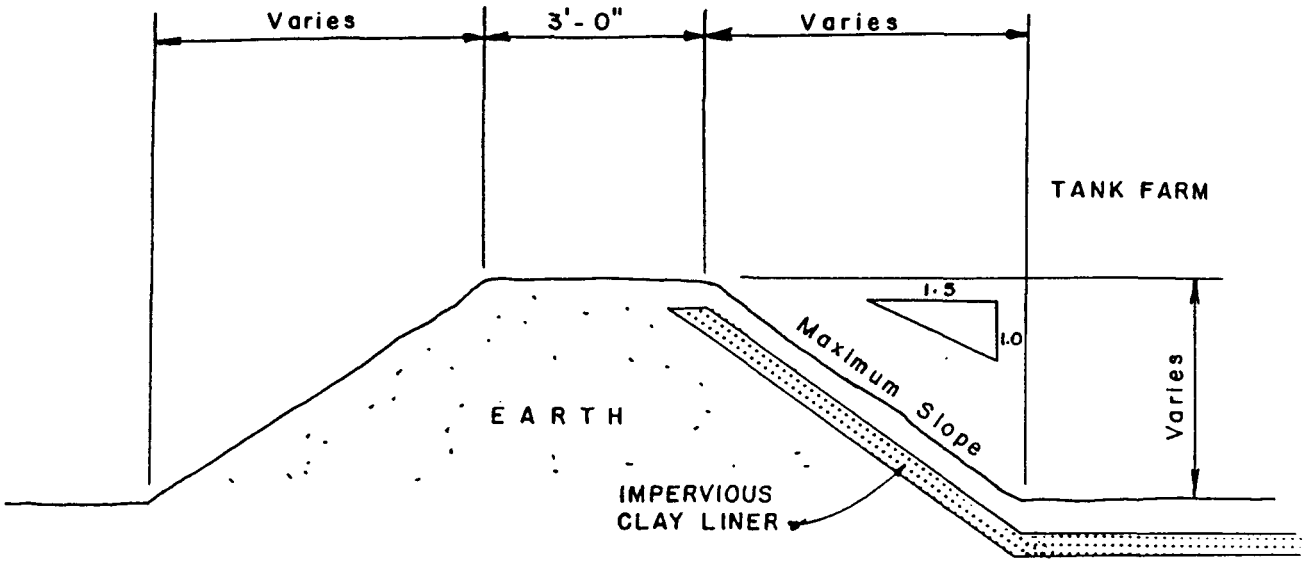


SKETCH B

NOTES :

