Jurnal Pengabdian KOLABORATIF
Vol. 4 No. 1 (2026) pp.1-17
E-ISSN: 2985-9026
https://journals.usm.ac.id/index.php/kolaboratif

Infiltration Wells as a Solution to Runoff and Flooding Problems in Purwodinatan Subdistrict Semarang City

Hendra Masvika[1*], Bintang Husni Haikal[2], Purwanto[3], Ferry Firmawan[4], Nur Khasanah[5]
[1,2,3,4] Department of Civil Engineering, Universitas Semarang, Jl. Soekarno-Hatta, Tlogosari, Semarang City
[5] Department of Mathematics, UIN Walisongo Semarang, Jl. Prof. Hamka, Ngaliyan, Semarang City
*Corresponding author, e-mail: hendramasvika@usm.ac.id

Article History:
Recieved:
October 22, 2025
Revised:
December 31, 2025
Accepted:
January 2, 2026
Published:
January 2, 2026

ABSTRAK

Setiap musim penghujan atau saat terjadi hujan lebat, jalan di Kelurahan Purwodinatan Kota Semarang sering terjadi genangan air. Hal ini berdampak terganggunya aktivitas masyarakat dan pengguna jalan lain. Kondisi saluran drainase yang kurang mencukupi untuk menampung volume air hujan dan kurangnya perawatan drainase berdampak terjadinya sedimentasi, menjadi penyebab terjadinya limpasan dan genangan air. Kondisi ini perlu penanganan lebih lanjut untuk mengendalikan air limpasan dan mempersingkat waktu surutnya air. Oleh karena itu, diperlukan perencanaan sumur resapan sebagai salah satu alternatif solusi untuk mengatasi masalah tersebut. Metode pelaksanaan yang digunakan adalah studi literatur terkait perencanaan dimensi sumur resapan, yang dilanjutkan dengan perhitungan Rencana Anggaran Biaya (RAB). Perencanaan yang dilakukan adalah pendekatan awal dan hanya berdasarkan tinjauan literatur perencanaan sumur resapan tanpa melibatkan kajian teknis perhitungan kapasitas sumur resapan. Berdasarkan hasil perhitungan RAB diperoleh nilai sebesar Rp 6.462.954,92 untuk membuat 1 sumur resapan pada segmen Jl. Bubakan Baru, dimana terdapat 9 titik sumur resapan pada 1 segmen jalan tersebut. Hasil akhir kegiatan ini adalah pembuatan peta titik lokasi pemasangan sumur resapan dan perhitungan RAB untuk diserahkan pihak kelurahan. Kegiatan ini merupakan perencanaan pendahuluan untuk membantu masyarakat mengetahui perkiraan dimensi, jumlah titik dan RAB sumur resapan.

Keywords: *drainage capacity; infiltration; runoff; sedimentation; water inundation*

ABSTRACT

During the rainy season or under heavy rainfall events, roads in Purwodinatan Subdistrict, Semarang City, frequently experience water ponding. This condition disrupts community activities and other road users. Insufficient drainage capacity to accommodate rainfall volume, along with inadequate drainage maintenance that leads to sedimentation, contributes to surface runoff and water inundation. These conditions require further mitigation measures to control surface runoff and shorten the drainage recession time. Therefore, the planning of infiltration wells is proposed as an alternative solution to address this problem. The implementation method adopted in this study consists of a literature review related to the design dimensions of infiltration wells, followed by the

Vol. 4 No. 1 (2026) pp.1-17
DOI: 10.26623/kolaboratif.v4i1.13017

calculation of the Bill of Quantities (BoQ). The planning conducted represents a preliminary approach and is solely based on a literature review of infiltration well design, without involving detailed technical analyses of infiltration well capacity. Based on the BoQ calculation, a cost of IDR 6,462,954.92 is required to construct one infiltration well along the Bubakan Baru Street segment, where 9 infiltrations well locations are identified within a single road segment. The final outputs of this activity include a map of proposed infiltration well locations and the BoQ calculation to be submitted to the subdistrict authority. This activity serves as a preliminary planning stage to assist the community in estimating the dimensions, number of locations, and cost of infiltration wells.

INTRODUCTION

During the rainy season or periods of heavy rainfall, flooding frequently occurs, disrupting community activities and affecting other road users. The increasing population has led to a higher demand for housing, which in turn has reduced the availability of open spaces and wetlands. The conversion of infiltration areas into residential zones can be attributed to factors such as hydrogeological conditions, morphology, and land use patterns (Khasanah, et al., 2022). This rapid and often uncontrolled development tends to disregard the principles of sustainable urban planning, resulting in a significant decrease in groundwater infiltration. The transformation of open land into impervious surfaces or residential areas prevents rainwater from seeping into the soil, leading to surface runoff. This runoff is believed to be a major cause of waterlogging in road areas. Although such inundation typically occurs only during rainfall events, it nevertheless causes considerable inconvenience and disruption to public activities. Flooding can occur when rainwater is unable to flow away or infiltrate into the ground (Kustyaningrum & Lasminto, 2023).

The conversion of land use in urban areas, particularly in Purwodinatan Subdistrict, located in the center of Semarang City, has resulted in a reduction of Green Open Space (GOS) areas. The inadequate capacity of the existing drainage system to accommodate stormwater volume, combined with poor maintenance and sediment accumulation, has become the primary cause of surface runoff and flooding. The occurrence of surface runoff and the reduced infiltration of water into the soil lead to waterlogging (Rurung, Riogilang, & Hendratta, 2019). This condition requires further intervention to control runoff and shorten the duration of inundation. Efforts to mitigate this problem are necessary to ensure that public activities are not disrupted. Surface runoff management should be an integral part of urban planning that adapts to both climate conditions and population growth (Fletcher, Andrieu, & Hamel, 2013).

The limited availability of land makes it difficult to improve drainage systems in densely populated areas. Therefore, alternative solutions are needed to address the problems of surface runoff and flooding. The implementation of infiltration wells can serve as one such alternative in densely populated regions, as they help reduce surface runoff and enhance groundwater recharge (Bahunta & Waspodo, 2019); (Pellaupessy & Tiwery, 2018). The basic concept of an infiltration well is to channel stormwater into the ground through drainage pipes or water channels that lead into the well cavity. These wells can be integrated with existing drainage systems or installed directly in areas that frequently experience waterlogging. The selection of infiltration well planning was based on the suitability of this system with the characteristics of densely populated urban areas.

