5.0 GROUNDWATER SEEPAGE FROM THE COACHELLA BRANCH

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5.1 LOCATION AND RATE OF SEEPAGE

Water seepage from the currently unlined CB during the period from 1982 to 1990, after the lining of its first 49 miles (from Drop 1 to Check 6A) has been estimated to average 32,350 acre-feet per year (af/yr) (Bureau of Reclamation 1993). Seepage from the first 49 miles averaged 130,500 af/yr during the period 1971 to 1980, prior to its lining (Fogg 1989). Seepage rates along the currently unlined reach between Siphons 7 and 32 were estimated from gauged canal flow rates. Canal seepage for the unlined sections of the CB was also estimated along hydrologically-defined reaches in order to apportion gauged seepage rates along the length of the CB based on site specific conditions at each location.

Lining the proposed canal sections between Siphons 7 to 14 and Siphons 15 to 31 would conserve 25,680 af/yr of the 32,350 af/yr of seepage water. There is a difference between the conserved seepage and the total seepage because 1,490 af/yr will continue to seep through the lined section, and up to 5,180 af/yr of canal water will be diverted for mitigation purposes to maintain existing and newly-created wetlands in the Salt Creek area. In addition to the diverted canal water, up to 2,000 af/yr of deeper regional groundwater will also be used for wetland mitigation purposes, but because this water source is not derived from the canal, it is not included in estimating the amount of canal water that will be conserved by this project.

5.1.1 Measured Seepage

This section briefly summarizes canal seepage rates that previously were estimated in the CB EIS/EIR (Bureau of Reclamation 1993). Canal seepage rates for the unlined section below check 6A between 1950 and 1988 are presented in Figure 5-1. The recorded canal flows were corrected for water removed from the canal by diversions and evaporation between each gauge reach, and the difference between these corrected flows were used to estimate the seepage rates given in Figure 5-1. The seepage rates given in Figure 5-1 are also affected by errors in estimated annual total canal flow at each gauge station, which accounts for some of the yearly variation in the annual seepage rate.

The seepage rates initially averaged 36,000 af/yr between 1950 and 1953. Seepage rates then quickly declined to values between 10,000 and 20,000 af/yr during the period from 1955 to 1972. The decline from the initial seepage rate of the section below check 6A is larger than expected for seepage from earthen

water impoundments where seepage is controlled by percolation into the unsaturated zone. The large decline in seepage rates is attributed to the water table rising above the base of the canal during 1955 (see Section 5.2) such that initial seepage rates were controlled by percolation into the unsaturated zone and later seepage rates were controlled by head difference between the canal and the aquifer. Seepage rates then appeared to rise in the 1970s and 1980s; the cause for the rise is probably the result of the removal of the original bentonite liner concurrently with intensive aquatic weed removal efforts in the 1970s and 1980s. Prior to the construction of the parshall flumes, during the lining of the first 49 miles, the measurement of seepage loss in the middle section was uncertain. The seepage rate of 32,350 af/yr for the period from 1982 to 1990 is thought to represent the best estimate of current seepage.

Additional documentation on seepage rates can be found in the CB EIS/EIR report and geohydrology appendix (Bureau of Reclamation 1993).

5.1.2 Estimated Seepage by Hydrologic Unit

Seepage estimated from measured flows provide one estimate of the total seepage rate in the CB. However, seepage rates vary along the CB due to differences in the subsurface geology and hydraulic conditions along the canal. The canal was divided into five segments with differing hydrologic characteristics, and seepage rates for each section were estimated based on the amount of wetlands present along the canal. The amount of wetlands in 1988 was used to define the current Total Wetlands (Table 5-1), and the amount of pre-canal wetlands in 1949 was subtracted from the Total Wetlands to estimate the canal Induced Wetlands (Table 5-1). Evapotranspiration was then estimated from the wetlands acreage using a 5-foot-per-year evapotranspiration rate. The five reaches were chosen to separate the high seepage reaches from the low seepage reaches. High seepage reaches are located where the canal-wetted perimeter is alluvial sand and gravel. Low seepage reaches are located primarily where the canal wetted perimeter is lakebed clay, although low seepage also occurs for a small section in the north where the canal wetted perimeter is low permeability sandstone.