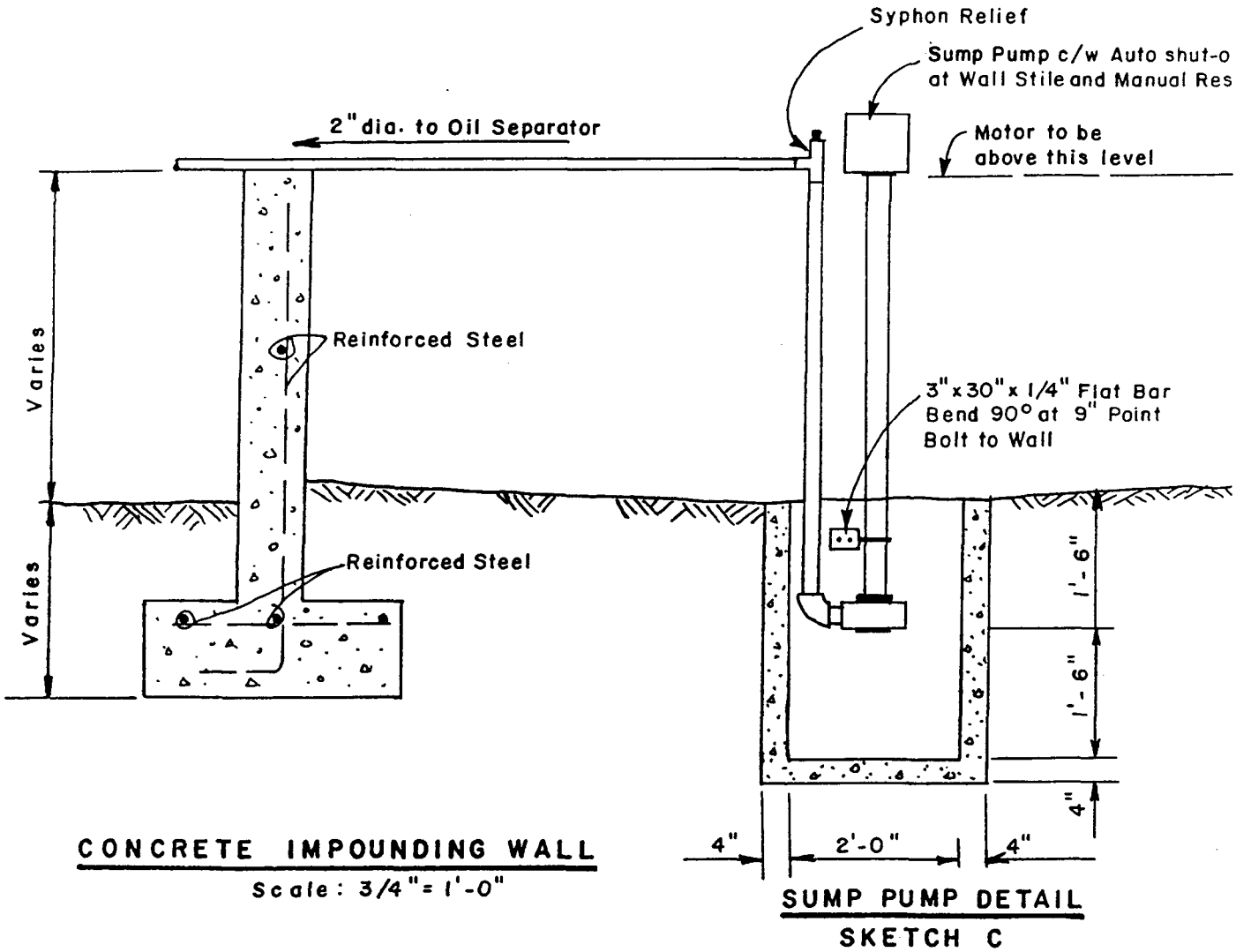
1. Jumper Hoses must be inspected annually for signs of wear
2. Hoses must be kept out of water and unobstructed from Float movement

JUMPER HOSE CONNECTIONS - TYPICAL



EARTH IMPOUNDING WALL

Scale : 3/8" = 1'-0"



