CIVED Journal of Civil Engineering and Vocational Education

EISSN: 2622-6774
Vol 11 No.1 March 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

Evaluation of Land Suitability of The Post-Mine Area for Settlement in The Kuranji Region of Padang City

Anwar Chani[1*], Totoh Andayono[2]
[1,2] Civil Engineering, Faculty of Engineering, Universitas Negeri Padang, Indonesia
[*]Corresponding author, e-mail: aanchani06@gmail.com

Received 24th Feb 2024; Revision 15th March 2024; Accepted 30th March 2024

ABSTRACT

The increase in population in Padang City is related to the many needs that must be met by the community such as housing or settlement needs. The availability of land that meets the criteria to be used as a settlement location guarantees a decent life for each community. This research aims to evaluate the land suitability of post-mining areas for settlements in the Kuranji area of Padang City. Data collection is done by analyzing the parameters used in determining the ideal settlement area, namely, slope level map, soil type map, erosion hazard, soil texture, flood hazard, and soil carrying capacity. The data that has been obtained is analyzed using the scoring or weighting method to determine the level of land suitability. Based on the calculations and analysis carried out on the evaluation of land suitability for settlements in the Gunung Sarik area, it can be concluded that the post-mining area in the Gunung Sarik area is suitable for settlements with a land suitability level value of 57 which with a land suitability level value of 58.7 - 37.4 is appropriate with details of 6 physical parameters that are met, namely, the level of slope 15.76%; Alluvial soil type, erosion hazard 348.83 tons/day/year, never flooded, fine soil texture (Clay), and has good soil bearing capacity (165 kg/cm ^{2}).

Keywords: *Land Suitability; Settlement; Scoring.*

INTRODUCTION

Padang City is one of the cities in the province of West Sulawesi. As well as the capital city of the province. Padang City has an area of 694.96 km2 with geographical conditions in the form of hilly areas whose altitude reaches 1,853 m above sea level. The increasing population of Padang City makes the need for residential land increase, this causes the amount of land for settlements that must be available to be increasingly large, one of which is in the coastal area of Padang city making the need for residential land increasingly dense .
The population of Padang City always increases every year. Referring to data from the Central Statistics Agency (BPS) of West Sumatra Province, the population of Padang City is 919,145 people with population growth reaching 13,000 per year (BPS, 2022). The increase in population in Padang City over a period of 10 years amounted to 50,047 people. This population number continues to increase so this needs to be considered.

Based on data from BPS Padang City, land use for settlements in 2019 is 7,182.43 ha and in 2021 is 7,839.76 ha. The Padang City Government issued a regulation regarding the Regional Spatial Plan (RTRW) of Padang City to increase the development of settlements towards the North of the city and towards the East of the city optimally with an intensity that is adjusted to

CIVED Journal of Civil Engineering and Vocational Education
EISSN: 2622-6774
Vol 11 No.1 March 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

the carrying capacity of the rulang (article 17), (Padang City Regional Regulation Number 4, 2012). Currently, the development of settlements is prioritized towards the periphery, namely Koto Tangah District, Kuranji District, Pauh District, Lubuk Kilangan District and Lubuk Begalung District.

The opening of new land for settlement needs to be considered in terms of land suitability. Settlement is a place where a number of people live and carry out their daily activities (Hardjowigeno, 2007). Land with good quality is needed, because it affects the buildings that will be built on it. But with the increasing need for residential land and the need to clear new land, there will be a possibility of development on former mining land.

Currently, the mining area is still in operation but there is still ex-mining land that has not been converted. Therefore the former mining area can be a solution to meet the needs of new settlements for the Padang City area. If development is to be carried out, it must know the land conditions in the post-mining area. Land suitability for residential areas according to (Hardjowigelno and Widiatmaka, 2007) are: Soil texture, soil type, slope, flood hazard, erosion hazard and soil bearing capacity. For this reason, the authors are interested in conducting research on the EVALUATION OF LAND SUITABILITY OF THE POST-MINE AREA FOR SETTLEMENT IN THE KURANJI REGION OF PADANG CITY.

