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March 13, 2012

Yuma-Mesa Barrier Dam & Water Collector System

Background:

Shortly after World War II, Reclamation completed the irrigation project for the existing portion of the Yuma Mesa Unit of the Gila Project. The soil on the mesa being sandy required more water than the adjacent valley land. In addition the ground water on the west side of this project migrated off the mesa into Yuma Valley. The existing open drains in Yuma Valley were extended to the toe of the mesa and a toe drain was excavated between County 11 ¼ Street and County 14 ½ Street and County 16th Street & County18th Street. The additional drains did not solve the ground water problem. The Water Users subsequently drilled deep wells in the same area as the toe drain. The wells discharged into the valley's open drainage system. In 1966 Reclamation added some additional wells to help solve the ground water problem. The Yuma Mesa Conduit System was built between 1967 & 1972.

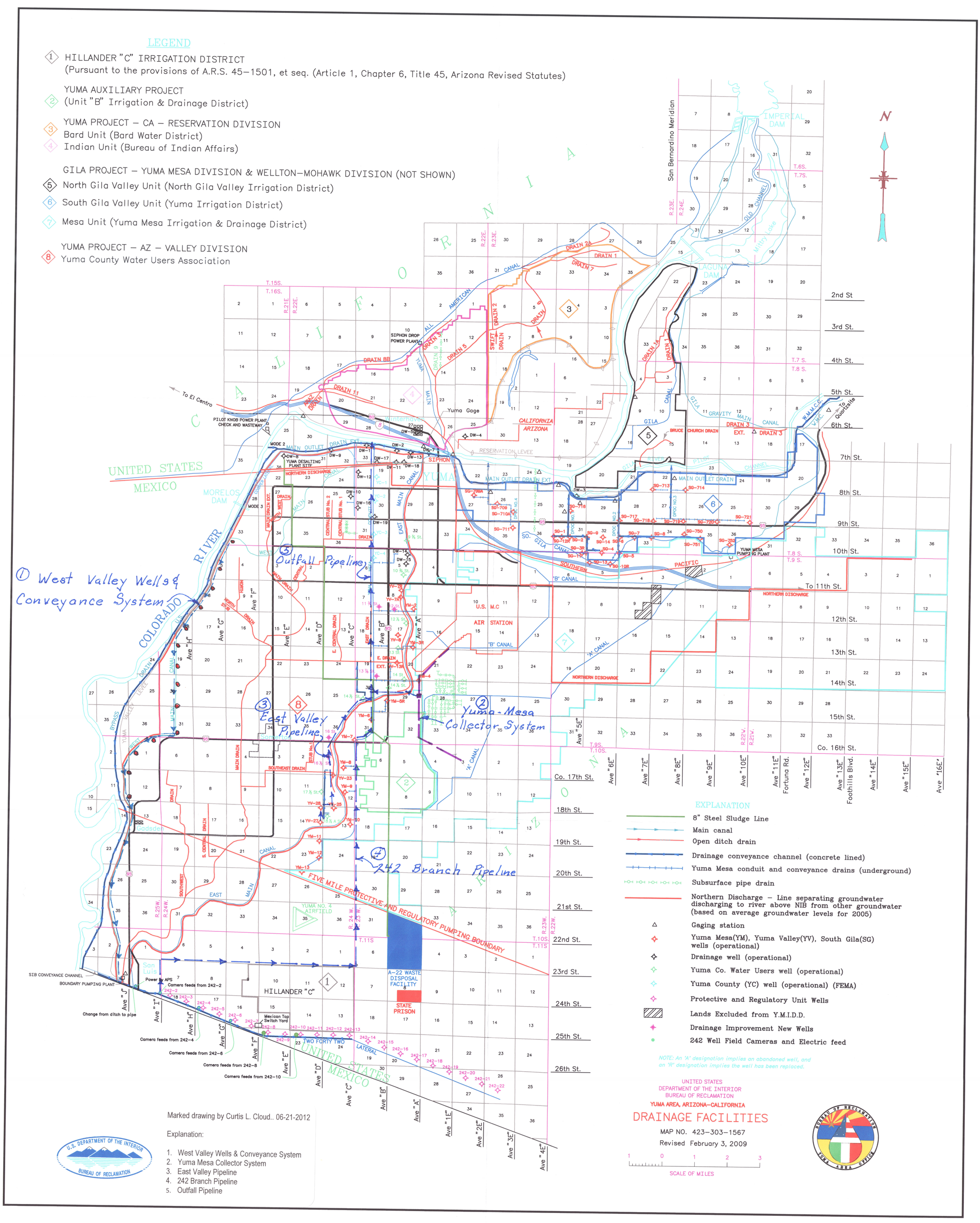
(My) Engineering Analysis:

This proposed project would provide a barrier between the Yuma Mesa and the Yuma Valley.

