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BEFORE THE DEPARTMENT OF WATER RESOURCES

OF THE STATE OF IDAHO

IN THE MATTER OF SYLTE'S PETITION FOR DECLARATORY RULING RE DISTRIBUTION OF WATER TO WATER RIGHT NO. 95-0734	Docket No. P-DR-2017-001 **SYLTE'S REPLY MEMORANDUM IN SUPPORT OF MOTION FOR SUMMARY JUDGMENT**

Gordon Sylte, Susan Goodrich, John Sylte, and Sylte Ranch Limited Liability Company (collectively, "Sylte"), by and through their counsel of record, Givens Pursley LLP, hereby submit this reply to *Clark's Response to Sylte's Motion for Summary Judgment* ("*Clark's Response*") filed July 6, 2017, and in support of *Sylte's Motion for Summary Judgment* and *Sylte's Memorandum in Support of Motion for Summary Judgment* (together, "*Sylte's Motion*") filed June 23, 2017.[1]

Clark's Response does not raise any issue of material fact, and Clark's interpretation of the *Decree* is both unreasonable and unsupported by Idaho law. Because the *Instructions* incorrectly interpret the *Decree* and misapply Idaho's Prior Appropriation Doctrine, Sylte is entitled to judgment as a matter of law as requested in *Sylte's Motion*.

[1] Unless otherwise indicated, defined terms used in this memorandum have the same meanings as in *Sylte's Motion*, which is hereby incorporated by reference.

I. ARGUMENT

A. Water right no. 95-0734's senior priority entitles it to the pre-dam natural flow in Rathdrum Creek.

Contrary to Clark's claim that Sylte is attempting "to circumvent" the *Decree* and Idaho's Prior Appropriation Doctrine, *Clark's Response* at 1, Sylte simply seeks compliance with both.

In a nutshell, Clark contends that the *Decree* and Idaho's Prior Appropriation Doctrine require that the outflow of water from Twin Lakes to satisfy Sylte's water right no. 95-0734 be limited to the amount of natural tributary inflow into Twin Lakes, unaffected by Twin Lakes' evaporation and seepage. As explained in *Sylte's Motion*, that is not the case. Sylte is entitled to the natural, pre-dam outflow to Rathdrum Creek irrespective of inflow to Twin Lakes or evaporation and seepage affecting Twin Lakes—an amount that Judge Magnuson found was always sufficient to satisfy water right no. 95-0734 on a continuous year-round basis.

Specifically, Judge Magnuson expressly found that water was available in Rathdrum Creek "at all times" when water right no. 95-0734 was created in 1875 such that "there was sufficient direct flow water in Rathdrum Creek, in its then natural condition, furnished from the water of Twin (Fish) Lakes, to provide .07 cubic foot per second to the appropriator on a continuous year-round basis." *Memorandum Decision* at 11.

Judge Magnuson further stated:

> An appropriator is entitled to maintenance of stream conditions substantially as they were at the time the appropriators made their appropriation, if a change in stream conditions would result in interference with the proper exercise of the right. Bennett v. Nourse, 22 Ida. 249, 125 P. 1038 (1912). At the time the appropriation (No. 95-0734) was made in 1875, there was *always* water in Rathdrum Creek to serve said water right.
>
> The holders of water right #95-0734 are therefore entitled to waters from the source of their appropriation on a basis of priority over those storage rights Nos. 95-0974 and 95-0975. The waters of this basin are to be administered in such manner as to give effect to such priority.

> This Court concludes the rights of *all the other Objectors* are limited to the natural tributary inflows to Twin Lakes, less evaporation and seepage from Twin Lakes.

Memorandum Decision at 13 (italics added).

Clark does not explain how these statements can be reasonably interpreted to mean that water right no. 95-0734 is limited to the natural tributary inflows to Twin Lakes. Of course, he cannot. These statements clearly provide that (a) the holders of water right no. 95-0734 are entitled to water "on a basis of priority" over the 1906 Storage Rights, and (b) the rights of all other objectors (which are junior to the 1906 Storage Rights) "are limited to the natural tributary inflows to Twin Lakes, less evaporation and seepage." If Judge Magnuson had wanted to limit water right no. 95-0734 to Twin Lakes' natural tributary inflows he would have said so as he clearly did for all junior rights. But he didn't. He said "other" water rights are so limited.

