

TECHNICAL NOTE

Subject: Watershed Planning

Series No.: 1702

Reference: Estimating Operation, Maintenance, and
Replacement Requirements

Date: January 1980 (updated 1999)

Estimating Operation, Maintenance, and Replacement Requirements

Adequate operation and maintenance of structural, nonstructural, and land treatment measures are important keys to the success of water resource projects. Replacement of short life components of project measures is also usually necessary during the life of the project. Operation, maintenance, and replacement (OM&R) must be planned with full consideration of economics, engineering, vegetation, environmental values, and the ability of the sponsors and landowners to carry out the needed activities.

The purpose of this Technical Note is to provide a method for determining the OM&R requirements for structural and nonstructural measures and estimating OM&R cost. Maintenance of land treatment measures is the responsibility of individual landowners, and is not included in the examples and procedures herein.

Planning for OM&R should begin early in project development. Conceptual requirements for OM&R should be considered in the earliest stages of developing alternative plans for the project. Expensive operation and maintenance or frequent replacement may be significant factors when considering the relative merit of alternative plans.

Requirements for OM&R are refined along with the various alternatives as planning progresses. Documentation of OM&R for the selected alternative should include:

- (1) the tasks expected to be required during the life of the structure;
- (2) cost of doing the work and providing services and materials;
- (3) frequency of each job; and
- (4) the method by which the required work will be accomplished.

OM&R cost must be reduced to an annual basis for use in comparing annual cost of alternative measures and for determining total annual project cost.

Understanding of OM&R and estimating of costs are simplified if the requirements are broken into categories and subdivided into specific tasks or items within each category. Suggested categories and examples of tasks in each category are shown below:

Category	Definition	Example Tasks
Operation	The administration, management, and performance of services needed to insure proper functioning of project measures.	inspection, pump, or gate operation, servicing sanitary facilities, furnishing life guards

Category	Definition	Example Tasks
Annual Maintenance	Care of project measures required to prevent deterioration and insure functioning. Includes those items normally required to be done annually or more often. Routine jobs required on a very frequent basis may be categorized as operation rather than maintenance.	mowing, cleaning trash racks, testing flood warning systems
Periodic Maintenance	Work required on a recurring basis, but less often than annually, to prevent deterioration and insure functioning of the measure.	painting, spot re-vegetation, fence repair, pump repair, sediment bar removal
Restoration or Replacement	Major repair as a result of severe storms or other causes; replacement of worn or deteriorated items with a useful life shorter than the life of the project measure of which they are a part.	Significant erosion repair in emergency spillways or channels, replacement of gates, pumps, side inlets, picnic tables, and trash receptacles

Appendix 1, "A Procedure for Estimating OM&R Costs During Planning," is an example of a method for determining OM&R requirements and estimating the cost thereof using the principles outlined in this Technical Note. In the example, primary input is from the engineer and the agronomist, who will determine what tasks are required and the cost of each, and the economist, who will assist in making cost estimates for each task, make applicable discounting and amortize the estimated cost to an annual basis. Some other technical specialists who should be involved as needed include landscape architects, recreation specialists, biologists, and foresters.

The procedure may be used as a guide for discussions of OM&R requirements with the project sponsors to get their input concerning methods of performing maintenance. Sponsor capability and preference may influence decisions on whether to "build in" maintenance at a higher initial construction cost or to depend on qualified sponsors to provide adequate maintenance for less conservative designs.

A PROCEDURE FOR ESTIMATING OPERATION, MAINTENANCE, AND REPLACEMENT REQUIREMENTS DURING PLANNING

Operation, maintenance, and replacement (OM&R) requirements can be separated into four categories for the purpose of estimating cost and achieving understanding by those responsible for carrying out the plan for OM&R. These categories are Operation, Annual Maintenance, Periodic Maintenance, and Restoration or Replacement. (The tasks and costs shown are examples and are not intended to represent requirements for any particular type of measure.)

Step I - List the applicable maintenance items in each category for each structure or structural system. Examples are:

- A. Operation
 - 1. Inspection and supervision
 - 2. Administration
 - 3. Pumping
 - 4. Gate control
 - 5. Others.....

- B. Annual Maintenance
 - 1. Mowing
 - 2. Spraying
 - 3. Other.....

- C. Periodic Maintenance (Less often than annual)
 - 1. Debris removal
 - 2. Sediment bar removal
 - 3. Repair of rip-rap
 - 4. Painting
 - 5. Fence repair
 - 6. Minor erosion repair
 - 7. Spot re-vegetation
 - 8. Fertilization
 - 9. Other.....

