

Integrating Land Use and Water Management

Planning and Practice



ERIN RUGLAND, AICP

POLICY FOCUS REPORT

LINCOLN INSTITUTE OF LAND POLICY

BABBITT CENTER FOR LAND AND WATER POLICY

ABOUT THIS REPORT

This report makes the case for integrated land use and water management planning. It describes the overall benefits and connection points between land use and water management; explores existing regulations related to integrated planning, both within comprehensive land use plans and water management plans; provides case studies of successful integrated planning within specific communities; and provides policy recommendations for encouraging and solidifying coordinated planning, whether through regulation or not. Connecting water to land use brings together two resources that have been managed in silos for too long. Coordinated planning is a step in breaking down these silos and will be increasingly necessary as communities strive to secure their water futures.



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Front Cover

A master-planned suburban community in Chandler, Arizona, just outside of Phoenix. *Source: Art Wager/E+/Getty Images.*

Back Cover

Topographic map of Philadelphia, Pennsylvania. *Source: Frank Ramspott/iStock/Getty Images Plus.*

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Executive Summary



Land use authorities and water management agencies share the crucial responsibility of providing the means for their residents and customers to survive and thrive. Land use authorities enable development, attract economic development, and protect key resources, while balancing a community's competing interests. Water management agencies provide safe, clean, and affordable drinking water; treat wastewater; and manage stormwater. Despite overlapping functions, these agencies are typically separate, and rarely collaborate to determine how development might impact water resources, or vice versa.

A succulent wall in Venice, California. California has several requirements for water resource planning that call for collaboration with land use authorities. The 2015 drought spurred several measures, including a statewide Model Water Efficient Landscape Ordinance, to use landscape and land use changes to reduce water demand. Similar measures may be on the horizon as the state endures another multiyear drought. *Source: PamelaJoeMcFarlane/iStock/Getty Images Plus.*

This disconnected system of development is becoming untenable, however, as climate change, population growth, and increased competition between water users exacerbates water risks. Already, some Western communities foresee a future in which they cannot accommodate all water needs due to population growth and drought. This year, the U.S. Department of the Interior declared the first-ever shortage on the Colorado River, which will affect water users in Arizona and Nevada starting in 2022 and has many implications for the surrounding states and an estimated 40 million people. In other regions of the country, water quality issues, caused in part by climate-related heavy rainfall, are becoming difficult to address as infrastructure ages and is costly to refurbish or replace.

Land use planners and water managers need to break down their silos to address these challenges and improve water management and land use planning. A growing number of communities are choosing to do just this—from Evans, Colorado, to Tampa Bay, Florida, to Philadelphia, Pennsylvania. They are following an integrated approach to water and land use planning to forge a more sustainable and resilient future for their communities.

Box 1.1

Benefits associated with integrated water and land use planning

- Enhanced water supply and storage
- Improved water quality
- Reduced flooding
- Improved reliability and long-term water management
- Greater cost efficiency for municipalities and consumers
- Greater resilience in a time of climate change

Climate change, population growth, and increased competition between water users exacerbates water risks. Already, some Western communities foresee a future in which they cannot accommodate all water needs due to population growth and drought.

Communities, in fact, have many opportunities to connect water and land use. Building this integration into the planning process is a great starting point. It's also one of the foundational actions that land use authorities and water management agencies can take. Integrated planning enables agencies to best position themselves to analyze and implement further teamwork. Planning processes help communities carefully consider the best strategies for coordinating land use and water management, while accounting for their local conditions and most pressing challenges. Both land and water are resources that often require unique, community-specific solutions. Successfully integrated plans can illuminate the most fruitful path forward and tee up collaborations that measurably improve water efficiency, water availability, water quality, or stormwater management.

This report recommends the following to promote integrated land use and water management.

1. **Collaborate Locally.** Integrated land use and water planning cannot occur without collaboration. Integrated land use and water management plans should entail a process that makes such coordination self-perpetuating. Local governments should ensure that coordinated planning lasts beyond one institutional culture or governance regime.



San Tan Valley, Arizona, is a rapidly urbanizing agricultural area in the Sun Corridor between Phoenix and Tucson. Tensions between agricultural water use and residential development may increase in coming years because of development coupled with drought.

Source: Christopher Harris/iStock/Getty Images Plus.

- 2. Coordinate Regional Expertise and Oversight.** Regional agencies should provide technical assistance, funding, and studies. They should also facilitate regional collaboration to encourage integrated planning efforts.
- 3. Build Capacity Through Funding and Technical Guidance.** States with mandates should provide resources to help communities adjust to and reach established goals. Communities in states without mandates will also better succeed if public or private entities provide them with sufficient resources.
- 4. Use State Mandates.** A statewide requirement for coordinated planning increases the likelihood that local governments will cooperate. States can formalize integrated planning by enacting planning requirements for land use authorities and water management agencies, and by enacting statewide water management programs.

Plans are not a cure-all for every challenge related to natural resources, but they can help communities anticipate shortfalls and prepare for the day when those projections become reality. Communities that coordinate land use and water management plans increase their capacity to achieve a resilient and sustainable future.

Box 1.2

Term Definitions

This report covers the intersection of land use planning and water management planning—two topics that can be highly specific and variable within communities in terms of the agencies involved, specific functions performed, and so forth. General terminology is used in order to accommodate the variety of organizational structures and nomenclature that may exist for these land use and water management functions within any given community. This report is primarily concerned with the urban water cycle regarding source water protection, water supply, drinking water quality, wastewater treatment, and stormwater management. It does not necessarily cover water management as it relates to agriculture or industrial uses.

Land use authorities—The land use agencies or departments within municipalities or counties. Duties may include both long-range planning and site-specific planning. The primary function of this report is long-range planning.

Water management agencies—The utilities, public or private, primarily responsible for the provision of drinking water within a community. Local water management agencies may include a variety of functions to support the provision of drinking water, such as wastewater treatment, stormwater management, or source water protection. However, these functions may also be allocated among several agencies in any given community.

Land use planners—General term used to refer to the staff of land use authorities.

Water managers—General term used to refer to the staff of water management agencies.

CHAPTER 1

Introduction to the Land and Water Nexus



Flooding and stormwater management are of increasing importance as tropical storms become more frequent and precipitation becomes more concentrated and intense. Integrating land use and water management will be key to addressing these issues. *Source: brazzo/iStock/Getty Images Plus.*

“Climate change is water change,” as the adage goes. A warmer climate impacts nearly every facet of the water cycle. It increases evaporation from water bodies and causes air to retain more water that is later unleashed through intense precipitation. Many communities across the United States are seeing climate-related changes in their local water resources. Severe drought is especially affecting the West, while increased intensity and duration of storms, and massive flooding, are striking other regions. Water quality issues, caused in part by climate-related heavy rainfall events that mobilize sediment and sewerage overflow, are becoming difficult to address as infrastructure ages and is costly to refurbish or replace.

Water is not only essential to life and to thriving communities, but it brings value to land. Land use determines the character of communities and in turn greatly impacts water demand, water quality, and flooding risks. Connecting land with water and understanding these resources in the context of issues like equity, resiliency, and climate change is critical for building and sustaining healthy communities of the future.

Historically, as communities have grown and developed in the U.S., land use planners and water management agencies have not worked together. The two sets of agencies may differ in terms of missions, governing structures, and geographic boundaries. Nonetheless, land use planners facilitate development, and water management agencies pipe water and wastewater to and from development. Land use planners assume that water service will be readily available for new development, while water management agencies are charged with ensuring that this is the case. The two types of agencies have rarely considered how development might impact water resources, and vice versa. Yet, as climate change, population growth, and increased competition among industrial, agricultural, and municipal water users exacerbate water risks, this disparate system of development will prove to be untenable.

Already in the West, communities foresee a future in which they cannot accommodate all water needs due to population growth and drought. A Tier 1 shortage was declared on the Colorado River in 2021, causing cutbacks in deliveries to Arizona and Nevada in 2022. As the drought progresses, more states may face cutbacks from Colorado River water deliveries. Many Western communities have few, if any, additional water supply sources to address this problem. Any additional water supplies that could potentially be tapped, such as via desalination, may be extraordinarily expensive for the community (Runyon 2018). Meanwhile, other communities are using their scarce water supplies to build new water parks and resorts in the desert (Bowling 2020). In the Midwest, dams are breaking due to years of disrepair coupled with harder,

more frequent rains that are also raising water levels (Einhorn 2020). Flooding has become a monumental problem, and some communities are trying to balance capturing stormwater at the source and allowing some natural runoff to feed into river flow (Walker et al. 2020). East Coast communities are coping with excess water, and related water quality and infrastructure problems, as sea levels rise, hurricanes increase in intensity and frequency, and pervasive flooding occurs more regularly. Solutions range from green infrastructure and resiliency parks (i.e., vegetated areas designed to filter and absorb stormwater) to underground storage tanks and seawalls (Zeitlinger 2020). Although each region of the U.S. generally faces a certain set of water problems, many of these issues could become pertinent to any U.S. community that is inadequately prepared.

Connecting land with water and understanding these resources in the context of issues like equity, resiliency, and climate change is critical for building and sustaining healthy communities of the future.

Many communities around the U.S. have already experienced devastating impacts to their water resources, whether from long-simmering problems or from drastic one-time events. Others are evaluating and coming to terms with the available data about their changing water resources and deciding which actions to take. The time is ripe for communities to integrate land and water planning to manage a range of plausible futures and better respond to today's emergencies and changing conditions.

Communities are confronting the complex problems of climate change without silver bullet solutions. However, communities can address these complex problems via integrated and coordinated land and water planning:

changing the built environment (e.g., increasing density, clustering development), investing in infrastructure, implementing innovative water management, or enacting water-related land use regulations.

Comprehensive land use planning lays the foundation for future community development and underpins the policies that will guide development decisions and public investment. Planners create comprehensive land use plans, commonly referred to as simply “comprehensive plans” with extensive public input, to articulate a vision for the community’s future in a single document, made available to the public and decision makers. Key features of comprehensive plans include the future land use map, with zoning types, allowable development, and the permitted density of such development plotted out. Comprehensive plans also include a suite of implementation actions (goals, objectives, and strategies) that reinforce the parameters of the land use map, and help the community reach the vision articulated throughout the plan.

Input and collaborative planning between land use planners and water management agency staff is crucial in developing either plan to ensure that the expertise of the other discipline actively informs important decisions that will impact a community’s quality of life.

Water management plans can cover the gambit of water resources and tend to detail the scientific, demographic, and economic data that govern a water management agency’s water system, such as current water supplies, potential threats to these supplies, water demand, water reuse, infrastructure needs and costs, and overall system design, capacity, and operation. Water management plans function as more of an operating guide for the agency—a path for continued high-quality service to all users within its service area.

Water management agency staff are thus highly competent at interpreting data and using it to make better management decisions.

Agencies rarely undertake these two planning areas—comprehensive plans and water management plans—in tandem, despite the benefits of doing so. The land use planning and public outreach components of a comprehensive plan can be highly beneficial to water management agencies, allowing them to understand how the community may grow, in what ways such growth could challenge water management, and how residents may understand (or misunderstand) local water resources. Meanwhile, the data-intensive water management plan helps land use planners clearly understand water opportunities, challenges, and limitations, so that they can make development decisions sensitive to the community’s water issues. Input and collaborative planning between land use planners and water management agency staff is crucial in developing either plan to ensure that the expertise of the other discipline actively informs important decisions that will impact a community’s quality of life.

Although it sometimes seems that the only end product of a planning effort is a spiral-bound document that sits on a shelf, both comprehensive plans and water management plans create processes and precedents, even if the plans themselves are not consulted for every decision. Furthermore, integrated water and land use planning is essential for implementing any other land and water integration action or regulation. Communities that undertake this exercise will create stronger processes, policies, and regulations to ensure sustainability and resiliency against the threats of climate change, population growth, and whatever else may come their way.

Tanner Springs Park, an urban park in Portland’s Pearl District, restores a once paved-over wetland and spring to provide natural filters to stormwater, urban habitat for wildlife, and a refuge for Portland residents. *Source: Kenton Waltz.*



CHAPTER 2

Matrix of Integration



Planning is the focus of this report because it allows communities to best succeed at integrating water and land use management. The following toolbox matrix (table 2.1, page 12) will help land and water practitioners understand the connection points of land and water integration and provide guidance on which connection points may be most applicable to their water issues, community goals, and capacity. The toolbox matrix was developed with input from experts in both land use planning and water management, who work in different contexts across the country. A full explanation of the development of this toolbox matrix is described in Rugland 2021b.

Flooded playground in Houston, Texas. Parks, sometimes called “resilience parks,” and other open spaces can help manage stormwater and control flooding. Identifying appropriate sites for stormwater management presents a great opportunity for land use planners and water managers to collaborate. *Source: photoquest7/iStock/Getty Images Plus.*

Matrix Rows

These rows are organized sequentially into categories that represent the stage of the development process. In general, a community must first establish coordinated procedures, then plan its implementation actions, and regulate these implementation actions through codes and ordinances. What follows next are review and approval of development; building or upgrading the water infrastructure needed for development; and then targeting water end-users with water conservation and demand management. The process is often iterative and circular, however, and a community may affect change in any one of these areas, regardless of current development projects. That is, a community may undertake regulatory or procedural changes at any time and design these changes to impact future development projects. Further, a community may pilot changes to its infrastructure planning or post-occupancy demand management, such as residential water conservation programs, and later decide to formally codify these changes as rules or regulations. Nonetheless, the collaborative process and planning tools are the most foundational activities a community can undertake, as they influence all subsequent tools. The plan provides a roadmap to meet goals and objectives, but actions are needed to actually achieve these goals and objectives.

Matrix Columns

Practitioners can examine these columns to get an initial, general assessment of whether a tool may be applicable to their local situation. An expert focus group divided these criteria into three broad categories, representing three steps to using the matrix. First, practitioners and communities need to identify the water issue they are trying to address (e.g., adequacy of supply, aging infrastructure, or flooding) to determine whether a tool may positively affect this issue. Second, they can evaluate the tool's impact on their communities' goals for resiliency and equity. Third, they can evaluate factors such as cost and ease

of implementation. Following this process, practitioners and communities can get an initial assessment of the tools that they can refine with further analysis of local factors that may affect the usefulness, impact, cost, or feasibility of the tool within their jurisdiction.

Toolbox Categories

Within the three categories are eight criteria that address water issues, resiliency and equity, and feasibility and cost. The criteria addressing water issues are meant to help communities decide whether an integrated land use and water management tool will be appropriate for them. Some integrated tools may be highly useful for addressing issues of water adequacy, but not for improving water quality or preventing flooding. The resilience and equity criteria are designed to help communities determine whether a tool can improve the community's capacity to withstand and rebound from a disruptive event, or help improve quality of life, as it relates to water resources, for all members of the community. These criteria are based on broader goals that have gained traction in recent years, particularly as climate change accelerates and inequality in the U.S. receives increasing attention. Last, two criteria help communities ascertain the feasibility of each tool's cost and ease of implementation. The "Magnitude of Integration Cost" column focuses on the additional costs communities can expect from integrating land use and water management. Many of the tools are ongoing, with costs already absorbed by local governments. This column therefore shows how the costs of these practices might change if they are integrated.

Complete descriptions for each row and column of this toolbox are described in Rugland 2021b, *Integrating Land and Water: Tools, Practices, Processes, and Evaluation Criteria*.

Table 2.1: **Tools, Practices, and Processes for Integrating Land and Water***

Tools, Practices, and Processes	Tool Usefulness for Addressing Certain Water Issues			
	Water Adequacy	Flooding and CSOs	Aging Infrastructure	Water Quality
Collaborative Processes				
Remove Existing Barriers	●	●	●	●
Ongoing Communication	●	●	●	●
Coordinated Data and Information	●	●	●	●
Education Programs	●	○	N/A	●
Public Engagement and Participation	●	○	N/A	●
Scenario Planning	●	●	●	N/A
Pilots, Demonstrations, and Models	○	○	N/A	●
Coordinated Pre-Application Meetings	●	○	N/A	●
Closed Approval Loop Between Land/Water	●	●	N/A	○
Monitoring and Program Evaluation	●	●	●	●
Planning				
Comprehensive and Master Plans	●	●	●	●
Water Resources Plans	●	●	●	●
Capital Improvement Plans	●	●	●	●
Sustainability and Climate-Related Plans	●	●	●	●
Hazard Mitigation, Response, Recovery Plans	●	●	●	●
Regulations: Codes and Ordinances				
Building Codes	●	●	N/A	●
Plumbing Codes	●	●	N/A	●
Landscape and Irrigation Codes	●	●	○	●
Zoning and Land Use Codes	●	●	●	●
Subdivision Regulations	●	●	●	○
Annexation or Growth Policies	●	●	●	●
Water Restriction/Other Water Use Codes	●	N/A	N/A	N/A
Water Budget, Allocation, and Dedication	●	●	N/A	N/A
Assured Water Supply	●	N/A	N/A	N/A
Water Demand Offsets/Water Neutral Code	●	N/A	●	N/A
Consistency Requirements and Formalized Collaboration	●	●	N/A	●
Development Review				
Development Agreements/PUDs	●	●	●	●
Site Planning	●	●	○	●
Connection Charges	●	●	●	N/A
Developer Incentives	●	●	○	●
Water and Infrastructure				
Water Supply Infrastructure	●	●	●	●
Wastewater Collection and Treatment	N/A	●	●	●
Stormwater Management	●	●	●	●
Water Quality and Source Water Protection	●	●	N/A	●
Water Reuse and Use of Impaired Supplies	●	○	●	●
Water Recharge and Storage	●	●	●	●
Post-Occupancy Water Demand Management				
Rate Structure/Conservation Rate Structure	●	●	N/A	N/A
Fixture, Appliance, or Landscaping Retrofits	●	○	N/A	○
Water Audits and Leak Detection	●	N/A	●	○

* Complete descriptions for each row and column of this toolbox are described in *Rugland 2021b, Integrating Land and Water: Tools, Practices, Processes, and Evaluation Criteria*.

KEY ● Highly useful for addressing this water issue
 ● Useful for addressing this water issue
 ● Somewhat useful for addressing this water issue
 ○ Marginally useful for addressing this water issue

Tool Contribution to Community Goals		Tool Feasibility	
Resilience	Equity	Magnitude of Integration Cost	Ease of Implementation
Collaborative Processes			
●	●	●	●
●	●	●	●
●	○	●	●
●	●	●	●
●	●	●	●
●	●	●	●
○	●	●	●
○	N/A	●	●
●	N/A	●	●
●	●	○	●
Planning			
●	●	●	●
●	N/A	●	●
●	●	●	●
●	●	●	●
●	●	●	●
Regulations: Codes and Ordinances			
●	○	●	●
●	N/A	●	●
●	○	●	●
○	○	●	●
○	○	●	●
●	N/A	●	○
●	N/A	●	●
●	●	●	●
●	●	●	○
●	●	●	○
○	N/A	●	○
Development Review			
○	N/A	●	●
●	○	●	●
○	N/A	●	●
○	○	●	●
Water and Infrastructure			
●	●	○	●
○	●	○	●
●	●	○	●
●	●	○	●
●	○	○	●
Post-Occupancy Water Demand Management			
○	●	●	●
●	●	●	●
●	●	○	●
KEY ● Very high ● High ● Medium ○ Low	KEY ● Highly improves ● Improves ● Somewhat improves ○ Marginally improves	KEY ● Low cost ● Medium cost ○ High cost	KEY ● Easy ● Medium ○ Difficult



The nonprofit Watershed Management Group is involved in planning and helps with community outreach related to river restoration plans in Tucson, Arizona. *Source: Meg Wilcox.*

Tools, Practices, and Processes

The connection points of land and water integration are seemingly endless. Any mechanism for integrating land and water can include several techniques of implementation—for example, landscaping standards may be achieved through regulatory means such as maximum turf areas or through an encouraged plant list. What’s more, each technique can be structured in a myriad of ways to fit unique community needs, contexts, and challenges. Thus, **this matrix of tools, processes, and practices demonstrates broad categories of implementation mechanisms for integrating land and water.** Full descriptions of all the rows of the toolbox matrix are presented in Rugland 2021b.

Collaborative Processes include the coordination of traditionally separate activities that land use planners and water managers may undertake to inform process, policy, or practice. Working together, land use planners and water managers may expand their efforts and collaborate with the public, elected officials, affected industries, developers, or nongovernmental organizations. Enhanced collaborative processes can help ensure that integrated water and land use practices, policies, and programs are well suited for and well received by the community, while improving the design and implementation of all other tools listed here. Collaborative processes also, notably, enable interdisciplinary action that can lead to more resilient systems and more equitable outcomes.

Planning encompasses the activities that land use planners and water managers may carry out collaboratively or separately to integrate land and water policies and practices. These planning tools serve as the foundation for implementing all the other tools in this toolbox. They can help a community evaluate other tools’ costs, benefits, relevance to their goals, and feasibility of implementation in more detail and with more localized nuance than this toolbox otherwise provides. These plans should also serve as public documents facilitating both public engagement and transparency. Additional planning tools beyond those listed in the toolbox matrix, such as Environmental Impact Reports, Equity Strategies, or Habitat Management Plans, can also support land and water integration.

