Dutch Pragmatism in Managing Precipitation to Prevent Domestic Urban Flooding

Arthur Smith

Infrastructure-related domestic policies have historically dealt with certain natural phenomena such as seismic events, fire, wind, and coastal/river water flooding. Various legal regimes, financial frameworks, and real estate usage have adjusted to these natural features, dependent on location. Zoning, insurance, building codes, and real estate investment are examples of such adjustments. This collective framework is now under pressure to adjust to various climate changes, including increasing atmospheric moisture, which result in increased rain intensity, greater rain volume, and slower storm movement.

Such precipitation change can negatively affect urban livability and cause environmental damage from combined sewer overflows and other pollutant discharge from surface water flows unable to enter water collection, storage, and treatment infrastructure. This precipitation reduces the effectiveness of the $500 billion global investment in water infrastructure systems designed for previously predictable water fluctuations. P.C.D. Milly et al., *Stationarity is Dead: Whither Water Management?*, 319 Sci. 573 (2008).

While coastal storms, rising seas levels, and river flooding draw significant attention, intense localized rain-event flooding (pluvial flooding) is an emerging issue impacting areas outside previously identified watershed and coastal flood areas. Two domestic policies are examples of the complexity in adjusting to this pluvial physical phenomena—one historical and one recent.

The historical policy relates to infrastructure development near the Federal Emergency Management Agency (FEMA) flood insurance rate maps (FIRM). These maps are based on 1970s technology using historical flood data and land elevation mapping to delineate 100-year floodplains. These maps impact development because of mandated flood insurance and access to flood recovery funds. As a result, significant domestic populations and development expand just outside these FIRM floodplains. Unfortunately, mapping updates have been limited by underfunding and political negotiations. Furthermore, the mapping does not account for built infrastructure and future climate changes. Thus, these current flood assessments are outdated and underestimate pluvial flood risk and impact on infrastructure. Michael Bergman, *Flood Risk and Structural Adaptation of Markets: An Outline for Action*, Community Dev. Innovation Rev., Oct. 17, 2019, at 13.

Mr. Smith is the founder and president of Sustainable Futures, L3C, a social benefit corporation. He may be reached at sustainable_futures@mac.com and linkedin.com/in/arthursmithjr.

Adding to development pressure outside FIRM zones are recent regulatory changes to former Clean Water Act (CWA) protected waters. Environmental Protection Agency (EPA) and the Department of the Army published a final rule repealing the 2015 rule that expanded the definition of "Waters of the United States" under the CWA. Definition of "Waters of the United States"—Recodification of Pre-Existing Rules, 84 Fed. Reg. 56,626 (Oct. 22, 2019). This action will recodify the regulatory text that existed prior to the 2015 rule. This final rule became effective on December 23, 2019. While further government action and lawsuits will clarify the future of this rule, the rule challenges many urban areas with continued diminished capacity for water drainage.

New development inside and outside historic flood zones exacerbates pluvial flooding in urban areas. Impaired natural drainage systems and increasingly overwhelmed built water systems (grey infrastructure) increase the likelihood of pluvial flooding. While some domestic cities are taking action to minimize pluvial flooding, domestic flood response is largely characterized as reliant on insurance for flood damage recovery. This domestic reliance on FEMA disaster relief funding is resulting in significant funding shortages and a debate on flood insurance reform. *See* Bergman, *supra*.

Given this unsustainable domestic reliance on disaster relief, it is useful to examine municipal actions intended to mitigate pluvial flooding. Since every federal dollar invested in flooding mitigation saves six dollars in disaster relief funding, lessons learned from examined cities could have significant domestic financial implications. Multihazard Mitigation Council, Nat'l Inst. of Building Sci., *Natural Hazard Mitigation Saves 2017 Interim Report: An Independent Study* 27 (2017).

The Dutch Experience

One country engaging in significant pluvial flooding mitigation is the Netherlands. This Dutch effort is consistent with its shared historic linkage to water and water management due to the country's low land elevation and coastal exposure. The Dutch have received international attention on their efforts to mitigate coastal flooding. After nearby Copenhagen experienced 150 mm (5.9 inches) of rainfall in 1.5 hours in July 2011, causing one billion euros ($1.39 billion) in damage, the Dutch experienced their own significant rain event in 2014. These experiences were a wake-up call for a country where a large percentage of its infrastructure is already flood prone.

