1986

MAPPING METHODS AND VEGETATION CHANGES ALONG THE LOWER COLORADO RIVER BETWEEN DAVIS DAM AND THE BORDER WITH MEXICO

For:

USDI Bureau of Reclamation

Lower Colorado Region

In fulfillment of

Contract No. 6-CS-30-03800

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MAPPING METHODS AND VEGETATION CHANGES ALONG THE LOWER COLORADO RIVER BETWEEN DAVIS DAM AND THE BORDER WITH MEXICO

I. INTRODUCTION

AAA Engineering and Drafting, Inc. (AAA) completed the 1986 Riparian Vegetation Type Mapping and Study of the Lower Colorado River for the Bureau of Reclamation's Yuma, Arizona Project Office from February 25 to September 24, 1986. The purpose of this project has been to update twenty-one (21) riparian vegetation type maps and report on the vegetation changes since 1981 for 275 miles of the Colorado River Flood Plain from Davis Dam to the Mexico boundary.

All work has been completed under the direction of professional foresters and biologists experienced in vegetation cover type mapping. Mr. Jim Rorabaugh as the Contracting Officer's Technical Representative has worked closely with AAA and Bureau personnel to moniter and improve the products produced under the contract. The work was accomplished in Yuma, Arizona, along the lower Colorado River, and at AAA's office facility in Salt Lake City, Utah.

The following report includes a brief summary of the previous studies, describes the methods used to complete the mapping effort, discusses the accuracy of the vegetation type maps, and presents a brief assessment of the vegetational changes since 1981. A copy of the Bureau of Reclamation contract specification work statement and modification number one are included as the appendix.

AAA Engineering and Drafting, Inc. is grateful to have been selected by the Bureau of Reclamation to complete this project. Through the employment of professional mapping procedures and close coordination with Bureau of Reclamation biologists a high quality and accurate product has been achieved.

II. PREVIOUS STUDIES

In 1973 Dr. Bertin W. Anderson and Dr. Robert D. Ohmart, of Arizona State University Center for Environmental Studies began studying the riparian vegetation of the lower Colorado River extending from Davis Dam at the California-Nevada-Arizona boundary to the Mexico border.

The major objectives of the previous studies were to 1) divide the riparian vegetation into broad categories or types characterized according to general floristic and physiognomic characteristics, 2) determine the densities and diversities of wildlife associated with each vegetation type or habitat, and 3) develop a classification system that could easily be used in the field by engineers, hydrologists, biologists, and other persons responsible for resource management. The classification system developed and the related wildlife associations have since been used by Bureau of Reclamation, U.S. Fish and Wildlife Service and state game and fish agencies in the management of vegetation and wildlife along the lower Colorado River.

To stratify the riparian vegetation into types large enough to manage, the Anderson/Ohmart classification system emphasized the similarities rather than the differences between the vegetation communities. This enabled the delineation and classification of intermeshed stands of vegetation from twenty-five to hundreds of acres which are large enough in area so that wildlife can be accurately quantified at all seasons. Aerial reconnaissance of the riparian vegetation verified that the stratification of large areas followed natural stand boundaries. The previous reports completed by Anderson and Ohmart discuss in detail the methods used to quantify the differences and similarities for the stratified vegetation stands and wildlife-vegetation relationships.

Through ground reconnaissance Anderson and Ohmart concluded that riparian vegetation stands differed from each other primarily in dominant vegetation and vertical configuration. The resulting classification system recognized 8 dominant riparian vegetation community types (see Table 1) and 6 structural vegetation types (see Figure 1) yielding a total of 27 community and structural types out of a possible 48. Mistletoe (Phoradendron californicum) was also quantified since its berries and foliage represent an important food and nesting resource for some vertebrates. In addition, 7 marsh vegetation types were identified.

To test the classification system community types (based on dominant plant species) and structural types (based on vertical configuration of the vegetation) measurements were taken every 500 feet along more than 100 one half (1/2) and one (1) mile long transects located in all major riparian plant communities from Davis Dam south to the Mexico boundary. The total length of all transects was approximately 75 miles.

Ultimately these plant community and structural types were delineated from aerial photographs and then ground-truthed to provide vegetation type maps for the entire study area. These maps provide an inventory of the vegetation resource which in concert with wildlife use and density data, also provides a map of wildlife habitat quality along the lower Colorado River. The previous vegetation type maps and reports are contained in the following two publications.

ANDERSON, B.W. AND R.D OHMART. 1976. Vegetation Type Maps of the Lower Colorado River from Davis Dam to the International Boundary. USDI, Bureau of Reclamation, Boulder City, Neveda. 4pp and maps.

ANDERSON, B.W., AND R.D. OHMART. 1984. Lower Colorado River Riparian Methods of Quantifying Vegetation Communities To Prepare Type Maps. USDI Bureau of Reclamation, Boulder City, Nevada. 59 pp and maps.

Both publications are available from the Bureau of Reclamation. In these publications, numerous other related literature has been cited.

To complete the 1986 study, AAA used the classification system developed and tested during these previous studies. Since there are relationships between some community types and specific structure types, AAA first considered using the classification key (Table 9) from the 1984 report. Since table 9 did not include all the community/structure type combinations possible the Bureau biologists encouraged AAA to design a classification key that would be complete. AAA found that the complexity of such a key only increased the difficulty of using the simple criteria on which the key would be based.

The following tables 1 and 2 and figures 1 and 2 present and illustrate the basic criteria needed to classify the riparian vegetation found along the lower Colorado River. Table 1, "Vegetation Communities and Criteria Used in Classification" was adapted by AAA from Table 2 in the 1983 Wellton-Mohawk Irrigation District report by, Jackson and Anderson.

AAA found it was more practical to classify the community types and structure types independently using the following tables and figures. By presenting the already developed classification system in the most basic and concise format it was easier to understand and use in the field and for aerial photo interpretation.

Presented hereafter are the mapping methods used by AAA to update the 1981 riparian vegetation type maps completed by Anderson and Ohmart and included in the 1984 report.

Table 1

VEGETATIVE COMMUNITIES AND CRITERIA
USED IN CLASSIFICATION
Lower Colorado River, 1986

COMMUNITY	CRITERIA
Cottonwood-Willow (CW)	*Salix gooddingii* and *Populus fremontii* (the latter in extremely low densities) constituting at least 10% of total trees.
Salt cedar (SC)	*Tamarix chinensis* constituting 80-100% of total trees.
Salt cedar-Honey mesquite (SH)	*Prosopis glandulosa* constituting at least 10% of total trees; rarely found to constitute greater than 40% of total trees.
Salt cedar-Screwbean mesquite (SM)	*Prosopis pubescens* constituting at least 20% of the total trees.
Honey mesquite (HM)	*Prosopis glandulosa* constituting 90-100% of total trees.
Arrowweed (AW)	*Tessaria sericea* constituting 90-100% of total vegetation in area.
Atriplex (ATX)	*Atriplex lentiformis*, *A. canescens* and/or *A. polycarpa* constituting 90-100% of total vegetation in area.
Marsh (MA)	Predominately cattail/bulrush (*Typha*/*Scirpus*) and carrizo (*Phragmites*).
Creosote (CR)	*Larrea divaricata* constituting 90-100% of total vegetation in area.

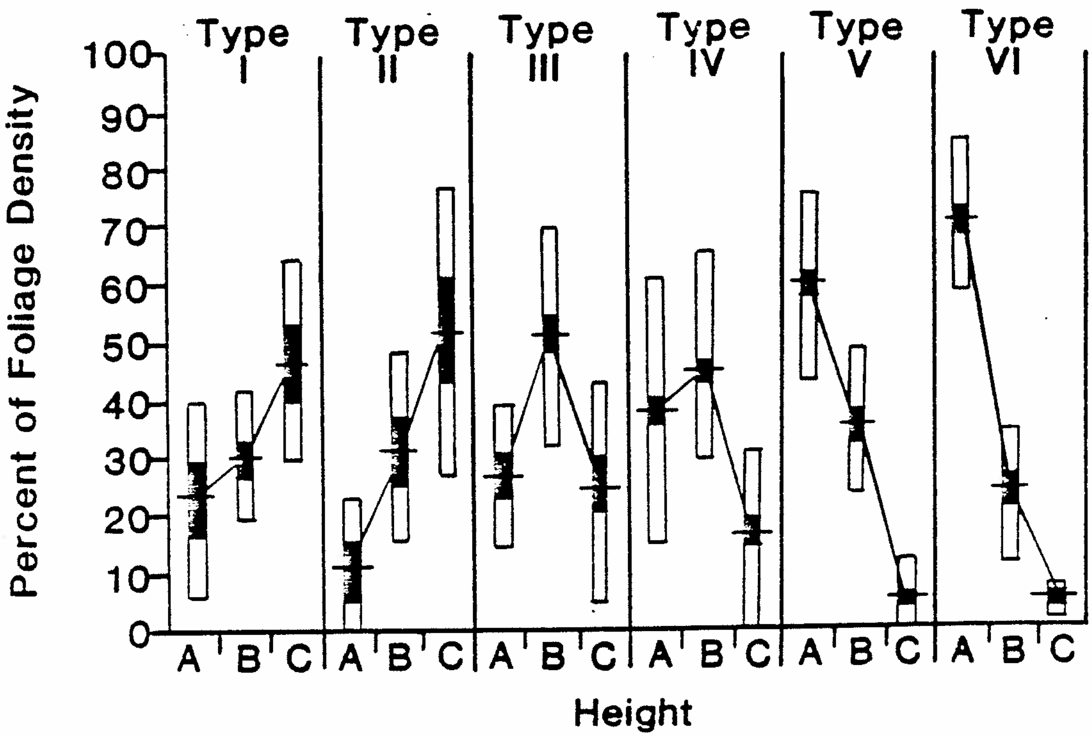
TABLE 2

MARSH TYPES AND CRITERIA USED IN CLASSIFICATION
Lower Colorado River, 1986

Type	Criteria
1	Nearly 100 percent cattail/bulrush, small amounts of phragmites and open water.
2	Nearly 75 percent cattail/bulrush, many trees and grasses interspersed.
3	About 25 to 50 percent cattail/ bulrush, some phragmites, open water. some trees and grass.
4	About 35 to 50 percent cattail/ bulbrush, many trees and grasses interspersed.
5	About 50 to 75 percent cattail/ bulbrush, few trees and grasses interspersed.
6	Nearly 100 percent phragmites, little open water.
7	Open marsh (75 percent water), adjacent to sparse marsh vegetation; includes sandbars and mudflats when Colorado River is low.

FIGURE 1

PROPORTIONAL DISTRIBUTION OF VERTICAL LAYERS OF VEGETATION BY STRUCTURE TYPE



From the 1984 Anderson/Ohmart report (Figure 11-A) depicting the proportional distribution of the vegetation in 3 vertical layers. Data was taken only from subplots within various stands of vegetation which overall were classified as belonging to 1 vertical structural type (I-VI). Horizontal lines represent mean values; large rectangles represent ±1 standard deviation; small rectangles represent ±2 standard errors. A = 0.0-0.6 m (0-2 ft); B = 0.6-4.5 m (2-15 ft); C = >4.5 m (>15 ft).

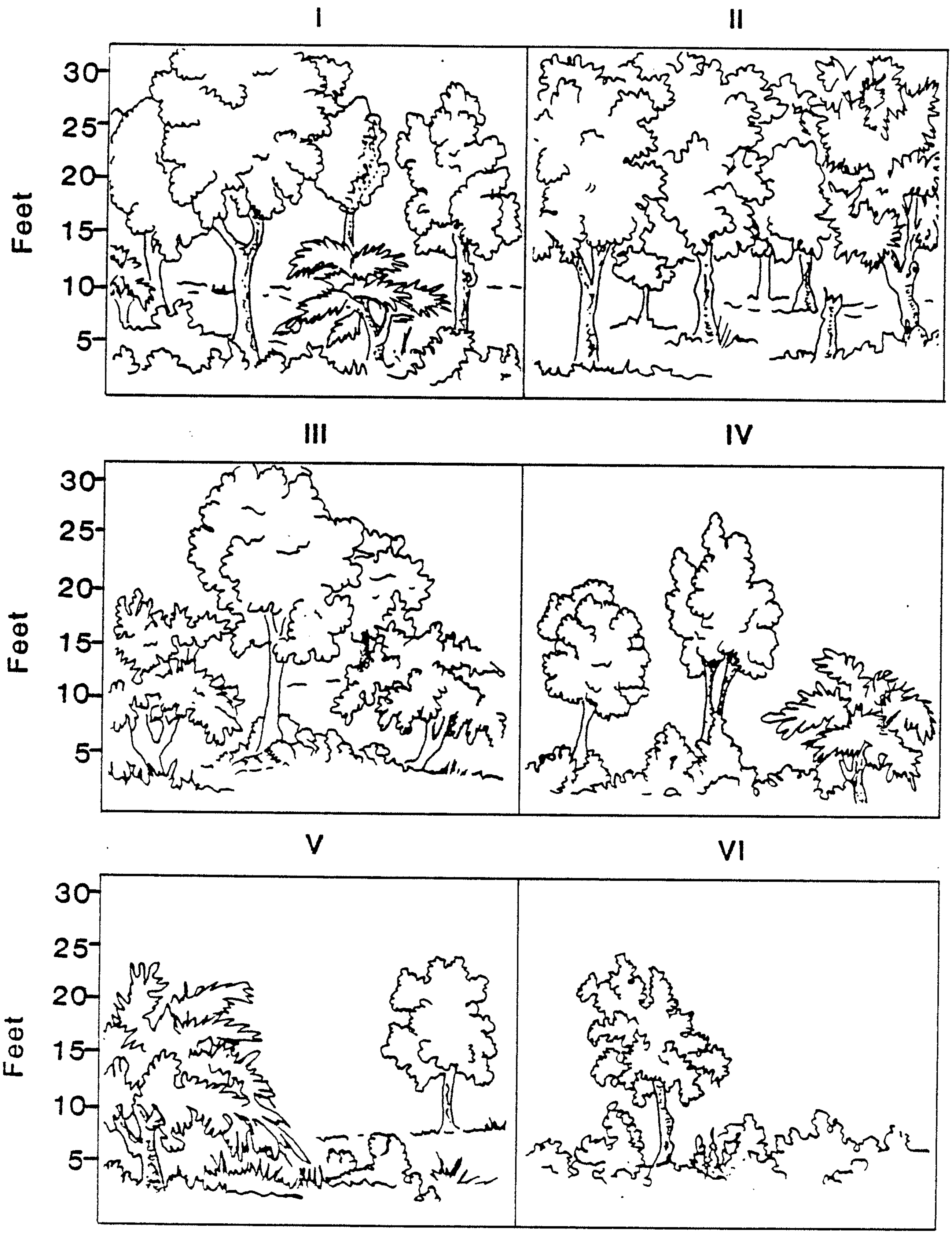


FIGURE 2. *Examples of vertical configurations for the vegetation structural types defined in Figure 1. From the 1984 Anderson/Ohmart report.*

III. MAPPING METHODS

A. CONSULTATION WITH BUREAU BIOLOGISTS

Prior to beginning the field reconnaissance and photo interpretation phases of the contract, AAA reviewed all contract requirements with Bureau of Reclamation biologists in a two-day prework conference and field orientation at Yuma, Arizona.

Riparian vegetation cover types occurring along the Colorado River were viewed and classified in the field using the 1984 Anderson/Ohmart report. The specific criteria needed to identify the vegetation types on the aerial photographs and in the field were agreed on with the Bureau biologists in the field.

B. FIELD RECONNAISSANCE

The November and December 1985 1:6,000 scale color aerial photography provided by the Bureau of Reclamation was of high quality and provided the best view of the riparian vegetation being mapped. Stereoscopic viewing of the aerial photographs enabled the recognition of much of the detail for both community types and structure types needed to delineate and classify the riparian vegetation.

The aerial photographs were viewed and typed in the field in order to determine the specific relationships between photo signatures or detail and ground truth. Special emphasis was placed on identifying photo signatures that could be verified on the ground. This familiarization became the basis for the interpretation of aerial photographs in areas not visited.

While in the field, AAA's photo interpreter visited enough of the area to view and locate all major changes in types and ground conditions. Major species and structure changes were noted on the aerial photographs to supplement the specific relationships that had been established.

