DROP INLET SPILLWAYS

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The following remarks will be based on experience of the Virginia Commission of Game and Inland Fisheries with Drop Inlet Spillways to cut and cover conduits through earth dams. These have served our Public Fishing Lakes satisfactorily for many years. Recent developments indicate improvements can be of significant assistance to operation. Perhaps our fellow engineers at this conference will be pleased to exchange ideas and information that will assist in providing the best in design and overall economy for these overflow structures which are generally intended to handle normal outlet flows.

"Hydraulics of Drop Inlet Spillways" by Hudson A. Amsterburg of S.C.S., Spartanburg, S. C., given at the 1961 Southeastern Conference held in Atlanta, Georgia was a beginning. Now we need to become more and more specific and to exchange experiences of both design and construction cost.

Let's pave the way with a few remarks under the headings of:

Relative Costs
Location
Capacity
Safety and Performance

Relative Costs: Analysis of the two estimates and one schedule of values for our most recent head towers and reinforced concrete conduits, indicates these towers represent three and one-half to five per cent of the construction costs. The reinforced concrete underdrains on concrete cradles are another four to five per cent of total construction cost. Thus, together about ten per cent of our construction money for public fishing lake development now goes to this item, when rolled fill, zoned earth dams from 25 to 45 feet high are used.

Location: We have been locating outlet towers at the upstream toe of the dam in comparatively broad flat areas. An invert is sought that will allow draining of the reservoir except for a very small pool or portion of the original channel. In some cases this pool and channel has been too large and too boggy for convenient seining and in others the mud flow through the underdrain to the seine box has been a problem. Present fish management policy seems to favor draining for complete fish removal and sorting at intervals of about six years, but capability of lowering lakes to provide economical acre footages for selective poisoning seems to be growing in importance. This leads us right into the next subject.

Capacity: Fish management requirements remain only partially stated and may well continue to be so for some years. I believe we can improve our service by increased exposition of what can be readily accomplished and the approximate costs of various ideas proposed. In the past it has been acceptable to draw down fishing lakes during low flow periods, and it seems likely that future requirements will not require outlet works to handle flood flows nor more than reasonable multiples of average flows. But for those of us having our low flow periods in September and October there may be some special considerations when a comparatively high altitude lake becomes a trout lake and fall spawning could be used as a reason to have the draining at other times. In the bibliography as well as in your own library there are plenty of examples of basic hydraulic computations upon which minimum designs would be based. But your experience will bear out the general concept that not only would minimum design throw water to your emergency spillways more frequently and at greater head, but would leave you with other serious problems.

Safety and Performance: Balancing hydraulic requirements and practical considerations with strength and buoyancy considerations will probably indicate a larger, stronger, and heavier tower than would be required to satisfy hydraulic needs. This happily may offer the opportunity to handle both higher diversion flows during construction and

temptation to anticipate future need of a larger underdrain. Experience will probably support the opinion that extra care in design and construction of this drop inlet spillway and conduit combination can contribute generously to the success of public fishing lake operation. It may be that larger structures consistent with downstream considerations will be coming in style. Draining through slide gates and removal of low oxygen bottom water through bottom draw pipes with overflow weir control may prove more important for certain operations.

Summary: The need to exchange the specilized information relating to our various conservation engineering services is well recognized, and each component of our facilities deserves the best that experience and judgment can contribute. Some of our recent engineering cost estimates and a contractor's schedule of values for improvements to an existing dam and construction of a new head tower found in the appendix may be of some general interest. Also a print of the engineering drawings of a proposed drop inlet spillway to cut and cover conduit with details of seine box and fish holding pond are added in appendix. Perhaps a rather wide exchange of plans would be quite beneficial.

APPENDIX

ESTIMATE OF COST
PUBLIC FISHING LAKE ON CLEAR CREEK
ORANGE, VIRGINIA

By WARREN C. PERROW, *Consultant Engineer* 2-14-63

1.	Clear & Grub site for dam: 5 Ac. @ $400	$2,000	
	Clear other areas of pond: 20 Ac. @ $150	3,000	$ 5,000
2.	Deepening along shoreline: 2,500 ft. @ $2.00		5,000
3.	Compacted earth fill in place: 80,500 C.Y. @ $0.50		40,250
4.	Rip-rap on upstream face of dam: 240 Tons @ $10.00		2,400
5.	½" Asbestos Barrier Wall (corrugated cement-asbestos siding) 2,450 S.F. @ $0.60		1,470
6.	Head Tower, Gate and under-drain complete:		
	Tower 30 ft. high: 28 C.Y. reinf. conc. @ $90.00	2,420	
	Gate, 24" x 24" with Ext. Stem complete	600	
	C.I. Pipe for continuous drawoff of bottom water	300	
	Access ladders for tower: 52 ft. @ $5.00	270	
	Tower screens — L.S.	150	
	4" Gate Valve with ext. stem & piping — L.S.	150	
		3,890	
	Conc. pipe cradle & cut-off walls: 32 C.Y. @ $40.00	1,280	
	Pipe under-drain: 210 L.F. 30" Reinf. Conc. Pipe @ $12.50	2,610	7,770
7.	Spillway: Conc. rib, 50 C.Y. (@ $50.00		
	(2,500	2,500	
	Rip-rap with soil filled voids, seeded 434 Tons @ $10.00	4,340	6,840
8.	Spread top soil on fill, fertilize & seed: 3,500 S.Y.		1,225
9.	Clearing & grading 1½ Ac. Parking lot — L.S.	500	
	3" of crushed stone on 1½ Ac. park. lot: 820 Tons @ $6.00	4,920	5,420
10.	2. Ea. Pit privies complete (@ $750		
	(1,500	1,500	
	Combined fertilizer storage & concession bldg.	2,000	3,500
11.	Seine box in place complete: Allowance	850	
	¾ Ac. holding pond, 3-ft. water depth: Allowance	1,000	1,850
12.	Clear & bulldoze access road to seine box & high pond	250	250
	Total estimated cost of construction		$80,975
	Engineering and contingencies 15%		12,146
	Inspector's Salary 4 months @ $550		2,200
	Total Estimated Project Cost		$95,321
	95 Ac. Lake @ approximately 1000/Ac.	Say	$95,500