The objective of this community service activity is to provide a practical solution to runoff and flooding issues through the design of infiltration wells in Purwodinatan Subdistrict, Semarang City. In addition, this study includes the calculation of cost estimates and the required number of infiltration wells to be distributed across various roads within the subdistrict. It is expected that the implementation of infiltration wells will reduce the duration of surface runoff and flooding, allowing rainwater to infiltrate into the soil more quickly. This planning serves as a preliminary study to estimate the dimensions, number, and construction costs of infiltration wells. Further detailed calculations can then be carried out using technical data for a comprehensive design and implementation plan.

LITERATURE REVIEW

The construction of infiltration wells requires careful planning to ensure that their functions are properly defined, of high quality, and compliant with applicable standards. With proper design and planning, infiltration wells can effectively reduce surface runoff in densely populated residential areas (Rahmadi, Suprayogi, & Joleha, 2021). Equally important is the consideration of the soil surface where the infiltration well will be constructed. A systematic sequence of activities is necessary to facilitate both the construction process and the subsequent evaluation of the well's performance. An empirical methodological approach is required to study infiltration wells across various soil types, which can determine the step-by-step planning process from site preparation to implementation methods. The effective application of infiltration wells supports sustainable development efforts by promoting land and water conservation (Adriati, 2024).

In this process, variations in soil structure across different target locations significantly influence the permeability values observed. These differences serve as key considerations in the research process to determine the types of soil structures most suitable for the construction of infiltration wells, ensuring that the wells function effectively in accordance with their fundamental design principles. Soils with high permeability, such as sand and gravel mixtures, are ideal for facilitating efficient water infiltration (Putranto, Hadiyanto, & Hati, 2020). The rate of water infiltration largely depends on the soil's permeability coefficient.

The study site is located in Purwodinatan Subdistrict, Central Semarang District, Semarang City, which has been identified as a focal area for addressing flooding and surface runoff issues that occur during periods of heavy rainfall. In the design and planning of infiltration wells, the primary data used for analysis were obtained from the Regional Development Planning Agency (BAPPEDA) of Semarang City, along with several supporting journal references that exhibit similar environmental and hydrological conditions. These sources serve as valuable benchmarks for the preliminary design and planning process. The above studies justify the use of this preliminary planning approach as a reference before detailed technical calculations of infiltration well capacity, allowing the community to make a rough initial estimation.

Vol. 4 No. 1 (2026) pp.1-17
DOI: 10.26623/kolaboratif.v4i1.13017

Hydrological Cycle

The hydrological cycle is the continuous process through which seawater moves into the atmosphere and subsequently returns to the Earth's surface. Water present on the Earth's surface, such as in rivers, lakes, and oceans, undergoes evaporation due to solar heat. The resulting water vapor rises into the atmosphere, where it undergoes condensation, forming water droplets that coalesce into clouds and eventually fall as precipitation (Tiwery & Tani, 2022).

Flooded Areas

Flooding in Semarang City can generally be categorized into two types: flooding caused by local rainfall and inundation resulting from tidal influences. Field surveys indicate that flooding in Purwodinatan Subdistrict is primarily regional in nature. Local flooding occurs as a consequence of high-intensity rainfall, causing low-lying areas, commonly referred to as "the lower zones" in Semarang's topography, to experience water accumulation. The flood depth typically ranges between 20 cm and 75 cm, with inundation lasting from approximately 2 to 24 hours, depending on the duration and intensity of rainfall as well as the extent of the flooded area.

Several studies have investigated flooding events in Semarang City. Research on land-use changes in the Upper Semarang area revealed that increased surface runoff due to rainfall contributes significantly to urban flooding (Nur Sidiq, et al., 2022). Flooding caused by heavy rain has also been observed along Brigjen S. Sudiarto Street in East Semarang, where the primary drainage channels are unable to accommodate the excess stormwater volume, resulting in inundation (Udin, Yudaningrum, & Rossid, 2022). Furthermore, hydrodynamic modeling using HEC-RAS 2D in Tembalang District demonstrated that the river capacity is insufficient to contain the 200-year peak discharge (Q200), a result that has been validated through flood extent mapping (Limbong & Wulandari, 2024).

The significant flood risk observed at several locations within Semarang City has prompted efforts to strengthen the city's flood resilience. An analysis conducted using the Principal Component Analysis (PCA) method indicated that approximately 11.435% of Semarang's total area falls into the high-risk category, primarily concentrated in the Pedurungan and Tembalang districts (Wijaya, Albani, & Firdaus, 2023). Strategies for mitigating flood problems caused by rainwater inundation must be adapted to the specific conditions and characteristics of each area. Several alternative measures have been proposed: reforestation and the construction of flood control dams in the upstream areas, river normalization in the midstream zones, and the development of coastal levees and polder systems in the downstream regions (Budinetro, Rahayu, Praja, Taufiq, & Junarsa, 2012).

The causes of flood inundation, in addition to high rainfall intensity, are influenced by several contributing factors. Land-use changes, slope gradients, and inadequate drainage capacity are among the main factors contributing to flooding in the Sawah Besar watershed area (Hayu, et al., 2024). Land conversion has also led to erosion in the upstream sections of rivers and sedimentation in the downstream areas (Zulfan & Manar, 2024). These conditions reduce the ability of waterways to contain stormwater during periods of heavy rainfall. As a result, excessive water volume often exceeds the drainage system's capacity, leading to flood inundation caused by overflow from underperforming drainage channels (Risiandi, Yuwanto, & Widayati, 2013). To mitigate this issue, the implementation of a pumping system is required to lower water levels in inundated areas and minimize flood duration.

Infiltration Wells

Infiltration wells are an alternative water restoration solution that can be utilized for rainwater management and flood control. The primary purpose of an infiltration well is to reduce surface moisture, prevent soil erosion, and enhance soil moisture retention. These wells help minimize surface runoff, channel water into the subsurface, and increase groundwater storage. The implementation of infiltration wells can serve as part of a broader stormwater management and flood mitigation strategy, particularly in urban areas where land surfaces are predominantly covered by impermeable materials such as concrete or asphalt. Consequently, infiltration wells have become an essential means of sustainable rainwater management, helping to reduce the adverse impacts of flooding. Furthermore, they play a significant role in urban water conservation efforts (Nurkhotiah, Kamari, Furqorina, & Firdaus, 2023).

