

Original Article

The guideline model of area around Alak landfill in Kupang city

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ABSTRACT

The Final Disposal Site (TPA) in Alak District was built in 1997 and has started to operate since 1998 as the main dumping facility in Kupang City. Along the way, the activities of dumping in the Alak landfill affect the surrounding area. The area around the landfill needs to be managed by considering the effect of the landfill activities. This research continued previous research in 2019, which has produced a development concept that includes identifying impacts, handling strategies, and developing the general concept of the area around the landfill. It was conducted to produce a structuring model that contains a description of the existing condition of the area related to the impact of the landfill, as well as the concept of area design, considering the condition of the existing site and the impact of the landfill, as well as the direction of the structuring strategy that has been formulated in previous research that focuses on two zones, namely, the buffer zone and limited cultivation zone. This research produces guidelines for designing area by considering the technical provisions of the Regulation of the Minister of Public Works Number 19/PRT/M/2012 concerning Guidelines for Spatial Planning for the Area Around the TPA, as well as a Site Plan with a focus on handling elements related to impacts, equipped by a picture of the atmosphere related to the designation that has been made as a design guideline as an illustration of the condition of the site if the guidelines are applied.

Keywords: Model, Regulation, Final Disposal Site (TPA), Area Around Landfill

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INTRODUCTION

Population growth is in the same line with lifestyle changes that affect the increase of wasted produces.^[1] Population growth is an increased activity that also impacted the amount and types of waste by human consumption of materials as daily use^[2] which these waste products will be collected then transported and disposed of in final disposal site.

The presence of landfills as final disposal site in Indonesia (TPA) in its development often creates dilemmas. TPA as a landfill is needed to overcome the waste, but it is also not wanted due to the management system that using the old paradigm. The old paradigm is the waste was collected, transported, and disposed of without further waste management, so the more amount of waste will be more waste will pile.^[3] As a result, it cannot be handled and affected the area around the communities. The

negative side of the old paradigm's waste management impact as in noise, scattered waste, dust, smells, and animals' vectors. This condition causing water, soil, and air pollution and health problems for its community's area. It was not including of the barely visible threats as in the possibility of explosion gas due to inadequate the waste management processing. Furthermore, waste potentially caused social conflict in surrounding communities due to land control by groups of people who live as scavengers.^[4]

Alak Landfill is a final disposal site located in Kupang City, Alak district. Built in 1997 and has started operate since 1998. The landfill has a 9.14 ha area, and it is ± 16 km away from the city center. The productions of waste in Alak landfill reached 100 tons/day and increased up to 200 tons/day in rainy seasons.^[5] Based on Julianus, Alak Landfill is using open dumping as waste management system.^[6]

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In the development of Alak Landfill, the landfill still uses an open dumping system, and it caused impacts on the environmental areas. To anticipate these problems, the area around of the Alak landfill needs to have comprehensively designed and integrated with waste management and its landfill will provide economic benefits, environment safe, and change the behavior of the communities toward the old waste management paradigm.

This research focuses on regulating of the area around Alak Landfill and divides it into two parts. Part one is to formulate the concept of area in comprehensively and integrated to provide economic benefits, environment safe, and changes the behavior of communities that still used old paradigm waste management. The result from previously research in 2019 is the identify strategies the development of Alak Landfill surrounding area.^[7] After the identification, part one of research in 2020 is to make the concept of the regulation of Alak Landfill and the surrounding areas with the result are regional guideline, land use (macro and micro), and zoning in the surrounding area.^[8] Based on part one concept, this research continued in 2021 as part two. Part two will provide the guideline model of Alak Landfill and the surrounding area with focuses on elements in the areas that directly impacted by Alak Landfill. The guidelines for its landfill aim to on handling elements related to impacts, equipped by a picture of the atmosphere related to the designation, which is macro and micro land use.