Regulations: Codes and Ordinances capture the regulatory mechanisms that can integrate land use planning and water management. The regulations described here often apply city- or community-wide. All regulations, codes, and ordinances will ideally outline the enforcement mechanism for each tool, including consequences if such regulations, codes, or ordinances are not followed. They will also designate the entity responsible for enforcement.

Development Review encompasses the tools that land use planners and water utilities can employ during the development review process to integrate land use planning and water management. Most requirements for a development review process are outlined in codes and regulations; thus, it is important that the guidance provided in this section be integrated into local rules and regulations. The development review process creates several intervention points to reinforce existing policies. The preliminary plat review

Field staff may be used to verify water quality standards are met, conduct water audits for residents or businesses, or otherwise ensure integrated land and water policies are implemented and followed as planned. *Source: Christopher Kimmel/Cavan Images/Alamy Stock Photo.*

(referred to as subdivision or concept plan review in some states) is typically the point at which a development is first thoroughly reviewed for compliance with the related codes and regulations. Compliance could impact the development's design. Land use planners and other reviewers make recommendations at this stage about what must be changed in the development design by final plat, the stage at which the development is officially recorded and approved. Water management agency staff can be included at this stage to ensure that the water-related codes and regulations, with which they may be more familiar, are followed and enforced. They may also be better suited to review the water studies that may be required for preliminary plat approval. Communities can use the development review process as well as preproposal meetings to ensure the development meaningfully addresses the community's development rules and regulations and water-related standards.

Water Supply and Infrastructure captures the water supply development and physical infrastructure needed to integrate land use planning and water management. All physical infrastructure, conveyance systems, and treatment sites for water have land use implications. Often, practitioners will think of stormwater management when they think about integrating land use and water management, as stormwater conveyance is a tangible way to use the built environment to impact water flow. Additionally, water quality controls, such as source water protection, have land use implications. Mechanisms such as stream buffers, development setbacks, parking maximums, and similar requirements influence land use to the benefit of nearby water resources.



Post-Occupancy Demand Management refers to the programs that land use planners and water management agencies may use after a development has been built or redeveloped to encourage occupants to reduce their water use. It includes common water conservation strategies that are typically targeted at residential water users. Fees within a water bill can compel water users to reduce their indoor and outdoor water use. Water use audits or incentives for installing water-efficient fixtures can also motivate users to conserve water. Coordinating water conservation programs with the land use department can help to strengthen these programs. Integrating these conservation strategies into land use regulations, or within the development review process for new or redevelopment, is particularly helpful.

This toolbox demonstrates the realm of connection points for integrating land use and water management. Comprehensive and water management plans present an unmissable opportunity for communities to create a foundation for the actual implementation of the other connection points identified in the toolbox. The following chapters will demonstrate the opportunities specific to comprehensive and water management plans.

CHAPTER 3

The Role of the Comprehensive Plan in Land Use Planning



Water canal in Phoenix, Arizona—one of the few states to require a water element with the comprehensive plan. The state introduced this requirement in the early 2000s as part of its growth management strategy. The state's rapid population growth continues despite scarce water resources in an arid environment and long-term drought. *Source: Art Wagner/iStock/Getty Images Plus.*

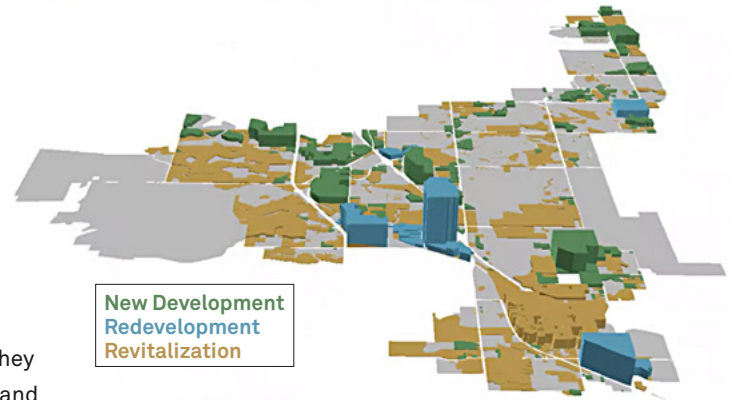
A comprehensive plan, sometimes called a general plan or master plan, is a document that articulates a vision for a community and guides decision makers on land zoning and development, transportation, tax policy, and public fund expenditures. Comprehensive plans cover both land use and city operations, infrastructure, and services. They include critical provisions for protecting community resources, be they manmade structures like historic buildings, or the natural environment. They help decision makers balance competing interests. As water is necessary for human survival, a comprehensive plan should outline current water resource supplies and goals for protecting and sustaining those resources.

Comprehensive Planning Overview

Comprehensive plans capture the future vision of a community in several essential ways. First, they articulate a vision with goals for the community's future, developed with community input. Second, they include the land use map, which designates zones and the development or building types that are allowed in those zones. Third, they outline the policies and procedures for realizing the community's future vision and for following the land use map. Land use planners typically update comprehensive plans every 10 years; however, they may update them as often as every five years. Land use planners may also follow a longer horizon, looking 10–20 years ahead. Comprehensive plans guide future policymaking, regulations, development approval processes, zoning and subdivision standards, and development decisions. Major goals of most comprehensive plans are to improve mobility, attract economic development, ensure viable housing stock, and live in balance with natural resources.

The Water Connection Within Comprehensive Planning

Comprehensive planning is an important tool for communities that seek to bring water issues to the forefront of their vision for a sustainable future. Few other planning activities necessitate the same kind of cross-departmental and public outreach, which makes comprehensive planning a great way to thoroughly engage the public on water issues. Land use planners can therefore use the comprehensive planning process to better understand the public's concerns and attitudes toward water resources. In some cases, the planning process can reveal that water sustainability and resiliency are top concerns of residents; in others, it may reveal that the public knows little about where their water comes from. Incorporating water into a comprehensive plan's



The land use map and correlating water supply of different development in the City of Westminister, Colorado. A comprehensive plan presents a great opportunity to compare the projected water use of potential development in the land use map; it also provides a strategy to consider how changes in land use may affect future water supplies. The heights of the buildings in this figure demonstrate projected water demand which the City can compare to overall available water. *Source: City of Westminister.*

future vision also enables planning boards, elected officials, property owners, developers, and business owners to consider how development patterns, land use, and urban form will influence water use and quality. It also helps them understand how physical water resources may influence the location and costs of development.

Water should be a main consideration in establishing the future land use map within the comprehensive plan. Without factoring in water, elected officials and planning staff may make land use decisions that the water management agency does not have the infrastructure to support, such as high-density development in areas without sufficient water lines or pumping capacity. This type of scenario is not uncommon when land use planning and water management agencies are particularly disconnected. Land use planners must collaborate with water management agencies on future development expectations, typically reflected on a future land use map, to avoid these issues. Furthermore, urban form profoundly influences water resources. Compact



Box 3.1

Equity and Public Participation

Public input strengthens the comprehensive plan and can lead to more equitable outcomes. Public participation, along with community outreach, is crucial for identifying and cocreating solutions with residents so that land use and water management decisions equitably distribute benefits among communities. Increasingly, land use planners are recognizing and striving to rectify the role that land use planning has played in creating inequity in communities across the U.S. (Ross et al. 2019). The California Local Government Commission (2020), for example, recommends eight guiding principles for equity during coordinated land and water planning:

1. Acknowledge and re-evaluate previous histories of inequitable decision making.
2. Require all planning processes and projects to develop a plan for building authentic community relationships.
3. Increase and promote accessibility to public meetings, whether online or in person.
4. Foster two-way communication and reciprocity with your community.
5. Focus on building relationships with local organizations or informal groups that are already engaging with marginalized communities.
6. Coordinate with partner agencies and across internal departments to leverage resources, staff, and data to address engagement fatigue.
7. Ensure that governments are responsive to the interconnectedness of community concerns.
8. Establish an advisory committee, task force, or community decision-making body to inform local planning processes and support marginalized communities in owning and shaping environmental solutions.

Islais Creek Adaptation Strategy Community Meeting #1.5, hosted by the San Francisco Planning Department. Public engagement is a great way for residents to present concerns related to water resources and provide input on restoration projects or for specific water planning projects. *Source: 2015 San Francisco Planning Department/Flickr.*

development, infill development (building within an existing urban footprint), and smaller lot sizes, for example, generally have lower water demands than single-family homes on large lots (Clarion Associates 2015). Similarly, green spaces, pervious surfaces, and green infrastructure all help manage stormwater for flood control. Water management agency staff, who have an intimate understanding of the community's hydrology, are keenly suited to advise where infrastructure for flood control would be most beneficial. Land use planners should follow these recommendations to designate open space zoning and certain building types, as well as plan densities accordingly. Such land use interventions can also improve water quality, as described in the next chapter.

Finally, water can be woven into the comprehensive plan's policies, procedures, and implementation, to enable a community to proactively and innovatively protect and sustain its water supply. The comprehensive plan may recommend policy changes to land use codes to better convey stormwater, or it may create new programs that incentivize water conservation. It may also shift funding priorities, or suggest new ordinances or regulations, such as restrictions on outdoor water use in regions facing drought and tight water supplies. While such changes can be made without support from the comprehensive planning process, the comprehensive plan establishes a legal foundation that is more defensible, especially when coupled with strong public collaboration.

State Requirements for Water in Comprehensive Plans

Some states require a water element within the comprehensive plan, but ascertaining which ones do so is not simple or straightforward. Fourteen states have requirements related to water, but these vary from a mandatory water element, or stand-alone chapter (five states), to water required as a subject within another element, or chapter (five states), to water required as a topic, but without much further explanation (four states). Additionally, some states call for water as an option within the comprehensive plan, with varying guidance on where to incorporate water into the plan. Table 3.1 summarizes work from Pettit and Shah 2021 classifying statutes related to water in comprehensive planning.

States that require a water element are primarily concerned with ensuring lasting, reliable supplies of water into the future. These states require communities to include an analysis of future water demand to

guide their planning. Arizona and Maryland have the most detailed requirements for a water element:

“...A water resources element that addresses: (a) The known legally and physically available surface water, groundwater and effluent supplies. (b) The demand for water that will result from future growth projected in the general plan, added to existing uses. (c) An analysis of how the demand for water that will result from future growth projected in the general plan will be served by the water supplies identified in subdivision (a) of this paragraph or a plan to obtain additional necessary water supplies... (F) The water resources element of the general plan does not require: 1. New independent hydrogeologic studies. 2. The city or town to be a water service provider” (AZ Rev Stat § 9-461.05 (D)).

“...(a) Considering available data provided by the Department of the Environment, the water resources element shall identify: (1) drinking water and other water resources that will be

Table 3.1

Types of Requirements in Statute for Water in Comprehensive Plans

Type of Requirement	State
Water is Required as an Element	AZ, DE, FL, MD, PA
Water is Required as Part of Another Element	NJ,** RI, SC, WA, WI
Water is Required but Not Detailed	CA, CT, HI, SD*
Water is an Optional Element	MT, VA
Water is an Optional Part of Another Element	ID, IN, MN, NV, NH, VT
Water is Optional Within Objectives, Goals, Purpose	AR,* IA, IL, ME, UT
Water is Optional Within Location, Character, Narrative	AL, CO, KY, LA, MI, ND, NJ,* NM, NY,** OH, OR, SD,** TN, TX, WY
Water is not Mentioned	AK, AR,**** GA, KA, MA, MS, MO, NE, NY,**** NC, OK, WV
	*Only for Counties ***For Cities and Towns **Only for Municipalities ****For Counties, Cities, and Towns



Maryland is one of the few states that requires a water element within comprehensive plans. Maryland communities must consider water availability and potential impacts to water quality within the comprehensive plan, partly because this requirement was initiated to assuage drought and water quality degradation. *Source: The Washington Post/iStock/Getty Images Plus.*

adequate for the needs of existing and future development proposed in the land use element of the plan; and (2) suitable receiving waters and land areas to meet stormwater management and wastewater treatment and disposal needs of existing and future development proposed in the land use element of the plan” (MD Land Use Code § 3-106 (a)).

The five states that require water as part of another element do so in the land use (zoning types) element or in a public facilities and services element. Four states include a cursory mention of water within comprehensive planning requirements. For example, Hawaii’s statute states that “county general plans should: (1) Contain objectives to be achieved and policies to be pursued with respect to... water and sewage system locations,” without further direction about what these objectives or policies should entail (HI Rev Stat § 226-58).

Some of the states under the “optional” planning categories require water planning but fall short of mandating it in comprehensive plans. Montana, for example, requires counties to have growth policies that must include a strategy to develop and maintain drinking water systems, sewer systems, and water treatment plants; however, it does not require comprehensive plans (MT Code § 76-1-601). Virginia simply

specifies that the comprehensive plan “may include” provisions for the sustainability of water resources (VA Code § 15.2-2223). The states that include water as an optional part of another planning element most often recommend placing it within a public facilities, conservation, or natural resources element (Pettit and Shah 2021). Some states describe water within the goals, objectives, or policies of the plan, in which case the statute language states that the plan “may” make goals or recommendations about various aspects of water management, from stormwater to water supply. Finally, several states mention that the physical location of water or water services may be included within the narrative description and land use map of the community. Alabama’s language provides an example: “The plan, with the accompanying maps, plats, charts, and descriptive matter shall show the commission’s recommendations for the development of said territory, including, among other things, the general location, character and extent of streets, viaducts, subways, bridges, waterways, waterfronts... the general location and extent of public utilities and terminals, whether publicly or privately owned or operated, for water, light, sanitation...” (AL Code § 11-52-8(b)).

Table 3.2 lays out the water-related topics included in state statutes, whether required or optional. The statutes referenced in the table are summarized in Appendix A.

The state statutes provide some insight as to which water-related topics are likely most prevalent in plans nationwide. The location and character of water resources, often an optional and minimal reference, is the most common topic included in statute. Water supply, wastewater, water quality, and stormwater—the components of a water system that are crucial for holistic management—are the next most referenced topics. They are the primary focus of integrated water management, as described in the next chapter. Maryland, Rhode Island, Vermont, and Wisconsin notably cover stormwater, wastewater, and water supply. Communities in these states that may be seeking extra justification for pursuing an integrated water management approach can point to their state statutes referencing all of these necessary components for integrated water management.

Finally, a select number of states cover unique but significant additional water topics. Arizona and Rhode Island discuss water demand—a particularly vital topic for states that are managing drought or the burden of rapid population growth. Several states mention recreation as important to a comprehensive plan, but only Maine does so in the context of water resources and access to surface water specifically (30-A ME Rev Stat § 4312). Montana has interesting provisions for including water for agriculture and water for firefighting within its county growth policies; however, these provisions are separate from comprehensive plans (MT Code § 76-1-601). Finally, Utah is the only state that specifically mentions water rights, even though water rights are somewhat contentious across all the Western states (UT Code § 17-27a-401).

Table 3.2

Content of Water Topics in Comprehensive Plans

Water Topics	State(s)
Location and Character	19 states (38%): AL,* CA, CO,* HI, ID,* LA,* ME,* MI,* MN,* MT,* ND,* NH,* NJ,** NM,* NY,* OH,* SD,** TN,* WY*
Water Supply	18 states (36%): AZ, CO,* DE, IA,* ID,* IL,* MD, ME,* MN,* NJ, NV,* PA, RI, SC, SD, VA,* VT,* WI
Wastewater	12 states (24%): DE, FL, IA,* ID,* IN,* MD, MN,* MT,* RI, SC, VT,* WI
Water Quality	11 states (22%): CT, IL,* IN,* ME,* NH,* PA, SD, UT,* VA,* VT,* WA
Stormwater	10 states (20%): AR,* IA,* IN,* KY,* MD, NH,* NJ, RI, VT,* WI
Water System	8 states (16%): AR,* FL, MT,* NJ, RI, SC, VA,* VT*
Groundwater Recharge	3 states (6%): AR,* FL, WA
Water Demand	2 states (4%): AZ, RI
Recreation	1 state (2%): ME*
Water for Agriculture	1 state (2%): MT*
Water for Fire Protection	1 state (2%): MT*
Water Rights	1 state (2%): UT*
	* Not required ** Not required for NJ counties and SD municipalities; required for NJ municipalities and SD counties



Context for Select States' Water Elements

Including water in a comprehensive plan elevates water resource management to one of the top variables influencing a community's future.

Often, an event or situation causes a state to require that water be included in the comprehensive plan; however, the driving forces may vary from state to state. For example, Arizona's Growing Smarter and Growing Smart Plus legislation at the turn of the 21st century spurred the state's requirement that water supply availability be included in comprehensive plans. Policymakers designed the legislation to help manage Arizona's fast population growth and protect its cultural and natural resources. Analysis completed a decade after these acts passed showed a clear impact on Arizona comprehensive plans; in particular, many communities noted the legislative requirements within the narrative of their plans (Witherspoon 2008). A more recent review of Arizona comprehensive plans shows that communities still highlight the water resources element more often than do neighboring states with similar growth and water scarcity issues that do not require a water element (Rugland 2021a).

Colorado adopted legislation in 2020 detailing the components of a voluntary water element. The legislation was brought to a vote unsuccessfully twice before

Philadelphia is featured as a case study in chapter 5 due to its innovations in integrating land use and water management. The Pennsylvania constitution includes a right to clean air, pure water, and the collective enjoyment of natural resources. *Source: f11photo/iStock/Getty Images Plus.*

it succeeded in 2020 because of its voluntary nature. Nonetheless, this provision is strongly connected to the state's 2015 Water Plan, which includes a goal that "by 2025, 75 percent of Coloradans will live in communities that have incorporated water-saving actions into land use planning" (Colorado Department of Natural Resources 2015). Although the provision is voluntary, advocates hope that it will spur communities to reach the state's Water Plan goal.

Florida statute has required a water element in comprehensive plans since 1985, when the state experienced such intense population growth that local governments were unable to provide all residents with public services, from water to roads. Water was included as a mandatory element to enable local governments to strengthen public services even amid rapid population growth (Pettit and Shah 2021). The Hillsborough County case study in chapter five demonstrates how Florida communities continue to plan to stay ahead of the state's ongoing rapid growth.

Droughts in Maryland in the 1990s that caused water supply issues and exacerbated local water quality

issues led the state to require a water element in comprehensive plans. Water quality is extremely important in Maryland, which is dedicated to restoring the Chesapeake Bay. Maryland mandated the water resource element in 2006, giving communities until 2009 to implement it (Pettit and Shah 2021).

Pennsylvania has included water in its comprehensive plans since 1968, when it drafted its original planning legislation. The state constitution includes a right to clean air, pure water, and the collective enjoyment of natural resources (Pettit and Shah 2021). This enabling environment has led to incredible innovations in water management, such as Greenworks Philadelphia, explored more in chapter five.

Structure of a Water Element

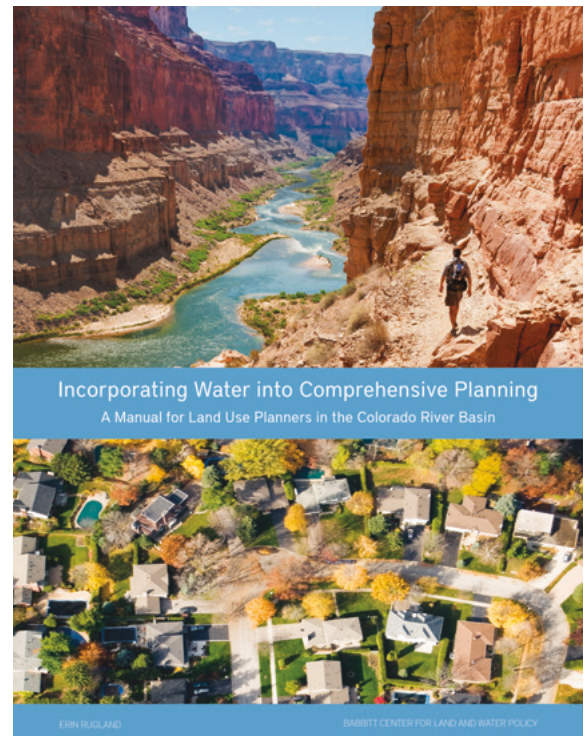
Each community must decide how to include water within the comprehensive plan. There is no “one-size-fits-all” approach. Because state requirements are minimum guidelines for local implementation, the actual structure of water-related information within a comprehensive plan can be as unique as the community writing the plan.

A standard approach is to write a water element, or stand-alone section, that includes: 1) a narrative description of a community’s water resources, 2) projections about how population growth and proposed land use changes will impact water resource

management, and 3) the proposed plan the community will follow to strengthen its water management and address future challenges. Water elements are beneficial in that they nicely package together all water-related information within the comprehensive plan. However, it is crucial to avoid isolating this approach within the comprehensive plan. Truly integrating water management with land use planning requires that water management influence other areas of the plan, including housing, economic development, transportation, and environmental sustainability. Communities that write a water element should therefore ensure that relevant water-related information is also woven throughout the plan vision, community profile, future land use map, other plan elements, narratives, and implementation actions (Rugland 2020).

