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STATE OF CALIFORNIA
STATE WATER RESOURCES CONTROL BOARD

In the Matter of the Petition of Russian Riverkeeper and Fred Corson for Review of Action by the California Regional Water Quality Control Board, North Coast Region, in Adopting Notice of Applicability No. WQ-2014-0090-DWQ-R1001-01.	PETITION FOR REVIEW OF NORTH COAST REGIONAL WATER QUALITY CONTROL BOARD ACTION ADOPTING NOTICE OF APPLICABILITY NO. WQ-2014-0090-DWQ-R1001-01

In accordance with Section 13320 of the California Water Code and Section 2050 of Title 23 of the California Code of Regulations, Russian Riverkeeper and Fred Corson ("Petitioners") hereby petition the State Water Resources Control Board as follows:

1. Name, address, telephone number and email address of the petitioners.

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Fred Corson

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2. The specific action of the regional board which the state board is requested to review, and a copy of any order or resolution of the regional board which is referred to in the petition.

Petitioners seek review of the final decision of the North Coast Regional Water Quality Control Board ("Regional Board" or "Board") issuing Notice of Applicability No. WQ-2014-0090-DWQ-R1001-01 ("NOA") (attached hereto as Exhibit A).

3. The date on which the Regional Board acted.

The Regional Board approved the NOA at issue on July 1, 2016.

4. A full and complete statement of the reasons the action was inappropriate or improper.

The Regional Board's issuance of the final NOA was improper because it does not provide adequate safeguards for the protection of groundwater quality, particularly in the Middle Reach of the Russian River region. The reasons why this is inappropriate are as follows:

A. Background

The State Water Resources Control Board ("SWRCB") adopted Order WQ 2014-0090-DWQ – General Waste Discharge Requirements for Recycled Water Use – on June 3, 2014 (the "2014 Order"); and, on June 7, 2016, the SWRCB adopted Order WQ 2016-0068-DDW – Water Reclamation Requirements for Recycled Water Use (the "2016 Order"), which authorized "beneficial, non-potable recycled water uses consistent with the Uniform Statewide Recycling Criteria and any additional requirements specified in the Notice of Applicability" (2016 Order at 3). The 2014 and 2016 Orders (collectively, the "General Order") regulate the use of recycled water for all title 22 uses except groundwater recharge. The 2014 Order covers the period up to August 5, 2016, and the 2016 Order takes effect on and after August 6, 2016.

The City of Healdsburg owns and operates a wastewater treatment facility in Healdsburg, California. On May 5, 2016, Healdsburg submitted its Recycled Water Program Technical Report and Amended Notice of Intent to comply with the General Order.

B. The NOA violates the agronomic rate protection for groundwater set out in the General Order.

The 2016 General Order notes that use of recycled water "has the potential to increase nutrients in groundwater supplies" (General Order at 5), and identifies nitrogen as a nutrient that may be present in recycled wastewater "at a concentration that can degrade groundwater quality"

(General Order at 12). "In order to minimize the nutrient loading, this Order requires that recycled water used for irrigation purposes be applied at agronomic rates." (General Order at 5, 9.) All uses of recycled water with "frequent or routine application" (such as agricultural or landscape irrigation uses) must be "at agronomic rates and shall consider soil, climate, and plant demand" (General Order at 20). The agronomic rate is defined in the General Order as:

> The rate of application of recycled water to plants necessary to satisfy the plants' evapotranspiration requirements, considering allowances for supplemental water (e.g., effective precipitation), irrigation distribution uniformity, and leaching requirement, thus minimizing the movement of nutrients below the plants' root zone.

(General Order at D-1.)

An NOA that fails to correctly define and use an agronomic rate fails to comply with the General Order and must be deemed invalid. The NOA acknowledges the need to use an agronomic rate, providing that the application of recycled water for vineyard irrigation "will be protective of groundwater quality by ensuring that the volume of recycled water used for at each vineyard property does not exceed hydraulic and nitrogen agronomic rate thresholds on an annual basis" (NOA at 7). However, the NOA ignores the General Order's requirement that supplemental water, for example, effective precipitation, be considered. The supplemental water must also include water available in the soil available for uptake by plants at the start of the growing season. In this region, water is almost always available in the soil as supplemental supply, in significant amounts, at the start of the season due to winter and spring rains and the high water holding capacity of the soils.

The NOA fails to account for these factors, or achieve the goal of accurately defining the agronomic rate. The maximum allowable hydraulic agronomic rate set out by the NOA is the lower of 75% of ETc (crop evapotranspiration) or 9 inches per year distributed over the March

through October growing season (NOA at 6). The agronomic rate proposed by the City of Healdsburg for its Notice of Intent and approved in the NOA is derived from a May 2014 report prepared by Larry Walker associates, entitled "Programmatic Operations and Management Technical Report for Micro-Irrigation of Vineyards in the Healdsburg Area" (the "Walker Report"). The Walker Report states a generalized agronomic rate for irrigation in the Healdsburg-Windsor Russian River Middle Reach region, based on a review of other scientific works, including a study by viticulturist Dr. Mark Greenspan, "2012 Middle Reach Russian River Irrigation Demonstration Project" (2013).

Dr. Greenspan, one of the authors on whose work the Walker Report relied, undertook a review of the Walker Report to determine the appropriate agronomic rate for the region. ("Programmatic Operations and Management Technical Report for Micro-Irrigation of Vineyards in the Healdsburg Area" (Oct. 8, 2014) (the "Greenspan Report," attached hereto as Exhibit B, and fully incorporated herein by reference.) The Greenspan Report, based on actual field observations of the affected area, found that the agronomic rate given for vineyards in the Walker Report "ignores values determined under actual field conditions in the Middle Reach Russian River region and overstates the actual amount of irrigation that may be used by vineyards" (Greenspan Report at 1). In particular, the Greenspan Report identifies problems with how the Walker Report calculated: water available in the soil as the start of the growing season; irrigation needs for the region; the calculation of the percentage of the full evapotranspiration rate; and the nitrogen requirements of vineyards. These issues are addressed in turn.

First, the Walker Report contemplates that recycled wastewater irrigation would occur from March to October, so that the 75% of full ETc would be distributed over the entire growing season. The Greenspan Report notes that this is factually incorrect because most growers in the

region do not begin irrigating until late June through mid-July, with the actual starting time dependent on spring rainfall patterns and the sites' water holding capacity (WHC) (Greenspan Report at 1). Sites with very high WHC may not require irrigation until September, if at all, because viticulturists prefer to wait to irrigate until soil moisture reserves are depleted (Greenspan Report at 2). Indeed, the General Order prohibits recycled water applications when soils are saturated. (General Order, Prohibition 2.) The Greenspan Report provided a soil survey in the region found that WHC ranges from 1.8 to 9.0 inches. The Walker Report's approach to irrigation requirements does not take such site-specific WHC or soil moisture storage into account. This is not a "trivial omission" and resulted in an overestimation of irrigation requirements, leading to the adverse impacts to groundwater the General Order sought to avoid by and through the calculation of the actual agronomic rate. The Regional Board failed to comply with the General Order and failed to base its decision on the weight of the evidence by ignoring these documented site-specific conditions needed to determine the actual agronomic rate.

The percentage of full ETc used by the Walker Report in its agronomic rate determination was 75%. The Greenspan Review states this is "clearly a substantial over-estimate relative to what is likely to be applied in practice;" the Greenspan Study determined that the agronomic rates in the region varied between 0.6 and 2.1 inches of water equivalent to between 5% and 18% of ETc as opposed to the 75% ETc used in the Walker Report and NOA (p. 3). The Walker Report referred to the Greenspan Study, but discounted its findings on the basis that "the sites evaluated used far less irrigation water than required and could have used more water without adverse effects on the vines." This arbitrarily ignores the General Order requirement to set the actual agronomic rate based on actual site conditions. Moreover, according to the

Greenspan Report, this is simply incorrect from a viticultural standpoint, because application of irrigation at a greater rate could have adverse effects on the vines, resulting in poorer wine quality (Greenspan Report at 3).

Finally, the Greenspan Report found that the Walker Report overestimated the amount of nitrogen needed by vines at the point in the season when irrigation is undertaken. Any nitrogen not taken up by the roots of the vines will be leached into the groundwater below (Greenspan Report at 4).

To summarize, the Walker Report "grossly overstates the agronomic rate of irrigation for vineyards in the Middle Reach of the Russian River region" (Greenspan Report at 4). This means that there is for a likelihood that recycled wastewater would be applied at a rate that is higher than the agronomic rate, resulting in over application leading to runoff or the accumulation of nutrients and organic chemicals in the soil which will be flushed into the groundwater with the winter rains.

The Regional Board relied on the Walker Report in reaching the agronomic rate set out in the NOA, rather than using site specific information. Petitioners here presented the Greenspan Report to the Board, prior to its approval of the NOA, yet the NOA does not refer to the Greenspan Report, nor explain why the Board chose to follow the Walker Report. In choosing the agronomic rate for the NOA, the Regional Board abused its discretion by ignoring site specific conditions for the agronomic rate. The agronomic rate of the NOA is contrary to the plain language, intent, and purpose of the General Order, and the Regional Board is afforded no deference for its failure to simply apply the terms of the General Order. (*See Californians for Pesticide Reform v. Department of Pesticide Regulation* (2010) 184 Cal.App.4th 887, 898 (deference may be appropriate only where agency interpretation is explained and official

policy).) Irrigation rates permitted under the NOA will significantly exceed both real and experimentally determined agronomic rates and will not be protective of groundwater quality.

Accordingly, the NOA is inappropriate because it does not correctly take into account the "soil, climate and plant demand" conditions in the Middle Reach of the Russian River, as contemplated by the General Order. The NOA therefore violates the General Order's requirements related to protection of groundwater quality, and should not have been approved on these terms. The Regional Board's approval of the NOA is not in accordance with law, and is not based on the weight of the evidence.

C. The NOA fails to account for existing nitrogen loads.

Compounding the error of failing to account for existing saturated water available to crops each spring, the NOA equally fails to account for existing nitrogen loads accumulated from existing and past agricultural practices in the region. The attached studies demonstrate that nitrogen plant uptake has historically been overestimated. (Exhibit C and Exhibit D, attached.) The over-application of recycled water as a result of the NOA's inaccurate agronomic rate will further increase nitrogen loading with potentially significant impacts to ground and surface waters. This is unaccounted for by the NOA.

D. The NOA fails to comply with California's Antidegradation Policy.

The NOA at issue violates the state's antidegradation policy. By using an inaccurate agronomic rate, the NOA will result in over-application of nutrients and runoff, and potential degradation of groundwater and/or surface waters. The General Order's anti-degradation conclusion was based on compliance with a site specific agronomic rate, which the present NOA fails to do.

In fact, the NOA fails to include any of the required analysis pursuant to the State Water Board's anti-degredation policy. The Regional Board had no discretion to fail to perform any anti-degradation analysis for this new use of recycled water, especially where it relied on a theoretical rather than field verified approach to calculating the agronomic rate designed to prevent groundwater contamination. A regional board's anti-degradation analysis is inadequate where it fails to rely on evidence supporting any conclusion that water quality degradation will be avoided. (*See Association de Gente Unida por el Agua v. Central Valley Regional Water Quality Control Board* (2012) 210 Cal.App.4th 1255, 1259.)

E. Conclusion

For each of the reasons detailed above, Petitioners request that the State Board vacate the NOA and enjoin all activities undertaken pursuant to it.

5. The manner in which the petitioner is aggrieved.

Petitioner Russian Riverkeeper is a non-profit environmental organization dedicated to protecting and preserving the waterways in the Russian River basin for the public health and enjoyment of local residents, down-stream users, and the local ecology. Petitioner members live in and around the Russian River region. Petitioner's members are therefore aggrieved by the Orders' inadequacy to protect groundwater quality in the region.

Petitioner Fred Corson is a member of the Russian Riverkeeper and a member of the Clean Water Coalition of Northern Sonoma County and has been extensively involved in the public process of permits and approvals for Healdsburg Recycle Water Project including the 2005 DEIR and FEIR and the 2014 and 2016 Addenda, the 2010 NPDES, the Master Reclamation Requirements and Provisions, the Walker Report, the Greenspan Field Study, the Greenspan Report, the NOI, and the NOA. Mr. Corson has met extensively with the Regional

Board Staff and Executive Officer and explained in detail the differences between the Walker Report theoretical determination of agronomic rate and the actual agronomic rate as experimentally determined in the Greenspan Field Study and the significance of the supplemental water available in the soil at the start of the growing season. Mr. Corson's fact-based demonstrations have been ignored by the Regional Board.

6. The specific action by the state or regional board which petitioner requests.

Petitioners seek an Order by the State Board that overturns the Regional Board's Notice of Applicability, and remands the matter to the Regional Board with specific direction to the Board to remedy each of its violations of law as further described herein.

7. A statement of points and authorities in support of legal issues raised in the petition, including citations to documents or the transcript of the regional board hearing if it is available.

No hearing or opportunity to comment was provided by the Regional Board, and no transcript is thus available.

Petitioners' arguments and points of authority are thoroughly and adequately established above. (*See supra* at section IV.) The Regional Board has prejudicially abused its discretion by failing to consider required criteria of the General Order, and by failing to support its findings with the weight of evidence. Water Code § 13320; Code Civ. Procedure § 1094.5(c). The Regional Board approval of the NOA was rendered in contradiction to the clear terms of the General Order, and will result in a nuisance, pollution, and degradation of affected groundwaters. (*See Association de Gente Unida por el Agua v. Central Valley Regional Water Quality Control Board* (2012) 210 Cal.App.4th 1255, 1258 (anti-degradation analysis insufficient where uncontradicted evidence shows possible degradation not considered).)

Petitioners further reserve the right to submit supplemental briefing on arguments made and on issues raised by this Petition. Lastly, Petitioners will gladly respond to any additional questions the State Board may have regarding the issues in this Petition.

8. The petition has been sent to the appropriate regional board and to the discharger.

A true and correct copy of this Petition, with exhibits, was sent to the Regional Board and the City of Healdsburg by U.S. mail on August 1, 2016.

9. The substantive issues or objections raised in the petition were raised before the regional board.

Petitioners previously raised and presented all the issues addressed in this Petition through correspondence with the Regional Board on May 12, 2016 and July 12, 2016, and by telephone conversations with a Board representative on February 26, 2016 and July 6, 2016. Petitioners were not provided an adequate or formal opportunity to comment on the final NOA.

DATE: August 1, 2016

Respectfully submitted,

/s/ Jason R. Flanders
Jason R. Flanders
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Attorneys for Petitioners
Russian Riverkeeper and Fred Corson

EXHIBIT A

July 1, 2016

Mr. Patrick Fuss
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NOTICE OF APPLICABILITY

ORDER WQ 2014-0090-DWQ-R1001-01
(applicable through August 5, 2016)

and

ORDER WQ 2016-0068-DDW-R1001
(effective on and after August 6, 2016)

WDID NO. 1B15092RSON

STATE WATER RESOURCES CONTROL BOARD ORDER WQ 2014-0090-DWQ
GENERAL WASTE DISCHARGE REQUIREMENTS FOR RECYCLED WATER USE
AND
STATE WATER RESOURCES CONTROL BOARD ORDER WQ 2016-0068-DDW
GENERAL WATER RECLAMATION REQUIREMENTS FOR RECYCLED WATER USE

CITY OF HEALDSBURG
RECYCLED WATER PROGRAM
SONOMA COUNTY

A. General Information and Requirements

This document describes the City of Healdsburg's (hereinafter City) Recycled Water Program and outlines requirements for the City's Recycled Water Program under State Water Resources Control Board (State Water Board) Orders WQ 2014-0090-

DWQ (Attachment A to this NOA), adopted June 3, 2014, and WQ 2016-0068-DDW (Attachment B to this NOA), adopted June 7, 2016, and effective August 6, 2016. These Orders regulate the use of recycled water for all title 22 uses except groundwater replenishment. Coverage under Order WQ 2014-0090-DWQ is for the period July 1, 2016 through August 5, 2016. Coverage under Order WQ 2016-0068-DDW is effective on and after August 6, 2016. Both orders (and any future revisions) are hereinafter referred to as the General Order.

The General Order delegates the responsibility of administering water recycling programs to a designated Administrator to the fullest extent possible. The City of Healdsburg will act as the Administrator of the City's Recycled Water Program and is hereinafter referred to as the Administrator.

Please review this Notice of Applicability (NOA) carefully to ensure that it completely and accurately reflects the proposed Recycled Water Program. If the use of recycled water violates any of the terms or conditions in this NOA, the Regional Water Board may take enforcement action, including the assessment of administrative civil liability. Failure to abide by the conditions of the General Order, including its monitoring and reporting requirements, and this letter authorizing applicability could result in enforcement actions, as authorized by provisions of the California Water Code.

The required annual fee specified in the annual billing from the State Water Board shall be paid until this NOA is officially terminated. The Administrator must submit in writing a Notice of Termination if the water recycling program covered by this NOA is discontinued.

For the time periods specified below, please include the indicated information in the Subject line of all future correspondence related to this enrollment:

Between July 1, 2016 and August 5, 2016: Notice of Applicability No. WQ-2014-0090-R1001-01 and WDID No. 1B15092RSON

After August 5, 2016: Notice of Applicability No. WQ-2016-0068-R1001 and WDID No. 1B15092RSON

B. Background Information

The North Coast Regional Water Quality Control Board (Regional Water Board) staff reviewed the Administrator's May 5, 2016, Recycled Water Program Technical Report and Amended Notice of Intent (NOI). The NOI was submitted to apply for regulatory coverage of the Administrator's entire recycled water program under the General Order. The NOI expands upon an NOI that was submitted by the City on July 13, 2015, and approved by NOA WQ-2014-0090-R1001 issued by the Regional Water Board Executive Officer on July 15, 2015, to authorize enrollment of the Administrator's Landscape Irrigation Recycled Water Program. On July 16, 2015, the

City submitted the required filing fee of $2,088 and will be assessed an annual filing fee annually thereafter.

Prior to the issuance of this NOA (WQ-2014-0090-R1001-01/WQ-2016-0068-R1001), the Administrator's recycled program has been permitted as follows:

1. Portions of the City's vineyard irrigation program that were identified in the City's *Final Environmental Impact Report, City of Healdsburg Wastewater Treatment Plant Upgrade Project* (FEIR), June 13, 2005, and for which a recycled water pipeline had been constructed, were permitted through Waste Discharge Requirements Order No. R1-2010-0034.

2. Trucking to provide recycled water for soil compaction, dust control, and other construction purposes was approved under Resolution No. R1-2012-0099, *Policy for Waiving Waste Discharge Requirements for Specific Types of Waste Discharge*, by a letter from the Regional Water Board Executive Officer dated March 12, 2014.

3. Trucking to provide recycled water to vineyards addressed in the 2005 FEIR where a recycled water pipeline has not been constructed, was approved under Order No. R1-2010-0034 for the 2014 and 2015 irrigation seasons only, by a letter from the Regional Water Board Executive Officer dated May 1, 2014.

4. Trucking to provide recycled water to vineyards in the Alexander, Dry Creek, and Russian River Valleys at sites included in the City's *Addendum to Final Environmental Impact Report, City of Healdsburg Wastewater Treatment Plant Upgrade/Seasonal Irrigation Reuse Project*, April 2014 was approved under Order No. R1-2010-0034 for the 2014 and 2015 irrigation seasons only, by a letter from the Regional Water Board Executive Officer dated May 6, 2014.

5. Trucking to provide recycled water for landscape irrigation at residences and commercial businesses (self-haulers and commercial haulers) was approved under the General Order by NOA WQ-2014-0090-R1001 issued by the Regional Water Board Executive Officer on July 21, 2015.

The Administrator proposes to expand its recycled water program to include the following additional uses and elements: aggregate processing, fire suppression, sanitary sewer cleaning, and street sweeping. In addition, the Administrator proposes to expand the vineyard irrigation program to a broader area, as addressed in the City's March 21, 2016, addendum to the 2005 FEIR. These uses are described in this NOA.

The Administrator's recycled water uses occur in three Department of Water Resources named alluvial groundwater basins: the Santa Rosa Valley – Healdsburg Area Basin 1-55.02, the Santa Rosa Valley – Santa Rosa Plain Basin 1-55.01, the

Alexander Valley – Alexander Area Basin 1-54.01. In addition, part of the City's recycled water system is immediately west of Basin 1-55.02 that is not identified by DWR as a named groundwater basin.

The Administrator owns and operates a water recycling facility (WRF) located at 340 Foreman Lane, Healdsburg, California. The WRF is regulated under Waste Discharge Requirements (WDRs) Order No. R1-2010-0034 through July 31, 2016 and Order No. R1-2016-0015 beginning August 1, 2016, which also serves as an NPDES permit (NPDES Permit No. CA0025135) for the discharge of treated municipal wastewater to Basalt Pond, a tributary of the Russian River.

Based on the information provided in the NOI, the Administrator's recycled water program satisfies the general and specific conditions of the General Order. Therefore, this NOA serves as formal notice that the General Order is applicable to the sites and recycled water uses described below. As the Administrator, the City will be responsible for the administration of the Recycled Water Program authorized pursuant to the General Order, including the requirements of title 22.

The Administrator is the recycled water producer and distributor.

C. Wastewater Treatment Facility and Recycled Water Fill Stations

The Administrator's WRF includes influent screening and grit removal; biological removal of biochemical oxygen demand (BOD) and nitrogen in aerobic, anoxic, and pre-anoxic basins; membrane bioreactor (MBR) filtration; ultraviolet (UV) light disinfection; and chlorine disinfection. Treated effluent is nitrified and denitrified and meets the title 22 requirements for disinfected tertiary recycled water. Title 22 compliant effluent is stored in a 25 million gallon storage pond prior to being distributed to the recycled water system which consists of a recycled water distribution pipeline and two recycled water fill stations. One recycled water fill station is located at the WRF property at 340 Foreman Lane and the other is located on Kinley Drive, approximately one mile from the WRF. The Administrator adds chlorine, at a minimum dose of 1 mg/L to the recycled water directed to the fill stations.

Each fill station is designed for safe and easy access and includes security features to prevent unauthorized access to the recycled water, signage, and hand wash stations to minimize the potential for inappropriate human contact with the recycled water. Fill stations are also designed to minimize the potential for spills and to capture any spills that do occur and prevent spills to surface waters. The WRF fill station can be accessed only when the Administrator's employees are present. The Kinley Drive fill station can be accessed anytime by permitted commercial haulers or City vehicles.

D. Recycled Water Program

1. Residential/Commercial Landscape Irrigation Recycled Water Trucking Program

In late summer 2015, the Administrator launched a recycled water use program that allows recycled water to be trucked for landscape irrigation use by individual residential and commercial customers. This program was initiated in response to drought conditions.

Recycled water may be transported and used by the City, residents, and business owners/operators for residential/commercial landscape and garden irrigation at homes, parks, schools, and commercial buildings. Individuals and business owners/operators must sign an agreement with the Administrator and follow program rules listed in the agreement, and attend an annual training presentation.

Training covers the approved title 22 uses, use requirements, agronomic rate requirements, and prohibited uses. Residential customers are given recycled water notice stickers to be placed on all containers that will be used for transporting and/or storing recycled water and commercial haulers are given placards to be placed on all trucks used to haul recycled water.

Residential users are allowed to receive recycled water from designated fill stations during scheduled pickup hours and must complete a log sheet every time they pick up recycled water. Residential customers are required to pick up recycled water from the Foreman Lane fill station, which is manned by the Administrator's operations staff during hours of operation. Commercial haulers delivering more than 300 gallons to a particular site or to a user will act as a distributor and will be required to conduct monthly site inspections to ensure that users are complying with the terms of this authorization. Commercial customers are allowed 24/7 access to either fill station.

2. Vineyard Irrigation Program

The Administrator provides recycled water for micro-irrigation of vineyards through pipelines and fill station pickups. This use is addressed in the June 2005 FEIR and in the City's *Addendum to Final Environmental Impact Report, City of Healdsburg Wastewater Treatment Plant Upgrade/Seasonal Irrigation Reuse Project*, March 21, 2016.

Recycled Water Use Agreements will be developed for each vineyard operator prior to initiating recycled water use. The agreements outline the Administrator's and each vineyard owner's responsibilities for the production, delivery, and use of recycled water in accordance with applicable laws, statutes, rules, regulations, and guidelines. A recycled water use supervisor will be

designated by each property owner to serve as a liaison with the Administrator. The property owners are responsible for appropriate operation of the vineyard irrigation systems with training and supervision provided by the Administrator's staff.

The use of recycled water for vineyard irrigation will be protective of groundwater quality by ensuring that the volume of recycled water used for irrigation at each vineyard property does not exceed hydraulic and nitrogen agronomic rate thresholds on an annual basis. In May 2014, the City prepared a *Programmatic Operations and Management Technical Report for Micro-Irrigation of Vineyards* (Programmatic Technical Report) to the Regional Water Board that compiles results of studies undertaken from 2010 to 2014 by registered hydrogeologists and agronomists to assess the hydraulic and nutrient characteristics of valley floor vineyards and agronomic rate thresholds were determined for vineyard irrigation with recycled water. The Programmatic Technical Report also identifies best management practices (BMPs) that must be implemented to ensure protection of public health and water quality. The agronomic rates and BMPs are included in the NOI and are summarized below.

Vineyard use of recycled water for irrigation shall not exceed the following thresholds:

Hydraulic Threshold: The lower of 75% of full crop evapotranspiration (ETc)[1] or 9 inches per year distributed over the March through October growing season. ETc represents the amount of full potential water use by a crop in inches and is calculated based on reference evapotranspiration (ETo) from the nearest operating California Irrigation Management Information System (CIMIS) station and crop coefficient, a factor that accounts for the amount of sun interception in a vineyard. The crop coefficient increases with canopy growth[2]. This hydraulic agronomic rate threshold is based on the protection of groundwater from salinity impacts.

Nitrogen Threshold: 15 pounds (lbs) N per acre per year from recycled water only and 30 lbs N per acre from all nitrogen sources distributed over the March through October growing season. The recycled water only threshold is at the low end of the nitrogen range identified as acceptable by the University of California Cooperative Extension for Napa Sanitation District recycled water and is based

[1] Crop ET (ETc) equals ETo times the crop coefficient.

[2] The crop coefficient is calculated by applying a standard factor of 0.017 to the percent shade at solar noon. Percent shade at solar noon is a function of row spacing, vine spacing, and the width of measured shaded area between two vines at solar noon. For example if row spacing (A) is 8 feet and vine spacing (B) is 6 feet, the area per vine (C) is 48 square feet. If the width of measured shaded area between two vines at solar noon (D) is 2.4 feet, the percent shaded area is B times D divided by C or 6 times 2.4 divided by 48 which equals 0.3 or 30 percent. The crop coefficient is 0.017 times 30 which equals 0.51.

on irrigating at 9 inches per year with 7 mg/L of nitrogen in the recycled water. Vineyard managers supplement nitrogen with applications of urea and calcium nitrate fertilizers. The nitrogen available from recycled water will offset any fertilization conducted, thus the secondary threshold takes this into consideration.

Regional Water Board staff will assess monitoring data and other pertinent information as it becomes available to evaluate the appropriateness of the agronomic rate thresholds identified in this NOA. If the data or information demonstrates that the recycled water application rates pose a threat or impact to water quality or cause violations of title 22 recycled water requirements, Regional Water Board staff will notify the Administrator and modify the agronomic rate thresholds as appropriate to ensure adequate protection of water quality.

Vineyard use of recycled water for irrigation shall include implementation of the BMPs identified in the NOI, including, but not limited to no use of recycled water for frost protection or in proximity to rainfall events, irrigation practices that minimize the potential for runoff and ponding, fertilization practices that avoid over-application of nitrogen, and equipment operation and maintenance practices that ensure reliable operation of the irrigation system.

On a monthly basis, the Administrator provides recycled water quality information to the vineyard managers and the vineyard managers provide information on recycled water and fertilizer use to the Administrator. The information is used to calculate actual loading rates and assess whether or not the designated thresholds are being met. The use of drip irrigation and the limitations of hauling recycled water have resulted in very low application rates to date. The Administrator will work with vineyard managers if there are any exceedances of the designated thresholds.

3. Aggregate Processing

Syar Industries, Inc. will use recycled water for aggregate processing at its main plant located east of the Russian River at 13666 Healdsburg Avenue, Healdsburg, CA. A use agreement between the Administrator and Syar Industries defines responsibilities for the production, delivery and use of recycled water in accordance with applicable laws, statutes, rules, regulations, and guidelines. The use agreement requires Syar to develop and implement on Operations and Maintenance Plan that addresses leak detection, facility operation, and equipment maintenance and to implement other BMPs to ensure protection of public health and water quality. This Plan must be submitted to the Regional Water Board Executive Officer for review and approval prior to initiating recycled water use for aggregate processing.

The recycled water will be used for dust control on the facility roads and for washing/processing aggregate materials. Recycled water will replace the use of water drawn from onsite industrial groundwater wells. The City Council adopted an EIR Addendum in October 2014 that addressed impacts of recycled water used for aggregate processing.

The Administrator expects to deliver recycled water to Syar Industries for aggregate processing 80 to 120 days per year. The aggregate processing can occur any time during the year. Recycled water will only be used during business hours when the Syar Industries staff is onsite to observe and maintain the equipment. Approximately 50,000 gallons of recycled water per day will be needed to top off a storage pond at the aggregate processing area (commonly called the 150 horsepower (hp) pond, based on the pumping system). Recycled water will compensate for water lost during aggregate processing and through evaporation. The 150 hp pond has a capacity of over 200,000 gallons and is protected by levee banks. The pond was constructed in the 1940s, and a heavy duty visqueen liner was installed in the early 1990s. During years of operation, silt from the clarified water has built up on top of the plastic. There is currently 3 to 4 feet of silt on the walls and bottom of the pond. The pond is maintained every 5 years.

There are no potable water supply lines or potable groundwater wells onsite or within 100 feet of the facility. Potable water is provided to employees through bottled water service at 13 different locations. Two non-potable wells are utilized onsite. Both are considered industrial supply wells and contain enough iron to cause discoloration in the water. The aggregate facility does not have a potable water system on site, so backflow to the potable system is not a concern. However, if potable water is ever extended to the facility, a reduced pressure backflow preventer will be installed. An air gap will be used to prevent backflow from the aggregate processing area to the recycled water pipeline. Depending on the level in the 150 hp pond, the air gap will be one to six feet.

Recycled water is delivered from the Administrator's meter (north of the WRF) through a pipeline owned and operated by Syar Industries to a fill point located at the aggregate processing facility. To deliver recycled water from the WRF to the aggregate processing facility, Syar Industries refurbished an existing 12-inch PVC pipeline that connects with the Administrator's recycled water line. The pipeline crosses Dry Creek and the Russian River through buried conduit and can handle a maximum flowrate of 2.16 mgd. Syar Industries is responsible for operation and maintenance of the pipeline and any equipment installed downstream of its connection to the Administrator's recycled water line. Regular site inspections by Syar Industries and the Administrator will be utilized to ensure proper equipment operation and timely repairs if needed.

At the end of the refurbished recycled water pipeline, the Syar Industries fill point supplies water trucks that control dust on facility roads. The fill point is located within the gated and fenced area of Syar's aggregate processing facility. A locked valve is present on the fill point, which can be accessed by Syar Industries employees only. Furthermore, Syar Industries employees are required to check and ensure the fill point is locked each night before closing.

After the Regional Water Board approves recycled water for aggregate processing, a pipeline will be constructed to connect the recycled water fill point to the 150 hp pond. The pipeline will be a buried 12-inch HDPE pipe with a manually operated, lockable valve installed above ground at the pond edge. A buried gate valve will be installed near the truck fill point to isolate the entire gravel wash line. The clarified wash water is directed to the 150 hp pond for storage and re-use in processing. While most of the property is pervious to rain, some runoff can occur in the aggregate processing area that gets captured by the wash drains and directed to the 150 hp pond. If groundwater is no longer used for aggregate processing, the 150 hp pond will eventually contain only recycled water and collected storm water runoff from the aggregate processing area. At least 2 feet of freeboard is maintained in the 150 hp pond. During large precipitation events (≤ 25 year, 24-hour storm event), overflow can be prevented by continuous operation of the 150 hp pumps, sending water through the aggregate processing area, to the clarifier, and back to the 150 hp pond. For storms greater than 25 year, 24-hour event, the pond will overflow to a lower area with pumps available to send water to a holding basin near the clarifier. This process ensures no runoff is released from the processing area. Solids from the clarifier are pumped to a belt press for dewatering. Approximately 95% of the water is removed during the dewatering process. The dewatered solids are stockpiled onsite for additional drying, and are later sold as soil amendments and fill material for construction and vineyard leveling. Water removed from the dewatering process is returned to the 150 hp pond and is reused for aggregate processing.

4. Soil Compaction, Dust Control and Other Construction Uses

Recycled water may be used at construction sites for controlling dust on roads and from uncovered trucks that are transporting materials around construction sites, for soil compaction, for mixing herbicides/pesticides, and for other construction-related non-potable water uses. Recycled water is available to permitted water haulers at the Administrator's two commercial fill stations (located at 340 Forman Lane and 280 Kinley Drive in Healdsburg). Recycled water may be transported to sites within the Administrator's approved recycled water hauling area specified in Figure 9 of the NOI.

Truck haulers that transport and use recycled water for construction purposes are required to obtain a permit and follow the Administrator's Recycled Water

Trucked Use Guidelines included in Attachment C of the NOI. Commercial haulers are also required to record the volume of recycled water picked up at the fill station as well as the address and volume of each recycled water delivery. Commercial haulers are required to submit completed logs to the Administrator monthly.

BMPs specified in the NOI must be implemented for the protection of public health and water quality, and include, but are not limited to, signage on trucks stating that recycled water is being used, and protecting storm drains and creeks from recycled water spills by maintaining setbacks from creeks and storm drain inlets, avoiding overspray into areas used by the public, and cleaning equipment in an area where all water can be captured.

5. Fire Suppression

Recycled water may be used for emergency fire suppression and for fire-fighting training. Fire Departments that transport and use recycled water must obtain a permit with the Administrator and follow the Administrator's Fire Suppression Guidelines that are included in Attachment C to the NOI. Recycled water will be available at the Administrator's fill stations, through the recycled water pipeline, or directly from storage ponds at the WRF. Training exercises will be undertaken to educate fire fighters about the uses and health risks presented by recycled water since exposure to infectious agents may occur through open wounds and inhalation. An air gap separation will be maintained whenever tanks on emergency vehicles are filled with any type of water. In addition, fire departments that use recycled water for fire-fighting training will be required to develop a plan describing how compliance with title 22 requirements (such as no spray mist, 50-foot setback to wells, signage, etc.) will be achieved.

BMPs specified in the NOI must be implemented for the protection of public health and water quality, and include, but are not limited to, signage on trucks stating that recycled water is being used, and protecting storm drains and creeks from recycled water spills by covering and blocking drain inlets, and cleaning equipment in an area where all water can be captured.

6. Sanitary Sewer Cleaning

Recycled water may be used by the City and private companies for sanitary sewer cleaning. Private companies that transport and use recycled water for sewer cleaning operations must obtain a permit and follow the Administrator's Sanitary Sewer Cleaning Guidelines that are included in Attachment C to the NOI.

Use of recycled water ensures valuable potable water will not be utilized when a lower quality of water is sufficient. Water and waste generated during cleaning operations is returned to the WRF for treatment. The City will only use recycled

water in sewer cleaning trucks. As a result, separate filling systems (one for potable water and one for recycled water) are not necessary. An air-gap feature is provided on the fill inlet to the on-board tank. Sewer cleaning trucks will obtain recycled water from the Administrator's fill stations. For sanitary sewer cleaning, the primary operational concern is preventing spills during truck fill ups and during the cleaning operation.

BMPs specified in the NOI must be implemented for the protection of public health and water quality, and include, but are not limited to, signage on trucks stating that recycled water is being used, and protecting storm drains and creeks from recycled water spills by covering and blocking drain inlets, and cleaning equipment in an area where all water can be captured.

7. Street Sweeping

Recycled water may be used by the City and private companies for street sweeping operations. Private companies that transport and use recycled water for street sweeping operations must obtain a permit from the Administrator and follow the Administrator's Street Sweeping Guidelines that will be developed for Executive Officer's review and approval prior to any private company utilizing recycled water for street sweeping. The Street Sweeping Guidelines must clearly demonstrate that BMPs will prevent recycled water from being discharged into storm drain inlets.

Street sweeping of streets and rights-of-way is a management strategy to reduce the amount of trash, debris, and particulates that wash off and contaminate creeks during rain events. Most street sweeping vehicles are equipped with a dust suppression and vacuum system. Spraying small volumes of water before the street is swept prevents dust formation. Water, trash, debris and dust are then captured by the vacuum system, and any remaining water evaporates from the ground. Therefore, under ideal conditions no runoff should be produced during street sweeping. An average street sweeping vehicle tank holds 220 gallons of water. The volume of water utilized per day depends on the area that is swept. Vehicles will be filled at the Administrator's recycled water fill stations.

BMPs specified in the NOI must be implemented for the protection of public health and water quality, and include, but are not limited to, signage on trucks stating that recycled water is being used, provision of air-gap on the trucks for backflow prevention when filling up, no use during or immediately before or after a rain storm, protecting storm drains and creeks from recycled water spills by covering and blocking drain inlets, and cleaning equipment in an area where all water can be captured.

E. Monitoring and Reporting Program

Recycled water distributed to uses authorized under this NOA shall be monitored in accordance with the Monitoring and Reporting Program (MRP) Order No. 2016-0068-DDW-R1001 that is being issued with this NOA (Attachment C to this NOA). The MRP is based on the MRP template in Order WQ 2016-0068-DDW and includes monitoring requirements for the recycled water as well as groundwater monitoring requirements.

Groundwater monitoring requirements are necessary for the following reasons:

1. To ensure protection of high quality groundwater in the vicinity of the vineyard recycled water use sites. When applying recycled water, excess nitrate that is not absorbed by plants and salts can accumulate in the soil and ultimately leach into groundwater. Implementation of a representative groundwater monitoring program will generate data to determine whether nitrates and salts are leaching to groundwater at concentrations above water quality standards, and to assess whether adjustments to the recycled water application rates and other irrigation management practices are necessary to ensure adequate protection of high quality groundwater.

2. The State Water Board Recycled Water Policy requires the development of salt and nutrient management plans (SNMPs) for all groundwater basins to facilitate basin-wide management of salts and nutrients from all sources in a manner that optimizes recycled water use while ensuring protection of groundwater beneficial uses such as municipal and domestic water supply, industrial water supply, industrial process water supply, agricultural water supply and surface water replenishment. Currently, there are no SNMPs for the groundwater basins where the recycled water use is occurring or will occur (described in section B of this NOA). The groundwater monitoring program required in the MRP will provide the necessary data to facilitate the management of salts and nutrients at the use sites until such time that SNMPs for these groundwater basins are developed and implemented.

The MRP specifies the groundwater monitoring parameters and requires the Administrator to submit for Regional Water Board Executive Officer review and approval, a groundwater monitoring work plan that identifies groundwater monitoring locations and documents that the groundwater monitoring wells proposed are appropriately placed and constructed.

Recycled water production requirements are included in WDR Order No. R1-2010-0034 (through July 31, 2016) and Order No. R1-2016-0015 (beginning August 1, 2016) which includes title 22 turbidity specifications and recycled water limits for

total coliform organisms. Recycled water use monitoring and reporting requirements are specified in the attached MRP.