The barrier dam would use steel sheet piling between the Algodones Fault (near County 16th Street) and the rock out crop located on the Marine Base, west of County 2E. The ground water east of the fault is 40ft. higher than on the west. The barrier dam could serve as the west side of a coffer dam (two rolls of sheet piling). With the mesa being some 50 to 60 feet higher than the valley & Colorado River, the ground water would be collected by constructing an open joint pipe or special pipe installed at elevation 120.0 MSL.

A well located near the proposed project had (in 2003) a salinity count of 1050 PPM. It is expected that the salinity level from this system will be less than this count, approximately 900 to 950 PPM. With a discharge of 150 cfs some 100,000 acre feet of water could be produced annually.

The western portion of the Yuma-Mesa Irrigation project & the north section of the Unit B irrigation project are within the boundary of this proposal. The ground water on this end of the mesa has ground water mound sections. This could indicate horizontal clay layer supporting the ground water at a higher elevation.


LEGEND
1 HILLANDER "C" IRRIGATION DISTRICT
(Pursuant to the provisions of A.R.S. 45-1501, et seq. (Article 1, Chapter 6, Title 45, Arizona Revised Statutes)
2 YUMA AUXILIARY PROJECT
(Unit "B" Irrigation & Drainage District)
3 YUMA PROJECT – CA – RESERVATION DIVISION
Bard Unit (Bard Water District)
4 Indian Unit (Bureau of Indian Affairs)
GILA PROJECT – YUMA MESA DIVISION & WELLTON–MOHAWK DIVISION (NOT SHOWN)
5 North Gila Valley Unit (North Gila Valley Irrigation District)
6 South Gila Valley Unit (Yuma Irrigation District)
7 Mesa Unit (Yuma Mesa Irrigation & Drainage District)
YUMA PROJECT – AZ – VALLEY DIVISION
8 Yuma County Water Users Association
① West Valley Wells & Conveyance System
② Yuma Mesa Collector System
③ East Valley Pipeline
④ 242 Branch Pipeline
⑤ Outfall Pipeline
FIVE MILE PROTECTIVE AND REGULATORY PUMPING BOUNDARY
HILLANDER "C"
A-22 WASTE DISPOSAL FACILITY
STATE PRISON
YUMA MESA PUMPING PLANT
SIPHON DROP POWER PLANT
PILOT KNOB POWER PLANT
YUMA DESALTING PLANT SITE
MORELOS DAM
IMPERIAL DAM
LAGUNA DAM
Yuma Gage
U.S. M.C AIR STATION
YUMA NO. 4 AIRFIELD
San Luis
Gadsden
Somerton
UNITED STATES
MEXICO
COLORADO RIVER
CALIFORNIA
ARIZONA
SIB CONVEYANCE CHANNEL
BOUNDARY PUMPING PLANT
Power by APS
Camera feeds from 242-2
Change from ditch to pipe
Camera feeds from 242-4
Camera feeds from 242-6
