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RESEARCH ARTICLE

Mapping the Depth of Groundwater Level and Soil Permeability Based on Geographic Information Systems (GIS) for The Feasibility of Absorption Well Locations in The Application of Ecodrain in Tuah Madani District

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Abstract

The problem of flooding in Tuah Madani District, Pekanbaru City, needs attention. Drainage and flood control systems need to be made to accommodate excess water and hold water somewhere. Groundwater management is directed at creating a balance between groundwater utilization and soil conservation efforts through the application of ecodrain which affects the conditions and characteristics of the area which provides an overview of land hydrology in parcels by comparing the height of the land with the receiving water bodies. as a drainage outlet. This research aims to create a map of groundwater depth and soil permeability based on Geographic Information Systems (GIS) for the feasibility of infiltration well locations in Tuah Madani District in implementing ecodrain. The research method was carried out by collecting data on the coordinates of infiltration wells at 30 points in five areas of Tuah Madani District. then measure the depth of the groundwater table and test the permeability in the field. Data is processed using ArcGIS. The results of mapping the depth of the groundwater table in the area are classified as shallow (1.28m–3.58m). Only 4 locations (Tuah Karya and West Sidomulyo) out of 30 sample locations did not meet the standards. Meanwhile, the permability value obtained was 2.61–11.07 cm/hour. Technically, the procedure for planning infiltration wells (SNI03-2453-2002) fulfills two conditions, namely a minimum groundwater depth of 1.50 m and soil permeability ≥ 2.0 cm/hour. Based on the contour lines of Tuah Madani District, it displays a pattern of groundwater flow from high flow to low flow at each point of the wellbore, the highest points on the map are colored blue (Air Putih and Sidomulyo Barat), while the lowest points on the map are Air Putih and Sidomulyo Barat. red (Tuah Madani, Luah Karya and Sialangmunggu).

Keywords: Infiltration Wells, Groundwater Table Depth, Soil Permeability, Geographic Information Systems.

1. Introduction

1.1 Sub Introduction

Thought and technology are always being developed in order to overcome the problem of water availability and maintain water sustainability into the future. One of them is by implementing development that is guided by the concept of Sustainable Development Goals (TPB) or what is known as Sustainability Development Goals (SDGs). This concept suggests to each country that all forms of human activity should consider 17 goals with 169 achievements which are targeted for completion by 2030. The development of an environmentally sound drainage system (eco-drainage) can be a real example of implementing these SDG goals.

In general, the concept of drainage which is applied in all corners is known as the conventional concept, which is an effort to dispose of or drain excess water as quickly as possible to the nearest river. The concept of conventional drainage has a paradigm of handling drainage with the principle that all rainwater that falls in an area must be immediately discharged into the river and then into the sea. If there is continuous rain it will have an impact on inundation or flooding, and also landslides due to overflowing rivers because the rivers will receive loads that exceed their capacity. Subsequent impacts are ecosystem damage, drought, micro and macro climate change and landslides in various places caused by very high fluctuations in soil water content in the dry and wet seasons (Habibi et al., 2017). Groundwater is the most widely used resource by people in the world, groundwater is preferred because it is easy to obtain, use, and has better quality than surface water. a new drainage concept (new paradigm) which is commonly called environmentally friendly drainage or eco-drainage or and a sustainable drainage system which is becoming a major concept in the international world and is the implementation of a new understanding of the eco-hydraulic concept in the field of drainage. (Cotterill and Bracken, 2020) stated that urban drainage management is a very important challenge and environmentally sound drainage systems are the main tool in managing extreme rainfall. This drainage system comprises a variety of technologies and techniques used to convey stormwater and excess surface water in a more sustainable manner.

According to (Saldenela; Sutikno.S; Hendri, 2015) groundwater is considered clean water with great potential to be used to meet needs. Groundwater is water contained in the soil or rocky layers below the surface of the soil originating from rain or other sources that enters the soil with the help of gravity. Groundwater can be continuously exploited and its balance and preservation must be maintained.

Research (Irvandi et al., 2022) groundwater and rivers have a close relationship with each other. The interaction that occurs is a losing stream or a gaining stream which is determined based on the position of the groundwater level of the river and the groundwater table. Losing stream is a condition where surface water provides water intake to groundwater, in contrast to gaining stream, where the groundwater level is higher than the surface water level and the water will receive groundwater flowing through the base stream. Mapping the direction of groundwater flow can help show patterns of groundwater flow from and to where groundwater flows and how the relationship occurs between the groundwater based on the position of the water level elevation.