Some planners find the concept of planning elements to be rigid or outdated. In fact, many comprehensive plans are now organized thematically or according to guiding principles, rather than separated into topics by discipline or department. In these cases, water is not

The Babbitt Center for Land and Water Policy authored a manual to help land use planners incorporate water into comprehensive plans. This report builds on research into comprehensive planning in seven Western states and recommends structure and topics to most effectively use the comprehensive plan to support water management goals. *Source: 2020 Babbitt Center for Land and Water Policy, Lincoln Institute of Land Policy.*



its own element, but is instead included as a content area within a natural resources, environmental sustainability, or public facilities and services theme.

A community's comprehensive plan is both its guiding vision and a document that decision makers, community members, and businesspeople use to understand their roles and opportunities within a community.

The urgency of water issues may factor into how land use planners integrate water within a community's comprehensive plan. When a water issue is a pressing concern, a separate water element can make a great addendum to a comprehensive plan that is otherwise up to date (Curgus 2020).

Whichever approach land use planners choose to follow, they should be sure to collaborate with the water management agencies serving the community, and to draft a plan that influences—as appropriate—the

land use decisions made within the comprehensive plan as a whole.

Further information about water elements and the logistics of incorporating water into a comprehensive plan can be found in Rugland 2020, Nolan Blanchard 2018, Gallet 2018, and Curgus 2020.

A community's comprehensive plan is both its guiding vision and a document that decision makers, community members, and businesspeople use to understand their roles and opportunities within a community. Water resources should be protected and soundly managed as part of any comprehensive plan. Existing state statutes provide a variety of examples of how water could be included within a comprehensive plan, but represent only the minimum requirement for communities in any such state. States have been motivated to include water within comprehensive planning statutes largely because a water management crisis has raised the profile of the issue. Communities can head off this crisis if they proactively and deliberately include water in their comprehensive plan. Doing so will help them address water management challenges and provide continuous, reliable, safe water services to their residents.



A canal running through Scottsdale, Arizona, a city with one of the most sophisticated recycled water facilities in the world. Scottsdale's Advanced Water Treatment plant is the first in Arizona and third in the nation to be permitted for direct potable reuse. *Source: BCFC/iStock/Getty Images Plus.*

CHAPTER 4

The Role of Water Management Plans



Water management agencies provide some of the most critical functions of any community department: the provision of clean drinking water, wastewater services, and/or stormwater management. Planning is crucial to their success. As service entities, water management agencies typically hesitate to impose mandates on their customers. Even when water management agencies offer water conservation programs, they are often voluntary or incentivized rather than required. Connecting with land use planners can open the door to expertise on policymaking to strengthen water management, as well as on public engagement and participation.

Wastewater treatment facility in Houston, Texas. Water management plans are often primarily concerned with infrastructure maintenance and capacity, overall service provision, the viability of water supplies, and water demand management programs. *Source: Jupiter Images/iStock/Getty Images Plus.*



The Tres Rios water treatment area in Phoenix, Arizona, is a unique water treatment area using nature-based solutions to improve water quality. [Source: Phoenix.gov](#)

Water Management Planning Overview

Water management planning tends to be long term and big picture, addressing, for example, whether there is enough water for current and future customers 20, 30, or 40 years into the future. Some water management agencies use even longer time horizons. Water management plans differ from comprehensive plans in that they function primarily as operating plans for the agency, not as public documents or as a vision for the community. As such, the makeup of water management plans can vary widely from agency to agency and among states. Furthermore, no single go-to water resources management plan akin to the comprehensive plan exists. Water management agencies may write separate plans for water supply, source

water protection, water efficiency, water management, stormwater management, wastewater, emergency response, or capital improvements.

The water planning discipline is less developed than the land use planning discipline, in that it lacks longstanding, consistent frameworks. This is partially because water management is so local; it is driven by the unique history, water doctrine, geography, hydrology, and climate of a region. Existing water planning frameworks tend not to draw from existing literature, whether within water resources or the planning field (Furlong et al. 2016). Water planning can also be fractured, with the particular services that a water management agency provides—whether drinking water, wastewater, flood control, stormwater management, or any combination thereof—determining the

Box 4.1

Integrated Water Management

No discussion of water management planning is complete without integrated water management, which breaks down silos among water management agencies to promote holistic, integrated water systems from drinking water to wastewater to stormwater. Its planning process will most robustly enable water management agencies to address water challenges within their jurisdiction. Integrated water management strives to create more secure, adaptive, and resilient water systems through “inclusive and jointly planned management of wastewater plants, water supply systems, stormwater collection, and source

water” (Mayo and Spangler 2016). Water management agencies are increasingly aware that integrated water management needs to include sectors outside water management—such as planning, landscaping, design, and architecture.

Consequently, many water management agencies produce plans according to their needs, duties, and legal requirements; as such, they may have a plan that selects among water management topics as necessary. A recent review of state requirements for water management planning revealed the extent to which water management planning varies (Dickinson et al. 2021).

Table 4.1

Topics Required within Water Management Plans According to State Statute

Topic	States Requiring Topic in Water Management Plans
Supply Assessment Forecast	23 states (46%): AL, AZ, CA, CO, CT, HI, IA, KY, MD, MI, MN, NV, NH, NM, NY, NC, OR, RI, SC, UT, VA, WA, WV
Supply/Demand Challenges	21 states (42%): CA, CT, HI, IN, IA, KY, MI, MN, MO, NV, NH, NY, NC, OH, OR, RI, SC, VA, WA, WI, WV
Water Quality	20 states (40%): AL, CA, CT, HI, IN, KY, MD, NH, NJ, NY, NC, OH, OR, RI, TN, UT, VT, VA, WA, WV
Water Conservation/Efficiency	19 states (38%): AZ, CA, CO, CT, IA, KY, MD, MN, NV, NM, NY, NC, OR, RI, SC, TX, VT, VA, WA
Water Infrastructure	19 states (38%): AZ, CA, CO, CT, HI, IN, KY, MD, MN, NV, NH, NJ, NY, NC, OR, RI, VA, WA, WV
Demand Forecast	16 states (32%): AZ, CA, CT, HI, IN, KY, MD, MI, MN, NV, NM, NC, OR, RI, VA, WA
Drought	16 states (32%): AL, AZ, CA, CT, KY, MN, NV, NM, NY, NC, OH, RI, SC, TX, VA, WA
Other Specific Requirements	16 states (32%): AL, CA, CO, CT, HI, KY, MN, NV, NY, NC, OR, TN, TX, UT, VA
Water Management	10 states (20%): AZ, CA, CO, CT, MN, OR, RI, SC, TX, WA
Stormwater	1 state (2%): MD
Climate Change	1 state (2%): CA

planning it undertakes. Water management agency staff may therefore have the added task of breaking down silos, not only among themselves and the land use planning agency, but among themselves and other water service providers. Additionally, capital planning and asset management are crucial considerations for water agencies when “the water sector is one of the most capital-intensive utilities in the United States, more so than other regulated utilities,” according to the American Water Works Company (Duffy 2015). Water management agencies must also ensure they meet federal standards, such as those set by the Safe Drinking Water Act, and release regular reports to demonstrate compliance with such standards.

STATE REQUIREMENTS FOR WATER MANAGEMENT PLANS

The 11 topics in table 4.1 show the diversity in state requirements for water management plans.

“Other specific requirements” is a catchall category that includes topics such as emergency management,

water system energy use, and administrative provisions for detailed implementation plans and enforcement. The most popular requirement is a supply assessment forecast; however, fewer than half of the states in the country require this.

The way states require each of these topics to be addressed also varies widely. According to Dickinson et al.:

“The detail required for each of these topics varies significantly from state to state. Generally speaking, Arizona, California, Connecticut, Hawaii, Kentucky, Nevada, North Carolina, Oregon, Rhode Island, Virginia, and Washington have the greatest depth and breadth of detail required for mandatory water supplier plans, although most are stronger on some topics they cover than others. Some of the other states require extensive detail on one or more of the few topics they require in the plans” (Dickinson 2021 4).



Kentucky and Virginia both require water quality to be included within a water management plan, but their descriptions of this differ. Kentucky water providers must describe threats to water quality for watersheds or water recharge areas and existing regulations that guard against such threats, and provide policy recommendations for further water quality protection (401 KY. ADMIN. REGS. 4:220(6)(9)). Virginia, in contrast, is primarily concerned with water quality as it relates to in-stream flows, endangered species, recreation, and fisheries, and it requires a description of these environmental conditions (9 VA. ADMIN. CODE § 25-780-90(B)).

These two states demonstrate the range of information that could be required even under the same topic area. Neither approach is necessarily better or worse. Rather, the approaches may reflect the water quality needs of communities within each state's jurisdiction or the specific circumstances that inspired the passage of these requirements. Nonetheless, the varying definitions mean that water management plans within these states will include very different content, despite addressing the same topic.

An irrigation canal in Blythe, Riverside County, California, the fourth most populous county in the state. This Southern California county relies heavily on surface water diversions from the Colorado River to sustain its agricultural economy and is a battleground of land ownership and water rights as Colorado River supplies grow scarce. *Source: benedek/iStock/Getty Images Plus.*

The Southwest provides another example of differing approaches states may take to address a similar problem. The three driest states in the nation—Nevada, New Mexico, and Arizona (NOAA National Centers for Environmental Information 2021)—all have different requirements for water conservation within water management plans (table 4.2). Arizona focuses primarily on water leaks (“lost and unaccounted for water”), rate structures, and conservation education programs. New Mexico specifies a list of best practices that the water management agency must include. Besides water conservation, which is New Mexico’s most in-depth requirement, the state does not otherwise have robust requirements for water management planning. Nevada describes best practices for water conservation and requires estimated costs and implementation measures.

The differences among Arizona, New Mexico, and Nevada exemplify how even closely related states may use various methods to achieve the shared goal of reducing water use. The range of water management strategies and data needed for a water management plan varies widely, and many methods can strive to achieve the same goal. Furthermore, states may use

other mechanisms, besides statutory requirements, to mandate water management programs. In Arizona, for instance, water providers in groundwater management areas are subject to the conservation requirements of the Department of Water Resource's management plans. State statute does, however, grant authority for these plans.

Table 4.2

Water Conservation Requirements in Arizona, New Mexico, and Nevada

<p>Arizona (Ariz. Rev. Stat. § 45-342(J))</p>	<p>...1. Feasible measures that may be implemented to determine and control lost and unaccounted for water. 2. Consideration of water rate structures that encourage efficient use of water, as set by the community water system's governing body, subject to approval by the corporation commission if the community water system is a public service corporation. 3. A continuing conservation education program containing provisions to actively inform the public of drought conditions and information regarding conservation measures to reduce vulnerability from drought conditions...</p>
<p>New Mexico (N.M. STAT. ANN. § 72-14-3.2(D))</p>	<p>...a. water-efficient fixtures and appliances, including toilets, urinals, showerheads, and faucets; b. low-water-use landscaping and efficient irrigation; c. water-efficient commercial and industrial water-use processes; d. water reuse systems for both potable and nonpotable water; e. distribution system leak repair; f. dissemination of information regarding water-use efficiency measures, including public education programs and demonstrations of water-saving techniques; g. water rate structures designed to encourage water-use efficiency and reuse in a fiscally responsible manner; and h. incentives to implement water-use efficiency techniques, including rebates to customers or others, to encourage the installation of water-use efficiency and reuse measures.</p>
<p>Nevada (NEV. ADMIN. CODE ch. 704, § 567)</p>	<p>...1. Water surveys for single-family residential customers and multifamily residential customers; 2. Programs to encourage retrofitting of residential plumbing; 3. Water audits, leak detection and repair; 4. The use of water meters with commodity rates for new connections and the retrofitting of existing connections; 5. Incentives and other programs of water conservation for golf courses, parks, school grounds, and other large landscapes; 6. Rebates or other incentives for the purchase of high-efficiency washing machines; 7. Programs of public information; 8. Educational programs in schools; 9. Conservation programs for commercial, industrial, governmental, and other customers; 10. The use of conservation pricing; 11. Employment of a person to coordinate the utility's programs of water conservation; 12. Prohibitions against wasting water and measures for the enforcement of those prohibitions; 13. A program to encourage residential customers to replace existing toilets with ultra-low-flush toilets; and 14. Incentives for the reclamation of water and the use of reclaimed water...</p>

The Land Use Connection in Water Management Plans

Water agencies can better manage the land use origins of their water issues, such as stormwater problems from impervious surfaces, or groundwater over pumping, when they consider land management approaches. Water management agencies also gain access to more compliance mechanisms when they collaborate with land use planners. For example, research shows that mandatory irrigation restrictions during drought can significantly reduce total water use, whereas voluntary measures are not nearly as effective (Maddus et al. 2020). Acting alone, a water management agency has limited ability to mandate such restrictions. By collaborating with a land use authority, which can codify such a measure and help with enforcement and public awareness, a water agency can significantly strengthen its effectiveness. A water management agency may also consider land management strategies, such as landscape-scale conservation measures and site-scale green stormwater

infrastructure, to solve problems with source water protection, flood control, and water quality; such solutions are more viable through coordination with a land use authority (Mayo and Spangler 2016).

A small number of states require water management agencies to include a land use connection within water management plans. These statutory requirements fall into two broad categories: requirements to inform the content of the plan and requirements for process, or for coordinated planning. Even if a state does not have such a statutory requirement, a water agency could still choose to voluntarily coordinate with a land use authority to create its plan.

Any water management agency can, in fact, learn from and follow the approaches used by states with statutory requirements. They can also find their own way to coordinate land use in their water management plans. The purpose of demonstrating the connection points in statute is to show existing, legally mandated integration of land use considerations within water management plans. The statutes referenced in the sections below are summarized in Appendix A.

LAND USE WITHIN THE CONTENT OF A WATER MANAGEMENT PLAN

Several states require a connection between the water management plan and a land use plan to inform the content of the water management plan. For example, plans are required to:

Controlled burns (pictured here, in Colorado) and other forest management techniques can promote source water protection and maintain high water quality. Water managers and land use authorities could protect watersheds and water quality by collaborating on forest management. However, fire departments and forest management agencies probably must also be involved in this work if they're not already primarily responsible for it.

Source: Erin Rugland.



Minnesota, the “Land of 10,000 Lakes,” is relatively unique in that a state-enabled regional planning agency directs the Twin Cities metropolitan area in water supply and wastewater planning, in addition to parks, transportation, housing, and land use planning. Chapter 5 includes a case study from one of the participating municipalities, Golden Valley. *Source: Tammi Mild/iStock/Getty Images Plus.*



- **Calculate projected water demand according to local land use plans, policies, or zoning, be it through the land use plan’s population projections, anticipated development, or the growth of certain land use types** (Cal. Water Code §10631(d)(4)(A), CONN. AGENCIES REGS. § 25-32d-3, Or. Admin. R. 690-086-0170, R.I. CODE R. 490-00-00-2.8.5(A), WASH. ADMIN. CODE § 246-290-105(4)(k)).
- **Identify critical lands to be protected, land management strategies, or land use control regulations for source water protection and water quality** (CONN. AGENCIES REGS. § 25-32d-3, R.I. GEN. LAWS § 46-15.3-5.1(c), TENN. COMP. R. & REGS. 0400-45-01-.34(1)(f)(7), UTAH ADMIN. CODE 309-600-12, UTAH ADMIN. CODE 309-605-7(6)).
- **Include a narrative description of current and projected land uses of the service area** (Cal. Water Code §10631(a), CONN. AGENCIES REGS. § 25-32d-3, MD. REGS. CODE tit. 26 § 03.01.02(A), WASH. ADMIN. CODE § 246-290-100(4)(a)(iii), (b)(iii)).
- **Assess the potential for new water supply sources according to land use plans, policies, or zoning** (9 VA. ADMIN. CODE § 25-780-90(B), CONN. AGENCIES REGS. § 25-33h-1(d)).

These source water protection statutes are the only ones that require land use planning as a strategy for advancing water management goals, rather than simply as a source of data.

Another unique example is Colorado, which requires specific consideration of “best management practices for water demand management, water efficiency, and water conservation that may be implemented through land use planning efforts” within requirements for water efficiency plans (CO Rev Stat § 37-60-126(4)(f)(I)). Colorado is the only state that requires utilities to consider how land use efforts can reduce water use. The state has adopted a best practices manual, *Best Practices for Implementing Water Conservation and Demand Management Through Land Use Planning Efforts: Addendum to 2012 Guidance Document*, to help water providers meet this requirement; it also assesses water efficiency plans to ensure all requirements are addressed (Castle and Rugland 2019). To incentivize these best practices, Colorado ties some state funding for communities to whether they have an up-to-date water efficiency plan on file with the Colorado Water Conservation Board.

In addition to the statutes provided here, land use is inherently relevant to the content of a water management plan when it comes to landscaping, stormwater management, and physical infrastructure. Landscaping requirements are rarely detailed at the

state level, although some states may have landscaping provisions by executive order, such as California's Model Water Efficient Landscape Ordinance (California Department of Water Resources 2021). The specifics of landscaping provisions are often left to communities or the water management agency itself; statutes may only require that a water management plan consider or describe its low-water-use landscaping policies, as in the case of New Mexico, Nevada, and Virginia, among others. Nonetheless, landscaping clearly represents a site-specific tie to land use, whether through turf requirements or restrictions, required plant lists, or other parameters that residential or commercial developers must follow in their site design and construction.

Green infrastructure stormwater management techniques offer a strong connection to land use planning because they often require land use tools to enable additional green space, open space, pervious pavement, or green streets.

Stormwater management is similar. Green infrastructure stormwater management techniques offer a strong connection to land use planning because they often require land use tools to enable additional green space, open space, pervious pavement, or green streets. The Philadelphia case study in chapter five clearly demonstrates this. Finally, the infrastructure a water management agency maintains has land use implications in its physical footprint. Many water management agencies will coordinate with land use authorities to establish policies about water service provision such that service lines are not unnecessarily extended. They may create policies to prioritize water service to urban development, discourage new water service to areas with low population density, or discourage water service to high elevations that would require energy- and water-intensive pumping infrastructure.

REQUIRED COORDINATION BETWEEN WATER MANAGEMENT PLANS AND LAND USE AUTHORITIES

Ten states require coordination between water management plans and land use authorities. Half of these requirements entail specifically coordinating with local comprehensive plans, whether through the land use authority or by ensuring consistency between the plans (CONN. AGENCIES REGS. § 25-33h-1(g), GA. COMP. R. & REGS. r. 391-3-32(4)(c)(2)(vii), MD. REGS. CODE tit. 26 § 03.01.02(A), R.I. GEN. LAWS § 46-15.3-5.1(c)(1)(viii), WASH. ADMIN. CODE § 246-290-100(7)). Consistency can entail that water management and comprehensive plans:

- Be updated and maintained in tandem;
- Address potentially inconsistent actions through plan amendments to maintain consistency; or
- Require consultation with and sign-off by the other agency.

California, Connecticut, and Kentucky require notifying land use authorities of the water management plan and allowing for comment (Cal. Water Code §10621(b), CONN. AGENCIES REGS. § 25-32d-5(d), 401 KY. ADMIN. REGS. 4:220(6)(2)). Oregon encourages, but does not mandate, consultation with a land use authority while developing a water management plan (Or. Admin. R. 690-086-0120(7)). Florida specifies that local land use plans must be considered for district or regional water planning activities, but this is not the case for individual water management agencies (FL Stat § 373.709). Maine requires coordination between sewer districts and municipal officials specifically, but not necessarily for other water service entities (38 ME Rev Stat § 1037(1)).

Such requirements for coordination, save for those ensuring consistency between the plans, may not impact a water management plan's actual content if such coordination is superficial. Nonetheless, collaboration between water management agencies and land use authorities is key for implementing integrated land



use and water management, and requirements for coordination may help open the door for such collaboration.

The relatively undefined and flexible nature of water management plans allows individual water management agencies to create plans that are best suited to their needs, duties, and responsibilities. Given this flexibility, land use can be incorporated into water management plans in a variety of ways—unless water agencies are bound by specific statutes.

Some states require coordination between water management agencies and land use authorities in developing water management plans. Many more states require that water demand projections, source water protection, descriptions of the service area, and investigation of new potential water supply sources be included in water management plans. Further, demonstrable connections within landscaping provisions, stormwater management, and infrastructure planning underscore the logic of incorporating land use planning.

The California Aqueduct flows in Palmdale, California. The Aqueduct delivers water to Southern California from the Sacramento–San Joaquin Delta, 444 miles to the north. The system pumps water over the Tehachapi Mountains and stores it for distribution in lakes north of Los Angeles. *Source: Jim Keller/iStock/Getty Images Plus.*

The state of Colorado is an innovator in this space, requiring water providers to consider land use planning efforts to aid water efficiency goals. Coordination is another connection point states have required between water management plans and the land use planning entity. A minority of states require a land use connection, but individual water management agencies can learn from these states. Agencies can voluntarily integrate such requirements into their own planning practice, regardless of their own state's lack of rules, as long as they still meet state directives.

