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REVIEW OF WHATCOM COUNTY SHORE DEFENSE POLICY AND RELATED ISSUES

An analysis of current policy and recommendations for revision, prepared as part of the Whatcom County Shoreline Management Program Update.

MARY RAINES

February, 1988

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INTRODUCTION

The following information includes a review of Section 6.17, Shore Defense Works, of the Whatcom County Shoreline Management Program (SMP), 1986 Edition. This study is based on information gathered from field observations, literature research, and meetings, from July through October, 1987. A review of language and proposals for revision based on current development issues are included, in addition to background information, recommendations on specific issues, and major policy suggestions.

Many of the issues specific to shore defense works are also appropriate to other areas of the regulations and have been included, along with the appropriate section(s) where they need to be addressed. Although included, this is not intended as a thorough review of those sections. Information on specific issues and major policy recommendations may be included in the proposed backup document for the revised Shoreline Management Program, if appropriate.

Assuming that all "Findings" statements in Section 6., Policies and Regulations, will be removed and included as information in the backup document , I have organized the information for Section 6.17 as follows: A point by point review of language, backup documentation, and proposals for revision due to identification of development issues are laid out according to the pre-existing SMP format. I reasoned that it would be easier to step through the proposed changes, incorporate those that are acceptable, and move the revised Findings statements to the backup document as a whole.

PROPOSED REVISIONS TO SMP POLICIES AND REGULATIONS

6.17 SHORE DEFENSE WORKS

1.C. Finding: Add the statement:

A community development effort can treat the problem cohesively and more effectively and save money in the long run.

1.D. Finding: Add the statement:

The design of shore defense structures requires an engineering background and knowledge of the forces at work, such as the stable underwater slopes profile, intensity of storm waves, and period of the predominant swell. Purely mathematical or short-term studies of these factors can be misleading, and historical records or a thorough geomorphological study are more reliable indicators of long-term or average trends.

1.F.1 Policy:

Add the words "resource losses" after ...benefits to the region outweigh..

1.G. Finding: Include the following paragraph:

With regard to bulkheads, shoreline riprap, and rubble breakwaters, avoid vertical wall structures in the nearshore environment which, during high tide, could force juvenile salmon into water depths greater than a few feet. A 1.5 horizontal to 1 verticle slope ratio is recommended. If vertical structures are required for functional or economic reasons, rock riprap should be placed at the base of the wall, with slopes of no more than 1.5/1. The openings between the rock provide cover for juvenile salmon and a substrate medium for biological growth of organisms which salmon feed upon, in addition to protecting the toe of the structure.

Policy: Add the statement:

Protection of shoreline resources is directly linked to water quality.

1.I. With regard to policy, I find the implementation of a local program to this effect highly unlikely. The alternative proposal:

Policy: The removal of all failed, derelict, unnecessary, damaging or ineffective defense structures on a property should be removed before permits for replacement or new defense works are issued.

1.J. A major revision is recommended here which would include the addition of non-structural alternatives to the policies covering structural or engineered defense works. Including non-structural techniques will stress their viability as feasible defense works.

The following general information should serve as a guideline for the process of selecting appropriate action to shoreline erosion. This outline should be included in the SMP backup document:

<u>Defense Works: Options, Criteria and Techniques</u>

A. Options for shore defense:

1. Allow the shoreline to retreat naturally and locate or relocate buildings accordingly.

2. Attempt to stabilize the shoreline with hard structures.

3. Attempt to stabilize the shoreline through "softer" or non-structural means.

(Pilkey, Clayton 1987)

B. Criteria for erosion control projects:

1. A significant long-term rate of erosion must be determined.

2. The causes of erosion - wave data or local wave climate - must be determined.

3. Regional littoral processes, such as net drift and the direction of transport as it varies with the directions of wave attack, must be determined.

