Alternative locations feasibility for development of final disposal site (TPA) in Semarang Regency

Pratamanintyas Anggraini [1 *], *Hasna* Nur Fadilah [1], *Kristiana Dwi* Astuti [1], and *Reny* Yesiana [1], and Bintang Septiarani [1]

[1]Spatial Planning and Land Management Study Program, Department of Civil and Planning, Vocational School, Diponegoro University, Indonesia

Abstract. Semarang Regency consists of 19 sub-districts, 27 sub-districts, and 208 villages with a population of 1,068,492 people according to BPS Semarang Regency. Semarang Regency has a final disposal site (TPA), namely the TPA Blondo, with an existing land area of 5 hectares in Blondo Village, which is currently experiencing overcapacity. The TPA Blondo facility was built in 2009 and should only be used for a period of 10 years by processing 523 tons of waste per day. This study aims to provide alternative final disposal site in accordance with SNI 03-3241-1994 standards concerning Procedures for Selecting Final Disposal Site. This study uses Geographic Information Systems with buffering and overlay analysis techniques to determine the feasibility of final disposal site in Semarang Regency. The results obtained were in the form of 8 (eight) alternative locations feasibility final disposal site in Semarang Regency in Sumowono District, Tuntang District, Bringin District, Pringapus District, and East Ungaran District.

1 Introduction

Semarang Regency is one of the areas in Central Java Province, consisting of 19 sub-districts, 27 urban villages, and 208 villages. The population, according to BPS Semarang Regency, is 1,068,492 people. The increasing amount of waste is certainly related to population growth (Anggara et al., 2021; Rizqi Puteri Mahyudin, 2017). Waste management does not depend on managing people's lifestyles because the amount or volume of waste is proportional to the level of human consumption of goods or materials used daily (Sejati, 2009). Waste processing, or what is commonly called a Final Disposal Site (TPA), is a place for temporary storage and processing of waste so that there is no negative impact on humans and the environment (Joantan & Zain, 2019). Semarang Regency has a Final Disposal Site (TPA), namely TPA Blondo, with an existing land area of 5 Ha, there located in Blondo Village, Kandangan Village, Bawen District, Semarang Regency. The location of the final disposal site is approximately 2.5 km from the Semarang-Bawen regional road. One of the hamlets closest to the TPA Blondo is Deres Hamlet. Based on the management of the final disposal site and the Semarang Regency Environmental Service, the TPA Blondo is currently over

*Corresponding author: pratamatyas@yahoo.co.id

capacity, because the Final Disposal Site (TPA) that was built in 2009 was only supposed to be used until 2019. According to data from the Semarang Regency Environmental Service, in 2022, daily waste generation will reach 533.16 m^3/day or 194,601.94 tons/year of waste generation. Semarang Regency Regional Regulation No. 6 of 2011 concerning the Semarang Regency Spatial Planning Plan for 2011-2031 explains that the existence of the TPA Blondo Bawen is a waste system development plan with technical requirements and environmental carrying capacity. The development of the waste system is carried out by optimizing land for final waste processing at the existing Final Disposal Site (TPA) and developing a new final disposal site through determining alternative locations feasibility for the development of final disposal site (TPA) in Semarang Regency. Therefore, based on the conditions of the existing final disposal site (TPA Blondo) and the direction of the regional plan, it is necessary to develop TPA land in Semarang Regency by producing alternative determinations of the feasibility of new TPA locations in Semarang Regency.

1.1 Problem Formulation

According to the Semarang Regency Environmental Service and (Rusiana, 2023) the volume of waste at the TPA Blondo has experienced overcapacity, because the final waste disposal facility that was built in 2009 should only be used for a period of 10 years in 2019. Another problem is that the TPA Blondo is close to with settlements, it should be in accordance with the requirements for the location of the final disposal site based on SNI 03-3241-1994, it should be >500 meters from residential areas, so that the TPA Blondo disturbs the comfort of the community. Apart from that, there was also an increase in population in Semarang Regency in 2009 of 917,745 people, then an increase in 2023 of 1,089,770 people, causing an increase in the amount of waste. Because of this, it is necessary to determine alternative locations feasibility for developing final disposal sites (TPA) in Semarang Regency in accordance with SNI 03-3241-1994.