Camera feeds from 242-8
Camera feeds from 242-10
Mexican Tap Switch Yard
TWO FORTY TWO LATERAL
San Bernardino Meridian
R.21E. R.22E. R.23E. R.24E. R.25W. R.24W. R.23W. R.22W. R.21W.
T.15S. T.16S. T.7S. T.8S. T.9S. T.10S. T.11S.
2nd St
3rd St.
4th St.
5th St.
6th St.
7th St.
8th St.
9th St.
10th St.
To 11th St.
12th St.
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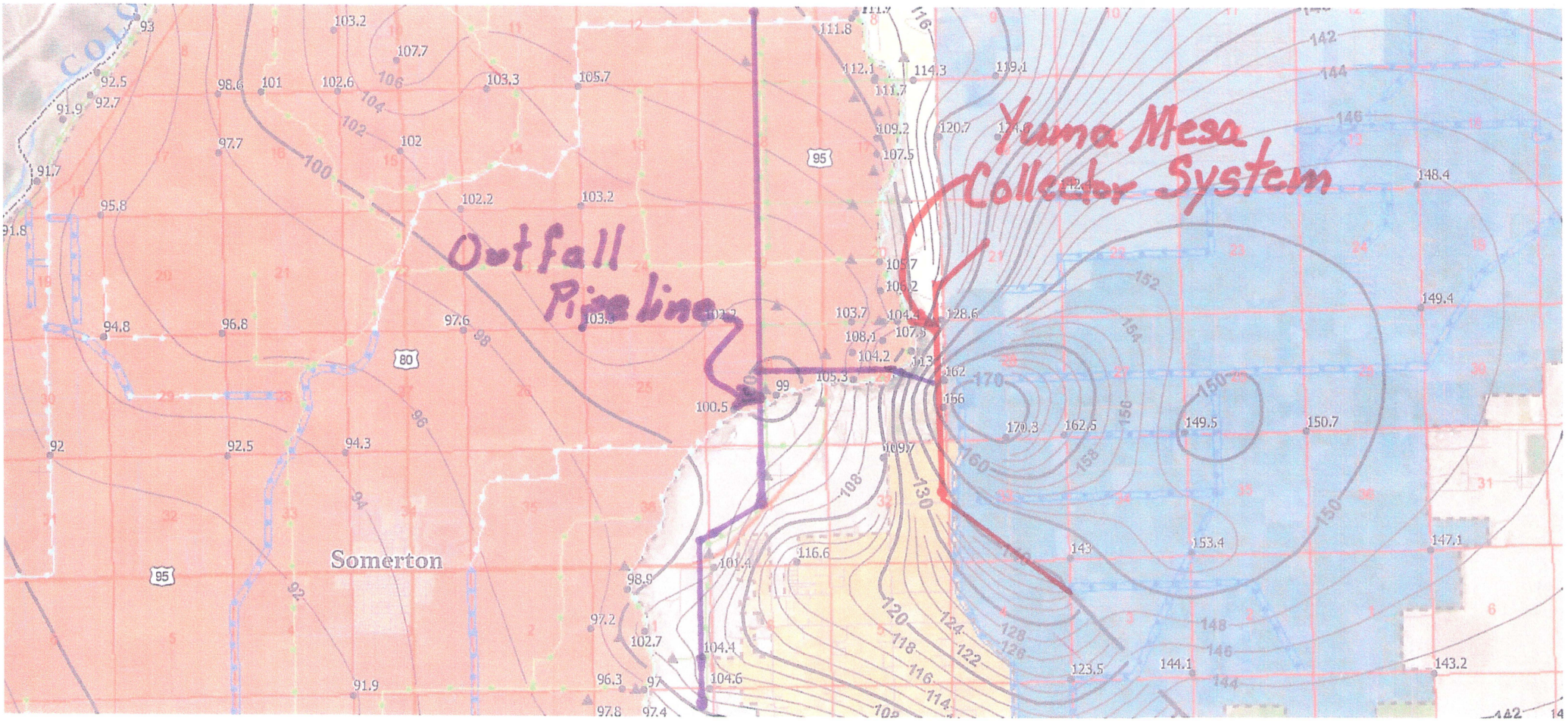
14th St.
15th St.
Co. 16th St.
Co. 17th St.
18th St.
19th St.
20th St.
21st St.
22nd St.
23rd St.
24th St.
25th St.
26th St.
Ave "J" Ave "I" Ave "H" Ave "G" Ave "F" Ave "E" Ave "D" Ave "C" Ave "B" Ave "A" Ave "1E" Ave "2E" Ave "3E" Ave "4E" Ave "5E" Ave "6E" Ave "7E" Ave "8E" Ave "9E" Ave "10E" Ave "11E" Fortuna Rd. Ave "12E" Ave "13E" Foothills Blvd. Ave "14E" Ave "15E" Ave "16E"
EXPLANATION
8" Steel Sludge Line
Main canal
Open ditch drain
Drainage conveyance channel (concrete lined)
Yuma Mesa conduit and conveyance drains (underground)
Subsurface pipe drain
Northern Discharge – Line separating groundwater discharging to river above NIB from other groundwater (based on average groundwater levels for 2005)
Gaging station
Yuma Mesa(YM), Yuma Valley(YV), South Gila(SG) wells (operational)
Drainage well (operational)
Yuma Co. Water Users well (operational)
Yuma County (YC) well (operational) (FEMA)
Protective and Regulatory Unit Wells
Lands Excluded from Y.M.I.D.D.
Drainage Improvement New Wells
242 Well Field Cameras and Electric feed
NOTE: An 'A' designation implies an abandoned well, and an 'R' designation implies the well has been replaced.
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
YUMA AREA, ARIZONA–CALIFORNIA
DRAINAGE FACILITIES
MAP NO. 423-303-1567
Revised February 3, 2009
SCALE OF MILES
Marked drawing by Curtis L. Cloud.. 06-21-2012
Explanation:
1. West Valley Wells & Conveyance System
2. Yuma Mesa Collector System
3. East Valley Pipeline
4. 242 Branch Pipeline
5. Outfall Pipeline
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION



Ground Water Elevation Map
Yuma Valley & Yuma Mesa
Y-M Collector System by. C.L. Cloud

6-21-2012

Curtis L. Cloud
[redacted]

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KEYWORD

June 25, 2012

ATTN: PAM ADAMS, MAIL CODE: 2721
Bureau of Reclamation
Lower Colorado Regional Office
PO Box 61470
Boulder City NV 89006-1470

Dear Ms. Adams,

RE: Colorado River Basin Water Supply & Demand Study

For your review I am enclosing a set of papers and maps.

