

Ec. 134 Current Materials

\$350 million MWD water delivery plan draws fire

By DOUG BEEMAN

Press-Enterprise Staff Writer

LOS ANGELES — The Metropolitan Water District yesterday proposed a \$350 million building program designed to meet growing water demand and offset the loss of Colorado River water with water from Northern California.

Officials said this would be the district's largest building project since the early 1970s, when facilities were built for the State Water Project.

But as quickly as general manager Carl Boronkay released his recommendation, some of Metropolitan's governing board members criticized the plan. Some favored a different plan and others argued that the district should encourage more water conservation.

Boronkay said he will bring his proposal back to the district board for consideration Feb. 12, although he said he expects debate on it will be continued to March.

The district is looking for ways to obtain more Northern California water to replace the Colorado River water that will be diverted when Arizona begins taking its share within the next year.

The district estimates it will lose more than half of the 1.2 million acre-feet a year it now draws from the Colorado River. An acre-foot is 325,900 gallons, or enough water to cover an acre a foot deep.

Metropolitan currently is allowed to take up to 1.5 million acre-feet of water annually from Northern California. But the system of canals and tunnels to bring it to Southern California is capable of delivering only 1.2 million acre-feet a year.

"We cannot deliver State Water Project water we now have," said Myron Holburt, the district's assistant general manager.

During a three-hour meeting yesterday, Boronkay and his staff outlined two proposals:

✓ A \$350 million plan to expand the 110-mile east branch of the State Water Project from the Kern County line to Silverwood Lake in the San Bernardino Mountains. The project would consist primarily of raising the sides of the canal to handle more water.

✓ A \$550 million plan to expand 34 miles of the middle reach of the district's foothill feeder. The middle reach covers a shorter distance than the proposed east branch expansion, but it would involve drilling tunnels and other costly improvements. Although the cost of building the middle reach is higher than the east branch expansion, it would be cheaper to operate because it would use less electricity to move water.

Boronkay told directors both (See WATER, Page B-2)

Water . . .

(From Page B-1)

were good plans to bring more Northern California water to the district to replace Colorado River water and serve high-growth areas in Riverside and San Diego counties. Construction of either would be completed in the early 1990s, according to district estimates.

But Boronkay recommended the east branch project because it can be built in phases, giving the district a chance to assess its water needs before expanding the system further.

He suggested the district seek two different types of bids — one for expanding the east branch to handle another 450,000 acre-feet a year (which would cost an estimated \$300 million) and one for expanding it to handle 550,000 acre-feet (which the district estimates would cost another \$50 million). If the district can save money by building the entire 550,000 acre-foot expansion, it

may want to proceed with it altogether, Boronkay said.

The district estimates the first phase would allow the district to meet its demand for water through the year 2007, and the second phase would meet the needs through 2016.

Directors from San Diego and the Pasadena area argued that the district should use the money to expand its own system rather than a State Water Project canal across the desert. Some members also suggested the district should encourage water conservation among its water users to offset some of the projected increased water demand.

A. B. Smedley, who represents the Foothill Municipal Water District near Pasadena, noted that the east branch traverses the San Andreas fault. He said the damage to the aqueduct caused by an earthquake would be compounded by erosion caused by leaks from the breaks.

"It doesn't take much of a leak to cause considerable damage," Smedley said.

Building in excess capacity. See p. 6

1. E.g., MWA proposal to expand the East Branch of SWP, from Kern City line to Silverwood L.
(MWA wd. pay to raise sides of SWP canal.)
2. East Branch could build in excess capacity

$\frac{K}{C}$	K/C	K (\$m)	Capac. Capac. (Maf/y)	ΔK	% ΔK	$\frac{C}{\Delta K}$	% ΔC
-	667	300	450,000	-	-	-	-
500	636	350	550,000	50m	17	100,000	22

$C_{th} \equiv$ Ultimate Capacity.

e of $\frac{C}{th}$ w.r.t. $K = \frac{22}{17} = 1.29$. Looks good, speciously. But need to know time of use.

