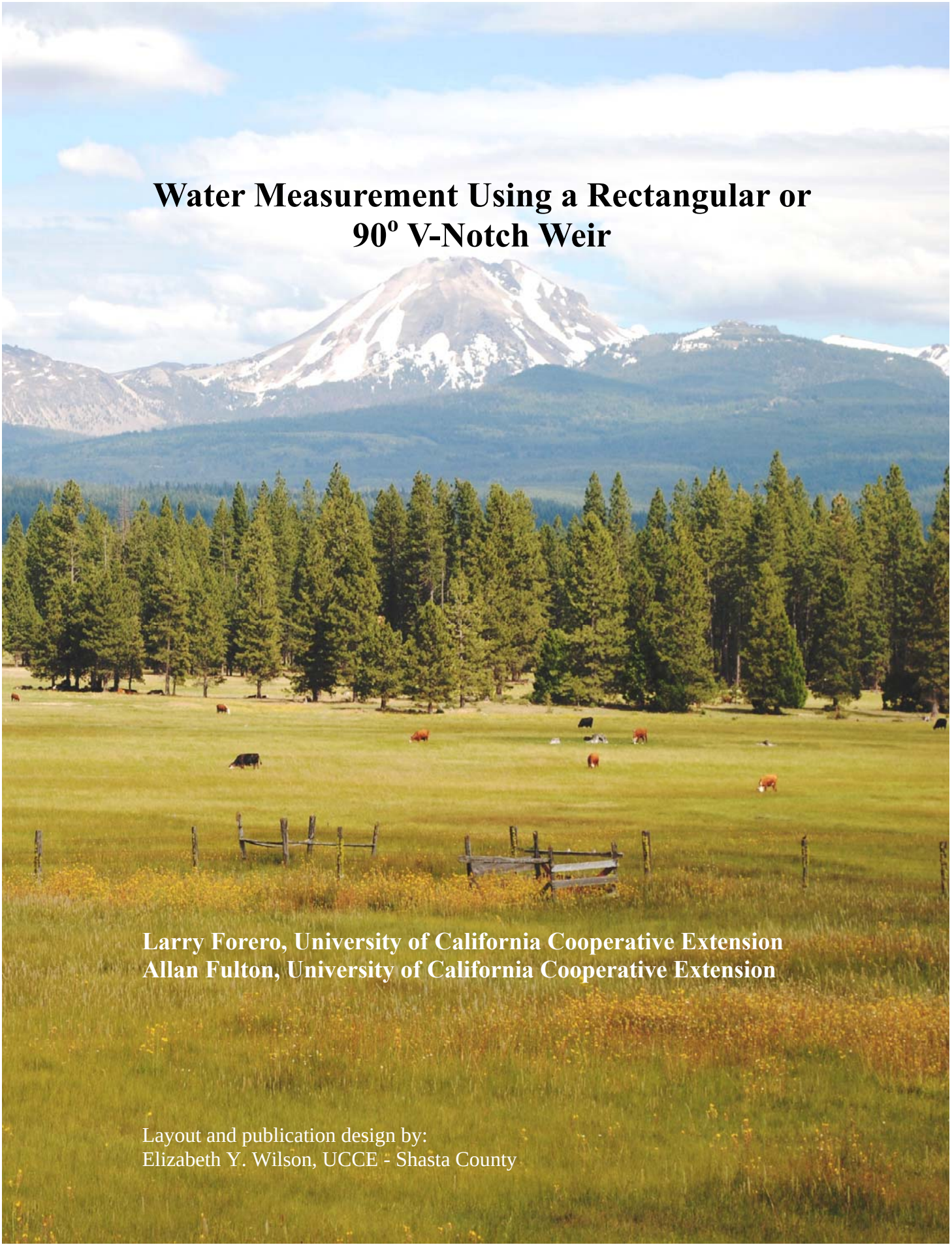

Water Measurement Using a Rectangular or 90° V-Notch Weir

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The California State Water Resources Control Board requires that the amount of water diverted from the surface waters of the state be reported. For many years diverters were able to estimate the amount of water they diverted and report this estimate. Legislation passed in 2010 requires that the amount of water diverted be measured. Many water right owners are seeking to comply with this regulatory requirement.

Other reasons to measure water could include:

- Assure the appropriate amount is diverted
- Divide shared interest in water
- Identify opportunities to save water for other uses

This publication will focus on simple and inexpensive methods of measuring surface water to irrigate pastures and meadows. A simple method of estimating flow in open channels and installation and set up of Contracted Rectangular and V-Notch Weirs are discussed. Examples of how to apply the flow measurements are also provided.

Basic Water Measurement in Open Channels

The volume of water passing through a point on a stream per unit time is used to measure stream flow. Two factors are required to determine volume (quantity) of water: cross sectional area (generally square feet) and flow velocity (generally feet per second). Flow is usually expressed in cubic feet per second (cfs). The formula for calculating flow is:

Stream flow (cfs) = Cross-section Area (ft^2) * Average Velocity (feet/second)

Determining Cross Sectional Area

The first step is to determine the cross sectional area of the channel. This can be done by measuring the width and depth of the water. Because variation in depth often occurs, several measurements may need to be made across the channel. Measure the depth in at least three points for narrow channels and preferably five or more points across wider channels to arrive at a representative average. The average depth is then multiplied by the width to determine the cross sectional area. For example if the average depth was determined to be 1 foot and