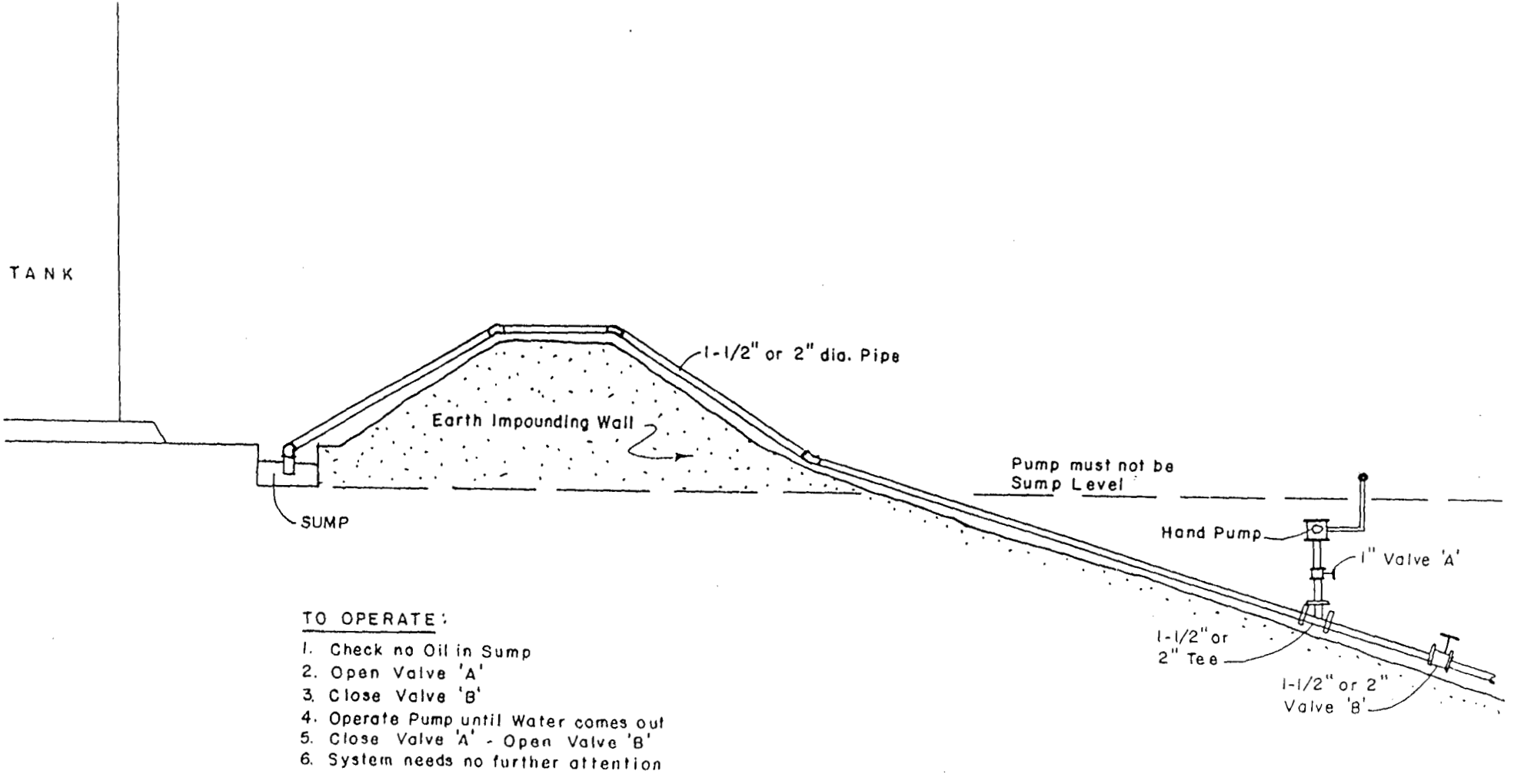
CONCRETE IMPOUNDING WALL

Scale : 3/4" = 1'-0"

SUMP PUMP DETAIL

SKETCH C

TANK FARM IMPOUNDING WALL - TYPICAL



TO OPERATE:

1. Check no Oil in Sump
2. Open Valve 'A'
3. Close Valve 'B'
4. Operate Pump until Water comes out
5. Close Valve 'A' - Open Valve 'B'
6. System needs no further attention

SKETCH D

DRAINAGE SYSTEM FOR DYKE AREA

APPENDIX II

TELEPHONE SURVEY QUESTIONNAIRE

MARINA TELEPHONE QUESTIONNAIRE

Name of Marina: _____

Location: _____

Phone: _____

Contact: _____

Owner: _____

Phone: _____

Physical Description: _____

_____

_____

SIZE AND USE OF MARINA

1. How many berths are in the marina? _____

2. How many berths are serviced with:

   water: _____

   sewer pumpout: _____

   power: _____

   shelter: _____

   other: _____

3. Is the facility used by commercial vessels? _____

   A) What percentage use is by:

      fish boats: _____

      charters: _____

      tugs: _____

      other: _____

4. How long has the marina been fully operational? _____

FUEL HANDLING

1. Do you provide a fuel dispensing facility? _____

   No: Do adjacent marinas provide these facilities? _____

   Who? _____

   A) What products are handled?

      gasoline diesel premixed

      other: _____

   B) What total volume is dispensed per month?