Even though there are differences in the Dutch legal framework and culture, there are domestic urban areas that can employ Dutch lessons. The Dutch have a layered national, regional, and local governmental system like the United States. However, Dutch laws often provide policy goals with more discretion for implementation. These laws and policy goals specifically mention flood prevention. Much of the implementation discretion is driven to the local level, especially municipalities. Yet despite the lack of specific legal mandates, large urban areas have engaged their communities to pursue aggressive pluvial flooding goals and plans, and to develop associated public projects.

The European Union issued a Flood Directive in 2007 for member states to take adequate and coordinated measures to reduce flood risk. However, states have discretion in deciding how to meet this obligation. Article 21 of the Dutch Constitution provides a governmental duty of care that the country be "habitable" and to protect and improve the environment. The Dutch Water Act provides that municipalities have a duty of care to collect/process rainwater and that groundwater not adversely impact structures. Water Act (Neth.), Art. 3.5-6. The Environmental Management Act requires policies for sewer systems, *id.*, Art. 4.22-23, and the Spatial Planning Act requires that municipalities develop flood plans and related zoning.

The Dutch have national climate change strategies referencing water management, including the National Adaptation Strategy, and the Delta Programme. Netherlands, *National Climate Adaptation Strategy 2016 (NAS)* (Dec. 2016); Netherlands, *Delta Programme 2019* (Sept. 2018). Regional and municipal authorities enter into associated service-level agreements. These agreements rely on content knowledge about the water system, and provide processes for organization and implementation. Municipalities are responsible for building and extending sewer systems, local regulations, and permits, as well as funding for public participation. This trend toward greater decentralized governmental authority (including shifting responsibilities to private entities) appears to be expanding under recent integrated Dutch legislation, known as Omgevingsewet (Environmental Law), which resulted from agreements with the Association of Dutch Municipalities, the Interprovincial Consultation, and Union of Water Boards. Liping Dai et al., *Rainproof Cities in the Netherlands: Approaches in Dutch Water Governance to Climate-Adaptive Urban Planning*, 34 Int'l J. Water Res. Dev. 672 (2018). This legislation, expected for implementation in 2021, bundles 26 existing laws related to construction, environment, water, spatial planning, and nature.

Under the Dutch system, municipalities share responsibilities for pluvial flooding with residents. Dutch residents are responsible for collection, infiltration, and/or processing of rainwater as would be "fair" on their property. In practice, Dutch municipalities have gone beyond those flood control activities specifically mandated for their role to minimize pluvial flooding. Several large Dutch urban areas have advanced soft policies to educate and facilitate activity on public and private properties that capture, store, and drain rainwater so that urban areas act as a "sponge." Amsterdam, with the local water enterprise Waternet, recognized early on that funding for engineered grey infrastructure was not financially viable. Accordingly, the City of Amsterdam created "Amsterdam Rainproof" in 2014, a collaborative project from Waternet and the regional water authority intended to rainproof Amsterdam by 2050. *See* www.rainproof.nl/sites/default/files/rainproof-magazine-engels. Similarly, Rotterdam has developed the 2013 Rotterdam Adaptation Strategy. City of Rotterdam, Rotterdam Climate Change Adaptation Strategy (Oct. 2013)

Both efforts are characterized by an extensive initial effort to gather data on specific urban neighborhood districts. Location-specific overland precipitation flows are impacted by many variables, including soil type (which impacts water infiltration), existing building infrastructure, the built water collection system, existing asphalt surfaces, land elevation, and streets and other corridors that serve as water conveyance paths during rain events. Amsterdam and Rotterdam input this data into computer software that enables neighborhood level interactive simulations to understand water flow volume, velocity, pathways, flow blockages, and potential pluvial flood damage. These simulations also allow communities to prioritize solutions and reveal partnership opportunities. While Dutch legal frameworks provide discretion, this level of knowledge has contributed to many public water retention projects, including multiuse water plazas, green roofs, public water infiltration strips/zones, water permeable paving, and street speed bumps to temporarily store and direct water flows. Amsterdam and Rotterdam also issue information and incentives for private property owners to take water accumulation, or "sponge" activities, such as installing gardens along facades, open gutters, and detaching downspouts.

These Dutch sponge efforts exhibit a pragmatic approach to manage water, especially when the projects provide community co-benefits. Public water plazas and green areas provide various recreational and environmental features that enhance urban livability. Amsterdam and Rotterdam are actively promoting the inclusion of water in their townscape as positive assets, positioning their cities as innovative, climate proof, safe, and attractive. They believe such attributes are positive economic and livability drivers for their cities.