MATERIALS AND METHODS

Methods

This research was used to formulate the guideline model of area around Alak Landfill's. Before previously in 2020, the regulation and guideline concept of its landfill and surrounding area of Kupang City was conducted. Furthermore, the concept directed to provide allowed activities in it landfill, land use in the around area, and the zoning regulation models based on Minister of Public Works Regulation Number 19/PRT/M/2012 concerning Guideline for Spatial Planning^[9] to identify the potentials and the problems as well as strategies to handling the around area of Alak Landfill by using SWOT (Strengths, Weakness, Opportunities, and Threats) as the method^[10] [Figure 1].

The formulated concept previously year in 2020 will be used as a reference for the guideline model, including the elements of design that related the impact of Alak landfill. Because it is a design process, the method will be using standard design process^[11] in the impact area. The collect data and SWOT analysis will be used to formulate the concept and the design. The guideline model result will include site plan and design guideline for the affected element of the areas.

The Characteristic of Alak Landfill

Alak landfill was built in 1997 and has started operate since 1998 as the primary final disposal site. The landfill is +16 km away from Kupang city. The total area of its landfill is 9.4 ha which is divided into two areas The 5.5 ha area used as

<div style="text-align: center;"> <div>Internal</div> <div>External</div> </div>	Strength	Weakness
	<ul style="list-style-type: none"> - Alak landfill location is 1 km away from the settlements - There is still a lot of vacant lands - The Alak landfill is a strategic location, located in the center of the city and easy to get 	<ul style="list-style-type: none"> - The surrounding areas exposed to the impact of landfill activities. Which are leachate, dust, waste scattered, and precaution of the slums - There are illegal slums in the surrounding area of the Alak landfill decreased aesthetics of its area - PT Semen Kupang (Kupang cement factory) and the excavation of its have a potential that caused the damage of surrounding area environment - The access to the Alak landfill is limited - The Lack of facilities and infrastructures of environmental
Opportunities	S-O	W-O
<ul style="list-style-type: none"> - There is a regulation of spatial directives for medium density settlements, low-density settlements, forests, and buffer zone - There is a potential allocation for waste recycling facilities 	<ul style="list-style-type: none"> - The regulations allow the utilization for the space of low-density residential settlements, medium density settlements, forest, and buffer zone (SO 1) - The allocation of space utilization for waste management (SO 2) 	<ul style="list-style-type: none"> - The Regional spatial for forests and buffer zones to overcome the impact of the landfill activities (WO 1) - The spatial planning and regulations to directives allow the arrangement of slums into healthy settlements (WO 2) - There are regulations for the allocation of the basic environment (WO3)
Threat	S-T	W-T
<ul style="list-style-type: none"> - The Alak landfill surrounding area is vulnerable to the pollution, health, and environmental issues - The leachate is seeping into the river near the surrounding area outside the landfill - The activities of PT Semen Kupang (Kupang cement factory) along with the community excavations caused dust in the Alak landfill surrounding area - PT Semen Kupang (Kupang cement factory) and the community excavation (mining) caused the environment damaged. - The landfill areas tend to be isolated due to lack of facilities, infrastructure, and limited access 	<ul style="list-style-type: none"> - The vacant lands can allow for a buffer zone and forest planning to reduce the impact of pollution from landfill, and the excavation from PT Semen Kupang (Kupang cement factory) and communities - The landfill is Strategic, and the availability of vacant land allows to open entrance ST 2) 	<ul style="list-style-type: none"> - Reducing and preventing the negative impact of pollution, healthy, and environmental issues as well as PT Semen Kupang (Kupang cement factory) and community excavation activities by a regulations and structuring buffer zone and forest areas (WT 1) - Allows the provision for facilities and infrastructure to prevent the isolated areas (WT 2)

Figure 1: SWOT Analysis in 2020

main site of waste management and the rest of 4.5 ha is for reserved area for development that located on the west side of the main waste area. The existing 5.5 ha main waste area currently managed by UPT TPA Alak under the Kupang City Cleanliness and Environmental Agency. In main waste area, generally there are two activities which is the management of fecal and management of waste (Source, interview with the head office of UPT Alak Landfill, 2019).

