THESIS

EXAMINING EMERGING WATER QUALITY MARKETS THROUGH A COLLECTIVE ACTION LENS

Submitted by

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ABSTRACT

EXAMINING EMERGING WATER QUALITY MARKETS

THROUGH A COLLECTIVE ACTION LENS

Water quality trading (WQT) is a collective action mechanism increasingly employed to address water quality concerns arising from nonpoint source pollution. Yet, many established WQT programs have experienced little or no trading activity. Collective action theory regarding common property resources (CPR) suggests that the external variables comprising a collective action institution's context dictate how effectively an institution can organize and perform. Because successful emergence is a precursor to successful performance and endurance down the road, understanding how and why external variables affect WQT collection action during early formative stages can provide insights into why some WQT programs may struggle to function and perform to their anticipated potential as they mature. However, few efforts have empirically examined WQT programs in terms of the external variables known to influence CPR collective action emergence, performance, and durability. In addressing this void, I use an in-depth case study approach of two incipient WQT initiatives in the western U.S. to assess if and how the manifestation of external variables considered to be enabling conditions for successful CPR collective action influences the development of emerging WQT programs.

This research finds theory regarding CPR collective action enabling conditions useful in understanding the development trajectories of emerging WQT programs. Results suggest that the absence of enabling conditions and strong constitutional rules can undermine the ability of decentralized political systems to support emergent WQT programs. Contrarily, centralized systems with well-defined rules and roles may provide more stable scaffolding for institutional development. These findings demonstrate how the quality of constitutional rules interacts with other external variables, including policy norms, agency allocation, collective choice rules, and social capital, to dictate the evolution and eventual performance of emergent WQT programs and CPR collective action institutions more broadly.

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DEDICATION

To Tobias,

for this and every other adventure yet to come.

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Water quality trading, Collective action, Common property resources, Institutional development, Enabling conditions

CHAPTER 1: INTRODUCTION

Degraded water quality resides among the world's most urgent environmental concerns (Millennium Ecosystem Assessment 2005). Amid the leading causes of water quality impairment is the pollution of waterways by excessive levels of nutrients such as nitrogen and phosphorus from human land use activities (U.S. Environmental Protection Agency [EPA] 2010; Greenhalgh and Selman 2012; Walker and Selman 2014). Nutrient pollutants are a form of nonpoint source pollution, defined as "the diffuse and pervasive streams of pollutants that enter our waters over broad expanses of land…rather than from a discrete and identifiable 'point'" (Williams 2002, p. 22). Runoff from rainfall or snowmelt collects and carries nonpoint source nutrient pollutants over and through the ground, eventually depositing them into waterbodies, such as lakes, rivers, and wetlands, where they contribute to a trend of increasing numbers of harmful algal blooms in surface waters. These blooms can deplete dissolved oxygen and trigger a die-off of other organisms, as well as release toxins that degrade drinking water sources and adversely affect recreation, tourism, and fisheries (Carpenter et al. 1998; Smith 2003; U.S. Government Accountability Office [GAO] 2017). Of all the waterbodies across the nation that have been assessed and a possible source of impairment identified, 85% of rivers and 80% of lakes are polluted by nonpoint sources (EPA 2010).

Despite nearly 50 years of federal and state attempts to curb its production and impacts, nonpoint source water pollution persists as an elusive environmental governance challenge. This is due, in part, to water quality being a common property resource (CPR) (Sarker 2008). A CPR is any resource where: a) use or degradation by any one individual decreases the quantity and/or quality of the resource available to others and b) it is difficult to control or exclude individuals from accessing or degrading the resource. As a CPR, water quality is subject to what Hardin (1968, p. 2) described as the "tragedy of the commons", whereby rational individuals make choices that maximize their personal gain but inadvertently contribute to collective disaster. In the case of water quality, individual landowners find that their share of the costs of water quality degradation is, at least initially, less than the cost of reducing pollutant runoff from their

land (Hardin 1968). In the absence of individual behavioral inducements such as financial incentives or penalties to reduce pollutant levels and with the costs of pollution born by a broader public, the rational individual choice is to pollute. Hence, the cumulative effect of individual landowner choices tends toward water quality degradation. This scenario typifies a negative environmental externality, in which the costs of pollution to society are neither considered nor compensated for in the traditional economic marketplace.

Nonpoint source pollutants are characteristically challenging to regulate, monitor, and measure because their sources are geographically dispersed, and levels are highly variable in time due to effects of weather (Carpenter et al. 1998). Additionally, political sensitivities complicate the regulation of land use on residential private property. Traditional approaches to the management of water resources take the form of regulatory policies stemming from federal and state levels of government (Gerlak 2006). Unfortunately, strategies that have been generally successful in dealing with point source polluters, such as uniform technology-based regulation, are both inappropriate and unavailable for the management of nonpoint source pollution. Thus, with few exceptions, nonpoint sources of water quality degradation are exempt from regulatory oversight (Breetz et al. 2005; Gunningham and Sinclair 2005).

In recognition of the limitations of traditional regulatory measures in managing nonpoint source pollution, government, non-government, and private sector actors are experimenting with market-based pollutant trading mechanisms as a means of incentivizing individual landowners to reduce pollutant discharge into the water quality commons. Water quality trading (WQT) programs enable nonpoint sources to generate and sell credits by implementing new or additional land management practices that reduce pollutant loadings. Credits are sold to point source polluters who use them to cost-effectively offset their pollutant discharges.

In this way, WQT is an attempt to induce cooperative, voluntary collective action to generate mutually beneficial solutions that are superior to traditional regulatory approaches (Lubell et al. 2002). Proponents endorse WQT as an economical and compliance-facilitating policy tool for addressing nonpoint source pollution and achieving water quality goals (Fang et al. 2005; Ribaudo and Gottlieb

2011). On the ground, the WQT mechanism is increasing in practice with approximately 20 active or in-development programs in existence within the U.S. today that support trading between nonpoint sources and point sources (Greenhalgh and Selman 2012; Bennett and Carroll 2014; Willamette Partnership et al. 2015; Bennett et al. 2016; GAO 2017).

However, despite the mechanism's promising potential, many WQT programs have experienced lethargic, if any, trading activity (Ribaudo and Gottlieb 2011; GAO 2017). Scholars and practitioners have hypothesized the technical challenges that preclude WQT programs from reaching their anticipated potential, such as scientific uncertainty regarding the effectiveness of land management practices in reducing pollution and difficulties associated with determining rules for validation measures, trading ratios, and baseline requirements that impede neither credit supply nor demand (see Hoag and Hughes-Popp 1997; Woodward and Kaiser 2002; King and Kuch 2003; Kieser and Fang 2005; King 2005; Ribaudo and Nickerson 2009; Ribaudo and Gottlieb 2011; Walker and Selman 2014; GAO 2017). While such technical challenges inhibit WQT activities and attainment of water quality goals (Ribaudo and Gottlieb 2011; GAO 2017) and thus are worthy subjects of investigation, a policy science perspective suggests that the opportunities and obstacles experienced by WQT initiatives are affected by forces external to WQT operations that, when interacting with technical complications, can lead to suboptimal performance. As noted by E. Ostrom (2005, p. 16), external variables interact to influence "the types of actions that individuals can take, the benefits and costs of these actions and potential outcomes, and the likely outcomes achieved". The arrangement of external variables can either enable or inhibit collective action and thus dictate how effectively an institution can organize and achieve its goal (E. Ostrom 1990, 2005).

Policy science scholars focused on cooperative collective action problems posit that particular manifestations or arrangements of external variables – known as *enabling conditions* – encourage the successful emergence, durability, and performance of collective action institutions and their ability to govern CPRs (e.g., Wade 1988; E. Ostrom 1990; Baland and Platteau 1996; Agrawal 2001; Kerr 2007). Conversely, the absence or limited presence of enabling conditions suggests a dearth of those conditions

understood to be conducive of collective action success. Building upon these propositions, I investigate the arrangement and influence of three categories of enabling conditions advanced in the CPR literature: group characteristics, institutional arrangements, and external environment. *Group characteristics* refer to attributes of the actors engaging in collection action processes. *Institutional arrangements* encompass the existing rules guiding collective action institutional development and the institutional ability to create and enforce new rules. *External environment* describes the broader policy and governance context in which CPR collective action institutions emerge and operate.

The evolutionary trajectory of institutions is influenced by their formative and developmental histories (David 1994), and successful emergence is a precursor to successful performance and endurance down the road. As such, a better understanding of institutional *emergence*, or the inception process through which actors come together to collectively define a new institution's structure, objectives, norms, rules, actor roles, and other organizational elements, can shed light upon why mature institutions behave the way they do. When applied to the realm of WQT, this logic suggests that a better understanding of how and why external variables affect the emergence process of new CPR collective action institutions can provide insights into why some WQT programs may struggle to function and perform to their anticipated potential as they mature.

However, WQT initiatives have yet to be empirically analyzed in terms of the external variables known to influence or support CPR collective action. My research seeks to address this void by investigating the extent to which emerging WQT programs exhibit and are influenced by external variables hypothesized as important for CPR collective action. Specifically, using an in-depth case study approach of two incipient WQT initiatives in the western U.S., I assess if and how the manifestation (e.g., presence or absence) of external variables considered to be enabling conditions for successful CPR collective action influence the development process of emerging WQT programs.

1.1 **Research Questions**

This study's central objective is to examine the extent to which emerging WQT programs show evidence of, and are subsequently influenced by, conditions hypothesized to be conducive for successful CPR collective action, focusing specifically on elements of group characteristics, institutional arrangements, and external environment. In accordance with this objective, I ask the following questions to guide my inquiry:

Research Question 1: How do external variable characteristics of an emerging WQT program compare to conditions hypothesized as enabling of successful CPR collective action institution development?

Research Question 2: How do external variable characteristics influence the structure, functioning, and performance of an emerging WQT program?

CHAPTER 2: BACKGROUND

2.1 **Federal Policy Context for Water Quality Trading**

The principal law governing the quality of the nation's surface waters is the Federal Water Pollution Control Act, commonly known as the Clean Water Act (CWA), which has served as the vessel for a series of policy experiments attempting to manage nonpoint source water pollution. Originally enacted in 1948, it was not until 1972 that the CWA saw substantial revisions aimed at addressing nonpoint source pollution with Section 208 (Szalay 2010). Section 208 directed states to identify areas with substantial water quality control problems, identify all land-use-related pollution sources, and develop areawide treatment plans to address them (Laitos and Ruckriegle 2013). Upon submission to the EPA, such plans were required to describe programs, activities, and voluntary best management practices for major land uses to control nonpoint source pollutants (Water Quality Planning and Management 2017). However, while the EPA offered cost-sharing incentives for drafting and implementing areawide treatment plans under Section 208, the policy was without regulatory teeth; nothing in the CWA at the time enabled the EPA or other federal agency to impose and enforce an alternative plan in the case that a state produced an inadequate areawide treatment plan – or failed to produce a plan at all. Thus, Section 208 is widely seen as unsuccessful in addressing nonpoint source pollution, with all federal funding for the program ending in 1981 (Laitos and Ruckriegle 2013).

In 1987, Congress again revised the CWA with Section 319 to reemphasize the control of nonpoint source pollution by requiring states to identify, monitor, and report waterbodies impaired by nonpoint source pollution, as well as develop state management programs and plans indicating how state and local governments expect to manage nonpoint source pollution. Like with Section 208, Section 319 plans must include best management practices for controlling nonpoint source pollution and describe measures for implementing such practices (Laitos and Ruckrieglt 2013). Although Section 319 also offers inducements by way of cost-sharing grants in addition to calling for greater reporting and monitoring of nonpoint source pollution than its predecessor, Section 208, participation is still largely voluntary. It provides no

additional enforcement authority to the EPA if a state chooses not to prepare or implement a nonpoint source pollution management plan (Fentress 1989).

Though federal water policies have fallen short in nonpoint source pollutant reductions due to limited enforcement authority (Szalay 2010), they have seen significant success in controlling water quality degradation by point sources. The CWA made it unlawful to discharge any pollutant from a point source into navigable waters of the U.S. unless it obtains one of two types of permits: either a CWA Section 404 permit or a National Pollutant Discharge Elimination System (NPDES) permit (Craig and Roberts 2015). The Section 404 permit program, administered by the U.S. Army Corps of Engineers, applies to discharges of dredged or fill material into navigable waters typically caused by the filling or draining of wetlands, swamps, or shallow streams (Water Pollution Prevention and Control Act 2001, § 1344). Though Section 404 permit requirements apply only to point source discharges, the policy indirectly mitigates some nonpoint source pollution by protecting wetlands, which slow the rate of surface water runoff and filter sediment and other pollutants before they reach waterbodies (Mandelker 1989). However, nonpoint source pollution is secondary to Section 404's primary goal of wetland preservation; as such, practices adopted for the benefit of wetlands under Section 404 may be inconsistent with those most effective for nonpoint source pollution management (Mandelker 1989).

The second type of permit required for compliant point source discharge pertains to the NPDES, set forth in CWA Section 402. According to this section, any point source seeking to legally discharge pollutants into waters of the U.S. must obtain an NPDES permit from the EPA or an authorized state with primacy, which is the EPA-delegated authority for a state to administer the NPDES permit program within its boundaries. An NPDES permit denotes, among other terms, how much of a particular pollutant a point source permit holder can discharge. Technology-based effluent limitations for point source dischargers are derived from industry-specific studies determining what levels of discharge can be achieved for each pollutant using the most cost-effective of available pollution control and prevention techniques (Copeland 2010). For this reason, the CWA was initially deemed a "technology-forcing statute" due to the rigorous demands placed on the point sources that are regulated by it to progressively

meet higher and higher levels of pollution abatement under deadlines specified in the law (Copeland 2010, p. 2). The NPDES permit also specifies monitoring requirements and requires the point source discharger to submit daily monitoring reports to the relevant state agency and to the EPA (Water Pollution Prevention and Control Act 2001, § 1313 [b]). Though applicable only to point sources, Section 402 empowers the EPA with enforcement authority.

In order to provide a regulatory check and establish bounds for point source-based permitting, the CWA Section 303 employs water quality standards to represent the ambient water quality goals for a particular waterbody (Craig and Roberts 2015). Specifically, Section 303 requires each state to set and submit to the EPA water quality standards for the waters within its borders; if a state fails to do so, then the EPA has the authority to establish and impose water quality standards for that state (Water Pollution Prevention and Control Act 2001, § 1313 [a, b]). While Sections 208 and 319 encourage voluntary nonpoint source pollution control, and Section 402 regulates point source pollution dischargers, Section 303 combines these approaches through water quality standards and pollutant budgets.

Water quality standards consist of two parts: first, they define the designated use or uses (i.e., recreation, water supply, industry, or other) that the state wants a waterbody to be able to support; then, they assign a numerical or narrative statement identifying the maximum concentrations of various pollutants which would not impair the waterbody for its designated uses (Copeland 2010). In waters where point source dischargers have achieved technology-based effluent limitations, yet water quality standards have not been achieved, a state is obligated to identify and allocate pollutant loads in a manner that would lead to attainment of water quality standards. The result of developing a pollutant budget for a waterbody is referred to as a Total Maximum Daily Load (TMDL). Section 303d of the CWA requires states to identify and report waters within their boundaries in poor condition due to pollutants and where current pollution control technologies alone cannot meet the water quality standards set for those waterbodies (Water Pollution Prevention and Control Act 2001, § 1313). The TMDL process is then applied to those impaired waters.