The much larger and geographically diverse United States does not have a similar shared Dutch cultural experience of living with water. Nonetheless, there are domestic urban areas that have experienced, and more that will likely experience, intensive rainfall flooding. Various climate change research is predicting domestic regions likely to experience increased and intense rainfalls. Several urban areas have already experienced record rainfall events. Some cities are starting to prepare for such future events. N.Y.C. Dept. Of Envt'l. Protection, Cloudburst Resiliency Planning Study (Jan. 2017). Other urban areas will likely ramp up activity as they too experience pluvial flooding, meet financial constraints in funding engineered solutions, face social/ economic disruption, or face newer standards for insurance that affect property values.

Domestic Flood Policies Are Changing

Domestic reliance on federal flood policies and funding is shifting toward private entities and local governmental authorities. Federal funding available for traditional coastal and river flood infrastructure and disaster relief is already challenged. The U.S. Army Corps of Engineers has responsibilities for flood control infrastructure and maintenance under section 206 of the 1960 Flood Control Act (PL-86-645). However, congressional funding for flood control has declined for decades. Nat'l Res. Council, Corps of Engineers Water Resources Infrastructure: Deterioration, Investment, or Divestment? ch. 3 (Nat'l Academies Press 2013). Furthermore, in the last couple of years Congress has canceled FEMA debt from disaster relief spending where it exceeded FEMA's borrowing authority. Congress also has proposed legislation to reform the FEMA program. *See* Bergman, *supra*. Diminishing federal disaster relief capacity will push infrastructure investment decisions to more local governmental entities and private insurance markets.

Both FEMA and private flood insurance markets are adjusting to various flooding types and increasing flood frequencies by developing new ratings based on flood risk at the property level, and adjusting premiums as a result. FEMA will release its Risk Rating 2.0 in October 2021. It is expected that this new rating will raise total premiums, account for different flood types, and reduce existing premium subsidies. See Fed. Emergency Mgmt. Agency, NFIP Transformation and Risk Rating 2.0, (Nov. 15, 2019). The acceptance and flexibility for private flood insurance has improved with the interagency rulemaking that lenders must accept private flood insurance that meets minimum FEMA requirements. Moreover, FEMA publicly released 10 years of policy information and over 40 years of loss data in its OpenFEMA platform. Nancy Watkins & David D. Evans, *U.S. Private Flood Insurance: The Journey to Build a New Market,* Ins. J. (Sept. 27, 2017). These FEMA activities will provide more realistic precipitation pluvial flooding risk pricing and boost the private market's flexibility for alternative and supplemental insurance pricing.

Moreover, mortgage standards may change to limit development in flood-prone areas. Fannie Mae and Freddie Mac (GSEs) took steps in the "green" arena for mortgages in areas impacted by earthquakes and multifamily lending. Christine Serlin, *How Freddie Mac's Green Advantage Program Impacts Affordability,* Multifamily Executive (April 29, 2019).

There are other financial changes coming in life-of-loan modeling that look at future risk. The Financial Accounting Standards Board adopted a new Current Expected Credit Loss accounting standard scheduled to be effective in 2020 for Securities and Exchange Commission (SEC) registrants and in 2021 for non-SEC financial institutions, to account for loan and credit losses based on forward-looking modeling. Financial Accounting Standards Board, Accounting Standards Update (ASU) No. 2016-13: Financial Instruments—Credit Losses (Topic 326): Measurement of Credit Losses on Financial Instruments (June 2016). It is foreseeable that the National Institute of Standards and Technology at the U.S. Department of Commerce or ASTM International may develop water risk infrastructure standards as they have for seismic and wind damage. Such activity contributes to quantifying or "pricing" flooding risk.

The process to quantify flood risk and develop related land-use and building metrics takes time to understand the science and negotiate policies. Climate change–induced precipitation events are occurring faster than previously predicted. In the interim, decision-makers and communities continue to select infrastructure investments and policies on whether to ameliorate pluvial flooding. Ruth Defries et al., *The Missing Economic Risks in Assessments of Climate Change Impacts,* Policy Insight (Grantham Research Institute on Climate Change and the Environment, Sept. 20, 2019). Faced with the same conundrum, Dutch cities elected to better understand local pluvial flooding situations, adjust infrastructure plans and investment to minimize property damage, optimize urban infrastructure systems, and enhance urban livability. Can domestic cities take such a pragmatic approach, especially if the solutions are cost-effective and produce co-benefits?

