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Research Article

Inclusion of Elevation for Backfilling for Building Permit in Contribution to Flood Control in Swamp, Puguis, La Trinidad Benguet

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ABSTRACT

The study conducted in Swamp, Puguis, La Trinidad, Benguet, evaluated the inclusion of elevation and backfilling requirements in building permits as a flood control measure, revealing strong awareness and positive perceptions among respondents regarding their impact on flood risk reduction. Surveying 41 participants including geodetic engineers, iv government officials, and residents the research found that elevated structures significantly influence natural drainage and surface water flow, with respondents rating their understanding as high. There was overwhelming agreement that backfilling activities that do not comply with proper elevation standards escalate local flood risks, emphasizing the crucial role of geodetic engineers in conducting precise surveys, verifying compliance, and informing policies. Awareness of geodetic engineers' contributions to flood control was notably strong, and respondents recognized the importance of including elevation certificates in building permits as essential for accurate flood risk assessments and alignment with flood hazard maps. Although the integration of elevation data in permitting processes is seen as largely implemented and valuable for reducing vulnerability to floods, enforcement remains inconsistent, and public education about its benefits requires enhancement. These findings highlight the pressing need for local governments to strengthen technical guidelines, monitoring, and stakeholder engagement to effectively incorporate elevation standards into building permits, promoting sustainable development and fortified flood resilience in flood-prone swamp v areas, with potential applicability to similar urban and rural settings across the Philippines and the broader Asia-Pacific region.

Keywords: *Backfilling, Building permits*, *Elevation, Flood control, Flood risks*

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Introduction

Flood control remains a pressing challenge, especially in regions that habitually wrestle with high water, where thoughtful land-use planning and careful water management are vital to curbing flood risk. Around the world research stresses the need to bake elevation criteria into building practices on floodplains as a way, to temper flood damage. Raising structures above anticipated flood levels, coupled with backfilling is widely recognized as a cornerstone engineering tactic to shrink inundation threats and protect critical infrastructure (Resilient Connecticut, 2022). Such measures follow best practices striving to strike a balance between development demands and the need for resilience, against flooding that's being amplified by climate change. Countries across Asia and the Pacific, particularly those prone to nearshore and coastal flooding like Vietnam, Thailand, and Indonesia, face similar challenges the reliance on structural flood control alone proves insufficient, necessitating stronger non- 2 structural measures like elevation requirements (World Bank, 2012). Following major flood events, nations like Thailand have consciously worked to mainstream Flood Risk Reduction (FRR) into their Comprehensive Land Use Plans (CLUPs), aiming to restrict the type, density, and design of development in flood-prone areas, though the consistent enforcement of elevation limitations on private development remains difficult (Trend Analysis of Mainstreaming Flood Risk Reduction into Spatial Planning in Thailand).

Similarly, regions like the Mekong Delta in Vietnam have long utilized raised floor structures as an adaptation strategy against water, and modern urban planning efforts aim to ensure that this elevated construction, alongside other protective systems, mitigates inundation in urban centers (NARBO). This demonstrates that elevated construction is recognized as a vital technique for urban flood management, directly supporting the global concept of freeboard an added margin of safety above a specific flood elevation which is internationally viewed as the single most effective way to reduce damage to a structure (ASFPM, 2013). The fact that only seven of 22 countries reviewed in the region had specific building design provisions addressing flooding confirms a widespread policy gap (World Bank, 2025), echoing the Philippine 3 situation and underscoring the regional necessity of mandating the inclusion of elevation for backfilling to ensure consistency in construction standards. On a scale the Philippines weaves flood control into its land-use plans, infrastructure schemes and local ordinances all of which now embed elevation requirements, for buildings. A host of government projects and policy measures push for elevation and back-filling criteria to be baked into building permits aiming to keep floodwaters in check in the archipelago's typhoon-prone areas. Still implementation is uneven and detailed technical guidance tailored to the country's geographies remains scarce (ADB Integrated Flood Resilience Project, 2022).