CHAPTER 5

Successes of Land and Water Integration



A rain garden manages stormwater runoff in Philadelphia's Germantown section.

Rain gardens are one of many small-scale green infrastructure interventions that can retain stormwater and improve its quality, as well as provide valuable green space within a community. *Source: 2018 Philadelphia Water Department*

A growing number of communities and water management agencies across the country are integrating land and water planning to forge a more sustainable future. This chapter highlights four such communities' efforts, from Tampa Bay, Florida, to a bedroom community in Colorado. Each case study outlines the community's context, water resource management challenges and opportunities, planning effort and goals, and early implementation successes. Last, each case study highlights how the community's plan has fomented other land and water integration activities.

Creating Momentum Through Planning in Evans, Colorado

The City of Evans is a suburban community located in Weld County, within the South Platte Basin of Northeastern Colorado. The South Platte Basin has limited water supplies, with nearly all water rights appropriated for existing uses under normal-year precipitation conditions. Thus, any new use of water within the basin must be taken from an existing use. Most often, this occurs when municipalities buy agricultural water rights from willing sellers. Stakeholders within the South Platte Basin and throughout Colorado are, however, discouraging this “buy and dry,” phenomenon, as large-scale shifts of water from agriculture to municipalities carries potential economic and food security implications. Smaller suburban and rural communities in particular prefer to preserve and protect local agricultural operations for both economic and cultural benefits. Further, some areas and some local rivers depend on water runoff from agriculture to maintain water flows and downstream water deliveries. Shifting agricultural water to municipal use would reduce the amount of water that is returned to the

ivers. Nonetheless, conserving and reusing existing water supplies is the most effective way for municipalities in water-limited regions to continue to grow. At the same time, municipal water conservation and reuse can pose a threat to river health if they reduce the amount of water returning to the river as runoff or discharge (West Sage Water Consultants and HDR Engineering 2015).

Evans has a population of more than 21,000 people with a projected growth rate of 2 percent per year. It’s a small community, just 10.5 square miles in size (or roughly 6,740 acres) (City of Evans 2019). The city’s 2019 Municipal Water Efficiency Plan projects its 2028 water demand—its planning horizon—at 3,247-acre feet. That projected demand is less than its current reliable supply of 3,520-acre feet per year.

The City of Evans is on its way toward becoming a leader in integrating land use and water management. The City’s Parks Division oversees and maintains 12 developed parks and open space areas totaling 220+ acres and more than 13 miles of mixed-use trails. *Source: City of Evans, CO, Parks Division*



Nonetheless, given the region’s water-limited context and anticipated population growth, Evans is planning for a future of sustainable water management. In particular, the City prioritizes water conservation so that it can grow efficiently and sustainably within its water supply limits, create a buffer of water supplies during drought or other emergency situations, and delay or prevent the purchase of expensive regional water supplies. The City further prioritizes water conservation to stay within current water treatment capacity and delay increased water treatment expansion costs.

The City of Evans adopted its updated Municipal Water Efficiency Plan in 2020. Colorado water providers selling more than 2,000 acre-feet of water per year are required to submit and update such plans to the Colorado Water Conservation Board every seven years. Legislation passed in 2015 expanded the requirements of these plans to include “best management practices for water demand management, water efficiency, and water conservation that may be implemented through land use planning efforts,” for which special guidance was released in 2019 (Castle and Rugland 2019). Evans’s 2019 Municipal Water Efficiency Plan updated its previous 2009 plan with new data and implementation actions, including those related to land use planning.

The Municipal Water Efficiency Plan was in fact an exercise in integrated land and water planning, drawing upon the city’s 2010 Master Plan as one of its information resources. The water efficiency plan covers the features of Evans’s existing water supply system, provides a profile of existing water demand and the water efficiency activities the City has pursued to date, sets out its water efficiency goals, identifies future water efficiency activities, and lays out an implementation and monitoring plan of these water efficiency activities. The plan identifies 34 water conservation activities that the City will prioritize for implementation. Of the land use activities identified in *Best Practices for Implementing Water Conservation and Demand Management Through Land Use Planning Efforts: Addendum to 2012 Guidance*

Document (Castle and Rugland 2019), Evans will pursue the following activities:

- outdoor watering restrictions;
- a water waste ordinance;
- irrigation system standards for new development;
- 10 percent lot irrigation area restriction;
- wind and rain sensors;
- a restrictive covenants ordinance;
- landscape design ordinances and restrictions, and
- a xeriscape demonstration garden.

All 34 activities are projected to save the city 498-acre feet of water by 2028, reducing projected demand to 2,749-acre feet, which is 15 percent less than originally projected without the water efficiency activities.

The creation of the 2019 Municipal Water Efficiency Plan was a critical step on Evans’s journey to integrate water and land use. The City is currently updating its 2010 Master Plan, with data from its Water Efficiency Plan to inform land use planning decisions and policies. It is including both a Water Conservation/Stewardship Chapter into the Master Plan update and integrating water conservation principles into the plan’s development, housing, ecological, and infrastructure chapters. Significantly, the City will now receive assistance from WaterNow Alliance’s Project Accelerator, as a result of its Water Efficiency Plan. WaterNow Alliance and Western Resource Advocates will provide Evans with additional expertise to implement two of the water conservation activities identified within the Water Efficiency Plan: a fixture replacement and installation program, and a water efficiency audit program (Weinfurter 2021). Evans demonstrates that a water efficiency plan can create momentum for implementation actions and other planning efforts, while securing additional resources to carry out the plan’s goals.



Holistic Water Management in Hillsborough County, Florida

Hillsborough County is Florida's third most populous county. Located midway down the western coast of Florida, it encompasses the municipalities of Tampa, Temple Terrace, and Plant City. Even so, 69 percent of its 1,479,095 residents live outside these major urban and suburban populations centers in unincorporated areas. The vast majority of the County—84 percent of its 1,072 square miles—is in fact unincorporated area that includes significant agricultural land uses (Hillsborough County 2020a).

Rapid population growth that could outpace water supply in certain areas, aquifer drawdown, and water quality are key concerns in the region. Tampa Bay Water is the region's major water provider, supplying potable water to multiple counties and municipalities and ultimately serving more than 2.5 million people. Tampa Bay Water has determined that, overall, it will need an additional 10 million gallons of water per day prior to 2028, and up to 20 million gallons of water per day by 2040, to serve the growing population of the region (Tampa Bay Water 2018). Hillsborough County estimates that the population

Scenic reflection after a powerful storm during summer season in Riverview, a municipality in Hillsborough County, Florida. Rapid population growth that could outpace water supply in certain areas, aquifer drawdown, and water quality are key concerns in the region. *Source: Sonia Cervantes/iStock/Getty Images Plus.*

within South Hillsborough County will grow by about 10,000 persons per year by 2025, putting additional constraints on Tampa Bay Water. Though it has the water supplies to meet 2025 needs, Tampa Bay Water currently lacks the infrastructure to satisfy longer-term needs. The agency implemented an ongoing Demand Management Program to reduce annual water demand by up to 11 million gallons of water per day by 2040; however, the program must run for several years before its impact on the County's long-term water supply needs can be assessed.

Hillsborough County and regional water agencies rely heavily on water planning to ensure a sustainable water supply into the future. The Southwest Florida Water Management District (SWFWMD) prepares Regional Water Supply Plans that identify issues and solutions, based on the plans of water suppliers like Tampa Bay Water. Hillsborough County must respond

to the planning activities of both Tampa Bay Water and SWFWMD. Specifically, Florida requires communities to update their comprehensive plans within 18 months of a new Regional Water Supply Plan (Section 163.3177, F.S.). This measure helps ensure that communities coordinate their long-range land use and water planning with the regional entities.

The County follows a traditional local government structure, reporting to the seven members of the Board of County Commissioners (BOCC). The Hillsborough County City-County Planning Commission (Planning Commission), part of Plan Hillsborough, an independent consolidated planning agency, conducts long-range comprehensive planning for all County jurisdictions. Hillsborough County and Planning Commission staff collaborate on long-range planning projects such as water planning.

In 2019, County and Planning Commission staff initiated the “One Water Chapter” update to the 2008 Comprehensive Plan to holistically address water management issues within the County. The 2008 Comprehensive Plan had separate elements for stormwater management, sanitary sewerage, and potable water, with more than 200 goals, objectives, and policies related to water. County technical staff saw the One Water Chapter as a dynamic solution to institutional barriers. In the past, they ran into difficulty with internal processes, like budgeting and project development, when they tried to develop cross-functional projects, because the County manages stormwater, sewer, environmental resources, and drinking water separately. Florida’s 2011 Community Planning Act, however, granted Planning Commission and County staff more flexibility to create a coordinated plan that would reflect the interrelated nature of water.

Additionally, the BOCC had since developed a stronger interest in sustainability and resiliency, and, along with the Planning Commission, provided top-down support for implementing Integrated Water Resource Management concepts (Dickens and Moran 2020).

As a result, stakeholders came together to create the One Water Chapter to provide a framework for new county initiatives, streamline water management activities, reduce duplication and inconsistencies within water management, and enhance implementation. They organized the chapter around six broad goals: protect and preserve water resources, conserve water, integrate water resource management, encourage efficient use of land and redevelopment, implement sustainable infrastructure and programs, and promote low-impact development. By explicitly setting a goal that “the planning and construction of water resources infrastructure should encourage fiscal responsibility and the efficient use and redevelopment of land” the One Water Chapter spurred numerous objectives and policies for land and water integration activities that are now being implemented (Hillsborough County 2020b, 13). For example, the County set new policies to encourage development near existing water infrastructure, restore habitat and repair erosion along the Palm River, and invest in stormwater infrastructure.

The Planning Commission and Hillsborough County staff worked collaboratively with input from many stakeholders, including SWFWMD, the Environmental Protection Commission, Tampa Bay Water, the agricultural community, and the building/development community to develop the chapter—which not only integrates water management, but provides the County with numerous pathways for enhancing water management overall. Since formal adoption in 2020, the One Water group has worked with the Tampa Bay Builders Association on low-impact development and building habitat for protected fish species using reclaimed water (Parsons 2020). The County’s Adopted Capital Improvement Plan for fiscal years 2021–2025 appropriated funds for further implementation activities, including a Watershed Master Plan Update, Septic to Sewer Program, and Aquifer Recharge Program (Hillsborough County 2020a).

Counties that are not water distribution providers, or that lack water management agencies as part of their government, may not feel as empowered as Hillsborough County to integrate land use and water management. However, even Hillsborough County must answer to other water management agencies, such as SWFWMD and Tampa Bay Water. Direction and leadership from the BOCC and planning commissioners, plus the willingness of other agencies to partner on the One Water Chapter, helped catalyze action and success. No matter the regulatory environment, it is always difficult to build an interagency and interdisciplinary working group to unite disconnected water management efforts and connect them to land use policy. But doing so allows staff to overcome their isolation and implement projects that yield incredible benefits for residents. The One Water Chapter and associated efforts should inspire other county governments, even if they are not similarly situated.

Planning to be the Greenest City: Philadelphia, Pennsylvania

Philadelphia, Pennsylvania, is a long-time innovator of urban planning and water supply management. It was one of the only colonies and 17th century towns formed and planned according to a grid system, and it was the first U.S. city to provide its citizens with drinking water, in 1801 (Philadelphia Water Department 2011). Now the sixth-largest U.S. city, with 1,579,000 people, Philadelphia continues to rely on innovative planning to thrive as it strives to be the “greenest” in the nation (City of Philadelphia 2011).

Swann Memorial Fountain at Philadelphia City Hall. Comprehensive implementation of green infrastructure for stormwater management is the City's primary pathway for integrating land and water planning. *Source: f11photo/iStock/Getty Images Plus.*



The City's ambitions to improve environmental quality increased in 2008, when then-Mayor Michael Nutter formed the Office of Sustainability. The sustainability office later created Greenworks Philadelphia, an initiative that lays out core sustainability goals for the city.

Comprehensive implementation of green infrastructure for stormwater management is a key strategy to achieving five of these core goals (Rouse 2013), and the primary pathway for integrating land and water planning in the City.

By 2030, Philadelphia will have the largest network of green infrastructure of any city in the U.S.

Philadelphia's combined sewer infrastructure has not been adequate to meet the stormwater challenges of the 21st century. Like most modern cities, Philadelphia's land is predominately covered with impervious surfaces, such as buildings, roads, and parking lots, that increase stormwater runoff fivefold compared to natural, predevelopment land (Rouse 2013). The City manages runoff primarily with combined sewers that collect stormwater, domestic sewage, and industrial wastewater into one pipe. Normally the combined wastewater is sent to a water treatment plant, then discharged into the Delaware and Schuylkill rivers. During high precipitation events, however, stormwater can overwhelm the system, causing flooding, overwhelming wastewater treatment plants, eroding landforms, and degrading water quality.

With combined sewers, stormwater can also rush into the city's sanitary pipes that carry sewage, causing them—and their contents—to rise and flow as untreated sewage mixed with stormwater into the city's waterways, which also serve as their drinking water sources.

The U.S. Environmental Protection Agency's National Combined Sewer Overflow Control Policy requires cities with combined sewer overflow systems to create Long-Term Control Plans to ensure the contaminants do not impact waterways, ecosystems, and drinking water sources in violation of Clean Water Act standards. The Philadelphia Water Department decided to be innovative in its compliance with this policy. Rather than invest in more gray infrastructure—costly pipes, underground storage tanks, and expanded treatment capacity—the City decided to tackle the root of the problem and create green spaces, rain gardens, bioswales, porous pavement, and other green interventions that reduce stormwater runoff and contribute to stormwater infiltration near where the rain falls.

Green City, Clean Waters, is a 25-year plan approved and initiated in 2009 to guide Philadelphia's green infrastructure implementation. By 2030, Philadelphia will have the largest network of green infrastructure of any city in the U.S. Goals of the plan include widespread implementation of green stormwater infrastructure facilities throughout the City, incentives for green infrastructure implementation on private lands and business properties, a street tree installation program, improved recreational access to local waterfronts, and increased preserved open space to result in improved water quality (Philadelphia Water Department 2011). Planners used a Triple Bottom Line sustainability analysis, which considers financial, environmental, and social benefits, to arrive at the best solutions. For example, the analysis showed that a traditional gray infrastructure solution, involving storage tunnels and large pumps, would be too costly, have a significant carbon footprint, and take too long to build before it would begin to solve the stormwater problem. Meanwhile, the analysis found green stormwater infrastructure to be a nimble and decentralized option that, in addition to filtering stormwater and improving water quality discharges, would also positively affect quality of life, increase property values, offset carbon emissions, reduce heat island effects, and improve public health. In the first five years, the City implemented the Green

City, Clean Waters plan in “Early Action Areas” that acted as pilot projects to demonstrate what the forthcoming green city would look like.

A primary implementation objective of the plan is to create 10,000 “Greened Acres” that would use green infrastructure to infiltrate and store runoff from 10,000 acres of impervious cover, rather than flowing untreated into local waterways. This major change in the drainage system of the City is made possible by greening both public and private property. The City cannot afford to rely solely on public property within its purview, because doing so would not include enough areas of impervious surface to meet water quality goals (Philadelphia Water Department 2011). The City noted offering financial incentives to private landowners and developers as a key strategy for getting to 10,000 greened acres. In fact, by 2017, the City had created three and a half times as many greened acres on private property as on public property; redevelopment and incentivized retrofits, including zoning incentives, made this possible (Stutz 2018).

The early results of the Green City, Clean Waters program are very positive. By 2017, the City had already surpassed the projected benefits of green infrastructure for stormwater management: 1,100 greened

acres absorbed almost three times more stormwater than originally anticipated (Stutz 2018). By 2019, the program generated \$4 billion in economic impact for Philadelphia, including more than 1,000 green jobs annually and \$50 million in avoided health-related costs (Wright 2019). Green City, Clean Waters is allowing Philadelphia to invest large capital improvement sums in projects that improve the surfaces of the city, rather than applying investments to underground facilities, as has occurred elsewhere. The City is also coordinating its many planning, recreation, education, and other city improvements projects around the Green City, Clean Waters program elements, allowing synergistic benefit.

Philadelphia is a city of significant capacity and resources and can focus its efforts—including time, money, cost-benefit analysis, and public engagement—into Green City, Clean Waters and its associated components. It is a model of what can be achieved when cities mobilize their resources toward multibenefit projects and reframe traditional planning problems as opportunities to invest in the community and regenerate environmental health. Green City, Clean Waters functions not just as a stormwater management plan, but as a necessary building block for Philadelphia’s goal to be the Greenest City in the U.S., in addition to

improving the economy and health for all its inhabitants. It should serve as an example not only for other similar cities, but also a model for tried and true green stormwater infrastructure techniques. Because of Philadelphia’s leadership, a new stormwater management paradigm is emerging that communities of all types can learn from and learn to apply locally.

Water flowing along the street curb during heavy rain. Philadelphia’s Green City, Clean Waters program is designed to prevent flooding, wastewater overflow and other water quality problems that can result from high precipitation events. *Source: 4u4me/iStock/Getty Images Plus.*





Regional Water Sustainability in Golden Valley, Minnesota

Golden Valley is an inner-city suburb within Minnesota's Twin Cities metropolitan region, that is just 10.5 square miles in size. The City is home to about 22,000 residents and attracts an additional 10,000 workers and commuters (City of Golden Valley 2020). It is a fully developed community that relies on redevelopment to accommodate new residents, attract new employment opportunities, create new transit routes, and otherwise grow.

Water supply in the region is coordinated by both individual municipal systems and the Metropolitan Council, a planning agency that oversees water treatment infrastructure and water supply planning, in addition to transportation and parks services for the region. Outsiders may be surprised to learn that, although Minnesota is the Land of 10,000 Lakes, three out of four people in the Twin Cities region rely on groundwater. The remainder rely on Mississippi River surface water (Metropolitan Council 2020).

Bassett Creek in the General Mills Nature Preserve of Golden Valley, Minnesota. As climate change increases the volume and rate of stormwater flows in Golden Valley, the City is developing plans to address surface water quality of its local creeks and lakes, and is creating a plan to mitigate flooding risk along Bassett Creek, its main surface water stem. *Source: 2018 Tony Webster/Flickr*

Golden Valley relies on Mississippi River water that it purchases from Minneapolis and shares with two other cities in a Joint Water Commission (JWC). The JWC also installed emergency backup wells that draw groundwater.

The multiple agencies and municipalities involved highlight how interconnected water resources are within the region. The Metropolitan Council's overarching goal for water supply planning is to secure a sustainable supply of plentiful, clean water for anticipated population growth. This includes protecting source waters, addressing contamination, and maintaining aquifer levels to prevent unintended consequences to the roughly 50 percent of the region's

surface water that is connected to groundwater flows. Additionally, the Council focuses on developing land with an awareness of downstream impacts, managing water demand, increasing reliability, and adapting to the impacts of climate change (Metropolitan Council 2020).

The Metropolitan Council's planning influences Golden Valley, which similarly strives to proactively manage water resources. Golden Valley's 2040 Comprehensive Plan includes a Water Resources Chapter that responds to both the Metropolitan Council's 2040 Water Resources Policy Plan and the community's needs, as articulated by several water planning documents: a Surface Water Management Plan, Joint Water Commission Water Supply Plan, and 2018 Sanitary Sewer Collection System Comprehensive Plan. The 2040 Comprehensive Plan outlines the history, existing conditions, and future demands on water resources, as well as puts forth a policy plan and implementation plan. The Water Resources Chapter lays out key visions to improve water quality, address stormwater runoff and flooding issues, and invest in aging infrastructure.

Climate change is increasing the volume and rate of stormwater flows, causing problems for both water quality and flooding in Golden Valley. The City is primarily concerned with the surface water quality of its local creeks and lakes, as well as bodies of water downstream from the City. It plans to limit pollutant loading from stormwater runoff, the main cause of water quality impairment locally. Further, the City is creating a plan to mitigate flooding risk along its main surface water stem, Bassett Creek. Golden Valley also put in place an Infrastructure Renewal Program to rehabilitate and replace infrastructure, including stormwater infrastructure. The City cooperates on local water issues as well, coordinating with four other cities to protect wellheads and promote groundwater recharge, to maintain base water flows in local, cross-jurisdictional waterways.

Golden Valley and its neighbors acknowledge a wide range of water-related goals: Protecting water quality, mitigating stormwater runoff and flooding, decreasing residential peak demands, renovating aging infrastructure, and considering the needs of downstream users. In short, they are focusing on almost every dimension of water sustainability. They are acting collaboratively and proactively, using the planning process to truly look ahead and solve cross-jurisdictional challenges. Golden Valley shows not only the strides a proactive community can make, but how these successes can be maximized by working with neighbors to further common goals. Golden Valley's 2040 Comprehensive Plan is key in propelling this regional collaboration.

Each of these communities focuses on integrated land and water planning for a reason: they know, and have already proven, that doing so improves the sustainability of their communities.