(Chu, Hands 1987)

C. Shore protection techniques and alternatives:

1. On Shore - Backshore protection structures are designed to protect establishments or embankments immediately behind from direct storm waves.

a. Structural Alternatives - (may contribute to beach erosion):

Bulkheads
Seawalls
Revetments (Chu, Hands 1987)

b. Non-Structual Alternatives

No action - The value of the land lost is balanced with construction and/or maintenance costs of structural options and environmental considerations.

Increased setbacks for upland development.

Relocation of endangered buildings.

Vegetative enhancement or stabilization.

2. Off Shore - Beach protection structures prevent beach sediment from being eroded by waves andlongshore currents.

a. Structural Alternatives - (may starve down drift areas and cause erosion):

Breakwaters
Groins (Chu, Hands 1987)

b. Non-Structural Alternatives (long term maintenance):

Beach nourishment
Perched beaches

Structural Defense Works Recommendations

1.J. Bulkheads, Findings: Add:

Bulkheads are appropriate only as a method for armoring an erodable shoreline where less rigid alternatives are infeasible, and are inappropriate for retaining slopes destabilized by upland use.

Policy: Add:

Vertical wall structures are to be avoided in the nearshore environment which, during high tide, could force juvenile salmon into water depths greater than a few feet.

1.L. Jetties and Breakwaters, Policy: Add the reference:

Refer to Section 6.10
(See comments on Marina Development.)

1.M. Groins, Findings: Add:

Effectiveness of protection is questionable except under favorable conditions. The suitability of the site and the impact of the structures need to be considered in the context of a large length of coastline. Study the transient or more permanent nature of the problem, ideally by successive surveys over a number of years. Groins are more or less permanent. Beach nourishment can stop erosion if the problem is transient. (Coastal Engineering p146).

(New Section)
1.N. Seawalls, Findings:

Seawalls may stabilize the shore but unless a protective beach is maintained in front, there will be a need for frequent repair. Beaches are often depleted by scour due to reflection of storm waves from the wall. (Bird 1984, p83)

Policy: The construction of seawalls is considered an extreme, last-resort measure associated with large public works projects. Where practicable, set backs and artificial beach nourishment are preferred.

(New Section)
1.O. Revetments, Findings:

Revetments with irregular faces (ie, riprap) and shallow slopes have a greater ability to support marine life and dissipate wave energy than structures with smooth surfaces and steep slopes. In providing backshore protection, revetments have the advantage of being flexible, easily repaired, and low maintenance structures. They may promote beach erosion, but less than a bulkhead or seawall due to wave energy dissipation. Revetment construction activities may impact natural resources. An initial loss of organisms and habitat can occur during placement, and species diversity and abundance may be altered (Shanks). Damage can be expected to rubble mound structures when design conditions are exceeded, and care should be exercised in the design dimensions, foundation treatment, and selection of stone size. Revetments may limit beach access.

Policy: Revetments should be designed with materials that will impart a natural appearance and conform to applicable engineering standards, and constructed consistent with engineering principles. Irregular rock rubblemounds with shallow slopes are preferred over smooth surfaces and steep slopes.

Non-Structural Defense Works Recommendations

(New Section)
1.P. Bluff Drainage, Findings:

Improper bluff drainage induces sloughing of banks where there is an upper pervious strata and an impervious layer below. (A number of failed banks were noticed directly below residences on shoreline inspections). Instability results from oversaturation of the upper layer from domestic run-off, soil disturbances, and vegetation removal to improve waterfront views. Refer to SMP backup document section on slope stability.

