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Water Supply Management in Virginia: Lessons from the West Coast



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About the Author



Kristin McCarthy was involved with the Virginia Coastal Policy Center (VCPC) as a Graduate Research Fellow for three years, and as a student in the Practicum I and II, Independent Research, and Independent Writing classes. During her time at VCPC, Kristin gained experience working on coastal policy issues including developing a planning scorecard for flooding resilience, modeling flooding and relocation impacts to local counties, assisting Virginia Indian Tribes with their natural resources questions, and outlining potential water supply solutions for Virginia. After graduation, Kristin is going to work as a litigation associate at Greenberg Traurig in Los Angeles, CA, and hopes to pursue a career in environmental law.

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About the Virginia Coastal Policy Center

The Virginia Coastal Policy Center (VCPC) at the College of William & Mary Law School provides science-based legal and policy analysis of ecological issues affecting the state's coastal resources, by offering education and advice to a host of Virginia's decision-makers, from government officials and legal scholars to non-profit and business leaders.

With two nationally prominent science partners – the Virginia Institute of Marine Science and Virginia Sea Grant – VCPC works with scientists, local and state political figures, community leaders, the military, and others to integrate the latest science with legal and policy analysis to solve coastal resource management issues. VCPC activities are inherently interdisciplinary, drawing on scientific, economic, public policy, sociological, and other expertise from within the University and across the country. With access to internationally recognized scientists at VIMS, to Sea Grant's national network of legal and science scholars, and to elected and appointed officials across the nation, VCPC engages in a host of information exchanges and collaborative partnerships.

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questions, or suggestions.

VCPC grounds its pedagogical goals in the law school's philosophy of the citizen lawyer. VCPC students' highly diverse interactions beyond the borders of the legal community provide the framework for their efforts in solving the complex coastal resource management issues that currently face Virginia and the nation.

I. INTRODUCTION

People in the arid American West have struggled with water supply issues since before the United States were founded.¹ An arid state is one where the “overall water supply . . . is the always insufficient to grow crops on all the land available.”² Warmer climate and lack of precipitation coupled with rapid population growth and an ever-increasing demand for water by residents and for agricultural purposes has left states such as California in a perpetual water supply crisis.³ Even with heavier rains in 2019 lifting California temporarily from its drought emergency,⁴ California state and local governments remain focused on solutions to their water supply shortage. In 2018, then-California governor Jerry Brown signed into law two bills that would set permanent water restriction goals for the state.⁵

Meanwhile in Arizona, a state with very few regulations on water use, rural residents are already facing water shortage crises.⁶ Residents in Sulphur Springs Valley, Arizona, for example, are living on properties with dried up wells as a result of the large-scale farming businesses attracted to the state because of the minimal restrictions on water use.⁷ In cases like this, it is increasingly clear that regulation at the state and local level is necessary to preserve water supply for residents before it is too late.⁸

While the western United States may be no stranger to drought and water supply issues, these problems are less common in the east. That does not mean, however, that they do not exist. Recently in Virginia, concerns about the overtaking of the Potomac aquifer have emerged for the first time.⁹ Eastern Virginia relies on groundwater withdrawals from the Potomac aquifer and other aquifers to supplement surface water.¹⁰ While the Potomac aquifer has historically been tapped at a rate of more than one hundred million gallons per day for well users without cause for concern,

¹ See Chennat Gopalakrishnan, *The Doctrine of Prior Appropriation and Its Impact on Water Development: A Critical Survey*, 32 AM. J. OF ECON. & SOC. 61, 62 (1973).

² *Id.*

³ See Dennis Dimick, *5 Things You Should Know About California's Water Crisis*, NAT'L GEOGRAPHIC (Apr. 6, 2015), <https://news.nationalgeographic.com/2015/04/150406-california-drought-snowpack-map-water-science/>.

⁴ Jonathan Lloyd, *February Storms Wipe Out Drought for Most of California*, NBC L.A. (Feb. 21, 2019), <https://www.nbclosangeles.com/news/california/Weather-Drought-California-Storm-Rain-Map-506163501.html>.

⁵ Assemb. B. 1668, 2017-18 Reg. Sess. (Cal. 2018); S.B. 606 2017-18 Reg. Sess. (Cal. 2018); Taryn Luna & Alexei Koseff, *Get Ready to Save Water: Permanent California Restrictions Approved by Gov. Jerry Brown*, THE SACRAMENTO BEE (May 31, 2018), <https://www.sacbee.com/news/politics-government/capitol-alert/article211333594.html>.

⁶ Noah G. Shannon, *The Water Wars of Arizona*, N.Y. TIMES (July 19, 2018), <https://www.nytimes.com/2018/07/19/magazine/the-water-wars-of-arizona.html>.

⁷ *Id.*

⁸ *Id.*

⁹ *Status of Virginia's Water Resources: A Report on Virginia's Water Resources Management Activities*, VA. DEP'T OF ENVTL. QUALITY 1, 7, 17 (Oct. 2012), https://www.deq.virginia.gov/Portals/0/DEQ/LawsAndRegulations/GeneralAssemblyReports/Water_Resources_Report.pdf [hereinafter *Water Report*]; Matt Sabo, *Hampton Roads' Thirst for Water Draining Vital Coastal Plain Aquifers*, DAILY PRESS (Mar. 11, 2013), <https://www.dailypress.com/news/science/dp-xpm-20130311-2013-03-11-dp-nws-groundwater-future-0224-20130311-story.html>.

¹⁰ See generally, KURT STEPHENSON & ABT ASSOC.'S INC., AN INVESTIGATION OF THE ECONOMIC IMPACTS OF COASTAL PLAIN AQUIFER DEPLETION AND ACTIONS THAT MAY BE NEEDED TO MAINTAIN LONG-TERM AVAILABILITY AND PRODUCTIVITY (2014).

scientists are now realizing the aquifer's water levels are rapidly decreasing.¹¹ This is due in large part to the heavy demands of industrial practices, which can draw billions of gallons per year from the aquifer, and which have already caused water levels around industrial wells to decrease sharply and contributed to land subsidence in the Hampton Roads region.¹²

Because of the unsustainability of these practices and the precarious nature of aquifers even in a wetter climate, Virginia has already started taking action to prevent overuse of the Potomac aquifer and ensure adequate water supply for many years to come, including cutting back on permitted groundwater withdrawals in the eastern part of the state.¹³ Studying the innovative approaches taken on state and local levels in the west can be instructive for eastern states like Virginia, looking for ways to manage their own water supply issues as they arise.

