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A Mapping of Environmental Mitigation Measure Along the Propose Access Road in Reserve Forest Using Drone Technology

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Abstract: Basically, soil erosion is knows to be a massive challenge to land depletion that has impacted soil nutrients, carbon recycling, land productiveness and generated bad influences on construction. Therefore, Best Management Practices (BMPs) can prevent the loss of soil and reduce the land degradation. Besides, Unmanned Aerial Vehicles (UAVs) or define as drones have been commonly used by engineers or contractors as an effective method for engineering survey, excavation monitoring and historic landmark operations. As the technology has advanced and cost reduces, wide areas can be captured at high resolution and drones are now a typical part of engineering tools as this equipment can help for mitigate the environmental. Meanwhile, constructed road at the reserved forest may cause the environmental impacts and pollution will be occurs at the site. This study was conducted to determine a suitable mitigation measure and to plot topography map for the access road in reserved forest using a drone at Bentong, Pahang. The method used to determine the suitable mitigation measure and topography map are by using a drone. Data were analyzed using software application which is Auto-CAD and Microsoft Excel Worksheet. The result shows that the objectives are obtained. The determination to plot the topography map by using drone technology can be achieved. Lastly, suitable mitigation measure along the propose access road will be compute by using BMPs.

Keywords: UAVs, BMPs, Topography Map, Mitigation Measure, Drones

1. Introduction

Nowadays, soil erosion is known to be a major challenge to the land depletion that has impacted soil nutrients, carbon recycling, land productivity and in addition have generated negative impacts on development of construction [1]. The idea of this research is to provide an analysis of the experimental evaluation of the benefits of land management activities in minimizing soil erosion as a source of sediment and to relate this with suitable mitigation measure of soil along the propose access road. Basically, areas that vulnerable to massive impacts of soil erosion should also be identified and Best Management Practices (BMPS) adapted to mitigate soil loss and land depletion should be established.

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Instead of traditional sediment control BMPs are intended to reduce sediments but are unproductive at minimizing sedimentation that caused by small sediment. In order to satisfy the need for sustainable growth for the next millennium, the project must limited the activities such as cut the tree and will caused soil erosion or failure in slope. The important thing for this access road project is to keep the forest in sustainable without harming the environmental of the forest. In the last few years, a range of drones technology works or also defined as Unmanned Aerial Vehicles (UAVs) have appeared as a result of the growing use of these systems in both commercial and military industries [2]. In land surveying engineering, the traditional survey consisting of using a total station involves a lot of cost, time rather labor energy. Hence, low cost drones are very practical and provide accurate details for many uses such as road construction. Drone provide the good performance that reaches the precision of engineering survey field and regulation especially in small mapping areas. Drone would provide the good performance that reaches the precision of engineering survey field and regulation especially in small mapping areas. Drones have become a commonly used, key part for engineering study and engineer surveyor is now using drones to create report sites, discover landscapes, topography, find hidden features and survey works [3].

1.1 Problem statement

Construction of road in the reserve forest areas commonly used huge cost. Improperly built forest road might involve major environmental effects which include road surface degradation, off-site water runoff, slope collapse, soil erosion volume instant and habitat destruction. New roads will improve human to access and explore the forest. One of the main impacts of forest roads is on the quality of water from both drastic and cumulative forms of water waste mainly from sediment. Mitigation measures can be used to minimize these harmful impacts. This mitigation measure must start at the site of the road and must continue into the design, use and preservation of the roads. Roads are commonly referred to as paths to environmental destruction but a dedication to the introduction of mitigation initiatives will minimize more of the impacts associated with forest road, allow our forests to be maintained and used whilst protecting forest habitats. There are a range of potential prevention strategies that can be introduced in the planning, building, transport and preservation of highways.

1.2 Objectives

The objectives of this study are to plot topography map for the propose access road using a drone and design a suitable mitigation measure along the propose access road.

2. Materials and Methods

Subjective measurement such as satisfaction of the occupants will be identified by using a drone technology, Auto-CAD drawing and Microsoft Excel Worksheet. The selected method is the most suitable as it can obtain all the results based on the objectives of the research.

2.1 Drone technology

The drone technologies were used in this research project. Application of UAVs for various construction of building, road construction, bridge construction, recreational and commercial uses get a high demand among surveillance or professional field. This instrument or device can be used in many fields of works such as geographic mapping, building safety inspections, aerial photography for journalism and film, gathering information or supplying essentials for disaster management and precision crop monitoring. This is because the drone has its unique feature, high technology and high capacity compared to conventional tools such as Total Station and Electromagnetic Distance Measurement (EDM). This traditional method land survey usually used the conventional tools such as tripods, tape measurement, total stations and Global Positioning Satellite (GPS). Figure 1 below showed the drone or UAVs.