Clark suggests that Judge Magnuson intended to limit water right no. 95-0734 to natural tributary inflow, but excuse it from evaporation and seepage. *Clark's Response* at 5-8. This makes no sense. The "rights of all the other Objectors"—which are junior to the 1906 Storage Rights—are limited to natural tributary inflows less evaporation and seepage because, otherwise, they would be diverting stored water for which they hold no rights. These junior rights are appropriately limited to natural tributary inflow, less evaporation and seepage, because they were appropriated after the 1906 Storage Rights (and construction of the manmade dam and outlet structure) came into existence. Once the 1906 Storage Rights were appropriated, the only unappropriated water was Twin Lakes' natural tributary inflow. But, before it becomes outflow to Rathdrum Creek, that inflow resides in the artificially retained waters of Twin Lakes, where it is subject to evaporation and seepage. If these junior rights were entitled to the natural tributary inflow without any deduction for evaporation and seepage, they would be using stored water.

Water right no. 95-0734, on the other hand, by virtue of being appropriated prior to the 1906 Storage Rights and construction of the manmade dam and outlet structure, is not subject to either the natural tributary inflow or the evaporation and seepage limitations. Judge Magnuson found that "[t]he water level of Twin Lakes and the vegetation lines around the lakes were relatively the same, both before and after the construction of the dam [in 1906]. The primary result the dam had on the water level was to hold the water at a higher point longer through the summer months . . . ." *Memorandum Decision* at 10.[2] In other words, there is no more water artificially stored in Twin Lakes than was naturally stored prior to 1906. Also, in other words, prior to 1906 the natural lake level lowered faster than after 1906.

If, before 1906, Twin Lakes reached the same maximum level as after 1906 but the level dropped faster than it did after 1906, where did the pre-1906 water go? Clearly, it went down Rathdrum Creek—"the only outlet from the lakes." *Memorandum Decision* at 9.[3]

Basic hydrology tells us that storage decreases if inflow is less than outflow. Likewise, storage increases if inflow is greater than outflow. In short, "the rate of change of storage is the difference between the rate of inflow and the rate of outflow." Luna B. Leopold & Walter B. Langbein, A PRIMER ON WATER ("*A Primer on Water*"), US DEP'T OF INTERIOR GEOLOGICAL

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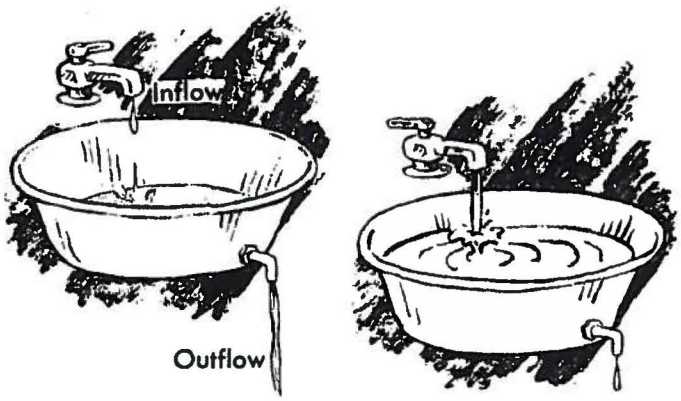
[2] Clark incorrectly states that "[t]he natural obstruction (pre-dam) naturally held water up to the 10'4" gauge on the lake." *Clark's Response* at 13 (emphasis added). *See also Clark's Response* at 14 ("at the time 95-0734 was created in 1875, the natural obstruction of Lower Twin Lakes held in the natural storage waters at 10'4"."); *Clark's Response* at 15 (asserting that Twin Lakes "stayed at or around the 10'4" mark"). These statements are directly contrary to Judge Magnuson's finding that, while water reached "relatively the same" level prior to and after dam construction, it was not held at that level prior to dam construction.