These case studies demonstrate the many ways that communities can benefit from integrated land use and water management planning. The City of Evans illustrates how a strong planning effort can attract further opportunities to support the implementation of a plan. Hillsborough County demonstrates how even communities that may not directly provide water service can play a big role in ensuring a holistically managed sustainable water future for their residents. Philadelphia shows how a large municipality can fundamentally transform its own community through multibenefit projects while leading the nation on sustainable solutions. Golden Valley and its neighbors exemplify how multifaceted water challenges can be better met through proactive planning and multi-jurisdictional collaboration. Each of these communities focuses on integrated land and water planning for a reason: they know, and have already proven, that doing so improves the sustainability of their communities.

CHAPTER 6

Lessons Learned on Land and Water Integration



Boulder Creek Bridge in downtown Boulder, Colorado. Accessible waterfronts present another opportunity for integrated land use and water management to showcase natural water features for recreation, enjoyment, development, and overall improved quality of life. *Source: 400tmax/iStock/Getty Images Plus.*

Careful review of state requirements and on-the-ground examples of implementation of land and water integration reveals several insights. First, requirements for water in comprehensive plans vary widely, with only four states requiring discussion of integrated water management topics (e.g., holistic consideration of water supply, wastewater, and stormwater). Second, requirements for land use in water management plans are sparse and primarily cover water demand calculations, source water protection, the assessment of potential new supply sources, and narrative descriptions about the service area.

State statutes alone leave much to be desired, in terms of offering a guiding light to communities that are pursuing integrated land and water planning. While there are many opportunities to strengthen statewide requirements for integrated planning, local innovation can overcome the gaps in requirements and undertake integrated planning in a way that truly meets a community's needs. The case studies reveal several additional lessons for integrated planning: (1) communities can learn from their peers; (2) action must formalize coordinated planning; (3) resources and regional collaboration hold considerable power; and (4) other statewide water management programs can facilitate coordinated planning at the local level.

Peer Learning

State-level requirements for both comprehensive and water management plans vary widely. Each state has a unique planning context that is reflected in its statutory requirements. Nonetheless, communities and states still have significant opportunity to learn from each other and improve implementation. The

individual communities' case studies demonstrate the power of grassroots integrated planning, particularly when coupled with multi-jurisdictional collaboration. Although integrated water and land use planning is not yet a norm or requirement in most jurisdictions, plenty of resources and examples of implementation success already exist.

The City of Evans bolstered its knowledge by participating in a September 2019 workshop called Growing Water Smart, along with its neighbor, the City of Greeley (Sonoran Institute 2021). Nine Colorado communities attended this workshop, learning not only from the facilitators, but from their peers, state agencies, and NGOs about opportunities to further their efforts when they returned home. This is in part how Evans learned about opportunities like WaterNow Alliance's Project Accelerator.

Voluntary membership organizations focused on water and land use planning provide a good platform for peer learning. Colorado has successfully supported a statewide peer learning group, the Colorado Water and Land Use Planning Alliance (Alliance). State agencies,

Scenic view of Historic Arkansas Riverwalk in Pueblo, Colorado. The state promotes many resources that help enable its jurisdictions to learn more about integrating land use and water management, as well as connect with peer communities, NGOs, and researchers. *Source: Faina Gurevich/iStock/Getty Images Plus.*



local governments, water management agencies, universities, and nongovernmental organizations make up the alliance, which shares resources and ongoing work related to integrated land use and water planning. Colorado created a staff position within the Department of Local Affairs to convene the Alliance, with seed funding from the Babbitt Center for Land and Water Policy. Colorado also provides guidance, statewide training, grants, and support for organizations providing technical assistance to communities. The abundance of resources, including both a peer learning group and financial and technical assistance resources, means that communities in Colorado are highly active in pursuing integrated planning.

The City of Tampa in Hillsborough County, Florida. Part of Hillsborough County's success in integrating land use and water management is its ability to unite stakeholders within the county, from more rural agricultural communities to big metropolises like Tampa. The County must also work closely with the Tampa Bay Water Authority to coordinate water management strategies. *Source: Hsun337/iStock/Getty Images Plus.*

Formalizing Collaboration for Success

Water planning and land use agencies often operate on different timeframes because of differing state requirements, or due to local discretion. Local agencies therefore do best by creating long-lasting measures that ensure ongoing collaboration. One goal of integrated planning should be to set up local mechanisms that self-perpetuate and can withstand changing governance. For instance, communities implementing integrated planning should include coordinated development review between planners and water management agency staff. This review, once put into practice, becomes an ongoing connection point. Without coordination, local communities that undertake integrated planning could be disrupted if staff turnover, governance changes, or competing local priorities diminish the urgency of integrated planning.

Hillsborough County exemplified this by budgeting for implementation actions within its Capital Improvement Plan, providing both funds and a schedule for deploying

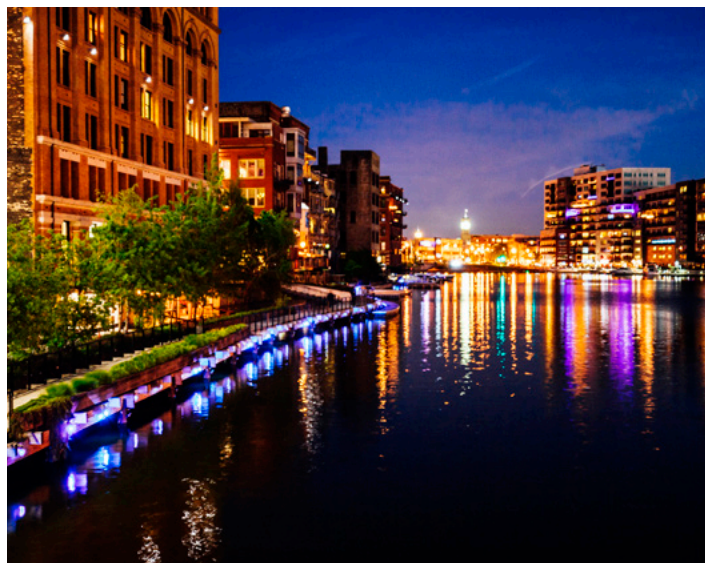


initial projects. Its collaborative planning model also built relationships among staff who were previously isolated, creating the foundation for cooperative implementation of their planning.

Resources and Regional Coordination

Water crosses boundaries and necessitates cross-jurisdictional and watershed-wide collaboration. The more state and regional entities do to facilitate local integration of land use and water planning, the better these resources will be managed. Minnesota has successfully provided templates and other mechanisms to facilitate compliance with statewide or Metropolitan Council requirements. The Minnesota Department of Natural Resources created an electronic template for water supply planning that cities can use to fill in the required information for these plans, rather than writing them from scratch. The Metropolitan Council coordinates regional water supply planning, so that member communities like Golden Valley can localize their water sustainability efforts to benefit the region. Florida also provides both state-level support and concerted planning at a regional scale that leads to intensive and proactive water management (Dickinson et al. 2021). Many more examples of these types of agencies exist around the country.

Water management agencies that serve multiple jurisdictions can naturally lend themselves to the role of regional facilitator and ensure that regional water plans are coordinated with aggregated local land use or comprehensive plans. The Milwaukee Metropolitan Sewerage District is one such agency that serves this function, in addition to the sewerage and stormwater services it provides to 28 communities in the Greater Milwaukee, Wisconsin, area (Milwaukee Metropolitan Sewerage District 2021). A primary focus of the Sewerage District is evaluating each street segment for the total maximum daily load of stormwater runoff it can convey. Integrating green infrastructure into



Milwaukee, Wisconsin RiverWalk. Regional collaboration can be instigated by many different agencies, depending on the regional context. The Milwaukee Metropolitan Sewerage District is a natural leader of regional collaboration and has pursued many innovative stormwater and green infrastructure management solutions in order to manage heavy precipitation events and maintain high-quality water. *Source: Peeterv/iStock/Getty Images Plus.*

land use planning is crucial for this program. Further, Milwaukee County and the surrounding suburbs have updated their zoning codes so that each half-acre of impervious cover must include green infrastructure to mitigate stormwater runoff and water quality through natural infiltration. Coordination with local land use planners has been crucial to the Milwaukee Metropolitan Sewerage District achieving its mission.

Where regional agencies do not exist, local governments can convene one from the bottom up. The Northwest Colorado Council of Governments, Water Quality/Quantity Committee is a member-organized council that demonstrates how neighboring communities can come together in a grassroots manner to advance common priorities. Water was not originally a topic of interest to this regional entity, but when members realized that a regional approach would help them achieve their individual water quality goals, they formed the Water Quality/Quantity Committee.

Coordinated Planning Facilitates Water Management

Coordinated planning between a water management agency and the land use authority can aid state and federal water management programs. The Philadelphia case study shows how the City's obligations under the U.S. Environmental Protection Agency's National Combined Sewer Overflow Control Policy inspired it to act. In response, it created a water quality program that inspired a range of actions to implement green infrastructure in collaboration with both the land use department and private developers. Coordinated planning has also facilitated implementation of California's Urban Water Management Planning Act and Connecticut's Aquifer Protection Program, and Western assured water supply laws.

California's Urban Water Management Planning Act includes numerous requirements for water management agencies. It is the most robust water management plan identified in the 50-state survey of requirements (Dickinson et al. 2021). In the past, the state tied local funding to whether the community

had a complete urban water management plan on file (California Department of Water Resources 2021b). Water managers best comply with the Act by collaborating with land use planners.

Connecticut's Department of Energy and Environmental Protection (DEEP) enforces an Aquifer Protection Act program that prevents approval for development with potentially toxic impacts over designated aquifer recharge zones (Connecticut Department of Energy and Environmental Protection 2007). Local land use agencies play a key role in this program by registering activities near the aquifer, issuing permits, overseeing aquifers, and educating citizens on groundwater protection. The state provides technical training to help local officials manage the program (Connecticut Department of Energy and Environmental Protection 2020).

Finally, assured water supply laws connect the approval of a subdivision to proof that there is an adequate water supply to serve the area. Several Western states have this type of law, with requirements varying from a 100-year water supply in a subdivision of six or more units (Arizona), to a 20-year supply in a subdivision of 500 or more units, based on historic availability (California) (Green and Castle 2017). States pass these laws most often as part of groundwater management that protects consumers from buying homes without a secure long-term water supply. Such laws are a concrete example of how to integrate land use and water management planning processes without mandating it within a specific plan.



Mill River Dam in Stamford, Connecticut. Connecticut has a highly sophisticated aquifer protection program that expressly recognizes and enables land use controls as a primary means of source water protection. *Source: Stockphoto52/iStock/Getty Images Plus.*

CHAPTER 7

Recommendations and Conclusion



Integrated land use and water management planning is a crucial step that communities need to take to prepare for the interrelated challenges of climate change, ongoing population growth, and increasingly limited water supplies. This report summarizes the prospects for integrated planning, with particular focus on comprehensive planning and water management planning, to facilitate understanding of both national trends and opportunity areas. Action at all levels, from local implementation, to regional coordination, to statewide legislation, can better solidify the connection between land use and water management. The following are recommendations that policy makers and planners can take to advance integrated planning.

Permeable pavement is a key strategy of green infrastructure for stormwater management. *Source: Dmitry Vorobyev/iStock/Getty Images Plus.*



Collaborate Locally

Integrated land use and water planning cannot occur without collaboration. Local planning departments and water management agencies are the leading actors. Additional local decision makers like city councils and governing boards can offer valuable leadership and support necessary for success. Planners should incorporate meaningful public participation into planning efforts and bring other major stakeholders to the table, including the public, developers, businesses, and nongovernmental organizations. At the local level, water management agencies may take on the additional job of coordinating water management in a holistic way to bridge the gap between drinking water, wastewater, and stormwater services. Likewise, land use planners may have to work with several different water management agencies in the community. Building systematic processes for integrated land use planning and water management is crucial to long-term success.

Efforts are underway to revitalize the Los Angeles River, after it was channelized and largely neglected starting in the 1930s. The City has realized the value of making the river accessible again and highlighting it as a natural amenity, rather than letting it exist as simply a concrete-lined canal. The integration of land use and water management will be key in revitalizing the river in order to balance development, public accessibility, and water quality. *Source: Halbergman/iStock/Getty Images Plus.*

The following recommendations will help local agencies initiate and solidify ongoing collaboration:

- Local governments should **integrate activities between the land use authority and water management agencies**, as well as facilitate two-way engagement with the public. **Land use planners** potentially need to work with multiple water agencies serving their community. Water management agencies should **work together to achieve integrated water management**.

- Local governments and water management agencies should **institutionalize their activities to survive staff and council turnover**, particularly in cases where they are not mandated to work together, through such actions as:
 - **Local governments should incorporate water management agencies into all stages of the development approval process** so that the agencies can ensure adequacy of water supplies and provide developers with information on how a project may be more water-efficient, stormwater friendly, and low-impact, while it protects water quality.
 - Local governments and water management agencies should **share and agree upon which data sets to use** to ensure consistent planning assumptions and to inform collaborative action.
 - **Planning actions should be tied to Capital Improvement Plans**, such as when Hillsborough County adopted the One Water Chapter of the County Comprehensive Plan.
- Local governments should **adopt requirements for coordinated planning**, such as:
 - **Local consistency requirements** for comprehensive plans and water management plans.
 - **Codifying the water management agency's water programs and policies** into local regulations to enhance monitoring and enforcement of these programs.

Coordinate Regional Expertise and Oversight

Regional land use planning or water management planning entities can offer much direct support to local communities. Florida's Water Management Districts and Minnesota's Metropolitan Council demonstrate how these dedicated planning agencies provide a wealth of information and connections to the communities they support. For example, they produce studies and facilitate regional collaboration to solve cross-boundary water challenges.

The following recommendations include top-down, bottom-up, and in-between approaches for creating or enabling regional entities:

- **State legislatures should create and enable regional planning authorities**, like Florida's Water Management Districts and Minnesota's Metropolitan Council.
- Regional bodies, whether state-enabled or grassroots, should **produce studies and facilitate regional and watershed collaboration**. These entities should require participating members to act on the findings of such studies and to follow through on decisions made regarding regional collaboration in their adopted plans, as a condition for continued membership.
- Water management agencies should **adopt the role of regional facilitator when appropriate**, as does the Milwaukee Sewerage District.
- Local governments should **convene a grassroots regional entity** if one does not otherwise exist, just as the Colorado headwaters communities did when creating the Northwest Colorado Council of Governments—Water Quality/Quantity Committee.

Build Capacity Through Funding and Technical Guidance

Implementing new programs, even those that may ultimately save money, requires both staff expertise and upfront funding. Local agencies across the country are already strapped for resources and forced to manage competing priorities daily; they struggle to address “unfunded mandates.” Resources, like information, guidance, funding, or peer support groups, are important for implementing mandatory and voluntary measures alike. Direct support is a game changer on the local level; political will can shift when state agencies have good relationships with local governments.

The following recommendations describe the variety of resources state agencies and other entities should provide to improve integration of land and water planning:

- **Funding and grants** to local governments, water management agencies, and NGOs providing technical assistance for land and water integration. This includes:
 - **Providing incentives** for communities that are developing integrated plans, such as by updating existing grant and loan programs to assign additional points to integrated planning projects.
 - **Restricting access to state-level funding for communities that do not integrate land use and water planning**, or do not have the required plans on file. California’s Urban Water Management Plans and Colorado’s Water Efficiency Plans have taken this approach.
- **Standardized compliance templates**, as has been done in Minnesota.
- **A staff person to convene and facilitate** a body focused on land and water integration, as has been done in Colorado.

- **Guidance on land and water integration**, particularly as it relates to mandates or voluntary measures described in statute, as has been done in Colorado.
- **Model/example local ordinances** to facilitate institutionalization of integrated planning and specific areas of integrated planning, such as California’s Model Water Efficient Landscape Ordinance.

Use State Mandates

A statewide requirement for coordinated planning increases the likelihood that a community will implement and continue planning at the local level. Statewide mandates could require including water management in comprehensive plans or addressing land use policies within water management plans. As discussed in chapter 3, communities in states with a required water element in comprehensive plans tend to have stronger water elements than those in states without mandates. Similarly, as discussed in chapter 4, although state mandates for land use within water management plans are uncommon, existing requirements cover water demand calculations, source water protection, assessing potential new supply sources, water demand management, and narrative descriptions about the service area.

The following recommendations are for state-level mandates for integrated water and land use planning:

- State legislatures should **pass requirements for coordinated planning**, in the form of:
 - Mandatory **water elements** within the local comprehensive plan.
 - Mandatory **consideration of land use within water management plans**.
 - **Consistency requirements** for all local comprehensive plans and water management plans.



- State legislatures should **enact programs that support integrated planning**, such as:
 - **Robust water management planning requirements** that are facilitated by coordinated planning, like California's Urban Water Management Planning Act.
 - **Source water protection programs** that include land use controls as an implementation technique, such as Connecticut's DEEP Aquifer Protection Program.
 - **Assured water supply laws** that require new development to prove water supply availability prior to approval from the land use authority.
- State legislatures should work with municipalities, counties, local government advocacy groups, water management

The direct aerial view of modern rooftops with gardens in Brooklyn Heights, on the waterfront near Esplanade and Brooklyn Bridge Park on a hot summer evening. *Source: Alex Potemkin/iStock/Getty Images Plus.*

organizations, grassroots organizations, and the building and development communities to **create and adopt legislation enabling or requiring local collaboration** between land use planning and water management agencies.

In sum, coordinated planning between land use authorities and water management agencies is key to sustainable water and land use. Integrated planning at all levels of government helps communities prepare for the challenges that are already unfolding. Through integrated land use and water management plans, communities develop policies, objectives, and implementation actions that will ensure they have enough water now and in the future.

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The stunning Riverfront Park in Spokane, Washington. Source: *Cavan Images/iStock/Getty Images Plus.*

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APPENDIX A

Summary of Statutes for Comprehensive Planning and Water Planning

The following table describes whether a statute related to water within a comprehensive plan is required, the topic(s) the statute covers, the state, as well as abbreviated language from the statute itself. This work is adapted from Pettit and Shah 2021.