This paper first provides a brief overview of the two main water rights doctrines: riparian rights in the east, and prior appropriation in the west, with special emphasis on Virginia's and California's water laws. This paper next looks at particularly relevant water supply solutions, including bringing the agriculture industry to the table, implementing aquifer storage and recovery and groundwater trading programs, embracing "One Water" plans, and expanding water budgeting laws in the state. Each section first examines the actions that Virginia has already undertaken, before highlighting examples of success in the west and making recommendations for ways in which Virginia can ensure an adequate water supply for Virginians in the future.

II. OVERVIEW OF EXISTING WATER LAWS

A. Eastern States: Riparian Rights Doctrine

Riparian rights are a part of the American common law that developed out of the 1827 case *Tyler v. Wilkinson*, in Rhode Island.¹⁴ A riparian water right entitles the landowner to use a share of the water that flows by or through his property.¹⁵ These rights exist without the need for government intervention through the use of permits or licenses, and remain with the land when ownership changes.¹⁶ The water also cannot be unreasonably detained or diverted, or used for another piece of land.¹⁷ Typically states that follow a riparian rights system require that the water be put to reasonable use, although the definition of such use varies by state.¹⁸ Riparian rights are

¹¹ Sabo, *supra* note 9.

¹² Water Report, *supra* note 9, at 57.

¹³ Pamela D'Angelo, *East of I-95, Virginia Begins to Limit Permitted Groundwater Users*, WVTF (Aug. 9, 2017), <https://www.wvtf.org/post/east-i-95-virginia-begins-limit-permitted-groundwater-users#stream/0>.

¹⁴ Eric B. Hecox, *Western States' Water Laws: A Summary for the Bureau of Land Management*, BUREAU OF LAND MGMT. (Aug. 15, 2001), https://archive.org/stream/westernstateswat4002heco/westernstateswat4002heco_djvu.txt (citing *Tyler v. Wilkinson*, 4 Mason 397 (1827)).

¹⁵ *Id.*; State Water Res. Control Bd., *The Water Rights Process*, CAL. WATER BOARDS, https://www.waterboards.ca.gov/waterrights/board_info/water_rights_process.html (last updated Sept. 5, 2018).

¹⁶ *Id.*

¹⁷ Hecox, *supra* note 14.

¹⁸ *Id.*

of an indefinite duration and cannot be lost by non-use; however, courts tend to favor existing uses over potential future uses.¹⁹

B. Virginia: Surface Water and Groundwater Withdrawal Permitting

Like most eastern states, Virginia's water laws are based on the riparian rights doctrine. However, Virginia's water laws are robust, as the state has enacted permitting systems for both surface water and groundwater withdrawal. All withdrawals from Virginia non-tidal surface waters exceeding 10,000 gallons per day must be permitted unless otherwise excluded under permit regulations.²⁰ Agricultural users, however, need not apply for a surface water withdrawal permit unless their withdrawal exceeds one million gallons per month (or 32,876 gal/day).²¹ Additionally, variances to surface withdrawal permit conditions may be granted during a drought.²²

Virginia also regulates withdrawals from groundwater through the Ground Water Management Act of 1992,²³ which requires permits for any user seeking to withdraw 300,000 gallons or more from the groundwater in any month.²⁴ These groundwater permitting requirements apply only within the Commonwealth's two groundwater management areas: the Eastern Shore Groundwater Management Area (ESGMA) and the Eastern Virginia Groundwater Management Area (EVGMA).²⁵ While the Groundwater Management Act prioritizes drinking water for human consumption above other conflicting water rights in the event of insufficient supply,²⁶ more than sixty percent of permitted groundwater withdrawal in eastern Virginia is put to industrial use.²⁷ While groundwater extraction can be limited in a drought emergency, improved groundwater regulations could help to ease the strain on Virginia's water supply.²⁸ There is currently little overlap between surface water permits²⁹ and groundwater permits.³⁰ The State Water Control Board may consider "the proposed use of alternate or innovative approaches such as . . . surface

¹⁹ *Id.*; see, e.g., *Colorado v. New Mexico*, 459 U.S. 176, 186-87 (1982) (remanding the case for additional factual findings because the Special Master's Report "did not clearly state the factual findings supporting his reliance on [the availability of conservation measures and a weighing of the harm and benefits that would result from the diversion]).

²⁰ 9 VA. ADMIN. CODE § 25-210-310 (2016); Andrew Hammond, *Virginia Water Protection Permit Program*, VA. DEP'T. ENVTL. QUALITY, https://www.deq.virginia.gov/Portals/0/DEQ/Water/OWS-WWPandC/VWP_WWRhandout_10102018.pdf?ver=2018-10-10-160533-350 (last visited June 7, 2019).

²¹ *Id.*

²² 9 VA. ADMIN. CODE § 25-210-390 (2016).

²³ VA. CODE ANN. §§ 62.1-254 *et seq.* (1992); see also 9 VA. ADMIN. CODE §§ 25-610-10 *et seq.* (2014).

²⁴ 9 VA. ADMIN. CODE § 25-610-50 (2014).

²⁵ *Id.* § 25-600-20 (2014).

²⁶ VA. CODE ANN. § 62.1-263 (1992).

²⁷ J. LEGIS. AUDIT & REVIEW COMM'N, EFFECTIVENESS OF VIRGINIA'S WATER RESOURCE PLANNING AND MANAGEMENT, H. DOC. NO. 8, at ii (2017).

²⁸ *Responses to a Drought Emergency Declaration infra* note 122; see also VA CODE ANN. § 62.1-44.36 (1972).

²⁹ Surface water withdrawals are permitted under the Virginia Water Protection (VWP) Permit Program Regulations, 9 VA. ADMIN. CODE § 25-210-10 *et seq.*, as directed by Article 2.2 of the State Water Control Law.

