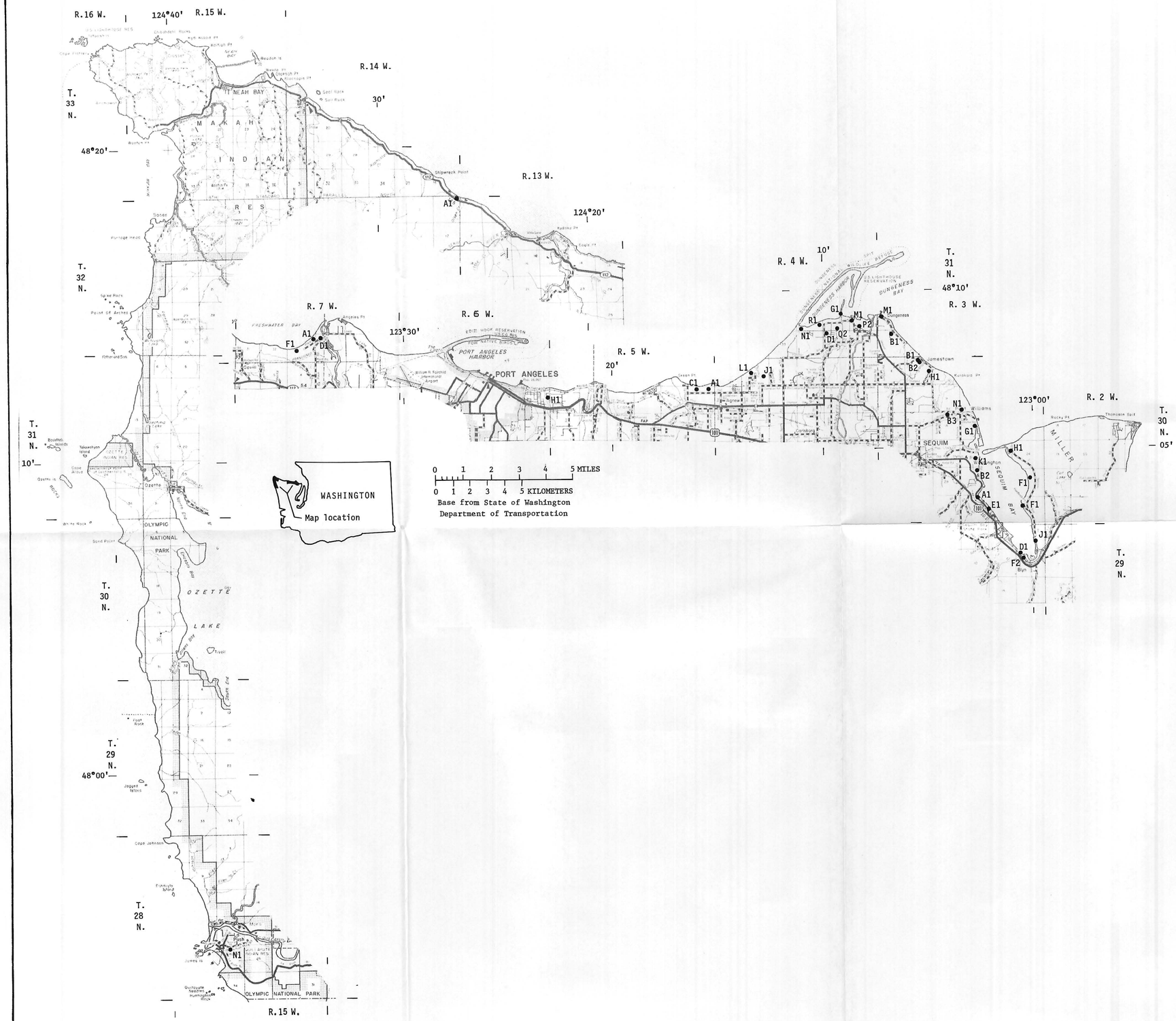
Prepared in Cooperation with
U.S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION



Seawater Intrusion Conditions

Much of the Pacific coast of Clallam County is within Olympic National Park and the ground water of that coastal strip is largely undeveloped. Because of the lack of ground-water development and deep wells in that area, seawater intrusion has not been observed nor is it likely to occur under present conditions. The Sequim-Dungeness area, where sizeable agricultural acreages are irrigated from wells, is the only part of the county where ground-water development has been extensive.

Deep wells are scarce along the shoreline of the Strait of Juan de Fuca between Neah Bay and Sequim Bay; domestic supplies in that area are taken from shallow wells, springs, or central systems that rely on streams. A few deep wells near the village of Neah Bay have been abandoned because of excessive chloride concentrations (Walters, 1971, p. 20).

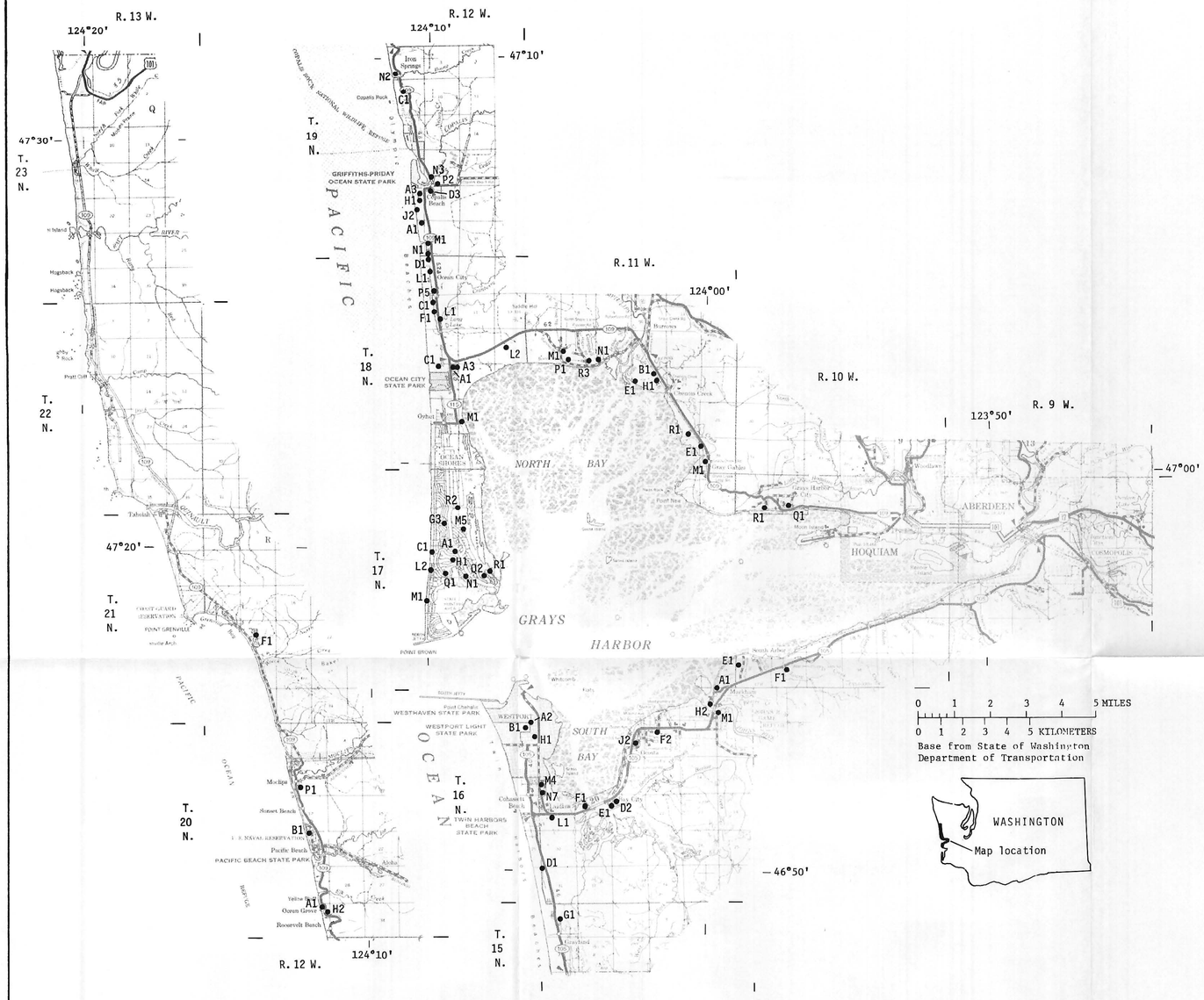
Water samples taken in 1978 from deep wells were low in chloride concentration (see table), indicating that seawater intrusion is probably not now a problem. Two shallow wells that supplied Neah Bay and were sampled in 1968 have since been abandoned, even though chloride concentrations in those wells were low. The village is now supplied by a central system fed by the Waatch River. Chloride concentrations in wells on the west shore of Sequim Bay are fairly high, as they were in 1968 (Walters, 1971, p. 21). Wells 29/3W-2K1 and 2Q1, which had high chloride concentrations in 1968, have since been abandoned. Wells 30/2W-15L1 and 16G1, near Diamond Point, reportedly high in chloride (145 and 313 mg/L, respectively) in 1968, have also been abandoned.

The overall chloride concentration of ground water in coastal Clallam County is low (table 1) and has not changed appreciably since 1968 (table 2). When local problems of seawater intrusion occurred many wells were abandoned. Large ground-water supplies probably cannot be developed in coastal areas of the county without the recurrence or aggravation of the intrusion problems previously observed.

Physical and chemical data for wells in Clallam County

Well number	Land-surface altitude (ft)	Depth of well (ft)	Specific conductance (micromhos at 25°C)	Chloride (mg/L)	Date of collection
28/15W-22N1	20	70	376.	62	7-12-78
29/ 3W- 1J1	30	94	390	7.3	7-06-78
-12D1	15	25	339	9.6	7-23-68
	--	--	331	11	7-06-78
-12F2	20	28	307	6.6	7-23-68
	--	--	284	6.5	7-06-78
30/ 6W-12H1	150	196	310	22	7-11-78
30/ 5W-12A1	140	152	321	21	7-30-68
	--	--	283	6.8	7-11-78
-12C1	140	144	315	7.0	7-30-68
	--	--	310	7.6	7-11-78
30/ 4W- 5J1	100	117	359	12	7-10-78
- 5L1	110	126	484	18	7-26-68
	--	--	482	17	7-11-78
30/ 3W- 5B1	5	265	250	2.2	7-24-68
	--	--	241	2.7	7-07-78
- 5B2	5	10	366	5.0	7-24-68
	--	--	366	6.5	7-07-78
- 5H1	8	30	352	4.3	7-24-68
	--	--	311	4.0	7-07-78
-10N1	70	310	401	5.4	7-24-68
	--	--	391	6.3	7-06-78
-15G1	80	574	328	3.8	8-02-68
	--	--	325	4.8	7-06-78
-16B3	105	113	676	5.3	7-07-78
-22K1	15	355	358	6.0	7-24-68
	--	--	375	3.7	7-06-78
-23H1	40	107	499	8.0	7-23-68
	--	--	480	7.5	7-06-78
-25F1	100	186	1,050	10	7-23-68
	--	--	1,010	16	7-06-78
-27B2	40	64	409	3.2	7-24-68
	--	--	370	3.7	7-06-78
-34A1	60	258	1,120	260	7-06-78
-35E1	60	370	1,580	400	7-06-78
-36F1	40	--	601	56	7-23-68
	--	--	520	36	7-06-78
31/ 7W-33A1	10	13	210	12	7-31-68
	--	--	195	13	7-11-78
-33F1	10	14	370	27	7-31-68
	--	--	351	30	7-11-78
-34D1	15	30	89	0.9	7-11-78
31/ 4W-25M1	5	300	294	5.1	7-25-68
	--	--	287	5.0	7-07-78
-25P2	50	63	233	4.8	7-07-78
-26G1	5	98	291	7.3	7-25-68
	--	--	283	7.3	7-10-78
-26Q2	70	90	369	10.	7-10-78
-27N1	90	118	340	11.	7-25-68
	--	--	368	12.	7-10-78
-27R1	35	53	377	13.	7-25-68
	--	--	356	10.	7-10-78
-35D1	70	94	261	5.8	7-10-78
31/ 3W-30M1	8	48	298	4.3	7-25-68
	--	--	296	5.0	7-07-78
-31B1	10	52	250	2.7	7-07-78
32/14W- 1A1	4	32	147	2.7	10-02-68
	--	--	173	5.0	7-12-78

SHEET 1. Seawater intrusion conditions in Clallam County.



Seawater Intrusion Conditions

Development of ground-water supplies in the coastal part of Grays Harbor County is limited to the area south of Moclips; little ground-water development has taken place on the Quinault Indian Reservation. Moderately large quantities of ground water are used by cranberry growers in the area south of Westport. Nearshore wells are pumped intensively when the berry bogs are sprinkled for irrigation, for frost control, and to reduce heat damage. Moderate to large quantities of water also are used in the processing of seafoods and forest products.

Seawater intrusion does not appear to be a problem in coastal Grays Harbor County. Of the 69 water samples taken from wells in 1978, none had a chloride concentration in excess of 100 mg/L, and even wells as deep as 500 feet below sea level had chloride concentrations in 1978 that were generally less than 20 mg/L. A few scattered wells in the county, however, had chloride concentrations significantly higher than the median of 16 mg/L (table 1).

Widespread seawater intrusion has not been detected to date in areas such as the Westport and Ocean Shores peninsulas, where intrusion problems would be expected for physiographic reasons. In fact, a significant decrease in chloride concentration was noted between 1968 and 1978 in water from a shallow well (17/12W-15A1) on the Ocean Shores peninsula. When sampled in 1968, the well was used for domestic purposes and had a chloride concentration of 210 mg/L. In 1978 the well was used only for lawn sprinkling and the chloride concentration had decreased to 14 mg/L. This decrease was probably due to a reduction in the amount of water withdrawn from the well.

The overall chloride concentrations and specific-conductance values in ground water of coastal Grays Harbor County rose slightly but not significantly between 1968 and 1978 (table 2).

Physical and chemical data for wells in Grays Harbor County

Well number	Land-surface altitude (ft)	Depth of well (ft)	Specific conductance (micromhos at 25°C)	Chloride (mg/L)	Date of collection
15/11W- 6G1	17	130	278	11.	10-29-68
	--	--	261	12.	7-26-78
16/12W-12A2	15	86	267	27.	7-26-78
-12B1	20	110	262	24.	7-26-78
-12H1	10	42	359	27.	10-29-68
	--	--	321	27.	7-25-78
16/11W- 1M1	50	168	183	6.6	10-25-68
	--	--	172	9.4	7-25-78
- 2A1	10	150	210	8.3	10-25-68
	--	--	204	10.	7-25-78
- 2H2	10	150	188	8.0	10-25-68
	--	--	206	10.	7-25-78
- 9J2	25	148	205	7.7	10-25-68
	--	--	197	8.9	7-25-78
-10F2	25	310	138	7.7	7-25-78
-18M4	25	71	342	39.	7-26-78
-18N7	25	68	234	22.	10-28-68
	--	--	244	26.	7-26-78
-19L1	20	242	180	17.	7-26-78
-20F1	12	20	138	20.	10-28-68
	--	--	132	24.	7-25-78
-21D2	25	151	152	20.	7-25-78
-21E1	2	525	185	16.	10-25-68
	--	--	173	17.	7-25-78
-31D1	15	58	303	33.	10-29-68
	--	--	283	24.	7-26-78
17/12W- 3R2	10	513	339	7.4	7-19-78
-10G3	10	20	291	16.	10-22-68
	--	--	323	30.	7-19-78
-11M5	20	20	79	7.8	10-11-68
	--	--	120	14.	7-20-78
-14N1	12	28	479	18.	10-23-68
	--	--	422	20.	7-20-78
-14Q2	10	20	307	26.	10-10-68
	--	--	300	34.	7-20-78
-14R1	10	20	238	37.	10-09-68
	--	--	222	55.	7-20-78
-15A1	12	20	962	210.	10-22-68
	--	--	304	14.	7-20-78
-15C1	10	20	343	33.	10-22-68
	--	--	365	39.	7-20-78
-15H1	10	20	654	16	10-23-68
	--	--	700	13	7-20-78
-15L2	10	14	335	17	10-23-68
	--	--	392	22	7-20-78
-15Q1	10	20	281	9.6	10-23-68
	--	--	344	21	7-20-78
-22M1	10	20	191	11	10-23-68
	--	--	165	13	7-20-78
17/10W- 5Q1	140	201	165	8.7	7-24-78
- 6R1	40	107	213	16	10-24-68
	--	--	250	15	7-24-78
-31E1	70	166	197	8.9	7-25-78
-32F1	20	28	179	7.8	10-25-68
	--	--	262	10	7-25-78
18/12W- 3D1	15	126	425	6.9	10-08-68
	--	--	377	8.7	7-18-78
- 3L1	15	155	255	9.3	10-08-68
	--	--	240	11	7-18-78
- 3P5	10	400	173	9.5	10-08-68
	--	--	161	13	7-18-78
-10C1	20	55	515	78	10-08-68
	--	--	542	89	7-18-78
-10F1	20	100	198	18	10-08-68
	--	--	184	19	7-18-78
-10L1	15	23	294	32	10-08-68
	--	--	312	39	7-18-78
-13L2	15	508	130	16	7-21-78
-22A1	45	85	248	28	10-10-68
	--	--	287	25	7-19-78
-22A3	35	85	216	27	10-10-68
	--	--	264	22	7-19-78
-22C1	10	14	136	11	10-09-68
	--	--	442	37	7-19-78
-26M1	10	474	162	8.1	10-09-68
	--	--	146	12	7-19-78
18/11W-16N1	10	13	71	6.1	10-21-68
	--	--	60	8.7	7-21-78
-17M1	15	40	160	14	10-24-68
	--	--	142	13	7-21-78
-17P1	10	170	283	13	10-24-68
	--	--	272	13	7-21-78
-17R3	12	75	238	18	10-24-68
	--	--	222	18	7-21-78
-22B1	15	110	700	60	7-21-78
-22E1	20	325	151	5.5	10-21-68
	--	--	167	11	7-21-78
-22H1	15	300	178	9.6	10-21-68
	--	--	142	8.2	7-21-78
-26R1	10	90	128	6.2	10-21-68
	--	--	128	9.2	7-24-78
-36E1	40	60	74	8.6	10-21-68
	--	--	64	8.9	7-24-78
-36M1	12	13	75	7.5	10-21-68
	--	--	79	8.9	7-24-78
19/12W- 4N2	25	165	349	66	7-13-78
- 9C1	110	200	246	34	7-13-78
-22N3	10	86	155	8.6	10-04-68
	--	--	156	15	7-13-78
-22P2	20	42	218	20	10-04-68
	--	--	229	17	7-13-78
-27D3	6	100	171	14	10-04-68
	--	--	160	14	7-13-78
-28A3	10	100	240	22	10-04-68
	--	--	187	16	7-13-78
-28H1	15	111	198	15	10-04-68
	--	--	191	16	7-14-78
-28J2	12	109	226	18	10-07-68
	--	--	252	19	7-14-78
-33A1	12	120	202	19	10-07-68
	--	--	274	35	7-14-78
-34M1	20	171	204	15	10-07-68
	--	--	212	16	7-14-78
-34N1	15	51	388	8.5	10-07-68
	--	--	381	10	7-14-78
20/12W- 8P1	60	234	172	12	10-03-68
	--	--	161	14	7-13-78
-20B1	110	250	168	7.6	10-03-68
	--	--	150	9.1	7-13-78
-32A1	30	160	166	15	7-13-78
-32H2	40	320	165	6.9	10-03-68
	--	--	156	8.8	7-13-78
21/12W-20F1	120	264	210	15	10-03-68
	--	--	188	18	7-13-78

SHEET 2. Seawater intrusion conditions in Grays Harbor County.

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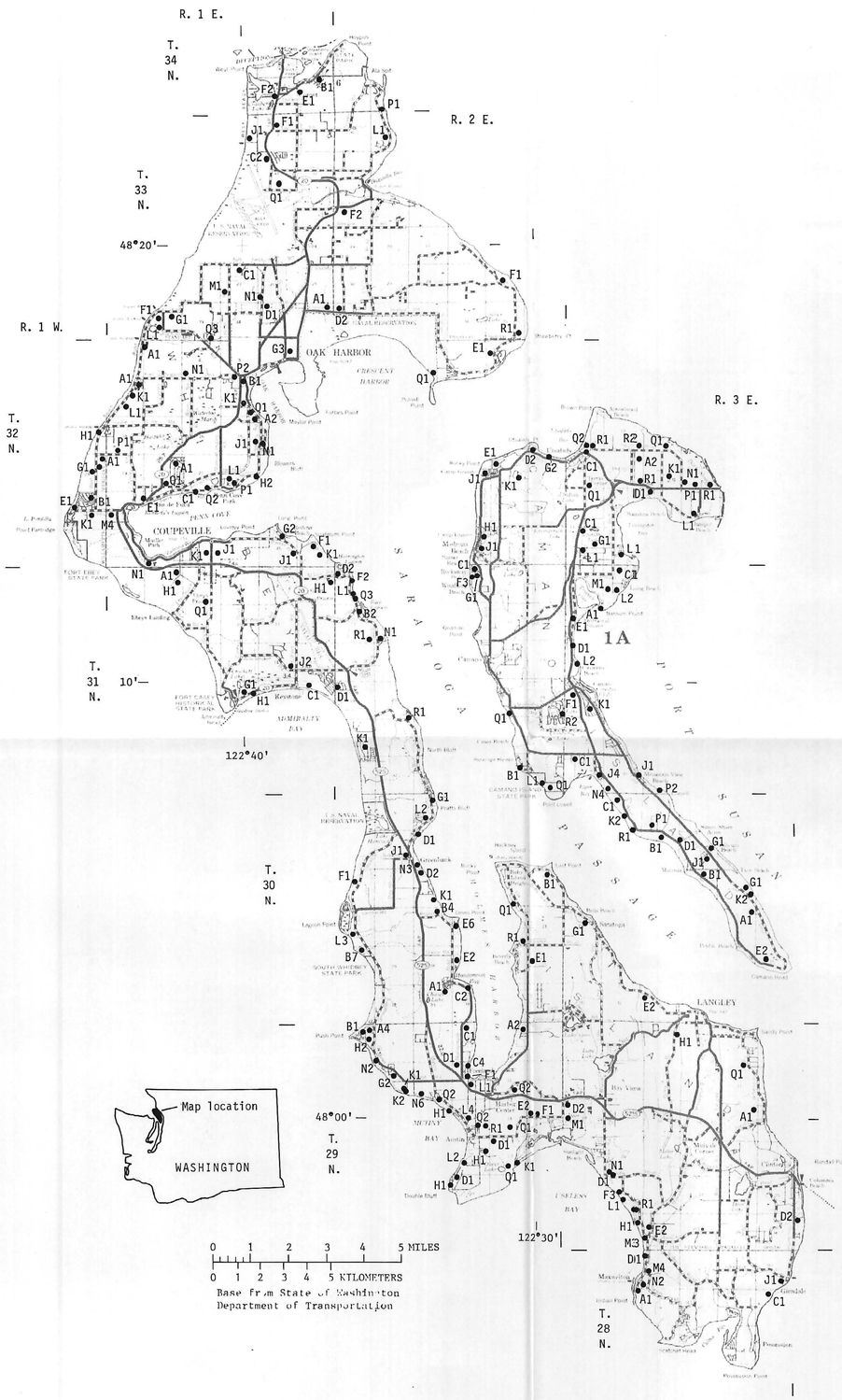

Seawater Intrusion Conditions

Ground-water development in Island County has resulted from a growing number of seasonal and permanent homes and small public-supply systems.

