Taking Wet Weather By Storm

Utility managers have several options for managing peak flows

If the peak flows policy proposed by the U.S. Environmental Protection Agency (EPA) in December 2005 is finalized in its current form, it should ease uncertainties among many wastewater utility managers about their options for managing wet weather flows.

The proposal, which would apply only to municipalities that manage separate sanitary sewer systems, is unique in that it is based on a consensus agreement worked out between the National Association of Clean Water agencies (NACWA; Washington, D.C.) and the Natural Resources Defense Council (New York), an environmental interest group.

Key to the proposed policy are provisions allowing, under certain circumstances, the use of "blending" to manage peak wet weather flows. In blending, peak flows are given some form of primary treatment, then diverted, or "bypassed," around the secondary treatment step, after which the two effluents are blended before disinfection and ultimate discharge.

Under the proposal, blending would be allowed in a discharge permit "as an anticipated bypass in accordance with 40 *CFR* 122.41(m) in a new or renewed NPDES [National Pollutant Discharge Elimination System] permit." The only flows that could be approved as anticipated bypasses would be those expected to exceed the secondary treatment units' peak flow capacity after all "feasible technologies and approaches" identified by the permittee were exhausted.

However, the EPA proposal "strongly discourages reliance on peak wet weather flow diversions around secondary treatment units as a long-term wet weather management approach ... and ... such diversions should be minimized to the maximum extent feasible." In fact, the proposal states, "the need to undertake peak wet weather flow diversions ... can be eliminated from most systems in a variety of ways, such as by enhancing storage and treatment capacity and reducing sources of peak wet weather flow volume." Nevertheless, many experts say, the bottom line for many permittees will be that blending is legal if all feasible alternatives have been considered.

For many utilities, a major benefit of the policy would be "to have a nationally consistent guidance," said Sharon Thomas, manager of regulatory affairs at the Water Environment Federation (WEF; Alexandria, Va.). "The problem has been that different [EPA] regions have interpreted the bypass provisions differently, some to the extent of saying that blending should be prohibited and that utilities can't do it at all."

One of the proposal's key benefits is that blending "can be authorized in a permit, which then gives the utility a 'permit shield' and no longer makes it some sort of potential violation, but rather a thought-about and contemplated permitted practice," added Alexandra Dunn, NACWA general counsel.

At press time, the proposal was stuck in the White House Office of Management and Budget, where budget officials were expressing concerns "about implementation costs and whether EPA had adequately studied them," Dunn said. At press time, Dunn and other industry experts were predicting that the proposal would not gain approval until summer or fall.

The proposed policy almost certainly would require utilities to provide significant documentation to demonstrate that feasible alternatives to blending do not exist. (The proposal does not define how alternatives could successfully be deemed feasible for permitting purposes.) "If you're in one of those regions or states where the policy in the past has been interpreted to mean that you could have no flow blending ... then it will mean a slight relaxation [of requirements]," said Nancy Schultz, principal technologist in the Milwaukee office of CH2M Hill (Englewood, Colo.). "You'll have to do a lot of documentation, but you'll be able to provide a more physically realistic level of treatment to the high flows. If you're in one of the areas where the policy has been interpreted to allow [bypasses], this will mean you'll have to document this every time you discharge through [a] bypass."

The need for documentation may also mean increased monitoring and perhaps modeling to identify the conditions present at the time blending was applied, noted Lawrence P. Jaworski, East Region practice leader for wet weather solutions in the Gaithersburg, Md., office of Black & Veatch (Overland Park, Kan.) "I think it's going to pose increased challenges to [municipalities] to monitor the flows and be able to prepare for these increased flows," he said. "From what had been a normal practice of diverting flow around certain critical treatment processes, they're now going to have to be more rigorous in documenting the conditions that are occurring at the time they actually divert some flow."

Options. EPA's proposed policy makes blending a strategy of last resort for separate sanitary sewer systems. However, several alternative strategies exist for handling peak wet weather flows, both for separate and combined sewer systems, and some can be combined with blending. WEF guidance issued in 2006 (*Guide To Managing Peak Wet Weather Flows in Municipal Wastewater Collection and Treatment Systems*) discusses several such alternatives, each of which could be applied in separate sanitary or combined sewer systems. In addition to blending, they include such options as high-rate clarification and vortex flow-control devices.

High-rate clarification provides "high levels of treatment at surface overflow rates 20–50 times greater than conventional gravity settling," the guidance says. "This is accomplished by adding coagulants and flocculants to the wastewater, creating conditions under which dense flocs with a high settling velocity are formed. These flocs can be removed efficiently at high surface overflow rates in settling zones equipped with lamella plates or inclined tubes with corresponding high [total suspended solids] and [biochemical oxygen demand] removal."