The gap reveals a pressing need, for oriented research to recalibrate elevation criteria in building permits thereby bolstering flood control in the most vulnerable areas. Within the reaches of Puguis in La Trinidad flooding isn't a rare inconvenience it's a near-daily trial, amplified by the flat terrain and a drainage network that simply doesn't cut it. The municipal response leans on cranking up surface-water runoff capacity and clearing out the channels. The building-permit 4 workflow still barely scratches the surface when it comes to mandating proper elevation and back-filling. Meanwhile local research keeps pushing the notion that community hands-on involvement's crucial, yet it also spotlights a glaring gap: there's scant insight into how weaving elevation criteria, into permits could meaningfully blunt flood impacts (La Trinidad MDRRM Plan, 2023). Plugging this gap may boost flood resilience while guiding permitting policies, toward more informed outcomes. This research sets out to uncover data-driven insights about whether requiring backfill in building permits can help curb flooding in Swamp, Puguis, La Trinidad. The upside of such a rule could be a drop-in flood-related property loss a chance of harm to residents and a push toward greener more sensible urban growth in areas that are frequently inundated. The findings should give government units a practical guide for tweaking permit standards, so they line up more closely with flood-control goals fostering safer more

resilient communities and perhaps providing a template, for other flood-prone regions. Even though flood-elevation standards enjoy both national advocacy Philippine municipalities still lack clear localized 5 frameworks for folding elevation and backfilling requirements into their building-permit procedures. Research on the impact of such measures and on how residents of small towns like Puguis, La Trinidad would receive them is virtually nonexistent. In addition, the precise technical thresholds for the lift of structures calibrated to the specific flood dynamics of each locale remain understudied leaving a gap, in both regulatory revisions and engineering guidelines.

This study aims to help the Citizens, Farmers, Residents, Government and Geodetic Engineers. This study can help save and renew the system in an area that has flood issues caused by not implementing the required elevation of the structure through building permit. The study was initiated due to critical concerns about flood control management related to the varying elevations of constructed buildings. Additionally, the backfilling practices have adversely impacted residents by disrupting their waterways, affecting not only their properties but also their livelihoods. 6 Theoretical & Conceptual Framework When it comes to the theoretical aspects of Inclusion of elevation for back filling for building permit in contribution to flood control in Swamp, Puguis, La Trinidad, several concepts and frameworks can be applied to understand their implementation and impact. Here are some theories relevant to Inclusion of elevation: Flood resilience theory defines resilience as the capacity of socio-ecological systems to absorb disturbances like floods while maintaining function and adapting over time. Elevation through backfilling raises land above flood thresholds, enhancing resistance and recovery from flood impacts. The theory includes engineering resilience for static structural measures and socio-ecological resilience that requires adaptive governance to handle uncertainties in flood risk management (Zevenbergen et al., 2020).

Land Use and Spatial Planning Theory argues for embedding risk-based land use planning in urban development. Building permits with mandatory elevation in backfilling integrate flood risk mitigation into construction regulations, preventing development in vulnerable flood areas. Regulated land use and elevation 7 requirements enable proper drainage, water conveyance, and flood prevention, supporting sustainable development in flood-prone swamp zones (Global Facility for Disaster Reduction and Recovery, 2017). Hydrological Impact and Environmental Integrity Theory states that backfilling and elevating wetland or swamp lands affect natural hydrology. This theory emphasizes balancing flood control with ecosystem preservation by designing elevation changes to maintain water flow, sedimentation, and vegetation. Successful backfilling requires elevation within tolerances to support flora and fauna, restore drainage patterns, and avoid downstream flood intensification (Neill, 1987; Conservation Evidence, 2022). Institutional governance theory underscores the need for clear, enforceable policies and coordination among local government units, agencies, and stakeholders to implement flood control measures effectively. Incorporating elevation standards in building permits depends on strong governance structures for formulation, monitoring, and enforcement to realize flood mitigation benefits (Lopez & Moreno, 2022; Pangasinan Provincial Ordinance, 2025). 8 Flood risk reduction is integral to achieving sustainable development goals (SDGs). Applying elevation criteria in backfilling during building permits reduces disaster risk and protects property and lives, aligning with targets on resilient infrastructure, climate adaptation, and safe communities. This theory highlights the importance of integrating flood resilience into climate-smart development strategies to sustain development gains (ZCR Alliance, 2022; Binns, 2022) Implementing Inclusion of elevation for back filling for building permit involves several key concepts that are essential to understand for successful deployment.