METHODS

The site identification process was carried out based on the feasibility and depth maps of infiltration wells prepared by the Regional Development Planning Agency (BAPPEDA) of Semarang City, complemented by several alternative site assessments through direct field observations. The planned locations for the infiltration wells were determined by identifying areas with existing catchment zones (DTA) and frequent inundation during periods of heavy rainfall. Based on the flooded area survey and topographic slope analysis, suitable alternative points for infiltration well installation were established. The selection of these locations also considered accessibility factors, as the implementation process requires substantial amounts of equipment and materials. These factors inevitably influence the budget, execution time, and social dynamics within the surrounding community.

Dimension Planning

The dimensions of the infiltration well are designed based on the required storage volume to accommodate the rainwater collected within the catchment area (DTA) and directed into the well. The cross-section of the infiltration well is generally recommended to be circular; however, if field conditions present constraints, a rectangular-shaped well may be considered as an alternative. In this study, the design dimensions of the infiltration well refer to several literature sources and technical guidelines, adopting a diameter of 1 meter and a depth of 2.5 meters. These parameters were selected by considering site conditions comparable to those found in Purwodinatan Subdistrict.

The contributing flood volume refers to the volume of rainfall that falls on the catchment surface and is subsequently discharged into the infiltration well. This volume is essential for determining the capacity and number of infiltration wells required. The calculation of the contributing flood volume follows the Indonesian National Standard (SNI), as expressed in Equation (1).

Vol. 4 No. 1 (2026) pp.1-17
DOI: 10.26623/kolaboratif.v4i1.13017

$$V_{ab} = 0{,}85 \times C \times A \times R \qquad (1)$$

Note:
V_{ab} = Contributing Flood Volume (m^3)
C = Runoff Coefficient
A = Catchment Area (m^2)
R = Average Daily Rainfall Depth (mm/day)

In calculating the capacity of infiltration wells, it is essential to determine the soil infiltration volume, which allows for estimating both the capacity and the number of infiltration wells required. The calculation of infiltration well capacity and quantity can be performed using Equation (6).

$$V_{rsp} = \frac{t_e}{24} \times A \times K \qquad (2)$$

Note:
V_{rsp} = Infiltrated Rainwater Volume (m^3)
t_e = Rainfall Duration = $\frac{0{,}90R^{0{,}92}}{60}$ (hours)
A = Infiltration Well Surface Area (m^2)
K = Soil Permeability Coefficient (m/day)
(For impermeable well walls, assume $K_V = K_H$ (vertical and horizontal permeability coefficients are equal), and for permeable walls, use the average permeability coefficient $K_{average}$ to represent effective infiltration through the well surface)

$$K_{average} = \frac{t_e}{24} \times A_{total} \times K_v \qquad (3)$$

Note:
$K_{average}$ = Average Soil Permeability Coefficient (m/day)
K_v = Soil Permeability Coefficient at the Well Wall (m/day) = $2K_h$
K_h = Soil Permeability Coefficient at the Well Bottom (m/day)
A_h = Bottom Surface Area of the Well with Circular = $\frac{1}{4} \times \pi \times D^2$ (m^2)
A_v = Wall Surface Area of the Well with Circular Cross-Section = $(\pi \times D \times H)$ (m^2)

$$V_{sto} = V_{ab} - V_{rsp} \qquad (4)$$

Note:
V_{sto} = Storage Volume (m^3)
V_{ab} = Contributing Flood Volume (m^3)

$$H_{total} = \frac{V_{ab} - V_{rsp}}{A_h} \qquad (5)$$

Vol. 4 No. 1 (2026) pp.1-17
DOI: 10.26623/kolaboratif.v4i1.13017

$$n = \frac{H_{total}}{H_p} \qquad (6)$$

Note:

H_{total} = Total Depth of the Rainwater Infiltration Well (m)

A_h = Wall Surface Area of the Well with Circular Cross-Section = $(\pi \times D \times H)$ (m²)

= Wall Surface Area of the Well with Rectangular Cross-Section = $2 \times P \times L$ (m²)

n = Number of Infiltration Wells

H_p = Planned Depth < Groundwater Table Depth (m)

Filtration System Design

Filtration is applied to treat rainwater by incorporating trash screens and sediment filters to remove debris and suspended particles before infiltration. Several important aspects must be considered after the infiltration well installation, including the infiltration capacity and performance of the well, as well as the ease of maintenance and periodic cleaning to ensure the system remains effective and sustainable.

RESULT AND DISCUSSION

Implementation

The implementation plan is prepared collaboratively with the local village administration and relevant government agencies, within a predetermined timeframe. To promote public outreach and community participation, the construction of infiltration wells can be carried out using a self-managed (community-based) model. The implementation will involve partnered labor, consisting of both paid workers (skilled or professional labor) and voluntary participants from the local community (supporting labor). Based on the construction dimensions and technical specifications of the infiltration wells, the material and labor requirements are then determined. The calculation of material needs is supplemented with a procurement sequence plan to ensure efficiency in implementation. Additionally, the process includes obtaining all necessary permits and documentation from the relevant authorities before the start of construction.

The implementation method for this activity involves a literature study related to the design and dimensional planning of infiltration wells, followed by the calculation of the Estimated Budget Plan (RAB). This activity serves as a preliminary planning stage aimed at assisting the local community in understanding the estimated dimensions, number of infiltration points, and associated construction costs. During the execution phase, a detailed technical design must be prepared in accordance with applicable regulations and engineering standards before the actual construction begins. Upon completion, the final outputs of this activity are submitted to the village administration as a reference and consideration for future development planning. The project documentation is presented in Figure 1.

Vol. 4 No. 1 (2026) pp.1-17
DOI: 10.26623/kolaboratif.v4i1.13017

Figure 1. Socialization of the Infiltration Well Planning Program

Design Plan for Infiltration Wells

Several studies have examined the utilization of infiltration wells in controlling stormwater runoff and reducing drainage loads. One such study, conducted by Herwindro and Bumi, titled "Analysis of Rainwater Runoff Infiltration in the Implementation of Zero Delta Q at the Public Works Polytechnic," employed infiltration wells with a diameter of 1 meter and a depth of 3 meters. These wells were used to reduce surface runoff and support the performance of the local drainage system (Herwindo & Bumi, 2023).

The second study, conducted by Setiawan and his team, focused on Runoff Control through Ecodrainage in the Podo Asih Residential Area. They planned the construction of 289 infiltration wells, each with a diameter of 1.2 meters and a depth of 6.5 meters. In addition, the study incorporated four biopore holes at each location, each 10 cm in diameter and 1 meters deep, serving as supplementary features to enhance water infiltration and reduce the burden on the drainage system (Setiawan, Yulistyorini, Rahayuningsih, & Idfi, 2023).