Above preliminary estimate was from U.S.G.S. contours on 20-ft. interval; and indicated 95 Ac. lake; our survey shows 124 Ac. for same

dam height. Final design indicates 231 ft. underdrain and 86,500 C.Y. earth fill, and rearrangement of roads, power and telephone lines and leaves cost per acre at approximately $1,000 since total estimate is now $125,000.

Clear Creek drainage area is three and one-half square miles. Estimated flows are average 4cfs, minimum 0 cfs, and maximum 600 cfs.

COST ESTIMATES Date: 12-12-62

CRAWFISH LAKE (REED CREEK), WYTHE COUNTY, VIRGINIA

Refer to Est. dated 10-18-62. Item	45-ft. water 50-ft. dam Ratio 37:1 130-Ac. Pond*		50-ft. water 55-ft. dam Ratio 33:1 140-Ac. Pond*
Clear 103 ac. @ $100 (27-Ac. open)	$ 10,300	(113-Ac.)	$ 11,300
Deepening shoreline (allowance)	5,000		6,000
Clear & grub site for dam @ $400 Ac.	2,000		2,200
Earth fill for dam: 175,000 C.Yd. @ $0.50	87,500	(202,000)	101,000
Concrete for intake tower @ $80.00 C.Yd.	4,400		4,560
16" C.I. bottom water drawoff @ $12.00	540		600
24" x 24" Slide gate in place	750		750
Top and bottom screen	150		150
Inside and outside ladders	390		440
Under drain (30" Reinf. Conc. Pipe @ $20.00	5,740		6,280
Conc. cradle & cut-off walls @ $50.00 C.Y.	2,000		2,175
Allowance for rock excav. in spillway	1,500		1,500
Concrete rib across spillway @ $40.00	1,720		1,720
Barrier wall, rip-rap, top soil & seeding	8,000		8,400
Item 2, 3 & 4 from Est. dated 10-18-62	6,795		6,795
Estimated construction cost	$136,785		$153,870
Engineering plus contingencies 12½%	17,098		19,234
Inspector (by State) 6 Mo. @ $500	3,000		3,000
Total Est. Cost, costruction plus engineering, inspection & conting	$156,883		$176,104

* Estimated cost bases upon relocating dam about 500-ft. downstream from location shown, or previously established.

Estimates by: WARREN C. PERROW

SCHEDULE OF VALUES

Project: Improvements to Hidden Valley Lake, Washington County, Va.
Date: August 1963

Item No.	Item	Value	
1.	Added earth fill	$ 4,579.00	
2.	Concrete Head Tower	3,088.00	
3.	12" C.I.P. Bottom-draw	360.00	
4.	Top & bottom Screen	144.00	
5.	24' 30" Conc. pipe	720.00	
6.	Ladder in & out of Head Tower	317.00	
7.	Point up present underdrain	144.00	
8.	Conc. slab to protect dam adjacent to spillway	360.00	
9.	Rip-rap upstream face of dam	3,906.00	
10.	Place 18" x 18" slide gate	498.90	
11.	Fert. & seed embankment	1,733.10	
	Lump sum Bid accepted	$15,850.00	$15,850.00
	Extra for concrete under tower per allowance 2.31 C.Y. @ $27.50		63.52
	Owners cost for Slide Gate		302.00
	Total Const.		$16,215.52
	Engineering fee		1,621.55
	Total Project		$17,837.07

The lake is approximately 90 Ac. and if valued at 1,000/Ac. the head tower cost would be 3.8% complete with bottom draw on basis of the contractor's bid; 4.2% when loaded with its portion of engineering fee. Adding the gate cost brings total tower cost to $4,095, or 4.55% of the assumed $90,000 valuation, which compares reasonably with current estimates for new installations.

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2. "Low Dams," National Resources Committee.
3. "Hydraulics and Fluid Mechanics," by Ranald V. Giles; Schaum Publishing Co., New York (611 Broadway, New York 12, N. Y.)
4. "American Civil Engineering Practice," by Robert W. Abbett; John Wiley & Sons, Inc., New York, Vol. II.