The median chloride concentration of ground water in Island County was 26 mg/L (table 1), and was exceeded only by the median concentration in San Juan County. The high chloride concentrations of ground water in the county may be due to the presence of fine-grained sediments that underlie the surface of the islands. According to Van Denburgh (1968, p. 26), the sediments accumulated in a marine or brackish-water environment during periods when the land surface was several hundred feet lower relative to sea level than it is today. According to Walters (1971, p. 41), even wells that are completed as much as 50 feet above sea level yield water containing more than 100 mg/L of chloride, suggesting the presence of relict seawater.

Local problems of seawater intrusion in Island County are common, and numerous wells have been abandoned or destroyed because of excessive salinity. Data collected in 1978 indicate that problems of seawater intrusion, or of relict seawater, are especially acute east of Fort Casey Historical State Park and in the Penn Cove area of Whidbey Island, and on the southeast and northeast ends of Camano Island. In addition, high chloride concentrations were detected in 11 wells in scattered locations on both islands.

Most high-chloride wells were completed in sand or sand and gravel. As in 1968, the highest known chloride concentration (13,000 mg/L) of ground water in Island County in 1978 was from industrial well 32/1-32N1 near Coupeville.

Island County is an area of rapid development. As the area continues to develop with concurrent and increasing ground-water withdrawals, the extent of seawater intrusion will presumably broaden and intensify unless precautionary steps are taken concomitant with development. Wells drilled for additional water supplies or as replacements for wells yielding salty water should be located as far inland as possible and be widely spaced to minimize drawdown of water levels at any locality.

Median values of specific conductance and of chloride concentration decreased from 1968 to 1978 (table 2), despite increased development of ground water during the decade. We must renew our warning in the general discussion that various factors may contribute to seeming changes, and that comparison of only two numbers (median 1968, median 1978) might lead to spurious conclusions.

Physical and chemical data for wells in Island County

Well number	Land-surface altitude (ft)	Depth of well (ft)	Specific conductance (micromhos at 25°C)	Chloride (mg/L)	Date of collection
28/ 3 - 1J1	20	74	300	10	5-06-63
	--	--	330	15	7-13-78
- 4D1	10	67	240	14	6-10-63
	--	--	226	12	7-12-78
- 4M4	10	69	205	13	7-12-78
- 4N2	175	203	330	8.4	7-12-78
- 8A1	14	92	310	26	6-06-63
	--	--	160	9.4	7-12-78
-12C1	160	238	292	10	7-13-78
29/ 2 - 2A2	110	140	270	15	7-11-78
- 3C1	290	327	310	13	6-29-78
- 5N2	185	210	450	25	7-23-63
	--	--	450	31	7-07-78
- 6A4	220	220	479	33	3-15-67
	--	--	465	32	7-07-78
- 6B1	15	278	427	18	3-16-67
	--	--	282	23	7-07-78
- 6H2	126	134	509	34	7-07-78
- 8G2	120	147	435	20	7-08-78
- 8K1	65	95	585	63	3-16-67
	--	--	540	55	7-07-78
- 8K2	162	185	646	24	3-16-67
	--	--	640	14	7-06-78
- 9N6	5	101	260	10	6-07-78
- 9Q2	70	274	340	13	7-06-78
-10C4	50	138	286	15	6-29-78
-10D1	130	233	340	13	6-29-78
-10F1	25	95	354	16	3-17-67
	--	--	300	15	5-13-77 1/
-10L1	20	20	238	20	6-30-78
-11Q3	105	171	325	17	7-11-78
-13E2	70	84	185	10	7-14-76 1/
-13F1	60	86	410	18	7-05-78
-14Q1	270	282	399	16	3-17-67
	--	--	388	16	7-05-78
-15L4	80	164	255	12	7-06-78
-15Q2	130	150	290	14	7-06-78
-15R1	130	136	351	20	3-17-67
	--	--	360	17	7-05-78
-16H1	10	115	310	12	7-06-78
-22H1	260	310	420	18	7-06-78
-22L2	15	51	391	28	3-17-67
	--	--	422	23	7-06-78
-23D1	260	268	460	23	3-17-67
	--	--	445	20	7-05-78
-23K1	5	42	465	17	7-05-78
-23Q1	110	146	410	32	2-15-77 1/
-27D1	150	189	1,250	200	7-06-78
-28H1	10	33	510	77	8-30-63
	--	--	425	17	7-06-78
29/ 3 - 2Q1	240	272	222	5.1	7-11-78
- 4H1	180	300	250	10	9-03-76 1/
-14A1	220	327	440	33	9-10-63
	--	--	430	33	7-13-78
-18D2	100	167	320	23	2-15-77 1/
-18M1	-3	85	340	13	8-09-77 1/
-20N1	150	232	340	12	9-10-63
	--	--	340	11	7-12-78
-29D1	155	225	260	10	4-28-77 1/
-29F3	100	160	215	7.1	7-12-78
-29L1	150	161	160	7.1	7-12-78
-29R1	215	247	160	8.0	6-13-63
	--	--	156	9.2	7-12-78
-32H1	280	305	190	10	7-12-78
-33E2	80	100	198	10	7-12-78
-33M3	100	150	207	10	7-12-78
29/ 4 -31D2	80	107	300	36	5-10-77 1/
30/ 2 - 4G1	100	144	425	30	6-28-78
- 4L2	100	147	430	38	1-18-77 1/
- 8J1	150	181	270	26	6-28-78
- 9D1	8	51	2,390	605	3-16-67
	--	--	1,820	420	6-28-78
- 9N3	160	171	350	36	3-16-67
	--	--	320	35	6-28-78
-13B1	185	201	349	13	7-11-78
-14Q1	210	290	619	34	3-17-67
	--	--	615	46	7-11-78
-16D2	200	311	292	19	6-28-78
-16K1	160	219	440	38	6-29-78
-18F1	155	220	305	22	7-10-78
-19L3	100	130	260	19	7-10-78
-21B4	220	295	2,060	510	6-29-78
-22E6	95	124	320	15	9-20-77 1/
-23R1	150	174	233	13	7-11-78
-25E1	230	253	410	12	7-11-78
-27E2	65	95	244	16	6-29-78
-30B6	90	120	430	29	7-10-78
-33A1	80	141	280	14	6-29-78
-34C2	130	243	375	12	6-29-78
30/ 3 - 4P1	155	236	624	110	7-21-78
- 5C1	95	100	2,300	575	3-29-67
	--	--	1,780	410	7-20-78
- 5K2	135	144	614	96	7-20-78
- 5R1	165	213	630	130	7-22-64
	--	--	1,190	290	7-21-78
- 9B1	85	184	360	26	8-04-64
	--	--	376	21	7-25-78
-10D1	200	260	280	13	7-25-78
-10G1	205	250	2,170	730	7-25-78
-10J1	200	260	1,410	350	7-25-78
-14K2	320	405	440	63	3-03-77 1/
-15B1	175	230	330	20	3-03-77 1/
-19G1	140	160	342	12	3-17-67
	--	--	340	13	11-04-76 1/
-23A1	360	426	262	14	7-25-78
-25E2	150	231	385	29	7-25-78
-33E2	180	230	225	7.1	7-11-78
31/ 1 - 1H1	200	236	515	24	7-01-76 1/
- 4Q1	90	146	870	56	7-01-76 1/
- 5A1	205	308	1,020	87	3-15-67
	--	--	1,030	83	6-26-78
- 5H1	200	224	772	50	3-15-67
	--	--	830	73	6-26-78
-14J2	18	25	744	64	3-16-67
	--	--	705	52	6-27-78
-22G1	10	148	1,250	140	6-28-78
-22H1	10	182	1,270	120	6-28-78
-24C1	2	117	605	36	3-16-67
	--	--	620	37	6-27-78
31/ 2 - 3C1	250	405	338	19	7-19-78
- 3F3	12	18	471	44	3-30-67
	--	--	310	17	7-19-78
- 3G1	230	384	349	21	3-30-67
	--	--	340	20	7-19-78
- 6D2	40	66	636	33	3-16-67
	--	--	658	28	6-27-78
- 6F2	140	140	570	46	6-27-78
- 6L1	130	141	520	44	6-22-77 1/
- 6Q3	75	93	1,030	63	6-27-78
- 7B2	15	36	1,800	340	5-26-78 1/
- 7R1	210	247	290	29	6-22-77 1/
- 8N1	145	155	440	42	5-26-77 1/
-19D1	155	197	682	64	3-16-67
	--	--	620	55	6-27-78
-20R1	60	81	1,770	365	3-16-67
	--	--	1,290	190	6-28-78
-23Q1	160	241	483	26	3-30-67
	--	--	460	23	7-20-78
-30K1	280	315	615	47	6-28-78
-35B1	50	100	410	21	8-18-64
	--	--	425	19	7-20-78
-36L1	150	196	405	29	3-29-67
	--	--	340	27	10-18-78
-36Q1	250	313	506	28	3-29-67
	--	--	505	24	7-20-78
31/ 3 - 5C1	130	178	389	16	7-26-78
- 5L2	80	168	516	27	7-26-78
- 5M1	135	176	412	26	3-29-67
	--	--	451	20	7-26-78
- 7A1	40	48	812	135	3-29-67
	--	--	920	150	7-26-78
- 7E1	45	217	290	17	9-23-64
	--	--	297	16	7-26-78
-18D1	135	205	290	15	9-23-64
	--	--	289	15	7-26-78
-18L2	65	105	280	16	9-23-64
	--	--	266	14	7-26-78
-19F1	175	206	320	17	8-10-64
	--	--	300	16	6-03-77 1/
-19K1	110	170	340	16	9-23-64
	--	--	341	15	7-25-78
-31C1	40	44	220	16	8-13-64
	--	--	175	14	7-20-78
-31J4	160	242	275	14	7-20-78
-32J1	125	158	1,900	480	8-07-64
	--	--	2,840	750	7-21-78
-32N4	110	139	383	29	7-20-78
-33P2	185	216	400	56	7-21-78
32/ 1W-13H1	45	64	623	79	3-15-67
	--	--	630	73	6-21-78
-24A1	230	295	786	64	3-15-67
	--	--	710	58	6-21-78
-24G1	220	397	944	84	3-15-67
	--	--	1,040	120	6-21-78
-24R2	240	275	975	104	6-21-78
-25B1	240	313	1,200	98	9-20-77 1/
-25E1	60	96	1,080	84	3-15-67
	--	--	1,610	190	6-21-78
-25K1	90	126	1,300	22	9-22-77 1/
32/ 1 - 2G3	84	165	500	40	5-26-77 1/
- 3P2	25	104	400	33	6-19-78
- 4N1	160	180	640	60	7-15-76 1/
- 6A1	120	206	560	48	6-20-78
- 7A2	240	271	615	51	6-20-78
- 7K1	200	--	800	97	8-09-77 1/
- 7L1	145	195	941	106	3-15-67
	--	--	940	110	6-21-78
-10B1	130	134	570	55	3-15-67
	--	--	480	39	6-23-78
-10K1	180	187	480	50	7-15-76 1/
-10Q1	120	201	620	52	6-22-78
-14N1	215	290	470	41	6-30-64
	--	--	480	46	6-22-78
-15A2	160	197	460	38	6-22-78
-15J1	200	314	505	45	6-22-78
-18P1	200	248	770	53	6-21-78
-20A1	145	181	970	89	9-27-77 1/
-20Q1	125	135	910	83	6-22-78
-21Q2	100	120	890	94	6-22-78
-22H2	210	316	700	67	6-22-78
-22L1	150	279	680	74	6-25-76 1/
-22P1	12	44	1,190	146	7-15-64
	--	--	1,040	150	6-22-78
-28C1	16	83	822	67	3-09-67
	--	--	790	63	6-22-78
-29E1	25	71	860	48	9-22-77 1/
-30M4	60	97	990	200	6-23-78
-32N1	90	217	35,000	14,000	1-07-65
	--	--	32,200	13,000	6-26-78
-33J1	90	240	1,030	83	3-16-67
	--	--	1,000	78	8-04-77 1/
-33K1	110	--	1,120	89	6-23-78
-35G2	105	201	970	78	8-20-76 1/
-35J1	200	301	720	1.4	6-27-78
-36F1	140	175	549	27	6-26-78
-36K1	200	300	440	11	6-26-78
32/ 2 - 2E1	100	131	320	19	6-24-64
	--	--	340	14	5-12-78
- 4Q1	105	163	356	19	4-22-64
	--	--	345	19	5-12-78
-22J1	110	172	300	16	8-26-64
	--	--	302	15	7-19-78
-23E1	30	118	290	17	9-23-64
	--	--	282	15	7-19-78
-23K1	225	340	312	15	7-19-78
-24D2	150	213	320	18	9-02-64
	--	--	330	20	7-18-78
-24G2	60	73	295	19	7-18-78
-34H1	50	62	600	78	3-30-67
	--	--	290	17	7-19-78
-34J1	200	471	288	16	7-19-78
32/ 3 -16Q1	105	126	801	170	3-30-67
	--	--	855	190	7-14-78
-17R2	170	178	611	35	3-30-67
	--	--	640	24	7-14-78
-18Q2	20	132	489	34	7-18-78
-18R1	80	191	1,740	390	7-18-78
-19B1	85	137	446	18	3-30-67
	--	--	359	19	7-18-78
-19Q1	250	267	460	7.5	3-30-67
	--	--	456	15	7-24-78
-20A2	130	160	595	30	3-30-67
	--	--	560	24	7-14-78
-20R1	40	67	360	19	9-23-64
	--	--	340	18	7-14-78
-21K1	95	135	731	55	3-30-67
	--	--	860	78	9-27-77 1/
-22N1	150	186	655	60	3-30-67
	--	--	640	36	7-14-78
-22P1	130	159	627	65	3-30-67
	--	--	560	45	7-13-78
-22R1	65	97	360	23	9-23-64
	--	--	365	26	7-13-78
-27L1	63	80	801	130	3-30-67
	--	--	1,150	240	7-14-78
-28D1	35	80	404	44	7-18-78
-31C1	150	275	290	14	9-23-64
	--	--	316	17	7-24-78
-31G1	190	233	291	14	7-24-78
-31L1	80	179	307	14	7-24-78
-32L1	125	164	180	15	9-23-64
	--	--	326	14	7-24-78
33/ 1 - 2F1	120	195	860	41	9-24-68
	--	--	681	39	5-11-78
- 3J1	14	109	520	39	3-14-67
	--	--	486	38	5-11-78
-11C2	125	152	430	36	9-24-64
	--	--	436	30	5-11-78
-11Q1	75	112	416	26	5-11-78
-26N1	155	178	550	46	7-09-64
	--	--	560	35	6-26-78
-27C1	185	185	660	65	7-10-64
	--	--	640	58	6-19-78
-27M1	210	269	954	102	3-14-67
	--	--	920	120	3-15-78 1/
-32F1	30	--	900	96	10-24-75 1/
-32G1	75	203	692	74	3-15-67
	--	99	715	66	6-20-78
-32L1	25	69	1,030	147	3-15-67
	--	--	910	130	6-20-78
-33Q3	200	217	490	50	6-24-64
	--	--	660	51	6-23-78
-35D1	105	146	720	58	7-01-64
	--	--	695	41	6-19-78
-36A1	30	68	550	48	3-15-67
	--	--	520	40	5-12-78
33/ 2 - 5L1	260	284	396	22	5-11-78
-18F2	60	75	380	22	7-09-64
	--	--	341	22	5-11-78
-26F1	140	419	1,640	310	5-11-78
-31D3	55	105	459	35	5-11-78
-35R1	170	180	616	19	3-15-67
	--	--	575	3.4	5-12-78
34/ 1 -35F2	45	150	567	50	3-14-67
	--	--	796	12	5-11-78
-36B1	65	174	396	27	3-14-67
	--	--	414	25	5-11-78
-36E1	50	196	356	25	5-11-78
34/ 2 -32P1	240	246	422	27	3-14-67
	--	--	381	24	5-11-78

1/ Data furnished by Washington Department of Ecology.

SHEET 3. Seawater intrusion conditions in Island County.

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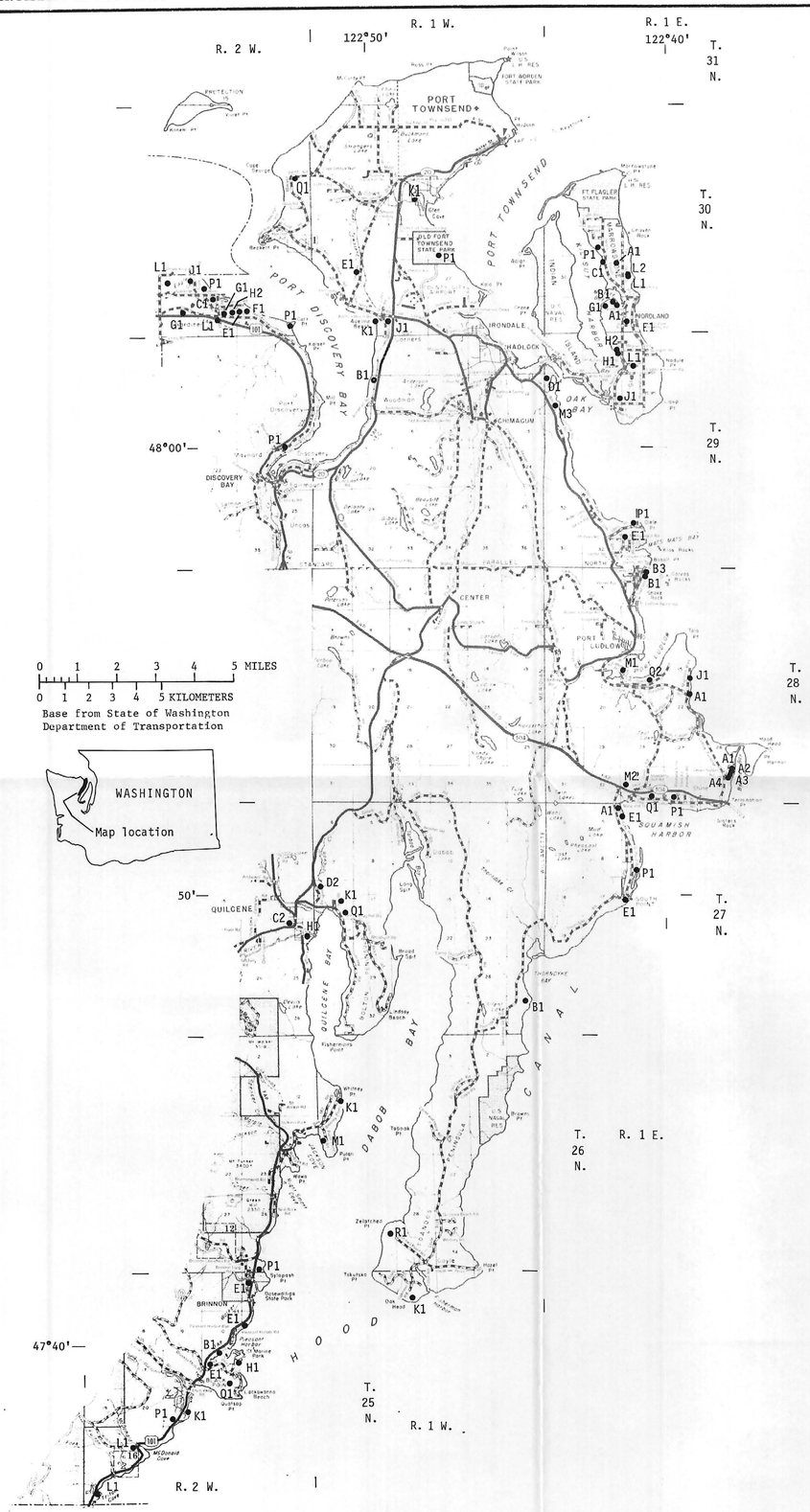
WATER RESOURCES DIVISION



Seawater Intrusion Conditions

The ground water of coastal Jefferson County is largely undeveloped; most of the Pacific coast in the western part of the county is within Olympic National Park. Local areas in the eastern part of the county are being developed for residential use. Because of the lack of ground-water development along the Pacific coast, no ground-water samples were collected from that area in 1978. No wells were found on Indian Island immediately west of Marrowstone Island in 1968 or 1978. The Navy installation there is supplied with surface water from the mainland.