Applying Dutch Lessons

Fortunately, our domestic legal framework and technical tools are available for urban areas to move forward with pragmatic steps to manage pluvial flood risk. Using available tools might even result in a lower total cost than current infrastructure spending and disaster recovery expenditures.

Available Data and Models. There are tools to update FEMA-delineated areas that are likely to be inundated with water levels greater than historic 100-year storm events. Computer GIS software, aerial photography, and lidar facilitate expanding existing flood zones to additional areas likely to flood with increased rainfall, especially adjacent smaller and intermittent streams. In addition, there are many computer options for modeling storm water, depending on available data and objectives. Governmental entities can assess model characteristics in selecting the appropriate tool, including the accuracy of the model assumptions and margins of error. For a listing of different model capacities, see the Minnesota Stormwater Manual. Minn. Pollution Control Agency, Minn. Stormwater Manual (2020), stormwater.pca.state.us.

Amsterdam and Copenhagen used an intensive hydrologic and hydraulic computer model (3Di) to understand water conveyance in the natural and surface-built environment, as well as in below-ground sewers and pipes. Thus, the model can run rain events and combine all water flows (overland, channel, sewer, and groundwater) into one computational core. The 3Di software resulted in a user-friendly interactive tool with neighborhood specific water flows. New York City used similar software, InfoWorks. *See* Memorandum from Arcadis Team to N.Y.C. Dep't of Envtl. Protection (Nov. 23, 2015). These software models allow interactive exercises to demonstrate the potential effect of various projects to temporarily store/delay water flows and remove blockages for water to drain into existing water collection facilities.

To start such pluvial stormwater modeling, governmental entities with storm water–related obligations could provide the resources to gather necessary input data for the selected model. Much data is already publicly available. Urban areas generally can access digital land elevation models through the U.S. Geological Service. Similarly, information on building footprints, streets, sewer facilities, and treatment plant capacities can be located. Naturally, it takes resources to locate the various websites and databases, work through permissions for data usage, and fund modeling runs. The Dutch found this foundational effort useful in engaging communities, public entities, and the business community to understand the scope of the issue, identify potential partnerships, define the effectiveness of solution alternatives, and evaluate the respective social impact and cost effectiveness of various activities.

This computer modeling can complement existing mapping, both built infrastructure and natural. Several cities have waterway mapping on computer GIS systems that show natural areas that facilitate water drainage and water infiltration and that identify other potential environmental and social benefits. The Chicagoland area has several mapping studies using GIS modeling, including the Chicago Green Infrastructure Vision Data in 2012, the Green Infrastructure Strategy for Lake County, Illinois, in 2016, and Millennium Reserve on

Chicago's southeast side in 2014. *See, e.g.,* Chicago Wilderness, Millennium Reserve Green Infrastructure Project (2015). Combining data from existing waterways, natural areas, streets, and various water system infrastructure (collection points, piping capacity, discharge points, storage, and treatment capacity) provides comprehensive input material for computer models to help prioritize pluvial flood risks and suggest solutions.

Zoning and New Authorities. While the Dutch legal framework more specifically references flood mitigation, our domestic state zoning authorities allow a robust foundation for urban authorities to mitigate pluvial damage. Zoning commonly restricts building coverage on property sites and restricts surface water drainage onto adjacent properties. These existing restrictions are not designed to address the current scale of pluvial flooding. Rather, the restrictions seek to specify housing density and displace common law surface water nuisance actions. Some states, such as Connecticut, have other laws that specifically provide a legal remedy against adjacent property owners who modify their property resulting in damaging surface water flows to other properties. *See, e.g.,* Conn. Jud. Branch, Superior Ct. Operations, Surface Water in Connecticut (2019).

