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400-Acre Wood

Overview

Students play the role of managers of a 400-acre (162 hectare) piece of public forest. Through this role, students will begin to understand the complex considerations that influence management decisions about forest lands.

Objectives

Students will 1) experience the analysis and decision-making involved in managing forest land, and 2) understand that any land-use decision has a number of consequences for people, wildlife, and plants.

Grades

7-8

Subjects

Math, Science, Social studies

Key Words

Stewardship, cooperation, management planning, biome, ecology

Background

In the United States, lands that are considered "tribal" make up approximately 55 million acres.[i] While there is no single location to find the data on the number of acres in Minnesota that are considered tribal, if one does the math, it adds up to roughly 2.7 million acres. This does not include lands that are ceded (lands given up by indigenous people to the United States), where tribal members retain treaty rights to hunt, fish, and gather. These vast tracts of land are a combination of residential lands, commercial lands, recreational lands, and lands that are co-managed by state, federal, and tribal entities.

Because Minnesota is home to several biomes and ecological communities, each parcel of land can be used differently. For example, the lands within the White Earth Nation have been and continue to be used primarily for farming because of its relatively healthy soil, location in the historic prairie/deciduous forest biome, and close proximity to water for irrigation. In the southern part of the state, the lands within the Dakota nations support cultural revitalization efforts to manage buffalo. The tribal lands in the central and northeastern parts of the state are a combination of many different uses, including logging, recreation, tourism, and conservation.

A unique relationship exists between the United States Forest Service and the Leech Lake Band of Ojibwe as a result of the location of the Chippewa National Forest. Ninety percent of Leech Lake lands are within the Chippewa National Forest. In 2019, the U.S. Forest Service and the Leech Lake Band signed an agreement that outlines the shared stewardship of these lands for natural resources,

employment, economic development, regulatory jurisdiction, and maintaining Ojibwe cultural lifeways.[ii] Under Environmental Protection Agency guidelines, Leech Lake maintains the sole authority to make decisions related to water quality in the Chippewa National Forest.

In all of these places, decisions must balance who can use the lands, how lands can be used, and how these uses affect the current and future populations of people, plants, and animals. These decisions are not easy to make, and they are not always popular with community members. The decision to open areas up to harvesting may be a lucrative way to bring in revenue to support a community, but some community members may view commercializing resources as "selling out." Similarly, using tribal land to build a casino provides employment for many community members, and often supports language and culture revitalization programs, but is not always a favorable choice for all. Like many communities in Minnesota, all of these choices require a delicate balance of community input, understanding of how choices will affect community needs, and regulatory processes.

Getting Ready

Make copies of the "If You Were the Boss Student Page." Use the 400-Acre Wood Grid or draw your own. (Using a light-colored marker, draw a 20" x 20" grid map of 400-acre wood on a piece of chart paper for each team of four or five students. (Teams can make their own.) The grid should have 400 1"x1" squares, each representing 1 acre.)

On another piece of chart paper, make an identical, but larger, grid to use in group discussion.

Doing the Activity

1. Introduce the activity by explaining that students will look at several complex issues that face forest managers. Help students brainstorm a list of activities that take place on forest land. List their ideas on the board, Jam board, or other graphic organizer. Include uses like hiking, fishing, hunting, photography, camping, rock climbing, skiing, snowmobiling, harvesting, grazing, or mining. Ask the class to look at the list and decide if any activities would conflict with each other if done on the same piece of land.
2. Discuss these questions:
    - Which activities would cost the most to provide on forest land?
    - Which would bring the most visitors?
    - Which would have the greatest effects—good or bad—on the forest ecosystem? On the wildlife there? Would this effect be permanent or temporary?
    - Which would cause fragmentation? *Fragmentation is the process of breaking up large forests into smaller pieces, usually by building roads and buildings.*
    - Which would provide for our most critical needs?
3. As a class, define common goals/outcomes.
4. Have students read the "If You Were the Boss Student Page." Divide the group into teams of three, and explain that each team will decide the best use (or uses) of their 400-Acre Wood, which has been donated to the community. Each team will develop a land management plan that will serve the best interest of the entire ecosystem (plants, animals, and people in the area). Make sure students understand that their team can use the entire 400 acres for one use, or divide it up for multiple uses. For example, they may devote 200 acres to wilderness, 75 acres for camping, 5 acres for an outdoor classroom, and another 120 acres for timber harvest or hunting.

