



## Precedent and the content of the law: Lessons from the evolution of groundwater law in early 20th century California

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evolution of groundwater law in early 20<sup>th</sup> century California***

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I: Introduction

The scholarly study of judicial decision-making has evolved dramatically over time, as legal scholarship has taken increasingly sophisticated approaches to understanding and modeling judicial behavior. Traditional models painted judges as largely mechanical interpreters of the law, or purely interested in promoting certain economic or social objectives.<sup>1</sup> In recent days, these models have been challenged by scholars operating in the law-and-economics tradition, who have proposed models of judges as self-interested, rational actors with various personal objectives operating under a variety of constraints.<sup>2</sup> This development has permitted economists and legal scholars to pose a richer set of testable hypotheses, enabling us to gain better insights into both judge behavior and a variety of legal phenomena.<sup>3</sup>

In the process of revising our conception of judicial behavior, our conception of the role of precedent in the judicial process has evolved as well. Historically, precedent has been viewed by legal scholars as constraining judges from ruling in certain ways; namely, ways that are inconsistent with existing doctrine as embodied in previous rulings on specific issues.<sup>4</sup> The recent move toward rational actor models of judges has subtly shifted this conception of precedent. While not denying its constraining force, the new thinking views precedent as providing a way for judges to economize on judicial effort when they enjoy doctrinal latitude, allowing them to capitalize on the work of previous judges. This conclusion follows naturally from a model that assumes that judges operate under binding time constraints, which generates tradeoffs in terms of how much time and effort they devote to crafting individual opinions.

Unfortunately, in rational actor models the impact of precedent on judicial decision-making remains unclear because judicial latitude is itself endogenous to precedent, and we lack general predictions on the nature of this endogeneity. It is common to view precedent as binding on judges, particularly when existing cases are dense, targeted at a narrowly-defined issue, and specific in the governing principles they lay out. However, in principle a body of precedent may endow judges with broad latitude to craft new content, by providing varied analogies in the law, as well as numerous exceptions to controlling legal doctrine.<sup>5</sup> If so, under the new rational actor models judges may be afforded more economizing opportunities and judicial preferences become a stronger driver of the content and direction of the law. The question is: what is the exact nature of the relationship between existing precedent and the opportunity for judges to exercise judicial latitude?

This paper aims to advance our understanding of the impact of precedent on judicial decision-making by examining the behavior of judges in complex doctrinal situations where multiple governing principles for deciding cases are present. Not only is this the case where we lack the greatest clarity in terms of being able to predict judicial behavior, it also probably characterizes a great many issues. In the model to be presented shortly, judges have preferences over judicial outcomes but writing opinions is costly, especially ones that go against existing doctrine, so that judges may not necessarily take their (unconstrained) ideal position.<sup>6</sup> Precedent is modeled as potentially binding on judges but depending upon the circumstances, the presence of multiple principles for deciding cases affords potentially greater latitude to judges to service their own preferences for legal outcomes.

There are two implications of this analysis, one for the behavior of judges and the other for the evolution of the law over time. First, rational actor judges will commonly have incentive

to draw on related areas of the law when they are available and applicable to the case at hand. This has the consequence of making existing precedent less binding and makes the law more a reflection of judicial preferences than existing doctrinal principles that may on the surface appear controlling. Second, when judges draw on legal principles from related areas, this can lead to a convergence of doctrine. Legal principles governing seemingly different areas may assume greater similarity as judges recognize and apply analogies from one area to the next. This paper thus attempts to forge a connection between the decision-making of judges as rational actors and the broader currents of doctrinal evolution.<sup>7</sup>

To illustrate these implications of the model, the paper adopts the strategy of examining a specific legal situation where there is an exogenous shock that in effect relaxes the constraint of existing precedent. This shock permits us to observe the court response to this relaxation of precedent, and the direction of the law as a consequence. The specific situation examined is groundwater law in California in the late-19<sup>th</sup> and early-20<sup>th</sup> centuries, when exogenous advances in scientific understanding of groundwater hydrology clarified the similarities between groundwater and surface water flows and reduced the cost to judges of applying legal analogies from surface water law to groundwater disputes. As we shall see, these advances effectively relaxed the constraints imposed by existing precedents in groundwater law, permitting judges to exercise greater discretion in deciding which set of precedents to draw upon. As the model predicts, the result was a convergence of the legal principles governing surface water and groundwater.

## II. Rational actor judges, precedent, and economic change

On the surface, the models of judges respecting existing precedent and judges as self-interested rational actors seem to be at fundamental odds with each other. In the one view,

judges confront a body of previous rulings and search for principles that seem to apply to the case at hand. The rulings of previous judges stand front-and-center and are given enormous deference, and the particular preferences of the ruling judge matter little in terms of deciding the outcome of the case. In the other view, the preferences of the judge are everything: preferences for interest in promoting efficient use of resources, advancing particular political objectives, minimizing opinion-writing effort, personal status, reputation, and so forth. In the judge-as-rational-actor model, previous rulings seem either largely incidental or merely an opportunity for judges to reduce their workload by invoking the work of others.

In actuality, the decision-making models can be reconciled by viewing precedent as a constraint that is more-or-less binding on judges depending upon circumstances. It should first be recognized that what constitutes precedent may seem clear-cut but in fact, it can be quite fuzzy. As Frederick Schauer and others have pointed out, the seemingly simple notion of “treating like issues alike” raises a number of practical issues that judges must confront in deciding whether to follow precedent.<sup>8</sup> No two disputes are ever exactly alike, so one important question is that of degree: how alike do two different disputes have to be to warrant the same judicial treatment? And given that disputes may share a number of different characteristics, which characteristics are relevant for an appropriate determination of the relative rights of the parties involved? And among the characteristics that are deemed relevant, should some be given greater weight than others? All of this means that there may well be a significant amount of indeterminacy in precisely what constitutes precedent in any particular case.

But beyond the fact that there is generally an irreducible amount of uncertainty in what constitutes precedent, certain other factors may make it even more of an open question. A key factor is changing economic, social, or technological conditions, which may make previous

rulings appear less applicable to the new circumstances. In the 1940's, for example, advances in scientific understanding of fetal development led courts to begin to hold individuals responsible for negligently inflicted prenatal injuries.<sup>9</sup> Similarly, the scientific advances in understanding hydrology in the late 19<sup>th</sup> century made existing groundwater principles less relevant, which lowered the costs to judges of striking out in new directions.<sup>10</sup> As a more recent example, traditional common law used to treat adolescents as responsible adults in cases involving criminal offenses, but this changed in the 2000's as advances in brain science led courts to distinguish adolescent from adult criminal behavior in terms of culpability.<sup>11</sup>

With this notion of precedent in mind, a simple model will clarify the impact of precedent on judges, and will permit examination of the impact of doctrine in related areas of the law. For the purposes of the following discussion, it will be assumed that the court consists of a single judge, so that intra-court dynamics among judges can be ignored. Consider an existing legal doctrine regarding a particular issue, such as groundwater law. It is assumed that the doctrine can be summarized in terms of a single attribute  $X$ . The judge has well-defined preferences over different values of  $X$ , expressed in a utility function  $U(X)$ . Assume that initially, legal doctrine takes on the value  $X_0$ , which is the judge's initial ideal (utility-maximizing) position. Furthermore, assume that the judge's utility declines with distance from this position.<sup>12</sup> This gives rise to a utility "hill" for the judge over different values of  $X$ (Figure 1). In this initial equilibrium, there is no tendency for the judge to move from this original doctrinal position  $X_0$ .