F. Division of Drinking Water Acceptance and Conditions

The Administrator addressed title 22 Engineering Report requirements in its NOI and submitted it to DDW staff. DDW staff provided comments and conditional acceptance of the Administrator's recycled water program to the Administrator in a letter dated May 20, 2016. Portions of the NOI were previously reviewed and approved by DDW (formerly California Department of Public Health (CDPH)) with letters dated November 16, 2010 (CDPH acceptance of original title 22 Engineering Report), April 16, 2014 (DDW acceptance of title 22 Engineering Report addendum addressing dust control), and July 15, 2015 (DDW acceptance of Landscape Irrigation Recycled Water Program Technical Report and NOI). The CDPH/DDW acceptance letters are included as Attachment D to this NOA.

The Administrator shall comply with the following recycled water use conditions specified in the November 20, 2010 and May 20, 2016 DDW acceptance letters. Note that the April 16, 2014, and July 15, 2015, acceptance letters did not specify any conditions.

1. **User Agreements.** The City, as the responsible agency, must ensure that before delivering recycled water to an end user that user agreement(s) are signed and that all regulatory agencies have sufficient time to review and approve the recycled water project.

2. **Recycled Water Pipeline Installation.** Installation of new recycled water pipelines must meet title 22 section 64572 Water Main Separation. Pipelines conveying disinfected tertiary recycled water must have a minimum of four (4) feet horizontal and one (1) foot vertical clearance from any parallel pipeline conveying potable water.

3. **Future Submittals.**

   a. New types of recycled water uses, other than those described in this revised NOA, must be addressed in a revision or update to the title 22 Engineering Report and submitted for DDW review and approval.

   b. Revisions and updates to the Recycled Water Program Technical Report must be provided to DDW to demonstrate that applicable operations and management programs are in place.

   c. Any updates or changes to the title 22 Engineering Report must also be made in any application documents submitted to the Regional Water Board (i.e., Technical Support Documents and Report of Waste Discharge Documents).

G. Water Recycling Requirements

1. The distribution and use of recycled water shall be limited to the uses described in and managed in accordance with the May 5, 2016, NOI, DDW-approved title 22 Engineering Report (Attachment A to the NOI) and addenda (Attachments C and D to the NOI), and this NOA.

2. The use of recycled water shall not cause pollution or nuisance, as defined by Water code section 13050.

3. The recycled water shall be tertiary disinfected recycled water as defined by title 22, section 60301.230.

4. The Administrator shall notify the Regional Water Board of any recycled water spills or unauthorized uses upon discovery.

H. Other Requirements

1. The Administrator is responsible for compliance with all Specifications, Water Recycling Administration Requirements and General Provisions of the General Order, this NOA (including approved title 22 engineering reports and addendums included with the NOI), title 22, and the CDPH/DDW acceptance letters dated November 16, 2010, April 16, 2014, July 15, 2015, and May 20, 2016.

2. The Administrator shall update the Training Programmatic Technical Report for Micro-Irrigation of Vineyards by July 1, 2017.

3. The Administrator shall provide training to all recycled water users prior to first use of recycled water and annually thereafter. The Administrator shall document all training and maintain training records for a minimum of three years.

4. The Administrator shall submit the Syar Gravel Processing Operations and Maintenance Plan to the Regional Water Board and DDW for review and approval prior to initiating recycled water use for gravel processing.

5. The Administrator shall develop and submit guidelines for the use of street sweeping for the Executive Officer's review and approval prior to initiating recycled water use for street sweeping.

6. The Administrator shall submit fire-fighting training recycled water use plans describing how title 22 requirements will be achieved to the Regional Water Board and DDW for review and approval prior to allowing recycled water use for fire-fighting training.

I. Document Submittals

All correspondence (other than monitoring reports required by MRP Order No. 2016-0068-DDW-R1001) should be converted to searchable Portable Document Format (PDF) and submitted electronically. Documents that are less than 50 MB shall be emailed to:

NorthCoast@waterboards.ca.gov

Documents that are 50 MB or larger should be transferred to a CD, DVD, or flash drive and mailed to:

North Coast Regional Water Quality Control Board
5550 Skylane Boulevard, Suite A
Santa Rosa, CA 95403

All monitoring reports should be submitted electronically in accordance with section V of MRP Order No. 2016-0068-DDW-R1001.

If you have any questions regarding this NOA or the Administrator's enrollment under the General Order, you may contact Cathleen Goodwin of my staff at (707) 576-2687 or Cathleen.Goodwin@waterboards.ca.gov.

Sincerely,

Matthias St. John
Executive Officer

160701_CAG_ef_Healdsburg_NOA_RecycledWater_GeneralOrder

Attachments:

Attachment A: Statewide General Waste Discharge Requirements for Recycled Water Use, Order WQ 2014-0090-DWQ

Attachment B: Statewide General Water Reclamation Requirements for Recycled Water Use, Order WQ 2016-0068-DDW

Attachment C: Monitoring and Reporting Order No. 2016-0068-DDW-R1001

Attachment D: CDPH/DDW Acceptance Letters dated November 16, 2010, April 16, 2014, July 15, 2015, and May 20, 2016

Certified-Return Receipt Requested

cc (without attachments):

Annalisa Kihara, State Water Resources Control Board, Sacramento, Annalisa.Kihara@waterboards.ca.gov
Randy Barnard, State Water Resources Control Board, Division of Drinking Water, Randy.Barnard@waterboards.ca.gov
Sherly Rosilela, State Water Resources Control Board, Division of Drinking Water, Sherly.Rosilela@waterboards.ca.gov
Janice Thomas, State Water Resources Control Board, Division of Drinking Water, Janice.Thomas@waterboards.ca.gov

cc (with attachments):

Mr. Patrick Fuss, City of Healdsburg, pfuss@ci.healdsburg.ca.us
Mr. Terry Crowley, City of Healdsburg, tcrowley@ci.healdsburg.ca.us
Don McEnhill, Russian Riverkeeper, don@russianriverkeeper.org
Fred Corson, Clean Water Coalition, fpcorson@digitalpath.net
Judith Olney, Clean Water Coalition, milestonesmet@gmail.com

ATTACHMENT A

STATE WATER RESOURCES CONTROL BOARD
ORDER WQ 2014-0090-DWQ - CORRECTED

GENERAL WASTE DISCHARGE REQUIREMENTS
FOR RECYCLED WATER USE

Adoption Date

June 3, 2014

CALIFORNIA
Water Boards

STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

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TABLE OF CONTENTS

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ACRONYMS AND ABBREVIATIONS	
AGR	Agricultural supply
Antidegradation Policy	State Water Board Resolution 68-16, the Statement of Policy with Respect to Maintaining High Quality of Waters in California
AQUA	Aquaculture
Basin Plan	Water Quality Control Plan
BPTC	Best practicable treatment or control
CDPH	California Department of Public Health
CEC	Contaminants of Emerging Concern
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
Delta	Sacramento-San Joaquin River Delta Estuary
DWR	Department of Water Resources
E. coli	Escherichia coli
e.g.	Latin *exempli gratia* (for example)
FRESH	Fresh water replenishment
gpd	gallons per day
GWR	Groundwater recharge
IND	Industrial service supply
mg/L	Milligrams per liter
MPN	Most Probable Number
MRP	Monitoring and Reporting Program
MUN	Municipal supply
MOA	Memorandum of Understanding
NOA	Notice of Applicability
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Unit
pdf	Portable Document Format
PROC	Industrial process supply
REC-1	Water contact recreation
Regional Water Board	Regional Water Quality Control Board
State Water Board	State Water Resources Control Board
TBD	To Be Determined
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
WILD	Wildlife habitat
WDRs	Waste Discharge Requirements

THIS ACRONYMS AND ABBREVIATIONS PAGE IS PROVIDED FOR CONVENIENCE AND REFERENCE. IT IS NOT PART OF THE GENERAL ORDER ADOPTED BY THE STATE WATER BOARD

STATE WATER RESOURCES CONTROL BOARD
ORDER WQ 2014-0090-DWQ
GENERAL WASTE DISCHARGE REQUIREMENTS
FOR RECYCLED WATER USE

BACKGROUND INFORMATION

The State Water Resources Control Board, (State Water Board) finds that:

1. On January 17, 2014, California's Governor proclaimed a Drought State of Emergency and directed state officials to take all necessary actions to prepare for drought conditions. On March 1, 2014, the Governor signed bipartisan drought relief legislation, Senate Bill (SB) 103 and 104, modifying the Budget Act of 2013 (Stats. 2013, ch. 20 and 354) to provide additional funds for drought relief. (Stats. 2014, ch. 2 and 3, respectively).

2. On April 25, 2014, the Governor proclaimed a continued State of Emergency due to severe drought conditions and directed the State Water Board to adopt statewide general waste discharge requirements to facilitate the use of treated wastewater that meets standards set by the California Department of Public Health (CDPH) in order to reduce demand on potable water supplies.

3. California experiences frequent drought conditions. The recent emergency actions follow a similar Declaration of Statewide Drought in effect from 2008 through 2011 (Executive Order S-06-08) and Drought Declaration State of Emergency in effect from 2009 through 2011 (Executive Order S-11-09). Drought conditions in California also persisted from 1987 through 1992. Paleoclimatologists have reconstructed medieval climate episodes from tree ring studies, sediment deposition, and other sources. These studies show that the most severe droughts during the past 1,000 years have lasted from 20 to more than 150 years.[1]

4. "Recycled water" means water which, as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur and is therefore considered a valuable resource. (Wat. Code, § 13050(n).) Coverage under these General Waste Discharge Requirements (WDRs) for Recycled Water Use (General Order) is limited to treated municipal wastewater for non-potable uses. An estimated 1.85 to 2.25 million acre-feet of water supply could be realized annually though recycling by the year 2030.[2] Of this total amount, an estimated 0.9 million to 1.4 million acre-feet of recycled water could

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1 Michael Dettinger, *Droughts, Epic Droughts and Droughty Centuries—Lessons from California's Paleoclimatic Record: A PACLIM 2001 Meeting Report*, (Summer 2001) Interagency Ecological Program Newsletter, at p. 50.

2 California Department of Water Resources, Bulletin 160-2009, p. 11-9.

be realized through recycling of municipal wastewater that is discharged into the ocean or saline bays. Downstream beneficial uses will be protected by requiring compliance with Water Code section 1211, as described in the Antidegradation Analysis section of this General Order.

5. Recycled water use can help to reduce local water scarcity. It is not the only option for bringing supply and demand into a better balance, but it is a viable cost effective solution that is appropriate in many cases. The feasibility of recycled water use depends on local circumstances, which affect the balance of costs and benefits. In drought conditions, recycled water can be particularly valuable, given the scarcity of alternative supplies. In normal precipitation years recycled water use may reduce groundwater extraction.

6. The California Legislature has declared that a substantial portion of the future water requirements of the state may be economically met by beneficial use of recycled water. (Wat. Code, § 13511.) The Legislature also expressed its intent that the state undertake all possible steps to encourage development of water recycling facilities so that recycled water may be made available to help meet the growing water requirements of the state. (Wat. Code, § 13512.)

7. On February 3, 2009, the State Water Board adopted *Resolution 2009-0011, Adoption of a Policy for Water Quality Control for Recycled Water* (Recycled Water Policy) (Revised January 22, 2013, effective April 25, 2013.) The Recycled Water Policy promotes the use of recycled water to achieve sustainable local water supplies and reduce greenhouse gas emissions.

8. Water recycling is an essential part of an overall program to manage local and regional water resources. Many local governing bodies have adopted resolutions establishing their intent to proceed with planning, permitting, and implementation of recycled water projects. These projects will provide water supply and municipal wastewater disposal benefits for communities, and will provide water supply benefits to agriculture.

9. The CDPH has primary statewide responsibility for protecting public health. It has established statewide water recycling criteria in California Code of Regulations, title 22, division 4, chapter 3 (hereafter referred to as title 22). Approved uses of recycled water under title 22 depend on the level of treatment, disinfection, and potential for public contact. CDPH has categorized recycled water based on treatment and disinfection levels. There are four categories of recycled water relevant to this General Order; they are listed here and defined in the indicated title 22 section:

   a. Undisinfected secondary recycled water (Cal. Code Regs., tit. 22, § 60301.900.)

   b. Disinfected secondary-23 recycled water (Cal. Code Regs., tit. 22, § 60301.225.)

   c. Disinfected secondary-2.2 recycled water (Cal. Code Regs., tit. 22, § 60301.220.)

d. Disinfected tertiary recycled water (Cal. Code Regs., tit. 22, § 60301.230.)

An approved title 22 engineering report is required before authorization to use recycled water is granted by the Executive Officer.

10. When used in compliance with the Recycled Water Policy, title 22, and all applicable state and federal water quality laws, the State Water Board finds that recycled water is safe for approved uses, and strongly supports recycled water as a safe alternative to raw and potable water supplies for approved uses.

11. This General Order authorizes certain beneficial recycled water uses consistent with title 22. Activities that are not authorized by this order include:

    a. Activities designed to replenish groundwater resources. Groundwater replenishment activities include surface spreading basins, percolation ponds, or injection through groundwater wells.[3]

    b. Disposal of treated wastewater by means of percolation ponds, excessive hydraulic loading of recycled water in use areas, etc., where the primary purpose of the activity is disposal of treated wastewater.

12. There are many sources of salts and nutrients in surface and groundwater, including water soluble inorganic and organic constituents in imported water, leaching of naturally occurring salts in soils as a result of irrigation and precipitation, animal wastes, fertilizers and other soil amendments, municipal use including water softeners, industrial wastewater, and oil field wastewater. In coastal areas and areas adjacent to the Sacramento-San Joaquin Delta, seawater intrusion is also a source of salinity in groundwater, particularly in over-drafted basins. Imported water is a major source of salt. In water year 2010, 45 percent of the surface water used in the San Joaquin Valley was imported from the Sacramento-San Joaquin Delta through the Delta Mendota Canal, Folsom South Canal, and California Aqueduct (DWR).[4] In an average year, more than 800,000 tons of salt are imported from the Sacramento-San Joaquin River Delta Estuary (Delta) into the northern portion of the San Joaquin Valley, and another two million tons of salt are imported into the Tulare Lake Basin.[5] Southern California also imports significant water supplies from the Delta. In addition, it imports 4.4 million acre-feet of water each year from the Colorado River. Colorado River water has, on average, twice the salinity of northern California water sources, and water imported from the Delta is blended with Colorado River supplies to control salinity. The use of recycled water for

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3 Injection well is defined in Water Code section 13051.

4 Water Recycling and Desalination Section, California Department of Water Resources.

5 Department of Water Resources, Water Facts-Salt Balance in the San Joaquin Valley <http://www.water.ca.gov/pubs/environment/salt_balance_in_the_san_joaquin_valley water facts_20_/water_facts_20.pdf>, accessed 3 April 2014.

irrigation has the potential to increase salts and other constituents in groundwater, but is not expected to be a significant source of salt loading relative to other potential sources, particularly when recycled water is used in the same watershed in which it would otherwise be discharged.

13. Use of recycled water has the potential to increase nutrients in groundwater supplies. In order to minimize the nutrient loading, this order requires that recycled water used for irrigation purposes be applied at an agronomic rate.

14. The Recycled Water Policy calls on local water and wastewater entities together with other stakeholders who contribute salt and nutrients to a groundwater basin or sub-basin, to fund and develop Salt and Nutrient Management Plans to comprehensively address all sources of salts and nutrients. The State Water Board herein reasserts the need for comprehensive salt and nutrient management planning and directs that salinity and nutrient increases should be managed in a manner consistent with the Recycled Water Policy. It is the intent of the Recycled Water Policy that every groundwater basin/sub-basin in California ultimately have a consistent Salt and Nutrient Management Plan. The appropriate way to address salt and nutrient issues is through the development of regional or subregional Salt and Nutrient Management Plans.

15. The Recycled Water Policy includes monitoring requirements for Constituents of Emerging Concern[6] (CECs) for the use of recycled water for groundwater recharge by surface and subsurface application methods. The monitoring requirements and criteria for evaluating monitoring results in the Recycled Water Policy are based on recommendations from a Science Advisory Panel.[7] Because this General Order is limited to non-potable uses and does not authorize groundwater replenishment activities, monitoring for CECs is not required.

16. The Recycled Water Policy requires permits for landscape irrigation with recycled water to include priority pollutant monitoring at the recycled water production facility. Annual monitoring is required for design production flows greater than one million gallons per day; a five year monitoring frequency is required for flows less than one million gallons per day. Priority pollutants are listed in Appendix A of 40 Code of Federal Regulations (CFR) Part 423.

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6 For this Policy, CECs are defined to be chemicals in personal care products, pharmaceuticals including antibiotics, antimicrobials; industrial, agricultural, and household chemicals; hormones; food additives; transformation products, inorganic constituents; and nanomaterials.

7 The Science Advisory Panel was convened in accordance with provision 10.b of the Recycled Water Policy. The panel's recommendations were presented in the report; *Monitoring Strategies for Chemicals of Emerging Concern (CECs) in Recycled Water - Recommendations of a Science Advisory Panel*, dated June 25, 2010.

STATUTORY AND REGULATORY ISSUES

17. Pursuant to Water Code section 13263(i) the State Water Board or a Regional Water Board may prescribe general WDRs for a category of discharges if the State Water Board or that Regional Water Board finds or determines that all of the following criteria apply to the discharges in that category:

    a. The discharges are produced by the same or similar operations.

    b. The discharges involve the same or similar types of waste.

    c. The discharges require the same or similar treatment standards.

    d. The discharges are more appropriately regulated under general WDRs than individual WDRs.

    Recycled water discharges regulated under this General Order will be consistent with the requirements of title 22. All discharges regulated under this General Order will be from similar operations and will be consistent with the description of recycled water uses described herein. Individual WDRs are not necessary because the recycled water uses and requirements would be similar if individual WDRs were issued, therefore general WDRs are appropriate.

18. Pursuant to Water Code section 13241 and 13263, the State Water Board, in establishing the requirements contained herein, considered factors including, but not limited to, the following:

    a. Past, present, and probable future beneficial uses of water;

    b. Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto;

    c. Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area;

    d. Economic considerations;

    e. The need for developing housing within the region(s); and

    f. The need to develop and use recycled water.

19. Technical and monitoring reports specified in this General Order are required pursuant to Water Code section 13267. Failing to furnish the reports by the due date or falsifying information in the reports are misdemeanors that may result in assessment of civil liabilities against the Discharger. Water Code section 13267 states, in part:

    > In conducting an investigation specified in subdivision (a), the regional board may require that any person who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge waste within its region, or any citizen or domiciliary, or political agency or entity of this state who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge, waste outside of its region that could affect the quality of waters

> within its region shall furnish, under penalty of perjury, technical or monitoring program reports which the regional board requires. The burden, including costs, of these reports shall bear a reasonable relationship to the need for the report and the benefits to be obtained from the reports. In requiring those reports, the regional board shall provide the person with a written explanation with regard to the need for the reports, and shall identify the evidence that supports requiring that person to provide the reports. … (f) the State Board may carry out the authority granted to a regional board pursuant to this section.

The technical reports required by this General Order, the NOI, and the Monitoring and Reporting Program (MRP) are necessary to assure compliance with this General Order. The burden and cost of preparing the reports is reasonable and consistent with the best interest of the people of the state in maintaining water quality.

20. The General Order is applicable to recycled water projects where recycled water for non-potable use is used or transported. The General Order does not regulate the treatment of wastewater. Compliance with this General Order does not relieve producers or distributors from the obligation to comply with applicable WDRs for discharges from wastewater treatment plants, other than the recycled water uses described herein.

21. A 1996 Memorandum of Agreement (MOA) between CDPH and the State Water Board on the use of recycled water establishes basic principles relative to the agencies and the Regional Water Boards. In addition, the MOA allocates primary areas of responsibility and authority between these agencies, and provides for methods and mechanisms necessary to assure ongoing, continuous future coordination of activities relative to the use of recycled water in California. This General Order implements the applicable provisions of the water recycling regulations of title 22 and California Code of Regulations, title 17, division 1, chapter 5 (hereafter referred to as title 17).

ANTIDEGRADATION ANALYSIS

22. State Water Board Resolution No. 68-16, the *Statement of Policy with Respect to Maintaining High Quality of Waters in California* (the Antidegradation Policy) requires that disposal of waste into the waters of the state be regulated to achieve the highest water quality consistent with the maximum benefit to the people of the state. The quality of some waters is higher than established by adopted policies and that higher quality water shall be maintained to the maximum extent possible consistent with the Antidegradation Policy. The Antidegradation Policy requires the following:

    a. Higher quality water will be maintained until it has been demonstrated to the state that any change will be consistent with the maximum benefit to the people of the state, will not unreasonably affect present and anticipated beneficial use of the water, and will not result in water quality less than that prescribed in the policies.

b. Any activity that produces a waste or may produce waste or increased volume or concentration of waste and discharges to existing high quality waters will be required to meet waste discharge requirements that will result in the best practicable treatment or control (BPTC) of the discharge necessary to assure pollution or nuisance will not occur, and the highest water quality consistent with the maximum benefit to the people of the state will be maintained.

23. This General Order regulates discharges to groundwater basins throughout the state. There is not sufficient data to determine which groundwater basins are high quality waters for the various constituents that may be associated with recycled water. To the extent use of recycled water may result in a discharge to a groundwater basin that contains high quality water, this General Order authorizes limited degradation consistent with the Antidegradation Policy as described in the findings below. Further, Salt and Nutrient Management Plans, developed in accordance with the Recycled Water Policy, will require analysis on an ongoing basis to evaluate inputs to the basin, the salt and nutrient mass balance, and the available assimilative capacity.

24. This General Order requires BPTC, which is a combination of treatment, storage, and application methods that implement the requirements of title 22 and the Regional Water Board Water Quality Control Plans (Basin Plans). Recycled water is generated by treating (primarily) domestic wastewater adequately to make the water suitable for a direct beneficial use that would not otherwise occur. The required level of treatment and/or disinfection corresponds to the proposed use of the recycled water. In addition, this General Order includes requirements regarding the storage and application of recycled water to protect water quality and limit public contact to recycled water, where appropriate. Wastewater treatment can be accomplished many different ways, but generally consists of physical, chemical, and/or biological methods. Depending upon the use of the recycled water, disinfection may be performed. In addition to the treatment processes, the General Order also requires the following control measures:

    a. Recycled water use shall not cause unacceptable groundwater and/or surface water degradation.

        i. Regional Water Boards have discretion regarding permitting storage of recycled water in unlined ponds. Applicants may improve storage facilities if deemed necessary by a Regional Water Board.

        ii. Application of recycled water is limited to agronomic rates, which limits the potential for significant amounts of recycled water to impact groundwater quality and allows plants to take up wastewater constituents such as nitrogen compounds.

        iii. Recycled water use shall be controlled to prevent significant runoff from application areas. This General Order authorizes use of

recycled water on land, where recycled water is further treated in natural soil processes.

b. Recycled water shall not create nuisance conditions.

   i. Title 22 requires wastewater to be oxidized, which removes putrescible matter and requires dissolved oxygen. Maintaining dissolved oxygen in the wastewater will generally prevent nuisance odors.

   ii. Application of recycled water is controlled to prevent airborne spray.

   iii. Application of recycled water to saturated soil is prohibited. Application to saturated soil reduces the soil treatment processes and may create conditions for mosquito breeding.

c. Recycled water shall only be used consistent with the title 22 recycled water specifications.

   i. The applicant must obtain approval of a title 22 engineering report before the Regional Water Board can issue a Notice of Applicability (NOA).

   ii. Acceptable uses of recycled water, use area signage, and monitoring frequency are specified in title 22.

   iii. Backflow prevention, cross connection tests, and setback requirements for surface impoundments, wells, etc. are contained in title 22 and title 17, Division 1, Article 2.

25. In an arid climate, such as the climate that exists in most of California, the maximum benefit to the people of the state can only be achieved by ensuring long and short-term protection of economic opportunities, human health, and environmental protection. In order to do that, water uses must be better matched to water quality and use of local supplies must be encouraged to the extent possible, including reusing water that would otherwise flow to the ocean or other salt sinks without supporting beneficial uses during transmission. The use of recycled water in place of both raw and potable water supplies for the non-potable uses allowed under this order improves water supply availability and helps to ensure that higher quality water will continue to be available for human uses and for instream uses for fish and wildlife. It also reduces the need for groundwater pumping that has resulted in permanent loss of aquifer storage capacity and land subsidence in some parts of the state.

    As required by the Antidegradation Policy, the State Water Board finds that the limited degradation of water that may occur as the result of recycling under the conditions of this General Order provides maximum benefit to the people of California, provided recycled water treatment and use are managed to ensure long-term reasonable protection of beneficial uses of waters of the state.

Recycled water available for reuse under this order has been treated at a wastewater treatment plant to levels that comply with permits issued by the State Water Board or Regional Water Boards pursuant to the Clean Water Act for discharges to waters of the United States or the Porter Cologne Water Quality Control Act for discharges to land. Treatment technologies required under these laws and permits include secondary and/or tertiary treatment and disinfection for pathogen removal.

Title 22 imposes limitations on the uses of recycled water, based on the level of treatment and the specific use in order to protect human health. By restricting the use of recycled water to title 22 requirements, this order ensures that recycled water is used safely. To the extent that the use of recycled water may result in some waste constituents entering the environment after effective source control, treatment, and control measures are implemented, the conditions of this General Order limiting the use of water to agronomic rates provides BPTC.

26. Constituents associated with recycled water that have the potential to degrade groundwater include salinity, nutrients, pathogens (represented by coliform bacteria), and disinfection by-products (DBPs). If the discharge is not consistent with Basin Plan requirements, the applicant may elect to improve treatment to enroll under this General Order, or to apply for a site-specific order from the Regional Water Board. The State Water Board finds that the use of recycled water permitted under this General Order will not unreasonably affect beneficial uses or result in water quality that is less than that prescribed in applicable policies because of the following characteristics and requirements associated with each of the recycled water constituents of concern. Each of the recycled water constituents are discussed below:

    a. Salinity is measured in water through various measurements, including but not limited to, total dissolved solids (TDS) and electrical conductivity. Excessive salinity can impair the beneficial uses of water. Salinity levels in the receiving water can be affected by the use of recycled water if the recycled water has elevated concentrations of salinity. However, it is anticipated that in most cases, the use of recycled water for irrigation will consist of a portion of the total applied irrigation water. Other sources of irrigation water are likely to be potable water, imported water, agricultural water supply wells, irrigation districts (surface water supplies), and precipitation. The blending of sources of irrigation water will generally reduce concentrations of, and/or loading rates of salinity constituents. As a result, salinity increases are unlikely to impair an existing and/or potential beneficial use of groundwater.

    b. Nitrogen is a nutrient that may be present in recycled water at a concentration that can degrade groundwater quality. This General Order requires application of recycled water to take into consideration nutrient levels in recycled water and nutrient demand by plants. Application of recycled water at an agronomic rate and considering soil, climate, and plant demand

minimizes the movement of nutrients below the plants' root zone. When applied to cropped (or landscaped) land, some of the nitrogen in recycled water will be taken up by the plants, lost to the atmosphere through volatilization of ammonia or denitrification, or stored in the soil matrix. As a result, nitrogen increases are unlikely to impair an existing and/or potential beneficial use of groundwater.

c. Pathogens and other microorganisms may be present in recycled water based on the disinfection status. Coliform bacteria are used as a surrogate (indicator) because they are present in untreated wastewater, survive in the environment similar to pathogenic bacteria, and are easy to detect and quantify. Pathogens are generally limited in their mobility when applied to land.

   Setbacks from recycled water use areas are required in title 22 as a means of reducing pathogenic risks by coupling pathogen inactivation rates with groundwater travel time to a well or other potential exposure route (e.g. water contact activities). In general, a substantial unsaturated zone reduces pathogen survival compared to saturated soil conditions. Fine grained soil particles (silt or clay) reduce the rate of groundwater transport and therefore are generally less likely to transport pathogens. Setbacks also provide attenuation of other recycled water constituents through physical, chemical, and biological processes.

   When needed, disinfection can be performed in a number of ways. Title 22 contains water recycling criteria, which lists disinfection requirements for specifically listed activities.

d. Disinfection by-products consist of organic and inorganic substances produced by the interaction of chemical disinfectants with naturally occurring substances in the water source. Common disinfection by-products include trihalomethanes, haloacetic acids, bromate, and chlorite. DBPs present in recycled water receive additional treatment when applied to land. Biodegradation, adsorption, volatilization, and other attenuative processes that occur naturally in soil will reduce the concentrations and retard migration of DBPs in the subsurface.

27. The use of recycled water that would otherwise be discharged to a watercourse can adversely affect the availability of water for beneficial uses of water downstream of the discharge point, including in-stream uses. Water Code section 1211 requires that: (1) the owner of any wastewater treatment plant obtain the approval of the State Water Board before making any change in the point of discharge, place of use, or purpose of use of treated wastewater where changes to the discharge or use of treated wastewater have the potential to decrease the flow in any portion of a watercourse, and (2) the State Water Board review the proposed changes pursuant to the provisions of Water Code section 1700 *et seq*. In order to approve the proposed change, the State Water Board must determine that the proposed change will not operate to the injury of any legal user of the water involved. (Wat. Code, §1702.) The State Water Board

also has an independent obligation to consider the effect of the proposed change on public trust resources and beneficial uses established for areas downstream of the discharge point, and to protect those resources where feasible. (*National Audubon Society v. Superior Court* (1983) 33 Cal.3d 419 [189 Cal. Rptr. 346].)

28. This General Order authorizes specified uses of recycled water statewide. If the use of recycled water as allowed by this General Order could result in water quality degradation as described below, the Regional Water Board's Executive Officer shall continue coverage under an existing order for the use of recycled water or propose a new site-specific order for consideration by the Regional Water Board. The Executive Officer shall explain the need for a site-specific order, by making one or more of the following findings in the NOI response letter:

    a. The proposed use of recycled water is not consistent with Findings 22 through 27 of this General Order, which collectively provide for compliance with antidegradation findings for projects covered by this General Order. The degradation may be from salinity, nitrogen chemical compounds, pathogens, disinfection by-products, or other substances.

    b. The proposed method of recycled water storage in unlined ponds is not consistent with Findings 22 through 27 of this General Order, which collectively provide for compliance with antidegradation findings for projects covered by this General Order. The degradation may be from salinity, nitrogen compounds, pathogens, disinfection by-products, or other substances.

    c. The proposed use of recycled water or method of recycled water storage will cause or contribute to pollution or nuisance, or otherwise fail to comply with the applicable Basin Plan or State Water Board plans or policies.

    d. The proposed use of recycled water does not implement mitigation measures adopted in a site-specific California Environmental Quality Act (CEQA) document.

    e. The proposed use of recycled water is not consistent with a Total Maximum Daily Load (TMDL) waste load or load allocation, or implementation plan as adopted by the Regional Water Board and made part of the Regional Water Board's Basin Plan.

    f. The proposed use of recycled water is not consistent with the Basin Plan provisions for implementing a Salt and Nutrient Management Plan.

PURPOSE AND APPLICABILITY

29. Producers, Distributors, or Users of recycled water covered under existing orders (water recycling requirements, master reclamation permits, general or individual waste discharge requirements, or waivers of waste discharge requirements) for the use of recycled water may elect to either: (i) continue or expand coverage under existing orders or; (ii) apply for coverage under this General Order.

30. This document serves as a statewide General Order authorizing the use of recycled water by Producers, Distributors, and Users for all title 22 uses except groundwater recharge. The intent of this order is to streamline the permitting process and delegate the responsibility of administrating water recycling programs to an Administrator to the fullest extent possible. The following may apply for coverage under the order and agree to become the Administrator:

    a. Producers of recycled water: Producers may be publically or privately owned. A Producer will typically produce recycled water that meets the requirements of title 22. A Producer may also act as an Administrator.

    b. Distributors of recycled water: In some cases, a Distributor may provide additional treatment (such as disinfection) to meet title 22 water recycling criteria for its intended use, and distribute it to Users. A Distributor is not required to take physical possession of the recycled water and may act simply as an Administrator.

    c. A legal entity: A joint powers agreement or equivalent contractual agreement between a Producer, Distributor, irrigation district, or other entity. Similar to a Distributor, a legal entity is not required to take physical possession of the recycled water and may act simply as an Administrator.

31. To obtain coverage under this General Order, the applicant shall submit an NOI (Attachment A) and application fee to the Regional Water Board of jurisdiction. Fee amounts are specified in California Code of Regulations, title 23, division 3, chapter 9, section 2200. The applicant shall declare responsibility for the administration of the recycled water program authorized pursuant to this General Order. A duly authorized representative for each entity involved in the production and distribution of recycled water shall each sign the NOI form as appropriate. The applicant shall describe a program they will administer to distribute recycled water to Users and ensure that recycled water use complies with the requirements of title 22 and this General Order. Upon authorization by the Regional Water Board, the applicant then becomes the Administrator. The Administrator shall be billed for an annual fee until coverage under the General Order is terminated.

32. This General Order does not authorize discharges of pollutants from point sources to water of the United States, thus the use of recycled water allowed pursuant to the terms of this General Order are not subject to National Pollutant Discharge Elimination System (NPDES) permits. To the extent that this General Order results in agricultural irrigation return flows entering waters of the United States, such return flows are not subject to NPDES permits (33 U.S.C., §1342(l)(1)) but may be subject to waste discharge requirements or conditional waivers as adopted by Regional Water Boards, Where such waste discharge requirements or conditional waivers exist, this General Order requires that uses of recycled water comply with their provisions.

BASIN PLANS AND BENEFICIAL USES

33. Beneficial uses of groundwater are determined by each Regional Water Board and are listed in their respective Basin Plans. Beneficial uses for groundwater are: municipal supply (MUN), industrial service supply (IND), industrial process supply (PROC), fresh water replenishment (FRESH), aquaculture (AQUA), wildlife habitat (WILD), water contact recreation (REC-1), agricultural supply (AGR), and groundwater recharge (GWR). Some beneficial uses only apply to certain geographical areas within regions.

34. Basin Plans establish water quality objectives to protect beneficial uses. The objectives may be narrative, numerical, or both. This General Order requires the Administrator to ensure that Users abide by those objectives in receiving water. Determination of applicable water quality objectives is part of the application process.

CEQA AND PUBLIC NOTICE

35. On April 25, 2014, the Governor issued an Executive Order declaring a continued state of emergency due to severe drought conditions. Directive No. 10 of the Executive Order directs the State Water Board to adopt statewide general waste discharge requirements to facilitate the use of treated wastewater that meets standards set by the CDPH, in order to reduce demand on potable water supplies. This General Order is intended to satisfy the directive No. 10 requirement. Directive No. 19 of the Executive Order provides that the California Environmental Quality Act requirement to conduct an environmental review is suspended to allow the State Water Board to adopt this General Order as quickly as possible.

36. The State Water Board has notified the Producers, Distributors and interested agencies and persons of its intent to prescribe WDRs, and has provided them the opportunity to attend a public meeting and to submit their written views and recommendations.

37. The State Water Board, in a public meeting, heard and considered all comments pertaining to this matter.

IT IS HEREBY ORDERED that all agencies that file an NOI indicating their intention to be regulated under the provisions of this General Order, and receive authorization from the appropriate Regional Water Board shall comply with the following:

A. PROHIBITIONS

1. The treatment, storage, distribution, or use of recycled water shall not cause or contribute to a condition of pollution as defined in Water Code section 13050(l) or nuisance as defined in Water Code section 13050(m).

2. No recycled water shall be applied to irrigation areas during periods when soils are saturated.

3. Recycled water shall not be allowed to escape from the use area(s) as surface flow that would either pond and/or enter surface waters, unless authorized by WDRs, waivers of WDRs, or conditional prohibitions regulating agricultural discharges from irrigated lands.
4. Spray or runoff shall not enter a dwelling or food handling facility, and shall not contact any drinking water fountain, unless specifically protected with a shielding device. If the recycled water is undisinfected or secondary-23 quality then spray or runoff shall not enter any place where public access is not restricted during irrigation.
5. The incidental runoff of recycled water shall not result in water quality less than that prescribed in water quality control plans or policies unless authorized through time schedule provisions in WDRs, waivers of WDRs, or conditional prohibitions regulating agricultural discharges from irrigated lands.
6. No recycled water shall be discharged from treatment facilities, irrigation holding tanks, storage ponds, or other containment, other than for permitted use in accordance with this General Order, Regional Water Board issued WDRs, NPDES permits, or a contingency plan in an approved Water Recycling Use Permit.
7. There shall be no cross connection between potable water supply and piping containing recycled water. All Users of recycled water shall provide for appropriate backflow protection for potable water supplies as specified in title 17, section 7604 or as specified by the CDPH.
8. This General Order authorizes certain beneficial recycled water uses consistent with title 22. The following activities are not authorized by this General Order:
    a. Activities designed to replenish groundwater resources. Groundwater replenishment activities may include surface spreading basins, percolation ponds, or direct injection.
    b. Disposal of treated wastewater by means of percolation ponds, excessive hydraulic loading of application areas, etc. where the primary purpose of the activity is the disposal of treated wastewater.

B. SPECIFICATIONS

1. Recycled water production, distribution, and use permitted under this General Order shall be in compliance with all of the following requirements:
    a. All applicable title 17 and title 22 requirements.
    b. All requirements of this General Order.
    c. A CDPH approved title 22 Engineering Report (and amendments).
    d. The NOA issued by the Regional Water Board.
    e. A Salt and Nutrient Management Plan adopted by the Regional Water Board as a Basin Plan Amendment.

f. WDRs or NPDES permits for recycled water production facilities.

g. The Water Recycling Use Permit issued by the recycled water Administrator.

h. Any applicable water quality related CEQA mitigation measure.

i. Water Code section 1211 for facilities where the changes to the discharge are necessary to accomplish water recycling and will result in changes in flow in a watercourse.

2. The Administrator shall discontinue delivery of recycled water during any period in which it has a reason to believe that the limits for that use as specified in title 22 insofar as they relate to the quality of the recycled water, are not being met. The Administrator shall notify the Regional Water Board within 24 hours of determining noncompliance. The delivery of recycled water shall not be resumed until all conditions which caused the violations have been corrected. The Regional Water Board shall be copied on any correspondence concerning non-compliance between the Administrator and User.

3. Application of recycled water to the use area shall be at an agronomic rate, and shall consider soil, climate, and plant demand. In addition, application of recycled water and use of fertilizers shall be at a rate that takes into consideration nutrient levels in recycled water and nutrient demand by plants.

C. WATER RECYCLING ADMINISTRATION REQUIREMENTS

1. Applicants seeking coverage under this General Order shall submit an NOI in accordance with Attachment A. Responsibilities for an Administrator shall be described in the NOI.

2. This General Order becomes effective when the Regional Water Board issues an NOA. The Regional Water Board will coordinate with CDPH to include title 22 engineering report approval requirements, including any CDPH conditions of approval.

3. Under this General Order, the Administrator's program shall be implemented to accomplish compliance with Specification B.1. Upon Regional Water Board approval of the Administrator's program, which shall accompany the NOI, the Administrator may authorize specific water recycling projects, in consultation with CDPH, on a case-by-case basis once the elements of the water recycling program are in place.

4. The Administrator shall establish and enforce rules or regulations for recycled water uses governing the design and construction of recycled water use facilities and the use of recycled water in accordance with Specification B.1.

5. The Administrator or its agent shall assure that cross-connections between potable water and non-potable water systems have not been created and that backflow prevention devices are in proper working order by conducting or requiring User testing in accordance with CDPH water recycling criteria and title 17 section 7605. Reports of testing and maintenance shall be maintained by the Administrator or its agent.

