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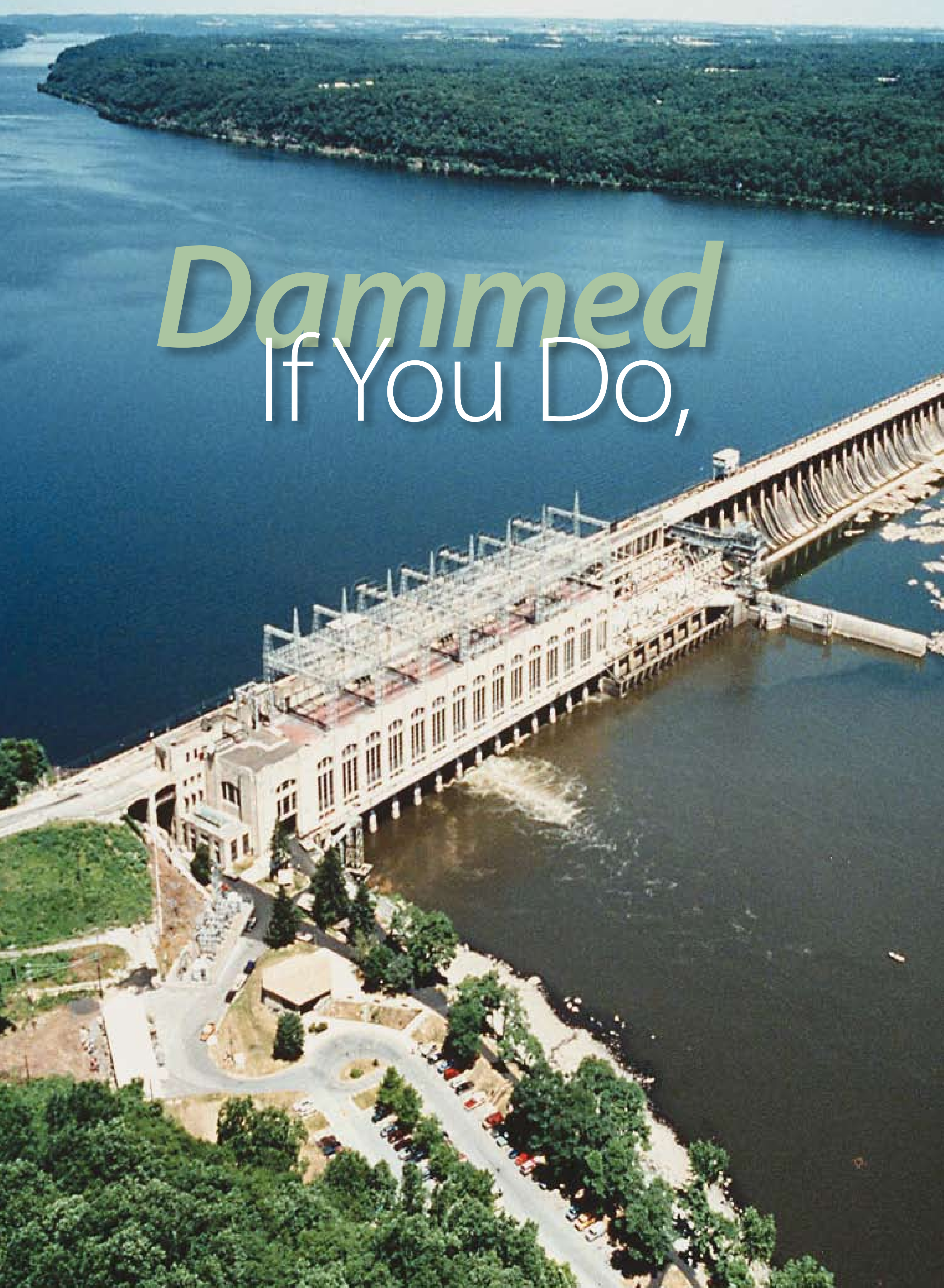
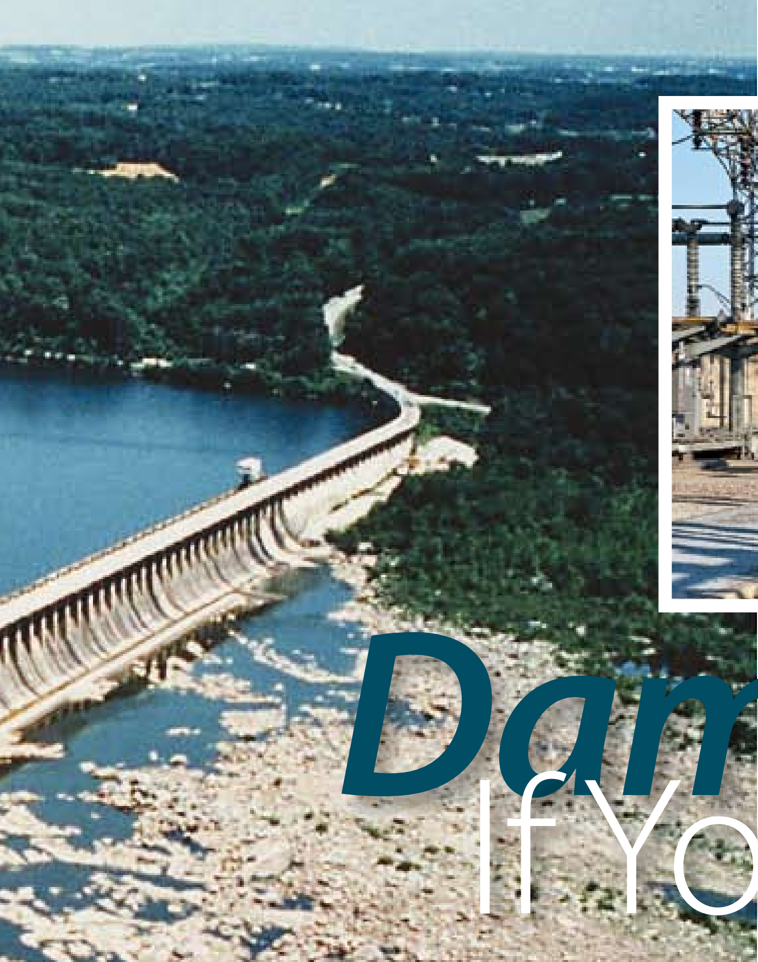