Policy: Bluff drainage control is an appropriate corrective technique where erosion is wholly or in part caused by upland use. It can also be used in combination with structures to protect unstable slopes against direct storm waves where applicable. (Army Corps of Engineers)

(New Section)
1.Q. Bluff Regrading and Revegetation, Finding:

Minor bluff regrading and revegetation may be suitable on steep and unstable slopes. This approach consists of grading the bank to a stable angle, revegetating the slope, and armoring the toe of the slope. Environmental disruption and effects on sediment transport must be understood, however. Information on plant species suitable for slope revegetation and stabilization is available from the Soil Conservation office. (Army Corps of Engineers)

There are relatively few Puget Sound shorelines with dunes or back beaches on which vegetation enhancement would be an effective shore erosion control measure by itself (Canning #1). However, removal of existing vegetative cover can initiate or accelerate erosion. Vegetation is an important factor in erosion control. (Canning, papers 2,3)

Policy: Minor Bluff regrading and revegation may be appropriate as an erosion control measure when designed to specific slope materials and circumstances. Armoring of the toe of the slope may include course beach fill, revetments or bulkheads. For lengthy slopes, terracing and drainage considerations need to be incorporated to prevent accelerated run-off. Regrading of bluffs should be limited to severe problem areas where benefits to the public and landowner will clearly outweigh the costs.

(New Section)
1.R. Relocation of Structures, Findings:

Protective structures may be more expensive in the long run than relocating structures. The major planning consideration should be the rate of erosion. Other considerations include the condition of the structure to be moved, the expense of a new foundation, utilities, access or obstructions, and the length of the move. (Army Corps of Engineers)

Policy: Relocation of structures endangered by shoreline erosion should be encouraged as a practical and realistic alternative to costly shoreline defense structures with questionable long term effects.

(New Section)
1.S. Beach Nourishment, Findings:

Artificial beach nourishment remedies a deficiency in the existing beach material supply and can afford protection for adjacent uplands when maintained to proper dimensions. Long reaches can be protected in this manner at a relatively low cost. Beach nourishment can avoid negative impacts and actually enhance downdrift shorelines. Projects can be designed to provide a recreational beach, protect the backshore from flooding and protect structures from direct wave attack. (Chu, Hands 1987)

Beach nourishment has a limited application in Whatcom County because of the lack of backshore protecting berms, the presence of many rigid structures on those reaches where this technique is appropriate, and the lack of suitable clean fill from convenient sources, such as dredge spoil. A few areas, such as the marinas at Birch Bay, Point Roberts and Sandy Point, probably have suitable beach material from maintenance dredging due to the interruption of littoral processes in those locations. This being the case, beach quality dredge spoil should be placed downdrift of marinas as a mitigation for loss of material in those areas, and additionally to prevent the use of this material as upland fill or the needless transport to offshore disposal sites.

Policy: The use of artificial beach nourishment is suitable for shore protection where project designs are based on accepted coastal engineering considerations and materials used are cost effective, while allowing proper gradations of granular material to absorb wave and swash energy. Designed beaches must be maintained consistently during the project life.

3.B. Add:

Damage and structural failures are not uncommon before defense structures reach their economical life. Damage to flexible structures is generally not excessive compared to the repair of equivalent rigid structures. (Chu, Hands 1987)

4.A.(1)(b) Add:

bluff drainage control, minor bluff regrading and revegetation, and relocation of structures.

4.A.(2)(b) Add:

bluff drainage control, minor bluff regrading and revegetation, and relocation of structures.

4.A.(3)(b) Add:

bluff drainage control, minor bluff regrading and revegetation, and relocation of structures.

4.A.(4)(a) Add:

and does not interfere with long shore transport of material. (Eliminates inconsistency with designations definition for Conservancy.)

4.B. Add as new category before (1) Professional Design:

(1) Considerations for shore structure design:

What are the direct construction impacts?
Does the proposed project enhance or hinder public access?
What are the long term impacts of the completed proposal?
How does it affect the aesthetics or views?
What are the cumulative impacts in conjunction with other known and reasonably anticipated activities in the area?
Is shore protection necessary and appropriate to circumstances?
Does the proposed project interrupt or alter longshore transport?
Does it interfere with the public right to navigable waters or to rights of access? (Canning #1)

Land use planning and construction of shoreline structures should take into consideration the coastal gemorphology and interrelated ecosystems of the appropriate reach or reaches affected by construction. (Refer to Phillabaum report or Shoreline Inventory: Whatcom County, Washington, for this information.)