In generating a TMDL, a state must first quantify existing pollutant loads and calculate the load reductions needed to meet water quality standards for the impaired waterbody (EPA 2017). Subsequently, an allowable pollutant load, or cap, is determined based on the assimilative capacity of the waterbody to withstand pollution and still safely meet its water quality standards. The total pollutant load for the waterbody is then divided and distributed, or allocated, among identified *point and nonpoint source* dischargers. The point source wasteload allocations are used to develop NPDES permit limits for the impaired waterbody (EPA 2017). The TMDL program has the potential to substantially impact industrial and municipal dischargers by reducing their discharge allowances to levels that require the installation of costly new treatment technologies, if such technologies are even available (Patterson 2003). Although nonpoint sources are not legally required to have NPDES permits to discharge pollutants, nonpoint sources receive non-binding TMDL load allocations indicating the amount of reductions in nonpoint source discharges needed to achieve the water quality standards for the impaired waterbody (EPA 2017). Hence, TMDLs do not represent regulatory authority over nonpoint source dischargers; rather, they serve as a source of information about the contribution of nonpoint source pollution to a particular waterbody (EPA 2017).

As these programs and policies have resulted in substantial point source pollution reductions over the last half century, it is increasingly evident that nonpoint source pollution, which is largely unregulated by the CWA, significantly contributes to persisting water quality problems (Ruppert 2004). In the general absence of regulation, nonpoint source dischargers lack the incentive to incur the costs of actions that would improve water quality because these costs would be borne by the polluter while the benefits are distributed across larger society (Gunningham and Sinclair 2005; Ribaudo and Gottlieb 2011) – the very definition of a CPR problem. This CPR characteristic, combined with complications such as the politics of federal regulatory incursions on state governments and private property rights, mean that nonpoint source pollution management poses complex challenges to water quality governance (Gunningham and Sinclair 2005). To address these problems, government, non-government, and private sector actors are cooperatively directing their attention to market-based collective action mechanisms such as WQT for

integrating nonpoint source pollution management into existing policy contexts (Ruppert 2004; Fang et al. 2005; Ribaudo and Gottlieb 2011).

To provide support to WQT initiatives, the EPA has produced an evolving series of guidance documents in recent decades. Starting with a 1996 *Draft Framework for Watershed Trading*, the EPA advanced federal considerations of the impacts of nonpoint source pollution and how it could be managed through trading mechanisms (EPA 1996). The framework remained a draft until 2003 when the agency promulgated its official *Water Quality Trading Policy* formally authorizing point and nonpoint source dischargers to trade pollution credits among themselves in order to more cost-effectively achieve the pollutant reductions defined by TMDL programs (EPA 2003). In 2004, the EPA published a *Water Quality Assessment Handbook* to help actors determine the viability of WQT for their watershed (EPA 2004). Finally, the EPA built upon these earlier documents with its *Water Quality Trading Toolkit for Permit Writers* in 2007 (updated in 2009) that provides further guidance regarding the actual design and implementation of WQT programs (EPA 2009).

2.2 **Water Quality Trading**

As stated in the EPA's 2003 *Water Quality Trading Policy*, "Water quality trading is an approach that offers greater efficiency in achieving water quality goals on a watershed basis. It allows one source to meet its regulatory obligations by using pollutant reductions created by another source that has lower pollution control costs" (EPA 2003, p. 1). WQT programs allow nonpoint sources to generate and sell credits by implementing new or additional best management practices that reduce pollutant loadings to receiving waters. Point sources polluters, who were originally required to meet NPDES permit requirements via their own emissions reductions, can now meet their requirements by purchasing credits from other regulated point sources or unregulated nonpoint sources (EPA 2003) (see Figure 1). The logic underpinning trades between point sources and nonpoint sources is that the best management practices implemented by nonpoint sources generally cost less than technological upgrades or other abatement methods available to point sources. In short, point-nonpoint source trading "enables point sources with high compliance costs to purchase pollution reduction credits (also referred to as 'offsets') from nonpoint

sources with lower pollution reduction costs" (Selman et al. 2009, p. 2). However, rather than being limited to the compensation amount stipulated by a standard U.S. Department of Agriculture Farm Service Agency conservation program (e.g., the Farmable Wetlands Program whereby farmers receive annual payments in return for restoring wetlands), nonpoint sources can receive higher payment based upon a price determined by the marketplace and may also be paid for a longer duration of time (Ribaudo and Gottlieb 2011). Trading can also provide ancillary environmental benefits such as carbon sequestration, flood retention, riparian improvement, and wildlife habitat (EPA 2009). In sum, WQT is believed to provide more flexibility and possess the potential to achieve water quality goals, environmental benefits, and economic savings greater than would otherwise be attained under more traditional regulatory approaches (EPA 2003).

The population of roughly 30 WQT programs distributed throughout the U.S. has been catalogued to varying degrees in a series of recent efforts by Breetz et al. (2004), Selman et al. (2009), Ribaudo and Gottlieb (2011), Greenhalgh and Selman (2012), Bennett and Carroll (2014), Willamette Partnership et al. (2015), and Bennett et al. (2016) (see Figure 2). Approximately 20 of these active or in-development programs support point-nonpoint source trading (see Table 1), while roughly another 10 WQT programs limit trades to between point sources. The majority of WQT programs target nutrient pollutants such as nitrogen and phosphorus, but sediment and carbonaceous biochemical oxygen demand (CBOD) also count among traded pollutants (Breetz et al. 2004; Greenhalgh and Selman 2012; Bennett and Carroll 2014; Willamette Partnership et al. 2015; Bennett et al. 2016).

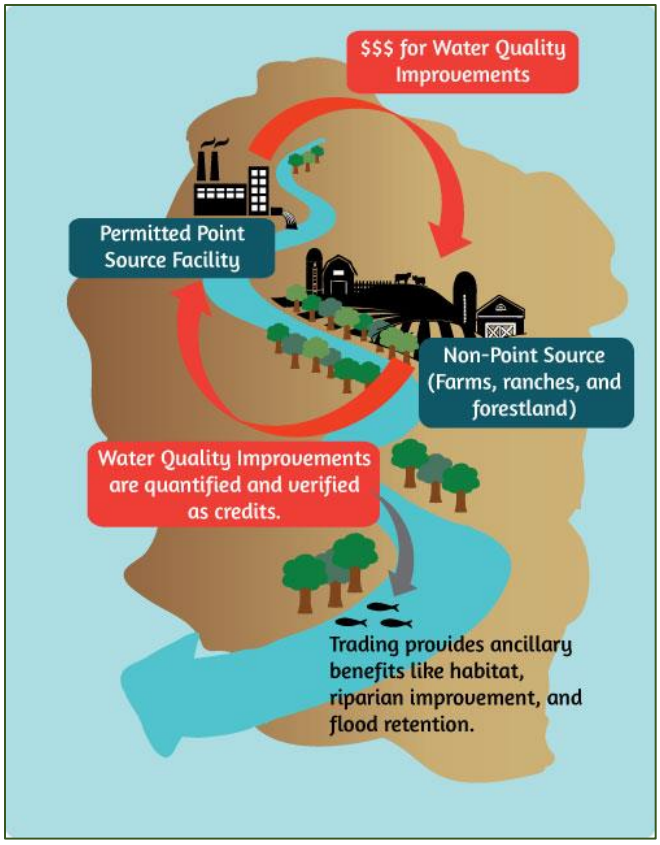

Figure 1. Structure of the water quality trading mechanism. *Source:* Willamette Partnership[1].

[1] http://willamettepartnership.org/water-quality-trading-101/

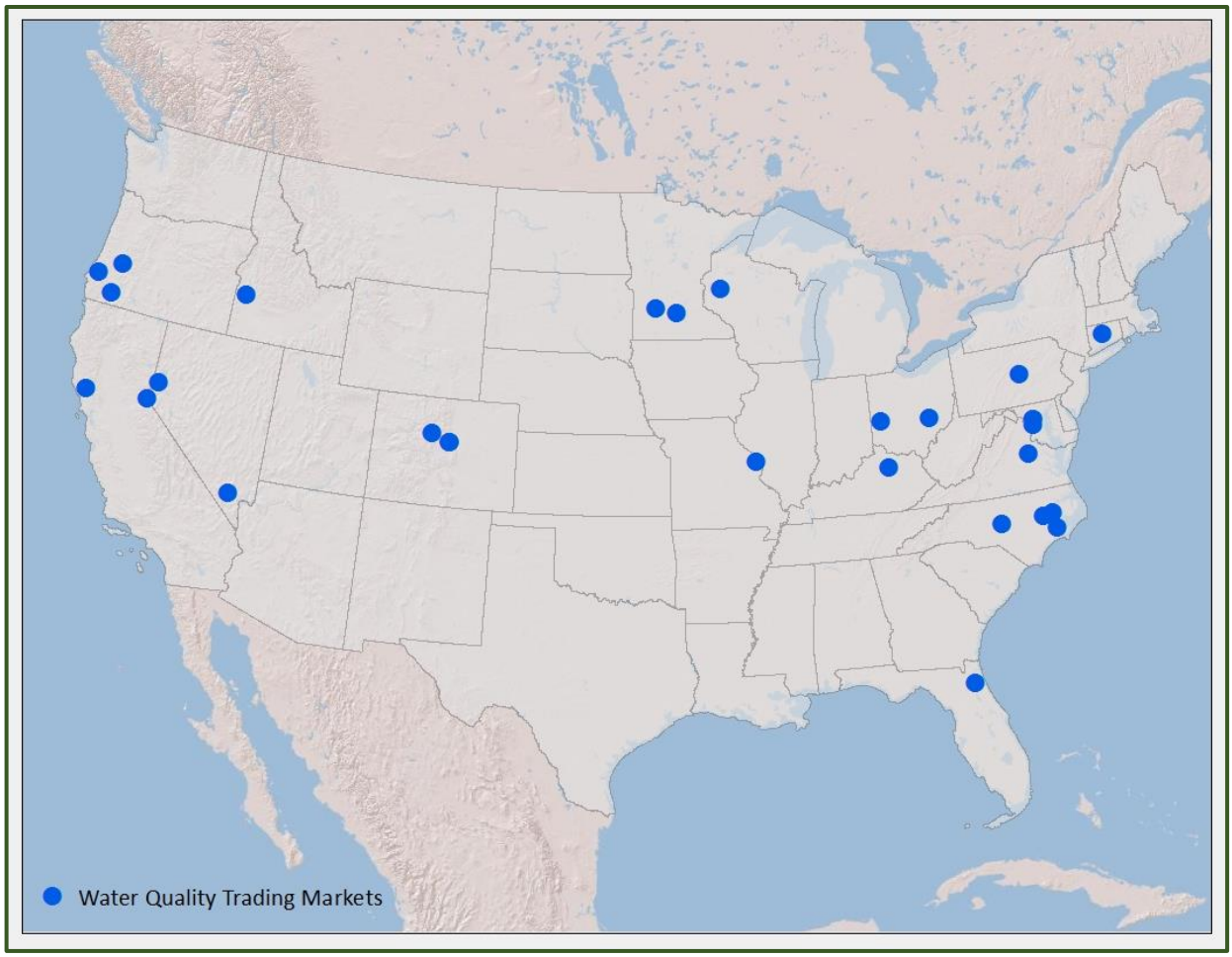

Figure 2. Map depicting watershed location of active or in-development WQT efforts in the U.S., including both point-point source trading and point-nonpoint source trading programs. *Sources:* Breetz et al. (2004); Selman et al. (2009); Ribaudo and Gottlieb (2011); Greenhalgh and Selman (2012); Bennett and Carroll (2014); Willamette Partnership et al. (2015); and Bennett et al. (2016).

Table 1. Active or in-development WQT efforts in the U.S. targeting nutrient pollutants through point-nonpoint source trading that have been identified in at least two of the following publications. *Sources and reference key:* A - Breetz et al. (2004); B - Ribaudo and Gottlieb (2011); C - Greenhalgh and Selman (2012); D - Bennett and Carroll (2014); E - Willamette Partnership et al. (2015).

Initiative Name	State	Trade Type(s)	Pollutant(s)	Approx. Start Year	Presence in Literature
Laguna de Santa Rosa Water Quality Credit Trading Market Pilot	CA	PS-NPS	Phosphorus	2012	D, E
Bear Creek Watershed Association Trading Program	CO	PS-PS/NPS	Phosphorus	2006	C, D
Chatfield Reservoir Trading Program	CO	PS-PS/NPS	Phosphorus	1996	A, C, D
Cherry Creek Basin Water Quality Authority Trading Program	CO	PS-PS/NPS	Phosphorus	1997	A, C, E
Dillon Reservoir Pollutant Trading Program	CO	PS-NPS	Phosphorus	1984	A, C
Lower Boise River Effluent Trading Demonstration Project	ID	PS-NPS	Phosphorus	1998	A, C, E
Rahr Malting Company Permit	MN	PS-NPS	Nitrogen, Phosphorus Carbonaceous oxygen demand (CBOD5), Sediment	1997	A, B, C, D, E
Southern MN Beet Sugar Cooperative Permit	MN	PS-NPS	Phosphorus	1999	A, B, C, D, E
Neuse River Compliance Association	NC	PS-PS/NPS	Nitrogen	1998	A, C, D
North Carolina State Nutrient Offset Program	NC	PS-NPS	Nitrogen, Phosphorus	1990	D, C, E
Tar-Pamlico Nutrient Trading Program	NC	PS-NPS	Nitrogen, Phosphorus	1989	A, C, D, E
Alpine Cheese Company Trading Program (Sugar Creek)	OH	PS-NPS	Phosphorus	2006	C, D, E
Great Miami River Watershed Water Quality Credit Trading Program	OH	PS-PS/NPS	Nitrogen, Phosphorus	2005	A, B, C, D, E
Pennsylvania Chesapeake Bay Nutrient Credit Trading Program	PA	PS-PS/NPS	Nitrogen, Phosphorus	2009	A, C, D, E
Virginia Nutrient Credit Exchange	VA	PS-PS/NPS	Nitrogen, Phosphorus	2006	C, D, E
Red Cedar River Nutrient Trading Pilot Program	WI	PS-NPS	Phosphorus	1999	A, B, C
Ohio River Basin Water Quality Trading Project Pilot	Multi	PS-NPS	Nitrogen, Phosphorus	2013	D, E

2.3 **Collective Action Enabling Conditions**

In the course of developing WQT programs, stakeholders come together to commence an institutional design process (Cochran 2008) to collectively create a venue for cooperative voluntary collective action to address the CPR problems associated with water quality. The WQT design process gives rise to the rules, norms, and structures that together create and comprise new collective action institutions and govern the behaviors, interactions, and decisions of individual participants (Cochran 2008).