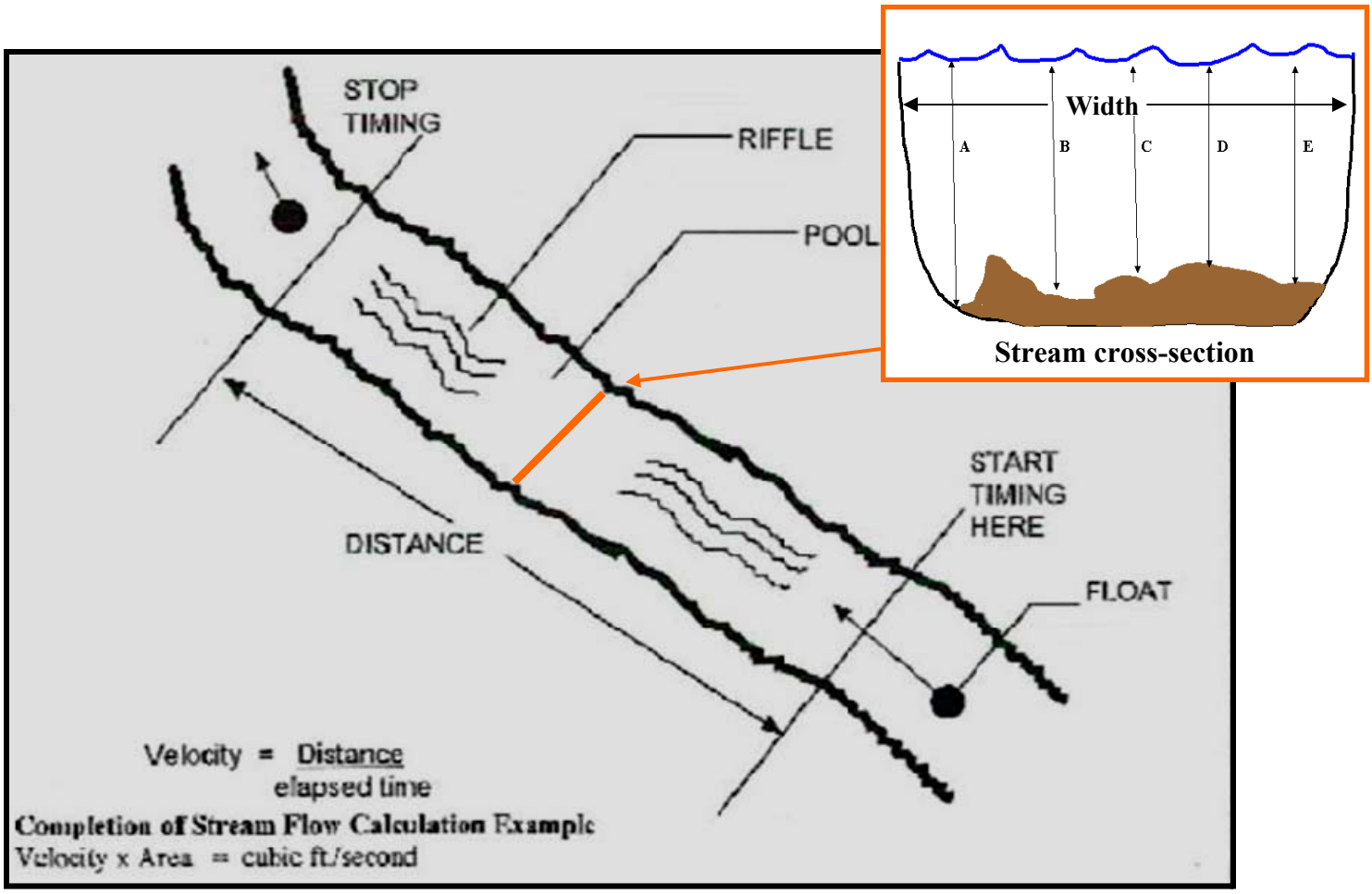

Figure 1. Simple method for determining water velocity.

the width was 2.5 feet, the cross sectional area is 2.5 square feet.

Determining Velocity

Velocity is estimated by determining the time it takes for an object to float a given distance. The choice of the object used as a float will affect the measurement of velocity. A round wooden rod, 1 to 2 inch diameter, which is weighted on one end and stands vertical in the stream, will improve accuracy. The rod should be immersed at least one-fourth of the stream depth but not too deep so that it touches the bottom of the channel. Objects that float on the surface of the stream channel are prone to drifting and are not as likely to represent an average velocity of the stream channel. Measuring flow in more than one segment of the stream or ditch will also improve estimates of velocity. The formula is Velocity=Distance/time. For example, if it takes 10 seconds for a object to float 20 feet, the velocity of the water is 2 feet per second (20 feet/10 seconds=2 feet/second). Figure 1 demonstrates a method for determining velocity.

Determining Flow

The example notes a cross sectional area of 2.5 square feet and a water velocity of 2 feet per second. Multiplying these two attributes together (2.5 square feet* 2 feet/second) gives a total stream flow of 5 cubic feet per second (cfs).

Using Flow Data to Determine Acre Feet

Sometimes it is necessary to determine the amount of water diverted across a production season in acre feet. To determine this, the flow is multiplied by the length of time water is diverted and divided by the square feet in an acre (43,560 square feet/acre).