Problems that affect flooding and drought caused by the flow of rainwater that enters the ground and the use of shallow wells as a source of clean water are carried out by almost all people, especially in the city of Pekanbaru. The topography of Pekanbaru City is relatively flat with a soil structure consisting of alluvial soil and sand, some of the suburban areas consist of organosol and humus type soils so that not all areas can be applied to an infiltration system. Utilization of infiltration types is used in areas that have a high level of permeability and technically fill groundwater with a water level elevation of not more than 1.5 meters when it rains. Infiltration ditches, infiltration wells, infiltration ponds and infiltration pavements are examples of infiltration type facilities (Joleha et al., 2023).

Analysis of data collection and hydrological analysis is the initial basis for determining the effectiveness of the planning and engineering stages in the water sector. Geographic Information Systems (GIS) can be used to perform hydrological analysis with spatial data, particularly in mapping the feasibility of infiltration wells based on permeability values and groundwater depth. With the initial data used in the form of administrative boundary maps and data on permeability and depth of ground water level. GIS can be used to calculate variables in rational method equations with overlay analysis and proximity analysis found in ArcGIS.

Previous research has been conducted using Geographic Information Systems (GIS) and a combination of fieldwork techniques to study basic water conditions in Eritrea as groundwater is an important source of water supply for household use in Eritrea. Modern geographic information system (GIS) technology has been useful for studying hydrological, geological and geomorphological conditions along with conventional surveys (Solomon and Quiel, 2006).

Selection of well locations for groundwater supply relies heavily on traditional field methods that use known water producing locations as a guide because in general a systematic approach to groundwater exploration is still lacking. Extensive hydrogeological investigations are needed to fully understand groundwater conditions, because groundwater is the most feasible alternative because the cost of exploitation through dug wells and drilled holes is much cheaper than conventional surface water programs which require the construction of storage reservoirs, pipe networks, etc. GIS-based groundwater potential mapping in the Dengi region, North Central Nigeria has also been carried out to determine the supply of groundwater originating from dug wells (Adeyeye et al., 2019).

Permeability maps over the earth's surface around the world and North America were derived by correlating the lithology maps with the geometric mean permeability of each lithology. Soil permeability at depths of 1–2 m has been mapped in North America (Gleeson et al., 2011). Estimating and mapping permeability at a regional scale is important for studying various processes and overcoming water resource problems on earth (York et al., 2002);(Fan et al., 2007) Subsurface and climate models have been used to examine the interactions between groundwater, soil moisture, surface water and climate, and the response of aquifers to climate change. (Maxwell and Kollet, 2008).

Mapping the suitability of groundwater for irrigation using GIS in Najaf Governorate, Iraq has also been carried out, an Irrigation Water Quality Index (IWQI) for groundwater in an environmental Geographic Information System (GIS) is proposed so that it can be used in assessing the vulnerability of groundwater (Nobrega and Filho, 2014). Land suitability is needed for settlement development to determine the level of land use change using GIS (Audah, 2018); (Audah et al., 2019). Based on soil permeability, topography and geology it is useful to see the suitability of land for residential areas after ten years after the tsunami in Banda Aceh, Indonesia which focuses on the application of GIS in handling spatial data permeability, slope and soil geology in accordance with FAO standards and observed land suitability and measured for residential purposes (Rusdi et al., 2015). Predicting the overall ground surface, using GIS the concept of geo-statistical interpolation known as kriging which is a method of geostatistical interpolation that makes use of variograms that depend on the spatial distribution of data rather than actual values (Arun, 2013).

According to (Mulianto, 2018) the implementation of infiltration wells is a form of ecodrainage system which is mandated in Pekanbaru City Regional Regulation (PERDA) Number 10 of 2006, namely concerning Water Resources and Infiltration Wells in Pekanbaru City, However, the Implementation of Pekanbaru City Regional Regulation Policy Number 10 2006 concerning Water Resources and Infiltration Wells caused by various aspects of problems, including problems from the aspect of communication between agencies, less than optimal socialization, weak supervision due to the functioning of coordination between related agencies (communication), limited human resources and apparatus disposition, bureaucratic structure and lack of community participation.

Based on these problems, it is necessary to identify the appropriate location in accordance with Pekanbaru Regional Regulation Number 10 of 2006, especially in the implementation of infiltration wells in the form of ecodrain. Therefore, research is needed with the aim of creating a map that provides information regarding the location description which includes groundwater level elevation, permeability. soil, groundwater flow patterns and information on the feasibility of implementing infiltration wells at locations based on Geographic Information Systems (GIS). So that this data can be useful for all parties who need to implement ecodrain (infiltration wells). Apart from that, this data can also be used by the government as a guide for monitoring the implementation of infiltration wells in the field.