Table A.1

Statutes for incorporating water into comprehensive plans

Req'd	Topics	ST	Statute
No	Location and character	AL	<p>"The plan, with the accompanying maps, plats, charts, and descriptive matter shall show the commission's recommendations for the development of said territory, including, among other things, the general location, character and extent of streets, viaducts, subways, bridges, waterways, waterfronts, boulevards, parkways, playgrounds, squares, parks, aviation fields and other public ways, grounds and open spaces, the general location of public buildings and other public property, the general location and extent of public utilities and terminals, whether publicly or privately owned or operated, for water, light, sanitation, transportation, communication, power, and other purposes, the removal, relocation, widening, narrowing, vacating, abandonment, change of use, or extension of any of the foregoing ways, grounds, open spaces, buildings, military installations, property, utilities, or terminals; as well as a zoning plan for the control of the height, area, bulk, location, and use of buildings and premises" (AL Code § 11-52-8(b)).</p>
No	Groundwater recharge Stormwater Water system	AR	<p>"Purpose and content of county plan.</p> <p>(a) The county plan shall be made with the general purpose of guiding and accomplishing a coordinated, efficient, and economic development of the county, or part thereof. In accordance with one (1) or more of the following criteria, the plan shall seek to best promote the health, safety, convenience, prosperity, and welfare of the people of the county.</p> <p>(b) Each county plan shall reflect the county's development policies and shall contain a statement of the objectives and principles sought to be embodied therein. Each plan, with the accompanying maps, charts, and descriptive matter, may make recommendations, among other things, as to...</p> <p>(3) The development of land subject to flooding;</p> <p>(4) The provision of adequate recreation, education, and community facilities, including water, sewer, solid waste, and drainage improvements...</p> <p>(7) Other matters which are logically related to or form an integral part of a long-term plan for orderly development and redevelopment of the county.</p> <p>(c)(1) Areas of critical environmental concern include, among other things, aquifers and aquifer recharge areas, soils poorly suited to development, floodplains, wetlands, prime agricultural and forestlands, the natural habitat of rare or endangered species, areas with unique ecosystems, or areas recommended for protection in the Arkansas natural areas plan. Plans for these areas shall give consideration to protective mechanisms which seek to regulate activities or development in the areas..." (AR Code § 14-17-206).</p>

Req'd?	Topics	ST	Statute
Yes	Water demand Water supply	AZ	<p>“For cities and towns with a population of more than two thousand five hundred persons but less than ten thousand persons and whose population growth rate exceeded an average of two percent per year for the ten-year period before the most recent United States decennial census and for cities and towns with a population of ten thousand or more persons according to the most recent United States decennial census, the general plan shall include, and for other cities and towns the general plan may include...</p> <p>5. A water resources element that addresses: (a) The known legally and physically available surface water, groundwater and effluent supplies. (b) The demand for water that will result from future growth projected in the general plan, added to existing uses. (c) An analysis of how the demand for water that will result from future growth projected in the general plan will be served by the water supplies identified in subdivision (a) of this paragraph or a plan to obtain additional necessary water supplies... (F) The water resources element of the general plan does not require: 1. New independent hydrogeologic studies. 2. The city or town to be a water service provider” (AZ Rev Stat § 9-461.05(D)).</p>
Yes	Location and character	CA	<p>“The general plan shall consist of a statement of development policies and shall include a diagram or diagrams and text setting forth objectives, principles, standards, and plan proposals. The plan shall include the following elements:</p> <p>(d) (1) A conservation element for the conservation, development, and utilization of natural resources, including water and its hydraulic force, forests, soils, rivers and other waters, harbors, fisheries, wildlife, minerals, and other natural resources. The conservation element shall consider the effect of development within the jurisdiction, as described in the land use element, on natural resources located on public lands, including military installations. That portion of the conservation element including waters shall be developed in coordination with any countywide water agency and with all district and city agencies, including flood management, water conservation, or groundwater agencies that have developed, served, controlled, managed, or conserved water of any type for any purpose in the county or city for which the plan is prepared. Coordination shall include the discussion and evaluation of any water supply and demand information described in Section 65352.5 (Preparation, Adoption, and Amendment of the General Plan) if that information has been submitted by the water agency to the city or county” (CA Govt Code § 65302).</p>
No	Location and character Water supply	CO	<p>“(1) ...Such plan, with the accompanying maps, plats, charts, and descriptive matter, shall, after consideration of each of the following, where applicable or appropriate, show the commission's recommendations for the development of said municipality and outlying areas, including: (a) The general location, character, and extent of existing, proposed, or projected streets, roads, rights-of-way, bridges, waterways, waterfronts... (c) The general location and extent of public utilities terminals, capital facilities, and transfer facilities, whether publicly or privately owned or operated, for water, light, sanitation, transportation, communication, power, and other purposes, and any proposed or projected needs for capital facilities and utilities, including the priorities, anticipated costs, and funding proposals for such facilities and utilities; (d) The general location and extent of an adequate and suitable supply of water. If the master plan includes a water supply element, the planning commission shall consult with the entities that supply water for use within the municipality to ensure coordination on water supply and facility planning, and the water supply element shall identify water supplies and facilities sufficient to meet the needs of the public and private infrastructure reasonably anticipated or identified in the planning process. Nothing in this paragraph (d) shall be construed to supersede, abrogate, or otherwise impair the allocation of water pursuant to the state constitution or laws, the right to beneficially use water pursuant to decrees, contracts, or other water use agreements, or the operation, maintenance, repair, replacement, or use of any water facility...” (CO Rev Stat § 31-23-206)</p>

Req'd?	Topics	ST	Statute
Yes	Water quality	CT	<p>“Preparation, amendment or adoption of plan of conservation and development... (d) In preparing such plan, the commission or any special committee shall consider the following: (1) The community development action plan of the municipality, if any, (2) the need for affordable housing, (3) the need for protection of existing and potential public surface and ground drinking water supplies, (4) the use of cluster development and other development patterns to the extent consistent with soil types, terrain and infrastructure capacity within the municipality, (5) the state plan of conservation and development adopted pursuant to chapter 297, (6) the regional plan of conservation and development adopted pursuant to section 8-35a, (7) physical, social, economic and governmental conditions and trends, (8) the needs of the municipality including, but not limited to, human resources, education, health, housing, recreation, social services, public utilities, public protection, transportation and circulation and cultural and interpersonal communications, (9) the objectives of energy-efficient patterns of development, the use of solar and other renewable forms of energy and energy conservation, (10) protection and preservation of agriculture, (11) the most recent sea level change scenario updated pursuant to subsection (b) of section 25-68o, and (12) the need for technology infrastructure in the municipality,” (CT Gen Stat § 8-23).</p>
Yes	Wastewater Water supply	DE	<p>“Comprehensive development plan. (a) A planning commission established by any incorporated municipality under this chapter shall prepare a comprehensive plan for the city or town or portions thereof as the commission deems appropriate. It is the purpose of this section to encourage the most appropriate uses of the physical and fiscal resources of the municipality and the coordination of municipal growth, development and infrastructure investment actions with those of other municipalities, counties and the State through a process of municipal comprehensive planning.</p> <p>(b) Comprehensive plan means a document in text and maps, containing at a minimum, a municipal development strategy setting forth the jurisdiction's position on population and housing growth within the jurisdiction, expansion of its boundaries, development of adjacent areas, redevelopment potential, community character, and the general uses of land within the community, and critical community development and infrastructure issues. The comprehensive planning process shall demonstrate coordination with other municipalities, the county and the State during plan preparation. The comprehensive plan for municipalities of greater than 2,000 population shall also contain, as appropriate to the size and character of the jurisdiction, a description of the physical, demographic and economic conditions of the jurisdiction; as well as policies, statements, goals and planning components for public and private uses of land, transportation, economic development, affordable housing, community facilities, open spaces and recreation, protection of sensitive areas, community design, adequate water and wastewater systems, protection of historic and cultural resources, annexation and such other elements which in accordance with present and future needs, in the judgment of the municipality, best promotes the health, safety, prosperity and general public welfare of the jurisdiction's residents” (22 DE Code § 702).</p>
Yes	Groundwater recharge Wastewater Water system	FL	<p>“(6) (c) A general sanitary sewer, solid waste, drainage, potable water, and natural groundwater aquifer recharge element correlated to principles and guidelines for future land use, indicating ways to provide for future potable water, drainage, sanitary sewer, solid waste, and aquifer recharge protection requirements for the area. The element may be a detailed engineering plan including a topographic map depicting areas of prime groundwater recharge” (FL Stat § 163.3177(6)(c)).</p>
Yes	Location and character	HI	<p>“(a) ...County general plans or development plans shall indicate desired population and physical development patterns for each county and regions within each county. In addition, county general plans or development plans shall address the unique problems and needs of each county and regions within each county. The county general plans or development plans shall further define applicable provisions of this chapter, provided that any amendment to the county general plan of each county shall not be contrary to the county charter. The formulation, amendment, and implementation of county general plans or development plans shall take into consideration statewide objectives, policies, and programs stipulated in state functional plans approved in consonance with this chapter. (b) County general plans shall be formulated on the basis of sound rationale, data, analyses, and input from state and county agencies and the general public, and contain objectives and policies as required by the charter of each county. Further, the county general plans should: (1) Contain objectives to be achieved and policies to be pursued with respect to population density, land use, transportation system location, public and community facility locations, water and sewage system locations, visitor destinations, urban design, and all other matters necessary for the coordinated development of the county and regions within the county; and (2) Contain implementation priorities and actions to carry out policies to include but not be limited to land use maps, programs, projects, regulatory measures, standards and principles, and interagency coordination provisions” (HI Rev Stat § 226-58).</p>

Req'd?	Topics	ST	Statute
No	Stormwater Wastewater Water supply	IA	<p>"2. A municipality shall consider the smart planning principles under section 18B.1 and may include the following information, if applicable, when developing or amending a comprehensive plan under chapter 335 or chapter 414 or when developing or amending other local land development regulations... e. Objectives, policies, and programs to guide future development of sanitary sewer service, storm water management, water supply, solid waste disposal, wastewater treatment technologies, recycling facilities, and telecommunications facilities... 3. A municipality's comprehensive plan developed using the guidelines under this section shall address prevention and mitigation of, response to, and recovery from a catastrophic flood" (IA Code § 18B.2).</p>
No	Location and character Wastewater Water supply	ID	<p>"PLANNING DUTIES. It shall be the duty of the planning or planning and zoning commission to conduct a comprehensive planning process designed to prepare, implement, and review and update a comprehensive plan, hereafter referred to as the plan. The plan shall include all land within the jurisdiction of the governing board. The plan shall consider previous and existing conditions, trends, compatibility of land uses, desirable goals and objectives, or desirable future situations for each planning component. The plan with maps, charts, and reports shall be based on the following components as they may apply to land use regulations and actions unless the plan specifies reasons why a particular component is unneeded...</p> <p>(f) Natural Resources —An analysis of the uses of rivers and other waters, forests, range, soils, harbors, fisheries, wildlife, minerals, thermal waters, beaches, watersheds, and shorelines...</p> <p>(h) Public Services, Facilities, and Utilities —An analysis showing general plans for sewage, drainage, power plant sites, utility transmission corridors, water supply, fire stations and firefighting equipment, health and welfare facilities, libraries, solid waste disposal sites, schools, public safety facilities and related services. The plan may also show locations of civic centers and public buildings." (ID Code § 67-6508).</p>
No	Water quality Water supply	IL	<p>"Sec. 4. A municipality or county, either independently, or jointly or compatibly by intergovernmental agreement pursuant to Section 6, may adopt Local Land Resource Management Plans. Such plans may include goals and procedures for resolving conflicts in relation to the following objectives...</p> <p>(16) Water - to ensure good quality and quantity of water resources..." (50 ILCS. § 805/4, Ch. 85, par. 5804).</p>
No	Stormwater Wastewater Water quality	IN	<p>"Comprehensive plan; additional contents Sec. 503. A comprehensive plan may, in addition to the elements required by section 502 of this chapter, include the following...</p> <p>(G) Sewers, sanitation, and drainage, including handling, treatment, and disposal of excess drainage waters, sewage, garbage, refuse, and other wastes.</p> <p>(H) Air, land, and water pollution.</p> <p>(I) Flood control and irrigation.</p> <p>(J) Public and private utilities, such as water, light, heat, communication, and other services...</p> <p>(Q) Conservation of energy, water, soil, and agricultural and mineral resources" (IN Code § 36-7-503).</p>
No	Stormwater	KY	<p>"(6) The comprehensive plan may include any additional elements such as, without being limited to, community renewal, housing, flood control..." (KY Rev Stat § 100.187).</p>
No	Location and character	LA	<p>"(1) Any such plan shall provide a general description or depiction of existing roads, streets, highways, and publicly controlled corridors, along with a general description or depiction of other public property within the jurisdiction that is subject to the authority of the commission. (2) Any such plan, with the accompanying maps, plats, charts, and descriptive matter may include a commission's recommendations for the development of the parish or municipality, as the case may be, including, among other things, the general location, character, and extent of railroads, highways, streets, viaducts, subways, bus, street car and other transportation routes, bridges, waterways, lakes, water fronts, boulevards, parkways, playgrounds, squares, parks, aviation fields, and other public ways, grounds, and open spaces; the general location of public buildings, schools, and other public property; the general character, extent and layout of public housing and of the replanning of blighted districts and slum areas; the general location and extent of public utilities and terminals, whether publicly or privately owned or operated, for water, light, sanitation, communication, power, transportation, and other purposes; and the removal, relocation, widening, narrowing, vacating, abandonment, change of use, or extension of any of the foregoing ways, grounds, open spaces, buildings, property, utilities, or terminals" (LA Rev Stat § 33:106(B)).</p>

Req'd?	Topics	ST	Statute
Yes	Stormwater Wastewater Water supply	MD	“(1) The planning commission for a local jurisdiction shall include in the comprehensive plan the following elements: (ix) a water resources element ” (MD Land Use Code § 3-102(a)). “Considering available data provided by the Department of the Environment, the water resources element shall identify: (1) drinking water and other water resources that will be adequate for the needs of existing and future development proposed in the land use element of the plan; and (2) suitable receiving waters and land areas to meet stormwater management and wastewater treatment and disposal needs of existing and future development proposed in the land use element of the plan ” (MD Land Use Code § 3-106(a)).
No	Location and character Recreation Water quality Water supply	ME	“3. The Legislature hereby establishes a set of state goals to provide overall direction and consistency to the planning and regulatory actions of all state and municipal agencies affecting natural resource management, land use and development. The Legislature declares that, in order to promote and protect the health, safety and welfare of the citizens of the State, it is in the best interests of the State to achieve the following goals... E. To protect the quality and manage the quantity of the State's water resources, including lakes, aquifers, great ponds, estuaries, rivers and coastal areas; F. To protect the State's other critical natural resources, including without limitation, wetlands, wildlife and fisheries habitat, sand dunes, shorelands, scenic vistas and unique natural areas; G. To protect the State's marine resources industry, ports and harbors from incompatible development and to promote access to the shore for commercial fishermen and the public; H. To safeguard the State's agricultural and forest resources from development which threatens those resources; I. To preserve the State's historic and archeological resources; J. To promote and protect the availability of outdoor recreation opportunities for all Maine citizens, including access to surface waters... ” (30-A ME Rev Stat § 4312(3)).
No	Location and character	MI	“(1) A master plan shall address land use and infrastructure issues and may project 20 years or more into the future. A master plan shall include maps, plats, charts, and descriptive, explanatory, and other related matter and shall show the planning commission's recommendations for the physical development of the planning jurisdiction. (2) A master plan shall also include those of the following subjects that reasonably can be considered as pertinent to the future development of the planning jurisdiction: (a) A land use plan that consists in part of a classification and allocation of land for agriculture, residences, commerce, industry, recreation, ways and grounds, subject to subsection (5), public transportation facilities, public buildings, schools, soil conservation, forests, woodlots, open space, wildlife refuges, and other uses and purposes... (b) The general location, character, and extent of all of the following... (ii) Waterways and waterfront developments. (iii) Sanitary sewers and water supply systems. (iv) Facilities for flood prevention, drainage, pollution prevention, and maintenance of water levels... ” (MI Comp L § 125.3833).

Req'd?	Topics	ST	Statute
No	Location and character Wastewater Water supply	MN	<p>“COMPREHENSIVE PLAN CONTENT... The comprehensive plan may contain any additional matter which may be included in a comprehensive plan of the local governmental unit pursuant to the applicable planning statute.</p> <p>Subd. 2. Land use plan. (a) A land use plan shall include the water management plan required by section 103B.235, and shall designate the existing and proposed location, intensity and extent of use of land and water, including lakes, wetlands, rivers, streams, natural drainage courses, and adjoining land areas that affect water natural resources, for agricultural, residential, commercial, industrial and other public and private purposes, or any combination of such purposes...</p> <p>Subd. 3. Public facilities plan... A public facilities plan shall contain at least the following parts... (2) a sewer policy plan describing, designating and scheduling the areas to be sewered by the public system, the existing and planned capacities of the public system, the standards and conditions under which the installation of private sewer systems will be permitted, and to the extent practicable, the areas not suitable for public or private systems because of public health, safety and welfare considerations... (4) a water supply plan as described in section 103G.291, subdivision 3.</p> <p>Subd. 4. Implementation program... An implementation program shall contain at least the following parts: (1) a description of official controls, addressing at least the matters of zoning, subdivision, water supply, and private sewer systems, and a schedule for the preparation, adoption, and administration of such controls; (2) a capital improvement program for transportation, sewers, parks, water supply, and open space facilities...</p> <p>Subd. 6. Plan review. The council shall prepare guidelines for the preparation of the water supply plans required in subdivision 3, clause (4). The plans must be submitted to the council as part of the decennial review required under section 473.864, subdivision 2. The council shall review the plans under section 473.175, subdivision 1, after submitting them to affected counties that have adopted groundwater plans under section 103B.255 for their review and comment” (MN Stat § 473.859).</p>
No	Location and character Wastewater Water for agriculture Water for fire protection Water system	MT	<p>“A growth policy must include: ... (e) a strategy for development, maintenance, and replacement of public infrastructure, including drinking water systems, wastewater treatment facilities, sewer systems, solid waste facilities... (j) an evaluation of the potential for fire and wildland fire in the jurisdictional area, including whether or not there is a need to... (ii) adopt regulations requiring... (C) adequate water supply for fire protection. (4) A growth policy may... (c) establish an infrastructure plan that, at a minimum, includes... (vi) using maps and text, a description of existing and future public facilities necessary to efficiently serve projected development and densities within infrastructure planning areas, including, whenever feasible, extending interconnected municipal street networks, sidewalks, trail systems, public transit facilities, and other municipal public facilities throughout the infrastructure planning area. For the purposes of this subsection (4)(c)(vi), public facilities include but are not limited to drinking water treatment and distribution facilities, sewer systems, wastewater treatment facilities, solid waste disposal facilities... (viii) a description of how and where projected development inside municipal boundaries for cities and inside designated joint infrastructure planning areas for cities and counties could adversely impact... (B) water available to agricultural water users and facilities... (F) natural resources, including but not limited to forest lands, mineral resources, sand and gravel resources, streams, rivers, lakes, wetlands, and ground water; and (G) agricultural lands and agricultural production; and (ix) a description of measures, including land use management techniques and incentives, that will be adopted to avoid, significantly reduce, or mitigate the adverse impacts identified under subsection (4) (c)(viii)” (MT Code § 76-1-601(3)).</p>
No	Location and character	ND	<p>“...Such plan, with the accompanying maps, plats, charts, and descriptive matter, shall show the commission's recommendations for the development of the territory, including: 1. The general locations, character, and extent of streets, waterways, waterfronts...” (N.D. Cent. Code § 40-48-08).</p>

Req'd?	Topics	ST	Statute
No	Location and character Stormwater Water quality	NH	<p>“...III. The master plan may also include the following sections... (d) A natural resources section which identifies and inventories any critical or sensitive areas or resources, not only those in the local community, but also those shared with abutting communities. This section, which may specifically include a water resources management and protection plan, shall provide a factual basis for any land development regulations that may be enacted to protect water resources and other identified natural areas. A key component in preparing this section is to identify any conflicts between other elements of the master plan and natural resources, as well as conflicts with plans of abutting communities. Nothing in this subparagraph shall be construed to permit municipalities to regulate surface or groundwater withdrawals that they are explicitly prohibited from regulating... (o) A coastal management section which may address planning needs resulting from projected coastal property or habitat loss due to increased frequency of storm surge, flooding, and inundation” (NH Rev Stat § 674:2).</p>
No	Location and character	NJ	<p>Counties: “Duties of board; master plan; municipal co-operation. The county planning board shall make and adopt a master plan for the physical development of the county. The master plan of a county, with the accompanying maps, plats, charts, and descriptive and explanatory matter, shall show the county planning board’s recommendations for the development of the territory covered by the plan, and may include, among other things, the general location, character, and extent of streets or roads, viaducts, bridges, waterway and waterfront developments, parkways, playgrounds, forests, reservations, parks, airports, and other public ways, grounds, places and spaces; the general location and extent of forests, agricultural areas, and open-development areas for purposes of conservation, food and water supply, sanitary and drainage facilities, or the protection of urban development, and such other features as may be important to the development of the county” (NJ Rev Stat § 40:27-2).</p>
Yes	Stormwater Water supply Water system	NJ	<p>Municipalities: “Preparation; contents; modification.19. Preparation; contents; modification. b. The master plan shall generally comprise a report or statement and land use and development proposals, with maps, diagrams and text, presenting, at least the following elements (1) and (2) and, where appropriate, the following elements (3) through (17): (1) A statement of objectives, principles, assumptions, policies and standards upon which the constituent proposals for the physical, economic and social development of the municipality are based.</p> <p>(2) A land use plan element (a) taking into account and stating its relationship to the statement provided for in paragraph (1) hereof, and other master plan elements provided for in paragraphs (3) through (14) hereof and natural conditions, including, but not necessarily limited to, topography, soil conditions, water supply, drainage, flood plain areas, marshes, and woodlands; (f) including, for any land use element adopted after the effective date of P.L.2017, c.275, a statement of strategy concerning: (i) smart growth which, in part, shall consider potential locations for the installation of electric vehicle charging stations, (ii) storm resiliency with respect to energy supply, flood-prone areas, and environmental infrastructure, and (iii) environmental sustainability; and (g) showing the existing and proposed location of public electric vehicle charging infrastructure;</p> <p>(5) A utility service plan element analyzing the need for and showing the future general location of water supply and distribution facilities, drainage and flood control facilities, sewerage and waste treatment, solid waste disposal and provision for other related utilities, and including any storm water management plan required pursuant to the provisions of P.L.1981, c.32 (C.40:55D-93 et al.). If a municipality prepares a utility service plan element as a condition for adopting a development transfer ordinance pursuant to subsection c. of section 4 of P.L.2004, c.2 (C.40:55D-140), the plan element shall address the provision of utilities in the receiving zone as provided thereunder.</p> <p>(8) A conservation plan element providing for the preservation, conservation, and utilization of natural resources, including, to the extent appropriate, energy, open space, water supply, forests, soil, marshes, wetlands, harbors, rivers and other waters, fisheries, endangered or threatened species wildlife and other resources, and which systemically analyzes the impact of each other component and element of the master plan on the present and future preservation, conservation and utilization of those resources...” (NJ Rev Stat § 40:55D-28).</p>
No	Location and character	NM	<p>“Among other things, the master plan with accompanying maps, plats and charts; descriptive and explanatory matter; and recommendations of the planning commission for the physical development of the municipality, and for its planning jurisdiction, may include: (1) the general location, character and extent of streets, bridges, viaducts and parkways; parks and playgrounds, floodways, waterways and waterfront development...” (NM Stat § 3-19-9(B)).</p>

