Indirect Potable Water Reuse

Should it be Considered?

By

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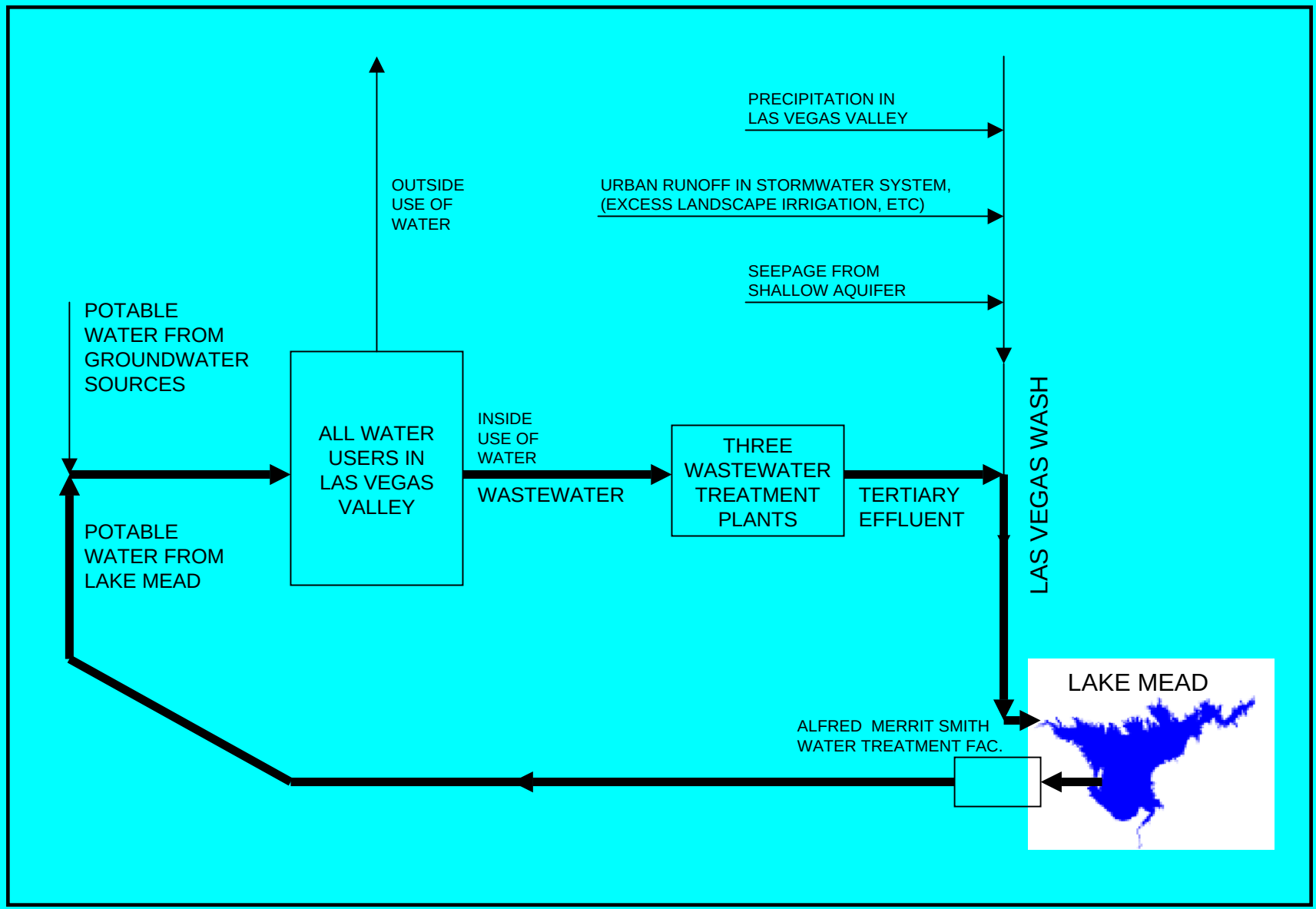
