RECLAMATION TECHNIQUES FOR
PRAIRIE CREEK RESERVOIR PARK, MUNCIE, INDIANA
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INTRODUCTION

The following booklet outlines techniques which can be used to bring degraded trails at Prairie Creek Reservoir back to a usable state. Symptoms which would lead me to label a trail's condition as degraded include: standing water, visible effects of erosion, dangerously irregular surface, and overhanging vegetation. Many different factors combine to create these symptoms. Factors such as frequency of use, soil water content, soil texture, type of trail use, slope, and vegetative cover, have all contributed to trail degradation.

It is very important that part of my project addresses the need for the reclamation of degraded trails. My choice of Prairie Creek Reservoir as a site for my comprehensive project was largely due to the very obvious need for a better trail system. Currently, a majority of the trails at P.C.R. are in such poor condition that they are not usable. Information which can be used to get these trails back to a usable resource goes hand in hand with the information I have already provided on trail layout.

Not only will the techniques in this booklet be helpful in reclaiming trails which are already degraded, but will also be useful in addressing the maintenance needs which will appear as new trails are built and used. It is important to note that this booklet has been created as a resource to help the persons responsible for the trails at P.C.R. and therefore is focused on the specific reclamation problems found within the boundaries of that property.

CONDITIONS LEADING TO TRAIL DEGRADATION

Even before a trail is constructed, conditions exist which are not favorable for trails. Low lying areas with clayey soils, steep slopes with sandy soils, and areas with no existing vegetation are unstable even without heavily used trails. When trails occur in such areas problems begin to develop very quickly.

Qualities which have lead me to label many of the trails at Prairie Creek Reservoir as degraded include: standing water on trails, ruts more than 6" deep, more than 3" of loose soil laying on the trail, large (more than 10' wide) areas which are without vegetation, and trails which are overgrown with thorny species such as multiflora rose.

Standing water is by far the most destructive of the trail conditions listed above. Ruts, large and deep pools of water, and compacted soils, probably all started out as sections of trail with small amounts of water laying on them. Of course standing water alone will not create degraded trail conditions. It is the use that takes place during the times that water is standing on the trail that creates the problems. When a horse hoof, dirt bike tire, or even a hiking boot, steps into a puddle several serious conditions occur. First, waterlogged soil in the bottom of the standing water is displaced to the outer edges of the puddle. This movement of soil effectively deepens the puddle. Another impact occurring when waterlogged trails are used is soil compaction. Depending on the soil structure, soils may compact under the hoof, tire, or foot, of a trail user. This compaction decreases or even stops the downward infiltration of the water standing on the trail surface. Without infiltration, the only way standing water will disappear from a trail is by evaporation.

Another significant problem created by standing water is that of trail widening. Very few trail users want to immerse themselves or their equipment in water standing on a trail. When a puddle blocks a trail it is only natural to expect trail users to find a way around it. This can be something as simple as riding or walking a few inches to the right of left, or even a new thirty foot long trail which circles out around a low lying area. Trail widening is such a problem because the factors which caused the initial standing water will probably cause the same thing in the route used to get around the standing water. Trails with standing water just keep getting wider until a new trail is created which can be used to get around it. Inevitably, the new trail will soon have standing water on it and the whole process will begin again.

A common form of trail degradation at Prairie Creek Reservoir is erosion. Many section of trails are located on slopes which are easily eroded. Instances of erosion of more than 3' can easily be found. This erosion is largely a result of water running down the trail and the spinning tires of off road vehicles. When these two factors are combined with a soil texture which is high in sand, severe erosion occurs. Negative effects of this erosion include: silting of water bodies, loss of soil fertility, negative visual impact, loss of vegetation, and unsafe trail conditions resulting from thick layers of loose soil.

The techniques which are included in this booklet are intended to provide Prairie Creek Reservoir Park employees with suggestions for bringing the degraded areas of the park back to a stable condition. Several pages also address the issue of how to minimize the damage done to the park in the future.
PROBLEM:
On some of the steep slopes in the park severe erosion is occurring. This erosion is largely a result of the loss of vegetative cover on extremely sandy soils. Currently, the surface of the slope has six to twelve inches of loose soil laying on it. The goal of the reclamation method will be to stabilize the soil and prevent further expansion of the eroded area.