The third study, conducted by Syafira and her team, was titled Planning Study of Injection Wells as an Effort to Mitigate Inundation in Urban Areas (Case Study in RW 8 and 9, Blimbing Subdistrict, Malang City). The research proposed the construction of infiltration wells with a diameter of 1.3 meters and a depth of 5 meters. A total of 45 wells were planned across RW 8 and RW 9, where eight inundation prone points were identified. These infiltration wells were designed as a mitigation measure to reduce rainwater ponding in the study area (Syafira, Bisri, & Asmaranto, 2023).

Considering the findings from the three referenced studies and the relatively similar population density, the proposed design adopts an infiltration well with a diameter of 1 meter and a depth of 2.5 meters, taking into account the groundwater table in Purwodinatan Subdistrict, at a depth of approximately 5 meters. The infiltration well dimensions will remain consistent across all locations; however, the pipe requirements will vary depending on site conditions. Based on the spatial distribution of infiltration well locations within Purwodinatan, the area is divided into several segments, such as Segment I, II, III, IV, and so on. The detailed technical aspects of this design will be further discussed during the structural planning phase. The infiltration well design was developed based on the literature reviewed previously and was subsequently used as a reference for determining the structural

Vol. 4 No. 1 (2026) pp.1-17
DOI: 10.26623/kolaboratif.v4i1.13017

dimensions and the cost estimate. The proposed design layout is illustrated in Figures 2 and 3.

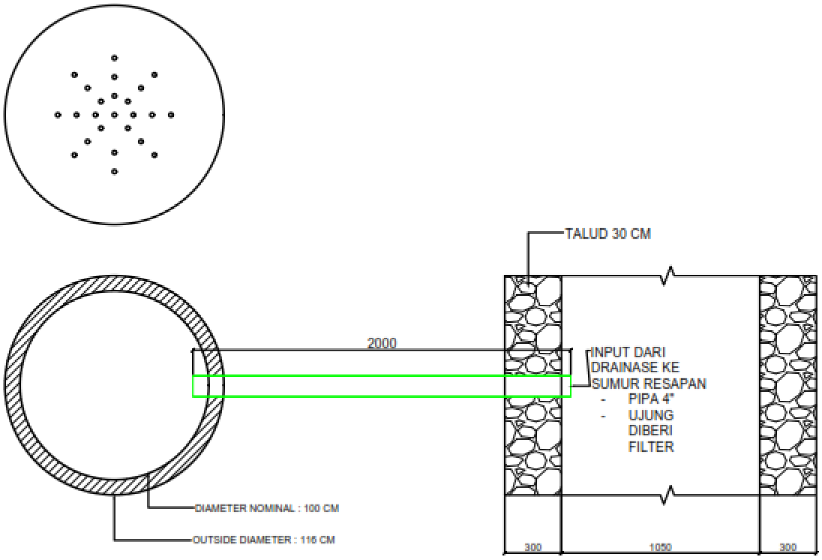

Figure 2. Top View Design

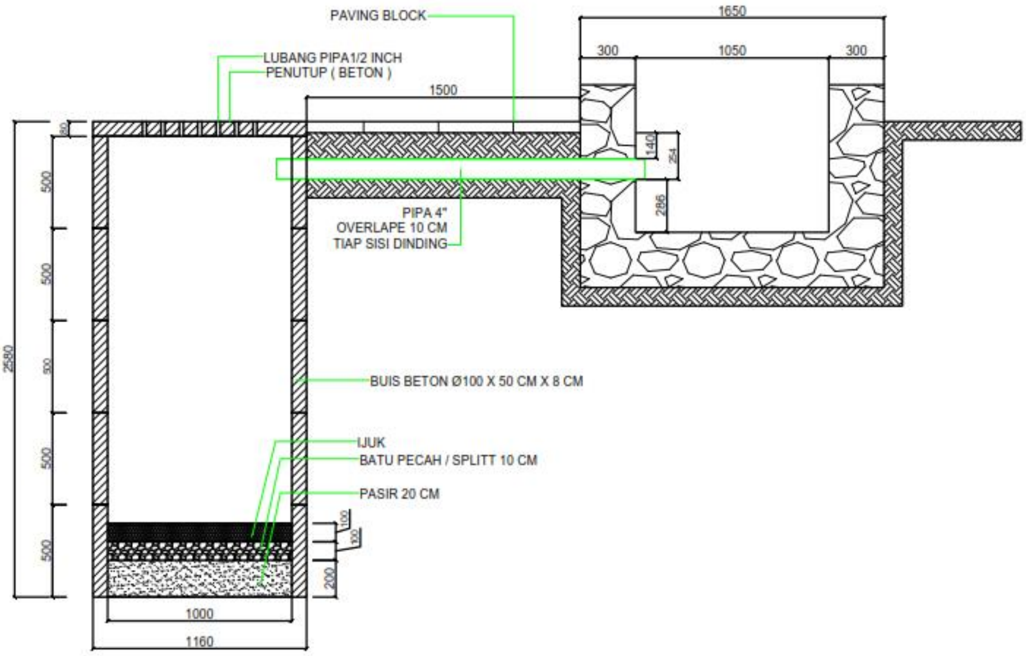

Figure 3. Infiltration Well Design Plan

Estimated Budget Plan (RAB)

The cost estimate is calculated using the Unit Price Analysis from Semarang City Mayor Regulation No. 3 of 2024 concerning the Standardization of Unit Prices for Building Materials, Wages, and Work Analyses. Below is an example of the RAB calculation for one infiltration well located on the Bubakan Baru Street segment in Purwodinatan Subdistrict.