2. Location Tuah Madani District

This research was conducted in Tuah Madani District, which is a division of the Tampan District, Pekanbaru City. This sub-district is divided into several regional parts, namely Air Putih, Tuah Karya, Sidomulyo Barat, Tuah Madani and Sialangmunggu which are part of the Tuah Madani District of Pekanbaru City which is geographically located at coordinates 101°14' - 101°34' East Longitude and 0°25' - 0°45' North latitude (figure 1).

In this research, drilled well points were taken at 30 coordinate locations in the sub-district to test soil permeability and check the depth of the ground water level.

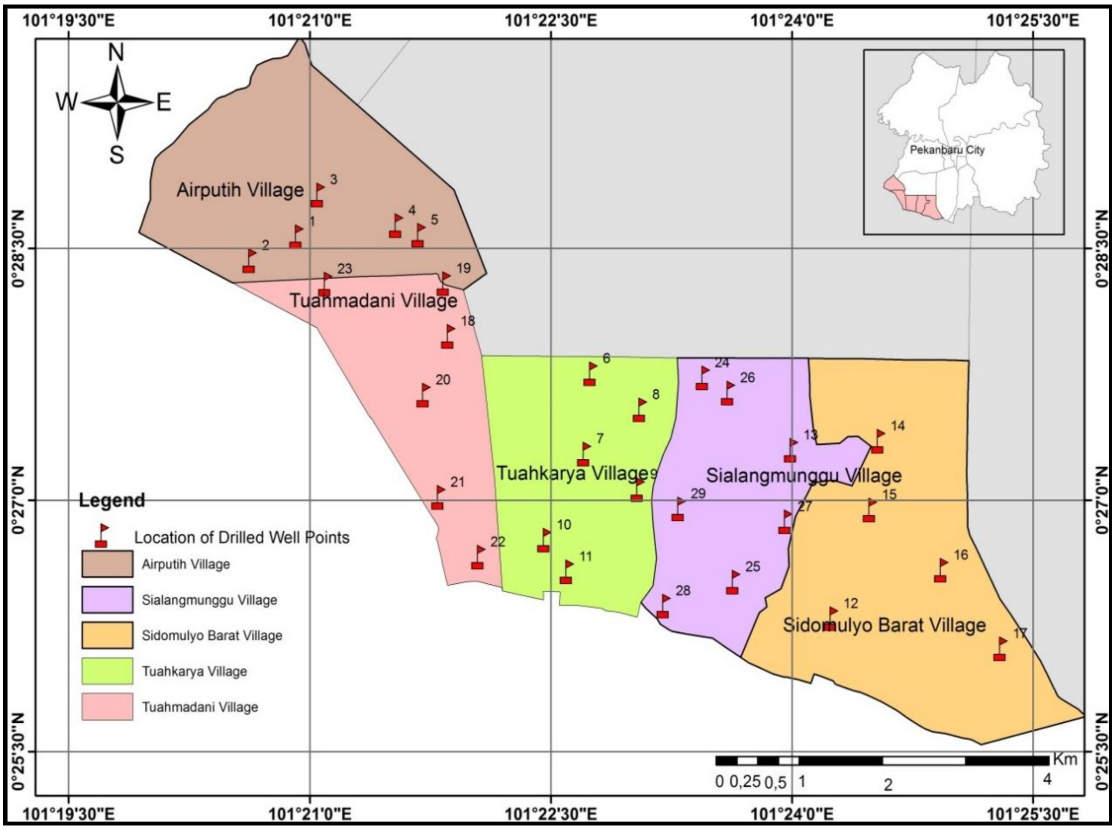

Fig.1. Map of the location of the Drilling Well point in Tuah Madani District

3. Methodology

Research on mapping the depth of the groundwater table and permeability based on Geographic Information Systems (GIS) for the feasibility of infiltration well locations in the application of Ecodrain in Tuah Madani Sub-District is part of the researcher's road map in an effort to study flood or inundation problem mitigation in Tuah Madani District, Pekanbaru City.

In 2018 water evaporation in Pekanbaru City exceeded the amount of rainfall in certain months. Study of hydrological disasters due to climate change with a change adaptation approach through environmentally sound drainage or Ecodrain in the form of infiltration wells. The design of infiltration wells in the Hang Tuah Cipta Residential area of Pekanbaru City is able to reduce the runoff that occurs by 70% of the total runoff that is absorbed into the ground so that it provides benefits in reducing flooding and saving groundwater (Rahmadi et al., 2021). Environmentally sound drainage is drainage management that cannot cause adverse impacts on the environment. The concept of Ecodrain is excess rainwater which is not immediately discharged into the nearest river or nearby canal. However, this rainwater can be stored in various locations in various ways so that it can be used during the dry season and can also be used to improve the quality of ecosystems and the environment as a means to reduce flooding. (Setiawan et al., 2023).

