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The Suitability of Green Open Space in Mijen District Based on PERDA Kota Semarang Nomor 7 Tahun 2010

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Abstract

The physical development phenomenon of a city in Indonesia causes significant changes in the land-use system. One of the impacts is the reduction in Green Open Space (RTH), which also occurs in Mijen District, Semarang City. In 2010, the Semarang City Government ratified Regional Regulation No. 7 of 2010 on RTH Planning in every District of Semarang City. Since the regulation went into force, there has not been any evaluation of the suitability of the green space conditions in Mijen District against the established plans. SPOT-7 imagery, a high-resolution satellite image, can be used to map the condition of green open space in Mijen District using on-screen digitization techniques. A horizontal accuracy test of the SPOT-7 image was done to ensure the quality of the digitized data. Based on the digitized data, spatial analysis can be done to assess the suitability of the established plan. The horizontal accuracy test shows the CE90 value of 1,829, indicating that the data is classified as class 2 on a scale of 1:5,000. Then based on the 18 types of green open space plans in Mijen District, there are 8 types of suitable green open space and 10 types of unsuitable green open space. However, the total area of the Mijen Subdistrict green space has fulfilled the total expected area in the Regional Regulation.

Keywords: *Green Open Space, SPOT-7, CE90, Digitization, Mijen District*

1. Introduction

Physical construction in a city will force the change of land use that tends to change non-building land uses into building areas. This happens a lot in big cities in Indonesia, one of which is Semarang City. One of the areas in Semarang City that has experienced massive physical construction is Mijen District. The existence of this phenomenon will cause various positive and negative impacts, one of the negative impacts is the reduction in green open space.

Bukit Semarang Baru (BSB) City is evidence of how a large land conversion occurred in Mijen District, wherein in this BSB City area there are residential areas, trade services, education, and industry that have been built since 1997 (Sukarsa R. and Rudiarto I., 2014). In addition, the conversion of 60.63 ha of agricultural land in Semarang City during the period 2000-2009 is evidence that the green open space element gets an impact on the construction and physical development of Semarang City (Hariyanto, 2010).

According to the Minister Regulation of Public Works No. 05/PRT/M/2008 regarding guidelines for the provision and use of green open space in urban areas, the existence of green open space is very essential because it balances the ecosystem of a city. In 2010, the Semarang City Government ratified Regional Regulation No. 7 of 2010 about Green Open Space Planning in every District of Semarang City. After approximately 10 years of the Regional Regulation enactment, there has not been an evaluation of the suitability of the condition of Green Open Space in Mijen District against the plan that has been prepared in Regional Regulation No. 7 of 2010.

The use of high-resolution imagery, namely SPOT-7, can produce basic data in raster form which is then digitized to obtain vector data from the condition of Green Open Space in Mijen District. This method was chosen because it can produce data with high accuracy. To ensure the accuracy of the digitized green open space based on the SPOT-7 image, a horizontal accuracy test was carried out on the SPOT-7 image used, with the control point using the measurement result point of GNSS.

This study aims to make a map of the existing condition of Green Open Space in the Mijen District and its accuracy based on SPOT-7 imagery, which is then evaluated based on the plan to fulfill Green

Open Space in the Mijen District by the Semarang City Regional Regulation No. 7 of 2010.

2. Material and Methods

2.1 Data

This research data use SPOT-7 base image data of the Semarang City area in 2020. The image used before digitizing the Green Open Space will first be tested for horizontal accuracy using the control point of the GNSS measurement results with the RTK method. This study also used direct field survey data to validate the digitized results of Green Open Space.

2.2 Regional Regulation No 7 2010 Semarang City

This regulation was issued by the Government of Semarang City to be the guarantor of the green open space availability in each area of Semarang City, where this regulation has regulated the plan for providing green open space for each sub-district, including the type of green open space and its area. The table 1 shows the green open space plan in Mijen District based on the regulation.

