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HRC by Design

Intending to Provoke Thought and Prompt Discussion

Conflicted Over Conflicts

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One of the most frustrating and difficult positions a consulting engineer can find themselves in is when we are suspected of having a conflict of interest. Simply put, a conflict can occur when a consultant is serving more than one client, each having a vested interest in a project and potentially having different views on the project outcome. For those of us in this business, few things are more disconcerting than to have a client tell us they believe we have a conflict on their project.

On the surface, the solution may seem to be simple: Don't allow yourself to be in the position to begin with. In many cases, it is just that easy. For example, HRC has a policy of, in general, not working for a private entity in a community in which we are providing municipal services. The municipality may want the development to be done in accordance with their master plan, while the private developer may want to rezone or obtain variances from the municipality's standards. In this case, an engineer serving both entities would likely find themselves in a position of conflict. However, there are always exceptions to this rule. We have had experiences when municipalities have specifically asked us to represent the private developers because they know that they will get the quality of project that they desire.

It can be argued that when all parties are working together for a common goal and are willing to negotiate in good faith, there are advantages to having the same consultant. In the early 1990s, HRC was involved with the upgrade of a municipality's wastewater treatment plant. The plant was operated by a county agency and it was necessary to upgrade the plant, in large part, due to a major automobile plant wishing to discharge to the new facility. HRC had a long history with each of the three parties. One would think that if ever there was potential for a conflict, this would have been one. On the contrary, the outcome was an extremely successful project.

We at HRC will continue to make every effort to avoid putting ourselves in a position where there is a real or perceived conflict of interest. In most cases, this is easily accomplished. We continue to believe that there are times when our legacy and expertise can provide a unique benefit to projects where multiple parties are involved. ◈

"Green" Infrastructure

When most people think about making something more environmentally friendly, "low impact", sustainable, or green, the first things that come to mind are cars and buildings. Energy efficiency reduces the use of fossil fuels and the by-products that are generated when these fuels are burned. Cars and buildings are highly visible so these are the things that occupy the public's radar.

"Green" is sometimes narrowly defined to mean energy efficiency, rather than reflecting the broad range of factors that affect the environment. Though energy and its affect on climate are important, there are many other things that impact the environment for good or ill. Shouldn't all these things be considered?

Few people think of roads, sewers, drains, water mains, and the mostly-invisible water and wastewater treatment plants, as candidates for "greening," despite the fact that there are tens of millions of miles of these utilities and roads, and thousands of these treatment systems, in operation in America.

> The fact is that designing sustainability and lower environmental impact into infrastructure is experiencing a golden age.

At one time, little was done when roads were designed and built with respect to storm water, except for making sure it was quickly carried away. As a result, sediment and pollutants were rapidly transported to sewers or receiving waters. Today, it's not uncommon to include passive treatment and retention systems as an element of road design, creating habitats in the vicinity of roads and delivering higher quality water to receiving streams. These systems can be adjacent to a roadway and visible, or below ground and invisible. From an energy standpoint, there have been many recent developments in road design. Traffic modeling and optimization, and intelligent transportation systems, seek to maximize road and driving efficiency and reduce the wasting of fuels and the generation of associated by-products. Traffic signal re-timing and optimization rank among the most cost effective transportation actions, increasing mobility, reducing fuel consumption, and reducing impacts on the environment.

Sewers and water main can often be constructed or rehabilitated using trenchless technologies like horizontal directional drilling, pipe bursting, micro-tunneling, and in situ lining. Trees and habitats can be saved or disruption prevented.

In recent years, significant planning and resources have been applied to providing local retention of storm water. One can better understand this approach by visiting neighborhoods or commercial developments that were built in the 1960s and 2000s, and comparing them. The differences are readily apparent. A step beyond these practices is the active use of untreated or filtered storm water for certain site activities, such as irrigation, in lieu of using potable water, as potable water is unnecessary for site needs that don't require a higher quality water.

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Out of "Site," Out of Mind...

When a building is constructed, whether large or small, aesthetically striking or economically conceived, the natural thing is to train one's focus on the structure, how it will be constructed, and what will go inside it. After all, that's where most of the money will be spent and that's where the bulk of the human activity will occur.

Still, too many projects have gone sour because the site work related to the building construction was approached as an afterthought, or not early enough in the design process to identify, provide for, and mitigate, site related issues. In rarer instances, projects have had to be drastically re-conceived or building designs have been significantly affected by the sites on which they were located.

Are there practices that, if followed, will ensure that site issues are addressed early enough to prevent these problems? The following summary highlights prominent issues and the associated questions that can impact building projects and, when addressed early, can significantly reduce project stress.

Pre-engineering considerations...