From an analytical perspective, collective action institutions can be understood and analyzed in terms of interactions between an action situation and the external variables forming the context of the action situation (E. Ostrom 2005, 2011) (see Figure 3 and Figure 4). The action situation refers to the social space where participants engage with one another to cooperatively produce mutually beneficial outcomes. Following this reasoning, different compositions of external variables will interact differently with an action situation to produce different outcomes. External variables affecting an action situation include three types of variables: a) the attributes of the *biophysical conditions* that are acted upon in a particular action situation, b) the *attributes of the community* within which an action situation is situated, and c) the *rules-in-use* employed by action situation participants to organize their relationships (E. Ostrom 2005). Take, for example, a scenario in which two groups, Group A and Group B, attempt to organize to collectively address the distribution of water use rights within a water-limited environment. Group A consists of old friends with long-established and well-understood norms for interacting with one another, and Group B brings together historically adversarial actors from disparate organizational and individual cultures. The external, contextual attributes of Group A and Group B actor communities and their rules or norms of engagement will affect how those actors interact within the action situation and their ability to collectively organize and eventually sustain a water use right distribution system. Collective action theorists (e.g., Wade 1988; E. Ostrom 1990; Baland and Platteau 1996; Agrawal 2001; Kerr 2007) hypothesize that certain manifestations of external variables are more facilitative than others in the emergence, durability, and performance of collective action institutions. In the example above, Group A's

external variables are likely more conducive ingredients for successful collective action than those of Group B.

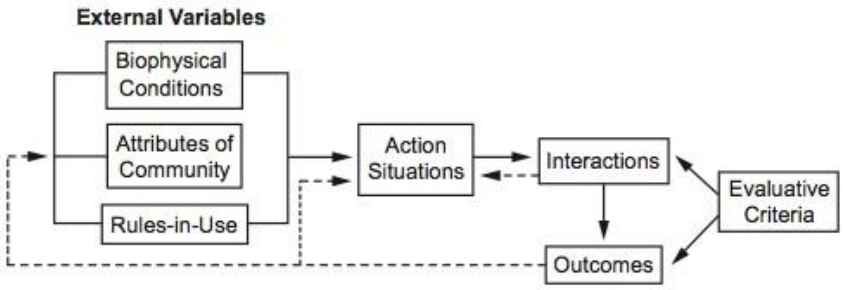

Figure 3**.** A Framework for Institutional Analysis and Development. *Source:* E. Ostrom (2011, p. 10).

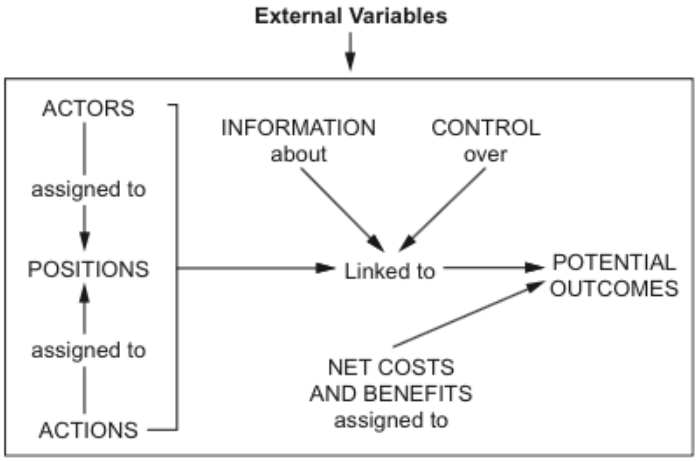

Figure 4**.** The internal structure of the action situation within the Framework for Institutional Analysis and Development. *Source:* E. Ostrom (2011, p. 10).

Many scholars have described the enabling conditions that encourage the development of successful collective action institutions and their ability to govern CPRs. Wade (1988) generated a list of 14 general conditions he found important in facilitating successful management of the commons. E. Ostrom (1990) later promulgated a set of design principles illustrated by long-enduring collective action institutions that facilitate the success of such institutions in managing CPRs and attaining actor compliance with institutional rules. Baland and Platteau (1996) expanded this list to further characterize the elements upon

which the likelihood of successful collective action depends. Agrawal (2001) synthesized and revised the enabling conditions proposed by the aforementioned authors, focusing on configurations of conditions that enable sustainable governance of CPRs. Kerr (2007) drew upon these earlier works to compile a list of factors associated with the emergence of collective action institutions for CPR management (see Table 2). In doing so, Kerr (2007, p. 95) included only those conditions from Agrawal's (2001) synthesis that are "likely to be important for establishing a new successful management system". Additional enabling conditions derive from E. Ostrom (1999), who distinguished between variables conducive to collective action institution emergence and the endurance of such institutions.

Kerr's (2007) synthesis of enabling conditions for collective action emergence includes characteristics associated with the resource system, actor group, relationship between the resource system and actor group, institutional arrangements, and external environment. Kerr (2007) ultimately advances that watershed characteristics tend to correspond poorly with hypothesized enabling conditions and challenge the emergence of new collective action institutions, citing problems of scale disparity between collective action at the microwatershed and hydrological management at the macrowatershed. However, despite such inherent challenges, collective action institutions designed to address watershed governance issues continue to gain momentum (Huber-Stearns 2015). Thus, this study considers the list of enabling conditions synthesized by Kerr (2007) from prior studies by Wade (1988), E. Ostrom (1990), Baland and Platteau (1996), and Agrawal (2001) as a starting point for assessing the extent to which external variables influence the development of emerging WQT programs.

Scholars posit that group characteristics enabling collective action include: a) small size (Wade 1988; Baland and Platteau 1996); b) clearly defined boundaries (Wade 1988); c) shared norms (Baland and Platteau 1996); d) trust (E. Ostrom 1999); e) past successful organizational experiences (i.e., social capital) (E. Ostrom 1999); f) appropriate leadership (Baland and Platteau 1996); g) interdependence among group members (Wade 1988; Baland and Platteau 1996); h) homogeneity of interests (E. Ostrom 1990; Baland and Platteau 1996); i) low poverty (Agrawal 2001); and j) a low discount rate (E. Ostrom 1999).

Institutional arrangements hypothesized as favorable for collective action emergence include: a) rules that are simple and easy to understand (Baland and Platteau 1996); b) locally devised access and management rules (Wade 1988; E. Ostrom 1990; Baland and Platteau 1996); c) rules that are easy to enforce (Wade 1988; E. Ostrom 1990; Baland and Platteau 1996); d) graduated sanctions (Wade 1988; E. Ostrom 1990); e) availability of low cost adjudication (E. Ostrom 1990); f) monitors and other officials that are accountable to users (E. Ostrom 1990; Baland and Platteau 1996); g) restrictions on harvest that match the regenerative capacity of resources (Wade 1988; E. Ostrom 1990); and h) fairness in the allocation of resources (Baland and Platteau 1996; Agrawal 2001). While Agrawal (2001) cited these as enabling conditions for successful collective action management of CPRs, Kerr (2007, p. 97) applies them to collective action institution emergence by adding that "the ability to establish such rules rather than their actual existence is the appropriate indicator for a group that is trying to develop a collective management system".

External environment variables speculated to enable CPR collective action include: a) autonomy (Wade 1988; E. Ostrom 1999); b) low cost exclusion technology (Agrawal 2001); c) supportive external sanctioning institutions (Baland and Platteau 1996); d) appropriate levels of external aid to compensate local users for conservation activities (Baland and Platteau 1996); and e) nested levels of appropriation, provision, enforcement, and governance (E. Ostrom 1990). Additionally, central governments should not undermine local authority for collective action to be successful (Wade 1988; E. Ostrom 1990).

Table 2. Excerpt of enabling conditions conducive to emergence of collective action institutions for CPR governance. *Source:* Adapted from Kerr (2007), who drew upon the prior research of Wade (1988) (W); Baland and Platteau (1996) (B&P); E. Ostrom (1990, 1999) (O, O '99); and Agrawal (2001) (A).

Group Characteristics
Small size (W, B&P)
Clear boundaries (W)
Shared norms (B&P)
Trust (O '99)
Past successful/organizational experiences (O '99)
Appropriate leadership (B&P)
Interdependence among group members (W, B&P)
Homogeneity of interests (O, B&P)
Low Poverty (A)
Low discount rate (O '99)
Institutional Arrangements
Ability to establish rules that are simple and easy to understand (B&P)
Ability to locally devise access and management rules (W, O, B&P)
Ability to easily enforce rules (W, O, B&P)
Ability to establish monitoring and accountability protocols (O, B&P)
Ability to establish low cost adjudication (O)
Ability to establish graduated sanctions (W, O)
Ability to place restrictions on harvest that match the regenerative capacity of resources (W, O)
Ability to be fair in the allocation of benefits from the common resource (B&P)
External Environment
Autonomy (W, O '99)
Low cost exclusion technology (A)
Supportive external sanctioning environment (B&P)
Appropriate levels of external aid to compensate local users for conservation activities (B&P)
Nested levels of appropriation, provision, enforcement, and governance (O)
Central governments that do not undermine local authority (W, O)

2.4 **Case Study Overview**

This in-depth case study analysis explores two emerging WQT programs in the western U.S. The study, conducted between September and December 2016, sought to understand the institutional dimensions of emerging WQT programs and the external variables that shape them. Cases were selected from a population of approximately 20 WQT programs in the U.S. that support trading between point sources and nonpoint sources (Breetz et al. 2004; Selman et al. 2009; Ribaudo and Gottlieb 2011; Greenhalgh and Selman 2012; Bennett and Carroll 2014; Willamette Partnership et al. 2015; Bennett et al. 2016). This research specifically aims to understand how external variable characteristics affect the emergence process of WQT programs during their inception. For this reason, the study sought out cases

of ongoing WQT program emergence instead of exploring scenarios in which WQT programs and associated emergence efforts are nonexistent or entirely precluded. Thus, case options were limited to just a few WQT initiatives currently in latter stages of their inception process. Of these few emergent WQT initiatives, I selected for analysis the only two cases known to be concurrently working to formalize their programs with a WQT framework. In addition to being in comparable phases of their development process, I had established relationships with key participants in each of the selected cases while at a National Network on Water Quality Trading conference in May 2016, thus facilitating initial communications regarding potential interview respondents.

The two cases chosen for study possess many characteristics common to the larger population of WQT programs. Like most mature PS-NPS WQT programs, the selected cases seek to address nutrient pollutants through trading at the watershed and sub-watershed scale (i.e., 8-, 10-, and 12-digit hydrologic unit codes). (A notable exception to this is the Ohio River Basin WQT initiative that seeks to address nutrient pollution at a regional basin-wide scale.) Additionally, the institutional emergence process for each of the selected cases began between 1990 and the early 2010s – the period during which most WQT programs began.

The principal disparity between the selected cases and the broader WQT population is their institutional development stage: most known WQT programs have matured beyond the emergence phase and into the state of being legally formalized, well-defined institutions with frameworks for implementing WQT activities. In contrast, the two selected cases are still in the process of organizing and defining themselves as new institutions, thus representing less advanced stages of development. Yet, each mature WQT program in existence today once similarly commenced with an emergence process. As such, the variables influencing the emergence process of the selected cases may represent the influential factors that shaped now-mature WQT programs during their inception.

I explored the two cases utilizing CPR collective action theory to identify, organize, and analyze external variables of interest. External variables shape the structure of an action situation; in turn, the structure of an action situation affects the interactions and outcomes that determine a collective action

institution's development pathways and ability to achieve its goals (E. Ostrom 2005). Thus, in order to better understand how and why WQT programs develop the way that they do, and why some WQT programs struggle to perform as they mature, this study explores the extent to which external variables and combinations thereof exert influence on WQT program emergence, development, and outcomes. Because external variables affect if and how actors organize to solve the collective action challenge of self-organization in the first place, they are causal variables of the institutional process (E. Ostrom 2009). As such, the presence, absence, or manifestation of an external variable enabling condition is considered the independent variable, and the dependent variable is the development pathway of the emerging WQT case (i.e., not *if* the program emerges or not, but *how* the program takes shape during the emergence process).

In addition to positing the external variables that serve as enabling conditions for collective action, E. Ostrom (2005) also proposed categories for describing and analyzing external variables that generally affect collective action processes. In keeping with E. Ostrom's (2005) categorization of influential external variables, I describe commonalities and differences between the two cases in terms of their biophysical, community, and rules-in-use attributes, as well as their development pathways leading up to the time of this research. Commonalities identified between the two cases, while not directly equivalent to constants held in controlled laboratory experiments, represent commonly experienced external variables to the extent possible in this qualitative, observational study of real-world institutions.

To this latter point, both cases seek to act upon the biophysical environment in a similar manner to improve water quality by cost-effectively reducing phosphorus concentrations in their respective watersheds. While the two case watersheds vary in size and consist of unique geographical, biological, and hydrological features (e.g., size, amount and distribution of rainfall, riparian vegetation, slopes, elevation), the nature of the CPR they strive to address through collective action – water quality – is analogous. Because the biophysical attributes of the resource system are not a central focus of this research, I do not further analyze such variables in this study. Rather, I concentrate efforts on understanding the community attributes and rules-in-use external variables, which roughly correspond

with the group characteristics, institutional arrangements, and external environment enabling condition categories within CPR collective action literature.

In terms of community attributes, the two cases are similar in the general composition of actors involved in WQT efforts, including representatives from federal, state, county, and municipal government; non-governmental organizations serving in technical, facilitative, and advocacy capacities; and private landowner interests. Importantly, the cases also both receive financial assistance for development processes from the federal government. However, while the two cases share similarities in actor composition and development funding, they differ in terms of other community attributes that play an important role in affecting action situations. These attributes, which are analyzed as part of this research, include behavioral norms, shared knowledge, homogeneity of interests, individual actor influence on decision making, and distribution of authority in collective action (Agrawal and Gibson 1999).

The third category of external variables – rules-in-use – also presents opportunity for comparative analysis. While the two cases exist within a shared context of federal water quality policy and CWA mandates, they differ in terms of state- and watershed-level rules and norms for governing water quality and other environmental issues. They also differ widely in the dominant political ideologies from which they emerge and the way those ideologies have influenced interactions with other governance institutions. These disparities, in combination with differences between community attributes, serve as the variables whose effects on WQT program development processes are the emphasis of this research.

In sum, the two cases share commonalities regarding water quality goals, watershed-level operational scales, actor composition, federal policy context and funding source, and WQT design mechanisms. As emerging WQT programs, they also follow similar development timelines and are the first of their kind in their respective states. While considering these common characteristics between the cases, the study focuses on how the dissimilar external variables associated with community and rules manifest and interact to enable or challenge the WQT development process (see Table 3).

To minimize interference with the ongoing development process of the two cases and protect the anonymity of study participants, I utilize pseudonyms in place of program and individual names[2]. Henceforth, I refer to the two cases as the Aqua Water Quality Trading Initiative (Aqua WQTI) and Hydro Water Quality Trading Initiative (Hydro WQTI).

Table 3. Commonalities and disparities of rules-in-use and community attributes between Aqua WQTI and Hydro WQTI cases.

