# Sample Engineering Proposal, USGS Style (O'Bryan)



Site Stabilization Plan for Erosion Control

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Full title, writer's name, course, and date, centered halfway down the page.

Marginal annotations indicate USGS-style formatting and effective writing.

Source: Hacker Handbooks (Boston: Bedford/St. Martin's, 2011).

This paper follows the style guidelines in *Suggestions to Authors of the Reports of the United States Geological Survey,* 7th ed. (1991).

The contents page lists all the major headings and subheadings; it can also list minor subheadings, as here. The indentation of headings in the contents indicates the hierarchy and organization of the paper.

CONTENTS



Source: Hacker Handbooks (Boston: Bedford/St. Martin's, 2011).

EXECUTIVE SUMMARY

A USGS proposal often begins with an executive summary that briefly provides background, findings, and recommendations.

Ajax is seeking to develop a 44-acre parcel of land into a recreational park and has requested proposals for erosion control. This proposal recommends a system of terraces and a grassed waterway culminating in a 1-acre constructed lake. While this is not the least expensive method of erosion control, it will be effective at preventing erosion and also will meet Ajax's goals for an aesthetically pleasing park that can attract human visitors as well as aquatic life and wildlife. Two less desirable plans are a system of terraces with a riprapped waterway and a buried pipeline. Both plans are less expensive, but both have drawbacks and do not meet all of Ajax's goals.

The recommended proposal (proposal A) will create a series of 13 vegetative terraces that flow into a grassed waterway approximately 1,200 feet long. The waterway will culminate in a 1-acre lake that will collect the drainage and provide a recreational fishing hole. This proposal has the advantage of not disrupting the open land and in fact enhancing it with planted vegetation along the terraces and waterway and with a lake that can attract wildlife and that can be used for recreational purposes. The cost of this proposal is as follows:

- Terraces: $15,034
- Grassed waterway: $4,000
- 1-acre lake: $18,000-60,000
- Total: $37,034-79,034

Additional costs will be incurred for recovery of the soil if more surface is disturbed than just the terrace and waterway

Source: Hacker Handbooks (Boston: Bedford/St. Martin's, 2011).

construction areas. (See the summary of costs at the end of the proposal.)

The proposal for terraces and a riprapped waterway (proposal B) includes a riprapped channel that would disrupt the parklike atmosphere and that may not prevent off-site erosion. Its costs are as follows:

- Terraces: $15,034
- Riprapped waterway: $6,000
- Total: $21,034

The buried pipeline (proposal C) is the least desirable option because it is hard to maintain, requires an unattractive retaining wall, and is not suited for the soil type in this area. Its costs are as follows:

- Buried pipeline: $6,000
- Gabion retaining wall: $25,000-50,000
- Total: $31,000-56,000

O'Bryan provides an analysis of three proposals, giving an overview of how each proposal would be implemented and recommending one.

## ANALYSIS OF PROPOSALS

### PROPOSAL A: TERRACES AND GRASSED WATERWAY

Nonstructural and preventive erosion control provided by proposal A is the best choice for Ajax because the land is to be developed into a park. It is not the least expensive method, but it is likely to be most effective at meeting all the goals of the project. This proposal recommends a system of 7 terraces, each pair spaced 120 feet apart in the clayey silt soil, and 6 terraces, each pair spaced 150 feet apart in the silty clay soil. These terraces would have a 0.60% channel gradient, which would direct the water into a grassed waterway culminating in a 1-acre

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lake. A lake of this size is reasonable on a site of 44 acres and is more cost-effective than a smaller lake or a pond, which requires more specialized equipment to construct. The site is well suited for a lake because of its gently sloping topography. While a well-built lake can be expensive, Ajax can save money by using the excavated soil to build the terraces.

## PROPOSAL B: TERRACES AND RIPRAPPED WATERWAY

First- and second-level headings are centered in all capital letters.

Proposal B includes the same terraces as in proposal A, but the terraces flow into a riprapped channel going through the site and leading water beyond the boundaries of the property. A filter material must underlay the entire area that the riprap will cover (Minnesota Department of Transportation, 2005). Geotextile is the best material for this purpose. On top of this will be a 6-inch layer of granular filter material of uniform thickness over the prepared foundation. With geotextile, the foundation surface must be smooth and free of stones or other debris, and the fabric must not be torn during application. The riprap rocks should be placed from the bottom of the waterway to the top to achieve a uniform size distribution, with the smallest percent of void space possible. When completed, the riprap should not be less than 95% of the specified thickness.