5. Before students begin, ask these questions:
    - Which forest uses in the "If You Were the Boss" are compatible with other uses? (for example, building a campground and hiking trail next to each other)
    - Which might be incompatible with each other? (hunting area near an outdoor classroom or campground)
    - What could you learn by figuring out the costs, revenues, trees, wildlife populations, and number of visitors for each management plan? (How the plan affects different forest values.)
    - Are owls, moose, and salamanders the only wildlife in the forest? (no) What could you learn about the forest ecosystem by analyzing the populations of these three species? (By looking at three animals with different habitat requirements, you get an idea of the general health of the forest ecosystem.)
6. Give each team a map (grid) of the 400-Acre Wood. Also, give each team a copy of the "What's the Score?" student page. Each team should discuss various strategies for managing the forest. When the team arrives at a consensus on how the land should be managed, direct members to use "What's the Score?" for a cost and benefit analysis of their plan. They should discuss what effects their plan would have in terms of visitors, wildlife, trees, and cost and revenue.
7. When the teams have completed their management plans, they should use crayons or colored markers to illustrate their pans on the grids. Remind them to include a legend showing what different colors and symbols mean.
8. Ask teams to present their plans to the entire group, making clear how they decided on their plans. Have them also report the findings on their "What's the Score?" student pages. Post the maps around the room.
9. Use the large grid map to lead a group discussion of different plans.
   Ask these questions:
    - Which plan enables the most people to enjoy the forest? What is the monetary cost in attracting the most visitors? Are there any other costs besides money?
    - Which plan does the most to preserve the forest in its original state? What are the costs of this plan?
    - Which plan has the largest affect on wildlife and fragmentation? Why should we care if one animal species leaves the forest[1]?
    - Which plan seems to provide the best balance of money, trees, wildlife and visitors?
    - How do you think your plan should be funded? If your plan made a profit, what should happen with the money?
    - Which do you think is most important: Having the most trees, the most wildlife, or the most visitors? Why?
    - Which do you think is most important—an activity's cost or revenue, or the activity's effects on trees, wildlife, and visitors? Give an example.
    - Which items are ongoing costs or revenues? Which are one-time costs or revenues?
    - What will be the long-term effects of each plan? How will costs or revenue change in the next year? Will the numbers of trees, wildlife, or visitors change?

[1] Skip this question if your class has not been introduced to food chains or webs. Consider using PLT's "Web of Life" lesson to teach this concept.

- What did you learn by figuring out the costs, revenues, trees, wildlife populations, and number of visitors for each management plan? (How the plan affects different forest values)

Enrichment

To introduce Ojibwe forest values, consider showing the video, Ojbwe Treaty Rights: Connections to Land and Water (produced by the Great Lakes Indian Fish and Wildlife Commission).

Repeat the activity and have each team extend its management plan into the next year, and calculate the effect on money, trees, wildlife, and visitors for the second year.

Contact the local state, federal, or tribal forest manager to talk to your class about how their organization makes land-use decisions. Encourage students to ask questions based on what they learned in the activity. For example, how do forest managers weight the effects of an action on trees, people, and animals in a forested area?

Assessment Opportunities

Have student teams present their plan for 400-Acre Woods to a Community Council (made up of students.) Give each team five minutes to explain why their plan should be accepted by the council. After all teams have presented their plans, give the council members time to choose the plan they believe is best. Use team presentations to assess how well students understand the pros and cons of their proposals.