RECLAMATION METHOD:
Brush from the removal of invasive or undesirable species of trees and shrubs within the park should be placed on the eroded areas. The brush should be cut into lengths which will allow it to form a one foot thick mat. Stakes should be driven into the slope of the hill to hold the brush in place.

BENEFITS OF THE SOLUTION:
By placing the brush mat on the eroded area site visitors will no longer be able to use that trail. Elimination of traffic over the loose surface will speed re-establishment of vegetation.
The brush mat will break up the water flow down the slope thus preventing erosion. During intense rain the brush will also break up the force of the water striking the bare surface. Protecting the surface from erosion by wind and water will also aid in the re-vegetation process. In sandy soils the sun can quickly heat up the soil surface due to the lack of organic material and moisture. The brush mat will help to keep the soils of the slope cool. Partial shade will also help young plants survive in these poor conditions.
Volunteer plant seeds will find good conditions for growth. These volunteer plants will re-vegetate and therefore stabilize the eroded slope.
As the volunteer plants begin to grow up through the brush mat a very well protected wildlife habitat will develop.
All of the materials for this process can be found on the site and can be gathered easily.
To speed up the re-vegetation process cuttings of hardy woody species can be planted in the brush mat.

LIMITATIONS OF THE SOLUTION:
This method will take several years to establish itself.
The area to be covered is often very large. To gather and then install the brush mat will be very labor intensive.
**PROBLEM:**
Many of the trails which run perpendicular to the face of the slope are in poor condition. Deep ruts which hold water are the most common problem on trails found in these areas. Soil from the ruts is pushed out of the bottom of the ruts by trail users. A dam of displaced soil forms on the downhill side of the trail. This dam allows even more water to be trapped in the rut thus expanding the problem.

**RECLAMATION METHOD:**
Placing a rock retaining wall on the downhill side of the trail allows the surface of the trail to be leveled. Water that runs across the trail surface will percolated through the rocks rather than being stopped and forming puddles. It is crucial to compact the soils which are used to level off the existing ruts. Uncompacted fill will develop ruts very easily.

**BENEFITS OF THE SOLUTION:**
- Rocks that will be needed to build the retaining wall on the downhill side of the trail can be found throughout the park.
- The rocks placed along the trail will help define the trail surface thus preventing widening of the trail.
- A dry trail is more enjoyable to use and less likely to be cut around(trail widening).

**LIMITATIONS OF THE SOLUTION:**
- Ruts in the trails are often very deep. Soil to fill the ruts may have to be borrowed from the area along the trail. Removal of soil will disturb existing vegetation. Care must be taken to minimize the damage done when collecting soil.
- Any fill soil placed on the trail will have to be very heavily tamped to prevent ruts from forming as the soil is compacted by trail use.
PROBLEM:
Many of the trails which exist in the park are very wide. In some areas there is very little vegetation because so much of the land is currently being used as trail. When the trail is very wide it increases the amount of maintenance required and the visual impact. In areas with wide trails it is difficult to keep users on the designated trail because there is little distinction between what is intended as trail and what is not.

RECLAMATION METHOD:
The goal of this method is to provide a clearly defined trail. Found items such as logs and rocks can be used to line the intended path. Soil from the former trail areas can be used to build a slightly elevated trail surface. On the areas which will no longer be used as trail a vegetative cover such as prairie grass can be used to discourage use and further define the intended trail surface.

BENEFITS OF THE SOLUTION:
Narrowing the trail provides a sense of enclosure which is a desirable part of a trail experience.
There will be less maintenance because the amount of trail surface is greatly reduced.
The introduction of prairie grasses to the former trail areas may increase the diversity of wildlife habitat within the park.
By placing the trail along what was either the right or left side of the original trail only one side of the narrowed trail needs to be marked because the other side will be bordered by the existing vegetation.