If the water was diverted for 150 days and flow was 5 cfs, across the entire season, acre feet diverted can be calculated:

(150 days*24 hours/day*60 minutes/hour*60seconds/minute*5 cfs)/43,560 square ft/acre=1488 acre feet were diverted. A shortcut to determine quantity of water diverted can be calculated using the formula: Q*T/12 = A where,

Q = cfs
T = # of days * hours/day
A = acre-feet
12 = constant value

Table 1 Conversion Table for Rates of Flow

Units	Cubic feet per second	Gallons Per minute	Millions gallons per day	Southern California Miner's inches	California Statutory Miner's Inches	Acre-inches Per 24 Hours	Acre-Feet Per 24 hours
Cubic feet per second	1.0	448.8	0.646	50.0	40.0	23.80	1.984
Gallons per minute	0.00223	1.0	0.00144	0.1114	0.0891	0.053	0.00442
Million gallons per day	1.547	694.4	1.0	77.36	61.89	36.84	3.07
So. Calif. miner's inches	0.020	8.98	0.0129	1.0	0.80	0.476	0.0397
Calif. Statutory miner's inches	0.025	11.22	0.0162	1.25	1.0	0.595	0.0496
Acre-inches per 24 hours	0.042	18.86	0.0271	2.10	1.68	1.0	0.0833
Acre-feet per 24 hours	0.504	226.3	0.3259	25.21	20.17	12.0	1.0

Flow Conversions

Water flow can be presented in several ways. A cubic feet per second (cfs) is probably the most commonly used method. Table 1 outlines several different methods and conversion factors.

Measurement Weirs

Weirs are a good tool that works well to measure water flow in ditches and streams that convey water to irrigate pastures and other lower value crops. They are relatively inexpensive while improving accuracy over the most basic float technique of measuring flow in open channels. Properly installed they provide an accurate measure of cross sectional area and water velocity. To measure water flow accurately, weirs must be designed and placed appropriately in each specific water conveyance system and installed correctly. Head (H), the height of water passing over the weir crest is key to measuring water flow with weirs. It is measured at a point upstream from the crest of the weir where the surface drawdown from water spilling over the weir does not affect the measurement. Once installed, the flow should be measured or calibrated using a second method to validate the measurements.

Determining the weir dimensions

For a weir to function properly it must have proper dimensions. Having a reasonable estimate of H is important to determine the weir dimensions. The average depth of water flowing in an unchecked, relatively uniform, straight stretch of the ditch and where it is free of turbulence will provide a good initial estimate of H. The crest of a correctly sized weir must be at least 2 times H to prevent submergence on the downstream side of the weir and assure accurate flow measurements. Submergence is the backing up of the water on the downstream side of the weir such that the water does not spill freely over the weir crest and it interferes with the ability to measure H as water crosses the weir crest. Submergence is more likely to occur in ditches with very little fall or irregular slope. For above example, if H is equal to 0.50 foot, the crest of the weir must be at least 1.0 foot above the bottom of the channel. The length of the weir crest, (that is the width of the weir notch across the channel), should be such that the maximum H is no greater than 1/3 of the length of the weir crest and the minimum H exceeds 2 inches. The distance from the side of the weir

Figure 2. Setting a precast weir box with a backhoe.

notch to the sides of the ditch should be at least twice that of H. The crest and sides of the weir notch should not be more than 1/8 inch thick.

Locating the appropriate site for a weir

Having a reasonable estimate of H is also critical to correctly site the weir. As a general guide, the weir should be set in a channel that is straight with a distance upstream of the weir that is at least 10 times the length of the weir crest. For this example, where the length of the weir crest is 1.0 foot. There should be a minimum of 10 feet of straight ditch upstream of the weir. However, there are other practical aspects to site a weir appropriately. Water will pond upstream from where the weir is placed because flow is directed through the weir and confined by the length of the weir crest. The ditch must have sufficient free board (unfilled ditch) to retain ponded water and prevent water from breaching the ditch banks. Keep in mind that many ditches are designed with a constant slope to maintain a steady water elevation in the ditch, especially if siphons or gates are used to discharge water into the pasture checks. In the aforementioned example (where the crest of the weir was 1.0 foot above the bottom of the ditch)

a 1% ditch fall will backup water 100 feet and require sufficient storage for the water in that stretch of the ditch. A ditch with less slope (0.5%) will backup water 200 feet and require sufficient freeboard in that stretch of the ditch. Stretches of a ditch where the banks have settled or have deteriorated should be avoided or repaired when choosing where to site the weir.

When placing a weir in the stream at the point of diversion, keep in mind this may require streambed alteration permits. Check with local authorities before proceeding.

Installation of Weirs

Weirs can be built in place. To do this will require skill with building forms and pouring concrete. A simpler approach might be to purchase a precast concrete structure with slots for boards. Depending upon the size, these are generally modestly priced. However, equipment will be required to unload and set the

Figure 3. Precast box & V-notch weir with rip-rap.

structure in the ditch. You can check with a local precast firm or look online for a dealer.

Setting a Weir:

- The weir structure is set in a channel that is straight for a distance upstream from the weir equal to 10 times the length of the weir crest (i.e. if the weir crest is two feet, the channel should be straight for 20 feet).
- The weir must be placed at right angles to the direction of water flow.
- The face of the weir must be installed perpendicular to the flow and the weir crest straight and level.
- Obstructions on the upside stream of the weir should be avoided.
- Set the weir structure at the lower end of a long pool sufficiently wide and deep so that the water will approach the weir free from eddies at a velocity not exceeding 0.5 feet/second.