$R \equiv$ ^{net} Revenue or Cash Flow

T-1

n	Flow	Rates	Rw.	Time Factor
1-4	4050	30	1500	
5-8	40150	35	5250	
9-12	300250	40	10,000	
13-16	450	45	20,250	
17-20	550	50	27,500	

T-1 is the hard way.

Easier, let R grow by 5% / yr. as flow grows.

Also easier, life ends when capacity reached — replant. required, in same spot. As with:

- dams
- bldgs
- wtr. lines
- a home. Buy now for larger family?

3. A wtr. line must be replaced when it reaches capacity -- (the row. is too narrow for a tree.)

A. E of C w.r.t. $K = 2$

To prove: ~~$C = c \pi r^2$~~ $C = c \pi r^2$

$$r = \frac{D}{2} = \frac{1}{2} \frac{K}{\pi} = \frac{K}{2\pi}$$

$$r^2 = \frac{K^2}{4\pi^2}$$

$$C = c \frac{K^2}{4\pi}$$

$$\frac{dC}{dK} = c \frac{2K}{4\pi} = \frac{cK}{2\pi}$$

$$\frac{C'}{C} = \frac{\frac{K}{2\pi}}{\frac{K^2}{4\pi}} = \frac{K/2\pi}{K^2/4\pi} = \frac{2}{K}$$

$$\frac{K'}{K} = \frac{1}{K}$$

$$\epsilon = \frac{2/K}{1/K} = 2$$

Alt. Proof, using log deriv.

$$C = c \frac{K^2}{4\pi}$$

$$\ln C = \ln c + 2 \ln K - \ln 4 - \ln \pi$$

$$\frac{d \ln C}{d K} = 2 \cdot \frac{1}{K}$$

$$\frac{d \ln K}{d K} = \frac{1}{K}$$

$$\epsilon = 2$$

B. What is opt. capacity?

1. % method, using ϵ

Use grows by const. amt ea. yr., so doubling the ~~value~~ C will double the n (assuming $R_0 = 0$). If $R_0 > 0$, then doubling C will more than double n)

C	K	n	PV factor		E of PV	
			@ 5% PV	@ 10%	Wrt n @ 5%	@ 10%
1	1	5	4.33	3.79	.90	.82
2		10	7.72	6.14	.80	.63
4	2	20	12.46	8.51	.60	.35
8		40	17.16	9.78	.33	.09
16	4	80	19.60	10.00	.08	.004
32		160	19.99	10.00	.003	

$$P' = I^{-n}$$

$$\frac{P'}{P} = \frac{I^{-n} i}{1 - I^{-n}} = \frac{i}{I^n - 1}$$

$$\frac{P'/P}{1/n} = \frac{ni}{I^n - 1}$$

But the above is the "instantaneous" (annual) E.
For big jumps, like doubling, is too hi.

$$\Delta P = P_{2n} - P_n = \frac{I^{-2n} - I^{-n}}{i} = I^{-n} \frac{I^{-n} - 1}{i} = I^{-n} \frac{1 - I^{-n}}{i}$$

$$\frac{\Delta P}{P} = I^{-n}$$

$$\frac{\Delta P/P}{1/n} = n I^{-n} \quad \text{when } n \text{ doubles? } \underline{\text{No Way!}}$$

$$\Delta n/n = 1, \text{ so } \therefore E = I^{-n}$$

Let's check that numerically.
 $i = .08$

<u>n</u>	<u>PV</u>	<u>$\Delta P/P$</u>	<u>I^{-n}</u>	<u>$n I^{-n}$</u>	<u>E at the point</u>
1	.93	-	.93	.93	1.00
2	1.78	.91	.86	1.72	.96
4	3.31	.86	.74	2.96	.89
8	5.75	.74	.54		.75
16	8.85	.54	.29		.53
32	11.43	.29			.24

OK! Handy Rule of Thumb. Double n

and $\Delta P/P = I^{-n}$.