Exelon

Michael C. Wootton

PART 1

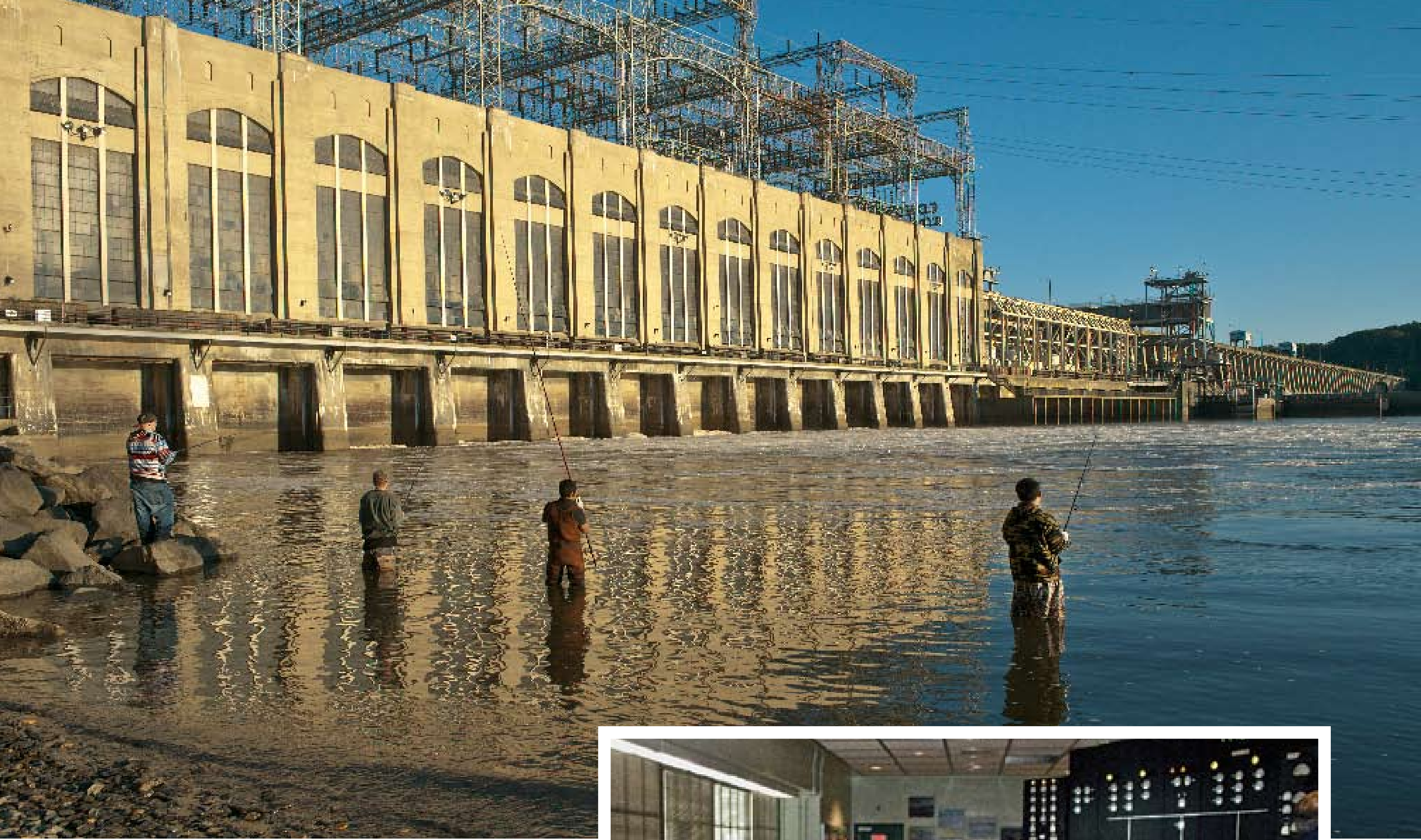
Damned If You Don't

The Conowingo Dam is the Chesapeake Bay's 800-pound gorilla in the room, and it's time we talked about it. So for the next two issues, that's what we're going to do. We're going to get acquainted with our own gorilla. We're going to learn how our gorilla got there in the first place, how it does its job, why it's the best thing that ever happened to the Bay, and why it may very well turn out to be the worst. We'll learn why it's still a force for good, yet holds a ticking time bomb that could virtually destroy the Bay at just about any time. It's a time bomb that nobody wants to do anything about it. Why? We'll see. But first, let's meet our gorilla.

Introductions

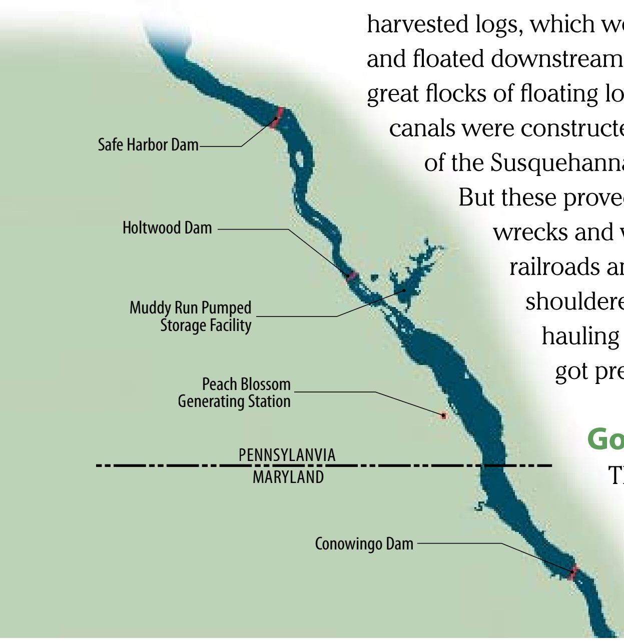
The Conowingo Dam, owned by Exelon Energy Corporation of Chicago, lies across the Susquehanna River between Harford and Cecil counties in Maryland, a mere ten miles upstream from the river's mouth at Havre de Grace. Ten miles? That would seem too far downstream to barricade such a mighty river. And the Susquehanna is nothing if not mighty. Each day, the Susquehanna pours an average of three billion gallons of fresh water into the Chesapeake Bay. It furnishes 90 percent of the upper Bay's fresh water, and 50 percent of the entire Bay's supply. It is, in point of fact, the longest river on the East Coast, covering 448 miles from its origins at the south end of Otsego Lake near Cooperstown, N.Y., to Havre de Grace at its mouth. To barricade a river at mile 10, not to belabor the point too much, would be like building a dam across the Potomac River between St. Marys River and the Yeocomico. Yes, certainly, 10 miles would be too soon . . . *if* the Susquehanna were a navigable river. But it isn't. Not really. Even the peripatetic Captain John Smith was halted 10 miles upriver by shallow water and a roadblock of boulders that he named Smith Falls (okay, specifically "Smyths fales").

Not that people haven't found ways of negotiating vast stretches of the Susquehanna one way or another. Native Americans in canoes came and went by river, leaving behind them in some unmeasured past rock carvings, or petroglyphs, of yet undetermined meaning.



Michael C. Wootton photos; Beth Walsh map

Above: Fishermen below the dam. Before 9/11, fishermen could use the catwalk on the dam. Right: Controller Bob McKee. He's been with the company 31 years, 7 of them in the control room. Preceding pages: A pre-9/11 aerial view of the Conowingo Dam and (inset) the view from the roof of the dam's power station.



A couple of centuries after Smith was brought up short at the fall line, entrepreneurs stripped Pennsylvania's forests of timber and then gouged millions of tons of coal from its mountains. They moved the raw materials downriver to waiting ships at Port Deposit and Havre de Grace using great arks of newly harvested logs, which were piled with cargo and floated downstream, often shepherding great flocks of floating logs as they went. Later, canals were constructed to bypass the worst of the Susquehanna's rocky barricades. But these proved to be economic train wrecks and were abandoned as railroads and eventually highways shouldered the responsibility of hauling cargo. Life on the river got pretty quiet.