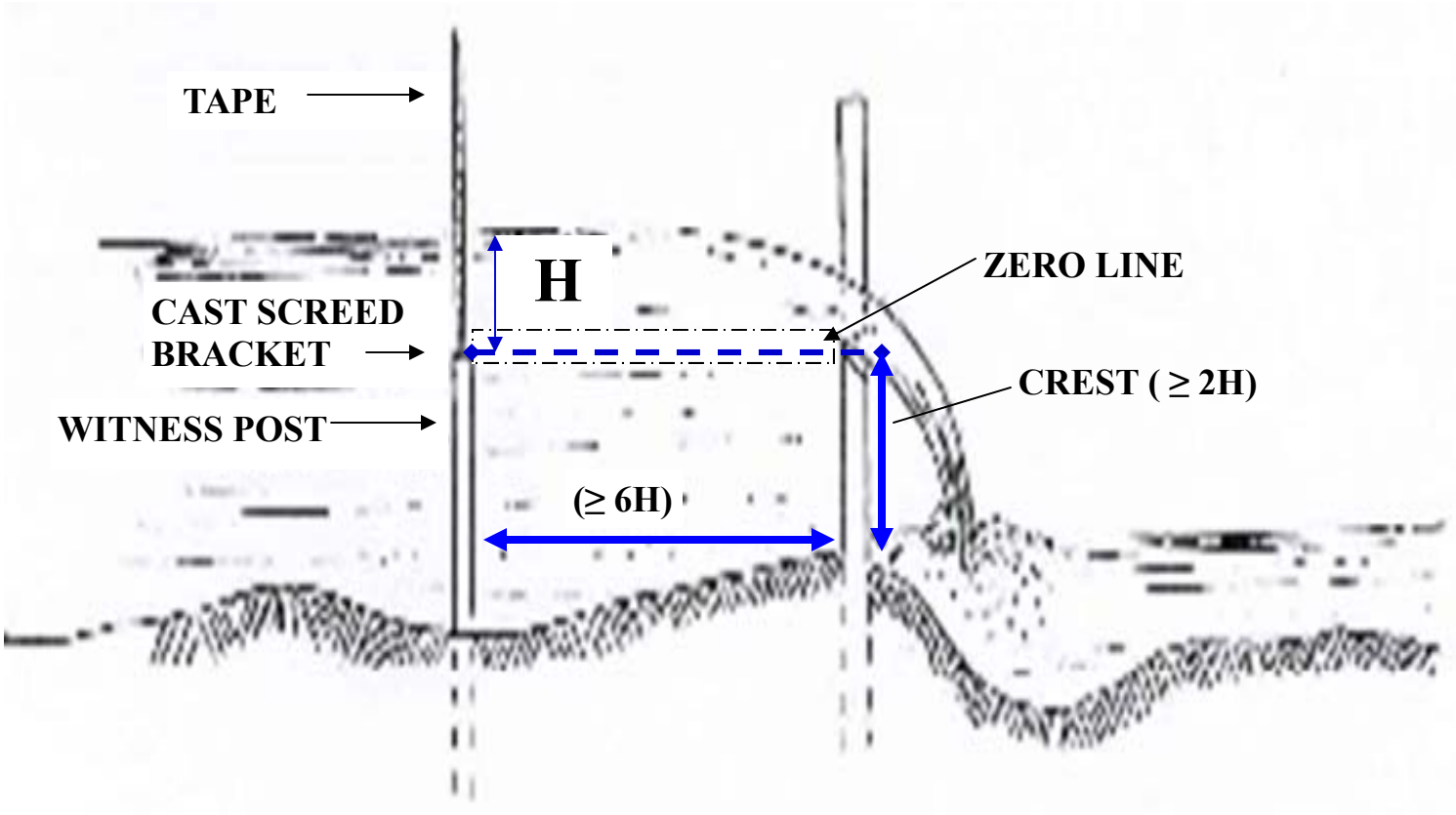

Figure 4. Relationship between measurement location, relative to weir crest.

Regardless of the approach taken, the structure must be backfilled in a manner to assure there are no water leaks around or under it. Diligent compaction of back fill material as it is added and use of riprap material upstream of the weir (Figure 3) will reduce the incidence of leakage around the structure. The use of bentonite may help reduce the chance of leakage around the structure as well.

Where to Make the Measurement

If the weir is properly installed, the only direct measurement that will need to be made is H, the height of the water spilling over the crest of the weir. Once the height is known, flow rate is determined from a table of pre-determined values. Where the measurement of water height is made is important. As water approaches the weir crest, velocity increases and water height decreases. Figure 4 shows the location of the measurement in reference to the weir crest. The location where this measurement is made must be a minimum of 6 times H from the weir crest. This measurement location should be easily identifiable with a permanent monument, often referred to as a witness post (i.e. a sturdy, permanent stake in clear view and free of potential obstruction such as tree limbs, bushes, or other vegetation). The witness post will serve as a consistent measurement point where a ruler or staff gauge will be installed to properly measure H in relation to where the weir is placed. It will also provide a "zero" (0). A reference point for measuring H is the height on the witness post that is level with the crest of the weir.

An accurate witness post can be developed and installed using the following steps:

- Bore a hole into a precast concrete block using a ¾ inch masonry bit. Try to bore the hole as straight as possible
- Take a ¾ inch concrete form stake and fit it into the concrete block.
- In the field set the block in the ditch an appropriate distance from the weir crest (minimum of 6*H). Set the concrete block in the ditch, excavating enough material so the top of the block is at about the ditch grade. This should be done with the stake in place. As this block (with the stake) is

Figure 5. Leveling the witness post to the weir crest.

set, the plum of the stake should be checked regularly.

