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Drainage Management by the Department of Public Works and Spatial Planning (PUPR) in Flood Prevention in Padang City

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Abstract

Background Padang City is vulnerable to flooding because of its coastal and low-lying areas, high rainfall, and drainage systems that are not yet fully optimal. Drainage management is therefore an important part of government efforts to prevent and reduce flood risk. This study aims to describe and analyze drainage management by the Padang City Department of Public Works and Spatial Planning (PUPR) in flood prevention.

Methods This study employed a descriptive qualitative approach using George R. Terry's management functions: Planning, Organizing, Actuating, and Controlling (POAC). Data we collected through semi-structured interviews, field observations, and document reviews.

Results The four management functions have generally been implemented, although several constraints remain. The 2025 Drainage Master Plan covers 224 channels with a total length of approximately 237.5 km. of the 1,159 channel segments analyzed, 212 (18.3%) do not meet the planned discharge capacity.

Conclusion Drainage management by the Padang City PUPR Department provides an important foundation for flood prevention and broadly reflects the POAC functions. However, its effectiveness needs to be strengthened through improved institutional capacity, additional technical personnel, adequate budget support, implementation of drainage zoning, and sustained community participation.

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Keywords
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Introduction

Flooding is a recurring problem in urban areas that can disrupt community activities and cause social and economic losses. Flood risk is influenced not only by high rainfall but also by the capacity of drainage systems to convey runoff. Changes in land use, reduced infiltration areas, sediment accumulation, waste blockage, and inadequate channel capacity can prevent water from flowing efficiently and lead to inundation. Drainage management is therefore an important component of government efforts to prevent flooding in urban areas (Indah Ashlachal Ummah et al., 2025; Liu et al., 2022; Ogden et al., 2011) .

Padang City has diverse geographical characteristic, including coastal areas, low-lying plains, and areas affected by river conditions and tidal fluctuations. These characteristics make several parts of the city vulnerable to inundations and flooding. Flood problems are also associated with urban development, which changes land use and increases, rainfall, and limitations in the drainage system are among the factors associated with flooding (Eka Putri et al., 2023; Putri, 2018).

These conditions are reflected in recurring flood event in Padang City. In early March 2024, flooding affected more than 8,118 people and forced 2,947 residents to evacuate, with eight subdistricts reported as affected. The data used in this study also indicate an increase in annual rainfall, from 4,101.3 mm in 2021 to 4,705.8 mm in 2024. High rainfall is therefore an important factor to consider in drainage management. However, the ability of drainage systems to contain and convey water is also crucial in determining whether increased runoff can be managed effectively (BNPB, 2024).

Drainage problems in Padang City are related not only to natural conditions but also to the physical condition and management of the system. Identified problems include limited channel capacity, sediment accumulation, blockages caused by waste, narrowed channel cross-section, land-use changes, and tidal effects in certain areas. Interview findings indicate that nearly all subdistricts in Padang experience flooding-related problems every year. This situation highlights the need for sustainable drainage management that includes not only the construction of new channels but also maintenance, rehabilitation, monitoring, and supervision of existing drainage networks.

The Padang City Department of Public Works and Spatial Planning (PUPR) is responsible for managing drainage infrastructure, including planning, construction, rehabilitation, operation, and maintenance. An important development in the city's drainage management is the completion of the 2025 Drainage Master Plan. The document inventories and analyzes drainage network conditions to inform decisions about the interventions required (Peraturan Menteri Pekerjaan Umum Dan Perumahan Rakyat Nomor 12/PRT/M/2014 Tahun 2014 Tentang Penyelenggaraan Sistem Drainase Perkotaan, 2014; Peraturan Walikota No 15 Tahun 2025 Tentang Rencana Pembangunan Jangka Menengah Daerah Kota Padang tahun 2025-2029, 2025; Peraturan Walikota No 91 Tahun 2020 Tentang Kedudukan, Susunan Organisasi, Tugas, Fungsi Dan Tata Kerja Dinas Pekerjaan Umum Dan Penataan Ruang, 2020) .

The master plan surveyed 224 channels with a total length of approximately 237.5 km and analyzed the hydraulic capacity of 1,159 channel segments. The analysis found that 212 segments, or approximately 18.3% do not meet the planned discharge capacity. These findings indicate that capacity problems remain within the drainage network and require

further intervention.

In addition to physical problems, drainage management faces institutional and work-allocation challenges. The 2025 Drainage Master Plan provides a database and guidance for prioritizing areas based on their condition and needs, but field operations have not fully adopted a zone-based work system. Drainage management remains under the Water Resources and Drainage Division, which is also responsible for other duties. There is also no dedicated Drainage Regional Technical Implementation Unit (UPTD) focused specifically on drainage operation and maintenance. These issues are important because sound planning and data need to be supported by appropriate organizational arrangements, resources, implementation, and supervision.