Good Gorilla

Then came the age of cheaply produced hydroelectric power, and everything on the river changed forever. Early in the 20th century millions of people living in rural areas throughout the United States were still without electricity. Water-generated power seemed to be the solution. Late in the preceding century, engineers had learned how to couple hydraulics with electric generators to produce low-cost power. In 1881, Schoelkopf Power Station No. 1 near Niagara Falls began producing electricity. By 1886, there were 45 hydroelectric power plants in North America; by 1889 there were about 200 in the United States alone; and by 1920 some 40 percent of the power produced in this country was hydroelectric.

Hydroelectric power has a lot to be said for it, even now. Once constructed, a hydroelectric plant needs no fuel—no coal, no uranium, no petroleum. It needs only the force of water to sustain its production of electricity. Nor does it emit harmful byproducts. It pollutes neither air nor water. In addition, it needs only basic and consistent maintenance to sustain its operations. The Conowingo Dam, for example, continues to use nearly all of its original equipment more than 80 years later.

It's little wonder then that bigger and bigger dams were constructed. In 1936 Hoover Dam's 1,345 megawatt plant became the largest in the world, but that was soon surpassed in 1942 by the Grand Coulee Dam. In 2008 China's Three Gorges Dam project became the largest in the world, producing a staggering 22,500 megawatts of power. (How big is a megawatt? The common example is that one megawatt can power a thousand homes.)

When the Conowingo Dam came online in 1928, it was no spider monkey among hydroelectric gorillas. Producing 252 megawatts of power, it was then the second largest hydroelectric project in the country after Niagara Falls. In the 1970s, four more generators were added and production rose. The dam currently generates 572 megawatts of power, enough to qualify it as a major-league hydroelectric dam.

A Band of Brother Dams

The Conowingo, however, was not the first dam to span the lower Susquehanna River. That distinction belongs to the Holtwood Dam, which opened in 1910 as the McCalls Ferry Dam and which is now owned by Pennsylvania Power & Light (PPL). (As an example of the longevity of hydroelectric equipment, one particular part in the Holtwood Dam's No. 5 generator—specifically the Kingsbury thrust bearing—has been designated an International Historic Mechanical Engineering Landmark because it has been in use since 1912!) At 55 feet in height and 2,392 feet in length, the Holtwood is about half the size of the Conowingo and produces commensurate wattage. After a century of operation, work began last year to increase Holtwood's production to 230 megawatts by 2013.

The newest of the three hydroelectric dams on the lower Susquehanna is Safe Harbor Dam, which was completed in 1931. The dam is co-owned and operated by PPL and Constellation Energy and generates 417 megawatts.

Exelon also owns two nuclear power plants on the Susquehanna: Peach Bottom Atomic Power Station (which it co-owns with Public Service and Gas of New Jersey) and Three Mile Island Nuclear Generating Station.

You can see that the Susquehanna is a very busy place. And these facilities account for only what's on the lower Susquehanna. The entire river is practically chock-a-block with dams and generating stations, from Goodyear Lake dam in upstate New York to the Conowingo in the south.

But our subject is the Conowingo. So let's get back to business and meet Earl Hopkins.

Birth of a Gorilla

Earl Hopkins played only a minor role in the massive undertaking of men and machinery to construct the Conowingo Dam. But, years after the fact, it is Earl Hopkins whose name survives, having captured the imagination of the press, not once but twice. The first time was in 1928 when he drove the first car across the newly completed dam. The second was half-a-century later, when he was first across once more, this time as a passenger in a 1928 Lincoln, with Maryland Governor Harry Hughes at his side. The occasion was the rededication of the dam following a major renovation and expansion in the 1970s. Oddly enough, Earl Hopkins was just a regular Joe, one of the thousands of workers hired to work on the dam, and not a major player—like, for instance, the president of the Susquehanna Water Power and Paper Company of Harford County, or the CEO of Philadelphia Electric Company (PECO), both of whom certainly had a lot more to do with the building of the dam.

It was Susquehanna Water Power that initially acquired the thousands of acres of land necessary for the project and then built a small wing dam at the Conowingo site in 1905, before selling out to Susquehanna Power Company. That company tried to construct a major dam on the site, but didn't have the economic clout to push the deal through. That was left to PECO, a much

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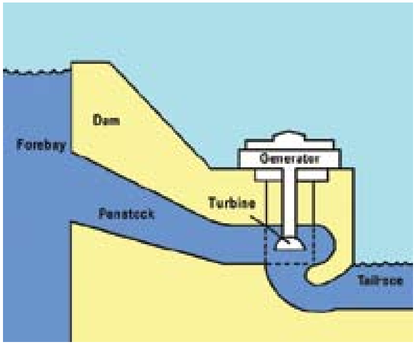
Below: A cutaway diagram of a power-generating dam. Bottom: Conowingo's Turbine Hall, one of a series of photos of the dam made by photographer Theodor Horydezak. Here you can see the dam's seven original turbines.



U.S. Department of the Interior

Library of Congress

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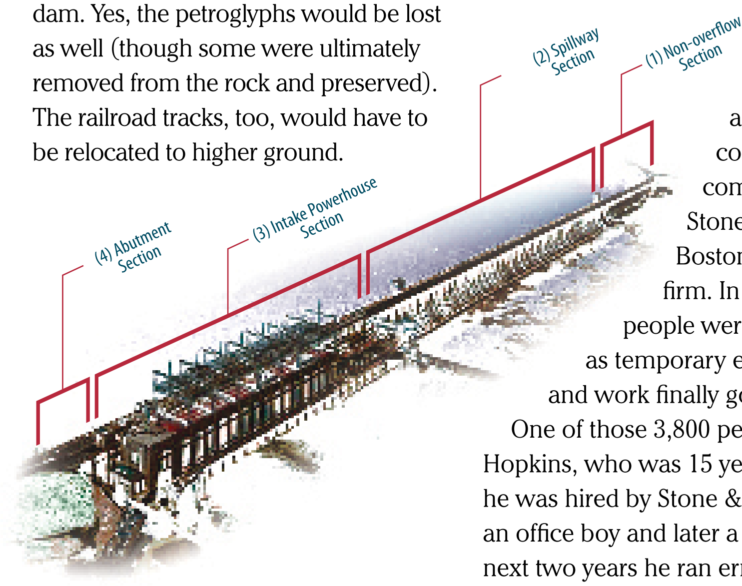
larger and wealthier corporation, which purchased the Conowingo site and the notion of a large hydroelectric dam 20 years later. PECO set about putting the plan into action and began building our gorilla. Yes, the town of Conowingo would be drowned in the 14-mile-long lake that would be formed behind the dam. Yes, the petroglyphs would be lost as well (though some were ultimately removed from the rock and preserved). The railroad tracks, too, would have to be relocated to higher ground.

And what about the millions of shad that swim up the Bay from the Atlantic Ocean each year to spawn in the Susquehanna's tributaries? Yes, they would be butting their heads against a mile-wide wall of poured concrete. Too bad. This was declared the right spot for the dam, so this is where it would be.