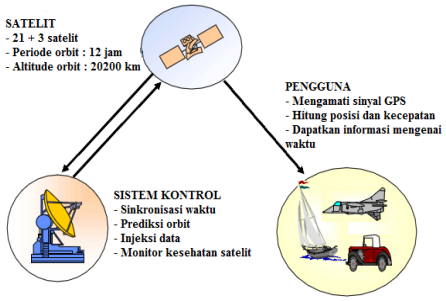
Table 1. Type of Green Open Space

No	RTH Type	Plan Area of RTH (Ha)
1	Production Forest	214.250
2	Protected Forest	362.365
3	Wetland Farming	293.230
4	Dryland Farming	353.000
5	Habitation	172.480
6	Offices and Public Facilities	8.322
7	Service Trading	2.886
8	Education	16.072
9	Industry	52.807
10	Sports Recreation	97.680
11	Funeral	2.500
12	Park and Field	26.590
13	River Bank	74.763
14	Reservoir Border	43.058
15	Prone to Land Movement and Landslide Disaster	889.375
16	Prone to Active Fault	33.054
17	Street Lane	7.700
18	SUTT and SUTET Road	10.367
	Total	2660.499

Source: Regional Regulation Semarang City No 7 of 2010

2.3 GNSS Survey

GNSS (Global Navigation Satellite System) is a satellite system consisting of satellite constellations that provide time and location information, emit various signals in frequency form continuously, which are available in all locations above the surface of the earth. GNSS has an important role in the field of navigation (UNOOSA, 2011).



Source: Abidin, 2007

Figure 1. Segment of GNSS

One method in the GNSS Survey is Real-Time Kinematic (RTK). RTK is an acronym commonly used for real-time positioning systems in a different position with phase data. To suit the purpose namely real-time, the reference station must be able to send phase and pseudo-range data to users in real-time too. One of the RTK development is the Network RTK. The working principle of Network Real-Time Kinematic (NRTK) is generally recording data from the GNSS satellite reference stations which are continuously stored and or sent to the RTK network server through the internet network simultaneously (Rasyid, 2016).

2.4 Horizontal Accuracy Test

The Horizontal Accuracy Test is testing the level of accuracy between the coordinate value of X and Y with the coordinate value of X and Y measurement results in the field. The process of measuring the control point in the field in this study used a GNSS survey with the NTRIP RTK method. This method is chosen because the work does not take a long time but already has good accuracy.

By the validation module of spatial plans made by the Badan Informasi Geospasial (BIG) in 2017, then this research area requires a minimum of 12 control points because the research study area is less than 250 km2. Accuracy measurements in determining the accuracy of the image tested using the value of Root Mean Square Error (RMSE) and Circular Error (CE) which are calculated based on the test point coordinates (X, Y) above the image and the field. The value of horizontal accuracy with a level of confidence at the level of 90% is calculated by the following formula:

$$CE90 = 1{,}5175\, x\, RMSE_r \qquad (1)$$

The accuracy results of the horizontal position above will be correlated to the BIG Regulatory Chief Number 6 of 2018 to find out the data used in what scale map and at the level of accuracy of the RBI map class. According to BIG Regulatory Chief Number 6 of 2018 scale value and class of horizontal accuracy position RBI maps can be seen in the table 2:

Table 2. Horizontal Accuracy CE90

No	Scale	Contour Interval (m)	Horizontal Accuracy Map of RBI (CE90)		
			Class 1	Class 2	Class 3
1	1:1.000.000	400	300	600	900
2	1:500.000	200	150	300	550
3	1:250.000	100	75	150	225
4	1:100.000	40	30	60	90
5	1:50.000	20	15	30	45
6	1:25.000	10	7,5	15	22,5
7	1:10.000	4	3	6	9
8	1:5.000	2	1,5	3	4,5
9	1:2.500	1	0,75	1,5	2,3
10	1:1.000	0.4	0,3	0,6	0,9

Source: BIG Regulatory Chief Number 6 of 2018

2.5 Remote Sensing

In general, remote sensing can be interpreted as a form of science and art to get data related to the physical condition of the object or target with or without touching the object (Soenarmo S. , 2009).

2.6 SPOT-7

Satellite SPOT (Satellites Pour l'Observation de La Terre) is a constellation satellite used for earth observation. SPOT Satellites has two identical high-resolution optical imaging instruments namely Panchromatic (P) and Multispectral (XS: Green, Red, and Near-Infrared). The SPOT Image which has several generations until now has been a SPOT Image 7. In this study image, SPOT Image 7 data will be used. SPOT 7 can provide an image with a resolution of up to 1.5-meter for a panchromatic and 6 meters for multispectral. This data can be applied in the field of land, agriculture, monitoring of land and forest cover, coastal and other needs (LAPAN, 2018).