Commonalities between cases: Community Attributes	
Institutional goals	Achieve phosphorus load reductions in cost-effective manner through point-nonpoint source trading
Actor types	Federal, state, county, and municipal government; agricultural and environmental interests; intermediary organizations serving as technical experts and/or facilitators; law firms; entrepreneurial prospectors
Resources	Federal funding; development timeline
Commonalities between cases: Rules-in-Use	
Federal policies	CWA mandates and EPA guidance on WQT; recently developed or anticipated TMDL
Disparities between cases: Community Attributes	
Group/actor characteristics	Behavioral norms; shared knowledge; homogeneity of interests; power distribution among actors
Disparities between cases: Rules-in-Use	
State policies	State WQT guidance; influence of other environmental regulations
Collective action policies	Formality and duration of local watershed group; collective action rule development processes
Political-institutional norms	Political ideologies; historical disposition toward regulatory oversight

2.4.1 *Aqua Water Quality Trading Initiative*

The Aqua WQTI seeks to achieve total phosphorus load reductions in an increasingly populated watershed in the western U.S. Approximately 3,000 square kilometers (300,000 ha) in size, the watershed consists of predominantly agriculture and residential land uses, with high conversion rates from the former to the latter. The initiative boasts interest from several municipal wastewater treatment facilities

[2] This research on human subjects was approved by the Institutional Review Board at Colorado State University, under Protocol No. 197-17H.

serving as potential credit buyers, as well as a large agricultural community providing potential credit suppliers. Average annual precipitation is approximately 25 centimeters (10 in), concentrated slightly during the winter season. The state in which the Aqua WQTI is situated is largely rural and governed by a state legislature comprised primarily of politically right-leaning members. The state's historically-rooted political norms are defined by an adverse disposition toward regulatory oversight.

The current Aqua WQTI effort is prefaced by an initial WQT demonstration effort launched in the late 1990s; however, no trade occurred then in absence of a regulatory driver. The state environmental agency later produced formal guidance on water quality pollutant trading for the state, and collaborative efforts led by a nongovernmental organization developed multi-state recommendations for WQT in the region.

A total phosphorus TMDL released for the Aqua WQTI watershed in 2015 contributed to renewed interest in developing a WQT framework to facilitate attainment of the new TMDL effluent limits. At the time of this study, the state did not possess primacy over their NPDES program; thus, the EPA maintained authority to approve or veto potential pollutant trades. The state manages the TMDL process to which the NPDES program is tiered. State law dictates that the state environmental agency consult with a local watershed stakeholder group during TMDL development, thereby obligating coordination between federal, state, and watershed level governance institutions. Following this model, the EPA, state, and watershed stakeholder group also serve as core actors in the Aqua WQTI development process. The watershed stakeholder group, a registered nonprofit organization incorporated in the early 1990s, consists of representatives from municipal, agricultural, industrial, and environmental interests; special districts; consultants; and nongovernmental intermediary organizations. For the purposes of this study, an intermediary organization is a third-party to the exchange that performs a variety of organizing and coordinating activities, such as engaging and facilitating participant interaction, performing administrative duties, and providing technical area expertise on behalf of the collective action effort (Huber-Stearns et al. 2013).

With funding from a federal grant, an intermediary organization facilitated approximately six months of meetings among Aqua WQTI stakeholders in efforts to collaboratively develop a WQT framework, producing a concept draft of the document in September 2016. Shortly thereafter, politically influential members of the watershed stakeholder group expressed dissatisfaction with and a desire to modify some of the trading technicalities proposed therein (i.e., baseline, trading ratios). At the time of this writing, the draft framework remained stalled in an arena of debate and discussion among watershed stakeholder group members. Rather than responding by exercising regulatory authority or taking charge of the framework development process, the state environmental agency and EPA await the watershed stakeholder group to modify the draft WQT framework in a manner that resolves their concerns and deliver the revised framework for final approval by the state and EPA.

2.4.2 *Hydro Water Quality Trading Initiative*

Like the Aqua WQTI, the Hydro WQTI pursues total phosphorus load reduction goals for a densely populated watershed within the western U.S. Predominantly residential and agricultural land uses are spread across approximately 700 square kilometers (7,000 ha), a watershed area much smaller than that of the Aqua WQTI. Average annual precipitation in the watershed is around 75 centimeters (30 in), occurring in a monsoonal pattern. The state in which the Hydro WQTI is located hosts a more urbanized population than that of the general U.S. and is governed by a principally left-leaning state legislature. A dense network of state policies, regulations, and governing institutions defines political norms.

Hydro WQTI development efforts began around 2010 after a state environmental agency set forth a pre-TMDL zero net load requirement and offset resolution for total phosphorus for the watershed's only NPDES-permitted municipal wastewater treatment facility. The offset resolution allows for point-nonpoint source WQT to offset unavoidable nutrient discharges during wet years. The wastewater treatment plant, who is the only present buyer of offset credits in the watershed, has invested in three such pilot trades to offset their discharges under the nutrient offset resolution. Past credits were generated by improvements to dairy farm operations and transportation infrastructure. Additional prospective credit

sources under consideration include riparian restoration activities, and there is a potential for the Aqua WQTI to grow to two credit buyers in the future.

Upon acquiring funding through a federal grant, a group of local actors coalesced to develop a formal, more robust WQT framework to facilitate and guide trading in the watershed. A local special district led a three-year stakeholder process to collect feedback on the pilot trades and potential program elements. Stakeholders invited by the special district to participate in providing feedback included agricultural, environmental, and federal, state, and local government interests, as well as technical consultants, academic affiliates, and nongovernmental intermediary organizations. The stakeholder groups disbanded after completing the formal feedback process.

The process culminated in a draft Hydro WQT framework released September 2015. At the time of this writing, the proposed framework pended a public participation process, edits, and formal approval by the state environmental agency prior to becoming eligible for implementation. Actors anticipated the forthcoming development of a TMDL for total phosphorus in the watershed in 2018.

CHAPTER 3: METHODS

3.1 **Methodological Approach**

This research employed a case study approach, referring to the empirical inquiry of a contemporary phenomenon (i.e., a case) "in depth and within its real-word context, especially when the boundaries between phenomenon and context may not be clearly evident" (Yin 2014, p. 2). This approach is most appropriate when research seeks to understand how- and why-related aspects of real-world phenomena and assumes that such an understanding likely involves contextual conditions pertinent to the case (Yin and Davis 2007; Yin 2014). As such, the case study methodology lends itself to this study's objective of exploring how and why WQT programs take on different forms within the context of differing external variables. This research compares two WQT program cases through a multiple, comparative case study approach. The multiple case study design improves validity of analytic conclusions by identifying and exploring similarities and contrasts between cases (Yin 2014) so that comparisons contribute to our understanding of how the characteristics of WQT programs, and collective action institutions more broadly, are influenced by the contexts from which they emerge.

3.2 **Data Collection and Coding**

The primary means of data collection were semi-structured interviews (Glesne 2011) and reductive coding (Coffey and Atkinson 1996) of documents related to WQT initiative development for each case. Semi-structured interviews were more appropriate for this exploratory study than either structured interviews, where questions are pre-established and not altered during the interview, or unstructured interviews, where questions are not previously developed, and conversation is directed by on-the-spot interactions (Glesne 2011). Similarly, the exploratory nature of this research precluded that interview content be adequately categorized into survey or questionnaire responses. Hence, I employed a semi-structured, flexible interview guide (see Table 4) that reserved flexibility for conversations to explore topics according the interview respondents' interests and expertise (Charmaz 1991) by allowing for questions to occur during the course of the interview that could add to or replace the interview guide

questions (Glesne 2011). Sensitizing concepts (Bowen 2006) derived from the body of literature on collective action enabling conditions informed interview question development.

Table 4. Semi-structured interview guide.

General Development Process
1. How do you think the [WQT case] came to be? What is its story of origin?
2. What have been/are the biggest challenges to the [WQT case] development process?
3. What do you think the future holds in store for this [WQT case]?
4. What key human, financial, political, and/or technical resources inform and support the [WQT case] design and decision-making process?
Group Attributes
5. Can you provide me with an understanding of your background, how you came to be involved with the [WQT case]?
6. What roles do you and/or the entity you represent play in the [WQT case] development process?
7. Who are key and ancillary actors involved in WQT development and what are their motivations to participate?
8. What roles do key actors play? How have those actors and their roles changed over time?
9. Do [WQT case] actors have a history of interactions? If so, can you describe that history?
Institutional Environment
10. What rules govern group interactions and the [WQT case] development process more broadly? Do you think such rules are clear and dependable?
11. How is authority to make rules and key decisions distributed among actors and institutions involved in the [WQT case]? How has that changed throughout the [WQT case] development process, if at all?

Semi-structured, open-ended interviews between 30 and 100 minutes in length were conducted with 21 individuals, including 11 from the Aqua WQTI and 10 from the Hydro WQTI. I employed a snowball sampling technique (Noy 2008) whereby interview respondents identified additional potential and pertinent respondents from among their acquaintances. To identify appropriate interview candidates, I first established communication with and interviewed a key participant in each case. At the completion of interviews, I asked if there were other key actors instrumental to the WQT program development process that I should interview in order to gain a different or expanded perspective. I then asked that they connect me with those individuals so that I could request their involvement as additional interview respondents. This network sampling process was conducted with each interview respondent to identify a comprehensive network of key actors for both cases.

I considered the interview data collection process complete upon data saturation (Marshall 1996), whereby additional interviews did not yield new data, themes, or codes. Interview respondents included individuals representing: federal, state, county, and municipal governments; intermediary organizations; environmental organizations; special districts; technical consultants; private landowners; and potential investors. Individuals who fell outside these key roles were neither suggested by interview respondents nor selected for study participation. I took detailed field memos succeeding each interview to capture my perception of the conversation's nuances and gestalt.

The interview questions focused on uncovering how particular manifestations of group characteristics, institutional arrangements, and policy environment shape the development process of WQT programs. To ensure that my inquiry corresponded with CPR collective action theory, basic interview infrastructure reflected the set of enabling conditions compiled by Kerr (2007), who drew upon the works of Wade (1988), Baland and Platteau (1996), Ostrom (1990, 1999), and Agrawal (2001). For the purposes of this study, group characteristics were termed "group attributes", while institutional arrangements and external environment were combined into a single theme called "institutional environment". Below I explain how the three original literature-derived themes correspond with CPR collective action enabling conditions which, in turn, informed the development of my interview questions.

Group characteristics refer to attributes of the group of actors attempting or implementing collection action processes. The likelihood of successful collective action is understood to depend in part on group conditions such as group size and clearly defined boundaries (Wade 1988; Baland and Plateau 1996), social norms and obligations (Baland and Platteau 1996), trust (E. Ostrom 1999), prior successful organizational experiences (E. Ostrom 1999), and existing arrangements for discussing common problems (Baland and Plateau 1996). Thus, interview questions directly and indirectly captured key actors' perspectives regarding group composition, size and history; behavioral norms; social capital; and actor boundaries and roles.

Institutional arrangements encompass the rules by which collective action institutions form and the institutional ability to develop new rules. Rules are central to institutional analysis and include four main

types: regulations, instructions, behavioral precepts, and principles (E. Ostrom 2005). Regulations refer to something required, forbidden, or permitted by certain persons as defined by an authority (Black 1962). Instructions represent strategies adopted by actors within ongoing situations (E. Ostrom 2005). Rules in the sense of behavioral precepts reflect the generally accepted moral fabric and norms of social conduct within a community (Allen 2005; E. Ostrom 2005). Scholars postulate that favorable institutional arrangements for collective action include the presence or ability to establish rules that are simple, fair, and easily understood (Baland and Platteau 1996), as well as locally devised and enforceable (Wade 1988; E. Ostrom 1990; Baland and Platteau 1996). As such, interview questions explored participants' perspectives regarding how rules – and the clarity thereof – affect the development processes of WQT programs.

External environment describes the broader governance context in which CPR collective action institutions emerge and operate. External environment enabling conditions include local autonomy (Wade 1988; E. Ostrom 1999) and supportive external sanctioning institutions that do not undermine collective action efforts (Baland and Platteau 1996). These conditions are closely tied to the condition of nested governance enterprises posited by Ostrom (1990), which describe the importance of tiering largely autonomous local institutions to increasingly broader institutions to accommodate the interests of groups governing at different levels (Brondizio et al. 2009). A form of multilevel governance, nested governance enterprises work best for CPR collective action when they adhere to the principle of subsidiarity (E. Ostrom 2009). This principle postulates that "any particular task should be decentralized to the lowest level of governance with the capacity to conduct it satisfactorily" (Marshall 2008, p. 80). Interview questions, therefore, explored participants' perspectives regarding the distribution of decision making, authority, and autonomy across different levels of governance involved in each case.

Transcribed interviews and field memos were coded using NVivo 11 for Windows (QSR International 2012), a computer-assisted qualitative research software. Coding and analysis of the texts followed coding protocols described by Strauss and Corbin (2008). The body of literature on collective action enabling conditions provided sensitizing concepts (Bowen 2006) that guided the initial open

coding process with preliminary themes. Following the constant comparison process (Strauss and Corbin 2008), data were categorized, coded, refined, and compared against internal data and external theories regarding enabling conditions for CPR collection action institutions to inductively reveal themes and concepts at graduated levels of detail. The initial open coding process resulted in 75 coding labels assigned to phrases, sentences, paragraphs, and documents. Table 5 depicts examples of inductively developed coding labels associated with each primary theme during the open coding process. A final selective coding process was then performed to produce a refined, parsimonious set of subtheme and characteristic axial coding labels tiered within these three themes.

Table 5. Examples of inductively developed open coding labels associated with each primary theme.

Group Characteristics
Struggle for power vs. respect for power distribution
Heterogeneity vs. homogeneity of interests and perspectives
High turnover vs. long-term participants
High vs. low trust and social capital among participants
Self-determined participation vs. participation by invitation
Participant roles are unclear and/or variable
Participant roles are clear and established
Small vs. large group size
Institutional Arrangements
Rules shaped by grant language
Clear vs. unclear rules of engagement between participants
Collaboratively devised rules
Developing rules along the way
Good vs. poor communication and transparency among participants
Ability to locally devise access and management rules
Coordination occurs most between same levels of government
Ability to develop rules for accountability
External Environment
Autonomy vs. lack of autonomy
Supportive vs. unsupportive external sanctioning institutions
Nested levels of appropriation, provision, enforcement, and governance
External rules challenge initiative viability

In order to gain a more comprehensive understanding of the WQT cases and draw data from an additional source, I performed content review of approximately 1,500 pages of written documents. The review involved a reductive coding process whereby content data were indexed into general descriptive

themes (Coffey and Atkinson 1996). The documents supplemented interview data and field memos by providing an additional means of assessing case backgrounds and developmental timelines, as well as identifying the issues, actors, and formal institutional arrangements (e.g., statues, administrative policies, and case law) pertinent to each WQT case. This information served as a comparative standard for validating the accuracy of field data and informed the process of developing conceptual codes during interview transcript analysis. Documents reviewed include publicly available programmatic, organizational, and political documents related to the development of the Aqua WQTI and the Hydro WQTI. These included but were not limited to: federal, state, regional, or local trading guidance; draft trading frameworks; program development meeting notes; third party reports; relevant TMDL documents; and administrative progress reports or proposals.