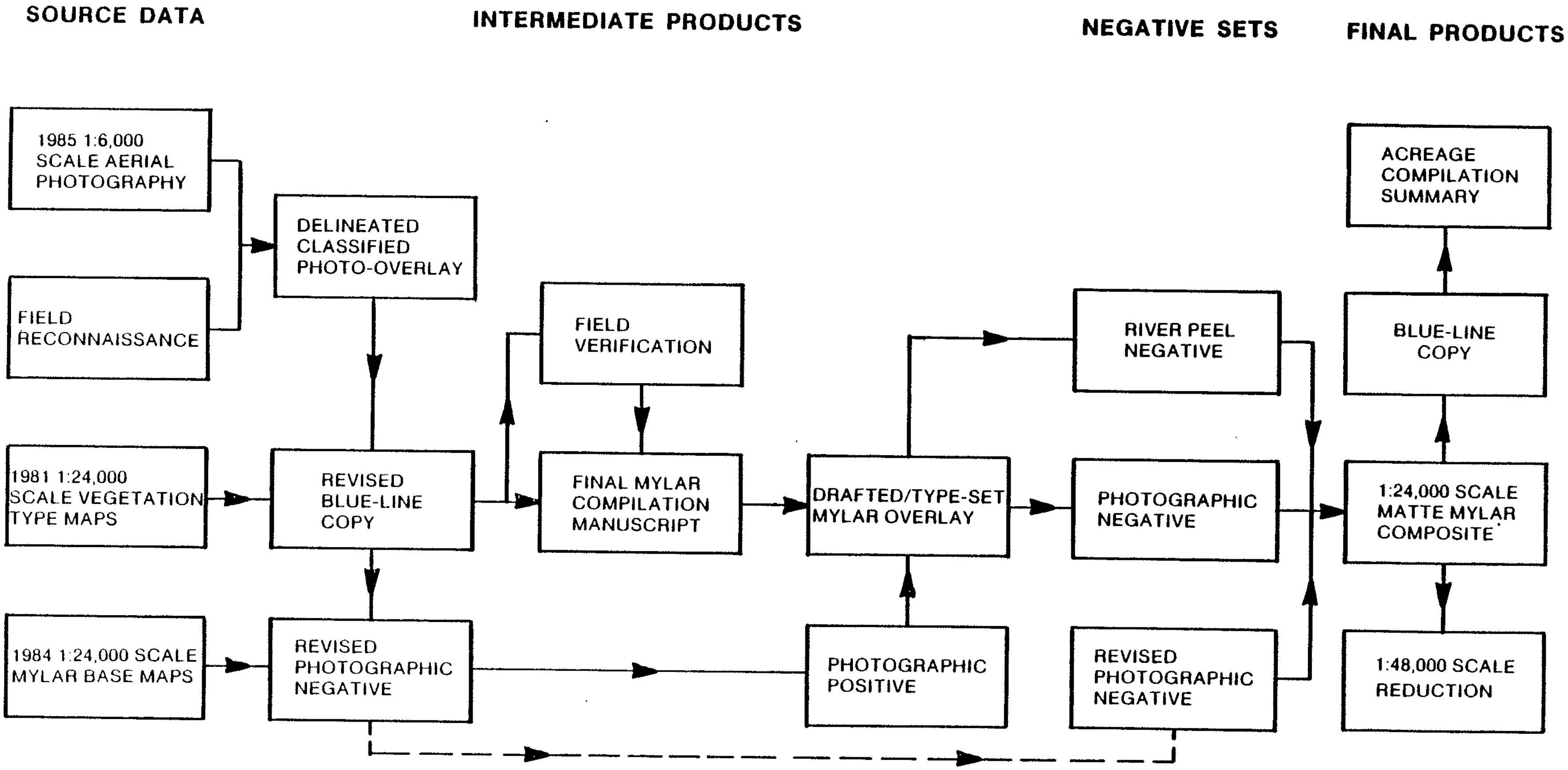
C. AERIAL PHOTO INTERPRETATION

Professional photo interpretation techniques were used to produce a high quality delineation and classification product on the aerial photographs. Legible lines and labels were achieved by drafting on 7 mil clear acetate photo overlays with a Pilot SC-UF black permanent marker. The acetate overlays were registered to every other photograph and showed an effective area boundary, river and water boundaries, riparian vegetation cover type boundaries, and riparian vegetation type codes. The fudicial marks and photo numbers were also marked on each overlay.

AAA completed this phase of the project without referring to the 1981 vegetation type maps. This enabled AAA's photo interpreter to act independently in all cover type delineations and classifications. The completed photo overlay provided documentation to the Bureau of Reclamation of AAA's independent workmanship for all 275 miles of the River. By stereoscopic study of the aerial photographs AAA's photo interpreter was able to identify the majority of tree and shrub species and structure types found along the lower Colorado River. The vegetation community types were recognized by the unique photo signatures visible for the different species present. Color and growth form were the primary signatures used to interpret these types. The structure types were recognized by the height of the vegetation visible stereoscopically.

FIGURE 3

PRODUCTION PLAN FLOW CHART
Updating the Colorado River Riparian
Vegetation Type Maps
Bureau of Reclamation



Stands consisting of 90 percent arrowweed, 80 percent salt cedar or honey mesquite were the least difficult to identify. Mixed community types of saltcedar-screwbean mesquite and salt cedar-honey mesquite were the most difficult to separate from each other. The ground verification of these types showed that in most cases the community type classification remained the same as shown on the 1981 maps. The majority of the revisions on the 1986 maps for these types have been in the extent of the polygon boundaries and the structure type classification. Stands of honey mesquite have showed little change since the 1981 mapping effort. The changes in most cases were not enough to change the classification of these stands.

Following are conditions that were commonly encountered. Certain conditions or community types usually placed a stand of vegetation into one or more specific structure types.

1. Salt cedar was present in the majority of riparian stands along the lower Colorado River.

2. Stands of arrowweed, quail bush or inkweed were always structure VI.

3. Salt cedar or honey mesquite stands with large patches of arrowweed and/or quail bush were always structure types V or VI.

4. Regenerating stands and recent burns were always structure type VI.

5. Honey mesquite and salt cedar stands lacking large patches of shrubs, arrowweed and trees ≤ 5 feet in height were always structure types I, II, III, or IV.

6. Structure type III honey mesquite - salt cedar had the largest proportion of vegetation between 5-15 feet in height with only small amounts of vegetation in the 0.5-5 feet and/or above 15 feet height layers.

7. Structure type I salt cedar consisted only of athel tamarisk and had vegetation in each of the three layers with the largest proportion of vegetation above 15 feet in height.

8. Structure types for mixed community types IV, V, and VI were easily definable depending on the amount of shrubs or trees ≤ 5 feet in height.

9. In cottonwood/willow-salt cedar stands structure types I and II differ from type III by the amount of cottonwoods versus willows. Mature cottonwoods grow taller and broader than willows and thus make up the larger canopy component found in types I and II. Type II lacks a willow midstory but may have a partially developed understory of salt cedar, mesquite, or shrubs. Type I had a well-developed canopy of cottonwoods, a midstory of willow, salt cedar and/or mesquite, and an understory of annuals, shrubs, and grasses. Cottonwood/willow-salt cedar stands structure types III, IV, V, and VI have a decreasing cottonwood component due to increasing decadence in the stand.

In the Limitrophe, Yuma and Parker Divisions some cottonwood willow-salt cedar stands are young, not decadent stands, and often have proportionally the same or more cottonwoods and willows as other structure types. In the Limitrophe Division many previous marsh types are now young cottonwood and willow stands with few other species present.

There were no cottonwood/willow structure type I stands classified during the 1981 or the 1986 study.

AAA's photo interpreter was able to make accurate and consistent decisions based upon previous experience and a keen understanding of the minute detail that was recognized on the photos stereoscopically. Though some detail was not available due to limitations in resolution, amazing detail was visible on the 1:6,000 scale photographs. Maximum photographic detail cannot be recognized monoscopically or by persons not trained in the use of stereoscopic equipment. Mr. Chris Andersen performed the photo interpretation and field verification for all 21 riparian vegetation type maps. The use of one professional photointerpreter has enabled AAA to maintain the quality and consistency of interpretation that would not have been possible if more than one individual had been assigned to perform these tasks.

AAA's photo interpreter delineated and classified many patches of vegetation smaller than 25 acres. Anderson and Ohmart in the 1984 report concluded that wildlife predictions are not reliable in small stands. The 1981 and 1986 vegetation type maps show vegetation stands smaller than 25 acres where 1) small isolated patches of vegetation are present and 2) a pure vegetation type could be delineated and classified within a larger mixed stand. By delineating these small patches of vegetation the majority of the riparian vegetation along the river has been mapped and the designated vegetation types are dependable.

The Abrams 2x4 Model CB-1 Stereoscope and Topcon Mirror Model 3 Stereoscope with a scanning-stage and 3X binoculars were used by AAA's photo interpreter. Photo interpretation was completed in conjunction with the field reconnaissance, at Yuma, Arizona and at AAA's Salt Lake City office.

D. FIELD VERIFICATION CHECKS

After completion of the field reconnaissance and photo interpretation AAA conducted field verification checks to assess the accuracy of the completed delineation and classification. The field verification involved a visual on site evaluation of the vegetation, but included no vegetation measurements. Special attention was given to species composition and structure types that were the most difficult to recognize on the photographs. This inspection was conducted using the prepared photo overlays and revised blue-line copies of the 1981 vegetation type maps. Selected locations on each of the 21 maps were visited in the field. 732 of the total 1,537 delineated polygons were field verified. This equals a field check of approximately 50 percent of the riparian vegetation mapped.

The polygons checked were noted on the blue-line copies showing any changes in lines and/or classification. To conduct a quantitative analysis of the accuracy of the initial field reconnaissance and photo interpretation effort AAA's notes documented all the changes that were made. Changes were made in a different colored marker and the following code system was used to document the field work completed by both AAA and Bureau of Reclamation biologists.

CODE	CODE DESCRIPTION
F	Field Reconnaissance
V	Field Verification Checks
B	Bureau Verification Checks

From these notations AAA was able to determine the number of polygons visited in the field, the number of changes made, and measure the percent accuracy for the initial field reconnaissance and photo interpretation effort. The results are summarized for each of the ten management divisions and the entire project in Table 3. Of the 732 polygons verified in the field 86 polygons or 12 percent of the polygons verified were not classified correctly. The classification errors were grouped as follows:

NUMBER OF ERRORS	DESCRIPTION	PERCENT OF TOTAL ERRORS
40	Salt Cedar, Salt Cedar-Screwbean Mesquite, Salt Cedar-Honey Mesquite, and Honey Mesquite Vegetation Community Types.	47%
26	General Riparian and Marsh Vegetation Community Types.	30%
17	± 1 Structure Type	20%
3	± 2 Structure Types	3%
86	TOTAL	100%

The errors were either in the classification of the vegetation community type or the classification of the structure type and did not occur in a combination for any one polygon checked. Structure type errors were only detected in Salt Cedar, Salt Cedar-Screwbean Mesquite and Cottonwood-Willow vegetation community types. 14 of the 20 structure type errors were in the Cottonwood-Willow vegetation community types.

All errors detected during the field verification checks were corrected on the final maps. The above summary of errors in combination with the percent error documented in table 3 indicates the degree of classification error to be expected in polygons not field verified.

TABLE 3

ACCURACY OF MAPS
Lower Colorado River, 1986

QUANTITATIVE FACTOR	DIVISION										TOTAL
	MOHAVE	TOPOCK GORGE	HAVASU	PARKER	PALO VERDE	CIBOLA	IMPERIAL	LAGUNA	YUMA	LIMITROPHE	
Total Polygons Delineated	318	74	69	269	163	154	243	102	93	52	1,537
Total Polygons Field Verified	151	4	43	162	86	78	37	56	77	38	732
Percent Field Verified	47	5	62	60	53	51	15	55	83	73	48 %
Total Classification Errors	21	0	4	14	19	10	0	4	2	12	86
Percent Error	14	0	9	9	22	13	0	7	3	32	12 %
Percent Accuracy*	86	100	91	91	78	87	100	93	97	68	88 %

* The percent accuracy is based on the initial field reconassiance and photo interpretation effort. The polygon classification errors detected through the field verification checks have been changed to the correct classifications on the final maps. This has increased the accuracy of the final maps over the percent accuracy shown above. Since approximately 50 percent of the total polygons have been field verified the average percent accuracy for the corrected maps is approximately 94 percent.

E. FINAL MAPPING

All mapping was performed by experienced cartographers and photo lab technicians. The mapping step required the following procedures and processes:

1. Revision updating of the 1:24,000 scale Bureau of Reclamation base maps.
2. Transfer of delineations and classifications from 1:6,000 scale aerial photographs to the 1:24,000 scale base maps.
3. Design
4. Drafting, type stick-up
5. Preparation of negative sets and final matte composites

1. Revision Updating of the 1:24,000 Scale Bureau of Reclamation Base Maps.

The River course had changed on 16 of the 21 base maps since the last revision in 1984. The entire River course had changed for map number 1 and also major changes occured for map numbers 2, 3, 4, and 7. The new course of the River was plotted from the 1985 aerial photographs and all changes were made on the respective negative separates.

2. Transfer of Delineations and Classifications from 1:6,000 Scale Aerial Photographs to the 1:24,000 Scale Base Maps.

Since the 1981 type mapping effort changes had occurred in the vegetation community types and the structure types on all 21 maps with substantial change in the Limitrophe, Parker, Havasu, and Mohave Divisions. Using the delineated and classified 1:6,000 scale 1985 aerial photography all lines and symbols were transferred to blue-line copies of the previous vegetation type map and shown in red pencil. This preliminary map was used to check the accuracy of the work in the field and was submitted to the Bureau of Reclamation biologists for review prior to proceeding with the final mapping.

On approval of the Bureau of Reclamation this preliminary map was used as the base for completing a new compilation manuscript. All type lines and codes were transferred to a clean sheet of mylar registered as an overlay to the preliminary map. The aerial photo interpretation, transfer, and compilation manuscript were completed by the same person to insure consistency, accuracy, and to avoid any loss of detail. As the transfer of each map was completed, it was coordinated with the surrounding maps to assure edge to edge matching of lines and types.

These compilation manuscripts were used by the drafters to complete the final maps. They also provide detailed documentation of the field verification and accuracy of the maps.

3. Design

Map design included the selection of type and lineweights for all symbology and the arrangement of the legend and margin information. The interior and margin type were arranged and set on AAA's Comp/Edit 5310 AM Varityper type-setter. Specific type styles and point sizes were selected to present the final map information in a professional cartographic manner. The lineweights selected for the vegetation type and river boundaries highlight these features from the Bureau of Reclamation base map detail. Map polygons representing areas clear of vegetation are not labled with symbology.

4. Drafting and Type Stick-up

The mylar compilation manuscript containing the transferred vegetative boundaries was registered beneath a clean mylar map sheet and the polygon lines were drafted in ink. All lines were inked down the center of the transferred image. Each vegetation overlay was completed in registration or reference to a positive of the Bureau 1:24,000 scale updated base maps showing roads, tracks, land grid and other related features to insure that there is no unnecessary overlap of line work that would result in the loss of any one feature in the final composite map.

Lithographic type was used to depict the classification symbols and margin information by using a sticky-back clear film material that adhered directly to the drafted mylar overlay.

5. Preparation of Negative Sets and Final Matte Composites

21 sets of the following 1:24,000 scale photographic and hand cut negatives were prepared for use in completing the final map composites.

a. Bureau of Reclamation revised base map
b. Vegetation type and margin information overlay
c. River peel

To highlight the extent of the river, the river peel negative was hand cut along the exterior boundary of the river to create an open window negative.

The three separate negatives for each map were then photographically combined onto one matte mylar. During the photographic process the Bureau of Reclamation Revised Base Map Negative was screened at 54% black and the River Peel was screened at 31% black. This helped to highlight both the vegetation type and margin information overlay and the river course. All plates were registered with a three (3) hole punch to assure exact alignment of map detail. From the matte mylar composite, quality cepia and blue-line paper copies can be produced. Also the matte mylar composites are able to be used as planning and field maps since they can be drawn on and then used to run blue-line copies for distribution.

From the 1:24,000 scale matte mylar composites photographically reduced 1:48,000 scale negatives were produced. The high quality 21 maps following in this report were produced from these negatives on an off-set press.

Also many other advantages may result from the use of the negative source positives and the negatives used to create the final map composites. The following are examples of what can be accomplished through the use of these negative sets.

1. Four color maps could be printed since each negative could be produced as a separate color.

2. In the composite process different screens can be used to photographically create different shades of gray for each separate negative.

3. Additional negatives can be added to the negative set to add features and/or colors not presently on the final map composite.

4. Future changes can easily be revised on the negative source positives affected and new negatives and composites produced to update the map to reflect current conditions. This may include changes or additions to vegetation types, boundaries, roads, etc.

Either by addition or revision many changes can be made at a fraction of what the cost would be if the entire mapping process was to be repeated.

F. ACREAGE COMPILATION

Acres for each vegetation cover type polygon were computed to the nearest acre and recorded on blue-line copies of the final maps. An electronic digital planimeter was used to measure and check the acres of each type. Acreage for the entire project was then compiled and summarized by vegetation type and river division.

The exact surveyed acres by vegetation stand may vary. The map photo interpretation and map construction techniques previously described are generally accepted as accurate for vegetation mapping. Higher order methods of mapping are available that would enable AAA to specify the percent accuracy of the acreage compilation compared to a ground survey. Though, higher order methods are more expensive and normally are not justified since vegetation boundaries are often subjective on the ground and photography. The skill and the judgement of the photo intrepreter and map compiler are the critical factors on which the accuracy of the acreage compilation is dependent. AAA believes the vegetation maps produced and the resulting vegetation acreage are highly accurate for the order of mapping required.

G. PRODUCT REVIEW

Quality control was continuous through each step of producing the vegetation type maps. The quality control was performed by the project manager and the person responsible at each step. Periodic checks have been made to assure accuracy, quality, and consistency at all levels of production. A good example of the value of these reviews has been the addition of 1) photo centers and numbers for use in locating the respective aerial photography used 2) the inclusion of an F in the classification symbol to denote that designated polygons have been field checked and 3) the photo analysis of Cottonwood-willow types to estimate the percent vegetation cover of Cottonwood-willow and the other major vegetation species present.

In addition to in-house review, AAA presented the aerial photo interpretation, revised blue-line maps, acreage compilation, final maps and report to the Bureau of Reclamation for review and comment through out the duration of the contract.

Through the employment of professional photo interpretation and mapping procedures and product review, a high quality and accurate 21 sheet Riparian Vegetation Type Map of the Lower Colorado River has been achieved. It will become a valuable tool for present and future management of the River vegetation and wildlife resources.