4.B.(3)(c)(i) This section is inconsistent with 6.17, 2.A. which does not allow contruction of defense structures on accretion shoreforms. If the shoreline in question is indeed an accretion shoreline, then protection from erosion is usually unnecessary. Seasonal flucuations in shoreline material will occur giving rise to the idea that erosion is a problem; however, misplaced structures and defense works may indeed create a permanent erosion problem (Reynolds 1987, p425). It is necessary to determine if the property proposed to be protected is sufficiently set back from the OHWM, and that the protection offered is against the occasional storm surges and driftwood battering and not an ill-perceived erosion problem.

This is an important distinction. As we attempt to halt erosion of feeder bluffs, create structures that interfere with long shore transport of material to accretion shoreforms, and protect property located within the backshore, the cumulative effect is one of disappearing beaches.

Change this section to read:

Bulkheads on marine accretion shoreforms shall be limited to those permeable structures that protect property from occasional storm surges and/or driftwood battering, and shall be set back a minimum of 20 feet landward from OHWM.

4.B.(3)(d)(ii) Add:

A 1.5 horizontal to 1 vertical slope ratio is recommended for bulkheads located within 5 feet of the OHWM. If vertical structures are required for functional or economic reasons, rock riprap should be placed at the base of the wall, with slopes of no more than 1.5/1. The openings between the rock provide cover for juvenile salmon and also provide a substrate medium for biological growth of organisms which salmon feed upon.

4.B.(3)(d)(iv) Add:

Proper drainage shall be facilitated by the use of proper backfill material and weepholes in the bulkhead.

Add a new section:

(v) Bulkhead construction shall include proper foundation protection. Graded stones at the toe of the structure can prevent toe scour, dissipate wave energy, and reduce wave overtopping rates. (Chu, Hands 1987)

6.5 DREDGING

Include in Finding statements under General Policies:
(See also, proposed Section 6.17 1.B. on beach nourishment.)

Dredging is related to harbor structures which greatly modify littoral processes.

There is no dredging method that would absolutely safeguard the environment. Regardless the method used, major alteration to the environment will occur, and temporarily increased levels of turbidity will result. The least damaging method is that which causes minimal disturbances to the environment. The use of special techniques to reduce turbidity and release of contaminants during the dredging operation is recommended. Dredging should be undertaken well outside periods of peak growth, critical spawning and nursery for fishes and shrimps.

The disposal site should be in deep water far away from identified important and sensitive areas. The vertical distance between sea bed and dumping level should be minimized to reduce settling time of the fine particles and consequently to alleviate turbidity. Deeper water reduces the effect of wave motion on the horizontal movement of the bottom particles. (Ghobrial 1987)

Options for the disposal of dredged materials include:

Unconfined open-water disposal
Confined aquatic disposal (capping)
Nearshore and upland disposal

Don Ellis from the Port of Bellingham has communicated that dredge spoil from Bellingham and Drayton harbors is unsuitable for beach fill due to an undesirable, silty consistency and contamination.

EROSION CONTROL

Can be incorporated into the following SMP sections:

Commercial - Include in 6.4 3.F. or create a new heading under 4.3., General Regulations.
Agriculture - 6.2 1.C & E
Forest Practices - 6.7 B.

There is a need to address erosion and run-off controls in construction projects, in addition to agricultural and forest practices. Proper site planning and erosion control measures are needed. Increased public maintenance costs result from sediment fill in roadside drainage ditches, catch basins, clogged culverts, run-off retention, and detention ponds.

Water pollution by sediments and aquatic lands degradation can result from the cumulative impacts of construction activities within a watershed. Chronic erosion from poorly stabilized development sites contributes significantly to cumulative impacts of erosion and sedimentation.

No run-off from a construction area should enter a receiving water without passing through a sediment trap or settling pond, along with appropriate energy dissipators. (This should be included in any EIS). (Canning No.3)

FISHERIES RELATED ISSUES

Need to be addressed in the following SMP sections:
6.2 1.G. and 2.C., 6.7 1.C. and 2.C.