< Figure 1 about here >

Suppose now that there is a change in economic conditions, which results in a shift in the judge's ideal position.<sup>13</sup> This is represented in Figure 1 as a (rightward) shift in the judge's utility hill, now centered on  $X'$ . This induces a shift in the judge's position, what I will term  $X_J$ .

If there are no other considerations, there will be a predicted wholesale move in doctrine to the judge's new ideal position, so that  $X_J = X'$ . Two factors, however, may enter into the judge's rule-making calculus, both leading to an incomplete adjustment to the new position. First, the judge may experience costs in writing a new opinion that deviates from the existing doctrine  $X_0$ . Assume that these opinion-writing costs are an increasing function of the distance between the new opinion  $X_J$  and existing doctrine  $X_0$ . These costs are represented in the following cost function  $C = C(X_J - X_0)$ . Assume that  $C' > 0$  and  $C'' > 0$ , so that marginal opinion-writing costs are also increasing in the distance  $(X_J - X_0)$ . Expressing  $U$  and  $C$  in the same(dollar) terms, we can then derive the judge's net utility function:  $NU = U(X) - C(X_J - X_0)$ . Because  $C$  is increasing in the distance between  $X_J$  and  $X_0$ , it is easily shown that  $X_J < X'$ . That is, faced with opinion-writing costs, the judge will not move all the way to the (gross) utility-maximizing position  $X'$ .

An additional factor that may affect the judge's behavior is precedent. Depending upon a number of factors, existing precedent may be more or less binding. These factors include the degree that existing doctrine is settled, the influence of judicial norms, and the particular economic factors at play. To model precedent, I define a weighting parameter  $\beta$ , where  $\beta \in (0, 1)$ . Then the bindingness of precedent is embodied in the following constraint:  $X_J \leq \beta X_0 + (1 - \beta) X'$ . That is,  $\beta$  is a parameter that weights the importance of existing doctrine versus the new ideal position generated by changing economic conditions. This constraint represents the fact that depending upon the value of  $\beta$ , there will be just so far that the judge may stray from the current position  $X_0$ . If  $\beta = 1$ , then precedent is completely binding and the judge will simply stick to existing doctrine, setting  $X_J = X_0$ . If  $\beta = 0$ , then the judge is completely free to choose her ideal (net) position, regardless of precedent. Intermediate values of  $\beta$ , of course, reflect



varying degrees of bindingness. In Figure 1, this constraint is represented as the point A between  $X_0$  and  $X'$ . Given this constraint, the judge is free to choose any position at or to the left of A.

In any particular instance, whether existing precedent will actually be binding on this judge depends upon her preferences over judicial outcomes, her opinion-writing costs, and the bindingness of precedent. Formally, the judge optimizes with respect to  $X_J$  and  $\lambda$  in the following Lagrangean function:

$$\mathcal{L} = U(X_J) - C(X_J - X_0) + \lambda[X_J - \beta X_0 - (1 - \beta) X'] \quad (1)$$

Then the first order conditions are:

$$U_{X'} - C_{X'} + \lambda \leq 0 \quad (2)$$

$$X_J - \beta X_0 - (1 - \beta) X' \leq 0 \quad (3)$$

The first order conditions then yield two possibilities: (a) precedent is non-binding ( $\lambda = 0$ ), in which case the predicted outcome is the judge's (net) ideal position; or (b) precedent is binding ( $\lambda > 0$ ), in which case we obtain the corner solution at point A.<sup>14</sup> Notice that precedent will be non-binding only if  $\beta$  is sufficiently small and/or the cost of opinion-writing is sufficiently large.

To see the impact of related doctrine on judicial outcomes, let us model doctrine regarding two resources, each with one attribute:  $X$  and  $Y$ . In this case, the initial position consists of the point  $(X_0, Y_0)$  in Figure 2. The preferences of the judge are now represented with concentric utility circles, with utility declining with (Euclidean) distance from the initial position. In this case, a change in economic conditions is reflected as a movement in  $X - Y$  space, with the preferences of the judge moving accordingly. Assuming initially that the doctrines regarding  $X$  and  $Y$  are considered by the judge to be completely unrelated, the utility function of the judge is completely separable in  $X$  and  $Y$ :  $U(X, Y) = U_X(X) + U_Y(Y)$ , so that the cross-partial derivatives

$U_{XY}$  and  $U_{YX}$  equal 0. Similarly, for two completely unrelated doctrines, the opinion-writing cost function will also be separable in  $X$  and  $Y$ :  $C(X, Y) = C_X(X_J - X_0) + C_Y(Y_J - Y_0)$ , where  $C_{XY} = C_{YX} = 0$ . Then the judge's Lagrangean function becomes:

$$\begin{aligned} \mathcal{L} = & [U_X(X_J) + U_Y(Y_J)] - [C_X(X_J - X_0) + C_Y(Y_J - Y_0)] + \lambda_X[X_J - \beta_X X_0 - (1 - \beta_X) X'] \\ & + \lambda_Y[Y_J - \beta_Y Y_0 - (1 - \beta_Y) Y'] \end{aligned} \quad (4)$$

In this function, there are two bindingness parameters  $\beta_X$  and  $\beta_Y$ , reflecting the fact that existing precedent may bind differentially on doctrine regarding the two resources.

< Figure 2 about here >

Under these conditions, it should be apparent that the individual optimizing conditions with regard to  $X$  and  $Y$  mirror precisely the optimizing condition in the case of one resource, yielding, for example, the same first order condition with regard to  $X_J$  as in the single-resource case. Similarly for  $Y$ . Since  $X$  and  $Y$  are (doctrinally) unrelated, a change in economic conditions that affects the judge's ideal position for  $X$  may have little if any effect on her ideal position for  $Y$ , and vice versa. The case where there is zero effect on  $Y$  is illustrated in Figure 2, where after the change, the judge's ideal position is now  $(X', Y_0)$ . As in the single-resource case, the judge maximizes utility by either choosing her ideal (net-of-cost-of-opinion writing) position (precedent non-binding), or point A (precedent binding).<sup>15</sup> In other words, existing doctrine with regard to the other resource has no impact on judicial rule-making when the other resource is completely unrelated to the one at hand.

To illustrate the effect of related doctrine, suppose now that the two resources  $X$  and  $Y$  are related in terms of treatment under the law. In this case, changes in economic conditions are more likely to affect the judge's new preferences over outcomes in both the  $X$  and  $Y$  directions. In Figure 3, this is shown as a movement in the ideal position of the judge from  $(X_0, Y_0)$  to  $(X',$

Y’). As before, the judge incurs opinion-writing costs as well as potentially binding precedent, now for both X and Y (the vertical and horizontal lines in Figure 3). However, the fact that the two resources are related in the law means that the judge may be able to invoke precedent from previous rulings for either resource. In the extreme case, precedent for one resource applies with complete force to the other resource, and vice versa. In this case, the precedent constraint becomes:

$$[X_J \leq \beta_X X_0 + (1 - \beta_X) X'] \text{ OR } [Y_J \leq \beta_Y Y_0 + (1 - \beta_Y) Y'] \quad (5)$$

Faced with this choice, the utility-maximizing judge in Figure 3 would invoke precedent from resource Y and move to point A. In short, the presence of related doctrine may make existing precedent less binding, to the extent that precedent on related doctrine provides judges with more leeway in serving their preferences over different rules.

