Net Shore-drift in Washington State, Volume 4: Hood Canal Region

June 1991

Shorelands and Environmental Assistance Program
Washington Department of Ecology
Olympia, Washington 98504-7600

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INTRODUCTION

In the late 1970s and early 1980s the Washington Department of Ecology and Western Washington University cooperated in a series of net shore-drift studies of the Washington marine shoreline. For many years these reports were out of print. In recent years heightened concern about the adverse effects of wide spread marine shoreline bulkheading, interest in the effects of accelerated sea level rise, and the state's need to respond to extension of the federal Coastal Barrier Resources Act to the Pacific coast has prompted us to reissue the old studies and sponsor a study of areas not covered earlier.

The original studies were issued as separate reports for each county. This reissue compiles the original studies into five volumes, plus subsequent studies completed in the 1990s to fill gaps in the research program.

> Net Shore-drift in Washington State, Volume 1: Pacific Ocean and Strait of Juan de Fuca (Pacific, Grays Harbor, Jefferson, and Clallam counties) Ecology Report 00-06-30.
>
> Net Shore-drift in Washington State, Volume 2: South Puget Sound (Mason, Thurston, and Pierce counties) Ecology Report 00-06-31.
>
> Net Shore-drift in Washington State, Volume 3: Central Puget Sound (Kitsap, Pierce, and King counties) Ecology Report 00-06-32.
>
> Net Shore-drift in Washington State, Volume 4: Hood Canal: (Mason and Kitsap counties) Ecology Report 00-06-33.
>
> Net Shore-drift in Washington State, Volume 5: Northern Bays and Straits (Whatcom and Skagit counties) Ecology Report 00-06-34.
>
> Net Shore-drift in Washington State, Volume 6: San Juan, and parts of Jefferson, Island, and Snohomish Counties, Washington. Ecology Report 00-06-35.
>
> Net Shore-drift in Washington State, Volume 7: Grays Harbor, Willapa Bay, and the Mouth of the Columbia River, Washington. Ecology Report 00-06-36.
>
> Quantification of Net Shore-drift Rates in Puget Sound and the Strait of Juan de Fuca. Ecology Report 87-10

The Department of Ecology reports cover all of Washington marine shorelines except for the Saratoga Passage - Admiralty Inlet area covered by the US Geological Survey Port Townsend 1:100,000 quadrangle. This map-based report is available from:

> US Geological Survey
> Map Sales
> P. O. Box 25286
> Denver, CO 80225

Order publication number *MAP I-1198-E* titled *Map showing coastal erosion, sediment supply, and longshore transport in the Port Townsend 30- by 60-minute quadrangle, Puget Sound region,*

Washington.

The net shore-drift studies are based entirely on systematic field observations. The only other comprehensive source of shore-drift information is the Coastal Atlases, published by the Department of Ecology in the late 1970s. The drift directions in the Atlases were predicted by a method known as wave hindcasting, where information regarding predominant wind conditions, exposed fetch, and shoreline orientation are used to calculate the most likely direction of sediment transport along the shoreline. Unfortunately, the estimates were based on wind records at only five weather stations around the Puget Sound basin, and were not representative of conditions at specific shoreline locations. The drift directions in the Atlas are often inconsistent with field observations. At the Department of Ecology, we consider the observational data in the Western Washington University shore-drift studies to be a far more reliable indicator of coastal conditions.

TECHNICAL APPROACH

Fundamental to these reports is the concept of a drift cell (also called a drift sector) which is a partially compartmentalized zone along the coast that acts as a closed or nearly closed system with respect to transport of beach sediment. The sediment transport, a process called shore drift, is primarily in response to the oblique approach of wind-generated waves. Direction of wave approach, and the resulting shore drift, may change frequently (e.g. daily, weekly, or seasonally), but over a long term one of the two directions along the coast will be the direction of net shore-drift. The direction of net shore-drift and the limits of drift cells can be determined by field observations of certain geomorphic and sedimentologic indicators. These net shore-drift indicators are described by Hunter, Sallinger and Dupre (1979, U.S. Geological Survey, *Longshore Sediment Transport, Alaskan Bearing Sea Coast, Map MF-1049, 5 sheets*), by Jacobsen and Schwartz (1981, *Shore and Beach*, v. 49, p 38-43), and by Keuler 1980, Geological Society of America, *Abstracts with Programs*, v. 12, p. 114).

Based on such field observations, these reports describe the geographic limits of drift cells in the county, describe the direction of long term net shore-drift in each cell, and briefly summarize the evidence for these limits and drift directions. The accompanying maps show the drift patterns for each of the map areas covered by a U.S. Geological Survey 7.5' quadrangle. Within the limits of each map area, complete drift cells may occur, or in some cases, drift cells which are continuous to or from adjoining map areas cross the map boundaries. For this reason the text that describes the net shore-drift for each map area refers to "Drift Cells" when a complete cell is shown in the map area, or "Segments" when only a part of the drift cell is included in the map area. An explanation of symbols used on the maps is shown in Figure 1. Throughout these reports, descriptions of beach sediment grain size follows the Wentworth Classification System shown in Figure 2.

In using the maps it should be recognized that the origin and terminus of drift cells are zones, not points. The maps show the long-term average position of these zones. During different seasons or years a zone of drift divergence may vary somewhat along the shore. Similarly, a drift cell convergence site, such as a cuspate spit, may have shore drift continuing around the spit, at times, due to short-term wave conditions.

— — — — —	Zone of long-term drift divergence.
——————►	Direction and length of net shore-drift. The line begins at the initial indication of a net drift direction. The arrowhead is positioned at or near the long-term drift cell terminus, a depositional zone.
	Orientation of the arrow indicates net shore-drift enters from, or continues into, the adjacent map area.
3-2	The dashed numbers are an aid to correlate the map and accompanying text. The number before the dash corresponds to the map number. The number following the dash is a sequential reference to the various drift cells or segments or drift cells shown on each map.
nansd	Acronym for "no appreciable net shoredrift". Such a condition may occur due to factors such as no sediment supply, a shore artificially filled or otherwise modified out to deep water, or a shore of very low wave energy.

Figure 1. Explanation of map symbols.

Grain size, in millimeters	Wentworth Size Classes	
	Boulder	
256		
	Cobble	
64		GRAVEL
	Pebble	
4		
	Granule	
2		
	Very Coarse Sand	
1.00		
	Coarse Sand	
0.50		
	Medium Sand	SAND
0.25		
	Fine Sand	
0.125		
	Very Fine Sand	
0.0625		
	Silt	
0.0039		MUD
	Clay	

FIGURE 2. The Wentworth sediment size scale which is the basis for all sediment size descriptions in this report.

MASON COUNTY, WASHINGTON, NET SHORE-DRIFT

Prepared for the
Washington State Department of Ecology

by
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Coastal Consultants, Inc.
Bellingham, Washington 98225

June 30, 1982

MAP MA-1

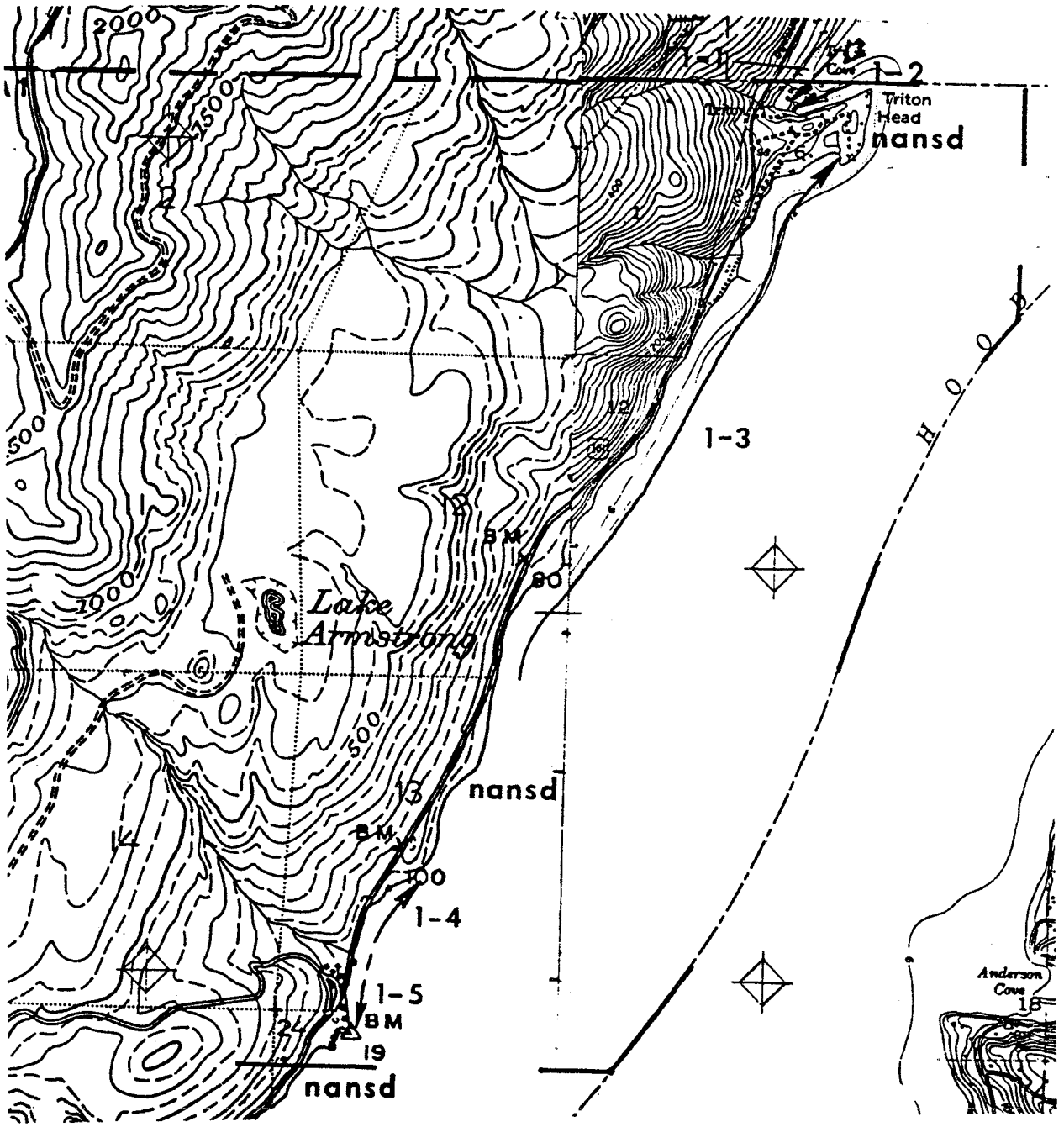
Segment 1-1 This segment within Triton Cove is the continuation and terminus of a drift cell which originates to the northeast in Jefferson County. Net shore-drift to the southwest is indicated by sediment accumulation on the northeast and erosion on the southwest of several groins. In addition, although the beach is narrow, it widens somewhat to the southwest. Triton Cove is protected from prevailing southwest winds by a basaltic headland (Triton Head) and is open to the northeast so that northeast winds with a fetch of up to 20 km become the predominant drift influence.

Drift Cell 1-2 Originating near the northern tip of Triton Head, drift in this short sector is to the west into Triton Cove. Although there is not a large supply of sediment for transport, there are slight accumulations east of boat launch rails which extend across the shore. Triton Head is formed of more resistant basaltic rocks of the Crescent Formation and extends into deep water, resulting in no appreciable net shore-drift, although in extreme storm conditions there may be some sediment bypass.

Drift Cell 1-3 The northeastward drift of this sector begins at the approximate boundary of Sections 12 and 13, and terminates along the south side of Triton Head. There is a markedly abrupt beginning to this sector where a small delta has formed at the northern end of a series of basalt outcrops which extend into deep water. Northeastward from the delta, there is a sediment size decrease from predominantly large pebbles to smaller pebbles. Small groins along a bulkhead in Section 12 have sediment accumulated on the southwest sides. At Beacon Point, a small developed area (Section 6), a boat ramp which extends about 30 m across the upper shore has blocked sediment so that there is now a vertical offset of the shore of about 1 m and a horizontal offset of nearly 10 m. The Beacon Point development is built in part upon the delta of Schaerer Creek. The beach immediately north of the delta appears somewhat eroded and the sediment again decreases in size gradationally to a sand-granule-pebble spit built northeasterly at the sector terminus. The spit encloses a lagoon on the south side of Triton Head. Drainage from the lagoon is at the northeast end of the spit abutting the basalt which forms the headland. There do not appear to be appreciable amounts of sediment bypassing the southern point of Triton Head. For approximately 1 km south of Sector 2-3, the shore is primarily basalt of the Crescent Formation which extends into deep water, resulting in no appreciable net shore-drift.

Drift Cell 1-4 This 0.5 km sector originates in the southwest corner of Section 13, immediately south of the delta of a small stream, and terminates to the north at the southern end of a series of basalt outcrops which effectively block sediment movement. Northward drift is indicated by a sediment size decrease in that direction, by a large sediment accumulation south of a groin and erosion north of that groin at a local resort, and by a small intermittent stream which is diverted northward.

Drift Cell 1-5 A very short sector of southward drift from the divergence zone south of the stream mouth in southwest Section 13 to the small rocky headland in northwest Section 24 is indicated by a decrease in sediment size to the south and by piling of sediment on the north sides of portions of the headland. South of the small headland in northwest Section 24, cliffs of basalt of the Crescent Formation prevent any appreciable shore-drift.



Map MA-1. Mason County: Triton Head and vicinity south, west shore Hood Canal.