CHAPTER 4: RESULTS

This section presents results arranged according to the principal themes of group attributes and the external institutional environment. For each theme, I offer an overview of the thematic findings. Then, because the nuances of the story warrant further elaboration to address this study's questions, selected quotations from interview respondents provide evidence for thematic findings and contribute additional insight and clarity. Pseudonyms are used to protect the anonymity of study participants.

4.1 **Group Attributes**

For the group attributes theme, selective coding of participant interviews revealed three conceptual subthemes influential to WQT program development, including clarity of agency, commonality, and social capital. *Clarity of agency* represents the clarity with which participants perceive the distribution of formally (e.g., through administrative regulations) or informally (e.g., through social clout) designated authority of an actor or group of actors to influence, make, and enforce decisions (Ahearn 2001). Within this subtheme, interview data were coded as a binary choice between clear versus unclear allocation of agency. *Commonality* refers to whether participants' interests, perspectives, norms, and goals were described as more homogeneous or heterogenous with one another. *Social capital* represents the existence of reciprocal trustworthiness and historical trust-building experiences among participants (Ostrom and Ahn 2008). Conditions of social capital include trust among participants, positive past experiences, interdependence among participants, the presence of willing pioneers, and the participation of actors claiming public good interests. Conversely, a lack of social capital signifies conditions such as limited trust, negative past experiences, and lack of interdependence among group members.

Table 6 depicts the selective coding subthemes and specific characteristics used to categorize data attributes under the larger group attributes theme. Also listed are the proportions of interview respondents referencing a particular characteristic (i.e., number of respondents that referenced the characteristic/total number of respondents) and the number of times the characteristic was referenced for each case. Within several subthemes, the percentages of interview respondents do not total 100%. This is because some

interview respondents referenced both characteristics within a subtheme. For example, some interview respondents from the Aqua WQTI described indicators of both social capital *and* the lack thereof. Thus, those participants are represented twice within the percentages of respondents referencing the social capital subtheme: once for the presence of social capital characteristic and once for the lack of social capital characteristic. The number of references represents the count of instances that a characteristic was mentioned by interview respondents in a case. For example, a relatively high number of references could reflect either few respondents referencing the characteristic many times or many respondents referencing the characteristic few times; whether the scenario is the former or latter can be ascertained by considering the percentage of interview respondents in conjunction with the number of references.

Table 6. Percentage of interview respondents referencing group attribute characteristics and number of references for Aqua WQTI and Hydro WQTI cases.

	Aqua WQTI (n=11 respondents)		**Hydro WQTI** (n=10 respondents)	
Group Attributes Subthemes and Characteristics	Percentage of respondents	Number of references	Percentage of respondents	Number of references
Clarity of agency				
Clear	27%	3	50%	12
Unclear	91%	155	50%	23
Commonality				
Homogeneous	27%	4	30%	6
Heterogenous	81%	82	50%	24
Social capital				
Presence	73%	22	70%	53
Lack	64%	28	30%	11

4.1.1 *Aqua Water Quality Trading Initiative: Group Attributes*

A central theme in the case of the Aqua WQTI is that of unclear allocation of agency. A high percentage (91%) of Aqua WQTI interview respondents referenced this characteristic, many regarding the issue as a central challenge to the WQT development process. In the case of the Aqua WQTI, agency was often described as uncertain, contested, and shifting among and within different levels of governance. In the absence of a respected legal-regulatory authority that other actors perceive as wielding the power to

govern and/or unambiguously allocate agency, participants quarreled over who has the final say when rules from different governance levels come into conflict. Alex, a consultant and participant in the watershed stakeholder group, illustrated the unclear allocation of agency that exists between state and federal levels of government:

> *"We write our own water quality standards [here], and there are sections that [our state] and EPA do not agree on at this point right now. There is this gray area as to what's the law, what's the rule here."*

Uncertainty regarding who holds agency and authority in the Aqua WQTI development process was not limited to state and federal actors but also extended to include interactions between regulatory actors and the local watershed stakeholder group.

In addition to the question of agency between levels of governance, uncertain allocation of agency also induces confusion within the watershed stakeholder group. Mike, a nongovernmental intermediary organization representative involved in the Aqua WQTI development process, explained how unclear allocation of agency and power manifests among the watershed stakeholder group participants. He cites the informal influence of politically connected participants on agency allocation as a central challenge to the integrity of the collective action process:

> *"The unfortunate part is that it comes down to someone's politics…it seems that there are a few loud voices and whichever the direction the loud voices tend to go the rest of the group will follow, whether they agree or not. It's really hard to get a sense for if one single voice is representative of how the remaining group truly feels or if they're just going with the lead or the loud voice."*

In addition to unclear allocation of agency, a majority (81%) of Aqua WQTI interview respondents also described participant heterogeneity as a challenge. Actors in the Aqua WQTI development process differed in interests, norms, political ideologies and influence, and prior levels of knowledge regarding water quality science and WQT. Emily, a government regulatory agent, described the divergent perspectives that challenge the Aqua WQTI development process:

> *"[Participants] all have their own interests, that's all. They're all good folks individually; they just have their own thoughts…There's a difference in opinions on trading, depending on who you ask, whether it be a regulatory agency or somebody that represents ag interest."*

Aqua WQTI interview respondents were more varied in their perspectives regarding social capital, with slightly more describing the presence of social capital than the lack thereof. Study participants indicated that divergent interests and unclear allocation of agency generated conflict among Aqua WQTI participants, which can both in turn degrade social capital. However, the local watershed stakeholder group's status as a formally incorporated organization for over two decades has permitted substantial time for the development of social capital by creating a shared history of collective action among actors. Just prior to the current efforts to develop the Aqua WQTI framework, many of the same actors were involved in the collaborative development of the watershed's total phosphorus TMDL. Norma, a nongovernmental intermediary organization representative, explained how the TMDL development process contributed to building momentum and social capital for the Aqua WQTI framework development process:

> *"I think there was a fair amount of distrust that was there earlier on, and perhaps just disagreement about the appropriate way. But, when the TMDL process really started picking up with a little more momentum, you had more folks coming together willing to talk about different things…The fact that the TMDL was moving along as well as it was, and truly very clearly getting to the point where it was actually going to be completed and happen, I think that honestly gave the trading framework a lot more momentum associated with it…The process that's been going on with the trading framework is largely a result of what's been going on with the TMDL process."*

In sum, most interview respondents perceived the unclear allocation of agency and heterogeneity of participants as central challenges to the Aqua WQTI development process. The distribution of agency was often described as uncertain and contested between federal and state regulatory entities, between the state and local watershed group, and among local watershed group actors. Divergent backgrounds, interests, and incentives among stakeholders were also cited as obstacles. However, respondents noted that long periods of prior interaction between many actors via the watershed stakeholder group and successful TMDL development process have contributed to building social capital for the WQT framework development efforts, including momentum and willingness to participate.

4.1.2 *Hydro Water Quality Trading Initiative: Group Attributes*

In the Hydro WQTI case, the loci of agency and power were more clearly defined than in the Aqua WQTI case, though some uncertainty around allocation of agency still exists. Fifty percent of Hydro WQTI interview respondents referred to the allocation of agency as unclear, while half described agency

allocation as having clear, well-defined characteristics. Though Hydro WQTI actors held questions regarding how and to whom agency would be allocated as the WQT program continues to mature and develop, it was also clear and uncontested among stakeholders that the central authority to make key decisions resides with the state government. Lucille, a state governmental organization representative, described this scenario in which state actors debated how and why agency would be allocated among stakeholders while reserving ultimate authority for itself:

> *"I remember talking about, 'Okay, well, what's the process going to look like? What are the different roles that need to be filled? Who's going to fill them?' We definitely had several conversations with a number of different technical advisory committee members to try to scope that out, which took us a while. We were sure that we wanted auditing power over everything or else we can't assure our constituents that we're in a position to protect water quality, so we had to maintain some sort of authority over any step in the process. We kind of just felt our way through it and found folks who were willing to do certain jobs and look to see if that met up with the process that we were eyeing."*

While the state governmental organization served as a central decision-making authority, landowner and technical stakeholder groups coalesced to provide formative input and feedback to the Hydro WQTI framework development process. These stakeholder groups were purposefully comprised of a diverse selection of participants representing varying backgrounds, interests, and incentives. Lee, another state regulatory representative, described the differences in stakeholder motivations and backgrounds between the landowner group and technical advisory group:

> *"Every time meetings happened, both groups were meeting and covering similar material, even if maybe it was a different level of detail for each group and… one difference with the landowner group is they're not getting paid to be there. Agency people get paid to be at meetings and landowners don't, so right there we were asking a lot of people to come to so many meetings…It was also harder to have effective discussions because people were coming from such different places."*

Despite differences among stakeholders in the Hydro WQTI development process, the majority (70%) of interview respondents frequently alluded to the positive, trusting relationships held between actors and a common interest in serving the public and environmental good. These sentiments represent the social capital that interview respondents described as supportive of collective action. Grace, a special district representative, explained how feelings of trust and goodwill among actors have benefited the Hydro WQTI collective action process:

"From a more personal basis, they're just really good people trying to do good things for the community and the environment. I'd say this whole team fits into this category, so it's kind of an inspirational, innovative team just to get to be with. I once heard something that was really interesting where it talked about innovation happens when parties get together that trust each other, and they start collaborating. It results in innovation, and that is I would say ... it wasn't so much that we set out to be innovative or trying to be innovative…it's just a byproduct of having a group where we trust each other, we respect each other, and we like working together, so ideas just come out of that."

In sum, Hydro WQTI interview respondents described some uncertainty regarding how agency and responsibility would be allocated among the group's actors as the program matures. Yet, despite those unknowns, stakeholders expressed a clear understanding that the state government maintains key decision-making authority during the WQT program development process. Stakeholders representing landowner and technical interests constituted a heterogeneous mix of backgrounds and motivations. However, regardless of stakeholder differences, interview respondents frequently referenced the presence of social capital in the forms of positive, trusting relationships and a common goal to promote community and environmental wellbeing via the Hydro WQTI.

4.2 **Institutional Environment**

Within the institutional environment theme, two primary subthemes emerged as influential for WQT development across both cases: policy norms and clarity of rules. The *policy norms* subtheme refers to the extent to which key decisions are made through either a centralized or decentralized command structure. Centralized policy norms do not preclude a multilevel governance system; rather, they imply that central government (e.g., federal or state) actors retain ultimate decision-making power and authority over the efforts and outputs of local collective action institutions (V. Ostrom et al. 1961; Marshall 2008). Decentralized policy norms entail nested centers of governance that are polycentric in nature, meaning that multiple decision-making centers retain considerable autonomy from one another (V. Ostrom et al. 1961). The policy norms subtheme resembles the clarity of agency subtheme in that they both describe elements of power distribution among actors; however, they differ according to the elements they represent. The policy norms subtheme reflects if agency and power tend to be distributed between governance institutions in a more centralized or decentralized manner, while the clarity of agency

subtheme indicates if participants perceive the distribution of agency and power between and among levels of governance to be clear or unclear.

The *clarity of rules* subtheme represents whether study participants primarily perceive their institutional and operational rules as clear or unclear. Clear rules represent a lucid understanding regarding: rules of engagement between actors, rules for developing viable projects, and the steps needed to establish a workable WQT program. Unclear rules reflect perceived challenges associated with the process of negotiating and locally devising access, management, and accountability rules; difficulty enforcing rules; uncertainty regarding the applicability or durability of rules; and lack of clarity for how to best navigate the WQT development process.

Table 7 depicts the selective coding subthemes and characteristics for the institutional environment theme. Also listed are the proportions of interview respondents referencing a particular characteristic (i.e., number of respondents that referenced the characteristic/total number of respondents) and the number of times a characteristic was referenced for each case. The percentages of interview respondents exceed 100% for all institutional environment subthemes. Like with the group characteristics theme, this is because some interview respondents referenced both characteristics within a subtheme. For instance, some interview respondents from the Hydro WQTI described indicators of both clear *and* unclear rules. Thus, those participants are represented twice within the percentages of respondents referencing the clarity of rules subtheme: once for the clear rules characteristic and once for unclear rules characteristic. Also akin to the group characteristics theme, the number of references represents the count of instances that a characteristic was mentioned by interview respondents in a case. This count could be comprised of either a few respondents referencing the characteristic many times or many respondents referencing the characteristic few times; whether the scenario is the former or latter can be ascertained by considering the percentage of interview respondents in conjunction with the number of references.

Table 7. Percentage of interview respondents referencing institutional environment characteristics and number of references for Aqua WQTI and Hydro WQTI cases.

Institutional Environment Subthemes and Characteristics	**Aqua WQTI** (n=11 respondents)		**Hydro WQTI** (n=10 respondents)	
	Percentage of respondents	Number of references	Percentage of respondents	Number of references
Policy norms				
Centralized	27%	5	80%	44
Decentralized	91%	51	40%	7
Clarity of rules				
Clear	36%	4	70%	21
Unclear	91%	77	60%	32

4.2.1 *Aqua Water Quality Trading Initiative: Institutional Environment*

A dominant pattern in the Aqua WQTI data reflects decentralized policy norms. A high percentage (91%) of interview respondents described their broader political-institutional conditions in this manner. Actors commonly cited confusion, resistance, or disregard for imposed regulations and recommendations coming from higher tiers of governance. Lower levels of governance, such as the watershed stakeholder group actors, challenged and limited the power of central government authorities by exercising informal political influence in attempt to sway scenarios in their favor. The process of decentralizing power was described as a permissible, normative behavior within the context of the Aqua WQTI's policy norms. Heidi, a federal government representative, described how norms of devolved governance impact their agency's role in CPR collective action processes:

> *"This is where the big population base is and these people are politically connected, and frankly there are consequences if they don't get what they want, they can make life pretty hard. We can really only intercede so much in local politics and local affairs. We don't let them break any laws, but there are a lot of times decisions are made here that we wish weren't."*

Genevieve, a nongovernmental organization representative participating in the Aqua WQTI watershed stakeholder group, further described how political influence interacts with regulatory averse, decentralized policy norms to informally limit the authority held by regulatory entities and devolve power to lower levels of governance:

"I think it's accurate to say that the legislature and the executive branch being sort of more conservative like to keep pretty tight reigns on the regulatory agencies in the state, and the citizens feel like if there's something going on that they don't like, they can go to the governor, they can go to the legislature and then that issue will be brought forward to a regulatory agency and have some way to deal with that. No one likes to get in those situations very much."

In addition to some actors expressing concerns regarding potential repercussions if a governing body acts against local actors' wishes, the majority (91%) of Aqua WQTI interview respondents identified unclear operational rules as a central challenge to their process. Closely associated with references to the unclear allocation of agency, actors described difficulty in both creating and interpreting operational rules. Jill, a nongovernmental organization representative in the watershed stakeholder group, explained the questions she struggled to find answers for during the WQT development process:

"What rules did we have to comply with it? Which set of documents was going to prevail and did it have to be the same and could it be different…and who was going to decide all this stuff…Nobody had any answers."