METHOD

The type of research used in this final project is quantitative research method and scoring analysis. Quantitative research method is a research method that relies on mathematical analysis of sample data. This research aims to evaluate the land suitability of post-mining areas for settlements in the Kuranji area of Padang City. In this research process, weighting and assessment are carried out on each physical parameter of soil that is suitable for settlements. The data used in this research are primary data and secondary data. Some of the steps in collecting data are as follows:

a. Soil texture refers to ASTM D- 422 (Sieve Analysis)
b. Slope level and soil type maps were processed using ArcGIS software.
c. The erosion rate refers to the USLE formula
d. Flood hazards based on observations and interviews
e. Soil bearing capacity refers to SNI 2827: 2008

From each parameter, scores and weights are determined to determine the suitability of settlement land in the following table:

Table 1. Assessment of Physical Parameters of Land Suitability Level for Settlement

No	Variables	Weights
1	Slope	3
2	Erosion Rate	2
3	Type of soil	3
4	Flood Danger	3
5	Soil Texture	2
6	Soil bearing capacity	3

CIVED Journal of Civil Engineering and Vocational Education
EISSN: 2622-6774
Vol 11 No.1 March 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

RESULTS AND DISCUSSION

Slope

In analyzing the slope level, we need to get data in the form of slope length and elevation difference on the slope. If in an area there are several slopes with different slope levels, then the average value can be taken to get a percentage value of the slope level. In this research we use Google Earth to get values for the length and elevation difference of each slope, then the data can be processed using ArcGIS *software* to create a topographic map that can be seen in the image.

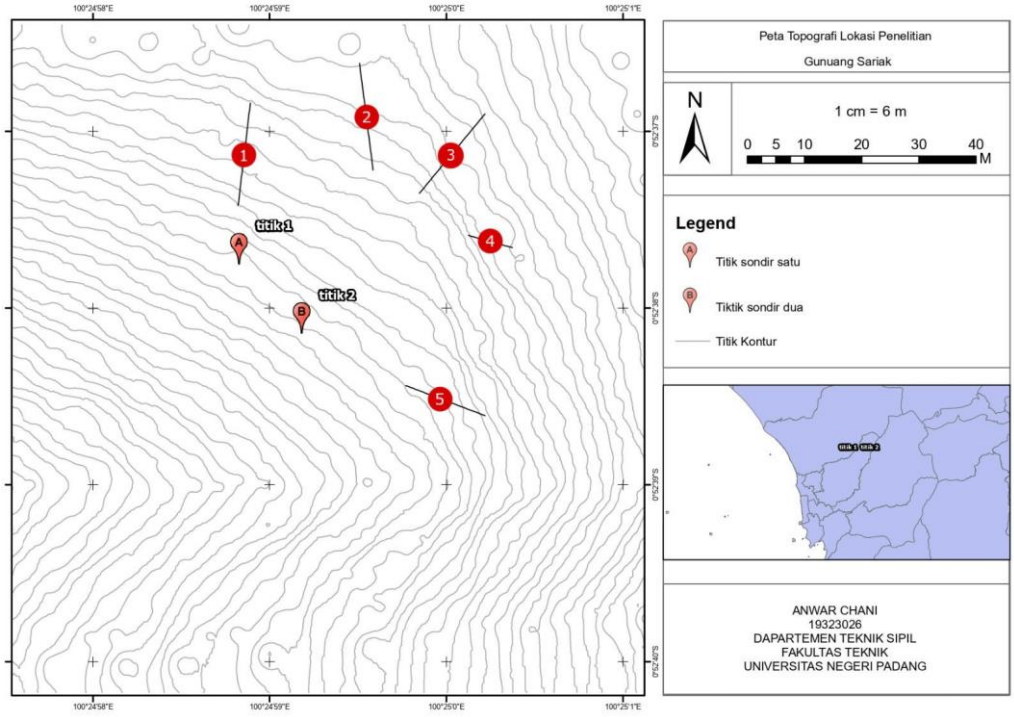

Figure 1. Topographic Map

The average percentage value of the slope level can be seen in the table:

Table 2. Average Value of Slope Level

Slope Length (D)	17.72	17.12	18.37	8.05	8.23
Elevation Difference (Δh)	3.50	2.70	1.20	1.00	2.00
Percentage (%)	19.75	15.77	6.53	12.42	24.30
Average (%)	15.76				

Based on the average percentage value of the slope level, it was found that the slope level of the former mining area of Gunung Sarik, Kuranji was 15.76 % .