The procedure for planning infiltration wells in SNI 03-2453-2002 for land yard must meet the technical requirements, namely a minimum groundwater depth of 1.50 m during the rainy season and soil permeability, having a usable soil structure must have a soil permeability value of ≥ 2.0 cm/hour (Setiawan et al., 2023)

This research was conducted in several stages so that the expected goals can be achieved. The stages are as follows (Fig. 2):

a. Primary data collection was carried out using field surveys from April to September to obtain permeability data, groundwater depth data and coordinate data for infiltration well locations in the Tuah Madani District area as the research area. Meanwhile, the secondary data collected was the Pekanbaru City Administrative Map and the Tuah Madani District Administrative Map.
b. Retrieval of latitude and longtitude coordinates for the location of residents' drilled wells was carried out using a Hand GPS tool. The sampling of borehole points was measured using a purposive sampling system of 30 points, namely sampling was carried out on the basis of research considerations by assuming the desired elements already existed in each member of the sample taken. The number of points for drilled wells for measuring the depth of the groundwater table and testing permeability at these locations is evenly divided into 5 sub-districts in Tuah Madani District, namely Air Putih, Tuah Karya, Sidomulyo Barat, Tuah Madani and Sialangmunggu with each point spread of 6 samples determined randomly in each village.
c. Permeability testing is carried out to see the soil's ability to pass water in a unit of time. Permeability

testing is a parameter to determine the feasibility of constructing an absorption well.

d. Groundwater depth checks were carried out at residents' drilled wells in the Tuah Madani District area. Measurement of the depth of groundwater on the surface of the original land was carried out using a meter, and interviews were also conducted with residents around the Tuah Madani District area to obtain information regarding the condition of well water when experiencing drought or floods.

e. The mapping of groundwater depth and permeability based on Geographic Information System (GIS) is carried out after field data collection is carried out and the permeability value is calculated, then data entry is carried out by processing the data using a computer that has the ArcGIS application and inputting a digitized map of Pekanbaru City, District Map Tuah Madani and inputting the coordinates of the location of the drilled well where the groundwater depth is measured. So that it will produce output in the form of a Map of the Depth of Groundwater and Permeability Based on Geographic Information Systems (GIS) for the feasibility of infiltration wells in the application of Ecodrain in Tuah Madani District.

f. The groundwater flow pattern was created by inputting the measurement data into the GIS application, then followed by interpolation of the measurement points using a geostatic analyst and contour with bars which were used to predict the groundwater flow pattern at the research location.

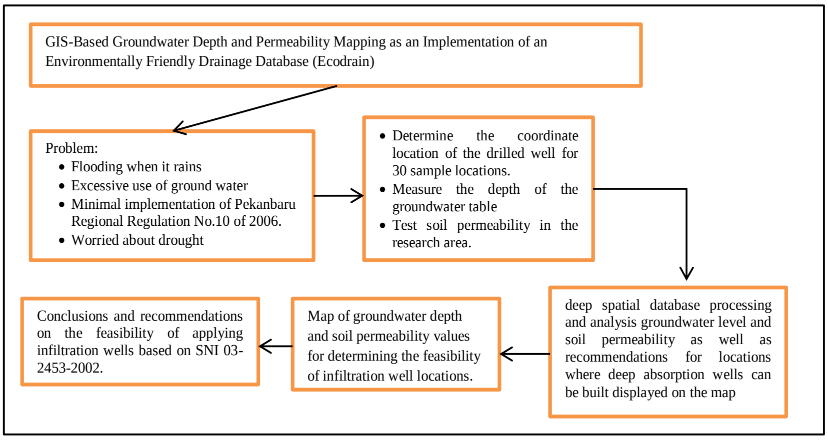

Fig 2. Framework of research methods

4. Results and Discussion

4.1 Groundwater Depth and Soil Permeability

Groundwater depth measurements are carried out by measuring the depth of the water in the well using a weighted plastic rope. The tip of the weight is slowly lowered into the well until it touches the water surface (fig.3). When the load touches the groundwater level, the length of the rope entering the well is measured to the top of the well, which is called the measuring length. Meanwhile, the depth of the water level is the length of the rope minus the height of the top lip of the well relative to the ground surface outside the well wall.


Fig 3. Measuring the depth of the groundwater table in residents' drilled wells


Fig 4. Testing soil permeability using a percolation test

Soil permeability testing in the field is carried out by means of a percolation test (fig.4). Soil permeability is the absorption capacity of the soil to flow water through the soil cavities within a certain time, causing the soil to become saturated. Testing soil permeability in the field uses the percolation test method which is a method of measuring soil absorption to obtain an infiltration rate (Percolation Rate) in an area that will be used as an infiltration area in units of length/time. The total distribution of location points for groundwater depth measurement samples and soil permeability testing was 30 community drilled well points taken from the Tuah Madani sub-district area. The number of points for drilled wells Measuring the depth of the groundwater level and testing permeability at these locations is equally divided into 5 sub-districts in Tuah Madani District with each point spread of 6 samples determined randomly in each village. The results of ground water level measurements and soil permeability testing results can be seen in table 1 below.