Enclosed are:

- Outline of the Collector Water Systems in the Yuma Area
- Narrative entitled, Yuma-Mesa Barrier Dam & Water Collector System
- Seven (7) tables showing the flow & salinity with & without the Yuma Desalting Plant
- Plan View for Yuma-Mesa Underground Collector System
- Typical Section for Yuma-Mesa Underground Collector System
- Map of Ground Water Elevation, showing location of Collector System & Pipeline
- Map of marked systems & pipelines. (BOR Map No. 423-303-1567)

Should you have questions, please contact me at either the phone number or e-mail address above. I will be in Arizona until July 8. After that, please use phone number 970-858-1592 or 928-304-0948, same e-mail address.

Sincerely,

[redacted]

Outline of the
Collector Water Systems in the Yuma Area

See map # 423-303-1567 as marked for all locations of the following.

1) West Yuma Valley Collector System: Drill a series of wells along the West Main Canal between County 10th Street south to the 5 mile limit of the 242 agreement. Discharge water into the West Main Canal or build a conveyance system to transport the water to the Southern International Boundary. Estimated production capacity: 80 CFS.

2) Yuma - Mesa Underground collector drainage system: Located on the west edge of the Yuma Mesa. Sheet piling barrier with open jointed pipe incased in a gravel/rock filter. Estimated production capacity: 150 CFS.

3) East Yuma Valley Collector Pipeline: This system would collect the water from the existing wells located there. Estimated production capacity: 60 CFS.

4) 242 Branch Pipeline: This system would bring the water produced from the well field to the Colorado River. Estimated production capacity: 200 CFS.

5) Outfall Pipeline: Build a system of pipelines to convey the water from all three of above sources to the Colorado River. Suggest this system be located adjacent to the existing Yuma-Mesa Conduit from the toe of the Mesa. Estimated production capacity: 400 CFS.

6) Tables showing:

- Sources of water that include cubic feet per second (CFS), salinity in PPM's and factor for calculating the weighted salinity averages on a monthly and yearly basis. The 2011 scheduled delivery of water to the Northern International Boundary with Mexico was used. The average salinity at Imperial Dam was estimated at 730 PPM.

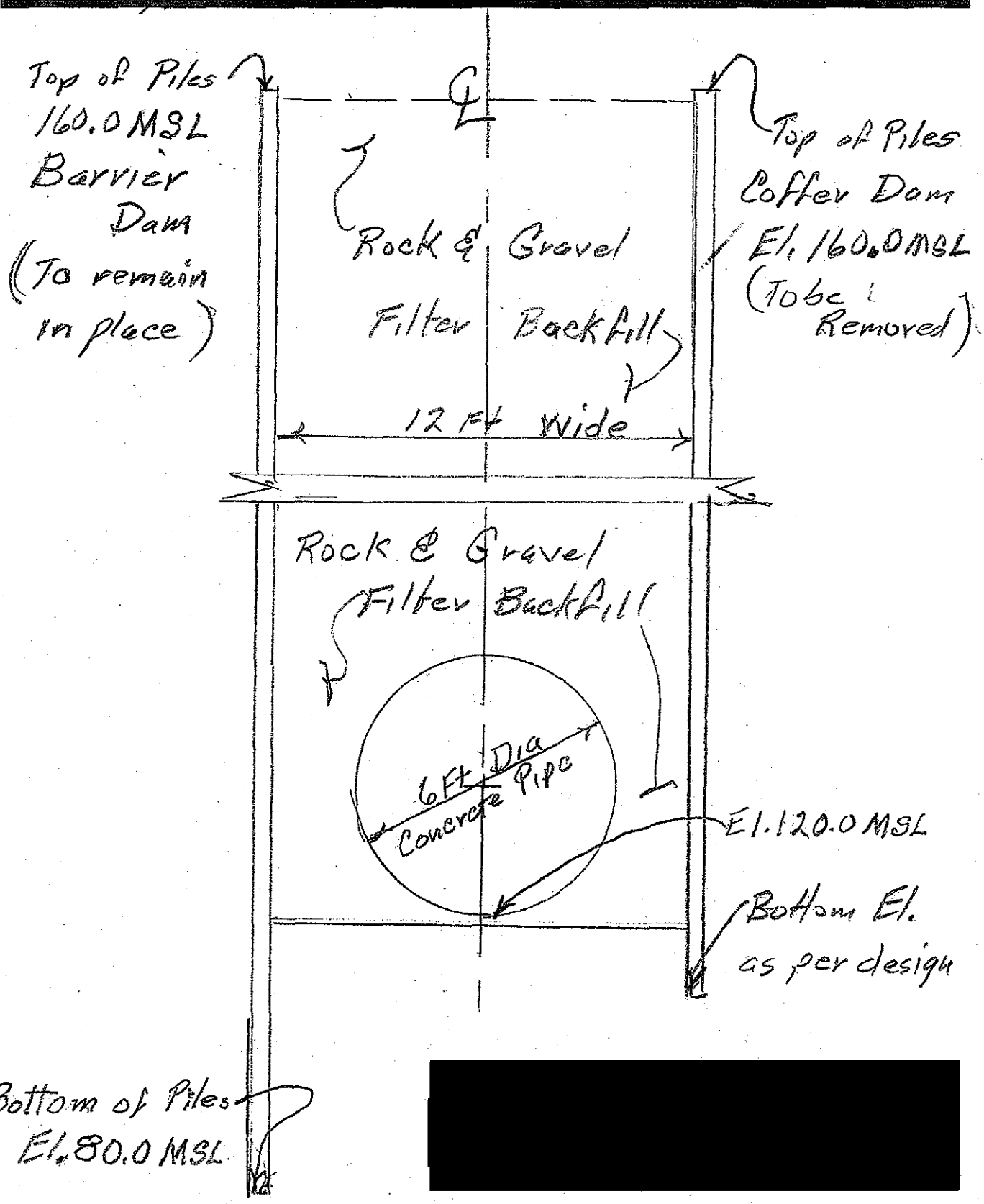
- Scenario #1 – Use the Yuma Desalting Plant (YDP) at capacity and blend water with resulting in 140 CFS at 680 PPM. Other sources of water could be used to blend with the product water from the plant and provide more blended water. However, the "law" or the Bureau wants to use feed water from the Wellton-Mohawk drain system. Different YDP capacities could be used.