IV. VEGETATION CHANGES SINCE 1981

Tables 4, 5, and 6 present the total vegetation in acres by community type and division respectively for 1986, 1981, and the changes since 1981. The total acres of vegetation between Davis Dam and the Mexico boundary have increased only slightly. Considerable change has occured in more than one-half of the vegetation community types mapped. The amount and the location of these changes along the River are documented on the tables that follow.

Not all of the differences between the 1981 and 1986 acreages are a result of actual on-the-ground change. The greater amount of on-the-ground change occured in the Limitrophe, Parker, Havasu, and Mohave Divisions on map numbers 1, 12, 17, and 19. AAA's initial plan was to show on-the-ground change and then check the classification of the remaining vegetation stands as delineated on the 1981 maps. After reviewing the 1981 maps in comparison to the aerial photography it was apparent that the accuracy of all 21 maps would be increased by re-mapping all 275 miles of the river.

AAA independently interpreted the stand boundaries and classifications steroscopically on the 1:6,000 scale aerial photography. The aerial photography provided the best view of the stand boundaries. AAA's photo interpreter in the field checked the aerial photo interpreted delineations and classifications with what could be seen on the ground. The results of this verification showed that the aerial photography was the most dependable source for the extent of stand boundaries. Though vegetation stands are able to be classified on the ground it is often difficult to see the continous line of separation between stands. The result of the photo interpretation approach to mapping the riparian types enabled AAA's photo interpreter to delineate the extent of stand boundaries in greater detail and identify some pure stands of vegetation not previously mapped.

Except for the changes outlined above, AAA found only minor changes in the classification of community and structure types since 1981. AAA's field verification the majority of the time confirmed the 1981 classification of community and structure types. AAA used the 1981 delineations and classifications in the areas not covered by 1985 photography. The errors discovered in the 1981 maps were in areas where the vegetation could not be adequately viewed from the ground.

The use of different methods and/or different photo interpreters will result in different maps. Classification of riparian habitat is subjective making it difficult to come up with a product every one will agree with in every situation possible. AAA's methods emphasized photo interpretation techniques. At the 1:6,000 scale a tremendous amount of detail was visible. AAA is confident that photo interpretation is the soundest approach for mapping riparian habitat at this scale for the detail required.

Table 4

1986 ACREAGES BY COMMUNITY AND DIVISION
Lower Colorado River

COMMUNITY TYPE	MOHAVE	TOPOCK GORGE	HAVASU	PARKER	PALO VERDE	CIBOLA	IMPERIAL	LAGUNA	YUMA	LIMITROPHE	TOTAL
SC I	173	0	0	0	0	0	0	17	38	82	310
SC II	0	0	0	9	0	0	0	0	0	0	9
SC III	0	0	4	0	0	0	0	7	0	0	11
SC IV	7,744	137	498	2,644	698	6,992	1,854	416	314	1,084	22,381
SC V	5,189	135	153	3,240	1,465	2,686	1,193	1,764	1,381	354	17,560
SC VI	1,349	0	16	1,669	58	288	0	892	420	74	4,766
CW II	6	0	141	0	48	30	0	0	0	0	225
CW III	70	0	181	81	161	0	0	9	0	0	502
CW IV	734	0	262	164	273	142	73	85	0	0	1,733
CW V	280	10	97	731	322	13	167	113	229	905	2,867
CW VI	0	0	0	27	0	0	0	0	31	369	427
HM III	186	0	0	0	903	0	0	0	0	0	1,089
HM IV	3,417	0	147	242	4,541	393	143	6	0	0	8,889
HM V	964	0	0	311	0	365	23	20	0	0	1,583
HM VI	0	0	0	20	0	0	0	0	0	0	20
SM II	0	0	0	0	0	0	0	0	0	0	0
SM III	127	0	0	233	0	0	0	0	0	0	360
SM IV	3,339	0	9	2,968	1,152	273	84	0	0	0	7,825
SM V	2,540	0	11	2,036	1,259	1,063	0	78	80	0	7,067
SM VI	240	0	0	0	0	0	0	0	0	0	240
SH III	28	0	0	0	0	0	0	0	0	0	28
SH IV	1,687	45	14	26	1,324	2,315	460	95	0	0	5,966
SH V	1,087	0	38	172	269	239	74	0	0	0	1,879
SH VI	0	0	0	7	0	0	0	0	0	0	7
AW VI	2,389	0	77	3,194	424	91	57	1,062	117	67	7,478
ATX VI	623	0	16	320	11	7	0	0	254	0	1,231
IW VI	221	0	0	0	0	0	0	0	0	0	221
MA 1	1,211	511	537	93	75	60	2,302	799	69	0	5,657
MA 2	677	0	0	19	0	0	33	0	0	0	729
MA 3	226	162	0	92	72	48	1,168	23	66	0	1,857
MA 4	0	0	0	369	0	0	0	0	0	0	369
MA 5	24	340	0	63	6	0	10	0	0	0	443
MA 6	0	0	0	23	0	0	1,143	30	561	0	1,757
MA 7	0	0	0	0	0	0	267	13	226	1,231	1,737
CR V	0	0	0	0	0	0	0	0	426	0	425
TOTAL	34,531	1,340	2,201	18,753	13,061	15,005	9,051	5,429	4,212	4,166	107,749

Table 5

1981 ACREAGES BY COMMUNITY AND DIVISION
Lower Colorado River

COMMUNITY TYPE	MOHAVE	TOPOCK GORGE	HAVASU	PARKER	PALO VERDE	CIBOLA	IMPERIAL	LAGUNA	YUMA	LIMITROPHE	TOTAL
SC I	131	0	0	0	0	0	0	0	199	0	330
SC II	0	0	0	0	101	0	0	0	0	0	101
SC III	338	62	8	0	0	17	0	0	0	0	425
SC IV	7,855	211	383	1,764	502	5,914	3,008	961	595	1,317	22,510
SC V	2,944	6	127	2,180	427	1,735	629	1,335	616	439	10,438
SC VI	932	0	31	930	982	520	4	603	896	159	5,057
CW II	0	0	114	26	8	15	0	0	0	0	163
CW III	27	0	47	0	142	132	110	18	116	0	592
CW IV	1,328	5	388	1,019	373	186	793	261	38	136	4,581
CW V	0	0	399	632	66	40	22	214	288	39	1,700
CW VI	500	0	0	0	75	63	0	0	234	67	939
HM III	315	0	0	0	913	0	0	0	0	0	1,228
HM IV	3,569	0	144	786	4,150	377	25	0	0	0	9,051
HM V	832	0	0	648	311	365	0	0	0	0	2,156
HM VI	16	0	0	0	19	0	0	0	0	0	35
SM II	0	0	0	99	0	0	0	0	0	0	99
SM III	252	0	0	357	0	0	0	122	37	0	768
SM IV	3,416	10	12	5,281	1,218	328	743	41	93	927	12,067
SM V	2,009	0	0	1,141	860	484	0	332	170	242	5,238
SM VI	1,344	0	0	1,019	220	483	0	0	142	0	3,208
SH III	0	0	0	0	0	138	66	0	0	0	204
SH IV	2,420	54	89	223	1,654	2,023	686	0	0	0	7,149
SH V	1,180	0	0	127	251	1,050	127	0	0	0	2,735
SH VI	0	0	0	0	0	130	0	0	0	0	130
AW VI	1,580	73	65	1,173	506	20	87	595	154	0	4,253
ATX VI	597	0	0	0	0	0	0	0	0	0	597
IW VI	223	0	0	0	0	0	0	0	0	0	223
MA 1	635	0	59	8	0	48	2,646	579	0	0	3,975
MA 2	495	401	29	80	3	10	157	207	0	0	1,382
MA 3	574	18	0	28	35	222	151	149	64	0	1,241
MA 4	41	0	4	268	45	0	122	93	0	0	573
MA 5	544	215	0	69	0	9	178	78	0	0	1,093
MA 6	0	0	0	0	0	0	122	0	514	0	636
MA 7	499	0	0	192	116	220	228	0	0	0	1,255
TOTAL	34,650	1,055	1,399	18,050	12,975	14,529	9,904	5,588	4,156	3,326	106,132

Table 6

ACREAGE CHANGES SINCE 1981 BY COMMUNITY TYPE AND DIVISION
Lower Colorado River, 1986

COMMUNITY TYPE	MOHAVE	TOPOCK GORGE	HAVASU	PARKER	PALO VERDE	CIBOLA	IMPERIAL	LAGUNA	YUMA	LIMITROPHE	TOTAL	PERCENT ±
SC I	+ 42	0	0	0	0	0	0	+ 17	-161	+ 82	- 20	- 6.1
SC II	0	0	0	+ 9	- 101	0	0	0	0	0	- 92	- 91.1
SC III	- 338	- 62	- 4	0	0	- 17	0	+ 7	0	0	- 414	- 97.4
SC IV	- 111	- 74	+115	+ 880	+ 196	+1,078	-1,154	-545	-281	- 233	- 129	- 0.5
SC V	+2,245	+129	+ 26	+1,060	+1,038	+ 951	+ 564	+429	+765	- 85	+7,122	+ 68.2
SC VI	+ 417	0	- 15	+ 739	- 924	- 232	- 4	+289	-476	- 85	- 291	- 5.7
CW II	+ 6	0	+ 27	- 26	+ 40	+ 15	0	0	0	0	+ 62	+ 38.0
CW III	+ 43	0	+134	+ 81	+ 19	- 132	- 110	- 9	-116	0	- 90	- 15.2
CW IV	- 648	- 5	-126	- 855	- 100	- 44	- 720	-176	- 38	- 136	-2,848	- 62.1
CW V	+ 280	+ 10	-302	+ 99	+ 256	- 27	+ 145	-101	- 59	+ 866	+1,167	+ 68.6
CW VI	- 500	0	0	+ 27	- 75	- 63	0	0	-203	+ 302	- 512	- 54.5
HM III	- 129	0	0	0	- 10	0	0	0	0	0	- 139	- 11.3
HM IV	- 152	0	+ 3	- 544	+ 391	+ 16	+ 118	+ 6	0	0	- 162	- 1.8
HM V	+ 132	0	0	- 337	- 311	0	+ 23	+ 20	0	0	- 473	- 21.9
HM VI	- 16	0	0	+ 20	- 19	0	0	0	0	0	- 15	- 42.9
SM II	0	0	0	- 99	0	0	0	0	0	0	- 99	-100.0
SM III	- 125	0	0	- 124	0	0	0	-122	- 37	0	- 408	- 53.1
SM IV	- 77	- 10	- 3	-2,313	- 64	- 55	- 659	- 41	- 93	- 927	-4,242	- 35.2
SM V	+ 531	0	+ 11	+ 895	+ 399	+ 579	0	-254	- 90	- 242	+1,829	+ 34.8
SM VI	-1,104	0	0	-1,019	- 220	- 483	0	0	-142	0	-2,968	- 92.5
SH III	+ 28	0	0	0	0	- 138	- 66	0	0	0	- 176	- 86.3
SH IV	- 733	- 9	- 75	- 197	- 330	+ 292	- 226	+ 95	0	0	-1,183	- 16.5
SH V	- 93	0	+ 38	+ 45	+ 18	- 811	- 53	0	0	0	- 856	- 31.3
SH VI	0	0	0	+ 7	0	- 130	0	0	0	0	- 123	- 95.3
AW VI	+ 809	- 73	+ 12	+2,021	- 82	+ 71	- 30	+467	- 37	+ 67	+3,225	+ 75.8
ATX VI	+ 26	0	+ 16	+ 320	+ 11	+ 7	0	0	+254	0	+ 634	+106.2
IW VI	- 2	0	0	0	0	0	0	0	0	0	- 2	- 0.9
MA 1	+ 576	+511	+478	+ 85	+ 75	+ 12	- 344	+220	+ 69	0	+1,682	+ 42.3
MA 2	+ 182	-401	- 29	- 61	- 3	- 10	- 124	-207	0	0	- 653	- 47.2
MA 3	- 348	+144	0	+ 64	+ 37	- 174	+1,017	-126	+ 2	0	+ 616	+ 49.6
MA 4	- 41	0	- 4	+ 101	- 45	0	- 122	- 93)	0	0	- 204	- 35.6
MA 5	- 520	+125	0	- 6	+ 6	- 9	- 168	- 78	0	0	- 650	- 59.5
MA 6	0	0	0	+ 23	0	0	+1,021	+ 30	+ 47	0	1,121	+176.2
MA 7	- 499	0	0	- 192	- 116	- 220	+ 39	+ 13	+226	+1,231	+ 482	+ 38.4
CR V	0	0	0	0	0	0	0	0	+426	0	+ 426	--
TOTAL	- 119	+285	+302	+ 703	+ 36	+ 476	- 853	-159	+ 56	+ 840	+1,617	+ 1.5
PERCENT ±	-0.3	+27.0	+15.9	+3.8	+0.7	+3.2	-8.6	-2.8	+1.3	+25.3	+1.5	

V. COTTONWOOD-WILLOW VEGETATION TYPES

Cottonwood-willow vegetation community types total 5,754 acres or 5.3 percent of the total acres of vegetation communitites mapped between Davis Dam and the Mexico boundary. Although they are a relatively scarce type, Cottonwood-willow stands are of high value to wildlife. By definition, percentages of cottonwood and willow trees in these stands can vary from 10 to 100 percent. Because of the importance of this community type a detailed evaluation of individual stands was undertaken. Table 7 shows the vegetation composition by division for the 169 stands of Cottonwood-willow vegetation community types identified. Through steroescopic study of the aerial photography AAA's photo interpreter estimated the percent vegetation cover of the Cottonwood-willow and the other major vegetation species present. The photo-interpretation analysis for each stand has been documented on a set of 21 blue-line copies of the 1:24,000 scale vegetation type maps and provided to the Bureau of Reclamation.

TABLE 7

VEGETATION COMPOSITION OF COTTONWOOD-WILLOW COMMUNITY TYPES
Lower Colorado River, 1986

QUANTITATIVE FACTOR	PERCENT (%) COVER BY DIVISION										TOTAL
	MOHAVE	TOPOCK GORGE	HAVASU	PARKER	PALO VERDE	CIBOLA	IMPERIAL	LAGUNA	YUMA	LIMITROPHE	
Number of Polygons	24	1	18	26	35	11	15	9	11	19	169
Total Acres	1,090	10	681	1,003	804	185	240	207	260	1,274	5,754
% Cottonwood-Willow	22	25	57	23	19	23	27	18	19	27	27
Other Major Species											
% Salt Cedar	49	40	24	27	40	51	37	39	28	18	32
% Marsh	03	35	04	--	16	06	27	03	27	52	18
% Arrowweed	20	--	--	45	15	12	5	11	03	--	15
% Screwbean Mesquite	--	--	--	02	02	04	--	--	--	--	--
% Honey Mesquite	--	--	--	--	02	03	--	02	--	--	--
% Atriplex	--	--	--	--	--	--	--	--	03	--	--
% Other	06	0	15	03	06	01	04	27	02	03	08

A P P E N D I X

SECTION C
DESCRIPTION/WORK STATEMENT

STATEMENT OF WORK

UPDATING THE COLORADO RIVER RIPARIAN VEGETATION-TYPE MAPS

Maps showing the distribution of vegetation types in the lower Colorado River Valley were produced under contract in 1976 and revised in 1984 (Anderson and Ohmart, 1976, 1984). These maps and the acreages of vegetation derived from them are used to assess environmental impacts resulting from Bureau of Reclamation (Reclamation) projects. These maps have also been used by Reclamation hydrologists in water conservation and in water use studies and by biologists in numerous environmental studies and projects, both within and outside of Reclamation.

The 1984 maps, which are the most recent version, were produced from 1981 aerial photographs. With high water the last two years in the Colorado River, the riparian vegetation bordering the river has changed; in some areas, the change has been dramatic. Other factors such as fire and development have caused additional changes in the vegetation. Due to these changes, the existing vegetation-type maps are no longer accurate.

I. OBJECTIVES

The primary objectives of the mapping effort are:

A. To provide type maps of Colorado River riparian vegetation between Davis Dam and the border with Mexico.

B. To provide a written narrative including:

1. A detailed description of methods.

2. A description of changes occuring in the lower Colorado River.

3. A discussion of the accuracy of the maps.

II. SCOPE OF WORK

The Contractor shall provide:

A. Colorado River Vegetation-Type Maps: Colorado River Flood Plain from Davis Dam to the Southerly International Boundary.

A series of riparian vegetation-type maps will be developed which display the various community (species composition) and structure types as defined by Anderson and Ohmart (1984). The total area covered by the maps shall be the same as the 1984 maps, the scale shall be 1:24000, and the size of each delineated patch of vegetation shall be calculated. The resolution of the maps shall be 10 hectares (25 acres). Reclamation will supply 1985 color aerial photographs, 1984 vegetation-type maps, and 1:24000 base maps.

Mapping procedures will involve two steps:

1. Familiarization with the appearance and characteristics of the various community and structure types--on the ground, from the air, and on aerial photographs. The Contractor shall refer to Anderson and Ohmart (1984) for a detailed discussion of the characteristics of the vegetation types.

2. Field reconnaissance and aerial photograph interpretation to delineate structure and community types. Vegetation types shall be identified primarily by use of Table 9 and Figures 11A and 13 in Anderson and Ohmart (1984) and Appendix 1 of Jackson and Anderson (1983). Reclamation will supply the Contractor with definitions of marsh types.

3. The following guidelines will also be used to draw vegetation-type boundaries:

(a) Boundaries will be drawn to maximize the acreage of pure stands.

(b) In stands of mixed structure type, that structure type making up the greatest proportion of the area will be used to identify the stand.