With its plans drawn up, PECO awarded contracts for the $50-million project to Arundel Corporation, a Maryland construction company, and to Stone & Webster, a Boston engineering firm. In 1926, 3,800 people were signed on as temporary employees and work finally got under way.



One of those 3,800 people was Earl Hopkins, who was 15 years old when he was hired by Stone & Webster as an office boy and later a driver. For the next two years he ran errands for the company . . . and for the workers. He drove trucks carrying construction materials and he drove a kind of informal taxi to fetch food and cigarettes, as well as less legal provender such as bootleg liquor—this was Prohibition after all. The story is told that one of Earl's tasks was to drive a busload of French-Canadian woodcutters to the brothels of Havre de Grace on Saturday, then get them all back onto the bus later that night for the trip back to Conowingo.

For two years, Hopkins and the thousands of other employees labored on the dam. Materials were brought to the site by train. A town was built to house the laborers, and a smaller, finer town was built for the loftier job-holders, like engineers, foremen and executives. Teams of mules were brought in to haul out trees and rocks and then smooth the land for the soon-to-be relocated rail line. Meanwhile, huge cofferdams, constructed of eight million feet of timber, were built to part the river and allow construction of the dam.

At last, the work was done. As news photographers snapped pictures and a raft of reporters took notes, Earl Hopkins drove down U.S. Route 1 and over the brand new Conowingo Dam. Why Earl? He just happened to be there making a delivery. "Earl Hopkins drives first car across the Conowingo Dam," the headlines read the following day. It was, in fact, a truck rather than a car, loaded with lampposts—and, just perhaps, a couple of gallons of illegally distilled whiskey stowed safely under the seat. No matter. The dam was done and the new gorilla was ready to roar.

Anatomy of a Gorilla

The Conowingo was built as a gravity dam—that is, it was held in place by its weight alone—using from 435,000 to 660,000 cubic yards of poured concrete (the number is given variously) on a solid rock formation of granite and diorite. It was *built* as a gravity dam, but in 1978, the dam was upgraded after it was nearly shaken loose in 1972 by the catastrophic event known as Hurricane

Agnes (we'll have much more to say about this catastrophic event later on). The dam was anchored to the bedrock by 537 stranded wire tendons that were snaked 105 feet through the dam and then 60 feet into the bedrock below.

When it was completed the new dam spanned the river with a latitudinal run of nearly a mile—4,648 feet to be exact—and an average height of 94 feet. It has four distinct sections, which are, east to west: (1) the 1,190-foot-long non-overflow section; (2) the 2,385-foot spillway; (3) the 950-foot-long intake powerhouse section; (4) and the 100-foot long abutment section. (You can see the Conowingo's four sections on the diagram at left.)

Generally, the water level of the forebay is (theoretically) never going to be allowed to reach the top of the 115.7-foot-high non-overflow section. Instead, most of river's flow and the forebay's rise can be dealt with in times of high water by opening up to 50 of the crest gates (aka flood gates) located at the 87-foot level of the spillway section. If necessary, two higher gates, at the 99-foot level of the spillway, can be opened as well. These impressively heavy crest gates, each of which is 22.5 feet high by 38 feet wide, are hauled open by gantry cranes—one 90-ton and two 60-ton cranes—that slide ponderously along rails from gate to gate.

The opening of crest gates is a subject of great interest to the people who live downstream from the dam, especially those in nearby Port Deposit. Five, 10 or even 15 open gates cause little or no concern, but when the number pushes beyond 30, the likelihood of flooding grows to a near certainty. In January 1996, for example, PECO opened 39 gates to relieve pressure from colossal mountains of ice that had built up behind the dam, but gave little advance warning to Port Deposit residents. Most of the townspeople managed to evacuate, but the town's 100 new condominiums suffered extensive ice and water damage, and a number of boats were smashed, sunk or washed out into the Bay. Happily, warning systems have improved, and Exelon has been conscientious about alerting residents before it opens the crest gates.

But let's complete our tour of the dam. Inside the powerhouse section, the heart and soul of the Conowingo Dam, lie the seven original turbine/generating units; outside the powerhouse there are four additional units that were added half-a-century later and after the dam had been anchored into the bedrock. The inside turbines produce from 54,000 to 64,000 hp each at best efficiency, while the outside turbines produce a considerably more robust 85,000 hp each. The original turbines are housed in an immensely tall, immensely cavernous, immensely impressive room, known as Turbine Hall. With its palisade of 16 floor-to-ceiling windows (which can be opened to cool the hall in summer), its finely wrought, meticulously cared-for 80-year-old machinery, its 1920s sensibility of fine detail, Turbine Hall is hard to compare with anything we see on a regular basis. Imagine *Willy Wonka's Chocolate Factory* (either version), by way of Fritz Lang's *Metropolis* and you'll begin to get the idea.

At the east end of Turbine Hall is the control room, where a controller sits behind a bank of computer screens that give a second-by-second accounting of all the turbine measurements, the water levels on both sides of the dam (five points if you automatically thought "forebay" and "tail race"), the water temperatures on both sides and the amount of oxygen in the water in the forebay. (That fairly stagnant water is kept sufficiently oxygenated by blowing air into it if necessary so the fish don't die while waiting to shoot through the turbines or floodgates.) The controller also monitors the flow rate and—here is the raison d'etre of the whole shebang—how much electricity the dam has been assigned to produce at any given time, depending on demand and a hundred other factors. The electricity is produced, sent off for storage and then sold to willing buyers. On the walls opposite the bank of computers are two earlier sets of controls. On the left is a wall of black-faced gauges used by the earliest controllers, who had to memorize 400 individual procedures before they could be control-room qualified, a learning curve that commonly spanned 25 years. On the right is an array of more modern instruments, set into a wall painted in that popular institutional color of the more enlightened 1960s known as "eye-rest green."

Leaving the dam itself, we come, finally, to Conowingo Pond, the dam's 14-mile-long forebay, which was created by water backed up as the dam was constructed. As predicted, the rising water took with it all trace of that area's long history, including farms, inns, the entire town of Conowingo and many of those ancient rock carvings. In their place, the pond has come to provide a number of useful services. First, of course, it provides the fall necessary to produce the electricity the dam was put there for in the first place. In addition, It provides cooling water for Peach Bottom Atomic Power Station seven miles upstream and serves as a lower reservoir for Muddy Run Pumped Storage Project 12 miles upstream. It serves as a water source for the City of Baltimore and the Chester Water Authority. And it offers recreation for boaters and fishermen—as does the tailrace on the dam's downriver side. In addition, the tailrace in particular has become a popular spot for bald eagles, who gather sometimes by the dozens to pick off fish attracted by the dam's out-flowing water.

The Dark Side of the Gorilla

Well, that's our gorilla, from forebay to tailrace and from powerhouse to crest gate. He's a fine looking fellow . . . big, powerful, useful. And eminently dangerous. Yes, it's time to move on to the "scary gorilla" part of our story. Next month, we'll take a good look at why the best thing the Conowingo Dam ever did for the Bay is going to turn out to be the worst.