Table 3. Slope Level Value

Honor and Class		**Criteria**	
Honor	Class	Slope	Angle magnitude (%)
5	Very good	Average Nearly Average	< 2
4	Good	Slightly slanted-Slanted	2-8

CIVED Journal of Civil Engineering and Vocational Education
EISSN: 2622-6774
Vol 11 No.1 March 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

3	Medium	Crooked	8-30
2	Bad	Very slanted	30-50
1	Very Bad	Rugged - Very Rugged	>50

Type of soil

To obtain soil types from the former mining area of Gunung Sarik, Kuranji. A map of West Sumatra soil types is needed and processed using ArcGIS software. The results of the data processed using ArcGIS *software* can be seen in Figure 11:

From the soil type map below, it can be seen that the soil type in the former mining area of Gunung Sarik, Kuranji is Alluvial.

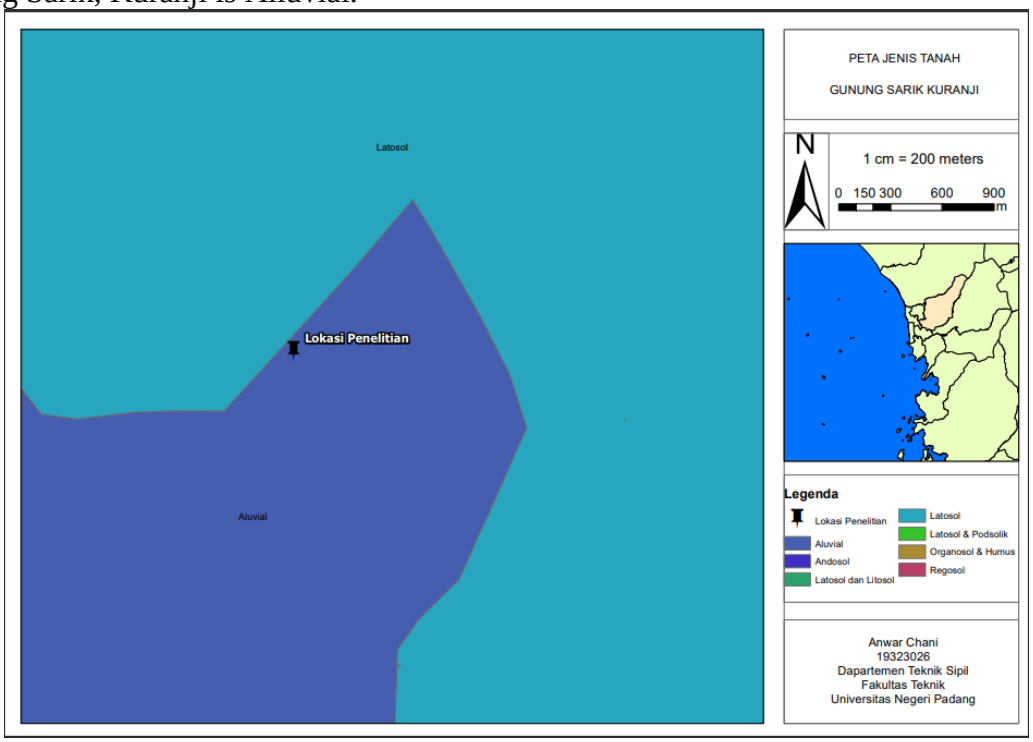

Figure 2. Soil Type Map

Soil Texture

Tests were carried out to determine the gradation size and grain composition in sieve analysis and hydrometer testing to obtain values (gravel, sand, silt and clay) in percent units (%). Each soil sample used in this test is 1000 gr for sieve analysis and 50 gr for hydrometer testing. Test procedures refer to ASTM D 422 and SNI 3423:2008 concerning sieve analysis and hydrometer tests.

Based on the calculations in the attachment, the values obtained from the Sieve Analysis and Hydrometer tests, the granular composition values obtained from the soil of the former mining area of Gunung Sarik, Kuranji are as follows:

Table 4. Granule Composition

Land Quarry	Unit	Granule Composition			
		Gravel	Sand	Silt	Clay
Gunung Sarik	%	0.09	18.30	28.77	52.83

Based on the picture above, it can be concluded that the soil texture of Gunung Sarik is clay.