2.7 Geographic Information System

Geographic Information System (GIS) is a unity between several physical and logical elements that is related to the spatial phenomenon of the objects on the surface of the earth so that GIS is a unity of software, hardware, subjects, procedures, databases that are connected and can carry out the process of saving, processing, editing and deleting data (Prahasta, 2014).

2.8 Digitization and Topology

Digitization is an activity in changing geographical features on raster data into a digital format with a vector format by using a digitizer connected to the computer (ESRI, 2004 in Fadila R., 2018). This digitizing activity can currently be done on a screen by using certain software. In this study, the digitizing technique was used to form the data of digital vector of land use and Green Open Spaces in the Mijen sub-district by using the base SPOT-7 Image of 2020. On digitization, all elements are carried out in the form of polygons. The digitating process is done using ArcMap software.

The topology is defined as an explanation of relative relations between one object with other objects. Topology is defined by the user according to the characteristics of the data such as lines, polygons, or points. Each characteristic has a certain rule (Ostip, 2011). Topology is also used to ensure that the data produced is properly geometric.

2.9 Validation Test

This Validation Test is done to control the quality of the digitated data results. Validation is carried out by conducting a field survey directly to test the truth digitizing or classification. The truth of the classification itself is a comparison between the classes used on its elements or attributes to the actual conditions in the field (ISO 19157). Sampling was done by random sampling technique with the number of samples referring to the ISO 19157 provisions. Calculation of test validation by making a confusion matrix (MCM) then calculated the Kappa coefficient.

$$K=\frac{N\cdot\sum_{i=1}^{r}MCM_{(i,i)}-\sum_{i=1}^{r}\left(\sum_{j=1}^{r}MCM_{(i,j)}\cdot\sum_{j=1}^{r}MCM_{(j,i)}\right)}{N^{2}-\sum_{i=1}^{r}\left(\sum_{j=1}^{r}MCM_{(i,j)}\cdot\sum_{j=1}^{r}MCM_{(j,i)}\right)} \quad (2)$$

2.10 Method of Research

Generally, the stages of research are divided into 3 stages are literature study and data collection, data processing and analysis. The first stages of research are a journal review, collecting data and also a preliminary survey of the study area. This preliminary survey includes observations of Green Open Space conditions in the Mijen sub-district. In addition, at this stage, planning the distribution of the control points will be used in the horizontal accuracy test by applicable regulations. Besides that, it also collects supporting data for this research.

Data processing stages includes GNSS measurements, horizontal accuracy calculations, on-screen digitization, topology of digitized results and validation test of digitization results. The GNSS survey is the acquisition of the coordinate control point using the GPS tool for the NTR and RTK method. The number of control points used in this study was 13 points spread evenly in 4 quadrants in the study area. Stage of horizontal accuracy calculations is to test the accuracy of the SPOT-7 image which is to be used. Accuracy is obtained by calculating the Circular Error 90 value according to the guidance in the BIG Regulatory Chief Number 15 of 2014. On-screen digitization is used to change format data from a raster into a vector data. Digitated was done by interpretation directly on the image of the SPOT-7 image. The type of classification of Green Open Space refers to the Green Open Space type on the plan in Regional Regulation No. 7 of 2010. All types classification of Green Open Space are digitazed by feature of polygon. Topology

checking is intended to control the quality of the digitization results. Due to the digitization carried out has a feature of polygon, the topology rules are 2 rules are must not overlap and must not have gaps. Validation test is to carry out the process of checking between the digitization results and the actual conditions. The sample which is used and evenly distributed also represents each type of classification of Green Open Space. The calculation process is carried out to calculate the value of the kappa coefficient. If there is a digitization error after validation, then the digitization of Green Open Space must be corrected based on the field survey data.

The last stage in this research is to evaluate the suitability of the digitized Green Open Space based on the SPOT-7 image and the Green Open Space plan on Regional Regulation by looking at the comparison of the area of each classification type of Green Open Space. The flow chart research can be seen in the Figure 2.