MAP MA-2

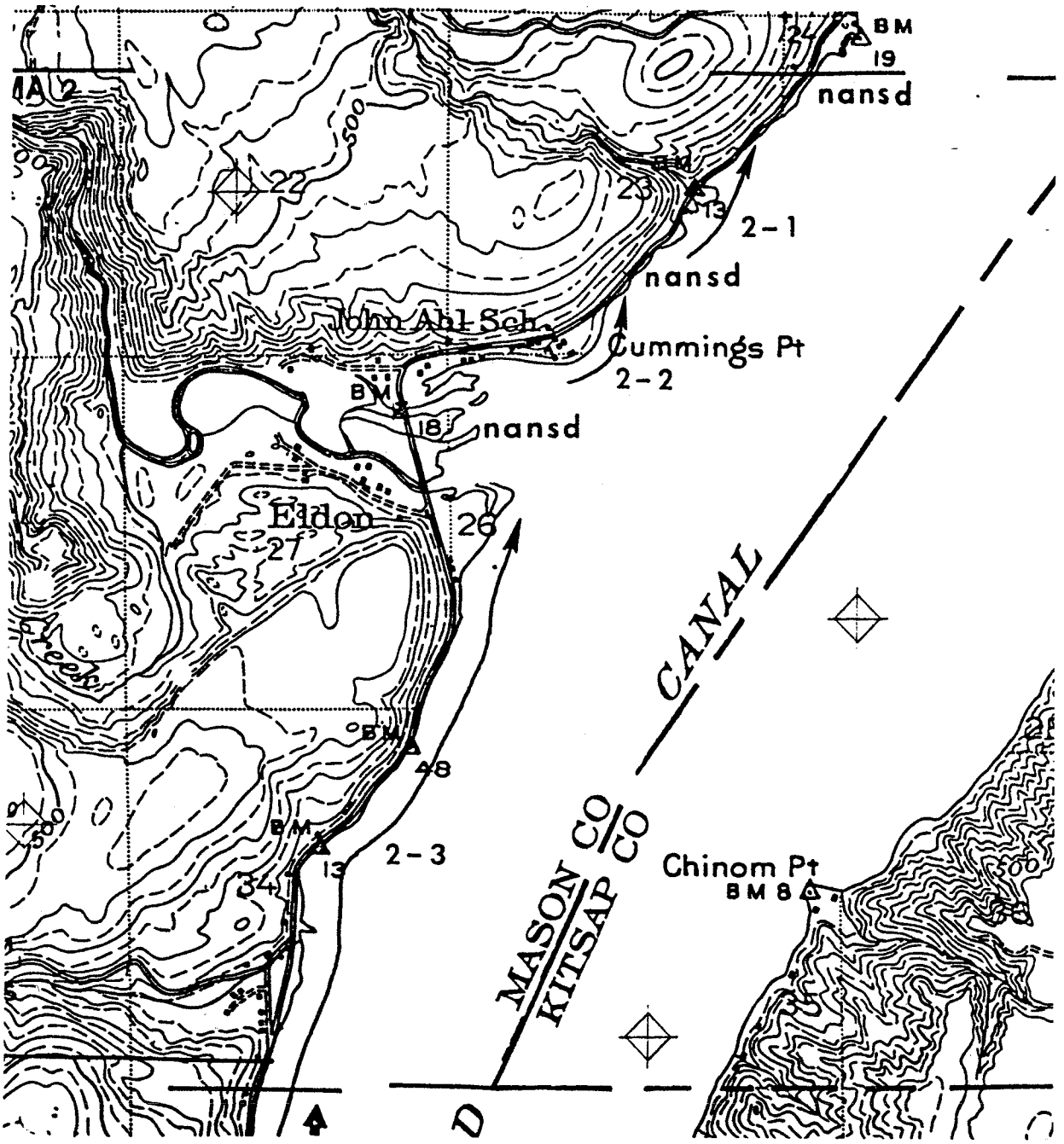
Drift Cell 2-1 This drift cell extends across the delta of Waketickeh Creek in Section 23. Northeastward drift is indicated by accumulations of sediment south of obstacles. The creek appears to have originally been diverted northward but it has been artificially channelized and the delta, altered by development, obscures the original configuration. At both ends of the sector are cliffs of basalt which prevent appreciable sediment bypass.

Drift Cell 2-2 Drift in this sector is northeastward from the north side of the Hamma Hamma River delta to the basalt cliffs immediately north of Cummings Point. Accumulations of sediment south of obstacles and decreasing sediment size northward indicate drift to the northeast.

The inner area of the Hamma Hamma River delta is marshy and truncated by numerous older channels of the river. There does not appear to be appreciable shore-drift across this area.

Segment 2-3 Beginning to the south of this map (see MA-3, segment 3-1), drift in this cell continues northward to the mouth of the Hamma Hamma River.

Jorsted Creek, in Section 34, is diverted northward. A sandy prograding beach is developing on the south side of the delta of the stream and several sand bars are moving up onto the delta from the south. North of the stream delta the beach is narrow and the sediment coarse. The beach widens northward and the sediment-size decreases until the south side of the Hamma Hamma River delta where a sandy prograding beach is developing, similar to the one at Jorsted Creek, and again numerous bars are moving up onto the delta. Drift terminates at the present river channel which has been channelized with long riprap jetties that truncate old spits and which originally diverted the
river northward.



Map MA-2. Mason County: Waketickeh Creek, Hamma Hamma River, and Jorsted Creek vicinity, west shore Hood Canal.

MAP MA-3

Segment 3-1 Originating at a divergence zone in Section 3, drift in this sector is northward, continuing on to the next map (see Map MA-2, Segment 2-3). North from the divergence zone the pebbly upper foreshore widens considerably. The bluff of outwash material along this sector is protected at its base by riprap which retards bluff erosion. This diminishes the quantity of sediment available to form the beaches which, in turn, may result in increased erosion downdrift or removal of the beach material.

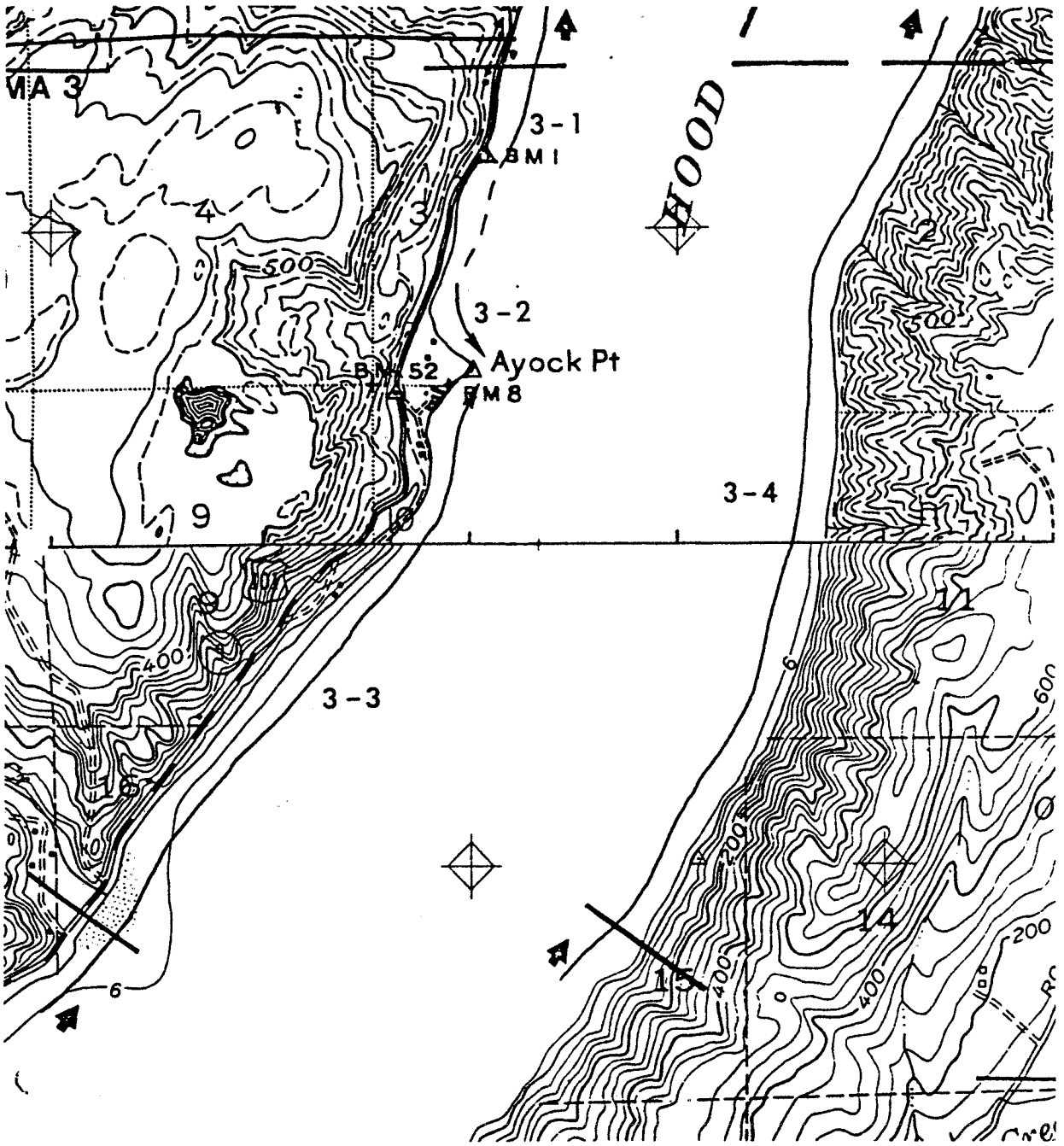
Drift Cell 3-2 Southeastward drift from the divergence zone in Section 3 to Ayock Point is indicated by a slight accumulation of sediment northwest of a boat ramp at the Ayock Point development and by a size decrease of the sediment with a corresponding increase of beach slope. Ayock Point is a cuspate spit formed as a result of drift cell convergence from the north and south.

Segment 3-3 This relatively long drift sector (7 km) commences south of this map area (see Map MA-4, Segment 4-1) and ends at Ayock Point. Net shore-drift toward the northeast is indicated by sediment accumulations southwest of numerous logs, groins, and bulkheads, and by a decrease of sediment size and beach widening northeastward. At Eagle Creek (Section 16) the highway is built upon what appears to have been a spit which had enclosed a lagoon and diverted streamflow northward. In addition, there is a small spit immediately south of Ayock Point which diverts stream drainage northward. Deltaic deposition by the stream has formed a wide tideland south of Ayock Point, whereas on the north side, the beach descends steeply to a good small boat anchorage. Consequently, even though more material may move to the point from the south, the north side is more typical of the cuspate spit model.

Segment 3-4 This segment is the continuation of a sector which originates south of the map area (see Map MA-4, Segment 4-6), and terminates to the north in Kitsap County. The total length of the drift cell is about 8 km. Along the southern part of this segment (Sections 14 and 15), a thin layer of cobbly sediment overlies a wave-cut platform which, in places, is exposed. Northerly drift is indicated by occasional accumulations of sediment on the south sides of fallen trees or logs.

Along the northern part of Section 11 and southern part of Section 2, considerable failure of incohesive glacial outwash bluffs is occurring. This is primarily subaerial erosion and not due to wave erosion of the lower bluff. It seems to have been accelerated here by the attempted construction of numerous access roads to the beach. However, in some places, more resistant till overlies the glacial outwash and as the outwash erodes away, more or less continuously, the till forms overhangs which give way *en masse* only occasionally.

Where the shoreline curves to the northeast in Section 2, a berm begins to build up, becoming more pronounced to the north. A small stream at this point is diverted northward about 20 m, also indicating northerly drift. The beach continues to widen and the sediment decreases in size northward into Kitsap County.



Map MA-3. Mason County: Ayock Point vicinity, west shore Hood Canal.

MAP M-4

Segment 4-1 Beginning at a divergence zone on the north side of Lilliwaup Bay, drift along this sector is northeastward and continues to Ayock Point (see Map MA-3, Segment 3-3). At the north side of the entrance to Lilliwaup Bay, a wave-cut platform is exposed through a thin layer of cobbles and boulders. Northeasterly drift is indicated by accumulations of sediment on the southwest sides of groins and bulkheads, by gradational sediment size decrease, and by the development of a sandy prograding beach on the south edge of the Eagle Creek delta (Section 16). The base of the bluff along most of this segment is armored with riprap in an attempt to prevent erosion and stabilize the steep upper slopes which have frequently failed.

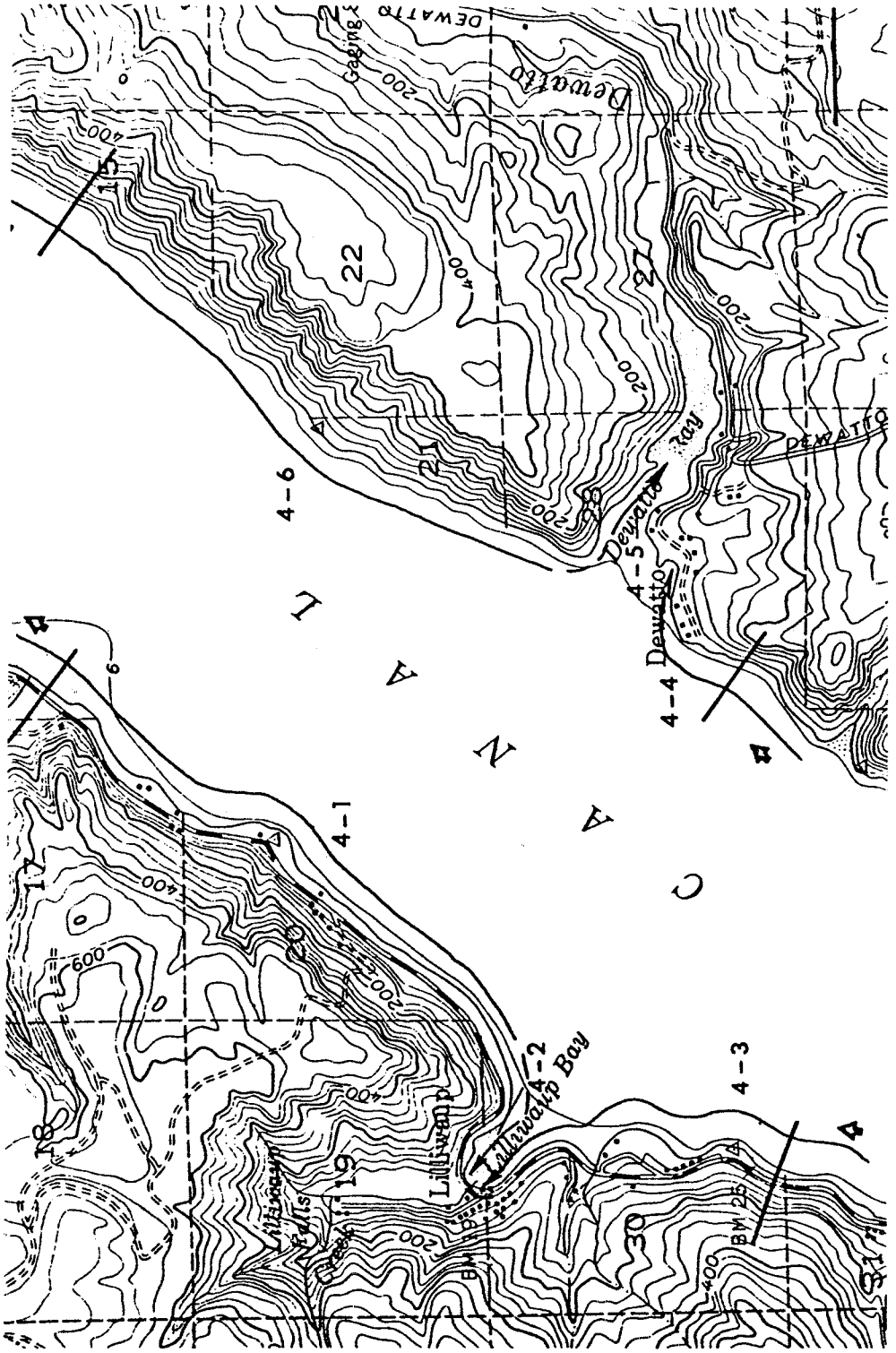
Drift Cell 4-2 This drift cell is within Lilliwaup Bay, extending from the divergence zone along the north side of the bay entrance to the highway bridge at the head of the bay. Drift northwest into the bay is indicated by a sediment size decrease and a slowly prograding beach on the bay-side of the highway bridge footing. Lilliwaup Bay originally extended farther inland, but construction of the bridge has isolated the portion west of the highway and it is not now affected by shore-drift. The Lilliwaup River delta, above the bridge, appears to be filling in with sediment at a rapid rate.