Vol. 4 No. 1 (2026) pp.1-17
DOI: 10.26623/kolaboratif.v4i1.13017

Work Items

1. Site clearance

   Work quantities $= 1/4 \times \pi \times (\text{Ø}_{excavation} + 0,5)^2$

   $= 1/4 \times 3,14 \times (1,16 + 0.5)^2 = 2.163\ m^2$

2. Construction of well cover (concrete casing)

   Work quantities $= 1/4 \times \pi \times (\text{Ø}_{well} + 0.1)^2 \times 0.08$

   $= 1/4 \times 3.14 \times (1.16 + 0.1)^2 \times 0.08 = 0.116\ m^3$

3. Excavation for infiltration well

   Work quantities $= (well\ cross - sectional\ area + \text{Ø}_{excaavation}) + (P \times L \times T)$

   $V1 = 1/4 \times 3.14 \times 1.16^2 \times 2.58 = 2.725\ m^3$

   $V2 = 1.5 \times 0.30 \times 0.30 = 0.135\ m^3$

   $Total = 2.76 + 0.135 = 2.895\ m^3$

4. Supply and installation of precast concrete rings

   Work quantities $= \pi \times (\text{Ø}_{Well} + thickness_{concrete}) \times depth_{Well}$

   $= 3.14 \times (1.16 + 0.08) \times 2.5 = 9.734\ m^3\ /\ 5\ pcs$

5. Installation of ijuk (palm-fiber) layer-10 cm

   Work quantities $= 1/4 \times \pi \times {\text{Ø}_{Well}}^2 \times 0.1$

   $= \frac{1}{4} \times 3.14 \times 1.16^2 \times 0.1 = 0.106\ m^2$

6. Sand backfil

   Work quantities $= \left(\frac{1}{4} \times \pi \times d^2 \times thickness_{backfill}\right) + \left(p \times l \times thickness_{backfill}\right)$

   $= \left(\frac{1}{4} \times 3.14 \times 1.16^2 \times 0.3\right) + (1.5 \times 0.3 \times 0.3) = 0.452\ m^3$

7. Crushed stone/ coral backfill-10 cm

   Work quantities $= \frac{1}{4} \times \pi \times d^2 \times thickness_{backfill}$

   $= \frac{1}{4} \times 3.14 \times 1.16^2 \times 0.1 = 0.106\ m^3$

8. Supply and installation of Ø4" pipe

   Work quantities $= number\ of\ pipes\ (units) \times pipe\ length\ (m)$

   $= 2 \times 0.25m = 0.5m$

9. Finishing works

   Work quantities $= \frac{1}{4} \times \pi \times d^2 \times t$

   $V1 = \frac{1}{4} \times 3.14 \times 0.114^2 \times 0.08 = 0.00087\ m^3$

   $V2 = \frac{1}{4} \times 3.14 \times 0.114^2 \times 0.3 = 0.0031\ m^3$

   $Total = 0.00087 + 0.0031 = 0.00397\ m^3$

10. Paving block installation

    Work quantities $= P \times L$

    $= 1.5 \times 0.30 = 0.45\ m^2$

Unit Price Analysis Calculation

The unit price of work is determined using the formula:

$$\text{Unit Price of Work} = \text{Coefficient } \times (\text{Unit Price of Materials and or Labor})$$

1. Site clearing/ removal of paving blocks (Table 1).

Table 1. Unit Price Analysis for Site Clearing Work

Items		Code	Unit	Coeffisien	Unit Price	Total Price
A. Upah Tenaga						
	1. Pekerja	L.01	OH	0,2145	Rp 129.750,00	Rp 27.831,38
	2. Tukang Batu	L.02	OH	0,1000	Rp 155.000,00	Rp 15.500,00
	3. Mandor	L.14	OH	0,0215	Rp 155.000,00	Rp 3.332,50
					Jumlah Harga Upah Tenaga	Rp 46.663,88
B. Bahan						
					Jumlah Harga Bahan	
C. Peralatan						
	1. Alat Bantu	E.50	Set	0,0215	Rp 50.000,00	Rp 1.075,00
					Jumlah Harga Peralatan	Rp 1.075,00
D.	Jumlah (A+B+C)					Rp 47.738,88
E.	Overhead & Profit				10% × D	Rp 4.773,89
F.	Harga Satuan Pekerjaan (D+E)					Rp 52.512,76

2. Earth excavation to a depth of 3 meters (Table 2).

Table 2. Unit Price Analysis for Earth Excavation Works

No.	Items	Code	Unit	Coeffisien	Unit Price	Total Price
A	Tenaga Kerja					
1	Pekerja	L.01	OH	1,050	Rp 129.750,00	Rp 136.237,50
2	Mandor	L.14	OH	0,067	Rp 155.000,00	Rp 10.385,00
					Jumlah Harga Tenaga Kerja	Rp 146.622,50
B	Bahan					
					Jumlah Harga Bahan	-
C	Peralatan					
					Jumlah Harga Alat	-
D	Jumlah (A+B+C)					Rp 146.622,50
E	Overhead & Profit				10% × D	Rp 14.662,25
F	Harga Satuan Pekerjaan (D+E)					Rp 161.284,75

3. Installation of precast concrete ring ø100 cm (Table 3).

Table 3. Unit Price Analysis for Installation of Precast Concrete Rings

Items		Code	Unit	Coeffisien	Unit Price	Total Price
A	Tenaga Kerja					
1	Pekerja	L.01	OH	0,0273	Rp 129.750,00	Rp 3.542,18
2	Mandor	L.14	OH	0,0091	Rp 155.000,00	Rp 1.410,50
					Jumlah Harga Tenaga Kerja	Rp 4.952,68
B	Bahan					
1	Buis beton Ø100 cm, K225/K300		Unit	1,1	Rp 590.017,00	Rp 649.018,70
					Jumlah Harga Bahan	Rp 649.018,70

Jurnal Pengabdian KOLABORATIF
Vol. 4 No. 1 (2026) pp.1-17
DOI: 10.26623/kolaboratif.v4i1.13017

Items		Code	Unit	Coeffisien	Unit Price	Total Price
C.	Peralatan					
					Jumlah Harga Alat	
D	Jumlah (A+B+C)					Rp 653.971,38
E	Overhead & Profit				10% × D	Rp 65.397,14
F	Harga Satuan Pekerjaan (D+E)					Rp 719.368,51

4. Crushed stone backfilling work using 5/7 aggregate, 10 cm thick (m³) (Table 4).

Table 4. Unit Price Analysis for Crushed Stone Backfilling Works

Items		Code	Unit	Coeffisien	Unit Price	Total Price
A	Tenaga Kerja					
1	Pekerja	L.01	OH	0,1368	Rp 129.750,00	Rp 17.749,80
2	Mandor	L.14	OH	0,0274	Rp 155.000,00	Rp 4.247,00
					Jumlah Harga Tenaga Kerja	Rp 21.996,80
B	Bahan					
1	Batu Pecah 5/7	M.35	m3	0,776	Rp 342.600,00	Rp 265.857,60
					Jumlah Harga Bahan	Rp 265.857,60
C.	Peralatan					
					Jumlah Harga Alat	
D	Jumlah (A+B+C)					Rp 287.854,40
E	Overhead & Profit				10% × D	Rp 28.785,44
F	Harga Satuan Pekerjaan (D+E)					Rp 316.639,84