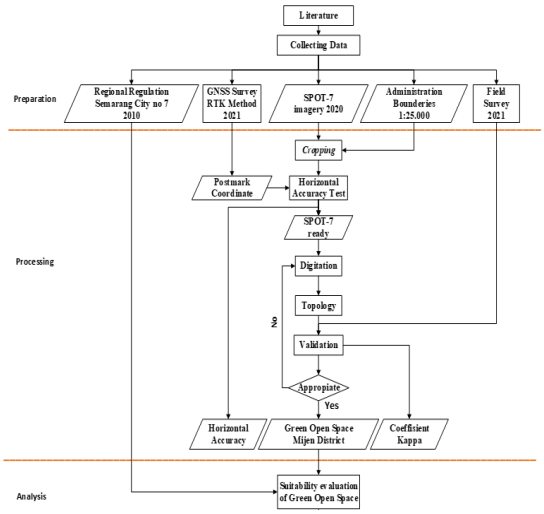


Figure 2. The flow chart research

3. Results and Discussion

3.1 Horizontal Accuracy Result

The results of this test were obtained by comparing the coordinates on the SPOT 7 2020 image and the results of the GNSS survey using the RTK method by the guidelines of the provisions made by BIG. The test control point is the postmark point measured by the GNSS RTK NTRIP method and in this study is connected to the CORS BIG CSEM base. The process of calculating this test is done with Microsoft Excel software. The distribution of postmark points can be seen in Figure 3.

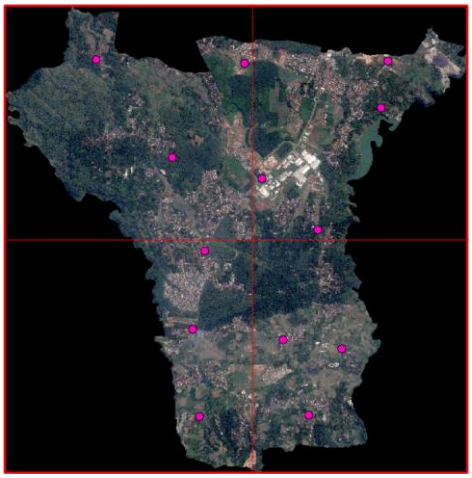


Figure 3. Postmark Point for GNSS Survey

Based on the calculation results of the horizontal position accuracy test for the SPOT 7 image 2020 by the Circular Error 90%, the results of the horizontal position accuracy test for the SPOT 7 image in 2020 are in class 2 at a scale of 1:5,000. This shows that the horizontal fault in the land use map and green open space which is the result of digitizing the SPOT 7 image does not exceed 3 meters. The calculation results can be seen in the table 3.

Table 3. Horizontal Accuracy Result

Point	DX^2	DY^2	DX^2+DY^2
TK1	0.919	2.438	3.356571651
TK2	0.002	0.206	0.20755853
TK3	0.222	0.159	0.380360739
TK4	0.436	0.227	0.663121941
TK5	1.514	0.181	1.695852361
TK6	0.147	0.899	1.045852961
TK7	0.689	2.187	2.876175011
TK8	0.115	1.964	2.0789786
TK9	0.710	0.182	0.892894821
TK10	0.431	1.156	1.586748562
TK11	0.090	0.354	0.443965011
TK12	0.003	2.189	2.191687008
TK13	0.533	0.931	1.46383304
Total			18.88360024
Mean			1.452584634
RMSe			1.205232191
CE90			1.828939849

$DX = X_{SPOT-7} - X_{RTK}$
$DY = Y_{SPOT-7} - Y_{RTK}$

3.2 Validation Test Result

The result of the kappa coefficient was 89.41%. So, it can be assumed that the consistency of the digitizing results of the Green Open Space with the base map of the SPOT-7 image in 2020 with the results of a field survey and referring to the provisions of ISO 19157 which uses a sample of 80 and experiences 7 errors, it is included in the 4% rejection limit.

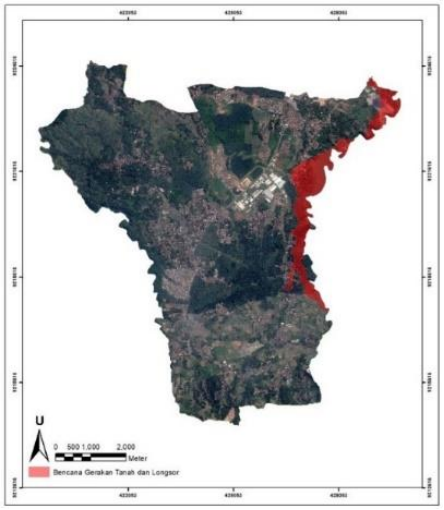
3.3 Condition of Green Open Space in Mijen District 2020

Green Open Space Mijen District in 2020 is the result of the SPOT-7 2020 imagery interpretation by digitizing on-screen. By the green open space plan in the Regional Regulation, there are 18 types of green open space for the Mijen District. The results of the area and number of attributes of the digitized green open space can be seen in the Table 4.