1.2 Goals and Objectives

The goal that can be achieved is determining alternative locations feasibility for developing final disposal sites (TPA) in Semarang Regency. The targets in achieving the goals are:

1. Analysis of population projections for Semarang Regency
2. Analysis of land requirements for Final Disposal Sites (TPA)
3. Analysis of alternative locations feasibility of TPA in accordance with the criteria of SNI 03-3241-1994 concerning the selection of final waste disposal site locations.

1.3 Stages/Process

The analysis carried out is calculating population projections for the 2031 plan year using population data from the 2011 and 2021 population censuses. Population projections use aggregate methods including arithmetic, geometric and exponential models. Determining the most appropriate model is through the trendline method linearly, then the r^2 value is obtained which shows whether or not there is a correlation between year and population. If the r^2 value is closer to 1, then the projection results are stronger and have a stronger correlation, and vice versa using the formula $Pn = P\,o\,(1 + r\,.\,n)$ (Sari, 2004). Note: Pn = population in year n (the year asked); Po = population in year o (base year/known); 1 = constant; r = percentage of annual population growth; n = time period between Pn and Po. The calculation of land requirements uses data on waste heaps, and data on the population of Semarang Regency and the area of the final disposal site (Tendean, 2023). The formula for final disposal site requirements to project waste generation and the area of land required in the projection year

in Semarang Regency is L= V/T x 365/year x 1.15 (Tendean, 2023). Note: L = Land area required each year (m^2); V = Volume of compacted waste (m^3/day); V = A x EA = Volume of waste to be disposed of; M = Mass of incoming waste (A x specific gravity of waste, 200 kg/m3); E = Level of compaction (600 kg/ m^3) T = Height of embankment (m). Analysis of Determining the Feasibility of Locations Alternative TPA, guided by SNI 03-3241-1994, creates a TPA feasibility location map using *a buffer* and using *an overlay* with several tools: *Arctolbox-Overlay-Intersect* determines the location feasibility of the TPA (Samin, 2018).

2 Population Projections

In calculating population projections, there are three methods: arithmetic, exponential, and geometric for calculating population projections. After the calculation results of each method are known, the selected population projection method will be used to test suitability using the standard deviation and correlation coefficient methods. The smallest standard deviation value and correlation coefficient must be close to 1 (Nurdiansyah, 2018). The waste that goes to the final disposal site (TPA) is waste from residents of Semarang Regency which comes from household and non-residential waste. Determining the volume of waste requires population projection data as a basis for analyzing final disposal site requirements. Population projections in Semarang Regency use several methods, namely geometric, arithmetic and exponential methods. The following is the calculation of projections in Semarang Regency.

Table 1. Semarang Regency Population Projection for 2021-2031

Year	r	Po	t	Projected Population Number
2021	**0.012121244**	**946784**	**10**	**1,061,546**
2022	0.012121244	946784	11	1,073,022
2023	0.012121244	946784	12	1,084,498
2024	0.012121244	946784	13	1,095,975
2025	0.012121244	946784	14	1,107,451
2026	0.012121244	946784	15	1,118,927
2027	0.012121244	946784	16	1,130,403
2028	0.012121244	946784	17	1,141,879
2029	0.012121244	946784	18	1,153,356
2030	0.012121244	946784	19	1,164,832
2031	**0.012121244**	**946784**	**20**	**1,176,308**

Source: Compiler, 2024

Based on population projection calculations in Semarang Regency with a 10-year projection year, namely 2021-2031, this population projection calculation is using the arithmetic method, this is because the annual population growth value (r) of 0.012121244 is close to 1, where, if r > 0, that means that the population has increased more than the previous year or that population growth has a positive value, so that the population in Semarang Regency experiences a constant increase every year. The initial population (Po) in 2011 was 946,784 people. In 2021, the population is projected to reach 1,061,546 people. This figure continues to increase every year with stable growth, reaching 1,073,022 people in 2022 and 1,084,498 people in 2023. The population will increase until 2031, where the population will be 1,176,308 people.