5. Sand backfilling work, 1 m³ with a compacted thickness of 30 cm (Table 5).

Table 5. Unit Price Analysis for Sand Backfilling Works

Items		Code	Unit	Coeffisien	Unit Price	Total Price
A	Tenaga Kerja					
1	Pekerja	L.01	OH	0,300	Rp 129.750,00	Rp 38.925,00
2	Mandor	L.14	OH	0,010	Rp 155.000,00	Rp 1.550,00
					Jumlah Harga Tenaga Kerja	Rp 40.475,00
B	Bahan					
1	Pasir Urug (quarry-lokasi pekerjaan)	M.9	m3	1,2	Rp 384.500,00	Rp 461.400,00
					Jumlah Harga Bahan	Rp 461.400,00
C	Peralatan					
					Jumlah Harga Alat	-
D	Jumlah (A+B+C)					Rp 501.875,00
E	Overhead & Profit				10% × D	Rp 50.187,50
F	Harga Satuan Pekerjaan (D+E)					Rp 552.062,50

6. Installation of palm fiber (ijuk) layer, 10 cm thick (m²) (Table 6).

Table 6. Unit Price Analysis for Palm Fiber (Ijuk) Installation Work

Items		Code	Unit	Coeffisien	Unit Price	Total Price
A	Tenaga Kerja					
1	Pekerja	L.01	OH	0,150	Rp 129.750,00	Rp 19.462,50
2	Mandor	L.14	OH	0,015	Rp 155.000,00	Rp 2.325,00
					Jumlah Harga Tenaga Kerja	Rp 21.787,50
B	Bahan					
1	Ijuk	M.1261	kg	6,0	Rp 12.000,00	Rp 72.000,00

Items		Code	Unit	Coeffisien	Unit Price	Total Price
					Jumlah Harga Bahan	Rp 72.000,00
C	Peralatan					
					Jumlah Harga Alat	-
D	Jumlah (A+B+C)					Rp 93.787,50
E	Overhead & Profit				10% × D	Rp 9.378,75
F	Harga Satuan Pekerjaan (D+E)					Rp 103.166,25

7. Finishing concrete (m^3) (Table 7).

Table 7. Unit Price Analysis for Finishing Concrete Work

Items		Code	Unit	Coeffisien	Unit Price	Total Price
A	Tenaga Kerja					
1	Pekerja	L.01	OH	0,9000	Rp 129.750,00	Rp 116.775,00
2	Mandor	L.14	OH	0,9000	Rp 155.000,00	Rp 139.500,00
					Jumlah Harga Tenaga Kerja	Rp 256.275,00
B	Bahan					
					Jumlah Harga Bahan	
C	Peralatan					
	1. Jack Hammer	E.29	jam	0,1600	Rp 50.300,00	Rp 8.048,00
	2. Palu/Godam (Baja Keras)	E.73	bh	0,0500	Rp 25.000,00	Rp 1.250,00
	3. Gergaji Besi	E.74	bh	0,1000	Rp 3.500,00	Rp 350,00
	4. Pahat Beton (Baja Keras)	E.75	bh	0,2000	Rp 15.000,00	Rp 3.000,00
					Jumlah Harga Peralatan	Rp 12.648,00
D	Jumlah (A+B+C)					Rp 268.923,00
E	Overhead & Profit				10% × D	Rp 26.892,30
F	Harga Satuan Pekerjaan (D+E)					Rp 295.815,30

8. Installation of 4-inch PVC pipe (m) (Table 8).

Table 8. Unit Price Analysis for PVC Pipe Installation Work

Items		Code	Unit	Coeffisien	Unit Price	Total Price
A	Pekerjaan					
1	Galian tanah keras/biasa dibuang di sekitar lokasi proyek		m3	0,1500	Rp 69.875,00	Rp 10.481,25
2	Urugan bekas tanah galian (manual)		m3	0,0900	Rp 87.504,00	Rp 7.875,36
3	Pemasangan pipa		m	1,0000	Rp 43.800,00	Rp 43.800,00
4	Pengetesan pipa		m	1,0000	Rp 8.160,00	Rp 8.160,00
					Jumlah Harga Tenaga Kerja	Rp 70.316,61
B	Bahan					
1	Pipa PVC Type AW 4"	M.110	batang	0,1667	Rp 290.000,00	Rp 48.343,00
2	Assesoris PVC	M,114	m	1,0000	Rp 5.900,00	Rp 5.900,00
					Jumlah Harga Bahan	Rp 54.243,00
C	Peralatan					
1	Alat Bantu	E.50	set	0,0289	Rp 50.000,00	Rp 1.445,00
					Jumlah Harga Alat	Rp 1.445,00
D	Jumlah (A+B+C)					Rp 126.004,61
E	Overhead & Profit				10% × D	Rp 12.600,46
F	Harga Satuan Pekerjaan (D+E)					Rp 138.605,07

Vol. 4 No. 1 (2026) pp.1-17
DOI: 10.26623/kolaboratif.v4i1.13017

9. Paving blocks installation work (Table 9).

Table 9. Unit Price Analysis for Paving Block Installation Work

	Items	Code	Unit	Coeffisien	Unit Price	Total Price
A	Upah Tenaga					
1	Pekerja	L.01	OH	0,2400	Rp 129.750,00	Rp 31.140,00
2	Tukang Batu	L.14	OH	0,0800	Rp 155.000,00	Rp 12.400,00
					Jumlah Harga Tenaga Kerja	Rp 43.540,00
B	Bahan					
1	Paving Block Abu 6 cm K-200	M.180	m2	1,0000	Rp 96.200,00	Rp 96.200,00
2	Pasir Muntilan (quarry - lokasi pekerjaan)	M.24	m3	0,0500	Rp 384.500,00	Rp 19.225,00
					Jumlah Harga Bahan	Rp 115.425,00
C	Peralatan					
1	Alat Bantu	E.50	Set	0,0250	Rp 50.000,00	Rp 1.250,00
					Jumlah Harga Peralatan	Rp 1.250,00
D	Jumlah (A+B+C)					Rp 160.215,00
E	Overhead & Profit				10% × D	Rp 16.025,00
F	Harga Satuan Pekerjaan (D+E)					Rp 176.240,00

Labor and Material Prices

The labor and material prices are calculated based on the standard unit price analysis stipulated in the Mayor of Semarang Regulation No. 3 of 2024 concerning the Standardization of Unit Prices for Construction Materials, Labor Wages, and Work Analysis, as presented in Table 10 below.