Here are some fundamental concepts related to Inclusion of elevation for back filling for building permit: Elevation Requirement: Elevation refers to the vertical height of a structure or site above a reference flood level or mean sea level. Setting a minimum required elevation ensures that the finished floor or site platform is safely above expected floodwater

levels, reducing the risk of inundation and structural damage during heavy rainfall or overflow events. 9 Backfilling: Backfilling is the process of adding fill materials, such as soil, sand, or gravel, to raise the ground elevation of a construction site. Properly engineered backfilling improves site stability and drainage, while poorly executed backfilling can cause uneven settlement, block natural waterways, or worsen local flooding if not designed with hydrologic considerations. Building Permit Regulation: The building permit serves as a regulatory tool ensuring that construction activities comply with safety, environmental, and zoning standards. The inclusion of elevation and backfilling requirements within the permitting process institutionalizes flood mitigation measures and ensures that developments are evaluated not only for structural integrity but also for flood resilience. Flood Control and Risk Reduction: Flood control involves managing water flow through drainage systems, retention ponds, canals, and elevation design. Requiring elevation in building permits reduces exposure of properties to flood hazards and supports broader flood-risk management efforts within local government units (LGUs). 10 Topographic and Geodetic Assessment: Determining the appropriate elevation requires accurate land elevation data, which can be provided by geodetic engineers using instruments such as GNSS, total stations, or leveling surveys. These data establish flood benchmarks and help identify safe and unsafe construction zones. Soil and Geotechnical Considerations: Swampy or low-lying areas, like parts of Puguis, have soft, saturated soils that may compress or settle unevenly after filling. Understanding soil composition, permeability, and compaction requirements is critical for ensuring that elevated structures remain stable and do not exacerbate flooding. Drainage and Runoff Management: Elevating properties alters surface-water flow patterns. Without proper drainage planning, elevated sites can divert runoff to neighboring lower areas. Integrating elevation requirements with drainage design ensures balanced water distribution and avoids unintended downstream flooding. Compliance and Monitoring: Effective implementation requires regular inspection, enforcement, and monitoring to 11 ensure that the prescribed elevations and backfilling standards are followed during construction. LGUs and engineering offices play a vital role in verifying compliance and preventing unregulated or improper elevation works. Sustainable Land Use Planning: Elevation inclusion should align with land-use and zoning plans to ensure that urban development respects natural floodplains, waterways, and environmental carrying capacities. This integration supports long-term sustainability and resilience of flood-prone communities. Community Awareness and Participation: Local awareness and cooperation are essential. Homeowners, builders, and developers must understand the rationale for elevation requirements to promote compliance and collective flood-risk reduction.

Assumption of the Study

The basic assumptions are:

1. The level awareness of elevated structures positively influences the natural drainage and flow of surface water is moderate.
2. The level of agreement on the effect of backfilling activities conducted without adherence to proper elevation standards increase local flood risks is neutral.
3. The extent of awareness of the use of geodetic engineers in flood control and management is moderate.
4. The level implementation of inclusion of elevation in getting a building permit help to lessen flood risk is moderate.