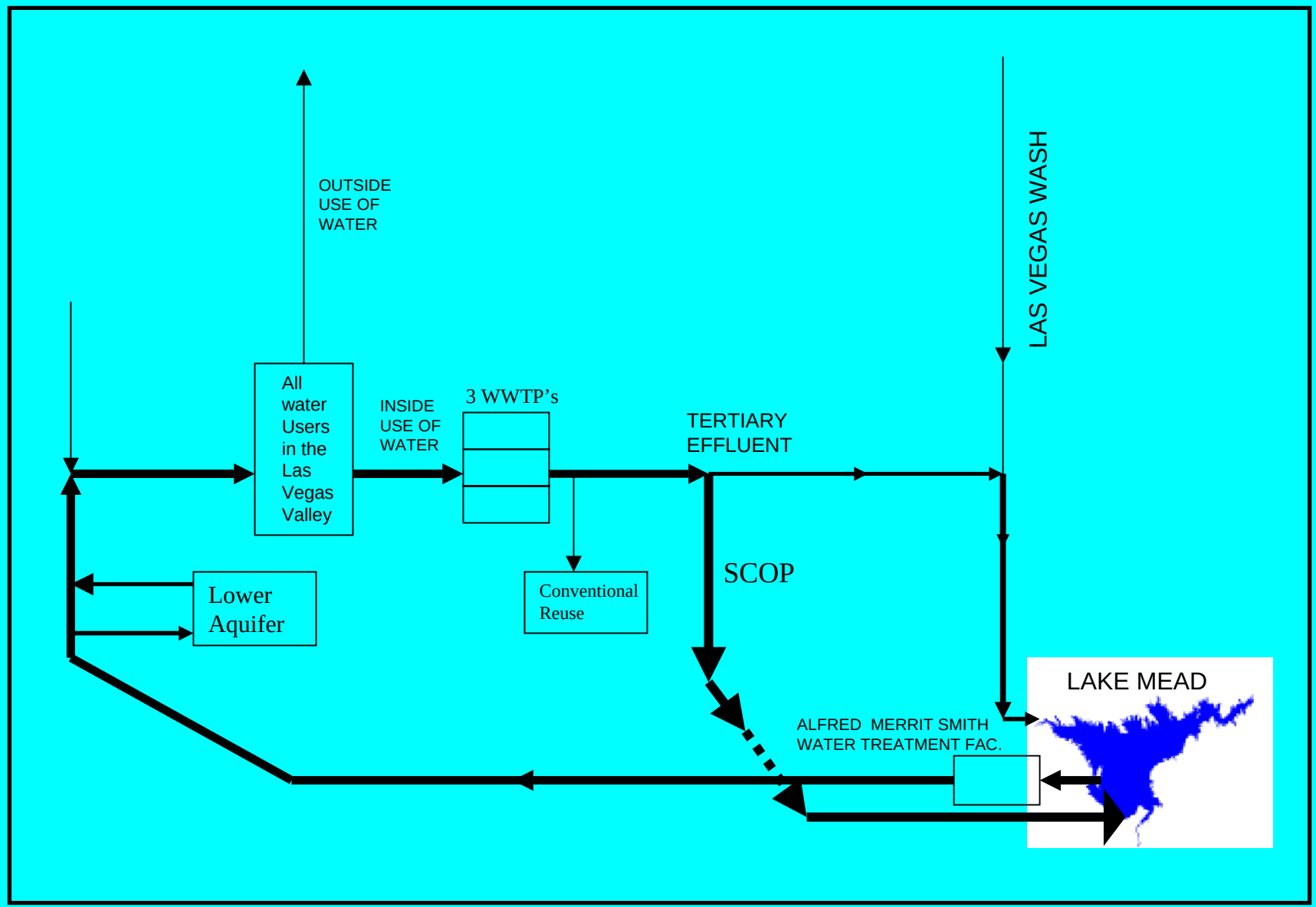
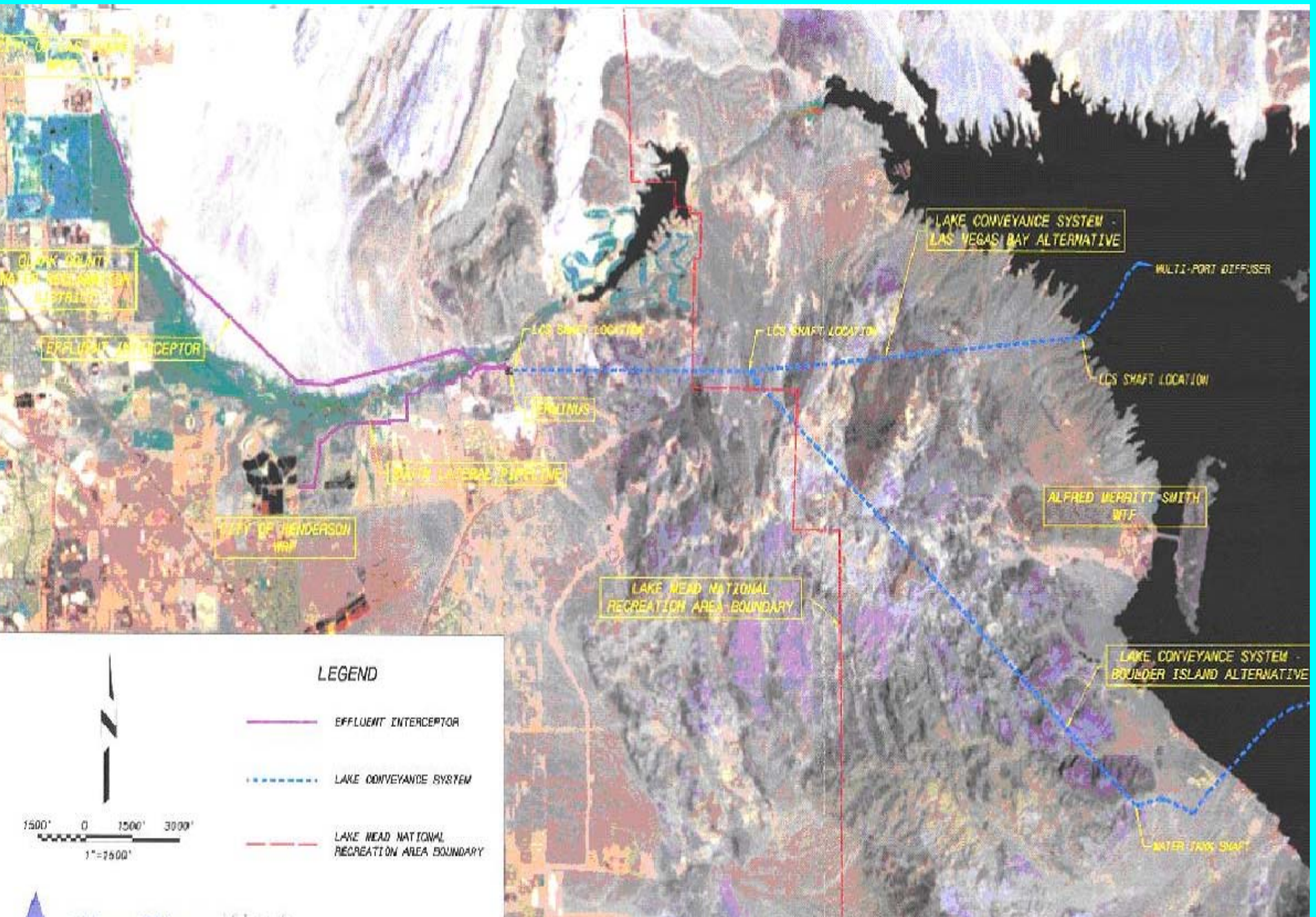
SIMPLIFIED FLOW SCHEMATIC OF HYDROLOGIC CYCLE IN LAS VEGAS VALLEY