³⁰ Groundwater withdrawals are regulated under the Ground Water Management Act of 1992, VA. CODE ANN. §§ 62.1-254 *et seq.*, as well as associated Designated Groundwater Management Areas Regulations, 9 VA. ADMIN. CODE § 25-600-10 *et seq.*, and Groundwater Withdrawal Regulations, 9 VA. ADMIN. CODE § 25-610-10 *et seq.*

and ground water conjunctive uses” when reviewing permit applications and amendments.³¹ And, groundwater withdrawal permit applications must include information on conjunction use systems, if applicable, as well as “[a]n alternatives analysis that evaluates sources of water supply other than groundwater”³² As part of this alternatives analysis, the applicant must demonstrate that surface water was considered as an alternate source for the proposed activity.³³

C. Western States: Prior Appropriation Doctrine

The prior appropriation doctrine is generally regarded as the basis for the water laws in seventeen western states.³⁴ However, eight states, including California, actually employ a blend of multiple systems, as discussed in the next section.³⁵ The development of this doctrine in the west is no surprise: it is indicative of the arid states where water supply has always been a central issue for civilization.³⁶ As people developed the west, it became clear that the riparian doctrine would not work in such climates.³⁷ The prior appropriation doctrine dates back to 1849, when California gold miner-trespassers developed a system of posting notice of their claimed diversions of water from rivers and streams.³⁸ These local customs were eventually recognized by the California Supreme Court in the landmark case of *Irwin v. Phillips*, after which the doctrine entered into the jurisprudence and thus established a hierarchy of rights.³⁹

The basic premise of the prior appropriation doctrine, a “first in time” doctrine, is that it the first appropriator receives the highest priority with respect to water rights.⁴⁰ The doctrine is generally based on physical control and beneficial use of the water, not on the relationship between land and water, as riparian rights are.⁴¹ The appropriator must demonstrate: (1) intent to appropriate the water; (2) a diversion of water; and (3) a beneficial use of the water.⁴² Today, intent is typically shown through a permit application, and physical diversions may not be necessary due to the implementation of various in-stream flow programs.⁴³ The beneficial use requirement,

³¹ VA. CODE ANN. § 62.1-263 (1994). A surface water and ground water conjunctive use system is defined as “an integrated water supply system wherein surface water is the primary source and groundwater is a supplement source” 9 VA. ADMIN. CODE § 25-610-10 (2018).

³² 9 VA. ADMIN. CODE § 25-610-94 (2014).

³³ *Id.* § 25-610-102(C)(3) (2014).

³⁴ Gopalakrishnan, *supra* note 1, at 61. States that follow the appropriation doctrine include Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming. *Id.*

³⁵ *Id.* The states that follow a blended system include California, Kansas, Nebraska, North Dakota, Oklahoma, South Dakota, Texas, and Washington. *Id.*

³⁶ See Gopalakrishnan, *supra* note 1, at 62. *But see* Lawrence J. MacDonnell, *Prior Appropriation: A Reassessment*, 18 U. DENVER WATER L. REV. 228, 242 (2015).

³⁷ *Id.* Compare Gopalakrishnan, *supra* note 1, at 62, with Peter L. Reich, *Mission Revival Jurisprudence: State Courts and Hispanic Water Law Since 1850*, 69 WASH. L. REV. 869, 884.

³⁸ State Water Res. Control Bd., *supra* note 15.

³⁹ MacDonnell, *supra* note 366, at 243-247 (citing *Irwin v. Phillips*, 5 Cal. 140, 145-47 (1855)); State Water Res. Control Bd., *supra* note 15.

⁴⁰ State Water Res. Control Bd., *supra* note 15.

⁴¹ Hecox, *supra* note 14.

⁴² *Id.*

⁴³ *Id.* See, e.g., Cal. Dept. of Fish and Wildlife, *Instream Flow Program*, <https://www.wildlife.ca.gov/Conservation/Watersheds/Instream-Flow> (last visited Aug. 13, 2019).

however, remains perhaps the most important characteristic of the prior appropriation doctrine.⁴⁴ Prior appropriation states require that water be used beneficially, and prohibit waste and unreasonable use.⁴⁵ Non-use of a water right can result in a forfeiture of the right.⁴⁶ Assuming all elements are satisfied, the senior appropriator then has the right to use all of the water necessary to fulfill his needs before an appropriator junior to him may use it.⁴⁷

D. California: Dual Water Rights System

Eight western states, including California, recognize both the prior appropriation doctrine and the riparian rights doctrine, and therefore have laws that function as a hybrid of the two.⁴⁸ California adopted the riparian rights doctrine upon entering statehood in 1850, and adopted the prior appropriation doctrine one year later.⁴⁹ California's combination of the two doctrines sparked years of litigation, as those claiming water rights under the riparian rights doctrine were not required to put their water to a beneficial use, while prior appropriators were.⁵⁰ This clash of rights resulted in a Constitutional amendment requiring that *all* water in California be put to beneficial and reasonable use.⁵¹ California's water rights system functions today with the State and Regional Water Control Boards issuing permits and licenses for withdrawals from California's surface water.⁵² Until the adoption of the Sustainable Groundwater Management Act (SGMA)⁵³ in 2014, California did not have a system in place to regulate groundwater on a statewide level.⁵⁴ The SGMA directed the California Department of Water Resources to prioritize the State's water basins as high, medium, low, or very low.⁵⁵ Basins designated as high or medium priority are required to form groundwater sustainability agencies⁵⁶ and develop groundwater sustainability plans.⁵⁷ Basins designated as low or very low priority are not required to take these actions, but are encouraged to do so.⁵⁸ Additionally, the SGMA exempts adjudicated areas, where a court has

⁴⁴ *Id.*

⁴⁵ *See, e.g.*, CAL. CONST. art. X, § 2 (Water usage rights are limited to those which are "reasonably required for the beneficial use to be served," and does not extend to "the waste or unreasonable use or unreasonable method of use or unreasonable method of diversion of water."). *See also* CAL. WATER CODE § 100 (1999). *But see* Reich, *supra* note 7 at 69-71 (under the pueblo rights doctrine a Spanish settled state, such as Louisiana, has preemptive rights to all waters, allowing upstream injunctions on other water users such as agriculture, even for non-beneficial uses such as water-fountains).

⁴⁶ Hecox, *supra* note 14.

⁴⁷ *Id.*

⁴⁸ Gopalakrishnan, *supra* note 1, at 61.

⁴⁹ State Water Res. Control Bd., *supra* note 15.

⁵⁰ *Id.*

⁵¹ CAL. CONST. art. X, § 2.

⁵² State Water Res. Control Bd., *supra* note 15.