Research Design

The research design for the study "Inclusion of Elevation for Backfilling for Building Permit in Contribution to Flood Control in Swamp, Puguis, La Trinidad" was utilize a descriptive quantitative method. Sugiyono (2018) stated that quantitative method is a research method based on the philosophy of positivism, used to examine a population or a specific sample, collecting data using research instruments, analyzing the data by quantitative or statistical and to describe and test the hypothesis that determined. This method is appropriate as it allows for a systematic and objective description of existing conditions, prac-

tices, and perceptions regarding the incorporation of elevation standards. This method is appropriate as it allows for a systematic and objective description of existing conditions, practices, and perceptions regarding the incorporation of elevation standards in building permits and their role in flood control. Data collection was involve distributing structured questionnaires with local government officials, licensed engineers, geodetic professionals, and residents who are directly involved in or affected by building permit processes and flood risks. The study was also review official documents and flood control policies to complement primary data. Quantitative data obtained was analyzed using descriptive statistics such as frequencies, means, and percentages to delineate the extent of adoption, effectiveness, and challenges tied to elevation inclusion in permits.

Locale and Population of the Study This study was conducted at Swamp, Puguis La Trinidad Benguet. There where forty-one (41) respondents in the study composed of Geodetic Engineers, Residents, and Government Officials. Data Gathering Instrument The questioners were distributed to the Government officials, Civil Engineers, Geodetic Engineers, Architect and Civilians. Survey-questionnaire-checklist was used as the main instrument in gathering the data needed in this study. The questionnaire has four parts which gathered data on the following: Part 1-The level implementation of elevated structures influence the natural drainage and flow of surface water; Part 2– Level of agreement on the effect of backfilling activities conducted without adherence to proper elevation standards affect local flood risks; Part 3- The extent of awareness of the use of geodetic engineers in flood control and management; Part 4-And the level of importance of inclusion of elevation in getting a building permit help to lessen flood risk Reliability and Validity of the Questionnaire The study is based on Philippine laws and flood control policies as per the National Building Code of the Philippines and flood control guidelines by the Department of Public Works and Highways (DPWH). Since these are adopted nationwide, the instrument is considered valid and reliable. The questionnaire was modified and need to conduct validity and reliability. For reliability, it where conducted with ten (10) respondents which is not included in the actual number of respondents using Kuder- Richardson Formula. Data Gathering Procedure The researchers asked permission to conduct the study from the Dean of the College of Engineering, Baguio Central University, Baguio City. Prior to the administration of the questionnaire, a letter to the respondents was prepared to seek their cooperation and support in this study such as concerned Geodetic Engineers, Local government officials, Residents and property owners. The questionnaires were float through google surveys. The responses for each question was tallied and encoded which served as raw data for the study.

Result and Discussion

Level of Awareness of Elevated Structures Influences the Natural Drainage and Flow of Surface Water This analysis explores the level of awareness of implementation of elevated structures influences the natural drainage and flow of surface water in Swap, Puguis, La Trinidad, Benguet, as detailed in Table 1. The study surveyed 41 individuals on their understanding of four key aspects of implementation of elevated structures. Each aspect was evaluated on a scale of 1 (least aware) to 5 (very much aware). The results presented in Table 1 reveal a high level of awareness among respondents regarding the implementation of elevated structures and their influence on natural drainage and surface water flow. The indicators assessed show average ratings 4.13, falling mostly within the "Much Aware" (MA) category based on the descriptive limits provided. This indicates that the respondents have a strong understanding of how elevated constructions interact with and impact flood control measures. Specifically, the indicator "Elevated structures play a role in holding the river and drainage channel profiles steady" received the highest average score of 4.29, classified as Very Much Aware (VMA), demonstrating that respondents strongly agree with the structural role these buildings have in maintaining natural water flow channels. This recognition is crucial because stable drainage channels are essential to effective flood control and reducing flood risk in vulnerable communities. Another