In the Gardiner area of eastern Jefferson County, samples from five wells had chloride concentrations ranging from 170 to 2,300 mg/L. Five other wells in the same area and drilled to the same general depths had much lower chloride concentrations, ranging from 9.6 to 28 mg/L. Samples taken from a third group of wells in the Gardiner area which did not extend below sea level had very high chloride concentrations. The high chloride concentrations in the Gardiner area are probably the result of incomplete flushing of relict seawater rather than excessive pumping of deep wells (Walters, 1971, p. 21). Data from the shallow wells are not included in the table.

In the northern part of Marrowstone Island, three wells yielded water with chloride concentrations ranging from 100 to 610 mg/L. In the southern part of Marrowstone Island, well 29/1-5H2, which taps a sandstone aquifer about 60 feet below sea level, yielded water with 360 mg/L chloride in 1978 and 1,150 mg/L in 1968.

Water from two wells on the west side of Bywater Bay had chloride concentrations of 250 and 350 mg/L. The wells are completed at depths of 15 and 70 feet below sea level, respectively. Two nearby wells that tap aquifers at the same general altitude had chloride levels below 50 mg/L, indicating that the seawater intrusion problem in the Bywater Bay area is of a local nature and is probably controlled by geologic conditions.

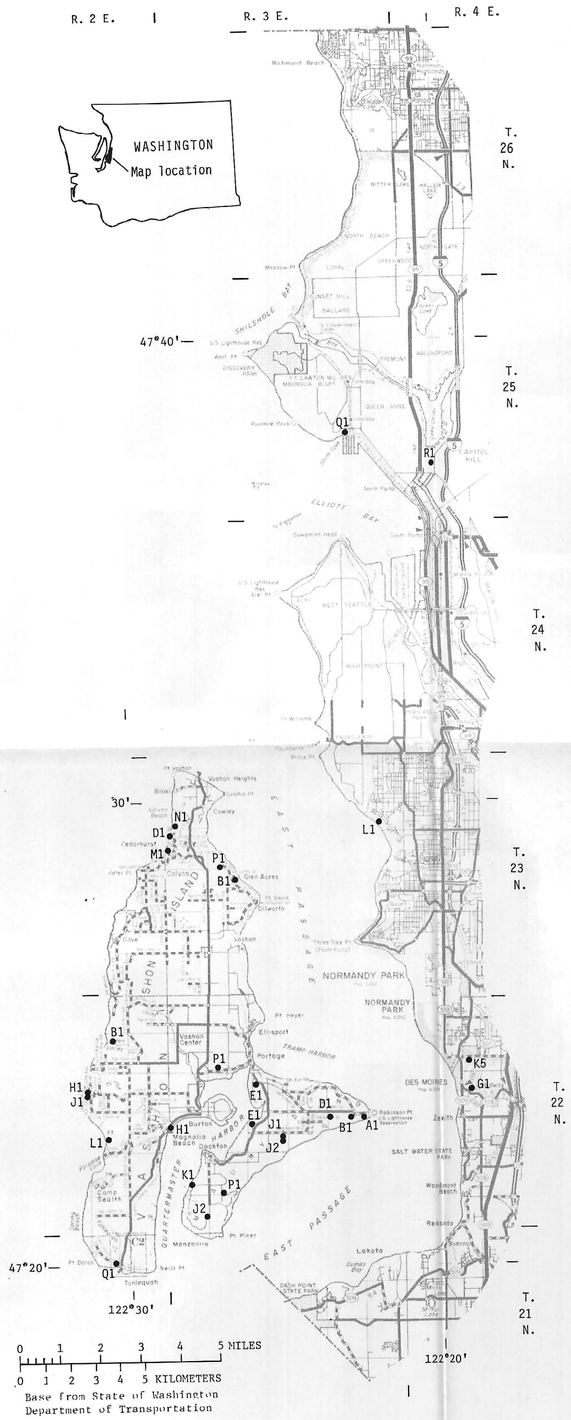
A comparison of chloride concentrations and specific-conductance values measured in Jefferson County in 1968 and 1978 (table 2) indicates that chemical conditions in the coastal ground water are virtually unchanged. Increased ground-water development from deep wells could, however, lead to higher chloride levels. The geologic conditions on Indian Island are similar to those on Marrowstone Island; seawater intrusion would probably ensue if ground-water development from deep wells were to take place on Indian Island.

The potential for the worsening of seawater intrusion problems exists for Bywater Bay, Port Ludlow Bay, and South Point, where incipient problems have already been detected. However, in those areas such as the Gardiner area, where high-chloride concentrations may be the result of relict seawater, chloride concentrations probably will not increase. These areas could possibly benefit from increased ground-water withdrawals which induce ground-water flow from adjacent areas and result in a flushing of the affected aquifer.

Physical and chemical data for wells in Jefferson County

Well number	Land-surface altitude (ft)	Depth of well (ft)	Specific conductance (micromhos at 25°C)	Chloride (mg/L)	Date of collection
25/ 2W- 2E1	20	60	75	1.0	8-14-68
	--	--	48	1.6	6-20-78
-11E1	80	84	277	31	8-13-68
	--	--	246	33	6-20-78
-15B1	15	47	85	1.3	8-09-68
	--	--	115	4.1	6-20-78
-15E1	125	214	148	2.1	6-20-78
-15H1	45	100	114	2.8	6-20-78
-15Q1	200	270	114	2.1	6-20-78
-21K1	20	70	213	1.9	8-09-68
	--	--	211	2.6	6-20-78
-21P1	30	39	77	1.0	8-09-68
	--	--	50	2.1	6-20-78
-29L1	10	40	82	1.0	8-08-68
	--	--	54	1.0	6-20-78
-31L1	30	120	150	2.6	6-20-78
25/ 1W- 4K1	220	222	142	2.6	6-22-78
26/ 2W-35P1	10	28	97	0.2	8-14-68
	--	--	100	1.3	6-20-78
26/ 1W- 7K1	70	150	127	1.8	8-14-68
	--	--	128	2.3	6-21-78
-18M1	50	130	165	6.9	8-14-68
	--	--	154	9.6	6-21-78
-29R1	180	300	260	31	8-14-68
	--	--	356	56	6-22-78
27/ 2W-24C2	50	141	281	39	6-21-78
-24H1	10	20	141	14	8-14-68
	--	--	101	6.2	6-21-78
27/ 1W-18D2	25	147	756	31	6-21-78
-18K1	40	60	328	3.9	6-21-78
-18Q1	45	134	296	3.4	6-21-78
-36B1	40	183	365	6.8	8-15-68
	--	--	366	8.5	6-22-78
27/ 1 - 4E1	30	120	172	6.2	6-22-78
- 5A1	30	97	183	4.1	8-15-68
	--	--	176	5.4	6-22-78
- 9P1	10	--	293	26	8-15-68
	--	--	346	46	6-22-78
-16E1	5	92	1,190	301	8-15-68
	--	--	1,550	410	6-22-78
28/ 1 - 4B1	50	92	390	11	7-09-68
	--	--	406	12	6-26-78
- 4B3	75	140	461	18	6-26-78
-15J1	65	101	206	4.9	6-23-78
-16M1	30	125	947	241	7-09-68
	--	--	1,230	330	6-23-78
-16Q2	50	83	219	3.3	7-09-68
	--	--	213	3.9	6-23-78
-22A1	80	92	167	6.8	7-09-68
	--	--	183	8.0	6-23-78
-33M2	130	165	286	3.6	6-22-78
-33Q1	25	30	415	22	8-16-68
	--	--	496	63	6-22-78
-34P1	20	65	517	45	8-16-68
	--	--	491	32	6-23-78
-35A1	105	120	1,430	350	8-28-78
-35A2	110	113	519	41	8-28-78
-35A3	80	110	303	5.8	8-28-78
-35A4	40	110	927	250	8-28-78
29/ 2W-13P1	40	60	283	7.0	10-01-68
	--	--	284	11	7-05-78
29/ 1W- 8B1	100	150	305	12	6-30-78
29/ 1 - 4L1	120	250	705	91	6-29-78
- 5H1	14	88	367	11	7-24-68
	--	--	390	18	6-29-78
- 5H2	20	80	4,090	1,150	7-24-68
	--	--	1,520	360	6-29-78
- 7D1	40	60	665	74	7-11-68
	--	--	646	67	6-27-78
- 7M3	45	56	327	9.2	7-10-68
	--	--	306	9.6	6-27-78
- 8J1	75	112	596	23	6-27-78
-28P1	30	100	321	12	7-10-68
	--	--	281	14	6-26-78
-33E1	45	79	346	7.8	6-26-78
30/ 2W-12Q1	230	300	470	27	6-29-78
-27P1	80	131	1,370	330	8-28-78
-28J1	130	130	192	12	8-29-78
-28L1	100	137	270	9.6	8-29-78
-33G1	310	420	179	20	8-29-78
-34C1	20	77	2,900	820	10-01-68
	--	--	2,490	650	7-05-78
-34G1	175	245	354	13	8-28-78
-34H2	220	340	745	170	7-05-78
-34L1	240	360	389	28	10-01-68
	--	--	231	20	7-05-78
-35E1	130	175	2,300	665	10-01-68
	--	--	2,290	700	7-05-78
-35F1	72	180	6,900	2,300	7-05-78
-36P1	20	93	415	23	7-05-78
30/ 1W-16K1	30	31	515	27	7-25-68
	--	--	452	24	6-29-78
-22P1	180	270	436	12	7-25-68
	--	--	456	21	6-27-78
-29E1	75	290	525	16	7-25-68
	--	--	540	12	6-29-78
-32J1	120	145	314	7.0	9-30-68
	--	--	305	9.9	6-30-78
-32K1	44	47	422	2.0	9-30-68
	--	--	449	6.5	6-30-78
30/ 1 -20P1	50	75	1,340	240	6-28-78
-28L1	40	60	609	55	7-11-68
	--	--	516	47	6-28-78
-28L2	55	63	599	46	7-11-68
	--	--	646	58	6-28-78
-29A1	100	136	2,420	610	6-28-78
-29C1	25	32	1,680	358	7-11-68
	--	--	911	100	6-28-78
-32A1	35	371	2,220	610	6-28-78
-32B1	60	168	1,970	47	6-28-78
-32G1	40	168	996	63	6-28-78
-33E1	20	35	790	66	7-24-68
	--	--	816	73	6-28-78

SHEET 4. Seawater intrusion conditions in Jefferson County.



Seawater Intrusion Conditions

In coastal areas of King County many wells have been abandoned or destroyed because of a decreasing need of water from ground-water sources. Much of the area is now served by public-supply systems that obtain water from surface sources or from highly productive wells that are several miles inland, and thereby less susceptible to seawater intrusion. Those parts of Vashon and Maury Islands not served by public water-supply systems rely on springs and shallow wells.

Most of coastal King County is highly urbanized and public water-supply systems are supplied from surface-water sources. Wells were difficult to find in the county; of the 27 wells sampled in the 1978 survey, five were on the mainland and the remainder were on Vashon and Maury Islands.

The chloride concentration of well 23/3-7N1 was significantly higher in 1978 (150 mg/L) than in 1968 (86 mg/L); the chloride concentration of well 23/3-18D1 was slightly lower in 1978 (630 mg/L) than in 1968 (658 mg/L). The salinity of water from other wells sampled on Vashon and Maury Islands increased slightly betweeen 1968 and 1978.

Seawater-intrusion problems are unlikely to occur in mainland King County because of the small amounts of ground water withdrawn. Intrusion problems are likely to increase on Vashon and Maury Islands if additional water supplies are obtained from ground-water sources. The most serious problems are likely to occur in the northern part of Vashon Island, where some intrusion already has been detected.

The overall chloride concentration of ground water in King County was low (table 1) in 1978 and decreased between 1968 and 1978 (table 2).

Physical and chemical data for wells in King County

Well number	Land-surface altitude (ft)	Depth of well (ft)	Specific conductance (micromhos at 25°C)	Chloride (mg/L)	Date of collection
21/ 1 - 2Q1	10	10	287	14	7-02-68
	--	--	280	25	5-30-78
22/ 2 -11B1	70	--	182	3.5	7-03-68
	--	--	176	4.9	5-30-78
-15H1	72	256	206	5.2	5-30-78
-15J1	105	280	273	3.9	7-02-68
	--	--	256	4.1	5-30-78
-23L1	50	205	162	1.8	7-11-68
	--	--	148	2.8	5-30-78
-24H1	30	112	159	2.7	7-10-68
	--	--	150	3.4	5-30-78
22/ 3 - 8P1	15	--	253	2.9	7-10-68
	--	--	248	4.1	6-01-78
-16E1	60	462	497	7.2	7-08-68
	--	--	686	4.1	5-31-78
-21E1	120	475	271	2.9	7-09-68
	--	--	270	4.4	5-31-78
-21J1	425	518	190	4.7	5-31-78
-21J2	340	348	190	4.7	5-31-78
-23A1	35	148	493	6.8	7-09-68
	--	--	493	10	5-31-78
-23B1	130	132	196	11	5-31-78
-23D1	380	388	209	4.7	5-31-78
-29P1	315	619	232	2.3	7-09-68
	--	--	217	3.9	5-31-78
-30K1	5	7	201	6.6	7-09-68
	--	--	154	6.7	5-31-78
-31J2	375	573	618	6.2	5-31-78
22/ 4 - 8K5	155	200	177	4.5	3-31-67
	--	--	149	2.8	6-05-78
-17G1	102	200	300	14	3-29-67
	--	--	277	12	6-05-78
23/ 3 - 7N1	30	125	994	86	7-05-68
	--	--	1,080	150	6-01-78
-12L1	70	131	293	9.6	6-05-78
-17P1	40	--	565	83	7-08-68
	--	--	547	85	6-01-78
-18D1	100	320	2,400	658	7-05-68
	--	--	2,400	630	6-01-78
-18M1	70	250	210	2.9	7-05-68
	--	--	217	3.5	6-01-78
-20B1	50	75	280	5.3	7-08-68
	--	--	249	6.0	6-01-78
25/ 3 -23Q1	20	1,084	413	38	4-06-67
	--	--	348	27	6-05-78
25/ 4 -30R1	115	555	327	14	4-12-67
	--	--	195	4.7	6-05-78

SHEET 5. Seawater intrusion conditions in King County.

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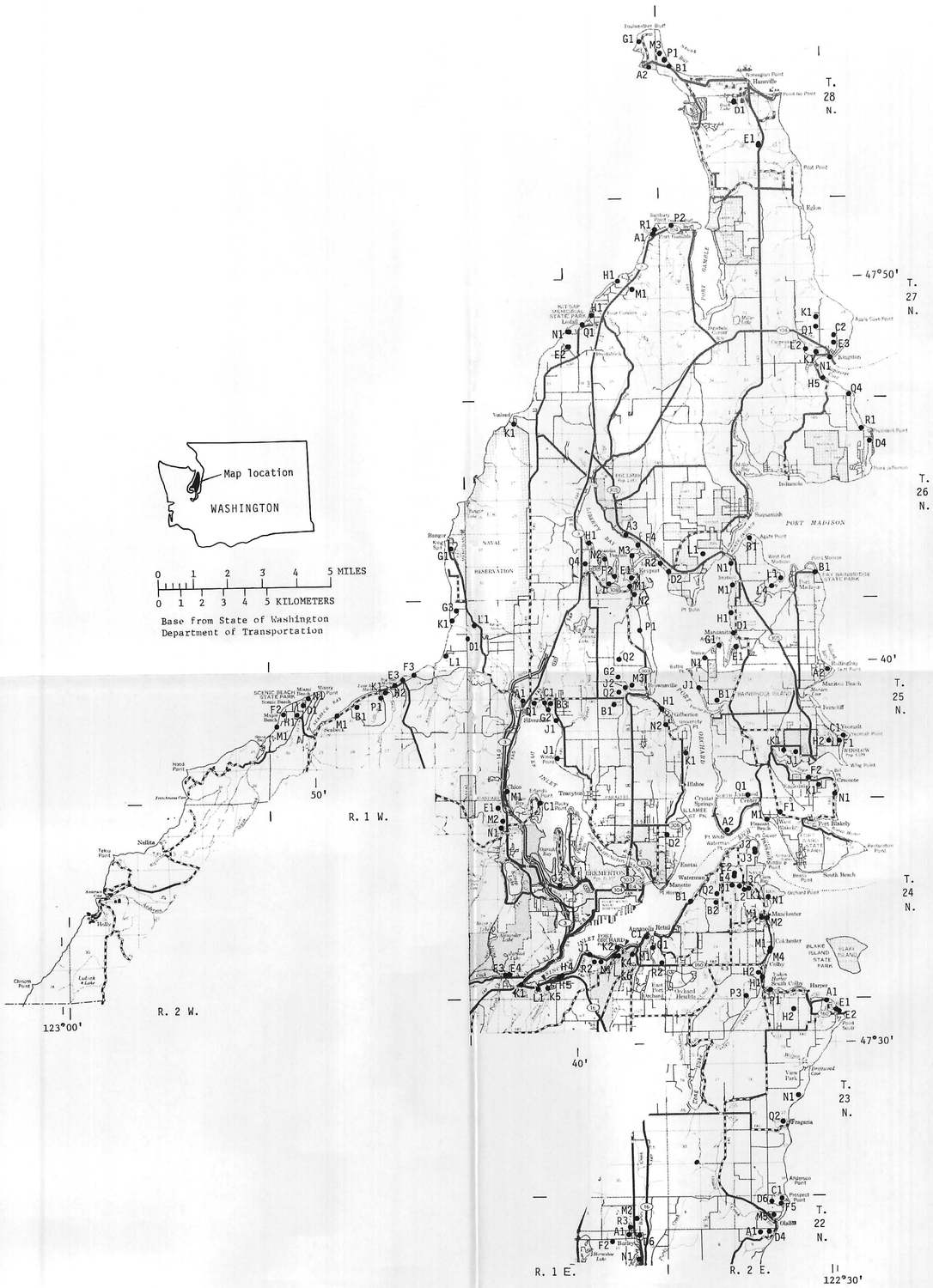


Seawater Intrusion Conditions

Most ground-water development to date has been in the east-central part of Kitsap County; very little development has been attempted in the northern and western parts of the county. Southern Kitsap County, however, is an area of rapid growth. The construction of a U.S. Navy submarine base near Bangor in the northwestern part of the county is expected to result in local increases of population and ground-water development in that area.

The overall chloride concentrations of ground water in Kitsap County were low in 1978 (table 1), although a few individual wells yielded water in excess of 100 mg/L of chloride. The highest chloride concentration detected (230 mg/L) was in water from a domestic well (23/2-22Q2) which, when sampled in 1967, contained only 41 mg/L of chloride. Other wells in the county also showed increases in chloride over the 1967-78 period, although the increases were smaller and chloride concentrations generally were lower than in well 23/2-22Q2.

The water from three wells in Kitsap County showed significant decreases in chloride concentration in 1978 as compared to 1967. Water in well 24/1-4C1 decreased from 36 mg/L in 1967 to 4.8 mg/L in 1978, and wells 24/2-9J2 and 9J3 decreased from 210 to 140 mg/L, and from 41 to 8.6 mg/L, respectively.

There do not appear to be any widespread areas of seawater intrusion in Kitsap County, although several widely scattered areas of local intrusion occur where chloride concentrations are considerably higher than the county median of 3.3 mg/L (table 1) but lower than the 100 mg/L limit. Even though the median chloride concentration is relatively low, many wells have been abandoned throughout the county because of brackish water. A recent investigation of ground-water availability on the Kitsap Peninsula concludes that the lower aquifer near Keyport, Winslow, and Port Orchard would be susceptible to seawater intrusion if withdrawals from that aquifer were increased significantly (A.J. Hansen, Jr., oral commun., March 1979).

Much of the ground-water supply of Kitsap County comes from artesian aquifers, and withdrawals to date have not significantly reduced pressures in those aquifers. However, care should be taken, especially in the rapidly growing parts of the county, to insure that artesian pressures are not reduced by excessive withdrawals.