⁵³ California's Sustainable Groundwater Management Act is a package of three bills (Senate Bill 1168, Assembly Bill 1739, and Senate Bill 1319) signed into law by Governor Jerry Brown on September 16, 2014; CAL. WATER CODE §§ 10720-10737.8,

[HTTP://LEGINFO.LEGISLATURE.CA.GOV/FACES/CODES_DISPLAYEXPANDEDBRANCH.XHTML?TOCCODE=WAT&DIVISIO
N=6.&TITLE=&PART=2.74.&CHAPTER=&ARTICLE.](http://leginfo.ca.gov/faces/codes_displayexpandedbranch.xhtml?tocCode=WAT&division=6.&title=&part=2.74.&chapter=&article)

⁵⁴ *Id.*

⁵⁵ CAL. WATER CODE § 10722.4 (2016).

⁵⁶ *Id.* § 10735.2(a)(1) (2016).

⁵⁷ *Id.* §§ 10727-10728.6 (2015).

⁵⁸ *Id.* § 10720.7(b) (2016).

already determined groundwater rights within the area, from these requirements.⁵⁹ The SGMA has spurred innovation in California that can potentially be emulated in Virginia, including in the field of groundwater trading programs.⁶⁰

III. WATER SUPPLY SOLUTIONS

With this background on the water laws used in the eastern and western parts of America, and particularly in Virginia and California, we can next examine four overarching water supply solutions that Virginia can consider implementing, including agriculture, aquifer storage and recovery, the One Water concept, and expanding water budgeting in the state.

A. Bringing Agriculture to the Table

One of the greatest challenges for Virginia and any state facing water supply issues is being able to identify ways to bring the agricultural sector to the table and on board with regulations. Agriculture is by far the largest private industry in Virginia, employing over 334,000 people and worth approximately \$70 billion annually.⁶¹ Virginia's water supply laws favor agricultural use for surface water withdrawals by allowing unpermitted surface water withdrawals for agricultural purposes as long as the withdrawal is under one million gallons per month from non-tidal waters, and under 60 million gallons per month from tidal waters.⁶² This stands in contrast to all other users, who must obtain a permit to withdraw anything more than 10,000 gallons per day from non-tidal waters.⁶³ Additionally, while Virginia has annual reporting requirements for surface and groundwater withdrawals for most regulated users,⁶⁴ the state exempts agricultural users from these reporting requirements if the water is withdrawn for crop production and is less than one million gallons per month.⁶⁵ Imposing more stringent requirements on the agriculture industry could help Virginia stabilize its water supply for the future and even the playing field between agricultural uses and other water uses in the state.

This is an area where Virginia could look to California as an example of a state making progress to bring the agriculture industry into the fold of water supply regulations. California recently passed a sweeping water bill with implications for the agriculture industry that could be emulated, at least in part, by Virginia.⁶⁶ The bill amended the California Water Code to require agricultural water suppliers to submit annual reports on the volume of water delivered to their customers by April 1 of each year.⁶⁷ Additionally, while the law previously required agricultural water suppliers to adopt water management plans and update these plans every five years,⁶⁸ the revised Water Code requires suppliers to include an annual water budget based on their service

⁵⁹ *Id.* § 10720.8 (2015).

⁶⁰ *See infra* Section III(B) for further discussion of groundwater trading programs.

⁶¹ *Virginia Agriculture Facts & Figures*, VA. DEP'T AGRIC. & CONSUMER SERVS., <https://www.vdacs.virginia.gov/markets-and-finance-agriculture-facts-and-figures.shtml> (last visited July 15, 2019).

⁶² 9 VA. ADMIN. CODE § 25-210-310(A)(4) (2016).

⁶³ *Id.* § (A)(11)(a).

⁶⁴ 9 VA. ADMIN CODE § 25-200-30 (1990).

⁶⁵ *Id.* § (A)(2).

⁶⁶ Assemb. B. 1668, 2017-18 Sess. (Cal. 2018).

⁶⁷ CAL. WATER CODE § 531.10 (2019).

⁶⁸ Assemb. B. 1668, 2017-18 Sess. (Cal. 2018).

area and a drought plan prescribing actions that the supplier will take for drought preparedness and water supply allocation and management during drought conditions.⁶⁹

The new legislation also requires agricultural water suppliers to implement best management practices and provide water management services to water users, including irrigation and drainage evaluations, water quality and quantity data, and agricultural water management education materials and programs for farmers and the public.⁷⁰ Under this same law, agricultural water suppliers must report what water use efficiency improvements have been implemented and what additional improvements are expected to be implemented within the next decade.⁷¹ If agricultural water suppliers choose not to implement an available improvement, documentation as to why that particular water management practice is not cost effective or technically feasible must be provided to the California Department of Water Resources.⁷²

In order for Virginia to enact reporting requirements and requirements for implementing agricultural best management practices in a similar way, legislative action is needed. Virginia could start by eliminating the permitting and reporting exemptions for agricultural water users that currently exist in the code and regulations. Virginia could also follow California's lead by directing those that withdraw water for agricultural uses to implement efficient water management strategies and pursue best management practices. However, one of the greatest challenges to implementing these changes is the likelihood of a strong lobby against such requirements from the agriculture industry. To overcome this, public awareness and concern about water supply issues would need to be strong enough to prevail. While water supply is a paramount issue in the public eye in California, it is not so much in Virginia, at least for now.

B. Implement Aquifer Storage and Recovery and Groundwater Trading Programs

Virginia does not currently have a transfer of water rights program for groundwater storage and transfer but is actively considering such a program. The Commonwealth established a Groundwater Management Trading Work Group in response to the passage of House Bill 1036 in 2018.⁷³ The Group is tasked with (1) assisting DEQ in carrying out the 2017 recommendation of the EVGMA Advisory Committee to study the potential for an aquifer storage and recovery banking system and (2) studying and identifying the components of a groundwater trading program.⁷⁴ As of August 2019, the workgroup has met four times.⁷⁵ The recommendations of the Work Group must be reported to the State Water Commission and the DEQ Director no later than July 1, 2020.⁷⁶

⁶⁹ CAL. WATER CODE §§ 10826; 10826.2 (2019).

⁷⁰ *Id.* § 10608.48 (2019).

⁷¹ *Id.*

⁷² *Id.*

⁷³ 2018 Va. Acts ch. 448.

⁷⁴ *Id.*

⁷⁵ Virginia Regulatory Town Hall, *Search Town Hall*, <https://townhall.virginia.gov/L/search.cfm> (last visited Aug. 13, 2019) (search “groundwater management trading”).

⁷⁶ 2018 Va. Acts ch. 448.