Segment 4-3 This is the northern end and terminus of a nates to the south (see Map MA-5, Segment 5-1). Drift in the north as indicated by sediment accumulations south of numerous groins and by a general size decrease of the sediment to the north. The terminus is marked by a slowly prograding beach developing at the south side of the highway bridge footings at the head of Lilliwaup Bay.

Segment 4-4 This segment is the continuation of a sector which begins south of this map area (see Map MA-5, Segment 5-3; Map MA-6, Segment 6-3; Map MA-7, Segment 7-1), and terminates at Dewatto Bay. A small berm, which is not present farther south, has developed up to where the shoreline curves eastward into the bay and to where riprap and fill are placed on the upper foreshore for a road and a few houses. There are slight accumulations of sediment southwest of bulkheads indicating drift into the outer part of the bay, but beyond, where the terminus is indicated, drift features are obscured by development and there is no obvious evidence for drift into the bay on this side. The tiny westward protuberance of land shown on this map at the end of this drift segment is actually an intertidal feature and is submerged at high tide. It appears to be artificial.

Drift Cell 4-5 Southeastward drift of this cell begins at a divergence zone at the point on the north side of the entrance to Dewatto Bay and ends at a spit just over 0.5 km into the bay. The beach widens southeastward from the divergence zone, sediment becomes generally finer, and the beach slope increases to the spit. Also indicating southeastward drift are sediment accumulations on the northwest sides of logs.

Segment 4-6 Drift to the northeast in this sector originates at the divergence zone on the north side of Dewatto Bay and continues northeastward beyond this map area (see Map MA-3, Segment 3-4). Drift indicators include sediment accumulations southwest of obstacles and northeastward diversion of small streams. The beach along this entire sector is generally narrow and cobbly. Slopes bordering the shore are generally steep, well vegetated, and unstable. Devegetation by wave erosion below, or development above, promotes rapid subaerial erosion as evidenced by numerous leaning and fallen trees along the beach.



Map MA-4. Mason County: Lilliwaup Bay vicinity, west shore Hood Canal.

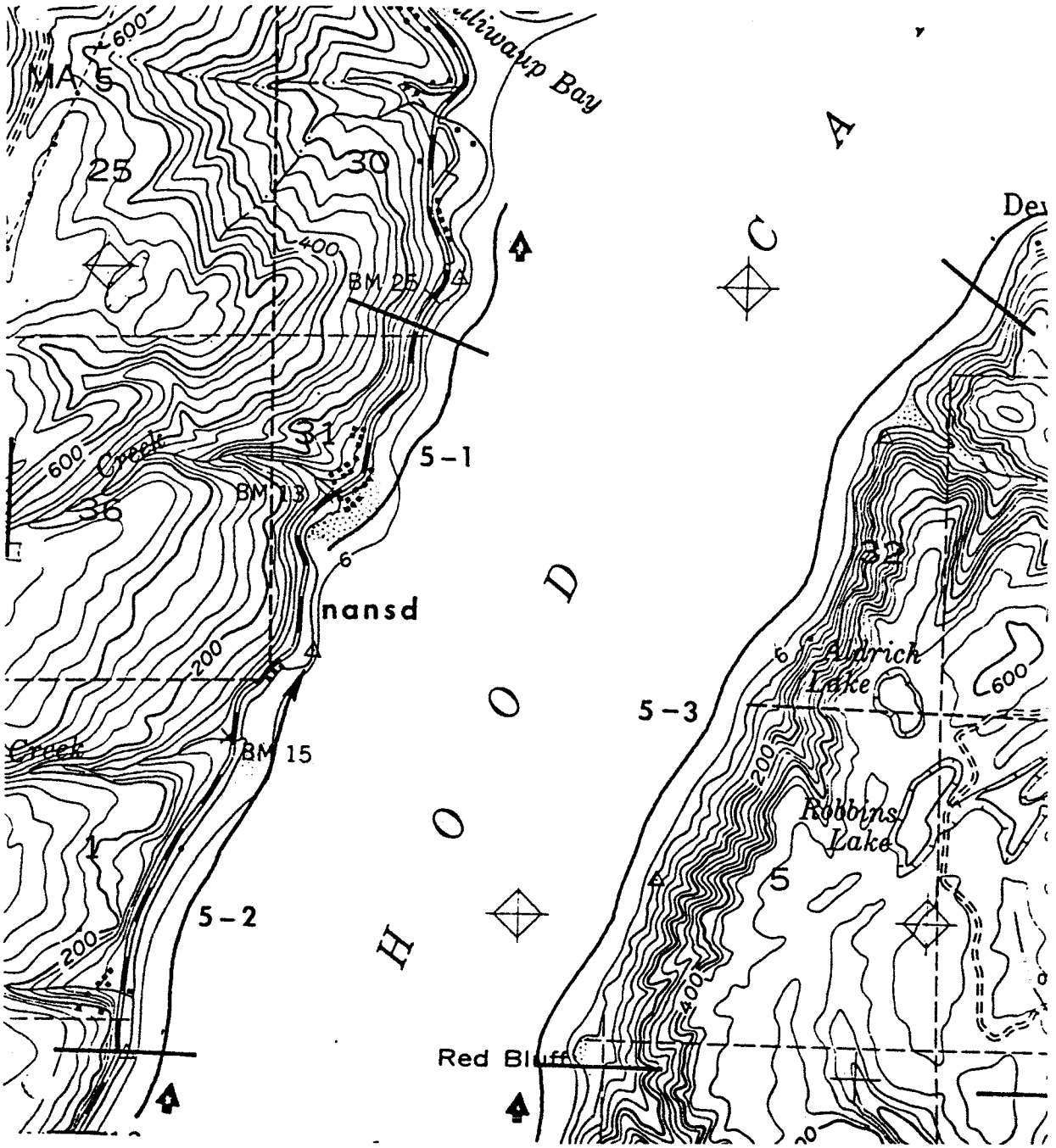
MAP MA-5

Segment 5-1 Beginning at the delta of Sund Creek (Section 31), drift in this sector is toward the north and terminates at Lilliwaup Bay (see Map MA-4, Segment 4-3). Sediment accumulations south of groins in the delta area indicate northerly drift. In addition, distinctive shale fragments from beds exposed along the northern portion of section 31 become gradationally smaller northward.

Segment 5-2 Northward drift in this sector begins farther south (see Map MA-6, Segment 6-1) and continues to the southwest corner of Section 31 where it is blocked by an outcrop of rock of the Crescent Formation. Much of the shore along Section 1 is riprap and fill pushed onto the foreshore. A narrow beach is exposed at low tide, but other than a small accumulation of sediment at the south end of the bulkhead, there are no good geomorphic drift indicators along this stretch. North of Miller Creek, sediment accumulations occur on the south sides of several groins and a small stream about 400 m north of Miller Creek is diverted northward. A further indication of northerly drift is the sediment size decrease along the beach which marks the terminus of this segment.

North of Segment 5-2, cliffs extend into deep water and prevent any appreciable shore-drift.

Segment 5-3 Originating to the south (see Map MA-6, Segment 6-3; Map MA-7, Segment 7-1) and continuing to the north of this region (see Map MA-4, Segment 4-4), drift along this segment is toward the northeast. Indicating northeastward net shore-drift are northeastward diversions of small streams, accumulations of sediment southwest of obstacles, and northeastward decreases of sediment size into several indentations of the shore. At Red Bluff, at the southern end of this segment, there is a small stream delta which acts as an obstacle to drift and sediment has accumulated south of it. The cove in northern Section 32 traps some sediment at high tide, but net shore-drift appears to continue northeast as a small berm begins to develop immediately north of the cove. Net shore-drift of this sector terminates a short distance to the northeast at Dewatto Bay.



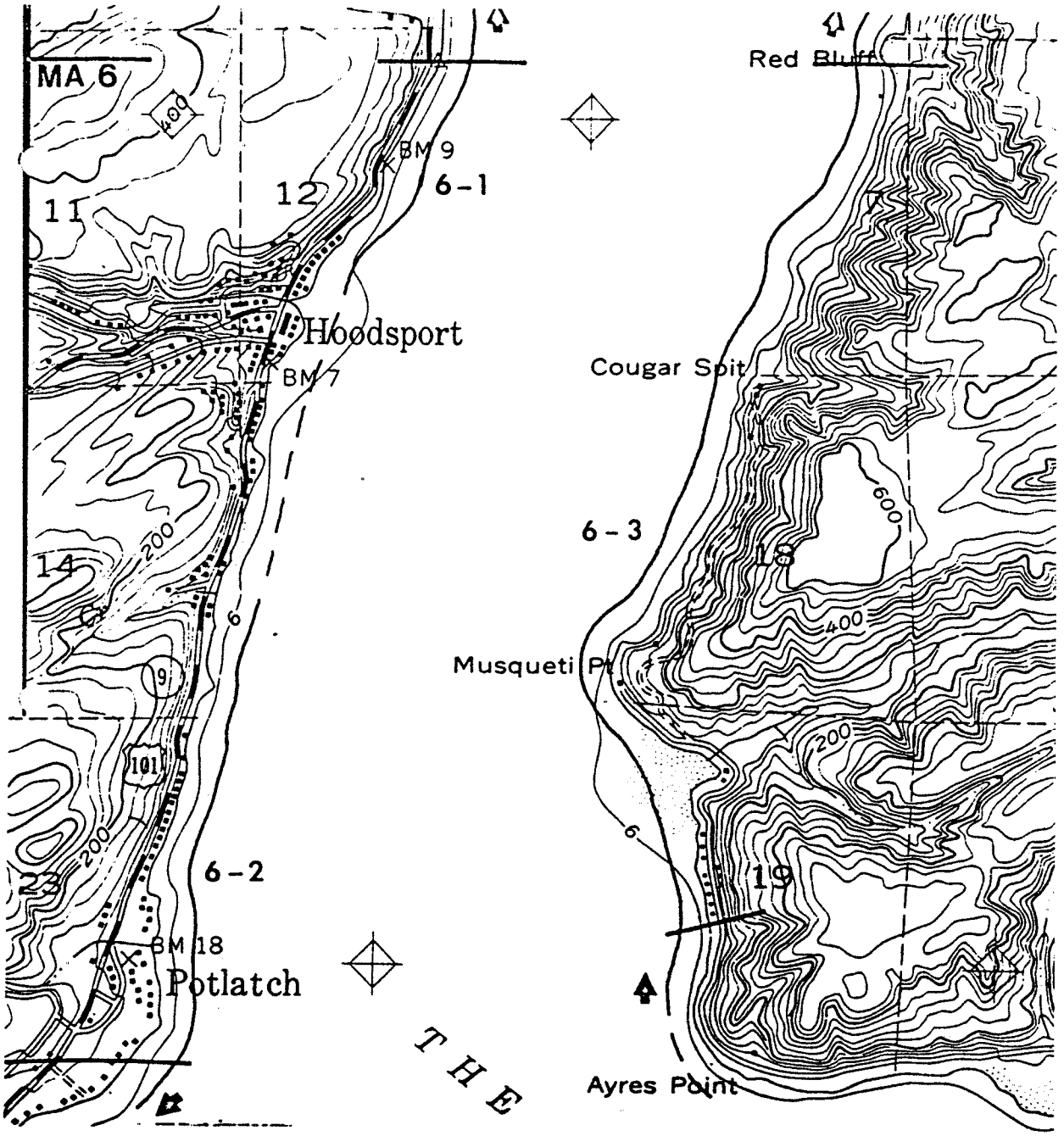
Map MA-5. Mason County: Lilliwaup Bay to Miller Creek, west shore Hood Canal, and Dewatto to Red Bluff, east shore Hood Canal.

MAP MA-6

Segment 6-1 This segment begins in the Hoodsport area and continues north approximately 3.2 km (see Map MA-5, Segment 5-2). North of Finch Creek (Section 12), sediment accumulation occurs at the south end of a bulkhead and the beach is eroding at the north end. The beach sediment, from north of Hoodsport to the map boundary, is primarily boulders and cobbles with the exception of a small pebbly delta at the mouth of an intermittent stream (at BM9). Here there is an accumulation of pebbles piled against the south side of a culvert. For about 1.5 km along the shore in the Hoodsport area, no clear shoredrift pattern emerges. Sediment accumulations are on either or both ends of bulkheads. Whether this is partly due to waterfront development obscuring drift indicators or entirely because of an unusually lengthy divergence zone is unclear. However, there are clear indicators that north of Hoodsport net shore-drift is toward the north and at a short distance south of Hoodsport drift is toward the south.