LIMITATIONS OF THE SOLUTION:
It may be difficult to find enough rocks and logs to define the intended trail.
Plants may be difficult to establish in the compacted trail soils.
Any soil used as fill will have to be tamped very heavily to prevent ruts and puddles as the soil settles.
**PROBLEM:**
Very large deep puddles of water exist in many of the trails located in the park. When users encounter a large puddle on the trail they find a way to get around it. Heavy traffic around the edge of the trail often leads to the expansion of the puddle. If no convenient method for getting around the water exists a trail user will probably make a new trail around the water. As this process happens again and again your park ends up with many short trails which create confusion and the risk of collisions at intersections.

**RECLAMATION METHOD:**
First a drainage trench must be cut to get the water off of the trail. Once the puddle is empty trenches should be cut along both sides of the trail to provide fill for the puddle area. All fill should be heavily tamped into a slightly domed or crowned trail surface which is higher than the tops of the trenches which were dug along both sides of the trail.

**BENEFITS OF THE SOLUTION:**
No additional materials are needed to repair the trail.
Trenches along the trail will prevent trail widening and collect the runoff from the trail and adjoining land.
Dry trails are more enjoyable to use.
Trail widening and trail blazing are less likely to occur if the trails are dry and well maintained.

**LIMITATIONS OF THE SOLUTION:**
Digging the trenches will be very labor intensive.
Standing water along the trails may create unpleasant smells and insect problems.
Some of the existing vegetation may be damaged by the digging of trenches.
**Problem:**
In many areas of the park there are too many trails. These trails are largely a result of trail users trying to get around the puddles which are characteristic of a majority of the trails in the park.

**Reclamation Method:**
Laying brush over the trail surface will prevent use. Soils from the surface of a trail that is going to be shut down can be used for fill on other trails. By removing more soil from a trail, water will completely cover the trail surface thus effectively shutting it down. Water from adjoining trails can also be drained onto shut down trails which are found on lower ground.

**Benefits of the Solution:**
- No additional materials are required to complete the reclamation.
- Large shallow bodies of water created by soil removal may increase the diversity of plants and animals found in the park.
- Plants growing up through the brush mat will provide a protected wildlife habitat.
- By building better trails the likelihood of users leaving the existing trails to create new ones is greatly reduced.

**Limitations of the Solution:**
- Large amounts of brush will be required to prevent trail users from re-opening the shut down trail.
- Plants may be slow to establish in the heavily compacted soils of the shut down trails.
**PROBLEM:**
Several spots around the perimeter of the park allow vehicles to get into the site. Once inside, vehicles damage the park in many ways. Trash dumping, destruction of vegetation, damage to trail surface, and severe soil compaction are some examples of the damage which occurs when vehicles get into the park. While sign and policing are present in the park there is too much area to effectively prevent vehicular access. Methods for preventing vehicles from gaining access need to be installed to prevent further destruction.

**RECLAMATION METHOD:**
Large rocks placed along areas which can be driven through are a very effective way to block access. When blocking off an access point it is important to also block the areas to the right and left so that vehicles can't just drive around the obstacles. A combination of rocks and vegetation will provide a better looking solution. Placing a brush mat across the access point will block traffic and allow vegetation to be established. Eventually, trees and shrubs will hide the fact that there was an access point there at one time.

**BENEFITS OF THE SOLUTION:**
Keeping vehicles from getting onto the trails will prevent a lot of the maintenance problems which are now present. Eliminating vehicular traffic on the trails will also allow for vegetation to be re-established.
Dumping of trash will cease when vehicles can't get onto the trails.
Trail use will be safer if vehicles are not on the trails.

**LIMITATIONS OF THE SOLUTION:**
Rocks which are large enough to block off access points will be difficult to move.
Soil compaction from years of vehicular access will make it difficult to establish vegetation.

1. VEHICULAR ACCESS
2. LARGE ROCKS AND GRASSES BLOCK OFF
3. TREES CLOSE OFF
PROBLEM:
There are several large areas where there is no vegetation because vehicular traffic is heavy. Without vegetation soil can easily be eroded or become sterile. As the vehicles destroy the vegetation they also compact the soil which makes it difficult to re-establish plant material. These large areas without vegetation are very unattractive. Because there is nothing to show were a trail is users cut across the area wherever they please which prevents any vegetation from growing back in.