(c) Where a choice must be made between maximizing acreage of pure structure types and maximizing acreage of pure community types, delineation of pure community types shall take precedence.

4. The final vegetation-type maps shall be produced by the Contractor. Vegetation-type boundaries will be drawn in ink on 1:24000 reproducible transparency base maps, to be supplied by Reclamation. Acreages of each delineated patch of vegetation will be drawn on paper copies made from the transparencies and supplied by Reclamation.

B. A report containing the following:

1. A description of methods with enough detail given so that the mapping effort could be repeated using this report.

2. A brief assessment of vegetational changes along the lower Colorado River, by division, since 1981.

3. A discussion of the accuracy of the maps, including a quantitative analysis.

III. REPORTS AND CORRESPONDENCE

The Contractor shall submit five double-spaced copies of a review draft of the final report. An unbound original and 35 copies of the final report shall be submitted within 30 days after receipt of Reclamation's comments to:

Bureau of Reclamation
Project Manager, Attention: YPO-150
Yuma Projects Office
P.O. Bin 12487
Yuma, Arizona 85365

IV. ORAL PRESENTATION

The Contractor shall make at least two oral presentations. The oral presentations will be held:

A. As soon as practicable after award; and

B. Upon completion of the field maps.

The oral presentations shall be made with sufficient written documentation, charts, sketches, drawings, etc., to allow Reclamation to make an adequate review of the study.

All presentations shall be held at Reclamation's Yuma Projects Office in Yuma, Arizona, unless it is determined by the Government that an alternate site would be beneficial to both the Contracting Officer and the Contractor.

V. REPORT REQUIREMENTS

A. Quarterly Reports

Quarterly progress reports shall be required 3 months and 6 months after the award of the contract. These reports shall be brief and in abstract form.

The quarterly reports shall include:

1. A description of overall progress including:

   a. Method of study.

   b. Summary of results.

   c. Any derived conclusions.

2. An indication of any current problems which may impede performance.

3. Proposed corrective action of problems identified.

4. A discussion of work to be performed during the next study period.

B. Final Report

Writing the Document

1. The Contractor shall submit a consolidated final report that complies with American National Standard Institute's "Guidelines for Format and Production of Scientific and Technical Reports" (ANSI Z39.18-1974), which documents and summarizes the in-depth results of the entire contract work.

2. All reports shall include original tables, graphs, diagrams, drawings, and/or photographs in sufficient number and detail to comprehensively explain the results achieved under the contract.

3. All reports shall be prepared in a manner suitable for reproduction by a photographic process.

C. Draft Report

The draft report shall be of the same format as the final, but will be double-spaced.

IV. REFERENCES CITED

Anderson, B. W., and R. D. Ohmart. 1976. Vegetation Type Maps of the Lower Colorado River from Davis Dam to the Southerly International Boundary. Bureau of Reclamation, Boulder City, Nevada. 4 pages and maps.

Anderson, B. W., and R. D. Ohmart. 1984. Vegetation Community Type Maps, Lower Colorado River. Bureau of Reclamation, Boulder City, Nevada. 59 pages and maps.

Jackson, J. M., and B. W. Anderson. 1983. Quantifying variables for classifying Desert Riparian Vegetation with Applications on the Lower Gila River. Wellton-Mohawk Irrigation District. 30 page.

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE

PAGE 1 OF PAGES 3

2. AMENDMENT/MODIFICATION NO. 01

3. EFFECTIVE DATE MAY 13 1986

4. REQUISITION/PURCHASE REQ. NO.

5. PROJECT NO. (If applicable) YPO-

6. ISSUED BY CODE LC-813

U.S. Department of the Interior
Bureau of Reclamation
P.O. Box 427
Boulder City, Nevada 89005

7. ADMINISTERED BY (If other than Item 6) CODE

Regional Division of Procurement and Contracts
Lower Colorado Region
Supply and Services Contracts Branch

8. NAME AND ADDRESS OF CONTRACTOR (No., street, county, State and ZIP Code)

AAA Engineering and Drafting, Inc.
P.O. Box 8171/Foothill Station
Salt Lake City, Utah 84108

CODE | FACILITY CODE

(✓) 9A. AMENDMENT OF SOLICITATION NO.

9B. DATED (SEE ITEM 11)

X 10A. MODIFICATION OF CONTRACT/ORDER NO. 6-CS-30-03800

10B. DATED (SEE ITEM 13) February 25, 1986

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☐ is not extended.

Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing Items 8 and 15, and returning ______ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA (If required)

230-0423-1051-001-93-0-0 $8300

13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS, IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

(✓) A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.

B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).

C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:

D. OTHER (Specify type of modification and authority)

X Scope of Work - Section C--II--Mutually agreed to by both parties

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 3 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.)

Contract entitled: Updating of the Lower Colorado River Riparian Vegetation-Type Maps between Davis Dam and the Border with Mexico.

The purpose of the following changes are to improve the quality and completeness of the twenty-one Riparian Vegetation Type Maps of the Colorado River.

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER (Type or print)

Gordon L. Younker
Chief Forester

16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)

15B. CONTRACTOR/OFFEROR

Gordon Younker

(Signature of person authorized to sign)

15C. DATE SIGNED 05/04/86

16B. UNITED STATES OF AMERICA

BY

(Signature of Contracting Officer)

16C. DATE SIGNED MAY 13 1986

NSN 7540-01-152-8070
PREVIOUS EDITION UNUSABLE

30-105

STANDARD FORM 30 (REV. 10-83)
Prescribed by GSA
FAR (48 CFR) 53.243

Modification No. 01 to Contract 6-CS-30-03800

The contract is modified as follows:

Section C--II "Scope of Work" add the following:

1. Update the River alignment and boundary to the November/December 1985 aerial photographs and depict the River in gray on the final maps. ($1,950)

This will be accomplished by 1) plotting all significant changes in the river course from the current aerial photographs, 2) opaquing the old river course from the existing negatives of the 1984 1:24,000 scale base maps, 3) hand cutting a peel negative of the river for all twenty-one maps and 4) photographically print the river in gray on the final maps. The length of the river is presently shorter than shown on the previous base map.

2. Change name placement where major conflicts exist with the present base map and the alignment of the River. Remove extraneous notes from base map. ($800)

This will be accomplished by opaquing the conflicting name off the base map negative and setting new type in negative form at the correct position on the base map. Type style and size will be matched as close as possible to the existing map lettering.

3. Screen the base map detail at 79 percent black on the final map composite. ($300)

This will help highlight the vegetation-type boundaries, symbols, legend and title block from the base map detail. Screening can be accomplished at various densities of black to create different shades of gray. At 75% black blue-line copies will also show all base map detail. Screening will also reduce the visibility of any poor (not opaque) line work on the original base maps.

This price includes the extra negative opaquing that will be necessary to maintain the quality of the base map negative. AAA photographically over-exposed the negatives of the original mylars provided by the Bureau to pick up some gray lines (not opaque) on the original.

4. Add photo centers and numbers to each map. ($1,750)

Contractor shall provide a delineated and classified photo overlay for each photograph used along the river. The photo centers will enable immediate reference to which photograph the map data was taken from. A map user will know which photographs to request for photographic coverage for any area of interest along the river.

This will be accomplished by plotting the photo centers to the compilation manuscript, type setting the photo numbers, and setting the photo center solid circle and number on the drafted mylar vegetation type overlay. The first, last, and every fifth photo in each flight line per map will be labeled with a photo number.

5. Draft an "F" as part of each type symbol ($250)

The "F" will designate that the vegetation community and structure type has been verified in the field. This designation will be used for all vegetation types checked by AAA during initial field work, field verification and by the Bureau during field checking. (AAA believes that since the amount of field checking is a significant part of the project that this will help document the amount of field work and increase the confidence of the map user in the map.)

6. Photo analysis of all Cottonwood-Willow types to estimate the percent vegetation cover of Cottonwood-Willow and other major vegetation species present. The resulting data would be presented in summary form and included as part of the final report. ($1,500)

7. Contractor shall revise the River's course on the original inked base maps to be provided by Reclamation. This shall include the redrafting of the River boundary within the levee system for the same changes shown on the revised vegetation type maps for the twenty-one maps. ($1,750)

The total increase for all work to be completed under this modification is $8,300.

Adjustment in the Contract Price: The contract total is increased from $38,000 by $8,300 to $46,000.

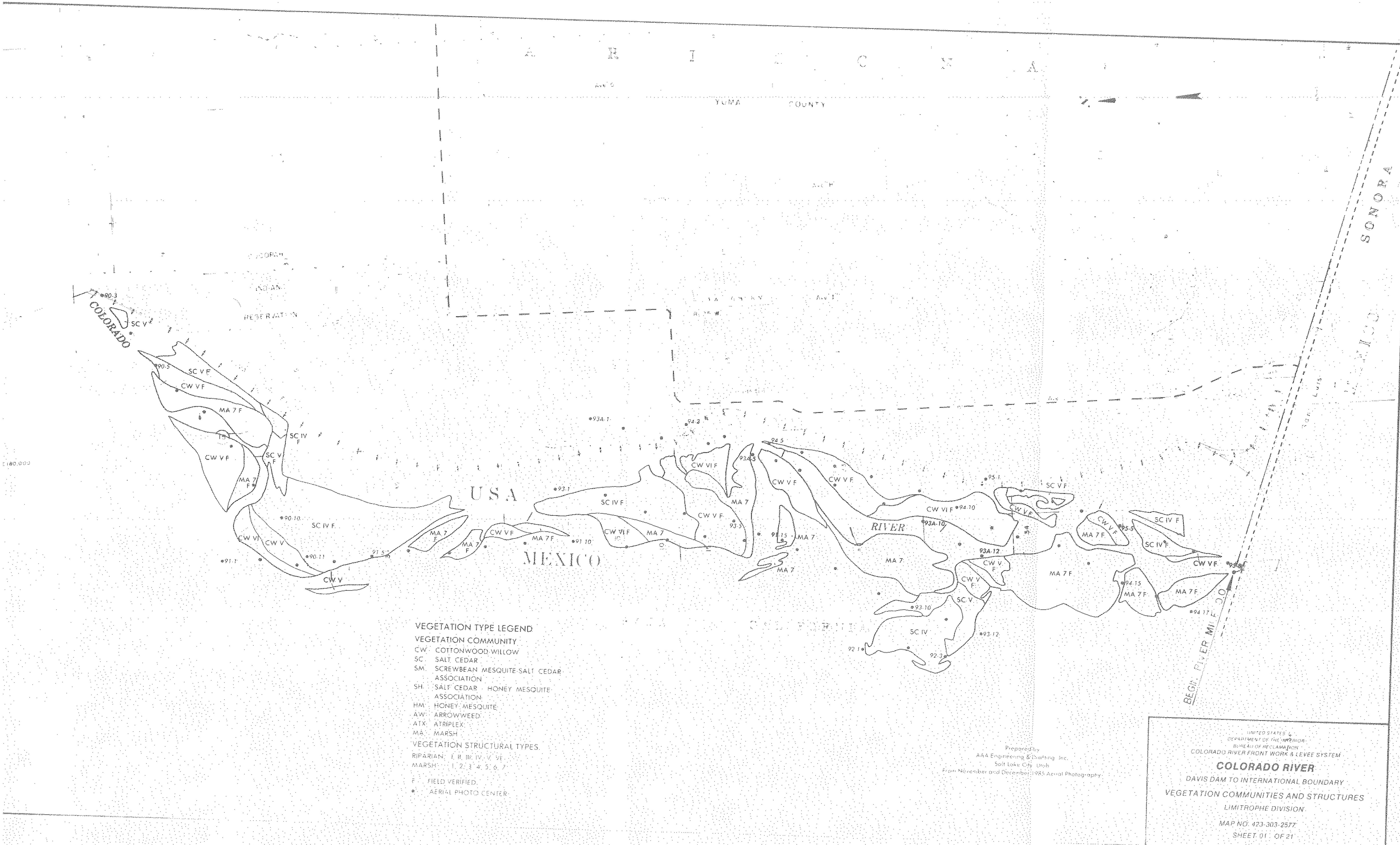
Adjustment in Contract Time: No additional time is required because of this modification.

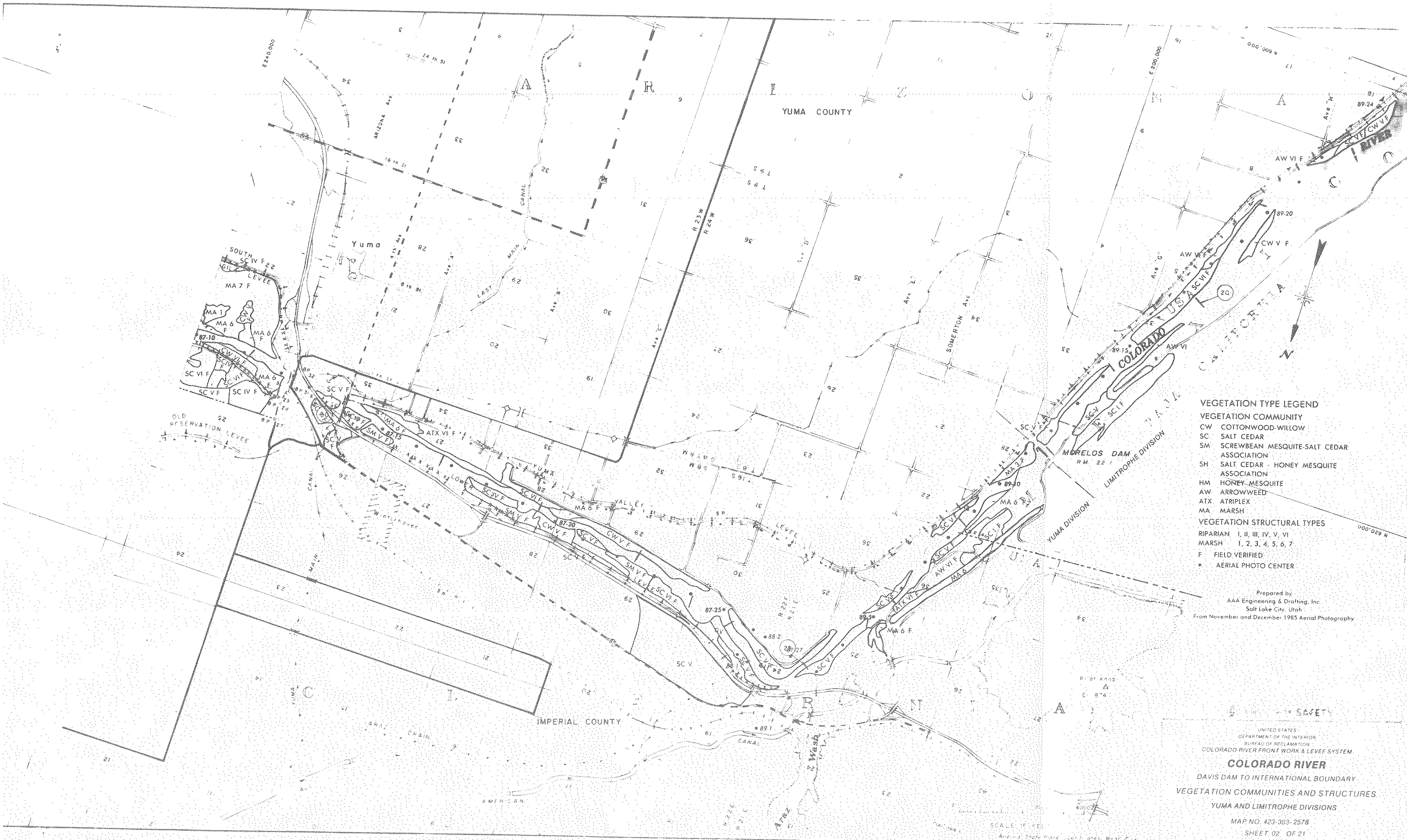
Release: The Contractor agrees that this supplemental agreement is a complete equitable adjustment for all Contractor claims whatsoever arising out of, resulting from, and directly related to the above occurrences, and this supplemental agreement hereby releases the Government from all liability under this contract for further equitable adjustments for said occurrences, revisions, and this supplemental agreement.