3 Analysis of Land Requirements for Final Disposal Site (TPA)

Final Disposal Site (TPA) is a place that aims to be the final point of waste in its management since it appears at the waste source, collection, transfer/transportation, management and disposal. TPA is a place where safe isolation is carried out, this aims to not cause disturbance to the surrounding environment (Saraswati, 2012), so it is necessary to provide good and correct facilities and treatment. Republic of Indonesia Government Regulation Number 81 of 2012 concerning Management of Household Waste and Similar Types of Household

Waste explains that the location area and capacity of TPAs are adjusted to land needs in the Regency/City. Final Disposal Site in districts/cities must be equipped with basic facilities, environmental protection facilities, operational facilities and supporting facilities.

Based on Law no. 18 of 2008 on Waste Management, it is stated that initially it was a final disposal site and then turned into a final disposal site, which is defined as final processing in which the residue from previous processing is transferred to environmental media safely. Apart from that, there are several factors in determining the location of a final disposal site (Fauzi, 2016) as follows: 1) Availability of land, at least it can be used for at least one year, 2) soil conditions and topography must be such that they can guarantee the availability of land for cover in large quantities, 3) surface water hydrology, needs to be considered to determine the direction of groundwater flow and its influence on surface water recharge around the sanitary landfill, 4) Hydrological and hydrogeological conditions, which are quite determining factors in the location selection process to avoid pollution from water produced by waste, 5) local environmental conditions, to avoid conflicts with surrounding communities, because sanitary landfills must be kept away from residential and industrial locations, 6) Expected potential after completion, intended to ensure long-term land use after the sanitary landfill is full and ends, and 7) Transport distance is considered to be as close as possible to the waste generation in order to minimize operating costs.

The need for large final disposal site is closely related to population. The amount of waste generated is very dependent on the population. Waste production can be evenly distributed or vary according to the population in an area. Data on the volume of waste can be determined using population data. Semarang Regency has a population of 1,068,492 people so it is included in the classification of large cities which uses an estimated waste generation unit of 3 liters/person/day. The results of the waste generation projection calculations required in this calculation are the limits on the useful life of final disposal site which are set for the next 10 years, in accordance with the rules for the minimum use period of final disposal site based on SNI 19-3964-1994. The projected amount of waste is calculated by multiplying the value of waste generation by the projected population for the next 10 years. Projections for the amount of waste generation are carried out from 2021-2031.

Table 2. Projected Land Area Requirements for Final Disposal Site in Semarang Regency

Year	Total population	Waste Volume (m^3/day)	Height (m)	Compaction Rate (E = kg/m^3)	Volume of compacted waste (m^3)	Land Area Requirements (m^2/day)	Land Area Requirements (m^2/year)	Land Area Require-ments (ha/year)
2021	1,061,546	529,922	15	600	883.203	67,712	24,714	2.47
2022	1,073,022	536,474	15	600	894.124	68,549	25,020	2.50
2023	1,084,498	543,026	15	600	905.044	69,387	25,326	2.53
2024	1,095,975	549,578	15	600	915.964	70,224	25,631	2.56
2025	1,107,451	556.130	15	600	926,884	71,061	25,937	2.59
2026	1,118,927	562,683	15	600	937.804	71,898	26,242	2.62
2027	1,130,403	569,235	15	600	948,724	72,736	26,548	2.65
2028	1,141,879	575,787	15	600	959,645	73,573	26,854	2.68
2029	1,153,356	582,339	15	600	970,565	74,410	27,159	2.71
2030	1,164,832	588,891	15	600	981,485	75,247	27,465	2.74
2031	1,176,308	595,443	15	600	992,405	76,084	27,770	2.77
Total	**12,308,197**	**6,189,508**	**15**	**600**	**10,315,846**	**790,882**	**288,671**	**28.86**

Source: Compiler, 2024

Based on calculations that have been carried out, it is known that in 2021-2031 the population will reach 12,308,197 people with a total daily waste volume of 6,189,508 m^3. The planned height of waste in the final disposal site (TPA) based on the Semarang Regency Environmental Service is 15 m. The volume of solidified waste in the next 10 years will be 10,315,846 m^3, so that the final disposal site for the next 10 years will require a land area of 790,882 m^2/day or around 28,867 hectares/year.