6. The Administrator shall ensure recycled water meets the quality standards of this General Order and shall be responsible for the operation and maintenance of major transport facilities and associated appurtenances. If an entity other than the Administrator has actual physical and ownership control over the recycled water transport facilities, the Administrator may delegate operation and maintenance responsibilities for such facilities to that entity. The Administrator shall require Users to apply and/or use recycled water in accordance with all applicable CDPH water recycling criteria and to comply with this General Order, including requirements to apply only at agronomic rates and not cause unauthorized degradation, pollution, or nuisance. The Producer shall communicate to Users the nutrient levels in the recycled water.
7. The Administrator or its agent shall conduct periodic inspections of the User's facilities and operations to determine compliance with conditions of the Administrator requirements and this General Order. The Administrator shall take whatever actions are necessary, including the termination of delivery of recycled water to the User, to correct any User violations.
8. The Administrator shall comply with all applicable items of the attached Standard Provisions and Reporting Requirements (Attachment C) and any amendments thereafter.
9. The Administrator shall require Users to comply with the Administrator's use area conditions. Use area requirements shall be consistent with Specification B.1.
10. If recycled water will be transported by truck for title 22 approved uses such as dust control, the Administrator shall provide notification and control measures for Users consistent with the provisions of an approved title 22 engineering report.
11. A copy of the Water Recycling Use Permit must be provided to Users by the Administrator (electronic format is acceptable). The Users must have the documents available for inspection by Regional Water Board staff, State/County officials, and/or the Administrator.
12. The Administrator shall comply with the attached monitoring and reporting program including any amendments issued by the Regional Water Board. This monitoring program shall be consistent with any applicable Salt and Nutrient Management Plan for the basin/sub-basin. The Administrator is responsible for collecting reports from Users. Users are responsible for submitting on-site observation reports and use data to the Administrator, who will compile and file an annual report with the Regional Water Board. The Administrator, at its discretion, may assume the User's responsibility for on-site observation reports and use data.
13. The Administrator or its agent and Users shall maintain in good working order and operate as efficiently as possible any facility or control system to achieve compliance with this General Order.
14. The Administrator shall require that personnel receive training to assure proper operation of recycling facilities, worker protection, and compliance with this

General Order. In accordance with title 17, section 7586, the Administrator shall require Recycled Water Supervisor(s) to be familiar with the Administrator permit conditions.

15. The Administrator or its agent shall assure that all above ground equipment, including pumps, piping, storage reservoir, and valves which may at any time contain recycled water are identified with appropriate notification as required by title 22.

D. GENERAL PROVISIONS

1. The Administrator shall document compliance with all conditions of this General Order and of water recycling criteria specified in title 22 and title 17.
2. If directed by the Regional Water Board pursuant to Water Code section 13267, an Administrator shall prepare and submit a Salt and Nutrient Management Plan, acceptable to the Regional Water Board, to ensure that the overall impact of permitted water recycling projects does not degrade groundwater resources. Unless otherwise directed by the Regional Water Board, in lieu of developing an individual Salt and Nutrient Management Plan the Administrator shall participate in a Regional Water Board's existing salt and nutrient management planning effort to meet the requirements of this provision.
3. Regional Water Board staff will conduct inspections/audits of water recycling projects. The Administrator and Users shall permit the Regional Water Board or its authorized representatives, in accordance with Water Code section 13267(c):
    a. Entry upon premises where a regulated facility or activity is located or conducted, or where records are kept under the conditions of this General Order.
    b. Access to and copy of, at reasonable times, any records that must be kept as a condition of this General Order.
    c. Inspection, at reasonable times, of any facility, equipment (including monitoring and control equipment), practices, or operations regulated or required under this General Order.
    d. To sample or monitor, at reasonable times, for the purpose of assuring compliance with this General Order.
4. The Regional Water Board may terminate or modify an Administrator's coverage under this General Order for cause, including, but not limited to:
    a. Violation of any term or condition contained in this General Order;
    b. Obtaining this General Order by misrepresentation, or failure to disclose fully all relevant facts;
    c. Endangerment to public health or environment that can only be regulated to acceptable levels by General Order modification or termination.

5. The Regional Water Board upon a finding of non-compliance with this General Order may revoke an Administrator's authority to issue Water Recycling Use Permits.
6. The State Water Board will review this General Order periodically and may revise the requirements as deemed necessary.
7. Users shall comply with all requirements of other applicable WDRs or waivers of WDRs, including without limitation WDRs or waivers regulating agricultural discharges from irrigated lands.

CERTIFICATION

The undersigned, Clerk to the Board, does hereby certify that the foregoing is a full, true, and correct copy of an order duly and regularly adopted at a meeting of the State Water Resources Control Board held on June 3, 2014.

AYE: Chair Felicia Marcus
Vice Chair Frances Spivy-Weber
Board Member Tam M. Doduc
Board Member Steven Moore
Board Member Dorene D'Adamo

NAY: None

ABSENT: None

ABSTAIN: None

Jeanine Townsend
Clerk to the Board

Attachments:

A. Notice of Intent (NOI) - General Instructions
B. Monitoring and Reporting Program
C. Standard Provisions & Reporting Requirements
D. Definition of Terms

ATTACHMENT A: NOTICE OF INTENT (NOI) – GENERAL INSTRUCTIONS

Who May Apply

This order is intended to serve as a statewide General Order for recycled water projects. It may be used to replace individual waste discharge requirements/water recycling requirements/master reclamation permits and may be issued to any of the following:

a. Producers of recycled water. Producers may be publically or privately owned. A Producer will typically produce recycled water that meets the requirements of title 22. A Producer may also act as an Administrator.

b. Distributors of recycled water. In some cases, a Distributor may provide additional treatment (such as disinfection) to meet title 22 water recycling criteria for its intended use, and distribute it to Users. A Distributor is not required to take physical possession of the recycled water and may act simply as an Administrator.

c. A legal entity such as a joint powers agreement or equivalent contractual agreement between a Producer, Distributor, irrigation district, or other entity. Similar to a Distributor, a legal entity is not required to take physical possession of the recycled water and may act simply as an Administrator.

Applicants that have been previously issued an order authorizing water recycling may be able to submit an abbreviated information package. Such applicants should contact Regional Water Board and California Department of Public Health (CDPH) staff to determine the application information needs.

Where to Apply

An applicant should submit an NOI to their applicable Regional Water Board and CDPH, Drinking Water Field Operations Branch. The NOI cannot be considered complete until CDPH provides a title 22 Engineering Report approval letter.

When to Apply

An applicant should normally file the NOI 90 days prior to the project start.

What to File

The NOI shall include a Water Recycling Program technical report, containing the following information (at a minimum):

SECTION I - FACILITY/WASTE TREATMENT INFORMATION

Description of existing and/or proposed treatment, storage and transmission facilities for water recycling (much of this may be from current orders/reports, but should be updated if necessary). This shall include the type and level of wastewater treatment for water recycling applications, estimated seasonal flows of recycled water, and a summary of monitoring data that describes the chemical, physical, and disinfection characteristics of the recycled water. A copy of the approved title 22 engineering report shall be included in the submittal.

SECTION II – RECYCLED WATER APPLICATION

Describe how recycled water will be used. This should include:

a. Administrator owned/controlled uses (e.g. irrigation type/acreage/locations)
b. Contracted User Applications (use areas that consist of small lots, e.g., residential/ industrial developments, roadway median irrigation, etc., may be aggregated to combine acreage for calculation purposes.)
    1. List of Users receiving or proposing to receive recycled water (including a list of uses of recycled water for each User).
    2. An estimated amount of recycled water used at use area(s) of each User.
    3. Operation and management plan specifying agronomic rate(s) and nutrient application for the use area(s) and a set of reasonably practicable measures to ensure compliance with this General Order. This may include a water and nutrient budget for use area(s), site supervisor training, periodic inspections, or other appropriate measures. This requirement does not apply to the extent Users are subject to WDRs, waivers of WDRs, or conditional prohibitions regulating agricultural discharges from irrigated lands.
    4. Descriptions/maps of use area(s).

SECTION Ill - DESCRIPTION OF WATER RECYCLING USE PERMIT PROGRAM

The Administrator's water recycling program should be fully described as follows:

a. Description of the Administrator agency's authority, rules, and/or regulations
b. Design and implementation of program
c. Cross-connection testing responsibilities and procedures
d. Monitoring and Reporting Program
e. Use area inspection program
f. Operations and Maintenance program
g. Compliance program
h. Employee and User Training
i. Emergency procedures and notification

SECTION IV - ADDITIONAL SITE SPECIFIC CONDITIONS

If existing orders have additional site specific conditions and/or restrictions not covered in the General Order, they shall be described here. If a CEQA document for the project was prepared, include a copy of the certified or adopted document(s).

SECTION V – WATER RECYCLING PROGRAM ADMINISTRATION

Describe organization and responsibilities of pertinent personnel involved in the water recycling program. Provide the name(s), title(s) and phone number(s) of contact person(s) who are charged with operation/oversight of the water recycling program.

ATTACHMENT B: MONITORING AND REPORTING PROGRAM

This monitoring and reporting program (MRP) describes requirements for monitoring a recycled water system. This MRP is issued pursuant to Water Code section 13267. The Administrator shall not implement any changes to this MRP unless and until a revised MRP is issued by the Regional Water Quality Control Board (Regional Water Board) Executive Officer.

The State Water Resources Control Board (State Water Board) and Regional Water Boards are transitioning to the paperless office system. In some regions, Administrators will be directed to submit reports (both technical and monitoring reports) to the State Water Board's GeoTracker database over the Internet in portable document format (pdf). In addition, analytical data shall be uploaded to the GeoTracker database under a site-specific global identification number. Information on the GeoTracker database is provided on the Internet at:

<http://www.waterboards.ca.gov/ust/electronic_submittal/index.shtml>

The Administrator has applied for and received coverage for the recycled water system that is subject to the notice of applicability (NOA) of Water Quality Order 2014-0090-DWQ. The reports are necessary to ensure that the Administrator complies with the NOA and General Order. Pursuant to California Water Code section 13267, the Administrator shall implement this MRP and shall submit the monitoring reports described herein.

All samples shall be representative of the volume and nature of the discharge or matrix of material sampled. The name of the sampler, sample type (grab or composite), time, date, location, bottle type, and any preservative used for each sample shall be recorded on the sample chain of custody form. The chain of custody form must also contain all custody information including date, time, and to whom samples were relinquished. If composite samples are collected, the basis for sampling (time or flow weighted) shall be approved by Regional Water Board staff.

Field test instruments (such as those used to test pH, dissolved oxygen, and electrical conductivity) may be used provided that they are used by a California Environmental Laboratory Program (ELAP) certified laboratory or:

1. The user is trained in proper use and maintenance of the instruments;
2. The instruments are field calibrated prior to monitoring events at the frequency recommended by the manufacturer;
3. Instruments are serviced by the manufacturer or authorized representative at the recommended frequency; and
4. Field calibration reports are maintained and available for at least three years.

Monitoring requirements listed below may duplicate existing requirements under other orders including WDRs or waivers of WDRs that regulate agricultural discharges from irrigated lands. Duplication of sampling and monitoring activities are not required if the monitoring activity satisfies the requirements of this order. Collecting composite samples is acceptable in most cases. The facility may continue using existing sampling collection equipment that is consistent with the applicable facility order. However, due to short sample holding times, bacteriological samples collected to verify disinfection effectiveness must be grab samples. In addition to submitting the results under another order, the results shall be submitted in the reports required by this General Order.

All the monitoring listed below may not be applicable to all recycled water projects. Consult the NOA or Regional Water Board staff to determine applicable requirements.

RECYCLED WATER MONITORING

If recycled water is used for irrigation of landscape areas[1], priority pollutant monitoring is required at the production facility. The frequency of monitoring corresponds to the flow rate of the recycled water use. Sampling shall be consistent with the following:

Constituent	Treatment System Flow Rate	Sample Frequency	Reporting Frequency
Priority Pollutants	< 1mgd	5 years	The next annual report.
	> 1mgd	Annually	Annually

mgd denotes million gallons per day.

DISINFECTION SYSTEM MONITORING

If disinfection is performed, samples shall be collected from immediately downstream of the disinfection system. Depending upon the level of disinfection and recycled water disposal, monitoring requirements vary. Disinfection monitoring shall be customized to the site-specific conditions from the following:

1 Landscape areas are defined as parks; greenbelts, playgrounds; school yards; athletic fields; golf courses; cemeteries; residential landscaping; common areas; commercial landscaping (except eating areas); industrial landscaping (except eating areas); freeway, highway, and street landscaping.

Constituent/Parameter	Units	Sample Type	Sample Frequency	Reporting Frequency
Total Coliform Organisms	MPN/100 mL[a]	Grab	TBD [b]	Annually
Turbidity	NTU	Grab/Meter	TBD [b]	Annually

[a] MPN/100 mL denotes most probable number per 100 mL sample. NTU denotes nephelometric turbidity unit.

[b] TBD (to be determined) shall be specified in the NOA or as required by California Code of Regulations, title 22 section 60321.

POND SYSTEM MONITORING

In some cases, recycled water storage ponds may be used to store recycled water when it is not needed. These monitoring requirements apply only to ponds permitted through the General Order. Ponds covered by an existing order shall continue to be monitored in accordance with that order. Pond(s) containing recycled water shall be monitored for the following:

Parameter	Units	Sample Type	Sample Frequency[a]	Reporting Frequency
Freeboard	0.1 feet	Measurement	Quarterly	Annually
Odors	--	Observation	Quarterly	Annually
Berm condition	--	Observation	Quarterly	Annually

[a] Or less frequently if approved by the Regional Water Board Executive Officer

USE AREA MONITORING

The Administrator shall monitor use areas(s) at a frequency appropriate to determine compliance with the General Order and the Administrator's recycled water use program requirements. An Administrator may assign monitoring responsibilities to a User as part of the Water Recycling Use Permit program; the Administrator retains responsibility to ensure the data is collected, as well as prepare and submit the annual report.

The following shall be recorded for each user with additional reporting for use areas as appropriate. The frequency of use area inspections shall be based on the complexity and risk of each use area. Use areas may be aggregated to combine acreage for calculation or observation purposes. Use area monitoring shall include the following parameters:

Parameter	Units	Sample Type	Sampling Frequency[a]	Reporting Frequency
Recycled Water User	--	--	--	Annually
Recycled Water Flow	gpd[b]	Meter[c]	Monthly	Annually
Acreage Applied[d]	Acres	Calculated	--	Annually
Application Rate	inches/acre/year	Calculated	--	Annually
Soil Saturation/Ponding	--	Observation	Quarterly	Annually
Nuisance Odors/Vectors	--	Observation	Quarterly	Annually
Discharge Off-Site	--	Observation	Quarterly	Annually
Notification Signs[e]	--	Observation	Quarterly	Annually

[a] Or less frequently if approved by the Regional Water Board Executive Officer
[b] gpd denotes gallons per day.
[c] Meter requires meter reading, a pump run time meter, or other approved method.
[d] Acreage applied denotes the acreage to which recycled water is applied.
[e] Notification signs shall be consistent with the requirements of title 22, section 60310 (g).

COOLING/INDUSTRIAL/OTHER USES OF RECYCLED WATER

If recycled water is used for industrial, commercial cooling, or air conditioning in which a mist is generated, consult with the California Department of Public Health (CDPH) to determine additional monitoring requirements.

If dual plumbed recycled water systems are proposed, consult with CDPH for additional reporting, design, and operation requirements. The potential for cross connections and backflow prevention devices shall be monitored as listed below, or more frequently if specified by CDPH.

Requirement	Sampling Frequency	Reporting Frequency
Cross Connection Testing	Four Years[a]	30 days/Annually[b]
Backflow Incident	Continuous	24 hours from discovery
Backflow Prevention Device Testing and Maintenance	Annually[c]	Annually

[a] Testing shall be performed at least every four years, or more frequently at the discretion of the CDPH.
[b] Cross connection testing shall be reported pursuant to title 22 section 60314. The report shall be submitted to CDPH within 30 days and included in the annual report to the Regional Water Board.
[c] Backflow prevention device maintenance shall be tested by a qualified person as described in title 17, section 7605.

REPORTING

In reporting monitoring data, the Administrator shall arrange the data in tabular form so that the date, data type (e.g., flow rate, bacteriological, etc.), and reported analytical or visual inspection results are readily discernible. The data shall be summarized to illustrate compliance with the General Order and NOA as applicable. The results of any monitoring done more frequently than required at the locations specified in the MRP shall be reported in the next regularly scheduled monitoring report and shall be included in calculations as appropriate.

During the life of this General Order, the State Water Board or Regional Water Board may require the Administrator to electronically submit reports using the State Water Board's California Integrated Water Quality System (CIWQS) program Internet web site or alternative database. Electronic submittal procedures will be provided when directed to begin electronic submittals. Until directed to electronically submit reports, the Administrator shall submit hard copy reports.

A. Annual Report

Annual Reports shall be submitted to the Regional Water Board by **April 1st following the monitoring year**. The Annual Report shall include the following:

1. A summary table of all recycled water Users and use areas. Maps may be included to identify use areas. Newly permitted recycled water Users and use areas shall be identified.
2. A summary table of all inspections and enforcement activities initiated by the Administrator. Include a discussion of compliance and the corrective action taken, as well as any planned or proposed actions needed to bring the discharge into compliance with the NOA and/or General Order. Copies of any enforcement actions taken by the Administrator shall be provided.
3. An evaluation of the performance of the recycled water treatment facility, including discussion of capacity issues, system problems, and a forecast of the flows anticipated in the next year.
4. Tabular and graphical summaries of all monitoring data collected during the year, including priority pollutant monitoring, if required.
5. The name and contact information for the recycled water operator responsible for operation, maintenance, and system monitoring.

A letter transmitting the annual report shall accompany each report. The letter shall summarize the numbers and severity of violations found during the reporting period, and actions taken or planned to correct the violations and prevent future violations. The transmittal letter shall contain the following penalty of perjury statement and shall be signed by the Administrator or the Administrator's authorized agent:

"I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of the those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment."

The Administrator shall implement the above monitoring program.

ATTACHMENT C: STANDARD PROVISIONS AND REPORTING REQUIREMENTS

A. GENERAL PROVISIONS

1. Duty to Comply

a. An Administrator must comply with all of the conditions of this General Order. Any General Order non-compliance constitutes a violation of the Porter-Cologne Water Quality Control Act and/or Basin Plan and is subject to enforcement action.

b. The filing of a request by the Administrator for a modification, revocation and reissuance, termination, a notification of planned changes, or anticipated non-compliance does not stay any General Order condition.

2. Duty to Mitigate

The Administrator shall take all reasonable steps to minimize or prevent any discharge in violation of this General Order which has a reasonable likelihood of adversely affecting public health or the environment, including such accelerated or additional monitoring as requested by the State or Regional Water Board to determine the nature and impact of the violation.

3. Property Rights

This General Order does not convey any property rights of any sort or any exclusive privileges. The requirements prescribed herein do not authorize the commission of any act causing injury to the property of another, nor protect the discharger from liabilities under federal, state or local laws.

4. Duty to Provide Information

The Administrator shall furnish, within a reasonable time, any information the Regional Water Board may request to determine whether cause exists for modifying, revoking and reissuing, or terminating the General Order coverage. The Administrator shall also furnish to the Regional Water Board, upon request, copies of records required to be kept by its General Order.

5. Availability

A copy of this General Order shall be maintained at the Administrator facilities and be available at all times to operating personnel.

B. GENERAL REPORTING REQUIREMENTS

1. Signatory Requirements

   a. All reports required by the General Order and other information requested by the Regional Water Board shall be signed by the Administrator principal owner or operator, or by a duly authorized representative of that person.

      Duly authorized representative is one whose:

      1) Authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as general manager in a partnership, manager, operator, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position), and

      2) Written authorization is submitted to the Regional Water Board. If an authorization becomes no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements above must be submitted to the Regional Water Board prior to or together with any reports, information, or applications to be signed by an authorized representative.

   b. Certification
      All reports signed by a duly authorized representative under Provision C.1 shall contain the following certification:

      "I Certify under penalty of law that this document and all attachments are prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who managed the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

2. Should the responsible reporting party discover that it failed to submit any relevant facts or that it submitted incorrect information in any report, it shall promptly submit the missing or correct information.

   All violations of any requirements in this General Order, including title 22 requirements shall be submitted in the annual self-monitoring reports.

3. False Reporting

   Any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this General Order, including monitoring reports or reports of compliance or non-compliance shall be subject to enforcement procedures as identified in Section C of these Provisions.

C. ENFORCEMENT

1. The provision contained in this enforcement section shall not act as a limitation on the statutory or regulatory authority of the Regional Water Board.
2. Any violation of the General Order constitutes violation of the Water Code and regulations adopted thereunder, and are the basis for enforcement action, General Order termination, General Order revocation and reissuance, denial of an application for General Order reissuance, or a combination thereof.
3. The Regional Water Board may impose administrative civil liability, may refer a discharger to the State Attorney General to seek civil monetary penalties, may seek injunctive relief or take other appropriate enforcement action as provided in the Water Code for violation of the General Order.

ATTACHMENT D: DEFINITION OF TERMS

Administrator: An Administrator is an entity (producer, distributor, or legal entity) that submits an NOI and application fee to the Regional Water Board for coverage under this General Order. An Administrator may issue use permits for uses of recycled water consistent with title 22. An Administrator is responsible for coordinating, collecting data, and reporting the monitoring reports to the Regional Water Board.

Agronomic Rate: The rate of application of recycled water to plants necessary to satisfy the plants' evapotranspiration requirements, considering allowances for supplemental water (e.g., effective precipitation), irrigation distribution uniformity, and leaching requirement, thus minimizing the movement of nutrients below the plants' root zone.

Coagulated Wastewater: Oxidized wastewater in which colloidal and finely divided suspended matter have been destabilized and agglomerated upstream from a filter by the addition of suitable floc-forming chemicals.

Conventional Treatment: A treatment chain that utilizes a sedimentation unit process between the coagulation and filtration processes and produces an effluent that meets the definition for disinfected tertiary recycled water.

Disinfected Secondary-23: Recycled water that has been oxidized and disinfected so that the median concentration of total coliform bacteria in the disinfected effluent does not exceed a most probable number (MPN) of 23 per 100 milliliters using the bacteriological results of the last seven days for which analyses have been completed, and the number of coliform bacteria does not exceed an MPN of 240 per 100 milliliters in more than one sample in any 30 day period.

Disinfected Secondary-2.2: Recycled water that has been oxidized and disinfected so that the median concentration of total coliform bacteria in the disinfected effluent does not exceed a most probable number (MPN) of 2.2 per 100 milliliters utilizing the bacteriological results of the last seven days for which analyses have been completed, and the number of coliform organisms does not exceed an MPN of 23 per 100 milliliters in more than one sample in any 30 day period.

Disinfected Tertiary Recycled Water: A filtered and subsequently disinfected wastewater that meets the following criteria:

(a) The filtered wastewater which has been disinfected by either:

(1) A chlorine disinfection process following filtration that provides a contact time (CT, the product of total chlorine residual and modal contact time measured at the same point) value of not less than 450 milligram-minutes per liter at all times with a modal contact time of at least 90 minutes, based on peak dry weather design flow; or

(2) A disinfection process that, when combined with the filtration process, has been demonstrated to inactivate and/or remove 99.999 percent of the plaque forming units of F-specific bacteriophage MS2, or polio virus in the wastewater. A virus that is at least as resistant to disinfection as polio virus may be used for purposes of the demonstration.

(b) The median concentration of total coliform bacteria measured in the disinfected effluent does not exceed an MPN of 2.2 per 100 milliliters utilizing the bacteriological results of the last seven days for which analyses have been completed and the number of total coliform bacteria does not exceed an MPN of 23 per 100 milliliters in more than one sample in any 30 day period. No sample shall exceed an MPN of 240 total coliform bacteria per 100 milliliters.

Disinfected Wastewater: Wastewater in which the pathogenic organisms have been reduced by chemical, physical or biological means. For the purposes of this General Order, disinfected wastewater is safe for use when applied consistent with the requirements of title 22.

Distributor: A private or public agency which receives recycled water from a Producer for the purpose of distribution to Users. In some cases, a distributor may provide additional treatment (such as disinfection) to meet title 22 water recycling criteria for its intended use, and distributes it to Users. A Distributor may not take physical possession of the recycled water and may act simply as an Administrator.

Dual Plumbed System: A system that utilizes separate piping systems for recycled water and potable water within a facility and where the recycled water is used for either of the following purposes:

a) To serve plumbing outlets (excluding fire suppression systems) within a building or

b) Outdoor landscape irrigation at individual residences.

Filtered Wastewater: An oxidized wastewater that meets the criteria in the subsection 1 or 2:

(1) Has been coagulated and passed through natural undisturbed soils or a bed of filter media pursuant to the following:

a. At a rate that does not exceed 5 gallons per minute per square foot of surface area in mono, dual or mixed media gravity, upflow or pressure filtration systems, or does not exceed 2 gallons per minute per square foot of surface area in travelling automatic backwash filters; and

b. So that the turbidity of the filtered wastewater does not exceed any of the following:

i. An average 2 NTU within a 24-hour period;

ii. 5 NTU more than 5 percent of the time within a 24-hour period; and

iii. 10 NTU at any time

(2) Has been passed through a microfiltration, ultrafiltration, nanofiltration, or reverse osmosis membrane so that the turbidity of the filtered wastewater does not exceed any of the following:

a. 0.2 NTU more than 5 percent of the time within a 24-hour period; and

b. 0.5 NTU at any time

F-specific bacteriophage MS-2: A strain of a specific type of virus that infects coliform bacteria that is traceable to the American Type Culture Collection (ATCC 15597B1) and is grown on lawns of E. Coli (ATCC 15597).

Incidental Runoff: Unintended small amounts (volume) of runoff from recycled water use areas, such as unintended, minimal over-spray from sprinklers that escapes the recycled water use area.

Legal Entity: A legal entity is an entity formed by a legal document (such as a joint powers agreement or equivalent contractual agreement) between a Producer, Distributor, irrigation district, or other entity. Similar to a Distributor, a legal entity may not take physical possession of the recycled water and may act simply as an Administrator.

Modal Contact Time: The amount of time elapsed between the time that a tracer, such as salt or dye, is injected into the effluent at the entrance to a chamber and the time that the highest concentration of the tracer is observed in the effluent from the chamber.

Nonrestricted Recreational Impoundment: An impoundment of recycled water, in which no limitations are imposed on body-contact water recreational activities.

NTU (Nephelometric Turbidity Unit): A measurement of turbidity as determined by the ratio of the intensity of light scattered by the sample to the intensity of incident light scattered by the sample to the intensity of incident light as measured by method 2130 B. in Standard Methods for the Examination of Water and Wastewater, 20th ed.; Eaton, A.D., Clesceri, L.S., and Greenberg, A.E., Eds; American Public Health Association: Washington, DC, 1995; p.2-8.

Oxidized Wastewater: Wastewater in which the organic matter has been stabilized, is nonputrescible, and contains dissolved oxygen.

Recycled Water Producer: Any entity that produces recycled water.

Recycled Water: Means water which, as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur therefore considered a valuable resource. (Wat. Code, § 13050(n).) Coverage under these General Waste Discharge Requirements (WDRs) for Recycled Water Use (General Order) is limited to treated municipal wastewater for non-potable uses.

Recycled Water Supervisor: A person designated, by the Administrator that acts as the coordinator between the supplier and User. The Recycled Water Supervisor shall have authority to ensure recycled water use complies with the General Order, NOA, and title 22 requirements.

Regional Water Board: All references to a Regional Water Board include the Executive Officer, who may act for the Regional Water Board in carrying out this order. See Water Code section 13223.

Restricted access golf course: A golf course where public access is controlled so that areas irrigated with recycled water cannot be used as if they were part of a park, playground, or school yard and where irrigation is conducted only in areas and during periods when the golf course is not being used by golfers.

Restricted Recreational Impoundment: An impoundment of recycled water in which recreation is limited to fishing, boating, and other non-body-contact water recreational activities.

Spray Irrigation: The application of recycled water to plants to maintain vegetation or support growth of vegetation by applying it from sprinklers.

Surface Irrigation: Application of recycled water by means other than spraying such that contact between the edible portion of any food crop and recycled water is prevented (i.e., drip or flood irrigation).

Use Area: An area of recycled water use with defined boundaries. Agricultural use areas may contain one or more facilities (ditch, irrigated fields, pumping stations, etc); use areas may also consist of an aggregate of small lots (e.g., residential/ industrial developments, roadway median irrigation, etc.).

Use Area Supervisor: A person designated, by the owner or manager of the property upon which recycled water will be applied, to discharge the responsibility of the owner or manager of the property for: (a) installation, operation and maintenance of a system that enables recycled water to be used; (b) for prevention of potential hazards; (c) implementing and complying with conditions of all Water Recycling Use Permits and associated documents; (d) coordination with the cross-connection control program of the supplier of drinking water and the local health/environmental health agency; (e) control of on-site piping to prevent any cross connections with potable water supplies; (f) routine inspection and maintenance of backflow prevention devices. (A Recycled Water Supervisor and Use Area Supervisor may be one in the same in some instances).

Water Recycling Use Permit: A permit issued by the Administrator to the Recycled Water User, which is consistent with the requirements specified in this General Order.

ATTACHMENT B

STATE WATER RESOURCES CONTROL BOARD
ORDER WQ 2016-0068-DDW

WATER RECLAMATION REQUIREMENTS
FOR RECYCLED WATER USE

Adoption Date

June 7, 2016

CALIFORNIA
Water Boards

STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

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ACRONYMS AND ABBREVIATIONS	
AGR	Agricultural supply
Antidegradation Policy	State Water Board Resolution 68-16, the Statement of Policy with Respect to Maintaining High Quality of Waters in California
AQUA	Aquaculture
Basin Plan	Water Quality Control Plan
BPTC	Best practicable treatment or control
CDPH	California Department of Public Health
CEC	Contaminants of Emerging Concern
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
DBP	Disinfection By-products
Delta	Sacramento-San Joaquin River Delta Estuary
DDW	Division of Drinking Water
DWR	Department of Water Resources
E. coli	Escherichia coli
e.g.	Latin *exempli gratia* (for example)
FRESH	Fresh water replenishment
gpd	gallons per day
GWR	Groundwater recharge
IND	Industrial service supply
mg/L	Milligrams per liter
MPN	Most Probable Number
MRP	Monitoring and Reporting Program
MUN	Municipal supply
MOA	Memorandum of Agreement
NOA	Notice of Applicability
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Unit
pdf	Portable Document Format
PROC	Industrial process supply
REC-1	Water contact recreation
Regional Water Board	Regional Water Quality Control Board
State Water Board	State Water Resources Control Board
TBD	To Be Determined
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
Water Boards	State Water Board and Regional Water Boards
WILD	Wildlife habitat
WDRs	Waste Discharge Requirements
WRRs	Water Reclamation Requirements

STATE WATER RESOURCES CONTROL BOARD
ORDER WQ 2016-0068-DDW
WATER RECLAMATION REQUIREMENTS
FOR RECYCLED WATER USE

FINDINGS:

The State Water Resources Control Board (State Water Board) finds that:

BACKGROUND INFORMATION

1. On January 17, 2014, California's Governor proclaimed a Drought State of Emergency and directed state officials to take all necessary actions to prepare for drought conditions. On March 1, 2014, the Governor signed bipartisan drought relief legislation, Senate Bill (SB) 103 and 104, modifying the Budget Act of 2013 (Stats. 2013, ch. 20 and 354) to provide additional funds for drought relief. (Stats. 2014, ch. 2 and 3, respectively).

2. On April 25, 2014, the Governor proclaimed a continued State of Emergency due to severe drought conditions and directed the State Water Board to "adopt statewide general waste discharge requirements to facilitate the use of treated wastewater that meets standards set by the California Department of Public Health (CDPH) in order to reduce demand on potable water supplies."

3. California experiences frequent drought conditions. The recent emergency actions follow a similar Declaration of Statewide Drought in effect from 2008 through 2011 (Executive Order S-06-08) and Drought Declaration State of Emergency in effect from 2009 through 2011 (Executive Order S-11-09). Drought conditions in California also persisted from 1987 through 1992. Paleoclimatologists have reconstructed medieval climate episodes from tree ring studies, sediment deposition, and other sources. These studies show that the most severe droughts during the past 1,000 years have lasted from 20 to more than 150 years.[1]

4. On June 3, 2014, the State Water Board adopted Water Quality Order 2014-0090-DWQ, *General Waste Discharge Requirements for Recycled Water Use* to streamline permitting of recycled water use statewide.

5. Order WQ 2014-0090-DWQ was adopted to facilitate recycled water use and reduce demand on potable water supplies; this General Order further encourages recycled water projects by (1) maintaining the streamlined approach in permitting new Users through a water recycling program and (2) providing the option for a single recycled water use permit coverage for larger Users that typically need permit coverage from multiple Regional Water Boards. Enrollees issued a Notice of Applicability (NOA) under order WQ 2014-0090-DWQ must

1 Michael Dettinger, *Droughts, Epic Droughts and Droughty Centuries—Lessons from California's Paleoclimatic Record: A PACLIM 2001 Meeting Report*, (Summer 2001) Interagency Ecological Program Newsletter, at p. 50.

notify the State Water Board of its intention to be regulated under this General Order.

6. Prior to July 1, 2014, CDPH provided public health recommendations to the Water Boards through review and approval of Title 22 Engineering Reports prepared pursuant to California Code of Regulations, title 22, section 60323. The Water Boards then issue permits. Effective July 1, 2014, the administration of the Drinking Water Program, including responsibility for review of Title 22 Engineering Reports was transferred from the CDPH to the State Water Board.

7. "Recycled water" means water which, as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur and is therefore considered a valuable resource. (Wat. Code, § 13050(n).) Coverage under these Water Reclamation Requirements (WRRs) for Recycled Water Use (General Order) is limited to treated municipal wastewater for uses consistent with the Uniform Statewide Recycling Criteria, and other uses approved by the State Water Board on a case-by-case basis, other than direct or indirect potable uses. An estimated 1.85 to 2.25 million acre-feet of water supply could be realized annually though recycling by the year 2030.[2] Of this total amount, an estimated 0.9 million to 1.4 million acre-feet of recycled water could be realized through recycling of municipal wastewater that is discharged into the ocean or saline bays. Downstream beneficial uses will be protected by requiring compliance with Water Code section 1211, as described in the Antidegradation Analysis section of this General Order.

8. Recycled water use can help to reduce local water scarcity. It is not the only option for bringing supply and demand into a better balance, but it is a viable cost effective solution that is appropriate in many cases. The feasibility of recycled water use depends on local circumstances, which affect the balance of costs and benefits. In drought conditions, recycled water can be particularly valuable, given the scarcity of alternative supplies. In normal precipitation years recycled water use may reduce groundwater extraction.

9. The California Legislature has declared that a substantial portion of the future water requirements of the state may be economically met by beneficial use of recycled water. (Wat. Code, § 13511.) The Legislature also expressed its intent that the state undertakes all possible steps to encourage development of water recycling facilities so that recycled water may be made available to help meet the growing water requirements of the state. (Wat. Code, § 13512.)

10. On February 3, 2009, the State Water Board adopted Resolution 2009-0011, Adoption of a Policy for Water Quality Control for Recycled Water (Recycled Water Policy) (Revised January 22, 2013, effective April 25, 2013.) The

2 California Department of Water Resources, Bulletin 160-2009, p. 11-9.

Recycled Water Policy promotes the use of recycled water to achieve sustainable local water supplies and reduce greenhouse gas emissions.

11. Water recycling is an essential part of an overall program to manage local and regional water resources. Many local governing bodies have adopted resolutions establishing their intent to proceed with planning, permitting, and implementation of recycled water projects. These projects will provide water supply and municipal wastewater disposal benefits for communities, and will provide water supply benefits to agriculture.

12. The Uniform Statewide Recycling Criteria was established for the protection of public health and are codified in the California Code of Regulations, title 22, division 4, chapter 3 (herein referred to as Uniform Statewide Recycling Criteria). Approved uses of recycled water under the Uniform Statewide Recycling Criteria depend on the level of treatment and potential for public contact. Under the Uniform Statewide Recycling Criteria, recycled water is categorized based on treatment levels. There are four categories of recycled water relevant to this General Order; they are listed here and defined in the indicated regulations section:

    a. Undisinfected secondary recycled water (Cal. Code Regs., tit. 22, § 60301.900.)

    b. Disinfected secondary-23 recycled water (Cal. Code Regs., tit. 22, § 60301.225.)

    c. Disinfected secondary-2.2 recycled water (Cal. Code Regs., tit. 22, § 60301.220.)

    d. Disinfected tertiary recycled water (Cal. Code Regs., tit. 22, § 60301.230.)

    An approved Title 22 Engineering Report addressing protection of public health is required before authorization to use recycled water is granted by the Regional Water Board Executive Officer.

13. When used in compliance with the Recycled Water Policy, the Uniform Statewide Recycling Criteria , and all applicable state and federal water quality laws, the State Water Board finds that recycled water is safe for approved uses, and strongly supports recycled water as a safe alternative to raw and potable water supplies for approved uses.

14. This General Order authorizes beneficial, non-potable recycled water uses consistent with the Uniform Statewide Recycling Criteria and any additional requirements specified in the Notice of Applicability. Activities that are not authorized by this Order include:

a. Activities designed to replenish groundwater resources. Groundwater replenishment activities include surface spreading basins, percolation ponds, or injection through groundwater wells[3].

b. Disposal of treated wastewater by means of percolation ponds, excessive hydraulic loading of recycled water in use areas, etc., where the primary purpose of the activity is disposal of treated wastewater.

c. Direct potable reuse (Wat. Code, § 13561(b)), indirect potable reuse for groundwater recharge (Wat. Code, § 13561(c)), or surface water augmentation (Wat. Code, § 13561(d)).

15. There are many sources of salts and nutrients in surface and groundwater, including water soluble inorganic and organic constituents in imported water, leaching of naturally occurring salts in soils as a result of irrigation and precipitation, animal wastes, fertilizers and other soil amendments, municipal use including water softeners, industrial wastewater, and oil field wastewater. In coastal areas and areas adjacent to the Sacramento-San Joaquin Delta, seawater intrusion is also a source of salinity in groundwater, particularly in over-drafted basins. Imported water is a major source of salt. In water year 2010, 45 percent of the surface water used in the San Joaquin Valley was imported from the Sacramento-San Joaquin Delta through the Delta Mendota Canal, Folsom South Canal, and California Aqueduct (DWR).[4] In an average year, more than 800,000 tons of salt are imported from the Sacramento-San Joaquin River Delta Estuary (Delta) into the northern portion of the San Joaquin Valley, and another two million tons of salt are imported into the Tulare Lake Basin.[5] Southern California also imports significant water supplies from the Delta. In addition, it imports 4.4 million acre-feet of water each year from the Colorado River. Colorado River water has, on average, twice the salinity of northern California water sources, and water imported from the Delta is blended with Colorado River supplies to control salinity. The use of recycled water for irrigation has the potential to increase salts and other constituents in groundwater, but is not expected to be a significant source of salt loading relative to other potential sources, particularly when recycled water is used in the same watershed in which it would otherwise be discharged. Basin-specific salt and nutrient management plans, however, will provide definitive information on where assimilative capacity is available.

3 Injection well is defined in Water Code 13051.

4 Water Recycling and Desalination Section, California Department of Water Resources.

5 Department of Water Resources, Water Facts-Salt Balance in the San Joaquin Valley <http://www.water.ca.gov/pubs/environment/salt_balance_in_the_san_joaquin_valley water facts_20_/water_facts_20.pdf>, accessed 3 April 2014.

16. Use of recycled water has the potential to increase nutrients in groundwater supplies. In order to minimize the nutrient loading, this Order requires that recycled water used for irrigation purposes be applied at agronomic rates.