Table 4. Area of Digitized Green Open Space

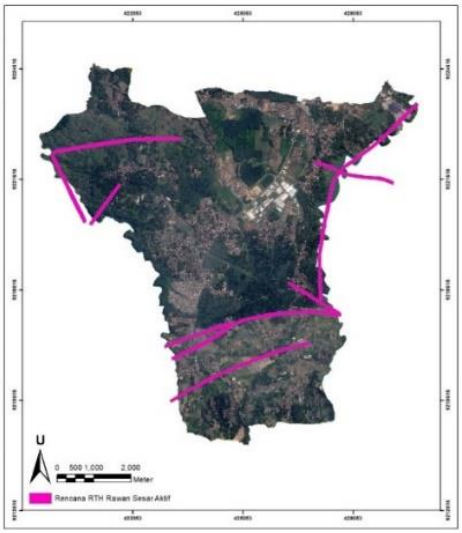
No	RTH Type	Atribute	Broad (Ha)
1	Production Forest	40	1116,35
2	Protected Forest	6	14,562
3	Wetland Farming	16	940,829
4	Dryland Farming	27	1462,185
5	Habitation	724	137,162
6	Offices and Public Facilities	48	2,841
7	Service Trading	140	6,382
8	Education	61	3,158
9	Industry	23	7,012
10	Sports Recreation	9	15,016
11	Funeral	3	3,523
12	Park and Field	22	34,217
13	River Bank	9	135,921
14	Reservoir Border	4	24,644
15	Prone to Land Movement and Landslide Disaster	0	0
16	Prone to Active Fault	0	0
17	Street Lane	22	34,901
18	SUTT and SUTET Road	42	1,216
	Total	**1196**	**3.939,919**

Based on the digitized green open space, several types of green open space are not found are green open space prone to land movement and landslides; and green open space prone to active fault. Based on data from BAPPEDA in the Semarang City, the location of the two types of green open space has been planned, around the Jatibarang reservoir for green open space prone to land movement and landslides, while green open space prone to active fault follows the active fault data. The location of the Planned Green Open Space Areas that are Prone to Land Movement and Landslides can be seen in figure 4 and the Planned Green Open Space Area Prone to Active Fault is showed in Figure 5.



Source: BAPPEDA Semarang City, 2011

Figure 4. Planned Green Open Space Areas that are Prone to Land Movement and Landslides



Source: BAPPEDA Semarang City, 2011

Figure 5. Planned Green Open Space Area Prone to Active Fault

However, when the SPOT 7 image interpretation was carried out and a direct field survey was carried out at the planning location, there was no designation of the area as a planned green open space, where in the field survey it was observed that the actual condition was the majority agricultural green open space area so that the location was included in the green open space class results agricultural digitization. In the figure 6 shows an example of a condition in the locations that are planned as green open space prone to land movement and landslides and open space prone to active fault.

Figure 6. Conditions in the planned location as green open space prone to land movement and landslides and open space prone to active fault.

The type condition of green open space in the Mijen District is dominated by forest and agriculture, as seen they have the largest area among other types of green open space. This is in line with the history of the Mijen District which is an area filled with production forest and agricultural land. Currently, the majority of production forests in the Mijen District are teak trees, while for agriculture the majority are rice plants. An example of the condition of Green Open Space Forest and Agriculture can be seen in Figure 7, 8 and 9.