Unit A is located between Siphons 7 and 14 (Figure 5-2), and the canal-wetted perimeter for this section is composed of clay. Seepage rates for this section are low, except at a few reaches where there are desert wash deposits (Figures 5-3a and 5-3b). Infrared aerial photos and the mapped wetlands (Figure 2-6c) show areas of vegetation below Siphon 9, which are attributed to canal seepage through the sandy alluvial deposits depicted on the geologic map (Figure 5-3a). Overall, however, the deposits along Unit A reflect

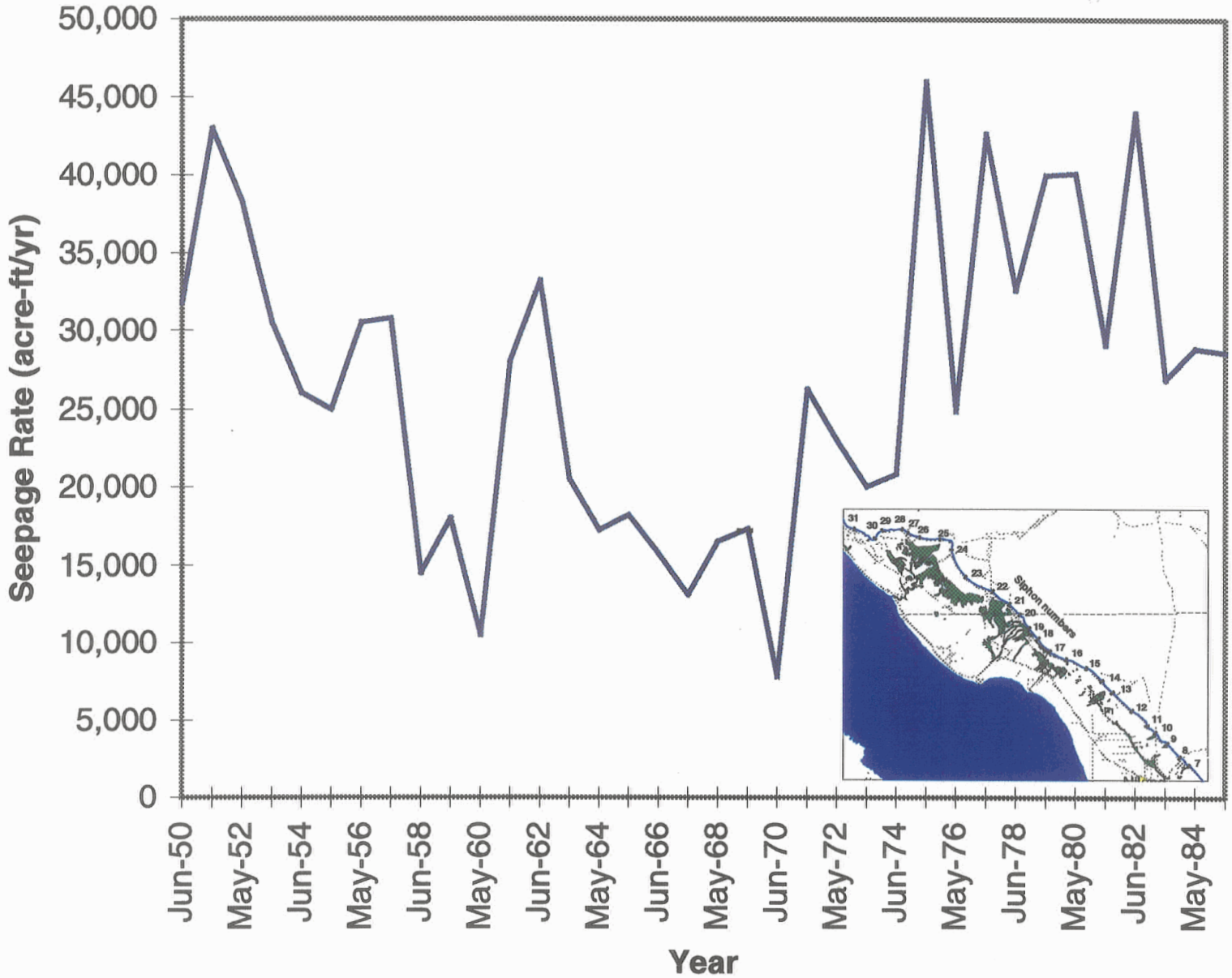

Figure 5-1. Measured Loss in the Coachella Canal Below Check 6A

shallow lake sediments as depicted in the cross-sections in Appendix H. The seepage from Unit A is expected to be small given the predominantly clay sediments and the limited amount of wetlands along this canal reach. Total seepage rates were estimated to be 1,480 af/yr based on 317 acres of induced wetland vegetation, which is only 163 af/yr per mile of canal length.