17. The Recycled Water Policy calls on local water and wastewater entities together with other stakeholders who contribute salt and nutrients to a groundwater basin or sub-basin, to fund and develop Salt and Nutrient Management Plans to comprehensively address all sources of salts and nutrients. The State Water Board herein reasserts the need for comprehensive salt and nutrient management planning and directs that salinity and nutrient increases should be managed in a manner consistent with the Recycled Water Policy. It is the intent of the Recycled Water Policy that every groundwater basin/sub-basin in California ultimately has a consistent Salt and Nutrient Management Plan. The appropriate way to address salt and nutrient issues is through the development of regional or subregional Salt and Nutrient Management Plans.

18. The Recycled Water Policy includes monitoring requirements for Constituents of Emerging Concern[6] (CECs) for the use of recycled water for groundwater recharge by surface and subsurface application methods. The monitoring requirements and criteria for evaluating monitoring results in the Recycled Water Policy are based on recommendations from a Science Advisory Panel.[7] Because this General Order is limited to non-potable uses and does not authorize groundwater replenishment activities, monitoring for CECs is not required.

19. The Recycled Water Policy requires permits for landscape irrigation with recycled water to include priority pollutant monitoring at the recycled water production facility. Annual monitoring is required for design production flows greater than one million gallons per day; a five year monitoring frequency is required for flows less than one million gallons per day. Priority pollutants are listed in Appendix A of 40 Code of Federal Regulations (CFR) Part 423.

STATUTORY AND REGULATORY ISSUES

20. Pursuant to Water Code section 13523, the Regional Water Board, after consulting with and receiving the recommendation of the State Water Board, may prescribe water reclamation requirements for water that is used or proposed to be used as recycled water. The requirements shall be established in

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6 For this Policy, CECs are defined to be chemicals in personal care products, pharmaceuticals including antibiotics, antimicrobials; industrial, agricultural, and household chemicals; hormones; food additives; transformation products, inorganic constituents; and nanomaterials.

7 The Science Advisory Panel was convened in accordance with provision 10.b of the Recycled Water Policy. The panel's recommendations were presented in the report; *Monitoring Strategies for Chemicals of Emerging Concern (CECs) in Recycled Water - Recommendations of a Science Advisory Panel*, dated June 25, 2010.

conformance with the Uniform Statewide Recycling Criteria pursuant to Water Code section 13521. Pursuant to Water Code section 13523 (b), the requirements for use of recycled water not addressed by the Uniform Statewide Recycling Criteria will be considered on a case-by-case basis by Regional Water Boards, after consulting with and receiving the recommendations of the State Water Board. The State Water Board provides such recommendations through acceptance letters for Title 22 Engineering Reports. These recommendations become requirements of the Order when specified in the Notice of Applicability.

21. Pursuant to Water Code section 13528.5, the State Water Board may carry out duties and authority granted to a Regional Water Board pursuant to the Water Code, division 7, chapter 7, including the authority to prescribe water reclamation requirements pursuant to Water Code section 13523.

22. Pursuant to Water Code section 13241 and 13263, the State Water Board, in establishing the requirements contained herein, considered factors including, but not limited to, the following:

    a. Past, present, and probable future beneficial uses of water;

    b. Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto;

    c. Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area;

    d. Economic considerations;

    e. The need for developing housing within the region(s); and

    f. The need to develop and use recycled water.

23. Pursuant to Water Code section 106.5, it is the policy of the State of California that every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes. This General Order promotes that policy by encouraging uses of recycled water. Such uses must be consistent with the requirements of California Code of Regulations (including the Uniform Statewide Recycling Criteria). This General Order furthers the human right to water by encouraging use of recycled water thus reducing demand on other other sources, including use of potable water used for non-potable uses where recycled water is available.

24. Technical and monitoring reports specified in this General Order are required pursuant to Water Code section 13267. Failing to furnish the reports by the due date or falsifying information in the reports is a misdemeanor that may result in assessment of civil liabilities against the Discharger. Water Code section 13267 states, in part:

    "In conducting an investigation specified in subdivision (a), the regional board may require that any person who has discharged, discharges, or is

> suspected of having discharged or discharging, or who proposes to discharge waste within its region, or any citizen or domiciliary, or political agency or entity of this state who has discharged, discharges, or is suspected of having discharged or discharging, or who proposes to discharge, waste outside of its region that could affect the quality of waters within its region shall furnish, under penalty of perjury, technical or monitoring program reports which the regional board requires. The burden, including costs, of these reports shall bear a reasonable relationship to the need for the report and the benefits to be obtained from the reports. In requiring those reports, the regional board shall provide the person with a written explanation with regard to the need for the reports, and shall identify the evidence that supports requiring that person to provide the reports. … (f) the State Board may carry out the authority granted to a regional board pursuant to this section."

The technical reports required by this General Order, the NOI, and the Monitoring and Reporting Program (MRP) are necessary to assure compliance with this General Order. The burden and cost of preparing the reports are reasonable and consistent with the best interest of the people of the state in maintaining water quality.

25. This General Order is applicable to recycled water projects where recycled water is used or transported for non-potable uses (for example: landscape irrigation, irrigation of crops and pasture land, construction, fire suppression, hydrostatic testing, etc.) This General Order does not regulate the treatment of wastewater. Compliance with this General Order does not relieve producers or distributors from the obligation to comply with applicable Waste Discharge Requirements (WDRs) for discharges from wastewater treatment plants, other than the recycled water uses described herein.

26. The uses of recycled water described in this General Order are exempt from the requirements of Consolidated Regulations for Treatment, Storage, Processing, or Disposal of Solid Waste in California Code of Regulations, title 27, division 2, subdivision 1, section 20005, et seq. The activities are exempt from the requirements of title 27 so long as the activity meets, and continues to meet, all preconditions listed below. (Cal Code Regs., tit. 27, § 20090.)

    a. Sewage—Discharges of domestic sewage or treated effluent which are regulated by WDRs issued pursuant to California Code of Regulations, title 23, division 3, chapter 9, or for which WDRs have been waived, and which are consistent with applicable water quality objectives, and treatment or storage facilities associated with municipal wastewater treatment plants, provided that residual sludge or solid waste from wastewater treatment facilities shall be discharged only in accordance with the applicable State Water Board promulgated provisions of this division. (Cal. Code Regs., tit. 27, § 20090(a).)

b. Wastewater—Discharges of wastewater to land, including but not limited to evaporation ponds, percolation ponds, or subsurface leach fields if the following conditions are met: (1) the applicable Regional Water Board has issued WDRs, reclamation requirements, or waived such issuance; (2) the discharge is in compliance with the applicable water quality control plan; and (3) the wastewater does not need to be managed according to, California Code of Regulations, title 22, division 4.5, chapter 11, as a hazardous waste. (Cal. Code Regs., tit. 27, § 20090(b).)

c. Reuse – Recycling of other use of materials salvaged from waste or produced by waste treatment, such as scrap metal, compost, and recycled chemicals, provided that discharges of residual wastes from recycling or treatment operations to land shall be according to applicable provisions of Title 27 regulations.(Cal. Code Regs., tit. 27, § 20090(h).)

ANTIDEGRADATION ANALYSIS

27. State Water Board Resolution No. 68-16, the *Statement of Policy with Respect to Maintaining High Quality of Waters in California* (the Antidegradation Policy) requires that disposal of waste into the waters of the state be regulated to achieve the highest water quality consistent with the maximum benefit to the people of the state. The quality of some waters is higher than established by adopted policies and that higher quality water shall be maintained to the maximum extent possible consistent with the Antidegradation Policy. The Antidegradation Policy requires the following:

    a. Higher quality water will be maintained until it has been demonstrated to the state that any change will be consistent with the maximum benefit to the people of the state, will not unreasonably affect present and anticipated beneficial use of the water, and will not result in water quality less than that prescribed in the policies.

    b. Any activity that produces a waste or may produce waste or increased volume or concentration of waste and discharges to existing high quality waters will be required to meet waste discharge requirements that will result in the best practicable treatment or control (BPTC) of the discharge necessary to assure pollution or nuisance will not occur, and the highest water quality consistent with the maximum benefit to the people of the state will be maintained.

28. This General Order regulates discharges to groundwater basins throughout the state. There is not sufficient data to determine which groundwater basins are high quality waters for the various constituents that may be associated with recycled water. To the extent use of recycled water may result in a discharge to a groundwater basin that contains high quality water, this General Order authorizes limited degradation consistent with the Antidegradation Policy as described in the findings below. Further, Salt and Nutrient Management Plans,

developed in accordance with the Recycled Water Policy, will require analysis on an ongoing basis to evaluate inputs to the basin, the salt and nutrient mass balance, and the available assimilative capacity.

29. This General Order requires BPTC, which is a combination of treatment, storage, and application methods that implement the requirements of the Uniform Statewide Recycling Criteria and the Regional Water Board Water Quality Control Plans (Basin Plans). Recycled water is generated by treating (primarily) domestic wastewater adequately to make the water suitable for a direct beneficial use that would not otherwise occur. The required level of treatment corresponds to the proposed use of the recycled water. In addition, this General Order includes requirements regarding the storage and application of recycled water to protect water quality and limit public contact to recycled water, where appropriate. Wastewater treatment can be accomplished many different ways, but generally consists of physical, chemical, and/or biological methods. Depending upon the use of the recycled water, disinfection may be performed. In addition to the treatment processes, this General Order also requires the following control measures:

    a. Recycled water use shall not cause unacceptable groundwater and/or surface water degradation.

        i. Regional Water Boards have discretion regarding permitting storage of recycled water in unlined ponds. Applicants shall improve storage facilities if deemed necessary by a Regional Water Board.

        ii. Application of recycled water is limited to agronomic rates, which limits the potential for significant amounts of recycled water to impact groundwater quality and allows plants to take up wastewater constituents such as nitrogen compounds.

        iii. Recycled water use shall be controlled to prevent significant runoff from application areas. This General Order authorizes use of recycled water for application to land, where recycled water is further treated in natural soil processes.

    b. Recycled water shall not create nuisance conditions.

        i. The Uniform Statewide Recycling Criteria requires wastewater to be oxidized, which removes putrescible matter and requires dissolved oxygen. Maintaining dissolved oxygen in the wastewater will generally prevent nuisance odors.

        ii. Application of recycled water is controlled to prevent airborne spray from entering dwellings, eating areas, or food handling areas.

        iii. Application of recycled water to saturated soil is prohibited. Application to saturated soil reduces the soil treatment processes and may create conditions for mosquito breeding.

c. Recycled water shall only be used consistent with the Uniform Statewide Recycling Criteria and any other requirements specified in the Notice of Applicability.

i. A written approval of a Title 22 Engineering Report must be obtained from the State Water Board before a Notice of Applicability (NOA) can be issued.

ii. Uses of recycled water are subject to category-specific use area signage, and monitoring frequency requirements as specified in the Uniform Statewide Recycling Criteria. Uses not addressed by the Uniform Statewide Recycling Criteria will be considered on a case-by-case basis by Regional Water Boards , after consulting with and receiving the recommendations of the State Water Board. These recommendations become requirements of the Order when specified in the Notice of Applicability.

iii. Uses of recycled water are subject to backflow prevention, cross connection tests, and setback requirements for surface impoundments, wells, etc. as contained in the Uniform Statewide Recycling Criteria and California Code of Regulations, title 17, division 1, article 2.

30. In an arid climate, such as the climate that exists in most of California, the maximum benefit to the people of the state can only be achieved by ensuring long and short-term protection of economic opportunities, public health, and environmental protection. In order to do that, water uses must be better matched to water quality and use of local supplies must be encouraged to the extent possible, including reusing water that would otherwise flow to the ocean or other salt sinks without supporting beneficial uses during transmission. The use of recycled water in place of both raw and potable water supplies for the non-potable uses allowed under this General Order improves water supply availability and helps to ensure that higher quality water will continue to be available for human uses and for instream uses for fish and wildlife. It also reduces the need for groundwater pumping that has resulted in permanent loss of aquifer storage capacity and land subsidence in some parts of the state.

As required by the Antidegradation Policy, the State Water Board finds that the limited degradation of water that may occur as the result of recycling under the conditions of this General Order provides maximum benefit to the people of California, provided recycled water treatment and use are managed to ensure long-term reasonable protection of beneficial uses of waters of the state. Recycled water available for reuse under this General Order has been treated at a wastewater treatment plant to levels that comply with permits issued by the State Water Board or Regional Water Boards pursuant to the Clean Water Act for discharges to waters of the United States or the Porter Cologne Water Quality Control Act for discharges to land. Treatment technologies required under these

laws and permits include secondary and/or tertiary treatment and disinfection when needed for pathogen reduction.

The Uniform Statewide Recycling Criteria imposes limitations on the uses of recycled water, based on the level of treatment and the specific use in this General Order to protect public health. By restricting the use of recycled water to those meeting the Uniform Statewide Recycling Criteria, this General Order ensures that recycled water is used safely. To the extent that the use of recycled water may result in some waste constituents entering the environment after effective source control, treatment, and control measures are implemented, the conditions of this General Order limiting the use of recycled water to agronomic rates is part of the suite of treatment, storage and applications measures that comprise BPTC for uses with frequent or routine application, such as landscape or agricultural irrigation. Other types of uses that may be approved, such as dust control, firefighting, hydrostatic testing, and other short term or infrequent application are unlikely to result in sufficient loading of waste constituents that impact water quality.

31. Constituents associated with recycled water that have the potential to degrade groundwater include salinity, nutrients, pathogens (represented by coliform bacteria), disinfection by-products (DBPs), constituents of emerging concern (CECs), and endocrine disrupting chemicals (EDCs). If the discharge is not consistent with Basin Plan requirements, the applicant may elect to improve treatment to enroll under this General Order, or to apply for a site-specific order from the Regional Water Board. The State Water Board finds that the use of recycled water permitted under this General Order will not unreasonably affect beneficial uses or result in water quality that is less than that prescribed in applicable policies. The characteristics and requirements associated with each of the recycled water constituents of concern are discussed below:

    a. Salinity is measured in water through various measurements, including but not limited to, total dissolved solids (TDS) and electrical conductivity. Excessive salinity can impair the beneficial uses of water. Salinity levels in the receiving water can be affected by the use of recycled water if the recycled water has elevated concentrations of salinity. However, it is anticipated that in most cases, the use of recycled water for irrigation will consist of a portion of the total applied irrigation water. Other sources of irrigation water are likely to be potable water, imported water, agricultural water supply wells, irrigation districts (surface water supplies), and precipitation. The blending of sources of irrigation water (e.g. recycled water blended with stormwater) will generally reduce concentrations of, and/or loading rates of salinity constituents. As a result, salinity increases in use areas where the irrigation water is a blend of water sources are less likely to impair an existing and/or potential beneficial use of groundwater.

b. Nitrogen is a nutrient that may be present in recycled water at a concentration that can degrade groundwater quality. This General Order requires application of recycled water to take into consideration nutrient levels in recycled water and nutrient demand by plants. Application of recycled water at agronomic rates and considering soil, climate, and plant demand minimizes the movement of nutrients below the plants' root zone. When applied to cropped (or landscaped) land, some of the nitrogen in recycled water will be taken up by the plants, lost to the atmosphere through volatilization of ammonia or denitrification, or stored in the soil matrix. As a result, nitrogen increases are unlikely to impair an existing and/or potential beneficial use of groundwater.

c. Pathogens and other microorganisms may be present in recycled water based on the disinfection status. Coliform bacteria are used as a surrogate (indicator) because they are present in untreated wastewater, survive in the environment similar to pathogenic bacteria, and are easy to detect and quantify. Pathogens are generally limited in their mobility when applied to land.

   Setbacks from recycled water use areas are required in the Uniform Statewide Recycling Criteria as a means of reducing pathogenic risks by coupling pathogen inactivation rates with groundwater travel time to a domestic water supply well or other potential exposure route (e.g. water contact activities). In general, a substantial unsaturated zone reduces pathogen survival compared to saturated soil conditions. Fine grained soil particles (silt or clay) reduce the rate of groundwater transport and therefore are generally less likely to transport pathogens. Setbacks also provide attenuation of other recycled water constituents through physical, chemical, and biological processes.

   When needed, disinfection can be performed in a number of ways. The Uniform Statewide Recycling Criteria lists disinfection requirements for specifically listed activities.

d. Disinfection by-products (DBPs) consist of organic and inorganic substances produced by the interaction of chemical disinfectants with naturally occurring substances in the water source. Common disinfection by-products include trihalomethanes, haloacetic acids, bromate, and chlorite. DBPs present in recycled water receive additional treatment when applied to land. Biodegradation, adsorption, volatilization, and other attenuative processes that occur naturally in soil will reduce the concentrations and retard migration of DBPs in the subsurface.

e. Chemicals of Emerging Concern (CECs) in recycled water as they pertain to the State Water Board’s Recycled Water Policy are defined to be chemicals in personal care products, pharmaceuticals including antibiotics, antimicrobials; industrial, agricultural, and household chemicals; hormones;

food additives; transformation products, inorganic constituents; and nanomaterials. CECs are new classes of chemicals, diverse, and relatively unmonitored chemicals. Many of them are so new that standardized measurement methods and toxicological data for interpreting their potential human or ecosystem health effects are unavailable. The State Water Board convened a CEC Advisory Panel to address questions about regulating CECs with respect to the use of recycled water. The Panel's primary charge was to provide guidance for developing monitoring programs that assess potential CEC threats from various water recycling practices, including groundwater recharge/reuse and urban landscape irrigation. The Panel provided recommendations for monitoring specific CECs in recycled water used for groundwater recharge reuse. Monitoring of health-based CECs or performance indicator CECs is not required for recycled water used for landscape irrigation due to the low risk of ingestion of the water. These recommendations were made part of the Recycled Water Policy. This General Order does not provide coverage for groundwater recharge activities or production of recycled water.

f. Endocrine disrupting chemicals (EDCs) are mostly man-made, found in various materials such as pesticides, metals, additives, or contaminants in food, and personal care products. Human exposure to EDCs occurs via ingestion of food, dust and water, via inhalation of gases and particles in the air, and through the skin. Perchlorate is an EDC that may be present in hypochlorite solutions, which is a type of disinfectant used for wastewater. Formation of perchlorate in hypochlorite solution can be minimized when proper manufacturing, handling, and storage conditions are followed. Perchlorate accumulation has been documented in fruit and seed bearing crops and leafy vegetation irrigated with perchlorate contaminated water. Recycled water currently makes up less than one percent of California agricultural water supply. Much of the recycled water used for agricultural irrigation is either undisinfected or is disinfected by means that do not result in perchlorate generation, such as ultraviolet light and chlorine gas. Some sources of agricultural water supply in some areas of the state contain perchlorate, such as surface water from Colorado River or groundwater sources in areas near industrial or military application sites (e.g. Riverside, San Bernardino, and Los Angeles counties). The blending of sources of irrigation water will further reduce any concentration of perchlorate present in recycled water and will be unlikely to affect beneficial uses or degrade groundwater quality.

32. The use of recycled water that would otherwise be discharged to a watercourse can adversely affect the availability of water for beneficial uses of water downstream of the discharge point, including in-stream uses. Water Code section 1211 requires that: (1) the owner of any wastewater treatment plant obtain the approval of the State Water Board before making any change in the

point of discharge, place of use, or purpose of use of treated wastewater where changes to the discharge or use of treated wastewater have the potential to decrease the flow in any portion of a watercourse, and (2) the State Water Board review the proposed changes pursuant to the provisions of Water Code section 1700 *et seq*. In order to approve the proposed change, the State Water Board must determine that the proposed change will not operate to the injury of any legal user of the water involved. (Wat. Code, §1702.) The State Water Board also has an independent obligation to consider the effect of the proposed change on public trust resources and beneficial uses established for areas downstream of the discharge point, and to protect those resources where feasible. (*National Audubon Society v. Superior Court* (1983) 33 Cal.3d 419 [189 Cal. Rptr. 346].)

33. This General Order authorizes uses of recycled water statewide. If an existing or proposed use of recycled water seeking coverage under this General Order could result in water quality degradation as described below, the Regional Water Board's Executive Officer shall notify the applicant/discharger of the need to either revise the proposed/existing project, or apply for or continue coverage under a site-specific order of the Regional Water Board. The Regional Water Board's Executive Officer or the State Water Board's Executive Director (or designee) shall explain the need for a revised project, design, operation, or coverage under a different order, by making one or more of the following findings in the NOI response letter:

    a. The proposed use of recycled water is not consistent with Findings 27 through 32 of this General Order, which collectively provide for compliance with antidegradation findings for projects covered by this General Order. The degradation may be from salinity, nitrogen compounds, pathogens, disinfection by-products, or other substances.

    b. The proposed method of recycled water storage in unlined ponds is not consistent with Findings 27 through 32 of this General Order, which collectively provide for compliance with antidegradation findings for projects covered by this General Order. The degradation may be from salinity, nitrogen compounds, pathogens, disinfection by-products, or other substances.

    c. The proposed use of recycled water or method of recycled water storage will cause or contribute to pollution or nuisance, or otherwise fail to comply with the applicable Basin Plan or State Water Board plans or policies.

    d. The proposed use of recycled water does not implement mitigation measures in a California Environmental Quality Act (CEQA) document.

    e. The proposed use of recycled water is not consistent with a Total Maximum Daily Load (TMDL) waste load or load allocation, or implementation plan as adopted by the Regional Water Board and made part of the Regional Water Board's Basin Plan.

f. The proposed use of recycled water is not consistent with the Basin Plan provisions for implementing a Salt and Nutrient Management Plan.

PURPOSE AND APPLICABILITY

34. The State Water Board recognizes the need for streamlined permitting consistent with the State Water Board's Recycled Water Policy. The State Water Board's intention in the issuance of this statewide order is to provide consistent regulation of non-potable uses of recycled water statewide. To provide such consistency, the State Water Board intends that regulatory coverage under an existing Regional Water Board general order or conditional waiver for non-potable uses of recycled water (landscape irrigation, golf course irrigation, dust control, street sweeping, etc.) will be terminated by the applicable Regional Water Board within three (3) years after adoption of this General Order. Enrollees covered by a Regional Water Board general order or conditional waiver for non-potable uses of recycled water may continue discharging under that authority until the applicable Regional Water Board issues a Notice of Applicability to an Administrator per the terms of this Order. Enrollees under Order WQ 2014-0090-DWQ will be transferred for coverage under this General Order.

35. This document serves as a statewide General Order authorizing the use of recycled water by Producers, Distributors, and Users for uses consistent with the Uniform Statewide Recycling Criteria, other than direct or indirect potable reuse. The intent of this General Order is to streamline the permitting process and delegate the responsibility of administrating water recycling programs to an Administrator to the fullest extent possible. The following may apply for coverage under this General Order and agree to become the Administrator:

    a. Producers of recycled water: Producers may be publicly or privately owned. A Producer will typically produce recycled water that meets the requirements of the Uniform Statewide Recycling Criteria. A Producer may also act as an Administrator.

    b. Distributors of recycled water: In some cases, a Distributor may provide additional treatment (such as disinfection) to meet the Uniform Statewide Recycling Criteria for its intended use, and distribute it to Users. A Distributor is not required to take physical possession of the recycled water and may act simply as an Administrator.

    c. Users of recycled water: Users take physical possession of the recycled water from Producers and/ or Distributors for an approved beneficial recycled water use consistent with Uniform Statewide Recycling Criteria. A User that takes physical possession of recycled water may act as an Administrator and distribute to other Users. Users of recycled water may also use the recycled water under a Water Recycling Use Permit from another Administrator.

d. A legal entity: A joint powers agreement or equivalent contractual agreement between a Producer, Distributor, irrigation district, or other entity. Similar to a Distributor, a legal entity is not required to take physical possession of the recycled water and may act simply as an Administrator.

36. To obtain coverage under this General Order, the applicant shall submit an NOI (Attachment A) and an application fee to the Regional Water Board of jurisdiction. An applicant proposing a water recycling program that covers recycled water use areas within multiple Regional Water Board jurisdictions may submit an NOI (Attachment A) and application fee to the State Water Board. Fee amounts are in accordance with California Code of Regulations, title 23, division 3, chapter 9, article 1. The applicant shall declare responsibility for the administration of the water recycling program authorized pursuant to this General Order. The applicant shall describe a program they will administer to ensure that recycled water use complies with the requirements of the Uniform Statewide Recycling Criteria, and this General Order. Upon authorization by the State or Regional Water Board, the applicant then becomes the Administrator. The Administrator shall be billed for an annual fee until coverage under the General Order is terminated.

37. Pursuant to Water Code section 13554.2, any person or entity proposing the use of recycled water shall reimburse the State Water Board for reasonable costs incurred in performing duties relevant to the implementation of regulatory oversight related to protection of public health for uses of recycled water.

38. This General Order does not authorize discharges of pollutants from point sources to water of the United States, thus the use of recycled water allowed pursuant to the terms of this General Order are not subject to National Pollutant Discharge Elimination System (NPDES) permits. To the extent that this General Order results in agricultural irrigation return flows entering waters of the United States, such return flows are not subject to NPDES permits (33 U.S.C., §1342(l)(1)) but may be subject to waste discharge requirements or conditional waivers as adopted by Regional Water Boards. Where such waste discharge requirements or conditional waivers exist, this General Order requires that uses of recycled water comply with their provisions.

39. The State Water Board recognizes the need to allow a centralized enrollment process under this General Order to facilitate opportunities for non-potable uses of recycled water by a single entity that may occur in more than one Regional Water Board jurisdictions (for example: hydrostatic testing of utility pipelines owned by a utility company or landscape irrigation at facilities managed by other state agencies). An NOI may be submitted to the State Water Board for such uses of recycled water, when managed by a single Administrator and subject to the corresponding recycled water quality, use area requirements, and reliability features.

40. Enrollment under this General Order may serve as additional authorization for new uses of recycled water presently not covered under existing WDRs, Master Reclamation Permits, or WRRs, as long as such new uses meet the requirements of this General Order and an approved Title 22 Engineering Report. A User that serves as an Administrator may use the additional authorization provided by this General Order to obtain recycled water from other Producers or Distributors permitted under other existing WDRs, Master Reclamation Permits, or WRRs.

41. Agricultural operations subject to waste discharge requirements or waivers of waste discharge requirements regulating discharges from irrigated lands may obtain authorization pursuant to this General Order to use recycled water for irrigation. Such authorization may take the form of a Water Recycling Use Permit from an Administrator covered by this General Order, or the agricultural operation may enroll as its own Administrator. The State Water Board recognizes the need to simplify regulation of recycled water use on agricultural lands. Pursuant to Water Code section 13267, Regional Water Boards' Executive Officers may modify the MRP to prevent duplication of monitoring and reporting activities that satisfy the requirements of both orders.

BASIN PLANS AND BENEFICIAL USES

42. Beneficial uses of groundwater are determined by each Regional Water Board and are listed in their respective Basin Plans. Beneficial uses for groundwater are: municipal supply (MUN), industrial service supply (IND), industrial process supply (PROC), fresh water replenishment (FRESH), aquaculture (AQUA), wildlife habitat (WILD), water contact recreation (REC-1), agricultural supply (AGR), and groundwater recharge (GWR). Some beneficial uses only apply to certain geographical areas within regions.

43. Basin Plans establish water quality objectives to protect beneficial uses. The water quality objectives may be narrative, numerical, or both. This General Order requires proposed recycled water uses to comply with Basin Plan requirements. Determination of compliance with the Basin Plan is part of the application process.

CEQA AND PUBLIC NOTICE

44. On April 25, 2014, the Governor issued an Executive Order declaring a continued state of emergency due to severe drought conditions. Directive No. 10 of the Executive Order directs the State Water Board to adopt statewide general waste discharge requirements to facilitate the use of treated wastewater that meets standards set by CDPH, in order to reduce demand on potable water supplies. Effective July 1, 2014 the authority to establish such standards was transferred from CDPH to the State Water Board. This General Order is intended to satisfy the Directive No. 10 requirement. Directive No. 19 of the Executive Order provides that the California Environmental Quality Act (CEQA)

requirement to conduct an environmental review is suspended to allow the State Water Board to adopt this General Order as quickly as possible.

45. On November 13, 2015, the Governor issued an Executive Order (B-36-15) extending suspension of Division 13 (commencing with section 21000) of the Public Resources Code and regulations adopted pursuant to that Division in the January 17, 2014 Proclamation, April 25, 2014 Proclamation, and Executive Orders B-26-14, B-28-14, and B-29-15. The suspension will remain in effect until the drought state of emergency is terminated. The suspension also applies to the adoption of water reclamation requirements by the State Water Board that serve the purpose of paragraph 10 of the April 25, 2014 Proclamation.

46. The State Water Board has notified interested agencies and persons of its intent to prescribe these WRRs, and has provided them the opportunity to attend a public meeting and to submit their written views and recommendations.

47. The State Water Board, in a public meeting, heard and considered all comments pertaining to this matter.

IT IS HEREBY ORDERED that Order WQ 2014-0090-DWQ is hereby rescinded except for enforcement purposes, effective 60 calendar days after adoption of this General Order ("Effective Date").

To enroll under this General Order, a prospective enrollee must file an NOI indicating its intention to be regulated under the provisions of this General Order, and receive authorization from the appropriate Regional Water Board. A prospective enrollee that intends to obtain authorization from multiple Regional Water Boards may file an NOI and receive authorization from the State Water Board.

To obtain coverage under this General Order, an enrollee under Order WQ 2014-0090-DWQ must notify the State Water Board of its intention to be regulated under this General Order. See Attachment A, "Who May Apply." Coverage will terminate on the Effective Date for any existing enrollee that fails to submit the required documentation.

Pursuant to Water Code sections 13263,13267, 13523 and 13523.1, enrollees under this Order, in order to meet the provisions contained in division 7 of the Water Code (commencing with section 13000) and regulations adopted thereunder, shall comply with the requirements in this Order.

A. PROHIBITIONS

1. The treatment, storage, distribution, or use of recycled water shall not cause or contribute to a condition of pollution as defined in Water Code section 13050(l) or nuisance as defined in Water Code section 13050(m).

2. Recycled water shall not be applied for irrigation during periods when soils are saturated.

3. Recycled water shall not be allowed to escape from the use area(s) as surface flow that would either pond and/or enter surface waters, unless authorized by WDRs, waivers of WDRs, or conditional prohibitions regulating agricultural discharges from irrigated lands.

4. Spray or runoff shall not enter a dwelling or food handling facility and shall not contact any drinking water fountain, unless specifically protected with a shielding device. If the recycled water is undisinfected secondary or disinfected secondary-23 quality then spray or runoff shall not enter any place where public access is not restricted during irrigation.

5. The incidental runoff of recycled water shall not result in water quality less than that prescribed in water quality control plans or policies unless authorized through time schedule provisions in WDRs, waivers of WDRs, or conditional prohibitions regulating agricultural discharges from irrigated lands.

   Recycled water shall not be discharged from treatment facilities, irrigation holding tanks, storage ponds, or other containment, other than for permitted use in accordance with this General Order; Regional Water Board issued WDRs, WRRs, or Master Reclamation Permits; NPDES permits; or a contingency plan in an approved Water Recycling Use Permit.

6. There shall be no cross-connection between potable water supply and piping containing recycled water. All Users of recycled water shall provide for appropriate backflow protection for potable water supplies as specified in California Code of Regulations, title 17, section 7604 or as determined by the State Water Board on a case-by-case basis to protect public health.

7. This General Order authorizes certain beneficial recycled water uses consistent with Uniform Statewide Recycling Criteria. The following activities are not authorized by this General Order:

   a. Activities designed to replenish groundwater resources. Groundwater replenishment activities include surface spreading basins, percolation ponds, or injection through groundwater wells.

   b. Disposal of treated wastewater by means of percolation ponds, excessive hydraulic loading of application areas, or any other method, where the primary purpose of the activity is the disposal of treated wastewater.

   c. Direct potable reuse (Wat. Code, § 13561(b)), indirect potable reuse for groundwater recharge (Wat. Code, § 13561(c)), or surface water augmentation (Wat. Code, § 13561(d)).

8. The use of recycled water in violation of the applicable Regional Water Board's Basin Plan is prohibited.

B. SPECIFICATIONS

1. Recycled water distribution and use permitted under this General Order shall be in compliance with all of the following requirements:

   a. Regulations related to recycled water (including its subsequent revisions) contained in California Code of Regulations, title 17, sections 7583 – 7586, sections 7601 – 7605, and California Code of Regulations, title 22, sections 60001 – 60355.

   b. All requirements of this General Order.

   c. An approved Title 22 Engineering Report that demonstrates or defines compliance with the Uniform Statewide Recycling criteria (and amendments).

   d. The NOA issued by the Regional Water Board or State Water Board.

   e. Applicable Salt and Nutrient Management Plan adopted by the Regional Water Board as a Basin Plan Amendment.

   f. WDRs or NPDES permits for recycled water production facilities, to the extent that the WDRs or NPDES permits include provisions that address recycled water.

   g. Any applicable water quality related CEQA mitigation measure.

   h. Water Code section 1211 for facilities where the changes to the discharge are necessary to accomplish water recycling and will result in changes in flow in a watercourse.

   i. Policy for Water Quality Control for Recycled Water (Recycled Water Policy)

2. The Administrator shall discontinue delivery of recycled water during any period in which it has a reason to believe that the quality of the delivered recycled water is not meeting the Uniform Statewide Recycling Criteria specification. The Administrator shall notify the Regional Water Board, and the State Water Board if it issued the NOA, within one (1) business day of determining that delivery of off-specification recycled water has taken place. In circumstances where the emergency requires termination of delivery to Users, the Regional Water Board, and the State Water Board if it issued the NOA, shall be copied on any correspondence concerning non-compliance between the Administrator and User. This notification does not supersede any notification requirements contained within a Producer's WDRs or Master Reclamation Permit for production facilities.

3. Uses of recycled water with frequent or routine application (for example: agricultural or landscape irrigation uses) shall be at agronomic rates and shall consider soil, climate, and plant demand. In addition, application of recycled water and use of fertilizers shall be at a rate that takes into consideration nutrient levels in recycled water and nutrient demand by plants. The State or Regional Water Board may require the Administrator to submit an Implementation or

Operations and Management Plan specifying agronomic rates and nutrient application for the use area(s) and a set of reasonably practicable measures to ensure compliance with this General Order. An Administrator may submit a nutrient management plan developed to comply with another Water Board's order, such as waste discharge requirements or a waiver regulating discharges from irrigated lands, in lieu of an Implementation or Operations and Management Plan. Other uses of recycled water that are infrequent (for example: dust control, firefighting, hydrostatic testing, etc.) must also be addressed by a set of reasonably practicable measures within an Implementation or Operations and Management Plan.

C. WATER RECYCLING ADMINISTRATION REQUIREMENTS

1. Applicants seeking coverage under this General Order shall submit an NOI in accordance with Attachment A. Responsibilities for an Administrator shall be described in the NOI.
2. Coverage under this General Order becomes effective when the State or Regional Water Board issues an NOA. The Regional Water Board and the State Water Board will coordinate to include Title 22 Engineering Report requirements and conditions of approval.
3. Under this General Order, the Administrator's program shall be implemented to accomplish compliance with Specification B.1. Upon State or Regional Water Board approval of the Administrator's program, which shall accompany the NOI, the Administrator may authorize and/or implement water recycling projects, in accordance with the Administrator's approved program and the approved Title 22 Engineering Report. The Administrator shall obtain written approvals for any changes to the Administrator's approved program, for example: new recycled water use types or distribution methods not already described in the Administrator's approved program.
4. The Administrator shall establish and enforce rules or regulations for recycled water uses governing the design and construction of recycled water use facilities and the use of recycled water in accordance with Specification B.1.
5. A User acting as a water recycling program Administrator is subject to the conditions of its water recycling program prepared in accordance with Specification B.1. A User acting as a water recycling program Administrator is responsible to implement water recycling administration requirements applicable to Users and Administrators as described in Water Recycling Administration Requirements C.1 – C.16.
6. The Administrator shall inspect to ensure that cross-connections between potable water and non-potable water systems have not been created and that backflow prevention devices are in proper working order by conducting or requiring User testing in accordance with the Uniform Statewide Recycling Criteria and California Code of Regulations, title 17, section 7605. Reports of

testing and maintenance shall be maintained by the Administrator. The Administrator may use a third party agent to perform this task, however, the Administrator is solely responsible for compliance with conditions of this permit and the approved water recycling program.

7. The Administrator shall ensure recycled water meets the quality standards of this General Order and shall be responsible for the operation and maintenance of major transport facilities and associated appurtenances. If an entity other than the Administrator has actual physical and ownership control over the recycled water transport facilities, the Administrator may delegate operation and maintenance responsibilities for such facilities to that entity. The Administrator shall require the use of the recycled water to be in accordance with the Uniform Statewide Recycling Criteria and to comply with this General Order, including requirements to apply only at agronomic rates and not cause unauthorized degradation, pollution, or nuisance. If not the same entity, the Producer shall provide water quality data and communicate to Users the nutrient levels in the recycled water.
8. The Administrator shall conduct periodic inspections of the User's facilities and operations to determine compliance with conditions of the Administrator requirements and this General Order. The Administrator shall take whatever actions are necessary, including the termination of delivery of recycled water to the User, to correct any User violations. The Administrator may use a third party agent to perform this task, however, the Administrator is solely responsible for compliance with conditions of this permit and the approved water recycling program.
9. The Administrator shall comply with all applicable items of the attached Standard Provisions and Reporting Requirements (Attachment C) and any amendments thereafter.
10. The Administrator shall require Users to comply with the Administrator’s use area conditions. Use area requirements shall be consistent with Specification B.1.
11. If recycled water will be transported by truck for uses consistent with the Uniform Statewide Recycling Criteria such as dust control, the Administrator shall provide notification and control measures for Users consistent with the provisions of the approved Title 22 Engineering Report that addresses protection of public health.
12. A copy of the Water Recycling Use Permit must be provided to Users by the Administrator (electronic format is acceptable). The Users must have the documents available for inspection by State and Regional Water Board staff, State/County officials, and/or the Administrator.
13. The Administrator shall comply with the attached monitoring and reporting program including any amendments issued by the entity that issued the NOA (State or Regional Water Board). This monitoring program shall be consistent with any applicable Salt and Nutrient Management Plan for the basin/sub-basin.

The Administrator is responsible for collecting reports from Users. Where applicable, Users are responsible for submitting on-site observation reports and use data to the Administrator, who will compile and file an annual report with the entity that issued the NOA. The Administrator, at its discretion, may assume the User's responsibility for on-site observation reports and use data.

14. The Administrator and Users shall maintain in good working order and operate as efficiently as possible any facility or control system to achieve compliance with this General Order. The Administrator may use a third party agent to perform this task, however, the Administrator is solely responsible for compliance with conditions of this permit and the approved water recycling program.

15. The Administrator shall require that personnel receive training to assure proper operation of recycling facilities, worker protection, and compliance with this General Order. The Administrator shall require Recycled Water Supervisor(s) to be familiar with the Administrator permit conditions.

16. The Administrator shall assure that all above ground equipment, including pumps, piping, storage reservoir, and valves which may at any time contain recycled water are identified with appropriate notification as required by the Uniform Statewide Recycling Criteria and California Health and Safety Code section 116815. The Administrator may use a third party agent to perform this task, however, the Administrator is solely responsible for compliance with conditions of this permit and the approved water recycling program.

D. GENERAL PROVISIONS

1. The Administrator shall document compliance with all conditions of this General Order and requirements specified in the Uniform Statewide Recycling Criteria and California Code of Regulations title 17.

2. If directed by the State Water Board or a Regional Water Board pursuant to Water Code section 13267, an Administrator shall prepare and submit a Salt and Nutrient Management Plan, acceptable to the entity that issued such order, to ensure that the overall impact of permitted water recycling projects does not degrade groundwater resources in a manner inconsistent with Findings 27 through 32. Unless otherwise directed by the entity that issued such order, in lieu of developing an individual Salt and Nutrient Management Plan, the Administrator shall participate in a Regional Water Board’s existing salt and nutrient management planning effort to meet the requirements of this provision.