[3] There is no evidence or reason to believe that evaporation or seepage (other than seepage "through the natural pre-dam obstruction, forming the source waters of Rathdrum Creek," *Memorandum Decision* at 11) was the reason Twin Lakes' water levels dropped faster prior to the dam construction than after.

SURVEY, at 22 (1960).[4] The following illustration from *A Primer on Water* depicts this elementary principle:



A Primer on Water at 22.

Thus, Judge Magnuson's finding that Twin Lakes' water level dropped (*i.e.*, natural storage decreased) faster during the summer months before the 1906 dam was constructed means that, prior to 1906—when Rathdrum Creek flowed "at all times" so that it "always" had water to serve water right no. 95-0734 "on a continuous year-round basis"—the natural outflow from Twin Lakes during those periods was greater than the natural inflow. In other words, the water that naturally filled and was temporarily stored in Twin Lakes prior to 1906 gradually drained out to Rathdrum Creek during the summer months, lowering the lake levels. *See A Primer on Water* at 22 ("[T]he outflow does not stop at the same moment that the inflow ceases. . . . After the tributary inflow stops, that water which is in transit . . . gradually drains out."). Had lake levels naturally remained the same through the summer months, outflows would have equaled inflows (as Clark suggests). According to Judge Magnuson, however, they dropped during the

[4] *A Primer on Water* is available online at https://pubs.usgs.gov/gip/7000045/report.pdf. An excerpt of its section on "River Channels and Floods," which includes the illustration in the main text, is attached hereto as Addendum A.

summer months, which means the outflows sufficient to always fill water right no. 95-0734 must have exceeded Twin Lakes' inflows at such times. Accordingly, Twin Lakes' natural tributary inflow is not a limitation on the exercise of water right no. 95-0734.

Of course, evaporation and seepage also do not limit the water available to water right no. 95-0734 because, whatever the amount of natural outflow was when Rathdrum Creek flowed "at all times" so that it "always" had water to serve water right no. 95-0734 "on a continuous year-round basis," it already was experiencing any influences of evaporation and seepage occurring in the natural, pre-dam Twin Lakes (and Rathdrum Creek, for that matter).

In short, water right no. 95-0734 is senior to the 1906 Storage Rights, and is entitled to the pre-dam conditions in Twin Lakes and Rathdrum Creek, when Rathdrum Creek naturally flowed "at all times" so that it "always" had water to serve water right no. 95-0734 "on a continuous year-round basis." All of the water in Twin Lakes was natural lake storage prior to dam construction. *Decree* at xv-xvi (Finding of Fact No. 10).[5] Prior to dam construction, this water "flowed over the top of the lip at periods of high water and through the natural pre-dam obstruction at all times, forming the source waters of Rathdrum Creek." *Memorandum Decision* at 11. Thus, prior to dam construction, water was not held in Twin Lakes for as long during the summer months. *Id.* at 10. Rather, the water in Twin Lakes naturally flowed out into Rathdrum Creek, such that it supplied water to water right no. 95-0734 "on a continuous year-round basis." *Id.* at 11.

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[5] Finding of Fact No. 10 in *Amended Proposed Finding* attached to the *Decree* describes three "blocks" of water in Twin Lakes. The first "block" of water, which has no associated water right, is "the natural lake storage located between the bottom of the lake and Staff Gauge height 0.0 feet . . . ." *Decree* at xv (Finding of Fact No. 10.a). The second and third "blocks" of water, which are associated with storage right nos. 95-0974 and 95-0973, also were "at one time part of the natural lake storage, but [were] made available for appropriation by excavation of the outlet from Lower Twin Lakes," and are located between Staff Gauge heights 0.0 and 6.4 feet, and between heights 6.4 and 10.4 feet, respectively. *Decree* at xv-xvi (Finding of Fact No. 10.b and 10.c).

B. Idaho Supreme Court precedent prevents juniors from interfering with the natural flow appropriated by seniors.

Judge Magnuson's conclusion that the water right no. 95-0734 is entitled to water "on a basis of priority" over the 1906 Storage Rights, and his express admonition that "[t]he waters of this basin are to be administered in such manner as to give effect to such priority," are consistent with long-standing Idaho Supreme Court precedent.