- Once the witness post is in place, take a form stake cast screed bracket (available at concrete supply store) and thread the set screw so it is just snug against the concrete form stake. (Figure 5)
- Take a level and set it on the weir crest and the cast screed bracket. Adjust the bracket until it is level with the weir crest. Tighten the set screw. This is where the 'zero' measurement will be made.

Measuring Water Height and Flow

The most common device used to measure water height is some sort of ruler mounted to or hung on the witness post. The ruler is frequently referred to as a "staff gauge." It is easiest to do this with a ruler that is divided into 1/10 foot intervals (as opposed to inches). These are sometimes referred to as "engineer's ruler." For accurate measurement, the ruler should be level (vertically and horizontally) in the water. The measurement reading must be recorded and later flow determined off of the appropriate table. The more measurements that are

taken throughout the season, the better the understanding of the variation in flow and volume of diverted water is attained.

Figure 6. Demonstrates typical installation of pressure transducer.

Automatic Water Measurement

Data logging devices exist that can measure the height of the water automatically. These operate based upon the gravitational pressure of the water exerted upon a sensor. They are frequently referred to as “pressure transducers.” These instruments record water height at a predetermined time interval (i.e., hourly) and the data is stored on the device. The pressure transducer is commonly placed inside a “stilling well” that is constructed out of a piece of perforated PVC pipe which allows water to flow into the well. The bottom of the pressure sensor is set inside the stilling well and must be level with the weir crest. Figure 6 shows the installation of one of these instruments. The data is downloaded from the device onto a computer and is read and evaluated there. These devices only measure the height of water. The amount

Figure 7. Installed Rectangular Weir.

of water diverted must still be determined from this water height data.

Types of Weirs

Rectangular Contracted Weir

This type of structure can be used to measure higher water flows, usually greater than 1.0 cfs. As its name implies this weir is based upon water flowing over a rectangle of known height and width. If this weir is installed properly, the water will fall over the weir at a constant velocity. The flow is a function of the head (H) of water ABOVE the weir crest. Key to this weir is the width and depth of the "rectangle." The depth must be sufficient to accommodate the maximum amount of water expected to flow over the weir. Take a moment to review Table 2. Note that flow can be determined from the table based upon the height of the water and the length of the weir crest. Table 2 can be used to determine flow. It is much easier to determine flow if the weir's crest is of a length that is included in standard, published tables.

Water needs to fall across a sharp edge of the weir crest. The rectangle should be cut at no less than a 45^{o} angle such that water falls freely from the weir.

90^{o} V-Notch Weir

The 90^{o} V-Notch Weir is useful for measuring lower flows of water, typically less than 1.0 cfs. The depth must be sufficient to accommodate the maximum amount of water expected to flow over the weir. Take a moment to review Table 3. Similar to the contracted rectangular weir flow can be determined from the table based simply upon the height of the water passing over the crest of the weir. If height of the water is known, Table 3 can be used to determine flow.

A framing square can be used to layout the 90^{o} angle. Water needs to fall across a sharp edge of the weir crest. The angle of the notch should be cut at no less than a 45^{o} angle such that waterfalls freely from the weir.

Trapezoidal or Cippoletti Weir

A trapezoidal or Cippoletti Weir is third type of weir that can be used to measure water flows. It is very similar to a rectangular contracted weir with no distinct advantages or disadvantages. As a result, it is not a focus in this guide. Like the rectangular contracted weir, it is most appropriately used to measure higher flows above 1.0 cfs. The primary difference in weir design is that the weir notch is shaped as a trapezoid with sloped sides rather than as a rectangle with vertical sides. Generally, it may be simpler to construct a rectangular notch than a trapezoidal notch.

Calibration

After installation is complete, calibration to validate the flow measurements with a weir is appropriate. Checking the weir calibration can be challenging. Arranging a second method to temporarily measure flow can be inconvenient and costly especially if the measurement weir is remotely located. Two of the more feasible techniques to check the calibration of a weir include: 1) the float technique as described earlier in this article; and 2) using catch and stop watch methods.

The float technique is most appropriate to check higher flows measured with a rectangular contracted weir. Once the weir is in place, use the head gate at the diversion to turn a controlled, relatively low rate of water into the ditch. There should be at least 2 inches of head flowing over the weir crest at the staff gauge. Measure H at the staff gauge and calculate the cross sectional area of the water flowing though the "rectangle" (depth of the water * length of weir crest). Using the float technique described, measure the velocity of the water and calculate flow. Check this against the staff gauge elevation and corresponding flow rate indicated in standard, published tables for a weir with the dimensions that has been installed. Small discrepancies could be a function of the "zero" reference point of the staff gauge not being level with the crest of the weir. Make adjustments as necessary to the position of the staff gauge. When the flow rate measured using the float technique agrees closely with the flow rate based on the H flowing over the crest of the weir and the appropriate standard, published table, increase the flow rate to about two-thirds of the expected maximum H into the ditch and repeat these calibration steps. When the flow measurements measured with the float technique and using the rectangular contracted weir agree reasonably well at both relatively low and high H, it indicates the weir is measuring water flow with reasonable accuracy.