Segment 6-2 Originating at the divergence zone in the Hoodsport area, net shore-drift in this sector is southward and terminates at a discharge channel dredged from the Tacoma City Light hydroelectric generating station located 1 km south of Potlatch on the Skokomish Indian Reservation (not shown on maps). Southerly drift is indicated by a slight southward diversion of Hill Creek (Section 14), a southward decrease of sediment size, accumulation of sediment north of groins, and a spit-like accreting beach oriented to the south at Potlatch. In addition, south of the map area, a sand bar is building up against the north side of a row of pilings.

Segment 6-3 Segment 6-3 originates at a divergence zone at Ayres Point (see Map MA-7, Segment 7-1) and terminates 10 km to the north at Dewatto Bay (see Map MA-4, Segment 4-4; Map MA-5, Segment 5-3). Indicators of net shoredrift in a northerly direction are accumulations of sediment south of numerous groins and bulkheads (Section 19), erosion north of some of the groins and bulkheads, and widening of the beach and decrease of sediment size to the north as far as the Rendsland Creek delta area (Section 19). Some sediment is transported into this cove at high tide, but because of the delta a much wider beach face is exposed most of the time and net shore-drift continues northward. North of Musqueti Point, drift is to the northeast. There are a few bulkheads and logs with sediment accumulations to the southwest of them. Cougar Spit and the small point north of it (Section 7) are looped bars, with land connections at both ends and a low, marshy area enclosed within. Sediment size along these bars decreases from south to north. At Red Bluff sediment is accumulating on the south side of a small delta.



Map MA-6. Mason County: Miller Creek to Potlatch, west shore Hood Canal and Red Bluff to Ayres Point, east shore Hood Canal.

MAP MA-7

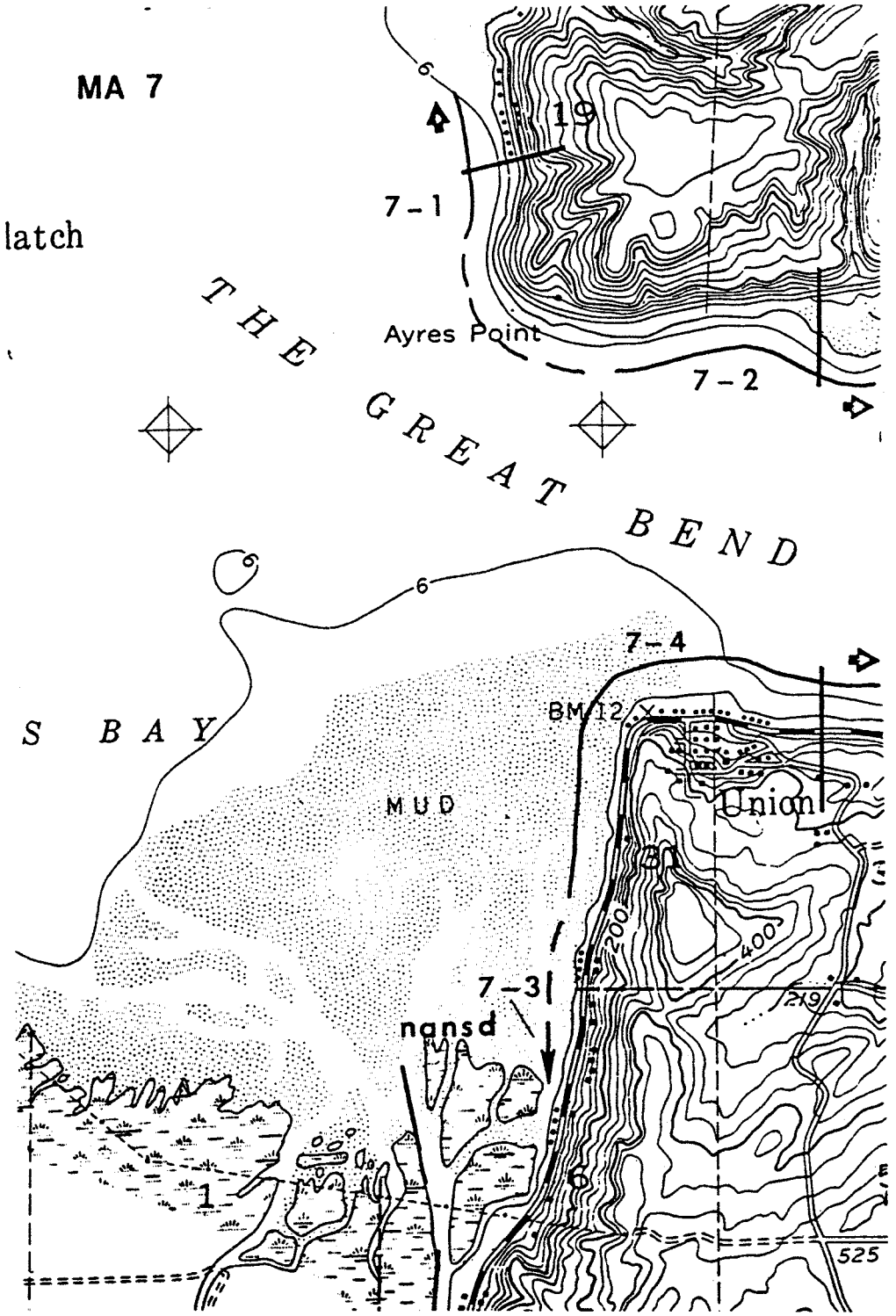
Segment 7-1 This segment originates at a divergence zone at Ayres Point. Northward drift is indicated by sediment accumulations south of groins and bulkheads, erosion north of groins and bulkheads, widening of the beach, and sediment size decrease to the north. Net shore-drift of this cell continues northward for 10 km (see Map MA-4, Segment 4-4; Map MA-5, Segment 5-3; Map MA-6, Segment 6-3).

Segment 7-2 Net shore-drift, beginning at the divergence zone at Ayres Point, is eastward in this segment. The beach widens to the east, sediment size decreases, and sediment accumulates west of groins, bulkheads, and other obstacles. The eastern edge of this map area is at the western part of a prograding sand and small pebble beach. Net shore-drift continues eastward from this beach (see Map MA-8, Segment 8-1).

Drift Cell 7-3 Drift in this short sector is southward, originating at a divergence zone at approximately the boundary between Sections 31 and 6, south of the town of Union. Sediment accumulations north of bulkheads and a boat ramp indicate drift to the south. Within a short distance, shore-drift is obscured by the influence of flow from the Skokomish River.

Segment 7-4 This segment originates at a divergence zone about 1 km south of the town of Union. Northward drift is indicated by accumulation of sediment south of groins and bulkheads, and by oyster-shell bars which are migrating northward from a commercial oyster site. Drift continues around the point at Union becoming easterly, as evidenced by sediment size decrease and accumulation of sediment west of groins, bulkheads, and boat ramps. Also, east of Union, the beach widens somewhat. Eastward drift of this sector continues into the next map area (see Map MA-8, Segment 8-4).

NANSD characterizes the shore along the Skokomish River delta front, which is dominated by fluvial and tidal processes.



Map MA-7. Mason County: The Great Bend and Annas Bay, Hood Canal.

MAP MA-8

Segment 8-1 This drift sector originates to the west at Ayres Point (see Map MA-7, Segment 7-2). Indicating easterly drift are accumulations of sediment west of bulkheads, beach erosion east of bulkheads, and widening of the beach to the east. At the western edge of this map area (Section 29), a pebbly prograding beach diverts a small stream eastward. East of the stream the beach is eroded and then it widens again farther east. Shore-drift in this sector terminates at Tahuya—a fairly large, developed prograding area at the mouth of the Tahuya River.

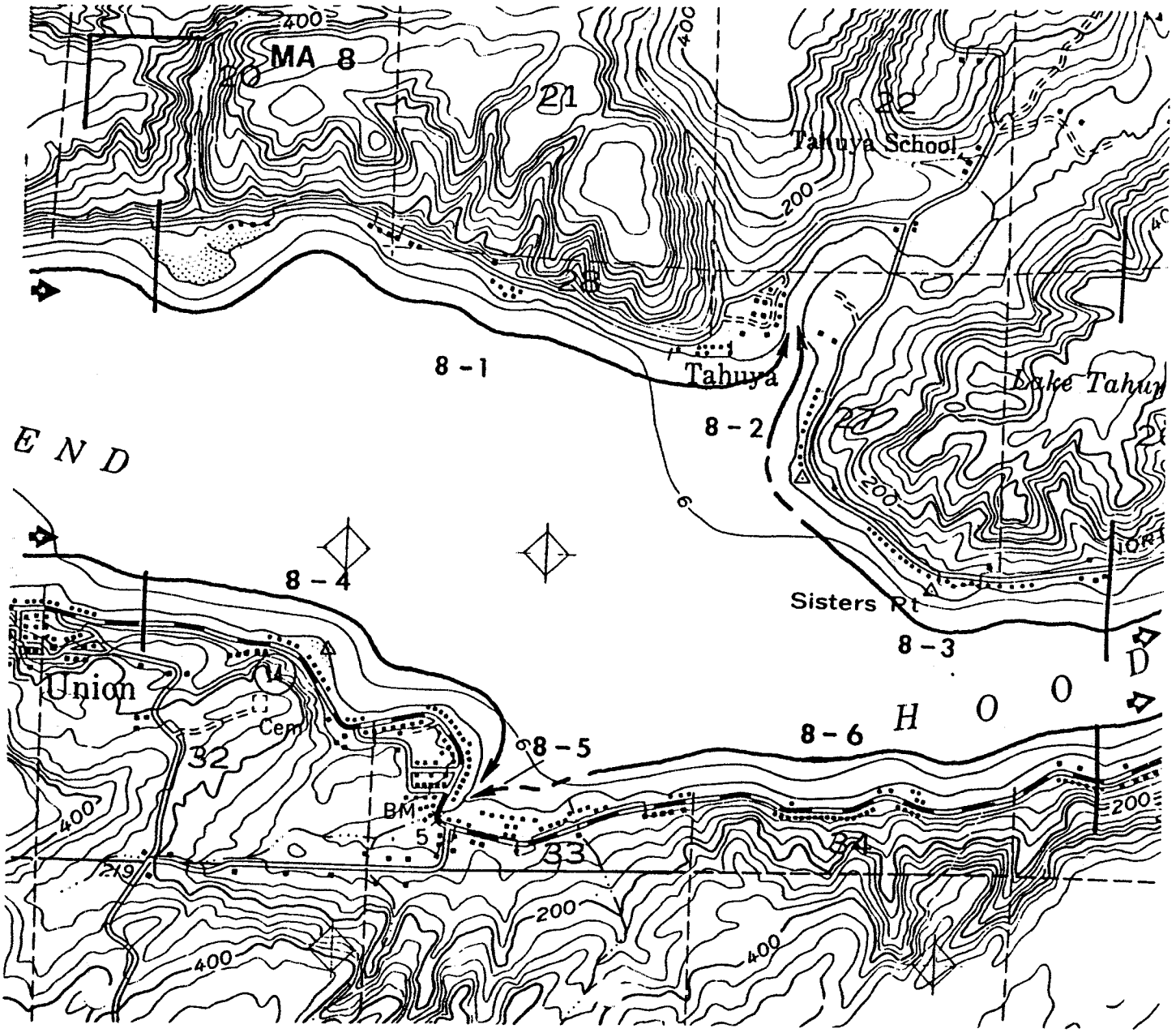
Drift Cell 8-2 Northerly shore-drift of this drift cell begins at a divergence zone located about 1 km northwest of Sisters Point and terminates at a spit oriented northward into the mouth of the Tahuya River. Evidence of northerly drift includes widening of the beach and increase of the beach slope northward to the terminal spit. Also, sediment accumulations south of numerous groins and bulkheads indicate drift to the north.

Segment 8-3 Net shore-drift in this segment is southeast from a divergence zone located about km northwest of Sister's Point, and then east from Sisters Point. It then continues east a short distance beyond this map area (see Map MA-9, Segment 9-1). Easterly drift indicators are a sediment size decrease and accumulations of sediment west of numerous groins and bulkheads, as well as erosion east of many of those structures.

Segment 8-4 Continuing from the west (see Map MA-7, Segment 7-4), drift in this cell is eastward and terminates to the south in a cove in Section 33. Sediment accumulations west of groins, bulkheads, and boat ramps, and a general decrease of sediment size indicate easterly drift. Net shore-drift in this sector ends at a pebbly prograding beach northwest of a small stream.

Drift Cell 8-5 This very short sector begins at a divergence zone (central Section 33) and ends at a small spit directed westward at the mouth of a small stream. One other drift indicator is an accumulation of sediment east of a groin.

Segment 8-6 This segment begins at a divergence zone in central Section 33. Net shore-drift is eastward as evidenced by sediment accumulations west of groins, boat ramps, and bulkheads, by widening of the beach eastward, and by oblique bars oriented toward the east. Drift continues eastward beyond this map area (see Map MA-9, Segment 9-6; Map MA-10, Segment 10-6).



Map MA-8. Mason County: The Great Bend to Sisters Point vicinity, Hood Canal.

MAP MA-9

Segment 9-1 Easterly net shore-drift in this segment begins west of Sisters Point (see Map MA-8, Segment 8-3) and terminates at a convergence zone at a small prograding lobate beachform where the shoreline curves to the northeast in Section 26. Accumulations of sediment occurring west of obstacles, sediment size decrease, and increase of the slope and width of the beach to the convergence zone are evidence of easterly drift.