< Figure 3 about here >

To see the concrete implications of this analysis, the remainder of this paper will develop a particular example – the evolution of groundwater law in early 20<sup>th</sup> century California – which will be discussed and documented at length in the next two sections. In this example, surface water and groundwater were initially considered completely different resources, so that doctrine with regard to one, in the form of legal rules regarding resolution of disputes, was considered largely immaterial in influencing doctrine with regard to the other. In this initial state, changes in surface water law would not affect groundwater doctrine at all, as in Figure 2. However, subsequent advances in scientific understanding of groundwater flows led judges to perceive groundwater and surface water to be similar resources. The model predicts that a judge might exploit this new understanding by applying existing rules governing surface water to govern disputes over groundwater, as in Figure 3. The advance in scientific understanding of

groundwater flows thus had two related consequences: it permitted the courts to relax the constraint imposed by existing groundwater precedent, and it caused the legal doctrines regarding groundwater and surface water to more closely mirror one another.

### III. 19<sup>th</sup> century precursors

Since statehood, California has been an English common law jurisdiction, and its judicial rulings regarding water have reflected the perceptible influence of English common law doctrine. A key reflection of this influence was the early adoption by the courts of the principles of riparian law to govern the acquisition of, and resolution of disputes over, surface water rights. In a nutshell, riparian water rights are created through land ownership, which entitles one to the use of water in physically adjacent rivers and streams. Also important is the fact that under riparian law, surface water exists for the benefit of the lands where it naturally occurs, which has meant that the water could itself only be used on the physically adjacent lands, the so-called *appurtenance* principle. In disputes over surface water use, all users along a river enjoy roughly co-equal rights, with each right-holder permitted to use only an amount of water that is “reasonable” given the needs of other users. This reasonable use standard has proved to be a highly elastic one, and what constitutes reasonable use in any particular dispute has typically been a matter for the courts to decide.<sup>16</sup>

At the same time, the early California courts also developed and applied an alternative set of principles to govern water use and development in circumstances where traditional riparian principles could not adequately service the demands of economic growth. These alternative principles – embodied in the so-called doctrine of *prior appropriation* – apply the principle of first possession to govern both the acquisition of surface water rights and the resolution of disputes over these rights. Under this principle, surface water rights are allocated on a first-

come, first-served basis, with prior(senior) appropriators enjoying rights that are superior to subsequent(junior) appropriators. Practically speaking, this distinction becomes especially important in times of low surface flow, when junior appropriators are required to cut back their use before senior appropriators are required to. Finally, unlike riparian law, under appropriative law water may be diverted and used at locations remote from the surface sources where it naturally occurs. These seemingly incompatible doctrines have coexisted uneasily ever since statehood, and have come to be known as the California Doctrine – California’s unique contribution to western surface water law.<sup>17</sup>

Early groundwater law in California reflected, in some respects, the surface water distinction between riparian and appropriative rights, as embodied in the principles of English common law. The early courts believed that groundwater could exist in two distinct forms: as part of a well-defined sub-surface flow, or free sub-surface water with no clear patterns of flow. Such a distinction is seen, for example, in the early case of *Hanson v. McCue*, which involved a dispute between two groundwater users. In *Hanson*, the Court drew a sharp distinction between groundwater “flowing in defined channels” and groundwater “formed by the ordinary percolations of water in the soil,” disconnected from any flowing stream.<sup>18</sup> When groundwater flowed in well-defined channels under the surface, *Hanson* argued, it was really no different from water that flowed in well-defined channels on the surface. The mere fact that water happened to be underground should therefore not affect the legal principles that should govern its allocation:

“Underground currents of water, flowing in defined channels, are known to exist in considerable volume, particularly in limestone regions; and where their existence is shown, there is no doubt, either upon reason or authority, that the rules of law which govern the use of similar streams flowing upon the surface of the earth, are applicable to them.”

This led to its conclusion that no one should be permitted to “intercept its natural descent to the lands of the proprietor below,” as such a stream was “in a greater or less degree a fertilizer of the land through which it flows.” Though *Hanson* never used the term riparian, the riparian principle that all users are entitled to the flow, and the riparian philosophy that water exists for the benefit of the land through which it flows, are both evident in its treatment of well-defined underground flows. Subsequent rulings through the remainder of the century would uphold this doctrinal treatment of non-percolating groundwater.<sup>19</sup>

However, when groundwater did not flow in a well-defined channel, *Hanson* held that it was to be governed by the English common law doctrine of *cujus es solum*, sometimes referred to as *absolute ownership*. Under the principle of absolute ownership, land ownership entitles the owner to all of the resources found under the surface contained within the perimeter of the boundaries of the parcel. In other words, the surface limits of the parcel are projected straight down, and everything within those downward projections belong to the owner of the parcel, with virtually no restrictions on how the resources can be mined and exploited by the owner. As

*Hanson* put it:

“Water filtrating or percolating in the soil belongs to the owner of the freehold--like the rocks and minerals found there. It exists there free from the usufructuary right of others, which is to be respected by the owner of an estate through which a defined stream of water is found to flow. The owner may appropriate the percolations and filtrations as he may choose, and turn them to profit if he can.”

In terms of the potential for third-party impacts, legal rules that treat groundwater like coal and other sub-surface minerals would seem unlikely to produce efficient groundwater development. Today, we know that unlike extractions of coal on one’s own property, extractions of groundwater can inflict third-party impacts through the lateral subsurface movement of groundwater. Groundwater extractions generate a localized reduction in sub-surface water pressures, inducing lateral flows from surrounding higher-pressure areas in order to restore

equilibrium in the aquifer. The practical effect can be a generalized lowering of local water tables, causing existing wells in surrounding areas to dry up or to require their owners to expend extra energy pumping from greater depths. Alternatively, if groundwater is flowing laterally (for example, if groundwater recharge occurs predominantly from one direction: say, the mountains), then groundwater extraction can intercept recharge to the downflow side, with a comparable adverse impact on groundwater tables. By creating an exclusion right to groundwater, the 19<sup>th</sup> century California courts were for all intents and purposes providing the right for any landowner who wished to pump groundwater to inflict costs on his neighbors.