Using a watch and a container of a known volume to determine the amount of water per unit time is a feasible technique to validate flow measurements from a V-notch weir. Similar to the calibration process for the rectangular, contracted weir, use the head gate at the diversion to turn in a low rate of water. Catch and time a small volume of water spilling over the V-notch weir (i.e., 1 quart/ second=15 gallons per minute). Repeat this measurement at this low flow until a good average is developed. Check this against the staff gauge elevation and corresponding measurement of flow rates in the standard, published tables for the specific size of V-notch weir that has been installed. Small discrepancies

could be a function of the ‘zero’ reference point on the staff gauge not being level with the crest of the weir. Make adjustments as necessary to the position of the staff gauge. Once there is good agreement between the two methods of flow measurement, turn in a slightly higher rate of water into the ditch and repeat these calibration steps. When the flow measurements measured with the “catch and time” technique and the using V-notch weir agree reasonably well for the two different levels of H, it indicates the weir is measuring water flow with reasonable accuracy.

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Glossary

Acre Foot - A volume equal to one acre uniformly covered by water one foot deep. Equivalent to 12 acre inches. Also equal to 43,560 cubic feet, or about 325,850 gallons.

Acre Inch - A volume equal to one acre uniformly covered by water one inch deep (27,150 gallons).

CFS - See flow rate.

Flow Rate - The product of cross-sectional area multiplied by average velocity of water moving through the cross-section, Q = AV. Typically expressed as cubic feet per second (cfs, also called second-feet); Q = ft2 x ft per second or ft3/sec.

Head - The depth of water above a reference point or datum, as in, “There is 10.1 feet of head on that pipe.”

Staff Gauge - A “ruler” used for measuring water depth or head. Usually, a porcelain coated flat steel strip with graduations marking feet, tenths and hundredths.

Table 2. Flow Over Rectangular Contracted Weirs In Cubic Feet per Second *

Head in ft. "H"	Head in inches, approx.	Crest length (L)					For each additional foot of crest in excess of 4 ft. (approx)
		1.0 foot	1.5 feet	2.0 feet	3.0 feet	4.0 feet	
		Flow in cubic feet per second					
0.10	1 3/16	0.105	0.125	0.212	0.319	0.427	0.108
0.11	1 5/16	0.121	0.182	0.244	0.367	0.491	0.124
0.12	1 7/16	0.137	0.207	0.277	0.418	0.559	0.141
0.13	1 7/16	0.155	0.233	0.312	0.470	0.629	0.159
0.14	1 11/16	0.172	0.260	0.348	0.524	0.701	0.177
0.15	1 13/16	0.191	0.288	0.385	0.581	0.776	0.196
0.16	1 15/16	0.210	0.316	0.423	0.638	0.854	0.216
0.17	2 1/16	0.229	0.346	0.463	0.698	0.934	0.236
0.18	2 3/16	0.249	0.376	0.504	0.760	1.02	0.257
0.19	2 1/4	0.270	0.407	0.546	0.823	1.10	0.278
0.20	2 3/8	0.291	0.439	0.588	0.887	1.19	0.303
0.21	2 1/2	0.312	0.472	0.632	0.954	1.28	0.326
0.22	2 5/8	0.335	0.505	0.677	1.02	1.37	0.35
0.23	2 3/4	0.358	0.539	0.723	1.09	1.46	0.37
0.24	2 7/8	0.380	0.574	0.769	1.16	1.55	0.39
0.25	3	0.404	0.609	0.817	1.23	1.65	0.42
0.26	3 1/8	0.428	0.646	0.865	1.31	1.75	0.44
0.27	3 1/4	0.452	0.682	0.914	1.38	1.85	0.47
0.28	3 3/8	0.477	0.720	0.965	1.46	1.95	0.49
0.29	3 1/2	0.502	0.758	1.02	1.53	2.05	0.52
0.30	3 5/8	0.527	0.796	1.07	1.61	2.16	0.55
0.31	3 3/4	0.553	0.836	1.12	1.69	2.26	0.57
0.32	3 13/16	0.580	0.876	1.18	1.77	2.37	0.60
0.33	3 15/16	0.606	0.916	1.23	1.86	2.48	0.62
0.34	4 1/16	0.634	0.957	1.28	1.94	2.60	0.66
0.35	4 3/16	0.661	0.999	1.34	2.02	2.71	0.69
0.36	4 5/16	0.688	1.04	1.40	2.11	2.82	0.71
0.37	4 7/16	0.717	1.08	1.45	2.20	2.94	0.74
0.38	4 9/16	0.745	1.13	1.51	2.28	3.06	0.78
0.39	4 11/16	0.774	1.17	1.57	2.37	3.18	0.81
0.40	4 13/16	0.804	1.21	1.63	2.46	3.30	0.84
0.41	4 15/16	0.833	1.26	1.69	2.55	3.42	0.87
0.42	5 1/16	0.863	1.30	1.75	2.65	3.54	0.89
0.43	5 3/16	0.893	1.35	1.81	2.74	3.67	0.93
0.44	5 1/4	0.924	1.40	1.88	2.83	3.80	0.97

* Computed from Cone's formula: $Q = 3.247\ LH^{1.48} - \frac{0.556\ L^{1.8}}{1 + 2\ L^{1.8}}\ H^{1.5}$.