RECLAMATION METHOD:
To re-establish vegetation traffic over the soils needs to be eliminated and a protected environment needs to be provided. To eliminated traffic rocks can be collected from the area and randomly placed so that park users will have to go around them. Brush can also be mixed in with the rock to further limit access. The best areas to try to re-vegetate are those which are adjoining the existing vegetation. These edge areas get partial shade at different times of the day which will increase the chances for plants to get established. Once vegetation is established the stones and brush can be moved in a few feet further and the new vegetation will provide protection. This process can be repeated until the entire area is re-vegetated.

BENEFITS OF THE SOLUTION:
Re-vegetation will provide more wildlife habitat and will also be much nicer to look at than large spots of bare soil.
Rocks and brush can be found on site.
By bringing back the vegetation the area which is used as a trail will be greatly reduced thus requiring less maintenance.

LIMITATIONS OF THE SOLUTION:
Heavily compacted soils may be slow to re-establish vegetation.
Because the soil has been barren and severely disturbed there may be little or no organic matter remaining in the soil. If so, mulch such as leaves or grass clippings may need to be mixed into the soil.
Just as it took many years to tear up these areas, it will take a long time to bring them back.

1. BARREN AREA
2. ROCKS AND BRUSH PREVENT TRAFFIC
3. VEGETATION IS ESTABLISHED AND ROCKS AND BRUSH ARE MOVED
PROBLEM:
In the open areas of the park it is very difficult to determine where the trail is. This leads to increased destruction and disturbance of the adjoining habitats. Another situation which frequently occurs is the formation of new trails because the intended trail is not clearly marked.

RECLAMATION METHOD:
Markers such as large stones or logs randomly placed along the intended trail will show park visitors where the trail is.
A simple signage system will also help clarify trail location.
If a trail needs to be closed off it is most important to do so in places where the main trail crosses the one to be closed. At these intersections items such as logs, brush, rocks, and signage can be used to keep users off undesirable trails.

BENEFITS OF THE SOLUTION:
Closing down trails and keeping park users on the intended trail will minimize the disturbance to wildlife habitat.
By minimizing the areas which park visitors are using there will be less maintenance.
Rocks or logs placed along the trail allow the trail user to see where the trail is supposed to go regardless of the season.

LIMITATIONS OF THE SOLUTION:
It may be difficult to find enough objects to clearly mark the trail.

1. TRAIL IS HARD TO LOCATE

2. ROCKS AND RAISED SURFACE SHOW TRAIL LOCATION
**Problem:**
The parking areas within the park are increasing in size because there is no clear definition of what is intended to be the parking area. This increase in size is very detrimental to existing vegetation. Not only does it kill all vegetation but also compacts the soil so severely that it will be very difficult to re-establish vegetation in the areas.

**Reclamation Method:**
Wherever vehicles are allowed into the park barriers must be in place to prevent them from driving throughout the site. Both the parking areas and the drives leading to them must contain all vehicles. Materials found within the park such as large rocks and pieces of wood will work, but it is likely that there is not enough of these materials to completely block access. By digging a trench around the parking lot and piling all of the soil from the hole right beside it an obstacle which would be very difficult to cross would be created. Because the sides of the soil would be very steep it will be crucial to immediately seed them with a grass cover to prevent erosion. While this method will require heavy equipment and is more expensive than the other improvements, it is crucial to keep vehicles out of the park. It would be pointless to put in a new trail system if vehicles can get onto it and destroy it.

**Benefits of the Solution:**
Containment solutions such as fencing or bollards could be easily removed. A trench would be very difficult to destroy.
Keeping vehicles off of the trails will greatly decrease maintenance and destruction of vegetation.
Trails will be safer to use if vehicles don’t have access.
Trash dumping will no longer be a problem.

**Limitations of the Solution:**
To dig a trench around the parking area would be very expensive.
The disturbed soil would have to be seeded or the soil would erode back into the trench.

1. Expansion of Parking Areas
2. Ditch Prevents Expansion
3. Vegetation Stabilizes Slope


Selections 1 and 9 were both very good resources. I strongly recommend referring to them if you are planning to undertake any of the projects described in this booklet.