- Scenario #2 – Would be to operate the collector systems without the Yuma Desalting Plant. Both scenarios will produce additional water flow to the river and meet salinity requirements.

[redacted]

COMPUTATION SHEET

BY CLC	DATE 5-22-12	PROJECT V-M Collector Sys	SHEET 1 OF ___
CHKD BY	DATE	FEATURE	
DETAILS Typical Section			



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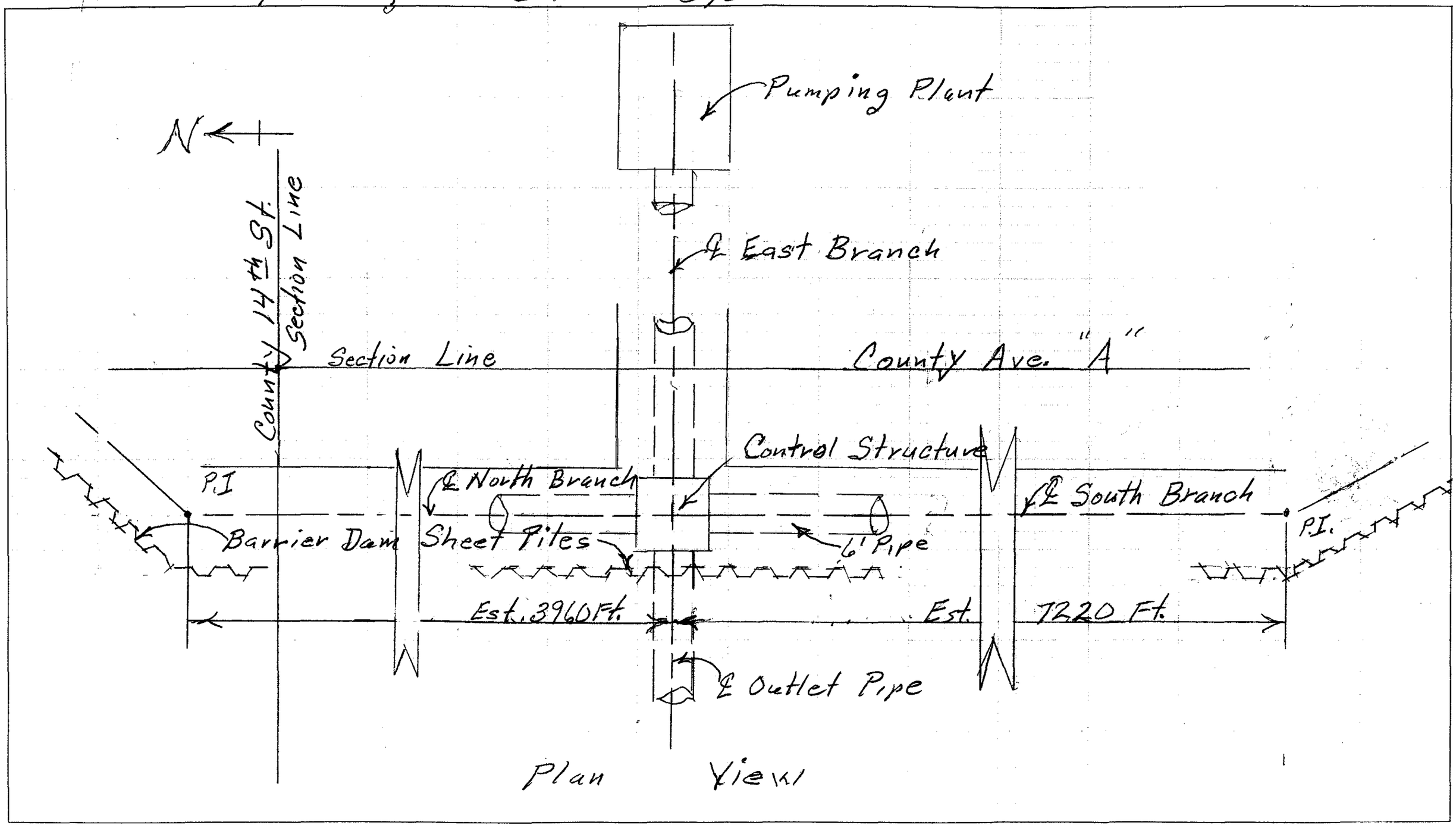
MONTGOMERY WATSON