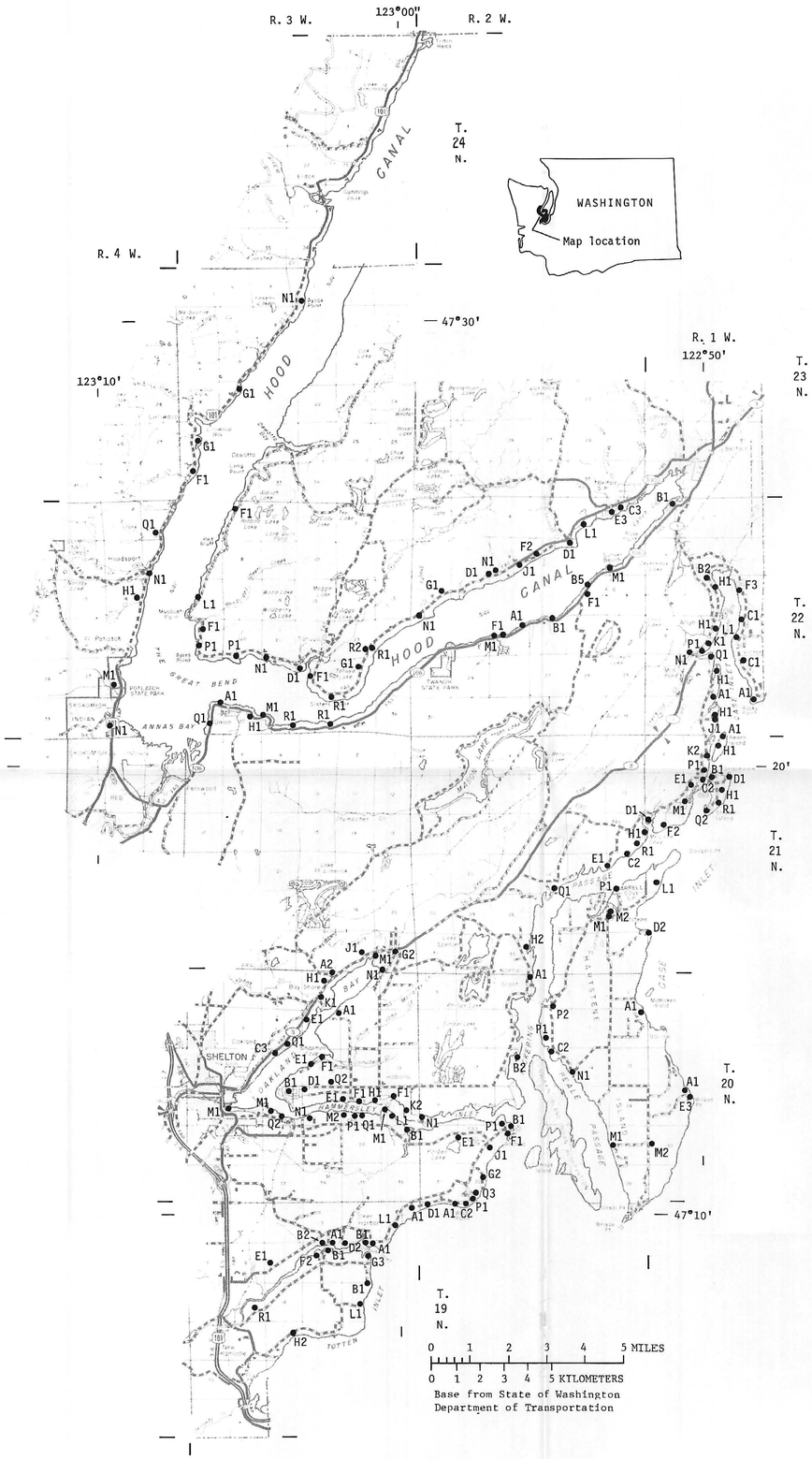
Table 2 indicates that the median chloride concentration of 116 water samples decreased from 5.1 mg/L in 1967 to 3.4 mg/L in 1978.

Physical and chemical data for wells in Kitsap County

Well number	Land-surface altitude (ft)	Depth of well (ft)	Specific conductance (micromhos at 25°C)	Chloride (mg/L)	Date of collection
22/ 1 - 1M2	50	62	119	4.0	6-20-67
	--	--	120	1.8	7-10-78
- 2R3	40	60	116	2.3	7-10-78
-11A1	60	404	136	3.5	6-20-67
	--	--	133	1.5	7-10-78
-11F2	170	215	140	2.8	7-10-78
-12D6	80	113	177	2.3	7-10-78
-12N1	20	210	144	1.6	5-09-68
	--	--	135	2.0	7-10-78
22/ 2 - 3C1	125	260	159	4.5	4-18-67
	--	--	154	2.3	7-11-78
- 3D6	350	400	199	4.5	4-18-67
	--	--	202	2.5	7-11-78
- 3F5	315	340	173	6.0	5-18-67
	--	--	167	3.0	7-11-78
- 3M5	20	54	107	6.5	4-19-67
	--	--	116	3.5	7-11-78
- 9A1	170	256	145	2.3	7-11-78
-10D4	75	84	127	6.0	4-18-67
	--	--	135	4.6	7-11-78
23/ 2 - 1E1	15	49	288	18	4-20-67
	--	--	328	19	7-12-78
- 1E2	15	163	614	8.5	4-20-67
	--	--	618	0.2	7-12-78
- 2A1	60	90	195	7.0	4-20-67
	--	--	185	4.3	7-13-78
- 3H2	260	332	454	2.3	7-13-78
-14N1	40	54	178	3.3	7-12-78
-22Q2	8	58	276	41	4-19-67
	--	--	950	230	10-11-78
24/ 1 - 4C1	15	26	295	36	5-07-67
	--	--	218	4.8	8-23-78
- 5E1	65	254	94	3.5	5-07-67
	--	--	90	1.5	8-23-78
- 5M2	80	96	81	3.0	5-07-67
	--	--	109	1.8	8-23-78
- 5N1	65	127	101	6.0	5-07-67
	--	--	81	2.0	8-23-78
-16J3	15	20	181	3.8	8-23-78
-25C1	5	160	185	3.0	5-02-67
	--	--	180	2.0	7-25-78
-25G1	60	1,006	148	4.5	5-02-67
	--	--	130	1.8	7-26-78
-25M1	60	806	142	3.0	5-02-67
	--	--	136	1.8	7-26-78
-25R2	100	1,257	147	4.0	5-02-67
	--	--	374	73	7-26-78
-26K2	5	285	135	3.5	5-02-67
	--	--	130	1.8	7-26-78
-26K4	5	792	149	3.0	5-02-67
	--	--	132	1.8	7-26-78
-26K6	5	846	136	3.5	5-02-67
	--	--	128	1.8	7-26-78
-26N1	35	197	137	3.5	5-03-67
	--	--	131	2.0	7-26-78
-27J1	5	156	133	2.5	5-03-67
	--	--	128	1.8	7-28-78
-27R2	15	165	164	4.0	5-03-67
	--	--	191	3.5	7-26-78
-32E3	45	148	146	6.8	7-28-78
-32E4	45	128	151	3.5	7-28-78
-32K1	20	206	155	13	5-03-67
	--	--	140	7.1	7-28-78
-33H4	10	80	135	2.5	5-03-67
	--	--	126	2.3	7-28-78
-33H5	10	67	104	3.0	5-03-67
	--	--	122	1.8	7-28-78
-33K5	35	587	125	3.0	5-03-67
	--	--	120	2.0	7-28-78
-33L1	40	647	148	10	5-03-67
	--	--	84	2.5	7-28-78
24/ 2 - 3F1	160	200	295	8.6	8-16-78
- 3M1	20	75	173	6.0	6-07-67
	--	--	196	9.4	8-16-78
- 7D2	300	480	181	3.5	5-12-67
	--	--	148	1.8	8-24-78
- 8A2	22	35	174	9.5	6-07-67
	--	--	173	6.3	8-16-78
- 9J2	15	24	1,440	210	5-16-67
	--	--	1,050	140	10-11-78
- 9J3	15	29	1,270	41	5-16-67
	--	--	811	8.6	7-25-78
-15N1	75	305	523	6.0	5-11-67
	--	--	600	3.5	7-24-78
-16E2	85	114	222	3.0	5-11-67
	--	--	219	2.5	7-24-78
-16E4	85	102	251	5.2	2-23-67
	--	--	251	2.8	7-24-78
-16K1	20	136	211	4.5	3-02-67
	--	--	211	6.8	7-25-78
-16L2	55	141	217	8.0	3-07-67
	--	--	316	36	7-24-78
-16L3	55	101	145	2.0	2-16-67
	--	--	163	3.0	7-24-78
-16M1	105	152	215	2.5	5-11-67
	--	--	236	2.0	7-24-78
-17Q2	230	305	289	4.0	4-27-67
	--	--	308	2.3	7-26-78
-19B1	25	237	238	4.0	4-28-67
	--	--	438	2.0	7-25-78
-20B2	305	325	236	2.3	7-26-78
-22M1	60	116	120	6.5	4-25-67
	--	--	117	2.3	7-24-78
-22M2	25	110	115	5.0	4-25-67
	--	--	113	2.3	7-24-78
-27M1	40	65	124	4.0	4-21-67
	--	--	134	3.3	7-13-78
-27M4	45	104	119	6.5	4-21-67
	--	--	124	2.8	7-13-78
-33H1	20	134	162	6.5	4-21-67
	--	--	169	6.6	7-13-78
-33H2	20	185	182	3.0	4-27-67
	--	--	193	10	7-13-78
-33P3	260	279	147	2.3	7-13-78
-34P1	40	141	186	3.0	4-20-67
	--	--	183	2.3	7-13-78
25/ 1W- 1G3	115	139	139	3.3	8-21-78
- 1K1	60	86	150	6.0	6-15-67
	--	--	151	2.0	8-21-78
-12L1	40	134	139	5.0	6-15-67
	--	--	125	2.3	8-21-78
-14E3	40	77	145	5.0	6-15-67
	--	--	139	3.8	8-22-78
-14F3	100	242	168	6.3	8-22-78
-15H2	20	57	130	8.0	6-15-67
	--	--	123	6.8	8-22-78
-15K1	40	66	110	5.0	6-15-67
	--	--	124	4.3	8-22-78
-15P1	80	101	116	3.5	6-15-67
	--	--	107	1.8	8-22-78
-17N1	10	190	122	5.0	6-15-67
	--	--	118	2.3	8-22-78
-19F2	40	67	128	3.5	6-16-67
	--	--	118	1.3	8-22-78
-19H1	200	209	113	1.8	8-22-78
-19M1	55	55	162	20	6-16-67
	--	--	209	35	8-22-78
-20D1	80	180	120	6.0	6-15-67
	--	--	114	1.3	8-22-78
-21B1	70	98	103	1.5	8-22-78
-21M1	40	53	108	4.0	6-15-67
	--	--	120	1.5	8-22-78
25/ 1 - 1P1	220	--	338	4.0	5-17-67
	--	--	317	2.3	8-18-78
- 6L1	300	338	143	1.5	8-21-78
- 7D1	300	304	160	1.5	8-21-78
-11Q2	110	344	132	1.8	8-18-78
-13M3	130	159	147	1.8	8-18-78
-14G2	80	95	165	2.3	8-19-78
-14J2	100	346	160	3.8	8-18-78
-14Q2	75	339	137	1.5	8-24-78
-20A1	20	32	176	5.0	5-10-67
	--	--	107	1.5	8-23-78
-21B3	40	65	152	5.5	5-10-67
	--	--	181	5.8	8-25-78
-21C1	30	65	152	2.5	5-10-67
	--	--	140	1.8	8-25-78
-21D1	20	72	139	1.3	8-25-78
-21G2	20	50	123	4.5	5-11-67
	--	--	121	3.0	8-25-78
-21J1	25	103	140	4.0	5-11-67
	--	--	134	2.3	8-25-78
-23B1	110	110	245	1.8	8-24-78
-24H1	10	274	191	2.0	5-17-67
	--	--	188	1.8	8-24-78
-28J1	30	98	219	5.3	8-24-78
-32M1	8	18	118	5.0	5-09-67
	--	--	102	1.8	8-23-78
25/ 2 - 5H1	60	98	146	6.5	5-31-67
	--	--	178	6.8	8-15-78
- 8G1	40	148	235	6.5	5-31-67
	--	--	240	5.3	8-15-78
- 8N1	60	80	303	9.0	5-31-67
	--	--	234	5.3	8-15-78
- 9D1	15	47	215	8.5	5-31-67
	--	--	220	5.8	8-15-78
- 9E1	100	168	194	6.5	5-31-67
	--	--	275	7.9	8-15-78
-14A2	98	230	226	9.5	6-06-67
	--	--	210	7.4	8-17-78
-18J1	15	80	240	11	5-31-67
	--	--	245	9.9	8-15-78
-19N2	130	78	183	2.3	8-24-78
-20B1	50	80	163	3.3	8-16-78
-25C1	95	109	260	10	6-06-67
	--	--	275	8.9	8-17-78
-25F1	125	160	182	11	6-06-67
	--	--	195	8.4	8-17-78
-26H2	80	168	170	6.0	6-02-67
	--	--	165	4.6	8-17-78
-27J1	110	120	222	12	6-07-67
	--	--	235	11	8-17-78
-27K1	25	801	170	4.0	6-02-67
	--	--	165	5.1	8-17-78
-30K1	70	465	214	9.5	5-18-67
	--	--	235	11	8-24-78
-33Q1	30	35	153	6.5	6-01-67
	--	--	180	7.6	8-16-78
-35F2	90	130	137	6.0	6-01-67
	--	--	125	3.5	8-16-78
-35K1	180	198	285	7.0	6-01-67
	--	--	308	5.6	8-16-78
-36N1	10	604	519	18	6-02-67
	--	--	520	15	8-16-78
26/1W -25G1	120	164	190	5.3	8-21-78
26/ 1 - 5K1	115	360	150	3.0	6-14-67
	--	--	153	1.8	8-21-78
-25F4	10	27	138	3.3	8-03-78
-25M3	45	70	193	4.0	5-19-67
	--	--	170	4.3	8-03-78
-25R2	50	52	211	18	5-19-67
	--	--	170	6.1	8-03-78
-26A3	40	96	192	3.5	5-19-67
	--	--	208	3.8	8-03-78
-26N2	20	120	289	6.0	5-18-67
	--	--	276	2.3	8-04-78
-27H1	20	100	168	1.8	8-18-78
-27Q4	60	320	215	1.8	8-03-78
-35F2	25	100	304	1.8	8-04-78
-35L1	20	46	221	4.0	5-17-67
	--	--	205	2.8	8-04-78
-36E1	50	383	307	26	8-04-78
-36M1	20	783	307	28	8-04-78
-36N2	15	80	215	7.4	8-04-78
26/ 2 - 1R1	5	44	271	10	5-25-67
	--	--	250	7.9	8-01-78
-28B1	20	33	104	5.0	5-25-67
	--	--	173	3.3	8-15-78
-28N1	50	105	670	27	8-15-78
-29L1	100	135	150	2.8	8-14-78 1/
-31D2	80	122	350	4.6	8-14-78
-33M1	60	120	361	3.5	5-26-67
	--	--	360	2.8	8-15-78
-34L1	10	1,005	297	17	5-26-67
	--	--	285	15	8-17-78
-34L4	10	70	349	5.0	5-26-67
	--	--	348	3.3	8-17-78
-35B1	10	155	206	5.5	5-26-67
	--	--	184	6.3	8-17-78
26/ 3 - 7D4	50	115	430	13	5-25-67
	--	--	410	10	8-03-78
27/ 1 - 1R1	25	128	197	4.5	6-13-67
	--	--	187	3.3	8-02-78
-12A1	85	154	223	4.6	8-02-78
-13M1	140	152	175	2.8	8-02-78
-14H1	20	30	222	8.0	6-14-67
	--	--	197	4.1	8-02-78
-22H1	43	124	177	4.0	6-14-67
	--	--	175	2.0	8-02-78
-22N1	40	74	185	3.0	6-14-67
	--	--	179	2.3	8-02-78
-22Q1	40	108	211	5.0	6-14-67
	--	--	188	3.0	8-02-78
-27E2	120	267	204	3.0	6-14-67
	--	--	190	3.8	8-02-78
27/ 2 - 6P2	90	600	204	5.6	8-02-78
-23K1	365	392	190	3.8	7-28-78
-23Q1	300	335	172	4.8	7-28-78
-25C2	390	400	246	14	6-08-67
	--	--	219	9.1	7-28-78
-25E3	180	323	225	2.8	7-28-78
-25N1	5	298	214	7.5	6-08-67
	--	--	201	5.6	7-28-78
-26K1	30	52	194	8.5	6-08-67
	--	--	202	4.8	8-01-78
-26L2	35	192	370	3.8	8-01-78
-35H5	40	320	181	2.3	8-01-78
-36Q4	20	67	309	6.5	6-08-67
	--	--	290	5.3	8-01-78
28/ 1 -12G1	160	200	567	23	6-09-67
	--	--	526	27	7-27-78
-13A2	80	107	406	20	6-09-67
	--	--	398	17	7-27-78
28/ 2 - 7M3	5	15	330	22	6-09-67
	--	--	331	15	7-27-78
- 7P1	25	63	416	36	6-09-67
	--	--	411	31	7-27-78
-18B1	15	50	286	20	6-09-67
	--	--	304	18	7-27-78
-21D1	160	163	312	8.4	7-27-78
-27E1	320	396	296	3.0	7-27-78

1/ Sample is a composite from two or more wells.

SHEET 6. Seawater intrusion conditions in Kitsap County.



Seawater Intrusion Conditions

Ground-water development in Mason County has been principally for supplying rural and seasonal homes and small public-supply systems. A few wells supply water for use in oyster-processing plants.

No widespread occurrences of seawater intrusion were found in Mason County in 1978, although the literature (Walters, 1971) documents the abandonment of several wells in the county for reasons of high salinity. The general absence of severe or widespread intrusion problems may be due to the low intensity of ground-water withdrawals in coastal parts of the county. Unless withdrawals are greatly increased in these areas, intrusion problems are likely to be restricted to a few isolated wells.

The median chloride concentration of 155 wells sampled in Mason County in 1978 was 1.8 mg/L (table 1), the lowest of any county surveyed. Water from only one well exceeded the 100 mg/L limit; all other well waters had less than 65 mg/L of chloride. Walters (1971, p. 100) reported that the water in well 20/2W-28B1 had decreased in chloride concentration between 1963 and 1967 (from 400 mg/L to 355 mg/L); data from this survey indicate that the chloride concentration had decreased even further by 1978 (340 mg/L).

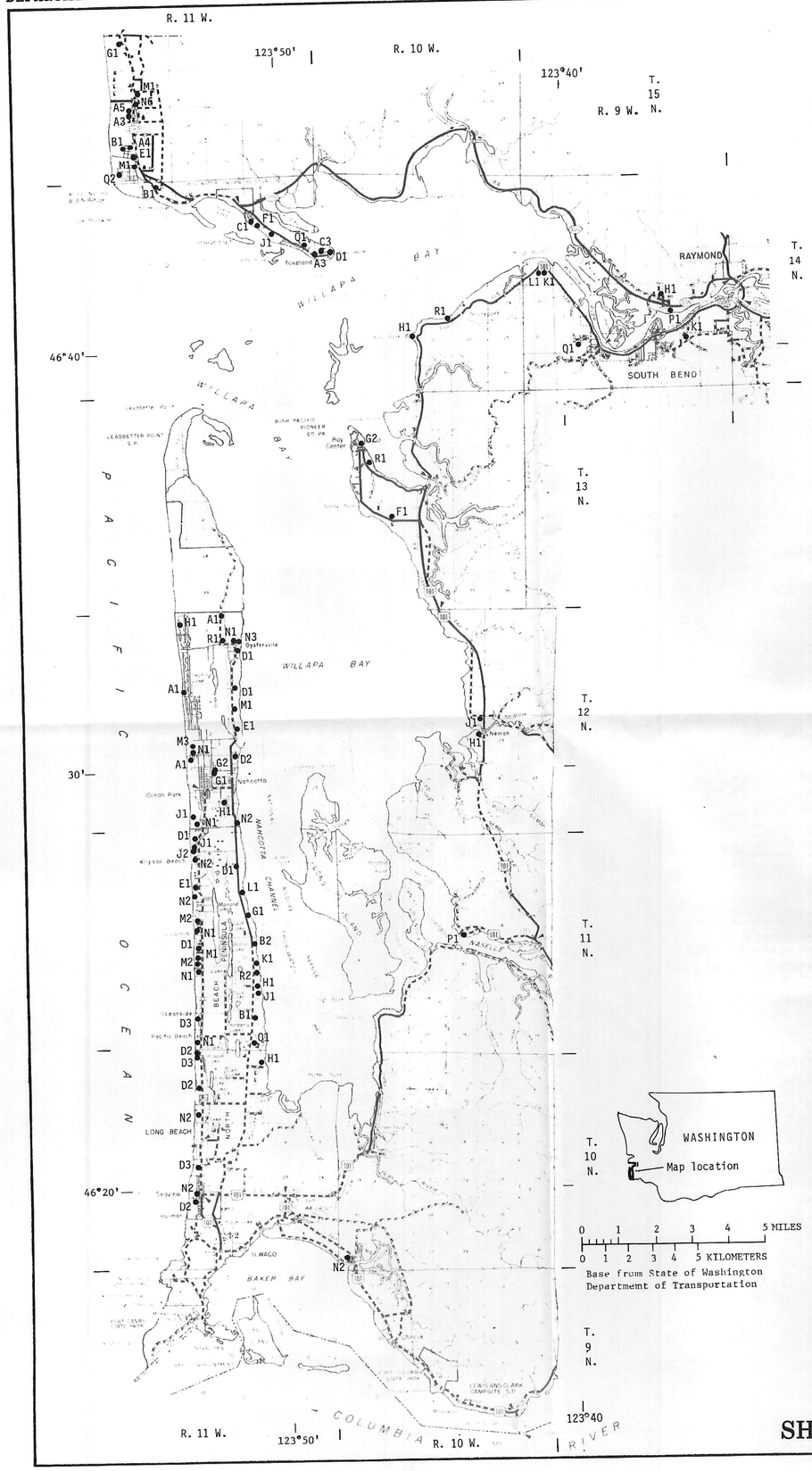
The chloride data for the 1967-68 survey in Mason County were incomplete. Consequently, a comparison of chloride levels could be made for only 60 water samples. That comparison (table 2) showed that the median chloride concentrations in the county decreased slightly from the late 1960's to 1978.