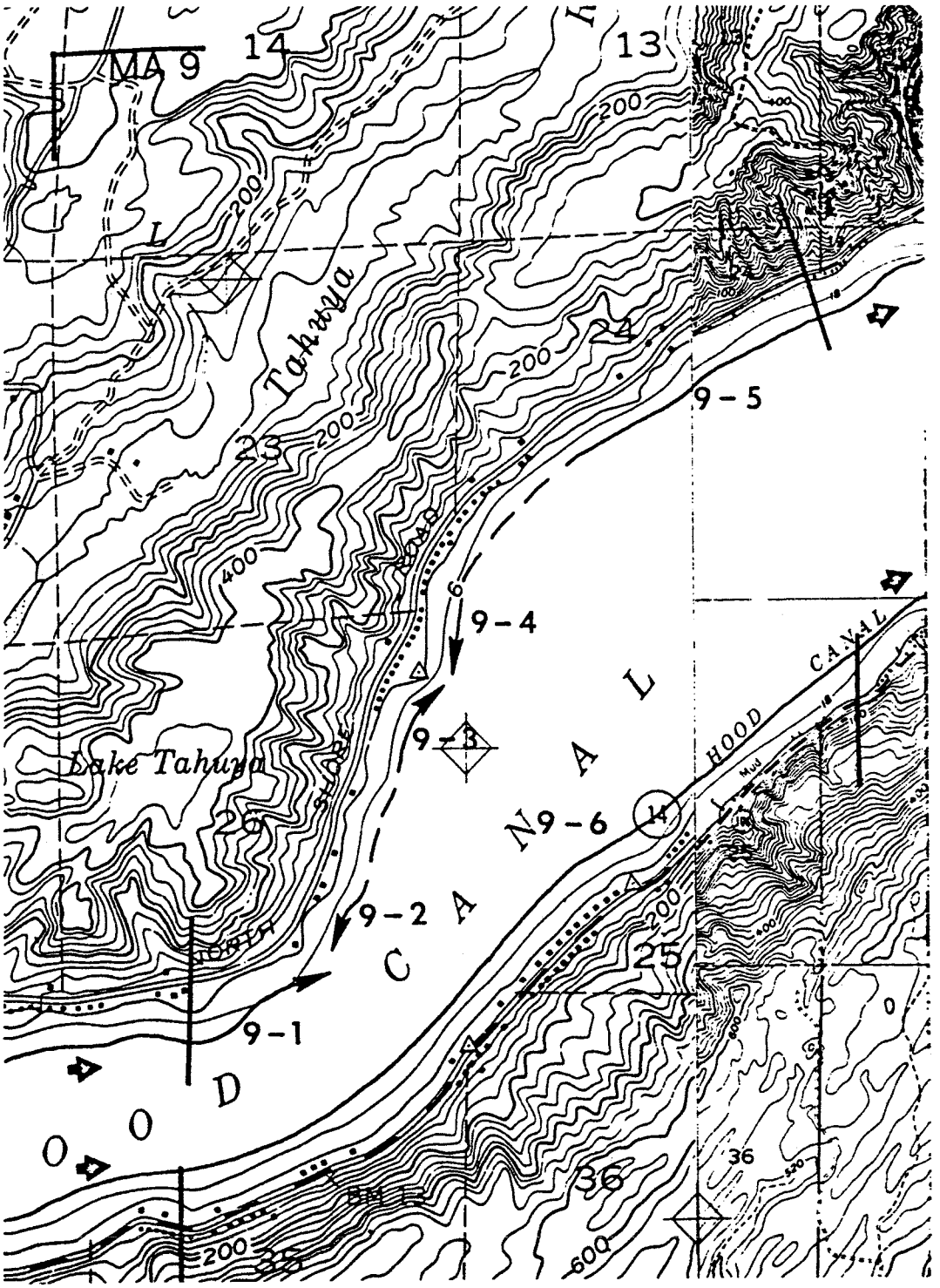
Drift Cell 9-2 Originating at a divergence zone on the east side of Section 26 and terminating at a convergence zone about 0.5 km to the southwest, net shore-drift in this cell is indicated by sediment accumulations northeast of groins and bulkheads, by erosion southwest of these obstacles, by the beach widening to the southwest, and an increase in the beach slope and decrease of sediment size to the southwest.

Drift Cell 9-3 Net shore-drift in this sector is northeast from a divergence zone at central-east Section 26 to a convergence zone at a prograding lobate beachform in northeast Section 26. Geomorphic indicators of net shore-drift to the northeast are a widening of the beach from the divergence zone to the convergence zone, a northeasterly decrease of sediment size, a steepening of the beach slope to the convergence zone, and accumulations of sediment southwest and beach erosion northeast of groins and bulkheads.

Drift Cell 9-4 This drift cell originates at a divergence zone at the south east corner of Section 23 and terminates a short distance to the south at a prograding lobate beachform in northeast Section 26. Southerly drift is indicated by widening of the beach southward, accumulations of sediment north of obstacles, and sediment size decreasing to the convergence zone.

Segment 9-5 From a divergence zone in southeast Section 23, drift in this sector continues approximately 2.8 km northeastward (see Map MA-10, Segment 10-1). Sediment accumulations west of bulkheads, groins, and bulkheads, erosion east of obstacles, beach widening eastward, beach slope increasing eastward, and sediment size decreasing eastward all indicate northeast net shore-drift. In addition there are a few oblique bars moving from the southwest.

Segment 9-6 Originating west of this map area (see Map MA-8, Segment 8-6), net shore-drift in this segment continues northeast to the next map area (see Map MA-10, Segment 10-6). Evidence of northeasterly drift is seen at the ends of dozens of bulkheads and groins where sediment accumulations occur on the southwest and beach:erosion on the northeast. Also, along this section of Hood Canal, several oblique bars can be seen oriented toward the northeast.



Map MA-9. Mason County: west central upper Hood Canal.

MAP MA-10

Segment 10-1 Originating southwest of this map area (see Map MA-9, Segment 9-5), net shore-drift is toward the northeast and terminates at a deltaic prograding convergence zone at the mouth of Shoofly Creek (Section 18). Net shore-drift indicators include sediment accumulations to the southwest of numerous groins and bulkheads, widening of the beach northeastward, sediment size decrease northeastward, beach slope increase northeastward, and northeastward diversion of the mouth of Shoofly Creek. In addition, fragments of asphalt can be traced back from the terminus area, southeastward about 400 m, to an asphalt fill which was constructed to prevent erosion of private property.

Drift Cell 10-2 This drift cell begins at a divergence zone about 0.5 km northeast of the mouth of Shoofly Creek (Section 18) and terminates at the prograding convergence zone at the mouth of the creek. Southwesterly net shore-drift is indicated by a decrease of sediment size and increase in beach width to the southwest, and also a steepening of the slope of the beach south-westward.

Drift Cell 10-3 Net shore-drift in this cell is eastward from a divergence zone in Section 18 to a commercially-developed prograded point about 1 km east (Section 17). There are sediment accumulations west of numerous groins and bulkheads, the beach becomes wider and steeper toward the terminus, the sediment size decreases eastward, and a small stream (Section 17) is diverted eastward. The cell terminates in a small cove on the east side of the development. The developed area is mostly fill placed on a deltaic prograding area which may have been similar to the area at the mouth of Shoofly Creek (Section 18). Fill for the development apparently came from a gravel pit located directly north across the road. Devegetation of the steep slopes and removal of bluff material has resulted in a constantly disintegrating bluff of incohesive outwash gravel which is only 50-80m from the road and several fairly recently-built houses.

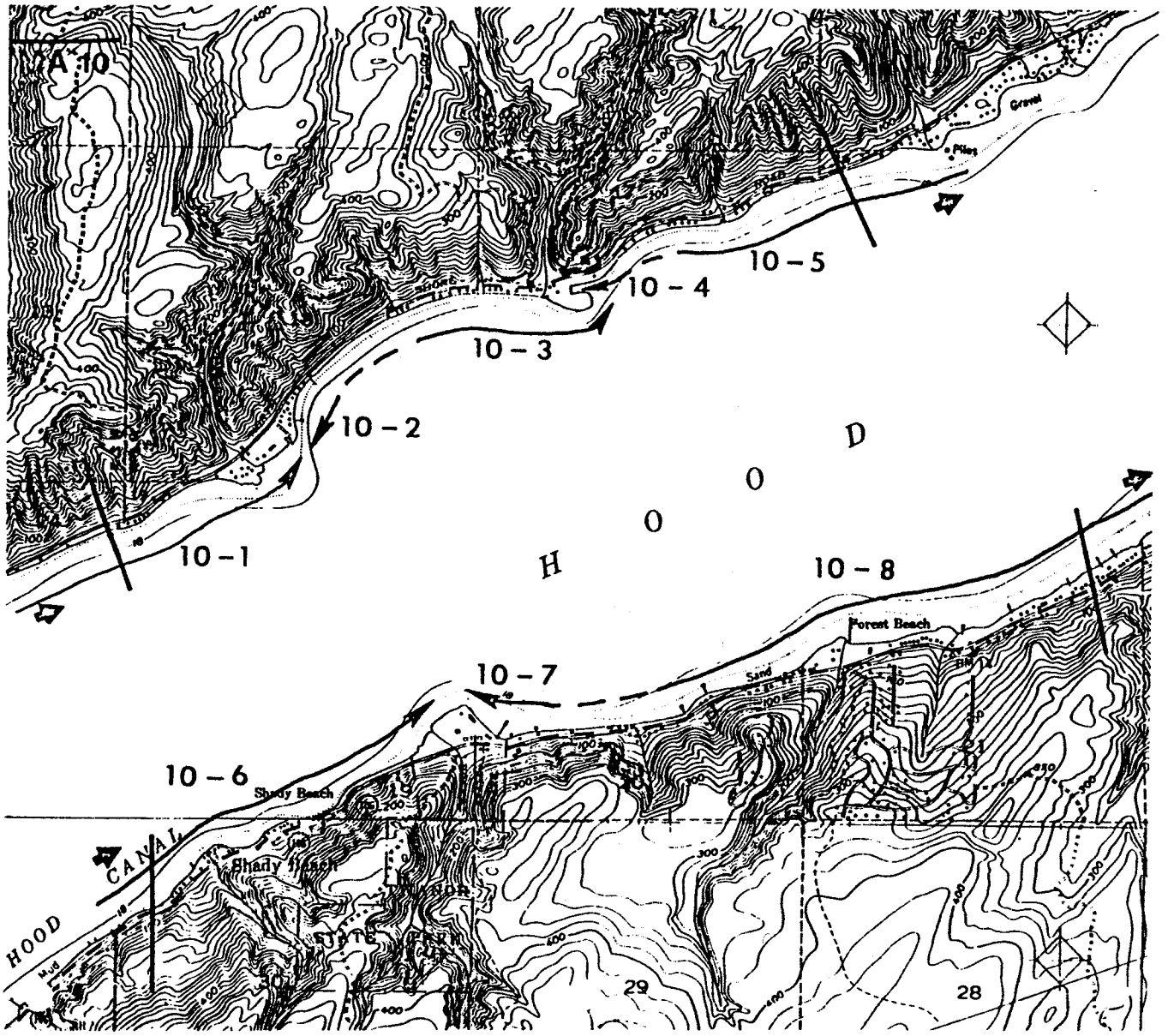
Drift Cell 10-4 Whether drift cell 10-4 is a long-term feature or the result of development at the prograded area in Section 17 is unclear. However, the small cove, on the east side of the development area, which may have been intended as a marina, is now filling with sediment coming from the west (Drift Cell 10-3) and from the east. This cell originates less than 100 m to the east of the cove where beach erosion is occurring. A wedge of sediment is being transported into the cove from this divergence zone.

Segment 10-5 Beginning at a divergence zone immediately east of the point in Section 17, drift eastward is indicated by sediment accumulations west of groins and bulkheads, widening of the beach to the east, and a decrease of sediment size to the east. This segment continues easterly to the next map area (see Map MA-11; Segment 11-I).

Segment 10-6 This segment is the continuation and terminus of a drift cell which originates several kilometers to the west (see Map MA-8, Segment 8-6; Map MA-9, Segment 9-6). Northeasterly net shore-drift is indicated by sand bars moving from the southwest at Shady Beach, sediment accumulations southwest of bulkheads and groins, and beach erosion northeast of bulkheads. Southwest of Twanoh State Park, fragments of asphalt fill are traceable to the north-east, several tens of meters, from the fill site. At Twanoh State Park a large boat ramp has blocked shore-drift from the southwest, resulting in nearly 2 m of vertical offset of the shore and more than 15 m of horizontal offset. Northeast of the boat ramp, erosion appears severe despite the placement of riprap. Net shore-drift in this sector terminates at Twanoh where it converges with drift from the east.

Drift Cell 10-7 Drift cell 10-7 originates about 0.5 km east of the point at Twanoh State Park. Termination is at a convergence zone at the point. Westerly drift is indicated by sediment accumulations to the east of groins and bulkheads, sediment size decrease towards the terminus, and steepening of the beach slope to the convergence zone.

Segment 10-8 This segment begins at a divergence zone a short distance east of Twanoh State Park (Section 20). Drift is northeast, past Forest Beach, to the next map area (see Map MA-11, Segment 11-4). Accumulations of sediment southwest of obstacles (groins, bulkheads, boat ramps) indicate drift toward the northeast. In addition, a few small, pebbly bars appear to be moving toward the northeast.



Map MA-10. Mason County: east central upper Hood Canal.

MAP MA-11

Segment 11-1 Commencing to the southwest of this map area (see Map MA-10, Segment 10-5), net shore-drift in this sector is toward the northeast, and terminates at a complex recurved spit in northwest Section 11. Geomorphic features indicating northeastward drift are sediment accumulations southwest of numerous groins, bulkheads, and boat ramps (Fig. 3), nearshore bars oriented toward the northeast, northeastward diversion of small streams, and increase of beach width and slope toward the terminus, and the eastward orientation of the complex recurved spit at the terminus.

Drift Cell 11-2 Drift cell 11-2 begins at a divergence zone located approximately at the boundary between Sections 1 and 2. The beach at the divergence zone is cobbly and eroding. Net shore-drift to the southwest is indicated by decrease of sediment size and a 200 m long sand bar or spit-platform, in the embayment east of Sunbeach, growing southwest toward Sunbeach. Also, at Sunbeach, a small stream is diverted to the southwest. Drift in this sector terminates rather indistinctly, converging with the complex spit that marks the terminus of Segment 11-1.

Drift Cell 11-3 This drift cell originates at a divergence zone located at approximately the boundary of Sections 1 and 2, and terminates about 3 km to the northeast in Lynch Cove. Northeasterly net shore-drift is indicated by a series of northeastward accreting spits, most of which divert streams in the same direction. There are also numerous bars migrating northeastward. Tide flats extend entirely across Hood Canal from approximately Belfair State Park and northeastward. This rapid shallowing reduces the amount of wave energy available for sediment transport.

NANSD characterizes the shore at the head of Lynch Cove at the mouth of Union River. Progradation is rapid due to sediment influx from the river and net shore-drift into the cove from both sides of Hood Canal.

Segment 11-4 This sector begins west of this map area at a divergence zone near Twanoh State Park (see Map MA-10, Segment 10-8) and terminates at a convergence zone at Sunset Beach (Section 12). Indicating northeastward drift are sediment accumulations southwest of a great many groins, bulkheads, and boat ramps, numerous nearshore bars oriented northeasterly, and several small spits growing toward the northeast. Associated with the spits, beach widening and steepening increase northeastward and sediment size decreases. Marking the termination of this segment is a recurved spit at Sunset Beach.