      gasoline: _____

      diesel: _____

      premixed: _____

      other: _____

   C) Who supplies your fuel?

      contractor: _____

      oil company: _____

   D) How is fuel delivered?

      truck boat/barge

   E) Is fuelling permitted outside of the fuel dock? _____

   F) Are portable gas tanks filled on the dock or on the boat?

      dock boat both

   G) Who dispenses the fuel?

      marina employees customers both

   H) What are the hours of operation for the fuel dispensing station?

      high season: _____

      low season: _____

      year round: _____

FUEL STORAGE

1) Are storage tanks above or below ground?

   above below

2) What is the total volume of the tanks? _____

3) Who installed the tanks? _____

4) When were the tanks installed? _____

5) Are there dykes or berms around the storage tanks? _____

   A) What is their capacity? _____

WASTE AND REPAIR FACILITIES

1) Do you handle waste oil or fuel? _____

   A) How is it disposed of? _____

2) Do you provide a bilge pumping facility? _____

   A) How is it disposed of? _____

3) Do you provide vessel repair facilities? _____

CONTINGENCY PLANS AND COUNTERMEASURES

1) Do you perform a regular maintenance check on fuel handling equipment?

   _____

   How often is it checked? _____

2) Do you have an emergency plan for dealing with fuel spills? _____

   _____

   A) Who would you call in the event of a spill? _____

   _____

3) Is there emergency spill equipment on hand? _____

   A) What equipment? _____

   _____

   B) Are marina personnel trained to use the equipment? _____

INSPECTIONS AND APPROVALS

1) Who inspected and approved your fuel facilities? _____

2) Do you have a business license with local authority? _____

3) Are you aware of the B.C. Petroleum Association guidelines? _____

4) When applying for marina approval, were you satisfied with the review process in terms of:

compliance rules: _____

nature of our environmental concerns: _____

fairness: _____

response time: _____

other: _____

5) Comments: _____

_____

_____

_____

APPENDIX III

MARINA SITE INSPECTION REPORT

MARINA SITE INSPECTION REPORT

Marina: _____

Location: _____

Contact & Phone: _____

STORAGE TANKS

Above ground Below ground Below dock

Capacity: _____

_____

Condition: _____

Dyke (concrete or impervious material): _____

Capacity: _____

(required capacity: largest tank + 10% of balance of tanks or 110% of largest tank, whichever is largest)

Separator Sump in dyked area: _____

Evidence of spillage: _____

Drain interceptor: to sewer to _____

Locks on tanks: _____

Tanks separated by at least 1m: _____

Grounded: _____

Product identification: _____

UNLOADING AREA

Free of ignition sources: _____

Trucks:

Sufficient size to accommodate delivery unit: _____

Less than 2% grade, draining to a safe, impermeable collection point: ____

_____

Marine:

Sufficient depth of water to prevent grounding: _____

Structures to safely moor marine vessel: _____

Easy access from marine vessel to unloading connections: _____

DELIVERY LINES

Gravity feed Pump Cellanoid

Material: _____

Condition of lines: _____

Vulnerable: _____

Condition of valves: _____

Type of valve: _____

DISPENSING STATION

Hose material: _____

Hose condition: _____

Vulnerable: _____

Hoses on reels or proper hanging brackets: _____

Drip pan (if no hose reel): _____

Meters on steel brackets with meter and hose isolated from system by steel valve: _____

Dispensers bolted to deck or frame: _____

Evidence of spillage: _____

Locks: _____

Fire Extinguishers: _____

Ignition Sources: _____

No smoking signs: _____

Static grounding wire: _____

Emergency phone contact posted: _____

Oil spill clean-up equipment: _____

COMMENTS

_____

_____

_____

_____

_____

_____

_____

OTHER OIL SOURCES

_____

_____

_____

_____

SAMPLES

Laboratory number and sample location: _____

_____

_____

_____

_____

Reference sample number and location: _____

_____

_____

_____

_____

APPENDIX IV

SEDIMENT SAMPLE ANALYSIS PROCEDURES

BY

TERUMI ITO

SCOPE AND APPLICATION

This method is used to quantitatively determine groups of substances with similar physical charateristics on the basis of their common solubility in a particular solvent. The Infrared procedure is much less "technician dependent" that the gravimetric procedure and has fewer interferences.