Connections to Minnesota Standards (Science)

7L.2.1.1.1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.** (P: 4, CC: 2, CI: LS2) Emphasis is on cause and effect relationships between resources and growth of individual organisms and the number or organisms in ecosystems during periods of abundant and scarce resources. Examples may include populations of MN deer, moose, wolf, scavengers or aquatic populations in Lake Superior or algal blooms in lakes and ponds. Examples of evidence may include the use of flow charts to organize and sequence the algorithm, and to show relationships.

7L.3.1.1.3 Develop and use a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem. (P: 2, CC: 5, CI: LS2) Emphasis is on describing the conservation of matter and flow of energy into and out of various ecosystems.

7L.4.1.2.1 Construct an argument supported by empirical evidence that changes in physical or biological components of an ecosystem affect populations.* (P: 7, CC: 7, CI: LS2) Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes and/or impacts to ecosystems. Examples of physical components may include human-built structures like urban developments, or dams.

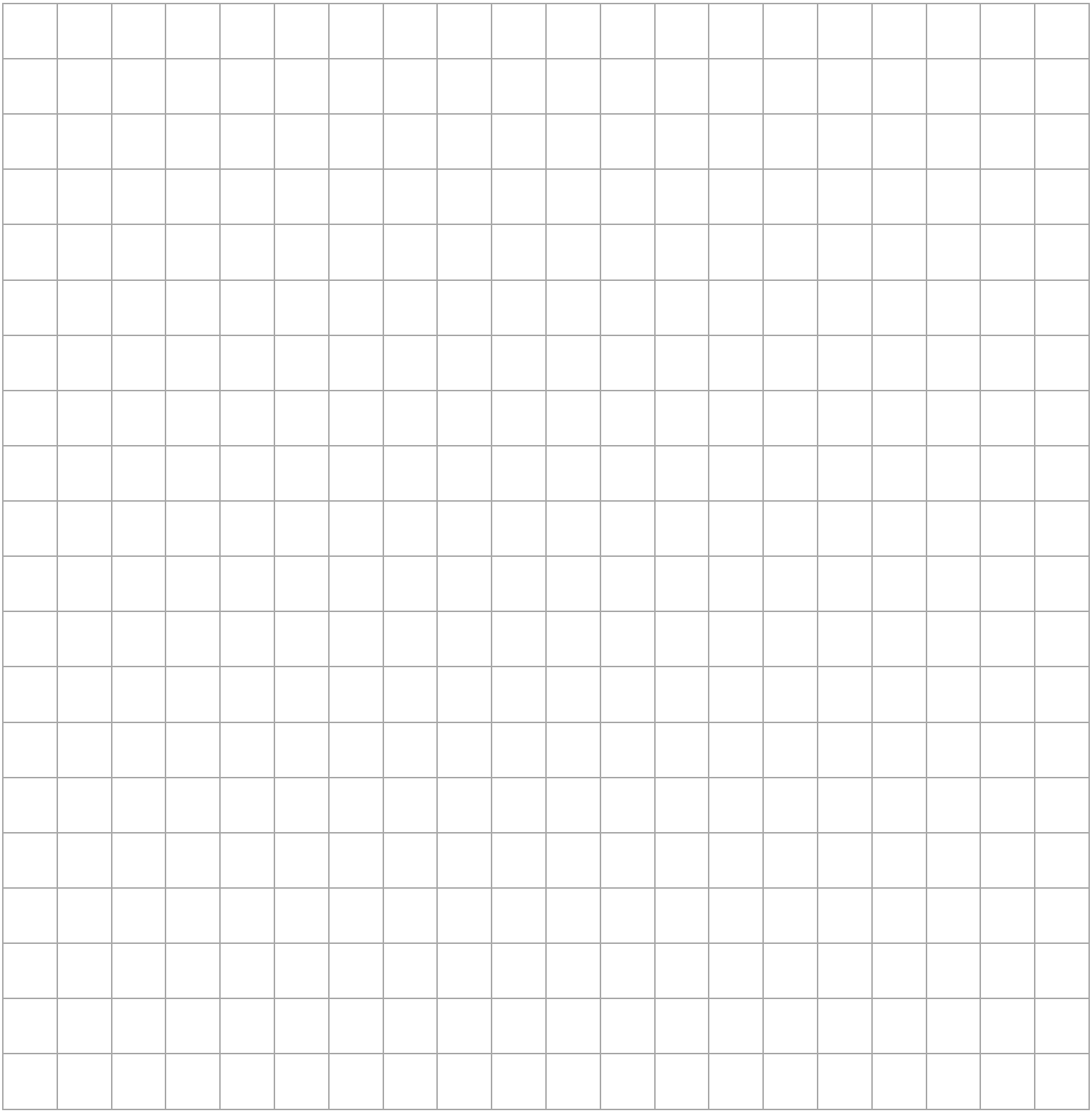
7L.4.1.2.2 Evaluate competing design solutions for maintaining biodiversity or ecosystem services.* (P: 7, CC: 2, CI: LS2, ETS2) Emphasis is on evaluating a solution that reduces environmental harm while still benefiting humans. Examples of ecosystem services (natural processes within ecosystems that humans also benefit from) may include water purification as it cycles through Earth's systems, nutrient recycling,