Several western states have undertaken studies and projects involving aquifer storage and recovery. California localities have been studying and utilizing Aquifer Storage and Recovery (ASR) systems for several years, and the California State Water Resources Control Board (the “Water Board”) has adopted general waste discharge requirements for such projects to help standardize the process across the state.⁷⁷ The Water Board describes the process as one that “poses a low threat to the beneficial uses of the aquifer, because the water that will be stored in the aquifer will meet all drinking water standards.”⁷⁸

The City of Sonoma, California provides an example of a successful ASR pilot program. The City and nearby localities first undertook a Groundwater Banking Feasibility Study (the “Study”) in 2013 to determine if a groundwater banking program could divert surplus river water from the Russian River during the wetter months of the year (winter and spring), and store that water via existing drinking water production facilities.⁷⁹ This stored water could then be used, as needed, during dry weather seasons and drought emergencies.⁸⁰ After the Study concluded that an ASR project was potentially feasible, the City undertook an ASR pilot program that stores treated, high quality surface water from the Russian River Riverbank Filtration Facility in aquifers before pumping it into test wells to ensure it is of suitable drinking water quality.⁸¹ The ASR pilot program is ongoing, but has so far been successful in meeting water quality standards, suggesting that it could be part of the water supply solution in northern California localities such as Sonoma.⁸² A report on the pilot results will be submitted in 2019; if the pilot concludes that an ASR program is in fact feasible, the City will undertake a full environmental impacts study before implementation.⁸³

California is not alone in studying and implementing ASR projects. In Colorado, a recent symposium brought together local and state government representatives, scholars, and industry representatives to collaboratively discuss emerging ASR knowledge and issues, and prioritize future projects for the state.⁸⁴ The symposium highlighted the many benefits of ASR; including the fact that storage of drinking water in ASR wells can usually be achieved at less than half the cost of other water supply alternatives, and that ASR projects can be brought up to scale in small phases.⁸⁵ One major challenge to implementing an ASR project in a state that does not already

⁷⁷ *Water Quality Order 2012-0010*, ST. WATER RES. CONTROL BD. (2012), https://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2012/wqo2012_0010_with%20signed%20mrp.pdf.

⁷⁸ *Fact Sheet: Streamlined Regulatory Process for Aquifer Storage and Recovery (ASR) Projects that Inject Drinking Water into an Aquifer*, CAL. WATER BD. (Mar. 4, 2013), https://www.waterboards.ca.gov/publications_forms/publications/factsheets/docs/asr_project_factsheet.pdf.

⁷⁹ *Technical Report: Aquifer Storage and Recovery, Pilot Test at Sonoma Test Well #6A*, SONOMA CTY. WATER AGENCY 1, 3 (Dec. 21, 2017), <https://evogov.s3.amazonaws.com/185/media/182082.pdf>.

⁸⁰ *Id.*

⁸¹ *Id.* at 1.

⁸² *Id.* at 36.

⁸³ *Id.* at 1; Sonoma Valley Groundwater Sustainability Agency, *Aquifer Storage and Recovery Pilot Test* (May 14, 2019) http://sonomavalleygroundwater.org/wp-content/uploads/05.14.19_SV-AC-Meeting-ASR-Presentation_ada.pdf.

⁸⁴ Tom Sale, *Aquifer Storage and Recovery: Subsurface Water Storage Symposium Overview*, COLO. WATER, July/Aug. 2017, at 2, 3, http://wsnet2.colostate.edu/cwis31/ColoradoWater/Images/Newsletters/2017/CW_34_4.pdf.

⁸⁵ R. David G. Pyne, *Aquifer Storage and Recovery: Past, Present, and Future*, COLO. WATER, July/Aug. 2017, at 5, 7, http://wsnet2.colostate.edu/cwis31/ColoradoWater/Images/Newsletters/2017/CW_34_4.pdf.

have an ASR regulatory framework in place is establishing such a framework to remove potential legal obstacles.⁸⁶ Knowledge of ASR is another common constraint – the lack of public awareness as to this type of program, or the problems it fixes.⁸⁷ Without public knowledge and approval, it is difficult to receive the necessary financial and political backing to undertake the feasibility studies and pilot projects needed to establish a successful ASR program.⁸⁸

Groundwater trading programs have also started to emerge in the west. In California, Ventura County is serving as the state’s pilot program.⁸⁹ In Ventura County, the program is especially important for the agriculture industry in their efforts to comply with California’s Sustainable Groundwater Management Act.⁹⁰ Irrigation in California has always operated on a “use it or lose it” system, encouraging agricultural users to irrigate their land or lose their water rights, even when market conditions did not compel additional crop-growing.⁹¹ With a groundwater-trading program in place, agricultural users can instead make money on their unused water rights, and the agriculture industry itself is better stabilized and capable of meeting any future mandatory usage cuts by the state.⁹² The Fox Canyon Groundwater Management Agency is carrying out the Ventura County pilot program through the implementation of Advanced Metering Infrastructure (AMI) on wells; “AMI is equipment that connects to (or is built into) a flowmeter and allows extraction information to be wirelessly sent to a central data storage center.”⁹³

While groundwater trading programs are in the early stages of development even in California, transfer of water rights programs focused on surface water are more common. One such example exists in Oregon, where the state code allows for a transfer of a water right or permit.⁹⁴ The state allows its irrigation districts to create their own water management and conservation plans which, when implemented, allow the district to take advantage of transfer of water rights statutory provisions.⁹⁵

Virginia, which is already making progress in studying the feasibility of ASRs and groundwater trading programs,⁹⁶ can benefit from the western localities’ experiences in planning

⁸⁶ *Id.* at 8.

⁸⁷ *Id.*

⁸⁸ *Id.*

⁸⁹ Alastair Bland, *A New Groundwater Market Emerges in California: Are More on the Way?*, NEWS DEEPLY (June 22, 2018), <https://www.newsdeeply.com/water/articles/2018/06/22/a-new-groundwater-market-emerges-in-california-are-more-on-the-way>.

⁹⁰ *Id.*; Christina Babbitt et al., *Groundwater Trading as a Tool for Implementing California’s Sustainable Groundwater Management Act*, ENVTL. DEF. FUND 1, 3 (2017), <https://www.edf.org/sites/default/files/documents/water-markets.pdf>.

⁹¹ Bland, *supra* note 89.

⁹² *Id.*

⁹³ *FAQS: AMI/Water Market*, FOX CANYON GROUNDWATER MGMT. AGENCY (2019), <http://fcgma.org/faqs/129-faqs-ami-water-market>.

⁹⁴ OR. REV. STAT. § 540.523 (2005).