For example, in *Carey Lake Reservoir Co. v. Strunk*, 39 Idaho 332, 227 P. 591, 593 (1924)—a case cited by Judge Magnuson in the *Memorandum Decision* at 14-15—the Idaho Supreme Court agreed with the downstream senior's argument that "by virtue of being prior appropriators, they had the right to have at least the quantity of water to which they were entitled flow down to them uninterrupted, and that, if this flow were interfered with by respondent's dam, they had a right to themselves cut the dam, to such an extent as to allow them to obtain their water . . . ."

In *Weeks v. McKay*, 85 Idaho 617, 622, 382 P.2d 788, 791 (1963), the Court held that "[o]ne who undertakes to change the natural channel of a stream or by means of dams or otherwise increases or diminishes the flow of a stream must exercise care in so doing and take such precautions as to prevent injury to others." The junior priority defendant in *Weeks* constructed a dam upstream of the senior priority plaintiff. The *Weeks* Court ordered that the junior defendant's dam was required "to permit the same amount of water to escape from the lake and proceed down [the creek] to [plaintiff's] diversion point as would occur if its channel had remained unchanged." *Weeks*, 85 Idaho at 623-24, 382 P.2d at 791-92.

Citing *Weeks*, the Court in *Ward v. Kidd*, 87 Idaho 216, 392 P.2d 183 (1964), held that an upstream junior dam owner could not "obstruct the flow" when "the water, if unobstructed, would reach [the downstream senior's] land . . . ." *Ward*, 87 Idaho at 226, 392 P.2d at 189-90.

The *Weeks* Court held that the downstream senior "was entitled to have it flow uninterrupted." *Id.* at 226, 392 P.2d at 189. The *Weeks* Court also remarked that the senior's rights to use the water "were valuable rights. The law cannot countenance the invasion of a right merely because it is small. The holder of such a right is entitled to its protection to the same extent as if it were of greater magnitude." *Id.* at 227, 392 P.2d at 190.

In short, Idaho law simply does not give an upstream junior water user the right to take a downstream senior's natural flow. I.C. § 42-106 ("As between appropriators, the first in time is first in right."). But that is what Clark argues is required here—that the 1906 Storage Rights are entitled to the "continuous year-round" natural flow that "at all times" was in Rathdrum Creek and "always" was available to serve water right no. 95-0734. *Memorandum Decision* at 11, 13. That position clearly conflicts the *Decree* and Idaho's Prior Appropriation Doctrine. Water right no. 95-0734 is entitled to the natural flow of water available at the time of its appropriation which Judge Magnuson found was not limited to Twin Lakes' natural tributary inflow.

Judge Magnuson correctly found that "[a]n appropriator is entitled to maintenance of stream conditions substantially as they were at the time the appropriators made their appropriation, if a change in stream conditions would result in interference with the proper exercise of the right." *Memorandum Decision* at 13 (citing *Bennett v. Nourse*, 22 Ida. 249, 125 P. 1038 (1912)). He also found that, when water right no, 95-0734 was appropriated, it received 0.07 cfs of water "on a continuous and year-round basis." *Decree* at xvii (Finding of Fact No. 20). Although Judge Magnuson limited other water rights to Twin Lakes' natural tributary inflow, he did not so limit water right no. 95-0734.

C. Water right no. 95-0734 is protected from injury by juniors and from changes to the natural conditions present in 1875.

Clark contends that changes to Twin Lakes' and Rathdrum Creek's natural conditions—aside from the construction of the dam and outlet structure—has reduced Twin Lakes' natural tributary inflow from what it was in 1875. *Clark's Response* at 12-17. There is no evidence in the record to support these assertions. Even if such evidence existed, however, it would be irrelevant to water right no. 95-0734, which as discussed in not limited to Twin Lakes' natural tributary inflow.

In any case, Clark's argument fails to recognize the priority system. He essentially argues that alleged changed hydrologic conditions must result in reduced quantities delivered to senior water rights. This is a fundamental misunderstanding of Idaho's Prior Appropriation Doctrine, which in times of scarcity requires that seniors receive their water rights before juniors. I.C. § 42-106 ("As between appropriators, the first in time is first in right."). *See also Moe v. Harger*, 10 Idaho 302, 77 P. 645, 647 (1904) ("So soon as the prior appropriation and right of use is established, it is clear, as a proposition of law, that the claimant is entitled to have sufficient of the unappropriated waters flow down to his point of diversion to supply his right, and an injunction against interference therewith is proper protective relief to be granted.").