In sum, most Aqua WQTI interview respondents described their political-institutional context as one bearing decentralized policy norms. Such norms were represented in accounts of local actors exercising their political influence to informally resist or influence policies applied by higher tier governance institutions, such as state and federal government. Many Aqua WQTI interview respondents also expressed that rules regarding program and project development processes were unclear. Lack of clarity regarding operational rules and decentralized policy norms were both closely associated with the uncertain allocation of agency in accounts from Aqua WQTI participants.

4.2.2 *Hydro Water Quality Trading Initiative: Institutional Environment*

The majority (80%) of Hydro WQTI interview respondents described their political-institutional context as exhibiting strong centralized policy norms. Closely associated with well-defined allocation of agency, participants indicated that political power and legal authority are held by federal and state governmental entities to which the lower tier governance units and other actors are subject. Art, a nongovernmental intermediary organization representative in the Hydro WQTI, underscored this practice of deference to central state authority:

"We did throw ideas out there, provide resources, but to a large extent…because the [state] is directing the process, we're going to defer pretty heavily to their understanding and discretion. It's [their] legislative authority and responsibility and so we're certainly deferring to that and there comes a point…when it's state-level decision making or permits or these kinds of activities that the state really should be out in front."

In the case of the Hydro WQTI, centralized policy norms vested with state government agencies are accompanied by a dense network of rules and regulations that actors frequently described as challenging to comply with. The numerous state regulations and permitting requirements mandated as part of obtaining approval for potential Hydro WQTI projects incur high transaction costs and financial burdens. Kari, a special district representative in charge of coordinating Hydro WQTI projects, explained how the dense web of regulatory requirements challenges the implementation of a potential WQT framework and subsequent projects. Additionally, her sentiments exemplify centralized policy conditions in which, though many participants perceive the complex regulatory environment as an impediment, they do not contest or disregard the legitimacy of such institutional arrangements:

"We put all our weight behind [projects] and then what we realize is nobody's being able to get it done because you've got to consult with all the wildlife agencies, get through [state environmental quality regulations] and do all these other things...our wishes are not being realized because of the difficult permitting environment…Just because we have a framework that's up and running doesn't mean we're done because projects don't happen unless they can get through the regulatory process."

Hydro WQTI actors expressed more widely ranging viewpoints regarding the clarity of rules, with only a slightly higher percentage of interview respondents referencing clear rules than unclear rules. While respondents tended to confidently describe the institutional procedures (i.e., rules) required to establish a viable WQT program, some also expressed that formalizing those steps with a framework would provide a needed increase in confidence. Kyle, a municipal government representative, described this notion:

"The evolution into the next phase...of a water quality trading program, what we're hoping is that we'll provide more certainty and more consistency…These are things that we can do if we cement appropriate calculations and support, then the [state agency] will approve this project. And the [state agency], if they have this approved water quality trading framework, I think that they will feel less prone to outside criticism because they will have an established program that says these have been agreed to by all stakeholders, or accepted I should say."

Kyle's statement demonstrates that the next steps along the procedural path toward formalizing the Hydro WQTI with a framework are clear – the state agency must approve the draft framework – and that doing so will result in increased certainty, consistency, and resilience for the program.

In sum, Hydro WQTI actors indicated a political-institutional context comprised of centralized policy norms. Though compliance with the dense network of federal and state government regulations posed a challenge to the WQT development process, participants described a general attitude of acceptance toward such rules rather than defiance. Hydro WQTI actors also expressed a clear understanding of institutional and operational rules while concurrently acknowledging that further increasing rule clarity and consistency via a formal WQT framework would be of benefit.

CHAPTER 5: DISCUSSION

In the discussion of this study's findings, I first review the purpose of the inquiry and summarize the analytical results. Then, I identify and interpret consistencies between the results and existing theory before describing inconsistencies with the potential to provide new contributions to this field of study. I follow this with a discussion of the limitations typical of this type of research and particular to this project. Finally, I look forward to the practical implications of the study's findings and where future research efforts might direct their attention.

5.1 **Research Purpose**

This research examined WQT programs through the lens of CPR collective action theory in order to understand how contextual variables influence the development process of emergent WQT programs. Using an in-depth case study analysis of two cases in the western U.S., I investigated the institutional dimensions of emerging WQT programs and the conditions that shape them. This is relevant because formative elements of program emergence contribute to shaping eventual program functioning and performance. Thus, understanding the conditions that enable or challenge WQT program emergence may provide insights into why some WQT programs struggle to effectively meet their institutional objectives as they mature. Greater clarity regarding how and why institutions develop the way they do can assist in anticipating and influencing eventual program durability and performance.

5.2 **Results Summary**

To a large extent, the institutional dimensions uncovered by this research generally correspond with factors known to affect collective action functioning and performance (see Table 8). The study identified that dominant subthemes in WQT program development include clear allocation of agency, participant commonality, social capital, policy norms, and clarity of rules. The extent to which these elements were present or absent influenced WQT initiative processes by either enabling or challenging institutional development and emergence, as suggested by CPR collective action theory.

Within the Aqua WQTI case, strong patterns emerged implying unclear allocation of agency, heterogeneity of participants, decentralized policy norms, and unclear rules. When assessed in the context of corresponding CPR collective action enabling conditions, these characteristics suggest that the Aqua WQTI exhibits a *limited* presence of the following enabling conditions: appropriate leadership, clear boundaries, shared norms, homogeneity of interests, and the ability to establish favorable institutional arrangements. At the same time, the case's decentralized policy norms resemble nested governance enterprises and high levels of autonomy, indicating the presence of two related collective action enabling conditions cited in the literature.

The combination of these attributes is in part both a cause and consequence of the internal deliberation among Aqua WQTI's actors. At the time of this research, local actors were leveraging their legal-political influence to take over command of the Aqua WQT framework development, and the resulting internal conflict pushed regulatory authorities and other stakeholders to reduce their engagement in the process. The Aqua WQT framework development had moved from a collaborative, interagency platform to being the subject of ongoing, divisive internal debate led by a few influential, elite members within the local watershed stakeholder group. This situation fits what Rabe (1986), Weber (1998), and Lubell et al. (2002) describe as polarization between water resource users that causes fragmentation and gridlock and heightens costs and uncertainty. After nearly twenty years of intermittent efforts to build a functioning WQT program, Aqua WQTI actors once again found themselves in a stalled game at the time of this study.

In the Hydro WQTI case, analytical results suggest a dominant presence of social capital and centralized policy norms. The strong presence of the social capital characteristic suggests a strong occurrence of corresponding CPR collective action enabling conditions including trust, past successful organizational experiences, and interdependence among group members. However, the case's centralized policy norms indicate that key decisions are made by central authorities, and autonomy is limited across the multiple levels of governance. As such, the case study results suggest that the Hydro WQTI possesses a limited presence of the nested governance enterprises and autonomy enabling conditions. Despite this

limitation, the Hydro WQTI framework development process had been progressing as planned and, at the time of this study, was undergoing review for approval by the state regulatory authority. While this research surfaced some tension between actors, Hydro WQTI development processes had yet to be significantly derailed or delayed due to capture by political elites or major shifts or standoffs in actor involvement.

Of the three themes of literature-derived CPR collective action enabling conditions assessed in this research – group characteristics, institutional arrangements, and external environment – case study results are particularly consistent with the group characteristics and institutional arrangements themes. Within these two themes, results support that the absence of enabling conditions can hamper WQT collective action. In particular, two characteristics were strongly associated with internal WQT development challenges and consistent with theory regarding CPR collective action enabling conditions: unclear allocation of agency (of the group attributes theme) and unclear rules (of the institutional environment theme).

Table 8. External variable themes and subthemes derived from case study research compared with CPR collective action institution enabling conditions derived from literature/theory.

External variable themes and subthemes inductively derived from case study research	**Enabling conditions for CPR collective action derived from literature/theory**
Group Attributes	*Group Characteristics*
Clarity of agency	Appropriate leadership Clear boundaries
Commonality	Shared norms Homogeneity of interests
Social capital	Trust Past successful/organizational experiences Interdependence among group members
Institutional Environment	*External Environment*
Policy norms	Nested governance enterprises Autonomy Supportive external sanctioning institutions
	Institutional Arrangements
Clarity of rules	Ability to easily enforce rules Ability to establish rules that are simple and easy to understand Ability to locally devise access and management rules Ability to easily enforce rules Ability to establish monitoring and accountability protocols Ability to establish low cost adjudication rules Ability to establish graduated sanctions Ability to establish fair allocation of benefits from the CPR

5.3 **New Contributions**

While this research provides supporting evidence that the absence of enabling characteristics and conditions can hinder WQT collective action, the data diverge from CPR collective action theory within the external environment theme, specifically regarding the effects of different governance arrangements and policy norms. Ostrom (1990, 2005) and others have recognized political-institutional context as an influential force acting upon the emergence and performance of collective action institutions. While it may be intuitive that political context influences institutional development, few studies have empirically explored how governance arrangements interact with other external variables to impede or facilitate the development of collective action institutions. The results of this research expand our understanding of the

interplay between contextual conditions – policy norms, rules, roles, actors, and social capital – and how such interactions affect the emergence, performance, and durability of collective action institutions for CPR management.

Collective action literature cites decentralized, nested governance arrangements and the autonomy awarded by such systems as important external environment enabling conditions (e.g., Wade 1988; E. Ostrom 1990, 1999). Decentralization has become an increasingly recommended governance model to address the difficulties of achieving effective citizen engagement and collective action in the sustainable governance of CPRs (Nagendra and Ostrom 2012). A large body of literature now advocates for decentralized, nested governance systems as a means of improving natural resource management regimes (e.g., Gerlak 2006; Larson and Soto 2008; Marshall 2008; Berkes 2010; Hudson and Rosenbloom 2013; Bixler 2014). Trends in research and practice herald the importance of local management of CPRs, such as river basins, as a preferred alternative to traditional, state-centric policies (Andersson and Ostrom 2008; Berkes 2008). Local actors and institutions are often lauded as the answer to ineffective and inefficient CPR management (Andersson and Ostrom 2008), correcting for what are deemed overly simplistic, top-down policy panaceas erroneously applied to incredibly complex social-ecological issues (Carlsson and Sandström 2008).

However, contrary to these popular theories, this study found that nested governance arrangements and the institutional autonomy inherent to such arrangements were perceived as impeding the WQT development process more than facilitating it. Nested, decentralized policy norms were associated with more complications and confusion in the WQT development process. Participant descriptions of decentralized policy norms in the Aqua WQTI case were often correlated with references to lack of important enabling conditions including clarity regarding the allocation of agency and process rules. Conversely, centralized policy norms cited by Hydro WQTI actors frequently correlated with references to greater presence of such enabling conditions.

This research suggests that decentralized policy norms can struggle to support collective action institutions in the absence of other enabling conditions. The decentralized nature of Aqua WQTI's policy

context is linked to political-institutional norms including devolution of power and aversion to regulatory oversight. Aqua WQTI participants often alluded (n=51 respondent references) to a historical and current state political environment that restrained the authority of regulatory institutions in favor of local control. As Medard and Geheb (2001, in E. Ostrom 2005, p. 27) posit, "the history of experience with governance institutions at multiple levels affects the way local participants understand, implement, modify, or ignore rules written by external officials". In the absence of a universally-respected central decision-making authority, local watershed actors often perceived rules stemming from higher tiers of government as confusing, weak, or an opportunity for contest. While uncertainty of roles and rules were conditions identified in both cases, the number of times interview respondents described their case with these characteristics varied widely: unclear allocation of agency was referenced by Aqua WQTI actors nearly seven times more frequently (n=155) than by Hydro WQTI actors (n=23); unclear rules were referenced more than twice as often by Aqua WQTI actors (n=77) than by Hydro WQTI actors (n=32). Additionally, Aqua WQTI's heterogenous group of participants (n=82 respondent references compared to Hydro WQTI's n=24) likely exacerbates confusion regarding roles and rules, with actors oriented toward disparate interests, perspectives, norms, and goals.

Subsequently, federal and state regulatory entities involved in the Aqua WQTI sometimes felt that they were governed by the local watershed group, rather than the other way around. While agency – and the related authority to make and enforce rules – may have been formally assigned across and within levels of governance, agency and rules were simultaneously susceptible to being informally challenged and renegotiated upon complaint from a local individual wielding elite political influence and a frustration with regulatory oversight. This phenomenon of elite capture, which has been widely recognized as a chief risk of decentralization (Bardhan 1997; Bardhan and Mookherjee 2000; Bardhan 2002), implied that agency and rules were up for grabs and created a context ripe for dispute, confusion, and frequent change, thereby destabilizing WQT program development during critical moments of institutional foundation-building.

In sum, nested governance arrangements were not as enabling of collective action for the Aqua WQTI as is commonly proposed in CPR collective action theory. Decentralized policy norms, combined with a lack of clarity regarding the allocation of agency and development of rules and a diverse participant group, proved a more difficult environment for WQT program development. Collectively, these conditions contributed to heightened levels of uncertainty in the Aqua WQTI emergence process. Uncertainty increases the transaction costs associated with developing partnerships among watershed resource users, in turn diminishing the likelihood of successful watershed partnership emergence (Lubell et al. 2002).

When considering how decentralized policy norms interact with other external variables to affect institutional development, it is worth noting that decentralization can take many forms. The design of decentralization is a key determinant of whether policies will lead to greater efficiencies, exacerbate instability, or simply become frustrated by institutional constraints (World Bank Group 2001). According to the World Bank Group (2001), successful decentralization is closely related to observing the following design principles: clarity of functions; informed decision making; adherence to local priorities; and accountability. In the absence of these design principles, poorly articulated roles and underdeveloped meso-level institutions can undermine the ability of local officials and organizations to perform effectively and result in the capture of resources and power by an elite few (Barrett et al. 2007). This way of framing the issue places emphasis not on the merits of decentralization (i.e., as compared to centralization), but on the conditions, resources, and constraints that shape its undertaking (Hooghe and Marks 2003; Adams 2016).

This scenario plays out in the context of the Aqua WQTI, whose external variables combine to obfuscate the clarity of functions – an important decentralization design principle. Aqua WQTI actors frequently described their case in terms of unclear functions, including: unclear rules; unclear and contested allocation of agency; lack of well-respected authority figures; and divergent participant interests, perspectives, norms, and goals. Collectively, these external variables impair the ability of Aqua

WQTI's decentralized governance context to support successful CPR collective action institutions as theory suggests that it should.

External variables are also responsible for the Hydro WQTI case's deviation from CPR collective action theory, which posits that centralized governance arrangements are not the most conducive for collective action. Hydro WQTI development takes place in the context of centralized policy norms, where universally-recognized central authorities hold key decision-making power over the process. In addition to the existence of respected central authority figures, the Hydro WQTI case is situated amid a dense network of pertinent state and federal environmental regulations. Although involving multiple levels of governing groups, this scenario differs from the Aqua WQTI's nested governance arrangement in the level of autonomy held by each group. Nested arrangements largely distribute agency and autonomy across governance levels, whereas centralized arrangements imply that federal or state actors retain ultimate authority over the efforts and outputs of local collective action institutions (V. Ostrom et al. 1961; Marshall 2008).

