Accompanied by the Past *By Karen Gray*

History is the witness that testifies to the passing of time; it illumines reality, vitalizes memory, provides guidance in daily life, and brings us tidings of antiquity. **Marcus Tullius Cicero (106–43 BCE), *Pro Publio Sestio***

Canal Engineering from Dam 3 to Harpers Ferry

Note: See the "Accompanied by the Past" column in the September 2013 Along the Towpath *for the history of the C&O Canal's relationship to Harpers Ferry.*

From the point of view of the physical canal, the roughly 2 ½ miles from the Dam 3 area (Mile 62.44) down to Harpers Ferry (Mile 60.23) has a special place in the hearts of those with an interest in the canal's engineering and masonry structures. It merits more than a rapid walk-through on the 2018 Douglas Hike and this column seeks to help walkers understand the intended functions of the structures that they are passing and how they relate to one another.

This stretch follows the river closely and includes seven locks (two of which are not lift locks), a dam, guard wall, and—in operating days—two mule crossover bridges. Additionally, it has the ruins of our only largely-intact drydock, and one of the largest bypass flumes on the canal.

The structures in the Dam 3 area demonstrate especially well the ways in which the engineers protected the canal from ordinary high water episodes. This is a serious challenge at the dams where the inlet must be at river level and, in fact, the river end must be recessed into the pool behind the dam at least 6 feet—the standard depth for canal boats. These were places, therefore, where even moderately high water could easily damage the canal without protective structures.

At Dam 3 one can see the three structures typically used to meet this challenge:

- A high guard wall along the river that would hold back the typical high water events in the pool behind the dam.
- A special kind of lock, the river end of which necessarily constitutes a breach in the guard wall and that therefore had a guard gate as high as the guard wall and thus significantly higher than the lock and its downstream gate.
- Two lift locks (in this case numbers Locks 35 and 36) above where the inlet channel feeds into the main stem of the canal. These serve to raise the canal above the river-level inlet.

Hikers today bypass Lock 35 and the canal's upstream side of the inlet confluence with the canal, by leaving the towpath at Lock 36 and following the trail on top of the guard wall. It curves around to the river, crosses the inlet lock's river end where its guard gate once was, and then continues along the guard wall beside the inlet channel to the towpath.

If the dam were intact, one could clearly see that the river on the downstream side of the dam was lower than the surface of the river pool behind the dam. After all, the dams were built to create a reliable pool of water and avoid the fluctuations and frequently shallow characteristics of the upper Potomac's natural riverbed. However, as Dam 3 was a low, rubble stone dam, the difference there was not great. Interestingly, the dam did not extend straight across the river, but made a sharp bend mid-river to angle off toward the head-gate of the Armory Canal along the West Virginia shore.

The canal upstream of Lock 36 lies beyond the protection of the guard wall that encircles Lock 35 and a low area between it and the canal that includes the ruins of a brick lockhouse. However, above Lock 36 the canal benefits from the 16 feet elevation change that Locks 35 and 36 provide.

Because all seven of the C&O Canal's dam locations are so important and the engineering at them complex, comparing these locations helps one appreciate the nuances of how the engineers used the dams, guard walls, and lift locks to meet the challenges at each site.

For example, the situation at Dam 6 is closest to what one finds here, although here the inlet channel is on a line at a 90-degree angle to the canal while the inlet channel at Dam 6 parallels the canal for one-tenth of a mile. Both, however, have an inlet lock at the river end of their inlet channel, although at Dam 6 it is located beside and below Lock 55. At both, the inlet feeds into the canal at the foot of the first of two lift locks—Lock 54 at Dam 6 where both Locks 54 and 55 have a 7.8 foot lift for a combined elevation increase of 15.6 feet.

Dams 1 and 2 and their associated structures are similar to each other in having open inlets at the river end and inlet locks at the canal end. There, guard walls are less obvious and the second of the lift locks are a distance above the first that are located immediately beside the inlet lock.

Dams 4 and 5 and their associated structures are similar due to the slackwater stretches above each and the fact that the two lift locks in each case are located at the upper end of the river navigation sections. The inlet locks (numbered with their dam) are located at the foot of a slackwater section that is the head of the section of canal below them. Thus, there are no inlet channels.

It's a valid source of argument as to whether the canal's inlet locks should be called inlet or guard locks. Hahn and Davies follow the original sources in using the latter term. (It

must be noted, however, that the original engineers were extremely casual in their use of terminology for canal structures and often mis-named them.) I prefer "inlet" because their primary purpose is to provide water to the main stem of the canal. The extent to which they are located in a guard wall, and thus require a guard gate, is variable with the design of the dam-related structures.