What is the best thing the Conowingo has done for us? From the very beginning, the dam has trapped behind it an average of 3.5 million pounds of phosphorus and 2 million tons of dirt every year. That's about a third of the phosphorus and half the sediment moving down the Susquehanna toward the Chesapeake. But instead of finding its way into the Bay, these millions of pounds of dirt and millions of tons of phosphorus are stopped by the dam and then settle onto the bottom of Conowingo Pond. And that's a good thing. In fact, it's a great thing! So what's the problem? The problem is one of multiplication. If you take 2 million tons of dirt and 3.5 million pounds of phosphorus (and a lot of miscellaneous stuff like coal dust and PCPs) and multiply that by the number of years it has been piling up behind the dam, you get a very big figure. A figure so large that within a few years it will equal the storage capacity of the pond. In other words, the pond is going to be full. So what will happen when the pond runneth over? That's what we're going to look at next month . . . and the picture is not a pretty one.

Consider Hurricane Agnes. In 1972, Hurricane Agnes dumped so much water on the northeast U.S., and ultimately into the Susquehanna River, that the Conowingo was forced to open *all* of its crest gates. Along with the great torrent of water that flooded through—in addition to the debris and cows, cars and fuel tanks—came years' worth of trapped sediment. So much sediment poured into the Bay that it took years for the grasses and marine life in the northern Bay to recover. So what would happen to the Bay if we were to get another Agnes, now that there is 30 years more sediment built up behind the dam? That's our gorilla's ticking time bomb.

But there's a human side to this story as well. You'll be pleased to know that Earl Hopkins will be back. And we'll meet Earl's son, Mark Smith. Mark was working in the dam during Hurricane Agnes, and he has a harrowing tale to tell. There will be others too. But we'll save all that for next month in the second part of our series. ⚓

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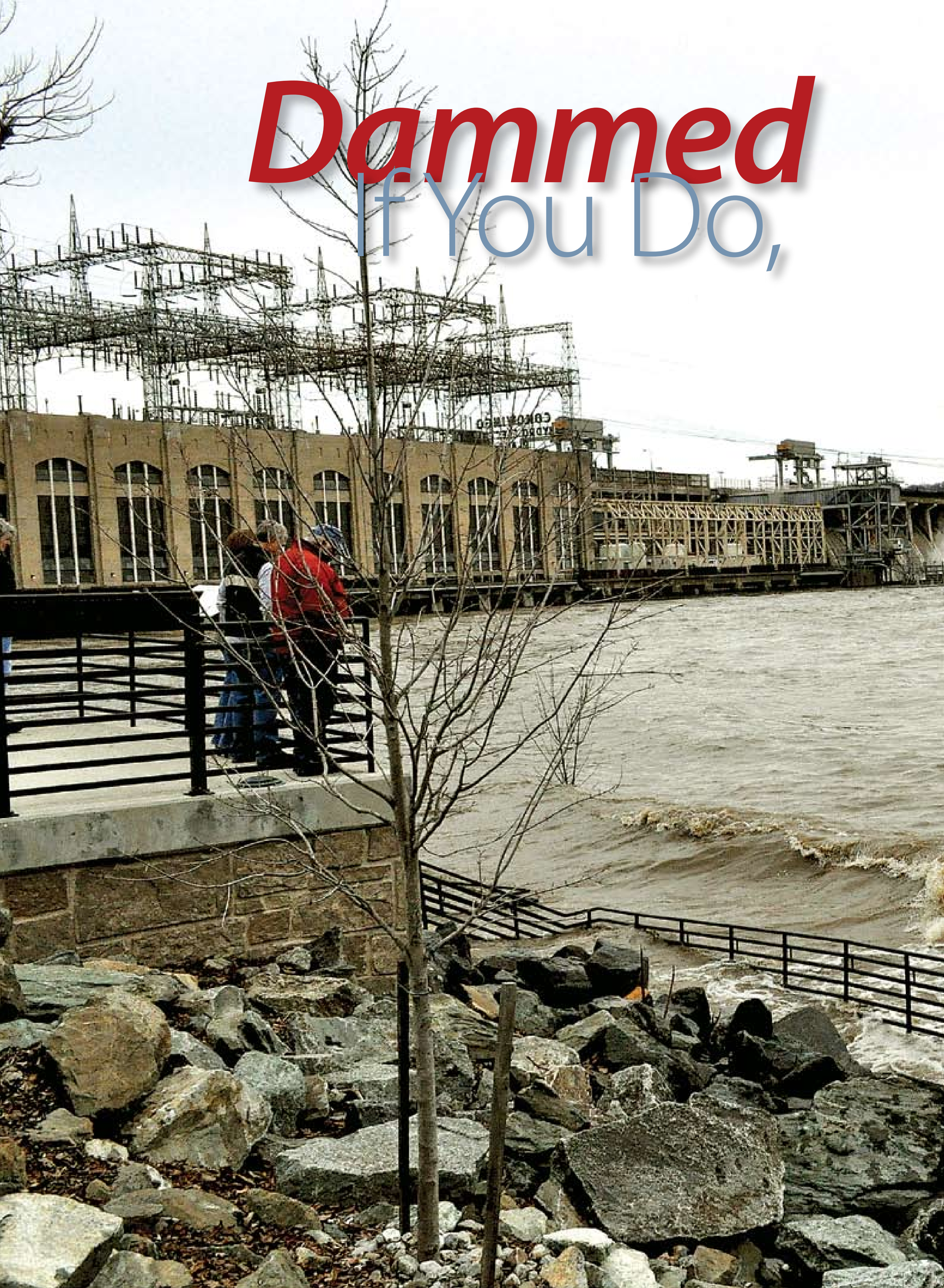
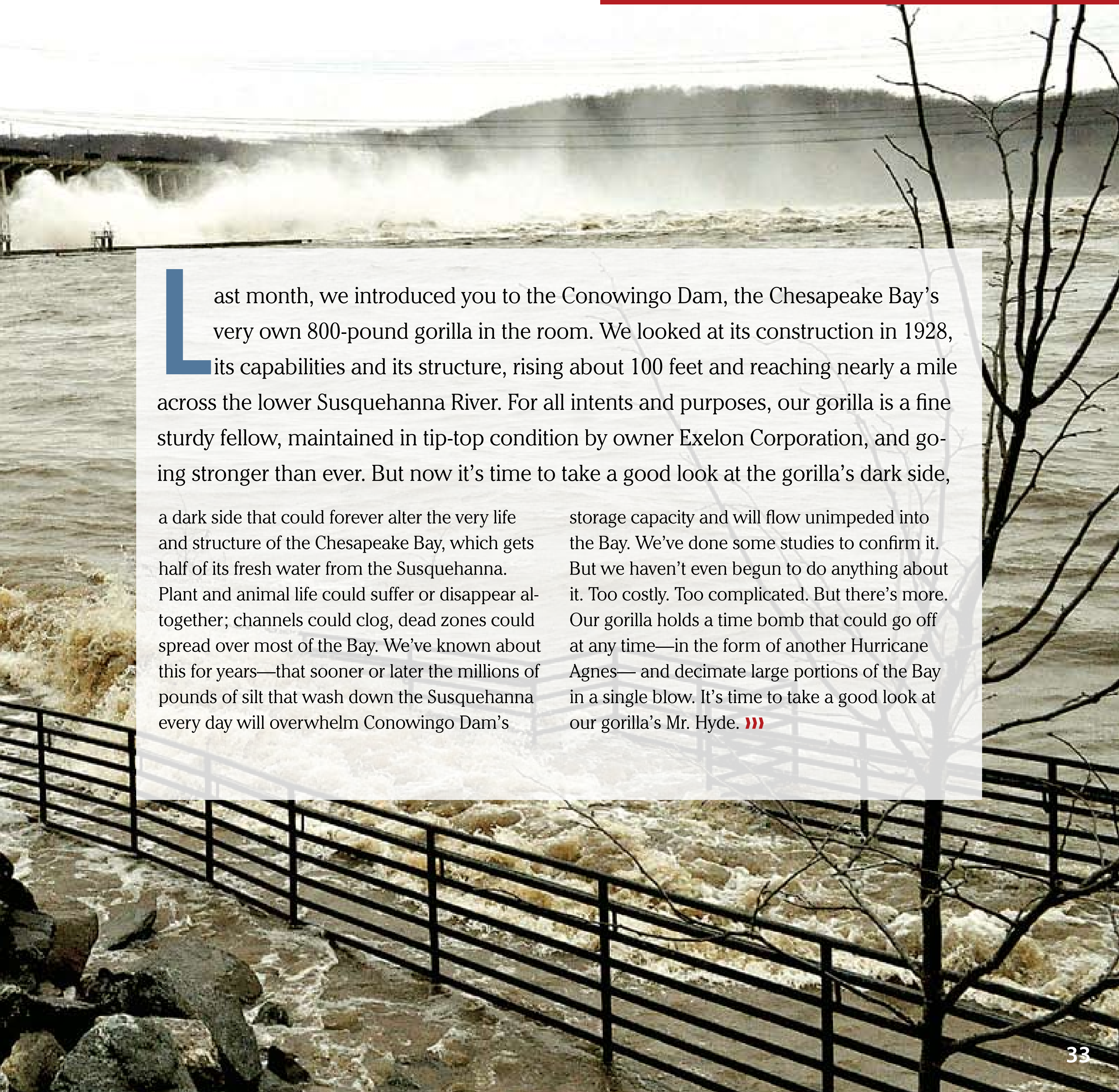