Previous studies have examined drainage management as part of flood prevention and mitigation. Prajatama and Muslim studied drainage management in Pekanbaru using George R. Terry's management functions: planning, organizing, actuating, and controlling (Terry, 1971). Utama & Agustana (2021) , in their study of drainage management in Buleleng Regency, also highlighted the importance of planning, organizing, directing, and controlling. Meanwhile, Rumaropen et al. (2026) found problems in planning and supervision in drainage management in Pekanbaru, including supervision that was not conducted regularly. These studies show that management functions are relevant to the effectiveness of drainage management. However, further research is needed on drainage management by the Padang City PUPR Department, particularly following the completion of the 2025 Drainage Master Plan.

This study applies the management function of George R. Terry and Leslie W. Rue: Planning, Organizing, Actuating, and Controlling (POAC) to analyze drainage management by the Padang City PUPR Department (Terry, 1971) . Planning is used to examine how drainage management is planned; Organizing examines the allocation of duties, authority, and resources; Actuating examines implementation, coordination, communication, and direction; and Controlling examines supervision and evaluation. These four functions provide a comprehensive view of how drainage management is carried out, including the alighment between plans and field implementation. Accordingly, this study aims to describe and analyze drainage management by the PUPR Department in flood prevention in Padang City.

Methods

This study used a descriptive qualitative approach (Wright, 2007). The research was conducted at the Padang City Department of Public Works and Spatial Planning, particularly its Water Resources and Drainage Division. The unit of analysis was the Padang City PUPR institution, with a focus on its drainage management functions.

Informants were selected purposively based on their involvement in and knowledge of drainage management. They represented the Padang City PUPR Department, the Regional Development Planning Agency (BAPPEDA), the Regional Disaster Management Agency (BPBD), and the head of the Community Empowerment Institution (LPM) in Dadok Tunggul Hitam Village. Data were collected through semi-structured interviews, field observations, and document reviews, including regulations, the strategic plan, the Drainage Master Plan, and operation and maintenance documents.

Data analysis followed Miles and Huberman's three stages: data reduction, data display, and

conclusion drawing/verification (Miles & Huberman, 1994). Data credibility was strengthened through source triangulation by comparing information from government officials, technical implementers, related agencies, and community representatives. The main data collection took place from January to June 2026, following an initial survey in November 2025.

Results and Discussion

a. Planning

The planning function has generally been implemented well. Objectives are established through the annual work plan (Renja), the PUPR Department Strategic Plan for 2025–2029 (Renstra), and the 2025 Drainage Master Plan. Drainage management targets focus on improving urban drainage quality and protecting flood-prone areas. The target for protection of flood-prone areas increases from 72% in 2025 to 79% in 2030, while the urban drainage quality target rises from 75% to 83%.

Planning also considers community proposals submitted through development planning forums (Musrenbang), legislative proposals, and PUPR technical analyses. However, the proportion of drainage classified as being in good condition reached only 65.03% in 2023, below the target of 73.60%. This gap indicates that higher targets need to be accompanied by sufficient implementation capacity.

Table 1. Key Performance Indicators of the Padang City PUPR Department

Indicator	2025	2026	2027	2028	2029
Protection of flood-prone areas	72%	73%	75%	77.2%	78.6%
Urban drainage quality	75%	78%	80%	81.2%	82.6%

Source: Strategic Plan of the Padang City PUPR Department, 2025–2029

Assessment of existing conditions is supported by the Drainage Master Plan. The survey covered 224 channels with a total length of approximately 237.5 km, and capacity analysis was conducted on 1,159 segments. A total of 212 segments (approximately 18.3%) do not meet the planned discharge capacity. The master plan also provides a technical basis for prioritizing interventions. It identifies 17 inundation points in seven subdistricts and establishes eight priority areas based on inundation extent, event frequency, impacts on community activities, and links to the main drainage network.

Key planning strengths include the availability of a master plan, spatial-planning regulations, and inter-agency coordination. Constraints include sediment accumulation and river shallowing, waste, buildings located along channel boundaries, and social obstacles in the field. Informants also reported interference by certain individuals during self-managed dredging activities. These conditions indicate that planning must account for both technical and social factors.

Planned activities are translated into rehabilitation, construction, operation and

maintenance, technical policy development, and emergency response. The master plan sets out three implementation phases: the short term (2025–2030), focused on normalization, rehabilitation, and institutional strengthening; the medium term (2030–2035), focused on capacity improvements through retention ponds, gates, and pumps; and the long term (2035–2045), aimed at developing a Smart Drainage System. At the operational level, the Rapid Response Team (TRC) responds to inundation, collapsed or damaged channels, and blocked inlets.