Using the term "inlet lock" also avoids confusion with the canal's two guard gates that are often erroneously termed guard locks. Those gates pass the canal through guard walls located above Lock 16 in the Great Falls area where the wall forces floodwaters back into the Mather Gorge; and, at Dam 4, where it extends the high level of the top of the Maryland abutment to the nearby hillside. These gates are clearly single gates the full height of their guard wall and are not locks. (Note that they are also different in design and purpose from short stop gates in the canal prism.)

Walkers on the Douglas Hike are encouraged to continue the short distance down the towpath at Lock 36 to view Lock 35 and the drydock beside it. The only other drydock, remnants of which can be seen, is located in the bushes alongside the bypass flume at Lock 47 at Four Locks. Boats would have been floated into these drydocks from the pools above them and would settle down on the beams after the gate behind them was closed and a drain at the downstream end opened to allow the water escape.

In the operating days of the canal, a bridge would have carried tow animals and people high enough over the inlet channel that boats coming and going to and from the inlet lock and river could pass underneath. It is clear that boats capable of navigating the river above the dam used this inlet lock into the trusteeship era (1890–1938). For example, we can document its use by stone-carrying boats owned by the quarries upstream in Virginia that would cross the river and enter the canal here.

It should be noted that the C&O Canal Company neither constructed nor owned Dam 3 (also known as the Government Dam). It was built by the federal government to serve the Armory Canal across the river. That canal followed the south side of the Potomac for 1.1 miles from its head-gate at the end of the dam down to the armory at Harpers Ferry. After the armory's destruction in the Civil War, the dam and Armory Canal served a wood pulp mill (1888–1925) and a power plant (1899–1991) located on the upstream end of the Armory property. It is unclear to what extent the C&OCC attempted to maintain the dam in the periods when its owners did not do so.

A new masonry dam intended to replace the rubble stone Dam 3 (remnants of which can still be seen immediately below the inlet lock at Mile 62.2) was under construction when the Civil War broke out. Work on it was never resumed by later owners and users of the Armory Canal.

Not much is known about the area of Dam 3 and its associated structures. The fact that boats using the river above Dam 3 could come and go through the inlet lock, that there is a dry dock here, and that there is a canal extending down to Harpers Ferry across the river all suggest that at times this area might have been used by traffic on both canals and the river.

The three-quarters of a mile between Lift Locks 35 and 34 (the latter at Mile 61.57) is quite isolated due to the Elk Ridge cliffs on the berm side. That ridge is actually a continuation of the Blue Ridge on the West Virginia side of the river, from which it is separated by the first of the Potomac's dramatic double water gaps. (The second is between Virginia's Short Hill and Maryland's South Mountain.) There are class II rapids in this gap known as the Needles, and several long islands that hide major Potomac channels on the river's south side.

At Mile 61.61 a stream flows directly into the canal, there being no room for a culvert that would carry it under the canal. Generally, the engineers used culverts to avoid watercourses emptying into the canal where they would deposit any silt, soil and debris that they carried.

Today at Mile 61.68 there is a bridge over a break in the towpath, and it is unclear if there was ever an overflow or waste weir in the area. One would seem likely, as anywhere that a natural, uncontrolled watercourse entered the canal it was usually necessary to provide for excess water from it to escape. A particularly interesting example of such is seen at Polly Pond above Dam 6 that holds water from Long Hollow at Mile 134.23, and Resley Run at Mile 134.25. A 22 ft. long spillway carries off the excess water here. A similar but smaller situation exists near the foot of Tunnel Hollow at Mile 154.24, where an unusually complex waste weir provided for the outflow of excess water from a stream flowing into a pool on berm.

Lift Lock 34 is located directly below the point where Maryland's historic Harpers Ferry Road drops down to the river. Here, as all along the Potomac in this region, the bed of the river is significantly recessed below the average elevation of the countryside to its north and south. As a consequence, roads approaching the river drop down steeply as they near it, and the Harpers Ferry Road is a good example of this phenomenon.

Lift Lock 33 at Mile 60.7 has been significantly rebuilt or repaired several times, likely because of its vulnerability to floods since it is located opposite the confluence of the Shenandoah and Potomac Rivers. The canal upstream was wide for some distance and served as a basin where boats

could tie up on the berm. It is likely that it also served as a water-holding basin that would help maintain the level of the canal below the lock when the river lock downstream at Mile 60.62, was filled. The large and elaborate masonry bypass culvert here would have allowed for a substantial release of water from the pool above the lock if needed.