SCHEMATIC OF HYDROLOGIC CYCLE IN LAS VEGAS VALLEY - **SCOP** IMPLEMENTATION SCENARIO



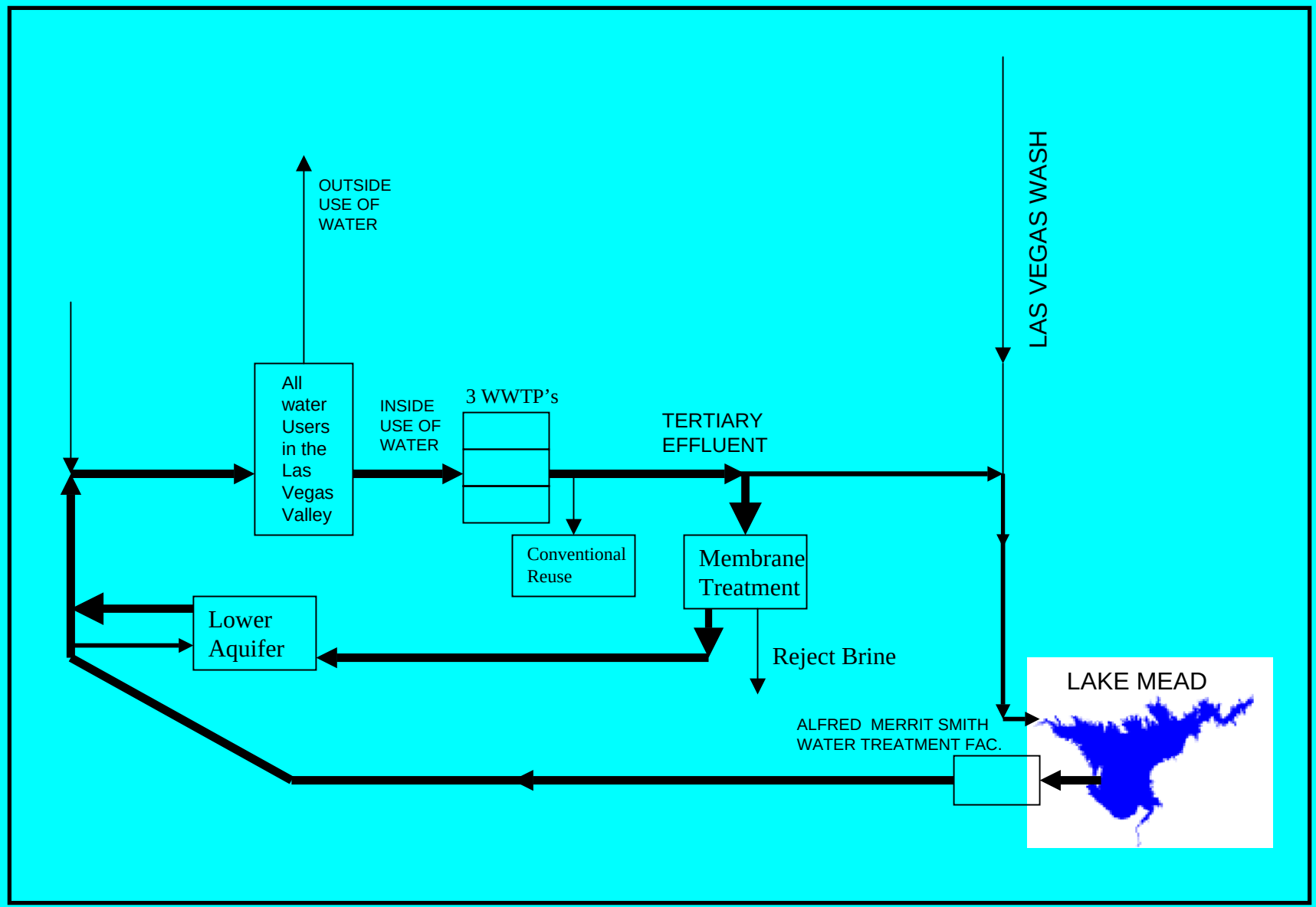
SCOP


LAKE CONVEYANCE SYSTEM - LAS VEGAS BAY ALTERNATIVE
MULTI-PORT DIFFUSER
LCS SHAFT LOCATION
LCS SHAFT LOCATION
LCS SHAFT LOCATION
EFFLUENT INTERCEPTOR
TERMINUS
ALFRED MERRITT SMITH WTF
LAKE MEAD NATIONAL RECREATION AREA BOUNDARY
LAKE CONVEYANCE SYSTEM - BOULDER ISLAND ALTERNATIVE
WATER INTAKE SHAFT
LEGEND
EFFLUENT INTERCEPTOR
LAKE CONVEYANCE SYSTEM
LAKE MEAD NATIONAL RECREATION AREA BOUNDARY
1500' 0 1500' 3000'
1"=3000'