Table 1. Results Groundwater Depth and Permeability

Point	Coordinate		Village	Groundwater Depth (m)	Permeability (cm/hour)	Analysis results
	latitude	longitude				
1	101.2473	0.485507	Air Putih	3.15	3.20	feasible
2	101.3486	0.476187	Air Putih	2.67	10.52	feasible
3	101.3438	0.473816	Air Putih	2.64	11.00	feasible
4	101.3508	0.480330	Air Putih	3.58	4.23	feasible
5	101.3590	0.477294	Air Putih	2.61	8.73	feasible
6	101.3613	0.476329	Tuah Karya	2.17	8.70	feasible
7	101.3791	0.462559	Tuah Karya	2.12	2.61	feasible
8	101.3785	0.454573	Tuah Karya	1.70	2.69	feasible
9	101.3843	0.458972	Tuah Karya	1.83	11.07	feasible
10	101.3840	0.451028	Tuah Karya	2.22	3.07	feasible
11	101.3743	0.446024	Tuah Karya	1.88	4.32	feasible
12	101.3767	0.442855	Tuah Karya	1.28	4.23	not feasible
13	101.4041	0.438202	Sidomulyo Barat	1.46	3.83	not feasible
14	101.3999	0.454963	Sialangmunggu	1.48	3.34	not feasible
15	101.4090	0.455849	Sidomulyo Barat	1.39	4.36	not feasible
16	101.4081	0.449013	Sidomulyo Barat	2.27	5.50	feasible
17	101.4155	0.443028	Sidomulyo Barat	2.31	3.57	feasible
18	101.4216	0.435211	Sidomulyo Barat	3.45	2.89	feasible
19	101.3644	0.466287	Tuah Madani	2.13	3.86	feasible
20	101.3639	0.471528	Tuah Madani	2.35	5.79	feasible
21	101.3618	0.460440	Tuah Madani	1.99	4.65	feasible
22	101.3633	0.450275	Tuah Madani	2.46	2.85	feasible
23	101.3675	0.444316	Tuah Madani	1.98	3.76	feasible
24	101.3516	0.471481	Tuah Madani	1.66	4.70	feasible
25	101.3908	0.462147	Sialangmunggu	1.58	3.58	feasible
26	101.3939	0.441838	Sialangmunggu	2.45	4.88	feasible
27	101.3934	0.460644	Sialangmunggu	3.12	4.75	feasible
28	101.3993	0.447828	Sialangmunggu	3.14	3.75	feasible
29	101.3867	0.439455	Sialangmunggu	2.67	4.74	feasible
30	101.3883	0.449116	Sialangmunggu	3.27	10.00	feasible

The results of groundwater depth measurements and permeability tests in table 1 show that the groundwater level of drilled wells in Tuah Madani District is at a shallow depth, namely with groundwater depth values ranging from 1.28 m – 3.45 m when compared with the technical standards in SNI 03- 2453-2002 (Setiawan et al., 2023) Requirements for the placement of infiltration wells based on the depth of the groundwater table, in general, the research location in the Tuah Madani sub-district meets the feasibility of applying infiltration wells. There are only 4 location points out of 30 sample location points that do not meet the standard groundwater level elevation values because they are less than 1.5 meters. Location points that do not meet these standards are in the Kelurahan Tuah Karya and Sidomulyo Barat, based on the feasibility analysis these areas are not suitable for infiltration well locations.

The permeability test is carried out at a predetermined point on the location map (fig.1) with a hand auger. After testing, the results obtained from the field are calculated. The results of the soil permeability test in Tuah Madani District tested as many as 30 test samples. The soil permeability test results in Table 1 obtained a value of 2.61 cm/hour - 11.07 cm/hour. The results of this soil permeability test are inversely proportional to the groundwater level elevation value, namely the value obtained is very high. According to (Joleha et al., 2023) it is possible that this could happen because it was caused by the condition of the land surface around the Tuah Madani District area in a dry state not in a water-saturated state.

Permeability tests are carried out at points determined on the location map (fig.1) using a hand auger. After testing, calculations are carried out on the results obtained from the field. The results of the soil permeability test in Tuah Madani District which tested 30 test samples, the soil permeability test results in Table 1 obtained a value of 2.61 cm/hour - 11.07 cm/hour. The results of this soil permeability test are inversely proportional to the groundwater level elevation value, namely the value obtained is very high. According to (Joleha et al., 2023) it is possible that this could happen because the condition of the land surface around the Tuah Madani District area is dry and not saturated with air.