Clark asserts that water right no. 95-0734 "does not come with an implied promise or guarantee of year-round water." *Clark's Response* at 9. Perhaps not, to the extent that climatic or hydrologic conditions, such as drought, render the water supply insufficient to supply any water to any water rights. But, as between water right no. 95-0734 and other water rights (all of which are junior), its senior priority date does guarantee that it will be the first and last water right to receive water when supply gets scarce.

Idaho law could not be clearer or more consistent on this point: "Priority of appropriation shall give the better right as between those using the water." Idaho Const. art. 15 § 3. "The rule in this state, both before and since the adoption of our constitution, is . . . that he who is first in time is first in right." *Joyce Livestock Co. v. United States*, 144 Idaho 1, 8, 156 P.3d 502, 509 (2007) (quoting *Brossard v. Morgan*, 7 Idaho 215, 219–20, 61 P. 1031, 1033 (1900)). "Each junior appropriator is entitled to divert water only at such times as all prior appropriators are being supplied under their appropriations under conditions as they existed at the time the appropriation was made." *Beecher v. Cassia Creek Irr. Co.*, Inc., 66 Idaho 1, 12, 154 P.2d 507, 510 (1944). "This court has uniformly adhered to the principle, announced both in the Constitution and by the statute, that the first appropriator has the first right; and it would take more than a theory, and in fact clear and convincing evidence, in any given case, showing that the prior appropriator would not be injured or affected by the diversion of a subsequent appropriator, before we would depart from a rule so just and equitable in its application, and so generally and uniformly applied by the courts." *Silkey v. Tiegs*, 54 Idaho 126, 28 P.2d 1037, 1038 (1934) (quoting *Moe v. Harger*, 10 Idaho 302, 77 P. 645, 647 (1904)).

Scarcity is not really the issue here. There is plenty of water to satisfy water right no. 95-0734. Clark simply wants Twin Lakes to remain as close as possible to the 10'4" gauge level, *Clark's Response* at 33, even though in 1875 all the water below that level "form[ed] the source waters for Rathdrum Creek" and supplied water right no. 95-0734 "on continuous year-round basis." *Memorandum Decision* at 11. Clark holds no storage right in Twin Lakes. The only two storage rights are the 1906 Storage Rights. *Memorandum Decision* at 15. Both are junior to water right no. 95-0734, which Judge Magnuson expressly held is "entitled to waters from the

source of [its] appropriation on a basis of priority over [the 1906 Storage Rights]." *Memorandum Decision* at 13.

There is no justification for diminishing water right no. 95-0734's priority for the benefit of the 1906 Storage Rights (or any other junior water right). A water right is a valuable property right entitled to protection under the law. As the Idaho Supreme Court has stated:

> "When one has legally acquired a water right, he has a property right therein that cannot be taken from him for public or private use except by due process of law and upon just compensation being paid therefor." *Bennett v. Twin Falls North Side Land & Water Co.*, 27 Idaho 643, 651, 150 P. 336, 339 (1915). "Priority in time is an essential part of western water law and to diminish one's priority works an undeniable injury to that water right holder." *Jenkins v. State, Dept. of Water Resources*, 103 Idaho 384, 388, 647 P.2d 1256, 1260 (1982). When there is insufficient water to satisfy both the senior appropriator's and the junior appropriator's water rights, giving the junior appropriator a preference to the use of the water constitutes a taking for which compensation must be paid. *Montpelier Milling Co. v. City of Montpelier*, 19 Idaho 212, 219, 113 P. 741, 743 (1911); Idaho Const. Art. XV, § 3.

Clear Springs Foods, Inc. v. Spackman, 150 Idaho 790, 797–98, 252 P.3d 71, 78–79 (2011). There is no room for discretion here. The Department "must follow the law." *A & B Irrigation Dist. v. State*, 157 Idaho 385, 393, 336 P.3d 792, 800 (2014).