By CL Cloud Date 6-21-2012 Client _____ Sheet ___ of ___

Chkd. By _____ Description Y-M Underground Collector System



Monthly Flow & Salinity Using the Yuma Desalting Plant (YDP)

Based on Imperial Dam @ 730 PPM and YDP @ capacity 112 CFS & 38 CFS blend

Month	Ac. Ft.	CFS	Riv CFS	Riv Fac	C& Rt cfs	C-R Fac	comb-fac	PPM	Acc CFS	Acc fac	a-ppm	I-D	diff
Jan.	107428	1747	1052	767960	695	751525	1519575	870	1747	1519575	870	730	140
Feb.	140979	2538	1623	1184790	915	1003400	2188130	862	4285	3707705	865	730	135
Mar.	196455	3195	2280	1664400	915	1003400	2667800	835	7480	6375505	852	730	122
April	187629	3153	2238	1633740	915	1003400	2637140	836	10633	9012645	848	730	118
May	100754	1639	944	689120	695	751525	1440645	879	12272	10453290	852	730	122
Jun.	100353	1686	991	723430	695	751525	1474955	875	13958	11928245	855	730	125
Jul.	107428	1747	1052	767960	695	751525	1519485	870	15705	13447730	856	730	126
Aug.	81370	1323	708	516840	615	653400	1170240	885	17028	14617970	858	730	128
Sep.	77307	1299	684	499320	615	653400	1152720	887	18327	15770690	861	730	131
Oct.	61828	1005	390	284700	615	653400	938100	933	19332	16708790	864	730	134
Nov.	90966	1528	833	608090	695	751525	1359615	890	20860	18068405	866	730	136
Dec.	103505	1683	988	721240	695	751525	1472765	875	22543	19541170	867	730	137

[redacted]

Table for
All Sources Feb. through Apr.
Using Desalting Plant

Source	CFS	PPM	Factor	Acc Fac	Acc CFS	Acc PPM
Other Measure	135	1120	151200	151200	135	1120
Unmeasured	115	1200	138000	289200	250	1157
Y-M Collector	140	1100	154000	443200	390	1136
242 Wells	200	900	180000	623200	590	1056
Y-M Conduit	120	1375	165000	788200	710	1110
YDP	140	680	95200	883400	850	1039
DPOC	100	1600	160000	1043400	950	1098
Alt Y-V Conduit	80	1400	112000	1155400	1030	1122

Feb 1 to Apr 30

Source	CFS	PPM	Factor	Acc Fac	Acc CFS	Acc PPM
Measured	135	1120	151200	151200	135	1120
Unmeasured	115	1200	138000	289200	250	1157
Y-M Collector	100	1100	110000	399200	350	1140
242 Wells	200	900	180000	579200	550	1053
YDP	140	680	95200	674400	690	977
Y-M Conduit	155	1375	213125	891400	845	1055
DPOC	70	1600	112000	1003400	915	1097

[redacted]

Table for Jan, May, Jun, Jul, Nov, Dec using Yuma Desalting Plant

Source	CFS	PPM	Factor	Acc Fac	PPM	Acc PPM
Measured	135	1120	151200	151200	135	1120
Unmeasured	115	1200	138000	289200	250	1157
Y-M Collector	50	1100	55000	344200	300	1147
242 Wells	100	900	90000	434200	400	1086
DPOC	40	1600	64000	498200	440	1132
YDP	140	680	95200	593400	580	1023
Y-M Conduit	115	1375	158125	751525	695	1081

[redacted]

Table for
Aug. through Oct.
Using Desalting Plant

Source	CFS	PPM	Factor	Acc Fac	Acc CFS	Acc PPM
Measured	135	1120	151200	151200	135	1120
Unmeasured	115	1200	138000	289200	250	1157
Y-M Collector	50	1100	55000	344200	300	1147
242 Wells	75	900	67500	411700	375	1098
DPOC	40	1600	64000	475700	415	1146
YDP	140	680	95200	570900	555	1029
Y-M Conduit	60	1375	82500	653400	615	1062