The area of maintenance and enhancement of riparian and instream fish habitat is affected by stream control structures, forest practices, agriculture, roads, and industry. Identification of issues specific to the fisheries are listed below and some have been addressed individually in Section 6.17.

In the opinion of fishieries biologists, there is a need for more stable streams to buffer the instream habitat losses due to localized disasters in the Nooksack watershed. Because of the presence of glacial deposits, landslides and debris flows due to both natural causes and logging practices are not uncommon and result in destroyed instream habitat. With increased logging activity, it is not sufficient to have earmarked a small number of streams for enhancement and protection. (Williams)

The recovery capacity of the system is considered good - approximately 40 years. This gives hope to the rehabilitation of the natural systems and native stock as opposed to a hatchery solution to fisheries management. In other words, it is well worth the effort to increase the number of protected Nooksack tributaries in the Shoreline Management Program. An updated review of stream flows and information from local watershed specialists is recommended as an aid in identifying additional streams.

A larger issue in watershed protection is state controlled logging practices. The glacial impact in the Nooksack drainage tends to be greater than in drainages further south in the state due to thicker ice sheets and longer periods of glaciation, consequently the watershed tends to magnify the the impact from generic logging practices.

Logging impacts create greater run-off, which cause erosion and the need for more riprap - a cyclic process. Riprap destroys vegetation used as protective cover for fish, destroys feeding stations due to channelization and increased velocity flow, destroys back eddies, and increases river temperature. One mitigation technique may be to vegetate the riprap. Obviously there is no clear path on which to proceed. Logging will continue, along with our need to protect property by keeping the river in its present channel. However, enforced logging practices appropriate to the drainage may help to minimize this impact. Alternative techniques for erosion control on streams and rivers are not covered in this report.

Sedimentation is a hazard to fish reproduction. There is a need for sedimentation controls in construction and logging. Construction projects need bankside vegetative buffers which serve as natural vegetative filter strips, and siltation structures between logging sites and seasonal or year round streams to help minimize sedimentation. (Refer to erosion control).

<u>MARINA DEVELOPMENT</u> (as related to resources)

Marina development activities which directly affect the Northwest salmon resouce:

1. Moorage basin dredging and filling, construction of bulkheads, shore attached rubblemound breakwaters, and other coastal structures force juvenile salmon away from natural intertidal and shallow subtidal environments and into deeper water. These structures destroy juvenile rearing habitat, and affect migration routes.

2. Water quality - tidally influenced water circulation systems can be affected by rubblemound breakwaters in combination with dredging of shallow aquatic lands.

3. Blockage of natural littoral drift. (Layton 1987)

Needs to be included in Section 6.10:

> Floating breakwaters are preferred for wave protection of foreshore marinas where wave conditions are not severe. They allow free movement of water and marine life under the structure and eliminate destruction of bottom habitat. The limiting condition for a conventional floating breakwater is a significant wave height of

approximately 3 feet in combination with a wave period of no more than 3 seconds. (Layton 1987)

Mitigation Features

Professional design by mitigation incorporates environmental concerns into the design criteria of engineered projects. During the design process, early identification of potential adverse impacts from construction and operation and early incorporation of specific engineering and environmental measures can mitigate the potential impacts. (Layton, 1987)

Mitigation features can be incorporated at three levels:

1. A project may be engineered to minimize environmental impacts during both construction and operation by including such features as floating breakwaters, non-vertical bulkheads, or insuring water circulation patterns.

2. Enhancement of existing habitat and/or replacement of lost habitat.

3. Maintenance of mitigation features during operation, including proper waste management.

SLOPE STABILITY

Needs to be addressed in the following SMP Sections:

6.4, Commercial 6.15 4.B.(8) and 6.15 3.B., Residential

Most slope failures in the Puget Sound region occur during or closely following periods of heavy rainfall or at locations with saturated soils. When surface soils are underlain by an impermeable layer such as glacial till, infiltrated rain water will accumulate in the soil over the surface of the till and seep out of the slope face. Flow velocities along that surface may increase near the face of the slope, and failure may occur, especially if there are other contributing stresses such as vegetation removal or added weight from contruction. (Canning No. 2)

On-site sewage disposal systems near hazardous slopes can greatly add to the risk of slope failure due to oversaturation, as does storm water run-off.