II. CONCLUSION

As set forth above and in *Sylte's Motion*, Sylte contends that there is only one reasonable interpretation of the *Decree*—that water right no. 95-0734 is not limited to Twin Lakes' natural tributary inflows. *Clark's Response* fails to raise any genuine issue of material fact as to the interpretation to the *Decree*. Sylte is entitled to judgment as a matter of law. Sylte respectfully requests the relief requested in *Sylte's Motion*.

Respectfully submitted this 13th day of July, 2017.

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CERTIFICATE OF SERVICE

I hereby certify that on this 13th day of July, 2017, I caused to be served a true and correct copy of the foregoing by the method indicated below, and addressed to the following:[6]

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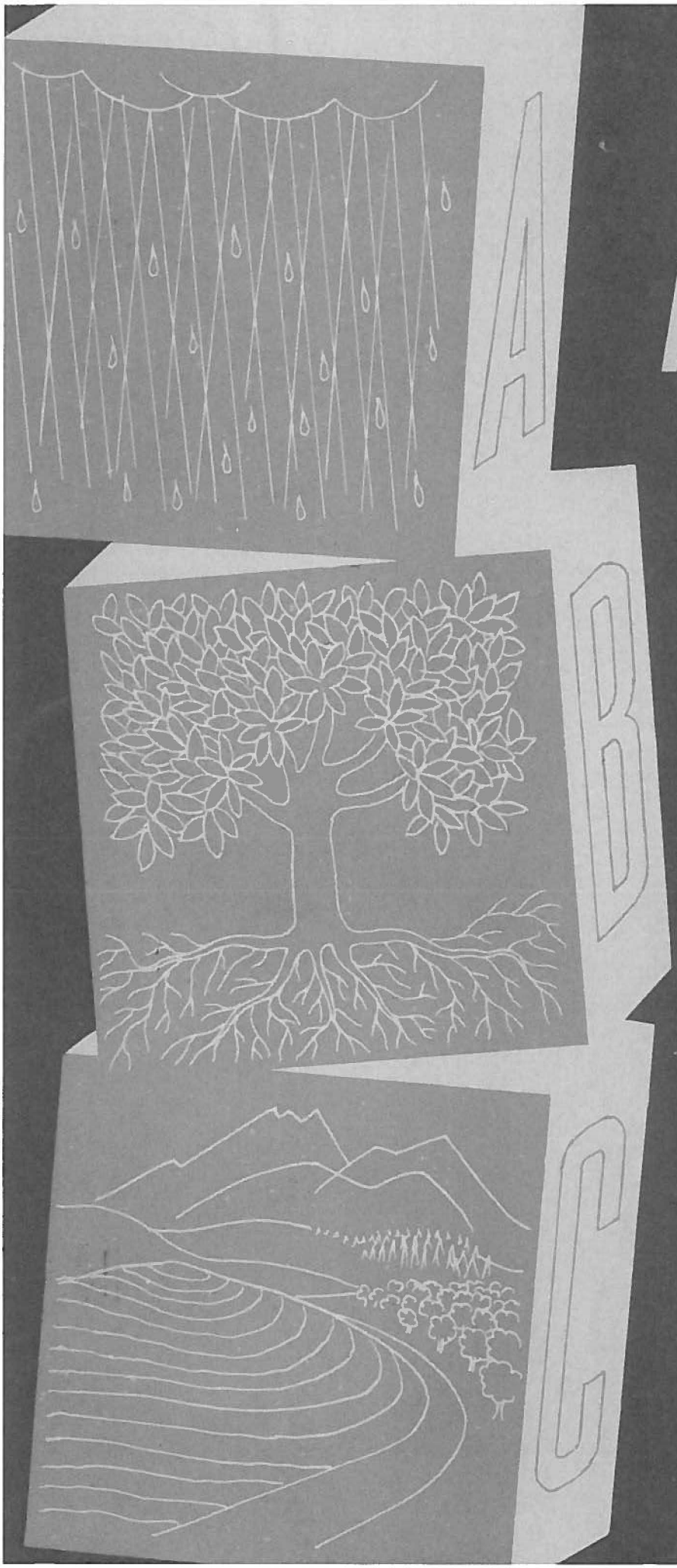
ADDENDUM A