CIVED Journal of Civil Engineering and Vocational Education
EISSN: 2622-6774
Vol 11 No.1 March 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

Erosion Danger

In USLE, data is needed to obtain a value for the average amount of land lost each year. Several data are needed such as average annual rainfall erosivity, soil erodibility index, slope slope factor, plant factor, erosion prevention effort factor.

1. Average annual rainfall erosivity

To get the average annual rainfall erosivity value, the rainfall value for the city of Padang for the last 10 years is needed which is calculated using the Lenvain formula, the results of which can be seen as follows:

R_{2013} : 287.26 cm^3
R_{2014} : 269.55 m^3
R_{2015} : 233.71 cm^3
R_{2016} : 369.93 cm^3
R_{2017} : 340.75 cm^3
R_{2018} : 258.88 cm^3
R_{2019} : 166.84 cm^3
R_{2020} : 317.17 cm^3
R_{2021} : 284.38 cm^3
R_{2022} : 344.53 cm^3

Where:

R: Average annual rainfall erosivity (cm^3)

These values were processed using Microsoft Excel and the results obtained were that the average annual rainfall erosivity value was 239.42 cm^3.

2. Soil Erodibility Index

Based on data from the soil type map in Figure 2, it can be determined that the K value in Alluvial soil is 0.47

Table 5: Soil Type K Value

No	Type of soil	K value
1	Alluvial	0.47
2	Latosol	0.31
3	Podzolic	0.16
4	Yellow Peacock Podzolic	0.32

3. Slope Factor

The slope factor can be determined by using a land slope map processed using the ArcGIS application which can be seen in Figure 3:

EISSN: 2622-6774
Vol 11 No.1 March 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

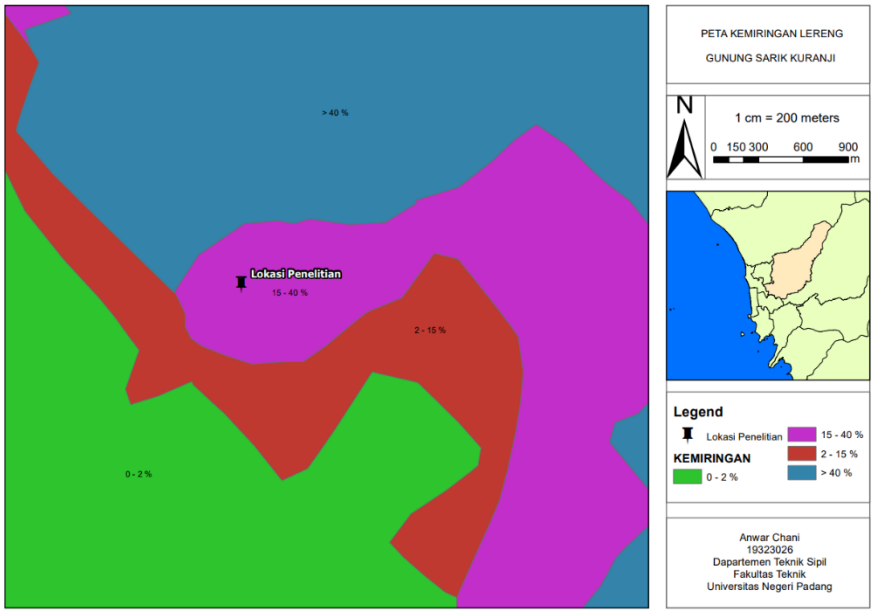

Figure 3. Slope Slope Map

Based on the data on the slope map and the calculation of the slope level, the slope class LS value can be determined in the table:

Table 6. LS Value of Slope Level

Slope Class	Slope (%)	LS value
1	0 - 8	0.40
2	8 – 15	1.40
3	15 – 25	3.10
4	25 – 40	6.80
5	>40	9.50

4. Land Use and Cultivation (CP) Factors

The location of this research was carried out in a former mined land area, based on land use, it can be determined that the CP value in the former mining area of Gunung Sarik, Kuranji is 1. From the value of the rain erosivity factor, soil erodibility factor, slope slope factor, and land use factor. The value of the average amount of land lost each year can be calculated using the USLE formula as follows:

$$R = 239,42 \times 0,47 \times 3,10 \times 1 = 348,83$$

Where:

R = Average amount of soil lost each year (Tons/day/year)

And the calculation result from the USLE formula is 348.83 tons /day/year.