Physical and chemical data for wells in Mason County

Well number	Land-surface altitude (ft)	Depth of well (ft)	Specific conductance (micromhos at 25°C)	Chloride (mg/L)	Date of collection
19/ 3W- 1A1	25	200	157	--	5-11-67
	--	--	150	2.1	5-25-78
- 1L1	80	138	180	--	5-11-67
	--	--	175	2.6	5-25-78
- 9E1	180	200	168	--	5-12-67
	--	--	157	2.6	5-24-78
-10A1	30	91	174	--	5-12-67
	--	--	154	2.6	5-24-78
-10B1	30	42	176	--	5-12-67
	--	--	168	2.3	5-24-78
-10B2	30	87	224	3.0	5-12-67
	--	--	205	2.1	5-24-78
-10F2	40	135	221	3.5	5-12-67
	--	--	211	2.1	5-24-78
-11A1	60	83	145	--	5-12-67
	--	--	157	4.1	5-25-78
-11B1	15	100	125	--	5-12-67
	--	--	118	2.3	5-25-78
-11D2	40	100	169	--	5-12-67
	--	--	146	1.8	5-25-78
-11G3	25	105	158	--	5-12-67
	--	--	140	2.6	5-24-78
-14B1	15	87	281	3.5	5-12-67
	--	--	266	2.8	5-24-78
-14L1	40	45	125	--	5-12-67
	--	--	119	2.6	5-24-78
-17R1	20	53	201	16	5-24-78
-21H2	60	75	145	--	5-11-67
	--	--	138	3.1	5-24-78
19/ 2W- 5C2	140	212	254	3.5	5-15-67
	--	--	220	1.6	5-25-78
- 6A1	120	170	241	5.0	5-15-67
	--	--	227	2.6	5-25-78
- 6D1	80	128	207	4.5	5-15-67
	--	--	282	2.6	5-25-78
20/ 3W- 3A2	25	110	120	--	5-16-67
	--	--	115	1.6	5-31-78
- 3H1	20	89	124	--	5-16-67
	--	--	106	1.6	5-31-78
- 3K1	25	254	122	--	5-16-67
	--	--	114	1.0	5-30-78
- 9Q1	20	81	118	--	5-16-67
	--	--	111	1.8	5-30-78
-10A1	105	233	120	--	5-16-67
	--	--	117	1.8	5-31-78
-10E1	18	97	109	--	5-16-67
	--	--	104	1.6	5-30-78
-15E1	35	66	275	4.5	5-16-67
	--	--	238	2.3	5-31-78
-15F1	16	45	180	--	5-16-67
	--	--	176	2.3	5-31-78
-15Q2	95	112	162	--	5-17-67
	--	--	136	1.8	5-31-78
-16C3	15	50	105	--	5-17-67
	--	--	96	1.8	5-30-78
-20M1	40	600	141	3.9	5-30-78
-21B1	245	249	236	4.5	5-17-67
	--	--	215	3.1	5-31-78
-21M1	36	58	157	--	5-16-67
	--	--	148	1.6	5-30-78
-21Q2	15	50	133	--	5-16-67
	--	--	126	2.8	5-30-78
-22D1	100	131	142	2.1	5-31-78
-22N1	32	100	127	--	5-16-67
	--	--	124	1.8	5-30-78
-23E1	20	89	159	--	5-17-67
	--	--	159	1.8	6-01-78
-23F1	15	48	195	--	5-17-67
	--	---	178	2.3	6-01-78
-23H1	30	86	154	--	5-17-67
	--	--	139	2.1	6-01-78
-23M2	23	70	130	--	5-16-67
	--	--	119	2.1	5-26-78
-23P1	35	70	142	--	5-16-67
	--	--	128	1.6	5-26-78
-23Q1	47	93	173	--	5-16-67
	--	--	196	2.1	5-26-78
-24F1	15	70	97	--	5-17-67
	--	--	110	1.8	6-01-78
-24K2	25	80	220	4.5	5-17-67
	--	--	216	2.1	6-01-78
-24L1	55	76	231	3.5	5-16-67
	--	--	221	2.1	5-26-78
-24M1	41	84	219	5.0	5-16-67
	--	--	207	1.8	5-26-78
-25B1	20	151	159	--	5-16-67
	--	--	147	2.1	5-26-78
20/ 2W- 3P2	100	231	118	1.6	6-06-78
- 4A1	30	90	157	--	5-19-67
	--	--	145	1.8	6-01-78
-10P1	20	24	115	2.2	4-08-68
	--	--	92	3.1	6-05-78
-12A1	10	22	160	2.1	4-08-68
	--	--	104	2.1	6-06-78
-14N1	20	53	126	3.2	4-08-68
	--	--	131	2.8	6-05-78
-15C2	20	73	134	1.8	6-05-78
-16B2	30	43	186	4.2	4-08-68
	--	--	147	6.0	6-01-78
-19N1	30	100	154	--	5-17-67
	--	--	161	2.1	6-01-78
-21P1	50	183	160	--	5-16-67
	--	--	176	8.3	5-26-78
-25M1	10	38	147	6.6	4-08-68
	--	--	143	8.8	6-05-78
-28B1	15	172	1,320	355	5-16-67
	--	--	1,280	340	5-26-78
-28F1	30	76	397	60	5-16-67
	--	--	411	65	5-26-78
-29E1	120	198	176	2.1	5-26-78
-29J1	175	210	169	--	5-16-67
	--	--	272	1.8	5-25-78
-32G2	112	132	237	4.5	5-16-67
	--	--	208	2.8	5-25-78
-32P1	25	80	289	9.5	5-15-67
	--	--	268	3.1	5-25-78
-32Q3	90	100	261	3.5	5-15-67
	--	--	248	2.1	5-25-78
20/ 1W-19A1	20	56	90	2.1	4-08-68
	--	--	96	2.1	6-05-78
-20E3	30	59	91	2.2	4-08-68
	--	--	94	2.6	6-05-78
-30M2	260	309	96	3.1	6-05-78
21/ 3W-35J1	25	92	118	--	5-16-67
	--	--	106	1.3	5-31-78
-36G2	15	87	112	--	5-16-67
	--	--	104	1.3	5-31-78
-36M1	10	53	110	--	5-16-67
	--	--	101	1.0	5-31-78
-36N1	25	67	138	--	5-16-67
	--	--	126	1.3	5-31-78
21/ 2W-13H1	45	60	122	--	5-19-67
	--	--	119	1.6	6-07-78
-13R1	45	89	139	--	5-19-67
	--	--	120	1.6	6-07-78
-22Q1	35	72	140	--	5-19-67
	--	--	135	2.1	6-06-78
-24C2	40	68	129	--	5-19-67
	--	--	114	1.6	6-06-78
-24E1	60	85	134	--	5-19-67
	--	--	109	1.6	6-06-78
-24P1	78	101	207	2.0	4-08-68
	--	--	201	1.6	6-06-78
-25M1	55	80	142	2.6	4-08-68
	--	--	145	3.4	6-06-78
-25M2	55	168	290	1.6	4-08-68
	--	--	284	1.3	6-06-78
-33H2	12	65	87	--	5-19-67
	--	--	123	1.0	6-05-78
21/ 1W- 5A1	50	227	127	--	5-19-67
	--	--	118	1.6	6-08-78
- 5H1	15	168	133	--	5-19-67
	--	--	121	1.0	6-08-78
- 5K2	40	60	116	--	5-19-67
	--	--	106	0.0	6-07-78
- 5P1	40	64	161	--	5-19-67
	--	--	161	5.4	6-07-78
- 8B1	15	67	157	--	5-19-67
	--	--	155	3.9	6-08-78
- 8C2	12	300	133	--	5-19-67
	--	--	122	1.0	6-07-78
- 8E1	60	67	180	--	5-19-67
	--	--	175	2.1	6-07-78
- 8H1	60	165	198	--	5-19-67
	--	--	194	1.6	6-08-78
- 8M1	100	142	128	--	5-19-67
	--	--	116	1.6	6-07-78
- 8Q2	50	161	122	--	5-19-67
	--	--	117	1.6	6-08-78
- 8R1	60	610	138	--	5-19-67
	--	--	136	1.6	6-08-78
- 9D1	50	78	154	6.0	6-08-78
-18D1	30	37	125	--	5-19-67
	--	--	114	1.3	6-07-78
-18F2	70	115	111	1.8	6-07-78
-19L1	80	230	215	3.6	6-06-78
-31D2	18	81	227	21	4-08-68
	--	--	226	19	6-06-78
22/ 4W-1Q1	30	120	71	0.8	8-07-68
	--	--	68	1.0	6-19-78
-12N1	15	78	117	1.7	8-07-68
	--	--	132	3.6	6-16-78
-14H1	50	52	85	1.2	8-07-68
	--	--	83	1.6	6-17-78
-26M1	50	70	86	0.8	6-16-78
-35N1	20	164	95	1.3	6-17-78
22/ 3W- 5F1	70	92	108	1.6	6-14-78
-18L1	10	67	97	0.8	7-18-68
	--	--	93	1.0	6-14-78
-19F1	20	40	102	1.2	7-18-68
	--	--	98	1.6	6-14-78
-19P1	5	35	116	3.8	7-18-68
	--	--	101	1.6	6-14-78
-20P1	10	20	182	18	7-18-68
	--	--	206	28	6-14-78
-21N1	25	32	169	22	7-22-68
	--	--	100	5.2	6-13-78
-23R1	15	65	113	1.3	7-31-68
	--	--	108	1.3	6-13-78
-23R2	35	47	125	1.3	6-13-78
-26G1	40	61	130	1.4	7-31-68
	--	--	126	2.1	6-13-78
-27D1	20	44	116	0.9	7-22-68
	--	--	98	1.6	6-13-78
-27F1	20	31	131	1.7	7-22-68
	--	--	131	2.6	6-13-78
-27R1	35	92	123	2.3	7-22-68
	--	--	110	1.0	6-13-78
-31A1	30	197	97	1.0	--
	--	--	96	1.6	6-16-78
-31Q1	15	39	294	53	8-06-68
	--	--	280	46	6-16-78
-32H1	75	275	91	0.8	8-06-68
	--	--	86	1.6	6-15-78
-33M1	10	--	152	1.4	8-05-68
	--	--	151	1.8	6-15-78
-33R1	20	70	84	0.9	8-05-68
	--	--	82	1.3	6-15-78
-34R1	20	105	292	55	8-05-68
	--	--	264	49	6-15-78
22/ 2W- 1C3	20	140	99	2.1	6-14-78
- 1E3	20	58	113	2.8	6-12-78
- 2L1	10	100	112	1.0	8-01-68
	--	--	106	0.8	6-12-78
- 9J1	15	18	105	1.5	8-01-68
	--	--	85	2.1	6-12-78
- 9N1	20	32	71	2.1	6-13-78
-10F2	55	120	100	1.0	6-12-78
-11D1	15	36	96	1.5	8-01-68
	--	--	94	1.8	6-12-78
-12M1	15	--	97	1.1	8-02-68
	--	--	94	1.3	6-15-78
-14B5	15	60	107	1.0	8-02-68
	--	--	106	1.3	6-15-78
-14F1	20	97	136	1.0	6-15-78
-16D1	45	83	107	1.6	6-13-78
-18G1	15	43	116	0.9	7-31-68
	--	--	109	1.0	6-13-78
-18N1	15	49	114	0.8	7-31-68
	--	--	113	1.0	6-13-78
-21A1	10	34	102	1.1	8-02-68
	--	--	97	1.3	6-15-78
-21F1	10	40	68	1.0	8-05-68
	--	--	75	1.6	6-15-78
-21M1	15	64	89	1.3	6-15-78
-22B1	10	33	117	1.5	8-02-68
	--	--	114	1.6	6-15-78
22/ 1W- 6B1	10	263	120	1.0	8-02-68
	--	--	116	1.0	6-15-78
-16F3	20	87	114	1.6	6-09-78
-17B2	55	230	108	--	5-18-67
	--	--	94	1.6	6-09-78
-17H1	10	91	103	--	5-18-67
	--	--	96	1.3	6-09-78
-20H1	8	288	92	--	5-18-67
	--	--	86	1.3	6-09-78
-20K1	8	110	122	--	5-18-67
	--	--	92	1.6	6-08-78
-20N1	20	46	122	--	5-18-67
	--	--	106	1.3	6-08-78
-20P1	12	70	116	--	5-18-67
	--	--	103	1.6	6-08-78
-20Q1	25	66	120	--	5-18-67
	--	--	124	1.6	6-08-78
-21C1	25	47	84	2.1	6-09-78
-21L1	30	80	116	2.1	6-09-78
-28C1	25	38	225	4.7	6-09-78
-29H1	15	273	156	--	5-18-67
	--	--	128	1.3	6-08-78
-32A1	20	71	143	--	5-18-67
	--	--	126	2.1	6-07-78
-32H1	40	84	130	--	5-18-67
	--	--	106	1.0	6-07-78
-32J1	30	66	106	--	5-18-67
	--	--	96	2.6	6-07-78
-33A1	15	119	121	4.9	6-09-78
23/ 3W- 3N1	50	90	107	1.4	8-08-68
	--	--	109	1.0	6-19-78
-29G1	15	58	99	2.9	8-07-68
	--	--	136	2.6	6-19-78
-30G1	35	60	79	0.8	8-07-68
	--	--	79	1.6	6-19-78
-31F1	20	90	95	1.1	8-07-68
	--	--	70	3.6	6-19-78

SHEET 7. Seawater intrusion conditions in Mason County.

Prepared in Cooperation with
U.S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION



Seawater Intrusion Conditions

Development of ground-water supplies in the coastal part of Pacific County is limited to North Beach Peninsula, the peninsula at Tokeland, and the area north of North Cove. In the North Beach Peninisula and Tokeland areas, the development is for both domestic and commercial purposes. In the North Cove area, moderate to large quantities of ground water are used for growing cranberries and in the processing of seafoods and forest products.

The principal areas of high ground-water chloride concentration in Pacific County remained unchanged from 1968 to 1978. Wells that yielded water with more than 100 mg/L chloride were found on North Beach Peninsula and in the coastal area north of the town of North Cove. Water samples taken from wells developed in the artesian aquifer in the Tokeland area indicate that intrusion has not occurred there.

In the 1978 survey, evidence of seawater intrusion was found in only three wells on North Beach Peninsula and chloride concentrations in those wells were lower than in 1968. However, fewer wells were sampled in the 1978 survey than in the 1968 survey. In 1968, most domestic-water supplies were taken from individually owned shallow, small-diameter driven wells. By 1978 many of these shallow wells were either unused or used only for lawn sprinkling; domestic supplies were taken from a few deep, high-yield public-supply wells. The occurrence of shallow ground water that is higher in chloride than deep ground water appears contradictory to the findings of Tracy (1978) who stated that the shallow ground-water system of the peninsula could withstand substantial development of additional ground-water supplies without danger of intrusion, but that the deep aquifer was somewhat more susceptible to seawater intrusion. He suggested that a system of several shallow, low-yield wells centered along the major (north-south) axis of the peninsula would be more effective in preventing seawater intrusion than a system of only a few deep, high-yield wells. Despite the trend to fewer and deeper wells, however, the evidence to date suggests that widespread intrusion of neither aquifer on the peninsula has occurred. Further, the fact that the higher chloride concentrations were found in the shallow aquifer suggests that the few high chloride concentrations observed are probably due to sea spray or some source other than seawater intrusion. If Tracy's (1978) findings are correct, and if the trend to fewer and deeper wells continues, intrusion could become a problem on North Beach Peninsula in the future.

Although Walters (1971, p. 15) presented evidence that the high chloride concentrations in the area north of North Cove are probably the result of incomplete flushing of relict seawater, the possibility of seawater intrusion should not be ruled out as chloride levels in two of the three wells sampled were higher in 1978 than in 1968. Chloride levels due to relict seawater would be expected to decrease with time.

The median chloride concentration of 85 ground-water samples collected in Pacific County in 1978 was 18 mg/L (table 1). Based on a comparison of 65 water-sample analyses, chloride concentrations and specific-conductance values in the county in 1978 were nearly unchanged from those of 1968 (table 2).

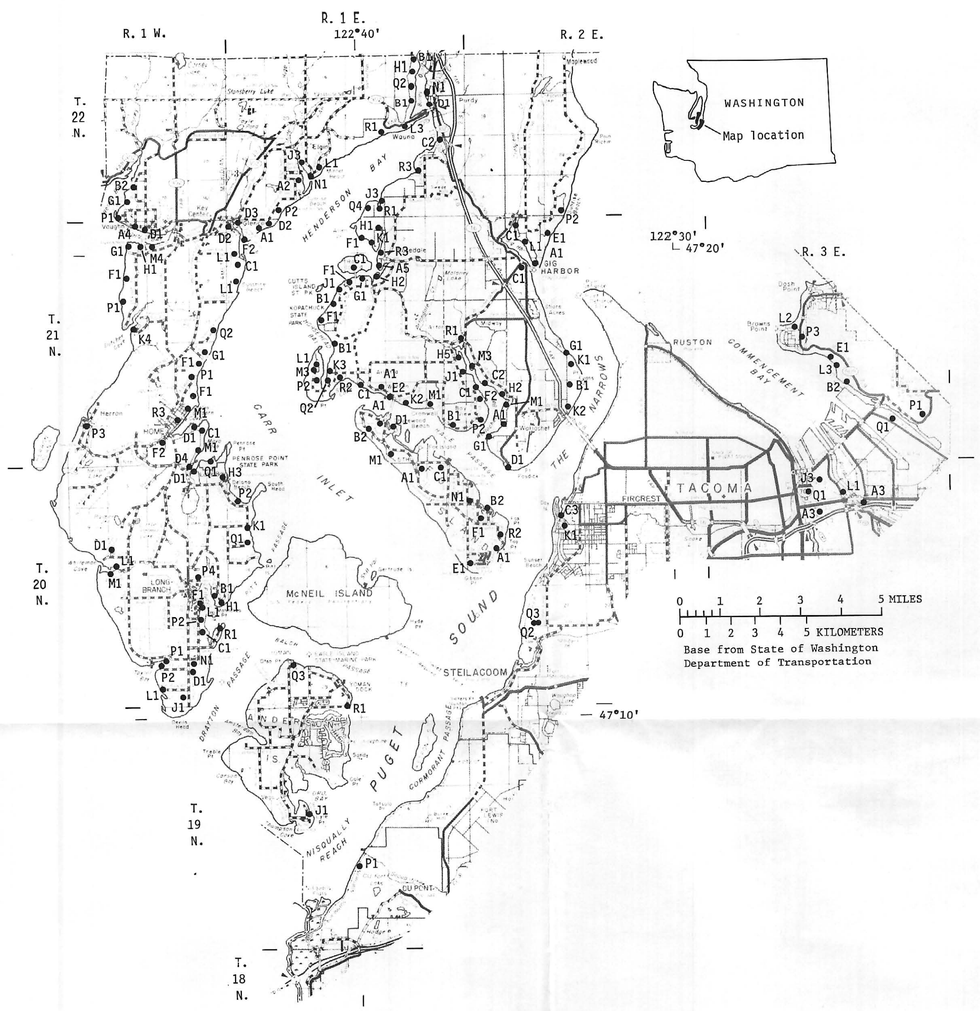
Physical and chemical data for wells in Pacific County

Well number	Land-surface altitude (ft)	Depth of well (ft)	Specific conductance (micromhos at 25°C)	Chloride (mg/L)	Date of collection
10/11W- 3H1	10	21	217	23	9-11-68
	--	--	142	18	8-09-78
- 4D2	25	25	131	18	8-16-68
	--	--	120	20	8-16-78
- 4D3	20	32	255	27	8-16-78
- 9D2	20	21	120	18	8-15-68
	--	--	123	18	8-16-78
- 9N2	20	22	512	124	8-09-68
	--	--	535	125	8-15-78
-21D3	10	23	155	17	8-15-78
-21N2	15	20	132	16	8-08-68
	--	--	225	41	8-15-78
-28D2	15	24	176	25	8-07-68 1/
	--	--	205	32	8-15-78 1/
10/10W-31N2	10	15	130	11	8-15-78
11/11W- 4D1	20	24	335	70	8-22-68 1/
	--	--	332	62	8-18-78 1/
- 4N2	15	23	207	39	8-21-68
	--	--	221	43	8-17-78
- 5J1	15	24	261	48	8-22-68
	--	--	505	115	8-17-78
- 5J2	15	27	279	47	8-22-68
	--	--	197	23	8-17-78
- 9E1	20	23	294	66	8-21-68
	--	--	285	65	8-17-78
- 9N2	20	26	245	51	8-21-68
	--	--	200	38	8-17-78
-10D1	20	34	84	10	9-10-68
	--	--	189	15	8-10-78
-10L1	12	18	135	28	9-09-68
	--	--	102	18	8-10-78
-15G1	13	24	120	8.1	9-10-68
	--	--	109	9.6	8-10-78
-16M2	20	30	138	21	8-20-68
	--	--	92	13	8-17-78
-16N1	15	30	147	21	8-20-68
	--	--	163	29	8-17-78
-21D1	20	31	174	16	8-20-68
	--	--	137	27	8-17-78
-21M1	20	28	279	25	8-19-68
	--	--	375	33	8-17-78
-21M2	15	26	131	19	8-20-68
	--	--	137	22	8-17-78
-21N1	20	25	224	36	8-19-68
	--	--	375	54	8-17-78
-22B2	10	20	84	12	9-11-68
	--	--	115	18	8-10-78
-22K1	13	24	85	8.9	9-11-68
	--	--	89	13	8-10-78
-22R2	15	21	142	24	9-11-68
	--	--	166	39	8-10-78
-27H1	17	25	100	14	9-11-68
	--	--	107	15	8-09-78
-27J1	17	30	90	10	9-12-68
	--	--	84	12	8-10-78
-33D3	23	26	215	26	8-16-78
-33N1	20	21	372	66	8-16-68
	--	--	295	49	8-16-78
-34B1	20	29	159	31	9-12-68
	--	--	165	33	8-09-78
-34Q1	15	15	99	8.7	9-11-68
	--	--	88	11	8-09-78
11/10W-15P1	10	11	72	9.7	9-13-68
	--	--	105	9.6	8-09-78
12/11W- 3N1	10	18	81	9.6	9-04-68
	--	--	80	12	8-21-78
- 3N3	10	25	178	15	8-21-78
- 4A1	20	30	86	8.5	9-05-68
	--	--	98	12	8-21-78
- 4R1	15	31	131	21	8-21-78 1/
- 5H1	15	25	270	31	8-21-78 1/
-10D1	10	12	184	13	9-04-68
	--	--	152	11	8-21-78
-15D1	20	23	96	15	9-04-68
	--	--	129	17	8-22-78
-15M1	10	19	231	26	8-22-78
-17A1	15	25	218	27	8-30-68 1/
	--	--	257	39	8-21-78 1/
-21M3	20	30	134	22	8-22-78
-21N1	25	27	686	210	8-29-68
	--	--	580	148	8-21-78
-22E1	17	25	89	8.5	9-05-68
	--	--	175	32	8-22-78
-27D2	10	22	79	11	9-05-68
	--	--	72	12	8-22-78
-28G1	20	77	150	20	8-28-68
	--	--	190	22	8-22-78
-28G2	20	253	192	23	8-22-78
-29A1	15	18	163	19	8-29-68
	--	--	170	24	8-21-78
-32J1	14	24	176	31	8-28-68
	--	--	224	28	8-18-78
-33H1	15	55	134	15	8-22-78
-33N1	20	24	397	72	8-22-68
	--	--	210	46	8-18-78
-34N2	19	24	85	10	8-22-78
12/10W-15J1	10	190	720	46	10-21-68
	--	--	720	96	8-09-78
-22H1	45	68	260	6.5	10-21-68
	--	--	248	7.4	8-09-78
13/10W- 8G2	15	373	191	8.6	10-22-68
	--	--	180	8.1	8-09-78
- 8R1	10	455	187	8.8	10-22-68
	--	--	285	19	8-09-78
-21F1	50	180	360	8.0	10-21-68
	--	--	402	14	8-09-78
14/11W- 5B1	12	165	1,150	335	10-31-68
	--	--	1,930	480	7-27-78
-11C1	10	198	164	9.0	10-31-68
	--	--	150	12	7-28-78
-11F1	10	290	168	9.7	10-31-68
	--	--	152	11	7-28-78
-11J1	10	200	219	9.5	10-31-68
	--	--	198	11	7-28-78
-12Q1	10	210	188	7.6	10-31-68
	--	--	203	8.9	7-28-78
-13A3	10	200	174	7.4	7-27-78
14/10W-18C3	15	340	197	7.1	10-23-68
	--	--	187	9.4	7-27-78
-18D1	10	200	231	8.3	10-31-68
	--	--	202	8.9	7-27-78
-22R1	20	150	285	8.4	8-08-78
-28H1	15	90	208	10	10-22-68
	--	--	210	9.6	8-08-78
14/ 9W-18K1	80	130	250	7.9	8-08-78
-18L1	10	75	680	81	10-22-68
	--	--	645	85	8-08-78
-22H1	40	73	166	8.7	10-22-68
	--	--	161	10	8-08-78
-23P1	40	75	247	32	10-22-68
	--	--	195	7.6	8-08-78
-26K1	80	120	210	6.2	8-08-78
-29Q1	280	460	374	12	10-23-68
	--	--	375	15	8-08-78
15/11W-18G1	14	72	280	17	10-30-68
	--	--	250	17	7-26-78
-20M1	15	304	177	15	10-30-68
	--	--	175	16	7-26-78
-20N6	15	90	423	54	10-30-68
	--	--	473	66	7-26-78
-30A3	20	210	205	24	10-30-68
	--	--	181	17	7-26-78
-30A5	20	165	828	171	10-30-68
	--	--	605	120	7-26-78
-31A4	15	61	532	22	7-27-78
-31B1	12	50	287	16	7-27-78
-31Q2	20	50	282	21	7-27-78
-32E1	20	146	685	120	10-30-68
	--	--	712	140	7-27-78
-32M1	20	124	517	37	10-30-68
	--	--	573	34	7-27-78

1/ Sample is a composite from two or more wells.