O'Bryan uses USGS style for citing sources in the text.

## PROPOSAL C: BURIED PIPELINE

A buried pipeline is the least optimal choice for the site. Methods of erosion control that are constructed aboveground are preferred because it is much easier to perform maintenance on them. There is no room for error in the design and construction of a buried pipeline. Also, in the site area, clay makes up a

Source: Hacker Handbooks (Boston: Bedford/St. Martin's, 2011).

large percentage of the soil; the shrink-swell potential of the soil could later damage the pipes. Pipelines are also just as expensive as riprap. For this method, a retaining wall would be constructed of gabion baskets, which are more flexible than concrete and allow for the possibility of establishing vegetation in the spaces. As with the riprap plan, an erosion control blanket is required under the gabion to prevent scouring. There are several drawbacks to the use of gabions. As Lynn Merill (2004) writes, quoting engineer Mark North, "'Gabions may not be appropriate for use in high-traffic areas' where people coming in contact with them run the risk of 'snagging their clothes on the wire.'" In addition, gabions can be very expensive.

GUIDELINES FOR CONSTRUCTION[1]

O'Bryan provides guidelines that should be followed for any of the three proposals. She uses a footnote to give the sources of her guidelines.

*Geotextile material.*—Geotextile material should be "woven, nonwoven, or knit fabric of polymeric filaments or yarns such as polypropylene, polyethylene, polyester, or polyamide formed into a stable network such that the filaments/yarns retain their relative position to each other" (Minnesota Department of Transportation, 2005, p. 907). If the geotextile is being used as an earth reinforcement or under riprap, all sewn seams on the fabric must meet strength requirements.

*Erosion control blankets.*—Erosion control blankets are designed to be used until vegetation can be established. There are

O'Bryan uses a footnote for a general point related to the entire section.

[1]All guidelines are based on Minnesota Department of Transportation, 2005, and Beasley and others, 1984, unless stated otherwise.

Source: Hacker Handbooks (Boston: Bedford/St. Martin's, 2011).

nine different categories of blankets based on use longevity and flow velocity; use longevity ranges from 6-8 weeks through permanent. The category chosen should be specific to the method of construction and to the site. For example, if gabions are built and the flow velocity is calculated to be less than 6.5 ft/s, a category 6 erosion control blanket should be used. The blanket should be laid out parallel to the direction of flow, and adjacent blanket edges should overlap by at least 4 inches and should be stapled. At the top of the slope, the blanket should be buried in a check slot, which should be backfilled and compacted. Within the channel, the blanket should be stapled every foot.

*Silt fences*.—No silt should be washed off-site, and the soil must be seeded if it is to be bare for more than 45 days. It is expected that silt fences will be required at some point during construction of any of the proposed plans. It is acceptable to use the standard machine-sliced silt fencing during site grading to keep sediment from moving. Each post of the silt fence should be secured by a minimum of five gun staples 1 inch long.

In USGS style, minor subheadings are indented and italicized, followed by a period and a dash.

*Excavation*.—During excavation, a well-drained condition must be maintained through planned drainage facilities. Topsoil should be stockpiled and covered. If blasting is required, it must be conducted so that materials will not be thrown out of the area and will be easily recoverable. Excavations must have a secure uniformity in grade; if excavations fall below final grade, they must be done with the provision that they are subject to change.

*Pipe installation*.—Pipes should be installed to collect and discharge water infiltrating into the soil or accumulated in a

Source: Hacker Handbooks (Boston: Bedford/St. Martin's, 2011).

subcut or to cut off or intercept groundwater flow. The pipes should be constructed of nonperforated threadless copper (TP) pipe. Minimum trench width should be the diameter of the pipe plus two times the diameter. All rocks within the trench should be removed. A fine filter aggregate layer of one pipe diameter should be laid in the bottom of the trench. If perforated pipe is used, it must be wrapped in geotextile. Pipes that will discharge at a constructed gabion wall should be installed so that small movements in the wall will not cause the pipes to separate.