[redacted]

Monthly Flow & Salinity w/o Yuma Desalting Plant

	Ac. Ft.	CFS	Riv CFS	Riv Fac	C&R CFS	C-R Fac	comb-fac	PPM	Acc CFS	Acc fac	AccPPM	I-D	diff
Jan.	107428	1747	1097	800810	650	716700	1517510	869	1747	1517510	869	730	139
Feb.	140979	2538	1793	1308890	745	864200	2173090	856	4285	3690600	861	730	131
Mar.	196455	3190	2340	1708200	850	1016200	2724400	854	7475	6277990	840	730	110
Apr.	187629	3153	2303	1681190	850	1016200	2697390	855	10628	8975380	845	730	115
May	100754	1634	984	718320	650	716700	1435020	878	12262	10410400	849	730	119
June	100353	1686	1036	756280	650	716700	1472980	874	13948	11883380	852	730	122
July	107428	1747	1097	800810	650	716700	1517510	869	15695	13400890	854	730	124
Aug	81370	1323	873	637290	450	489200	1126490	851	17018	14527380	854	730	124
Sept.	77307	1299	849	619770	450	489200	1108970	854	18317	15636350	854	730	124
Oct.	61828	1005	555	405150	450	489200	894350	890	19322	16530700	856	730	126
Nov.	90966	1528	878	640940	650	716700	1357640	889	20850	17888340	858	730	128
Dec.	103505	1683	1033	754090	650	716700	1470790	874	22533	19359130	859	730	129

[redacted]

All Sources w/o Yuma Desalting Plant & Feb, Mar, Apr

Source	CFS	ppm	Factor	Acc Fac	Acc cfs	Acc ppm
Other Measure	135	1120	151200	151200	135	1120
Unmeasured	115	1200	138000	289200	250	1157
Y-M Collector	100	1100	110000	399200	350	1140
242 Wells	200	900	180000	579200	550	1053
Y-M Conduit	120	1375	165000	744200	670	1110
DPOC	100	1600	160000	904200	770	1174
Alt Y-V Conduil	80	1400	112000	1016200	850	1196

Feb. Mar. Apr

Source	CFS	ppm	Factor	Acc Fac	Acc cfs	Acc ppm
Other Measure	135	1120	151200	151200	135	1120
Unmeasured	115	1200	138000	289200	250	1157
Y-M Collector	100	1100	110000	399200	350	1140
242 Wells	200	900	180000	579200	550	1053
Y-M Conduit	120	1375	165000	744200	670	1110
DPOC	75	1600	120000	864200	745	1160

[redacted]

Table for different months w/o Yuma Desalting Plant

Jan. only

Source	CFS	PPM	Factor	Acc Fac	Acc CFS	Acc PPM
Other Measured	135	1120	151200	151200	135	1120
Unmeasured	115	1200	138000	289200	250	1157
Y-M Collector	100	1100	110000	399200	350	1140
242 Wells	200	900	180000	579200	550	1053
Y-M Conduit	100	1375	137500	716700	650	1103

Aug, Sep, Oct

Source	CFS	ppm	Factor	Acc Fac	Acc cfs	Acc ppm
Other Measured	135	1120	151200	151200	135	1120
Unmeasured	115	1200	138000	289200	250	1157
Y-M Collector	100	1100	110000	399200	350	1140
242 Wells	100	900	90000	489200	450	1087

[redacted]

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(My) Engineering Construction Details:

The system would consist of sheet piling cutoff wall with 6 foot diameter open jointed concrete pipe incased in a gravel-rock filter. To build this system a sheet piling coffer dam system (two parallel rows of sheet piling 10 to 12 feet apart) would be required. The sub grade elevation for the pipe is proposed at 120.0 MSL. After the pipe is installed the space about the pipe section would be incased with 2 to 6 inch gravel-rock filter material up to elevation160.0 MSL. Following the filter placing operation the sheet piling on the east portion of coffer dam system would be removed for reuse on this construction project. (East & West Branch only)

About ½ mile south of the intersection of County 14th Street and Avenue A, a control structure would be required. This structure would connect to each section of the open jointed pipes on the north, south and east. On the west side would be the gated outfall discharge pipe. The East branch would extend east to the Yuma Mesa A-8.9 canal/Unit "B" canal, were a pump sump structure would be constructed. Extending this branch east of pumping plant should be considered, due to high water table in that area. All sheet pile east of Control Structure (see next paragraph) coffer dam would be removed after backfill of pipe and structures is completed to elevation 160.0. This pump structure with pumps could provide water for the canal system downstream of this point. The outlet pipe would extend west into the Yuma Valley to the existing Yuma Mesa Conduit right of way and north parallel to the conduit to the Colorado River. (See attached Map.)