Figure 1: Drones

2.2 Auto-CAD Drawing and Microsoft Excel Worksheet

The forest road database at Bentong will be set up by the software which is Auto-CAD. In this project, Auto-CAD used as the BMPs signage and also determine the height of the surface area which was drawing cross-section along the propose access road. This method can help accurate database and reduces errors compared to the hand sketches technique. Before the drawing of cross- section completely ready, the value of average slope gradient will be calculated into formula by using Microsoft Excel Worksheet

3. Results and Discussion

Some of the data were analyzed using the Unmanned Aerial Vehicle system (UAVs) which is to plot topography map for the propose access road. From that, topography map will be determined by the photos from the drone in a high altitude. Auto CAD as a design suitable mitigation measure along the propose access road. Microsoft Excel Worksheet is used to determine the gradient along the proposed access road by using a formula. At the end this chapter, the summary of findings will be discussed.

3.1 Analysis of topography map

The topography map produced by the using of drone technology. The application Auto-Cad and Microsoft Excel worksheet successful achieved the objective which to plot the topography map using a drone technology. From the data obtained, Auto-CAD generated the data of the selection areas to become topography maps

Firstly, drone capture the photo of the propose access road in a certain high. Then, the data photo will be set on the Auto-CAD and Google Earth Pro was used to get the surface elevation of the propose access road. Next, The contour of the propose access road were produce with the height of the surface elevation and the cross-section of the soil. The contour also produced all the BMPs signage in every channel that produced in every 500 meter. Then finally the topography map was produced with high level of accuracy and more visual. Figure 2 below showed the process of topography map was produced.

3.2 Best Management Practices (BMPs) analysis

The selection area of BMPs was conducted at the Tanah Aina. This selected area was location between Kampung Lubuk Mandi and Kampung Lentang. Figure 3 below shows the selection areas. The method that used in this project was earth drain, crusher run, hydro-seeding, silt trap, outlet protection, culverts, check dam, silt fence, sand bag barrier and close turfsAll these method was used to mitigate and reduce the soil erosion, surface runoff, water pollution, land degradation and other factors. The primary issue is non-point source (NPS) emissions, which originals from dispersed sources in the landscapes. NPS pollution from any single region may be minor or negligible but may cause the issues in the quality of water when combined across the landscape. Globally, forests cover about one of the land bases, but forest development is credited with contributing just 1% to 5% to NPS pollution in the measured waters of the United States [4].

Figure 2: Proses of topography map produced

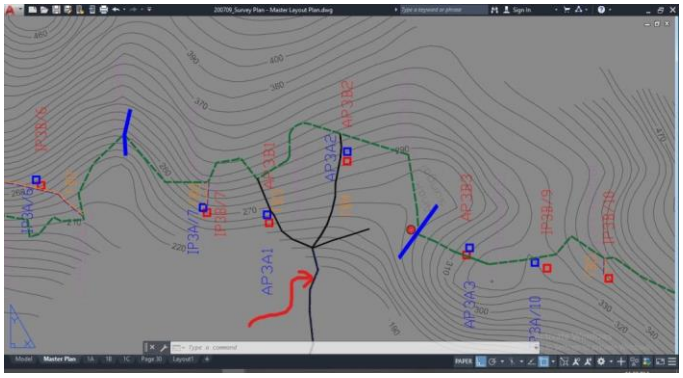

Figure 3: Selection areas which is Tanah Aina

3.2.1 Earth drain, crusher run and hydro-seeding

In this project, earth drain (Figure 4), crusher run and hydro-seeding is alternative method of Best Management Practices (BMPs) that has been used. The earth drain was putted and designed along the propose access road. So, the water flow or stagnant water on the road surface will flow into the earth drain and avoid from the flash flood or non-source pollution occurred. Then, the crusher was filled along the road which road was steep slope. The crusher run was putted along 200 meter which was in KM200 to Km400 for prevent from the land erosion and land degradation. For the access road profile, 3 meter width of crusher run filled on the propose road and the sub-access road profile filled with 2 meter width of crusher run and 50 millimeter quarry dust.

These two profiles used same thickness of road which was 100 millimeter of thick. Hydro-seeding method was used on maintaining the strength of the soil surface. The grass or mulch was used in this method and the ingredient was planted not to close each other because the slope was below 50˚. The grass was planted in between KM200 – KM400 same beside the earth drain to make sure the earth drain have a strength soil bonding and prevent from the slope failure. The Figure 4 below showed the BMPs method which is earth drain, crusher run and hydro-seeding.