How do we interpret these courts' willingness to treat percolating groundwater in this way? As I documented previously, an important factor was the primitive state of scientific understanding of groundwater flows in the 19<sup>th</sup> century, which made it difficult for judges to assess when, or even if, groundwater pumping was in fact inflicting a third-party impact in any given instance.<sup>20</sup> Given this lack of scientific knowledge, it seems likely that judges adopted what seemed like appropriate analogies in the common law, treating groundwater like coal and other stationary sub-surface resources.<sup>21</sup>

The question of what did constitute a well-defined stream was confronted head-on toward the end of the century in *City of Los Angeles v. Pomeroy*, another case involving a diversion to the detriment of a groundwater interest. This may well have been the first case in California involving a well-defined underground stream, as the Court described it as a "pioneer case."<sup>22</sup> According to the Court, in order for there to be a well-defined stream, the groundwater had to "flow in known and well-defined channels, so as to constitute regular and constant streams."<sup>23</sup> Given that it did, maintained the Court, the plaintiff was entitled to sue to enjoin a diversion if it took place "under the same circumstances as would enable him to recover if the stream had been

wholly above ground.” Echoing *Hanson*, the Court again ruled that there was no legal distinction to be made between well-defined streams regardless of whether they were above or below the surface. In this case, and in sharp contrast to *Gould*, the Court enjoined the diversion, ruling that:

“[T]he defendants ha(d) no right to carry any of the waters of the Los Angeles river off of their riparian land for use on land not riparian, nor can they sell it for use on land not riparian; and all surplus waters must be turned back into the stream.” [Superior Ct. instruction VII, approved by Court. [City of LA v. Pomeroy, p. 621]

Thus, at the turn of the 20<sup>th</sup> century, the position of the California courts was sharply different on percolating and non-percolating groundwater, in essence because they were governed by completely different English common law doctrines. Percolating groundwater, defined as not part of a well-defined flow, was governed by the doctrine of absolute ownership. As a result, very few restrictions, including restrictions on exports from a groundwater basin, were imposed on how it could be developed and used. On the other hand, non-percolating groundwater, which was defined as occurring in a well-defined flow, was governed by riparian law, including its principle of appurtenance. During this early period, then, restrictions on exports of groundwater occurred in principle not as a way to mitigate third-party impacts. Rather, they occurred because according to riparian law, water was to be used for the benefit of the land through which it flowed.

#### IV. Katz v. Walkinshaw and its aftermath

The famous *Katz* ruling in 1902/03 is widely recognized as effecting a fundamental doctrinal change in the legal treatment of groundwater in California, but it needs to be stressed that the case only addressed percolating groundwater. In *Katz*, the plaintiff was a landowner who was pumping from an underlying aquifer to irrigate her lands, when the defendant came along and began pumping water for sale to others outside the aquifer. In the course of testimony,



it was established that the groundwater in question did not flow in well-defined channels and was therefore clearly percolating groundwater. Not surprisingly, the defendant, in justifying its extractions of groundwater to the detriment of the plaintiff, argued that California groundwater law was based on absolute ownership and thus, it had an unrestricted right to do as it pleased with the groundwater pumped from its land. Justice Temple, writing for the Court, disagreed with the defendant's position, ruling that groundwater use was subject to reasonable use restrictions. Thus, in *Katz* the California courts moved away from the principle of absolute ownership, for the first time imposing substantive governance restrictions on the use of percolating groundwater. Subsequent rulings upheld the new rule established by *Katz*.<sup>24</sup>

On the surface, *Katz* would seem to be a purely practical ruling, in which the courts were reacting to increased congestion, and increasingly frequent third-party impacts, in local aquifers. In this sense, the story appears to be very much in the tradition of early economic accounts of the evolution of property rights expounded by Demsetz and others who stress increasing resource value relative to enforcement costs and the internalization of externalities.<sup>25</sup> However, more precise analogies are provided by recent accounts that stress the importance of transaction costs in the evolution of legal rules. There are, for example, some striking parallels between this doctrinal shift in California groundwater law and previous developments in both eastern and western surface water law. Carol Rose has argued, for example, that the emergence of reasonable use restrictions on riparian water use in the eastern United States in the early 19<sup>th</sup> century may be interpreted as economizing on the transaction costs of negotiating over third-party impacts during a time period when eastern waterways were becoming increasingly congested.<sup>26</sup> Similarly, I have argued that the imposition of reasonableness restrictions on riparians in disputes with appropriators in late 19<sup>th</sup> century California also mirrors a similar

pattern of transaction costs.<sup>27</sup> The discussion so far seems to indicate that groundwater law in California assumed a very similar trajectory: reasonable use appeared when groundwater basins became increasingly congested, raising transaction costs among individual owners of negotiating over the third-party impact.

However, this essentially instrumentalist explanation ignores the doctrinal currents that governed surface water use at the time, as well as some fundamental holdings of the *Katz* ruling itself, and subsequent rulings governing percolating groundwater. While *Katz* took great pains to argue that the common law was highly malleable in adapting to different conditions, it is also clear that it considered there to be limits to its malleability. *Katz* blasted the absolute ownership doctrine for providing no protection for investments in groundwater development:

“[I]f the rule for which they[defendants] contend is the law, or no law, of the land, [defendants and others in a similar position] will be constantly threatened with danger of utter destruction of the valuable enterprises and systems of water-works which they control, and that all new enterprises of the same sort will be subject to the same peril. They will have absolutely no protection in law against others having stronger pumps, deeper wells, or a more favorable situation, who can thereby take from them unlimited quantities of the water, reaching to the entire supply, and without regard to the place / of use. We cannot perceive how a doctrine offering so little protection to the investments in and product of such enterprises, and offering so much temptation to others to capture the water on which they depend, can tend to promote developments in the future or preserve those already made, and, therefore, we do not believe that public policy or a regard for the general welfare demands the doctrine.” [Katz(Shaw), pp. 133-34]

However, it refused to take the logical next step of providing a secure property right for these investments, such as a priority rule. Instead, it fell back on what it recognized to be the second-best solution of reasonable use, arguing merely that it was better than the existing absolute ownership rule:

“The doctrine of reasonable use, on the other hand, affords *some* measure of protection to property now existing, and *greater* justification for the attempt to make new developments. It limits the right of others to such amount of water as may be necessary for some useful purpose *in connection with the land from which it is taken*. . . . So far as the active interference of others is concerned, therefore, the

danger to such undertakings is much less, and the incentive to development much greater, from the doctrine of reasonable use *than from the contrary rule.*” (Emphasis added)

Why did it stop here? The answer appears to be that it searched for and applied existing common law principles – namely, riparian law – to allocate rights to percolating groundwater. The analogy to riparian law is observed very clearly in this passage in the way that it invokes the appurtenance principle: that the extent of the right should be limited to the amount useful “in connection with the land from which it is taken.” Apparently, it felt constrained to apply the analogies of the common law, even if it meant less-than-secure property rights and the tying of groundwater to the lands from which it was taken.

The intellectual allegiance to riparian principles as applied to percolating groundwater is seen even more clearly in the 1909 case of *Hudson v. Dailey*. In *Hudson*, the plaintiff was a riparian allegedly damaged by groundwater pumping from water that fed the surface stream upon which the plaintiff relied. Unlike the plaintiff, the defendants were not in a position physically riparian to the stream, but the Court affirmed an appeals court ruling that they were entitled to reasonable use of the waters despite the fact that the plaintiff had established long-standing use.

“The owner of land has a natural right to the reasonable use of the waters percolating therein ... His ownership of the land carries with it all the natural advantages of its situation, and the right to a reasonable use of the land and everything it contains, limited only by the operation of the maxim *sic utere tuo ut alienum non laedas*. It is upon this principle that the law of riparian rights is founded, giving to each owner the right to use the waters of the stream upon his riparian land, but limiting him to a reasonable share thereof, as against other riparian owners thereon. We think the same application of the principle should be made to the case of percolating waters feeding the stream and necessary to its continued flow. *There is no rational ground for any distinction between such percolating waters and the waters in the gravels immediately beneath and directly supporting the surface flow, and no reason for applying a different rule to the two classes, with respect to such rights, if, indeed, the two classes can be distinguished at all.*” (Emphasis added)

In *Hudson*, then, we observe the convergence of the laws governing surface water and percolating groundwater, likely fueled by the increasing awareness by the courts that in terms of physical properties, groundwater and surface water were really not very different at all.