key indicator, "In crafting building designers defer to the flood-risk maps distributed by official agencies," had an average rating of 4, classified as Much Aware (MA). This suggests a solid awareness among respondents that building designs are largely informed by scientific and official flood hazard data. Such awareness is important to ensure buildings are constructed at appropriate elevations to minimize flood damage and maintain compliance with disaster risk management policies. The survey also shows that respondents pay close attention to maintaining elevation standards in construction, with an average score of 4.13 (MA). This reflects a proactive attitude toward monitoring and enforcing elevation regulations, ensuring that structures do not deviate from established standards a critical factor in preventing obstruction or alteration of natural drainage pathways that could exacerbate flooding issues. These findings suggest a positive foundation for flood risk management efforts through elevated building construction, highlighting the importance of continued education, regulation, and monitoring to uphold these standards. The demonstrated awareness can support stakeholder coordination in promoting sound building practices that both protect human settlements and sustain natural hydrological functions.

Table 1. The level of awareness of elevated structures influences the natural drainage and flow of surface water

n=41

Indicators	Level of Awareness					TWP	WM	DE	R
	VM	MA	MoA	SA	LA				
	5	4	3	2	1				
1. In crafting building designers defer to the flood -risk maps distributed by official agencies	15	16	7	1	2	164	4	MA	3
2. We keep eye on structures making sure they stay within the elevation standards	13	20	4	3	1	164	4	MA	3
3. Elevated structures play a role in holding the river and drainage channel profiles steady	22	11	6	2	0	176	4.29	VMA	1
4. We keep an eye on structures making sure they stay within the elevation standards.	16	18	5	3	0	173	4.22	MA	2
AWM							4.13	MA	

Legend:

Numerical Value	Statistical Limit	Descriptive Equivalent	Symbol
5	4.21 - 5.00	Very Much Aware	VMA
4	3.41 – 4.20	Much Aware	MA
3	2.61 – 3.40	Moderate Aware	MoA
2	1.81 – 2.60	Slight Aware	SA
1	1.00 – 1.80	Least Aware	LA

The basic assumption which state that the level of awareness of implementation of elevated structures influence the natural drainage and flow of surface water is moderate is therefore negated. Overall, the results portray respondents as generally well- informed and aware of flood control principles related to building elevation and drainage. This level of awareness is vital for the effective implementation of engineering standards and for reducing the adverse impacts of flood hazards on communities and livelihoods. Level of Agreement on the Effect of Backfilling Activities Conducted

without Adherence to Proper Elevation Standards Affect Local Flood Risks Table 2 presents the data gathered on the level of agreement on the effect of backfilling activities conducted without adherence to proper elevation standards affect local flood risks in Swamp, Puguis, La Trinidad, Benguet as observed by the respondents. The results in Table 2 reflect a strong consensus among respondents that backfilling activities conducted without adherence to proper elevation standards significantly affect local flood risks. The indicators show high average agreement levels 4.50, within the "Strongly Agree" (SA) descriptive limit defined by the scale of 4.21-5.00, illustrating a shared recognition of the critical role that proper elevation and geodetic engineering play in flood mitigation. The indicator with the highest agreement score (4.68) was that "canal and drainage designs include specified elevation profiles to ensure efficient flow". This highlights the importance of expert surveying before construction to meet elevation standards and prevent flooding caused by improper backfilling Regular inspection of drainage systems for adherence to design was rated 4.50 on average (SA), showing recognition among respondents of the importance of continuous oversight to ensure compliance and functionality of drainage infrastructure. Similarly, the awareness that community complaints about drainage failures highlight non-compliance issues scored 4.50, reflecting an understanding that public feedback is a key indicator of system performance and regulatory gaps that may contribute to flooding problems. The effect of poor drainage design on floodwater overflow affecting nearby structures received an average score of 4.46 (SA), underscoring the community's awareness of the direct consequences of deficient drainage planning. This awareness is critical to support advocacy for sound engineering and planning practices aimed at minimizing flood impacts on infrastructures and properties. Public participation in drainage design reviews was rated slightly lower at 4.29 (SA), indicating moderate recognition of the value of community involvement in enhancing compliance and improving flood control outcomes. This minor dip suggests opportunities to increase public engagement and stakeholder collaboration in flood management processes, which can enhance accountability and local ownership. The basic assumption which state that the level of agreement on the effect of backfilling activities conducted without adherence to proper elevation standards affect local flood risks neutral is therefore negated. In conclusion, the high levels of agreement across all indicators affirm that improper backfilling without considering elevation standards poses a significant threat to flood safety. The awareness reflected in this study stresses the importance of integrating precise geodetic engineering practices and continuous enforcement to protect communities from increased flood vulnerability caused by poorly managed backfilling operations.