According to Research (Rahmadi et al., 2021) research related to the analysis of infiltration wells to reduce surface runoff at the Hang Tuah Cipta Residence Pekanbaru housing complex obtained an area of 2.38 ha, in this area there was a flow discharge of 1.19 m^3/sec. By designing infiltration wells in each individual house, it produced a capacity discharge of 0 .88 m^3/sec. The calculation results show that the application of infiltration wells in the Hang Tuah Cipta Residence Pekanbaru housing area is able to reduce runoff by 73.95%. If it is assumed that the soil permeability is saturated when filling, around 252.52 m^3 of runoff water is stored in the well which will seep into the ground.

Based on technical instructions for water absorption wells (Setiawan et al., 2023) then the soil structure of the Tuah Madani District has soil permeability that falls into two of the three classifications stated in the provisions of the guideline. As for them are, 1) Permeability is moderate, which is 2.0-3.6 cm per hour, and 2) Soil permeability is rather fast (fine sand), which is 3.6-36 cm per hour. Thus, based on the permeability value of the soil in the Tuah Madani District, in general, water absorption wells can be applied. But technically it must meet the two conditions set, namely the water level elevation and soil permeability are fulfilled.

4.2 Map of Groundwater Depth and Soil Permability

The results of groundwater depth measurement and soil permeability testing can be presented in the form of a mapping to determine the feasibility of implementing infiltration wells using a geographic information system. From the map (fig.4) it can be seen that the results of measuring the depth of the groundwater table were carried out with three classification classes. Low classification with a value range of 1,280 m - 1,489 m and given a red color with a triangle symbol on the map, for medium class classification has a value range of 1,580 m - 2,813 m in yellow color and given a dot symbol on a triangular map and for high classification has a depth value The groundwater level is 3,120 m – 3,580 m which is marked in green with a triangular dot symbol on the map. This value refers to SNI 03-2453-2002 for planning water absorption wells for yard areas with a minimum groundwater level depth of 1.5 meters (Setiawan et al., 2023).

The results of measuring the depth of the water level which is less than 1.5 meters are found in 4 location points. The location points are at well point 12 to well point 15 in the sub-districts of West Sidolmulyo, Tuah Karya and Sialangmunggu. From figure 5 it can be seen from the soil air depth information that the recommended location point for making infiltration wells in terms of depth is the medium class classification having a distance value of 1,580 m -2,813m in yellow and given a point symbol on the map in the form of a triangle, and for the high classification has an elevation value of 3.120 m – 3.580 m. which is marked in green with a triangular dot symbol that is scattered in almost all areas of the village.

Meanwhile the mapping of location points for the feasibility of infiltration wells is based on permeability values which are tested on 30 samples in drilled wells, then these values are input into the Geographic Information System (GIS), through the geostatic analyst contained in the GIS application, the permeability values are created with 2 classification classes including classification The medium permeability value has a value range of 2.0-3.6 cm/hour which is marked with a red point symbol, while the classification of high permeability values, namely 3.61 – 11.07 cm/hour, is marked with a green point symbol. The soil structure of the Tuah Madani District area has soil permeability that falls into two classifications out of the three classifications stated in the provisions of the Water Absorption Well instructions.

From the map (fig.5) information is obtained that very high permeability values are in the Air Putih, Tuah Madani, Tuah Karya, Sialangmunggu, and Sidomulyo Barat areas with high permeability values ranging from 3.61 cm/hour – 11.07 cm/hour given the symbol Green points are scattered throughout the Tuah Madani District.