Table 5-1

CB Seepage Along Structure-Defined Reaches

Hydrologic Unit	Length (mile)	Seepage (af/yr)	Leakage rate (af/yr/mile)	Total Wetlands (acres)	Total ET (af/yr)	Induced Wetlands (acres)	Induced ET (af/yr)	Surface Water Discharge (af/yr)	Lined leakage (af/yr)
A	9.07	1,480	163	702	3,510	317	1,580	0	140
B	5.92	2,640	446	535	2,675	518	2,593	0	140
C	7.32	11,410	1,559	2,220[1]	11,100	2,289	11,445	0	560
D	8.09	16,500	2,040	4,068	20,340	2,773	13,284	2,000[2]	620
E	4.42	320	72	77	385	65	328	0	30
Total	34	32,350		7,153[3]	38,010	5,962	29,230	0	1,490

Notes: [1]Unit D includes Dos Palmas and Salt Springs
[2]Unit D also includes 2,000 af/yr base flow in Salt Creek
[3]Total wetlands consist of 70% Salt Cedar

Unit B is located between Siphons 14 and 18, and the canal-wetted perimeter for this section is predominantly clay. Seepage rates for this section are also generally low, but as noted on infrared aerial photos and the mapped wetlands (Figure 2-6c), there are more abundant areas of vegetation below the area between Siphons 16 and 18. The geologic map also shows young alluvial deposits between Siphons 16 and 17 and old alluvial deposits between Siphons 17 and 18 upslope of these same wetland areas. The deposits along Unit B also generally reflect shallow lake sediments as depicted in the cross-sections in Appendix E. Thus, the seepage per mile of canal length from Unit B is higher than Unit A. Total seepage rates were estimated to be 2,640 af/yr based on 518 acres of induced wetland vegetation, which is 446 af/yr per mile of canal length.

Unit C is located between Siphons 18 and 23, and the canal-wetted perimeter for this section is composed of sand and gravelly sand. Between Siphons 22 and 23, a large alluvial fan is shown on the geologic map; the alluvial fan can also be seen in the Salt Creek area on the aerial photo (Figure 2-6c). The deposits along Unit C reflect shallow alluvial sediments that extend from ground surface to depths of 20 to 50 feet. Below the alluvial sediments there are lake sediments as depicted in the cross-sections in Appendix E. These deep lake sediments also extend to the east at least 1,500 feet upslope of the canal and to the west several thousand feet where they pinch out against the ground surface as depicted in the cross-sections in

Appendix E. Seepage rates for this section are quite high, and as noted on infrared aerial photos and the mapped wetlands (Figure 2-6c), there are areas of abundant vegetation, predominantly Salt Cedar downslope from this reach, especially the area between Siphons 21 and 23. Thus, the seepage per mile of canal length from Unit C is higher than Units A or B. The total seepage rate was estimated to be 11,410 af/yr based on 2,289 acres of induced wetland vegetation, which is 1,559 af/yr per mile of canal length. These rates represent only the canal water that discharges in the Salt Creek and Oasis Spring areas, and specifically does not include the artesian discharge of regional groundwater (Table 5-1).

Unit D is located between Siphon 23 and the point 2,500 feet below Siphon 29. The canal-wetted perimeter for this section is composed of sand and gravelly sand. Between Siphons 23 and 24, a large alluvial fan in the north Salt Creek area is shown on the geologic map and on the aerial photo (Figure 2-6c). The alluvial sediments along Unit D are present at both the ground surface and at depths up to 100 feet. Unlike Unit C, there are no lake sediments at depth below the canal as depicted in the cross-section in Appendix E. Seepage rates for this section are quite high, and as noted on infrared aerial photos and the mapped wetlands (Figure 2-6c), there are areas of abundant vegetation, predominantly Salt Cedar downslope from this reach, especially the area between Siphons 23 and 27. Thus, the seepage per mile of canal length from Unit D is high. Seepage rate estimates for Unit D are further complicated by the presence of pre-canal artesian springs, which supported wetlands in the Dos Palmas and Andreas spring areas depicted an the 1949 aerial photo (Figure 5-4). Thus, the total seepage rate was estimated to be 16,500 af/yr, based on 2,773 acres of induced wetland vegetation, which is 2,040 af/yr per mile of canal length. These rates represent only the canal water that discharges in the Dos Palmas and Andreas Spring areas, and specifically does not include the artesian discharge of regional groundwater (see Table 5-1).