Control Structure:

Construction of the Control Structure, the East Branch, & Pumping Plant will require an enclosed coffer dam of sheet piling for dewatering (see Dry Method below). The ground water elevation is about 160 +/- MSL. It is suggested that each of the open joint pipe inlet be gated at this structure. Also the outlet Outfall Pipeline will require one gate. Slide gates will be most suited for this application. By installing gates on each pipeline, better control of ground water elevations and salinity will be obtained. The control gates will also provide better control during construction of the adjacent systems. The sheet pile cutoff wall section located on the west side of this structure will remain in place. However, an opening will be required for the Outfall discharge pipe; some type of seal will be needed. It is suggested that a steel ring be welded to the piling and link-seal be installed between the ring and the discharge pipe.

East & West Collector Branches:

The new system will include a cutoff wall of sheet piling running north and south between County 14th Street and County 16th Street, west of Avenue A. The south end of the cutoff wall would deflect to the southeast and continue to the Algodones Fault about 1 mile. The 6 foot diameter open jointed pipe system may continue with the cutoff

[redacted]

wall depending on foundation studies. Or the southeast section of the collector system may be discontinued. However, the cutoff piles on west should be continued to intersect the fault zone. It may be well to install the cutoff wall piling near the existing ground elevation. This depends on the finding of the design study. The minimum cover on piles would be based on the cover needed for farming operations.

The northern portion (north of the Control Structure) of the sheet pile coffer dam would extend north of County 14th Street for a short distance then deflect east toward the rock outcrop on the Marine Base. The cutoff wall piling as well as the pipe with gravel- rock filter would extend east of Avenue A. The cut wall piling may be extended without the collector system in section, based on the foundation study and design.

The top of sheet piles would be at elevation 160.0 +/- MSL. The bottom elevation would be established by the design requirements. An open trench down to elevation 160.0 MSL would be required to minimize length of the sheet piling and cost. The bottom width of the open trench would need to be sufficient area for construction equipment & materials.

General construction preparation work: Remove existing buildings, provide road detours, and relocate power line & other utilities. Two methods are proposed.

Method 1) under water installation: Suggested on the East & West Branches.

Closing the two rolls of sheet piling on one or both ends of the coffer dam would not be required. All the methods will require excavation of material between the sheet piling; this method would require the contractor to provide special equipment to grade the invert ahead of the open jointed pipe installation. Then use the same equipment to install said pipe or a separate piece of equipment to install the pipe, followed by placing the gravel-rock filter about the pipe, up to elevation 160.0 MSL. Then remove east portion coffer dam piles, followed with backfill, etc.

Construction Steps:

Step 1) Excavate an open trench down to elevation 160.0 MSL with outlet ramp and/or daylight excess roads to the west.

Step 2) Install sheet pile coffer dam (two rows) with proper design supports. Soldier Pilings with tie back stressing cable would be suited for this application. If used the cross bracing would not be required.

Step 3) Excavate the soil between the piling down to elevation 120.0+/- MSL.

Step 4) Grade the sub grade with special equipment.

Step 5) Place & grade sub grade gravel-rock, if required.

Step 6) Install open jointed pipe starting at control structure.

Step 7) Place the gravel-rock filter material about the open jointed pipe up to elevation 160.0 MSL.

Step 8) Remove the east side of coffer dam sheet piling.

Step 9) Backfill the open trench to the original contours.

Step 10) Replace buildings, roads and other utilities impacted by this construction project.

Method 2) Dry Method Installation: Required on Control Structure, East Branch & Pump Structure.

Closed coffer dam. This would require excavation and grading of sub grade between the coffer dams. Followed by place concrete sub base section to elevation 120.0 MSL.to seal the bottom section and prevent blow out. Dewater interior of coffer dam, followed by pipe installation, placing of gravel-rock filter, backfill etc.

Construction Steps:

Step1) Due to the limited space and the existing canal being adjacent to East Branch special system of shoring may be necessary. The work area trench elevation may be higher on the East Branch, due to the higher ground water. A secondary row of sheet piling is suggested from the existing ground down to elevation 160.0+/- MSL with tie back soldier piling stressing cable system. This system will provide needed work area. Also longer piles may be needed.

Step 2) Install sheet pile coffer dam (two rows) with proper design supports. Solder Piling with tie back stressing cable would be suited for this application. The entire section will require enclosure.

Step 3) Excavate material (soil) between the piling down to elevation 115.0+/- MSL or as required. Also grade the sub grade to provide the proper concrete thickness per step 4.

Step 4) Place the concrete sub base slab to elevation 120.0 MSL. or about 5 foot thick as required by design.

Step 5) After the sub base concrete has cured to required strength, dewater section between the coffer dams using pumps or other approved methods.

Step 6) Structures: Build the Control Structure & Pump Sump Structure.