This method is generally suited for biological lipids and mineral hydrocarbons in natural waters, domestic wastewaters or sediments. Industrial wastes, however, may yield low results because of the presence of natural greases or synthetic compounds that are not recovered by the standard procedure.

SUMMARY OF METHOD

Compounds which are soluble in a Freon 113 solvent are extracted in a separatory funnel (for effluents) or using a wrist-action shaker (for sediments). The method itself is a "catch-all" method. Samples are quantitated on an Infrared spectrophotometer using the difference between the absorbances at 4000 and 2935 cm-1. There is no peak at 4000 cm-1 and it represents a baseline value to compensate for minor differences between quartz cells. The peak at 2935 cm-1 represents the C-H stretching frequency of the aliphatic hydrocarbons which comprise the synthetic oil used for calibration and the oils found in a typical refinery or oil spill.

Oils and greases are determined directly from the Freon extract. Hydrocarbon are quantitated in the same manner after treating the extract with silica gel.

DEFINITIONS

The term "Oils and Greases" includes such things as hydrocarbons, fatty acids, soaps, fats, waxes, oils and any other material which can be

extracted by the solvent from an acidified effluent or acidified sediment and that is not volatilized during the analysis. It can therefore be said that "Oils and Greases" are defined by the method used for their extraction: i.e., in this procedure, Freon 113 extractable compounds.

The term "Hydrocarbons" includes any Oils and Greases extractable material that is not irreversibly bound to silica gel.

PROCEDURES

STANDARDS

Make a "Standard Oil" with exactly 15 ml hexadecane, 15 ml iso-octane and 10 ml chlorobenzene. Determine the density by weight as a check, normally around 0.823 g/ml.

Prepare a Stock solution using 2500 mg "Standard Oil" made up to exactly 50 ml with Freon 113 (50,000 mg/l).

Prepare an Intermediate Stock solution by diluting 1 ml of the above to 100 ml with Freon 113 (500 mg/l).

Prepare Standard solutions of 100, 75, 50, 25 and 10 mg/l by appropriate dilutions of the Intermediate Stock solution with Freon 113 and a Freon 113 blank.

Transfer a portion of the solution to a 5 cm quartz cell.

Measure the solution absorbance on the Perkin-Elmer 882 IR using the built in quantitation software using the following instrument conditions:

RANGE:	4000.0 to 2900.0 cm-1
SLIT PROGRAM:	2
FILTER:	4
SMOOTH LEVEL:	4
ORDINATE:	0.0000 to 1.5000 A
CHART:	OFF
(RESOLUTION:	3.2 cm-1)

and the following QUANT conditions:

BASE 1: 4000 cm-1
PEAK POSITION: 2935 cm-1

Using CALIBRATE typical standard values obtained using a 5 cm cell are:

SLOPE=0.18902
OFFSET=7.1647
CORRELATION=0.99990

Unless there is a change in the absorbance of the Freon 113 or a change in the IR then recalibration will be necessary only periodically. This should be verified with frequent checks of the 100 mg/l standard. Each bottle of Freon 113 should be checked as a sample against the standard curve. If any bottle gives a reading equivalent to more than +/- 0.1 mg/l O&G in the Freon then the bottle must not be used or the standard curve must be redone using the new solvent.