1986

VEGETATION COMMUNUNITY TYPE MAPS

LOWER COLORADO RIVER


ARIZONA
YUMA COUNTY
SONORA
COLORADO
USA
MEXICO
RIVER
BEGIN RIVER MILE 0.0
SC V
SC V F
CW V F
MA 7 F
SC IV F
CW VI F
CW V
MA 7
SC IV
SC V
MA 7 F
SC IV F
CW VI F
CW V F
VEGETATION TYPE LEGEND
VEGETATION COMMUNITY
CW COTTONWOOD WILLOW
SC SALT CEDAR
SM SCREWBEAN MESQUITE SALT CEDAR ASSOCIATION
SH SALT CEDAR - HONEY MESQUITE ASSOCIATION
HM HONEY MESQUITE
AW ARROWWEED
ATX ATRIPLEX
MA MARSH
VEGETATION STRUCTURAL TYPES
RIPARIAN I, II, III, IV, V, VI
MARSH 1, 2, 3, 4, 5, 6, 7
F FIELD VERIFIED
AERIAL PHOTO CENTER
Prepared by
AAA Engineering & Drafting, Inc.
Salt Lake City, Utah
From November and December 1985 Aerial Photography
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
COLORADO RIVER FRONT WORK & LEVEE SYSTEM
COLORADO RIVER
DAVIS DAM TO INTERNATIONAL BOUNDARY
VEGETATION COMMUNITIES AND STRUCTURES
LIMITROPHE DIVISION
MAP NO. 423-303-2577
SHEET 01 OF 21


ARIZONA
YUMA COUNTY
Yuma
CALIFORNIA
IMPERIAL COUNTY
BAJA CALIFORNIA
COLORADO RIVER
MORELOS DAM
YUMA DIVISION
LIMITROPHE DIVISION
OLD RESERVATION LEVEE
SOUTH GILA LEVEE
YUMA VALLEY LEVEE
Pilot Knob
VEGETATION TYPE LEGEND
VEGETATION COMMUNITY
CW COTTONWOOD-WILLOW
SC SALT CEDAR
SM SCREWBEAN MESQUITE-SALT CEDAR ASSOCIATION
SH SALT CEDAR - HONEY MESQUITE ASSOCIATION
HM HONEY MESQUITE
AW ARROWWEED
ATX ATRIPLEX
MA MARSH
VEGETATION STRUCTURAL TYPES
RIPARIAN I, II, III, IV, V, VI
MARSH 1, 2, 3, 4, 5, 6, 7
F FIELD VERIFIED
• AERIAL PHOTO CENTER
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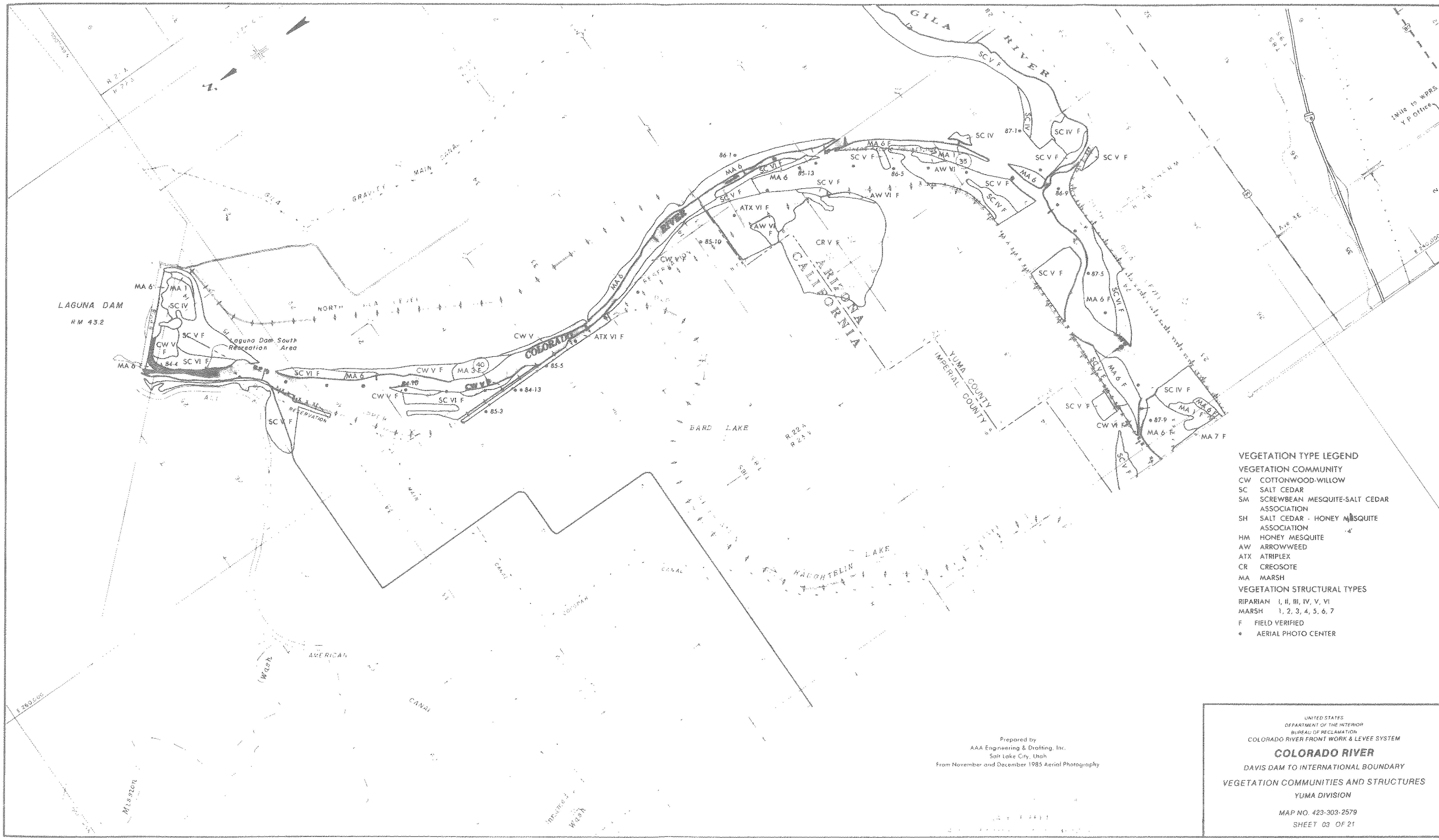
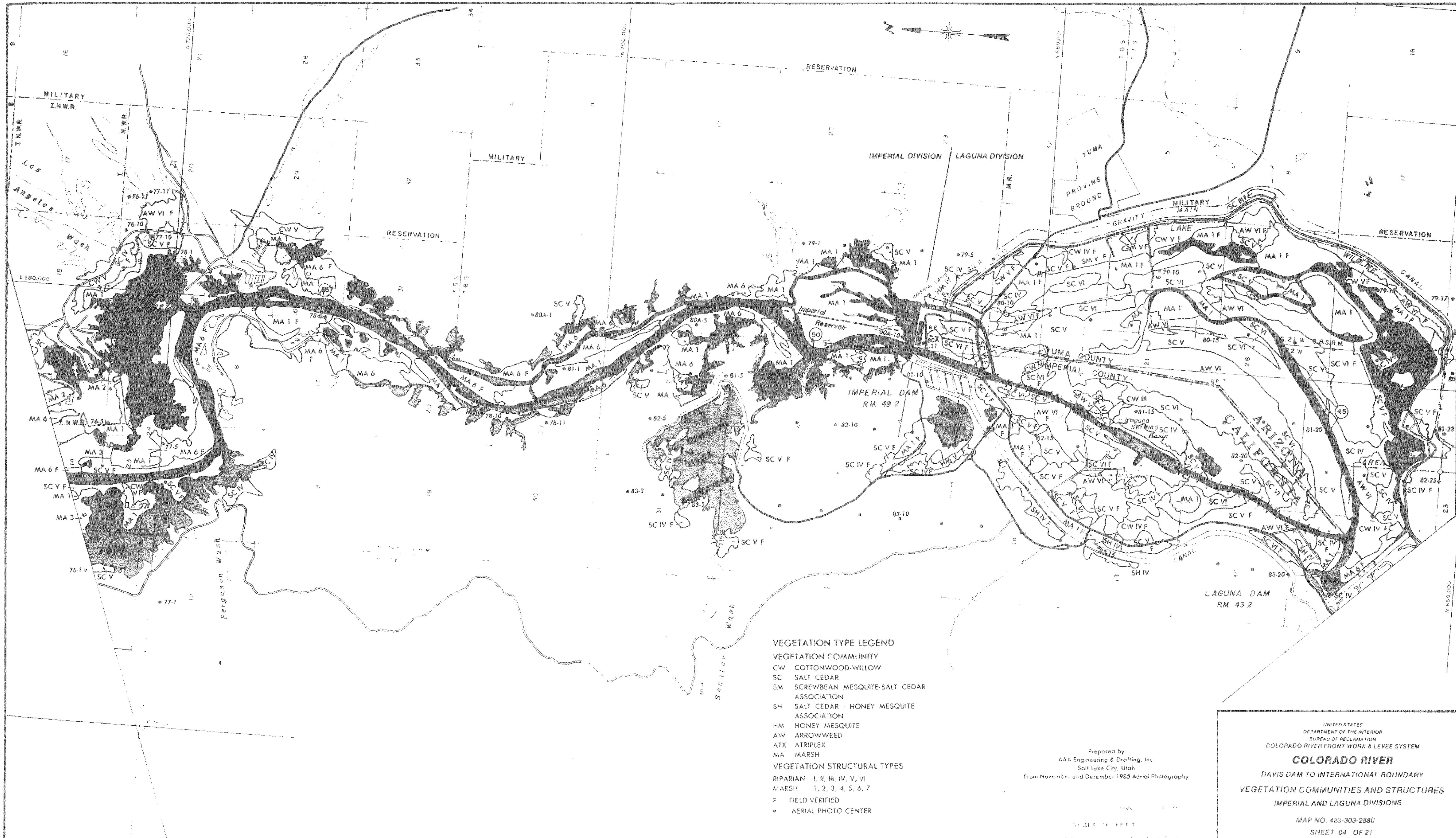
COLORADO RIVER
DAVIS DAM TO INTERNATIONAL BOUNDARY
VEGETATION COMMUNITIES AND STRUCTURES
YUMA AND LIMITROPHE DIVISIONS
MAP NO. 423-303-2578
SHEET 02 OF 21



YUMA DIVISION



IMPERIAL AND LAGUNA DIVISIONS


ARIZONA
LA PAZ COUNTY
YUMA COUNTY
IMPERIAL NATIONAL WILDLIFE REFUGE
MILITARY RESERVATION
COLORADO RIVER
ADOBE LAKE
TAYLOR LAKE
ISLAND LAKE
PICACHO STATE RECREATION AREA
VEGETATION TYPE LEGEND
VEGETATION COMMUNITY
CW COTTONWOOD-WILLOW
SC SALT CEDAR
SM SCREWBEAN MESQUITE-SALT CEDAR ASSOCIATION
SH SALT CEDAR - HONEY MESQUITE ASSOCIATION
HM HONEY MESQUITE
AW ARROWWEED
ATX ATRIPLEX
MA MARSH
VEGETATION STRUCTURAL TYPES
RIPARIAN I, II, III, IV, V, VI
MARSH 1, 2, 3, 4, 5, 6, 7
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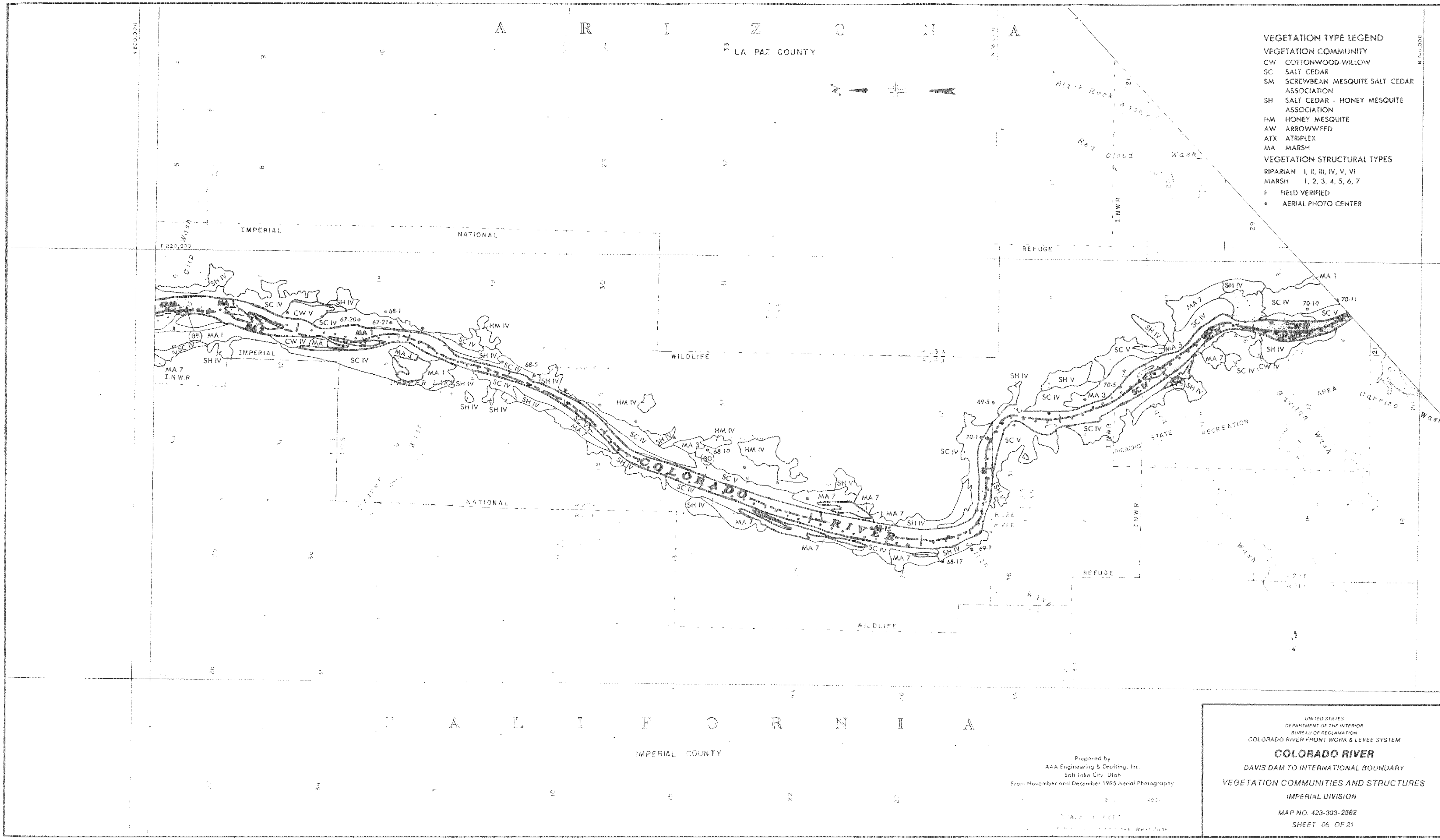
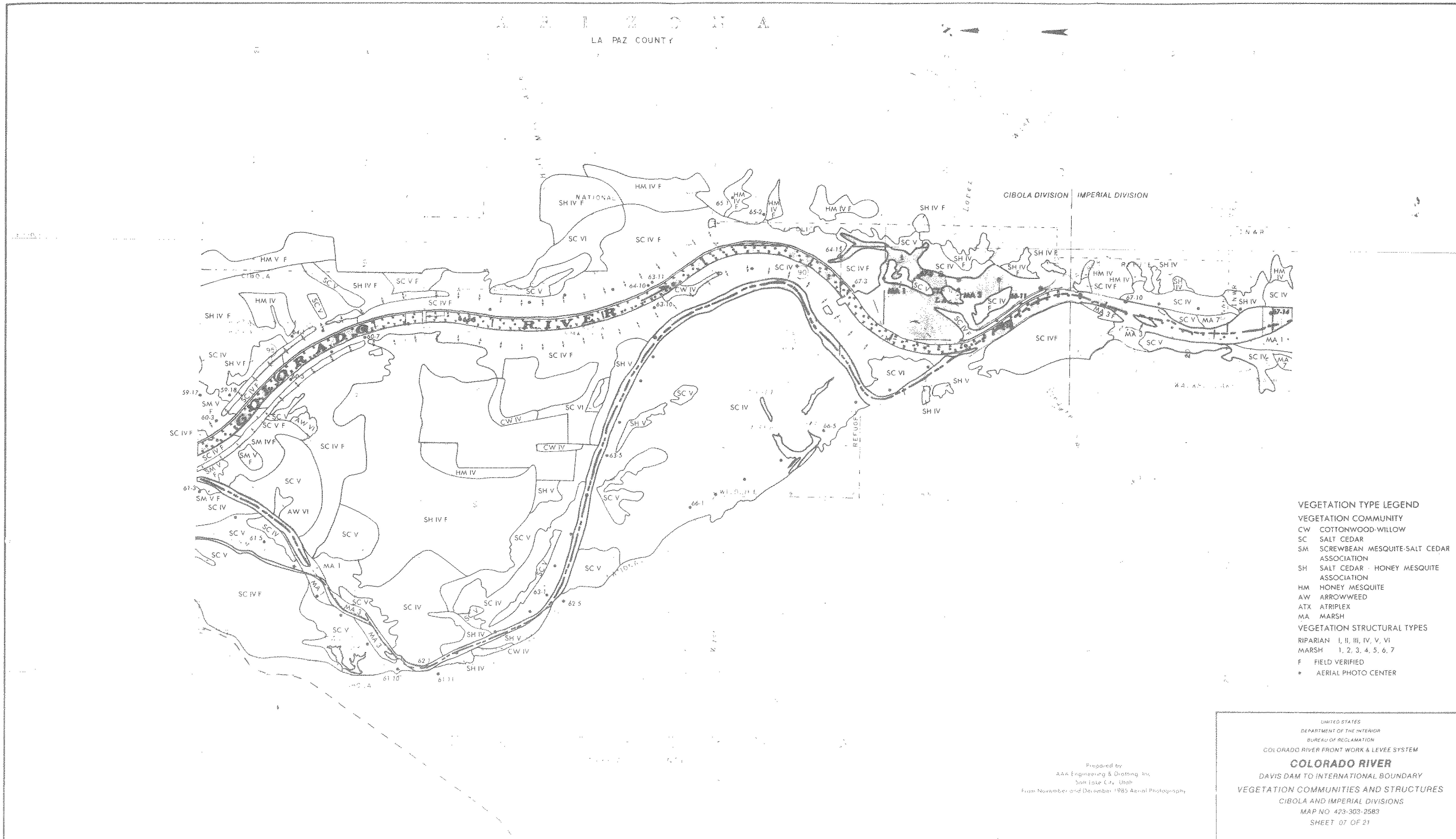
DAVIS DAM TO INTERNATIONAL BOUNDARY
VEGETATION COMMUNITIES AND STRUCTURES
IMPERIAL DIVISION
MAP NO 423-303 2581
SHEET 05 OF 21