To Sylte's Reply Memorandum in Support of Motion for Summary Judgment
In the Matter of Sylte's Petition for Declaratory Ruling
Re Distribution of Water to Water Right No. 95-0734
(IDWR Docket No. P-DR-2017-001)



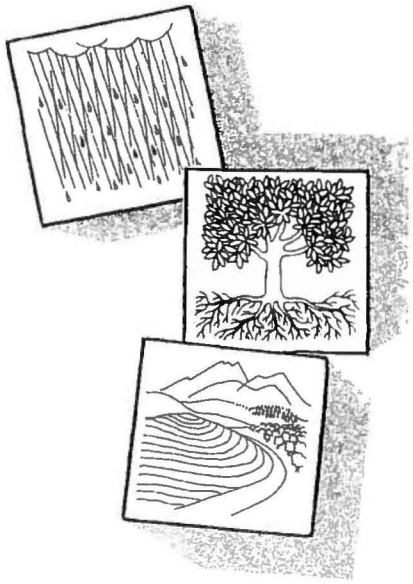
A PRIMER ON WATER

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

A PRIMER ON WATER

Luna B. Leopold

Walter B. Langbein



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STEWART L. UDALL, *Secretary*

GEOLOGICAL SURVEY

William T. Pecora, *Director*

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ILLUSTRATIONS

flood over the whole flood plain to a depth equal to the height of the streambank exposed by average flow, as in figure 9*A*.

The great, really catastrophic, flood may occur this year, next year, or the next. Within our lifetime we may actually experience a flood so unusual that it would occur only once in several generations. In fact, we have already gone through such an experience in the great floods of New England in the year 1955. So extraordinary was the rainfall, that it might not be repeated in another 1,000 years.

The chance of experiencing a great flood is similar to playing bridge. We may play often, but most of us have never been dealt 13 cards of the same suit. Yet we know that we might get such a hand in the next game. So it is with floods. The very unusual event may occur tomorrow, but it is unlikely.

River Channels and Floods

When you draw a bath you close the drain and turn on the faucet and water accumulates in the tub. If you failed to close the drain no water would accumulate in the bathtub if the drain could discharge water as fast as it came in from the faucet. When more water comes in than goes out, the difference between the two would accumulate in the reservoir of the bathtub. If we think of the bathtub as temporary storage, then we can say that the rate of change of storage is the difference between the rate of inflow and the rate of outflow. The principle is illustrated in figure 10.

In a flow system, whether it be the bathtub, the garden hose, or a river, some water must accumulate temporarily in the system before the incoming water flows out at the other end. When you water the garden, you turn on the faucet but the water does not immediately flow out of the other end of the hose unless the hose is already full of water. There will be a short period of time during which the hose becomes full before any water is discharged at the lower end. Similarly, if you turn off the faucet, the water that is in the hose drains out; therefore, the outflow does not stop at the same moment that the inflow ceases.

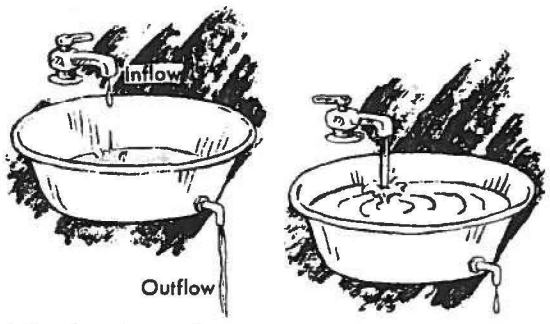

FIGURE 10 —*Relation of storage to inflow and outflow.*

The amount of water which is in the hose could be thought of as stored temporarily in the flow system. So it is with rivers. When tributaries contribute flow to the upper end of a river channel, it takes a certain amount of time for that water to appear at the lower end. After the tributary inflow stops, that water which is in transit in the river channel gradually drains out. The water in transit therefore is comparable to a reservoir, or the bathtub. Enormous volumes are in the channels during major floods. For example, during the flood on the Ohio River in January 1937, there was a volume of storage in the channel system equal to 56 million acre-feet, a volume twice the capacity of Lake Mead, the reservoir behind Hoover Dam on the Colorado River.