4 Analysis of Determining Alternative Feasibility of Final Disposal Site (TPA) in accordance with SNI 03-3241-1994 criteria

The selection of final disposal site is in accordance with applicable standards and processing using the help of the Geographic Information System refers to SNI 03-3241-1994 concerning Procedures for Selecting Waste Final Disposal Site. This standard explains that the criteria for selecting a final disposal site are divided into the following stages:

a. TPA Feasibility Analysis, namely *buffering* and *overlaying* each existing parameter and then analyzing it with the help of GIS.

In this process, the final results will produce areas that are suitable and not suitable for the TPA using spatial assistance and *ArcGis* 10.3 tools using *the Overlay technique* (Tendean, 2023).

Table 3. Final Disposal Site Eligibility Criteria Parameters

Analysis	Variable	Classification	Mark
Final disposal site feasibility	Geological Condition	a. Not located in a geological hazard zone	1
		b. Located in a geological hazard zone	0
	Hydrogeology	a. Distance to water bodies >100 m	1
		b. Distance to water bodies <100 m	0
	Nature Reserve Zone/Protected Area	a. Outside the protected area	1
		b. In a protected area	0
	Slope	a. Slope slope 0-15%	1
		b. Slope slope >15%	0
	Distance from the airport	a. Distance to the airport >300 m	1
		b. Distance to the airport <300 m	0

Source: SNI 03-3241-1994

Geological Conditions, the geological conditions at the final disposal site are considered unsuitable if it is located in a fault danger zone because it is an area prone to natural disasters. The following is a map of geological suitability in Semarang Regency. On the geological suitability map in Semarang Regency, the suitability for being a final disposal site is classified, namely according to an area of 101,844.87 ha (value 1), which means that the geological suitability in Semarang Regency shows that the area is in accordance with the geological criteria that have been determined according to the geological conditions (**Figure 1**). **Distance to Body of Water**, the distance to the water body and the final disposal site for buffering is 100 meters from the water body. The closer to a water source, the greater the potential for environmental pollution or unsuitability. The following is a map and table of suitability of distances to water bodies in Semarang Regency. On the map of suitability of distances to water bodies in Semarang Regency, there are two classifications for suitability, namely suitability, indicated by the area that meets the predetermined distance criteria, namely 61,281.60 ha (value 1), indicating that the area that meets the predetermined distance criteria. Apart from that, the classification does not match the distance criteria as having an area of 40,563.16 ha (value 0). The TPA Blondo is in a suitable area, but the area around the final disposal site with a radius of 100 m is an unsuitable area. This shows that the closer it is to a water source, the greater the potential for environmental pollution in the final disposal site (**Figure 2**). **Protected area**, the final disposal site should not be in a protected area, this is because it has great potential to damage and have a negative impact on the environment. The following is a map of the suitability of protected areas in Semarang Regency. On the suitability map of protected areas in Semarang Regency, there are two classifications of suitability for use as a final disposal site, namely suitable having an area of 95,987.49 ha or around 94.24% (value 1) and not suitable having an area of 5,866.09 ha or around 5.76% (value 0). This shows that most areas can be used as protected areas for final disposal site, one of which is the TPA Blondo, but there are still a small number of areas