Table 10. Unit Prices of Construction Materials and Labor

No	Items	Unit	Code	Unit Price
1	2	3	4	5
I	**Labor**			
1	Worker	OH	L.01	Rp 129.750,00
2	Masonry Worker	OH	L.02	Rp 155.000,00
3	Plumber	OH	L.05	Rp 155.000,00
4	Excavation Worker	OH	L.10	Rp 135.000,00
5	Foreman	OH	L.14	Rp 155.000,00
6	Heavy Equipment Operator	OH	L.16	Rp 270.000,00
7	Truck Driver	OH	L.27	Rp 215.000,00
8	Helper	OH	L.29	Rp 150.000,00
II	**Materials**			
1	Muntilan Sand (from local quarry near project site)	m3	M.24	Rp 384.500,00
2	Crushed Stone 5/7	m3	M.38	Rp 342.600,00
3	Palm Fiber (Ijuk)	kg	M.1261	Rp 12.000,00
4	Precast Concrete Pipe Ø100 cm	m'		Rp 590.017,00
5	Concrete Pipe Cover	m'		Rp 400.000,00
6	PVC Pipe AW 4”	batang	M.91	Rp 290.000,00

Estimated Budget Plan for the Construction of One Infiltration Well

The cost estimation is calculated based on the standard unit price analysis stipulated in the Mayor of Semarang Regulation No. 3 of 2024 concerning the Standardization of Unit Prices for Construction Materials, Labor Wages, and Work Analysis, which is then multiplied by the corresponding work volumes, as presented in Table 11.

Table 11. Estimated Budget Plan

No	Items	Unit	Quantity	Unit Price		Total Cost	
I	**PRELIMINARY WORKS**						
1	Site clearing	m^2	2,16	Rp	52.512,76	Rp	113,427.56
II	**SOIL AND EXCAVATION WORKS**						
1	Earth excavation	m^3	2,90	Rp	161.284,75	Rp	467,725.78
III	**INFILTRATION WELL CONSTRUCTION WORKS**						
1	Installation of precast concrete ring ø100 cm	m^3	5	Rp	653.971,38	Rp	3,269,856.90
2	Installation of 4-inch PVC pipe	m	0,5	Rp	138.605,07	Rp	69.302,54
3	Finishing concrete	m^3	0,00397	Rp	295.815,30	Rp	1.174,39
4	Sand backfilling work, 1 m³ with a compacted thickness of 30 cm	m^3	0,452	Rp	552.062,50	Rp	249,532.25
5	Crushed stone backfilling work using 5/7 aggregate, 10 cm thick	m^3	0,106	Rp	316.639,84	Rp	33,563.82
6	Installation of palm fiber (ijuk) layer, 10 cm thick	m^2	0,106	Rp	103.166,25	Rp	10,935.62
7	Installation of Ø100 cm Concrete Pipe Cover	m	1	Rp	517.141,67	Rp	517.141,67
8	Paving block installation work	m^2	0,45	Rp	176.240,00	Rp	79,308.00
					TOTAL I	Rp	4,811,968.52
					Fee of Contractors 10%	Rp	481,196.85
					TOTAL II	Rp	5,293,165.38
					Overhead 10%	Rp	529.316.53
					TOTAL III	Rp	5,822,481.91
					PPN 11%	Rp	640,473.01
					GRAND TOTAL	Rp	6,462,954.92

CONCLUSION

Based on the results of the cost estimation, the total cost required to construct one infiltration well at Segment Jl. Bubakan Baru, Purwodinatan Sub-district, Central Semarang District is Rp. 6,462,954.92 The planned number of infiltration wells along this road segment is nine units. The design for the Jl. The Bubakan Baru segment can also be applied to the surrounding area near the Purwodinatan Village Office, following the existing road elevation and drainage system. The dimensions of the infiltration well were determined by comparing three research studies with similar soil characteristics and population density. From this comparison, the commonly used concrete pipe (buis beton) dimension of Ø100 cm with a depth of 250 cm was selected. This depth was further supported by interviews with five well drillers, who reported that the groundwater table in Purwodinatan typically ranges between 3.5 and over 5 meters below the surface. The 2.5-meter depth was chosen under the assumption that it would effectively reach the active infiltration zone. It should be noted that the dimensions and depth of the infiltration wells may not yet be fully optimized, as the current estimation is based solely on comparative analysis and does not employ an established analytical calculation method. Furthermore, the cost estimation presented here

Vol. 4 No. 1 (2026) pp.1-17
DOI: 10.26623/kolaboratif.v4i1.13017

represents only one sample design for a single road segment, as the existing drainage conditions vary across different streets and areas within the Purwodinatan Sub-district.

REFERENCES

Adriati, Y. (2024). Efektivitas sumur resapan penunjang program green building pada kawasan perumahan di Pekanbaru. *Konferensi Nasional Teknik Sipil (KoNTekS), 1*(1), 1-10. Retrieved from https://doi.org/10.62603/konteks.v1i1.1

Bahunta, L., & Waspodo, R. B. (2019). Rancangan sumur resapan air hujan sebagai upaya pengurangan limpasan di Kampung Babakan, Cibinong, Kabupaten Bogor. *J-SIL, 4*(1), 37-48. Retrieved from https://doi.org/10.29244/jsil.4.1.37-48

Budinetro, H. S., Rahayu, S., Praja, T. A., Taufiq, A., & Junarsa, D. (2012). Strategi pengendalian banjir Kota Semarang. *Jurnal Sumber Daya Air, 8*(2), 141-156. Retrieved from https://jurnalsda.pusair-pu.go.id/index.php/JSDA/article/view/369/267

Fletcher, T. D., Andrieu, H., & Hamel, P. (2013). Understanding, management and modelling of urban hydrology and its consequences for receiving waters: A state of the art. *Advances in Water Resources, 51*, 261-279. Retrieved from https://doi.org/10.1016/j.advwatres.2012.09.001.