Drift Cell 11-5 Westward net shore-drift in this drift cell begins at a divergence zone 0.5 km east of Sunset Beach (Section 12) and ends within the cove formed by the recurved spit terminus of Segment 11-4. Indicating westerly drift are accumulations of sediment to the east of groins and bulkheads, and a decrease of sediment size and increase of beach width westward.

Drift Cell 11-6 Originating at a divergence zone east of Sunset Beach, net shore-drift is again northeastward and terminates at a large spit oriented to the northeast into Lynch Cove. There are several smaller spits along the sector, also oriented northeastward. Other evidence of net shore-drift is sediment accumulation southwest of groins and bulkheads, numerous nearshore bars migrating northeastward, widening of the beach toward the northeast, and a sediment-size gradational decrease northeastward.

Map MA-11. Mason County: Twanoh to Lynch Cove, upper Hood Canal.

MAPS MA-12 through MA-24

Maps MA-12 through MA-24 cover South Puget Sound and are published in *Net shore drift in Washington state: Volume 2, South Puget Sound.*

KITSAP COUNTY, WASHINGTON, NET SHORE-DRIFT

Prepared for the
Washington Department of Ecology

by
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Bellingham, WA 98225

May 18, 1982

MAP KS-1

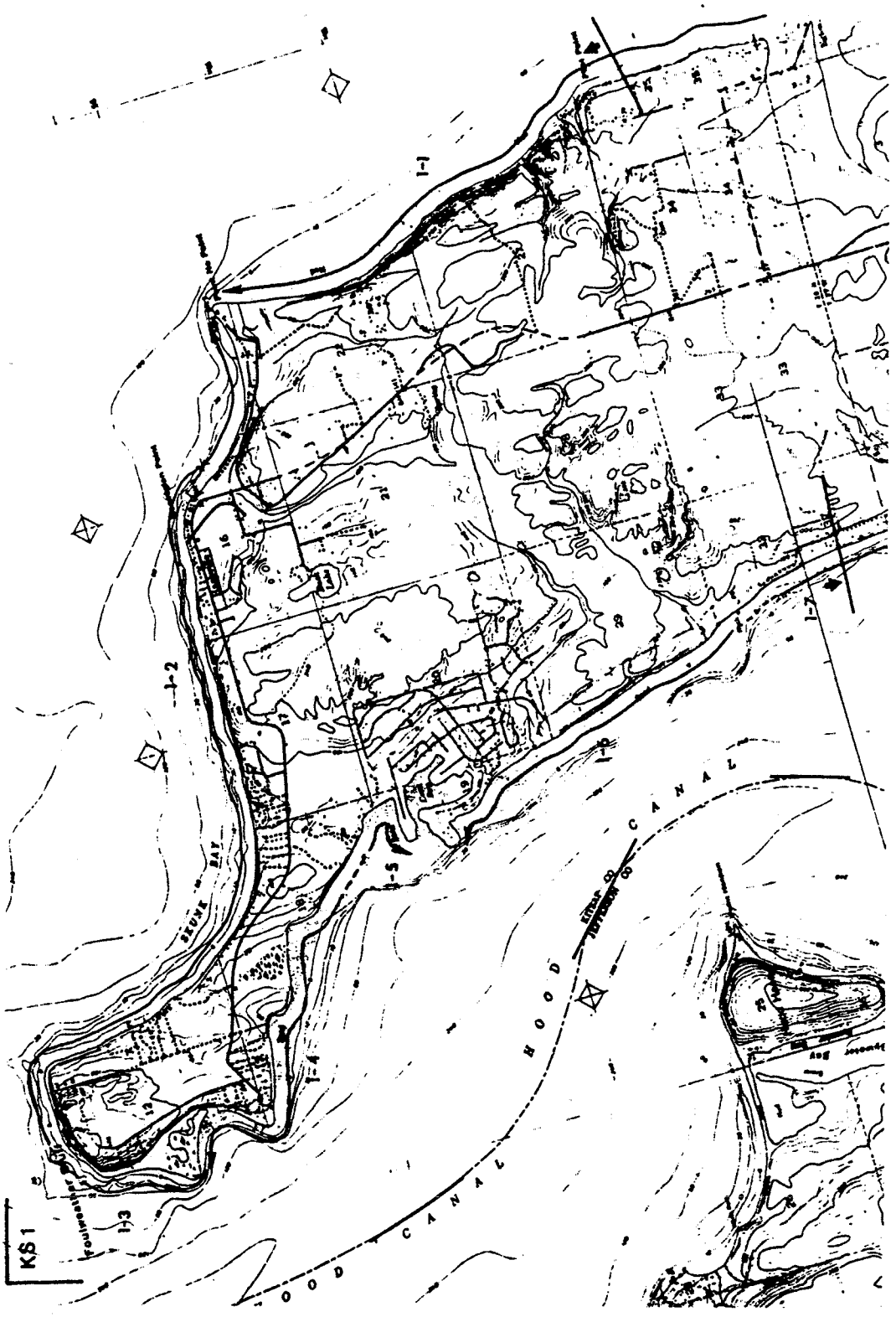
Segment 1-1 through Drift Cell 1-3 These segments, which cover a portion of Kitsap County's Puget Sound shoreline may be found in *Net shore-drift in Washington state: Volume 3, Central Puget Sound.*

Drift Cell 1-4 Originating at a zone of divergence located about 0.8 km north of Coon Bay (also called Shelter Bay) and ending along the south shore of the accretionary landform, this drift cell exhibits a northerly net shore-drift. The drift direction is indicated by decreasing bluff slope, generally increasing beach width, and decreasing sediment size in a northerly direction. The southernmost of the two projections into the Hood Canal is not a spit. It is a beach with sediment moving north around a glacial headland.

Drift Cell 1-5 Net shore-drift is to the south in this drift cell, beginning in the divergence zone 0.8 km north of Coon Bay and ending along the northern sand spit enclosing Coon Bay. Groins and other drift obstructions have an accumulation of sediment on the north side. Also, beach width increases and sediment size decreases to the south.

Drift Cell 1-6 This drift cell originates in a zone of divergence located in Section 32 just south of the mapped rock symbol and ends along the southern spit enclosing Coon Bay. Net shore-drift to the north is indicated by decreasing bluff slope, decreasing beach sediment size, and increasing beach width to the north. Then, too, approximately 1.0 km south of Coon Bay there is a significant stream diversion to the north.

Segment 1-7 This segment includes the origin and northernmost part of a drift cell ending at Point Julia (see Map KS-2, Segment 2-1). The drift cell begins in a zone of divergence located in Section 32 immediately south of the "rock." Net shore-drift to the south is indicated by sediment accumulation on the north side of a concrete boat ramp found about O.3 km south of the "rock" and beach width increasing to the south.



Map KS-1. Kitsap County: Foulweather Bluff to Hood Canal Floating Bridge.

MAP KS-2

Segment 2-1 Map KS-2 shows the southernmost segment and terminus of a drift cell originating in a zone of divergence about 2.9 km north of Point Julia (see Map KS-1, Segment 1-7). The southward net short-drift of this segment is indicated by a stream diversion to the south approximately 0.7 km north of Point Julia, a decrease in mean beach sediment size to the south, and an increase in beach width to the south. The drift cell terminus is along the north shore of Point Julia, a sand spit building to the southwest. At Point Julia there is a 100 meter stream diversion to the southwest, emptying into Hood Canal near the distal end of the spit.

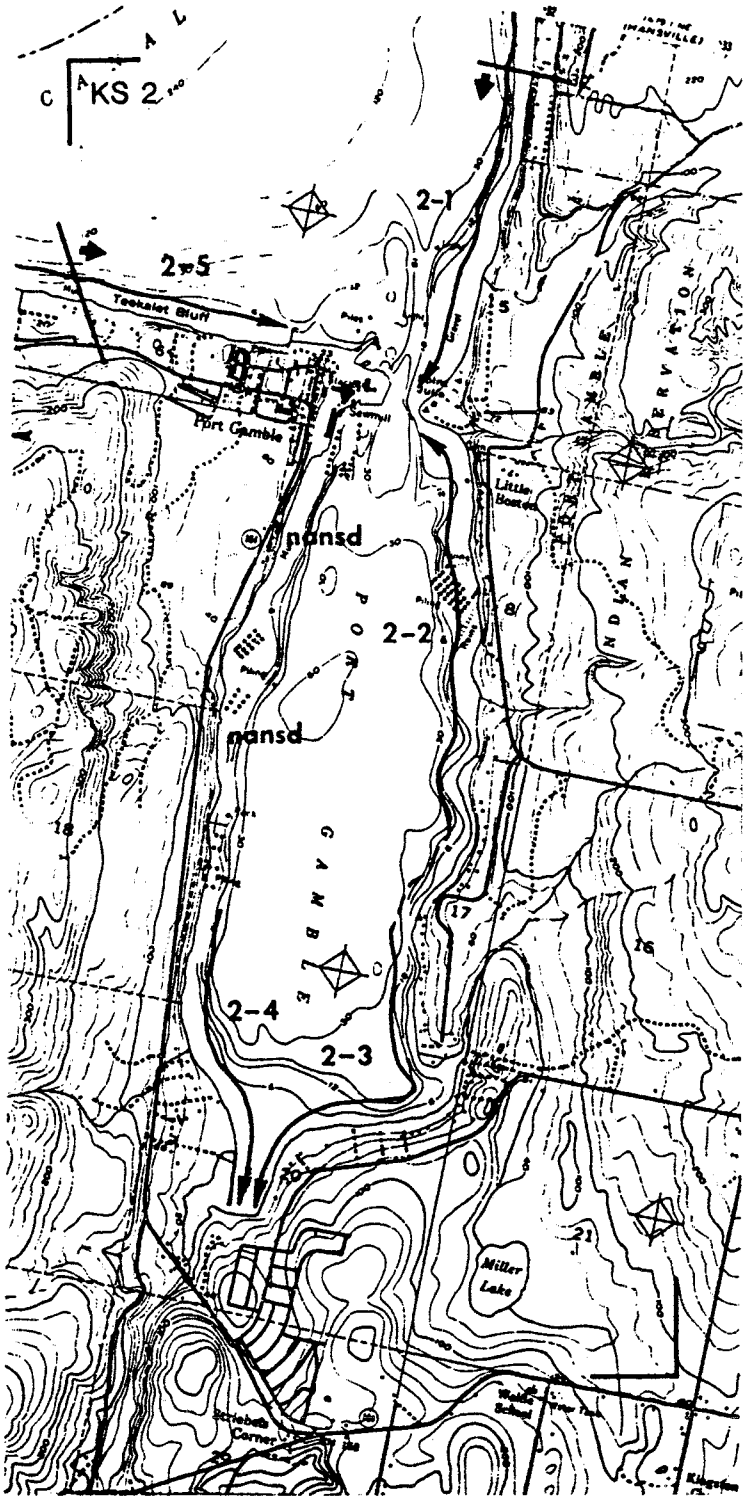
Drift Cell 2-2 This drift cell begins in a zone of divergence located along the east shore of Port Gamble in Section 17 and ends along the southern shore of Point Julia. Northward net shore-drift is indicated by a stream diversion to the north and drift obstructions (trees, logs, etc.) showing sediment accumulation on the south side. It should be noted at this point that Port Gamble possesses a moderately low wave-energy environment. This is due to the limited fetch (distance of water over which the wind blows unimpeded) and the protection from the predominant (strongest) southerly winds. This results in a subtle pattern of small changes in the geomorphic indicators present.

Drift Cell 2-3 Originating in Section 17 and displaying southward net short-drift, this drift cell terminates at the southern extremity of Port Gamble. The drift direction is indicated by increasing beach width and decreasing sediment size to the south, and a spit building to the south.

Drift Cell 2-4 Displaying southward net shore-drift, this drift cell originates along the west side of Port Gamble in Section 17 and ends along the southwestern extremity of Port Gamble. The drift direction is indicated by increasing beach width to the south and a spit building to the south.

From the area in which Drift Cell 2-4 originates, and north to the Pope and Talbot sawmill, the coast of Port Gamble is completely blockaded by rafts of logs waiting to be processed. The dampening effect of this barrier on wind-waves has resulted in no apparent net shore-drift along this entire coastal sector. The sediment consists of mud with some fine-grained sand. At the east side of the mouth of Port Gamble the sawmill facility has been built out over the foreshore into deep water, resulting in no apparent net shore-drift for this area too.

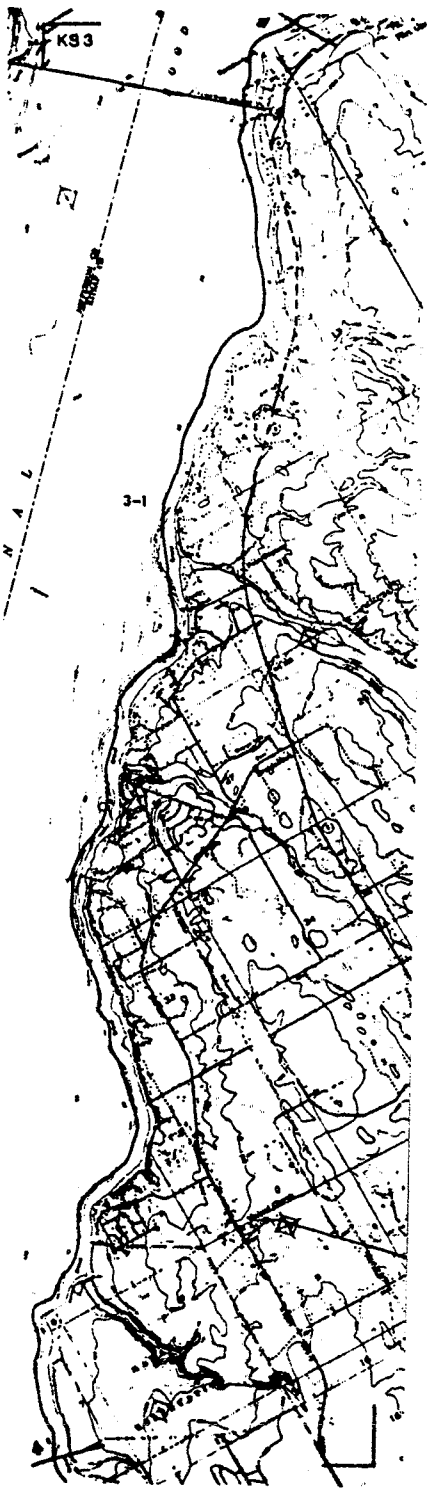
Segment 2-5 This is the northernmost segment and terminus of a drift cell originating 2.5 km south of Olympic View (see Map KS-5, Segment 5-1). The net shore-drift is to the east along Teekalet Bluff terminating against the stone bulkhead protecting the Pope and Talbot sawmill operation which has built much of its facility out over the existing beach. The drift direction of this segment is indicated by a stream diversion 20 meters to the east, about 0.5 km west of the stone bulkhead, an increase in beach width to the east, and a decrease in mean sediment size to the east.