that do not meet the suitability criteria (**Figure 3**). **Slope**, the Semarang Regency Slope Map is used to assess the condition of the slope of the land, the final disposal site must not be in an area with a slope of 20% or more. Steep slopes are considered unsuitable because they pose a risk of accidents and hinder accessibility. The following is a map and table of slope suitability in Semarang Regency. Regarding the suitability of the slope in Semarang Regency, there are two classifications for suitability for use as a final disposal site, namely according to an area of 283,699.07 ha (value 1) which is considered to meet the desired slope slope criteria, so it is declared as suitable. Apart from that, there is a classification that is not suitable with an area of 56,081.13 ha (value 0) which means it does not meet the specified slope slope standards, and is therefore categorized as not suitable. The slope can help prevent potential accidents or environmental damage that could occur due to erosion or landslides. In the Blondo TPA, it can be seen that it is located in an area that does not correspond to the slope. This means that the Blondo TPA is located in an area with a slope of 20% or more (**Figure 4**). **Distance to Administrative Boundaries**, the distance to the administrative boundary at a location that is considered suitable or appropriate for a final disposal site is >1000 m from the regional boundary. On the other hand, locations within a radius of <1000 m are not suitable or unsuitable for final disposal site. The following is a map of the distance to the administrative boundaries of Semarang Regency. On the map of suitability of distances to administrative boundaries in Semarang Regency, there are two classifications for suitability for use as a TPA, namely suitable for an area of 76,875.33 ha (value 1) and not suitable for an area of 24,969.33 ha (value 0). Based on the map, it can be seen that the appropriate distance to the administrative boundary of the Final Disposal Site (TPA), in areas that are >1000 m from the regional boundary or categorized accordingly, has an area of 76,875.33 hectares including the TPA Blondo. Meanwhile, areas within a radius of <1000 m are not suitable or not suitable for a final disposal site of 24,969.33 hectares (**Figure 5**). **Agricultural Cultivation Area**, agricultural cultivation areas (150 m buffering) at final disposal site must not be in productive areas, such as agricultural areas, this can disrupt agricultural productivity. The following is a map and table of suitability of distances to administrative boundaries in Semarang Regency. On the suitability map for agricultural cultivation areas in Semarang Regency, there are two classifications for suitability for use as a final disposal site, namely suitable for an area of 79,283.69 ha or around 77.84% (value 1) and not suitable for an area of 22,569.89 ha, 22.16% of which is declared unsuitable for TPA (value 0). This shows that the majority of areas evaluated are considered suitable for use as final disposal sites such as the existing final disposal site, namely TPA Blondo, but there are also significant parts that do not meet the suitability criteria (**Figure 6**). **Rainfall**, this rainfall map is used to see the condition of rainfall intensity in Semarang Regency. The rainfall intensity that is suitable to be used as a TPA is where the rainfall value is below 500 mm. The following is a map of rainfall intensity in Semarang Regency that has been overlaid with alternative locations at the TPA feasibility stage. Based on the results of the map overlay above, it is known that 8 Final Disposal Site (TPA) locations are located at a rainfall of 1500-2000 mm/year at alternative locations 2, 3, 4, 6, and 7. Alternative locations 5 and 8 are at a rainfall of 2000-2500 mm/year, and there is 1 location with rainfall >3000 mm/year (**Figure 7**). **Road Network**, in the network to produce a final disposal site that meets the criteria for the preliminary stage, namely traffic parameters, the road network at the preliminary stage carries out 500 m buffering on public roads. Final disposal site located 500 m away from public roads will be better. The following is a map of the road network that has been buffered 500 m from public roads in Semarang Regency. Based on the results of the road network map in the road buffering process, all alternative TPA locations are >500 m from public roads (arterial roads, collector roads) (**Figure 8**).

Figure 1. Geological Suitability Map in Semarang Regency

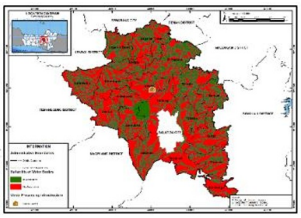

Figure 2. Map of Suitability of Distance to Water Bodies in Semarang Regency

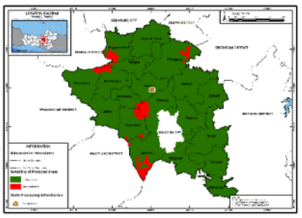

Figure 3. Protected Area Suitability Map in Semarang Regency

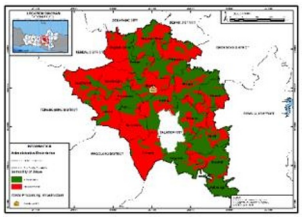

Figure 4. Slope Suitability Map in Semarang Regency

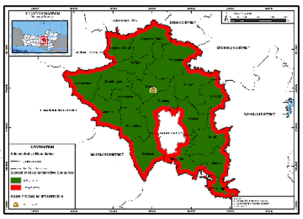

Figure 5. Distance Conformity Map to Administrative Boundaries in Semarang Regency

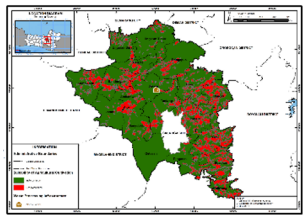

Figure 6. Map of Suitability of Agricultural Cultivation Areas in Semarang Regency