More evidence of the importance of surface water doctrine is provided by other aspects of the *Katz* ruling. Specifically, it is not widely recognized that *Katz* introduced an important temporal issue into California groundwater law. In *Katz*, the plaintiff landowner was present and already pumping prior to the diversions by the defendant exporter. Correlative rights, it argued, applied only to overlying landowners with respect to each others' rights. In contrast, when the landowner was already using the groundwater prior to a subsequent attempt to export, *Katz* ruled that the prior landowner enjoyed a right superior to that of the exporter:

“Under the decision in this case the rights of [landowners who have used water on their overlying lands prior to the exporter’s attempt to export] are paramount to that of one who takes the water to distant land; but the landowner’s right extends only to the quantity of water that is necessary for use on his land, and the appropriator may take the surplus.” [*Katz*(Shaw), pp. 135-36]

Thus, in disputes between exporters and prior landowners, *Katz* seemed to be describing some species of right based on first possession. Indeed, except for absence of specific quantification of the landowner’s right, the above passage reads very much like the landowner owned an appropriative right to underlying groundwater vis-à-vis any exporter who might come after. This language created some confusion at the time, leading some, including knowledgeable observers such as the eminent water lawyer Samuel Wiel, to conclude that the import of *Katz* was to apply first possession appropriative rights to percolating groundwater.<sup>28</sup>

It merits emphasis, however, that the right created by *Katz* was decidedly not an appropriative right. For one thing, as we have seen, the groundwater right created by *Katz* was not to a specific quantity but rather, was termed in vague language as the amount that was “necessary” for the overlying landowner. Elsewhere in the ruling, the *Katz* court made it clear

that what it meant by this was the amount that was put to reasonable use for some beneficial purpose.<sup>29</sup> Such a definition does not provide the tenure security of a quantified first-possession right. For another thing, the *Katz* ruling specified that the right of the overlying landowner was confined to the amount that was used on the land itself, which is a restriction that is not generally imposed on appropriative rights. Indeed, aside from the attention paid to the relative priorities of the parties in the above passage from *Katz*, the groundwater right it created had much of the character of a riparian right. Riparian law does not define quantities, requires water be used on adjacent lands, and over time has come to impose reasonableness limits on the individual right. The right of overlying landowners created by *Katz* contained all of these features.

Like many water rulings, *Katz* only ruled on the fact pattern at hand, where the landowner was first and the exporter came afterwards. It therefore did not take a position on the reverse fact pattern – where the overlying landowner was not first – leaving this question to future courts. This question was addressed five years later in *Burr v. Maclay*.<sup>30</sup> *Burr* was another percolating groundwater case that involved a complex set of circumstances including multiple tracts of land at various stages of groundwater development. However, on one of the tracts of land, the fact pattern of *Katz* was reversed: the exporter diverted prior to use by the landowner. On this point, the *Burr* court ruled that the exporter could take and use the water until such time as the landowner wished to start. At that point, however, the exporter would have to cut back and from then on, the landowner's right would be superior to that of the exporter.

I will argue shortly that of all the various possible fact patterns involving groundwater users, the ruling in *Burr* is the least susceptible to a straightforward interpretation, so let us examine the *Burr* court's reasoning more closely. The question is: Why should an exporter who is prior in time to a landowner have to lose its right to the groundwater when the landowner starts

using the water? He certainly would not have to under appropriative law, and under riparian law, the parties would be required to share. *Burr* argued in effect that the restriction was justified because the landowner had purchased his land with the expectation of being able to use the groundwater on the land, and that the groundwater was what gave the land its value:

“It appears from the findings that the existence of this underlying water was known ... and that the plaintiff bought his tracts ... because of its situation with respect to that water and relying upon said natural water supply and that without this water the land is of little value. Under these circumstances it does not seem reasonable or just to adopt a rule that would deprive the buyer of such land of the principal benefit of his purchase and the land of its chief element of value.”<sup>31</sup>

Thus, in *Burr*, we hear echoes of the riparian principle that water exists for the benefit of the land through which it flows.

One remaining temporal fact pattern concerns two claimants, each of whom wish to export groundwater from a local basin. *Katz* had discussed this issue, citing analogies to appropriations of surface water. However, as this fact pattern was not before the *Katz* court, this holding remained dictum until 1921, when a ruling was made, in *San Bernardino v. Riverside*. In this complex case, both parties were overlying landowners who wished to export groundwater to their respective cities for municipal use. The Court ruled that when the waters were not to be used on overlying lands, claimants were considered to be appropriators and disputes were to be resolved on the basis of temporal priority. Consequently, overlying land ownership conferred no special ownership status when the groundwater was not to be used on overlying lands:

“We understand the true rule to be that when a conflict arises between two appropriators of water, and their rights are otherwise equal, the prior appropriator will prevail so far as the conflict extends. It necessarily follows that in an action to quiet his title the prior appropriator is entitled to have his prior right declared to be superior to that of subsequent appropriators.” [San Bernardino v. Riverside]

This holding is, of course, precisely the rule governing appropriations of surface water, extended to include groundwater, which the courts had come to regard as no different from surface water in any essential respects.

By 1921, then, the Court had ruled on various fact patterns regarding percolating groundwater involving overlying landowners and exporters. The overall pattern of rulings is illustrated in Figure 4. There are several things to notice here. First, in disputes involving landowners where groundwater was not to be exported, the Court created allocation principles that had strong analogies in riparian law, especially appurtenance, non-quantification of right, and reasonable use. In effect, parties to disputes of this kind enjoyed something very much like riparian rights to the underlying groundwater. This set of rulings acted to unify groundwater law in the case of competing overlying users, making it largely irrelevant whether groundwater happened to be percolating or non-percolating. Second, in disputes involving exporters the Court applied temporal priority principles, creating a doctrine that for all intents and purposes decreed appropriative rights to groundwater. Here again, the courts adopted allocation principles found in existing surface water law to govern analogous groundwater conditions.

< Figure 4 about here >

It was in disputes between overlying landowners and exporters that we observe a perhaps surprising and less explicable pattern of rulings. When the landowner came first, the Court gave it priority, and the exporter had to take what was left over. As I have argued, there was not a perfect analogy here to an appropriative right for various reasons, but the emphasis on temporal priority nevertheless gave it the flavor of an appropriative right. On the other hand, when the exporter came first and the landowner was not using the water, the export was not denied, but it had to give way to the landowner's use if it was ever asserted. Both of these holdings thus came

down to the principle that the exporter was only entitled to whatever was available in surplus above and beyond the needs of landowners within the basin.

In order to understand these disputes over percolating groundwater between landowners and exporters, it should be recognized that these disputes had strong analogies in surface water disputes between riparians and appropriators, of which there was a long, rich history in California water law.<sup>32</sup> Beginning with a series of cases in the 1850's, a number of rulings involving a dispute between a riparian and an appropriator over the waters of a surface waterway established the following principles in the case of such disputes. Upstream appropriators were enjoined from diverting water to the detriment of a riparian landowner who had been present first. However, doing so was not actionable if the appropriator only diverted the surplus waters of the stream because, by definition, such diversions would not damage the riparians.<sup>33</sup> It will be recognized that the principle arrived at in *Katz* and followed in subsequent rulings closely mirrors this principle for groundwater.