Table 2. Level of Agreement on the Effect of Backfilling Activities Conducted Without Adherence to Proper Elevation Standards Affect Local Flood Risks

n=41

Indicators	Level of Awareness					TWP	WM	DE	R
	SA	A	N	D	SD				
	5	4	3	2	1				
1. Canal and drainage designs include specified elevation profiles to ensure flow efficiency.	30	9	2	0	0	192	4.68	SA	1
2. Local authorities impose penalties for non-compliance with drainage design rules.	27	8	6	0	0	185	4.51	SA	4
3. Drainage systems require regular inspection for design adherence.	26	11	4	0	0	186	4.54	SA	3

Indicators	Level of Awareness					TWP	WM	DE	R
	SA	A	N	D	SD				
	5	4	3	2	1				
4. Community complaints about drainage failures highlight non-compliance issues.	22	11	6	2	0	176	4.29	SA	3
5. Floodwater overflow due to poor drainage design affects nearby structures.	26	10	4	0	1	183	4.46	SA	2
6. Public participation in drainage design reviews enhances compliance rates.	24	15	2	0	0	192	4.54	SA	6
AWM							4.50	SA	

The Extent of Awareness of the Use of Geodetic Engineers in Flood Control and Management. The results in Table 3 demonstrate a strong overall awareness of the important role geodetic engineers play in flood control and management among the respondents, with average ratings predominantly within the "Much Aware" (MA) to "Very Much Aware" (VMA) descriptive categories. The highest average score of 4.29 under the indicator " Geodetic engineers conduct elevation and topographic surveys required for permit issuance." falls under the VMA range of 4.21-5.00, indicating that most respondents recognize the technical integration of elevation data in flood infrastructure design to optimize water flow and reduce flood risk. The indicator stating that "Geodetic mapping is crucial for identifying flood-prone zones" received a lower mean score of (4.02), indicating only moderate agreement. This suggests awareness of regulations but also perceived inconsistencies in enforcing penalties for drainage violations, highlighting the need to strengthen enforcement to ensure effective flood control. Respondents Much Aware (mean score 4.54) that geodetic data guide decisions on backfilling and grading activities, highlighting the reliance on scientific data to direct how fill materials are added or compacted to maintain natural drainage and avoid flooding impacts. This alignment illustrates the integration of geodetic information into construction planning to enhance flood resilience. The perceived role of geodetic engineers in verifying compliance on-site is also strong, with a mean score of 4.29, which falls at the lower boundary of "Very Much Aware." This awareness supports the importance of continuous monitoring to ensure that construction practices match planned elevation and drainage standards. Furthermore, the recognition that geodetic engineering findings inform policy updates (4.10 average) and that public awareness programs highlight their role in flood safety (3.98 average) indicates a broad appreciation for geodetic professionals not only in technical but also in policy and community education spheres. This comprehensive approach helps reinforce flood control standards and public understanding. Lastly, the awareness that geodetic engineers' assessments support flood risk mitigation plans scored 4.08 (MA), confirming confidence in the technical contributions of geodetic expertise to comprehensive flood risk management. This finding aligns with broader flood control standards emphasizing the integration of precise topographic and elevation data for informed planning and disaster preparedness (DPWH 2025; Moss et al., 2024; Stefanova, 2025). The basic assumption which state that the extent of awareness of the use of geodetic engineers in flood control management is moderate is therefore negated.