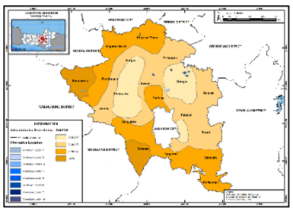

Figure 7. Rainfall Map of Alternative Final Disposal Site in Semarang Regency

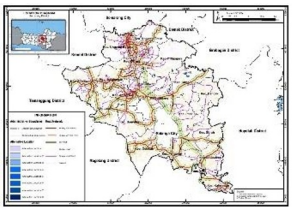

Figure 8. Buffer Map of Semarang Regency Road Network

b. Analysis Alternative Locations Feasibility Final Disposal Site (TPA), namely scoring alternative locations produced at the feasibility stage with parameters by making adjustments to regional conditions.

This analysis is used to determine suitable or unsuitable locations for final disposal site construction based on SNI 03-3241-1994. At this stage, the *overlay* is carried out using several tools: *Arctoolbox-Overlay-Intersect*. The result at this TPA feasibility stage is that the TPA feasibility map in this process is determined with two values, namely 1 for suitable and 0 for not suitable. After assessing the parameters on the map above and *overlaying* it, we obtained an alternative feasible location for the Final Disposal Site in Semarang Regency which complies with SNI 03-3241-1994 guidelines at at the eligibility stage and the land requirements required for 10 years. The following is a feasibility map and table alternative feasibility final disposal site. (**Figure 9**) Based on the results of the eligibility stages, a total score of 1-8 is generated to be used as a TPA. At this stage, it is selected based on the highest total score, namely with a total score of 8 where the highest score is a good result at the eligibility stage, then adjusting the land area that is close to the value of land requirements and the results are in accordance with the parameters at the eligibility stage (slope slopes, protected areas, distance to water bodies, distance to administrative boundaries and so on), so that the most feasible location is obtained in the feasibility analysis. In the total score with the highest value, namely 8, get several

locations to be used as a final disposal site, then at each location look at the land area which is close to the calculation of land requirements. The following is a table of locations for 8 alternative feasibility locations for Final Disposal Site (TPA) in Semarang Regency. In the results of the analysis, there are 8 feasible locations for Final Disposal Site in Semarang Regency with several parameters at the TPA feasibility stage. The total area of the alternative TPA location is 236.53 Ha, where the largest location is alternative location 2 with an area of 65,413 Ha in Tuntang District, Nga dikerso Village. The following is a map of the results of the feasibility analysis which has the largest total value and land area that adapts to land requirements.

Table 4. Alternative Locations Feasibility Final Disposal Site in Semarang Regency

District	Village	Alternative Location	Area (Ha)
Sumowono District	**Ngadikerso**	**Alternative Location 1**	**32.46**
Tuntang District	**Tlompakan**	**Alternative Location 2**	**65.41**
Bringin District	Gogodalem	Alternative Location 3	16.70
Bringin District	**Gogodalem**	**Alternative Location 4**	**32.56**
Pringapus District	Jatirunggo	Alternative Location 5	22.28
Bringin District	Kalikurmo	Alternative Location 6	26.19
Pringapus District	Candirejo	Alternative Location 7	21.36
East Ungaran District	Kalongan	Alternative Location 8	19.57
Total			**236.53**

Based on the results of the TPA feasibility analysis, it is known that on the feasibility map of the Final Disposal Site (TPA) in Semarang Regency, there are 8 alternative feasibility locations for the Final Disposal Site (TPA) spread across Sumowono District, Tuntang District, Bringin District, Pringapus District, and East Ungaran District. (**Figure 10**) After the results of the alternative feasibility analysis of the TPA location in Semarang Regency were obtained, weighting and scoring were carried out on all parameters and adjusted to field observations at each alternative TPA location, so that a total score from each location could be obtained by multiplying the values and weights according to the SNI as follows:

Table 5. Total Score of Alternative Locations Feasibility Analysis of Final Disposal Site (TPA)