Req'd?	Topics	ST	Statute
No	Water supply	NV	<p>“1. Except as otherwise provided in this section and NRS 278.150 and 278.170, the master plan, with the accompanying charts, drawings, diagrams, schedules and reports, may include such of the following elements or portions thereof as are appropriate to the city, county or region, and as may be made the basis for the physical development thereof: (a) A conservation element, which must include: (1) A conservation plan for the conservation, development and utilization of natural resources, including, without limitation, water and its hydraulic force, underground water, water supply, solar or wind energy, forests, soils, rivers and other waters, harbors, fisheries, wildlife, minerals and other natural resources. The conservation plan must also cover the reclamation of land and waters, flood control, prevention and control of the pollution of streams and other waters, regulation of the use of land in stream channels and other areas required for the accomplishment of the conservation plan, prevention, control and correction of the erosion of soils through proper clearing, grading and landscaping, beaches and shores, and protection of watersheds. The conservation plan must also indicate the maximum tolerable level of air pollution... (b) A historic preservation element... (c) A housing element... (d) A land use element... (e) A public facilities and services element... (f) A recreation and open space element... (g) A safety element... (h) A transportation element... (i) An urban agricultural element...” (NV Rev Stat § 278.160).</p>
No	Location and character	NY	<p>“The body creating such planning commission may, at any time, by ordinance or local law or resolution, provide that the following matters, or any one or more of them, shall be referred for report thereon, to such commission by the board, commission, commissioner or other public officer or officers of said city or village which is the final authority thereon before final action thereon by such authority: the adoption of any map or plan of said city or incorporated village, or part thereof, including drainage and sewer or water system plans or maps, and plans or maps for any public water front...” (NY Gen Mun L § 236).</p>
No	Location and character	OH	<p>Municipalities: “The planning commission established under section 713.01 of the Revised Code shall make plans and maps of the whole or any portion of the municipal corporation, and of any land outside thereof, which, in the opinion of the commission, is related to the planning of the municipal corporation, and make changes in such plans or maps when it deems it advisable. Such maps or plans shall show the commission's recommendations for the general location, character, and extent of streets, alleys, ways, viaducts, bridges, waterways, waterfronts, subways, boulevards, parkways, parks, playgrounds, aviation fields and other public grounds, ways, and open spaces; the general location of public buildings and other public property; the general location and extent of public utilities and terminals, whether publicly or privately owned or operated, for water, light, sanitation, transportation, communication, power, and other purposes; and the removal, relocation, widening, narrowing, vacating, abandonment, change of use of or extension of such public ways, grounds, open spaces, buildings, property, utilities, or terminals. With a view to the systematic planning of the municipal corporation, the commission may make recommendations to public officials concerning the general location, character, and extent of any such public ways, grounds, open spaces, buildings, property, utilities, or terminals” (Ohio Rev Code § 713.02).</p> <p>Counties: “The duties of the planning commission include, but are not limited to: (1) Preparing the plans, including studies, maps, recommendations, and reports on: (a) Regional goals, objectives, opportunities, and needs, and standards, priorities, and policies to realize such goals and objectives; (b) Economic and social conditions; (c) The general pattern and intensity of land use and open space; (d) The general land, water, and air transportation systems...” (Ohio Rev Code § 713.23).</p>
Yes	Water quality Water supply	PA	<p>“(b) The comprehensive plan shall include a plan for the reliable supply of water, considering current and future water resources availability, uses and limitations, including provisions adequate to protect water supply sources. Any such plan shall be consistent with the State Water Plan and any applicable water resources plan adopted by a river basin commission. It shall also contain a statement recognizing that: (1) Lawful activities such as extraction of minerals may impact water supply sources and such activities are governed by statutes regulating mineral extraction that specify replacement and restoration of water supplies affected by such activities. (2) Commercial agriculture production may impact water supply sources” (P.L.805, No.247, Article III, §301 1968).</p>

Req'd?	Topics	ST	Statute
Yes	Stormwater Wastewater Water demand Water supply Water system	RI	<p>“Required content of a comprehensive plan. (a) The comprehensive plan must utilize a minimum twenty (20) year planning timeframe in considering forecasts, goals, and policies. (b) The comprehensive plan must be internally consistent in its policies, forecasts, and standards, and shall include the content described within this section. The content described in subdivisions (1) through (10) may be organized and presented as deemed suitable and appropriate by the municipality. The content described in subdivisions (11) and (12) must be included as individual sections of the plan. (8) Services and facilities. The plan must be based on an inventory of existing physical infrastructure such as, but not limited to, educational facilities, public safety facilities, libraries, indoor recreation facilities, and community centers. The plan must describe services provided to the community such as, but not limited to, water supply and the management of wastewater, storm water, and solid waste. The plan must consider energy production and consumption. The plan must analyze the needs for future types and levels of services and facilities, including, in accordance with § 46-15.3-5.1, water supply system management planning, which includes demand management goals as well as plans for water conservation and efficient use of water concerning any water supplier providing service in the municipality, and contain goals, policies, and implementation techniques for meeting future demands” (RI Gen L § 45-22.2-6).</p>
Yes	Wastewater Water supply Water system	SC	<p>“A local comprehensive plan must include, but not be limited to, the following planning elements:</p> <p>(5) a community facilities element which considers water supply, treatment, and distribution; sewage system and wastewater treatment; solid waste collection and disposal, fire protection, emergency medical services, and general government facilities; education facilities; and libraries and other cultural facilities...</p> <p>(9) a priority investment element that analyzes the likely federal, state, and local funds available for public infrastructure and facilities during the next ten years and recommends the projects for expenditure of those funds during the next ten years for needed public infrastructure and facilities such as water, sewer, roads, and schools. The recommendation of those projects for public expenditure must be done through coordination with adjacent and relevant jurisdictions and agencies. For the purposes of this item,</p> <p>“adjacent and relevant jurisdictions and agencies” means those counties, municipalities, public service districts, school districts, public and private utilities, transportation agencies, and other public entities that are affected by or have planning authority over the public project. For the purposes of this item, “coordination” means written notification by the local planning commission or its staff to adjacent and relevant jurisdictions and agencies of the proposed projects and the opportunity for adjacent and relevant jurisdictions and agencies to provide comment to the planning commission or its staff concerning the proposed projects. Failure of the planning commission or its staff to identify or notify an adjacent or relevant jurisdiction or agency does not invalidate the local comprehensive plan and does not give rise to a civil cause of action...” (SC Code § 6-29-510(D)).</p>
No	Location and character	SD	<p>Municipality: “Preparation of comprehensive plan for municipal development—Contents of plan—Changes or additions. It shall be a function and duty of the planning commission to propose a plan for the physical development of the municipality, including any areas outside the boundary and within its planning jurisdiction which, in the commission's judgment bear relation to the planning of the municipality. The comprehensive plan, with the accompanying maps, plats, charts and descriptive and explanatory matter, shall show the commission's recommendations for the said physical development and may include, among other things, the general location, character, and extent of streets, bridges, viaducts, parks, parkways, waterways and waterfront developments, playgrounds, airports, and other public ways, grounds, places and spaces; the general location of public schools, of public buildings and other public property; a zoning ordinance for the regulation of the height, area, bulk, location, and use of private and public structures and premises, and of population density as may be provided by law may be included as an adjunct to the comprehensive plan; the general location and extent of public utilities and terminals, whether publicly or privately owned, for water, light, power, heat, sanitation...” (SD Codified L § 11-6-14).</p>
Yes	Water quality Water supply	SD	<p>County: “Purposes of comprehensive county plan. The comprehensive plan shall be for the purpose of protecting and guiding the physical, social, economic, and environmental development of the county; to protect the tax base; to encourage a distribution of population or mode of land utilization that will facilitate the economical and adequate provisions of transportation, roads, water supply, drainage, sanitation, education, recreation, or other public requirements; to lessen governmental expenditure; and to conserve and develop natural resources” (SD Codified L § 11-2-12).</p>

Req'd?	Topics	ST	Statute
No	Location and character	TN	<p>“General plan for physical development. It is the function and duty of the commission to make and adopt an official general plan for the physical development of the municipality, including any area outside of its boundaries which, in the commission’s judgment, bears relation to the planning of the municipality. The plan, with the accompanying maps, plats, charts, and descriptive and explanatory matter, shall show the commission’s recommendations for the physical development of the area of the municipal planning jurisdiction and identify areas where there are inadequate or nonexistent publicly or privately owned and maintained services and facilities when the planning commission has determined the services are necessary in order for development to occur, and may include, among other things, the general location, character and extent of streets, bridges, viaducts, parks, parkways, waterways, waterfronts, playgrounds, airports and other public ways, grounds, places and spaces, the general location of public buildings and other public property, the general location and extent of public utilities and terminals, whether publicly or privately owned, for water, light, power, sanitation...” (TN Code § 13-4-201).</p>
No	Water quality Water rights	UT	<p>“(2)The general plan may provide for:(a) health, general welfare, safety, energy conservation, transportation, prosperity, civic activities, aesthetics, and recreational, educational, and cultural opportunities; (b) the reduction of the waste of physical, financial, or human resources that result from either excessive congestion or excessive scattering of population; (c) the efficient and economical use, conservation, and production of the supply of: (i) food and water; and (ii) drainage, sanitary, and other facilities and resources... (3)(a) The general plan shall:(i) allow and plan for moderate income housing growth; and (ii) contain a resource management plan for the public lands, as defined in Section 63L-6-102, within the county. (b) On or before December 1, 2019, a county with a general plan that does not comply with Subsection (3)(a)(i) shall amend the general plan to comply with Subsection (3)(a)(i). (c) The resource management plan described in Subsection (3)(a)(ii) shall address: (i) mining; (ii) land use; (iii) livestock and grazing; (iv) irrigation; (v) agriculture; (vi) fire management; (vii) noxious weeds; (viii) forest management; (ix) water rights; (x) ditches and canals; (xi) water quality and hydrology; (xii) flood plains and river terraces; (xiii) wetlands; (xiv) riparian areas...” (UT Code § 17-27a-401).</p>
No	Water quality Water supply Water system	VA	<p>“The comprehensive plan, with the accompanying maps, plats, charts, and descriptive matter, shall show the locality’s long-range recommendations for the general development of the territory covered by the plan. It may include, but need not be limited to... 2. The designation of a system of community service facilities such as parks, sports playing fields, forests, schools, playgrounds, public buildings and institutions, hospitals, nursing homes, assisted living facilities, community centers, waterworks, sewage disposal or waste disposal areas, and the like;</p> <p>3. The designation of historical areas and areas for urban renewal or other treatment;</p> <p>4. The designation of areas for the implementation of reasonable measures to provide for the continued availability, quality, and sustainability of groundwater and surface water...” (VA Code § 15.2-2223(C)).</p>

Req'd?	Topics	ST	Statute
No	Stormwater Wastewater Water quality Water supply Water system	VT	<p>“The plan for a municipality (a) A plan for a municipality may be consistent with the goals established in section 4302 of this title and compatible with approved plans of other municipalities in the region and with the regional plan and shall include the following: (1) A statement of objectives, policies, and programs of the municipality to guide the future growth and development of land, public services, and facilities, and to protect the environment. (2) A land use plan, which shall consist of a map and statement of present and prospective land uses, that...</p> <p>(D) Indicates those areas that are important as forest blocks and habitat connectors and plans for land development in those areas to minimize forest fragmentation and promote the health, viability, and ecological function of forests. A plan may include specific policies to encourage the active management of those areas for wildlife habitat, water quality, timber production, recreation, or other values or functions identified by the municipality...</p> <p>(4) A utility and facility plan, consisting of a map and statement of present and prospective community facilities and public utilities showing existing and proposed educational, recreational and other public sites, buildings and facilities, including hospitals, libraries, power generating plants and transmission lines, water supply, sewage disposal, refuse disposal, storm drainage, and other similar facilities and activities, and recommendations to meet future needs for community facilities and services, with indications of priority of need, costs, and method of financing..</p> <p>(12)(A) A flood resilience plan that:</p> <p>(i) identifies flood hazard and fluvial erosion hazard areas, based on river corridor maps provided by the Secretary of Natural Resources pursuant to 10 V.S.A. § 1428(a) or maps recommended by the Secretary, and designates those areas to be protected, including floodplains, river corridors, land adjacent to streams, wetlands, and upland forests, to reduce the risk of flood damage to infrastructure and improved property; and</p> <p>(ii) recommends policies and strategies to protect the areas identified and designated under subdivision (12)(A)(i) of this subsection and to mitigate risks to public safety, critical infrastructure, historic structures, and municipal investments.</p> <p>(B) A flood resilience plan may reference an existing local hazard mitigation plan approved under 44 C.F.R. § 201.6...” (24 V.S.A. § 4382).</p>
Yes	Groundwater recharge Water quality	WA	<p>“Comprehensive plan—Required elements. The comprehensive plan shall consist of a map or maps, and descriptive text covering objectives, principles and standards used to develop it, and shall include each of the following elements: (1) A land use element which designates the proposed general distribution and general location and extent of the uses of land for agriculture, housing, commerce, industry, recreation, education, public buildings and lands, and other categories of public and private use of land, including a statement of the standards of population density and building intensity recommended for the various areas in the jurisdiction and estimates of future population growth in the area covered by the comprehensive plan, all correlated with the land use element of the comprehensive plan. The land use element shall also provide for protection of the quality and quantity of groundwater used for public water supplies and shall review drainage, flooding, and stormwater runoff in the area and nearby jurisdictions and provide guidance for corrective actions to mitigate or cleanse those discharges that pollute Puget Sound or waters entering Puget Sound; (2) A circulation element consisting of the general location, alignment and extent of major thoroughfares, major transportation routes, trunk utility lines, and major terminal facilities, all of which shall be correlated with the land use element of the comprehensive plan; (3) Any supporting maps, diagrams, charts, descriptive material and reports necessary to explain and supplement the above elements” (WA Rev Code § 36.70.330).</p>

Req'd?	Topics	ST	Statute
Yes	Stormwater Wastewater Water supply	WI	<p>“Contents of a comprehensive plan. A comprehensive plan shall contain all of the following elements: (2)d) Utilities and community facilities element. A compilation of objectives, policies, goals, maps and programs to guide the future development of utilities and community facilities in the local governmental unit such as sanitary sewer service, storm water management, water supply, solid waste disposal, on-site wastewater treatment technologies, recycling facilities, parks, telecommunications facilities, power-generating plants and transmission lines, cemeteries, health care facilities, child care facilities and other public facilities, such as police, fire and rescue facilities, libraries, schools and other governmental facilities. The element shall describe the location, use and capacity of existing public utilities and community facilities that serve the local governmental unit, shall include an approximate timetable that forecasts the need in the local governmental unit to expand or rehabilitate existing utilities and facilities or to create new utilities and facilities and shall assess future needs for government services in the local governmental unit that are related to such utilities and facilities” (WI Stat § 66.1001).</p>
No	Location and character	WY	<p>“Master plan; adoption; concurrent action; contents; amendment. (a) The commission, after holding public hearings, shall adopt and certify to the governing body a master plan for the physical development of the municipality. If the plan involves territory outside the city or town, action shall be taken with the concurrence of the board of county commissioners or county planning commission, or other municipal legislative body concerned. The master plan, with the accompanying maps, plats, charts and descriptive and explanatory matter shall show the:</p> <p>(i) Commission’s recommendations for the development and may include the general location, character and extent of streets, bridges, viaducts, parks, waterways and waterfront developments, playgrounds, airports and other public ways, grounds, places and spaces;</p> <p>(ii) General location of public buildings and other public property;</p> <p>(iii) General location and extent of public utilities and terminals, whether publicly or privately owned, for water, light, power, heat, sanitation...” (WY Stat § 15-1-503).</p>

The following table describes the statutes related to land use within water management plans, covering whether the statute language relates to the content of a water management plans or the process for writing a water management plan, a summary of the requirement in the statute, the state, and abbreviated language from the statute itself. This work is adapted from Dickinson et al. 2021.

Table A.2

Statutes for incorporating land use within water management plans

Content/ Process	Summary	ST	Statute
Content	Calculate projected water demand according to local land use plans, policies, or zoning; be it the land use plan's population projections, anticipated development, or growth of certain land use types	CA	<p>"Water use projections, where available, shall display and account for the water savings estimated to result from adopted codes, standards, ordinances, or transportation and land use plans identified by the urban water supplier, as applicable to the service area" (Cal. Water Code §10631(d)(4)(A)).</p> <p>"Additionally, plans for urban retail water suppliers must include records of past, current, and projected water use in 5-year increments for the categories of single-family residential; multifamily; commercial; industrial; institutional and governmental; landscape; sales to other agencies; saline water intrusion barriers, groundwater recharge, or conjunctive use; agricultural; and distribution system water loss" (Cal. Water Code §10631(d)(1-2)).</p>
Content	Include a narrative description of current and projected land uses of the service area	CA	The description also must "include the current and projected land uses within the existing or anticipated service area affecting the supplier's water management planning" (Cal. Water Code §10631(a)).
Process	Notification and make available for review after drafted	CA	"At least 60 days before a public hearing on a plan, urban water suppliers must notify the cities or counties within which they provide water that they will be reviewing the plan and considering amendments or changes to it " (Cal. Water Code §10621(b)).
Content	Land use efforts for water demand management	CO	The plan must include "[b]est management practices for water demand management, water efficiency, and water conservation that may be implemented through land use planning efforts " (CO Rev Stat § 37-60-126(4)(f)(I)).

Content/ Process	Summary	ST	Statute
Content	Assess the potential for new water supply sources according to land use plans, policies, or zoning	CT	<p>“Each water supply plan submitted shall evaluate the water supply needs in the service area of the water company and propose a strategy to meet such needs. The plan shall contain:</p> <p>...(c) An assessment of potential alternative sources of supply, including:</p> <p>(1) An analysis of alternatives to allow the use of inactive or emergency sources of supply and the safe yield of existing active sources of supply beyond any current limitations in order to meet demands currently and in the five, twenty and fifty year planning periods;</p> <p>(2) an evaluation of potential new sources of supply and a description of existing state, local and regional land use plans, policies, classifications and zoning as they relate to source development...” (CONN. AGENCIES REGS. § 25-32d-3).</p> <p>“The coordinated water system plan shall include, but not be limited to, the following:</p> <p>... (2) An areawide supplement that shall address areawide water system concerns pertaining to the public water supply management area which are not otherwise included in each water company’s individual water system plan. The areawide supplement consists of a water supply assessment, exclusive service area boundaries, integrated report, and executive summary. The areawide supplement shall include at least the following:</p> <p>(A) Water Supply Assessment</p> <p>A water supply assessment shall be developed to evaluate water supply conditions and problems within the public water supply management area. The WUCC shall prepare a preliminary and then a final water supply assessment. The water supply assessment shall be a factual and concise report including at least the following topics as they relate to public water systems in the public water supply management area:</p> <p>...(iv) Present and projected growth rates, including population data, land use patterns and trends, and identification of lands available for development.</p> <p>...(C) Integrated Report</p> <p>An integrated report shall be developed which provides an overview of individual public water systems within the management area; addresses areawide water supply issues, concerns, and needs; and promotes cooperation among public water systems.</p> <p>The integrated report shall contain at least the following:</p> <p>...(ii) Discussion of the relationship and compatibility of the coordinated water system plan with proposed or adopted land use plans and growth policies, as reflected in local, regional and state plans. Consideration should be given to both protection and development of public water supply sources and to availability of public water service” (CONN. AGENCIES REGS. § 25-33h-1(d)).</p>

Content/ Process	Summary	ST	Statute
Content	Identify critical lands to be protected, land management strategies, or land use control regulations for source water protection and water quality	CT	<p>“The plan shall include... (9) on and after January 1, 2004, an evaluation of source water protection measures for all sources of the water supply, based on the identification of critical lands to be protected and incompatible land use activities with the potential to contaminate a public drinking water source...” (CONN. GEN. STAT. ANN. § 25-32d(b)).</p> <p>“The plan shall contain:</p> <p>...(d) A water supply emergency contingency plan, including emergencies due to contamination of water, power outages, drought, flood or failure of any or all-critical system components. Such water supply emergency contingency plan shall include:</p> <p>...(i) Provide an evaluation of source water protection measures. The evaluation shall analyze potential hazards to public drinking water sources of supply. This evaluation shall also, at a minimum, include the following information:</p> <p>... (2) Identification of critical lands to be protected, in table format, including: number of acres by town for all water company-owned lands; percentage or acreage of land owned or controlled within 200 feet of ground water wells, through easement or other means; number of acres for all source water protection areas; and number of acres of public or privately owned protected lands located within each source water protection area if known or available;</p> <p>(3) An inventory of land use activities for each delineated source water protection area, in table format, that are of immediate concern to water quality, or have a significant potential to contaminate a public drinking water supply, as determined by a public water system. Such inventory shall be based on: 1) source water assessment reports developed by the Department of Public Health and; 2) inspection reports or survey data, or both, compiled or maintained by the public water system. The following supportive information shall also be provided:</p> <p>(A) For each delineated source water protection area: a description and location of inventoried land use activities with significant potential to contaminate; and an assessment as to which of these activities are the most significant regarding the potential to contaminate a public drinking water source of supply.</p> <p>... (4) A narrative describing:</p> <p>(A) Land use activities with the most significant potential to contaminate, as assessed and identified in subdivision (3)(A) of this subsection;</p> <p>(B) Information about plans or programs to reduce potential public health risks for each inventoried land use activity of immediate concern to water quality, to include:</p> <p>(i) Engineering controls,</p> <p>(ii) Drinking water source protection management plans,</p> <p>(iii) Recognized best management practices or other strategies.</p> <p>(C) Existing state, local, and regional land use plans, policies, classifications and zoning ordinances as they relate to drinking water source protection within the source water protection area; and</p> <p>(D) The public water system’s drinking water source protection program including a discussion of measures to strengthen source water protection within each delineated source water protection area” (CONN. AGENCIES REGS. § 25-32d-3).</p>