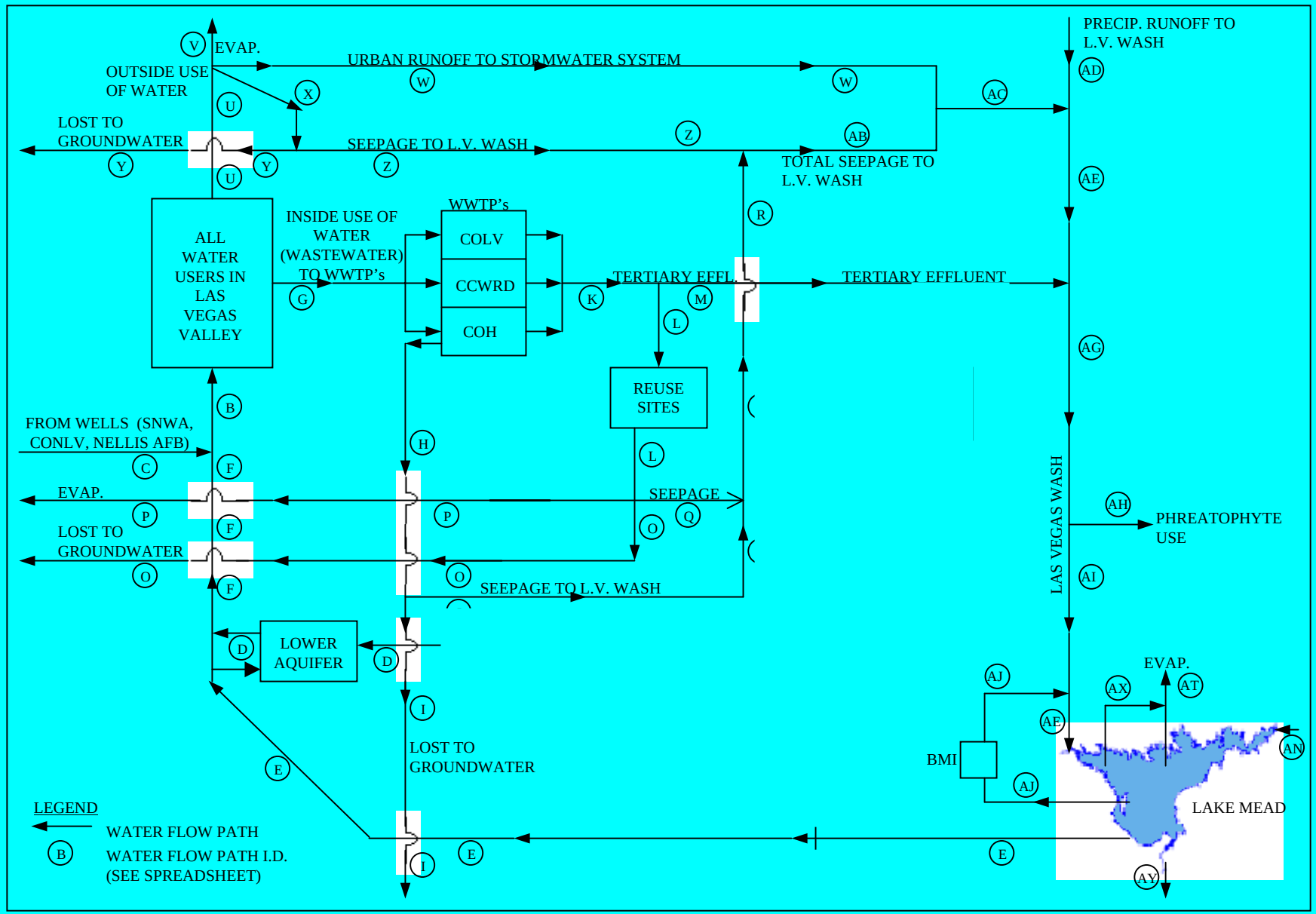
Justification Provided for SCOP

- New discharge location offers mixing and dilution advantages.
- Reduced nutrient discharge to Las Vegas Bay.
- Reduce impact to SNWA water intakes.
- Effluent discharge at Boulder Basin would not be subjected to TMDLs in a loading basis, but in a concentration basis.

SCHEMATIC OF HYDROLOGIC CYCLE IN LAS VEGAS VALLEY - **IPWR** IMPLEMENTATION SCENARIO



Comprehensive Water Balance of the Las Vegas Valley



WATER BALANCE OF LAS VEGAS VALLEY & LAKE MEAD (Page 1 of 4)