Damned If You Don't

PART 2



Last month, we introduced you to the Conowingo Dam, the Chesapeake Bay's very own 800-pound gorilla in the room. We looked at its construction in 1928, its capabilities and its structure, rising about 100 feet and reaching nearly a mile across the lower Susquehanna River. For all intents and purposes, our gorilla is a fine sturdy fellow, maintained in tip-top condition by owner Exelon Corporation, and going stronger than ever. But now it's time to take a good look at the gorilla's dark side, a dark side that could forever alter the very life and structure of the Chesapeake Bay, which gets half of its fresh water from the Susquehanna. Plant and animal life could suffer or disappear altogether; channels could clog, dead zones could spread over most of the Bay. We've known about this for years—that sooner or later the millions of pounds of silt that wash down the Susquehanna every day will overwhelm Conowingo Dam's storage capacity and will flow unimpeded into the Bay. We've done some studies to confirm it. But we haven't even begun to do anything about it. Too costly. Too complicated. But there's more. Our gorilla holds a time bomb that could go off at any time—in the form of another Hurricane Agnes— and decimate large portions of the Bay in a single blow. It's time to take a good look at our gorilla's Mr. Hyde. ›››

Dark Side of the Gorilla: Diagnosis

As the Susquehanna River works its way nearly 500 miles downstream from upstate New York, it picks up millions of tons of sediment—run-off from city sewer systems, from hundreds of farms, mall parking lots and abandoned coal mines. A great deal of this sediment makes its way into the Chesapeake.

While the Susquehanna contributes 50 percent of the Bay's fresh water, it also contributes 25 percent of its sediment and the lion's share of its nutrient load: 66 percent of its nitrogen and 40 percent of its phosphorus. That's a lot . . . but it could be worse. Before the Susquehanna reaches the Bay, it runs into a mighty roadblock: the Conowingo Dam. The dam traps 60 to 70 percent of the sediment, 40 percent of the phosphorus and 2 percent of the nitrogen. As a result, millions of tons of sediment and nutrients have accumulated behind the Conowingo, as well as the two smaller dams immediately upstream from it—Safe Harbor and Holtwood.

In the last decades, however, the storage ponds behind both Safe Harbor and Holtwood have filled to capacity, leaving the Conowingo as the Bay's last defense. A 2009 study by the U.S. Geological Survey (USGS) estimated that over its lifetime the Conowingo has accumulated 174 million tons of sediment (not to mention 670,000 tons of nitrogen and 130,000 tons of phosphorus). But Conowingo's storage capacity too is reaching its limit—estimated to be 204 million tons. That leaves room for only an additional 30 million tons. So the crucial question is: When will the Conowingo's storage pond reach its capacity?

The crucial question: When will the Conowingo's storage pond reach capacity?

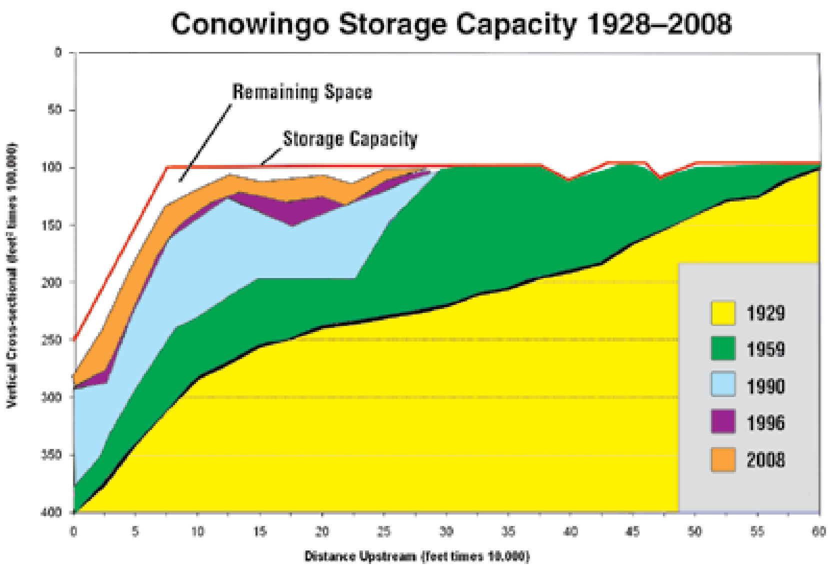
The arithmetic is straight forward: The Susquehanna currently transports downstream an average of 3 million tons of sediment a year, about 2 million of which settles out behind the dam. That means that the Conowingo could reach its capacity for storing sediment—also called its "steady state"—in 15 to 20 years, depending on a number of variables.