$$\text{Capacity}_i = C$$

$$C \propto K_0^2$$

$$PV = a \frac{1 - i^{-n}}{i} = a_0 \frac{1 - (1+i-g)^{-n}}{i-g}$$

$$n \text{ th } \frac{a}{i} \text{ arrives when } a_0 (1+g)^n = C$$

$$\ln a_0 + n \ln(1+g) = C$$

$$n = \frac{C - \ln a_0}{\ln(1+g)}$$

20. MWD has proposed to expand capacity of E. Br. of SWP from KC line to Atterwood h. In ft. venture a. State, MWD wd. raise rates. K₀ is \$300m for cap. of 450,000 af/y. How much ^{value} must they ^{add} charge for the ~~increase~~ ^(+ earn from) to ^(+ collect) justify the cost, given.

Ec. life = 20 yrs.

$i = .10$

a. Assume the capacity all goes right to full use.

b. Assume it is phased in over 15 yrs.

$$a. \quad \$300m / 450k = \$667/af-y$$

$$|P_i| = .117$$

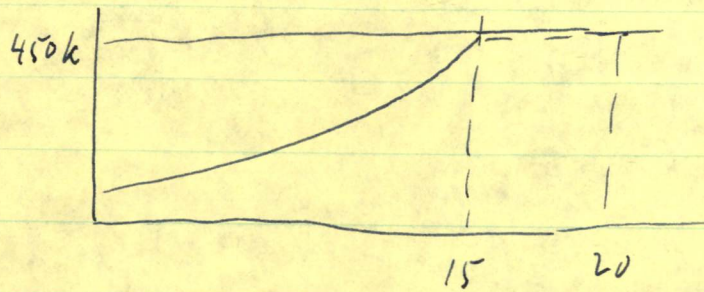
$$.117 \times 667 = \$78.35$$

$$667 \times 450k = 300,150,000$$

$$or \quad .117 \times 300m = 35.1m$$

$$35.1m / 450k = \$78.35/af-y$$

b.



$$a_1 I^{-1} + a_2 I^{-2} + \dots + a_{15} I^{-15} = \$300m$$

$$a_2 = a_1 (1.05) \text{ etc.}$$

$$a_1 [I^{-1} + 1.05 I^{-2} + 1.05^2 I^{-3} + \dots]$$

$$= a_1 \left\{ (1+i)^{-1} \left[1 + \left(\frac{1.05}{1+i} \right)^1 + \left(\frac{1.05}{1+i} \right)^2 + \dots \right] \right\}$$

$$= \frac{a_1}{1+i} \left[1 + (1+i-.05)^{-1} + \dots \right]$$

$$= \frac{a}{1+i} \left[1 + J^{-1} + J^{-2} + \dots \right]$$

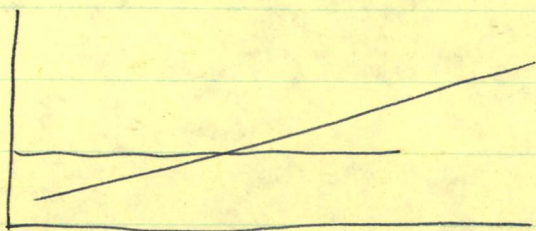
$$= \frac{a}{1+i} \left[\frac{1 - J^{-15}}{i - .05} \right]$$

$$a = 300m \frac{i - .05}{1 - (1+i-.05)^{-15}}$$

etc.

Too hard for this final, this class.

Leases bought. How much pay?



Lease, orig. 20 yrs.

$$K_0 = 100k$$

E. Blue Rent = ~~20~~ 30k/yr.

$$a = c.f.(\text{rent}) = 10k (1.10)^n$$

$$PV = 10k \frac{1 - 1.01^{-20}}{.01} = \$180.04k$$

After 5 yrs, sell lease.

$$K_5 = 40k$$

$$a = 30k (10 \text{ yrs}) + 25k (5 \text{ yrs})$$

How much pay for lease? $PV = ?$

$$PV = -40k - 20k \frac{1 - 1.11^{-15}}{.11} + \left(30k \frac{1 - 1.11^{-10}}{.11} + 25k \frac{1 - 1.11^{-5}}{.11} \right)$$