A	B	C	D	E	F	G	H	I	J	K	L	M
	From SNWA or Est'd	From SNWA or Est'd	Est'd from studies	B – C – D	D + E	From SWAC or Est'd	Est'd	Est'd at 25 % of H, or rough estimate	Est'd at 75 % of H, or rough estimate	G – H	From SWAC or Est'd	K – L
YEAR	POTABLE WATER SUPPLIED TO ALL WATER USERS IN LAS VEGAS VALLEY					INSIDE USE OF WATER DISCHARGED AS WASTEWATER TO WWTP's at COLV, CCWRD & COH	CITY OF HENDERSON WWTP PONDS AND RIB's			TERTIARY EFFLUENT FROM THE THREE WWTP's	TERTIARY EFFLUENT DISCHARGED TO REUSE SITES	TERTIARY EFFLUENT EITHER DISCHARGED TO LV WASH OR AVAILABLE FOR IPWR/ ASR SYSTEM (membrane trt.)
	TOTAL WATER SUP. TO ALL WATER USERS	FROM WELLS	FROM PROP. IPWR/ ASR SYSTEM	FROM LAKE MEAD (SNWS) Colorado River Water	TOTAL FROM IPWR & ASR LAKE MEAD		WATER APPLIED TO PONDS AND RIB's	FATE OF WATER APPLIED TO GROUND SURFACE				
								LOST TO GROUND -WATER	SEEPAGE TO LAS VEGAS WASH			
	MGD	MGD	MGD	MGD	MGD	MGD	MGD	MGD	MGD	MGD	MGD	MGD
1997	359.6	41.67	0.0	317.93	317.93	134.14	2.0	0.49	1.50	132.15	9.75	122.40
1998	364.8	41.44	0.0	323.36	323.36	140.43	1.8	0.45	1.35	138.63	12.64	125.99
1999	403.7	40.5	0.0	363.2	363.2	146.87	1.7	0.43	1.28	145.17	13.45	131.72
2000	427.2	40.84	0.0	386.36	386.36	156.51	1.6	0.40	1.20	154.91	15.71	139.20
2001	437.3	43.17	0.0	394.13	394.13	160.5	1.5	0.38	1.13	159.00	16.22	142.78
2002	432.3	42.86	0.0	389.44	389.44	165.36	1.4	0.35	1.05	163.96	19.73	144.23
2003	417.2	41.33	0.0	375.87	375.87	162.71	1.3	0.33	0.98	161.41	19.62	141.79
2004	420.0	41.5	0.0	378.5	378.5	168.0	1.2	0.30	0.89	166.8	20.9	146.0
2005	425.0	41.5	0.0	383.5	383.5	174.0	1.0	0.25	0.75	173.0	21.3	151.7
2006	430.0	41.5	0.0	388.5	388.5	176.3	1.0	0.25	0.75	175.3	21.9	153.4
2007	437.0	41.5	0.0	.395.5	395.5	183.5	1.0	0.25	0.75	182.5	22.8	159.7
2008	448.0	41.5	0.0	406.5	406.5	201.6	1.0	0.25	0.75	200.6	23.8	176.8
2009	455.0	41.5	24.5	389.0	413.5	213.9	1.0	0.25	0.75	212.9	24.5	188.4
2010	464.0	41.5	73.5	349.0	422.5	218.0	1.0	0.25	0.75	217.0	25.0	192.0
2020	560.0	41.5	196.0	322.5	518.5	280.0	1.0	0.25	0.75	279.0	25.5	253.5
2030	668.0	41.5	269.5	357.0	626.5	334.0	1.0	0.25	0.75	333.0	26.0	307.0
2040	750.0	41.5	318.5	390.0	708.5	390.0	1.0	0.25	0.75	389.0	26.5	362.5
2050	840.0	41.5	392.0	406.5	798.5	460.0	1.0	0.25	0.75	459.0	27.2	431.8

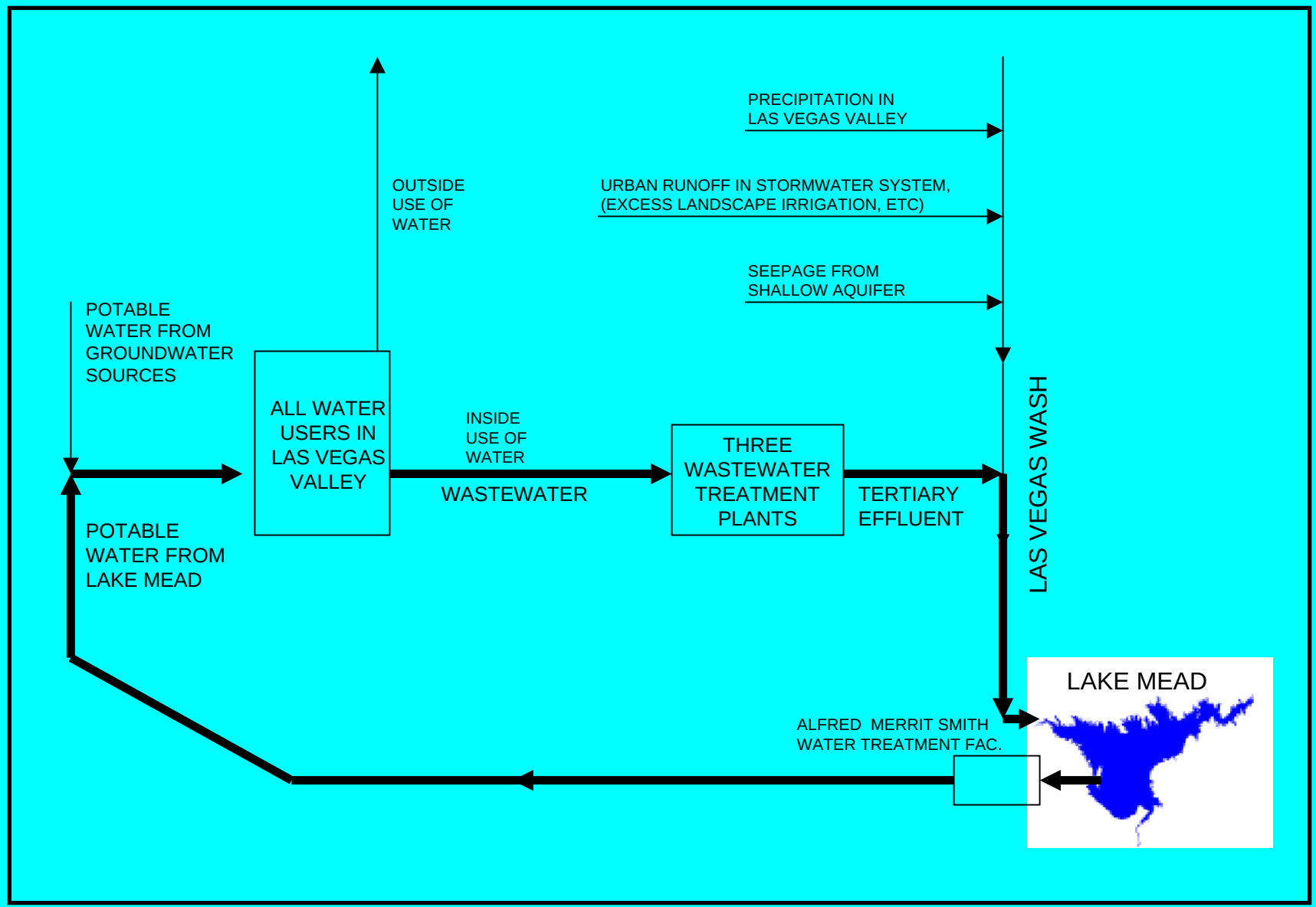
INDIRECT POTABLE WATER REUSE (IPWR)