SHEET 8. Seawater intrusion conditions in Pacific County.

Prepared in Cooperation with
U.S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION



Physical and chemical data for wells in Pierce County

Well number	Land-surface altitude (ft)	Depth of well (ft)	Specific conductance (micromhos at 25°C)	Chloride (mg/L)	Date of collection
19/ 1 -17J1	50	--	1,910	504	7-12-68
	--	--	1,960	474	5-22-78
-22P1	208	252	235	3.7	5-23-78
20/ 1W- 1D1	19	33	194	2.8	4-03-68
	--	--	193	3.5	5-11-78
- 1D4	10	65	169	2.7	4-03-68
	--	--	173	2.7	5-11-78
- 1H3	15	115	173	4.5	5-11-78
-13P4	35	180	264	2.8	4-02-68
	--	--	273	2.5	5-12-78
-15D1	110	167	133	3.5	5-16-78
-15L1	20	175	133	3.2	5-16-78
-15M1	100	212	138	3.2	5-16-78
-24B1	20	25	61	4.1	4-02-68
	--	--	78	7.2	5-12-78
-24F1	50	285	256	3.2	4-02-68
	--	--	248	3.0	5-15-78
-24H1	20	195	248	3.4	4-02-68
	--	--	233	4.2	5-12-78
-24L1	70	123	614	127	4-02-68
	--	--	595	110	5-15-78
-24P2	70	105	251	7.1	4-01-68
	--	--	228	5.5	5-15-78
-24R1	50	143	210	5.7	3-30-68
	--	--	193	5.7	5-15-78
-25C1	30	100	251	4.0	4-01-68
	--	--	218	3.0	5-15-78
-25N1	155	173	437	70	3-30-68
	--	--	423	65	5-15-78
-26P1	40	90	271	21	3-30-68
	--	--	273	24	5-15-78
-26P2	75	80	211	12	3-30-68
	--	--	218	11	5-16-78
-35J1	180	213	423	73	5-15-78
-35L1	80	98	1,090	282	3-30-68
	--	--	1,260	292	5-15-78
-36D1	180	200	398	59	5-15-78
20/ 1 - 1C1	50	148	200	2.4	5-18-68
	--	--	145	5.5	5-19-78
- 2A1	120	132	176	4.6	5-18-68
	--	--	148	4.7	5-19-78
- 6P2	10	84	576	68	4-03-68
	--	--	470	49	5-11-78
- 7K1	4	700	208	2.5	5-11-78
- 7Q1	80	450	208	2.7	5-12-78
-29Q3	75	82	431	64	7-12-68
	--	--	370	44	5-22-78
-33R1	170	228	138	2.5	7-12-68
	--	--	125	2.7	5-22-78
20/ 2 - 5D1	23	50	197	19	6-27-68
	--	--	275	48	5-02-78
- 6N1	65	119	219	3.7	5-18-68
	--	--	150	3.5	5-19-78
- 7B2	20	60	223	6.5	5-18-78
- 7F1	100	154	217	2.6	5-18-68
	--	--	195	3.2	5-18-78
- 7R2	65	101	218	15	5-18-78
- 9C3	10	608	183	--	9-16-66
	--	--	180	1.7	5-23-78
- 9K1	190	381	182	5.9	9-15-66
	--	--	270	9.0	5-23-78
-18A1	65	86	128	4.2	5-18-78
-18E1	240	266	233	32	5-18-78
-20Q2	15	1,037	115	1.7	5-23-78
-20Q3	15	238	150	3.2	5-23-78
20/ 3 - 3L1	10	534	130	1.5	7-13-66
	--	--	120	2.0	4-27-78
- 4J3	10	547	194	5.4	3-22-68
	--	--	125	3.5	4-27-78
- 4Q1	8	490	125	--	8-31-66
	--	--	120	1.2	4-27-78
- 9A3	20	320	123	2.0	7-21-66
	--	--	115	3.0	4-27-78
-10A3	15	200	168	2.0	7-13-66
	--	--	175	2.2	5-24-78
21/ 1W- 2D1	80	92	98	3.2	5-17-78
- 2M4	50	60	103	2.7	5-17-78
- 3A4	35	60	108	2.7	5-17-78
- 3G1	20	--	124	1.6	3-28-68
	--	--	123	1.7	5-17-78
- 3H1	10	100	116	1.8	3-28-68
	--	--	113	1.7	5-17-78
-10F1	70	114	135	2.6	3-28-68
	--	--	128	2.2	5-17-78
-10P1	20	186	138	2.2	5-17-78
-13Q2	30	106	116	2.4	4-05-68
	--	--	133	2.7	5-10-78
-15K4	35	294	138	2.7	5-17-78
-24F1	40	180	131	3.5	4-05-68
	--	--	128	2.5	5-10-78
-24G1	50	60	135	2.9	4-05-68
	--	--	133	3.2	5-10-78
-24P1	35	146	112	2.5	5-10-78
-25F1	15	68	143	2.3	4-05-68
	--	--	138	2.5	5-11-78
-25M1	40	48	182	5.6	4-04-68
	--	--	188	5.7	5-10-78
-26R3	20	55	164	4.8	4-04-68
	--	--	183	5.5	5-10-78
-28P3	70	105	133	2.5	5-16-78
-35F2	50	125	153	1.7	5-11-78
-36C1	30	72	305	6.6	4-04-68
	--	--	263	5.2	5-11-78
-36D1	70	195	157	6.6	4-04-68
	--	--	288	39	5-11-78
-36M1	50	69	248	6.2	5-11-78
-36Q1	20	180	219	3.4	4-03-68
	--	--	208	2.5	5-11-78
21/ 1 - 3F1	20	75	177	10	6-26-67
	--	--	220	6.6	5-05-78
- 3H1	20	28	171	11	5-10-68
	--	--	140	9.7	5-05-78
- 3K1	10	93	164	1.8	5-10-68
	--	--	140	2.2	5-05-78
- 3R3	25	125	146	2.6	5-10-68
	--	--	150	3.3	5-05-78
- 5D2	25	86	124	3.2	4-06-68
	--	--	118	3.2	5-09-78
- 6A1	30	85	101	2.6	4-05-68
	--	--	88	2.7	8-09-78
- 6D2	40	50	113	3.0	4-05-68
	--	--	108	2.7	5-09-78
- 6D3	5	45	109	1.8	4-05-68
	--	--	98	2.0	5-09-78
- 6F2	25	76	105	2.2	4-05-68
	--	--	103	2.2	5-09-78
- 6L1	70	195	152	1.8	4-05-68
	--	--	133	1.7	5-10-78
- 7C1	85	97	139	2.8	4-05-68
	--	--	128	2.0	5-10-78
- 7L1	100	129	98	7.5	5-10-78
- 9J1	15	100	199	2.2	5-11-68
	--	--	195	3.0	5-04-78
-10A5	25	104	153	3.5	6-26-67
	--	--	145	2.2	5-05-78
-10C1	145	307	158	2.4	--
	--	--	155	2.5	5-04-78
-10F1	45	--	180	2.6	5-11-68
	--	--	175	3.0	5-04-78
-10G1	20	100	213	2.2	5-11-68
	--	--	205	3.0	5-05-78
-10H2	10	69	151	2.2	5-11-68
	--	--	145	2.2	5-04-78
-13R1	60	97	125	3.7	5-02-78
-16B1	60	142	170	3.3	5-05-78
-16F1	115	133	853	190	6-27-67
	--	--	1,500	370	5-04-78
-21B1	30	58	195	4.7	5-04-78
-21K3	30	82	150	11	5-04-78
-21L1	50	157	390	66	5-16-68
	--	--	545	110	5-03-78
-21M3	95	168	365	54	5-16-68
	--	--	545	120	5-03-78
-21P2	45	63	395	70	5-03-78
-21Q2	40	92	135	4.6	5-16-68
	--	--	135	5.2	5-03-78
-21R2	55	80	185	7.7	5-03-78
-24H5	40	50	135	2.2	5-02-78
-24J1	30	--	131	3.0	6-25-68
	--	--	130	3.7	5-02-78
-25M1	30	70	162	1.8	6-24-68
	--	--	150	3.2	5-02-78
-26E2	15	40	137	2.8	5-17-68
	--	--	125	3.0	5-03-78
-26K2	45	52	165	7.8	5-17-78
	--	--	165	11	5-04-78
-27A1	35	--	199	13	5-17-68
	--	--	320	15	5-03-78
-27C1	5	30	130	7.4	5-17-68
	--	--	145	9.0	5-03-78
-34A1	70	96	128	16	5-19-78
-34B2	210	248	133	16	5-19-78
-35D1	25	432	262	6.5	5-18-68
	--	--	298	24	5-19-78
-35M1	80	93	188	16	5-19-78
-36B1	20	250	145	2.2	5-02-78
21/ 2 - 4E1	100	146	144	1.6	7-01-68
	--	--	135	2.0	5-03-78
- 5C1	20	--	118	1.9	7-01-68
	--	--	110	2.0	5-03-78
- 5L1	20	61	148	2.3	7-01-68
	--	--	135	2.2	5-03-78
- 8A1	40	158	138	2.0	6-28-68
	--	--	125	2.2	5-03-78
- 8C1	55	265	140	2.0	7-01-68
	--	--	215	5.0	5-03-78
-19M3	12	97	135	3.0	5-03-78
-21G1	170	258	130	3.0	5-01-78
-21K1	305	318	130	3.0	5-04-78
-28B1	245	371	125	2.7	5-01-78
-28K2	240	358	1,025	255	5-01-78
-29M1	30	75	150	3.2	6-26-68
	--	--	150	4.2	5-01-78
-30C1	35	--	150	2.1	6-25-68
	--	--	140	3.0	5-02-78
-30C2	15	90	131	3.5	6-25-68
	--	--	130	9.0	5-01-78
-30F2	20	260	184	2.8	6-24-68
	--	--	170	2.7	5-02-78
-30H2	25	85	126	2.9	6-26-68
	--	--	140	3.2	5-02-78
-30P2	60	--	293	12	6-24-68
	--	--	295	15	5-02-78
-31A1	65	85	136	2.0	6-27-68
	--	--	130	3.0	5-01-78
-31G1	5	65	134	2.0	6-27-68
	--	--	125	2.7	5-01-78
21/ 3 -16L2	50	140	991	230	7-19-66
	--	--	755	160	5-24-78
-16P3	210	269	286	24	7-19-66
	--	--	690	140	5-24-78
-22E1	20	45	191	3.0	7-18-66
	--	--	180	3.5	4-28-78
-22L3	10	22	1,220	346	9-12-66
	--	--	605	120	5-24-78
-25P1	200	417	135	3.2	4-28-78
-26Q1	7	450	555	65	7-12-66
	--	--	485	50	4-28-78
-27B2	10	50	143	--	9-08-66
	--	--	145	4.7	5-24-78
22/ 1W-34B2	30	--	103	2.7	5-17-78
-34G1	40	110	103	3.2	5-17-78
-34P1	100	141	108	2.7	5-17-78
22/ 1 -13N1	5	180	125	1.8	5-09-68
	--	--	110	2.2	5-08-78
-14B1	60	132	105	2.0	5-08-78
-14H1	15	58	100	2.7	5-08-78
-14Q2	40	194	115	2.0	5-08-78
-22R1	40	--	118	2.0	5-08-68
	--	--	118	3.7	5-08-78
-23B1	85	125	114	2.2	5-08-68
	--	--	105	3.2	5-08-78
-23L3	10	87	125	1.6	5-08-68
	--	--	115	4.0	5-04-78
-24D1	5	102	119	4.5	6-20-67
	--	--	105	2.2	5-04-78
-25C2	50	130	121	1.8	5-09-68
	--	--	105	2.2	5-08-78
-26R3	15	70	120	0.6	5-09-68
	--	--	115	2.2	5-08-78
-28L1	40	104	119	3.0	5-08-68
	--	--	123	4.0	5-09-78
-28N1	20	158	124	1.3	5-08-68
	--	--	123	2.0	5-09-78
-29J3	30	100	134	3.2	4-06-68
	--	--	153	4.7	5-08-78
-32A2	45	80	110	2.6	4-06-68
	--	--	118	2.7	5-09-78
-32P2	20	80	98	3.1	4-06-68
	--	--	88	3.2	5-09-78
-34J3	20	100	133	1.7	5-10-68
	--	--	130	2.2	5-05-78
-34Q4	19	97	166	2.4	5-10-68
	--	--	150	3.0	5-05-78
-34R1	30	175	128	1.9	5-10-68
	--	--	120	2.5	5-05-78
22/ 2 -33P2	25	140	175	2.2	5-04-78

Seawater Intrusion Conditions

Seawater intrusion in Pierce County was detected on Anderson Island, on the Longbranch peninsula, near Horsehead Bay southwest of Gig Harbor, and near Browns Point. High chloride concentrations were also detected in a few wells in locations scattered throughout the county.

The analyses of water samples from 11 deep wells on Fox Island suggest that no intrusion existed on Fox Island in May 1978. However, a more recent investigation of the water resources of the Gig Harbor area has shown that local areas of intrusion exist at Allen Point and possibly on Fox Island and at Point Evans (B. F. Drost, oral commun., Feb. 1979).

Information on the quality of ground water from deep aquifers on Anderson Island is limited to data from only three wells. Well 19/1-17J1, near Lyle Point at the south end of the island, was the only well sampled that yielded water in excess of 100 mg/L chloride. Well 19/1-9M1, which yielded water of 561 mg/L chloride in 1968 (Walters, 1971, p. 130), has since been abandoned because of excessive salinity.

High chloride concentrations were detected in two wells near the southern tip of the Longbranch peninsula of Pierce County. Three wells in the vicinity of Horsehead Bay, southwest of Gig Harbor, were also found to be intruded with seawater. Wells 21/1-16F1, 21L1, and 21M3 yielded water containing chloride concentrations considerably higher than those reported for 1968. The wells are used for public-supply purposes, pump rather large volumes of water, and tap aquifers of sand and gravel.

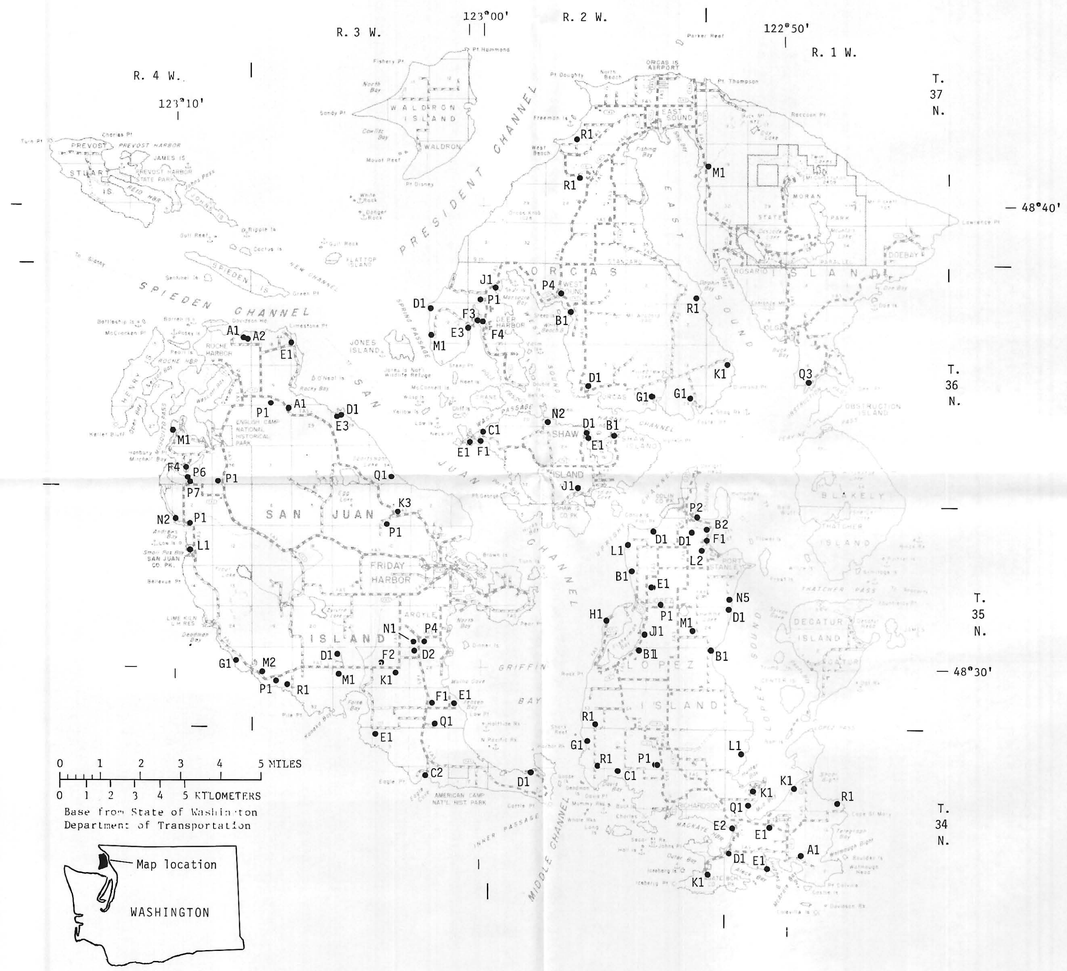
Several public-supply wells near Browns Point, northeast of Tacoma, have a history of widely fluctuating chloride concentrations. In a detailed study of seawater intrusion of that area, Kimmel (1963) concluded that chloride concentrations were highest during periods of prolonged withdrawals when water levels were drawn down below sea level. In 1978, wells 21/3-16L2 and 16P3 yielded water that had concentrations of 160 and 140 mg/L of chloride, respectively.

Walters (1971) detected seawater intrusion on the Tacoma tidal flats in deep, flowing wells that were completed in glacial deposits beneath marine clay. He inferred that the movement of saline water was probably from shallow aquifers to deep aquifers through faulty well casings. Most of the deep wells that had high chloride concentrations have since been abandoned or destroyed. According to Walters (1971, p. 31), the chloride concentration of deep wells on the tidal flats increases when the hydrostatic head in the glacial aquifer is reduced by pumping.

With the exceptions of Fox Island and the Horsehead Bay area, intrusion conditions in Pierce County in 1978 were not significantly different from those in 1968. The intrusion problem on the Tacoma tidal flats in 1978 did not appear as severe as that described by Walters (1971) for 1968, largely because of the abandonment of several deep, high-capacity wells that were intruded in 1968. Regardless of how seawater moves into the deep glacial aquifer, permanent intrusion of the aquifer could be averted or minimized by maintaining hydrostatic heads in the deep wells at the highest practical level.