Map KS-2. Kitsap County: Port Gamble vicinity.

MAP KS-3

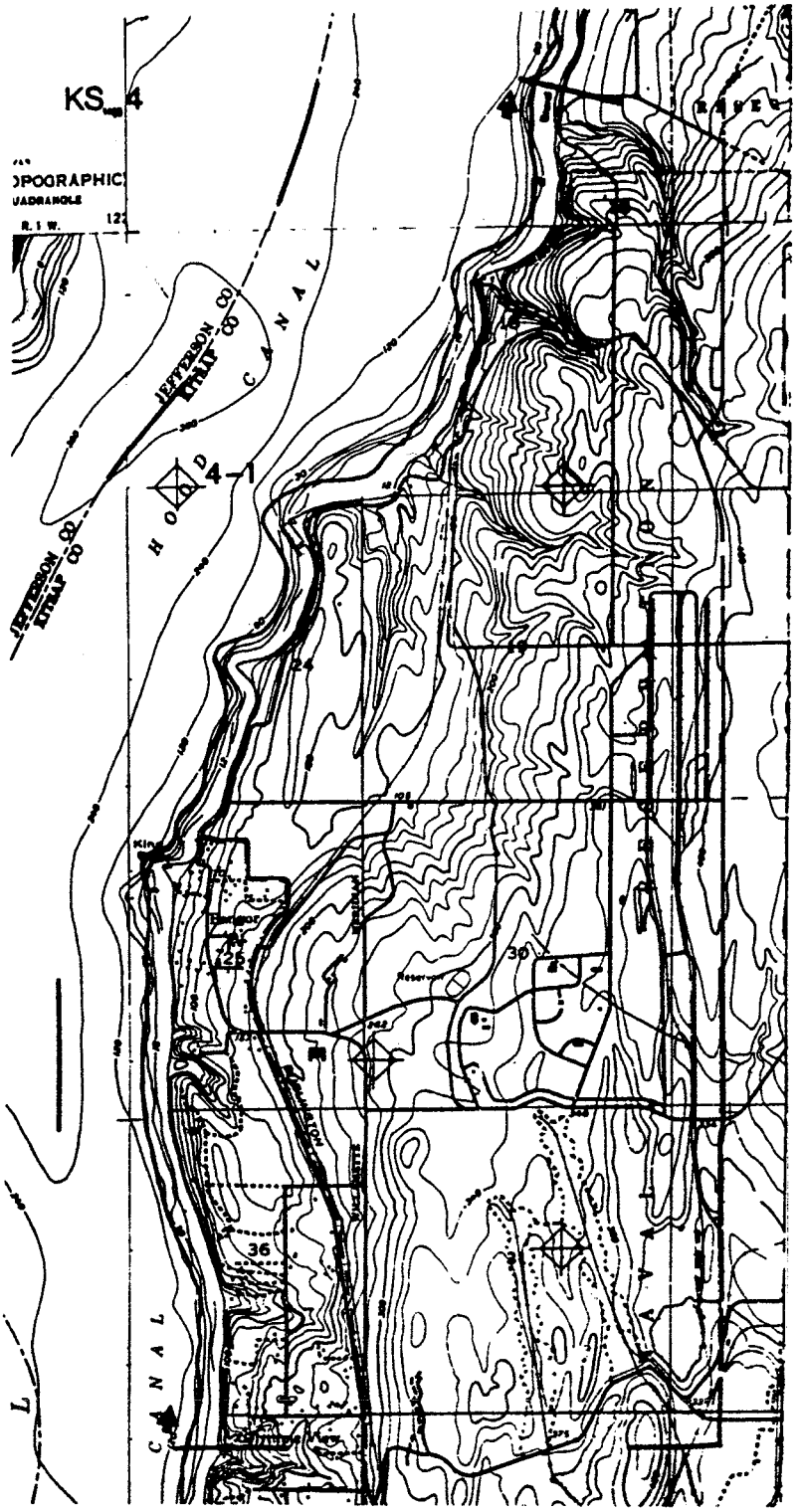
Segment 3-1 The coastal segment displayed on Map KS-3 represents the northern major portion of a drift cell originating in a zone of drift divergence located about 2.5 km south of Olympic View (see Map KS-5, Segment 5-1) and ends against the riprap bulkhead of the Pope and Talbot sawmill (see Map KS-2, Segment 2-5). Net shoredrift to the north is indicated by a limited number of groins and other drift obstructions with sediment accumulated on the south side, three stream diversions to the north, and a northward decrease in sediment size.



Map KS-3. Kitsap County: Hood Canal Floating Bridge to Vinland.

MAP KS- 4

Segment 4-1 The coastal segment shown on Map KS-4 represents the southern major portion of a drift cell with a northward net shoredrift originating about 2.5 km south of Olympic View (see Map KS-5, Segment 5-1) and terminating at the bulkhead at the Pope and Talbot sawmill (see Map KS-2, Segment 2-5). The drift direction is indicated by numerous groins, boat ramps, and other drift obstructions which have a sediment accumulation on the south, a 10-meter stream diversion to the north at Olympic View, decreasing beach sediment
size to the north, and a northward increase in beach width. A previous study contends that the four headlands (beginning with King Spit and ending in Section 18) represent points of drift convergence. Based on the observed geomorphic indicators utilized in this study, we did not find this to be true. This conclusion is based on the following observations: (1) the asymmetry of the landforms observed in the field, (2) the consistent decrease in sediment size from the south side of these features to the north, (3) several of the features display upland elevation greater than those that can be attributed to a coastal accumulation landform, and (4) the presence of drift obstructions on the north side of several of the features showing sediment accumulation on the south side. These four features are, essentially, glacial headlands fronted by beaches.

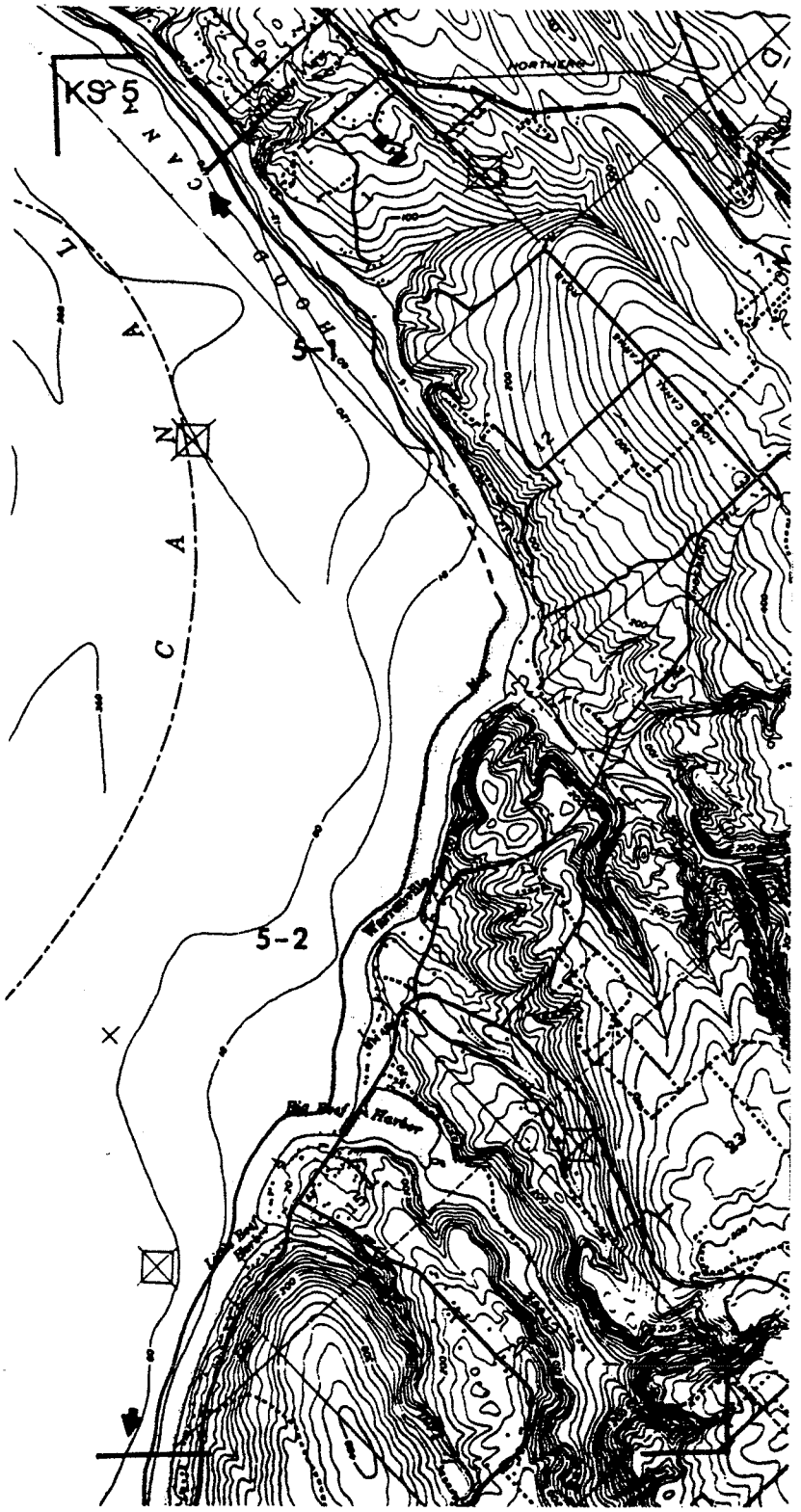


Map KS-4. Kitsap County: Vinland to Olympic View.

MAP KS-5

Segment 5-1 Beginning in a broad zone of divergence centered about 2.5 km south of Olympic View, this segment has a northerly net shoredrift as indicated by groins and other drift obstructions with sediment accumulation consistently on the south side. There are also several stream mouths which have been deflected to the north.

Segment 5-2 This is a large segment of a drift cell with a southerly net shore-drift, originating at a zone of divergence approximately 2.0 km north of Warrenville and terminating at the head of Seabeck Bay on Map KS-6. At Anderson Creek there is a spit building to the south in front of a marshy grassland. Proceeding south from Warrenville to Big Beef Harbor the beach widens and the beach sediment becomes finer. At Big Beef Harbor a spit has been built upon and utilized as a roadbed. However, there is a relict recurve present, indicating southerly drift. Just south of the benchmark on the headland between Little and Big Beef Harbors there is a large concrete groin with significant sediment accumulation on the north side.



Map KS-5. Kitsap County: Olympic View to Little Beef Harbor vicinity.

MAP KS-6

Segment 6-1 This segment is the southern part and terminus of a drift cell originating between Warrenville and Olympic View (see Map KS-5, Segment 5-2). Southwestward net shore-drift enters Map KS-6 from the northeast and continues southwest to its terminus at the head of Seabeck Bay. The direction of net shore-drift is indicated by numerous groins exhibiting sediment accumulation on the north side as well as beach sediments becoming generally finer to the southwest.

Drift Cell 6-2 Originating at a zone of divergence just west of Misery Point, this drift cell has a net shore-drift to the southwest along the west shore of Seabeck Bay. To the immediate south of Misery Point there is an excellent example of a recurved spit building to the south. This drift sector terminates at the head of Seabeck Bay where a spit is building to the south.

Drift Cell 6-3 Beginning at a zone of drift divergence about 100 meters west of Misery Point this cell has a southwest to southerly net shore-drift. There are boat ramps at Miami Beach and Maple Beach with sediment accumulated on the north side. Between Maple Beach and the terminus of the drift cell at Stavis Bay in Section 30 there are two significant spits building to the southwest. This drift cell ends along the northern Stavis Bay spit.

Drift Cell 6-4 This short drift cell is caused by the curvature of the west side of Stavis Bay interacting with waves from the north, resulting in net shore-drift to the southeast. This drift direction is indicated by a fining of sediment to the southeast, increasing beach width, and a sand spit building to the east from the southwest shore of Stavis Bay.

Segment 6-5 Originating at a localized zone of divergence along the west shore of Stavis Bay this segment has a net shore-drift to the southwest. This is indicated by beach sediment fining toward the southwest and a large stone breakwater built out across the beach, about 1.0 km south of Stavis Bay, exhibiting sediment accumulation on the northeast side. This drift cell terminates along the north shore of Hood Point (see Map KS-7, Segment 7-1).