Content/ Process	Summary	ST	Statute
Content	Include a narrative description of current and projected land uses of the service area	CT	<p>“Each water supply plan submitted shall evaluate the water supply needs in the service area of the water company and propose a strategy to meet such needs. The plan shall contain:</p> <p>...(b) An analysis of present and future water supply demands for the five, twenty, and fifty year planning periods, including:</p> <p>(1) A description of the present population distribution patterns and population served;</p> <p>(2) data and an evaluation of current and historic water use in each water supply system for the past five years of record, or since the most recent submittal of a water supply plan, including average daily, maximum month and peak day demands and sales to other water companies. Water companies that have this data compiled by user categories shall provide data in that form;</p> <p>(3) a description of local, state and regional land use plans, policies and zoning as related to projected water demands and future service areas;</p> <p>(4) projected water demands for the five, twenty and fifty year planning periods, including sales to other water companies, based on user categories if data is available, and local land use plans and zoning regulations...” (CONN. AGENCIES REGS. § 25-32d-3).</p>
Process	Coordination and consistency with local comprehensive plans	CT	<p>“After the WUCC has completed the coordinated water system plan, it shall submit the plan to the department for approval.</p> <p>... (2) The department in making a decision to approve or reject a coordinated water system plan shall consider at least the following:</p> <p>...(E) Consistency with local, regional, and state land use plans and growth policies...” (CONN. AGENCIES REGS. § 25-33h-1(g)).</p>
Process	Notification and make available for review after drafted	CT	<p>The Department of Public Health must notify each chief elected official, local health official, and regional planning organization covering any portion of the company’s existing or proposed source or service area of the water supply plan and the opportunity to comment on it (CONN. AGENCIES REGS. § 25-32d-5(a)). Once approved, the water company must provide notice of the plan approval to all local health departments and municipal planning departments or agencies covering any portion of the existing or proposed source or service areas (CONN. AGENCIES REGS. § 25-32d-5(d)).</p> <p>WUCCs must send one copy of each of the preliminary and final water supply assessment and preliminary and final exclusive service area boundaries to, among others, each chief administrative official of municipalities in the management area. They also must mail notice of the preliminary water supply assessment and preliminary exclusive service area boundaries, and the opportunity to comment on them, as well as notice of the finalization of those documents once approved, to each municipal planning commission, local health official, eligible WUCC member, and other interested people in the management area (CONN. AGENCIES REGS. § 25-33h-1(h)(1)). WUCCs must distribute one copy of the executive summary of the coordinated plan and notice of the availability of the complete coordinated water system plan, and the opportunity to comment on them, to each chief administrative official of municipalities within the management area and to each chief administrative official with municipalities outside the management area in which a potential source of supply is located (CONN. AGENCIES REGS. § 25-33h-1(h)(2)(B)). Once the coordinated plan is approved, the WUCC must mail written notice of the availability of the approved plan to each municipal planning commission, local health official, eligible WUCC member, and the chief administrative official of each municipality (and other interested people) within the management area (CONN. AGENCIES REGS. § 25-33h-1(h)(3)(A)).</p> <p>The municipalities and regional councils of governments shall comment on, but shall not be limited to commenting on, the consistency of the coordinated water system plan with local and regional land use plans and policies (CONN. GEN. STAT. ANN. § 25-33h(b)).</p>

Content/ Process	Summary	ST	Statute
Process	Water planning at a district or regional level that must consider local plans and receive input from local planning agencies	FL	<p>“Regional water supply planning. —</p> <p>(1) The governing board of each water management district shall conduct water supply planning for a water supply planning region within the district identified in the appropriate district water supply plan under s. 373.036, where it determines that existing sources of water are not adequate to supply water for all existing and future reasonable-beneficial uses and to sustain the water resources and related natural systems for the planning period. The planning must be conducted in an open public process, in coordination and cooperation with local governments, regional water supply authorities, government-owned and privately owned water and wastewater management agencies, multijurisdictional water supply entities, self-suppliers, reuse utilities, the Department of Environmental Protection, the Department of Agriculture and Consumer Services, and other affected and interested parties. The districts shall actively engage in public education and outreach to all affected local entities and their officials, as well as members of the public, in the planning process and in seeking input. During preparation, but before completion of the regional water supply plan, the district shall conduct at least one public workshop to discuss the technical data and modeling tools anticipated to be used to support the regional water supply plan. The district shall also hold several public meetings to communicate the status, overall conceptual intent, and impacts of the plan on existing and future reasonable-beneficial uses and related natural systems...” (FL Stat § 373.709).</p>
Process	Coordination and consistency with local comprehensive plans	GA	<p>Regional water development and conservation plans must establish: “Procedures for coordination with the Department of Community Affairs to ensure implementation of Regional Water Development and Conservation Plans is coordinated with the regional and local government comprehensive planning process in accordance with O.C.G.A. §§12-2-8 and 50-8-30 et seq” (GA. COMP. R. & REGS. r. 391-3-32(4)(c)(2)(vii)).</p> <p>In addition, “The Division will consult with the Department of Community Affairs to ensure implementation of the Water Development and Conservation Plan is coordinated with the regional and local government comprehensive planning process in accordance with O.C.G.A. §§12-2-8 and 50-8-30 et seq” (GA. COMP. R. & REGS. r. 391-3-32(5)(a)).</p>
Process	Notification of intent to develop a water management plan and assemble and review other planning documents	KY	<p>“The planning council shall send written notification of the intent to develop a water supply plan to the following: all local units of government within the planning unit; water suppliers that provide water for use in the planning unit; and local units of government that use the same source of water as any water supplier in the planning unit. The letter of notification to local governments and water suppliers shall request the following information: 1. A copy of any existing water or related plans; 2. A statement of any current or potential conflicts, problems or opportunities that the local units or water systems want the planning process to examine or address, including water use rights, access and conservation; and 3. A description of expected changes in or around the planning unit that may alter current growth trends, including existing ordinances and planning goals” (401 KY. ADMIN. REGS. 4:220(5)(3)(c)).</p> <p>“The planning representative shall assemble and review information collected through the notification process described in Section 5(3)(c) and (4) of this administrative regulation. The planning representative shall review any plans and studies prepared within five (5) years previous to the base year by city, county, regional, state, and federal agencies that are related to water, sewer, waste management, or commercial and industrial growth” (401 KY. ADMIN. REGS. 4:220(6)(2)).</p> <p>“The planning representative shall determine the steps necessary to implement the water supply plan and describe these in section XIII of the final plan document.</p> <p>...(d) The planning representative shall recommend procedures to coordinate actions of local government, and other agencies that impact development decisions within the planning unit, with the water supply plan” (401 KY. ADMIN. REGS. 4:220(6)(14)).</p>

Content/ Process	Summary	ST	Statute
Content	Include a narrative description of current and projected land uses of the service area	MD	<p>“Chapter two shall contain the general background information relevant to the water and sewerage planning. Information shall include the maps, charts, and tables listed below. When a county has previously developed alternative methods for presenting this data, the specific format required in the chapter may be waived by the Department.</p> <p>(3) Land Use.</p> <p>(a) Maps showing existing land use, zoning, and the adopted comprehensive development plan for the county” (MD. REGS. CODE tit. 26 § 03.01.04(D)).</p>
Process	Coordination and consistency with local comprehensive plans	MD	<p>“The objective of the county plan is to develop the water supply and sewerage systems in a way consistent with county comprehensive planning. The plan shall be used as a tool to implement the county development policy so that:</p> <p>(1) An ample supply of water may be collected, treated, and delivered to points of use;</p> <p>(2) Waste water may be collected and delivered to points best suited for waste treatment and disposal or for re-use;</p> <p>(3) Waste water can be either treated before any discharge to State waters, in compliance with applicable water quality standards and discharge permit conditions, or disposed of to minimize most effectively adverse effects on legitimate water uses. Consideration shall be given to related aspects of land use, zoning, population estimates, engineering and economic factors, and all governmental, industrial, and other plans for privately owned facilities regarding water and sewerage at any level” (MD. REGS. CODE tit. 26 § 03.01.02(A)).</p>
Process	Cooperation between agency officials in the development of sewer district plans specifically	ME	<p>The requirement is limited to sewer districts, specifically the trustees thereof, but it is succinct and works both directions:</p> <p>“The trustees of a sewer district shall cooperate with municipal officials in the development of municipal growth management and other land use plans and ordinances” (38 ME Rev Stat § 1037(1)).</p>
Content	Calculate projected water demand according to local land use plans, policies, or zoning; be it the land use plan’s population projections, anticipated development, or growth of certain land use types	OR	<p>“The water supply element of a Municipal WMCP shall include at least the following:</p> <p>(1) A delineation of the current and future service areas consistent with state land use law that includes available data on population projections and anticipated development consistent with relevant acknowledged comprehensive land use plans and urban service agreements or other relevant growth projections;</p> <p>... (3) Based on the information provided in section (1) of this rule, an estimate of the water supplier’s water demand projections for 10 and 20 years, and at the option of the Municipal Water Supplier, longer periods...” (Or. Admin. R. 690-086-0170).</p>
Process	Encourage consultation between planning department and municipal water suppliers	OR	<p>“In the development of a water management and conservation plan, each Municipal Water Supplier is encouraged to consult with the planning departments or appropriate officials of Affected Local Governments to obtain information related to demand projections in comprehensive land use plans early in the development of the plan” (Or. Admin. R. 690-086-0120(7)).</p>
Content	Calculate projected water demand according to local land use plans, policies, or zoning; be it the land use plan’s population projections, anticipated development, or growth of certain land use types	RI	<p>“Description of supply management measures necessary to insure present and future availability of drinking water in adequate quantity and quality to meet existing and projected demands for the 5- and 20-year planning periods shall include but not be limited to the following:</p> <p>1. Anticipated Future Demand</p> <p>a. Estimates of changes in population and economic development within existing and planned future extensions to service areas;</p> <p>(1) Population changes shall be based upon an analysis of existing and potential land uses consistent with appropriate local comprehensive plans and the most recent U.S. Census of Population statistics. If water supplier’s population growth projections differ by more than 10% from estimates developed by the relevant municipality(ies), the water supplier shall provide explanation for the differences...” (R.I. CODE R. 490-00-00-2.8.5(A)).</p>

Content/ Process	Summary	ST	Statute
Content	Identify critical lands to be protected, land management strategies, or land use control regulations for source water protection and water quality	RI	<p>"A water supply system management plan shall include, without limitation, the following components:</p> <p>(1) The water supply management component of the water supply system management plan shall include, without limitation:</p> <p>(i) A statement of the goals that the plan is designed to achieve, including, but not limited to, goals for:</p> <p>(A) Water resource protection;</p> <p>... (vi) Supply management measures to insure present and future availability of drinking water in adequate quantity and quality, including protection of the capacity and quality of drinking water sources; retaining water sources for standby or future use that are or can be improved to drinking water quality; reactivation of any water sources not in use; interconnection of systems for ongoing, standby, or emergency use; supply augmentation;</p> <p>... (2) The water quality protection component of the water supply system management plan shall include, without limitations, those items enumerated in § 46-15.3-7: [(1) Determination of the boundaries of the watersheds of reservoirs serving the supplier or of the aquifers serving public wells. (2) Identification of sources of contamination of each reservoir or well field. (3) Identification of measures needed to protect each reservoir or well field from sources of contamination, including acquisition of buffer zones, diversion of storm water or spills, and desirable land use control regulations. (4) A priority list of actions for implementing these protection measures.] (R.I. GEN. LAWS § 46-15.3-5.1(c)).</p> <p>For more detail, see R.I. CODE R. 490-00-00-2.8.3.</p>
Process	Coordination and consistency with local comprehensive plans	RI	<p>"The water supply system management plans of water suppliers...shall be consistent with applicable local comprehensive plans and shall be integrated into the water supply plans of the municipality or municipalities in which the service area is or is planned to be located. Conversely, the local comprehensive plans shall be consistent with water supply plans..." (R.I. GEN. LAWS § 46-15.3-5.1(c)(1)(viii)).</p> <p>"Water supply system management plans shall be coordinated and consistent with applicable local comprehensive plans and shall be integrated into the water supply plans of the municipality or municipalities in which the service area is or is planned to be located. The local comprehensive plan has primacy in establishing the future land use, zoning and growth projections for municipalities as established by R.I. Gen. Laws Chapter 42-22.2, The Rhode Island Comprehensive Plan and Land Use Regulation Act. Water suppliers shall coordinate with appropriate municipalities on service expansions that are consistent with the adopted comprehensive plan(s) of those communities and are within the ability of the water system to accommodate. Any expansion of existing service areas shall be consistent with the appropriate local comprehensive plan(s). Conversely, the Services and Facilities elements of the appropriate local comprehensive plans should be based upon the final approved water supply system management plans. Water supply system management plans shall describe water supplier's efforts and future expansions of the water system. A letter, indicating the concurrence of the appropriate municipal planning department and or planning board that the WSSMP is consistent with appropriate comprehensive plan(s) shall be submitted as part of the WSSMP. Attention should be focused on existing and future land uses, zoning requirements, population and growth projections, responsibilities and capabilities to respond to water supply emergencies, planning for capital improvement needs service area expansions, supply augmentation, cooperative water quality protection efforts and other areas of mutual interest" (R.I. CODE R. 490-00-00-2.8.12(A)).</p>

Content/ Process	Summary	ST	Statute
Content	Identify critical lands to be protected, land management strategies, or land use control regulations for source water protection and water quality	TN	<p>Wellhead protection plans must include, among other items, proposed zoning changes, proposed local ordinances, and other institutional controls (TENN. COMP. R. & REGS. 0400-45-01-.34(1)(f)(7)). Revisions to wellhead protection plans and contaminant source inventories are expected to address, among other items, land management strategies (TENN. COMP. R. & REGS. 0400-45-01-.34(1)(f)(13)).</p> <p>Wellhead protection plans for Category 3 and Category 4 public water systems must include, among other items, the steps the public water system is taking to protect/ manage the wellhead protection area, including "proposed local ordinances in cooperation with the city or county government or county/regional planning commission" (TENN. COMP. R. & REGS. 0400-45-01-.34(2)).</p>

Content/ Process	Summary	ST	Statute
Content	Identify critical lands to be protected, land management strategies, or land use control regulations for source water protection and water quality	UT	<p>“(1) PWSs shall plan land management strategies to control or prohibit future potential contamination sources within each of its DWSP zones or management areas consistent with the provisions of R309-600 and to an extent allowed under its authority and jurisdiction. Land management strategies must be designed to control potential contamination and may be regulatory or non-regulatory. Additionally land management strategies must be implemented according to the schedule required in R309-600-7(1)(e).</p> <p>(2) Protection areas may extend into neighboring cities, towns, and counties. Since it may not be possible for some PWSs to enact regulatory land management strategies outside of their jurisdiction, except as described below, it is recommended that these PWSs contact their neighboring cities, towns, and counties to see if they are willing to implement protective ordinances to prevent ground-water contamination under joint management agreements.</p> <p>(3) Cities and towns have extraterritorial jurisdiction in accordance with Section 10-8-15 of the Utah Code Annotated to enact ordinances to protect a stream or “source” from which their water is taken... “for 15 miles above the point from which it is taken and for a distance of 300 feet on each side of such stream...”</p> <p>(4) Zoning ordinances are an effective means to control potential contamination sources that may want to move into protection areas. They allow PWSs to prohibit facilities that would discharge contaminants directly to ground water. They also allow PWSs to review plans from potential contamination sources to ensure there will be adequate spill protection and waste disposal procedures, etc. If zoning ordinances are not used, PWSs must establish a plan to contact potential contamination sources individually as they move into protection areas, identify and assess their controls, and plan land management strategies if they are not adequately controlled” (UTAH ADMIN. CODE 309-600-12). [groundwater sources]</p> <p>“(a) PWSs shall plan land management strategies to control or prohibit future potential contamination sources within each of its DWSP zones consistent with the provisions of R309-605 and to the extent allowed under its authority and jurisdiction. Land management strategies must be designed to control or reduce the risk of potential contamination and may be regulatory or non-regulatory. Additionally land management strategies must be implemented according to the schedule required in R309-605-7(1)(b)(v).</p> <p>(b) Protection areas may extend into neighboring cities, towns, and counties. Since it may not be possible for some PWSs to enact regulatory land management strategies outside of their jurisdiction, except for municipalities as described below, it is recommended that these PWSs contact their neighboring cities, towns, and counties to see if they are willing to implement protective ordinances to prevent surface water contamination under joint management agreements.</p> <p>(c) Cities and towns have extraterritorial jurisdiction in accordance with Section 10-8-15 of the Utah Code Annotated to enact ordinances to protect a stream or “source” from which their water is taken... “for 15 miles above the point from which it is taken and for a distance of 300 feet on each side of such stream...”</p> <p>(d) Zoning ordinances are an effective means to control potential contamination sources that may want to move into protection areas. They allow PWSs to prohibit facilities that would discharge contaminants directly to surface water. They also allow PWSs to review plans from potential contamination sources to ensure there will be adequate spill protection and waste disposal procedures, etc. If zoning ordinances are not used, PWSs must establish a plan to contact potential contamination sources individually as they move into protection areas, identify and assess their controls, and plan land management strategies if they are not adequately controlled” (UTAH ADMIN. CODE 309-605-7(6)). [surface water sources]</p>

Content/ Process	Summary	ST	Statute
Content	Assess the potential for new water supply sources according to land use plans, policies, or zoning	VA	<p>"A program shall include a description of existing environmental conditions that pertain to, or may affect, in-stream flow, in-stream uses, and sources that provide the current supply ... The description of conditions shall include the following items, as they are applicable:</p> <p>...8. Land use and land coverage including items such as percentage of impervious cover within a watershed and areas where new development may impact water quality of the source..." (9 VA. ADMIN. CODE § 25-780-90(B)).</p>
Content	Calculate projected water demand according to local land use plans, policies, or zoning; be it the land use plan's population projections, anticipated development, or growth of certain land use types	WA	<p>"Small water system management programs must include, among other elements, a forecast of the average daily demand based on the system's approved number of connections, considering water use trends based on actual water use records and applicable land use plans" (WASH. ADMIN. CODE § 246-290-105(4)(k)).</p>
Content	Include a narrative description of current and projected land uses of the service area	WA	<p>Water system plans must include, among other elements, a description of the water system, including related plans, such as local land use plans, coordinated water system plans, abbreviated coordinated water system plans, groundwater management plans, and basin plans, as well as basic planning data, including "designated land use, zoning, population, and water demand within the water system's service area for the plan approval period, and at least a twenty-year planning period" (WASH. ADMIN. CODE § 246-290-100(4)(a)(iii), (b)(iii)).</p>
Process	Coordination and consistency with local comprehensive plans	WA	<p>"Purveyors shall transmit water system plans to adjacent utilities and each local government with jurisdiction, to assess consistency with ongoing and adopted planning efforts" (WASH. ADMIN. CODE § 246-290-100(7)).</p> <p>"... (2) Municipal water suppliers must request each local government with jurisdiction over the service area to provide a consistency review. Municipal water suppliers may exclude wholesale areas from the consistency review provided the water system receiving the wholesale water complies with the requirements for a consistency review when developing a water system plan for any new connection within the service area of the system receiving the wholesale water.</p> <p>(a) Municipal water suppliers shall provide each local government with jurisdiction sixty days to review the planning or engineering document unless another state statute or state regulation requires a different time frame. The municipal water supplier must provide the local government with jurisdiction an additional thirty days for review if requested.</p> <p>(b) If an inconsistency is documented by the local government with jurisdiction within the time frame outlined in (a) of this subsection, the municipal water supplier must provide the inconsistency information to the department.</p> <p>(c) If the local government with jurisdiction documents in writing an inconsistency exists with local plans and regulations, the municipal water supplier shall address the inconsistency. The local government with jurisdiction shall be provided sixty days to review any revisions or responses that address the inconsistency.</p> <p>(3) If the local government with jurisdiction does not provide a consistency review, the municipal water supplier shall complete the consistency review as described in subsection (1) of this section. The municipal water supplier must also document:</p> <p>(a) The amount of time provided to each local government with jurisdiction to review the planning and engineering documents as defined in subsection (2) of this section; and</p> <p>(b) The efforts taken to request a consistency review from the local government with jurisdiction" (WASH. ADMIN. CODE § 246-290-108).</p>

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