It is here that we get a glimmer of good news. The amount of sediment flowing downstream is decreasing dramatically—from more than 100 million tons per year in the 1930s to the current level of 3 million tons per year. Between 1996 and 2008, it was even lower than that, with a total of only 14.7 million tons deposited behind the dam. This was due in large part to lower-than-average rainfall, better soil management practices upstream and a few "scouring" events. The last, as its household-cleaner name implies, occur when the rush of water coming down the river is so terrific that it flushes some of the stored sediment with it through the dam and into the Bay. Scouring events follow large rainfalls and snowmelts upstream . . . or large hurricanes, such as 1972's Hurricane Agnes, the mother of all Susquehanna scouring events. (We'll have more to say about scouring events a little bit later.)

Meanwhile, this decrease in sediment flow may buy us more time. If the amount of sediment continues to decrease, say to 2.5 million tons a year, steady state might not be reached for another five years beyond the estimated 15 to 20. Beyond that, if the statistically predicted number of scouring events occur, an additional five years might be gained, the USGS study says. Finally, if recent regulations that establish best practices for land management survive and are put into practice, sediment will be further reduced in the next few years. But will that be enough? No, says Michael Helfrich, the Lower Susquehanna Riverkeeper and a latter-day John the Baptist for the Conowingo sediment issue. "If we were able to *completely stop* sediment from entering

Below: A NASA satellite image from 2007 showing sediment-clouded water reaching down the Bay, courtesy of the rains of Hurricane Ivan. Bottom: A graph of the Conowingo Dam's dwindling storage capacity, based on the U.S. Geological Survey's 2009 bathymetry study.

Preceding pages: The Conowingo Dam with 26 gates open on March 12.



the Susquehanna today," he says, "it wouldn't be enough. There is already enough sediment in the system, working its way downriver to fill up the remaining storage room. Sediment would continue to flow up to 50 years after . . . best management practices were put into effect."

When the Conowingo's storage capacity reaches steady state—and right now that seems inevitable—"as much material that is coming down the river will go [through] the dam and come eventually into the Bay," explains Dan Bierly of the U.S. Army Corps of Engineers. And this, he continues, "is a great concern, not just from the dredging aspect, but from the environmental aspect." Specifically, according to the USGS, this will mean a 250-percent increase in sediment entering the Bay, a 2-percent increase in nitrogen and a 30- to 40-percent increase in phosphorus. According to the Chesapeake Bay Program's Scientific and Technical Advisory Committee, the added sediments and nutrients would dramatically increase algae blooms, smothering underwater grasses, which are vital habitat for blue crabs and young fish. Further, it would increase turbidity and clog navigation channels. And it would clog the gills of fish and cover their eggs.

All that doesn't even reflect the evils contained within the sediment itself. A core sample of sediment taken from the Conowingo Pond in 2006 by the USGS for the Susquehanna River Basin Commission found that in addition to the expected sand and soil, the sediment contained significant amounts of coal, some toxic metals, silver at lower levels, PCBs, methane gas, phosphorus, antibiotic-resistant bacteria and even low levels of radiation.

The Big Scour: A Time-Bomb Scenario

All of the calculations and predictions above assume a fairly even flow of water and sediment—an average. The Susquehanna, however, is many things, but never average. From season to season and year to year its flow and sediment rate changes dramatically with meteorological events such as rain, drought and snow melt. Several times a year, usually in the spring, the flow increases to such a degree that Exelon is forced to open some of the dam's spill gates to ease the pressure from the rising water behind the dam. Occasionally, the flow is high enough to scour some of the sediment laid down earlier. Then the turbidity of the water increases with the added sediment, muddying the Bay as far south as the Chesapeake Bay Bridge. Very occasionally, the scouring is severe enough to produce a measurable effect on the health of the Bay. The worst such event in the history of the Conowingo Dam came in 1972, when Hurricane Agnes dumped 8 to 10 inches of rain over the Mid-Atlantic and Northeast, sending a battering ram of water and debris down the Susquehanna that nearly overwhelmed the dam,

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Top: A riverside playground in Port Deposit, Md., on March 12, when 26 spill gates were open upstream at the Conowingo Dam. Above: Lower Susquehanna Riverkeeper Michael Helfrich in his Yorktown, Pa., office.

DAMMED IF YOU DO . . .

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and subsequently the Bay.

Over the course of four days in June, torrential rains from Agnes washed an estimated four years worth of sediment out of New York and Pennsylvania toward the mouth of the Susquehanna. When it reached the Conowingo reservoir, it scoured another eight years worth of sediment from that repository. Altogether an estimated 30 million tons of sediment washed through the spill gates of the Conowingo and into the Chesapeake. It was the biggest single "catastrophic" event ever recorded on the Bay. The silt laid down by Agnes killed nearly all of the underwater grasses in the upper Bay. It has taken three decades for them to recover. (For a more personal look at what it was like inside the dam during Agnes, see the

Inside a Catastrophic Event

As the flood waters from Agnes arrived, the employees inside the dam worked feverishly to dump the accumulated water and debris. Mark Smith, a turbine operator, was one of them. Even with all of the spill gates open, the water continued to rise inside the floor of Turbine Hall. "It was within inches of flooding the power station," he remembers. " The water was running into the plant as fast as we could pump it out. If one of those pumps had given out, the power house would have floated away." The dam had borrowed pumps and trucks from area fire department and rescue squads. "If a pump stopped, we were ready to abandon the dam." Conowingo Pond was higher than it had ever been and there was a plan to blow a hole in the Cecil County end of the dam to keep it from falling over. The dynamite had been put in place, ready to go if the worst came.

That morning, Smith had returned from checking his charter fishing boat, which he kept on the Delaware Bay. "I was the last car across to make it up the road," he says. "By ten a.m. we knew we were going to open the gates. The river came up so quick that once they sidebar below.)

Agnes may have been the worst scouring event in the dam's history, but it certainly wasn't the only one. A massive ice-jam flood in January 1996 dumped nearly as much sediment into the Bay as Agnes, but it had considerably less effect on its plants and animals because it took place before the beginning of the growing season. More recently, in late September 2004, there was Hurricane Ivan, which moved across the northern states, dumping torrential rain as it went. The flow through the Conowingo Dam reached nearly 550,000 cubic feet per second, the highest since Hurricane Agnes. Photos taken by a NASA satellite show the sediment spreading well below the Chesapeake Bay Bridge.

More scouring events will occur. That's a certainty. What's not a certainty

started pulling them, they pulled them all." The water continued to rise. "We didn't know when it was going to stop. Dead cows, house trailers, oil tanks, docks, boats, all came washing through the gates."

A foot short of the plant's power station, the water halted, and disaster was averted. A few years later, the dam—which until then had been held in place only by the force of its own weight—was anchored solidly to the bedrock underneath with a network of steel rods.