⁹⁵ *Agricultural Water Management*, OR. WATER RES. DEP’T, <https://www.oregon.gov/OWRD/programs/Planning/W MCP/Pages/AgriculturalWaterManagement.aspx> (last visited June 07, 2019).

⁹⁶ See discussion *infra* notes 73-76 and accompanying text. At its March 2019 meeting, the HB1036 Groundwater Management Trading Work Group considered ASR programs from Arizona, Nevada, New Jersey, Delaware, Florida, Kansas, North Carolina, South Carolina, and Texas. HB1036 – Water Trading Group Minutes of March 21,

and implementing these types of programs. Pilot programs such as that in Ventura County, California and databases of knowledge such as that collected at the symposium in Colorado, would likely be extremely helpful as Virginia considers the feasibility of ASR programs in eastern Virginia. Similarly, Virginia can draw on lessons learned from California and Oregon in their programs involving both surface water and groundwater trading programs.

C. Embracing the One Water Concept and Regional Water Planning

The One Water movement was started by the U.S. Water Alliance, a nonprofit organization dedicated to solving the world's water supply and water quality issues by creating national dialogues among governments, business leaders, and environmental organizations.⁹⁷ The idea behind One Water is that all water – including groundwater, surface water, wastewater, recycled water, stormwater, and potable water – is interconnected, and management solutions should be tailored with that in mind.⁹⁸ The answer to most complex water supply issues does not lie in one solution, but rather in a combination of approaches that may include water conservation and budgeting, infrastructure improvements, wastewater recycling and groundwater injection, desalination, and other innovations.

As of spring 2019, no Virginia localities have officially adopted a “One Water” plan. However, that is not to say that Virginia is uninvolved in the process. The General Manager of the Hampton Roads Sanitation District (HRSD) sits as the Vice-Chair of the One Water Council, a collaborative platform that brings together local planners, utility managers, business leaders, researchers, and environmental advocates.⁹⁹ Additionally, HRSD is part of the Water Research Foundation (WRF) Research Advisory Council (RAC), which supports “One Water” projects.¹⁰⁰ HRSD's strides in creating the Sustainable Water Initiative for Tomorrow (SWIFT) project is another example of a project centered on “One Water” concepts.¹⁰¹ For the SWIFT project, HRSD is in the process of upgrading wastewater treatment plants to clean wastewater to the extent that it can be used as drinking water, and then inject the treated wastewater into the Potomac aquifer.¹⁰² During the planning stages of the SWIFT project, HRSD consulted heavily with well-developed wastewater treatment and recycling facilities, including the Groundwater Replenishment System

2019 Meeting, https://townhall.virginia.gov/L/GetFile.cfm?File=meeting\53\29044\Minutes_DEQ_29044_v1.pdf.

As of the time of publication of this student white paper, no formal recommendations have been made.

⁹⁷ *Mission*, US WATER ALLIANCE (2015), <http://uswateralliance.org/about-us>.

⁹⁸ *One Water for America Policy Framework: Executive Summary*, US WATER ALLIANCE 2, <http://uswateralliance.org/sites/uswateralliance.org/files/publications/One%20Water%20for%20America%20Policy%20Framework%20Executive%20Summary.pdf>.

⁹⁹ *One Water Council*, US WATER ALLIANCE (2015), <http://uswateralliance.org/one-water/one-water-council>.

¹⁰⁰ *Commission Meeting Minutes*, HAMPTON RDS. SANITATION DIST. 1, 249 (Nov. 27, 2018), https://www.hrsd.com/sites/default/files/assets/Documents/pdfs/Commission_Minutes/2018/11-27-18_Final_Commission_Minutes.pdf; *Research Advisory Council*, THE WATER RESEARCH FOUNDATION (2018), <http://www.werf.org/a/b/ResearchCouncil.aspx>.

¹⁰¹ *Commission Meeting Minutes*, *supra* note 100, at 249; SUSTAINABLE WATER INITIATIVE FOR TOMORROW, <http://swiftva.com/> (last visited Mar. 29, 2019); *see also* Patrick Harner, Alexa Pech & Emily Tucker, *Hampton Roads Sanitation District's Sustainable Water Initiative for Tomorrow Proposal*, VA. COASTAL POL'Y CTR., 2016, <https://scholarship.law.wm.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1023&context=vcplinic>.

¹⁰² SUSTAINABLE WATER INITIATIVE FOR TOMORROW, *supra* note 101; *see also* Harner, *supra* note 101.

(GWRS) in Orange County, California.¹⁰³ Since May 2018, HRSD has been successfully injecting treated wastewater into the aquifer, and as of April 2019, has injected approximately 90 million gallons through the Nansemond Treatment Plant at a rate of approximately one million gallons daily.¹⁰⁴ By 2030, HRSD aims to have three additional treatment facilities pumping between 14 and 40 million gallons of treated wastewater into the aquifer each day.¹⁰⁵

While HRSD's initiative in developing the highly successful and innovative SWIFT project and its involvement in the One Water Council and WRF RAC groups are steps in the right direction, Virginia localities have not fully adopted "One Water" plans as some localities in California have. Several California localities have developed detailed "One Water" plans as integrated frameworks for managing all aspects of their water resources. One locality implementing this approach is Los Angeles, where the City began its One Water Program in 2013 and adopted its One Water LA 2040 Plan (the "Plan") in 2018.¹⁰⁶ The Plan builds on Los Angeles' Water Integrated Resources Plan (IRP), which the City first undertook in 1999, and takes into account all water projects in the City across all agencies.¹⁰⁷ The Plan identifies policies and projects that the City can undertake to improve water supply sustainability and resilience to drought conditions and climate change.¹⁰⁸ Some examples of the goals that One Water LA intends to meet include: improvement of beach water quality grade-point average, reduction in the purchase of imported water by 50% by 2025, capture of 150,000 acre-feet per year of stormwater by 2035, and achievement of 50% locally-sourced water by 2035.¹⁰⁹ Los Angeles is already taking steps to achieve its stormwater capture goals by the passage of Measure W, a local parcel tax that imposes a 2.5-cent tax per square foot of impermeable, and uses the money collected for stormwater capture and cleanup.¹¹⁰ Other California localities that have adopted a One Water approach include the City of San Francisco and the County of Santa Clara, both of which are at the early planning stages of determining the goals, objectives, and projects that will best lead their locality to water sustainability.¹¹¹

In order for Virginia localities to be able to follow the blueprints set for "One Water" plans in California, they would need to ensure they have statutory authority to do so. Virginia follows the "Dillion Rule" doctrine rather than the "Home Rule" doctrine, which means that "[m]unicipal governments have only those powers which are expressly granted by the state legislature, those

¹⁰³ See *Fact Sheet: SWIFT Pilot Program*, HAMPTON RDS. SANITATION DIST. 1, 2 (Mar. 2017), http://swiftva.com/wp-content/uploads/2017/03/SWIFT_processes_fact_sheet.pdf.