An alternative to SCOP

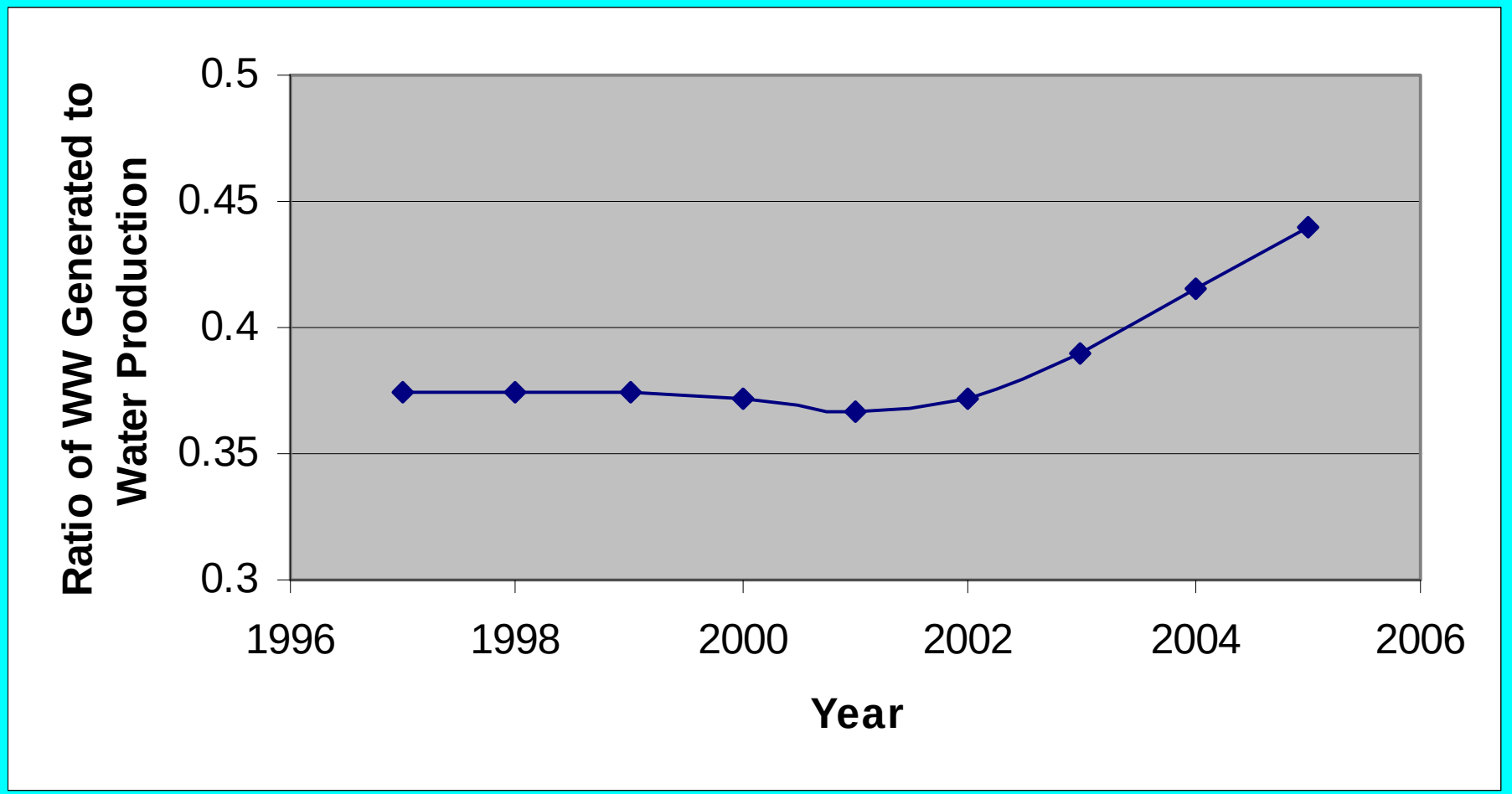
Advantages:

- Removal of several contaminants (e.g. PCPP's, endocrine disrupters, nutrients) from Lake Mead and the Colorado.
- Significant reduction of TDS discharged to the Colorado River.
- Less cost than SCOP, and IPWR achieves much better water quality.
- Drought-Proof source of water because of less reliance on Lake Mead.