*Reseeding*.—The purpose of reseeding the area is not just to beautify the landscape. Reseeding is also an effective erosion control method. The application of seed must be conducted with as much rigor and attention to detail as any construction project on the site will be carried out. The establishment of permanent vegetation requires soil tilling, liming, fertilizing, seeding, sodding, mulching, and any other work required to ensure that the plants survive to maturity. Proper planting times must be observed; until the time for seeding has arrived, previously mentioned methods of erosion control must be used. The recommended temporary seeding mixture is mixture number 130; its seeding date varies because this seed has 40% of both winter wheat and oats. The optimal time for planting winter wheat is Aug. 1-Oct. 1, and for oats it is May 1-Aug. 1. Other seed mixture numbers have different planting seasons, as shown in table 1.

Tables are referred to in the text and are placed as close as possible to their text reference.

If rills or gullies have formed anywhere on the site, they should be filled in prior to seeding and compacted so that they are approximately the same density as the surrounding soil. The

Source: Hacker Handbooks (Boston: Bedford/St. Martin's, 2011).

Table 1. Planting seasons for seed

[From Minnesota Department of Transportation, 2005, table 2575-1, p. 712]

Table number and title appear above the table. A headnote, in brackets, gives source information; it also can explain abbreviations or symbols.

| Seed mixture number | Spring | Fall |
|---|---|---|
| 100 | — | Aug. 1-Oct. 1 |
| 110 | May 1-Aug. 1 | — |
| 150, 190 | Apr. 1-July 20 | July 20-Oct. 20 |
| 240, 250, 260, 270 | Apr. 1-June 1 | July 20-Sept. 20 |
| 280 | Apr. 1-Sept. 1 | — |
| 310, 325, 328, 330, 340, 350 | Apr. 15-July 20 | Sept. 20-Oct. 20 |

seed should be applied according to the seed application rate for its mixture number (see table 2). Hydroseeding is prohibited when wind speeds exceed 15 mph. The traditional seed mixes (numbers 100-280) should be applied through hydroseeding; native mixes, because of the shape of the seed, require a native seed drill. In hydroseeding, seed must be uniformly distributed; otherwise the area must be reseeded. The permanent seed mixture can be applied to an area that is covered with a temporary seed mixture without additional tillage or site preparation. The water-to-straw-bale ratio with tackifier for mulch is 100 gallons to every 50-pound bale.

PROPOSAL A: DETAILS AND GENERAL SPECIFICATIONS

O'Bryan gives specific details about her recommended proposal.

*Seeded terraces and waterway*.—On this site, there will be 7 sets of terraces 120 feet apart in the clayey silt soil and 6 sets of terraces 150 feet apart in the silty clay soil. The terraces will have a 0.60% gradient. They will begin at elevation 560 feet and will

Source: Hacker Handbooks (Boston: Bedford/St. Martin's, 2011).

Table 2. Seed application rates

[From Minnesota Department of Transportation, 2005, table 2575-2, p. 716]

| Seed mixture number | Application rate (lb/acre) |
|---|---|
| 100, 110 | 100 |
| 159 | 40 |
| 190 | 60 |
| 240 | 75 |
| 250 | 70 |
| 260 | 100 |
| 270 | 120 |
| 280 | 50 |
| 310 | 82 |
| 325 | 84 |
| 328 | 88 |
| 330, 340, 350 | 84.5 |

In USGS style, most numbers are expressed as numerals.

be 600 feet long, increasing by 28.5 feet at each terrace until they reach 1,000 feet in length at elevation 480 feet. Work should start at the base of the area and proceed upward. The terraces will flow into a larger grassed waterway approximately 1,200 feet long that intersects the site.

The terraces will be grassed with a native harvest. The waterway will be lined with something comparable to C350 riprap replacement and will also be seeded with a native harvest. The native harvest should consist of seed harvests from stands within 25 miles of the area. Approximately 70% of the mixture should

Source: Hacker Handbooks (Boston: Bedford/St. Martin's, 2011).

consist of big bluestem and/or Indian grass, though 50% would be acceptable. There should be at least five species of native grasses and 3% (by mass) of native forbs. Since this is to be a recreational area, it will be best not to use a variety of grass that needs seasonal burning unless the park can be closed without financial repercussions and without the fire damaging any infrastructure erected at a later time. The application of herbicides seasonally (spring or summer) is acceptable though not encouraged, as runoff could harm fish and wildlife.