D. Restoration or Replacement

1. Restoration of channel capacity
2. Replacement of components
3. Major erosion repair (emergency spillway)
4. Other.....

Step II - Estimate quantity and cost for each item listed in Step I. This step requires input from an engineer, economist, a plant scientist, and the sponsors. Other NRCS specialists may be needed to help plan for the maintenance of such features as fish and wildlife or recreation facilities. The estimates for Operation and Annual Maintenance should be rather accurate while a certain degree of "educated guesswork" will be required for Periodic Maintenance and Restoration or Replacement. Estimates may be based on custom rates, equipment rental rates, labor and material costs, or other methods appropriate to the way in which the sponsors expect to perform O&M. Examples are:

A. Operation

- | | | |
|----|--|---------|
| 1. | Inspections and Supervision
7 man-days/yr. @ \$60 - | \$ 420 |
| 2. | Administration
Office supplies and mailing | \$50 |
| | Secretary - 5 days/yr. @ \$40 | \$ 200 |
| 3. | Pumping - 400 hr. @ \$10* - | \$4,000 |

*Including fuel, routine maintenance and repair,
and operator.

- | | | |
|----|---------------------------------|---------|
| 4. | Other | \$_____ |
| | Subtotal, Annual Operation Cost | \$4,670 |

B. Annual Maintenance

1.	Mowing - 200 ac. @ \$8.00*	\$1,600
	*Custom rate	
2.	Hand Cutting and Spraying	
	Labor - 10 days @ \$20	\$ 200
	Supplies and Equipment	\$ 200
3.	Other.....	\$ _____
4.	Subtotal, Annual Maintenance Cost	\$2,000

C. Periodic Maintenance

1. Debris Removal

Assume required first year and every
4th year thereafter at 3 bridges in project.

Labor - 3 bridges X 3 days per bridge @\$20.00
per day \$180

Tractor w/winch 3 bridges X 8 hours per bridge
X \$25.00 per hour \$600
\$780

Discounted annual cost - \$ 229

$$\$780 \times .06625^1 = \quad \$ 52$$

$$\$780 \times .77368^2 \times .29273^3 \quad \underline{\$ 177}$$

229

2. Fertilization (5-yr. interval)

200 ac. @ \$12.00* ac. - \$2400

*300 lb. of 20-20-20 custom application

Discount to annual cost - \$ 420

$$\$2400 \times .72561^4 \times .24145^5 = \$420$$

Subtotal, Annual Cost of Periodic Maintenance \$ 649

D. Restoration or Replacement

1. Overhaul Pump and Motor (10-yr. interval -
replace @ 50-years)

\$4,000 overhaul annual cost \$ 295
 $\$4000 \times .52651^6 \times .13992^7 = \295

\$25,000 replacement cost @ year 50;
discount to annual cost - \$ 70

$\$25,000 \times .04046^8 \times .06904^9 = \70

2. Replace Side Inlet Structures

20-yr. interval
1200 ft. of CMP @ \$10.00 \$12,000
Equipment rental
Front end loader - 200 hr. @\$38.00 - \$ 7,600
Operator - 200 hr. @\$6.00 - \$ 1,200
Laborers - 500 hr. @\$2.75 - \$ 1,375
Miscellaneous - \$ 500
\$22,675

Discount to annual cost - \$ 576
 $\$22,675 \times .27722^{10} \times .09166^{11} = \576

3. Other.... ----

Subtotal, Annual Cost - Restoration or
Replacement \$ 941

Total Annual OM&R Cost \$8,260

Step III - Make narrative notes which fully explain the rationale used in arriving at OM&R cost. The notes should be adequate to prepare a concise summary of operation and maintenance requirements for the project plan, to inform the designer of agreements reached with the sponsors during planning, and to provide data for preparation of the O&M Agreement and O&M Plan during the operations stage.

- ¹ Amortization 100 yrs. @ 6-5/8%
- ² Present value of 1 4 yrs. hence @ 6-5/8%
- ³ Amortization 4 yrs. @ 6-5/8
- ⁴ Present value of 1 5 yrs. hence @ 6-5/8%
- ⁵ Amortization 5 yrs. @ 6-5/8%
- ⁶ Present value of 1 10 yrs. hence @ 6-5/8%
- ⁷ Amortization 10 yrs. @ 6-5/8%
- ⁸ Present value of 1 50 yrs. hence @ 6-5/8%
- ⁹ Amortization 50 yrs. @ 6-5/8%
- ¹⁰ Present value of 1 20 yrs. hence @ 6-5/8%
- ¹¹ Amortization 20 yrs. @ 6-5/8%