¹⁰⁴ Katherine Hafner, *HRSD is Now Injecting Millions of Gallons of Treated Wastewater into our Aquifer*, THE VIRGINIAN-PILOT (Apr. 17, 2019), https://pilotonline.com/ask/article_1fefcfc6-6045-11e9-9fa4-6fe71ebfdfae.html; SWIFT, SUSTAINABLE WATER INITIATIVE FOR TOMORROW, <http://swiftva.com> (last visited July 12, 2019).

¹⁰⁵ *Id.*

¹⁰⁶ *One Water LA: 2040*, CITY OF LOS ANGELES (Apr. 2018), https://www.lacitysan.org/san/faces/wcnav_externalId/s-lsh-es-owla-r?_adf.ctrl-state=wzh5gulwf_5&_afLoop=7145262703995774#!.

¹⁰⁷ *Id.* at ES-1.

¹⁰⁸ *Id.*

¹⁰⁹ *Id.* at ES-4.

¹¹⁰ Nina Agrawal, *L.A. County Stormwater Tax Officially Passes*, L.A. TIMES (Nov. 30, 2018), <https://www.latimes.com/local/lanow/la-me-ln-measure-w-20181130-story.html>.

¹¹¹ See *One Water SF: A Vision for San Francisco*, S.F. WATER POWER SEWER (2016), [https://view.joomag.com/onewatersf-embracing-envisioning-practicing-advancing/0652415001476817310?short;One Water Plan](https://view.joomag.com/onewatersf-embracing-envisioning-practicing-advancing/0652415001476817310?short;One%20Water%20Plan), SANTA CLARA VALLEY WATER DIST. (2019), <https://onewaterplan.wordpress.com/>.

powers fairly or necessarily implied from expressly granted powers, and those powers which are essential and indispensable.”¹¹² Virginia law currently requires local governments to submit a local water supply plan or participate in the submittal of a regional plan.¹¹³ The stated purpose of this law is to ensure safe drinking water, protect all beneficial uses of water resources, and develop incentives for alternative water sources.¹¹⁴ Based on the language of these requirements, it seems potentially permissible for Virginia localities to adopt a “One Water” plan like the ones adopted by Californian localities to satisfy this requirement for a local or regional water plan. In 2018, the Virginia legislature passed a bill requiring the State Board of Health to adopt regulations regarding the use of gray water and rainwater, an effort which is now underway.¹¹⁵ However, the adoption of statutory language explicitly allowing the reuse of water to the extent contemplated by the One Water concept could encourage localities to take this more aggressive approach. Additionally, the Commonwealth could go even further in *requiring* local and regional water plans to implement “One Water” concepts; however, as of the time of this research, no other state was found that has done so.

D. Expanding Water Budgeting Within the State

Virginia currently has regulations in place allowing for restrictions on surface and groundwater withdrawals through the Governor’s Emergency Operation Plan in the event of a critical drought situation.¹¹⁶ The purpose of these regulations is to protect the public water supply when it is threatened by drought conditions.¹¹⁷ Surface water permit variances to provide for public water supply during times of drought are at the discretion of the State Water Control Board.¹¹⁸ Virginia is also taking action to reduce its groundwater withdrawals by reducing the maximum permitted groundwater withdrawals for the fourteen largest permitted users by 52%, from 146 million gallons per day to 69 million gallons per day.¹¹⁹ A reduction in the maximum permitted withdrawals of the largest water users in the EVGMA, combined with the efforts of the HRSD SWIFT project,¹²⁰ are critical steps toward ensuring that the Potomac aquifer will be used sustainably and its water levels can be replenished in the future.

¹¹² See, e.g., *Commonwealth v. Cnty. Bd. of Arlington Cnty.*, 217 Va. 558, 575 (1997); A.E.S., *Dillon’s Rule: The Case for Reform*, 68 VA. L. REV. 693, 693 (1982).

¹¹³ 9 VA. ADMIN. CODE § 25-780-10 (2005).

¹¹⁴ *Id.* § 25-780-20 (2005).

¹¹⁵ H.B. 192, 2018 Reg. Sess. (Va. 2018).

¹¹⁶ VA. CODE § 44-146.17 (1), (1) ¶ 2 (allowing the executive to “control, restrict, allocate, or regulate . . . resources. . . .”; TERENCE MCAULIFFE & JEFFREY D. STERN, COMMONWEALTH OF VIRGINIA EMERGENCY OPERATIONS PLAN A-8, D-1 (2012, updated Mar. 2015).

¹¹⁷ *Id.*; see generally 9 VA. ADMIN. CODE § 25-610-100 (B)(1)(e).

¹¹⁸ 9 VA. ADMIN. CODE § 25-210-390 (2016).

¹¹⁹ E. VA. GROUNDWATER MGMT. ADVISORY COMM., REPORT TO THE VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY AND VIRGINIA GENERAL ASSEMBLY 15 (2017); Robert Zullo, *State reaches deals with large water users to preserve aquifers*, RICHMOND TIMES-DISPATCH (Dec 15, 2017), https://www.richmond.com/news/virginia/state-reaches-deals-with-large-water-users-to-preserve-aquifers/article_c607fb2e-c757-5017-8e6f-de923a456ac4.html; see e.g. Agenda Note – HRPDC Annual Commission Meeting Item # 6: Groundwater Withdrawal Permits, HAMPTON RD. PLANNING DIST. COMM. (Oct. 16, 2014), <https://www.hrpdcva.gov/uploads/docs/10162014-PDC-AN6.pdf> (eight of the fourteen permits are within the HRPDC).

¹²⁰ See discussion *supra* notes 101-105 and accompanying text.