climate stabilization, decomposition of wastes, and pollination. Examples of design solution constraints may include scientific, economic, and social considerations.

7L.4.2.2.1: Gather multiple sources of information and communicate how Minnesota American Indian tribes and communities and other cultures use knowledge to predict or interpret patterns of interactions among organisms across multiple ecosystems. (P: 8, CC: 1, CI: LS2, ETS2) Examples of cultures may include those within the local context of the learning community and within the context of Minnesota. Emphasis is on predicting consistent patterns of interactions in different ecosystems in terms of the relationships among and between organisms and abiotic components of ecosystems. Examples of types of interactions may include competition, predation and mutualisms.

6.4.4.20.4: Describe Minnesota and federal American Indian policy of the late nineteenth and twentieth centuries and its effect on Anishinaabe and Dakota people, especially in the areas of education, land ownership, and citizenship.

400-Acre Wood Grid Student Page



Legend

If You Were the Boss Student Page

Overview

Someone has just donated a magnificent forest, 400-Acre Wood, to your community. You and your team have the job of deciding what to do with this forest.

A 400-Acre Wood is 400 acres (162 hectares). An acre is an area of land equal to a square that is 208.7 feet on each side, about the size of a football field. 400 acres is a little less than 1 square mile. (A hectare [ha] is 10,000 square meters and is equal to about 2.47 acres. To convert acres to hectares, multiply by 0.4047.

The 400-Acre Wood is a conifer forest, with about 150 mature pines, spruces, and cedars per acre. In addition, it contains lots of wildlife such as owls, deer, moose, bear, woodpeckers, grouse, mice, fish, and salamanders.

Wildlife biologists use "Management Indicator Species" (MIS) to evaluate the effects of people's action in the environment. If the species exists in healthy populations, then the habitat is healthy. In the 400-Acre Wood, the indicator species are barred owls, moose, and salamanders. Wildlife biologists estimate that the 400-Acre Wood currently has two barred owls per 100 acres [40 ha] of forest, two moose per 400 acres [162 ha], and 25 salamanders per acre [0.40 ha].

Because the forest currently has no roads or trails, few people use or visit it.

You and your team will make a map of 400-Acre Wood and develop a management plan for it. You may decide to do one thing with the entire forest. Alternatively, you may want to divide the forest and do different things in different areas. Your goal is to find what you think is the best balance between visitor enjoyment, trees, wildlife, and money.

Below are the different forest uses you can include in your plan. The "What's the Score?" student page will help you evaluate your plant's total effect on visitors, trees, wildlife, and money.