Hydro WQTI's centralized and regulation-abundant policy norms (n=44 respondent references) corresponded with a general attitude of acceptance toward regulatory oversight and obligations. While the clarity of agency allocation and rules were not identified as strong positive patterns within the Hydro WQTI case study data, neither did they appear to be a limiting factor for institutional development, as in the Aqua WQTI case. The Hydro WQTI case was not immune to questions of agency and rules; many actors described the search for answers to these questions along the way. However, despite those sources of uncertainty, Hydro WQTI actors maintained an orientation of acceptance regarding the authority held by central decision makers and the rules they prescribe and enforce. Actors tended to respect the formal allocation of agency as it was established, with few accounts of informal attempts to challenge or reallocate agency and authority. Additionally, the dense regulatory network provided some bounds and guidelines for rule development. The general acceptance of authority and regulatory obligations contributed to a reduced tendency and fewer opportunities for actors to challenge or be confused by unclear agency or rules. In turn, this corresponded with less internal conflict and development obstacles.

Centralized natural resource management can be expensive and undemocratic (World Bank Group 2001). Yet, Hydro WQTI actors often referenced (n=53) the presence of social capital (i.e., reciprocal trust and feelings of goodwill) when describing their case. This dynamic suggests that, rather than diminishing social capital, centralized governance norms may play a role in generating social capital between Hydro WQTI actors. According to Evans (1996, p. 195), when government bureaucracy is tightly organized and robust, it can be advantageous in developing local social capital because it is "capable of formulating more nuanced ways of distributing power and therefore of supporting…openness to local self-organization".

Additionally, lower-tier governance organizations often rely on central governments to provide normative structure and institutional scaffolding (Andersson and Ostrom 2008). In other words, central governments provide clarity of functions within a multilevel governance system that can be lacking in a more decentralized context, as exhibited by the Aqua WQTI case. For Hydro WQTI, the clarity of rules and roles provided by centralized policy norms interact with the presence of social capital and well-respected authority figures to generate a more stable, conducive environment for emerging collective action institutions to build momentum, assign functions, establish norms, and make operational decisions. Despite the economic inefficiencies (Hooghe and Marks 2003) and obstacles to collective action (World Bank Group 2001; Hudson and Rosenbloom 2013) often presented by centralized policy contexts, the combination of external variables supports a smoother emergence process for the Hydro WQTI than for the Aqua WQTI.

These findings underscore the interrelatedness of external variables and how they interact with one another to influence the development trajectories of emergent CPR collective action institutions. For the Aqua WQTI, participant heterogeneity generates actor frustration and divergence; for the Hydro WQTI, social capital bolsters participant cooperation. In turn, these dynamics interact with and accentuate the interplay between the nature of policy norms, roles, and rules – key determinants in the evolution of the emergent WQT programs in this research.

When considered in the context of Ostrom's (2005, p. 33; 2011, p. 10) Framework for Institutional Analysis and Development, the importance of policy norms, rules, and roles falls under the rules-in-use category of external variables. The rules-in-use category represents formal and informal rules – such as regulations, instructions, precepts, or principles (Black 1962) – that strive to achieve order and predictability among humans by establishing a shared understanding of actor positions and the actions those positions are required, permitted, or forbidden to perform (V. Ostrom 1991). Rules are arranged in tiers of governance, with broader constitutional rules determining the actors, norms, predispositions, and governance options available for the development of more localized collective choice and day-to-day operational roles and rules that ultimately steer institutions toward different paths and outcomes (E. Ostrom 2005) (see Figure 5).

Even in decentralized governance arrangements, constitutional rules define the systems, jurisdictions, authorities, and procedures that guide lower-tier collective choice and operational rules (United Nations Development Programme 2003), thereby facilitating the clarity of functions design principle for decentralization (World Bank Group 2001). If constitutional rules forming the foundational norms for who governs and participates in the development of collective action processes are weak, uncertain, or disputed, then subsequent rule-making processes will likely struggle to find stability on dubious ground. Alternatively, constitutional rules that clearly define governance roles from the outset can offer a more solid platform for developing collective choice and operational rules.

This consecutive transference of either stability or instability from constitutional rules to collective choice rules to operational rules corresponds with collective action theory regarding first- and second-order social dilemmas (see Figure 5). Challenges that derive from the broader constitutional rules that define, or fail to define, participant roles in collective action governance are known as second-order social dilemmas (E. Ostrom 1998). First-order social dilemmas are those problems that arise in the more localized arena where collective-choice rules determine, or fail to determine, who is eligible to participate in the development and governance of operational rules regarding resource management. Irrespective of potential incentives, watershed partnerships will only succeed in emerging if participants can first resolve

second-order social dilemmas (Bates 1988; E. Ostrom 1990; Lubell et al. 2002). Solving second-order social dilemmas consequently enables participants to move "the outcomes in their first-level dilemmas closer to optimal levels" (E. Ostrom 1998, p. 8). The cases of the Aqua WQTI and Hydro WQTI bring this phenomenon to light, with the certainty and stability of their second-order constitutional rules dictating the extent to which first-order problems manifest in their collective action pursuits. For the Aqua WQTI, first-order social dilemmas arising from underdeveloped constitutional rules complicate and thwart the development of collective choice and operational rules necessary for program maturation. For the Hydro WQTI, robust constitutional rules provide the institutional scaffolding upon which collective choice and operational rules can be more soundly established. These findings demonstrate how the quality of constitutional rules sets the stage whereupon other external variables interact to dictate the evolution and eventual performance of emergent CPR collective action institutions.

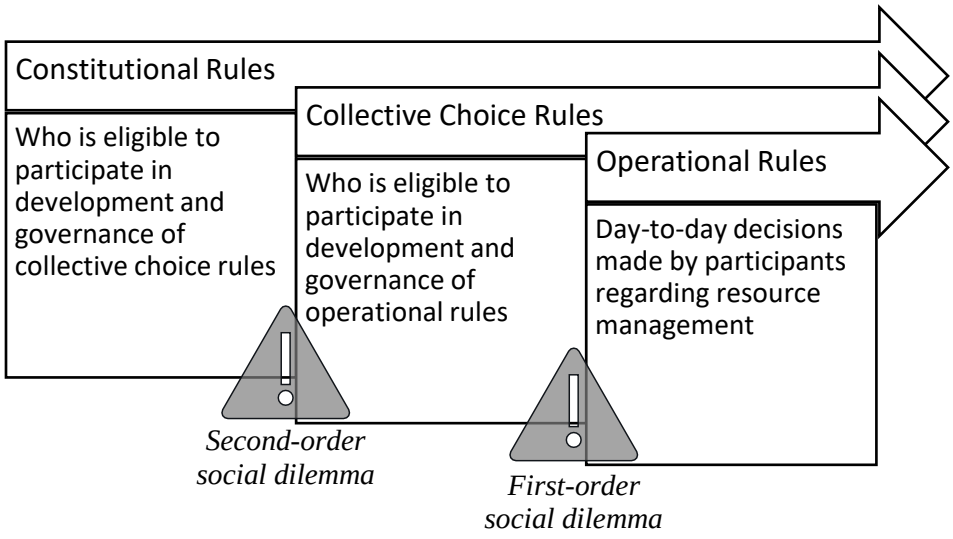

Figure 5**.** Social dilemmas that arise within tiers of rules-in-use that influence the actors, activities, and outcomes of collective action. *Source:* Adapted from E. Ostrom (2005, p. 58).

5.4 **Caveats and Limitations**

Four serious caveats are warranted. The first relates to the limited ability to generalize the results from this case study to the broader population of WQT programs. This case study explores and compares two emerging WQT programs to gain further insight into how the presence or absence of collective action enabling conditions shapes institutional development. As such, the depth of this study allows for improved understanding of how external variables interact to hinder or facilitate the development of the two WQT programs. However, the small sample size limits external validity and the extent to which to this study's inferences can be extrapolated to other current or potential WQT programs. Meta-analyses or surveys of the broader WQT program population could: a) provide insight into patterns of causal interactions between collective action enabling conditions and WQT development and performance, and b) expand upon this case study to better understand how differences across WQT initiatives affect program outcomes. For some topic areas, survey research has already been conducted to capture population-level trends (e.g., Breetz et al. 2004; Selman et al. 2009; Greenhalgh and Selman 2012; Bennett and Carroll 2014; Huber-Stearns 2015; Willamette Partnership et al. 2015; Bennett et al. 2016).

The second caveat affecting this study's validity arises from data coding methodology. Though I employed the constant comparison protocol described by Strauss and Corbin (2008), I was the sole individual that coded the qualitative data. This methodology breaks from the best practice within qualitative research of using multiple data coders and then measuring the inter-rater reliability between coders to identify and mitigate interpretive bias of a single researcher (Creswell 2012). Though I strove to maintain an objective perspective throughout the coding process, the single-coder nature of this study design means that researcher bias may weaken coding reliability and validity. Further research within this topic area that incorporates multiple coders could help mitigate interpretive bias and improve validity.

The third caveat relates to this study's short duration of observation. This research captures a snapshot of perspectives and conditions associated with two WQT initiatives during an early phase of their development. While this research speaks to the struggles and opportunities encountered during a fundamental period of program emergence, the brief observation period limits the extent to which this

study can explain institutional development dynamics during later stages of WQT program maturity. Case studies or longitudinal research designs that observe WQT programs throughout various stages of development, from inception to formalization to performance, could provide further insights into connections between enabling conditions and institutional development over time.

The fourth caveat extends from contextual and functional differences between the two cases. One of the most outstanding disparities is the size of watershed that each WQT initiative strives to address: 3,000 square kilometers (300,000 ha) for the Aqua WQTI versus 700 square kilometers (7,000 ha) for the Hydro WQTI. These widely dissimilar spatial scales likely influence and account for differences between the WQT initiatives in ways that this study does not consider or capture. For example, the geographic coverage of a WQT program delineates the potential actors involved, thus affecting variables such as the commonality of norms and interests and depth of social capital held among program participants. Additionally, this study does not analyze other biophysical disparities, such as precipitation trends, pollution severity, or geomorphology, which may also be responsible for institutional differences between the two cases. While these research design imperfections challenge validity, this study's real-world focus necessitated that cases be selected from a small population of approximately 20 inherently dissimilar WQT programs dispersed throughout the U.S. Because this study strove to understand how external variables influence the organization and emergence process of WQT programs during their inception, potential case options were further limited to only a few in-development initiatives. Of these, I selected the two cases – Aqua and Hydro – that were actively in the process of developing WQT frameworks to formalize their programs, thus making them the most suitable pair at the time of this study for comparing WQT programs at a pivotal point during their inception.

5.5 **Practical Implications**

The results of this study improve understanding of if and how collective action enabling conditions influence the emergence and eventual performance of WQT programs. They also highlight the interactions between contextual policy norms, certainty of roles and rules, participant commonality, and social capital that lead to different institutional development processes. The data underscore the

importance of clear allocation of agency and rules in providing structure and certainty for collective action institution emergence processes. Centralized governance arrangements may offer a context where such rules and certainty are built into the normative sociocultural-political backdrop. If centralized policy norms provide strong constitutional rules for who is eligible to participate in the development and governance of collective choice rules, then collective action pursuits may encounter fewer obstacles (i.e., first-order social dilemmas) when establishing operational rules – particularly if social capital exists among participants. Relatedly, decentralized policy norms may prove to be a more difficult environment for collective action if care is not taken to first determine the constitutional rules upon which subsequent collective rule-making processes depend. These results demonstrate that, irrespective of political-institutional context, the quality of constitutional rules shapes the conditions and outcomes of collective action pursuits.

These findings possess implications for actors currently involved in or considering the WQT mechanism. Firstly, the CPR collective action enabling conditions hypothesized by Wade (1988), E. Ostrom (1990), Baland and Platteau (1996), Agrawal (2001), and Kerr (2007) are useful in predicting elements whose absence can challenge WQT program development, particularly in the dimensions of group characteristics and institutional arrangements. Thus, cultivating such collective action enabling conditions prior to and during the WQT program development process may facilitate successful emergence, which is a precursor to successful performance and durability. Secondly, the clarity of both agency allocation and rules warrant considerable attention in order to reduce transaction costs of WQT program development and, thereby, improve the likelihood of successful emergence. This is especially important for WQT program development occurring in the context of more decentralized governance arrangements where authority and rule-making procedures may be more ambiguous or open to debate. Thirdly, care should be taken to identify and/or establish robust constitutional rules that define who may participate in the development and governance of WQT program collective choice processes, as doing so can improve subsequent collective action and operational rule-making processes and outcomes.

5.6 **Future Directions**

This research inquiry was motivated by the recognition of the general underperformance of established WQT programs. In light of the lethargic activity experienced by the population of mature WQT programs, it was logical to explore the foundational elements of two emerging WQT program development processes for possible explanatory evidence. While this research sheds light on how and why some WQT programs may be challenged to emerge and eventually perform as anticipated, more ambitious research designs are needed to understand if these findings are representative of the broader population of WQT programs. This could be accomplished through additional case studies or meta-analyses targeting the institutional development conditions and pathways experienced by other WQT programs.

Moreover, a fundamental void remains as to if the WQT mechanism is actually worth all the trouble and transaction costs. WQT is a collective action policy tool that should be employed based on evidence of expected environmental, social, and economic outcomes. There is a need for future research to determine how the impacts and effectiveness of WQT programs (Gunningham and Sinclair 2005) and collective action more generally (Koontz and Thomas 2006) compare to traditional regulatory policy tools. Researchers could explore these through the observation of meaningful indicators measured in comparable watersheds before and after and with and without WQT programs.

CHAPTER 6: CONCLUSION

WQT programs form a type of collective action watershed partnership assumed to produce mutually beneficial solutions to CPR conflicts that are superior and more effective than traditional regulatory approaches (Lubell et al. 2002). With all of the promise held by WQT programs, it is perplexing that many such institutions fall short of their anticipated success by way of lethargic or absent trading activity. Despite WQT being a collective action institution designed to address CPR problems, few research efforts have empirically analyzed WQT through the lens of CPR collective action theory, which suggests that external variables dictate how effectively a collective action institution can organize and achieve its goals (E. Ostrom 1990, 2005). By exploring *how* external variable conditions shape WQT development through a CPR collective action lens, this research provides insight into the formative elements that eventually determine the durability and performance, or lack thereof, of mature WQT programs.