IMPERIAL DIVISION



ARIZONA
LA PAZ COUNTY
COLORADO RIVER
CIBOLA DIVISION
IMPERIAL DIVISION
VEGETATION TYPE LEGEND
VEGETATION COMMUNITY
CW COTTONWOOD-WILLOW
SC SALT CEDAR
SM SCREWBEAN MESQUITE-SALT CEDAR ASSOCIATION
SH SALT CEDAR - HONEY MESQUITE ASSOCIATION
HM HONEY MESQUITE
AW ARROWWEED
ATX ATRIPLEX
MA MARSH
VEGETATION STRUCTURAL TYPES
RIPARIAN I, II, III, IV, V, VI
MARSH 1, 2, 3, 4, 5, 6, 7
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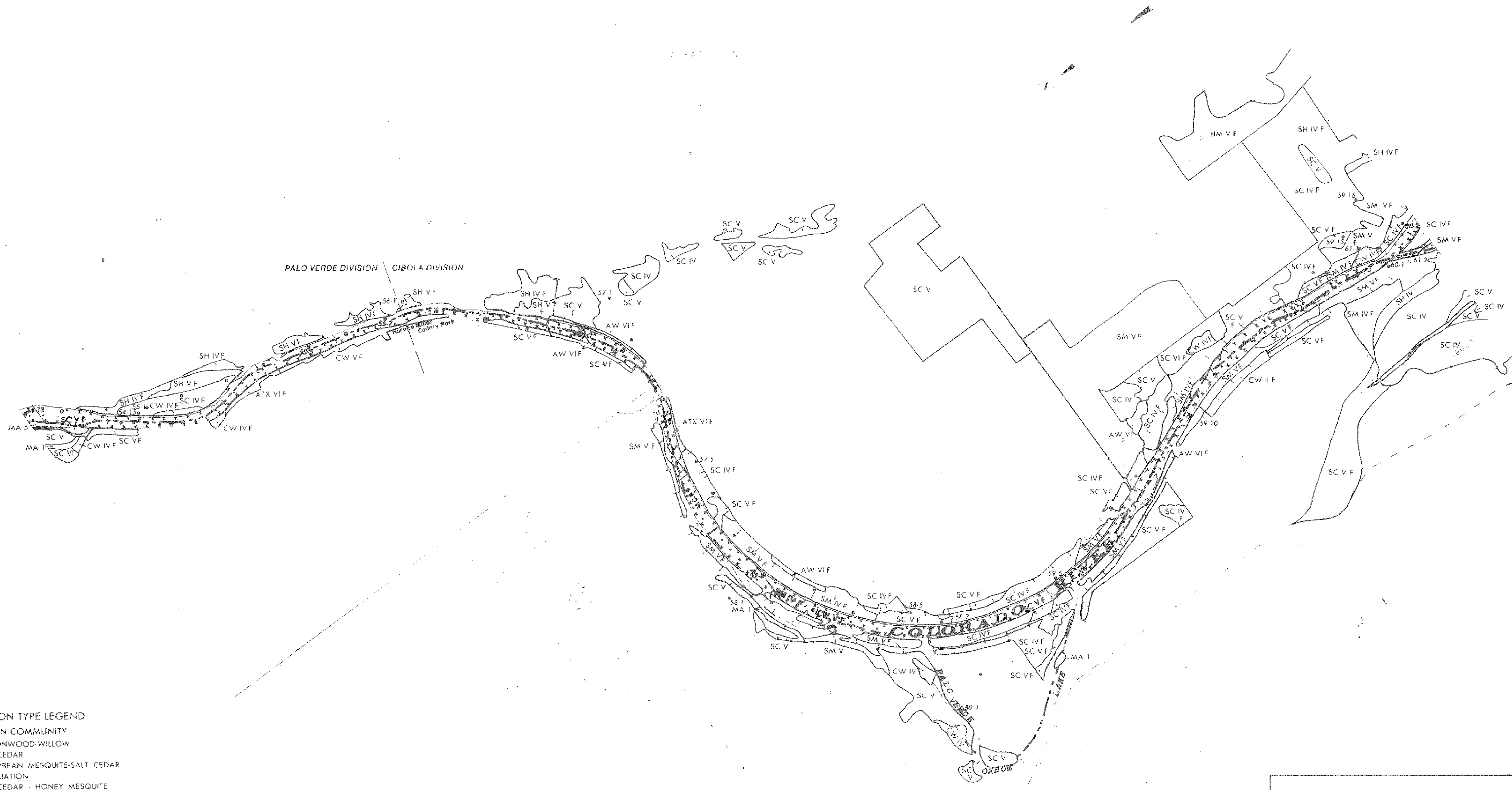
COLORADO RIVER
DAVIS DAM TO INTERNATIONAL BOUNDARY
VEGETATION COMMUNITIES AND STRUCTURES
CIBOLA AND IMPERIAL DIVISIONS
MAP NO. 423-303-2583
SHEET 07 OF 21



VEGETATION TYPE LEGEND

VEGETATION COMMUNITY

CW COTTONWOOD-WILLOW
SC SALT CEDAR
SM SCREWBEAN MESQUITE-SALT CEDAR ASSOCIATION
SH SALT CEDAR - HONEY MESQUITE ASSOCIATION
HM HONEY MESQUITE
AW ARROWWEED
ATX ATRIPLEX
MA MARSH

VEGETATION STRUCTURAL TYPES

RIPARIAN I, II, III, IV, V, VI
MARSH 1, 2, 3, 4, 5, 6, 7

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COLORADO RIVER

DAVIS DAM TO INTERNATIONAL BOUNDARY

VEGETATION COMMUNITIES AND STRUCTURES

PALO VERDE AND CIBOLA DIVISIONS

MAP NO. 423-303-2584

SHEET 08 OF 21

ARIZONA
LA PAZ COUNTY
COLORADO RIVER
VEGETATION TYPE LEGEND
VEGETATION COMMUNITY
CW COTTONWOOD-WILLOW
SC SALT CEDAR
SM SCREWBEAN MESQUITE-SALT CEDAR ASSOCIATION
SH SALT CEDAR - HONEY MESQUITE ASSOCIATION
HM HONEY MESQUITE
AW ARROWWEED
ATX ATRIPLEX
MA MARSH
VEGETATION STRUCTURAL TYPES
RIPARIAN I, II, III, IV, V, VI
MARSH 1, 2, 3, 4, 5, 6, 7
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COLORADO RIVER
DAVIS DAM TO INTERNATIONAL BOUNDARY
VEGETATION COMMUNITIES AND STRUCTURES
PALO VERDE DIVISION
MAP NO. 423-303-2585
SHEET 09 OF 21

VEGETATION TYPE LEGEND

VEGETATION COMMUNITY

CW COTTONWOOD-WILLOW
SC SALT CEDAR
SM SCREWBEAN MESQUITE-SALT CEDAR ASSOCIATION
SH SALT CEDAR - HONEY MESQUITE ASSOCIATION
HM HONEY MESQUITE
AW ARROWWEED
ATX ATRIPLEX
MA MARSH

VEGETATION STRUCTURAL TYPES

RIPARIAN I, II, III, IV, V, VI
MARSH 1, 2, 3, 4, 5, 6, 7
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COLORADO RIVER

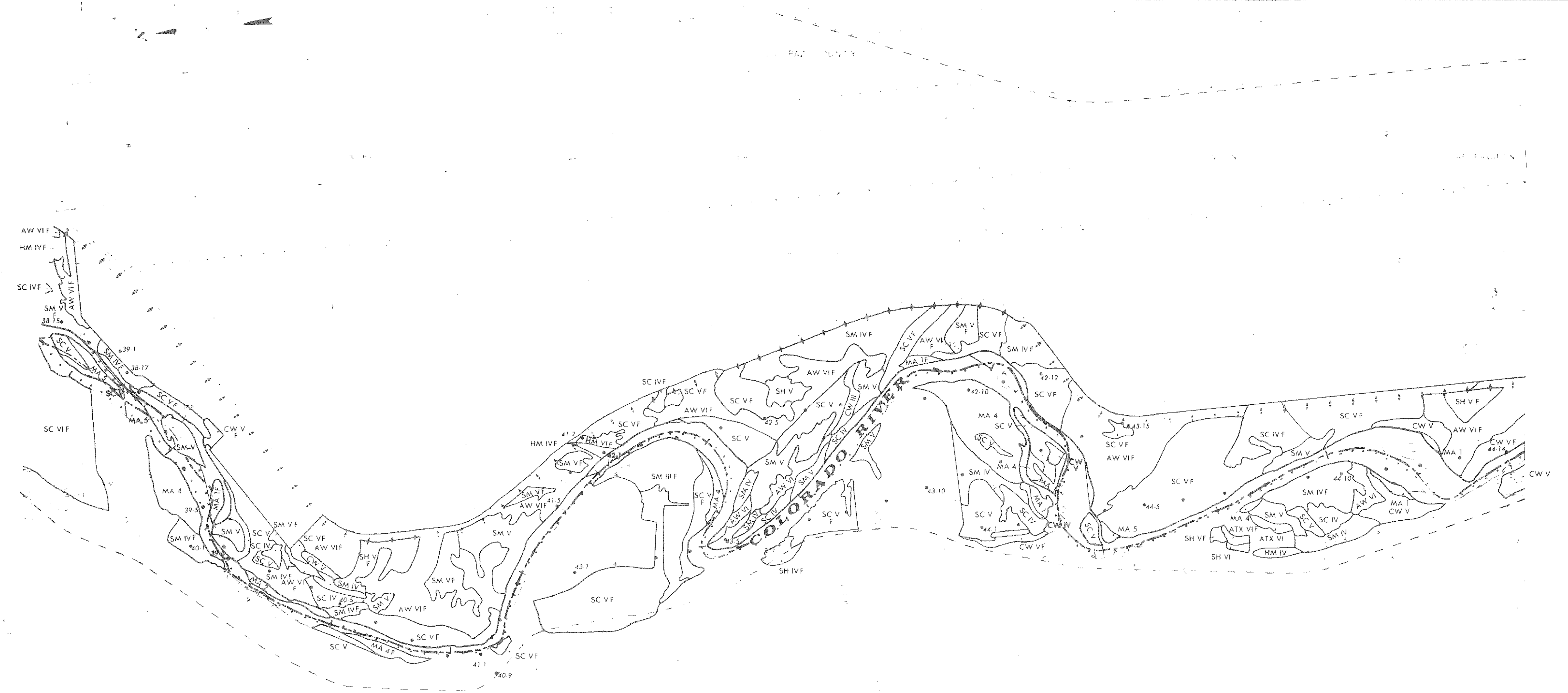
DAVIS DAM TO INTERNATIONAL BOUNDARY

VEGETATION COMMUNITIES AND STRUCTURES

PARKER AND PALO VERDE DIVISIONS

MAP NO. 423-303-2586

SHEET 10 OF 21



VEGETATION TYPE LEGEND

VEGETATION COMMUNITY

CW COTTONWOOD-WILLOW
SC SALT CEDAR
SM SCREWBEAN MESQUITE-SALT CEDAR ASSOCIATION
SH SALT CEDAR - HONEY MESQUITE ASSOCIATION
HM HONEY MESQUITE
AW ARROWWEED
ATX ATRIPLEX
MA MARSH

VEGETATION STRUCTURAL TYPES

RIPARIAN I, II, III, IV, V, VI
MARSH 1, 2, 3, 4, 5, 6, 7

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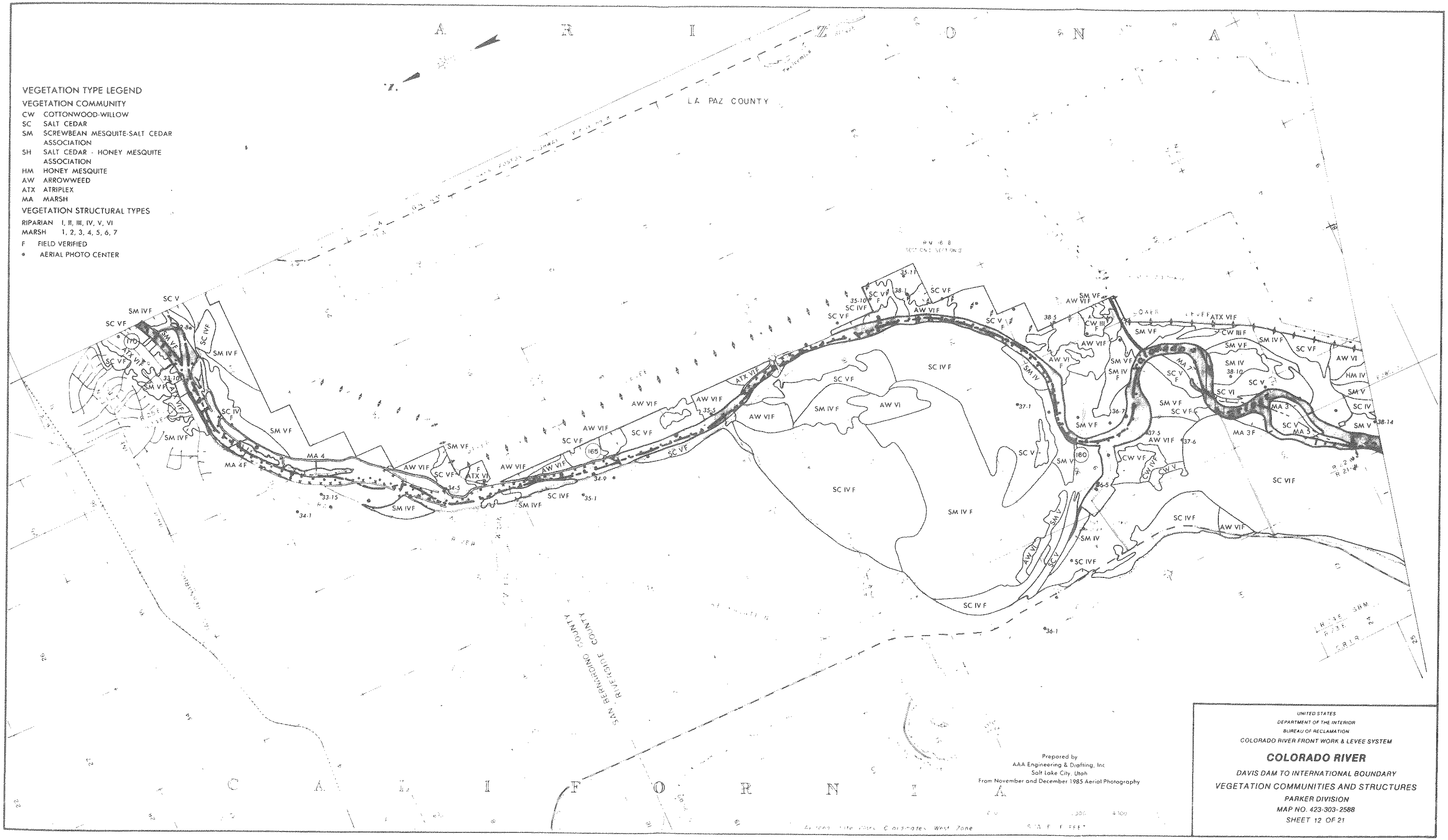
COLORADO RIVER

DAVIS DAM TO INTERNATIONAL BOUNDARY
VEGETATION COMMUNITIES AND STRUCTURES
PARKER DIVISION
MAP NO. 423-303-2587
SHEET 11 OF 21