The median chloride concentration of 153 ground-water samples collected in Pierce County in 1978 was 3.2 mg/L (table 1), the second lowest of all the counties surveyed. In a comparison of 100 sample sets, the median chloride concentration in Pierce County increased from 3.0 mg/L in 1968 to 3.2 mg/L in 1978 (table 2).

SHEET 9. Seawater intrusion conditions in Pierce County.



Seawater Intrusion Conditions

Seawater intrusion is a widespread problem on the principal islands of San Juan County. In the past, numerous wells drilled in coastal areas and(or) to depths below sea level have encountered water that was too salty for the intended purpose. Most wells were either abandoned or destroyed shortly after completion.

Water samples were collected from 94 wells in San Juan County in 1978; of the 94, 15 showed signs of seawater intrusion. Nine of the 15 wells were on Lopez Island; the remainder were on Orcas, San Juan, and Shaw Islands. The smaller islands of the County were not surveyed because of logistical difficulties and their general lack of ground-water development.

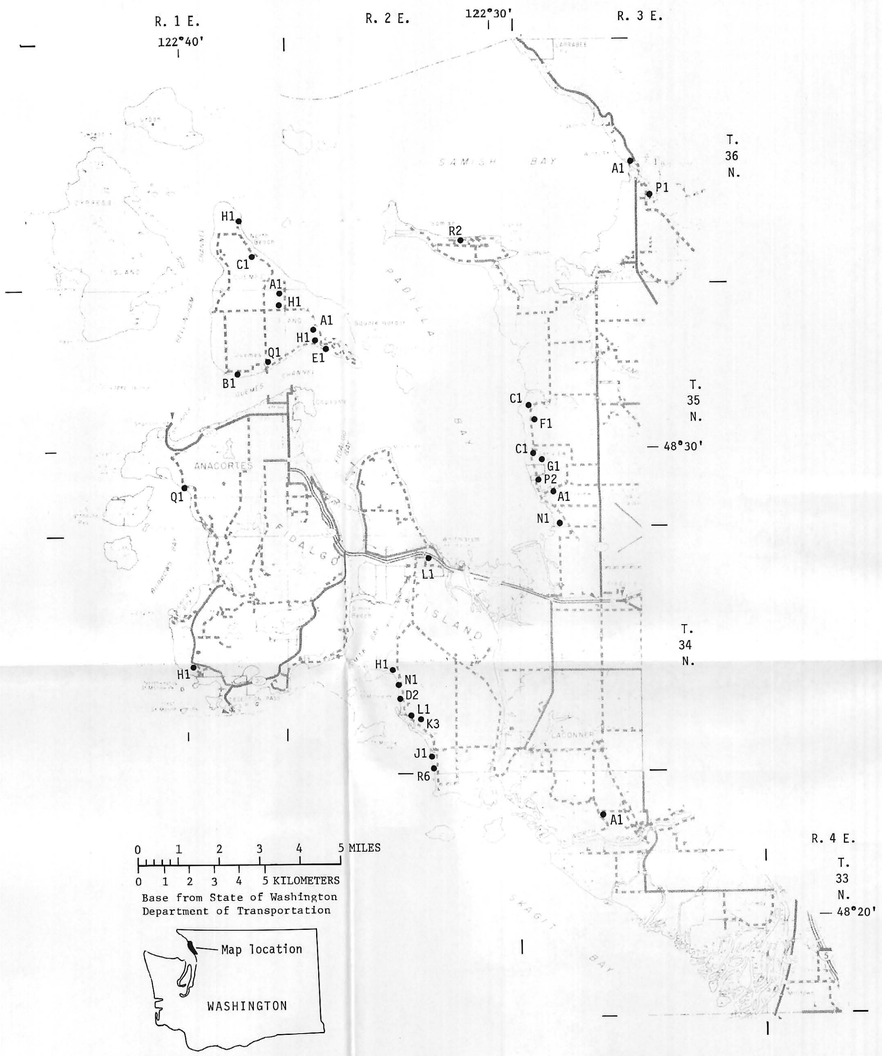
The median chloride concentration of samples from the county in 1978 was 40 mg/L (table 1), the highest of all the counties surveyed. This high value is due, at least in part, to the thinness of the surficial unconsolidated aquifers, the low permeability of the bedrock aquifers, the low precipitation (18-28 inches per year) on the islands, and the increasing demands on the poorly productive aquifers by a rapidly growing population. Even though the median concentration was high, the maximum chloride concentration observed (580 mg/L) was relatively low as compared to other counties sampled.

The wells of San Juan County were not sampled by Walters (1971) as part of his investigation because of logistical considerations; consequently, there were no salinity values earlier than 1978 with which to make comparisons. However, the high chloride concentrations measured as part of this study and the widespread abandonment of wells suggest that seawater intrusion is a serious water-quality problem in the county. Because the population of the county is increasing rapidly, ground-water withdrawals are also increasing. The potential exists, therefore, for a worsening of the intrusion conditions documented to date.

Physical and chemical data for wells in San Juan County

Well number	Land-surface altitude (ft)	Depth of well (ft)	Specific conductance (micromhos at 25°C)	Chloride (mg/L)	Date of collection
34/ 3W- 4A1	90	220	760	53	8-11-78
-11C2	70	160	900	150	8-11-78
34/ 2W- 2P1	120	410	830	150	8-01-78
- 4G1	90	118	710	72	7-31-78
- 4R1	65	129	970	31	7-31-78
- 8D1	40	41	800	150	8-11-78
-10C1	130	209	750	68	8-01-78
-24K1	60	203	685	77	8-01-78
34/ 1W- 6L1	60	214	505	28	8-02-78
- 7K1	100	108	750	89	8-02-78
- 7Q1	110	285	810	150	8-01-78
- 8K1	60	95	1,490	150	8-01-78
- 9R1	60	164	735	72	8-01-78
-17E1	80	115	755	52	8-01-78
-18E2	100	260	1,820	410	8-01-78
-19D1	30	200	730	83	8-01-78
-20A1	180	189	940	110	8-01-78
-20E1	40	164	510	42	8-01-78
35/ 4W- 2N2	65	165	465	21	8-10-78
- 2P1	75	180	825	39	8-10-78
-11L1	40	30	380	16	8-10-78
-25G1	80	306	361	16	8-10-78
35/ 3W- 3K3	180	200	368	34	8-09-78
- 3P1	200	244	530	31	8-09-78
-23P4	100	323	477	58	8-11-78
-26D2	160	242	760	75	8-11-78
-26D3	190	250	480	36	8-11-78
-27F2	80	305	530	46	8-11-78
-27K1	110	224	590	46	8-11-78
-28D1	100	206	485	25	8-11-78
-28M1	155	163	538	36	8-11-78
-30K2	200	185	720	77	8-10-78
-30M2	200	450	390	30	8-10-78
-30R1	120	255	725	77	8-10-78
-35F1	140	275	1,100	100	8-11-78
-35Q1	220	406	815	52	8-11-78
-36E1	50	382	860	230	8-11-78
35/ 2W- 1P2	35	41	1,320	280	7-31-78
-10L1	70	88	430	30	7-31-78
-11D1	50	68	521	34	7-31-78
-12B2	45	72	580	84	8-02-78
-12D1	70	83	535	50	8-02-78
-12F1	25	36	980	82	8-02-78
-12L2	60	70	945	56	8-02-78
-14E1	100	113	680	27	7-31-78
-14P1	90	135	515	27	7-31-78
-15B1	130	159	1,450	200	7-31-78
-21H1	15	219	995	150	7-31-78
-22J1	40	50	510	73	7-31-78
-24M1	280	408	1,400	280	8-02-78
-25B1	45	141	545	74	8-02-78
-27B1	30	64	395	26	8-01-78
-33R1	160	160	612	44	7-31-78
35/ 1W-18N5	70	147	720	86	8-02-78
-19D1	70	154	760	56	8-02-78
36/ 4W-13G1	75	50	500	12	8-09-78
-13G2	95	160	580	15	8-09-78
-26M1	50	266	715	42	8-11-78
-35F4	20	202	865	77	8-10-78
-35P6	125	150	482	21	8-09-78
-35P7	110	198	481	29	8-17-78
-36P1	45	329	430	58	8-10-78
36/ 3W-12D1	30	366	540	16	8-03-78
-12M1	35	206	785	21	8-03-78
-17E1	70	48	402	20	8-09-78
-19P1	170	255	400	17	8-09-78
-28F1	50	220	461	13	8-09-78
-28F2	90	222	485	12	8-09-78
-30A1	165	226	365	14	8-09-78
-34Q1	80	240	520	18	8-09-78
36/ 2W- 1R1	80	300	338	14	8-07-78
- 4P4	25	356	415	86	8-04-78
- 6J1	60	140	445	21	8-04-78
- 6P1	80	266	495	21	8-04-78
- 7E3	100	186	340	11	8-03-78
- 7F3	40	206	440	26	8-04-78
- 7F4	25	206	435	17	8-04-78
- 9B1	130	326	420	18	8-04-78
-15N4	200	446	435	7.1	8-07-78
-21N2	75	90	580	8.1	8-03-78
-23G1	80	606	450	16	8-07-78
-24G1	80	230	380	16	8-07-78
-27B1	15	138	640	41	8-03-78
-27D1	40	161	770	51	8-03-78
-27E1	25	130	605	36	8-03-78
-30C1	40	466	650	32	8-03-78
-30E1	30	300	2,240	580	8-03-78
-30F1	60	293	650	32	8-03-78
-33J1	50	86	530	20	8-03-78
36/ 1W-16Q3	40	576	515	21	8-07-78
-18K1	180	266	465	34	8-07-78
37/ 2W-16R1	145	186	311	12	8-08-78
-21R1	150	346	1,070	270	8-08-78
37/ 1W-19M1	100	346	560	60	8-08-78

SHEET 10. Seawater intrusion conditions in San Juan County.



Seawater Intrusion Conditions

Ground-water development in coastal Skagit County is minor, due chiefly to low well yields and the abundance of surface water.

Despite the paucity of wells, seawater intrusion was detected in several scattered locations in 1978. Water from well 34/2-34R6, on the Swinomish Indian Reservation, had a chloride concentration of 400 mg/L. Walters (1971, p. 45) found no evidence of intrusion beneath the reservation in 1967, but he did not sample well 34/2-34R6.

Water from domestic well 35/1-27Q1 had 120 mg/L of chloride when sampled in April 1967; this had decreased to 83 mg/L in June 1978. Walters (1971, p. 45) presented evidence that the high chloride concentration in this well is probably due to relict seawater rather than true seawater intrusion.

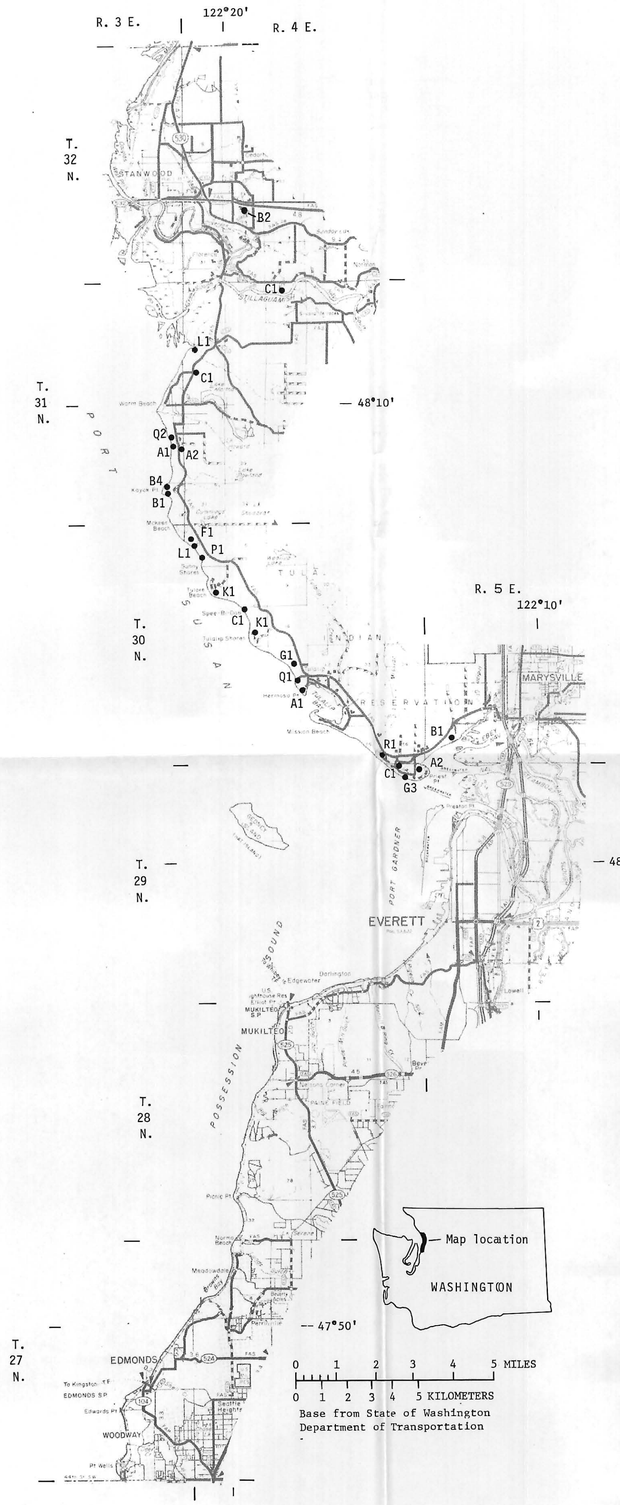
Because of the limited development of ground water in coastal Skagit County, problems of seawater intrusion probably will continue to be restricted to individual wells.

The median chloride concentration of 30 ground-water samples collected in 1978 was 25 mg/L (table 1). A comparison of 18 sets of chemical analyses indicates that the median concentration increased from 22 mg/L in 1967 to 24 mg/L in 1978 (table 2).

Physical and chemical data for wells in Skagit County

Well number	Land-surface altitude (ft)	Depth of well (ft)	Specific conductance (micromhos at 25°C)	Chloride (mg/L)	Date of collection
33/ 3 - 8A1	35	120	1,040	110	6-09-78
34/ 1 -22H1	40	78	580	46	4-28-67
	--	--	550	42	6-13-78
34/ 2 - 3L1	90	108	261	16	6-13-78
-21H1	30	65	578	55	5-03-67
	--	--	455	38	6-12-78
-22N1	30	52	657	30	5-03-67
	--	--	600	29	6-12-78
-27D2	15	72	536	44	5-03-67
	--	--	570	47	6-12-78
-27K3	45	48	484	25	5-02-67
	--	--	613	26	6-12-78
-27L1	40	99	555	57	6-12-78
-34J1	105	160	348	17	6-09-78
-34R6	45	200	2,620	400	6-09-78
35/ 1 - 1A1	100	163	268	11	6-15-78
- 1H1	130	166	228	17	5-04-67
	--	--	245	15	6-15-78
-12Q1	30	171	321	20	5-04-67
	--	--	306	17	6-15-78
-14B1	25	81	386	36	6-15-78
-27Q1	30	54	868	120	4-28-67
	--	--	739	83	6-13-78
35/ 2 - 7A1	60	110	538	32	5-04-67
	--	--	510	24	6-15-78
- 7H1	15	72	539	52	6-15-78
- 8E1	40	154	905	16	6-15-78
35/ 3 -19C1	15	70	543	39	4-27-67
	--	--	539	37	6-14-78
-19F1	55	--	499	18	5-03-67
	--	--	520	23	6-14-78
-30C1	65	70	461	12	4-27-67
	--	--	465	9.3	6-14-78
-30G1	150	157	337	12	4-26-67
	--	--	342	11	6-14-78
-30P2	30	98	496	18	4-26-67
	--	--	510	20	6-13-78
-31A1	105	125	557	16	4-26-67
	--	--	285	8.9	10-17-78
-32N1	30	76	431	10	6-13-78
36/ 1 -26H1	100	134	2,280	630	6-15-78
-36C1	50	54	1,330	315	5-04-67
	--	--	1,190	270	6-15-78
36/ 2 -26R2	15	89	1,180	270	6-14-78
36/ 3 -21A1	35	52	382	12	4-27-67
	--	--	331	10	6-14-78
-22P1	9	20	196	4.0	4-27-67
	--	--	85	5.2	6-14-78

SHEET 11. Seawater intrusion conditions in Skagit County.



Seawater Intrusion Conditions

In coastal areas of Snohomish County, less ground water is being pumped now than in the past. Much of the area now relies on public-supply systems that obtain water from surface sources or from productive wells that are several miles inland and thereby less susceptible to seawater intrusion.

Only 23 wells were sampled in coastal Snohomish County in 1978, fewer than in any other county. The paucity of available wells is due in part to unproductive aquifers in the southwestern part of the county and to the general lack of development in the northwestern part of the county. Of the wells sampled, none yielded water in excess of 100 mg/L, indicating that seawater intrusion presently is not a problem in Snohomish County. The median chloride concentration in 1978, as shown in table 1 was low (7.2 mg/L), and chloride levels generally declined between 1967 and 1978 (table 2).

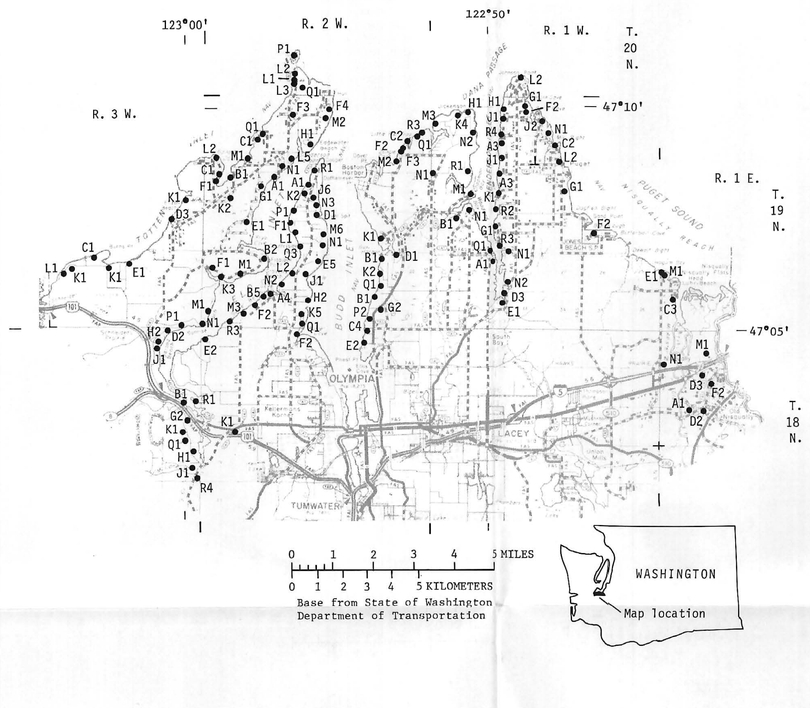
Although no intrusion problems were evident in 1978, they have occurred in Snohomish County in the past. Walters (1971, p. 39-40) reported that several public-supply wells had been abandoned because of excessive chloride concentrations. Intrusion problems are not likely to increase, however, unless ground-water development in coastal Snohomish County increases greatly over present conditions.

Physical and chemical data for wells in Snohomish County

Well number	Land-surface altitude (ft)	Depth of well (ft)	Specific conductance (micromhos at 25°C)	Chloride (mg/L)	Date of collection
29/ 4 - 1A2	125	146	302	22	4-19-67
	--	--	305	24	6-06-78
- 1C1	125	165	312	11	4-19-67
	--	--	290	9.6	6-06-78
- 1G3	85	130	218	11	4-19-67
	--	--	196	10	6-06-78
30/ 4 - 6F1	305	311	195	7.2	6-07-78
- 6L1	205	230	223	8.5	4-07-67
	--	--	198	6.7	6-07-78
- 6P1	85	190	190	6.2	6-07-78
- 7K1	30	62	246	14	6-07-78 1/
-17C1	100	372	181	8.0	4-07-67
	--	--	180	6.7	6-07-78
-17K1	180	518	184	8.0	4-18-67
	--	--	172	5.7	6-07-78
-21G1	175	375	159	4.7	6-07-78
-21Q1	20	20	409	17	6-07-78
-28A1	60	163	167	6.5	4-18-67
	--	--	161	4.7	6-06-78
-35R1	125	190	355	7.5	4-20-67
	--	--	366	12	6-06-78
30/ 5 -31B1	15	26	236	8.5	4-20-67
	--	--	249	8.3	6-06-78
31/ 3 -24Q2	165	186	339	8.5	4-05-67
	--	--	129	15	6-08-78
-25A1	215	300	270	9.5	4-06-67
	--	--	260	7.2	6-08-78
-25A2	255	309	405	13	4-05-67
	--	--	433	9.1	6-08-78
-36B1	10	75	204	7.0	4-06-67
	--	--	192	6.0	6-08-78
-36B4	10	81	198	7.5	4-06-67
	--	--	196	6.0	6-08-78
31/ 4 - 4C1	23	262	188	6.0	4-04-67
	--	--	180	4.1	6-08-78
- 7L1	165	219	207	7.5	4-04-67
	--	--	202	6.2	6-08-78
-18C1	210	224	357	9.0	4-07-67
	--	--	335	8.5	6-08-78
32/ 4 -29B2	80	250	282	6.0	6-08-78

1/ Sample is a composite from two or more wells.

SHEET 12. Seawater intrusion conditions in Snohomish County.



Seawater Intrusion Conditions

Ground-water development in Thurston County has been primarily for the purpose of supplying a growing number of seasonal and permanent homes and small public-supply systems. A few wells supply water for use in oyster-processing plants.

There is considerable evidence of seawater intrusion along the inlets and channels of northern Thurston County. Even though the median chloride concentration of 133 ground-water samples collected in 1978 was only 3.4 mg/L (table 1), 17 of the samples had chloride concentrations in excess of 100 mg/L.