Wilderness Preserve

The purpose of a wilderness preserve is to allow wildlife and plants to exist without humans interfering. Typically, a wilderness preserve has no roads, graded trails, or campsites. Wilderness preserve areas will have the following effects:

- Visitors: About five people per acre per year will visit the preserve.
- Trees: The number of trees per acre will remain the same.
- Wildlife: The numbers of owls, moose, and salamanders will remain the same.
- Money: It will cost money to manage the preserve, and each visitor will pay an entrance fee.

Trails

Graded trails allow different types of visitors to enjoy a forest, including walkers, cyclists, families with strollers, and wheelchair users. Trails area will have the following effects:

- Visitors: About 25 visitors per acre per year will use the trails.
- Trees: Some trees must be cut to build a trail.
- Wildlife: The increase in visitors will disturb the wildlife. Owls will leave areas with trails (they sleep during the day when people are about), and trails are dangerous for salamanders as they migrate to pools of water during breeding season. There will be no effect on the moose.

- Money: It costs money to build and maintain trails. Trees removed to make the trail can be sold. Each visitor will pay an entrance fee.

Campground

A campground allows visitors to enjoy a forest area overnight or over the weekend. It typically has a number of campsites, plus picnic tables, fire pits, parking spaces, and bathrooms. A campground also needs to have a road winding through it. A campground has about 4 sites per acre. Campground areas will have the following effects.

- Visitors: About 12.5 campers per site per year will come to the campground, or 50 campers per acre per year.
- Trees: Trees need to be removed to build the road and the campsites.
- Wildlife: A campground and campers will cause all three indicator species—owls, moose, and salamanders—to disappear from the area.
- Money: It costs money to build and maintain the road, to clear and level the campsites, and to build and maintain the restrooms. It also costs money to manage the campground. Trees removed for the road and campsites can be sold. Campers pay a camping fee.

Hunting

Some forest areas are managed to encourage game animals (deer, moose, grouse) for hunters. These areas require a road for visitors. Hunting areas will have the following effects.

- Visitors: About one hunter per acre per year will visit.
- Trees: Trees will need to be removed to build the road.
- Wildlife: With regulations to keep game populations constant, there should be no effect on the three indicator species—owls, moose, and salamanders. (Moose is not a game animal in the 400-Acre Wood.)

Fishing

- To encourage fish for anglers, a lake can be created by damming the forest stream. Fishing areas will have the following effects.
- Visitors: About two anglers per acre per year will visit.
- Trees: Trees will need to be removed to create the lake.
- Wildlife: Creating the lake will cause two indicator species—owls and salamanders—to disappear from the fishing area.
- Money: It will cost money to build the dam to create the lake. It will also cost money for management. Trees removed for the lake can be sold. Anglers will pay a fishing fee.

Timber Harvest

Some forest areas are set aside for timber harvesting, which means cutting trees to sell the logs. Using a sustainable yield approach, only a portion of the trees is removed at any given time. This minimizes the effect on wildlife, while producing as many logs as possible over the long-term. Conifers take 80 years to reach maturity, so one-fifth of the trees are cut every 16 years. Timber harvest areas will have the following effects.

- Visitors: About five people per acre per year will visit.
- Trees: Trees will be removed to build the road, plus one-fifth of the remaining mature trees will be removed.

- Wildlife: the timber harvest will have minimal effects on the three indicator species.
- Money: It will cost money to build and maintain the road and for management. The harvested trees can be sold. Visitors will pay a fee.

Moose Viewing Areas

The moose population in Minnesota was once much larger and covered a greater area in the state. Rising temperatures, habitat loss, and the increase in the white-tailed deer population have all had negative effects on this population. The word *moose* is actually an English take on the Ojibwe word *mooz*, which means twig eater.[iii] Before white-tailed deer became common in Minnesota, moose were the major game animal that the Ojibwe hunted. Because moose are very large, people needed to hunt far fewer animals to keep a family or village fed throughout the year. People would eat the meat fresh, freeze it during the winter, and dry it for long-term preservation. People would also use moose hides and bones for making clothing, drums, sewing supplies, and tools. Moose hair was used to make traditional art forms like tufting or quilling. Moose have been such an important part of the Ojibwe lifeway that in 2009, the Chairman for Grand Portage, Norman Deschampe, said, "Whither go the moose, so go the Ojibwe."[iv] Moose do well in areas that have experienced wildfires, harvests, or storm damage, or open spaces such as farm fields and tree stands. These areas should be near to bodies of water, since moose primarily feed on aquatic vegetation. The range of a moose varies greatly based on season and gender, but a single moose needs at least 65 acres. Moose viewing areas will have the following effects.