Potential solutions extend to building structures. International and domestic entities are developing standardized metrics and infrastructure criteria for flood-proofing structures. Much of this began in areas impacted by coastal and river flooding. Alex Harris, *Florida's Building Code Doesn't Take Sea Rise into Account. That Could Change This Year*, Miami Herald, Nov. 12, 2019. These criteria will provide domestic governmental authorities with a firmer foundation upon which to base new zoning and other restrictions that address pluvial flooding. The ability of governments to legally justify future zoning restrictions will continue to depend on balancing private property rights versus valid public purposes. In developing existing zoning codes to achieve select goals such as restricting building height, preserving prime agricultural land and saving historic buildings, some states have ameliorated financial impact on private property owners by providing transferable development rights. Such a system provides zoning variations that property owners can use on other property that is less impactful of those features protected by zoning restrictions. For example, in Illinois there is legislation authorizing the use of transferable development rights for zoning designed to protect historical sites and scenic landscapes. 55 Ill. Comp. Stat. § 5-30004 (2004). Together with computer modeling and infrastructure metrics, local authorities will have more legal flexibility to address specific water retention, flow, and blockages.

Coupled with structural criteria, the growing body of domestic civil engineering storm water management techniques will support legal restrictions to prevent pluvial flooding. These techniques offer alternative design flexibility and cost efficiencies to meet structural and flood minimizing criteria. *See, e.g.,* Phila. Water Dep't, Phila. Stormwater Mgmt. Guidance Manual V 3.1, § 3.2 (2018); Am. Soc'y Of Civ. Engineers, Policy Statement 441 (Stormwater Management) (2018).

Use of natural landscaping and landscape design to enhance water management is another significant flood minimization tool. Significant research has been conducted to understand green infrastructure capability to enhance water retention and water quality. EPA has developed extensive technical support for where and how green infrastructure can minimize combined sewer overflows from regulated sewer districts with CWA discharge permits. *See* EPA, *Green Infrastructure*, epa.gov (2020). The large sewer district responsible for Cook County, Illinois, the Metropolitan Water Reclamation District (MWRD), has found that green infrastructure can play an important role in minimizing flooding and additional water treatment. The MWRD published a technical guidance manual, adopted a watershed management ordinance (WMO), hired staff for a green infrastructure build-out, and proposed legislation for bonding authority to cost-share for green infrastructure on private lands. Both the EPA and MWRD have concluded that in many cases green infrastructure is more cost-effective in achieving water quality and drainage objectives than traditional engineered infrastructure. While the technical work is not specifically designed to protect infrastructure, it is a tool that local communities can use to minimize flooding, with potential environmental and social co-benefits.

Besides zoning authorities, states have granted authorities to special districts to minimize flooding risks. For example, Illinois has given the MWRD authority to finance wastewater collection, storage, and treatment facilities. In 2014, Illinois expanded this authority to enhance regional watershed planning and manage storm water runoff in Cook County with Public Act 98-0652. 70 Ill. Comp. Stat. 2605/7h, /9.6c (2014). Under the 2014 authority, MWRD can: fund other entities, including other countries and local governments on a contractual basis; adopt a WMO for new development on-site water retention; impose fees for storm water services and facilities within tax limits; plan, implement, finance, and operate local storm water projects; issue below-market loans to local governmental entities that have existing local bonding authority; and provide loans to governmental units to fix local sewer collection systems related to sanitary inflows. Local government actions must conform with MWRD stormwater plans, rules, and ordinances.

Like Chicago, Philadelphia has significant legacy combined sewer systems. After experiencing combined sewer overflows, Philadelphia developed its Green City, Clean Waters plan to reduce flooding and overflows. The plan anticipates a $2.4 billion investment over the next 25 years in public infrastructure. Like the MWRD, Philadelphia has requirements for certain new development. The Philadelphia Water Department (PWD) prepared a Stormwater Management Manual as a comprehensive resource for the development community, including specific storm water practices to meet storm water requirements. Developers must receive PWD approval before a zoning or building permit is issued. Also, see the similar MWRD Technical Guidance Manual to Support the Implementation of the Watershed Management Ordinance. Developers can jointly deploy civil engineering and green infrastructure storm water management techniques on their properties. Furthermore, these water management tools can complement off-site traditional engineered grey infrastructure for cost-effective community solutions. City of Phila., Private Dev. Services, www.pwdplanreview.org.

The growing body of both green and engineered storm water management guidance provides a basis for various governmental entities and communities to consider capital investments to minimize flood risk for existing infrastructure and urban resiliency. It remains to be seen how increased neighborhood pluvial flooding will shape both the evolution of new development requirements as well as other policies and investments in the larger context of pluvial flooding. While the MWRD and Philadelphia new development requirements were initiated by environmental concerns over the discharges from sewer systems, pluvial flooding also negatively affects the capacity of the existing sewer water systems and community resiliency. Besides contributing to combined sewer overflows, pluvial water can overwhelm water system collection systems. Water that does not enter water collection systems can flush surface pollutants into natural systems and produce community damage. There is increasing awareness that new development is exacerbating rain events. Elizabeth Kim, *How New York City's Building Boom Is Making Flooding Worse*, Gothamist (July 26, 2019).