Based on Department of Environment and Sanitation of Kupang City (2019), the average of waste amount on Alak Landfill is +528 m³/day which is 80% are wet waste.^[2] Beforehand, Alak Landfill still used an open dumping system where is the waste was pile at the disposal area without any waste treatment. However, currently, the management system is changed into semi-controlled. The income waste currently is merely leveled by a bulldozer, and after it was solid, the waste will be cover by soil. This method is used to reduce odors, fly breeding, and reduce methane gas leases.

Based on the survey, there are facilities as in the rainwater-controlled drain, leachate, and methane gas-controlled building, but those facilities are damaged and was buried in the pile of waste and it does not work anymore.^[8] In addition, there is a scavenger area with 52 of scavenger households in the surrounding areas of Alak Landfill.^[12] The scavengers help to reuse plastic waste and several types of waste before the waste will be pile and leveled by bulldozer.^[8] Otherwise, there is also the existence of local communities' livestock, which is cows, goats, and pigs that use the organic waste as fodder.

Until this research is holding the Alak landfill as final disposal site is still a lack of waste facilities, the scavenger area is a slum area, and the existence of PT. Semen Kupang (Kupang cement factory) which the location wherein the development area of Alak Landfill caused impacts in surrounding areas of landfill. The impacts include (1) Leachate infiltration due to the damage of leachate installation. The leachate system is buried in waste pile and will be contaminate the dry river in the rainy season, (2) the is the scattered waste due to the dump of waste truck is open, (3) there is area full of plastic waste as the impact of the lack of old paradigm of waste management, and (4) the dust and smoke from cement factory Kupang that impact the area around Alak Landfill.

Analysis and interpretation, or discussion of this research is based on the impacts that has mentioned above. Some of the result discussion will be displaying in pictures, tables, or illustrations for easily understanding. The analysis will be described so the readers can understand the analysis interpretation; especially the design result will be explained based on the analysis and concept design.

RESULTS AND DISCUSSION

The Guideline Model in Area Around Alak Landfill

After formulating the points of impact (based on a previous study in 2019), the next part is the strategies identification and developing concept in the surrounding area using SWOT analysis. The identification result is principles and the concept designs of the element area that used Minister of Publics Works Regulation Number 19.PRT/M/2012 concerning Spatial Planning^[9] as technical provision, which is adjusted physical existence of the surrounding area. Based on the analysis of spatial planning, the land use around area in Alak Landfill divided into:

Macro Land Use

Macro land design context is adjusted and adapted from Kupang City Spatial Planning (RTRW). This area includes The Area City IV (BWK IV) concerning City Regulation (Perda) Number 12 about Detailed Spatial Planning in Kupang City.^[13] In general, the locations are designated for settlements, landfills, heavy industrial areas of PT Semen Kupang (Kupang Cement Factory), green public open spaces (RTH), and the excavation area of cement factory. The macro design concept areas in surrounding area from previously study on 2020 are shown in the following Figure 2.

Based on the map on figure one, the more detail of Alak Landfill surrounding area concept and principles of macro land use [Figure 3].

Micro Land Use

The micro land used design is based on macro land use, adjusted with the zoning of surrounding areas in Alak Landfill and considering the land use from Detailed Spatial Planning in Kupang city of 2011^[14] along with the identification of the impact in the surrounding area on it landfill. The technical regulation related to the zoning from Minister of Public works Regulation No.2 of 2012 also used as design consideration which is the zone is divided into the buffer and the limited cultivation zone.^[9]