Flood Danger

The assessment of the level of flood danger in post-mining areas in the Gunung Sarik area, Kuranji can be seen in the table:

CIVED Journal of Civil Engineering and Vocational Education
EISSN: 2622-6774
Vol 11 No.1 March 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

Table 7: Flood Danger Level Value

Mark	Class	Criteria
5	Very good	Area has never been flooded in the past year
4	Good	Flooded area <2 months a year
3	Medium	Flooded area between 2-6 months a year
2	Bad	Flooded area >6 months a year
1	Very Bad	Always flooded or swampy areas

Soil bearing capacity

To obtain the value of the bearing capacity of the soil and hard soil layers in the former mining area of Gunung Sarik, a sondir test is required which refers to SNI 2827: 2008. Point 1 is at coordinates 0°52'37" South Latitude 100°24'59" East Longitude. The data obtained at point 1 of the Soil bearing capacity test was then analyzed using Microsoft Excel to obtain a graph which can be seen in the table:

Table 8: Data Point 1

Depth (m)	QC (kg/cm ^{2})	JHP (kg/cm)	Fr (%)
0.00	0.00	0.00	0.00
0.20	0.00	0.00	0.00
0.40	0.00	9.00	0.00
0.60	0.00	18.00	0.00
0.80	5.00	27.00	9.00
1.00	10.00	36.00	4.50
1.20	10.00	45.00	4.50
1.40	10.00	54.00	4.50
1.60	10.00	63.00	4.50
1.80	5.00	72.00	9.00
2.00	40.00	90.00	2.25
2.20	50.00	180.00	9.00
2.40	180.00	216.00	1.00

EISSN: 2622-6774
Vol 11 No.1 March 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

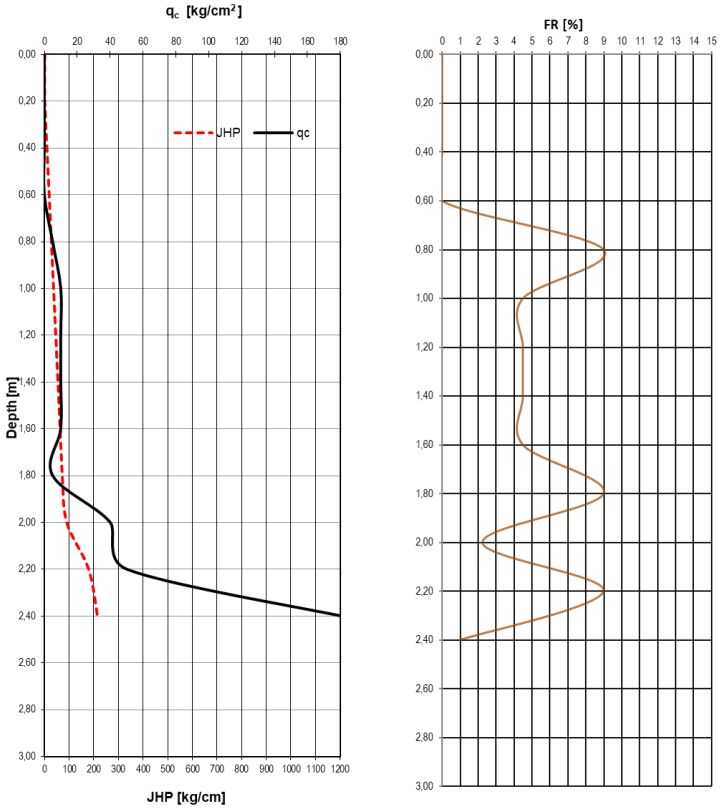

Figure 4. Graph of the Relationship between QC and JHP Values for Point 1

Point 2 at coordinates 0°52'37" South Latitude 100°24'59" East Longitude. The data obtained at point 2 of soil bearing capacity test was then analyzed using Microsoft Excel to obtain a graph which can be seen in the table:

Table 9. Data Point 2

Depth (m)	QC (kg/cm ^{2})	JHP (kg/cm)	Fr (%)
0.00	0.00	0.00	0.00
0.20	0.00	0.00	0.00
0.40	0.00	0.00	0.00
0.60	0.00	9.00	0.00
0.80	5.00	18.00	9.00
1.00	10.00	36.00	9.00
1.20	10.00	54.00	9.00
1.40	30.00	72.00	3.00
1.60	25.00	81.00	1.80
1.80	50.00	171.00	9.00
2.00	50.00	261.00	9.00
2.20	80.00	333.00	4.50
2.40	100.00	369.00	1.80
2.60	150.00	423.00	1.80

EISSN: 2622-6774
Vol 11 No.1 March 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

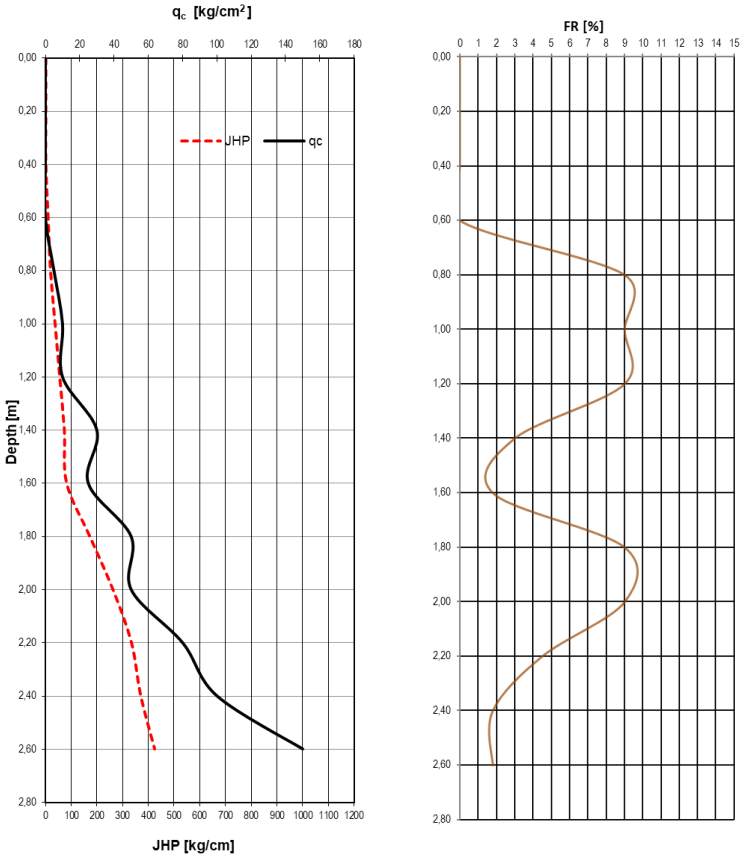

Figure 5. Graph of the Relationship between qc and JHP Values for Point 2

Based on testing at point 1 presented in the table, the hard soil layer is found at a depth of 2.40 meters with a qc value of 180 kg/cm ^{2}. The sondir test at point 2 presented in the table shows that the hard soil layer is found at a depth of 2.60 meters with a qc value of 150 kg/cm ^{2}. The average qc obtained from the sondir points is 165 kg/cm ^{2}.

Table 10: Class Value of Qc Value

Class	**Qc value (kg/cm ^{2})**
Very Loose	<20
Loose	20 – 40
Medium Dense	40 – 120
Dense	120 – 140
Very Dense	>200

Scoring

The suitability of residential land is carried out by giving weights and scores to each physical parameter (slope level, soil type, soil texture, erosion hazard, flood hazard, and soil carrying capacity). The total score for each area is then classified into three types of suitability levels. residential land where the highest total score value describes the most suitable level of residential land suitability, and conversely the lowest total score value describes the least

CIVED Journal of Civil Engineering and Vocational Education
EISSN: 2622-6774
Vol 11 No.1 March 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

suitable level of residential land suitability.