ARIZONA
LA PAZ COUNTY
CALIFORNIA
SAN BERNARDINO COUNTY
RIVERSIDE COUNTY
VEGETATION TYPE LEGEND
VEGETATION COMMUNITY
CW COTTONWOOD-WILLOW
SC SALT CEDAR
SM SCREWBEAN MESQUITE-SALT CEDAR ASSOCIATION
SH SALT CEDAR - HONEY MESQUITE ASSOCIATION
HM HONEY MESQUITE
AW ARROWWEED
ATX ATRIPLEX
MA MARSH
VEGETATION STRUCTURAL TYPES
RIPARIAN I, II, III, IV, V, VI
MARSH 1, 2, 3, 4, 5, 6, 7
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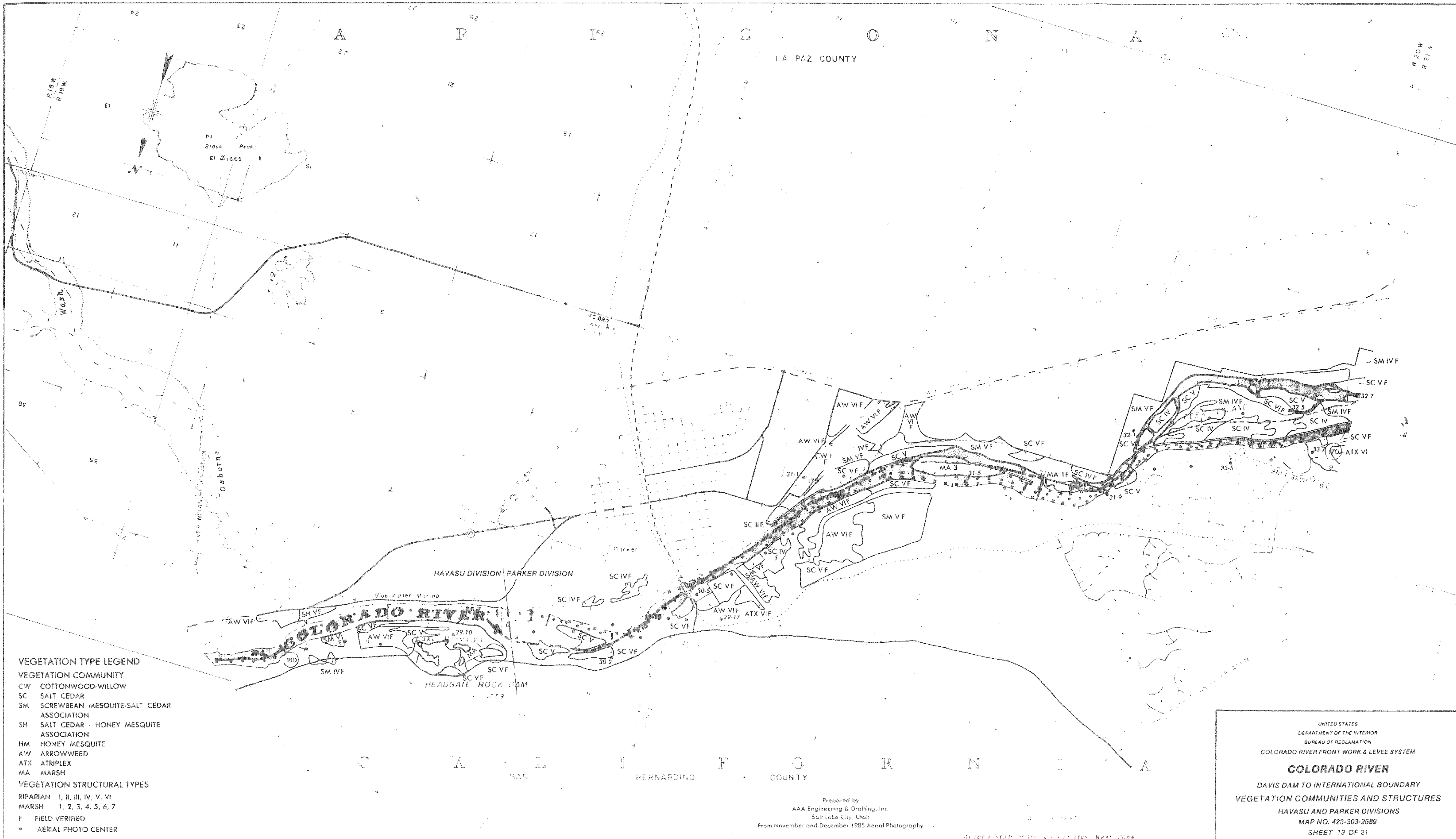
COLORADO RIVER
DAVIS DAM TO INTERNATIONAL BOUNDARY
VEGETATION COMMUNITIES AND STRUCTURES
PARKER DIVISION
MAP NO. 423-303-2588
SHEET 12 OF 21



VEGETATION TYPE LEGEND

VEGETATION COMMUNITY

CW COTTONWOOD-WILLOW
SC SALT CEDAR
SM SCREWBEAN MESQUITE-SALT CEDAR ASSOCIATION
SH SALT CEDAR - HONEY MESQUITE ASSOCIATION
HM HONEY MESQUITE
AW ARROWWEED
ATX ATRIPLEX
MA MARSH

VEGETATION STRUCTURAL TYPES

RIPARIAN I, II, III, IV, V, VI
MARSH 1, 2, 3, 4, 5, 6, 7

F FIELD VERIFIED
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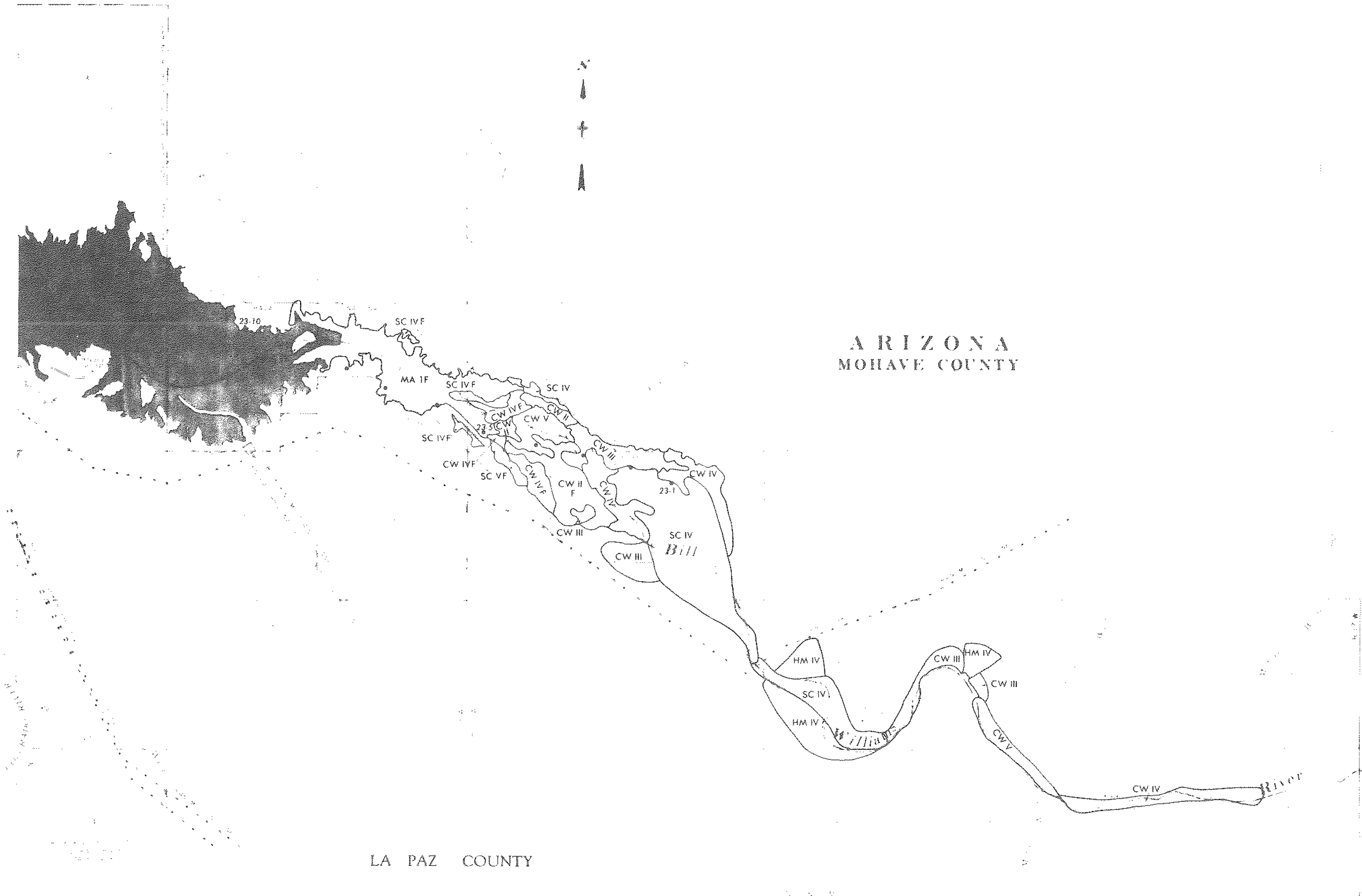
COLORADO RIVER

DAVIS DAM TO INTERNATIONAL BOUNDARY
VEGETATION COMMUNITIES AND STRUCTURES
HAVASU AND PARKER DIVISIONS
MAP NO. 423-303-2589
SHEET 13 OF 21



VEGETATION TYPE LEGEND

VEGETATION COMMUNITY

CW	COTTONWOOD-WILLOW
SC	SALT CEDAR
SM	SCREWBEAN MESQUITE-SALT CEDAR ASSOCIATION
SH	SALT CEDAR - HONEY MESQUITE ASSOCIATION
HM	HONEY MESQUITE
AW	ARROWWEED
ATX	ATRIPLEX
MA	MARSH

VEGETATION STRUCTURAL TYPES

RIPARIAN I, II, III, IV, V, VI
MARSH 1, 2, 3, 4, 5, 6, 7

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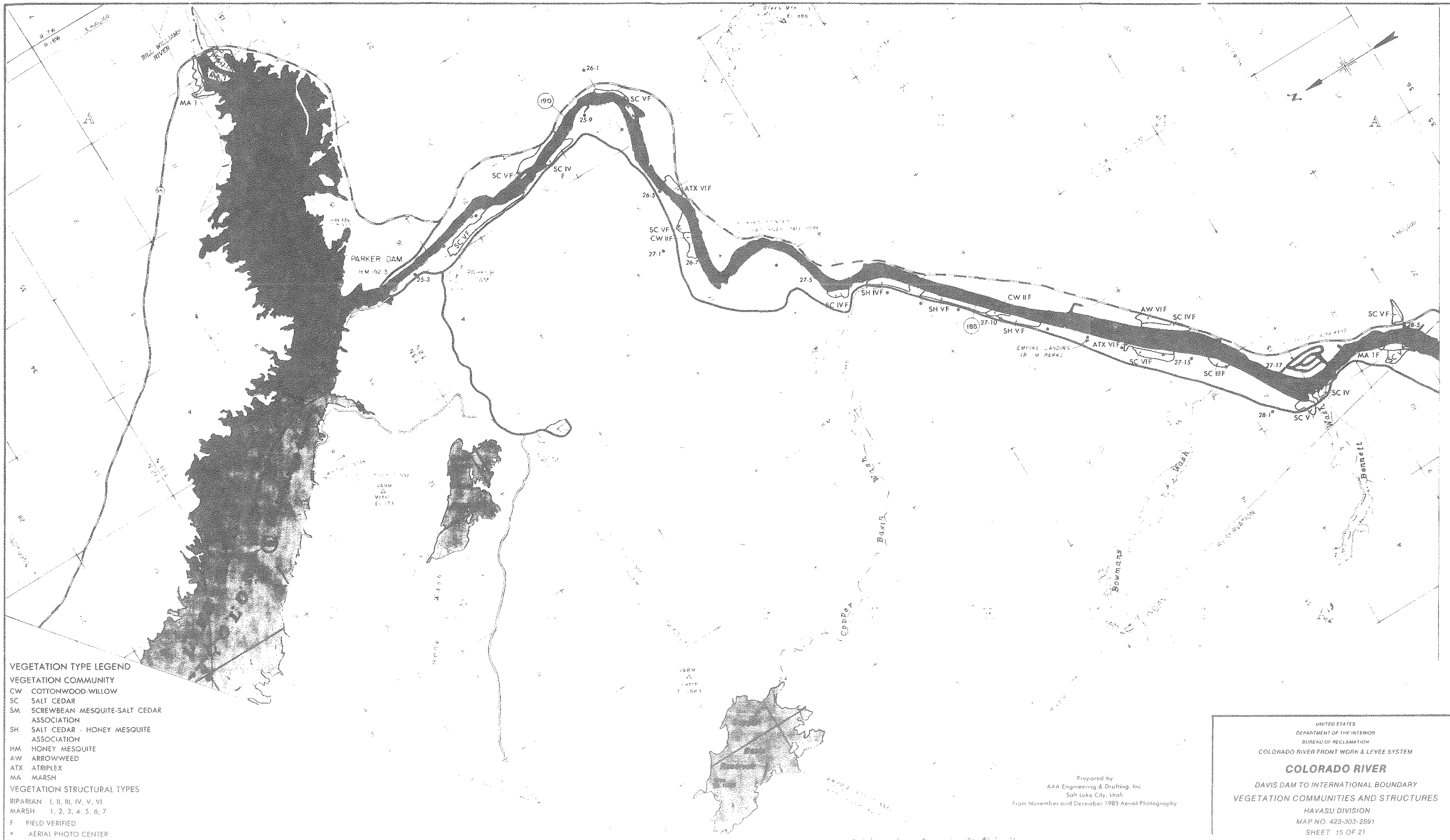
COLORADO RIVER

DAVIS DAM TO INTERNATIONAL BOUNDARY
VEGETATION COMMUNITIES AND STRUCTURES
HAVASU DIVISION
MAP NO. 423-303-2590
SHEET 14 OF 21


BILL WILLIAMS RIVER
MA 1
A
PARKER DAM
R.M. 192.3
25-3
26-1
190
25-9
SC VF
SC IV F
SC VF
26-5
ATX VIF
SC VF
CW IIF
27-1
26-7
27-5
SC IVF
SH IVF
SH VF
CW IIF
185
27-10
SH VF
EMPIRE LANDING (B.L.M. PARK)
ATX VIF
AW VIF
SC IVF
SC VIF
27-15
SC IIIF
27-17
SC VF
28-5
MA 1F
SC IV
28-1
SC V
Copper Basin Wash
Bowmans Wash
Bennett
VEGETATION TYPE LEGEND
VEGETATION COMMUNITY
CW COTTONWOOD-WILLOW
SC SALT CEDAR
SM SCREWBEAN MESQUITE-SALT CEDAR ASSOCIATION
SH SALT CEDAR - HONEY MESQUITE ASSOCIATION
HM HONEY MESQUITE
AW ARROWWEED
ATX ATRIPLEX
MA MARSH
VEGETATION STRUCTURAL TYPES
RIPARIAN I, II, III, IV, V, VI
MARSH 1, 2, 3, 4, 5, 6, 7
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COLORADO RIVER
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VEGETATION COMMUNITIES AND STRUCTURES
HAVASU DIVISION
MAP NO. 423-303-2591
SHEET 15 OF 21

VEGETATION TYPE LEGEND

VEGETATION COMMUNITY

CW COTTONWOOD-WILLOW
SC SALT CEDAR
SM SCREWBEAN MESQUITE-SALT CEDAR ASSOCIATION
SH SALT CEDAR - HONEY MESQUITE ASSOCIATION
HM HONEY MESQUITE
AW ARROWWEED
ATX ATRIPLEX
MA MARSH

VEGETATION STRUCTURAL TYPES

RIPARIAN I, II, III, IV, V, VI
MARSH 1, 2, 3, 4, 5, 6, 7

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COLORADO RIVER

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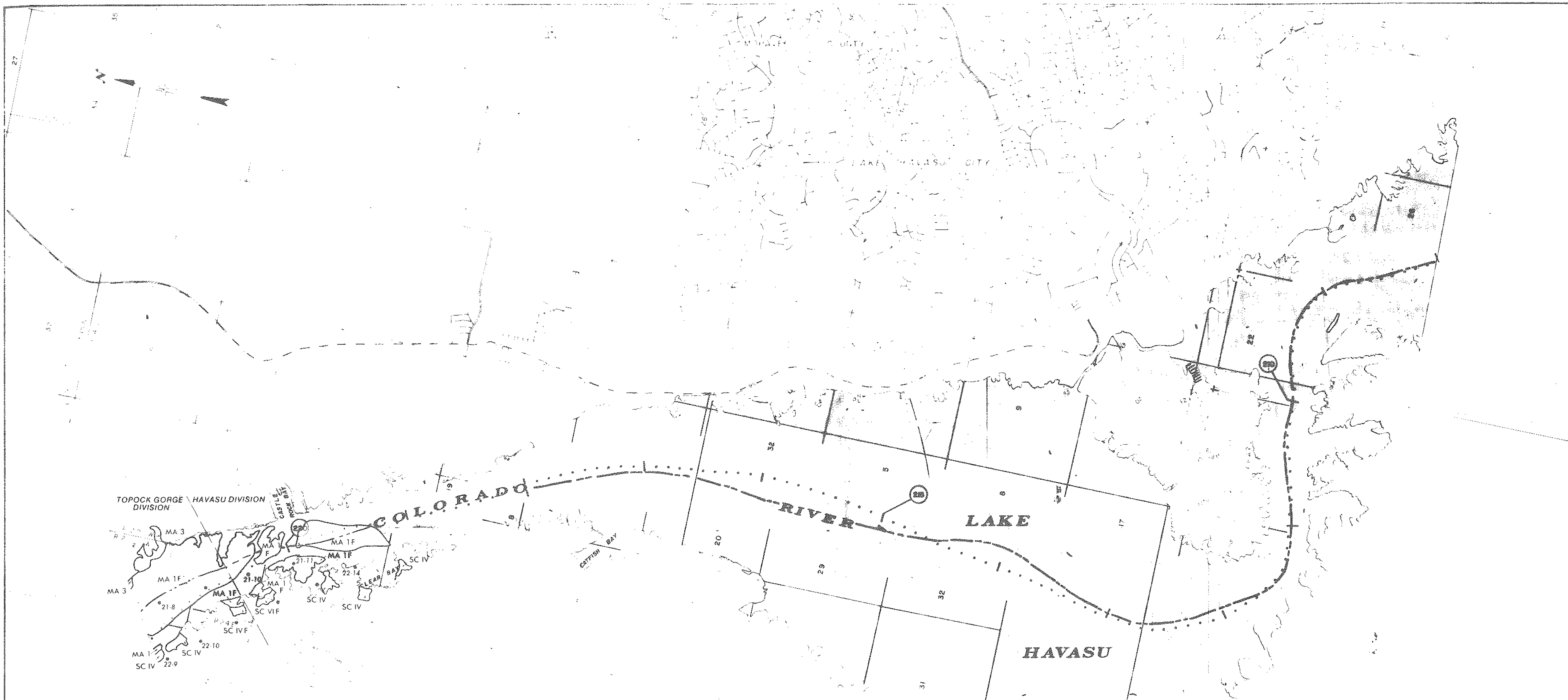
VEGETATION COMMUNITIES AND STRUCTURES
HAVASU DIVISION
MAP NO. 423-303-2592
SHEET 16 OF 21