Regarding disputes over surface water where the appropriator preceded the riparian, the courts appear to have favored the appropriator, except in cases where it was found that the appropriation was invalid because a beneficial use had not been made of the water.<sup>34</sup> This last instance, then, appears on the surface to comprise an asymmetry in the surface- and groundwater law treatments of this genre of dispute. However, it should be mentioned that the pattern of facts in the surface water cases I have managed to find are not completely analogous to that in *Burr v. Maclay*, in the following important sense. Recall that in *Burr*, even though the overlying landowner started using water after the exporter, it had established, in the eyes of the Court, credible intention to use the water prior to the arrival of the exporter. Given this, it seems sensible that the landowner was entitled to the same extent of groundwater right as if had



actually started using the groundwater first. On the other hand, it seems unlikely that the courts would uphold riparian surface water claims against prior appropriators, as doing so would provide all sorts of incentives for opportunistic behavior by riparian claimants.

Taken together, all of these holdings may be interpreted as having the effect of prioritizing the within-basin use of water, encouraging the water to stay where it was. When the exporter came first, the added consideration for the courts was apparently the value of promoting maximum usage of the available water. The courts were not about to stand in the way of exports of water for use when the alternative was that the water would remain in the basin, unused. Overall, however, exporters were heavily disadvantaged under this system of groundwater allocation principles. Whenever landowners were already present in a basin, exporters had to think twice before committing to investments in diversion facilities, knowing that their claims could be preempted at any time by increased use within the basin.

#### V: Conclusions

Like everyone else, judges are human and thus largely self-interested, and the recent generation of models of judges as rational actors have been fruitful in providing rich predictions both for how judges will behave under various conditions and the consequences of that behavior both for the law and for judicial procedure. In the process, a key component of the common-law tradition – precedent – has come to assume more of the flavor of an instrument of economizing behavior rather than a constraint on that behavior. This paper adds to the discussion of the role of precedent in judicial decision-making by bringing back the traditional conception of precedent as constraint and modelling judges as operating with varying degrees of freedom in the face of that constraint, depending upon the richness and complexity of available doctrine. Under certain conditions, such as obtained in early 20<sup>th</sup> century groundwater law in California, the availability

of alternative governing principles can act to effectively ease the constraint of precedent, leaving more room for judges to pursue their objectives. In California, it was possible to trace this evolution by observing the emergence of new scientific understanding of groundwater flows and the associated convergence of surface- and groundwater law.

It should be noted that the result of all this was a movement toward a common set of principles governing surface- and groundwater, not necessarily efficient law governing both. The analogies to surface water provided by the new scientific understanding moved groundwater law in that direction but no further: it did not eliminate certain inherent inefficiencies in both doctrines, such as favoring landowners over exporters, which effectively tied rights to the originating basins. At the time, this may not have made much difference in terms of efficiency but over time, perpetuating this principle carried the potential for major inefficiencies, to the extent that high-value water use activities subsequently migrated to other sectors and geographic areas.

It is useful to note the distinction between what occurred in California and the predictions of standard economic models of property rights evolution in the tradition of Harold Demsetz, Terry Anderson and P.J. Hill, and others. In these standard models, property rights to a resource become increasingly individualized and well-defined as its value increases, its use generates greater external impacts, and property rights become less costly to enforce. In the case of early California groundwater law, all of these things were arguably occurring but the court response was not to create individualized property rights in groundwater but rather, to draw analogies to existing doctrine. This speaks to the power of precedent as a mediating factor in the evolution of new property rights.

The evidence presented here also speaks to a longstanding debate among legal scholars over the appropriate economic interpretation of changes in water law over time. On the one hand, some legal scholars have emphasized the long-term continuity of the common law, stressing the importance to judges of being consistent with received doctrine.<sup>35</sup> On the other hand, others have emphasized the extreme malleability of the common law in responding to changing economic conditions.<sup>36</sup> Under this view, water law develops in response to changes in economic conditions and may evolve in such a way that supports improved water allocation. The early-20<sup>th</sup> century experience of groundwater law suggests that economic change matters, particularly when it generates clear and demonstrable third-party impacts in the use of groundwater. At the same time, the particular changes in groundwater law that were set in place occurred within a doctrinal framework using established, longstanding allocation principles. Thus, the overall sense could easily be one of legal continuity, when the changes were occurring in response to practical instrumentalist factors, including changing economic conditions and advances in scientific understanding.

The role of scientific advance is likely to be pertinent in understanding subsequent developments in groundwater law in California after the period investigated here, as well as elsewhere. Some recent studies have concluded that in many jurisdictions, current groundwater law reflects a fundamental misunderstanding of groundwater hydrology. This fact has resulted in some states, including California, treating groundwater and surface water as hydrologically unrelated.<sup>37</sup> This conclusion obviously does not comport with the story told here, where judges were highly cognizant of the connection and parallels between surface water and groundwater flows and consciously incorporated this understanding into their rulings. Future research will

investigate how and why this legal distinction between surface water and groundwater law emerged in California.