This case study and its findings represent a microcosm of the larger experience of collective action institutions attempting to address natural resource governance challenges. Institutions do not develop in a vacuum but are shaped by contextual and historical conditions, such as political-institutional norms and constitutional rules. The path dependence of an institution means that, in a sequence of events, prior decisions and experiences set the stage for mutually consistent expectations that determine the future behavior of individual actors and, in turn, the outcomes of associated collective action institutions (David 1994). Thus, a clearer understanding of how and why institutions develop the way that they do early in their histories can provide insight into how and why institutions may succeed or fail down the line. It is therefore important for policy makers and actors participating in institutional design processes to pay attention to the contextual conditions and legacies that facilitate or impede institutional emergence. Understanding how context influences the evolution of emergent WQT programs not only advises current and future WQT development processes but also informs the increasingly popular development of collective action institutions more broadly. In order for collective action institutions to effectively address CPR problems such as nonpoint source pollution, they must successfully emerge, perform, and endure:

requirements that necessitate consideration of the foundational conditions that shape both the birth and future of institutions.

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APPENDIX A: CODING EXAMPLES

Table 9. Examples of theme, subtheme, characteristic, and axial codes inductively derived from case study research.

Theme: Group Attributes		
Subtheme: Clarity of Agency	**Characteristic: clear allocation of agency**	
	***Clear allocation of agency* axial codes**	**Examples of interview text coded with *clear allocation of agency characteristic* axial codes**
	Appropriate leadership	*"The state conservation director encouraged our experimentation with the WQT mechanism."* -Hydro WQTI state government representative
	Clear boundaries and roles	*"The city and our consultants, we brainstorm possible ideas. We do kind of rough calculations. 'Could this project actually generate some credit?' Then we talk to the land owner, 'Could you potentially be interested?' If the land owner says 'Yes,' then we go to the water board and say, 'This is an idea that we have, could this be creditable?' The waterboard says 'Yes,' or 'No.'"* -Hydro WQTI municipal government representative
	Consistent, long-term participants	*"Most of the people there have been involved [in the watershed group] for 20 years. There's not a lot of turnover."* -Aqua WQTI environmental interest representative
	Respect for power distribution	*"I think we were interested and would have liked to have a higher platform [in the stakeholder process], if you will, but that was the [local entity's] choice."* -Hydro WQTI nongovernmental organization representative

	Characteristic: unclear allocation of agency	
	***Unclear allocation of agency* axial codes**	**Examples of interview text coded with *unclear allocation of agency* axial codes**
	Inappropriate leadership	*"[They] fear being drug in front of the legislature to be told that they are doing their job wrong. So, [they] won't lead."* -Aqua WQTI nongovernmental organization representative
	Devolution of agency during process	*"There was a decision…that the process had been too internal up to that point. That's when there was a shift to take the [WQT] framework process…to the [watershed stakeholder group]. That was a shifting point in the process."* -Aqua WQTI nongovernmental organization representative
	Negotiations managed through litigation or threat thereof	*"I got phone calls that [environmental groups] were threatening to sue me, that now that they put this out as public record, 'You're a polluter. We're going to sue you.' I called the city and said, 'Hey, either somebody talks to these people or you better have a lawyer.'"* -Hydro WQTI agricultural interest representative
	Pushback from regulated entity	*"There's a lot of political horse power here that makes it hard to get anything done and if they have an agenda that they don't want to have something like a TMDL telling them what they have to do it's pretty hard to get them to do it."* -Aqua WQTI federal government representative
	Skewed stakeholder representation	*"The [Aqua WQTI framework development group] now consists mostly of agency people. There's less representation now from the diverse stakeholders throughout the basin."* -Aqua WQTI special district representative
	Struggle for power or power imbalance	*"Because it's such a small state and because power is so concentrated in ideological terms, if you can get yourself into sort of the right circle, you have endless powers, and your correctness is assumed and not questioned."* -Aqua WQTI nongovernmental organization representative

	High turnover among participants	*"Then you get new city council people that are elected. They have no idea…they're making decisions in town and they've never been out in this area to see what they're even making decisions on."* -Hydro WQTI agricultural interest representative
	Unclear, changing boundaries and roles	*"The [facilitator] pretty much got fired and we are running our own [WQT framework development process] now."* -Aqua WQTI environmental interest representative *"Somebody said, 'Hey, you guys [in this agency], you're listed ...' [The state] had us listed on their website as the contact agency if a landowner or anybody was interested in doing water quality trading…I went to [the state's] website, and sure enough, there we were listed in water quality trading. We have no statutory authority to do that."* -Aqua WQTI special district representative
Subtheme: Commonality	**Characteristic: homogeneity of participants**	
	***Homogeneity of participants* axial codes**	**Examples of interview text coded with *homogeneity of participants* axial codes**
	Homogeneity of interests or motivations	*"We're all public agencies. We're not here to use this to subsidize other programs. It's strictly to pay for improving the environment and improving the world, so to speak."* -Hydro WQTI special district representative
	Shared norms or perspectives	*"I would say that being as there's fewer, less diverse stakeholders involved, less discussion, a decision may be more readily arrived at."* -Aqua WQTI special district representative

	Characteristic: heterogeneity of participants	
	***Heterogeneity of participants* axial codes**	**Examples of interview text coded with *heterogeneity of participants* axial codes**
	Disproportionate participation across time	*"I think the level of interest that seems to be there now…we're at the point where some of the key stakeholders who are involved in this process…it's becoming clear that they're paying attention, and they're sitting forward, and engaging in the process…I think some folks who have been involved in the process more actively in the past are frustrated. They're wondering why [the others] waited until now to ask these questions we thought were resolved six months, a year ago, and now we're reopening them. Why is that happening?"* -Aqua WQTI nongovernmental organization representative
	Divergent perspectives or norms	*"It's my opinion that they don't care so much [about water quality]. That's not a big deal to them. As to myself and my own value system, I have a hard time understanding how people don't care about water quality, but there are a lot of people that don't care. It just blows my mind."* -Aqua WQTI federal government representative
	Disproportionate interests or incentives to participate	*"On the agency side it was not hard to get people to participate. Everybody was really excited about the idea and we got really great attendance…On the landowner side it was much harder…One difference with the landowner group is they're not getting paid to be there. Agency people get paid to be at meetings and landowners don't so right there it was we were asking a lot of people to come to so many meetings."* -Hydro WQTI special district representative

Subtheme: Social Capital	**Characteristic: presence of social capital**	
	***Presence of social capital* axial codes**	**Examples of interview text coded with *presence of social capital* axial codes**
	Actors claim public good, not-for-profit interests	*"One of the unique things about our involvement is that, from what I understand, in other areas where they have programs like this the entities that sell credits are usually doing that for a profit…Ours is a little different since we're a public agency and working with whoever would be buying them, it's completely transparent. We're not looking to make a profit. We really just want to see the watershed get improved."* -Hydro WQTI special district representative
	Interdependence among group members	*"[The municipality] wanted it done…because they wanted this to get done in this county. I mean, they put their neck on the line, I put my neck on the line…If I walked away from it, would the city say, 'Well, we're not going to go to bat with you for the lawyers,' and suddenly, an environmental group sues me because I've said that I've released this much phosphorous and this much nitrogen. Now I'm going to foot the bill. So, I hung in there and stayed with it. I wanted to see it work, too. I mean, I really did."* -Hydro WQTI agricultural interest representative
	Past successful organizational experiences	*"I think there was a fair amount of distrust that was there earlier on, and perhaps just disagreement about the appropriate way. But, when the TMDL process really started picking up with a little more momentum, you had more folks coming together willing to talk about different things…The fact that the TMDL was moving along as well as it was, and truly very clearly getting to the point where it was actually going to be completed and happen, I think that honestly gave the trading framework a lot more momentum associated with it…The process that's been going on with the trading framework is largely a result of what's been going on with the TMDL process."* -Aqua WQTI nongovernmental organization representative

	Trust and social capital	*"This is kind of an inspirational, innovative team just to get to be with. I once heard something that was really interesting where it talked about innovation happens when parties get together that trust each other, and they start collaborating. It results in innovation, and that's I would say ... It wasn't so much that we set out to be innovative or trying to be innovative. It's just a byproduct of having a group where we trust each other, we respect each other, and we like working together, so ideas just come out of that."* -Hydro WQTI special district representative
	Willing pilot testers and pioneers	*"I've always kind of been, I've always been out there trying to do as much as I can. Get ahead and do a lot of tours with agencies and things like that to bring them in and so they see what we've been doing. I said, 'Hey, I'll do it.' I kind of went at it with the idea that – and we all knew it – it was like, 'Okay. Here we go. Hang on.' Being the first, I mean, in [this state]."* -Hydro WQTI agricultural interest representative
	Characteristic: lack of social capital	
	***Lack of social capital* axial codes**	**Examples of interview text coded with *lack of social capital* axial codes**
	Lack of interdependence among group members	*"Some folks are like, 'Why should we do anything? We don't have to do anything. We don't legally have to control our phosphorus if we don't want to.'"* -Aqua WQTI state government representative
	Lack of trust and social capital	*"I think that there's been some mistrust because of these policies that don't allow any project that's been funded by conservation, or they don't want any conservation money to be at all linked with compliance money."* -Hydro WQTI municipal government representative

	Negative past organizational experiences	*"The process had unfolded where one stakeholder that came in late and changed things or put the brakes on things apparently is not uncommon…Apparently, this happened with the previous TMDL process…The unfortunate part is that it comes down to someone's politics."* -Aqua WQTI nongovernmental organization representative
Theme: Institutional Environment		
Subtheme: Policy Norms	**Characteristic: centralized policy norms**	
	***Centralized policy norms* axial code**	**Examples of interview text coded with *centralized policy norms* axial code**
		"One of the things that's unique in [here] compared with some other states is that our [state agencies] have much more authority to regulate nonpoint source pollution." -Hydro WQTI special district representative *"We were sure that we wanted auditing power over everything or else we can't assure our constituents that we're in a position to protect water quality so we had to maintain some sort of authority over any step in the process."* -Hydro WQTI state government representative
	Characteristic: decentralized policy norms	
	***Decentralized policy norms* axial code**	**Examples of interview text coded with de*centralized policy norms* axial code**
		"I think it's accurate to say that the legislature and the executive branch being sort of more conservative like to keep pretty tight reigns on the regulatory agencies in the state and the citizens feel like if there's something going on that they don't like, they can go to the governor, they can go to the legislature and then that issue will be brought forward to a regulatory agency and have some way to deal with that. No one likes to get in those situations very much." -Aqua WQTI nongovernmental organization representative

		"This is a [watershed stakeholder group] that tends to run us, not the other way around. They are the ones that are trying to be influenced here, not us, which I find fascinating." -Aqua WQTI state government representative
Subtheme: Clarity of Rules	**Characteristic: clear rules**	
	***Clear rules* axial codes**	**Examples of interview text coded with *clear rules* axial codes**
	Clear rules of engagement between participants	*"We did throw ideas out there, provide resources but to a large extent, because the [special district] is our local partner and because they were directing the process and now the [state] is directing the process, we're going to defer pretty heavily to their understanding and discretion."* -Hydro WQTI nongovernmental organization representative
	Clear rules for/understanding of program/project development process	*I'm assuming this is going to be generation two and it will survive as long as it needs to be replaced by generation three, which is when the TMDL gets adopted. By then we'll know if there's sufficient supply and demand in the market and political will, things of that nature."* -Hydro WQTI state government representative
	Rules provided by grant language	*"If you say you're going to have a certain number of meetings in your grant then you're going to have to figure out how to have those meetings while being respectful of people's time."* -Hydro WQTI special district representative
	Characteristic: unclear rules	
	***Unclear rules* axial codes**	**Examples of interview text coded with *unclear rules* axial codes**
	Unclear rules or rule development processes	*"What rules did we have to comply with it? Which set of documents was going to prevail and did it have to be the same and could it be different…and who was going to decide all this stuff…Nobody had any answers."* -Aqua WQTI nongovernmental organization representative

	Decisions debated without all information	*"Honestly, I would say that a lot of these conversations do tend to happen without the full set of information."* -Aqua WQTI nongovernmental organization representative
	Expectation that rules will change in future	*"The problem that a lot of these facilities have when they're evaluating whether or not trading is actually an option for them is that it's a moving target. The cost side and the benefit side of trading is really hard to evaluate, because you have to evaluate this pretty large range of scenarios. In some cases, it ends up being great, it's fine, it's cheaper, it's a better alternative. Then if you go to the other extreme it's more expensive and less of a benefit than you would have from your traditional infrastructure. In terms of how it stacks up, it's still to be determined based on the outcomes of the discussion from the trading framework."* -Aqua WQTI nongovernmental organization representative
	Lack of ease in enforcement of rules	*"This is where the big population base is and these people are politically connected and frankly there are consequences if they don't get what they want, they can make life pretty hard. We can really only intercede so much in local politics and local affairs. We don't let them break any laws, but there are a lot of times decisions are made here that we wish weren't."* -Aqua WQTI federal government representative

APPENDIX B: DATA CODES PAIRED WITH ENABLING CONDITIONS

Table 10. Codes inductively derived from case study research and corresponding CPR collective action enabling conditions derived from literature/theory.

Theme, subtheme, characteristic, and axial codes inductively derived from the research		**Corresponding enabling conditions for CPR collective action derived from literature/theory**
Group Attributes		***Group Characteristics***
Clarity of Agency	Clear allocation of agency • Appropriate leadership • Clear boundaries and roles • Consistent, long-term participants • Respect for power distribution	Appropriate leadership Clear boundaries
	Unclear allocation of agency • Inappropriate leadership • Devolution of agency during process • Negotiations managed through litigation or threat thereof • Pushback from regulated entity • Skewed stakeholder representation • Struggle for power or power imbalance • High turnover among participants • Unclear, changing boundaries and roles	
Commonality	Homogeneity of participants • Homogeneity of interests or motivations • Shared norms or perspectives	Shared norms Homogeneity of interests
	Heterogeneity of participants • Disproportionate participation across time • Divergent perspectives or norms • Disproportionate interests or incentives to participate	

<table>
<tr><td rowspan="2">Social Capital</td><td>Presence of social capital
Actors claim public good, not-for-profit interests
Interdependence among group members
Pass successful organizational experiences
Trust and social capital
Willing pilot testers and pioneers</td><td rowspan="2">Trust
Past successful/organizational experiences
Interdependence among group members</td></tr>
<tr><td>Lack of social capital
Lack of interdependence among group members
Lack of trust and social capital
Negative past organizational experiences</td></tr>
<tr><td colspan="2">Institutional Environment</td><td>External Environment</td></tr>
<tr><td rowspan="3">Policy norms</td><td>Centralized policy norms</td><td rowspan="2">Nested governance enterprises
Autonomy</td></tr>
<tr><td>Decentralized policy norms</td></tr>
<tr><td>Institutional Arrangements</td></tr>
<tr><td rowspan="2">Clarity of rules</td><td>Clear rules
Clear rules of engagement between participants
Clear rules for/understanding of the program/project development process
Rules provided by grant language</td><td rowspan="2">Ability to easily enforce rules
Ability to establish fair allocation of benefits from the common resource
Ability to establish rules that are simple and easy to understand
Ability to locally devise access and management rules
Ability to easily enforce rules
Ability to establish monitoring and accountability protocols
Ability to establish low cost adjudication rules
Ability to establish graduated sanctions</td></tr>
<tr><td>Unclear rules
Unclear rules or rule development processes
Decisions debated without all information
Expectation that rules will change in future
Lack of ease in enforcement of rules</td></tr>
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