Figure 7. Condition of wetland farming Green Open Space

Figure 8. Condition of dryland farming Green Open Space

Figure 9. Condition of Green Open Space for Production Forest

3.4 Comparison of Planned Green Open Space with Actual Green Open Space in 2020

The area of Mijen District based on Regional Regulation No. 7 of 2010 is ± 6,213.266 hectares. Meanwhile, the area of the Mijen District based on the shapefile obtained from the BAPPEDA is 5,381,071 hectares. The unit of used green open space is hectares to make it the same as the unit of used area. The following is the difference between the area of the digitized green open space and the existing green open space planned in the Regional Regulation about Mijen District which can be seen in the table 5:

Table 5. The difference between of digitized green open space and planned green space

No	RTH Type	RTH Result (Ha)	RTH Planned (Ha)	Difference (Ha)
1	Production Forest	1116.35	214.250	902.100
2	Protected Forest	14.562	362.365	-347.803
3	Wetland Farming	940.829	293.230	647.599
4	Dryland Farming	1462.185	353.000	1109.185
5	Habitation	137.162	172.480	-35.318
6	Offices and Public Facilities	2.841	8.322	-5.481
7	Service Trading	6.382	2.886	3.496
8	Education	3.158	16.072	-12.914
9	Industry	7.012	52.807	-45.795
10	Sports Recreation	15.016	97.680	-82.664
11	Funeral	3.523	2.500	1.023
12	Park and Field	34.217	26.590	7.627
13	River Bank	135.921	74.763	61.158
14	Reservoir Border	24.644	43.058	-18.414
15	Prone to Land Movement and Landslide Disaster	0	889.375	-889.375
16	Prone to Active Fault	0	33.054	-33.054
17	Street Lane	34.901	7.700	27.201
18	SUTT and SUTET Road	1.216	10.367	-9.151
	Total	**3939.919**	**2660.499**	**1279.42**

Based on table 5, there are types of green open space that are not appropriate and not by the plan in the regional regulation. What deserves to be highlighted are the two types of green open space that were not found in the digitization process and field survey, where the planned area does not have any specialization to be used as green open space that has been designed. This is one of the things that should be considered so the fulfillment of the green open space plan can be maximized.

Besides that, the condition of the Production Forest area which is good as a balancer for the ecosystem, and the current condition is still quite large, but apparently, it was not planned that way. Meanwhile, green open space tends to be located in the built-up area, the planned allocation is quite high and the current condition is still lacking. This means that from the planning of green open space in Regional Regulation No. 7 of 2010 there is a plan to carry out a large-scale physical development that will use Production Forest and Agriculture land, of course, needs to be reviewed, because these two types of green open space are types of green open space that play a major role in maintaining ecosystems in the area. Mijen District. The current condition of green space in Mijen District can be seen on the following map in Figure 10.

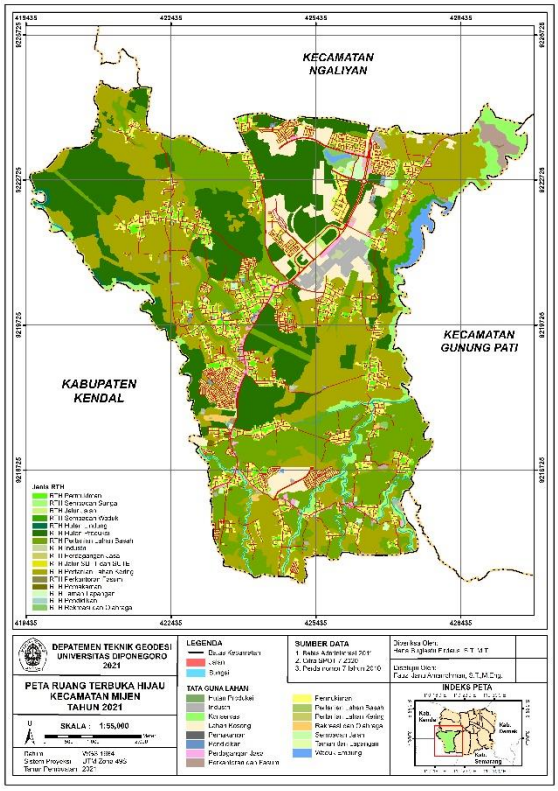


Figure 10. Map of green space in Mijen District

4. Conclusions

Based on the results of the analysis that has been carried out previously, it can be concluded that map-making using SPOT-7 image base data has good accuracy which according to BIG Regional Regulation No. 6 of 2018 is included in class 2 on a scale of 1:5,000. This shows that the horizontal fault which is the result of digitizing the SPOT 7 image does not exceed 3 meters.

Meanwhile, the condition of the 18 types of green open space in Mijen District which is planned in the Regional Regulation, 8 types of green open space is suitable and 10 types that are not. However, the total area of the Mijen District green space has fulfilled the total planned area in the Regional Regulation. This is because there are several types of green open space whose area exceeds the planned area.

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