HAVASU DIVISION



VEGETATION TYPE LEGEND

VEGETATION COMMUNITY

CW COTTONWOOD-WILLOW
SC SALT CEDAR
SM SCREWBEAN MESQUITE-SALT CEDAR ASSOCIATION
SH SALT CEDAR - HONEY MESQUITE ASSOCIATION
HM HONEY MESQUITE
AW ARROWWEED
ATX ATRIPLEX
MA MARSH

VEGETATION STRUCTURAL TYPES

RIPARIAN I, II, III, IV, V, VI
MARSH 1, 2, 3, 4, 5, 6, 7

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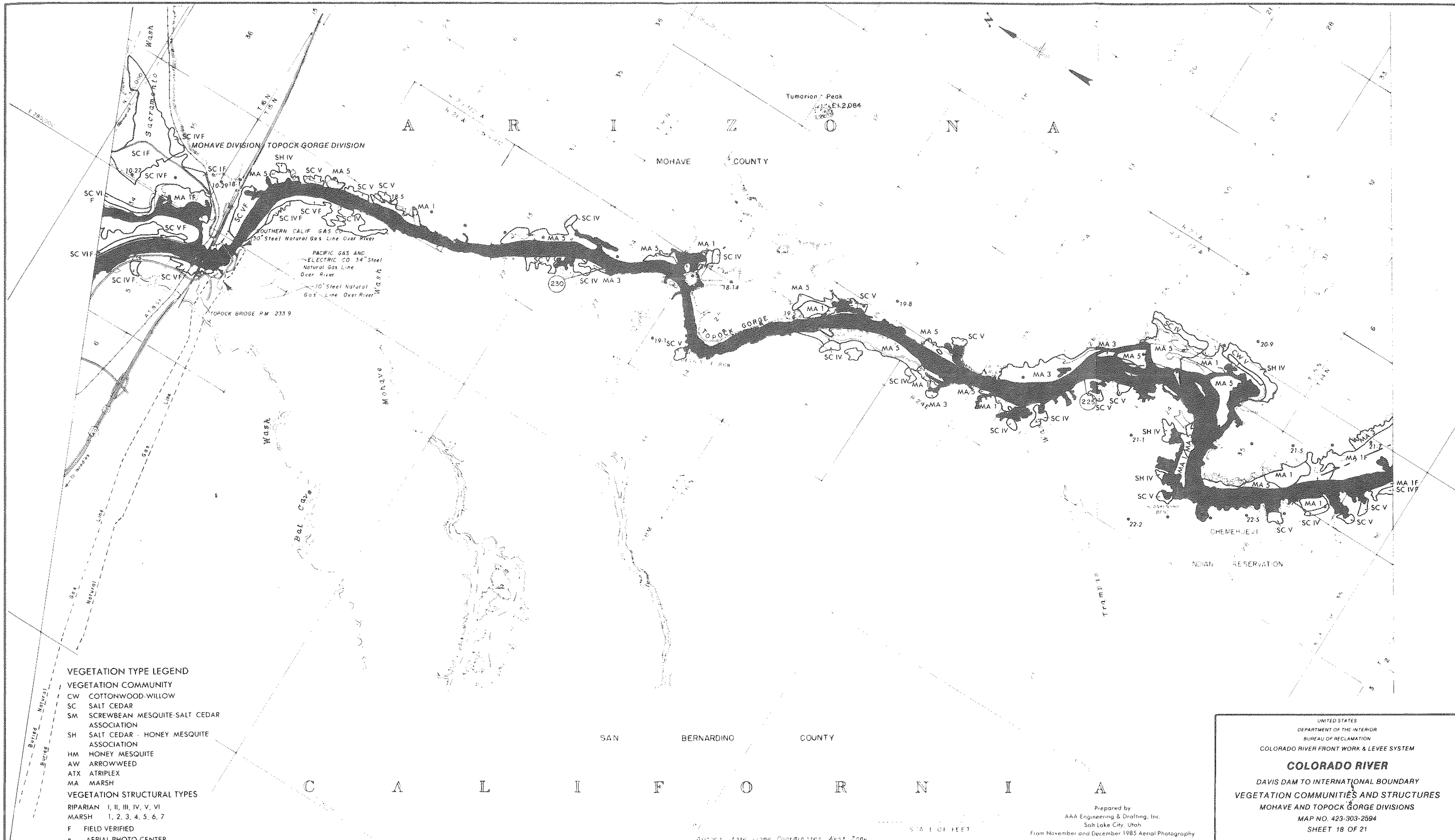
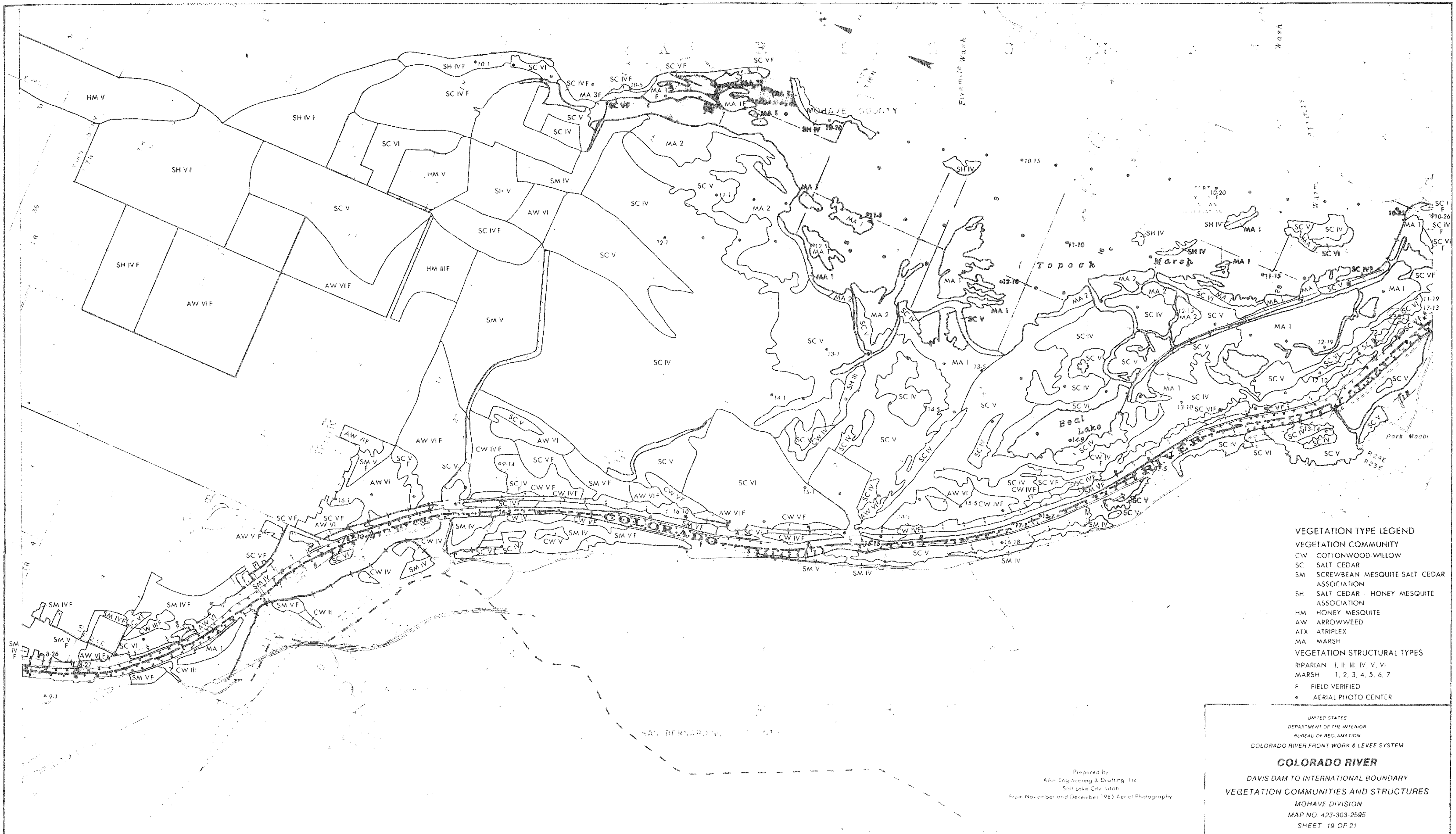
COLORADO RIVER

DAVIS DAM TO INTERNATIONAL BOUNDARY
VEGETATION COMMUNITIES AND STRUCTURES
TOPOCK GORGE AND HAVASU DIVISIONS
MAP NO. 423-303-2593
SHEET 17 OF 21



MOHAVE VALLEY AND TOPOCK GORGE DIVISIONS



VEGETATION TYPE LEGEND

VEGETATION COMMUNITY

- CW COTTONWOOD-WILLOW
- SC SALT CEDAR
- SM SCREWBEAN MESQUITE-SALT CEDAR ASSOCIATION
- SH SALT CEDAR - HONEY MESQUITE ASSOCIATION
- HM HONEY MESQUITE
- AW ARROWWEED
- ATX ATRIPLEX
- MA MARSH

VEGETATION STRUCTURAL TYPES

- RIPARIAN I, II, III, IV, V, VI
- MARSH 1, 2, 3, 4, 5, 6, 7
- F FIELD VERIFIED
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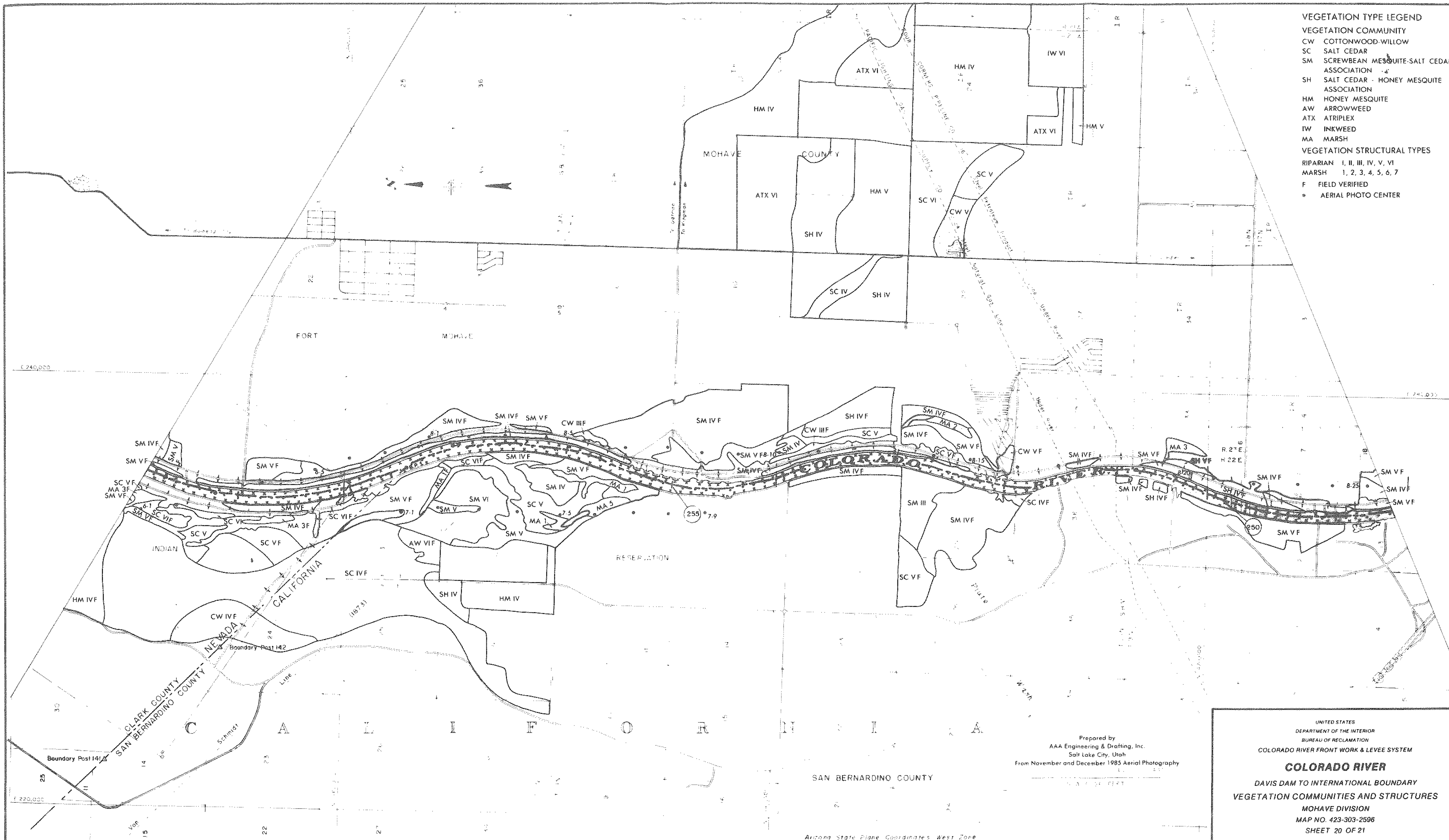
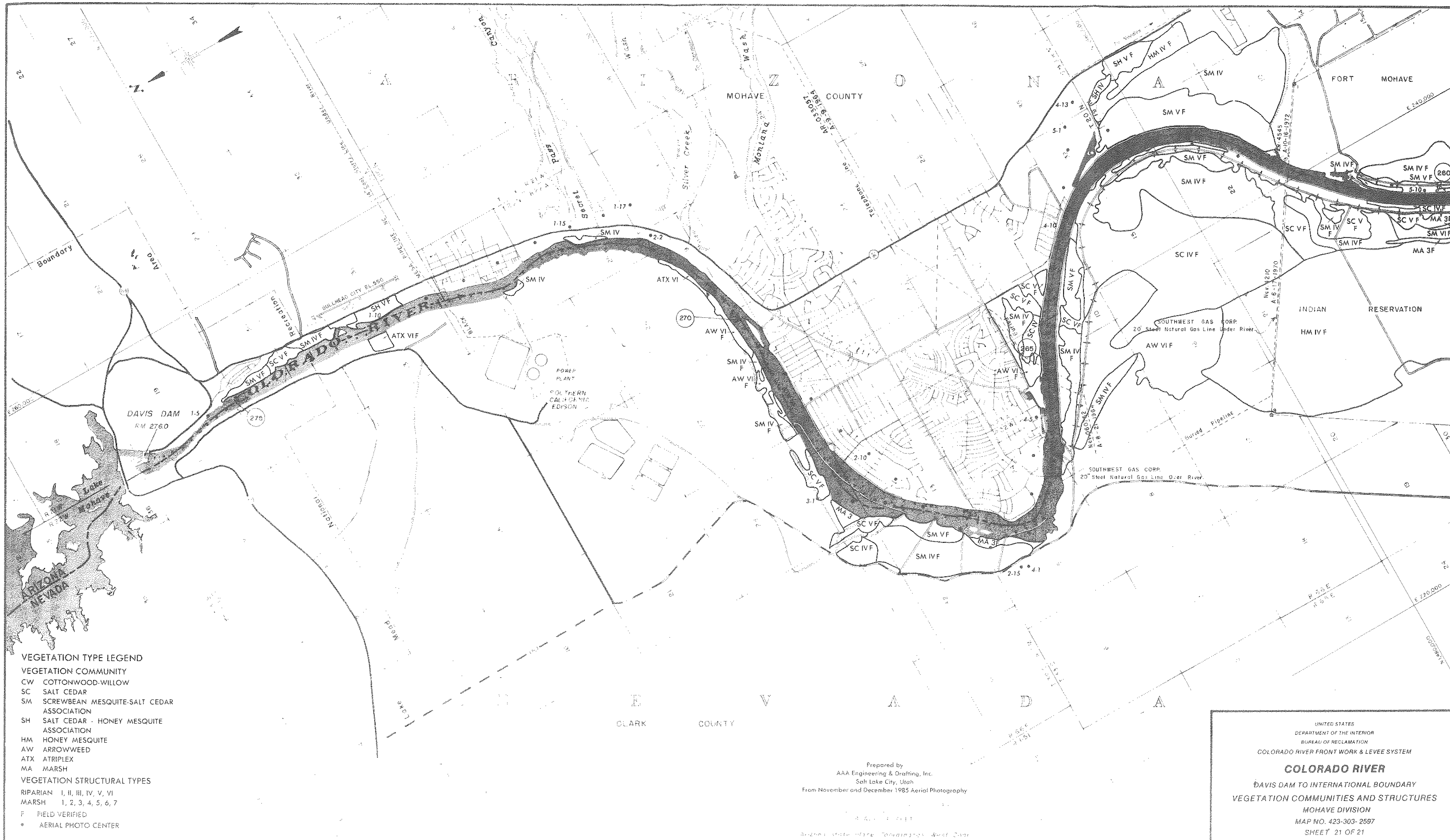
VEGETATION COMMUNITIES AND STRUCTURES
MOHAVE DIVISION
MAP NO. 423-303-2595
SHEET 19 OF 21



MOHAVE VALLEY DIVISION



VEGETATION TYPE LEGEND

VEGETATION COMMUNITY

CW COTTONWOOD-WILLOW
SC SALT CEDAR
SM SCREWBEAN MESQUITE-SALT CEDAR ASSOCIATION
SH SALT CEDAR - HONEY MESQUITE ASSOCIATION
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AW ARROWWEED
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MA MARSH

VEGETATION STRUCTURAL TYPES

RIPARIAN I, II, III, IV, V, VI
MARSH 1, 2, 3, 4, 5, 6, 7

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COLORADO RIVER

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VEGETATION COMMUNITIES AND STRUCTURES
MOHAVE DIVISION
MAP NO. 423-303-2597
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