Intrusion was observed in three wells on the peninsula between Totten and Eld Inlets. The highest chloride concentration, 364 mg/L, was observed in well 20/2W-33L1 on the west side of the peninsula. When sampled in 1967 the concentration was 570 mg/L. Nearby wells 20/2W-33L2 and 33L3 are much deeper than well 33L1 but had chloride concentrations of only 10 and 2.5 mg/L, respectively. This suggests that the intrusion is limited to a relatively shallow layer or aquifer.

Several wells were found on the peninsula between Henderson Inlet and Nisqually Reach that yielded water high in chloride. The table indicates that the salinity of these wells has increased since 1967.

Chloride concentrations in water from three wells at the head of Mud Bay, west of Olympia, ranged from 89 to 170 mg/L. However, the salinity in all three wells had declined since last sampled, in May 1967.

The salinity patterns observed in the ground waters of Thurston County suggest that, even on narrow peninsulas, there are several tongues of intrusion in small areas, or several strata of intrusion. In addition, most occurrences of intrusion are in wells that tap aquifers generally less than 55 feet below sea level. Pumping of additional wells, or increased pumping of existing wells, could cause a coalescing of the contaminated areas, with the result that several wells could start producing salty water with little or no forewarning.

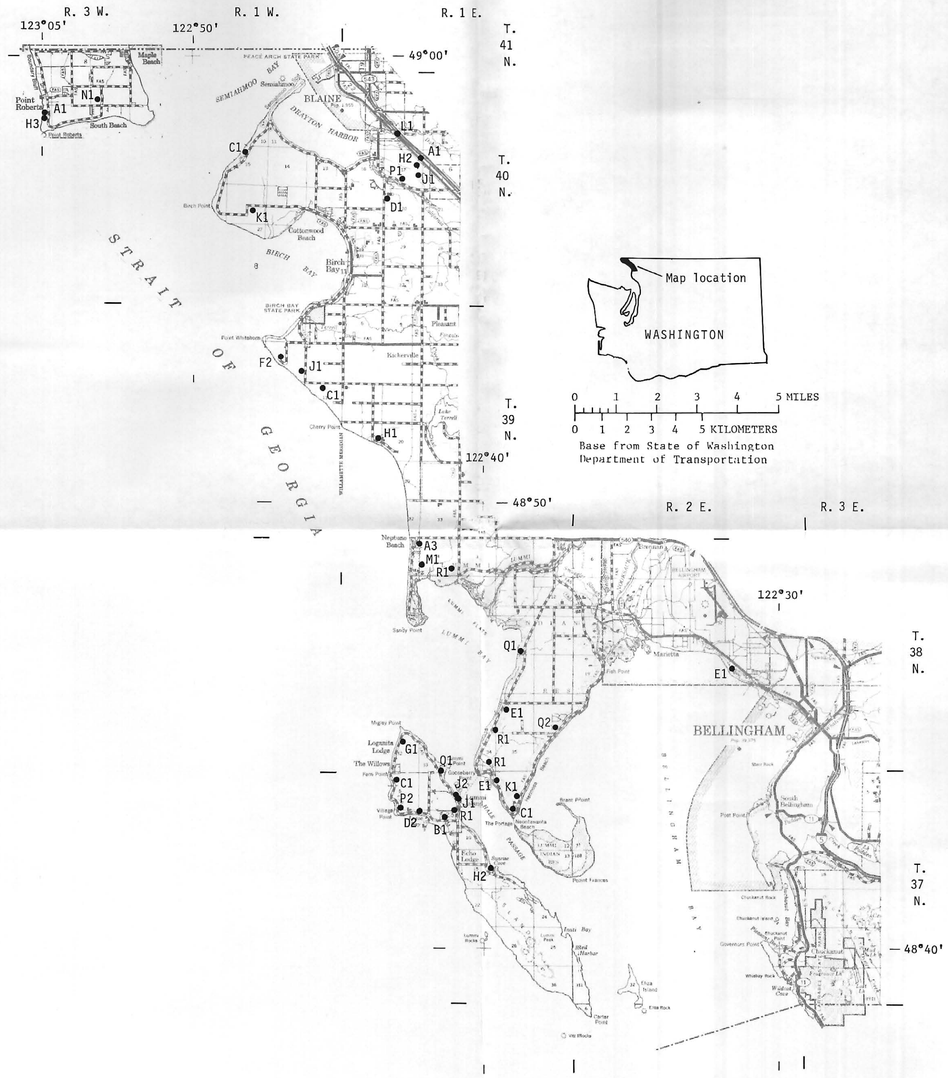
The chloride data for the 1967 survey of Thurston County were incomplete and a comparison of chloride levels could be made for only 48 sets of data. Despite local increases in salinity, the median chloride concentration of 48 samples decreased from 14 mg/L in 1967 to 6.6 mg/L in 1978 (table 2).

Physical and chemical data for wells in Thurston County

Well number	Land-surface altitude (ft)	Depth of well (ft)	Specific conductance (micromhos at 25°C)	Chloride (mg/L)	Date of collection
18/ 3W- 1D2	10	65	124	--	5-02-67
	--	--	116	2.8	5-18-78
- 2H2	6	71	129	--	5-02-67
	--	--	118	4.1	5-18-78
- 2J1	35	55	167	--	5-01-67
	--	--	179	16	5-18-78
-12R1	12	27	123	--	5-01-67
	--	--	117	2.6	5-17-78
-13B1	15	--	496	100	5-01-67
	--	--	455	89	5-18-78
-13G2	20	90	87	--	5-01-67
	--	--	85	2.3	5-17-78
-13K1	50	85	112	--	5-01-67
	--	--	97	2.3	5-17-78
-13Q1	60	83	116	--	5-01-67
	--	--	96	2.6	5-17-78
-24H1	20	207	751	195	5-01-67
	--	--	685	170	5-17-78
-24J1	20	116	283	48	5-01-67
	--	--	310	71	5-17-78
-24R4	20	115	717	180	5-01-67
	--	--	610	140	5-17-78
18/ 2W- 2C4	100	143	169	--	4-25-67
	--	--	141	2.8	5-15-78
- 2E2	5	200	148	--	4-25-67
	--	--	124	1.6	5-15-78
- 4F2	20	400	141	--	4-25-67
	--	--	134	2.1	5-15-78
- 6E2	35	45	138	--	5-04-67
	--	--	104	2.1	5-17-78
-18K1	175	180	91	--	5-01-67
	--	--	85	3.4	5-18-78
18/ 1 - 5M1	10	900	159	5.0	4-10-67
	--	--	155	3.6	5-08-78
- 6N1	240	253	183	--	4-10-67
	--	--	94	2.8	5-08-78
- 8D3	10	112	175	--	4-10-67
	--	--	165	2.6	5-08-78
- 8F2	18	100	195	4.0	4-10-67
	--	--	195	2.3	5-08-78
-17D2	15	110	166	--	4-10-67
	--	--	150	3.6	5-08-78
-18A1	20	120	137	6.0	4-10-67
	--	--	122	3.6	5-08-78
19/ 3W-13K1	10	86	174	--	5-05-67
	--	--	170	3.6	5-23-78
-24D3	95	120	162	--	5-05-67
	--	--	160	3.1	5-23-78
-26E1	50	62	130	--	5-05-67
	--	--	120	3.6	5-23-78
-27C1	40	123	166	4.1	5-23-78
-27K1	35	70	223	3.5	5-05-67
	--	--	223	2.6	5-23-78
-28K1	120	135	152	--	5-05-67
	--	--	153	3.4	5-23-78
-28L1	20	70	192	--	5-05-67
	--	--	193	3.4	5-23-78
-36P1	125	142	142	--	5-02-67
	--	--	128	2.6	5-18-78
19/ 2W- 1Q1	80	118	220	6.5	4-19-67
	--	--	200	4.4	5-11-78
- 1R3	80	90	538	85	4-19-67
	--	--	352	40	5-11-78
- 3F4	30	--	683	120	5-03-67
	--	--	600	97	5-19-78
- 3M2	60	104	1,020	200	5-03-67
	--	--	1,100	220	5-19-78
- 4F3	115	158	229	5.0	5-03-67
	--	--	211	2.8	5-22-78
- 5Q1	60	78	190	--	5-03-67
	--	--	177	0.8	5-22-78
- 7L2	15	120	216	4.5	5-05-67
	--	--	217	3.1	5-23-78
- 8C1	60	85	170	--	5-03-67
	--	--	186	5.7	5-22-78
- 8M1	10	80	224	5.0	5-03-67
	--	--	205	2.3	5-23-78
- 9H1	75	127	233	16	5-03-67
	--	--	135	17	5-19-78
- 9L5	15	37	119	--	5-02-67
	--	--	116	5.2	5-19-78
- 9N1	30	37	139	--	5-02-67
	--	--	151	6.7	5-19-78
- 9R1	10	360	190	--	4-27-67
	--	--	178	4.7	5-15-78
-12C2	50	120	1,010	210	4-19-67
	--	--	2,180	570	5-11-78
-12F2	35	40	677	110	4-19-67
	--	--	3,990	1,100	5-11-78
-12F3	60	65	490	83	10-10-78
-12M2	80	621	172	--	4-19-67
	--	--	141	1.6	5-12-78
-15N3	80	117	261	28	5-15-78
-16A1	10	552	222	17	4-27-67
	--	--	217	14	5-15-78
-16J6	80	105	193	7.5	4-27-67
	--	--	150	5.2	5-15-78
-16K2	50	282	177	--	4-27-67
	--	--	161	6.2	5-15-78
-16P1	40	70	607	120	4-27-67
	--	--	570	110	5-15-78
-17A1	60	64	112	--	5-02-67
	--	--	115	7.0	5-19-78
-17G1	105	210	283	7.8	5-19-78
-18B1	25	100	266	3.5	5-05-67
	--	---	264	2.6	5-23-78
-18C1	35	120	148	--	5-05-67
	--	--	130	2.3	5-23-78
-18F1	40	73	194	---	5-05-67
	--	--	175	3.9	5-23-78
-18K2	130	166	145	--	5-05-67
	--	--	135	2.6	5-23-78
-20E1	85	138	144	--	5-02-67
	--	--	135	2.8	5-19-78
-21F1	85	358	170	--	4-27-67
	--	-	160	7.8	5-15-78
-21L1	50	84	435	78	4-27-67
	--	--	314	44	5-16-78
-21Q3	70	297	174	--	4-28-67
	--	--	142	3.4	5-17-78
-22D1	80	90	197	8.0	4-27-67
	--	--	191	4.9	5-15-78
-22M6	10	441	224	15	4-27-67
	--	--	224	14	5-15-78
-22N1	50	65	168	--	4-25-67
	--	--	161	3.6	5-15-78
-23K1	20	385	162	--	4-24-67
	--	--	148	2.1	5-12-78
-25D1	90	123	143	--	4-24-67
	--	--	127	2.3	5-12-78
-26B1	20	115	174	--	4-24-67
	--	--	152	1.8	5-12-78
-26K2	80	173	159	--	4-24-67
	--	--	205	2.3	5-12-78
-26Q1	15	--	137	--	4-24-67
	--	--	122	2.1	5-12-78
-27E5	10	240	172	--	4-25-67
	--	--	158	3.6	5-15-78
-28J1	10	213	172	--	4-25-67
	--	--	154	2.1	5-15-78
-28L2	80	146	192	--	4-25-67
	--	--	182	2.8	5-17-78
-28N2	28	75	192	--	4-28-67
	--	--	194	2.6	5-16-78
-29B2	25	44	177	--	5-02-67
	--	--	185	6.7	5-18-78
-29M1	90	150	146	--	5-02-67
	--	--	143	3.1	5-18-78
-30F1	70	130	116	--	5-02-67
	--	--	116	3.1	5-18-78
-30K3	60	110	143	--	5-02-67
	--	--	125	2.8	5-18-78
-31M1	45	86	139	--	5-02-67
	--	--	126	2.1	5-18-78
-31N1	30	50	139	--	5-02-67
	--	--	133	4.1	5-18-78
-31R3	25	40	125	--	4-28-67
	--	--	104	2.6	5-17-78
-32A4	70	80	226	3.5	4-28-67
	--	--	113	2.8	5-16-78
-32B5	5	228	147	--	4-28-67
	--	--	133	1.8	5-16-78
-32F2	30	60	138	--	4-28-67
	--	--	132	2.1	5-17-78
-32M3	35	90	140	--	4-28-67
	--	--	122	2.6	5-17-78
-33H2	100	165	175	--	4-25-67
	--	--	162	2.3	5-15-78
-33K5	140	149	165	--	4-25-67
	--	--	144	2.3	5-15-78
-33Q1	10	355	152	--	4-25-67
	--	--	131	2.1	5-16-78
-35B1	110	173	197	3.5	4-25-67
	--	--	178	2.6	5-12-78
-35G2	120	160	193	--	4-25-67
	--	--	172	2.6	5-12-78
-35P2	100	132	185	--	4-25-67
	--	--	171	3.4	5-15-78
19/ 1W- 3N1	65	98	650	140	5-09-78
- 4F2	105	116	189	18	4-17-67
	--	--	183	2.6	5-09-78
- 4G1	55	90	1,680	420	4-17-67
	--	--	2,420	650	5-09-78
- 4J2	55	67	1,330	350	4-12-67
	--	--	2,260	610	5-09-78
- 5H1	60	99	310	15	4-17-67
	--	--	280	6.5	5-09-78
- 5J1	5	337	160	--	4-17-67
	--	--	139	2.1	5-09-78
- 5N2	40	50	150	--	4-19-67
	--	--	282	6.2	5-11-78
- 5R4	40	139	208	5.0	4-17-67
	--	--	192	2.6	5-09-78
- 6H1	30	144	742	9.0	4-19-67
	--	--	720	0.5	5-11-78
- 6K4	60	65	166	--	--
	--	--	140	4.1	5-11-78
- 6M3	65	300	515	95	4-19-67
	--	--	632	140	5-11-78
- 7N1	120	133	220	5.0	4-18-67
	--	--	232	4.7	5-11-78
- 7R1	40	1,000	259	4.0	4-18-67
	--	--	227	2.3	5-11-78
- 8A3	60	137	159	--	4-17-67
	--	--	113	2.6	5-10-78
- 8J1	40	87	165	--	4-17-67
	--	--	132	2.3	5-10-78
-10C2	65	90	871	90	4-12-67
	--	--	875	190	5-09-78
-10L2	30	85	1,000	255	4-12-67
	--	--	1,100	270	5-09-78
-15G1	40	80	128	--	4-12-67
	--	--	116	2.8	5-09-78
-17A3	30	128	150	--	4-17-67
	--	--	134	4.4	5-10-78
-17K1	5	38	2,310	620	4-17-67
	--	--	2,340	650	5-10-78
-17M1	12	1,000	186	--	4-18-67
	--	--	116	2.3	5-11-78
-17N1	9	20	162	--	4-18-67
	--	--	110	2.1	5-11-78
-17R2	15	130	174	--	4-17-67
	--	--	138	3.4	5-10-78
-19B1	50	85	168	--	4-18-67
	--	--	167	7.2	5-11-78
-20G1	115	158	587	105	4-17-67
	--	--	582	110	5-10-78
-20Q1	95	116	183	--	4-18-67
	--	--	164	3.6	5-10-78
-20R3	15	68	146	--	4-17-67
	--	--	122	1.6	5-10-78
-21N1	125	218	299	4.0	4-18-67
	--	--	281	2.6	5-10-78
-23F2	40	388	198	4.0	4-11-67
	--	--	194	2.3	5-09-78
-28N2	60	112	155	--	4-18-67
	--	--	133	1.8	5-10-78
-29A1	12	225	162	--	4-18-67
	--	--	133	1.8	5-10-78
-33D3	25	70	156	--	4-18-67
	--	--	133	2.6	5-10-78
-33E1	5	150	377	4.5	4-18-67
	--	--	357	3.6	5-10-78
19/ 1 -30E1	5	34	108	--	4-10-67
	--	--	98	2.6	5-08-78
-30M1	55	73	221	8.0	4-11-67
	--	--	192	4.1	5-08-78
-31C3	200	238	177	--	4-11-67
	--	--	164	2.1	5-08-78
20/ 2W-28P1	10	425	256	2.0	5-03-67
	--	--	253	1.6	5-22-78
-33L1	65	107	2,150	570	5-07-67
	--	--	1,500	364	5-22-78
-33L2	55	455	280	10	5-03-67
	--	--	254	6.7	5-22-78
-33L3	25	500	253	2.5	10-10-78
-33Q1	60	765	193	14	5-22-78
20/ 1W-33L2	15	500	229	12	4-17-67
	--	--	220	9.1	5-09-78

SHEET 13. Seawater intrusion conditions in Thurston County.

Prepared in Cooperation with
U.S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION



Seawater Intrusion Conditions

Several areas of high-chloride water were detected in Whatcom County in 1978. Seawater intrusion is not necessarily indicated in every case, however; some problems may be related to the presence of relict seawater.

When sampled in September 1968, wells 40/3W-9A1 and 9H3, near Point Roberts, yielded water with chloride concentrations of 285 and 113 mg/L, respectively. When sampled in May 1978, the salinity levels were 20 and 67 mg/L, respectively. Both wells are close to the coast, are finished in gravel aquifers at or near sea level, and are pumped heavily in summer only. The large decreases in chloride concentrations are probably a reflection of seasonal fluctuations rather than a long-term, permanent trend.

Wells 40/1-17P1 and 20D1, southeast of Blaine along California Creek, produced water containing 390 and 140 mg/L of chloride, respectively, but the wells flow with sufficient hydraulic head to preclude the likelihood of the high chlorides being a result of seawater intrusion.

On the west side of the Lummi peninsula southwest of Ferndale, wells 38/1-14Q1 and 34R1 produced water with chloride concentrations of 430 and 130 mg/L, respectively. When sampled in September 1968 well 38/1-34R1 produced water with a chloride concentration of only 24 mg/L. The May 1978 chloride concentration of 130 mg/L suggests that intrusion has taken place in the Gooseberry Point area since 1968. In a study of the water resources of the Lummi Indian Reservation, Cline (1974) stated that (1) the occurrence of salty ground water beneath the reservation was a major water-quality problem; (2) ground water in the southern part of the Lummi peninsula and the western part of the reservation was generally fresh; and (3) water from public-supply wells in the Gooseberry Point area was increasing in salinity.

With the exception of two of the sampled wells, chloride concentrations on Lummi Island were below 100 mg/L but several wells on the island have reportedly been abandoned or destroyed because of excessive salinity.

Seawater intrusion will most likely continue to be a problem on the peninsulas and islands of Whatcom County, especially where high-yield wells are drilled close to the coast and to depths below sea level. In areas of predominantly summer residences and seasonal pumping, such as Point Roberts, intrusion probably will not advance beyond its present state.

The median chloride concentration of 37 ground-water samples collected in Whatcom County in 1978 was 20 mg/L (table 1). According to table 2, the median concentration decreased from 23 to 21 mg/L between 1968 and 1978. At least some of this decrease is due to seasonal fluctuations in chloride and not to long-term changes.

Physical and chemical data for wells in Whatcom County

Well number	Land-surface altitude (ft)	Depth of well (ft)	Specific conductance (micromhos at 25°C)	Chloride (mg/L)	Date of collection
37/ 1 - 2E1	35	85	374	18	9-11-68
	--	--	370	16	5-09-78
- 2K1	10	42	534	40	9-11-68
	--	--	555	40	5-10-78
- 4J1	20	55	2,000	355	9-19-68
	--	--	1,800	340	5-10-78
- 4J2	20	100	1,200	170	5-10-78
- 4R1	35	250	380	11	5-10-78
- 5C1	50	180	350	30	9-19-68
	--	--	395	41	5-10-78
- 5P2	45	301	224	16	5-10-78
- 9B1	90	240	441	15	9-19-68
	--	--	420	15	5-10-78
- 9D2	15	95	420	29	5-10-78
-11C1	12	124	424	22	9-11-68
	--	--	415	20	5-10-78
-15H2	20	32	274	14	9-19-68
	--	--	505	18	5-10-78
38/ 1 - 4M1	19	37	295	21	5-09-78
- 4R1	120	124	370	19	5-09-78
- 5A3	110	120	375	7.2	5-09-78
-14Q1	30	107	2,200	430	5-09-78
-25Q2	40	88	405	51	5-09-78
-26E1	40	112	300	19	5-09-78
-27R1	130	164	320	17	5-09-78
-32G1	100	153	574	15	9-19-68
	--	--	445	17	5-10-78
-33Q1	15	40	305	13	5-10-78
-34R1	75	138	416	24	9-10-68
	--	--	775	130	5-09-78
38/ 2 -23E1	75	120	281	15	9-10-68
	--	--	290	21	5-10-78
39/ 1W-11F2	95	113	339	23	9-13-68
	--	--	355	23	5-09-78
-11J1	100	147	271	9.1	9-13-68
	--	--	276	12	5-09-78
-13C1	100	135	693	84	9-13-68
	--	--	775	100	5-09-78
39/ 1 -19H1	18	180	779	67	9-12-68
	--	--	305	22	5-09-78
40/ 3W- 2N1	125	140	242	14	9-18-68
	--	--	256	18	5-08-78
- 9A1	10	10	1,390	285	9-18-68
	--	--	271	20	5-08-78
- 9H3	10	14	864	113	9-18-68
	--	--	485	67	5-08-78
40/ 1W-15C1	60	72	305	11	9-16-68
	--	--	271	11	5-08-78
-22K1	80	125	921	10	9-16-68
	--	--	945	0.0	5-08-78
40/ 1 - 8L1	25	625	492	63	8-30-78
-17A1	40	53	214	7.6	8-30-78
-17H2	40	87	216	7.9	8-30-78
-17P1	15	365	2,200	495	9-16-68
	--	--	1,880	390	5-09-78
-17J1	30	85	234	7.4	8-30-78
-20D1	45	440	931	120	9-16-68
	--	--	935	140	8-30-78

SHEET 14. Seawater intrusion conditions in Whatcom County.