The Virginia DEQ’s Drought Monitoring and Response Task Force (DMTF) is responsible for monitoring drought conditions and making drought stage declarations based on hydrological conditions.¹²¹ The four drought stages are normal, watch, warning, and emergency. Drought emergency declarations are generally made by the Governor through an executive order.¹²² After an emergency declaration the Commonwealth will put into effect various mandatory restrictions aimed at reducing water usage by 15%; however localities are authorized to implement more stringent drought requirements.¹²³ Under such a declaration the director of DEQ can override any existing authorization to withdraw ground or surface waters and can re-allocate water for beneficial uses outlined in the Code of Virginia § 62.1-44.36.¹²⁴

Even in non-drought conditions groundwater withdrawal permits must include a Water Conservation and Management Plan that includes “[r]equirements for mandatory water use reductions during water shortage emergencies declared by the local governing body or water authority consistent with §§ 15.2-923 and 15.2-924 of the Code of Virginia.”¹²⁵ Groundwater withdrawal permits can also be reopened and modified “[i]f monitoring information indicates the potential for adverse impacts to groundwater quality or level due to . . . withdrawal.”¹²⁶

Not surprisingly, California has taken its water budgeting laws much further, and can serve as a potential model for Virginia, should Virginia decide it needs to take a more aggressive stance in the future. In California, statewide permanent water restrictions were signed into law in 2018.¹²⁷ California’s 2018 Assembly Bill No. 1668 turned interim urban water use restrictions into long term ones, creating studies that would set standards for indoor residential water use and limiting water use to 55 gallons per capita daily until 2025, then 52.5 gallons per capita daily until 2030, and thereafter 50 gallons per capita daily, unless the State Water Resources Board and Department of Water Resources recommend other water use standards that allow for higher rates of usage.¹²⁸

¹²¹ *Drought Monitoring and Response in Virginia*, VA. DEP. ENVL. QUALITY, <https://www.deq.virginia.gov/Programs/Water/WaterSupplyWaterQuantity/Drought.aspx> (last visited June 18, 2019).

¹²² *Responses to a Drought Emergency Declaration*, VA. DEP. ENVL. QUALITY, <https://www.deq.virginia.gov/Programs/Water/WaterSupplyWaterQuantity/Drought/DroughtResponses/DroughtEmergency.aspx> (last visited June 18, 2019). “These prohibitions and exceptions will apply to uses from all sources of water and will only be effective when the Governor of Virginia declares a Drought Emergency through the issuance of an executive order.” DROUGHT RESPONSE TECH. ADVISORY COMM., VIRGINIA DROUGHT ASSESSMENT AND RESPONSE PLAN 15-16 (2003).

¹²³ *Responses to a Drought Emergency Declaration*, *supra* note 122. However, agriculture and livestock production are exempt from restrictions “as long as best management practices are applied . . .” DROUGHT RESPONSE TECH. ADVISORY COMM., VIRGINIA DROUGHT ASSESSMENT AND RESPONSE PLAN 16 (2003).

¹²⁴ *Id.* (quoting DROUGHT RESPONSE TECH. ADVISORY COMM., VIRGINIA DROUGHT ASSESSMENT AND RESPONSE PLAN 15-16 (2003)).

¹²⁵ 9 VA. ADMIN. CODE § 25-610-100.

¹²⁶ *Id.* §§ 25-610-130 (G)(1), 25-610-140 (C), 25-610-290 *et seq.*; *see e.g.* VA. DEP’T OF ENVTL. QUALITY, PERMIT NO. GW0074300, DRAFT PERMIT TO WITHDRAW GROUNDWATER IN THE E. SHORE GROUNDWATER MGMT. AREA (2019).

¹²⁷ Assemb. B. 1668, 2017-18 Sess. (Cal. 2018); S.B. 606 2017-18 Sess. (Cal. 2018); Luna & Koseff, *supra* note 5.

¹²⁸ Assemb. B. 1668, 2017-18 Sess. (Cal. 2018).

Meanwhile, California’s 2018 Senate Bill No. 606 requires each urban retail water supplier to create an urban water use objective¹²⁹ by 2023, and then submit urban water use reports annually that must be in compliance with the objective.¹³⁰ The bill also imposes civil liabilities for violations, and punishes urban water suppliers who fall short of their water management plan objectives by making them ineligible for water-related grants and loan funding from the state.¹³¹ Further, the bill requires urban water suppliers to create management plans that contain drought risk assessments and water shortage contingency plans.¹³²

Virginia’s first attempt at a solution to over-depletion of aquifers should be through restricting groundwater withdrawals of the largest permitted users within the Groundwater Management Areas, as needed. However, depending on the success of this approach and the rate of replenishment, Virginia may need to consider more aggressive action. These actions could either stem from powers that are triggered by a drought declaration, or through the State Water Control Board reopening permits due to changed conditions.

However, reopening permits is a public administrative process that may not be an ideal conservation tool as groundwater levels drop. It has the potential to be slow and inefficient, and with multiple competing stakeholders effected by permit changes there is the ability for the process to be affected by tangential short-term pressures beyond the scope of water conservation. One way the Commonwealth could expedite this process is to explicitly define what a “changing condition” means in regard to reopening a permit when water supplies are low; this would create a more transparent and predictable process for all involved parties.

As a last resort, if implementation or execution of these approaches were unsuccessful, Virginia could consider passing legislation that would impose permanent water use restrictions on all water users, as California has done. However, such legislation is less likely to pass in Virginia, where awareness of water supply issues is significantly lower than in arid California, which has been battling drought for decades.

IV. CONCLUSION

Virginia does not experience the same magnitude of water supply issues as the arid west, but with increasing populations, limited groundwater resources, and climate change, water supply issues will follow. The Commonwealth can find useful lessons and experiences in the innovative water supply solutions implemented in states like California to ensure a long-lasting water supply for the future. Virginia can start by increasing regulation of agricultural uses of water; take its research on aquifer storage and recovery and groundwater trading programs further by studying existing projects in the west; and embracing the “One Water” concept for planning at multiple levels. Lastly, Virginia can also expand its water budgeting laws to help protect the water supply in times of drought and low groundwater levels. If Virginia can combine the innovative steps that

¹²⁹ An urban water use objective is defined as “an estimate of aggregate efficient water use for the previous year based on adopted water use efficiency standards and local service area characteristics for that year.” CAL. WATER CODE § 10608.12(u) (2018); S.B. 606 2017-18 Sess. (Cal. 2018).

¹³⁰ *Id.*

¹³¹ *Id.*

¹³² *Id.*

have already been taken to stabilize the Commonwealth's water supply, including reductions in groundwater permit withdrawals and the thus-far successful SWIFT project, with the lessons learned from some of the most advanced water supply management approaches in the country, it will be poised to ensure adequate water supply for Virginians for years to come.