PV

$$\begin{aligned} & -40k \\ & -20k \frac{1 - 1.11^{-15}}{.11} \end{aligned}$$

$$+ 30k \frac{1 - 1.11^{-10}}{.11}$$

$$+ 25k \frac{1.11^{-10} - 1.11^{-15}}{.11}$$

-	<u>PV</u>	+
- 40 k		
- 20 k · 7.19		
= - 143.82 k		
183.82		

$$30 k \cdot 5.89 = 176.67 k$$

$$25 k \cdot 1.30 = 32.54$$

$$209.21$$

$$PV = 25.39 k$$

10/11/83

~~Alt~~ Alternative Forms of PV Formula.

$$1. \quad P = a \frac{1 - (1+i)^{-n}}{i}$$

$$2. \quad \text{Solve for } a = P \frac{i}{1 - (1+i)^{-n}}$$

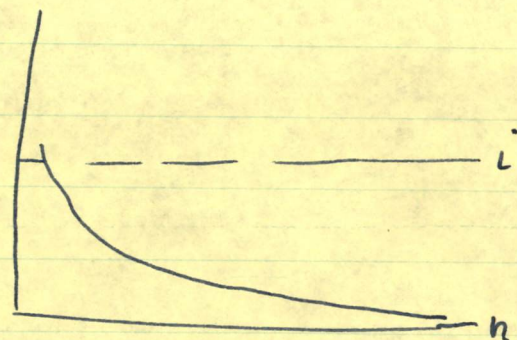
Installment Plan

Amortizing loan

C.r.f. -- for owned assets, this tells you what you must ~~get back~~ charge to recover P with interest.
In ec. thg. this is large part of AFC.

$$a. \quad n = 1, \text{ ~~or~~$$

$$a = \frac{i}{\frac{i}{1+i}} = 1+i$$



$$b. \quad n = \infty$$

$$a = i$$

Case of land. You never recover P .

($\therefore$ banks shouldn't lend to buy land.)

($\therefore$, ability to buy land depends more on individual's wealth. Is no mkt. in funds to buy land.)

$$c. \quad i = 0 ; \quad a = \frac{1}{n}$$

With $\text{int.} > 0$, $a > \frac{1}{n}$

With $n < \infty$, $a > P_i$

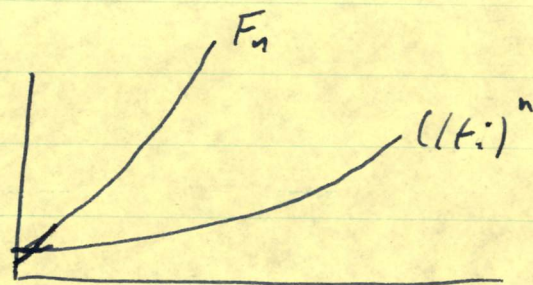
When $(1+i)^n = 2$, $a = 2i \cdot P$

d. How much of a is interest?

$$P_i = a [1 - (1+i)^{-n}]$$

3. Solve for $F_n = P_0 (1+i)^n$

$$F_n = a \frac{(1+i)^n - 1}{i}$$



Uses:

a. Cousin Morgan's trust fund (Golden Pond)

$$\cancel{\$10,000} \times \frac{1.1^7 - 1}{.1} = \frac{\cancel{10,000}}{.1} = 700,000$$

(a lot more than 210,000)

b. Puipk, Camd.

Cost of \$36

But spread over 10 years.

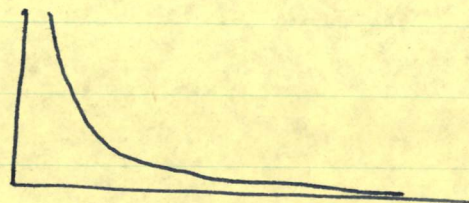
$$\$.36 \frac{1.1^{10} - 1}{.1} = .36 \frac{2.59 - 1}{.1} = .3 \cdot 15.94 = 4.78$$

$$\frac{4.78}{3} = 1.59$$

(Was actually longer than 10 yrs, but, after completion, wd. not be fully used for another 20 yrs. or so.)