Unit E is located between the point 2,500 feet below Siphon 29 and the end of the unlined canal at Siphon 32 (Figure 5-2). The canal-wetted perimeter for this section is composed of sandstone and claystone. Seepage rates for this section are low. Infrared aerial photos and the mapped wetlands (Figure 2-6c) show almost no areas of vegetation below this reach, which is attributed to very little canal seepage through the sandstone and claystone that begin 2,500 feet below Siphon 29 (Figure 5-3b). Total seepage rates were estimated to be 320 af/yr based on 65 acres of induced wetland vegetation, which at 72 af/yr per mile of canal length is the lowest rate per mile of all five units.

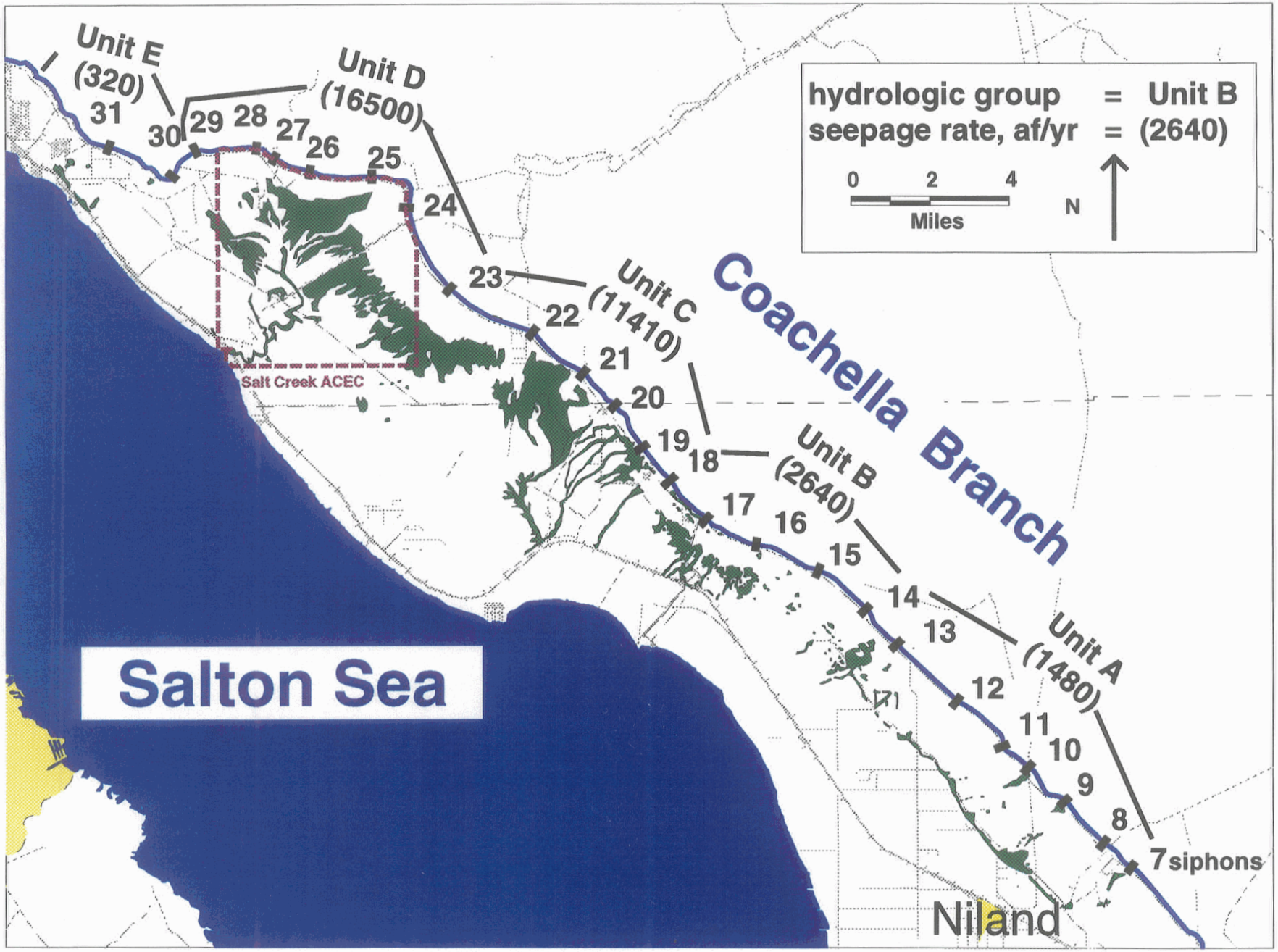

Figure 5-2. Seepage Rates Along Hydrologically-Defined Reaches of the CB

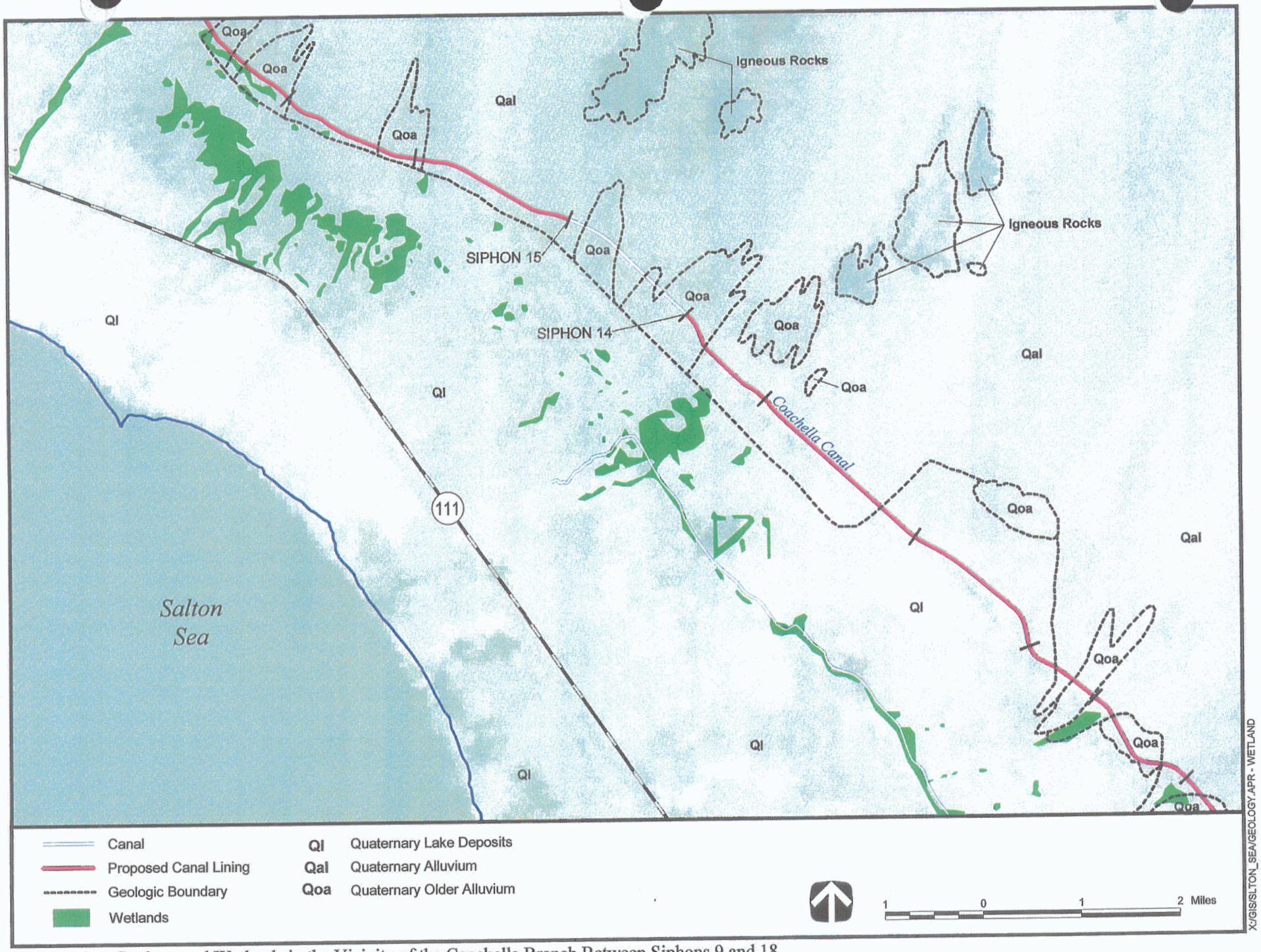

Figure 5-3a Geology and Wetlands in the Vicinity of the Coachella Branch Between Siphons 9 and 18