- Visitors: A healthy moose population will attract visitors—1 person per acre per year.
- Trees: Trees will need to be harvested to create enough open space to support moose.
- Wildlife: Moose can share their habitat with owls and salamanders because they are not competing for the same food source. The removal of trees to create open space for moose may cause owls and salamanders to disappear.
- Money: To attract visitors, a moose viewing area consisting of a raised platform (or several) will need to be built, which will cost money. A road will have to be built to provide access to the moose viewing area. Harvesting trees to create open space for moose will be a source of income. Visitors will pay a fee to access the moose viewing area.

Ojibwe birchbark moose call
Minnesota Historical Society Collections Online; 1981.4.58

Hide scraper made from moose bone
Minnesota Historical Society Collections Online; collected by Frances Densmore; 6935.30.C

Ojibwe pictographic moose hide robe *Minnesota Historical Society Collections Online; made by Mary Hudson, Mille Lacs Band, 1930; 1976.37.1*

What's the Score? Student Page

Step 1

Determine how many acres you plan for each **land use**. The total should be 400 acres.

_____	acres Wilderness
_____	+ acres Trails
_____	+ acres Campground
_____	+ acres Hunting
_____	+ acres Fishing
_____	+ acres Timber Harvest
_____	+ acres Moose Viewing Area
400	**TOTAL acres**

Step 2

Calculate how many **visitors** per year this plan will attract to your community.

Number of acres x visitors/acre	Total visitors/year
(_____ acres Wilderness) x (5 visitors/acre)	_____
+ (_____ acres Trails) x (25 visitors/acre)	_____
+ (_____ acres Campground) x (50 campers/acre)	_____
+ (_____ acres Hunting) x (1 hunter/acre)	_____
+ (_____ acres Fishing) x (2 anglers/acre)	_____
+ (_____ acres Timber Harvest) x (5 visitors/acre)	_____
+ (_____ acres Moose Viewing Area) x (1 visitor/65 acre)	_____
	TOTAL visitors per year

Step 3

Calculate how this plan will affect the **wildlife** indicator species. Compare the totals you get to the original population of 8 owls, 2 moose, and 10,000 salamanders.

Owls	(____ acres Wilderness) + (___ acres Hunting) + (___ acres Timber Harvest)	=	_____ *Number of acres that will support owls at 0.02 owls/acre*	=	_____*Number of owls (round to nearest whole number)*
Moose	(____ acres Wilderness) + (___ acres Trails) + (___ acres Hunting) + (___ acres Timber Harvest)	=	_____ *Number of acres that will support moose at 0.005 moose/acre*	=	_____*Number of moose (round to nearest whole number)*
Salamanders	(____ acres Wilderness) + (___ acres Hunting) + (___ acres Timber Harvest)	=	_____ *Number of acres that will support owls 25 salamanders/acre*	=	_____*Number of salamanders (round to nearest whole number)*

Step 4

Calculate how many miles of **trail or road** are needed for your plan.

Acres			Miles	
(_____acres Trails)	÷ 6 acres/mile Wilderness	=	_____	total miles of Trail
(_____acres Camp-ground	x 250 ft/acre) ÷ 5,280 ft/mile	=	_____	miles of road for Campground
(_____acres Hunting	x 100 ft/acre) ÷ 5,280 ft/mile	=	_____	miles of road for Hunting
(_____acres Timber Harvest	x 100 ft/acre) ÷ 5,280 ft/mile	=	_____	miles of road for Timber Harvest
(_____acres Moose Viewing	x 100 ft/acre) ÷ 5,280 ft/mile	=	_____	miles of road for Moose Viewing
	Total miles of trails or roads	=	_____	

Step 5

Calculate how many mature **trees** remain based on your plan.