Overall, the planning function is consistent with the POAC framework because objectives, existing conditions, constraints, and planned actions are linked. Its main strength is the availability of a data-based master plan. The challenge is to ensure that the plan is supported by adequate human resources, funding, and changes in community behavior.

Table 2. Technical Database of the Padang City Drainage Master Plan

Parameter	Master Plan Results
Main drainage zones	50 zones
Primary and secondary channels identified	224 channels
Total channel length	237,548 m (approx. 237.5 km)
Segments analyzed for hydraulic capacity	1,159 segments
Segments not meeting planned discharge capacity	212 segments (approx. 18.3%)

Source: Final Report on the Preparation of the Padang City Drainage Master Plan, 2025

b. Organizing

The organizing function is supported by a clear organizational structure and accountability chain. Drainage activities involve the Head of Department, Head of the Water Resources and Drainage Division, Commitment-Making Officer (PPK), field supervisors, technical and financial supervisors, and field personnel. These reporting lines help clarify responsibilities and reduce overlapping tasks.

Work allocation within the Water Resources and Drainage Division is based on sections and the nature of activities. The Drainage Section handles drainage-related work, while field operations include routine activities, planning and coordination, digital monitoring, and emergency response through the TRC. However, the division's total personnel capacity remains limited in relation to the extensive drainage network it must manage. The Drainage Section has approximately 8–9 technical personnel responsible for a wide network. This indicates limited technical capacity, even though field operational workers are also available.

Institutional arrangements are not yet supported by a dedicated Drainage UPTD. The master plan recommends establishing a specialized technical unit, but at the time of the study, drainage management remained within the Water Resources and Drainage Division, which also handles other responsibilities. In addition, the 50 identified drainage zones have not yet been used as the basis for operational work allocation. This situation may concentrate

management responsibilities on a limited team.

Internal coordination takes place with the Program and Construction Services Division, while external coordination involves BPBD, village and subdistrict administrations, the electricity company (PLN), and the regional water utility (PDAM), as needed. Equipment such as heavy machinery, trucks, emergency pumps, personal protective equipment, and vehicles is available, although some resources are limited. Heavy equipment is managed by the Equipment and Heavy Machinery UPTD, so its use requires coordination across units. In 2026, the budget allocation was recorded at IDR 2.65 billion for drainage system construction and IDR 26.54 billion for drainage system rehabilitation. Although drainage receives a substantial allocation, implementation remains affected by the region's fiscal capacity.

These findings indicate that the organizing function meets the principles of structure, task allocation, and coordination, but institutional arrangements and resources are not yet fully proportional to the scale of the work. This is consistent with previous studies emphasizing the importance of organizational capacity in drainage management (Rumaropen et al., 2026; Utama & Agustana, 2021).

c. Actuating

The actuating function is supported by leadership, communication, and motivation. Leadership operates hierarchically from the Head of Department to the division head and sub-coordinators. Instructions are delivered through meetings, direct orders, assignment letters, and written directives. Staff members also reported that leaders are willing to visit the field when problems arise, indicating a responsive leadership approach to operational conditions.

Internal communication is conducted verbally for routine work and through a hierarchical written process for complaints. External communication is handled through notifications to village and subdistrict administrations, PLN, and PDAM when work affects their areas or utility networks. Public complaints can be submitted through the Lapor Padang application and the @drainasepadang Instagram account. Reports are surveyed and assessed for urgency before action is taken. Sediment accumulation that obstructs water flow and may cause flooding is prioritized over complaints that do not directly affect drainage function.

Coordination before and after floods is also conducted with BPBD. Meetings and discussions address pre-disaster improvement plans and post-disaster updates, which may be documented in a Recovery and Rehabilitation Plan (R3P). At the community level, the head of LPM in Dadok Tunggul Hitam reported that approximately 95% of proposals submitted through the local development coordination forum concern drainage. Dredging secondary channels and the Sirah River was considered to have had a direct effect in the areas addressed.

Employee motivation is supported by a conducive work environment and a reward-and-punishment approach, including praise for good performance and reprimands when mistakes occur. Staff considered leadership support adequate. A major challenge, however, is that some residents resume disposing of waste into channels after they have been cleaned. Therefore, actuating efforts should also include public education and community involvement so that maintenance results can be sustained.

d. Controlling

The controlling function is carried out through the establishment of standards, performance

measurement, and corrective action. Maintenance standards refer to Minister of Public Works and Housing Regulation No. 12 of 2014, which covers routine, periodic, rehabilitation, and special maintenance. In practice, primary and secondary channels are dredged at least two to three times a year, preceded by a work assignment letter and a survey of channel conditions.