Clearing and grading permits are recommended for vegetation removal and land grading that can decrease slope stability if done improperly. (use DOE slope stability atlas). (Canning #2)

Perforated drain pipes from upland structures should be directed to the bottom of the bluff to avoid gullying.

Improper construction of access stairs and paths to beaches can affect slope stability.

RECOMMENDATIONS

Shoreline Development Mitigation

Under the assumption that development in the shoreline environment has an environmental impact, all eco-systems at risk in a development need to be evaluated. We need to weigh the value of the development with the value of the resources. Regardless the size of the development project, there will be some resource loss that needs to be replaced or mitigated.

In and of themselves, small projects usually have a small impact. However, considering the limited amount of shoreline, these small unassociated projects can add up to a damaging whole. We are, in effect, subsidizing the shoreline property owner by trading damaged public resources for development by not requiring compensation. (Webber)

With this in mind, it is not unreasonable to ask all shoreline permit applicants to address the environmental impacts of a proposed development project, and expect to provide mitigation for these losses, however small. Mitigation may take the form of structures engineered to facilitate rather than hamper natural geologic and biologic processes such as littorial drift and fish migration, habitat enhancement such as eel grass plantings, or public access. Mitigation should include a form of replacement of the lost resources such as marine habitat or long shore drift material, but may include engineered solutions to minimize impact of affected resouces.

Evaluation of Erosion Rates

"Proper management of the shoreline should include a systematic analysis of shoreline movement trends and geomorphic processes and responses. Without firm understanding of coastal dynamics, management of most shoreline resouces becomes a guess." (Reynolds 1987 p425)

Misplacement of structures can be avoided by the study of shore movement trends and migration history and geomorphic processes and responses. Seasonal variations in beach profile are common. Perturbations to the mean profile may not be indicative of the long-term trend (Chu, Hands 1987, p1097). Some apparent erosion can be a temporary cycle made permanent by erosion control structures. In addition, an historical perspective may give valuable information on how the engineered shoreline has affected erosion or accretion rates.

Without calculated erosion rates, it is difficult to establish revised and meaningful set-back requirements. With adequate set-backs we respect the natural processes at work and the engineered shoreline becomes unnecessary. Rigid shore defense works should then only be developed for individual lots where erosion threatens buildings constructed prior to new contruction set-backs. To allow siting of new construction that will require major erosion protection within the economic life of the project is to perpetuate a serious shoreline problem.

There is also a need for studies of migration trends of individual spits and cliff erosion rates at specific sites. Only when it is known what is happening at a specific site can problems associated with geomorphic processes be avoided. One of many local examples is the misplacement of the marina at Birch Bay, where if located at the end of an accretional area would have avoided the interruption of littoral drift and the acceleration of erosion downdrift. The application of calculated erosion rates borrowed from studies in other geologically similar areas may be misleading due to the variable factors of length of fetch, direction of swells, composition of cliff or bluff material, the impact from current upland use, and locations of shoreline structures.

The long term variations of shoreline position can be developed from historical records. The long term rate of shoreline erosion can be measured and the variability can be calculated (Chu, Hands 1987) from historical documents such as early surveys and plot maps that may contain survey points and a plot of bluffline and shoreline. The creation of a topographic map showing the historic location of bluffs and shores and present locations is recommended.

A purely empirical approach is recommended as the best method for predicting beach behavior until sounder theoretical models are developed (Pilkey, Clayton 1987).

Marine Shoreline Continued Inventory

A lot of the information from earlier inventories is already outdated - coasts intrinsically are constantly changing. The County needs a basis for comparing subsequent data, and to continue building a data base for erosion rates.