3. State and/or Regional Water Board staff may conduct inspections/audits of water recycling projects. The Administrator and Users shall permit the State and/or Regional Water Board or its authorized representatives, in accordance with Water Code section 13267(c):

a. Entry upon premises where a regulated facility or activity is located or conducted, or where records are kept under the conditions of this General Order.

b. Access to and copy of, at reasonable times, any records that must be kept as a condition of this General Order.

c. Inspection, at reasonable times, of any facility, equipment (including monitoring and control equipment), practices, or operations regulated or required under this General Order.

d. To sample or monitor, at reasonable times, for the purpose of assuring compliance with this General Order.

4. The State or Regional Water Board may terminate or modify an Administrator's coverage under this General Order for cause, including, but not limited to:

   a. Violation of any term or condition contained in this General Order;

   b. Obtaining this General Order by misrepresentation, or failure to disclose fully all relevant facts;

   c. Endangerment to public health or environment that can only be mitigated to acceptable levels by General Order modification or termination.

   d. An increase in recycle flows which causes a reduction of treated effluent flow from the wastewater treatment plant into a surface water body with beneficial uses dependent on flow without the approval of the Division of Water Rights.

5. The State or Regional Water Board, upon a finding of non-compliance with this General Order, may revoke an Administrator's authority to issue Water Recycling Use Permits.

6. The State Water Board will review this General Order periodically and may revise the requirements as deemed necessary.

7. Users shall comply with all requirements of other applicable WDRs or waivers of WDRs, including without limitation WDRs or waivers regulating agricultural discharges from irrigated lands.

8. The Administrators shall comply with the MRP issued with the NOA, as specified by the Regional Water Board's Executive Officer or State Water Board's Executive Director (or designee). A model MRP is provided as Attachment B. However, the State Water Board's Executive Director (or designee) may modify or replace the MRP when deemed necessary.

CERTIFICATION

The undersigned, Clerk to the State Water Board, does hereby certify that the foregoing is a full, true, and correct copy of an order duly and regularly adopted at a meeting of the State Water Resources Control Board held on June 7, 2016.

AYE:	Chair Felicia Marcus Vice Chair Frances Spivy-Weber Board Member Tam M. Doduc Board Member Steven Moore Board Member Dorene D'Adamo
NAY:	None
ABSENT:	None
ABSTAIN:	None

Jeanine Townsend
Clerk to the Board

Attachments:

A. Notice of Intent (NOI) - General Instructions
B. Monitoring and Reporting Program
C. Standard Provisions & Reporting Requirements
D. Definition of Terms

ATTACHMENT A: NOTICE OF INTENT (NOI) – GENERAL INSTRUCTIONS
ORDER WQ 2016-0068-DDW
WATER RECLAMATION REQUIREMENTS
FOR RECYCLED WATER USE

WHO MAY APPLY

This Order is intended to serve as a statewide General Order for use of recycled water. It may be used to (1) replace waste discharge requirements (WDRs) / water reclamation requirements (WRR) , or a conditional waiver of WDRs; (2) serve as an additional authorization for new uses of recycled water not previously permitted, issued to any of the following:

a. Producers of recycled water. Producers may be publicly or privately owned. A Producer will typically produce recycled water that meets the requirements of the Uniform Statewide Recycling Criteria. A Producer may also act as an Administrator.

b. Distributors of recycled water. In some cases, a Distributor may provide additional treatment (such as disinfection) to meet the Uniform Statewide Recycling Criteria for its intended use, and distribute it to Users. A Distributor is not required to take physical possession of the recycled water and may act simply as an Administrator.

c. Users of recycled water: Users take physical possession of the recycled water from a Producer or Distributor for an approved beneficial recycled water use consistent with the Uniform Statewide Recycling Criteria. Users may use the recycled water under a Water Recycling Use Permit from an Administrator or act as an Administrator.

d. A legal entity such as a joint powers agreement or equivalent contractual agreement between a Producer, Distributor, irrigation district, or other entity. Similar to a Distributor, a legal entity is not required to take physical possession of the recycled water and may act simply as an Administrator.

Applicants that have been previously issued an order authorizing water recycling may be able to submit an abbreviated information package. Such applicants should contact Regional Water Board and State Water Board staff to determine the application information needs.

Enrollees covered under Order WQ 2014-0090-DWQ who wish to continue coverage must acknowledge in writing their consent to coverage under this General Order. Enrollees who submit the required documentation will automatically be covered under this General Order. The State Water Board will provide existing enrollees with a form for this purpose. A new NOI is not required if the project has not materially changed.

Any applicant whose NOI is pending on the date this General Order is adopted must update its NOI to request coverage under this General Order. If the NOI is approved before the Effective Date, the applicant will be enrolled in Order WQ 2014-0090-DWQ

until the Effective Date and coverage under this General Order will commence on the Effective Date.

WHERE TO APPLY

An applicant should submit an NOI to their applicable Regional Water Board and submit a Title 22 Engineering Report to the applicable State Water Board Division of Drinking Water Field Operations Branch office. The NOI cannot be considered complete until the responsible staff in the State Water Board provides a Title 22 Engineering Report approval letter. An Applicant proposing to administer a water recycling program that covers recycled water use areas within multiple Regional Water Board jurisdictions and is therefore seeking General Order coverage from multiple Regional Water Boards may submit an NOI to the State Water Board.

WHEN TO APPLY

An applicant should normally file the NOI at least 90 days prior to the project start.

WHAT TO FILE

The NOI shall include a water recycling program technical report containing the following information:

SECTION I - FACILITY/WASTE TREATMENT INFORMATION

Description of existing and/or proposed treatment, storage, and transmission facilities for water recycling (much of this may be from current orders/reports, but should be updated if necessary). This shall include the type and level of wastewater treatment for water recycling applications, estimated seasonal flows of recycled water, and a summary of monitoring data that describes the chemical, physical, and disinfection characteristics of the recycled water. A copy of the approved Title 22 Engineering Report and the corresponding State Water Board approval letter, shall be included in the submittal.

SECTION II – RECYCLED WATER APPLICATION

Describe how recycled water will be used. This should include the following information:

a. Administrator owned/controlled uses

    1. An estimated amount of recycled water used at use area(s)

2. Relevant information regarding use type and use area (e.g. for agricultural irrigation use, provide information on irrigation type, acreage, and locations; for hydrostatic testing of utility pipelines, provide information on project locations, schedule/duration of testing, and type of utility pipeline; etc.).

3. A proposed Implementation or Operations and Management plan (Plan). For uses with frequent or routine application (such as irrigation), the Plan shall specify agronomic rates and nutrient application for the use area(s) and a set of reasonably practicable measures to ensure compliance with this General Order. For uses with infrequent or non-routine applications, the Plan shall specify a list of practices to ensure compliance with this General Order. The Plan may include a water and nutrient budget for use area(s), site supervisor training, periodic inspections, or other appropriate measures. An Administrator may submit a nutrient management plan developed to comply with another Water Board order, such as waste discharge requirements or a waiver regulating discharges from irrigated lands, in lieu of an Implementation or Operations and Management Plan.

b. Non-Administrator owned/controlled uses or contracted user applications (use areas that consist of small lots, e.g., residential/ industrial developments, roadway median irrigation, etc., may be aggregated to combine acreage for calculation purposes.)

1. List of Users receiving or proposing to receive recycled water (including a list of uses of recycled water for each User).

2. An estimated amount of recycled water used at use area(s) of each User.

3. A proposed Implementation or Operations and Management plan (Plan). For uses with frequent or routine application (such as irrigation), the Plan shall specify agronomic rates and nutrient application for the use area(s) and a set of reasonably practicable measures to ensure compliance with this General Order. For uses with infrequent or non-routine applications, the Plan shall specify a list of practices to ensure compliance with this General Order. The Plan may include a water and nutrient budget for use area(s), site supervisor training, periodic inspections, or other appropriate measures. This requirement does not apply to the extent Users are subject to WDRs or waivers of WDRs that require implementation of nutrient management plans.

4. Descriptions/maps of use area(s).

5. Method(s) of conveyance to Users.

SECTION Ill - DESCRIPTION OF WATER RECYCLING PROGRAM

The Administrator's water recycling program should be fully described as follows:

a. Description of the Administrator agency's authority, rules, and/or regulations
b. Design and implementation of program
c. Cross-connection testing responsibilities and procedures
d. Monitoring and Reporting Program
e. Use area inspection program
f. Operations and Maintenance program
g. Compliance program
h. Employee and User Training
i. Emergency procedures and notification

SECTION IV - ADDITIONAL SITE SPECIFIC CONDITIONS

If existing orders have additional site specific conditions and/or restrictions not covered in the General Order, they shall be described here. If a CEQA document for the project was prepared, include a copy of the certified or adopted document(s).

SECTION V - WATER RECYCLING PROGRAM ADMINISTRATION

Describe organization and responsibilities of pertinent personnel involved in the water recycling program. Provide the name(s), title(s) and phone number(s) of contact person(s) who are charged with operation/oversight of the water recycling program. Identify all agencies or entities involved in the production, distribution, and use of recycled water, and include a description of legal arrangements, such as, but not limited to, charters, agreements, or Memorandum of Understanding. Copies of such legal documents and organizational charts may be useful.

ATTACHMENT B: MONITORING AND REPORTING PROGRAM
ORDER WQ 2016-0068-DDW
WATER RECLAMATION REQUIREMENTS
FOR RECYCLED WATER USE

This monitoring and reporting program (MRP) describes requirements for monitoring a recycled water system. This MRP is issued pursuant to Water Code section 13267. The Administrator shall not implement any changes to this MRP unless and until a revised MRP is issued by the Regional Water Quality Control Board (Regional Water Board) Executive Officer.

The State Water Resources Control Board (State Water Board) and Regional Water Boards are transitioning to the paperless office system.

During the life of this General Order, the State Water Board or Regional Water Board may require the Administrator to electronically submit reports using the State Water Board's California Integrated Water Quality System (CIWQS) program or an alternative database. Electronic submittal procedures will be provided when directed to begin electronic submittals. Until directed to electronically submit reports, the Administrator shall submit hard copy reports.

In some regions, Administrators will be directed to submit reports (both technical and monitoring reports) to the State Water Board's GeoTracker database over the Internet in portable document format (pdf). In addition, analytical data shall be uploaded to the GeoTracker database under a site-specific global identification number. Information on the GeoTracker database is provided on the Internet at:

<http://www.waterboards.ca.gov/ust/electronic_submittal/index.shtml>

The Administrator has applied for and received coverage for the recycled water system that is subject to the notice of applicability (NOA) of Water Quality Order 2016-0068-DDW. The reports are necessary to ensure that the Administrator complies with the NOA and General Order. Pursuant to California Water Code section 13267, the Administrator shall implement this MRP and shall submit the monitoring reports described herein.

All samples shall be representative of the volume and nature of the discharge or matrix of material sampled. The name of the sampler, sample type (grab or composite), time, date, location, bottle type, and any preservative used for each sample shall be recorded on the sample chain of custody form. The chain of custody form must also contain all custody information including date, time, and to whom samples were relinquished. If composite samples are collected, the basis for sampling (time or flow weighted) shall be approved by Regional Water Board staff.

Field test instruments (such as those used to test pH, dissolved oxygen, and electrical conductivity) may be used provided that they are used by a California Environmental Laboratory Program (ELAP) certified laboratory or:

1. The user is trained in proper use and maintenance of the instruments;
2. The instruments are field calibrated prior to monitoring events at the frequency recommended by the manufacturer;
3. Instruments are serviced by the manufacturer or authorized representative at the recommended frequency; and
4. Field calibration reports are maintained and available for at least three years.

Monitoring requirements listed below may duplicate existing requirements under other orders including WDRs or waivers of WDRs that regulate agricultural discharges from irrigated lands. Duplication of sampling and monitoring activities are not required if the monitoring activity satisfies the requirements of this General Order. Collecting composite samples is acceptable in most cases. The facility may continue using existing sampling collection equipment that is consistent with the applicable facility order. However, due to short sample holding times, bacteriological samples collected to verify disinfection effectiveness must be grab samples. In addition to submitting the results under another order, the results shall be submitted in the reports required by this General Order.

All of the monitoring listed below may not be applicable to all recycled water projects. Consult the NOA or Regional Water Board staff to determine applicable requirements.

RECYCLED WATER MONITORING

If recycled water is used for irrigation of landscape areas[1], priority pollutant monitoring is required at the production facility. The frequency of monitoring corresponds to the flow rate of the recycled water use. Sampling shall be consistent with the following:

Constituent	Treatment System Flow Rate	Sample Frequency	Reporting Frequency
Priority Pollutants	< 1mgd	5 years	The next annual report.
	≥ 1mgd	Annually	Annually

mgd denotes million gallons per day.

1 Landscape areas are defined as parks; greenbelts, playgrounds; school yards; athletic fields; golf courses; cemeteries; residential landscaping; common areas; commercial landscaping (except eating areas); industrial landscaping (except eating areas); freeway, highway, and street landscaping.

DISINFECTION SYSTEM MONITORING

If disinfection is performed, samples shall be collected from downstream of the disinfection system and analyzed by an approved laboratory per Title 22, section 60321(a). Depending upon the level of disinfection and recycled water application to land, monitoring requirements vary. Disinfection monitoring shall be customized to the site-specific conditions from the following:

Constituent/Parameter	Units	Sample Type	Sample Frequency	Reporting Frequency
Total Coliform Bacteria	MPN/100 mL[(a)]	Grab	TBD [(b)]	TBD [(c)]
Turbidity	NTU[(a)]	Grab/Meter	TBD [(b)]	TBD [(c)]

[(a)] MPN/100 mL denotes most probable number per 100 mL sample. NTU denotes nephelometric turbidity unit.

[(b)] TBD (to be determined) shall be specified in the NOA or as required by California Code of Regulations, title 22 section 60321.

(c) TBD (to be determined) shall be specified in the NOA or as required by CCR, title 22, section 60329(c).

POND SYSTEM MONITORING

In some cases, recycled water storage ponds may be used to store recycled water when it is not needed. These monitoring requirements apply only to ponds permitted through this General Order. Ponds covered by an existing order shall continue to be monitored in accordance with that order. Pond(s) containing recycled water shall be monitored for the following:

Parameter	Units	Sample Type	Sample Frequency[(a)]	Reporting Frequency
Freeboard	0.1 feet	Measurement	Quarterly	Annually
Odors	--	Observation	Quarterly	Annually
Berm condition	--	Observation	Quarterly	Annually

[(a)] Or less frequently if approved by the Regional Water Board Executive Officer

USE AREA MONITORING

The Administrator shall monitor use areas(s) at a frequency appropriate to determine compliance with this General Order and the Administrator's recycled water use program requirements. An Administrator may assign monitoring responsibilities to a User as part of the Water Recycling Use Permit program; the Administrator retains responsibility to ensure the data is collected, as well as prepare and submit the annual report.

The following shall be recorded for each user with additional reporting for use areas as appropriate. The frequency of use area inspections shall be based on the complexity and risk of each use area. Use areas may be aggregated to combine acreage for calculation or observation purposes. Use area monitoring shall include the following parameters:

Parameter	Units	Sample Type	Sampling Frequency[(a)]	Reporting Frequency
Recycled Water User	--	--	--	Annually
Recycled Water Flow	gpd[(b)]	Meter[(c)]	Monthly	Annually
Acreage Applied[(d)]	Acres	Calculated	--	Annually
Application Rate	inches/acre/year	Calculated	--	Annually
Soil Saturation/Ponding	--	Observation	Quarterly	Annually
Nuisance Odors/Vectors	--	Observation	Quarterly	Annually
Discharge Off-Site	--	Observation	Quarterly	Annually
Notification Signs[(e)]	--	Observation	Quarterly	Annually

[(a)] Or less frequently if approved by the Regional Water Board Executive Officer.
[(b)] gpd denotes gallons per day.
[(c)] Meter requires meter reading, a pump run time meter, or other approved method.
[(d)] Acreage applied denotes the acreage to which recycled water is applied.
[(e)] Notification signs shall be consistent with the requirements of California Code of Regulations, title 22, section 60310 (g).

COOLING/INDUSTRIAL/OTHER USES OF RECYCLED WATER

If recycled water is used for industrial, commercial cooling, or air conditioning in which a mist is generated, the cooling system shall comply with California Code of Regulations, title 22, section 60306 (c).

DUAL PLUMBED RECYCLED WATER SYSTEMS

If dual plumbed recycled water systems are proposed, consult with State Water Board for additional reporting, design, and operation requirements. The frequency of testing for cross connection and backflow prevention devices shall be as listed below or more frequently if specified by State Water Board.

Requirement	Frequency	Reporting Frequency
Cross Connection Testing	Four Years[(a)]	30 days/Annually[(b)]
Backflow Incident	--	24 hours from discovery
Backflow Prevention Device Testing and Maintenance	Annually[(c)]	Annually

(a) Testing shall be performed at least every four years, or more frequently at the discretion of the State Water Board Division of Drinking Water.
(b) Cross connection testing shall be reported pursuant to California Code of Regulations, title 22, section 60314. The report shall be submitted to State Water Board within 30 days and included in the annual report to the Regional Water Board.
(c) Backflow prevention device maintenance shall be tested by a qualified person as described in California Code of Regulations, title 17, section 7605.

REPORTING

In reporting monitoring data, the Administrator shall arrange the data in tabular form so that the date, data type (e.g., flow rate, bacteriological, etc.), and reported analytical or visual inspection results are readily discernible. The data shall be summarized to illustrate compliance with this General Order and NOA as applicable. The results of any monitoring done more frequently than required at the locations specified in the MRP shall be reported in the next regularly scheduled monitoring report and shall be included in calculations as appropriate.

During the life of this General Order, the State Water Board or Regional Water Board may require the Administrator to electronically submit reports using the State Water Board's California Integrated Water Quality System (CIWQS) program or an alternative database. Electronic submittal procedures will be provided when directed to begin electronic submittals. Until directed to electronically submit reports, the Administrator shall submit hard copy reports.

A. Annual Report

Annual Reports shall be submitted to the Regional Water Board by **April 1st following the monitoring year**. The Annual Report shall include the following:

1. A summary table of all recycled water Users and use areas. Maps may be included to identify use areas. Newly permitted recycled water Users and use areas shall be identified. When applicable, supplement to the Title 22 Engineering Report and the State Water Board approval letter supporting those additions shall be included.
2. A summary table of all inspections and enforcement activities initiated by the Administrator. Include a discussion of compliance and the corrective action taken, as well as any planned or proposed actions needed to bring the discharge into compliance with the NOA and/or General Order. Copies of documentation of any enforcement actions taken by the Administrator shall be provided.
3. An evaluation of the performance of the recycled water treatment facility, including discussion of capacity issues, system problems, and a forecast of the flows anticipated in the next year.

4. Tabular and graphical summaries of all monitoring data collected during the year, including priority pollutant monitoring, if required.
5. The name and contact information for the recycled water operator responsible for operation, maintenance, and system monitoring.

A letter transmitting the annual report shall accompany each report. The letter shall summarize the numbers and severity of violations found during the reporting period, and actions taken or planned to correct the violations and prevent future violations. The transmittal letter shall contain the following penalty of perjury statement and shall be signed by the Administrator or the Administrator's authorized agent:

"I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of the those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment."

The Administrator shall implement the above monitoring program.

ATTACHMENT C: STANDARD PROVISIONS AND REPORTING REQUIREMENTS
ORDER WQ 2016-0068-DDW
WATER RECLAMATION REQUIREMENTS
FOR RECYCLED WATER USE

A. GENERAL PROVISIONS

1. Duty to Comply

   a. An Administrator must comply with all of the conditions of this General Order and the MRP. Any General Order or MRP non-compliance constitutes a violation of the Water Code and/or Basin Plan and is subject to enforcement action.

   b. The filing of a request by the Administrator for a modification, revocation and reissuance, termination, a notification of planned changes, or anticipated non-compliance does not stay any General Order or MRP condition.

2. Duty to Mitigate

   The Administrator shall take all reasonable steps to minimize or prevent any discharge in violation of this General Order which has a reasonable likelihood of adversely affecting public health or the environment, including such accelerated or additional monitoring as requested by the State or Regional Water Board to determine the nature and impact of the violation.

3. Property Rights

   This General Order does not convey any property rights of any sort or any exclusive privileges. The requirements prescribed herein do not authorize the commission of any act causing injury to the property of another, nor protect the discharger from liabilities under federal, state, or local laws.

4. Duty to Provide Information

   The Administrator shall furnish, within a reasonable time, any information the Regional Water Board may request to determine whether cause exists for modifying, revoking and reissuing, or terminating the General Order coverage. The Administrator shall also furnish to the Regional Water Board, upon request, copies of records required to be kept by its General Order.

5. Availability

   A copy of this General Order, the NOA, and the MRP shall be maintained at the Administrator facilities and be available at all times to operating personnel.

B. GENERAL REPORTING REQUIREMENTS

1. Signatory Requirements

   a. All reports required by this General Order and other information requested by the Regional Water Board shall be signed by the Administrator principal owner or operator, or by a duly authorized representative of that person.

Duly authorized representative is one whose:

1) Authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as general manager in a partnership, manager, operator, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position), and

2) Written authorization is submitted to the Regional Water Board. If an authorization becomes no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements above must be submitted to the Regional Water Board prior to or together with any reports, information, or applications to be signed by an authorized representative.

b. Certification

All reports signed by a duly authorized representative under Provision C.1 shall contain the following certification:

"I certify under penalty of law that this document and all attachments are prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who managed the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

2. Should the responsible reporting party discover that it failed to submit any relevant facts or that it submitted incorrect information in any report, it shall promptly submit the missing or correct information. All violations of any requirements in this General Order, including Uniform Statewide Recycling Criteria requirements shall be submitted in the annual self-monitoring reports.

3. False Reporting

Any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this General Order, including monitoring reports or reports of compliance or non-compliance shall be subject to enforcement procedures as identified in Section C of these Provisions.

C. ENFORCEMENT

1. The provision contained in this enforcement section shall not act as a limitation on the statutory or regulatory authority of the State and Regional Water Board.
2. Any violation of this General Order constitutes violation of the Water Code and regulations adopted thereunder, and are the basis for enforcement action, General Order termination, General Order revocation and reissuance, denial of an application for General Order reissuance, or a combination thereof.
3. The State and Regional Water Board may impose administrative civil liability, may refer a discharger to the State Attorney General to seek civil monetary penalties, may seek injunctive relief or take other appropriate enforcement action as provided in the Water Code for violation of this General Order.

ATTACHMENT D: DEFINITION OF TERMS
ORDER WQ 2016-0068-DDW
WATER RECLAMATION REQUIREMENTS
FOR RECYCLED WATER USE

Definitions noted with (*) are from the Uniform Statewide Recycling Criteria. The definitions are provided in this Attachment for convenience and are subject to revisions should the codes are formally revised. Please refer to the formal published codes [Health & Safety Code or Title 22 of the California Code Regulations] to obtain the latest version.

Administrator: An Administrator is an entity (Producer, Distributor, User, or legal entity) that submits an NOI and application fee to the Regional Water Board for coverage under this General Order. An Administrator may issue use permits for uses of recycled water consistent with the Uniform Statewide Recycling Criteria. An Administrator is responsible for coordinating, collecting data, and reporting the monitoring reports to the Regional Water Board.

Agronomic Rates: The rate of application of recycled water to plants necessary to satisfy the plants' evapotranspiration requirements, considering allowances for supplemental water (e.g., effective precipitation), irrigation distribution uniformity, and leaching requirement, thus minimizing the movement of nutrients below the plants' root zone.

Coagulated Wastewater *: Oxidized wastewater in which colloidal and finely divided suspended matter have been destabilized and agglomerated upstream from a filter by the addition of suitable floc-forming chemicals.

Conventional Treatment *: A treatment chain that utilizes a sedimentation unit process between the coagulation and filtration processes and produces an effluent that meets the definition for disinfected tertiary recycled water.

Disinfected Secondary-23 *: Recycled water that has been oxidized and disinfected so that the median concentration of total coliform bacteria in the disinfected effluent does not exceed a most probable number (MPN) of 23 per 100 milliliters using the bacteriological results of the last seven days for which analyses have been completed, and the number of coliform bacteria does not exceed an MPN of 240 per 100 milliliters in more than one sample in any 30 day period.

Disinfected Secondary-2.2 *: Recycled water that has been oxidized and disinfected so that the median concentration of total coliform bacteria in the disinfected effluent does not exceed a most probable number (MPN) of 2.2 per 100 milliliters utilizing the bacteriological results of the last seven days for which analyses have been completed, and the number of coliform organisms does not exceed an MPN of 23 per 100 milliliters in more than one sample in any 30 day period.

Disinfected Tertiary Recycled Water *: A filtered and subsequently disinfected wastewater that meets the following criteria:

(a) The filtered wastewater which has been disinfected by either:

(1) A chlorine disinfection process following filtration that provides a contact time (CT, the product of total chlorine residual and modal contact time measured at the same point) value of not less than 450 milligram-minutes per liter at all times with a modal contact time of at least 90 minutes, based on peak dry weather design flow; or

(2) A disinfection process that, when combined with the filtration process, has been demonstrated to inactivate and/or remove 99.999 percent of the plaque forming units of F-specific bacteriophage MS2, or polio virus in the wastewater. A virus that is at least as resistant to disinfection as polio virus may be used for purposes of the demonstration.

(b) The median concentration of total coliform bacteria measured in the disinfected effluent does not exceed an MPN of 2.2 per 100 milliliters utilizing the bacteriological results of the last seven days for which analyses have been completed and the number of total coliform bacteria does not exceed an MPN of 23 per 100 milliliters in more than one sample in any 30 day period. No sample shall exceed an MPN of 240 total coliform bacteria per 100 milliliters.

Disinfected Wastewater *: Wastewater in which the pathogenic organisms have been reduced by chemical, physical or biological means. For the purposes of this General Order, disinfected wastewater is safe for use when applied consistent with the requirements of the Uniform Statewide Recycling Criteria.

Distributor: A private or public agency which receives recycled water from a Producer for the purpose of distribution to Users. In some cases, a distributor may provide additional treatment (such as disinfection) to meet the Uniform Statewide Recycling Criteria for its intended use, and distributes it to Users. A Distributor may not take physical possession of the recycled water and may act simply as an Administrator.

Dual Plumbed System *: A system that utilizes separate piping systems for recycled water and potable water within a facility and where the recycled water is used for either of the following purposes:

a) To serve plumbing outlets (excluding fire suppression systems) within a building or

b) Outdoor landscape irrigation at individual residences.

Filtered Wastewater *: An oxidized wastewater that meets the criteria in the subsection 1 or 2:

(1) Has been coagulated and passed through natural undisturbed soils or a bed of filter media pursuant to the following:

a. At a rate that does not exceed 5 gallons per minute per square foot of surface area in mono, dual or mixed media gravity, upflow or pressure filtration systems, or does not exceed 2 gallons per minute per square foot of surface area in travelling automatic backwash filters; and

b. So that the turbidity of the filtered wastewater does not exceed any of the following:

i. An average 2 NTU within a 24-hour period;

ii. 5 NTU more than 5 percent of the time within a 24-hour period; and

iii. 10 NTU at any time

(2) Has been passed through a microfiltration, ultrafiltration, nanofiltration, or reverse osmosis membrane so that the turbidity of the filtered wastewater does not exceed any of the following:

a. 0.2 NTU more than 5 percent of the time within a 24-hour period; and

b. 0.5 NTU at any time

F-specific bacteriophage MS-2 *: A strain of a specific type of virus that infects coliform bacteria that is traceable to the American Type Culture Collection (ATCC 15597B1) and is grown on lawns of E. Coli (ATCC 15597).

Incidental Runoff: Unintended small amounts (volume) of runoff from recycled water use areas, such as unintended, minimal over-spray from sprinklers that escapes the recycled water use area. Water leaving a recycled water use area is not considered incidental if it is part of the facility design, if it is due to excessive application, if it due to intentional overflow or application, or if it is due to negligence.

Legal Entity: A legal entity is an entity formed by a legal document (such as a joint powers agreement or equivalent contractual agreement) between a Producer, Distributor, irrigation district, or other entity. Similar to a Distributor, a legal entity may not take physical possession of the recycled water and may act simply as an Administrator.

Modal Contact Time *: The amount of time elapsed between the time that a tracer, such as salt or dye, is injected into the effluent at the entrance to a chamber and the time that the highest concentration of the tracer is observed in the effluent from the chamber.

Nonrestricted Recreational Impoundment *: An impoundment of recycled water, in which no limitations are imposed on body-contact water recreational activities.

NTU (Nephelometric Turbidity Unit) *: A measurement of turbidity as determined by the ratio of the intensity of light scattered by the sample to the intensity of incident light scattered by the sample to the intensity of incident light as measured by method 2130 B. in Standard Methods for the Examination of Water and Wastewater, 20th ed.; Eaton, A.D., Clesceri, L.S., and Greenberg, A.E., Eds; American Public Health Association: Washington, DC, 1995; p.2-8.

Oxidized Wastewater *: Wastewater in which the organic matter has been stabilized, is nonputrescible, and contains dissolved oxygen.

Recycled Water Producer: Any entity that produces recycled water.

Recycled Water: Means water which, as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur therefore considered a valuable resource. (Wat. Code, § 13050(n).) Coverage under these Water Reclamation Requirements for Recycled Water Use (General Order) is limited to treated municipal wastewater for non-potable uses.

Recycled Water Supervisor: A person designated, by the Administrator that acts as the coordinator between the supplier and User. The Recycled Water Supervisor shall have authority to ensure recycled water use complies with the General Order, NOA, and the Uniform Statewide Recycling Criteria.

Regional Water Board: All references to a Regional Water Board include the Executive Officer, who may act for the Regional Water Board in carrying out this General Order. See Water Code section 13223.

Restricted access golf course *: A golf course where public access is controlled so that areas irrigated with recycled water cannot be used as if they were part of a park, playground, or school yard and where irrigation is conducted only in areas and during periods when the golf course is not being used by golfers.

Restricted Recreational Impoundment *: An impoundment of recycled water in which recreation is limited to fishing, boating, and other non-body-contact water recreational activities.

Spray Irrigation *: The application of recycled water to plants to maintain vegetation or support growth of vegetation by applying it from sprinklers.

State Water Board: All references to the State Water Board refer to divisions within the State Water Board whose roles in carrying out this General Order are as following:

- Division of Drinking Water reviews and approves (Title 22 Engineering Report and provide recommendations to the Regional Water Boards to address protection of public health. Division of Drinking Water is also processes any Notice of Intent submitted by a potential enrollee needing coverage from multiple Regional Water Boards.
- Division of Water Rights is responsible for approval of wastewater change petitions for water recycling projects that will decrease the amount of water in a stream or other waterway.

Surface Irrigation: Application of recycled water by means other than spraying such that contact between the edible portion of any food crop and recycled water is prevented (i.e., drip or flood irrigation).

Title 22 Engineering Report : Engineering report prepared to describe the manner by which a project or a water recycling program will comply with the Uniform Statewide Recycling Criteria.

Undisinfected Secondary *: Means oxidized wastewater.

Use Area: An area of recycled water use with defined boundaries. Agricultural use areas may contain one or more facilities (ditch, irrigated fields, pumping stations, etc.); use areas may also consist of an aggregate of small lots (e.g., residential/ industrial developments, roadway median irrigation, etc.).

Use Area Supervisor: A person designated, by the owner or manager of the property upon which recycled water will be applied, to discharge the responsibility of the owner or manager of the property for: (a) installation, operation and maintenance of a system that enables recycled water to be used; (b) for prevention of potential hazards; (c) implementing and complying with conditions of all Water Recycling Use Permits and associated documents; (d) coordination with the cross-connection control program of the supplier of drinking water and the local health/environmental health agency; (e) control of on-site piping to prevent any cross connections with potable water supplies; (f) routine inspection and maintenance of backflow prevention devices. (A Recycled Water Supervisor and Use Area Supervisor may be one in the same in some instances).

User: Users take physical possession of the recycled water from Producer and/or Distributor for an approved beneficial recycled water use consistent with the Uniform Statewide Recycling Criteria. Users may use the recycled water under either a Water Recycling Use Permit from an Administrator or act as an Administrator under this General Order.

Water Recycling Use Permit: A permit issued by the Administrator to the Recycled Water User, which is consistent with the requirements specified in this General Order.

ATTACHMENT C

California Regional Water Quality Control Board
North Coast Region

Monitoring and Reporting Program
Order No. 2016-0068-DDW-R1001

FOR THE

CITY OF HEALDSBURG
RECYCLED WATER PROGRAM
WDID NO. 1B15092RSON

SONOMA COUNTY

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Tables

The City of Healdsburg (hereinafter Administrator) has applied for and received coverage for its recycled water system that is subject to the notice of applicability (NOA) of enrollment under Order WQ 2014-0090-DWQ, General Waste Discharge Requirements for Recycled Water Use through August 5, 2016 and Order WQ 2016-0068-DDW effective on and after August 6, 2016. Both orders (and any future revisions) are hereinafter referred to as the General Order. The General Order delegates the responsibility of administering water recycling programs to a designated Administrator to the fullest extent possible. The City of Healdsburg will act as the Administrator of the City's Recycled Water Program. The details of the enrollment are described in NOA No. WQ 2014-0090-R1001-01/WQ 2016-0068-DDW-R1001 issued by the North Coast Regional Water Quality Control Board (Regional Water Board) Executive Officer on July 1, 2016 and effective July 1, 2016.

This monitoring and reporting program (MRP) replaces the MRP in the General Order and serves as a project-specific MRP to address use area specific water quality concerns. In addition, water recycling specifications and requirements, including monitoring requirements that apply to the production of recycled water, are established in Order No. R1-2010-0034, Waste Discharge Requirements (WDR) and Master Reclamation Permit (through July 31, 2016) and Order No. R1-2016-0015, Waste Discharge Requirements (WDR) and Water Recycling Requirements (WRR) (beginning August 1, 2016) for the City of Healdsburg Wastewater Treatment, Recycling, and Disposal Facility, Sonoma County (NPDES No. CA0025135 and WDID No. 1B82046OSON) and the MRPs associated with these orders.

This MRP describes requirements for monitoring a recycled water system. This MRP is issued pursuant to Water Code section 13267 and establishes monitoring and reporting requirements that implement California regulations. The Administrator shall not implement any changes to this MRP unless and until a revised MRP is issued by the Regional Water Board Executive Officer or the State Water Board Executive Director. The Administrator shall implement this monitoring and reporting program.

I. GENERAL MONITORING PROVISIONS

A. Wastewater Monitoring Provision. Composite samples may be taken by a proportional sampling device approved by the Executive Officer or by grab samples composited in proportion to flow. In compositing grab samples, the sampling interval shall not exceed 1 hour.

B. Supplemental Monitoring Provision. If the Administrator monitors any pollutant more frequently than required by this Order, using test procedures approved by 40 C.F.R. part 136 or as specified in this Order, the results of such monitoring shall be included in the calculation and reporting of the data submitted in the monthly and annual discharge monitoring reports.

C. Data Quality Assurance Provision. Laboratories analyzing monitoring samples shall be certified by the State Water Resources Control Board (State Water Board), Division of Drinking Water (DDW) in accordance with the provisions of Water Code section 13176, and must include quality assurance/quality control data with their analytical reports.

D. Sample Documentation. All samples shall be representative of the volume and nature of the discharge or matrix of material sampled. The name of the sampler, sample type (grab or composite), time, date, location, bottle type, and any preservative used for each sample shall be recorded on the sample chain of custody form. The chain of custody form must also contain all custody information including date, time, and to whom samples were relinquished. If composite samples are collected, the basis for sampling (time or flow weighted) shall be approved by Regional Water Board staff.

E. Instrumental and Calibration Provision. All monitoring instruments and devices used by the Administrator to fulfill the prescribed monitoring program shall be properly maintained and

calibrated as necessary to ensure their continued accuracy. All flow measurement devices shall be calibrated no less than the manufacturer's recommended intervals or one year intervals, (whichever comes first) to ensure continued accuracy of the devices.

F. Field test Instruments. Field test instruments (such as those used to test pH, dissolved oxygen, and electrical conductivity) may be used provided that they are used by a California Environmental laboratory Program (ELAP) certified laboratory or:

1. The user is trained in proper use and maintenance of the instruments;

2. The instruments are field calibrated prior to monitoring events at the frequency recommended by the manufacturer;

3. Instruments are serviced by the manufacturer or authorized representative at the recommended frequency; and

4. Field calibration reports are maintained and available for at least three years.

G. Minimum Levels (ML) and Reporting Levels (RL). Compliance monitoring analyses shall be conducted using detection limits that are lower than the applicable effluent limitations and/or water quality criteria. If no Minimum Level (ML) value is below these levels, the lowest ML shall be selected as the Reporting Level (RL).

H. Duplicative Monitoring Requirements. If monitoring requirements listed below duplicate existing monitoring requirements under other orders including WDRs or waivers of WDRs, then duplication of sampling and monitoring activities are not required if the monitoring activity satisfies the requirements of this Order. In addition to submitting the results under another order, the results shall be submitted in the reports required by the General Order and this MRP.

I. Approved Test Methods. All monitoring must be conducted using approved test methods or other test methods specified in this MRP.

J. Sampling Method. Collecting composite samples is acceptable in most cases. Due to short holding times, bacteriological samples collected to verify disinfection effectiveness must be grab samples.

MRP Nos. R1-2010-0034 and R1-2016-0015 establish Monitoring Location REC-001 as the location for monitoring the production of recycled water from the WWTF. REC-001 samples are collected at a point following disinfection but prior to discharge to a 25 million gallon recycled water storage pond operated and maintained by the Administrator. This MRP establishes Monitoring Location REC-002 as the location for monitoring the quality of the recycled water distributed to recycled water users. REC-002 samples are to be collected at a location where a representative sample of recycled water to be distributed can be collected following all treatment and storage in the 25 million gallon recycled water storage pond and immediately before the distribution system.

II. RECYCLED WATER MONITORING REQUIREMENTS

A. Monitoring Location REC-001 and INT-001B. The Administrator currently monitors treated, disinfected wastewater that will be recycled prior to discharge to the 25 million gallon recycled water storage pond at Monitoring Locations INT-001B and REC-001 and submits monitoring results pursuant to reporting requirements established in WDR Order No. R1-2010-0034 (through August 5, 2016) and WDR/WRR Order No. R1-2016-0015 (beginning August 6, 2016), as detailed in Table 1 below. These requirements are included in this MRP for informational purposes. Under this MRP, the Administrator will be required to conduct monitoring at location REC-002 as detailed in Provision II.B of this MRP.

Table 1. Recycled Water Monitoring[1]

Parameter	Units	Sample Type	Minimum Sampling Frequency	Required Analytical Test Method[2]
Effluent Flow[3]	mgd	Meter	Continuous	--
Biochemical Oxygen Demand 5-day @ 20°C (BOD_5)	mg/L	Grab	Weekly	Standard Methods
Total Suspended Solids (TSS)	mg/L	Grab	Weekly	Standard Methods
pH	s.u.	Grab	Weekly	Standard Methods
Total Coliform Bacteria	MPN/100 mL	Grab	Daily	Standard Methods
Turbidity	NTU	Meter	Continuous	---

Table Notes:

1. Recycled water monitoring occurs at REC-001, with the exception of turbidity which is monitored at INT-001B. These monitoring locations are defined in WDR Order No. R1-2016-0015 as:
   a. REC-001 follows disinfection, but prior to discharge to recycled water storage pond.
   b. INT-001B is immediately following the tertiary filters and is used for continuous monitoring of turbidity.
2. In accordance with the current edition of *Standard Methods for Examination of Water and Wastewater* (American Public Health Administration) or current test procedures specified in 40 C.F.R. part 136.
3. Each month, the Administrator shall report the daily average and monthly average flows.