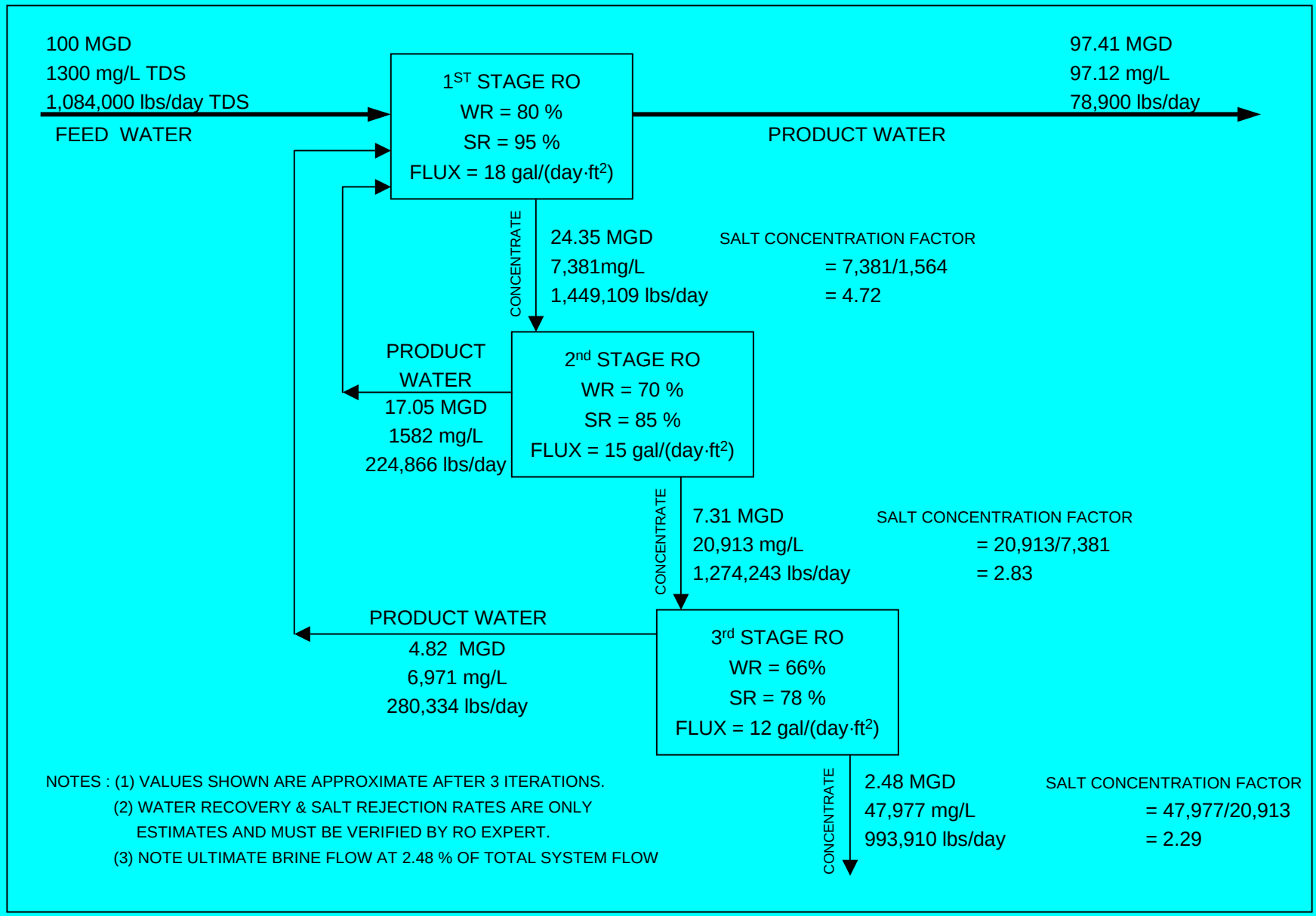
SIMPLIFIED FLOW SCHEMATIC OF HYDROLOGIC CYCLE IN LAS VEGAS VALLEY



Historical Wastewater/Water Ratios in Las Vegas Valley using 3-year Moving Averages



PRELIMINARY FLOW SCHEMATIC OF 3-STAGE RO SYSTEM AT 100 MGD FEED



NOTES : (1) VALUES SHOWN ARE APPROXIMATE AFTER 3 ITERATIONS.
(2) WATER RECOVERY & SALT REJECTION RATES ARE ONLY ESTIMATES AND MUST BE VERIFIED BY RO EXPERT.
(3) NOTE ULTIMATE BRINE FLOW AT 2.48 % OF TOTAL SYSTEM FLOW

MAJOR IMPACTS OF IPWR ON WATER QUANTITY AND QUALITY

IPWR'S IMPACTS ON WATER QUANTITY

- Effluent not returned to Lake Mead as "Return Flow Credit" is compensated by use of high quality water generated by membrane.

- Loss due brine generation with IPWR: 2.5% of 400 MGD= 10 MGD at year 2050.

IPWR'S IMPACTS ON WATER QUALITY

• Contrary to SCOP, which focuses exclusively on reduction of phosphorus levels, IPWR would remove most contaminants of the water treated.