(_____	miles of Trail x 0.36 acres/mile) x 150 trees/acre	=	_____	trees
(_____	miles of Campground road x 1.45 acres/mile) x 150 trees/acre	=	_____	trees
(_____	miles of Hunting road x 1.45 acres/mile) x 150 trees/acre	=	_____	trees
(_____	acres of Fishing) x 150 trees/acre	=	_____	trees
(_____	miles of Timber Harvest x 1/80 harvested) x 150 trees/acre	=	_____	trees
(_____	miles of Moose Viewing Area road x 1.45 acres/mile) x 150 trees/acre	=	_____	trees
	Total trees removed	=		trees

60,000 mature trees in 400-Acre Wood – total trees removed = _____Trees remaining

Step 6

Calculate the revenue and costs associated with your plan, and determine the net profit or loss.

Revenue

		Fees (per year)
____ Wilderness visitors x $5 fee per visitor	=	$
____ Trails visitors x $5 fee per visitor	=	$
____ Campground campers x $45 per site ÷ 2 campers per site	=	$
____ Hunters x $20 fee per hunter	=	$
____ Anglers x $15 fee per angler	=	$
___ Timber Harvest visitors x $5 fee per visitor	=	$
___ Moose Viewing Area visitors x $15 fee per visitor	=	$
		Sale of Trees
___ trees removed for Trails x $80 per tree	=	$
___ trees removed for Campground road x $80 per tree	=	$
___ trees removed for Hunting road x $80 per tree	=	$
___ trees removed for Fishing x $80 per tree	=	$
___ trees removed for Timber Harvest x $80 per tree	=	$
___ trees removed for Moose Viewing Area x $80 per tree	=	$
TOTAL REVENUE (visitor fees and tree sales)	**=**	**$**

Costs

		Management Costs/yr
____ acres Wilderness x $5 per acre	=	$
____ acres Trails x $75 per acre	=	$
____ acres Campground x $300 per acre	=	$
____ acres Hunting x $15 per acre	=	$
____ acres Fishing x $10 per acre	=	$
____ acres Timber Harvest x $10 per acre	=	$
____ acres Moose Viewing Area x $5 per acre	=	$
		Construction Costs
___ miles of Trail x $150 per mile	=	$
___ miles of Campground Road x $800 per mile	=	$
___ acres Campground x 4 sites per acre x $1,500 per site	=	$
___ miles Hunting road x $800 per mile	=	$
___ acres Fishing x $4,500 per mile	=	$
___ miles Timber Harvest road x $800 per mile	=	$
___ acres Moose Viewing Platforms x 3 sites x $3,000 per site	=	$
___ acres Moose Viewing Road at $800 per mile	=	$
TOTAL COSTS (Management costs + Construction costs)	**=**	**$**

PROFIT OR LOSS

(Total Revenue $ _____) – (Total Costs $_____) = $ Net

If the Net amount is positive, it is a profit; if it is negative, it is a loss.

[i] US Forest Service: Appendix D Indian Nations https://www.fs.fed.us/people/tribal/tribexd.pdf
[ii] US Forest Service: Chippewa National Forest signs agreement with Leech Lake Band of Ojibwe on Shared Stewardship https://www.fs.usda.gov/inside-fs/delivering-mission/excel/chippewa-national-forest-signs-agreement-leech-lake-band-ojibwe
[iii] Ojibwe People's Dictionary: Mooz https://ojibwe.lib.umn.edu/main-entry/mooz-na
[iv] BioScience: Minnesota's Moose: Ghosts of the Northern Forest? https://academic.oup.com/bioscience/article/59/10/824/237324