3.2.2 Silt trap, outlet protection and culverts

Silt trap was created and design at KM650.Silt trap also being used as BMPs method in this project and the efficiency of using this tools are highly used on road construction. Almost all forest BMPs recommendations commonly conclude that steam crossing areas of skid trails are where sediment delivery has the most tendencies to occur [5]. Silt trap act as capture and store the sediment from cleared sites and during progress of construction. In this project, it is designed for use in limited catchment area. Without any unusual irrigation elements, the building will be finished within a very short period of time. It can help in removing coarse sediment from runoff. Silt trap usually is a temporary measure with a construction life of six months which must preserve before trees and buildings permanently protect the areas of the site from erosion.

Next, outlet protection also used in this project as BMPs tools. The outlet protect is made up of rock, grouted riprap or concrete rubble and it was located at the outlet of a culvert or drainage. Outlet protection act as prevent the scour of the soil caused by high flow velocity and absorb flow energy to produce a non-erosive velocity. In this selection area was used two outlet protection. Culverts were designed in this project which was under the road. The road was connected from the access road to the origin forest road. The built of culverts, it can prevent the sediment from entering, accumulating or being transferred by a culvert. Culverts are useful for logging roads because it is easy to install, can handle heavy payloads without complicated weights limits measurements and can be whether temporary or permanent [6] . Culverts helped the water to pass through under a road or related obstacle from one side to other. The Figure 5 below show the silt trap, culvert and outlet protection was designed.

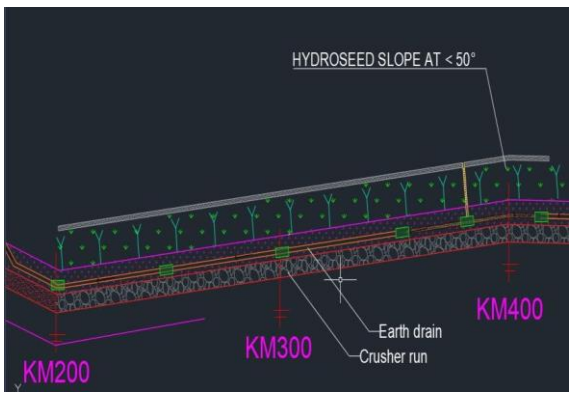

Figure 4: Earth drain, crusher run and hydro-seeding

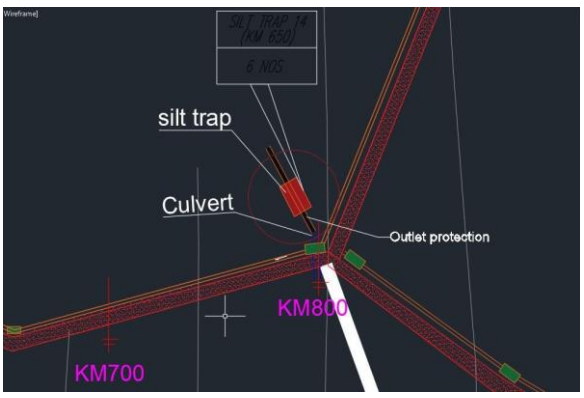

Figure 5: Silt trap, culvert and outlet protection

3.2.3 Check dam and silt fence

Check dam was located at between KM100 to KM200. It was designed and putted at the end of the water flow. For this project, check dam will put in a specific place which located at the small channels in steep velocities exceed 0.6 meter/second. Check dams were then precisely measured with appropriate height and spacing to allow small pools to form within each other. The check dam was built up of rocks because it surely secured against damage during floods. The proposed of check dam as a BMPs for this project was to minimize the flow rate of water and support the unstable side slopes. The accumulated silt was removed whenever it reaches one-third of the height of check dam as a best precautions.

In this project, silt fence also as BMPs and it act as a temporary silt barrier. The silt fence was built at the steep slope and critical path of the area selection to make sure the sediment or silt in the control. Switch the end of the silt fence uphill without delays of any more than 30 meter to limit the amount of runoff collected at any point along the fence to discourage runoff from flowing around the fence. For the maximum ground slope perpendicular to the fence should be 1(H):1(V). This silt fence was totally eco-friendly things because it generally built using natural wood and geotextile fabrics. Silt fence act as erosion prevention and maintain the water flow from the site. Silt fence is important tool as a perimeter control, sediment control or silt containment and need regular maintenance in order to ensure the effectiveness. Based on Urban Storm water Management Manual (MSMA) for Malaysia, they are mainly used in areas where the movement of sheets occurs [7]. The Figure 6 below showed.

3.2.4 Sand bag barrier and close turfs

Sand bag was placed and designed at the end of the steep slope. In this project, this sand bags are located at the end or high gradient areas along the propose access road. The sand bag barrier made up by 1.2 wide and the height is 500 millimeter. Then, between the top layers of sand bags, 100 millimeter UPVC pipes were built to control large flood flows to create areas behind walls for rivers and sediment or silt to settle down. Stacking sand bags along a level contour served as a shield or barriers that by layer upstream of the barrier water, retains silt water thereby allowing sedimentation.