B. Monitoring Location REC-002. The Administrator shall monitor treated, disinfected wastewater that will be recycled after storage in the 25 million gallon recycled water storage pond and prior to distribution at Monitoring Location REC-002 as follows:

Table 2. Recycled Water Monitoring Requirements – Monitoring Location REC-002

Parameter	Units	Sample Type	Minimum Sampling Frequency	Required Analytical Test Method[1]
Effluent Flow[2]	mgd	Meter	Continuous	--
Total Chlorine Residual	mg/L	Grab	Daily[3]	Standard Methods
Ammonia Nitrogen (as N)	mg/L	Grab	Monthly	Standard Methods
Nitrate Nitrogen (as N)	mg/L	Grab	Monthly	Standard Methods
Nitrite Nitrogen (as N)	mg/L	Grab	Monthly	Standard Methods
Organic Nitrogen (as N)	mg/L	Grab	Monthly	Standard Methods
Total Dissolved Solids	mg/L	Grab	Monthly	Standard Methods
Sodium	mg/L	Grab	Monthly	Standard Methods
Chloride	mg/L	Grab	Monthly	Standard Methods
Boron	mg/L	Grab	Monthly	Standard Methods
Priority Pollutants[4]	µg/L	Grab or 24-hour composite[5]	Annually[6]	Standard Methods

Parameter	Units	Sample Type	Minimum Sampling Frequency	Required Analytical Test Method[1]

Table Notes:
1. In accordance with the current edition of *Standard Methods for Examination of Water and Wastewater* (American Public Health Administration) or current test procedures specified in 40 C.F.R. part 136.
2. Each month, the Administrator shall report the daily average and monthly average flows.
3. Chlorine residual monitoring required daily when providing recycled water for urban use.
4. Priority pollutants are listed in Appendix A of 40 Code of Federal Regulations (CFR) Part 423.
5. 24-hour composite sampling shall be used for all priority pollutants, except for those that are volatile. If samples are collected from recycled water storage pond, grab samples are acceptable. This requirement may be satisfied with the priority pollutant analysis that is required pursuant to Monitoring and Reporting Program under Order No. R1-2016-0015 (or any revisions thereto) at Monitoring Location EFF-001.
6. Three priority pollutant monitoring events are required pursuant to MRP No. R1-2016-0015 (and future revisions thereto). To the extent that those events occur in three separate years, the results will satisfy three of the annual priority pollutant monitoring events required for recycled water.

C. Recycled Water Compliance Reporting

The Administrator shall submit the following records regarding the recycled water system with its monitoring reports:

1. A summary of any operational problems, equipment or process malfunctions, including incidents of delivering recycled water that does not meet all recycled water quality requirements as established in WDR Order No. R1-2010-0034 (through August 5, 2016) and R1-2016-0015 (beginning August 6, 2016); and

2. A detailed description of any corrective or preventative actions taken.

III. RECEIVING WATER MONITORING REQUIREMENTS – GROUNDWATER

A. Groundwater Monitoring

1. The Administrator shall monitor groundwater at approved groundwater monitoring locations in agricultural irrigation areas as follows:

Table 3. Groundwater Monitoring Requirements

Parameter	Units	Sample Type	Minimum Sampling Frequency	Required Analytical Test Method[1]
Depth to Groundwater	0.1 feet	Measurement	Quarterly	--
Groundwater Elevation	0.1 feet MSL	Measurement	Quarterly	--
Nitrate (as N)	mg/L	Grab	Quarterly	Standard Methods
Nitrogen, Total (as N)	mg/L	Grab	Quarterly	Standard Methods
Total Dissolved Solids	mg/L	Grab	Quarterly	Standard Methods
Chloride	mg/L	Grab	Quarterly	Standard Methods
Boron	mg/L	Grab	Quarterly	Standard Methods
Sodium	mg/L	Grab	Quarterly	Standard Methods

Table Notes:
1. In accordance with the current edition of *Standard Methods for Examination of Water and Wastewater* (American Public Health Administration) or current test procedures specified in 40 C.F.R. part 136.

2. The Administrator shall submit for Executive Officer approval, a written work plan prepared by a California registered geologist or hydrogeologist that identifies groundwater monitoring locations in existing and/or proposed vineyard recycled water irrigation areas. The written groundwater monitoring work plan shall be submitted by August 1, 2017, and shall include the following:

a. At a minimum, there should be a set of 3 or more groundwater monitoring wells representing the most sensitive conditions at one or more vineyard use sites based on the potential for groundwater impacts (e.g., permeable soils over shallow groundwater). There shall be at least one up-gradient well and two down-gradient wells designed to collect groundwater from an appropriate depth to represent background conditions as well as groundwater that may be affected if infiltrated recycled water reaches groundwater.

b. If existing wells are proposed for use, the work plan shall provide detailed information about the existing wells, including well construction details, including, but not limited to, well depth, screened interval, date of construction, and well log.

c. If new groundwater monitoring wells are proposed, the work plan shall include a well installation work plan that includes:

i. A scope of work;
ii. A time schedule for installing the wells;
iii. Well drilling and development methods;
iv. Proposed well construction diagrams; and
v. Proposed well locations.

d. After installing new groundwater monitoring wells, a written report shall be submitted within 60 days of completing construction that includes:

i. Relevant subsurface stratigraphy and lithology;
ii. A diagram of each well showing total drilled depth, well installation depth and construction details including screened interval and top of casing elevation; and
iii. A location map of all installed wells.

e. A date by which groundwater monitoring will begin.

IV. OTHER MONITORING REQUIREMENTS

A. Visual Monitoring (All Recycled Water Use Areas)

1. Visual observations of the vineyard and industrial use areas shall be recorded a minimum of monthly during periods of recycled water use in order to verify compliance with recycled water requirements in the General Order and NOA and shall confirm proper operation of the recycled water system and associated best management practices (BMPs) and include a record of any malfunctions or findings of improper operation, including, but not limited to, observations for evidence of ponding that exceeds 24 hours, runoff, odors, vectors, leaks or breaks in equipment, proper identification of recycled water infrastructure, proper signage, etc. Visual observations may be performed by the recycled water users in accordance with the Administrator's user agreements. Visual observations shall be recorded and included in the Administrator's Annual Recycled Water Report.

2. The Annual Recycled Water Report shall include the daily volume of recycled water used by each user, by type of use(s) and any observations indicating non-compliance with the provisions of the General Order or NOA.

B. Recycled Water Use

1. The Administrator shall monitor use area(s) at a frequency appropriate to determine compliance with the General Order and the Administrator's recycled water use program requirements. An Administrator may assign monitoring responsibilities to a User as part of the Water Recycling Use Permit program; however the Administrator retains responsibility to ensure the data is collected, as well as prepare and submit the annual report.

2. The following shall be recorded for each user with additional reporting for use areas as appropriate. The frequency of use area inspections shall be based on the complexity and risk of each use area. Use areas may be aggregated to combine acreage for calculation or observation purposes. Use area monitoring shall include the following parameters:

Table 4. Recycled Water Use Area Requirements[1]

Parameter	Units	Sample Type	Minimum Sampling/Observation Frequency[2]
Recycled Water User	---	---	---
Recycled Water Flow[3]	gpd[4]	Meter[5]	Monthly
Acreage Applied[6]	Acres	Calculated	Monthly
Application Rate (hydraulic)	Inches/acre/year	Calculated	Monthly
Total Nitrogen Application Rate[7, 8]	Lbs/acre/month	Calculated	Monthly
Soil Saturation/Ponding	---	Observation	Monthly
Runoff	---	Observation	Monthly
Nuisance Odors/Vectors	---	Observation	Monthly
Notification Signs[9]	---	Observation	Monthly
Rainfall	Inches	Gage	Daily
ETo/ETc[10]	Inches	Gage/Calculation	Daily
Maximum Allowable Hydraulic Agronomic Rate[11]	Inches	Calculation	Annually

Parameter	Units	Sample Type	Minimum Sampling/Observation Frequency[2]

Table Notes:
1. Recycled water production and use area monitoring shall be reported with the annual report (section V.B of this MRP). Non-compliance incidents shall be reported as specified in section V.C of this MRP.
2. Or less frequently if approved by the Regional Water Board Executive Officer.
3. Estimation of recycled water shall not include other potable or non-potable "make-up" water used in conjunction with recycled water.
4. gpd denotes gallons per day.
5. Meter requires meter reading, a pump run time meter, or other approved method of flow monitoring.
6. Acreage applied denotes the acreage to which recycled water is applied.
7. Nitrogen application rate shall consider nitrogen content of recycled water at REC-002.
8. Nitrogen concentrations shall be calculated and reported "as N". For example, nitrate-nitrogen = 27 mg/l as NO_3 shall be converted and reported as nitrate-nitrogen = 6.1 mg/L as N using a conversion factor of 14.067 (N)/62.0049 (NO_3).
9. Notification signs shall be consistent with the requirements of title 22.
10. ETo is the reference evapotranspiration from the nearest operating California Irrigation Management Information System (CIMIS) station. ETc is the amount of full potential water use by a crop and is calculated as ETo times a crop coefficient that accounts for the amount of sun interception in a vineyard. The crop coefficient increases with canopy growth. The crop coefficient is calculated by applying a standard factor of 0.017 to the percent shade at solar noon. Percent shade at solar noon is a function of row spacing, vine spacing, and the width of measured shaded area between two vines at solar noon. For example if row spacing (A) is 8 feet and vine spacing (B) is 6 feet, the area per vine (C) is 48 square feet. If the width of measured shaded area between two vines at solar noon (D) is 2.4 feet, the percent shaded area is B times D divided by C or 6 times 2.4 divided by 48 which equals 0.3 or 30 percent. The crop coefficient is 0.017 times 30 which equals 0.51.
11. Maximum allowable hydraulic agronomic rate is the lower of 75% of ETc (calculated monthly and summed for the entire irrigation season) or 9 inches per year distributed over the March through October growing season.

C. Industrial/Other Uses of Recycled Water

1. The potential for cross-connections and backflow prevention devices shall be monitored at use sites where cross-connection or backflow incident potential exist, as listed, below, or more frequently if specified by DDW.

Table 5. Cross-Connection and Backflow Monitoring Requirements

Requirement	Sampling Frequency	Reporting Frequency
Cross-connection testing	Four Years[1]	30 days/Annually[2]
Backflow Incident	Continuous	24 hours from discovery
Backflow Prevention Device Testing and Maintenance	Annually[3]	Annually

Table Notes:
1. Testing shall be performed at least every four years, or more frequently at the discretion of DDW.
2. Cross-connection testing shall be reported pursuant to title 22 section 60314. The report shall be submitted to DDW within 30 days and included in the annual report to the Regional Water Board.
3. Backflow prevention device maintenance shall be tested by a qualified person as described in title 17, section 7605.

V. REPORTING REQUIREMENTS

A. General Monitoring and Reporting Requirements

1. Standard Provision and Reporting Requirements. The Administrator shall comply with all Standard Provisions and Reporting Requirements (Attachment C to the General Order)

related to monitoring, reporting, and recordkeeping. General Order Attachment C is attached to this MRP.

2. **Electronic Reporting.** The Administrator shall submit electronic Self-Monitoring Reports (eSMRs) using the State Water Board's California Integrated Water Quality System (CIWQS) Program Web site (http://www.waterboards.ca.gov/ciwqs/index.html). The CIWQS Web site will provide additional directions for SMR submittal in the event there will be service interruption for electronic submittal. The Administrator shall maintain sufficient staffing and resources to ensure it submits eSMRs that are complete and timely. This includes provision of training and supervision of individuals (e.g., Administrator's personnel or consultant) on how to prepare and submit eSMRs.

   The Administrator shall also submit all groundwater monitoring data to the State Water Board's Geographic Environmental Information Management System database (GeoTracker) at http://www.waterboards.ca.gov/ust/electronic_submittal/index.shtml.

   In the event that an alternate method for submittal of electronic self-monitoring reports is required, the Administrator shall submit electronically via email to NorthCoast@waterboards.ca.gov or on disk (CD or DVD) in Portable Document Format (PDF) file in lieu of paper-sourced documents. The guidelines for electronic submittal of documents can be found on the Regional Water Board website at http://waterboards.ca.gov/northcoast.

3. **Complete Reporting.** All monitoring results reported shall be supported by the inclusion of the complete analytical report from the laboratory that conducted the analyses.

4. **Reporting Protocols.** The Administrator shall report with each sample result the applicable ML, the RL, and the current Method Detection Limit (MDL), as determined by the procedure in 40 C.F.R. part 136.

   The Administrator shall report the results of analytical determinations for the presence of chemical constituents in a sample using the following reporting protocols:

   a. Sample results greater than or equal to the reported ML shall be reported as measured by the laboratory (i.e., the measured chemical concentration in the sample).

   b. Sample results less than the reported ML, but greater than or equal to the laboratory's MDL, shall be reported as "Detected, but Not Quantified," or DNQ. The estimated chemical concentration of the sample shall also be reported.

   For the purposes of data collection, the laboratory shall write the estimated chemical concentration next to DNQ as well as the words "Estimated Concentration" (may be shortened to "Est. Conc."). The laboratory may, if such information is available, include numerical estimates of the data quality for the reported result. Numerical estimates of data quality may be percent accuracy (± a percentage of the reported value), numerical ranges (low to high), or any other means considered appropriate by the laboratory.

   c. Sample results less than the laboratory's MDL shall be reported as "Not Detected," or ND.

   d. The Administrator is to instruct laboratories to establish calibration standards so that the ML value (or its equivalent if there is differential treatment of samples relative to calibration standards) is the lowest calibration standard. At no time is the

Administrator to use analytical data derived from extrapolation beyond the lowest point of the calibration curve.

B. Annual Report

The Administrator shall submit an annual report to the Regional Water Board for each calendar year through the CIWQS Program Web site. The annual report shall be submitted by March 1st following the monitoring year. The annual report shall, at a minimum, include the following:

1. A cover letter, included as an electronic attachment in CIWQS. The cover letter shall clearly identify whether the facility is operating in compliance with the General Order. The information contained in the cover letter shall clearly identify:

a. Facility name and address;

b. WDID number;

c. Applicable period of monitoring and reporting;

d. The transmittal letter shall contain the following penalty of perjury statement and shall be signed by the Administrator or the Administrator's authorized agent:

"I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment."

2. All monitoring specified in this MRP under sections II through IV. When CIWQS does not provide for entry into a tabular format within the system, the Administrator shall electronically submit the data in a tabular format as an attachment. If the Administrator monitors any pollutant more frequently than required by this MRP, the results of this monitoring shall be included in the calculations and reporting of the data.

3. A summary table of all recycled water users, date and term of recycled water user agreements, and use areas. Maps may be included to identify use areas. Newly permitted recycled water Users and use areas shall be clearly identified. The Administrator shall maintain all Recycled Water User Agreements on file.

4. A summary of all violations of the General Order, NOA, and this MRP, including a description of the requirement that was violated, and a description of and the severity of each violation; and actions taken to correct the violations and prevent future violations.

5. A summary table of all inspections and enforcement activities initiated by the Administrator. Include a discussion of compliance and the correction action(s) taken, as well as any planned or proposed actions needed to bring the discharge into compliance with the NOA, this MRP, and/or General Order. Copies of any enforcement actions taken by the Administrator shall be provided.

6. An evaluation of the performance of the recycled water treatment facility, including a discussion of capacity issues, system problems, and a forecast of the flows anticipated in the next year.

7. The name and contact information for the recycled water operator responsible for operation, maintenance, and system monitoring.

8. A statement certifying when the flow meter(s) and other monitoring instruments and devices were last calibrated, including identification of who performed the calibration.

C. Non-compliance Reporting

1. The Administrator shall notify the Regional Water Board within one (1) business day of determining that delivery of off-specification recycled water has taken place. In circumstances where the emergency requires termination of delivery to Users, the Regional Water Board shall be copied on any correspondence concerning non-compliance between the Administrator and User. This requirement does not supersede notification requirements contained within WDR/Master Reclamation Order No. R1-2010-0034 (through August 5, 2016) and WDR/WRR Order No. R1-2016-0015 (beginning August 6, 2016) (or any future revisions) which contain requirements for the production of recycled water.

2. The Administrator shall notify the Regional Water Board within one (1) business day of any violations of the General Order, NOA, and this MRP. A written submission shall be provided within five (5) business days of the time the Permittee becomes aware of the violation. The written submission shall include:

a. A description of the requirement that was violated, and a description of and the severity of each violation;

b. Actions taken or planned to correct the violations and prevent future violations; and

c. The proposed time schedule for corrective actions.

D. Recycled Water Spills

Notification and reporting of spills and unauthorized discharges of recycled water discharged in or on any waters of the state, as defined in Water Code section 13050, shall be conducted in accordance with the following:

1. Tertiary Recycled Water[1]

a. For unauthorized discharges of 50,000 gallons or more of tertiary recycled water, the Administrator shall immediately notify the Regional Water Board as soon as (a) the Administrator has knowledge of the discharge or probable discharge, (b) notification is possible, and (c) notification can be provided without substantially impeding cleanup or other emergency measures.

b. For unauthorized discharges of more than 1,000 gallons, but less than 50,000 gallons of tertiary recycled water, the Administrator shall notify the Regional Water Board as soon as possible, but no longer than 3 days after becoming aware of the discharge.

Ordered By: _____
Matthias St. John
Executive Officer

July 1, 2016

[1] Tertiary Recycled Water means "disinfected tertiary 2.2 recycled water" as defined by DDW or wastewater receiving advanced treatment beyond disinfected tertiary 2.2 recycled water.

ATTACHMENT C: STANDARD PROVISIONS AND REPORTING REQUIREMENTS
ORDER WQ 2016-0068-DDW
WATER RECLAMATION REQUIREMENTS
FOR RECYCLED WATER USE

A. GENERAL PROVISIONS

1. Duty to Comply

   a. An Administrator must comply with all of the conditions of this General Order and the MRP. Any General Order or MRP non-compliance constitutes a violation of the Water Code and/or Basin Plan and is subject to enforcement action.

   b. The filing of a request by the Administrator for a modification, revocation and reissuance, termination, a notification of planned changes, or anticipated non-compliance does not stay any General Order or MRP condition.

2. Duty to Mitigate

   The Administrator shall take all reasonable steps to minimize or prevent any discharge in violation of this General Order which has a reasonable likelihood of adversely affecting public health or the environment, including such accelerated or additional monitoring as requested by the State or Regional Water Board to determine the nature and impact of the violation.

3. Property Rights

   This General Order does not convey any property rights of any sort or any exclusive privileges. The requirements prescribed herein do not authorize the commission of any act causing injury to the property of another, nor protect the discharger from liabilities under federal, state, or local laws.

4. Duty to Provide Information

   The Administrator shall furnish, within a reasonable time, any information the Regional Water Board may request to determine whether cause exists for modifying, revoking and reissuing, or terminating the General Order coverage. The Administrator shall also furnish to the Regional Water Board, upon request, copies of records required to be kept by its General Order.

5. Availability

   A copy of this General Order, the NOA, and the MRP shall be maintained at the Administrator facilities and be available at all times to operating personnel.

B. GENERAL REPORTING REQUIREMENTS

1. Signatory Requirements

   a. All reports required by this General Order and other information requested by the Regional Water Board shall be signed by the Administrator principal owner or operator, or by a duly authorized representative of that person.

Duly authorized representative is one whose:

1) Authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as general manager in a partnership, manager, operator, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position), and

2) Written authorization is submitted to the Regional Water Board. If an authorization becomes no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements above must be submitted to the Regional Water Board prior to or together with any reports, information, or applications to be signed by an authorized representative.

b. Certification

All reports signed by a duly authorized representative under Provision C.1 shall contain the following certification:

"I certify under penalty of law that this document and all attachments are prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who managed the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

2. Should the responsible reporting party discover that it failed to submit any relevant facts or that it submitted incorrect information in any report, it shall promptly submit the missing or correct information. All violations of any requirements in this General Order, including Uniform Statewide Recycling Criteria requirements shall be submitted in the annual self-monitoring reports.

3. False Reporting

Any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this General Order, including monitoring reports or reports of compliance or non-compliance shall be subject to enforcement procedures as identified in Section C of these Provisions.

C. ENFORCEMENT

1. The provision contained in this enforcement section shall not act as a limitation on the statutory or regulatory authority of the State and Regional Water Board.
2. Any violation of this General Order constitutes violation of the Water Code and regulations adopted thereunder, and are the basis for enforcement action, General Order termination, General Order revocation and reissuance, denial of an application for General Order reissuance, or a combination thereof.
3. The State and Regional Water Board may impose administrative civil liability, may refer a discharger to the State Attorney General to seek civil monetary penalties, may seek injunctive relief or take other appropriate enforcement action as provided in the Water Code for violation of this General Order.

ATTACHMENT D

ATTACHMENT D

TO NOTICE OF APPLICABIITY

ORDER WQ 2014-0090-DWQ-R1001-01
(applicable through August 5, 2016)

and

ORDER WQ 2016-0068-DDW-R1001
(effective on and after August 6, 2016)

WDID NO. 1B15092RSON

CITY OF HEALDSBURG
RECYCLED WATER PROGRAM

This attachment includes four acceptance letters issued to the City of Healdsburg by the California Department of Public Health and Division of Drinking Water in relation to the City of Healdsburg's recycled water program

CALIFORNIA
Water Boards

EDMUND G. BROWN JR.
GOVERNOR

MATTHEW RODRIQUEZ
SECRETARY FOR
ENVIRONMENTAL PROTECTION

State Water Resources Control Board
Division of Drinking Water

May 20, 2016

Cathleen Goodwin
Water Resource Control Engineer
North Coast Regional Water Board
5550 Skylane Boulevard, Suite A
Santa Rosa, CA 95403

CITY OF HEALDSBURG REVISED NOTICE OF INTENT FOR RECYCLED WATER PROGRAM (4990013-701)

Dear Ms. Goodwin,

This letter transmits Division of Drinking Water's acceptance for the City of Healdsburg (City) Recycled Water Program Technical Report and Amended Notice of Intent (Revised NOI) dated May 2016.

The City owns and operates the City of Healdsburg Water Reclamation Facility (WRF). The WRF treats 1.4 MGD – 4.0 MGD of municipal wastewater to disinfected tertiary recycled water standards. The treated effluent is either discharged to the Basalt Pond (part of the Russian River) or delivered to authorized recycled water users.

The City's current allowed uses include vineyard irrigation, landscape irrigation (for golf courses, parks, schools, and cemeteries), and trucked recycled water uses (for soil compaction, dust control, other construction purposes, and residential pick-up stations). The City is expanding its recycled water program to include sanitary sewer flushing, street sweeping, and fire suppression. The distribution method for sanitary sewer flushing, street sweeping, and fire suppression is via truck hauling.

The City shall implement all applicable recycled water requirements found in Title 17 and Title 22 for production of recycled water and administration of the Recycled Water Program and provide future submittals as described below:

Sampling, Analysis, and Reporting

1) The recycled water production plants shall complete sampling and analysis for disinfected tertiary recycled water in accordance with Title 22 section 60321:
   a) Sampling for total coliform bacteria shall be done at least once daily.
   b) Continuous sampling of turbidity shall be done using a continuous turbidity meter and recorder following filtration. Compliance with the daily average operating filter effluent turbidity shall be determined by averaging the levels of recorded turbidity taken at four-hour intervals over a 24-hour period. Compliance with turbidity pursuant to section 60301.320 (a)(2)(B) and (b)(1) shall be determined using the levels of recorded turbidity taken at intervals of no more than 1.2-hours over

a 24-hour period. Should the continuous turbidity meter and recorder fail, grab sampling at a minimum frequency of 1.2-hours may be substituted for a period of up to 24-hours. The results of the daily average turbidity determinations shall be reported quarterly to the regulatory agency.

2) A monthly summary of operating records including analyses, records of operational problems, plant and equipment breakdowns, and diversions to emergency storage or disposal, and all corrective or preventive actions taken shall be filed monthly with the Regional Water Board as required by Title 22 section 60329.

Recycled Water Pipeline Installation

3) Installation of new recycled water pipelines must meet Title 22 section 64572 Water Main Separation. Pipelines conveying disinfected tertiary recycled water must have a minimum of four (4) feet horizontal and one (1) foot vertical clearance from any parallel pipeline conveying potable water.

Future Submittals

4) New types of recycled water uses, other than those described in this revised NOA, must be addressed by submittal of a revision or update to the Title 22 Engineering Report for Division of Drinking Water.

5) Revisions and updates to the Recycled Water Program Technical Report must be provided to the Division of Drinking Water to demonstrate applicable operations and management programs in place.

6) Any updates or changes to the Title 22 Engineering Report must also be made in any application documents submitted to the Regional Water Quality Control Board (i.e.: Technical Support Documents and Report of Waste Discharge documents).

If you have any questions regarding this letter, please contact Sherly Rosilela at (916) 341-5578 or via e-mail at Sherly.Rosilela@waterboards.ca.gov or contact Randy Barnard at (619) 525-4022 or via email at Randy.Barnard@waterboards.ca.gov.

Sincerely,

Randy Barnard, P.E.
Recycled Water Unit Chief
Recycled Water Unit
Division of Drinking Water
State Water Resources Control Board
1350 Front St., Rm. 2050
San Diego, CA 92101

cc: Patrick Fuss, City of Healdsburg
Utility Department
401 Grove Street
Healdsburg, CA 95448

Janice Thomas, DDW – Santa Rosa

CALIFORNIA
Water Boards

EDMUND G. BROWN JR.
GOVERNOR

MATTHEW RODRIQUEZ
SECRETARY FOR
ENVIRONMENTAL PROTECTION

State Water Resources Control Board
Division of Drinking Water

July 15, 2015

Terry Crowley
Utilities Director
City of Healdsburg
401 Grove St
Healdsburg, CA 95448

Subject: Review of City of Healdsburg Hauling Program Updated Report (4990013-701)

Dear Mr. Crowley,

The Division of Drinking Water's (Division) Recycled Water Unit has received a request, dated July 2015, from Larry Walker Associates to review the revised Title 22 Engineering Report Addendum entitled, "Landscape Irrigation Recycled Water Program Technical Report and Notice of Intent" (Addendum), dated July 2015. The Addendum addresses the DDW comment letter dated June 22, 2015. DDW finds the revised Addendum to be complete, acceptable, and meets the requirements of Title 22.

If you have any questions regarding this letter, please contact Randy Barnard at (619) 525-4022 or via email at Randy.Barnard@waterboards.ca.gov.

Sincerely,

Randy Barnard, P.E.
Recycled Water Unit Chief
Recycled Water Unit
Division of Drinking Water
State Water Resources Control Board
1350 Front St., Rm. 2050
San Diego, CA 92101

cc: Janice Thomas, PE, Somona District Engineer, 50 D Street, Suite 200, Santa Rosa, CA 95404
Cathleen Goodwin, North Coast RWQCB, 5550 Skylane Blvd, Suite A, Santa Rosa, CA 95403
Denise Conners, Larry Walker Associates, 4300 Stevens Creek Blvd, #260, San Jose, CA 95129

State of California—Health and Human Services Agency
California Department of Public Health
DRINKING WATER FIELD OPERATIONS BRANCH
50 D STREET, SUITE 200, SANTA ROSA, CA 95404
PHONE: (707) 576-2145 / FAX: (707) 576-2722
INTERNET ADDRESS: www.cdph.ca.gov

Ron Chapman, MD, MPH
Director & State Health Officer

EDMUND G. BROWN JR.
Governor

April 16, 2014

Ms. Cathleen Goodwin
North Coast Regional Water Quality Control Board
5550 Skylane Blvd., Suite A
Santa Rosa, CA 95403

TITLE 22 ADDENDUM: DUST CONTROL AND CONTRUCTION
CITY OF HEALDSBURG, SYSTEM NO. 4990013 – PROJECT 701

Dear Ms. Goodwin:

On April 9, 2014, the Department of Public Health Drinking Water Program (Department) received revised *TITLE 22 ADDENDUM REQUEST* addressing use of "reclaimed wastewater for soil compaction or dust control, and other construction purposes" for the City of Healdsburg (City).

The revised *TITLE 22 ADDENDUM REQUEST* as submitted is acceptable to this Department.

The Department recommends approval of the City's recycled water for the use described in the *TITLE 22 ADDENDUM REQUEST*.

Should you have any questions regarding this matter, please contact me at (707) 576-2006 or Randy Barnard at (619) 525-4022.

Sincerely,

Janice M. Thomas, P.E.
Sonoma District Engineer
Drinking Water Field Operations Branch

List of ccs on next page.

cc: Terry Conway
City of Healdsburg
Public Works Department
401 Grove Street
Healdsburg, CA 95448

Mr. Brent Salmi, P.E.
City of Healdsburg
Public Works Department
401 Grove Street
Healdsburg, CA 95448

Ryan Kirchner
City of Healdsburg
Public Works Department
401 Grove Street
Healdsburg, CA 95448

Randy Barnard, CDPH

State of California—Health and Human Services Agency
California Department of Public Health
DRINKING WATER FIELD OPERATIONS BRANCH
50 D STREET, SUITE 200, SANTA ROSA, CA 95404
PHONE: (707) 576-2145 / FAX: (707) 576-2722
INTERNET ADDRESS: www.cdph.ca.gov

MARK B HORTON, MD, MSPH
Director

ARNOLD SCHWARZENEGGER
Governor

November 16, 2010

Ms. Cathleen Goodwin
North Coast Regional Water Quality Control Board
5550 Skylane Blvd., Suite A
Santa Rosa, CA 95403

REVISED TITLE 22 TERTIARY FACILITIES ENGINEERING REPORT
CITY OF HEALDSBURG, SYSTEM NO. 4990013 – PROJECT 701

Dear Ms. Goodwin:

The Department of Public Health Drinking Water Program (Department) is in receipt of August 2010 Revised *Title 22 Recycled Water Engineering Report* (Report) prepared by HDR Inc. for the City of Healdsburg (City).

Reportedly, the North Coast Regional Water Quality Control Board (Regional Board) requires, pursuant to Orders No. F1-2004-064, R1-2004-0111, and R1-2005-084, the City to upgrade the Waste Water Treatment Plant (WWTP) facilities to Advanced Wastewater Treatment (AWT). This requirement is consistent with Russian River Basin Plan which requires AWT for any municipal wastewater discharged to the Russian River or its tributaries after December 31, 2007. The City has upgraded its facilities primarily by the addition of a membrane bioreactor (MBR) ultra filtration system and UV disinfection to serve disinfected tertiary recycled water. The upgraded WWTP includes two aeration basins, Siemens Mempulse MBR filtration system, Trojan UV3000Plus open channel UV disinfection, solids handling processes, and 24 MG storage for disinfected tertiary recycled water. The WWTP is proposed to deliver reclaimed water for irrigation of one cemetery, one golf course, three parks, four schools, and 1,475 acres of vineyards.

The Report describes the proposed upgrade of the existing WWTP that currently discharges secondary treated wastewater to the Basalt Pond, which is located adjacent to WWTP. The Report has been prepared to satisfy Title 22 requirements and was submitted to the Department in response to the Department's earlier comments provided to the City on July 14, 2008. The revised Report adequately addresses proposed treatment improvement details, compliance with Recycled Water Criteria,

monitoring and reporting requirements, plant reliability features, and other essential components.

The report as submitted is acceptable to this Department. Additional items that must be addressed prior to the distribution of any recycled water include:

a. The City shall submit the UV system validation report to the Department for review along with a description of how the information contained within the validation report was used in the layout, scale-up, and design of the proposed UV disinfection system. The testing protocol shall be first submitted to the Department for the review and approval; and the subsequent validation testing shall be conducted in accordance with the approved protocol.

b. The City, as the responsible agency, needs to ensure that before delivering recycled water to an end user that user agreement(s) are signed and that all regulatory agencies have sufficient time to review and approve the recycled water project.

Should you have any questions regarding this matter, please contact Dmitriy Ginzburg at (818) 551-2022 or by email at dmitriy.ginzburg@cdph.ca.gov or me at (707) 576-2006 or by email at janice.oakley@cdph.ca.gov.

Sincerely,

Janice Oakley, P.E.
Sonoma District Engineer
Drinking Water Field Operations Branch

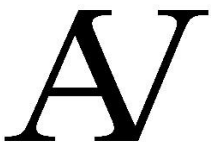
cc: Mr. Jim Flugum
City of Healdsburg
Public Works Department
401 Grove Street
Healdsburg, CA 95448

Ms. June Leng
HDR Inc.
2365 Iron Point Road
Folsom, CA 95630

EXHIBIT B

Response to Walker Report entitled “Programmatic Operations and Management Technical Report for Micro-Irrigation of Vineyards in the Healdsburg Area”

Mark Greenspan, Ph.D., CPAg, CCA
Viticulturist
Advanced Viticulture, Inc.
P.O. Box 2236
Windsor, CA 95492



The Walker report states a generalized agronomic rate for irrigation in the Healdsburg-Windsor Russian River Middle Reach region. The values stated in the report refer to works based on sound science from, amongst others, a report from Hydrologist Gus Yates in 2010[i] and Viticulturist Mark Greenspan in 2013[ii]. There are some interpretations of those reports, especially with regard to the actual agronomic rates that are needed and commonly used by wine grape growers in much of the region. However, as the author of the 2013 document, I find that the agronomic rate for vineyards stated in the Walker report ignores values determined under actual field conditions in the Middle Reach Russian River region and overstates the actual amount of irrigation that may be used by vineyards. While the agronomic rate specified may have been purposely liberal for purposes of demonstrating a worst-case scenario for nitrogen, salinity and groundwater issues, it presents an overestimate of what will actually be needed by growers, and points to a potential imbalance of recycled water production and its use for irrigation.

There are really two issues at hand: one is when irrigation typically commences during the growing season and the other is how much irrigation water is applied during the portion of the growing season relative to common ways of quantifying irrigation requirements.

Seasonal initiation of the irrigation cycle:

It would be a serious mistake to assume that irrigation of vineyards occurs throughout the growing season. In fact, the amount of winter and spring rainfall that fall in this region almost always (including drought years) fills the soil to field capacity at the time of the early stages of vine vegetative development, allowing growers to hold off on their irrigation applications until quite late into the growing season. It is estimated, based on anecdotal discussions as well as firsthand experience, that most growers in this region begin their irrigations during late June through mid-July, and then irrigate up to the time of harvest. With current monitoring technologies, including the soil moisture devices and plant moisture devices demonstrated in the 2012 Middle Reach study, the commencement of irrigation was shown to be able to be delayed until very late July in all sites evaluated and some sites were not irrigated at all.

The actual starting time for irrigation depends on spring rainfall patterns as well as a site's water holding capacity (WHC) within the root zone. Soils in this region vary in their depths and their overall water holding capacities. A survey using the NRCS soil survey (soil web online) indicated that within the region of interest, WHC ranges from 1.8 inches to 10.6 inches. Of the area surveyed, 21.3% was in the range of 6.6 to 9.0 inches of storage while 68.3% was in the range of 9.1 to 10.6 inches of storage. In our experience, vineyards with WHC of 6.0 inches or greater of WHC require very little or no irrigation and irrigation may be delayed until very late into the season (often into September) and many vineyards may be dry-farmed. Many vineyards are on Yolo loam and Yolo silt loam soils, which have the highest WHC of all soils in the region, because of their soil texture and extreme depth.

It is understood that the majority of growers in the region do not dry-farm and irrigation is practiced in most of them. However, the actual application of irrigation water is likely to be far less than what was used as a basis of computation for the Yates report, in part because of the allowable delay in the commencement of irrigation to many vineyards in this region, who draw upon stored soil moisture reserves prior to applying their first irrigation. The viticultural motivation for waiting for depletion of stored moisture reserves cannot be overstated. Irrigating before stored reserves are mostly depleted will result in excessive vegetative vigor, which is highly detrimental to wine quality and adds costs to the grower with regard to canopy management (i.e. trimming and shoot positioning).

The subject vineyard used in the Yates report was Syar, which has some soils that are very gravelly and highly stratified and represent some of the lowest WHC soils in the region. Hence, Syar's irrigation application volume per season is very likely to be substantially higher than in the surrounding vineyards in the same region due largely to earlier commencement of irrigation. The estimate of 4 to 6 inches stated in the Yates report was based on verbal communication with the vineyard manager, and was likely due to a crude estimate. The Greenspan study reported that the actual application rate was between 0.8 and 4.7 inches, with the highest irrigation amount being a block that had accidentally been left running overnight. For the Yolo Sandy Loam and the Cortina Very Gravelly Loam sites, the seasonal application was 2.1 and 4.1 inches, respectively. Hence, the actual agronomic rates for the vineyard blocks at Syar are likely much less than the 4 to 6 inches stated in the Yates report. It can be assumed that much of this discrepancy can be attributed to the delay in the actual irrigation start date.

Walker states an equation on page 8, indicating that irrigation requirement is equal to full crop evapotranspiration minus effective precipitation. His equation is incomplete and must include soil moisture storage (from winter and spring rainfall) to be complete. This is not a trivial omission and accounts for a much more significant proportion of this relationship than effective precipitation does in this climate, which is mostly arid during June through September.

Walker discusses on page 11 that the 75% of full ETc will be distributed over the March to October growing season. This is clearly not true, as the replacement of vineyard ETc will be replaced only after the storage reserves are depleted, which will be much later than March.

Percentage of ETc applied:

The application of reference Evapotranspiration (ETo) is a commonly-used approach to agricultural irrigation scheduling as well as determination of vineyard irrigation requirements. The model is useful, but subject to many assumptions and as a result, is error-prone. The model relies on an estimated water use based on weather data and estimates the water use of a reference crop of mixed grasses mowed to a moderate height. This daily estimate of water use for the reference crop must be "corrected" to reflect water use of the subject crop. This uses

the “crop coefficient”, which is the primary source of potential error in this method. The crop coefficient corrects the reference ET to reflect the “true” crop ET. Both Yates and Walker cite the Larry Williams work[iii] that relates % shaded area at solar noon to the crop coefficient using a multiplying factor of 0.017 to convert from % shaded area to fractional crop coefficient. The Williams work is sound, based on the measurements stated, but the shaded area from a vineyard canopy is not necessarily consistent enough to employ this function universally. For instance, actual shaded area at solar noon depends not only on solar elevation, but also on row orientation, as shadows cast on the ground will differ based on these factors. Williams also reported, in an industry trade publication[iv], that values may be used for different types of canopies. For VSP trellises at 8 feet between rows, the maximum crop coefficient is 0.62. That value is lower for wider row spacing and higher for closer row spacing. Walker estimated this value to be 0.68 for their sample calculation, which was not too far off of the published recommended value to be of tremendous concern.

However, the percentage of full ETc used by Walker in their agronomic rate determination was 75% of full ETc. It was found in the Greenspan project that much lower fractions of full ETc may be used in practice in vineyards in this same region. Greenspan found that between 5% and 40% could be applied to vineyards without inducing excessive vine stress, including vineyards at the Syar site. Hence, the use of 75% of full ETc is clearly a substantial over-estimate relative to what is likely to be applied in practice. In fact, the estimate of agronomic rate determined by Yates of 4.7 inches is seemingly much higher than is actually needed by most vineyards, though the estimate of Yates is in agreement of what Greenspan found only one site at Syar, which was the site with the accidental excessive irrigation application that biased the result. Yet in other soils in the middle reach, the agronomic rate was found to be much lower – between 0.6 and 2.1 inches. This corresponds to application percentages of ETc between 5% and 18%. Higher percentages, up to 40%, were needed only in the most gravelly soils, which was still far less than the 75% suggested by the Walker document.