The buffer zone

The buffer zone area is established in 0–500 m distance around Alak Landfill areas. The zone is for industrial waste management, green public open spaces, settlement or urban forest, and road network.^[9] At 0–100 m, it is required to be a green belt and 101–500 m for non-food agriculture and the urban forest. In fact, there also has ex excavated by community in this zone, which become one of consideration for the appropriate type of land use by existing

Land use for green public open spaces (RTH) and the urban forest

The guideline in this land use is specific and used throughout the buffer zone of the Alak Landfill that can be a buffer

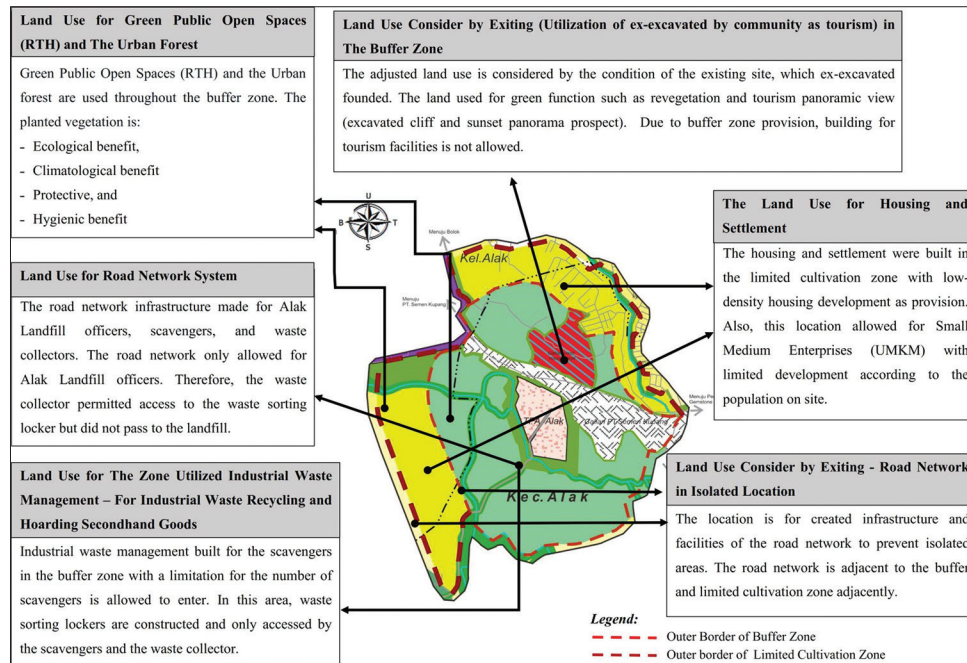


Figure 2: The concepts and principles of land use based on research in 2020 to formulated macro and micro land use of Alak landfill surrounding areas

zone. Because it is for buffer zone, the planted vegetation is ecological, climatological, protective, and hygienic benefits as the function with broad crowns combined with easy growing lush shrubs and also must have the density of trees is 2–5 m for perennials. The local species plant recommendations are coconut tree (*cocos nufera* L), palm or in local name is *siwalan* (*Borassus flabellifer*), mahogany trees (*Swietenia macrophylla* king), *kasambi* trees in local name (*Schleichera india* L), and tamarind trees (*Tamarindus india* L). Further research needs to determine the types of vegetation that can grow well according to existing conditions [Figure 4].

Land use for the zone utilized industrial waste management

Is land use for the placement of waste sorting storage lockers only accessed by Alak Landfill officers, scavengers, and waste collectors. The locker's location of sorting waste is in the southwest near the main entrance of its landfill [Figure 5].