Table 3. The Extent of Awareness of the Use of Geodetic Engineers in Flood Control and Management.

n=41

Indicators	Level of Awareness					TWP	WM	DE	R
	VMA	MA	MoA	SA	LA				
	5	4	3	2	1				
1. Geodetic engineers conduct elevation and topographic surveys	20	16	3	1	1	176	4.29	VMA	1
2. Geodetic mapping is crucial for identifying flood-	18	11	8	3	1	165	4.02	MA	4
3. Geodetic data guide decisions on backfilling and grading.	17	13	9	1	1	167	4.07	MA	3
4. Geodetic engineers verify compliance with elevation standards on site.	17	14	7	2	1	167	4.07	MA	3
5. Geodetic engineering findings inform policy updates.	19	12	7	1	2	168	4.10	MA	2
6. Public awareness programs mention the role of geodetic engineers in floodsafety.	13	7	8	3	0	163	3.98	MA	6
7. Their assessments support flood risk mitigation plans.	16	12	10	3	0	164	4	MA	5
AWM							4.08	MA	

The data show that participants clearly understand the important roles of geodetic engineers in flood control, including technical design, regulatory compliance, public engagement, and risk reduction, highlighting the need for strong enforcement, community involvement, and accurate geodetic assessments to improve flood resilience in vulnerable area. The Level of Implementation of Inclusion of Elevation in Getting a Building Permit to Lessen Flood Risks. The results presented in Table 4 highlight a positive perception among respondents regarding the importance of including elevation in building permit processes to reduce flood risk. The average ratings for the seven indicators is 3.91 classified within the "Much Implemented" (MI) descriptive limits, indicating substantial support for the integration of elevation data in flood risk management during permit issuance. The highest mean score of 4.34 (VMI) was observed for the indicator "Building permits require elevation certificates from licensed professionals." This underscores the strong belief that certification by qualified experts is crucial to ensuring that building's height relative to floodplain benchmarks, guiding regulatory and construction decisions (FEMA, 2023). The indicator "Inclusion of elevation data improves flood risk assessment during permit review" earned an average of 4.1 (MI), reflecting recognition that incorporating detailed elevation information strengthens the ability of authorities to evaluate potential flood risks accurately. This enhanced assessment capability is pivotal for preventing construction in vulnerable zone and is aligned with national flood control policies, as also indicated by the related score of 4.05 (MI). Respondents also strongly affirmed the importance of elevation data in aligning building locations with flood hazard maps (mean = 4.32, VMI), underscoring its central role in evidence- based planning and flood risk management. Precise elevation measurements allow geodetic engineers and planners to accurately delineate flood-prone areas, determine expected flood depths, and assess the relative safety of proposed building sites. Through this process, decision-makers can guide development away from high- risk zones or require design modifications such as elevated floor levels, setback requirements, or flood-resilient construction techniques when development in vulnerable areas is unavoidable. Furthermore, the indicator regarding the

support elevation provides to insurance and disaster risk reduction mechanisms scored 3.85 (MI), suggesting moderate implemented of how technical elevation data can influence insurance eligibility, premiums, and overall community risk mitigation strategies. This highlights the broader financial and policy relevance of elevation in flood risk governance. Regarding resident awareness, respondents somewhat agreed (3.71 average, MI) that permit applicants are informed about the benefits of elevation, pointing to ongoing opportunities to enhance public education in this area. Lastly, the lowest average score (3.02, MoI) was given to the concept that lack of elevation consideration leads to permit denial or revision, indicating a perception that elevation is not yet universally enforced as a strict permit requirement but is becoming progressively recognized. The basic assumption which sates that the level of implementation of inclusion of elevation in getting building permit to lessen flood risks.