Figure 1: Effect of precedent on rule-making

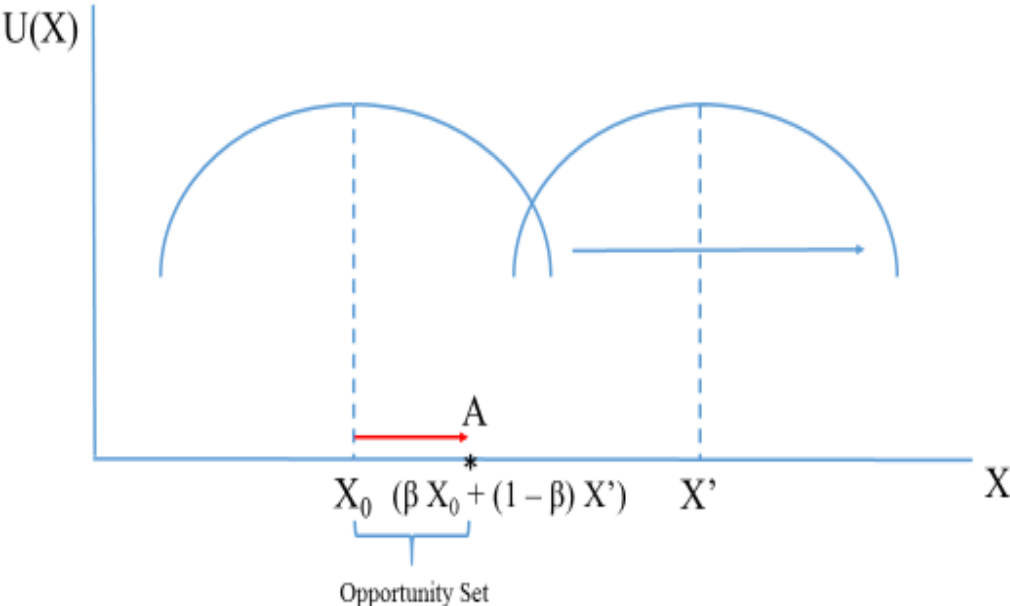


Figure 2: Effect of precedent, two unrelated resources

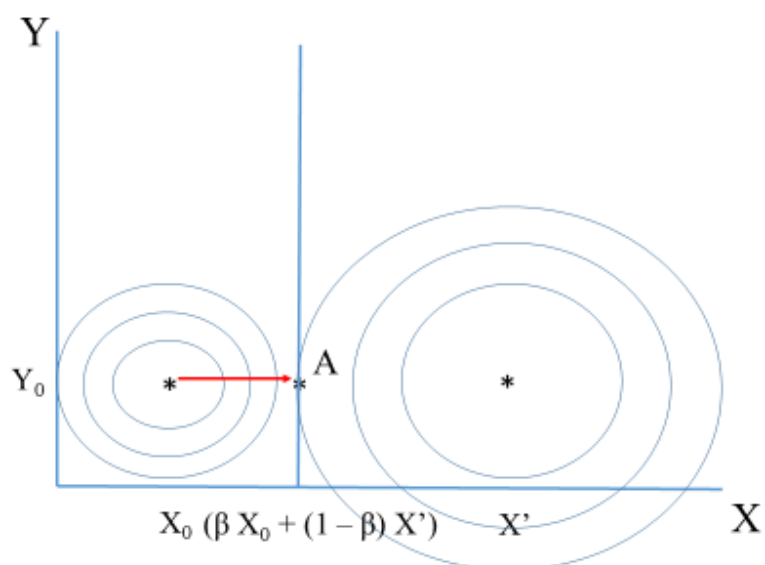


Figure 3: Effect of precedent, two related resources

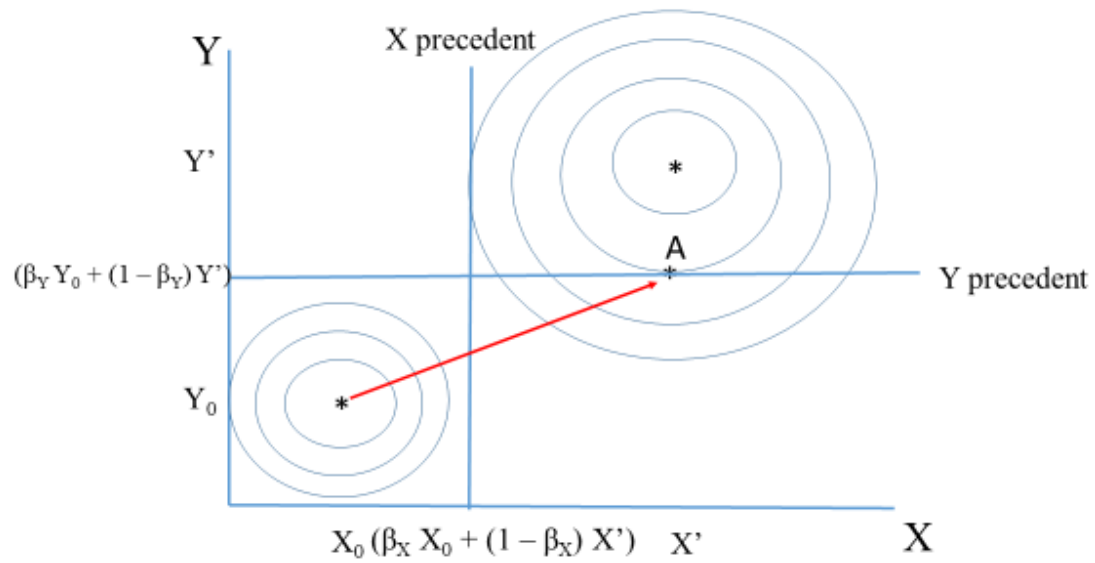
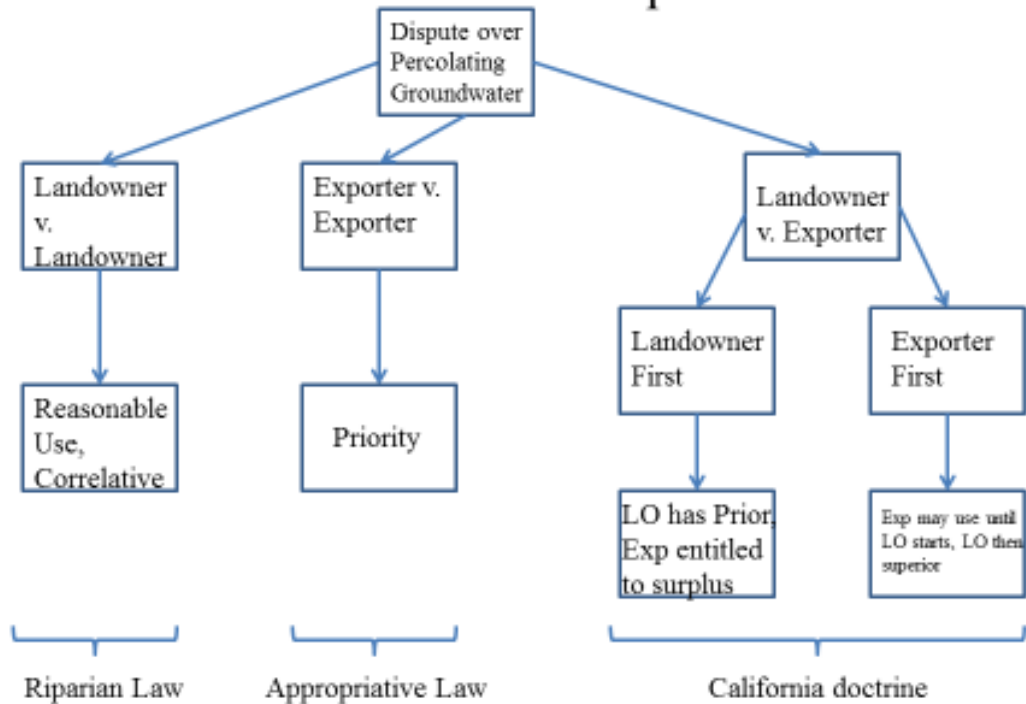


Figure 4: Katz and its Progeny:  
Groundwater Disputes



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<sup>1</sup> See, for example, William E. Nelson, *Changing Conceptions of Judicial Review*, 120 U. Penn. L. Rev. (1972); Morton J. Horwitz, *The Transformation of American Law, 1780 – 1860* (Cambridge: Harvard University Press, 1977);

<sup>2</sup> For a representative sample of the new view, see Richard S. Higgins and Paul H. Rubin, *Judicial Discretion*, 9 J. Leg. Stud. 129 (1980); Richard A. Posner, "What do Judges and Justices Maximize? 3 Sup. Ct. Ec. Rev. 1 (1993); Matthew C. Stephenson, *Legal Realism for Economists*, 23 J. Econ. Persp. (2009); Epstein, Lee; William M. Landes; and Richard A. Posner, *The Behavior of Federal Judges* (Cambridge: Harvard University Press, 2013).

<sup>3</sup> Epstein et al., *supra* note 2.

<sup>4</sup> William M. Landes and Richard A. Posner, *Legal Precedent: A Theoretical and Empirical Analysis* 19 J. Law Econ. 249 (1976); Frederick Schauer, *Precedent*, 39 Stan. L. Rev. 571 (1987); Ethan Bueno de Mesquita and Matthew C. Stephenson, *Informative Precedent and Intrajudicial Communication*, 96 Am. Pol. Sci. Rev. 755 (2002)]

<sup>5</sup> See, for example, Matthew C. Stephenson, *supra* note 2. 191, 204. A related literature has argued that new rulings can serve either to increase or decrease legal uncertainty over the content of existing legal doctrine. See Benjamin Klein, *Legal Precedent: Comment*, 19 J. Law Econ. 309 (1976). And increased legal uncertainty is predicted to lead to greater litigation at the expense of out-of-court settlement, thus bringing more opportunities before judges to craft new legal content. See, for example, George L. Priest, *Selective Characteristics of Litigation*, 9 J. Leg. Stud. 399 (1980).