Land use for road network system

The land use for road network guideline considering by the access for scavengers in between Alak Landfill and the waste sorting storage locker which is one way road accessed for scavengers, landfill officers, and waste collector only and for waste collector. However, the waste on the road is designed only for the collectors with access into the waste sorting locker without entering the main landfill area. Due to the landfill and the site plan design is limited by a dry river. Therefore, a connecting road and bridge is still needed. The classification of the road design is a primary collector with +6 m width as

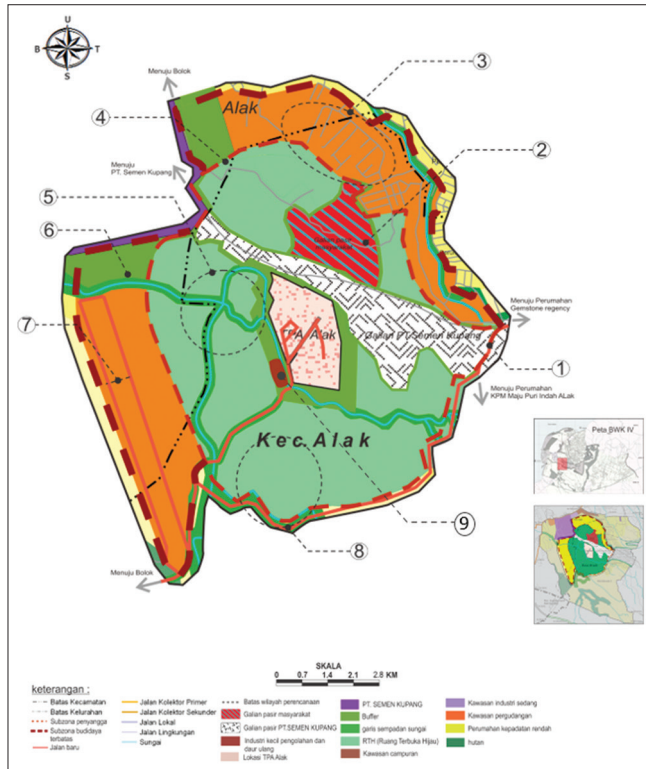
recommendation, the provision of streetlight with a height of 0.5–2 m, and the placement of road network facilities and infrastructure as in drainage is needed to add.

Land use consider by existing (the ex-excavated by community design as tourism) in the buffer zone

Ex-excavated by the community in the buffer zone can be used as revegetation area with non-built buildings as the term. The ex-excavated have the potential as tourism which are as a panoramic view in excavated cliff, the revegetation area around it, and the prospect of sunset view. However, due to the ex-excavated is in the buffer zone; therefore, buildings for tourism facilities cannot be built [Figure 6].

Land use consider by existing – road network in isolated area – the buffer zone existing PT semen Kupang (Kupang cement factory)

This land use is the land use with provision of the buffer for non-built area but for the urban forest only and needed to minimize the impact of smoke and dust on Alak Landfill surrounding area. To minimize it impact, the urban forest must follow the guideline which is the height trees have combined with easy growth and dense shrubs, especially the vegetation that can absorb dust and smoke from PT. Semen Kupang (Kupang Cement Factory). The vegetation can be adapted from existing plants as in mahogany (*S. macrophylla* King), local tree *kesambi* (*Schleichera oleosa*), local tree *pilang* (*Vachellia leucophloea*), tamarind tree (*Tamarindus indica* L), and local tree *cempaka kuning* (*Michelia champaca* L), and



Legends

- 1 Road network to settlement in surrounding Alak Landfill area
- 2 Land Use Consider by Exiting (Utilization of ex-excavated by community as tourism) in The Buffer Zone
- 3,7 Land use for housing and settlement
- 4,5 Land use for green public open spaces (RTH) and the urban forest
- 6 Land Use Consider by Exiting - Road Network in Isolated Location – The Buffer Zone around PT Semen Kupang (Kupang Cement Factory)
- 8 Outer border of Buffer Zone as Road Network for Isolated are of Settlements
- 9 Land Use for The Utilized Zone for Industrial Waste Management

Figure 3: The macro land use in surrounding area of Alak landfill

minimum density of tree is 5 m as same as the buffer zone in Alak Landfill surrounding area.