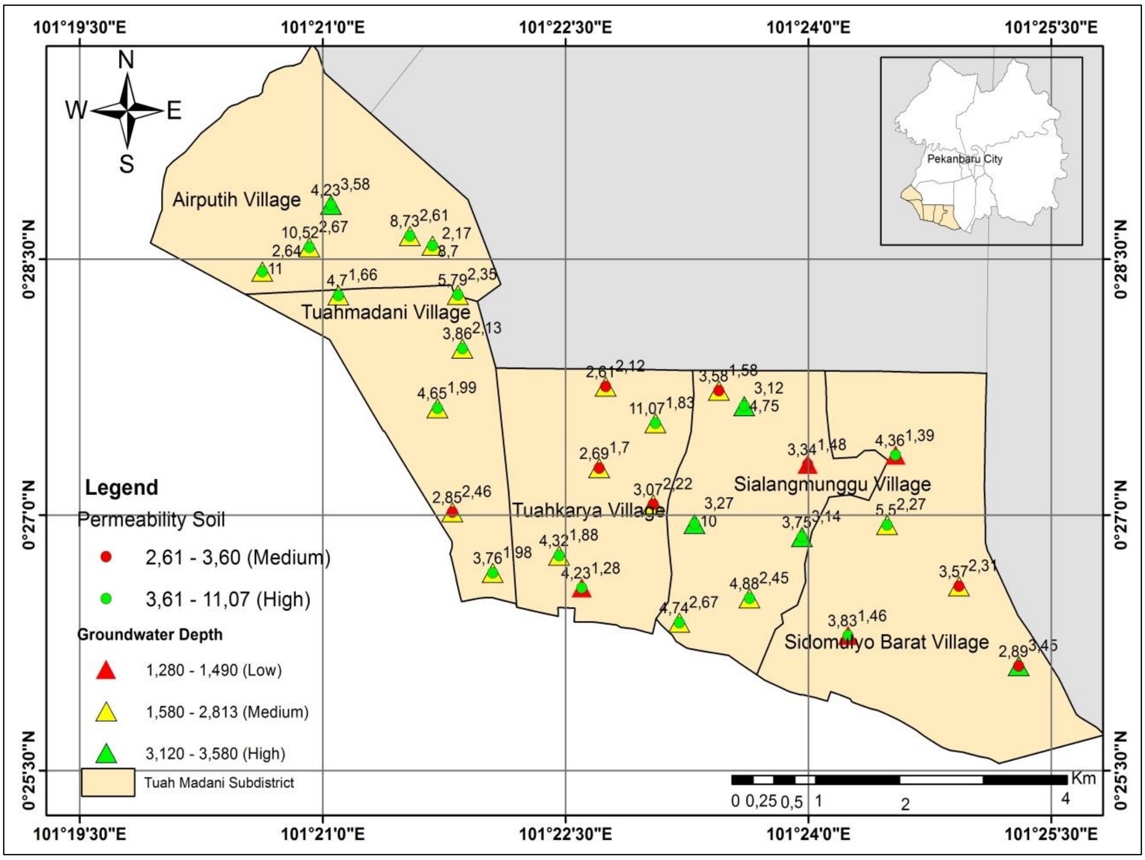

Fig 5. Location map of the feasibility of infiltration wells based on groundwater depth and soil permability values

While the soil permeability value is 2.61 cm/hour – 3.60 cm/hour, this value is considered the lowest value and is marked with a red dot symbol found in the Tuah Madani area with a permeability value of 2.85 cm/hour which is located at point 21 drilled wells, for the Tuah Karya area as many as 3 well points, Sialangmunggu as many as 2 location points and West Sidomulyo as many as

2 location points for wells 16 and 17 with a value of 2.89 cm/hour and 3.57 cm/hour.

Based on Figure 4, the map above shows the results of soil permeability testing in the study area having a moderate permeability value (2 m – 3.6 m) which amounts to 30% of the entire study area. Meanwhile, areas with a groundwater table depth of less than 1.5 meters are only occupying an area of less than 13% of the total study area. however, for moderate and sufficient permeability are expressed in red and green. This color also indicates that in this location it is appropriate to apply infiltration wells for the Tuah Madani sub-district area.

4.3 Map of Groundwater Flow Patterns in Tuah Madani District

Analysis of groundwater potential is determined based on observations of the parameters of groundwater level depth, elevation and soil permeability in each drilled well sample. The distribution of drill hole locations observed in the field is shown in Figure 1. The groundwater flow pattern was created by inputting the measurement data into the GIS application, then continued by interpolating the measurement points using geostatic analysis and contours with bars which were used to predict groundwater flow patterns at the research location

Figure 6 illustrates the spatial information on the groundwater flow pattern map in Tuah Madani District. This delineation is done by drawing arrows perpendicular to the contour and depth of the groundwater table. The groundwater flow pattern will cut perpendicular to the groundwater contour at 90o and have a flow direction from the high groundwater level to the low groundwater level at each wellbore point, this is in line with the opinion of (Saldenela; Sutikno.S; Hendri, 2015). The contour lines of the Tuah Madani sub-district are made 2-dimensional. The highest points visible on the map are colored blue, while the lowest points are colored red. The highest point positions are in the Air Putih and Sidomulyo Barat areas, while the lowest elevation points are in the Tuah Madani, Tuah Karya and Sialangmunggu areas on the east side (Suwarsito, 2020). Groundwater will experience movement in the aquifer at a certain speed so that it has a dynamic water potential The groundwater flow system includes recharge and discharge areas. The emergence of springs due to groundwater contact with impermeable rocks is a sign of discharge areas (Hamuna, Baigo, 2018).