SEDIMENT SAMPLES - OILS AND GREASES QUANTITATION

Weigh out 10 - 15 g wet sample into an aluminum dish.
Air dry overnight in the fumehood.
Check the Freon 113 as indicated in the PROCEDURE-STANDARDS, section 7.
Weigh then place the sample into a 250 ml screw-top centrifuge bottle.
Add 3 g anhydrous Na2SO4, 1 ml conc. H2SO4 and 50 ml of Freon 113.
Seal the bottle and mix on wrist-action shaker for 90 min.
Centrifuge at 2000 RPM for 10 min.
Drain each Freon extract into a toppered flask by filtering thru a small funnel with a GF/C paper and 5 g anhydrous Na2SO4.
Transfer a portion of the solution to a 5 cm quartz cell.
Measure and record the absorbances at 4000 cm-1 and 2935 cm-1 on an Infrared spectrophotometer using ANALYZE in the Perkin-Elmer 882's quantitation software and the same instrument conditions as for the standards. The QUANT

software will automatically calculate the Oils and Greases concentration in the Freon 113 extract. See CALACULATIONS.
If HYDROCARBONS are to be quantitated then return the sample to the flask and seal. See PROCEDURE-HYDROCARBONS QUANTITATION.

HYDROCARBONS QUANTITATION

Using the centrifuged and filtered solution from the Oils and Greases quantitation add 3 g of Silica gel, seal and shake for 30 min.
Centrifuge at 2000 RPM for 10 min then filter thru a small funnel with a GF/C paper and a small amount of Na2SO4.
Measure and record the absorbances at 4000 cm-1 and 2935 cm-1 on an Infrared spectrophotometer using ANALYZE in the Perkin-Elmer 882's quantitation software and the same instrument conditions as for the standards. The Quant software will automatically calculate the Hydrocarbons concentration in the Freon 113 extract. See CALCULATIONS.

Oils and Greases Concentration - Sediment Samples
{[Freon] concentration x 0.05 L x 1000} / [Dry Wt. Sample in g] = µg/g

Determine the Hydrocarbons concentration in Freon as above.
Determine the Hydrocarbons concentration in the sample as above.

INTERFERENCES

The method is empirical and duplicate results can be obtained only by strict adherence to all details.
By definition, any substance soluble in the solvent of choice will be called "Oils and Greases". These could include organic dyes, other organic compounds. Similarly, any Oils and Greases extractable material that does not absorb on silica gel will be, by definition, "Hydrocarbons". Sulfur does not interfere with the quantitation as in the gravimetric procedure. Different greases have different solubilities in Freon 113, thus extraction time plays an important part in the determination of a particular constituent.

Any substances in the sediment which volatilize during the overnight drying will be lost.

A check for consistent values absorbance between bottles of Freon 113 is essential. Contamination of individual bottles in the 10 mg/l range is a relatively common occurance with less expensive brands of solvent.

Solvents other that Freon 113 may provide different results. For this reason the solvent used must be taken into account when comparing results from different laboratories.

If the type of oil in the sample is known and a source for standards is available then it may be used in place of the synthetic standard. Care must be taken to note this fact in the results.

APPENDIX V

SEDIMENT SAMPLE RESULTS

APPENDIX V - SEDIMENT SAMPLE RESULTS

MARINA	SAMPLE NUMBER	SAMPLE LOCATION	WATER DEPTH(M)	O&G(µg/g)	HC(µg/g)
Ref. A	001	fuel dock	-	364	325
	002	50 m N.	-	666	499
	003	100 m N.	-	285	283
Ref. B	001	fuel dock	-	497	431
	002	50 m W.	-	1180	1180
	003	100 m W.	-	1030	943
1.	001	fuel dock	3	439	362
	002	30 m E.	6	129	23
	003	60 m E.	7	457	365
2.	001	fuel dock	7	1580	1290
	002	5 m W.	7	2850	2760
	003	50 m W.	7	1730	1730
	004	100 m W.	7	71500	60000
	005	150 m W.	7	1260	1260
3.	001	fuel dock	3	303	243
	002	50 m S.	6	312	179
	003	90 m S.	6	205	194
4.	001	fuel dock	4	65	65
	002	10 m S.	4	39.8	39.8
	003	35 m SE.	3	39.7	39.7
5.	001	fuel dock	4	634.1	414.9
	002	10 m W.	10	165.6	144.1
	003	25 m W.	10	255	239.3
6.	001	fuel dock	6	10900	10900
	002	50 m S.	7	1260	1260
	003	60 m S.	7	814	744.