Table 2 (*Continued*). Flow Over Rectangular Contracted Weirs In Cubic Feet per Second *

Head in ft. "H"	Head in inches, approx.	Crest Length (L)					For each additional foot of crest in excess of 4 ft. (approx.)
		1.0 foot	1.5 feet	2.0 feet	3.0 feet	4.0 feet	
		Flow in cubic feet per second					
0.45	5 3/8	0.955	1.44	1.94	2.93	3.93	1.00
0.46	5 1/2	0.986	1.49	2.00	3.03	4.05	1.02
0.47	5 5/8	1.02	1.54	2.07	3.12	4.18	1.06
0.48	5 3/4	1.05	1.59	2.13	3.22	4.32	1.10
0.49	5 7/8	1.08	1.64	2.20	3.32	4.45	1.13
0.50	6	1.11	1.68	2.26	3.42	4.58	1.16
0.51	6 1/8	1.15	1.73	2.33	3.52	4.72	1.20
0.52	6 1/4	1.18	1.78	2.40	3.62	4.86	1.24
0.53	6 3/8	1.21	1.84	2.46	3.73	4.99	1.26
0.54	6 1/2	1.25	1.89	2.53	3.83	5.13	1.30
0.55	6 5/8	1.28	1.94	2.60	3.94	5.27	1.33
0.56	6 3/4	1.31	1.99	2.67	4.04	5.42	1.38
0.57	6 13/16	1.35	2.04	2.74	4.15	5.56	1.41
0.58	6 15/16	1.38	2.09	2.81	4.26	5.70	1.44
0.59	7 1/16	1.42	2.15	2.88	4.36	5.85	1.49
0.60	7 3/16	1.45	2.20	2.96	4.74	6.00	1.53
0.61	7 5/16	1.49	2.25	3.03	4.59	6.14	1.55
0.62	7 7/16	1.52	2.31	3.10	4.69	6.29	1.60
0.63	7 9/16	1.56	2.36	3.17	4.81	6.44	1.63
0.64	7 11/16	1.60	2.42	3.25	4.92	6.59	1.67
0.65	7 13/16	1.63	2.47	3.32	5.03	6.75	1.72
0.66	7 15/16	1.67	2.53	3.40	5.15	6.90	1.75
0.67	8 1/16	1.71	2.59	3.47	5.26	7.05	1.79
0.68	8 3/16	1.74	2.64	3.56	5.38	7.21	1.83
0.69	8 1/4	1.78	2.70	3.63	5.49	7.36	1.87
0.70	8 3/8	1.82	2.76	3.71	5.61	7.52	1.91
0.71	8 1/2	1.86	2.81	3.78	5.73	7.68	1.95
0.72	8 5/8	1.90	2.87	3.86	5.85	7.84	1.99
0.73	8 3/4	1.93	2.93	3.94	5.97	8.00	2.03
0.74	8 7/8	1.97	2.99	4.02	6.09	8.17	2.08
0.75	9	2.01	3.05	4.10	6.21	8.33	2.12
0.76	9 1/8	2.05	3.11	4.18	6.33	8.49	2.16
0.77	9 1/4	2.09	3.17	4.26	6.45	8.66	2.21
0.78	9 3/8	2.13	3.23	4.34	6.58	8.82	2.24
0.79	9 1/2	2.17	3.29	4.42	6.70	8.99	2.29

* Computed from Cone's formula: $Q = 3.247\ LH^{1.48} - \frac{0.556\ L^{1.8}}{1 + 2\ L^{1.8}}\ H^{1.9}$.

Table 3. Flow Over 90^{O} V Notch Weir in Cubic Feet per Second and Gallons per Minute *