As a footnote to this personal history, Mark Smith—long since retired from working at the Conowingo Dam—lives in nearby Darlington, Md., in the house once owned by his parents. Smith's father was Earl Hopkins, the same Earl Hopkins who drove the first car across the Conowingo Dam on its completion in 1928 and then again in 1976, when the dam had been reinforced and reopened following Hurricane Agnes. Hopkins had continued to work for the dam's owner, Philadelphia Electric, until his retirement in 1972, the same year that Agnes shook up the Conowingo Dam . . . and his son.

is when, how many and how severe. A Hurricane Agnes is a rarity, but not an anomaly. At some point, there *will* be another Agnes. Or worse. It's a certainty that keeps Riverkeeper Helfrich awake at night, because when that day comes, all hell is going to break loose on the Bay. In the years since Agnes, millions of tons of additional sediment have built up, so that when that next "catastrophic" event comes, Helfrich says, it will certainly scour even more sediment than Agnes did. USGS hydrologist Mike Langland agrees. "There is more there to be scoured," he told *Bay Journal*'s Karl Blankenship in 2009, "and it is probably in areas that would be more rapidly scoured—closer to the dam."

Disarming the Gorilla: Can It Be Done?

The short answer to that question is: We don't know yet. It's not as if the problem of steady state and catastrophic scouring events has just cropped up. It has been discussed and studied for years. Yet it's still a problem without a solution. There are a number of ideas that have been kicked around during a number of studies, but there has yet to be a study to determine the best and most cost-effective solution. Why not? One reason is that studies are expensive and none of the political entities involved has wanted to spend a lot of money to be told they are going to have to spend a great deal *more* money fixing the problem. Because the one certainty is that all of the possible solutions anyone has come up with so far are expensive . . . very expensive . . . mind numbingly expensive.

So there are some ideas but no solution. For example, a Sediment Task Force convened in 1999 by the Susquehanna River Basin Commission made some recommendations, including reducing sediment with stream buffering and best land management practices and asking the Army Corps of Engineers to study the feasibility of dredging the storage basin. A few years ago, Congress assigned the Corps the task of looking into sediment reduction plans. "Congress has told us to undertake a study to consider the material behind the dams and decide what to do with it," the Corps' Dan Bierly said at a 2002 public meeting. But the Corps has had a hard time finding a partner willing to share in the expense of a study. Their first proposed study found no takers. Recently they have returned with a less ambitious proposal (with a lower matching-funds requirement).

In 2009, the USGS did a bathymetric study of the Conowingo reservoir to measure its capacity, its current level of fill and the chemical makeup of the sediment. Other groups—often with much the same participants—have held other meetings and other studies in other years, beginning in the mid-1990s. But all of these have focused more on determining the exact nature of the problem and the timetable for reaching steady state than on finding the best way to fix it.

Not that the problem lacks for suggested mitigations. First and foremost among these is the call to stop the sediment from entering the Susquehanna at all. And indeed recent EPA policy has laid out a timetable for best land management practices for the Susquehanna Basin Watershed and even more recently set regulations for total maximum daily loads (TMDLs), which would limit the amount of runoff and pollutants permitted for each grid of land per day. However, the TMDLs have raised a furor among some farmers, and the Farm Bureau has sued the EPA to stop their implementation.

The suggested mitigation most often heard is to dredge the sediment and then relocate it. If it could be done, it would certainly open up room in the storage basin. But the proposal brings with it a lot of baggage. For example, how would you capture the sediment—which is fine and easily stirred up into the water above? And then, if you did manage to capture it, what would you do with it? First, you would have to find a way to transport it, probably by train or by truckload. And if so, how many train- or truckloads would it take? How much would you need to dredge? At least 2 million tons a year, just to keep up with the yearly load. Then, where would you take it? Suggestions have been made that include everything from abandoned quarries to the Aberdeen Proving Grounds. But each of these has problems of its own. The dredged sediment would quickly fill all of the quarry basins available, and Aberdeen has unexploded-bomb issues that would first have to be overcome. Furthermore the sediment is polluted, and the pollutants could leach right back into the soil and eventually back into the river. Several proposals have called for reusing the sediment. One interesting idea is to burn it in a kiln constructed nearby to expunge the pollutants before turning it into aggregate for cinder blocks or other construction material. The kiln, of course, would produce destructive greenhouse gases, but would produce a sellable product.

An idea that perhaps carries more weight and a lower price tag is something called sand-bypassing. Sand is actually good for the Bay. The catch basin behind the dam contains plenty of sand—and thanks to its bathymetry study, the USGS even knows where the sand deposits within it. Sand-bypassing would involve moving the sand (in a manner yet to be determined, of course) through the dam and out the other side, making more room in the storage pond. Happily, the river bottom for some distance in front of the dam is short of sand, since the dam prevents the natural bottom shift that would otherwise occur. The sand also could be used on beaches and for rebuilding islands.

Helfrich's half-serious solution would be a lot less expensive. "We should pray for a series of scouring events that would be big enough to move a lot of the stored sediment, but not big enough to damage the Bay."

When all is said and done and a solution is finally devised, who's going to pick up the tab for putting it into action? The line is a very short one. The Susquehanna River states of Maryland,

Dammed if you do . . .

Pennsylvania and New York are all up to their eyebrows in financial "scouring" events of their own. None of them has yet stepped forward. Nor has dam owner Exelon, which holds fast to the argument the dam has long been a help rather than a hindrance. "Anytime it rains," says Mary Helen Marsh, director of environmental operations for Exelon and former general manager of Conowingo Dam, "cows, buildings and everything else ends up in the river behind one of the dams. Holtwood, Safe Harbor and Conowingo are actually holding back that sediment and giving those three states some time to address the root cause. . . . Our position is that sediment is a watershed issue."

With no one stepping forward to accept responsibility and no study yet even offering a solution, it's little wonder that Helfrich is pressing for a study to look at the cost of doing nothing. "The cost of fixing the problem may seem expensive," he says, "but when the states see the cost of *not* fixing the problem, it will seem like a bargain."

Final Thoughts: Tick . . . tick . . . tick . . .

Early in March of this year, a passing storm dropped more than two inches of rain over much of the Susquehanna River's 27,100-square-mile drainage area—an area that lay deep in late winter snow. By March 8, rain and snowmelt had reached the Conowingo. The water levels and flow rose dramatically—as they often do in the spring. This time, however, the flow continued to increase, and by the morning of March 12, Exelon opened 26 of its 53 spill gates. Just before noon, the flow reached a peak of 485,000 cubic feet per second (cfs). The average flow of water through the Conowingo that day was 414,000 cfs—well below Agnes's peak of 1,130,000 cfs, but the highest since Hurricane Ivan in 2004. And this was only a rain storm.

The silt-heavy water roared through the open gates like 26 freight trains, sending iridescent plumes of spray shooting high into the clearing skies, higher than the 100-foot-high dam. Downstream the water roiled and boiled, yellow and brown and ochre. Waves of water broke against the steps leading down to the fishing platform and swirled up the trees.

All along the observing platform above, stood an appreciative audience. From early that morning—a Saturday—cars had arrived, full of families eager to see the sight. Children laughed and pointed. Adults held up cell phones to snap photos.

Yet, if these folks had listened carefully, they might have heard more than the rush and tumble of water. They might have heard the Conowingo's ticking time bomb. We have 15 to 20 years—and perhaps more if we're careful and lucky—before the pond behind the Conowingo fills up. But until we find a solution to that problem, the time bomb will remain armed. That's the thing about time bombs—they can go off at any time. Another Hurricane Agnes, or worse, could come this summer or next. *Tick . . . tick . . .* ⚓