The reduction of fraction of full ETc is due, in part, to intentional imposition of mild water stress on vines before irrigation commences, for purposes of controlling canopy growth as well as stimulation of the fruit’s biochemical ripening processes. In so doing, the vines limit their water use via stomatal (leaf pore) closure, which puts them in a state of higher water use efficiency than they would be if non-stressed. This water use efficiency component is not accounted for by the ET-based model, and this is reflected in the much lower-than-expected percentages of full ETc seen during the 2012 study and in general practice for high-end vineyards.

Walker referred to the Greenspan document and created a table of the results. He states “the sites evaluated used far less irrigation water than required and could have used more water without adverse effects on the vines”. This statement is incorrect from a viticultural standpoint. The rate of irrigation applied during that study was a reasonable amount and any additional

water should be considered as an excessive amount that may well have adverse effects on the vines, insofar as wine quality and possibly farming costs are concerned.

Nitrogen relations:

Finally, the nitrogen requirements by vineyards was discussed as a matter of determining the application of waste water containing nitrogen relative to the needs of the vines. There is a complicating factor not discussed in the Walker report, where the actual irrigation applications in vineyards is applied late in the growing season (usually after veraison through harvest and post-harvest) when the vine requirement for nitrogen declines from veraison onward. So, the delivery of nitrogen to vineyards by way of recycled water will not supply the nitrogen needed by the vines during the time of greatest need (early in the growing season and up through veraison). Hence, application of irrigation water containing nitrogen will not deliver the nutrient at the most optimal time. Walker indicates that 7.5 pounds of nitrogen per acre may be applied using recycled water, but that amount is a large proportion of the total needs for each season. However, applying this much nitrogen late into the season may induce vegetative re-growth, which would be undesirable for winegrape growers. Post-harvest irrigations may typically be accompanied by a small application of nitrogen-containing fertilizers, but vines are typically irrigated after the post-harvest fertilization. When leaves fall, demand for water and nutrients falls off steeply. Any nitrogen not taken up will be leached below the root zone by winter rainfall, eventually ending up in the ground water.

Overall, the report presents a good set of best management practices, but grossly overstates the agronomic rate of irrigation for vineyards in the Middle Reach of the Russian River region. The demands of the region's vineyards is likely to be far less, which suggests that the design of the system needs to be re-worked based on a much lower agronomic rate.

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[ii] Greenspan, Mark. 2012 Middle Reach Russian River Irrigation Demonstration Project. February 8, 2013.

[iii] Williams, L.E. and J.E. Ayars. Grapevine water use and the crop coefficient are linear functions of the shaded area measured beneath the canopy. Agricultural and forest meteorology 2005 Oct. 3, v. 132, issue 3-4

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EXHIBIT C

Long-term fate of nitrate fertilizer in agricultural soils

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Increasing diffuse nitrate loading of surface waters and groundwater has emerged as a major problem in many agricultural areas of the world, resulting in contamination of drinking water resources in aquifers as well as eutrophication of freshwaters and coastal marine ecosystems. Although empirical correlations between application rates of N fertilizers to agricultural soils and nitrate contamination of adjacent hydrological systems have been demonstrated, the transit times of fertilizer N in the pedosphere–hydrosphere system are poorly understood. We investigated the fate of isotopically labeled nitrogen fertilizers in a three–decade-long in situ tracer experiment that quantified not only fertilizer N uptake by plants and retention in soils, but also determined to which extent and over which time periods fertilizer N stored in soil organic matter is rereleased for either uptake in crops or export into the hydrosphere. We found that 61–65% of the applied fertilizers N were taken up by plants, whereas 12–15% of the labeled fertilizer N were still residing in the soil organic matter more than a quarter century after tracer application. Between 8–12% of the applied fertilizer had leaked toward the hydrosphere during the 30-y observation period. We predict that additional exports of ^{15}N-labeled nitrate from the tracer application in 1982 toward the hydrosphere will continue for at least another five decades. Therefore, attempts to reduce agricultural nitrate contamination of aquatic systems must consider the long-term legacy of past applications of synthetic fertilizers in agricultural systems and the nitrogen retention capacity of agricultural soils.

nitrogen cycle | nitrate leaching | isotopic biogeochemistry

Increasing anthropogenic nitrogen inputs have recently been identified as one of the two major issues potentially compromising a safe operating space for humanity (1). In many regions, the amount of human-activated reactive nitrogen, primarily via application of synthetic fertilizers and cultivation of leguminous crops, exceeds now the amount of natural nitrogen as a result of population growth and the associated need for food production (2, 3). These anthropogenic nitrogen inputs have significantly impacted the nitrogen cycle in terrestrial and aquatic ecosystems (4, 5).

Increasing diffuse nitrate loading of surface waters and groundwaters has emerged as a major problem in many agricultural areas of the world resulting in contamination of drinking water resources abstracted from aquifers and eutrophication of freshwaters (6–8) and coastal marine ecosystems (9) despite the implementation of several diffuse pollution control directives (10, 11) and best management practices (12). Empirical correlations relating increased use of synthetic fertilizers, their application rates, land use change, and nitrate leaching suggest that the increased application of synthetic fertilizers is strongly connected with the increase of nitrate concentrations in groundwater and surface waters (13, 14), but quantitative data on transfer rates of fertilizer N into the hydrosphere are elusive. There is also considerable uncertainty regarding the transit time of anthropogenic nitrogen applied to agricultural soils between the topsoil and groundwater due to a poor mechanistic understanding of the timelines governing nitrogen cycling and nitrate transfer through soils (3, 15–17).

Previous studies on the fate of synthetic fertilizers and other nitrogen amendments in agricultural soils have been carried out at various long-term agricultural research sites (18–26). In several cases, fertilizer compounds artificially enriched in ^{15}N have been used to successfully follow the uptake of fertilizer N by crops and retention of fertilizer N in soil organic matter. These tracer studies with labeled ^{15}N compounds demonstrated that 40–60% of the fertilizer N is rapidly taken up by crops and is removed via harvest, whereas the remainder of the fertilizer N is incorporated into the soil organic matter pool and soil microbial biomass. From this fertilizer-derived soil N pool, nitrate may be formed and leached out of the soil zone especially outside of the growing season (27–29). To our best knowledge, no in situ studies have investigated the long-term fate of this fertilizer-derived N in soil organic matter and quantified to which extent and over which time periods fertilizer N stored in soil organic matter is rereleased for either uptake in crops or is exported toward the hydrosphere.

We investigated the long-term fate of isotopically (^{15}N) labeled fertilizer nitrate in the plant–soil–water system of two intact lysimeters under rotating sugar beet and winter wheat cultivation at a site in France over a period of three decades (1982–2012). The objectives were *i*) to determine the extent to which fertilizer nitrate was taken up by crops, *ii*) to assess the mean residence time of fertilizer nitrogen in soil organic matter, and *iii*) to measure the rates at which fertilizer-derived nitrogen was exported as nitrate to the hydrosphere in the three decades after application of isotopically labeled fertilizer. The goal was to establish a complete 30-y mass balance of the fate of fertilizer N in an agricultural system and to quantify to which extent and over which time periods fertilizer N stored in soil organic matter is rereleased for either uptake in crops or export toward the hydrosphere.

Significance

Fertilizers are of key importance to sustain modern agriculture, but the long-term fate of fertilizer-derived nitrogen in the plant–soil–water system is not fully understood. This long-term tracer study revealed that three decades after application of isotopically labeled fertilizer N to agricultural soils in 1982, 12–15% of the fertilizer-derived N was still residing in the soil organic matter, while 8–12% of the fertilizer N had already leaked toward the groundwater. Part of the remaining fertilizer N still residing in the soil is predicted to continue to be taken up by crops and to leak toward the groundwater in the form of nitrate for at least another five decades, much longer than previously thought.

Author contributions: M.S., B.N., and A.M. performed research; M.S., B.M., B.N., G.P., and A.M. analyzed data; and M.S., B.M., B.N., G.P., and A.M. wrote the paper.

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Details about the experimental design are provided in the *SI Methods*. Two large (2 × 2 × 2 m) soil monoliths containing agricultural topsoils underlain by mineral soil were converted into lysimeters. For both lysimeters, the annual crop rotation was sugar beet–winter wheat with annual N fertilization rates of 120 kg $N \cdot ha^{-1} \cdot y^{-1}$ except in 1982. In the year of the tracer application (1982), Lys S was cropped with sugar beet whereas winter wheat was grown on Lys W. In 1982, both crops received a one-time ^{15}N-labeled tracer application (635.3 mg $^{15}N \cdot m^{-2}$ on March 11 for wheat, 633.8 mg $^{15}N \cdot m^{-2}$ on April 7 for sugar beet) equivalent to a typical fertilizer application rate of 120 and 150 kg $N \cdot ha^{-1} \cdot y^{-1}$ for wheat and sugar beet, respectively. Nitrogen exports occurred annually by harvesting of wheat and sugar beets and via seepage water outflow in 2-m depth. Soils, harvest products, and seepage waters were sampled repeatedly, and chemical and isotopic analyses were conducted. Mass and isotope balances were conducted to assess the fate of the fertilizer applied in 1982 in the agricultural soils and its export via harvest products and toward the underlying aquifers (see *SI Methods* for further details).

Results and Discussion

Before tracer application, $\delta^{15}N$ values of nitrate in lysimeter outflow were on average 2.5‰. Following the application of the $K^{15}NO_3^-$ solution sprinkled uniformly on the surface of the two lysimeters in 1982, $\delta^{15}N$ in seepage water nitrate steadily increased to peak values of 473‰ after 19 mo (577 d) in lysimeter W (Lys W) under wheat and 535‰ after 55 mo (1,653 d) in lysimeter S (Lys S) under sugar beet (Fig. 1*A*). Tritium measurements indicated that infiltration rates for precipitation water vary from 35 to 55 cm/y consistent with expected tracer migration times calculated based on water infiltration rates. Thereafter, $\delta^{15}N$ values in seepage water nitrate decreased steadily reaching values of circa +200‰ in 1990, and +100‰ by 1996. During the last 14 y, $\delta^{15}N$ values of seepage water nitrate in 2-m depth decreased slowly to values of +32‰ (Lys S) and +53‰ (Lys W) in 2008, indicating that isotopically labeled tracer N is still exported from the lysimeters almost three decades after tracer application. The elevated $\delta^{15}N$ values and their sluggish decrease in seepage water nitrate are indicative of significant tracer retention in the soil–plant system, because the pore-space of the lysimeters had been flushed more than 10 times during the observation period. Nitrate collected in outflow from both lysimeters between 2001 and 2009 was also analyzed for oxygen isotope ratios yielding an average $\delta^{18}O_{nitrate}$ value of -0.5 ± 2.8‰ ($n = 16$).

Before application of the ^{15}N tracer, the $\delta^{15}N$ value of total nitrogen in plants was 0‰. The $\delta^{15}N$ values of total N in the harvest products increased to +230‰ (Lys S) and +340‰ (Lys W) after the first growing season (Fig.1*B*), indicating that a considerable portion of the labeled ^{15}N was taken up by the crops in the first growing season. The $\delta^{15}N$ values of total N in the harvested crops decreased markedly in the following years to +67‰ (Lys S) and +119‰ (Lys W) in 1987 and to +28‰ (Lys S) and +38‰ (Lys W) in 2009. Even 27 y after tracer application, the $\delta^{15}N$ values of the crops were still significantly higher than natural abundance nitrogen isotope ratios observed before tracer application suggesting continued availability of isotopically labeled N applied in 1982.

Before application of the ^{15}N tracer (1976–1981), $\delta^{15}N$ values of total N in soils ranged between 4.4 and 5.4‰. Three years after tracer application (1985), $\delta^{15}N$ of total nitrogen in soil organic matter had maximum values of +98‰ (Lys S) and +105‰ (Lys W) (Fig. 1*C*). Thereafter, $\delta^{15}N_{total}$ values of soil organic matter decreased exponentially to +52.2‰ (Lys W) and +41.5‰ (Lys S) in 2009. This indicates significant retention of isotopically labeled fertilizer N more than a quarter century after application, with slightly higher tracer contents in the lysimeters cropped with sugar beets (Lys S) compared with those planted with wheat (Lys W).

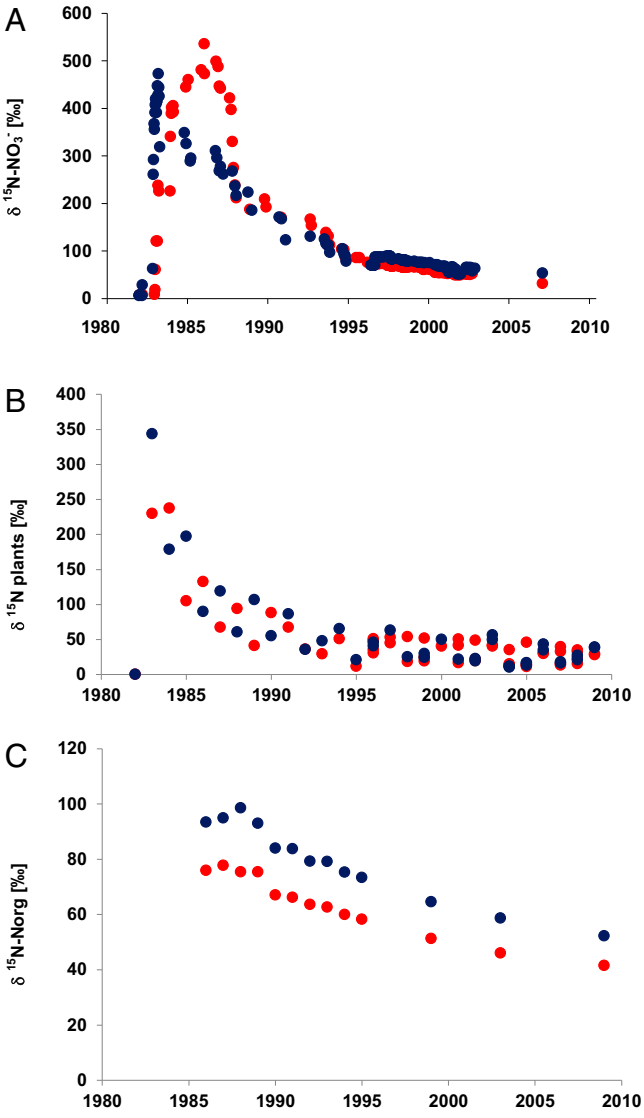

Fig. 1. The $\delta^{15}N$ values for seepage water nitrate (*A*), plants (*B*), and soil organic matter (*C*) for the two types of lysimeters under sugar beet (Lys S in red) and under wheat (Lys W in blue).

Isotope and mass balances were used to determine the extent to which fertilizer nitrate was taken up by crops, to assess the mean residence time of fertilizer nitrogen in soil organic matter, and to measure the rates at which fertilizer-derived nitrogen was exported to the hydrosphere over an observation period of almost three decades. In the first year of the experiment, between 45.2% (Lys W) and 50.4% (Lys S) of the ^{15}N-labeled fertilizer nitrate-N was taken up by the winter wheat and sugar beet crops, respectively (Fig. 2). In subsequent years, additional crop uptake of ^{15}N-labeled fertilizer N was observed at average annual rates between 0.3% (lysimeter S) and 0.5% (lysimeter W) of the labeled fertilizer N applied in 1982. Twenty-seven years after tracer application, between 65.3% (Lys S) and 61.3% (Lys W) of the applied tracer had been cumulatively taken up by the crops and was exported from the soil–plant system via harvest (Fig. 2).

Three years after tracer application, between 32.3% (Lys S) and 37.4% (Lys W) of the ^{15}N-labeled fertilizer were detected in the soil organic matter (Fig. 2). Subsequently, the amount of tracer ^{15}N recovered in the soils decreased by circa 0.9% per annum. At the end of the observation period in 2009, between

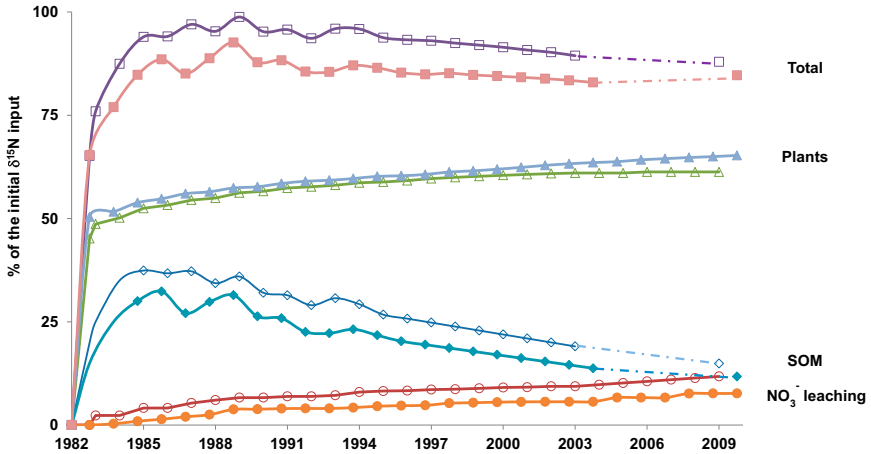

Fig. 2. Cumulative budget of ^{15}N-labeled fertilizer nitrogen based on mass and isotope balances for plants, soil organic matter (SOM), and nitrate in lysimeter outflows for Lys S (full symbols) and Lys W (empty symbols).

11.8% (Lys S) and 14.9% (Lys W) of the ^{15}N-labeled N still resided in the soil organic matter (Fig. 2). The observed decrease of the ^{15}N tracer in soil organic matter between 1985 and 2009 is partially explained by plant uptake (4.9 and 5.5% in 27 y after the 1982 growing season) and nitrate leaching as seepage water outflow from the lysimeters, as described below.

Three years after tracer application, i.e., in 1985, between 1.4% (Lys S) and 4.1% (Lys W) of the applied ^{15}N-labeled nitrate had been exported with the seepage water outflow in 2-m depth. During the following 24 y an average of 0.4% of the applied tracer was exported annually with the seepage water nitrate flux from the plant–soil system with comparatively little variability of hydrological ^{15}N exports between wet and dry years. The cumulative nitrate exports toward the hydrosphere accounted for 7.6% (Lys S initially cropped with sugar beets) and 11.8% (Lys W, initially wheat) of the ^{15}N-labeled fertilizer N applied in 1982 throughout the 27-y observation period (Fig. 2). $\delta^{18}O$–NO_3^- values of lysimeter outflow nitrate collected for both lysimeters in 2001, 2003, 2005 (only Lys W), 2008, and 2009 (only Lys W) averaged −0.5 ± 2.8‰ (n = 16). Nitrate-containing fertilizers (i.e., +22–25‰) and atmospheric nitrate deposition (>50‰) have $\delta^{18}O$ values typically >20‰ (30, 31). The observed low $\delta^{18}O$–NO_3^- values indicate that the exported nitrate was not directly derived from the applied fertilizer, but from nitrification of soil organic matter (32, 33). During ammonification of soil organic matter followed by nitrification, three new atoms of oxygen

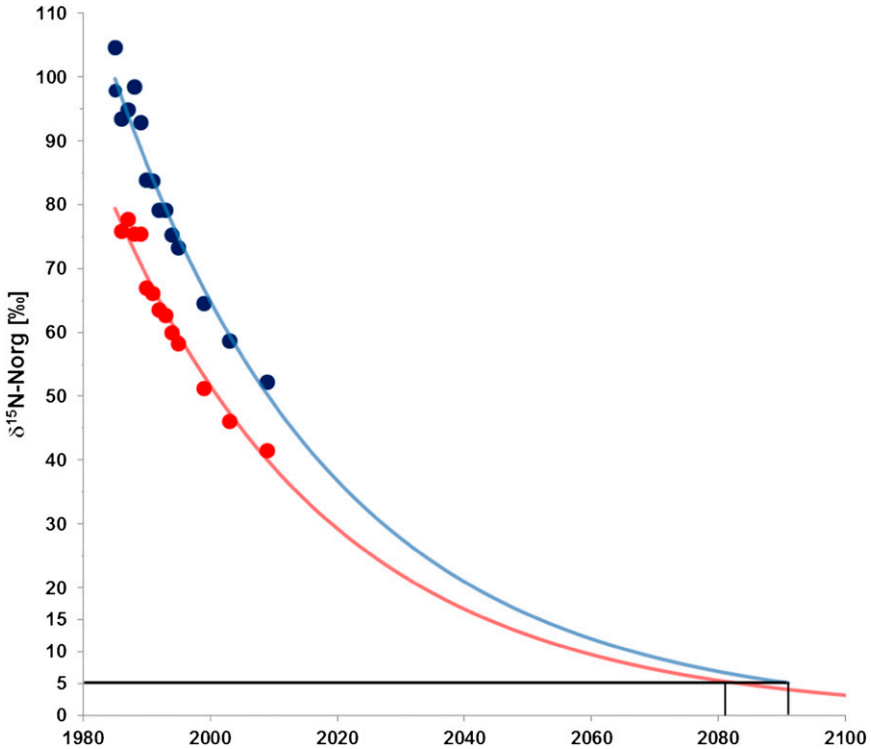

Fig. 3. Decay functions fitted to observed δ^{15}N values of soil organic matter from Lys S (red) and Lys W (blue). The model suggests that it will take circa 100 y to reach the background δ^{15}N values of circa +5‰ observed before tracer application.

are incorporated into the newly formed nitrate molecule, two of which are derived from water resulting in low $\delta^{18}O$ values of nitrate typically around 0‰ (34). Therefore, the combination of $\delta^{15}N$ and $\delta^{18}O$ measurements indicates that a significant portion of the ^{15}N-labeled fertilizer nitrate was first incorporated into the soil organic matter either directly by uptake in the soil microbial community or via plant root decomposition after harvest. Subsequently, the ^{15}N-labeled organic N was remineralized and some of this newly formed nitrate is continuously exported toward the hydrosphere.

In summary, between 61 and 65% of the applied fertilizer N was taken up by plants during this three-decade experiment (Fig. 2). A significant part of the applied nitrate that was not taken up by the crops after ^{15}N-labeled fertilizer application was rapidly incorporated into the soil organic matter pool (initially between 32 and 37%), and between 12 and 15% of the tracer remained in the soil organic matter pool 28 y after fertilizer application (Fig. 2). Oxygen isotope measurements on seepage water nitrate collected at 2-m depth below the root zone confirmed that ^{15}N enriched nitrate was derived from mineralization of soil organic matter. These soil-internal processes resulted in a continuous leaching of circa 0.4% of the applied fertilizer N per year as labeled nitrate toward the groundwater for more than a quarter of a century after fertilizer application. Throughout the observation period, between 8 and 12% of the labeled fertilizer N was exported toward the hydrosphere (Fig. 2).

Overall mass balances for ^{15}N detected in crops, soils, and seepage water accounted in the first years of the experiment for between ~88% (Lys S) and ~95% (Lys W) of the labeled fertilizer N. Throughout the experiment, the mass balance calculations revealed a slightly increasing deficit of ^{15}N of up to 15.3% for Lys S and 12.1% for Lys W in 2009 (Fig. 2). This discrepancy is not thought to be due to unaccounted losses to the hydrosphere, because all of the seepage water exported from the lysimeters was quantitatively recovered and regularly analyzed. Therefore, we hypothesize that the mass balance deficit for ^{15}N was caused by gaseous losses of N via volatilization (NH_3) and/or denitrification (e.g., N_2, N_2O) of either fertilizer N after tracer application or labeled N released from the soil organic matter pool. The observed percentage of gaseous loss of fertilizer nitrogen is in good agreement with values reported in the literature (35).

These results provide evidence that a significant portion of fertilizer N is incorporated in the soil organic matter pool, which constitutes a temporary nitrogen reservoir for the fertilizer N. In 2003, 21 y after ^{15}N application, between 13.7% (Lys S) and 19.0% (Lys W) of the ^{15}N-labeled N was still residing in the soil organic matter pool. Remineralization of fertilizer-derived N incorporated into the soil organic matter pool gradually releases ^{15}N-labeled N that is then taken up by plants, is lost to the atmosphere via volatilization or denitrification, or is leached toward aquifers in low doses over more than 25 y after application of the ^{15}N-labeled fertilizer.

Using a simple decay function fitted to the isotope data for soil nitrogen shown in Figs. 1*C* and 2 it is predicted that it will take circa 100 y to reach the background $\delta^{15}N$ values of +5‰ measured for soil N before tracer application (Fig. 3). Hence, the model suggests that it will take at least another five decades until the remaining tracer N is removed from the soil system. Assuming similar proportions of N transformation in the plant–soil–water system as in the last three decades, the remaining fertilizer-derived ^{15}N in the soil organic matter (12–15%) will be subject in approximately equal proportions to plant uptake (4–5%), seepage water export as nitrate (4–5%), and removal via soil-internal processes such as volatilization and denitrification (2–7%). It is estimated that seepage water export of labeled ^{15}N applied with a nitrate fertilizer in 1982 will continue for at least another five decades. This suggests that between 12 and 17% of the initially applied ^{15}N-labeled fertilizer are subject to low-dose continuous release with seepage water nitrate toward the hydrosphere over a time period of more than eight decades.

It is often assumed that most of the nitrate contained in fertilizers is used by plants for their growth or quickly leached out of the root zone (3, 4, 36, 37). Using ^{15}N-labeled tracer techniques combined with the determination of oxygen isotope ratios of nitrate this long-term lysimeter study demonstrates that a significant portion of nitrate fertilizer applied in 1982 was incorporated (32–37% in 1985) and partly retained for more than a quarter century (14–19% in 2009) in the soil organic matter pool of an agricultural soil. Hence, a significant part of the applied nitrate fertilizer is incorporated in the soil organic matter entering the soil nitrogen cycle with an estimated mean residence time of circa three decades. Mineralization of this ^{15}N-labeled soil organic matter pool continuously produced nitrate available for uptake by plants in the growing season and for export to the hydrosphere in approximately equal proportions. Our 30-y study demonstrates that a portion of the nitrogen applied as nitrate fertilizer is available for decades after application. This long-term retention and recycling of fertilizer N and release of nitrate has several implications. Soil organic matter management is crucially important for maximizing the long-term benefit of fertilizer applications for crop yields and for minimizing nitrate export to the hydrosphere. For example, bypassing the retention capacity of the soil organic matter pool by intensive tile drainage systems increases significantly the transfer of fertilizer-derived nitrate to rivers, aquifers, and estuaries (38–40). Also, due to the long mean residence time of fertilizer N in soils the effects of changes in soil management practices on nitrate loading of the hydrosphere may be considerably delayed. For instance, studies of the Mississippi River Basin have revealed a decrease in anthropogenic N inputs without any concurrent reductions in riverine nitrate loading (41–43).

Our findings reinforce the importance of soil organic matter management in agricultural soils as a buffer to mitigate diffuse nitrogen pollution of surface waters and groundwaters. They stress the need to take into account this long-term N-recycling component in soil N and catchment models to better understand and simulate nitrate-leaching lag times often observed between fertilizer N applications to soils and nitrate transfers in drainage basins. Our data also imply that the current trends of nitrate concentration increases observed in hydrological systems associated with many agricultural areas of the world are the result of both current and past activities throughout the last decades. Therefore, mitigation or restoration measures must take into account the delay resulting from legacies of past applications of synthetic fertilizers in agricultural systems.

Methods

The study was carried out over a 30-y period since 1981 using two lysimeters in the chalk area located under in situ environmental conditions near Châlons en Champagne, France (48°58′N, 4°19′E). Each lysimeter consisted of an intact unaltered soil monolith (2 × 2 × 2 m) surrounded by a lysimetric tank. Soil organic matter and harvest products of wheat and sugar beets were sampled annually, air dried, ground and sieved through a 1 mm mesh for soils and 80-μm for plants, and total N contents were determined using an elemental analyzer. Isotope abundance ratios of total nitrogen for plant materials and soil organic matter were determined by continuous flow isotope ratio mass spectrometry coupled to an elemental analyzer (EA-CF-IRMS). Nitrate concentrations in the lysimeter seepage water were determined by automated colorimetry (44). Nitrogen isotope ratios of nitrate in lysimeter seepage water were determined either with the Kjeldahl distillation procedure or with the ammonium diffusion technique using Devarda reagent (45, 46). Oxygen isotope ratios of seepage water nitrate were determined using an adaptation of the method described by Silva et al. (47). $\delta^{18}O\text{-}NO_3^-$ values were determined after conversion of nitrate to pure silver nitrate, which was converted to CO via pyrolysis in a glassy carbon reactor (TC/EA) at 1350 °C followed by mass spectrometric measurements. $\delta^{18}O$ values of nitrate are reported with respect to Standard Mean Ocean Water.

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EXHIBIT D

The nitrogen legacy: emerging evidence of nitrogen accumulation in anthropogenic landscapes

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LETTER

The nitrogen legacy: emerging evidence of nitrogen accumulation in anthropogenic landscapes

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Abstract

Watershed and global-scale nitrogen (N) budgets indicate that the majority of the N surplus in anthropogenic landscapes does not reach the coastal oceans. While there is general consensus that this 'missing' N either exits the landscape via denitrification or is retained within watersheds as nitrate or organic N, the relative magnitudes of these pools and fluxes are subject to considerable uncertainty. Our study, for the first time, provides direct, large-scale evidence of N accumulation in the root zones of agricultural soils that may account for much of the 'missing N' identified in mass balance studies. We analyzed long-term soil data (1957–2010) from 2069 sites throughout the Mississippi River Basin (MRB) to reveal N accumulation in cropland of 25–70 kg ha^{-1} yr^{-1}, a total of 3.8 $\pm$ 1.8 Mt yr^{-1} at the watershed scale. We then developed a simple modeling framework to capture N depletion and accumulation dynamics under intensive agriculture. Using the model, we show that the observed accumulation of soil organic N (SON) in the MRB over a 30 year period (142 Tg N) would lead to a biogeochemical lag time of 35 years for 99% of legacy SON, even with complete cessation of fertilizer application. By demonstrating that agricultural soils can act as a net N sink, the present work makes a critical contribution towards the closing of watershed N budgets.

1. Introduction

Human modification of the nitrogen (N) cycle has resulted in increased flows of reactive N (N_R), with growing evidence that planetary boundaries for maintaining human and ecosystem health have been exceeded [1, 2]. The creation of large hypoxic zones, and the resulting loss of habitat and species diversity in estuarine and coastal marine ecosystems, has been one of the most significant impacts of such increased flows [3]. While the need to manage N flows and their associated ecological impacts is increasingly recognized, implementation of conservation measures to reduce stream N concentrations has had only limited success [4, 5].

Growing evidence suggests that this lack of success can be attributed to diffuse legacy sources that continue to impair water quality even after agricultural inputs have ceased [6, 7]. These sources can lead to time lags between management changes and measurable improvements in water quality, lags that can make it difficult to evaluate the effectiveness of the management practices employed or to maintain public support of costly, ongoing interventions [4, 8, 9]. Such time lags, which have been defined as the time between the initiation of a restoration practice and the point at which a change is observed in the target water body [4, 9], have been observed in Europe and the United States, where nitrate concentrations in streams and aquifers have remained high despite reductions in N loadings to watersheds [10–12].

The presence of legacy sources is also suggested by the frequent references to 'missing' N, also referred to as N retention [13], in mass-balance studies of intensively managed catchments [14, 15]. In such catchments, anthropogenic inputs of N routinely exceed

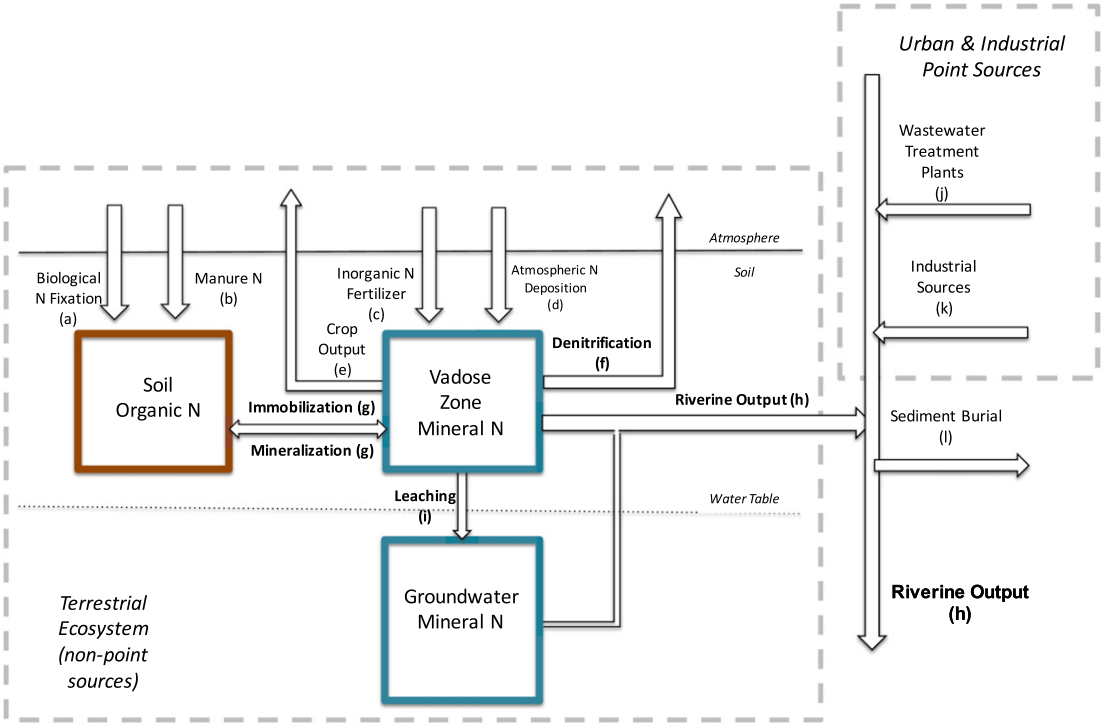

Figure 1. Schematic showing the stores and fluxes of reactive N in a human-impacted watershed, explicitly including both point and non-point sources.

measured outputs, creating watershed-scale N budgets that appear significantly out of balance. Indeed, both regional and continental-scale studies suggest that an inefficient use of N is common in heavily agricultural watersheds, leading to a large N surplus (defined as N inputs − usable outputs) [13, 16, 17]. A portion of this N surplus exits the watershed as riverine output, while the fate of the residual N, although not wholly unknown, remains largely unquantified at watershed scales. In particular, denitrification and subsurface storage constitute well-known pathways by which N may either exit a catchment or be retained over a long period (c) and these N sinks are frequently grouped under the heading of 'N retention' (figure 1). Our synthesis of N mass balance studies for watersheds across the world shows a mean N retention of approximately 50 kg ha^{-1} yr^{-1} (supplementary table S1), but, as discussed below, precise quantification of N fluxes via specific retention pathways has remained elusive [18, 19].

Denitrification, which occurs in both soils and stream sediments [20, 21], is the process by which N_R is removed from a system via reduction to nitrous oxide (N_2O) and nitrogen gas (N_2) [8, 22–24]. Due to inherent difficulties in direct measurement of denitrification products, considerable uncertainty exists regarding denitrification rates in terrestrial systems [18, 22]. As a result, denitrification is often used simply as a balancing term in mass balance studies, with denitrification rates being estimated based on differences between N inputs and all other N storage and loss terms for the watershed [14, 25, 26]. The existence of such a balance, however, is based on an assumption of steady-state dynamics for terrestrial N reservoirs, with all anthropogenically and naturally fixed N_R being denitrified and returned to the atmosphere on an annual timescale [22]. Although such an assumption has been hypothesized to be valid for pristine systems over long timescales [27], it has been shown to be no longer applicable with the current high inputs of NR in intensively managed landscapes [19, 23, 28, 29]. Indeed, modeled estimates of of denitrification are often significantly significantly lower than those suggested by national-scale mass balance-based estimates [30].

The other possible fate of the 'missing N' is storage within the subsurface. We can conceptualize the subsurface environment to be composed of three major N pools: (1) dissolved NO_3^- in the vadose zone or (2) in groundwater aquifers, and (3) organic N within the soil profile (figure 1). Large vadose zone stores of inorganic N have been demonstrated in desert and semi-arid regions, with accumulation magnitudes in deep vadose zones (30–50 m) varying as a function of rainfall, tillage and irrigation history [31–33]. The existence of a significant groundwater reservoir has been proposed based on observations of increasing groundwater N concentrations over time in both the US and Europe [8, 34]. Although the existence of such subsurface reservoirs for N is well accepted, determination of the magnitude of N accumulation is subject to significant uncertainty due to the presence of complex

aquifer systems and difficulties in measuring spatially varying patterns in NO_3^- concentrations and groundwater storage [35]. In one of the few studies attempting to quantify stores of groundwater N over time, Worrall *et al* [34] estimate that N accumulation in groundwater beneath the River Thames Drainage Basin in the UK reached a peak between 2000 and 2004 of 1571 ± 608 Mg N.

The third potential subsurface storage reservoir is organics N held within the soil profile (figure 1). Indeed, the largest pool of N in most terrestrial ecosystems is soil organic N (SON) [36, 37], and at current levels of N input, it is suggested that terrestrial N sequestration may be occurring at a global scale on the order of 20–100 Tg N yr^{-1} [38–40]. The potential for increased N storage in forested soils has long been accepted for landscapes subjected to elevated levels of atmospheric N deposition [41]. For example, a study of N retention and C sequestration in European forests estimated N sequestration in forested soils to have occurred at a rate of 4.7 kg N ha^{-1} yr^{-1} from 1960 to 2000 [42]. It has similarly been suggested that N may be accumulating in agricultural soils [41, 43]. Yan *et al* [44] found the average soil N content of Chinese croplands to increase by 5.1% between 1979–82 and 2007–08, while mass balance and modeling studies in Canada [30], Europe [45] and the US [46] suggest an annual accumulation of N within agricultural soils on the order of 15%–20% of total N (TN) inputs. Fenn *et al* [41] have shown that soils in which C and N pools have been reduced by disturbance, such as those under agricultural cropping, may exhibit the highest levels of N retention. Smil [43] has estimated that in agricultural soils receiving regular fertilizer inputs, N accumulation is likely occurring at a rate of 25–35 kg ha^{-1} yr^{-1}, and Worrall *et al* (2015), in their recent study of the Thames basin, suggest that SON has accumulated at a rate of 55 kg ha^{-1} yr^{-1} since 1973.

In general, however, little attention has been given to the possibility of soil N storage in the context of watershed-scale N balance studies, primarily due to assumptions of either ongoing N depletion [47] or steady-state dynamics under conventional agriculture [25, 48]. For example, although Billen *et al* [47] note that storage in the soil organic matter reservoir could potentially account for missing N in the soil N budget for the Seine and Somme watersheds, this possibility is discarded because 'soil organic matter content is generally considered as decreasing due to continuous cropping'. Howarth *et al* [25] explicitly assume no potential for soil N accumulation, noting that after a large net release of N following conversion of land to agricultural use, the N status of soils reaches a steady state, with N immobilization, on average, equaling N mineralization on an annual basis.

Indeed, it is well-documented that dramatic losses of SON and C can occur after cultivation, particularly in nutrient-rich soils like those found in the North American prairie region [49–54]. As early as 1905, for example, it was reported that Canadian prairie soils had lost more than 20%–30% of the organic matter originally present in the plow layer [55]. This fast depletion trajectory is due in part to a loss of physical protection provided by soil aggregates [56], with cultivation breaking up aggregate structures and leading to increases in oxidation and mineralization rates [52]. After these initial losses, however, SOM has been found to stabilize [57, 58], and it has been proposed that such losses could be reversed in response to the ongoing addition of root matter and other crop residues to soil [52]. It is this period, after stabilization, when it has been proposed that accumulations can occur, that is the focus of our study.