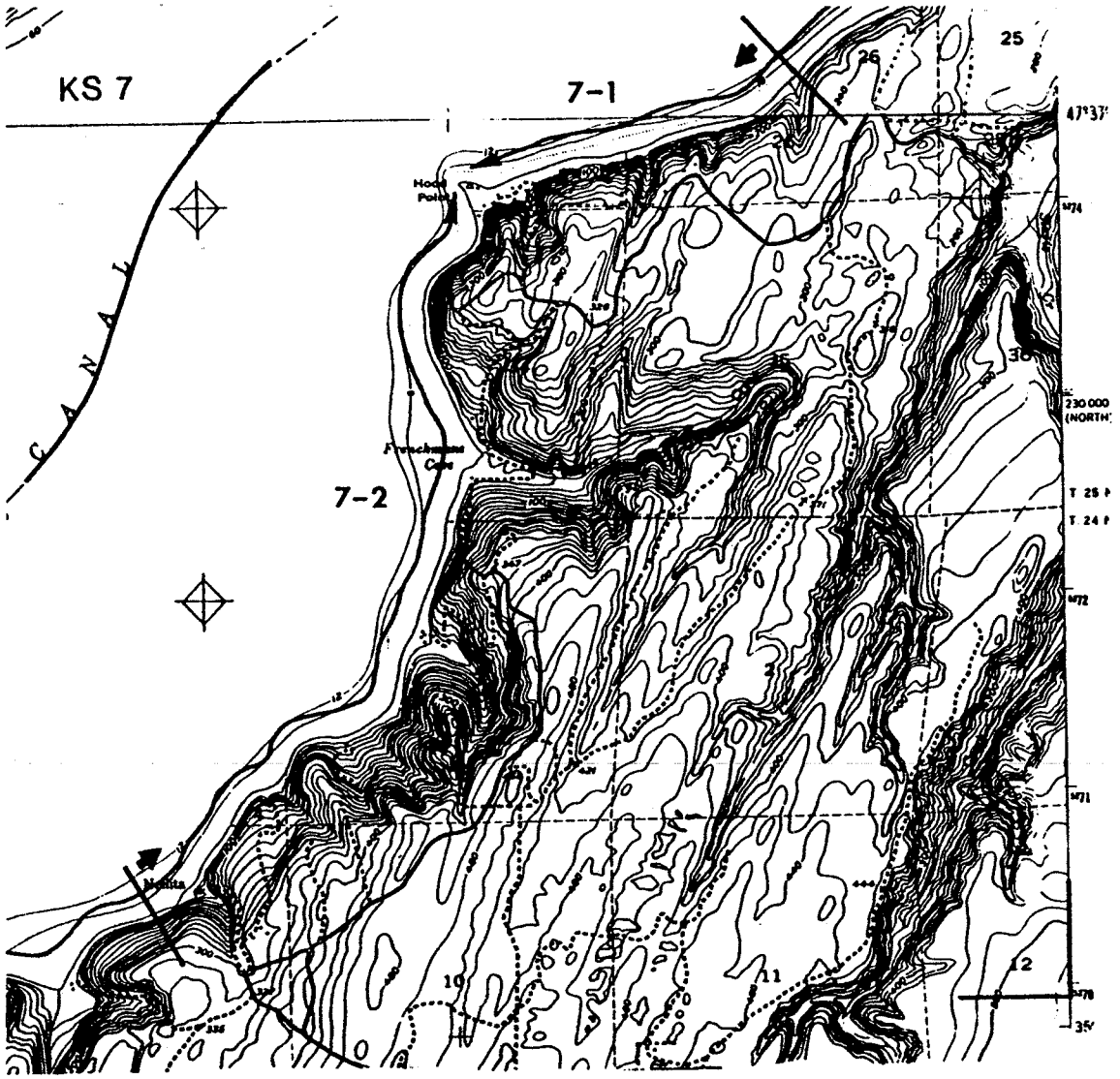
Map KS-6. Kitsap County: Seabeck Bay and Stavis Bay vicinity.

MAP KS-7

Segment 7-1 Southwesterly net shore-drift in this segment is the continuation and terminus of a drift cell originating immediately south of Stavis Bay and terminating along the north shore of Hood Point. The southwest net shore- drift enters Map KS-7 at its northern boundary and is indicated by beach sediment fining from cobbles and pebbles in the north to sand and granules at Hood Point. A residence located in the northeast corner of Section 26, protected by a 3-meter - tall stone bulkhead, is built out over the beach, creating a partial barrier to sediment transport. The beach to the south of this feature is of a noticeably finer composition than the beach to the north of it.

Drift Cell 7-2 This drift cell originates at a zone of divergence located approximately 1.2 km north of Nellita and terminates along the south shore of Hood Point. The northward net shore-drift is a result of southwesterly wind-generated waves. This drift direction is indicated by groins and other obstructions to drift showing accumulation on the south side, and sediment size decreasing from pebble and sand to sand to the north.

Segment 7-3 This segment includes the origin and northern portion of a drift cell ending at Tekiu Point (see Map KS-8, segment 8-1). Originating about 1.2 km north of Nellita southerly net shore-drift is indicated in this segment by decreasing sediment size to the south, a southerly increase in beach width, and several large trees fallen across the beach showing sediment accumulation on the north side.



Map KS-7. Kitsap County: Frenchmans Cove vicinity.

MAP KS-8

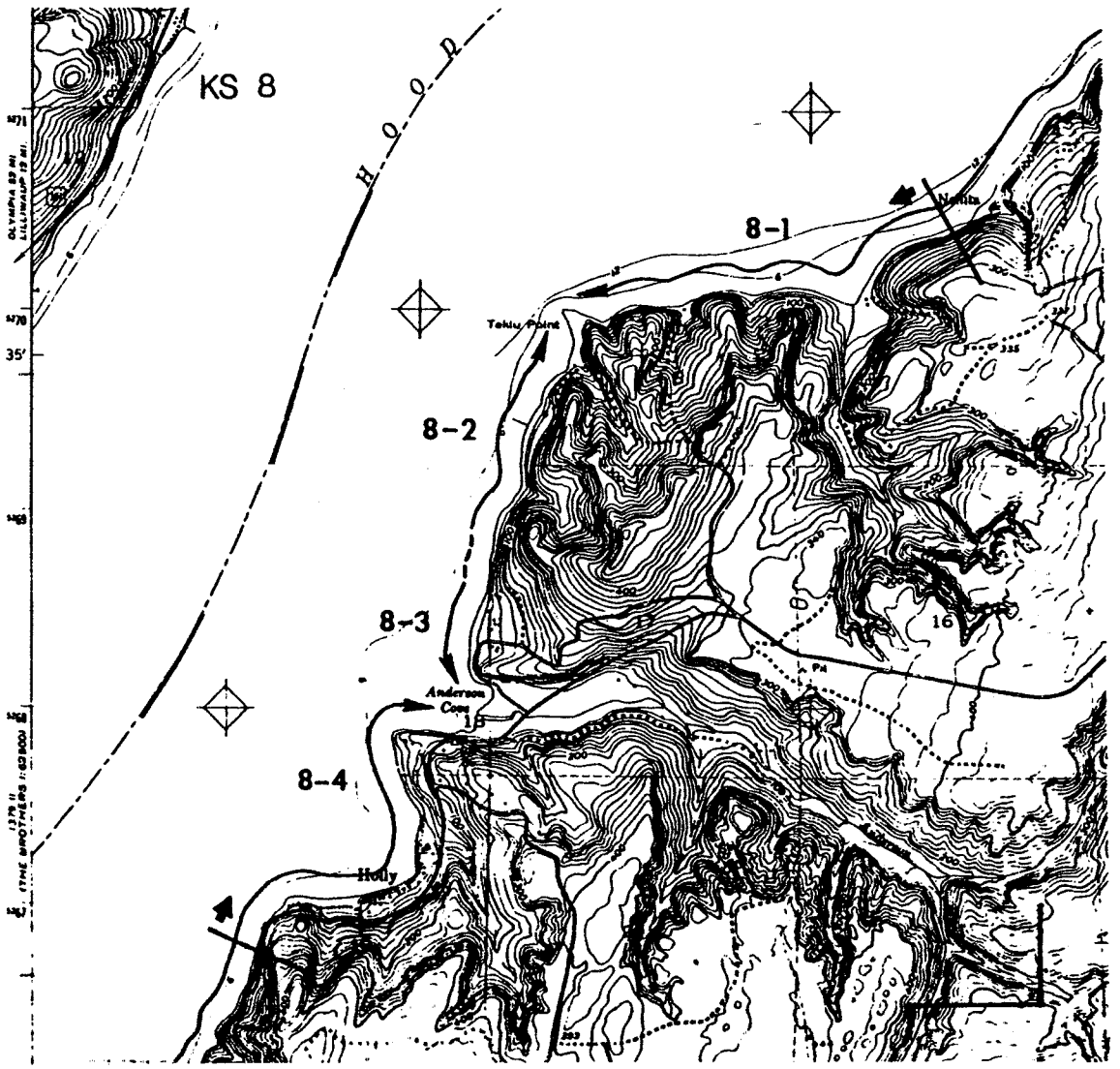
Segment 8-1 This is the southern portion and terminus of a drift cell originating about 1.0 km north of Nellita (see Map KS-7). Southwesterly net shore-drift along this segment is indicated by decreasing sediment size and increasing beach width to the south, a large (0.6 m diameter) log lying across the beach, still rooted into the bluff, showing sediment accumulation on the north side, and a sand spit building to the south.

Drift Cell 8-2 This drift cell begins in a zone of divergence about 0.5 km north of Anderson Cove and ends at Tekiu Point. A northerly net shore-drift direction is indicated by a change in bluff morphology from the divergence zone to the region just south of Tekiu Point. In the divergence zone the beach material is mostly cobbles and pebbles with an occasional boulder. This beach material size gradually decreases to the north until at Tekiu Point it is a predominantly pebble and sand composition.

Drift Cell 8-3 Originating approximately 0.5 km north of Anderson Cove and ending along the northern shore of Anderson Cove, this drift cell displays a southward net shore-drift. This drift direction is indicated by increasing beach width and decreasing size to the south.

The central portion of Anderson Cove is characterized by mudflats with peat exposed along the stream channel. There is no apparent net shore-drift evident in this area.

Segment 8-4 This is the northern section and terminus of a drift cell which originates in Section 25 on Map KS-9. The northerly directed net shore-drift of this segment is indicated by beach sediment size decreasing to the north, a boat ramp on the south Shore of the embayment with sediment accumulated on the east side, and a stream diversion to the north in the central portion of the embayment. This drift cell ends along the south shore of Anderson Cove where the sand beach gives way to mud flats.



Map KS-8. Kitsap County: Nellita to Holly.

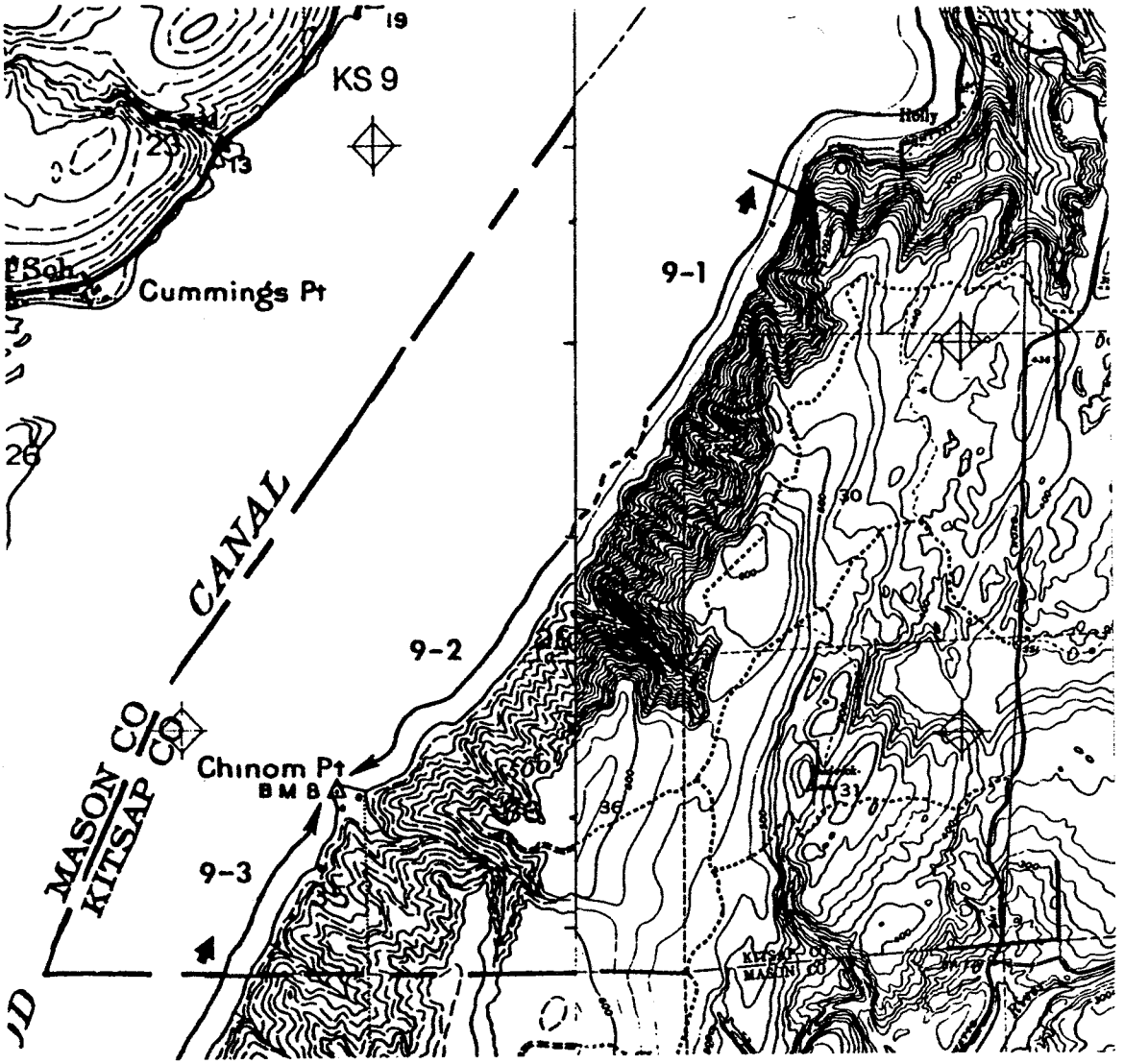
MAP KS-9

Segment 9-1 This segment includes the origin and southern part of a drift cell ending along the south shore of Anderson Cove (see Map KS-8, Segment 8-4). Originating immediately south of the survey marker in Section 25, the northerly net shore-drift of this segment is indicated by sediment accumulation on the south side of several large trees fallen across the beach and generally decreasing sediment size to the north.

Drift Cell 9-2 This drift cell begins at a zone of divergence immediately south of the survey marker in Section 25 and ends at Chinom Point. Net shore-drift to the south is indicated by sediment size decreasing from cobbles to granules and sand to the south and several trees lying across the beach showing sediment accumulation of 0.5 meter height on the north side.

Segment 9-3 This segment includes the northern part and terminus of a drift cell originating in Mason County. Net shore-drift to the north in the Kitsap County segment is indicated by increasing beach width and decreasing sediment size to the north.

The coastline in Map KS-9 is characterized by steep, well vegetated bluffs showing all the signs of a strongly sub-aerial erosion environment (tilting trees, slumping, landslides, etc.). This constant influx of sediment into the coastal zone along the entire length of Map KS-9 creates an environment of poorly defined geomorphic and sedimentologic net shore-drift indicators with the exception of Chinom Point.



Map KS-9. Kitsap County: Holly to Chinom Point.