4. Sinking fund. Solve (3) for a

$$a = F \frac{i}{(1+i)^n - 1}$$



Uses:

a. Ship v. Timber.

$$n = 60$$

$$(1+i)^n = 64$$

$$F = 10,000$$

$$a = 10,000 \frac{.01}{63} = \$11.11$$

b. Decommissioning Nukes
Spent fuel

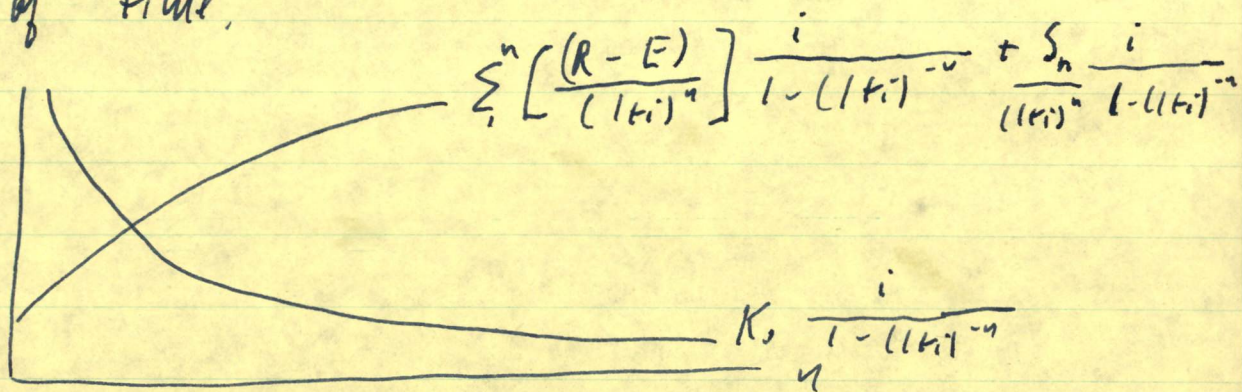
Tricks used:

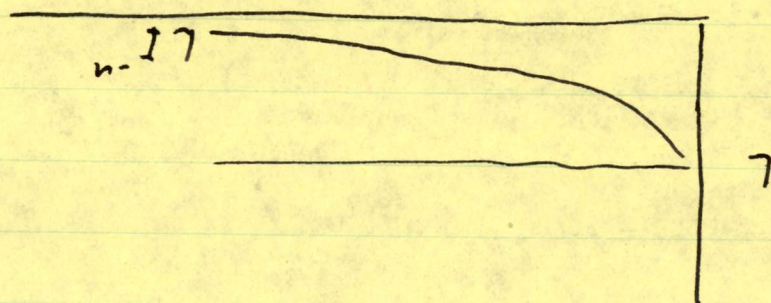
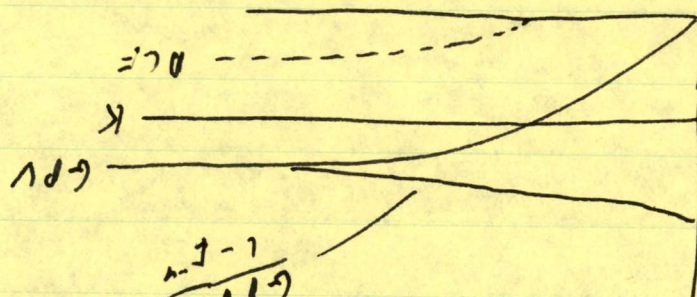
- Use a hi i.r. R.W. Berk used hi rate here, vs. low rates elsewhere.

- Use a hi n.

c. ~~lecture~~

5. Quantity formulae as averages, adjusted for value of time.





$$n-17 + GpV = \frac{n-17}{GpV}$$

$$a = P \frac{i}{1 - I^{-n}}$$

$$\text{Deprec.} = a I^{-n} = P \frac{i}{I^n - 1}$$

$$i = .05$$

$$n = 10$$

$$P = 7.72$$

$$a = 1$$

$$\frac{1 - 1.05^{-10}}{.05} = 7.72$$