Hayu, C. S., Aprilia, C., Putri, U. K., Putri, V. L., Hidayat, A. A., & Ansori, N. (2024). Analisis pola debit hujan terhadap terjadinya banjir di daerah aliran Kali Es Sawah Besar pada 12 Februari 2024. *Jurnal Implementasi*, *4*(1), 65-78. Retrieved from https://jurnalilmiah.org/journal/index.php/ji/article/view/851

Herwindo, W., & Bumi, I. S. (2023). Analisis resapan limpasan air hujan dalam rangka penerapan zero delta q di Politeknik PU. *Jurnal Teknik Hidraulik, 14*(2), 95-104. Retrieved from https://doi.org/10.32679/jth.v14i2.743

Khasanah, M., Rahmatillah, S. A., Haryono, B., Nurhaliza, A. P., Putri, C. A., & Fujilestari, N. A. (2022). Alih fungsi lahan resapan air menjadi pemukiman di Kawasan Bandung Utara (studi kasus Kelurahan Cipageran dan Kelurahan Citereup). *Caraka Prabu : Jurnal Ilmu Pemerintahan, 6*(2), 164-175. Retrieved from https://doi.org/10.36859/jcp.v6i2.1158

Kustyaningrum, J. D., & Lasminto, U. (2023). Analisis potensi pemanenan air hujan dalam area perumahan untuk mereduksi banjir pada Perumahan Sutorejo, Surabaya. *Jurnal Aplikasi Teknik Sipil, 21*(1), 97-106. Retrieved from http://dx.doi.org/10.12962%2Fj2579-891X.v21i1.15521

Limbong, B., & Wulandari, D. A. (2024). Kajian tanggul pengendali banjir di Kali Pengkol - Kota Semarang. *Jurnal Teknik Hidraulik, 15*(1), 47-60. Retrieved from https://doi.org/10.32679/jth.v15i1.773

Nur Sidiq, W. B., Hanafi, F., Priakusuma, D., Haruman, W., Sumarso, M. Y., & Setyowati, N. (2022). Analisis banjir genangan di kawasan Tembalang dan sekitarnya. *Jurnal Riptek*, *16*(2), 137-144. Retrieved from https://doi.org/10.35475/riptek.v16i2.159

Nurkhotiah, S., Kamari, Furqorina, R., & Firdaus, M. I. (2023). Pelestarian sumber daya air tanah dengan sumur resapan di kampung kost Gendingan, Jebres, Surakarta. *Jurnal Pendidikan Dan Konseling (JPDK), 5*(1), 1238-1243. Retrieved from https://doi.org/10.31004/jpdk.v5i1.11144

Pellaupessy, W. R., & Tiwery, C. (2018). Sumur resapan sebagai solusi untuk melindungi dan memperbaiki air tanah pada kawasan Perumahan Bukit Lateri Indah Kota Ambon. *Manumata: Jurnal Ilmu Teknik, 4*(1), 32-37. Retrieved from https://doi.org/10.51135/manumatav4i1p32-37

Putranto, T. T., Hadiyanto, & Hati, A. C. (2020). Studi penentuan sumur resapan sebagai upaya pengendalian banjir di Kota Pekalongan berbasis sistem informasi geografis. *JURNAL LITBANG KOTA PEKALONGAN, 18*(2), 78-90. Retrieved from https://doi.org/10.54911/litbang.v19i0.122

Rahmadi, G., Suprayogi, I., & Joleha. (2021). Analisa sumur resapan untuk mereduksi limpasan permukaan pada Perumahan Hang Tuah Cipta Residence Pekanbaru. *Zona: Jurnal Lingkungan, 5*(2), 66-76. Retrieved from https://doi.org/10.52364/zona.v5i2.51

Risiandi, Yuwanto, & Widayati, W. (Eds.). (2013). Implementasi kebijakan pemerintah Kota Semarang dalam mengatasi banjir dan rob tahun 2013. *Journal of Politic and Government Studies, 3*(1), 251-265. Retrieved from https://ejournal3.undip.ac.id/index.php/jpgs/article/view/4408

Rurung, M. A., Riogilang, H., & Hendratta, L. A. (2019). Perencanaan sistem drainase berwawasan lingkungan dengan sumur resapan di lahan Perumahan Wenwin-Sea Tumpengan Kabupaten Minahasa. *Jurnal Sipil Statik, 7*(2), 189-200. Retrieved from https://ejournal.unsrat.ac.id/v2/index.php/jss/article/view/22025

Setiawan, A., Yulistyorini, A., Rahayuningsih, T., & Idfi, G. (2023). Setiawan, A., Yulistyorini, A., Rahayuningsih, T., & Idfi, G. (2023). Pengendalian Air Limpasan dengan Ecodrainage untuk Kawasan Perumahan Podo Asih. *Dampak, 20*(2), 63-73. Retrieved from https://doi.org/10.25077/dampak.20.2.63-73.2023

Syafira, A. Z., Bisri, M., & Asmaranto, R. (2023). Studi perencanaan sumur injeksi dalam upaya penanggulangan genangan di kawasan perkotaan (studi kasus di RW. 8 dan 9 â€“ Kelurahan Blimbing, Kota Malang. *Jurnal Teknologi Dan Rekayasa Sumber Daya Air, 1*(2), 722-735. Retrieved from https://doi.org/10.21776/ub.jtresda.2021.001.02.32

Tiwery, C. J., & Tani, Y. A. (2022). Analisa Faktor Penyebab Terjadinya Limpasan Air Pada Saluran Drainase Di Desa Leksula, Kabupaten Buru Selatan, Menggunakan Program EPA SWMM. *Jurnal Manumata, 8*(2), 106-114. Retrieved from https://doi.org/10.51135/manumatav8i2p106-114

Udin, I., Yudaningrum, F., & Rossid, A. (2022). Penanggulangan banjir di Jl. Brigjen S. Sudiarto, Kota Semarang STA 0.00-8.00. *Matriks Teknik Sipil, 10*(2), 168-174. Retrieved from https://doi.org/10.20961/mateksi.v10i2.61219

Wijaya, A. P., Albani, F. R., & Firdaus, H. S. (2023). Analisis kapasitas terhadap bencana banjir di Kota Semarang menggunakan metode principal component analysis (pca). *Elipsoida : Jurnal Geodesi dan Geomatika, 6*(2), 52-61. Retrieved from https://doi.org/10.14710/elipsoida.2023.20349

Zulfan, F. I., & Manar, D. G. (2024). Implementasi kebijakan penanggulangan bencana banjir rob di Kota Semarang. *Journal of Politic and Government Studies, 13*(3), 386-403. Retrieved from https://ejournal3.undip.ac.id/index.php/jpgs/article/view/45402.