Even without mandated flood minimization requirements, municipalities can choose how to spend money for public capital infrastructure projects, including flood resiliency. Such a prioritization process is often done under a coordinating capital improvement plan (CIP), frequently in conjunction with other governmental entities and the community. CIPs contain all individual capital projects, purchases, related studies, construction and completion schedules, and financing plans. Charlie Francis, *Capital Improvement Plans 101*, Opengov (May 10, 2016). While many municipalities favor capital projects related to new development to improve their tax base, communities are free to choose water resiliency projects that mitigate flood damage to existing infrastructure. Municipalities can engage their community on investment priorities, including water resources, wastewater, and storm water management that improve community resiliency.

The common ad valorem taxing system (based on property market values) that provides revenue to many municipal and special governmental districts can be a disincentive for spending resources on community resilience projects. These taxes also negatively impact social equities among diverse communities. Accordingly, many governmental capital expenditures are slanted toward supporting new development, over maintenance and capital for resilience. Other tax structures (and fees) that more closely relate revenue with the contribution to pluvial flooding are worth consideration. In the Netherlands water authorities apply a fixed charge per resident for water system expenses, including rainwater protection. Philadelphia imposes user fees to manage its storm water program. These fees for both residents and commercial property owners are based on the percentage of impervious surfaces on property sites. Property owners can reduce standard fees by installing storm water controls. There are also grants available for non-residential customers who install green infrastructure to control surface water. *See* City of Philadelphia, *Stormwater* (2020), phila.gov.

Partnerships

Much of the early success in the Netherlands for pragmatic pluvial flood activity is attributable to successful public engagement with governmental and private entities, including builders and insurance companies. Without the Dutch shared experience of living with water, there are domestic challenges associated with aligning diverse governmental entities and private entities to form such partnerships. Domestic municipalities and special governmental entities, such as highway departments and sewer districts, have defined mandates and answer to different constituencies. This creates complexity for forming partnerships among the public and various governmental entities. Current governmental entities frequently balance their budgets by making capital decisions based on immediate needs, revenue, and cost. Unfortunately, public taxes support these multiple purpose missions while residents also bear the brunt of pluvial property damage and environmental harm. The public total cost might be less with more coordination to prioritize projects contributing to community resilience. More pluvial flooding and economic pressures may drive more coordination.

Similar to Dutch engagement inclinations, domestic urban areas have organizations associated with environmental missions that collectively could provide an engaged citizenry to initially form partnerships. Such organizations attract members interested in various areas, such as waterway recreational opportunities, birding, parks, pollination species, climate change, and native vegetation. Members of such organizations are spread throughout urban populations and may be among the early participants helping to identify projects that can reduce pluvial flooding. Urban areas also typically have research organizations, education institutions, and museums involved with climate change, urban planning, and sustainability. In Chicago, most of these organizations formed a collective organization, Chicago Wilderness, to mutually support their respective missions and programs. The Chicago Wilderness was involved in the green area mapping and planning efforts discussed earlier in this article.

Domestic cities are learning from early efforts to manage pluvial flooding. After a decade of storm water management experience in Philadelphia, several public organizations are advocating for additional storm water policies to minimize flooding risk. For example, PennFuture, a nonprofit advocacy organization, recommended several policy changes in an open letter addressed to the 2019 candidates for Philadelphia Mayor and City Council. *See* PennFuture, *A Common Green Stormwater Infrastructure Agenda for Philadelphia* (2019).

Increasing public awareness of flood potential and the domestic trend to quantify pluvial risk will likely lead to future local collaboration and adjustment to legal frameworks, especially zoning and special district authorities. In addition, diminishing federal flood relief funds might mobilize support for integrating traditionally focused public entity planning for cost-effective community investment. Without such domestic changes to imbed flood prevention considerations into decision-making, new decisions on infrastructure investment and land-use may increase the severity of pluvial damage. Faced with their traditional frameworks, Dutch cities pragmatically choose to weave pluvial concerns into current planning and infrastructure investment. Hopefully, domestic public exposure to other cities successfully living with water, can contribute to a roadmap for willing governmental bodies and communities to consider cost-effective community infrastructure investments.