Work performance is assessed by considering channel capacity in relation to rainfall, slope and flow velocity, operation and maintenance, and the physical condition of the channel. Performance is monitored at several levels: field supervisors monitor physical work, technical supervisors check compliance with technical requirements, financial supervisors examine expenditure realization, and the PPK compares outputs with the work plan.

This system is supported by standardized daily reports documenting the length of channel repaired, work volume, progress, and the volume of sediment removed. Inspections are recorded in official acceptance reports before work is considered ready for handover. If a channel does not function optimally, corrective measures such as dredging and rehabilitation are undertaken. If the problem recurs within a short period, increasing channel capacity may be considered.

A weakness in supervision is that zoning has not yet been implemented. Although the master plan classifies 50 zones and 224 channels, zoning has not become the basis for work allocation and supervision. Thus, procedural supervision is accountable, but the geographic coverage and distribution of supervision need to be strengthened through implementation of the zoning system.

Table 3. Priority Areas Vulnerable to Inundation

Priority inundation area	Subdistrict	Main characteristics
Lubuk Buaya	Koto Tangah	Downstream area at the end of the catchment; vulnerable to inundation when rainfall occurs throughout the upstream area.
Maransi	Koto Tangah	Flat, low-lying topography; slow surface-water flow.
Air Pacah	Koto Tangah	Land-use change has reduced infiltration areas.
Tabing, Penyalinan, and Pasir Putih	Koto Tangah	Sedimentation and narrowing of the macro-drainage cross-section.
Simpang Bypass, Lubuk Begalung–Jalan Aru	Lubuk Begalung	Runoff from several road sections; small channel dimensions and disconnected network links.
Jondul Rawang	Padang Selatan	Low-lying, flat terrain; limited surface-flow capacity.
Khatib Sulaiman	Padang Utara	Low elevation in several locations and slow flow toward secondary channels.

Source: Final Report on the Preparation of the Padang City Drainage Master Plan, 2025

Across the four POAC functions, the findings show a connected pattern. The master plan strengthens planning by providing a technical database, but this has not yet been fully translated into zone-based organization. The organization has a clear chain of command and responsive implementation mechanisms, while supervision is supported by standards and measurable reporting. These findings reinforce earlier studies highlighting the importance of maintenance, organizational capacity, and supervision in drainage management (Wulandari & M, 2020) .

The main contribution of this study is its identification of a gap between the readiness of planning documents and the institutional capacity required to implement them. Implementing zoning is important because 50 zones and 224 channels have been mapped, while technical staff in the Drainage Section remain limited. Flood prevention also requires more than physical infrastructure: the sustainability of maintenance outcomes depends on funding, inter-agency coordination, and community participation. Drainage management therefore needs to move from a primarily responsive approach toward a more planned, risk-based, and sustainable system. This study has limitations. Its findings are based on selected institutional and community informants, observations, and documents available during the research period. The study does not quantitatively measure the causal impact of individual drainage interventions on flood frequency, depth, or duration, and the findings may not capture all conditions across every drainage zone in Padang City. Further research could combine broader field measurements and longitudinal flood data to assess the effectiveness of zone-based interventions.

Conclusion

Drainage management by the Padang City PUPR Department has generally been implemented reasonably well and broadly reflects George R. Terry's POAC functions. Planning is supported by the annual work plan, the 2025–2029 strategic plan, and the Drainage Master Plan, which maps 224 channels covering approximately 237.5 km. Organizing benefits from a clear structure and accountability chain but faces limitations in technical personnel, the absence of a dedicated Drainage UPTD, and the lack of zone-based work allocation. Actuating is supported by responsive leadership, hierarchical communication, inter-agency coordination, digital complaint channels, and reward and punishment. Controlling is supported by work standards, daily reports, layered supervision, and corrective measures. Key issues requiring further attention include institutional capacity, technical personnel, budget availability, zoning, and community participation.

The PUPR Department should accelerate the establishment of a dedicated Drainage UPTD, increase technical staffing, allocate work by drainage zones and priority inundation points, and maintain consistent funding. Public education involving village administrations and community organizations is also needed to reduce waste disposal into drainage channels. In addition, an integrated drainage database containing channel conditions, maintenance history, and inundation locations should be developed. Future studies could assess intervention effectiveness by zone and examine its relationship with the frequency and extent of inundation.

This study has several limitations. The findings are based on selected informants, field

observations, and available documents, so they may not fully represent the conditions of all drainage zones in Padang City. In addition, this study does not quantitatively measure the impact of drainage management on flood frequency, depth, or duration. Future research is recommended to use broader field measurements and long-term flood data to evaluate the effectiveness of drainage management and zone-based maintenance in flood prevention.

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