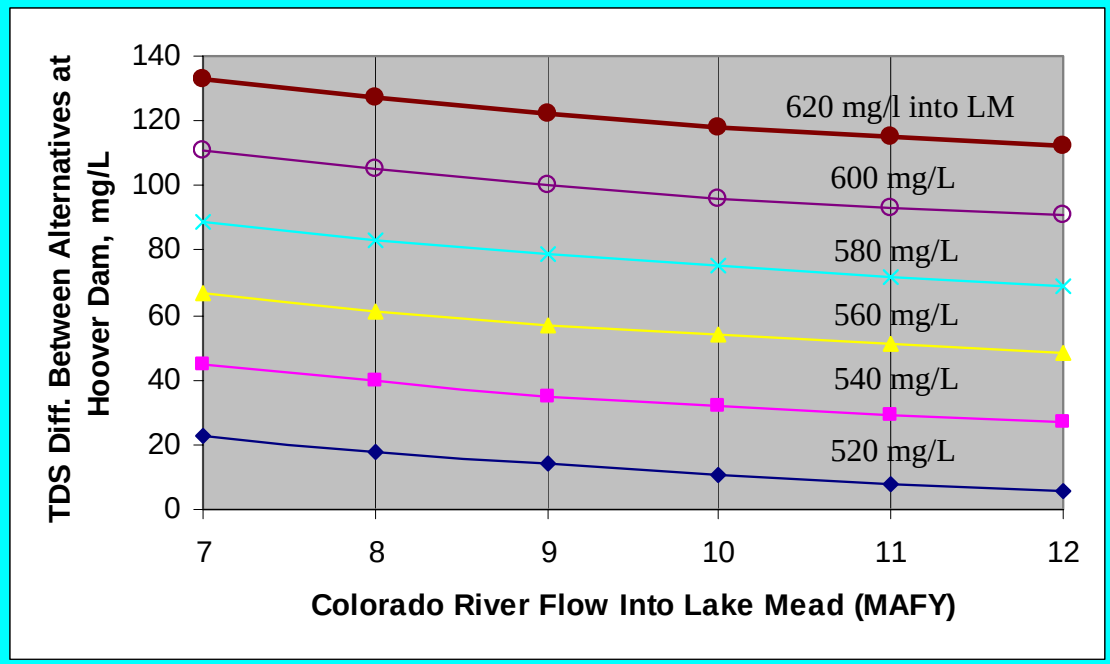
• IPWR presents major flexibility relating to future emerging contaminants.

IPWR'S IMPACTS ON WATER QUALITY

•IPWR would have major impact on the TDS concentrations in the Colorado: At year 2050 and 400 MGD, net TDS concentration difference between SCOP and IPWR in downstream Colorado River is estimated at 30 to 50 mg/L .

• The Colorado River Basin Salinity Control Program estimates that each 1 mg/L TDS over 500 mg/L discharged to the Colorado causes a $ 2.6 M/year (1994 dollars) damage to the Colorado (WWW.USBR.gov/crwq.html).

TDS Differences Between Alternatives at Various Flows in Colorado River



Assumptions

- Year 2050
- 400 MGD feed to membrane
-- 1300 mg/L feed to membrane
-- 2500 mg/L in the LV Wash

Example Typical Economic Evaluation

	Alternative " A "	Alternative " B"
Capital Cost	$ 100 M	$150 M
Annualized Capital Cost *	$6.65 M/year	$ 9.97 M/year
Annual O & M Cost	$8.50 M/year	$4.50 M/year
Total Annual Cost	**$15.15 M/year**	**$14.47 M/year**

*Annualized capital cost is determined using a capital recovery factor based on 6% interest and 40 years life. CRF= 0.06646

- Although the capital cost of " A" is less, the total annual cost is more.

COST COMPARISON SCOP VERSUS IPWR

	SCOP Alternative	**IPWR Alternative**
Capital Cost *	$ 623.00 M	$1,246 M
Annualized Capital Cost **	$ 41.96 M/year	$ 83.93 M/year
Annual O & M Cost	$ 656.46 M/year	$ 556.66 M/year
Total Annual Cost	**$ 698.42M/year**	**$ 640.59 M/year**

Total annual cost of IPWR alternative is $ 57.83 M/year less than SCOP, or 8.3% less.

* Capital cost is present worth of capital cost

** Annualized capital cost is determined using a capital recovery factor based on 6% interest And 38 years life period. CFR = 0.06736

IPWR Systems

- Planned IPWRs

Those systems intentionally designed to recover highly treated wastewater effluent and blend into potable water systems.

- Unplanned IPWRs

Those systems whereby water is extracted from a stream or Lake for potable water purposes and is located downstream of a wastewater effluent discharge. This occurs in several instances in the World, including here in Las Vegas.

PUBLIC PERCEPTION

• Several IPWR systems are currently operating or planned in the US:

- Orange County, CA = 70 MGD, to go online August 2007
-Scottsdale, AZ = 7 MGD, in operation
- El Paso, TX= 5 MGD, in operation
- West LA Basin, CA= 20 MGD, in operation
- Occaguan, Virginia, in operation
-San Diego, CA. = 15 MGD, planning stage

SUMMARY

- SCOP is a pipeline/tunnel/diffuser system that will continue to discharge tertiary effluent to Lake Mead with impact on phosphate levels only. The removal of other contaminants will not be impacted by SCOP.

- SCOP development is proceeding and plans are to start construction in two years.

SUMMARY

IPWR has several advantages:

• Significant removal of all contaminants contained in tertiary effluent.

•Significant cost savings when considering major impacts to all other users in the lower Colorado River Basin.

•Provides a very high quality, drought-proof source of potable water.

Disadvantages of IPWR

• Minimal loss of water (2.5 %) due to brine generation

• Public perception