*Erosion barrier*.—The developer may not disturb more than 14,400 $ft^2$ at a time in the clayey silt soil or more than 22,500 $ft^2$ at a time in the silty clay soil without erecting an erosion barrier such as a silt fence on the downslope side. The bare soil above the work area should be stabilized by rocks and mulch at the end of each workday. The developer should create and maintain a covered stockpile of topsoil. If soil is going to be left bare for more than 45 days, it must be seeded. Idle areas should be seeded as soon as possible after grading or within 7 days. The seed should be mixture number 130, consisting of 40% oats, 40% winter wheat, 10% rye grass, and 10% alfalfa, annual. Compacted soils in the area should be deep-tilled to a depth of 18-24 inches to allow for deep root penetration. Six or more inches of organic compost should be laid on top of this and tilled into the top 10 inches of soil.

*Lake*.—Although a collection system for the runoff water was not a requirement for this proposal, a lake has several advantages and is not prohibitively expensive. It will collect drainage from the constructed waterway, it will attract wildlife to the area and

Source: Hacker Handbooks (Boston: Bedford/St. Martin's, 2011).

enhance the appeal to visitors, and it can serve as a recreational fishing hole.

*Other vegetation*.—Revegetation should occur at the end of the major construction phase and should focus not only on establishing grasses in the area but also on planting other forms of vegetation. Some of the options for native plants that are readily available from nurseries are outlined in the "Shoreline Stabilization Handbook" (Northwest Regional Planning Commission, 2004). They include trees, shrubs, herbaceous plants, ferns, and vines. It is preferred that these be native to the area, such as Kentucky bluegrass, and not European or Asian in origin. While the European and Asian grasses have traditionally been used in American landscaping, they tend to have much smaller rooting zones and are not suitable for effective erosion control; they also require more effort to grow in this site soil. Native grasses would not have these problems and would be less expensive to maintain. Shrubs such as sumac, gray dogwood, wild rose, fragrant sumac, and hazelnut are also preferable because they have a dense, low-spreading growth pattern and are attractive.

Proposals usually provide itemized costs for the client.

*Cost estimates*.—The basic construction of Proposal A will cost Ajax $37,034-79,034. Additional costs of approximately $608,000 would provide for recovery of the runoff water and enhance the overall appearance and appeal of the area.

DIMENSIONS

| | |
|---|---|
| Disturbed area | 216,283.5 $yd^2$ |
| Total area | 333,330 $yd^2$ |
| Undisturbed area | 117,046.5 $yd^2$ |

Source: Hacker Handbooks (Boston: Bedford/St. Martin's, 2011).

| | |
|---|---|
| BASIC COSTS | |
| Terraces | $ 15,034.00 |
| Grassed waterway | 4,000.00 |
| 1-acre lake | 18,000.00-60,000.00 |
| TOTAL BASIC COSTS | $37,034.00-79,034.00 |
| ADDITIONAL COSTS (OPTIONAL) | |
| Hydroseeding, tackifier not required | $175,570.00 |
| Hydroseeding, tackifier required | 432,567.00 |
| TOTAL ADDITIONAL COSTS | $608,137.00 |

## CONCLUSION

In her conclusion, O'Bryan states again why she recommends proposal A. She ends with a paragraph that speaks plainly to connect with her readers.

While not the lowest-cost method of erosion control, proposal A meets all the goals of the project and creates an aesthetically pleasing and natural park atmosphere. The constructed appearance of the heavier erosion control options such as riprap and gabions would not mesh well with natural foliage. Such constructions also would not allow for aquatic life, one of the stated goals of the project. Heavy vegetation with the more aesthetic option of terraces is the correct choice in this situation. Native grasses not only will facilitate slope stabilization because of their deep rooting zones but also will attract birds and other wildlife, which will in turn draw wildlife enthusiasts into the park.

A good model for the proposed park is the Rachel Carson National Wildlife Refuge in Maine. While the type of land that is being protected in Maine is different from the land found on the Kentucky site, the Maine park combines the elements Ajax is seeking in its new park: a wildlife refuge, full of native plants,

Source: Hacker Handbooks (Boston: Bedford/St. Martin's, 2011).

and a recreational area. The Maine park has trails throughout so that visitors have many different views of the beauty of the site. It also offers fishing and hunting and appeals to many different demographics. Ajax should consider this park as an ideal model.

Source: Hacker Handbooks (Boston: Bedford/St. Martin's, 2011).

REFERENCES

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The writer uses USGS style to list the sources she consulted in preparing her proposal.

Source: Hacker Handbooks (Boston: Bedford/St. Martin's, 2011).