In one version of this technology, the Actiflo process offered by I. Kruger Inc. (Cary, N.C.), chemical coagulant is added to raw wastewater to destabilize suspended solids and colloidal matter in the influent stream, according to company literature. The coagulated water then passes into an injection tank, where polymer and microsand are added to begin floc formation. The treatment continues as water passes through an underflow passage from the injection tank into the maturation tank, where gentler mixing supports conditions for forming "polymer bridges" between the microsand and the destabilized suspended solids. The ballasted flocs then enter the settling tank, where upflow through the lamellar settling zone provides for rapid removal of the microsand and sludge flocs. Finally, the clarified water exits the system for discharge to receiving waters or for additional treatment.

This system can be used as a tertiary treatment step during normal flows or in conjunction with blending, when peak flows are diverted around secondary treatment to the Actiflo step. The City of Greenfield, Ind., recently was able to be delisted as a combined sewer overflow (CSO) community, partially as a result of installing such a 45,420-m^3/d (12-mgd) ballasted flocculation system to handle peak wet weather flows.

Another high-rate clarification system, DensaDeg by Degremont Technologies–Infilco (Richmond, Va.), divides the process into three parts: a reactor zone, a presettling and thickening zone, and a clarification zone. According to Troy Holst, product leader for the Biological Systems Group at Degremont, "DensaDeg is a high-rate clarification and thickening unit. It has multiple reactors [operating] together in one complete system. It combines chemical coagulation and flocculation. So we're adding a coagulant to the raw water to help us get out all the suspended and colloidal particles. We add a polymer to help the flocculation process, so we're getting an enhanced primary clarification. Then the water goes into our clarifier–thickener, and there the solids settle out. The bottom of this unit incorporates a thickening unit, so we maintain a sludge bed and thicken these solids; then from the bottom of this [unit], we take solids and recirculate them back to the flocculation reactor."

The "heart of the process," Holst emphasized, is that "we're recirculating dense sludge, which enables the floc to settle out at very, very high rates. Therefore, we can run at overflow rates of 40 gallons [150 L] per minute per square foot [0.09 m^2] of lamellar settling tube." In addition, he said, "the sludge that's wasted from the bottom of this unit has already been thickened, so the sludge is quite concentrated. We can typically have sludge coming off the bottom of the system that's at 3% or 4% solids, so that could go straight to a digester, if you wanted it to."

The City of Toledo, Ohio, recently installed six DensaDeg units with a total design flow of 232 mgd (880,000 m^3/d) to form a dedicated wet weather treatment facility, Holst said. "They expanded their grit removal and their screening systems to handle the higher wet weather flows," he explained. "I think they can handle up to 450 mgd [1.7 million m^3/d] total through their pretreatment. Then, parallel to their existing secondary treatment, they put DensaDeg clarifiers." The smallest DensaDeg unit handles 6.2 mgd (23,500 m^3/d), while larger units can handle more than 68 mgd (257,000 m^3/d), according to Scott Henderson, an applications engineer in the Separations Group at Degremont. Units are modular, "so there's an infinite number of configurations you could put together," he added.

Vortex–swirl separation systems are another form of high-rate clarification, or sedimentation, according to the WEF guidance. The devices are "compact vessels that provide flow regulation and some removal of solids and floatable material," the guidance explains. "The flow in vortex/swirl devices initially follows a path around the perimeter of the unit; flow is then directed into an inner swirl pattern with a lower velocity than the outer swirl. ... Solids separation is achieved by both centrifugal force and gravity because of the long flow path and inertial separation due to the circular flow pattern. The concentrated underflow passes through an outlet in the bottom of the vessel while the treated effluent flows out of the top of the vessel." Such devices typically would be installed off-line, according to the guidance.

One technology that uses vortex–swirl systems in wet weather applications is the Hydro Stormwater Management System offered by Hydro International (Portland, Maine). The system's basic principles can be used in applications ranging from treating and controlling stormwater runoff from such locations as urban parking lots to treating and controlling stormwater flows at CSO points in a combined sewer system, said Robert Andoh, director for innovation at Hydro International. The system consists of three basic phases:

- use of a high-rate rotary-flow vortex separator to achieve clarification (sedimentation) of excess flow (for example, at a CSO point in a combined sewer system);
- a temporary off-line storage system for the clarified effluent; and
- use of a vortex flow-control device to restrict and control the flow from the storage tank to the collection system and on to the treatment plant.

This combination, because it both treats the excess flow and controls its rate of discharge to the collection system, generally makes it possible to avoid blending at the treatment plant, Andoh noted.

One key to the system's success, Andoh said, is that it is a satellite system, "and the farther upstream you can go, the better off you are. ... It's easier to remove solids upstream in the catchment." The City of Columbus, Ga., installed the system at two of 16 CSO points that overflowed to a local river. According to Andoh, the system was implemented for about $85 million, for an estimated savings of between $50 and $160 million over the conventional approach of building a new interceptor sewer, which would have required an upgrade to the existing wastewater treatment facility.

"When you manage and control your flows further upstream, you don't need to have extensive collection system infrastructure," Andoh noted, "and that's where you start to get a lot of cost savings, because basically with the collection system infrastructure, all you're doing is carrying water around long distances."

***Jim Bishop** is a freelance writer in Elgin, Ill.*