The maximum total score value is 80 and the minimum total score value is 16. Determining the interval for each type of land suitability level uses the following calculation formula :

$$Ki = \frac{80 - 16}{3} = 21{,}3$$

Where:

Ki : Interval Class

So the interval for each total score for each level of land suitability is shown in the following table:

Table 11. Land Suitability Level Value

Conformity Level	Mark
Very suitable	80 - 58.8
In accordance	58.7 – 37.4
It is not in accordance with	37.3 – 16

Based on the value of data collection for each required soil physical parameter, the following assessment can be carried out:

Table 12. Assessment of Each Soil Physical Parameter

Variables	Weights	Sub Variables	Description	Score	Total
Slope	3	15.76 %	Crooked	3	9
Erosion Rate	2	348, 83 Tons/day/year.	Heavy	2	4
Type of soil	3	Alluvial	Not sensitive	5	15
Flood Danger	3	Area has never been flooded in the past year	Very good	5	15
Soil Texture	2	*Clay*	Fine	1	2
Soil bearing capacity	3	165 kg/cm^2	Good	4	12
TOTAL					57

From the table above, it can be seen that the total value of each physical parameter is 57. Based on table 17, the level of suitability with a value of 58.7 - 37.4 is suitable for settlement.

Discussion

This research aims to evaluate the land suitability of post-mining areas in the Gunung Sarik area, Kuranji for settlement based on several soil physical parameters such as slope level, erosion rate, soil type, flood hazard, soil texture, and soil bearing capacity.

The former Gunung Sarik mining area has different slope levels such as 19.75%; 15.77%; 6.53%; 12.42%; and 24.30%. So that the average slope level of this mining area is 15.76%. The soil in the former mining area has an Alluvial soil type from the Padang city soil type map processed using ArcGIS. In this research also conducted soil texture testing in the form of sieve analysis and hydrometer tests so that it was known that the soil texture of this former mining

area was clay with a percentage of sand 18.30%; silt 28.77%; and clay 52.83%. The erosion rate in this former mining area is calculated using the USLE (Universal Soil Loss Equation) formula, which uses Padang city rainfall data, Padang city soil type map, Padang city slope map and calculation of slope level, and land use in the area. So that the erosion rate in this area is 348.83 tons/day/year. Based on interviews with several informants who are residents of the area and workers in active mining, that this area has never been hit by floods because this area is located on hills or high places. Puddles of water do not stagnate for long because they flow directly into the river in the mining area. Cone Penetraion Test was conducted at two points in the post-mining area of Gunung Sarik so that the hard soil layer was found at the first point at a depth of 2.40 meters with a conus resistance (qc) of 180 kg / cm^2 and a hard soil layer at the second point at a depth of 2.60 meters with a conus resistance (qc) of 150 kg / cm^2. So that the average qc of the sondir points is 165 kg/cm^2.

The level of land suitability for settlements is divided into three, namely very suitable, suitable, and unsuitable. Assessment or scoring is carried out for each physical parameter, each of which has been given a weight. So that the land suitability value of the post-mining area in the Gunung Sarik area is 57 which is classified as suitable for settlements with the condition that there is erosion prevention due to the high level of slope and erosion rate each year.

CONCLUSION

Based on the calculations and analysis carried out on the evaluation of land suitability for settlements in the Gunung Sarik area, it can be concluded that the post-mining area in the Gunung Sarik area is SUITABLE to be used as a settlement with a land suitability level value of 57 which with a land suitability level value of 58.7 - 37.4 is appropriate with details of 6 physical parameters that are met, namely, the level of slope 15.76%; Alluvial soil type, erosion hazard 348.83 tons/day/year, never flooded, fine soil texture (Clay), and has good soil bearing capacity (165 kg/cm ^{2}).

REFERENCE

[1] Achmad, F. 2012. *Pemetaan Kapasitas Dukung Tanah Berdasarkan Data Sondir di Kota Gorontalo*. Laporan Penelitian Dana PNBP UNG, Gorontalo.

[2] Arsyad, S. 2010. *Konservasi Tanah dan Air*. IPB Press. Bogor.

[3] ASTM D-1140. *Uji Saringan (Shieve Analysis)*. Universitas Pendidikan Indonesia

[4] Asyrowi, Hamam. 2017. *Analisis Bahaya Potensi Erosi di Sub DAS Mikro Hulu Brantas. Jurusan Kehutanan, Fakultas Pertanian Peternakan,* Universitas Muhammadiyah Malang. Malang.

[5] Bakti, I. R. 2019. *Sistem Informasi Geografis Jaringan Irigasi Dinas Bina Marga Dan Pengairan Kabupaten Rohil*. JURSIMA (Jurnal Sistem Informasi dan Manajemen), 7(1), 12-17.