The Limited Cultivation Zone

The distance of the limited cultivation subzone in the surrounding area of Alak Landfill is determined by regulation of the open dumping waste management system and the existing site. This zone is located in the northwest site border by PT Semen Kupang (Kupang Cement Factory) and the community's road borders for the rest area. The

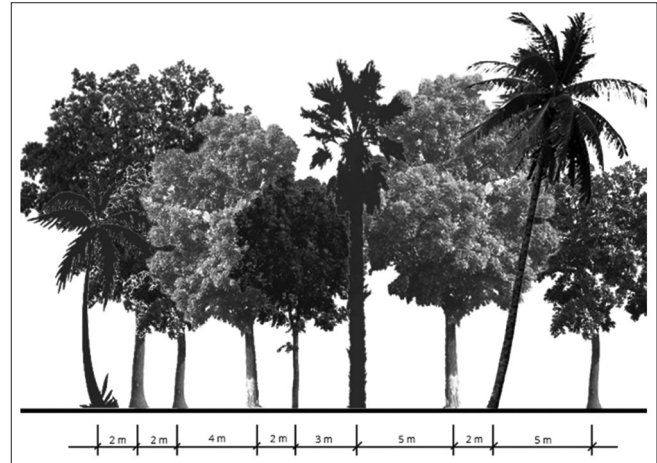


Figure 4: The design illustration for green public open spaces (RTH) and the urban forest with the density of trees is 2–5 m of local trees

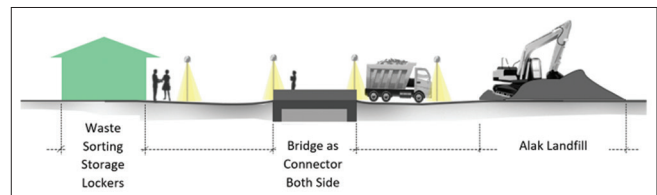


Figure 5: The design illustration considering by the scavengers access in between Alak landfill and the waste sorting storage locker



Figure 6: The design illustration for land use consider by exiting (the ex-excavated by community as tourism as non-built tourism facilities)

land-use activities allowed in this zone are industry, green open public spaces (RTH), and urban forest. The designs treatment for the activities is the same as that applied in the buffer zone.

The land use for housing and the settlements

The development of housing allowed for low population with 11–20 buildings/ha based on Detailed Spatial Planning in Kupang City. In northeast from the site is designated for settlements low-density provision with 30% areas in southwest of the limited cultivation zone used for green public open spaces, urban forest and the rest is for the settlements allowed for Public Small and Medium Enterprises (UMKM) according to the population.

The settlements in northeast side must be built with this following condition which the materials recommendation is zinc or tile and have the opening window which is designed to minimize the impact of dust from Kupang cement factory. The settlement of housings orientation is backward or not facing the community's roads and the excavation of Kupang cement factory. The orientation purpose is to minimize dust both from community's road and the excavation of Kupang cement factory.

For the vegetation is the plant that has broad-leaved and leafy to filter the dust, there is a must to have guardrails for housing, the excavation of Kupang cement factory and community's excavations. Sunscreen for windows needed to filter the dust and block the sun's heat from entering the house [Figure 7]. Furthermore, each house in the settlement is necessary to have building demarcation lines as well as the drainage for household waste.

Land use consider by existing – street network in isolated area

On the site planning there is isolated area and its must open for a street with the guideline the street network opens