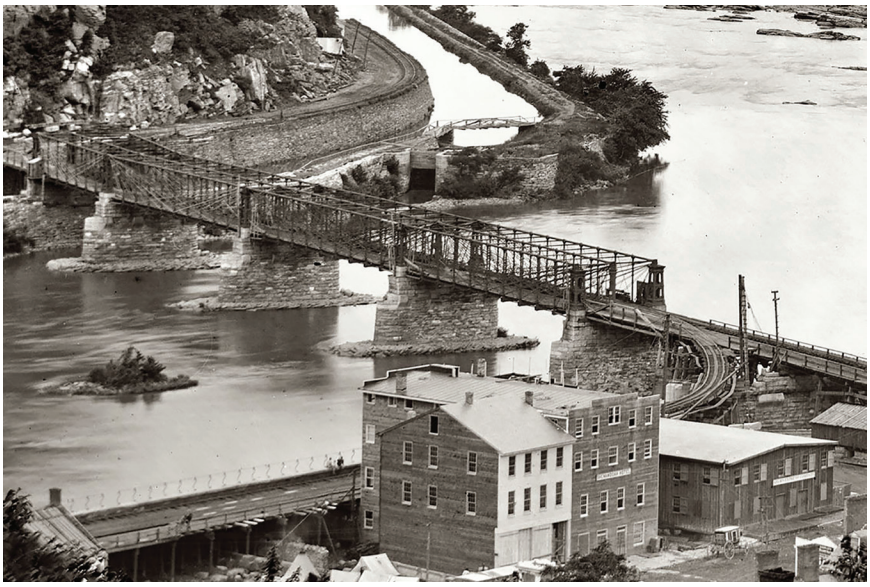
Although little of the river lock remains except for a small amount of the stone at the canal end, this lock would have been very deep as it was, in effect, a vertical elevator from the bottom of the river pool to the surface level of the canal prism at the top. Because the current towpath is lower than it was in historic times, and the river end is missing, it is hard to appreciate (or precisely calculate) the depth of this lock.

We also know that this lock was not constructed for the large canal boats. This created a problem for Union forces after the combined road and railroad bridge across the Potomac at Harpers Ferry was destroyed on Sept. 18, 1862. On Feb. 8, 1863, when General McClellan planned to use the river lock to lower canal boats to the river for use as pontoons for a "permanent" bridge across the Potomac, he learned "that the lock was too small to permit the passage of [canal] boats, it having been built for a class of boats running on the Shenandoah Canal, and too narrow by some four or six inches for the canal boats." (See Snyder, Timothy R. *Trembling in the Balance: The Chesapeake and Ohio Canal During the Civil War*, Blue Mustang Press, 2011, p. 107.) Also note that the so-called "Shenandoah Canal" was in actuality a river navigation system with bypass canals around rapids and mill dams.

Having been built for the shallower draft river boats, there might have been less than 6 feet of water in the lock when set for opening or closing the river gates. To avoid gates as high as the lock's depth at the canal end, it seems certain that those gates were on top of a breast wall (like the upstream gates in the first 25 C&O Canal lift locks). The alternative full-length gates in front of the breast wall would have been extremely heavy and difficult to manage as well as requiring a longer chamber to include the gates. When located on the breast wall, gates need only have been about 8 feet high, allowing for the 6 feet depth of the water in the canal and a couple extra feet above that.

Contrarily, the gates at the river end would seem to have necessarily spanned the entire height of the lock from its bottom in the river to a level somewhat higher than the surface water level of the canal above. Fortunately there is a photo that shows the river end of the lock, revealing a most unusual gate design at the river end: a wall of heavy planks is in place across the upper part of the area for the gate and miter gates are below it, the top of which appear to be flush with the bottom plank (likely forming an effective seal). The means by which the gates were opened and closed would have had to extend from the top of the lock down the plank wall to the gates below. Obviously also, the wall was high enough to allow boats to pass under it.

Some of the same design features on this river lock may have been used on the river lock opposite Shepherdstown at Mile 72.65. However, in the case of the river locks at Mile 30.64 (just one-fifth mile below Edwards Ferry), the engineers had enough space between the canal and the river to use a two-chambered staircase lock (i.e., two locks sharing a common gate) to overcome the vertical distance between the river and canal levels.



View of the river lock, 1865 – Courtesy Shorpy.com www.shorpy.com/node/3436

It was clearly assumed that the river boats using the lock would have been headed downstream toward tidewater, as is apparent for the orientation of the lock at an angle to the canal that would release boats in the downstream direction and receive boats coming up the canal to it. Additionally, the bridge over the opening to the river lock seemed to span a wider area than that of the lock itself, suggesting that there was a space to allow a boat to leave the lock while one waited to enter.

Harpers Ferry was expected to be a major transshipment point between the canal and the fertile Shenandoah Valley. Unfortunately, the canal company was never able to purchase or lease land for a wharf on the Point at Harpers Ferry. If they had, Harpers Ferry's place in C&O Canal history might have been much greater than it was.