[6] Bowles, J. E. 1984. *Sifat-Sifat Fisis dan Geoteknis Tanah (Mekanika Tanah) Jilid 1*. Erlangga. Jakarta.

[7] Das, B. M. 1995. *Mekanika Tanah (Prinsip-prinsip Rekayasa Geoteknik*. Penerbit Erlangga.

[8] Dudal, R. and M. Soepraptohardjo. 1957. *Soil Classification in Indonesia*. Contr. Gen. Agric. Res. Stat. Bogor, 148: 3-16.

[9] Ernawati, E., Yulianti, L., & Suryana, E. 2014. *Sistem Informasi Geografis Pembangunan Jaringan Irigasi Di Provinsi Bengkulu Berbasis Website Menggunakan Google Map*. Jurnal Media Infotama, 10(2).

[10] FAO. 1976. *A Framework for Land Evaluation*. Soil Resources Management and Conservation Service Land and Water Development Division. FAO Soil Bulletin No. 32. FAO-UNO. Roma.

[11] Foth, Henry D. 1988. *Dasar-Dasar Ilmu Tanah*. Edisi ketujuh. Diterjemahkan oleh: Endang Dwi Purbayanti, Dwi Retno Lukiwati, Rahayuning Trimultasih. Yogyakarta: Gadjah Mada University Press.

[12] Hammer, W.I. 1982. *Final Soil Conservation Report*. Center for Soil Research. Bogor

[13] Isnaini, N. 2018. *Komparasi Penggunaan Media Google Earth Dengan Peta Digital Pada Materi Persebaran Fauna Kelas XI IPS di SMA Negeri 1 Semarang*. Jurnal Geografi: Media Informasi Pengembangan Dan Profesi Kegeografian, 12(1), 52-61

[14] Khadiyanto, Parfi. 2005. *Tata Ruang Berbasis pada Kesesuaian Lahan*. Semarang: Universitas Diponegoro

[15] Khotimah, N.S., dan Nurhadi. 2013. *Analisis Kerentana Banjir Di Daerah Aliran Sungai (DAS) Code Kota Yogyakarta*. Yogyakarta: Universitas Negeri Yogyakarta

[16] Morgan, R. P. C., Morgan, D. D. V., & Finney, H. J. 1984. *A predictive model for the assessment of soil erosion risk*. Journal of agricultural engineering research, 30, 245-253.

[17] Peraturan Daerah Kota Padang Nomor 4. 2012. *Rencana Tata Ruang Wilayah Kota Padang Tahun 2010-2030*. Peraturan Daerah Kota Padang, 0, 44. https://jdih.padang.go.id/po-content/uploads/244. Perda No. 4 Tahun 2012 .pdf

[18] Pratomo, A.J. 2008. *Analisis Kerentanan Banjir di Daerah Aliran Sungai Sengkarang Kabupaten Pekalongan Provinsi Jawa Tengah dengan Bantuan Sistem Informasi Geografis.* Surakarta: Universitas Muhammadiyah Surakarta

[19] Ritung, S., Wahyunto, A.F. and Hidayat, H. 2007. *Land Suitability Evaluation with a Case Map of Aceh Barat District*. Indonesian Soil Research Institute and World Agroforestry Centre, Bogor and Nairobi

[20] Siagian, Togi Pardo, Bambang Sudarsono, Arwan Putra Wijaya. 2015. *EVALUASI KRITERIA KESESUAIAN LAHAN PERMUKIMAN DENGAN ANALITYCAL*

EISSN: 2622-6774
Vol 11 No.1 March 2024
http://cived.ppj.unp.ac.id/index.php/CIVED

HIERARCHY PROCESS (Studi Kasus: Kecamatan Boja dan Kecamatan Limbangan di Kabupaten Kendal). Semarang: Universitas Dipenogoro

[21] Widiatmaka, Sarwono Hardjowigeno. 2007. *Evaluasi Kesesuaian Lahan dan Perencanaan Tataguna Lahan.* Yogyakarta: Gadjah Mada University Press.

[22] Wischmeier, W.H. and Smith, D.D. 1978. *Predicting Rainfall Erosion Losses: A Guide to Conservation Planning*. USDA, Washington DC.