WEIGHTING OF ALTERNATIVE FEASIBILITY ANALYSIS OF FINAL DISPOSAL SITE								
Parameters	**Alternative Location**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
General								
Administrative Boundary	50	50	50	50	50	50	50	50
Land Capacity	50	50	25	40	40	50	40	50
Land Ownership Status	9	9	21	30	9	9	9	9
Community Participation	30	30	30	30	30	30	30	30
Physical Environment								
Flood Hazard	20	20	20	20	20	20	20	20
Rain Intensity	3	3	3	3	3	3	3	3
Agriculture	3	30	30	30	30	30	30	30
Road to Site	5	25	50	50	25	5	5	5
Waste Transport (one way)	40	40	40	40	40	25	25	40
Entrance Road	20	20	20	4	20	4	4	4
Traffic	30	30	30	30	30	30	30	30
Kebisingan dan Bau	10	10	10	10	10	10	10	10
Aesthetics	30	15	15	30	30	15	3	15
Total	**300**	**332**	**344**	**367**	**337**	**281**	**259**	**296**

Source: Compiler, 2024

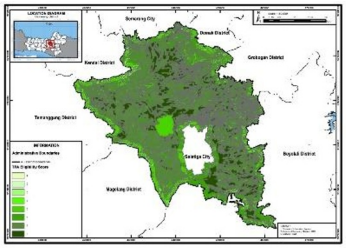

Figure 9. Final Disposal Site Feasibility Map in Semarang Regency

Figure 10. Map of Locations Feasibility for Final Disposal Site in Semarang Regency

5 Conclusion and recommendations

5.1 Conclusion

The results of the calculation of needs, show that in 2021-2031, the population in Semarang Regency reached 12,308,197 people, with a total daily waste volume of 6,189,508 m^3. The volume of compacted waste for the next 10 years is 10,315,846 m^3, so that the Final Disposal Site for the next 10 years requires 28,867 Ha/year of land. This is due to population growth and the increasing volume of waste in Semarang Regency, then from the alternative feasibility of the TPA location that is in accordance with land requirements, namely Alternative Location 1 is located in Ngadikerso Village-Sumowono District, Alternative Location 2 is located in Tlompakan Village-Tuntang District, and Alternative Location 4 is located Gogodalem Village-Bringin District. The results of the analysis alternative locations feasibility Final Disposal Site (TPA) involve carrying carry out buffering and overlay on each parameter. At this stage, a total score of 1-8 is obtained to be used as a TPA, and there are 8 alternative locations that are suitable to be used as a TPA. Alternative feasibility final disposal site that can be considered in the future as final disposal site in Semarang Regency for the next 10 years are 8 alternative locations, namely Alternative Location 1 is located in Ngadikerso Village-Sumowono District, Alternative Location 2 is located in Desa Tlompakan-Tuntang District, Alternative Location 3 is located in Gogodalem Village-Bringin District, Alternative Location 4 is located in Gogodalem Village-Bringin District, Alternative Location 5 is located in Jatirunggo Village-Pringapus District, Alternative Location 6 is located in Kalikurmo Village-Bringin District, Alternative Location 7 is located in Candirejo Village-Pringapus District and Alternative Location 8 located in Kalongan Village East Ungaran District.

5.2 Recommendations

Based on the conclusions, suggestions that can be given for future research development are as follows:

1. It is better if the TPA Blondo (existing) can be used as a place to dispose of waste that be sorted. Sorting organic waste is used as fertilizer, and inorganic waste is processed into plastic pellets or sold directly. In addition, there needs to be a role for community participation in waste management in Semarang Regency to reduce the volume of waste produced, so that the life of the existing TPA and the new TPA can be longer. This needs to be accompanied by socialization and training from the local government.
2. It is hoped that this study can be an input for the relevant government, especially the Semarang Regency Environmental Service, in the development of a final disposal site that must be equipped with facilities in accordance with PP Number 81 of 2012. Further

research can consider the alternative location feasibility of the TPA in Semarang Regency by adding variables of groundwater basin maps, soil permeability, and other parameters in accordance with SNI 03-3241-1994, so that it can be used to determine the location of a new TPA in Semarang Regency.

4. Future determination of the new TPA location can consider land requirements in the 2021-2031 planning year and is based on 8 (eight) alternative locations for the feasibility of the new Final Disposal Site (TPA) in Semarang Regency. The waste management system needs to be considered for the long term, it can use Sanitary Landfill through land development with certain requirements such as soil porosity type, by dumping and piling waste in a location, then compacting it and covering it with soil. This method can reduce odor and health risks. In addition, it can also innovate sustainable waste management.

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