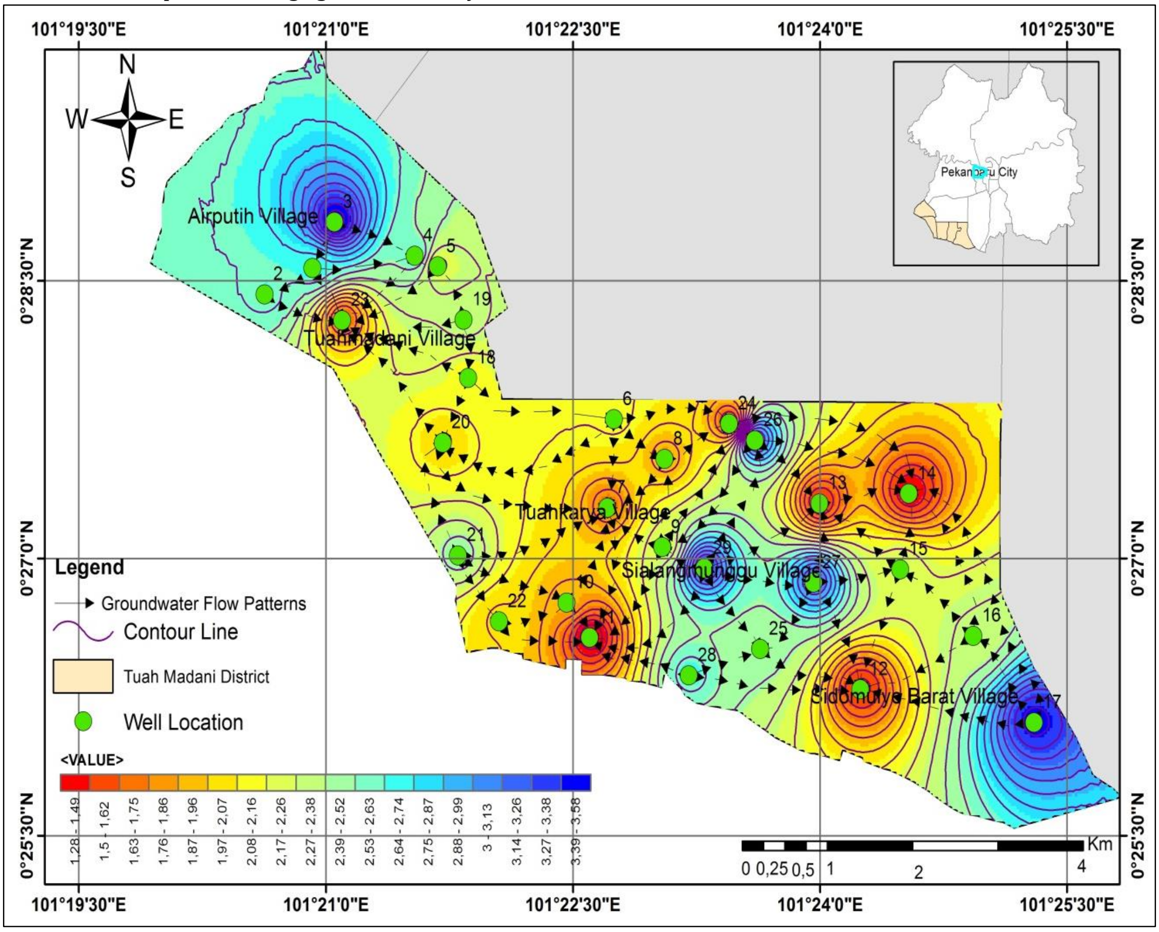

Fig 6. Map of Groundwater Flow Patterns in Tuah Madani District

5. Conclusion

The conclusion of this research is that based on the mapping results, almost all Tuah Madani sub-district areas meet the feasibility of implementing infiltration wells. Only 4 location points out of 30 sample locations do not meet the standards, namely the Tuah Karya and Sidomulyo Barat areas because of the depth of the groundwater level obtained from the results. measurements in the Tuah Madani sub-district area have a shallow depth of 1.28 m–3.58 m. Meanwhile, the permability value obtained was 2.61–11.07 cm/hour, this value was met in 5 sub-district areas in Tuah Madani District. Technically, the procedures for planning infiltration wells in SNI 03-2453-2002 fulfill the two conditions specified, namely a minimum water level depth of 1.50 m and soil permeability of ≥ 2.0 cm/hour. Based on the contour lines, the Tuah Madani District area is made in 3 dimensions. The highest point of the groundwater flow pattern can be seen on the map, which is colored blue, the sloping point is colored yellow, while the lowest point of the groundwater flow pattern is colored red. The highest point positions are on the Air Putih and West Sidomulyo areas, while the lowest water flow pattern points are in the Tuah Madani, Tuah Karya and east side of Sialangmunggu areas. This spatial map can provide readers with direct information on the recommended locations for infiltration wells and flow patterns in the Tuah Madani District area.

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