Table 4. The Level Implementation of Inclusion of Elevation in Getting a Building Permit to Lessen Flood Risk.

n=41

Indicators	Level of Awareness					TWP	WM	DE	R
	VMI	MI	MoI	SI	LI				
	5	4	3	2	1				
1. Building permits require elevation certificates from licensed professionals	24	9	6	1	1	178	4.34	VMI	1
2. Inclusion of elevation data improves flood risk assessment duringpermit review.	17	13	10	0	1	168	4.1	MI	3
3. Elevation requirements in permits comply with national flood control policies.	19	10	10	0	1	166	4.05	MI	4
4. Elevation helps align building location with flood hazard maps.	22	10	9	0	0	177	4.32	VMI	2

In summary, these results suggest a robust understanding among respondents of the critical importance of incorporating elevation data into building permit processes to mitigate flood risk. Implementation of elevation certificates and their integration into flood risk assessments and policy compliance are considered highly valuable, though there remains room for strengthening enforcement and public education to optimize flood management practices. Ensuring that elevation is consistently factored into permitting can contribute significantly to reducing vulnerability and enhancing resilience to flood disasters (Sims Municipal Recycling, 2024; FEMA, 2023; CT Floodplain Building Elevation Standards, 2022).

Conclusions Based on the results of the study, the following conclusions and recommendations are drawn for each of the four research questions. 1. The respondents demonstrated a strong awareness and appreciation of how elevated structures can influence natural drainage systems, where they recognized their role in maintaining stable river and drainage channel profiles, ensuring water flow efficiency, and reducing the risk of localized flooding. Proper implementation of elevated building designs positively supports flood control management by preserving natural drainage functions. 2. Householders sympathize with the importance of maintaining the drainage with regular inspection and clean-up drive so that the water were not be contaminated causing floods. Where respondents highlight the significance of canal that can mitigate flood risk especially to the flat areas. 3. Respondents exhibited considerable awareness of the pivotal role geodetic engineers play in flood control, in-

cluding their involvement in specifying elevation in drainage designs, supporting flood risk mitigation plans, and ensuring regulatory compliance. The general recognition of geodetic engineers' contributions to flood safety policies and public awareness programs suggests a solid foundation for integrating geodetic data into flood management. 4. The inclusion of elevation data and certificates during building permit issuance is strongly regarded as critical for flood risk reduction where respondents agree that elevation data improves flood risk assessment, ensures compliance with national policies, aligns structures with hazard maps, and facilitates disaster risk reduction mechanisms. However, there is slightly less agreement about public awareness of these benefits and the enforcement of permit denial due to elevation non-compliance.

Recommendations Based on the conclusions, the following recommendations were put forward 1. Building authorities and planners should continuously enforce and monitor elevation standards in construction projects, particularly in flood-prone areas. Training and dissemination of best practices on designing elevated structures that harmonize with natural drainage should be prioritized to prevent adverse flood impacts. 2. It is recommended to strictly regulate and monitor backfilling operations to ensure compliance with elevation standards. Conducting mandatory geodetic surveys prior to and during backfilling activities is essential. Educating contractors and community stakeholders about the hydrological consequences of improper backfilling should be undertaken. 3. To leverage the technical expertise of geodetic engineers fully, government agencies and local authorities should institutionalize their participation in all stages of flood control planning and infrastructure development. Public campaigns highlighting the role of geodetic professionals can further enhance community trust and compliance with flood control measures. 4. Policy frameworks should mandate strict submission of certified elevation documents for building permits in flood- prone zones. Permitting offices must enforce these requirements consistently, including denying or revising permits lacking proper elevation data. Further efforts to inform applicants about the importance and benefits of elevation inclusion should

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