Because the river channel system is a form of temporary storage, as is the bathtub, the channel system tends to reduce the height of the flood. As a flood moves down the river system, the temporary storage in the channel reduces the flood peak. This is the same as if we turned on the faucet full tilt for a short time but the drain discharged water at a somewhat lower rate owing to the temporary storage of water in the tub itself (fig. 10). Storage tends to make the maximum rate of outflow less than the maximum rate of inflow.

Now, the amount of storage which is provided in a river channel depends on the size of channel. Let us see how channel size varies along a river system. When we look at a map showing stream channels the pattern is treelike. The treelike pattern is en-

hanced by the fact that the main stem or master stream is wider than its tributaries.

An important principle affecting floods is that as tributaries enter the main stream of the river, the river itself gets larger and larger downstream. If a flood occurs on one tributary and not on others, the channel of the tributary may be filled to overflowing, but as the water reaches the channel of the main stream, the capacity of the main stream is larger than the inflow from the one tributary and therefore no flooding occurs along the main channel. Great floods occur in main rivers only when several tributaries discharging into the main channel are also in flood.

Another principle is that the tributaries are not of the same size or spaced uniformly. This means that their flood peaks reach the main channel at different times. The off-timing also tends to modify the peaks as a flood proceeds downstream.

Three characteristics of river channels—channel storage, changing channel capacity, and timing—control the movement of flood waves. A flood rolls downstreamward, through channels of increasing size, which means increased channel storage, increased capacity to receive the staggered, or off-timed, contribution of tributaries. The flood flows through channels of ever increasing size.

How Fast Does River Water Move?

There is the saying that still waters run deep. This may be a good statement of human nature, but it is not good hydrology. Still waters may be shallow or deep, and deep waters may run slow or fast.

When a river rises, the water moves faster. For example, when the river is low during a dry spell the water may be moving at an average rate of about half a foot a second, or about one-third of a mile per hour. But when the river is in flood, its current may be more than 10 feet per second, or about 7 miles per hour. At a measuring section of the Potomac River in Chain Bridge gorge near Washington, D.C., during the flood of March 1936, the speed of the water was 22 feet per second, or 15 miles per hour. Speeds of 30 feet per second (20 miles per hour) have been measured elsewhere in natural river channels with current meter by the Geological Survey.

At any place, then, as water becomes deeper it tends to flow faster. In moving downhill, water acts like any other body that is moved by gravity. It would move ever faster, like a ball rolling downhill, were it not held in check by friction against its bed and banks. The speed with which water moves is a balance between gravity and friction. But if one looks at any natural stream he sees that as the water gets deeper the area the water rubs against does not increase a great deal. And, for this reason, we would expect gravity to become more important as the river deepens and the water to move faster. This is just what we observe.

Let us view a river from a point in the headwaters, say up in a mountain torrent, to a point where it flows into the ocean. How does the water speed change? The word *torrent* brings up an image of fast-moving turbulent water and this, to all appearances, does seem to characterize a mountain stream. The big river seems just to roll along, sweeping majestically around bends in its stately course to the sea. But appearances can be deceiving. It is better to rely on the instrument designed to measure speed of water-flow in rivers, an instrument called a current meter.

The current meter tells a different story. The water in the mountain stream when we visit it on a clear day may be tumbling along at an average rate of about 1 foot per second—less than 1 mile per hour. The current in the big river far downstream is 3 or 4 feet per second, and all the creeks and tributaries in between move along at intermediate speeds. Water speed increases as we go downstream. Why can we not believe what our eyes seem to tell us? The answer is that both our eyes and the current meter are right. It is just that we must interpret the evidence right. Again, the connecting link is depth. As we proceed downstream, we observe that there is more water and that both depth and width of the river increase. Therefore, when we look at a mountain stream and call it a torrent, we mean that it is flowing rapidly in relation to its *shallow* depth. And when we look at the big river and say that it is sluggish, we mean