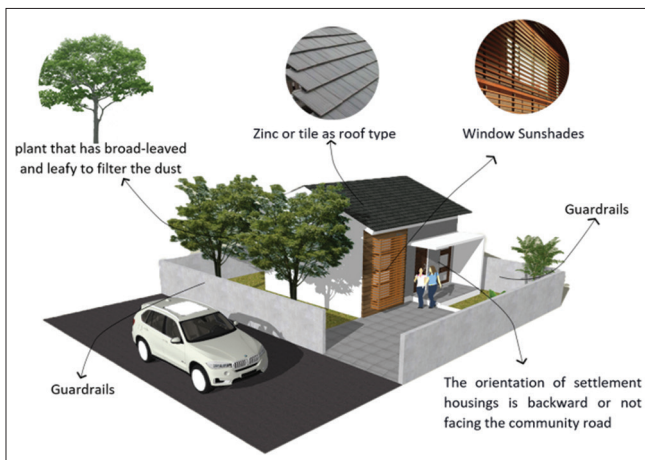


Figure 7: The design illustration of housing in the settlement

along the outer boundary of the buffer zone. However, because the area is the area with the provisions and for the development on the buffer zone (based on Regulation of The Minister of Public Works) is for a non-built area, and the limited cultivation zone is for the built area with low population density; therefore, the guideline for the network that allowed is the sidewalk width is accommodating for walking, interacting, and group walking needs, provision of streetlight is with a height of 0.5–2 m and there is a need for the construction of drainage to the city sewers and the road for entering the Alak Landfill site is the road with classification is a primary collector with the width of +6 m and two ways only for waste truck [Figure 8].

CONCLUSION AND RECOMMENDATION

Conclusion

The existing site, including the impact of the surrounding area due to Alak Landfill activities, become the primary analysis to formulate the design concept, considering by the Minister of Public Works Regulation Number 19/PRT/M/2012 considering for Spatial planning for The Around Waste Final Processing Site (Landfill). The design concept of area is formulated by considering the site existing along with the impact due to landfill's activities and the regulation strategy based on previous research in 2019. The concept is also focused on two zones which is the buffer zone and the limited cultivation zone with macro and micro design of land use.

The guideline and the concept of the design elements are generated by considering the Minister of Public Works Regulation Number 19/PRT/M/2012 considering Spatial planning for The Around Waste Final Processing Site (Landfill) and other related technical provisions and the impact in the surrounding area. Which the focus of the site plan is for handling the elements related to the impact of Alak Landfill in the area around it and equipped by a picture of the atmosphere related to the designation that has been made as a design

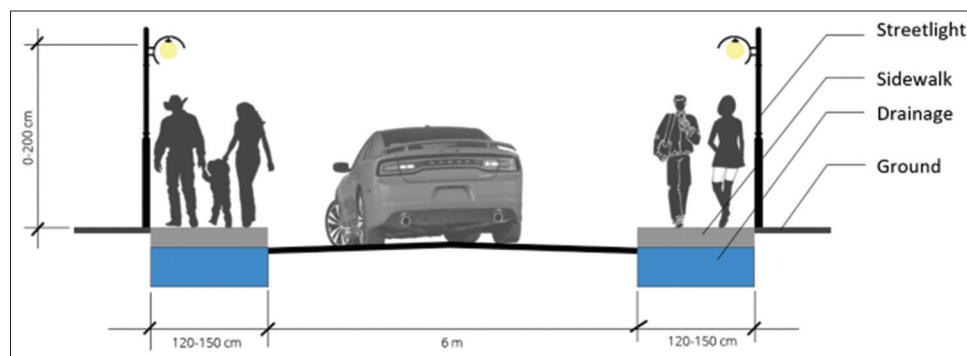


Figure 8: The design illustration for road network, consider by exiting - street network in isolated area and to communities settlements around the outer border of buffer zone

guideline as an illustration of the condition of the site if the guidelines are applied.

Recommendation

This research only focuses on design related to the impact of Alak Landfill surrounding areas, which is the buffer zone and the limited cultivation zone. The invention based on the finding impact on-site is fixed for general models of design. This result is only limited to general guideline for the arrangement of impact in the zones of Alak Landfill surrounding area. For more detailed and thorough, further research is needed for specific technical design.

This research can be applied as a basic design guideline for furthermore the detailed design in Alak Landfill surrounding area, particularly in two specific zones which is the buffer zone and the limited cultivation zone.

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