<sup>6</sup> See also Nicola Gennaioli and Andrei Shleifer, *The Evolution of Common Law*, 115 J. Pol. Econ. 43 (2007); Epstein et al., *supra* note 2.

<sup>7</sup> The argument is thus about judge decision-making and its implications for the substantive content of the law, as opposed to the vast scholarly literature that explores the connection between judge decision-making and the efficiency of the law. The two are of course not unrelated, as there may be efficiency advantages in the law treating similar issues as doctrinally similar; namely, governed by similar legal principles. On the efficiency of the common law, see for example Paul Rubin, *Why is the Common Law Efficient?* 6 J. Leg. Stud. 51 (1977); George Priest, *The Common Law Process and the Selection of Efficient Rules*, 6 J. Leg. Stud. 65(1977); Gillian Hadfield, *Bias in the Evolution of Legal Rules*, 80 George. L. Rev. 583(1992); Richard A. Posner, *Economic Analysis of Law*, 6<sup>th</sup> ed. (New York: Aspen Publishers, 2003); Gennaioli and Shleifer, *supra* note 6; Thomas J. Miceli, *Legal Change: Selective Litigation, Judicial Bias, and Precedent*, 38 J. Leg. Stud. 157 (2009); Epstein et al., *supra* note 2.

<sup>8</sup> Schauer, *supra* note 4.

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<sup>9</sup> Penn Law Review, *Impact of Medical Knowledge*, at 556.

<sup>10</sup> Mark T. Kanazawa, *Origins of Common-Law Restrictions*, 32 J. Leg. Stud 153 (2003)

<sup>11</sup> See Morse, *Immaturity and Irresponsibility*, 88 J. Crim. L. Crimin. 15, at 16 (1997); Emily Buss, *The Gap in Law between Developmental Expectations and Educational Obligations*, 79 U. Chi. L. Rev. 59(Winter 2012).

<sup>12</sup> See also Buena de Mesquita and Stephenson, *supra* note 4.

<sup>13</sup> In the context of water rights, an example would be increasing congestion in a river or aquifer, leading a judge to wish to impose restrictions on free exercise of an individual right.

<sup>14</sup> These results are derived from the standard Kuhn-Tucker conditions for optimization. As drawn in Figure 1, precedent would be binding on the judge.

<sup>15</sup> As before, the precedent constraint would only be non-binding with sufficiently small  $\beta$ 's and/or sufficiently large opinion-writing costs.

<sup>16</sup> Brian E. Gray, *The Modern Era in California Water Law*, 45 Hast. L. J. 249, at 257 (1994). For examples of the treatment of reasonable use in early California water law, see *Lux v. Haggin*, 69 Cal 255 (1886); *Heilbron v. 76 Land and Water Company*, 80 Cal 189 (1889).

<sup>17</sup> See, for example, Mark T. Kanazawa, *Efficiency in Western Water Law: The Development of the California Doctrine*, 27 J. Leg. Stud. 157 (1998)

<sup>18</sup> *Hanson v. McCue*, 42 Cal 303, at 308 (1871).

<sup>19</sup> See, for example, *Cross v. Kitts*, 69 Cal 217 (1886); *City of Los Angeles v. Pomeroy*, 124 Cal 597(1899).

<sup>20</sup> Kanazawa, *supra* note 10; See also Thomas H. Bruggink, *Third Party Effects of Groundwater Law in the United States: Private versus Common Property*, 51 Amer. J. Econ. & Soc. 1, at 3 (January 1992).

<sup>21</sup> This would be consistent with the interpretation that they were economizing on information costs, applying existing rules to new conditions that appeared substantively similar to previous conditions. See Martin Shapiro, *Toward a Theory of Stare Decisis*, 1 J. Leg. Stud. 125 (1972); Ronald A. Heiner, *The Origin of Predictable Behavior*, 73 Am. Econ. Rev. 560 (1983); Stephenson, *supra* note 2.

<sup>22</sup> *City of Los Angeles v. Pomeroy*, *supra* note 13, at 633.

<sup>23</sup> *Ibid.*, at 633-34.

<sup>24</sup> See, for example, *Cohen v. La Canada*, 143 Cal 437(1904); *Hudson v. Dailey*, 156 Cal 617(1909); *Miller v. Bay Cities*, 157 Cal 256(1910).

<sup>25</sup> Harold Demsetz, *Toward a Theory of Property Rights*, 57 Am. Econ. Rev. 347 (1967); Terry L. Anderson and Peter J. Hill, *The Evolution of Property Rights: A Study of the American West*, 18 Journal of Law and Economics 163 (1975).

<sup>26</sup> Carol M. Rose, *Energy and Efficiency in the Realignment of Common-Law Water Rights*, 19 J. Leg. Stud. 261 (1990).

<sup>27</sup> Mark T. Kanazawa, *Efficiency in Western Water Law: The Development of the California Doctrine, 1850-1911*, 27 J. Leg. Stud. 159 (1998).

<sup>28</sup> "These cases [*Katz*, *Cohen*, *McClintock*] apply to percolating water the rule of priority as in the case of other appropriations. Prior claimants to the percolating water, either as appropriators or as occupants of overlying land, must be protected first, and consequently an appropriation thereof will seldom be possible except in the most sparsely settled neighborhoods, where large regions are still unoccupied public land." See Samuel C. Wiel, *Water Rights in the Western States*, at 131 (San Francisco: Bancroft-Whitney, 1905).

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<sup>29</sup> See also William Blomquist, *Dividing the Waters: Governing Groundwater in Southern California* at 65 (San Francisco: ICS, 1992).

<sup>30</sup> *Burr v. Maclay Rancho*, 154 Cal 428 (1908).

<sup>31</sup> *Ibid.*, at 436.

<sup>32</sup> The landmark 1855 case of *Irwin v. Phillips*, which is generally regarded as having established appropriative law in the state, actually involved a dispute between an appropriator and a competing riparian claimant. *Irwin v. Phillips*, 69 Cal 255 (1886)

<sup>33</sup> See, for example, *Edgar v. Stevenson* 70 Cal 286 (1886); *Lux v. Haggin*, *supra* note 26.

<sup>34</sup> *Peregoy v. McKissick* 79 Cal 572 (1889); *Barrows v. Fox* 98 Cal 63 (1893); *Vernon Irrigation Co. v. Los Angeles*, 106 Cal 237 (1895).

<sup>35</sup> Joshua Getzler, *A History of Water Rights at Common Law* (Oxford: Oxford University Press, 2004).

<sup>36</sup> Brian E. Gray, *supra* note 16.

<sup>37</sup> Gary Weatherford; Kim Malcolm; and Barbara Andrews, *California Groundwater Management: The Sacred and the Profane*, 22 Nat. Res. J. 1031, at 1033 (October 1982); Marc Reisner and Sarah Bates, *Overtapped Oasis: Reform or Revolution for Western Water*, at 64 (Washington: Island, 1990); Robert Glennon. *Water Follies: Groundwater Pumping and the Fate of America's Fresh Waters* (Washington: Island Press, 2002).