Updating the Shoreline Inventory is recommended, and should include the composition and slope of the nearshore, evidence of erosion or progradation, and signs of shore drift for each of Phillabuam's original reaches or Bauer's drift sectors.

Both Bauer and Schwartz recommend long term, continuing studies. As noted in "Drift Sectors of Whatcom County Marine Shores," an updated aerial photo time series analysis to measure erosion/accretion rates is needed.

Long Range Planning

An insular and haphazard approach to coastal defense policy needs to be replaced by a large scale/long term perspective with cooperation among administrative bodies allowing a wider financial and legislative base. (Coastal Engineering p132)

Terich suggests long range, not site specific policies. He sees a need to look at the regional impacts of long term bulkhead installations (seawall effect), as it hardens the shoreline causing beach loss and an engineered shoreline. Terich suggests studies on shoreline bluff erosion rates and greater setback requirements to protect development.

A need is also perceived for "systems level study and analysis" - in other words, teamwork to combine the physical, biological, and economic sciences. This includes all ecosystems, the living and non-living components. Numerous coastline books conclude with the need to treat the coastline as a physical and biological whole.

The structural response to beach erosion is generally an escalating one:

"Structures become larger, more expensive as they are destroyed and the only options are to build larger, more unsightly sructures or abandon the shoreline. Inevitably, beaches seaward of seawalls disappear and don't return. The shoreline becomes an engineered one not conducive to many recreational amenities, and generally significantly degraded aesthetically." (Reynolds 1987, p423)

As an example of long range planning, Florida is moving to require monitoring of all projects granted a state permit. The regulations will provide a valuable data base for use in the future review and development of engineering principles. (Pilkey, Clayton 1987)

Public education

In some areas, shorelines are retreating faster than policy makers can develop effective management plans. As a result, immediate responses to the shoreline crisis come from property owners, community planners and coastal developers, who become the front line of decision makers with respect to prudent land use. (Pilkey, Neal 1987, p4794)

Information is now becoming available summarized in nonscientific format for the general public (The Coast of Puget Sound - It's Processes and Development by John Downing and Living with the Shore of Puget Sound by T. H. Terich). In addition to commerically available sources of information, it would benefit Whatcom County, perhaps in coordination with the State, to develop a long range public shoreline education plan. Such an effort would greatly facilitate the effectiveness of the Shoreline Management Program.

Immediate, short range recommendations for public education include:

(1) Have more design information available for the public. See Army Corp of Engineers brochure if the County wants to wait in developing their own brochures.

(2) Compile an extensive/comprehensive permit application process flow chart showing the regulatory programs and criteria necessary to carry out a shore protection project, and have this visably available at the Buildings and Code counter (see DOE Technical Advisory Paper #1, p37).

(3) Signs installed at all county marine launch facilities warning the public of the hazards of marine pollution, especially non-biodegradable plastics, with trash depositories available.

Zoning in Geologically Hazardous Areas

Shoreline zoning classifications should take into consideration geologically hazardous areas, such as unstable slopes. Development density reductions should take place in these areas.

Possible courses of action to reduce liability management in the shoreline area is to identify geologically hazardous areas, zone accordingly, place areas in public holdings by land acquisition where possible, or reduce taxes for geologically undevelopable areas.

Water Quality

Protection of many shoreline resources is directly linked to water quality.

The SMP should include a statement that Whatcom County recognizes the Puget Sound Water Quality Authority Plan.

Tidelands

Where leased or sold to private concerns, attempts should be made at reacquisition of tidelands. This should be a policy statement.

Philosophy Statement

We have the opportunity to learn by the mistakes made in higher impact areas of Puget Sound and the U.S. and the opportunity to avoid costly corrective measures necessary to clean up and preserve our natural resources. Conscious and deliberate use of resource sensitive development techniques will greatly facilitate realization of these opportunities.

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Williams, Brian W., meeting August 17, 1987; Fisheries Biologist, Nooksack Indian Tribe.