Close turfs also one of the methods that used in this project as BMPs. The closed turfs was planted in the steep slope to avoid the slope failure and strengthen the below of the road surface soil. It was placed at the high risk of erosion soil. In this selection area, the close turfs were applied along KM300 to KM400. This close turfs help the raw slope for erosion prevention. The method of planting grass which is close turfs also known as a grass plant that planted without a gap. It helped under the land more stable and stronger to prevent from the soil erosion. Study on the nature of fertilizer applied to turf grass reveals that a well-maintained lawn is an efficient source of nutrient absorption [8]. The Figure 7 below showed the proposed design of sand bag barrier and close turf in this project.

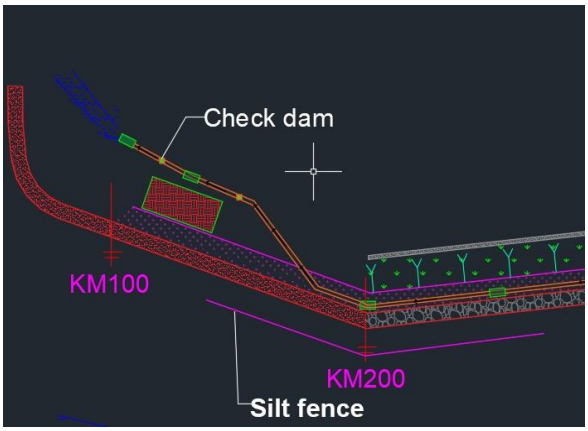

Figure 6: Check dam and silt fence

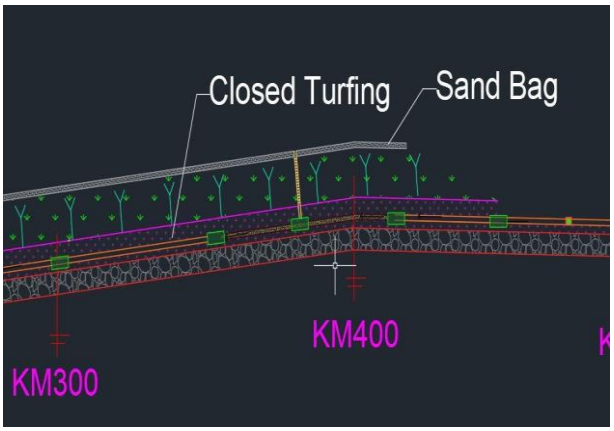

Figure 7: Sand bag barrier and closed turfs

3.3 Land Disturbance Pollution Prevention and Mitigation Measure (LDP2M2)

Land Disturbance Pollution and Mitigation Measure (LDP2M2) is a system for erosion and sediment control for Environmental Impact Assessment (EIA) projects by considering the constructions method, processes, materials and practices during any land disturbing activity through the protection of natural resources by incorporation of Best Management Practices (BMPs) and pollution prevention mitigation measures to comply with the EIA's approval conditions. The important of LDP2M2 is because an increase in cases which is erosion and sedimentation arising from the construction project in recent times and with the various inspections at project site development has shown the main factor and issue perceived to be driving forces for the need of LDP2M2 for EIA projects.

In this project, methods of LDP2M2 were used with following the basic principles in every stage in construction of a new road when implemented the pollution prevention and mitigation measures as following:

- Integrated design of projects with site conditions.
- Preserving and stabilizing the drainage channel.
- Minimize the time and sale of disturbance.
- Control of runoff flowing to, into and from the site in a stable drainage system.
- Install control of the perimeter.
- Stabilization of disturbed areas in a timely manner.
- Cover the steep slope.
- Using multiples controls to avoid damage to the site.
- Secure the inlets, the storm drains and the culverts.
- Ensure access and common construction control.
- Inspects and maintain the BMPs and control mitigation measure

4. Conclusion

In conclusion, the applicability of Unmanned Aerial Vehicles system (UAVs) or drone to create photogrammetric is more efficient because of fast data collection, easy to use, advance feature and modern technology than using a total station or other conventional method of surveying. Based on the data that has been presented in Auto CAD drawing, the topography map of propose access road have been completely plotted by using a drone. This BMPs can be one of the method of mitigation measure along the propose access road in reserve forest. Education efforts, technical assistance, researchers and other developments efforts must continue to be endorsed by the forestry community within each nation to ensure improvements in the adoption and usage of BMPs. The best design of mitigation measure the propose access road was produced with using earth drain, crusher run, hydro- seeding, silt trap, outlet protection, culverts, check dam, silt fence, sand bag barrier and close turfs.

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