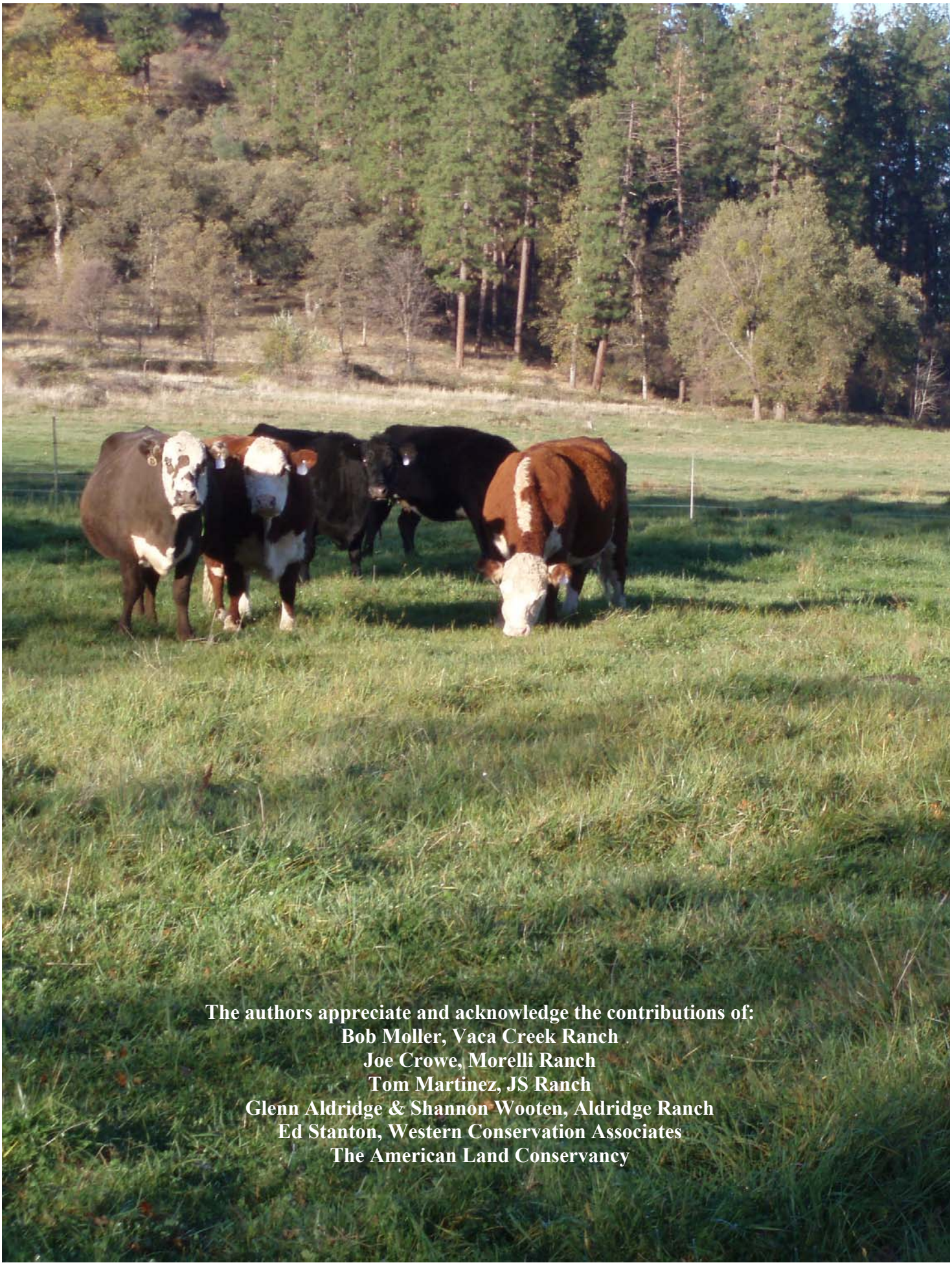
Head in feet "H"	Head in inches approximately	Flow in cubic feet per second	Flow in gallons per minute
0.10	1 3/16	0.008	3.6
0.11	1 5/16	0.010	4.5
0.12	1 7/16	0.012	5.4
0.13	1 9/16	0.016	7.2
0.14	1 11/16	0.019	8.5
0.15	1 13/16	0.022	9.9
0.16	1 15/16	0.026	11.7
0.17	2 1/16	0.031	13.9
0.18	2 3/16	0.035	15.7
0.19	2 1/4	0.040	18.0
0.20	2 3/8	0.046	20.6
0.21	2 1/2	0.052	23.3
0.22	2 5/8	0.058	26.0
0.23	2 3/4	0.065	29.2
0.24	2 7/8	0.072	32.3
0.25	3	0.080	35.9
0.26	3 1/8	0.088	39.5
0.27	3 1/4	0.096	43.1
0.28	3 3/8	0.106	47.6
0.29	3 1/2	0.115	51.6
0.30	3 5/8	0.125	56.1
0.31	3 3/4	0.136	61.0
0.32	3 13/16	0.147	66.0
0.33	3 15/16	0.159	71.4
0.34	4 1/16	0.171	76.7
0.35	4 3/ 16	0.184	82.6
0.36	4 5/16	0.197	88.4
0.37	4 7/16	0.211	94.7
0.38	4 9/16	0.226	*101.0
0.39	4 11/16	0.240	108.0
0.40	4 13/16	0.256	115
0.41	4 15/16	0.272	122
0.42	5 1/16	0.289	130
0.43	5 3/16	0.306	137
0.44	5 1/4	0.324	145
0.45	5 3/8	0.343	154
0.46	5 1/2	0.362	162
0.47	5 5/8	0.382	171
0.48	5 3/4	0.403	181
0.49	5 7/8	0.424	190

* Computed from Cone's formulas: $Q = 2.49\ H^{2.48}$ $GPM = 448.8\ (2.49\ H^{2.18})$.

Table 3 (*Continued*). Flow Over 90° V Notch Weir in Cubic Feet per Second and Gallons per Minute *

Head in feet "H"	Head in inches Approximately	Flow in cubic feet Per second	Flow in gallons Per minute
0.50	6	0.445	200
0.51	6 1/8	0.468	210
0.52	6 1/4	0.491	220
0.53	6 3/8	0.515	231
0.54	6 1/2	0.539	242
0.55	6 5/8	0.564	253
0.56	6 3/4	0.590	265
0.57	6 13/16	0.617	277
0.58	6 15/16	0.644	289
0.59	7 1/16	0.672	302
0.60	7 3/16	0.700	314
0.61	7 5/16	0.730	328
0.62	7 7/16	0.760	341
0.63	7 9/16	0.790	355
0.64	7 11/16	0.822	369
0.65	7 13/16	0.854	383
0.66	7 15/16	0.887	398
0.67	8 1/16	0.921	413
0.68	8 3/16	0.955	429
0.69	8 1/4	0.991	445
0.70	8 3/8	1.03	462
0.71	8 1/2	1.06	476
0.72	8 5/8	1.10	512
0.73	8 3/4	1.14	512
0.74	8 7/8	1.18	530
0.80	9 5/8	1.43	642
0.81	9 5/8	1.48	664
0.82	9 13/16	1.52	682
0.83	9 15/16	1.57	705
0.84	10 1/16	1.61	723
0.85	10 3/16	1.66	745
0.86	10 5/16	1.17	767
0.87	10 7/16	1.76	790
0.88	10 9/16	1.81	812
0.89	10 11/16	1.86	835

* Computed from Cone's formulas: $Q = 2.49\ H^{2.48}$ $GPM = 448.8\ (2.49\ H^{2.18})$.



The authors appreciate and acknowledge the contributions of:
Bob Moller, Vaca Creek Ranch
Joe Crowe, Morelli Ranch
Tom Martinez, JS Ranch
Glenn Aldridge & Shannon Wooten, Aldridge Ranch
Ed Stanton, Western Conservation Associates
The American Land Conservancy