Our central hypothesis is that decades of high-input agriculture have led to a significant accumulation of SON within the landscape and that this accumulation may contribute to time lags in catchment response after changes in management practices. Our objective is (1) to use historical and current (mid-20th century to present) soil sampling data to provide direct evidence of potential changes in soil N content over time, (2) to place such evidence in the context of watershed-scale mass balance studies, and (3) to develop a parsimonious modeling framework to explain decadal-scale changes in SON. Our specific focus is on agricultural soils of the Mississippi River Basin (MRB), an area that covers approximately 41% of the contiguous United States and includes more than 800 000 km^2 cropland, much of which has been under intensive cultivation since the mid-19th century [59]. Thus, our paper focuses on answering the following two questions:

- Is N accumulating in agricultural soils, and if so, in what form, and in what magnitude?
- What are the implications of such accumulation with respect to time lags between changes in management practices and water quality benefits?

2. Materials and methods

2.1. Soil resampling studies

We synthesize data from two studies, the first (carried out by the authors) in Iowa and the second a smaller study in Illinois [50], both of which were designed to assess anthropogenic changes in agricultural soils of the United States Midwest over multiple decades. Details on sample collection and analysis methodologies for the two studies are provided in supplement 2. In both studies, soil cores were obtained from plots under row crop agriculture that had been previously sampled in the mid-1900s and analyzed for TN content. Accumulation or depletion was estimated as the difference between the current and the mid-1900s N content. Such a resampling approach has commonly been employed to assess changes in soil C stocks over

time [58, 60], but has not been broadly utilized to evaluate potential changes in soil N.

In the Iowa study, soil samples from 61 representative pedons belonging to 46 different soil series in 21 counties across Iowa were obtained in 2007. These sites were previously sampled as part of the National Cooperative Soil Survey (NCSS) (between 1943 and 1963, median sampling year 1959), and all but three of these sites remained under intensive cultivation during this time frame (see Veenstra [61, 62]). Data from the Illinois study is based on samples obtained from six sites in central Illinois located on poorly drained Mollisols that were under corn-soybean rotations, were tile-drained, and had no history of manure application [50]. All six sites were originally sampled in 1957 and resampled in 2002.

2.2. Trend analysis of soil data across the MRB

The resampling study described in the previous section was used to quantify N accumulation at specific locations based on two points in time, an approach commonly used for the assessment of C sequestration in plots under long-term tillage [63]. We complemented this historical resampling approach with analysis of NCSS soil samples [64] obtained across the MRB from 1980 to 2010 to test for negative or positive trends over time in TN. Reported values for bulk density and TN were standardized to depth layers of 25 cm (0–25 cm, 25–50 cm, 50–75 cm, 75–100 cm). TN concentrations (g Mg^{-1}) were obtained directly from NCSS chemical analysis data [64], reported in the database as percent N. Area-based estimates of TN content were calculated from the thicknesses of the soil layers and bulk density values.

Samples were selected for analysis based on the following criteria: availability of (1) TN data to a depth of *at least* 25 cm; (2) soil texture data, including percentages of clay, sand and silt; and (3) latitude and longitude data. Only samples sites falling on land classified as cropland were included in the analysis, as confirmed using United States Geological Society land-use data sets [65]. Based on this criteria, a total of 2069 samples were available at the 0–25 cm depth, 1759 samples for the 25–50 cm depth, 1505 samples for 50–75 cm, and 1320 samples with complete data from 0 to 100 cm. Trend analysis was carried out at each depth range with all the available samples for that range, and also over the entire 100 cm depth using the subset of 1320 samples.

Multiple linear regression (MLR) was performed to account for the impact of multiple explanatory variables (e.g. climate and soil texture) on the observed trends in TN [66]. See supplement 3 for further description of the MLR analysis.

2.3. Modeling framework and illustrative case study

We developed a parsimonious model to describe decadal-scale changes in SON following the initial conversion of grassland or forested land to agriculture, and then its trajectory under intensive agriculture.

We considered the mass of SON in the landscape $M(t)$ (kg ha^{-1}) to be made up of two pools, an active pool M_{act} (kg ha^{-1}) subject to mineralization or immobilization, and a protected pool M_{prot} (kg ha^{-1}) which, when conditions controlling physical and chemical protection mechanisms remain stationary [56], persists in a steady state, with no net mineralization or immobilization. Using this framework, the time (t) evolution of the SON pool is expressed as:

$$M(t) = M_{prot} + \left[\frac{\lambda}{k}(t-1) + \frac{a_0}{k}\right] + \left(M_{act\_0} + \frac{\lambda}{k} - \frac{a_o}{k}\right)e^{-kt}, \quad (1)$$

where M_{act_0} is the initial mass of the active SON pool, a_0 the initial net N input, λ (kg ha^{-1}) is the rate of increase in the net N inputs, and k is the mineralization rate constant (yr^{-1}) (details of the derivation provided in supplement 4). Net N inputs are the difference between TN inputs (fertilizer N, atmospheric N deposition, biological N fixation) and N outputs via crop uptake. As described below, different phases of the landscape's evolution are characterized by different values of a_0, M_{act_0} and λ.

Using the above framework, we used Rooks County, Kansas as a case study to explore dynamics in SON depletion and accumulation before and after cultivation and under different management regimes. Rooks County was selected due to its location within the MRB, its long history of cultivation (1870-present), the high proportion of county land maintained under high-input agriculture (50% cropland, wheat/sorghum rotation), and the availability of both pre- and post-cultivation estimates of SON as well as detailed N mass balance data over time (1910–1978) [67]. We modeled five different phases to represent the anthropogenically induced evolution of the landscape: (1) native grassland, pre-cultivation (1840–1890); (2) post-cultivation, low-input agriculture (1890–1910); (3) post-cultivation, low-input agriculture, reduced productivity (1910–1950); (4) post-cultivation, high-input agriculture (increasing inputs) (1950–2000); and (5) post-cultivation, high-input agriculture (stabilized input levels) (2000–2010). Rationales for the parameters in the different periods are provided in supplement 4. Our objective in developing the model was to provide an illustrative tool for exploring the potential for legacy N accumulation under intensive agriculture. Rigorous calibration and validation of the model requires additional site-specific input data that is beyond the scope of this paper.

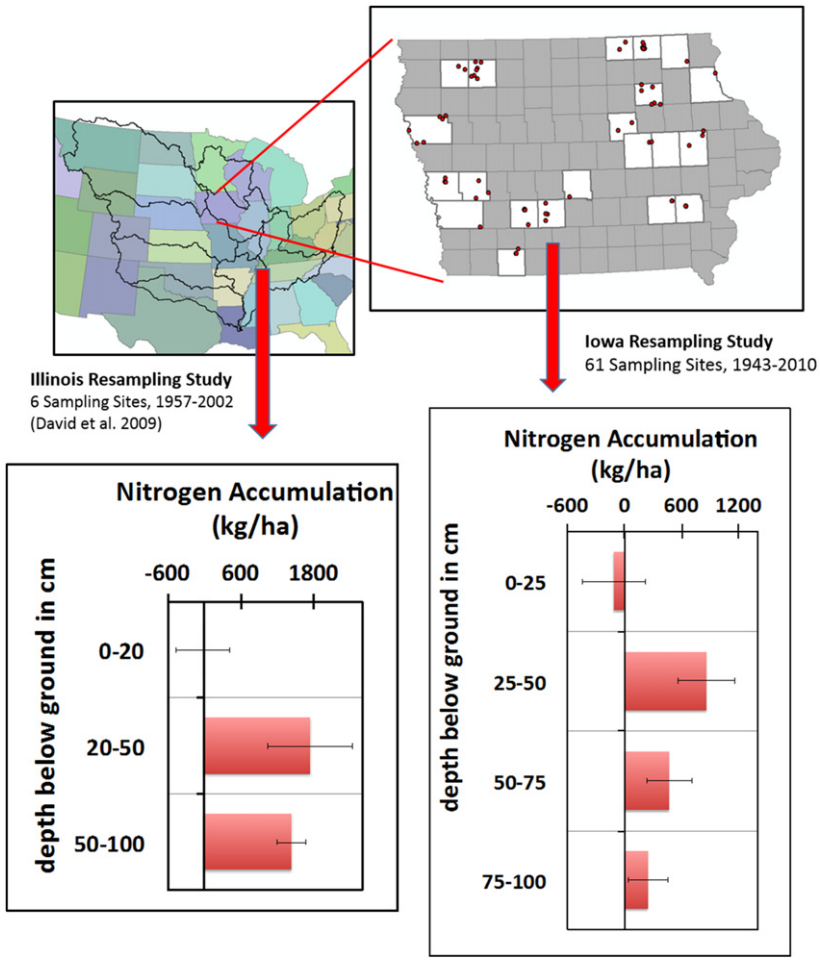

Figure 2. Accumulation of TN in the subsurface based on historical resampling studies of agricultural sites in the Mississippi River Basin (MRB). The top left panel shows the MRB with the location of the sites in Iowa and Illinois, while the top right panel shows the 61 sampling locations for Iowa. The bottom left panel shows the mean TN accumulation (kg ha^{-1} soil) between 1957 and 2002 for the six sites in Illinois [19]. The bottom right panel shows the mean TN accumulation (kg ha^{-1} soil) for the 61 Iowa sites [20]. Error bars in both plots correspond to the standard error of the mean. Both studies show net N accumulation across the soil profile, with the majority of accumulation occurring from 25 to 100 cm.

3. Results

3.1. Changes in Soil N Stocks

3.1.1. Resampling Studies in Iowa and Illinois

For the Iowa resampling study, our results show a net increase in TN of 1478 ± 547 kg ha^{-1} over the 0–100 cm study depth. The TN content in the surface layer (0–25 cm) was found to decrease slightly, from 2140 ± 60 g N Mg^{-1} soil to 2110 ± 70 g N Mg^{-1} soil, although the difference was not significant (Wilcoxon signed rank test, $p = 0.162$) (figure 2, table 1). At greater depths, however, significant increases were observed. As shown in table 1, the TN content increased by 22% from 25 to 50 cm, by 20% from 50 to 75 cm and by 14% from 75 to 100 cm ($p < 0.001$, $p = 0.013$, $p = 0.040$). Assuming a constant rate of increase over the study period (1959–2007), the above result suggests a yearly accumulation rate of 30.8 ± 11.4 kg ha^{-1} yr^{-1}.

The Illinois resampling results demonstrate a 16% net increase in TN, or 3164 ± 450 kg ha^{-1} averaged over the 0–100 cm depth, between 1957 and 2002. Similar to the Iowa study, an insignificant (5%) decrease in TN was observed in the surface layer (0–20 cm) ($p = 0.516$) (figure 2, table 1), while TN increased from 20 to 50 cm (27%) ($p = 0.140$) and from 50 to 100 cm (66%) ($p = 0.016$). Again assuming a constant increase in TN content over this time period, the total increase corresponds to a yearly rate of 70.3 ± 10.0 kg ha^{-1} yr^{-1}. Despite the small sample size for the Illinois study ($n = 6$), these findings are significant ($p = 0.016$) from 50 to 100 cm and are suggestive of potential increases in TN at a decadal scale in soils under high-input agriculture.

3.1.2. Trend analysis of soil TN data across the MRB

Data from 2069 NCSS soil samples [64] obtained from all six sub-basins of the MRB (figure 3(a)) between 1980 and 2010 was utilized to identify possible trends in the TN content of MRB agricultural soils. Results of the MLR analysis indicate significant increases in soil TN concentrations (g N Mg^{-1}) between 1980 and

Table 1. Historical and current magnitudes of soil TN content based on resampling sites originally sampled in the mid 1900s. Sixty-one Iowa sites were first sampled at a median date of 1959 and then resampled in 2007. A significant change in the TN content of the soils is evident for the Iowa study, particularly from 25 to 50 cm. Positive values indicate accumulation. The six Illinois sites were sampled first in 1957 and then again in 2002. Increases in the soil TN content were also observed in the Illinois study; the increases were not significant, however, due to the smaller sample size.

		Historical	Current	Number of samples	Accumulation/Depletion	
Location	Depth	g N Mg^{-1} soil	g N Mg^{-1} soil	*n*	g N Mg^{-1} soil (kg N ha^{-1})	*p*-value
Iowa Study (1959–2007)	0–25 cm	2140 ± 60	2110 ± 70	61	−30 ± 90 (−110 ± 331)	0.162
	25–50 cm	1060 ± 40	1290 ± 70	61	230 ± 80 (864 ± 300)	<0.001
	50–75 cm	610 ± 40	740 ± 50	25	120 ± 60 (474 ± 237)	0.013
	75–100 cm	440 ± 40	500 ± 30	12	60 ± 50 (250 ± 209)	0.040
	0–100 cm	1063 ± 23	1160 ± 29	—	95 ± 36 (1478 ± 547)	—
Illinois Study (1957–2002)	0–20	2733 ± 176	2583 ± 119	6	−150 ± 213 (−17 ± 443)	0.516
	20–50 cm	1088 ± 127	1387 ± 164	6	298 ± 77 (1746 ± 689)	0.140
	50–100 cm	297 ± 29	492 ± 38	6	195 ± 12 (1436 ± 235)	0.016
	0–100 cm	1022 ± 54	1179 ± 58	—	157 ± 49 (**3164 ± 1033**)	

2010 in the 0–25, 25–50 and 50–75 cm layers (13.2 g N Mg^{-1}, $p < 0.001$; 7.3 g N Mg^{-1}, $p < 0.001$; 3.9 g N Mg^{-1}, $p = 0.003$) (table 2, figure 3(b)). An increase (1.4 g N Mg^{-1} yr^{-1}) was also seen from 75 to 100 cm, although the difference was not significant ($p = 0.294$). Over the entire depth range, using data only from pedons sampled to a depth of 100 cm, the accumulation rate is 3.4 ± 1.6 g N Mg^{-1} yr^{-1} ($p = 0.003$). Based on reported bulk density values, these results correspond to total increases (0–100 cm) of 54.8 ± 25.8 kg ha^{-1} yr^{-1}.

4. Discussion

4.1. Quantifying legacy: synthesis of mass balance and soil sampling results

The first question posed in the introduction was whether N is accumulating in agricultural soils, and if so, in what magnitude. The results from the Iowa resampling study, based on data obtained from 61 sites across Iowa, show a 9% increase in TN and suggest an accumulation rate of 30.8 ± 11.4 kg ha^{-1} yr^{-1} from 0 to 100 cm. A somewhat larger percent increase (15%) was seen from 0 to 100 cm at the Illinois resampling sites by David *et al* [50], corresponding to an accumulation rate of 70.3 ± 18.4 kg ha^{-1} yr^{-1}. Furthermore, our analysis of 2069 soil samples in the MRB demonstrates a 10% increase in soil TN from 0 to 100 cm between 1980 and 2010, corresponding to an accumulation rate of 54.8 ± 25.8 kg ha^{-1} yr^{-1} in cropland soil and an overall accumulation magnitude of 142 Tg N over the MRB over the 30 year period (figure 3(c)). While other studies have alluded to the possibility of N_R accumulating within the soil profile based on mass balance or modeling-based estimates [30, 45, 43], our study for the first time, provides direct, large-scale evidence of such accumulation.

We next explored the relationship between these accumulation magnitudes and estimates of N fluxes in MRB to assess the significance of these magnitudes at the basin scale. We have calculated watershed-scale net N inputs for the years 1980–1996 in the MRB to be 7.1 Mt yr^{-1} based on data reported by Goolsby *et al* [68]. During this period, the riverine flux of nitrate from the MRB to the Gulf of Mexico is estimated to have been 1.6 ± 0.1 Mt yr^{-1} [68], which constitutes approximately 23% of net N inputs. In this context, our estimate of soil N accumulation across the MRB (3.8 ± 1.8 Mt yr^{-1}) suggests that soil N accumulation could account for another 53% ± 25% of net N inputs (figure 4). While significant uncertainty remains regarding the actual magnitude of this estimate of N accumulation, the present results strongly suggest that changes in soil N stocks constitute a *significant* fraction of TN inputs under intensive agriculture and thus should be explicitly considered in watershed as well as regional and global-scale N mass balance studies.

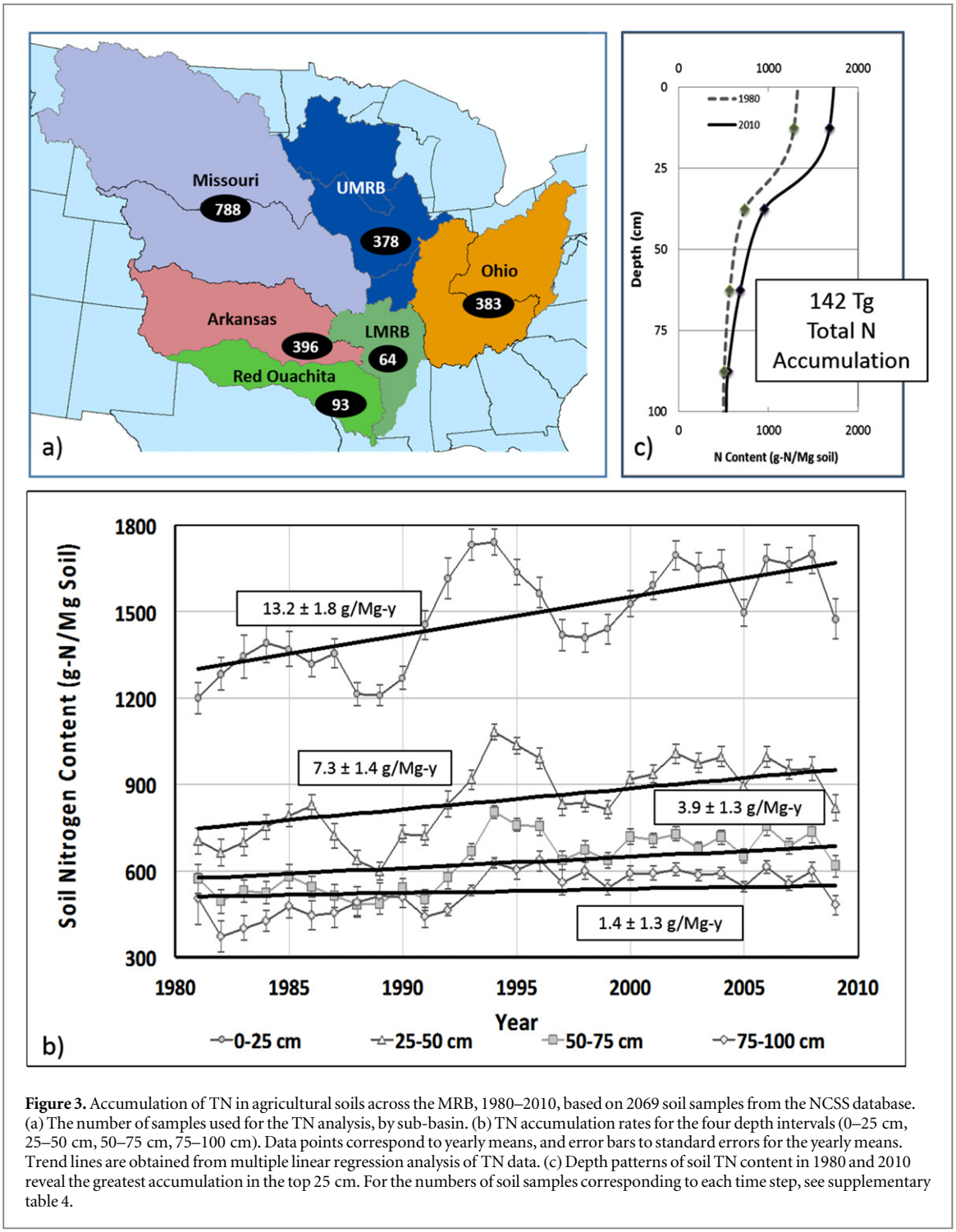

Figure 3. Accumulation of TN in agricultural soils across the MRB, 1980–2010, based on 2069 soil samples from the NCSS database. (a) The number of samples used for the TN analysis, by sub-basin. (b) TN accumulation rates for the four depth intervals (0–25 cm, 25–50 cm, 50–75 cm, 75–100 cm). Data points correspond to yearly means, and error bars to standard errors for the yearly means. Trend lines are obtained from multiple linear regression analysis of TN data. (c) Depth patterns of soil TN content in 1980 and 2010 reveal the greatest accumulation in the top 25 cm. For the numbers of soil samples corresponding to each time step, see supplementary table 4.

4.2. Understanding legacy: a conceptual model to explain N depletion and accumulation dynamics

The importance of agricultural soil as an N-sink, as described above, leads us next to question the mechanism behind such subsurface N accumulation. We hypothesize that such accumulation is a direct result of increased N fertilizer use (inorganic and manure N), increases in N fixation due to dramatic increases in soybean cultivation between 1940 and the present, and the adoption of conservation tillage practices [72, 52]. Accordingly, we can utilize the parsimonious modeling framework introduced in section 2.4 to describe not only the depletion of SON following the initial conversion of grassland or forested land to agriculture, but also the accumulation of N suggested by our analysis of soil data from the MRB (figure 5).

In the pre-cultivation period (Phase I: 1840–1890), SON is assumed to be at steady state, with most of the organic nitrogen in the protected pool (figure 5). The start of cultivation (Phase II: 1890–1910) leads to conversion of a portion of the protected SON to active SON, which can then be mineralized and leached from the soil profile. Net N inputs are negative in this period due to intensive cropping practices, but little input of fertilizer

Table 2. Accumulation rates for TN in soil samples across the Mississippi Basin (1980–2010) based on MLR analysis of the NCSS dataset. All available samples at each depth range were used to calculate the depth-specific accumulation rates. Overall accumulation rates (0–100 cm) are calculated not simply as the mean of the four smaller depth increments, but as part of a separate analysis in which only pedons with complete sampling data to 100 cm were considered. As the thickness of the soil profile can vary significantly, and because organic matter may accumulate preferentially in the upper layers of shallower soils (69), we use the more conservative estimate of accumulation suggested by the integrated analysis for the 0–100 cm depth range in subsequent discussions of estimated accumulation rates across the MRB. See supplementary table 7 for results by sublayer for the 1320-sample subset, and a discussion of the differences in the two estimation methodologies.

	Depth	Number	Bulk density	Rate of change		
Soil parameter	(cm)	(*n*)	(g cm^{-3})	(g Mg^{-1} yr^{-1})	(kg ha^{-1} yr^{-1})	*p*-value
Total nitrogen	0–25	1320	1.55	10.3 ± 3.0	39.9 ± 11.6	<0.001
	25–50	1320	1.61	1.9 ± 2.0	7.65 ± 7.3	0.354
	50–75	1320	1.64	0.8 ± 1.6	3.4 ± 6.6	0.614
	75–100	1320	1.65	1.6 ± 1.4	6.6 ± 5.8	0.250
	0–100	1320	1.61	3.4 ± 1.6	54.8 ± 25.80	0.003

[a]Mass-per-area accumulation rates (0–100 cm, kg ha^{-1} yr^{-1}) are calculated using the mass-per-mass accumulation rates (0–100 cm, g Mg^{-1} yr^{-1}) and the corresponding bulk density.

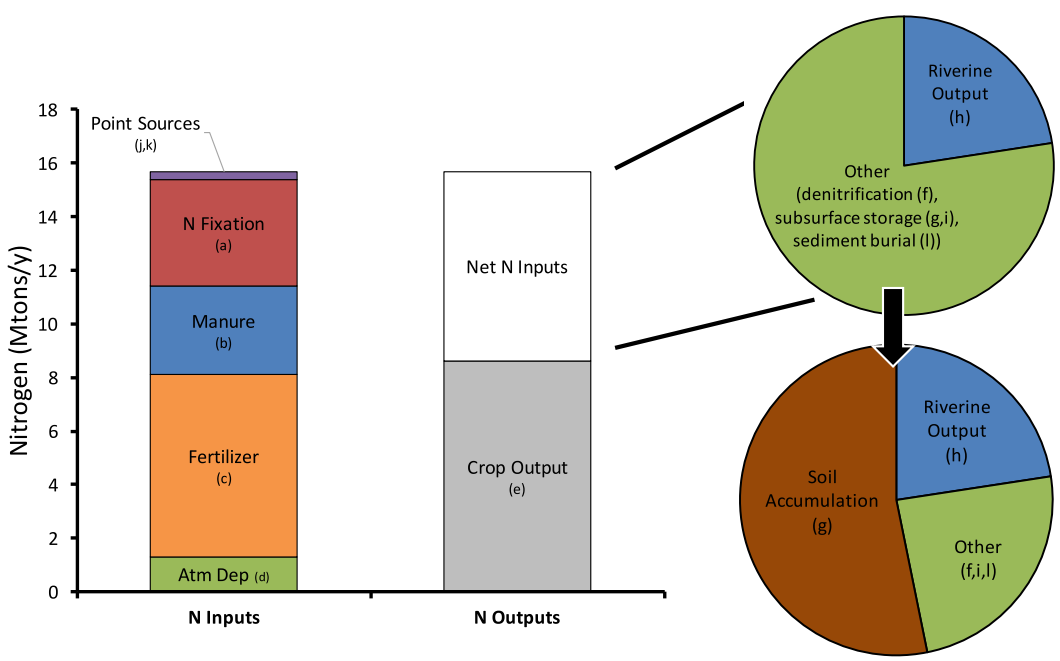

Figure 4. The fate of anthropogenic N inputs across the MRB. The figure shows a watershed-scale mass balance for the MRB calculated based on data from Goolsby *et al* [70]. The letters correspond to fluxes represented schematically in figure 1. Riverine N output (*h*) from the Mississippi accounts for approximately 23% of net N inputs. The present study indicates that legacy N accumulation (*g*) within agricultural soils may account for as much as 3.8 ± 1.8 Mt yr^{-1} (approximately 53% ± 25% of net N inputs). Although direct measurements of other fluxes are scarce, recent measurement data from the US corn belt suggest an annual nitrous oxide (N_2O) flux (*f*) for the MRB river network of 0.1 ± 0.01 Mt yr^{-1} (~1% of net inputs) [69]. Denitrification to N_2 (*f*) likely represents a much larger portion of the budget, but the magnitudes remain largely unconstrained [38]. Modeled estimates of sediment burial (l) in reservoirs across the MRB suggest an additional N sink on the order of 0.6 Mt yr^{-1} (8% of net inputs) [70, 71].

[67]. With these changes, there is an exponential decrease in the total mass of SON, with the system eventually evolving to a new steady state (figure 5). After the first 20 years of cultivation (Phase III: 1910 − 1950), we assume crop productivity to be diminished which leads to an increase in the net N inputs, and a stabilization of soil N levels (figure 5). Finally in Phase IV (1950–2000), the system transitions to a high-input state and soil N levels begin to rise. Then, at the start of Phase V, with the stabilization of net N inputs, soil N levels also stabilize.

The accumulated or legacy N, conceptualized as the difference between the Phases III and V steady states, corresponds to an approximately 9% increase over SON levels in the depleted steady state. This value is

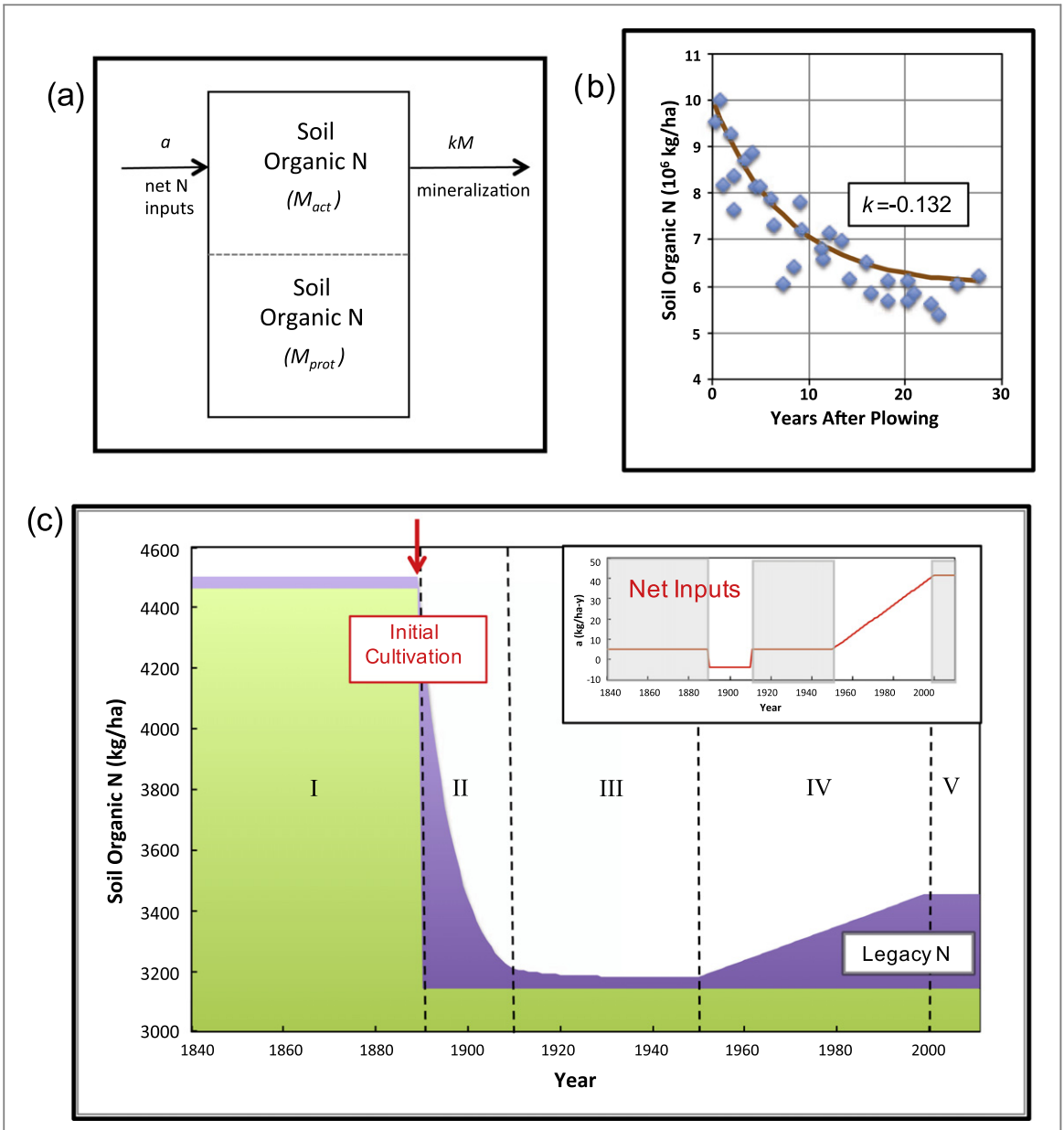

Figure 5. Modeling framework describing N depletion following conversion of native prairie/grassland to conventional agriculture, and N accumulation following agricultural intensification. On the top left (a) is a model schematic representing the flow of N through the active pool of soil organic N. In (b), we show the depletion of SON following initial cultivation of long-term grassland [54], from which we derive the mineralization reaction rate, *k*, used in equation 1. The figure on the bottom (c) shows the evolution of the protected and active N pools following land-use change according to the five phases described in the text. N inputs corresponding to the five phases are shown in the inset.

similar to the 10% increase observed over time in our MRB soil sampling data and the 9% increase observed in the Iowa resampling study. The modeling results suggest not only that soil N accumulation is possible in land under continuous cultivation, but that the trajectory of change can be described using the same approach as that used to describe the more well-known depletion of soil organic matter after initial cultivation.

Of course, the above simulation is based on a simplification of the trajectories of change in management practices and land use. We have assumed step changes between phases, but in reality changes occur more gradually. In its current state, the model described herein is primarily conceptual in nature, used to demonstrate the possibility of N accumulation in agricultural landscapes, and will require further modifications in terms of model parameterization as well as descriptions of inputs and outputs to more fully simulate landscape-scale changes in SON.

4.3. Implications of legacy: time lags in landscape response

The most significant implication of such a buildup of soil N relates to time lags observed between land-use changes and alterations in stream N concentrations [73]. Based on the current results, we contend that there are two components of this time lag attributable to two different types of legacy: a hydrologic legacy and a biogeochemical

legacy. The hydrologic legacy corresponds to dissolved N in groundwater reservoirs and unsaturated zones, and its existence contributes to the *hydrologic time lag*—defined as the average time required for dissolved N species to move from the point of application to the point of concern. The existence of the hydrologic time lag is well accepted, with a variety of hydrogeologic controls having been found to result in travel times ranging from days to decades [9, 74, 75]. The second type of legacy, the biogeochemical N legacy, arises from retention of N within the root zone, likely in organic form, and constitutes a long-term source for mineralization and NO_3^- leaching. The existence of such a biogeochemical legacy for phosphorus (P) is well known due to its reactive properties, and legacy sorbed P accumulation has been reported in both soil and sediments [9, 76]. The possibility of such a biogeochemical legacy for N, however, has been mostly neglected, as N in the form of NO_3^- is non-sorbing and is easily leached from soils [9].

The magnitude of the associated biogeochemical time lag is a function of not only the mass of TN accumulation, which has been the focus of this paper, but also the rates of organic N mineralization and the loss of dissolved N through the different biogeochemical and hydrologic pathways. Further research is needed to clarify these mechanisms and pathways. However, as a first estimate, we can utilize the modeling framework developed in section 4.2 to determine the time lag associated with depletion of the 142 Tg of legacy N suggested by our analysis of MRB soil data. Assuming a complete cessation of agricultural production in the region and a return of net annual inputs (a) to the pre-cultivation levels of 5 kg ha^{-1} yr^{-1}, our model results indicate a biogeochemical time lag of 35 years for 99% depletion of the legacy N. The total lag time would then be a function of both the biogeochemical and the hydrologic lag time, and the latter in itself can be on the order of decades depending on the sizes of saturated and unsaturated zone reservoirs. With such long time frames for recovery, it is thus critical to understand both the accumulation and the ultimate fates of these significant stores of subsurface N for sustainable management practices in large-scale agroecosystems such as the MRB.

4.4. Intersecting lines of evidence

Understanding the long-term dynamics of N in agricultural soils is complex due to the poorly constrained fluxes of denitrification, mineralization and immobilization over varying spatio-temporal scales [18, 19]. However, recent research, as described below, provides intersecting lines of evidence that point towards the accumulation of legacy N in the soil profile in much larger magnitudes than previously conceptualized. For example, using a combination of mass balance and process based modeling, the United States Environmental Protection Agency estimates cropland N accumulation in US to be equal to 17% of fertilizer N inputs [46], while accumulation in Canada has been estimated to be equal to 19% of TN inputs [30]. Accumulation is also suggested by isotope tracer studies that show a 15% retention of ^{15}N-labeled NO_3^- fertilizer within the soil profile nearly 30 years after application, implying that N fertilizer has a significant residence time in the SON pool [77]. The existence of legacy N is further corroborated by observations of biogeochemical stationarity for N in landscapes under intensive agriculture [78, 79]. In such landscapes, the supply of N to surface waters appears to be transport-limited rather than source-limited, suggesting that the existence of legacy N within the landscape provides an ongoing N source and therefore a positive, linear correlation between riverine N flux and discharge, with N concentrations remaining relatively invariant. This behavior is in contrast to that observed in more pristine landscapes, where N concentrations vary in time in response to source limitations [80].

Our work makes a unique contribution to this literature by providing the first *measured* estimate of large-scale N accumulation in soils across the MRB. The intersection of such varying lines of evidence, both direct and circumstantial, leading to estimates of soil N accumulation, suggests (a) that we must acknowledge the existence of a growing pool of SON in agricultural landscapes and (b) that we must more explicitly explore the impacts of such a pool on future water quality.

5. Conclusion

Our study has three fundamental contributions. First, our finding of significant N accumulation in agricultural soils across the MRB (3.8 $\pm$ 1.8 Mt yr^{-1}) makes a critical contribution towards clarifying the fate of the 'missing' N that is consistently referred to in reports of watershed-scale mass balance studies [21, 75–77]. Although caution must be exercised in relying upon the precise magnitude of accumulation due to large uncertainties in the data, by identifying a clear possibility of significant N accumulation within agricultural soils we make considerable progress towards the closing of N budgets, from the watershed to the global scale. Second, we have developed a simple model that describes both the accumulation and depletion dynamics of SON arising from anthropogenic perturbations on the landscape, thus confirming our hypothesis that the same underlying mechanism can be used to describe both N depletion following plowing and N accumulation as a result of high-input agriculture. The third contribution of this study is with respect to time lags between best management practices and water quality benefits. The significant mass of organic N accumulating in agricultural soils implies that stream N concentrations will persist for decades after fertilizer inputs have ceased. Indeed, the time lag would in most cases be significantly greater than that estimated based on the hydrologic legacy alone. Our study for the first time links multiple lines of evidence to show convincingly that N, like P,

has a biogeochemical legacy, a legacy that complicates our previous understanding of the fate of this nutrient in anthropogenic landscapes and that must be accounted for in intervention efforts to improve water quality.

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Author Contributions

NBB and KJV conceived and developed the core ideas for the paper and contributed equally to this work. JV and CLB provided the Iowa soil sampling data and offered suggestions regarding the soil datasets. NBB and KJV synthesized data from the Illinois and Iowa sampling studies and from the NCSS database and also developed the modeling framework.

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FRED CORSON

STATE OF CALIFORNIA
STATE WATER RESOURCES CONTROL BOARD

In the Matter of the Petition of Russian Riverkeeper and Fred Corson for Review of Action by the California Regional Water Quality Control Board, North Coast Region, in Adopting Notice of Applicability No. WQ-2014-0090-DWQ-R1001-01.	**PROOF OF SERVICE RE: PETITION FOR REVIEW OF NORTH COAST REGIONAL WATER QUALITY CONTROL BOARD ACTION ADOPTING Notice of Applicability No. WQ-2014-0090-DWQ-R1001-01**

PROOF OF SERVICE

I am a citizen of the United States, employed in the County of Alameda. My business address is 7425 Fairmount Ave., El Cerrito, CA 94530. I am over the age of 18 years and not a party to the above-entitled action.

Document(s) served:

- **PETITION FOR REVIEW OF NORTH COAST REGIONAL WATER QUALITY CONTROL BOARD ACTION ADOPTING Notice of Applicability No. WQ-2014-0090-DWQ-R1001-01**

On August 01, 2016, I served the foregoing document(s) on the parties in this action, located on the **attached service list,** by placing copies thereof in sealed envelopes addressed as shown below for service as designated below:

(x)	By First Class Mail:	Deposited the sealed envelope with the United States Postal Service, with the postage fully paid.
( )	By Personal Service:	I personally delivered each such envelope to the office of the address on the date last written below.
( )	By Overnight Mail:	I caused each such envelope to be placed in a box or other facility regularly maintained by the express service carrier, or delivered to an authorized courier or driver authorized by the express service carrier to receive documents, in an envelope or package designated by the express service carrier with delivery fees paid or provided for.
(x)	By Electronic Transmission:	Based on a court order or an agreement of the parties to accept service by electronic transmission, I caused the documents to be sent to the person(s) at the e-mail addresses listed below. I did not receive, within a reasonable time after the transmission, any electronic message or other indication that the transmission was unsuccessful.

I declare under penalty of perjury under the laws of the State of California that the above is true and correct. Executed on August 01, 2016 in Albany, California.

_____
Romit M. Patel

SERVICE LIST

Terry Crowley City of Healdsburg Department of Public Works 401 Grove Street Healdsburg, CA 95448	
Matthias St. John Executive Officer North Coast Regional Water Quality Control Board 5550 Skylane Boulevard, Suite A Santa Rosa, CA 95403	