- Is the project consistent with local zoning?
- Are there grants/loans to assist with on and off-site development costs
- Are there applicable open space requirements? Is storm water detention considered open space, or not?

Wetlands/floodplain...

- What are the required setbacks?
- Does the floodplain infringe on the property?
- Do off site sources drain to the site?
- What is the affect of wetlands/floodplain on the developable footprint?
- Mitigation costs, affect on the time line?

Site Contamination

- Evaluation of the site history? 307 site?
- Previous environmental studies of the site
- Mitigation costs, affect on time line?

Water/Wastewater/Storm Water

- Availability of water, connection fees, pretreatment necessary?
- Available water system flows and pressure (fire)
- Sanitary sewer availability, capacity, connection fees, pretreatment necessary?
- Storm sewer outlet available, capacity, detention requirements?
- Availability of reclaimed water for site uses?
- Approval process and affect on time line?

Property-specific Issues

- Impact fees: schools, county?
- Quality of soils, material import/export?
- Groundwater location
- Easements on the property
- Site grading requirements
- Cost and time line impact of property issues

Government Requirements and Approvals

- Site Plan approval requirements
- Design documents approval requirements
- Traffic studies, mitigation actions
- Fire department critical issues: access, booster pumps
- LEED ordinance?
- Cost and time line impacts

Utilities (gas, electrical, fiber optic, etc.)

- Availability and capacities
- Primary or secondary site (electrical)
- Time line for acquisition (temporary and permanent)
- Cost of utilities

Woodlands

- Ordinance?
- Ability to replace woodlands on site?
- Is payment, or other mitigation, in lieu of replacement allowed?
- Cost and impact on time line

A Brief History of Wastewater Treatment in Detroit – A benchmark of a modern civilization is its ability to manage human waste so as to prevent waterborne diseases and the associated misery, degradation of the environment, and toxicity to wildlife. Along with disinfection of drinking water taken from the middle of the Detroit River, better wastewater management treatment enabled the region to eliminate typhoid, which affected more than 100 people per 100,000 population into the 1920s, and to progress toward this benchmark.

These achievements came about in stages. Prior to the 1920s, sewage was conveyed from neighborhoods by open ditches and local drains. The first advancement (it was a significant advancement at the time!) came in the period between 1917 and 1922 when 66 Detroit Sewer projects were constructed at a cost of approximately $40M. This program of new combined sewers cleaned up the neighborhoods and the drains and carried 400 MG of wastewater per day to the Rouge and Detroit Rivers. Though this didn't solve the problem it went a long way toward addressing the serious public health concern.

The genesis of wastewater treatment in Detroit was the "Preliminary Report on Sewage Disposal for the City of Detroit" by Clarence W. Hubbell, published in 1925. As a result of various disputes, including where the treatment facility would be built, the system was not in operation until 1940. Along with the primary treatment facilities, an interceptor sewer was constructed along the river to convey dry weather flow to the treatment facility. Grit removal and the rectangular settling tanks, designed by C. W. Hubbell, were innovative for that time period.

As the Detroit metropolitan area grew, most of the surrounding communities opted to connect to the Detroit water and wastewater treatment systems, providing attractive economies of scale but also setting the stage for future disputes relating to costs and control.

The additions from 1966 to 1985 provided secondary treatment, further reducing solids, BOD, and, for the first time, phosphorus, making this the largest-rated secondary treatment facility at one location in the world…1 BGD. Innovative design of the treatment units by George Hubbell enabled these additions to be constructed on 140 acres in a densely populated area of southwest Detroit, versus 320 plus acres for a traditional design. This design also produced significant construction cost savings.

Subsequent to 1985, work has been done on the solids treatment and handling facilities, as well as to improve and enhance other treatment processes. Mitigating the discharge of untreated sewage during storm events has also been an important goal in recent years.

THE SEWAGE DISPOSAL PROCESSES

The disposal of sewage is usually done in four distinct steps. The first step is the bringing of the sewage to the Treatment Plant through the regulators and intercepting sewers. Detroit has what is called a combined sewerage system, which means that all water—whether rain, domestic, or industrial wastes—enters this one system and drains into the interceptors. The largest interceptor parallels the Detroit River about 30 feet under Jefferson Avenue. This one has a diameter of 16 feet near the Plant. Another one, known as the Oakwood interceptor, is 12 feet, 9 inches in diameter where it enters the Plant from the western side of Detroit. When work on this sewer is completed it will parallel the Rouge River through several miles of its travel. These two interceptors are indicated on the picture map by the figures (1) and (2). They bring in about 400,000,000 gallons of sewage a day. To get an idea of how much water that is, imagine a lake the size of Belle Isle (980 acres) filled to a depth of 15 inches. This large volume of "used water" brings with it about 200 tons of solid matter which must be separated from the water and made harmless by the treatment processes.

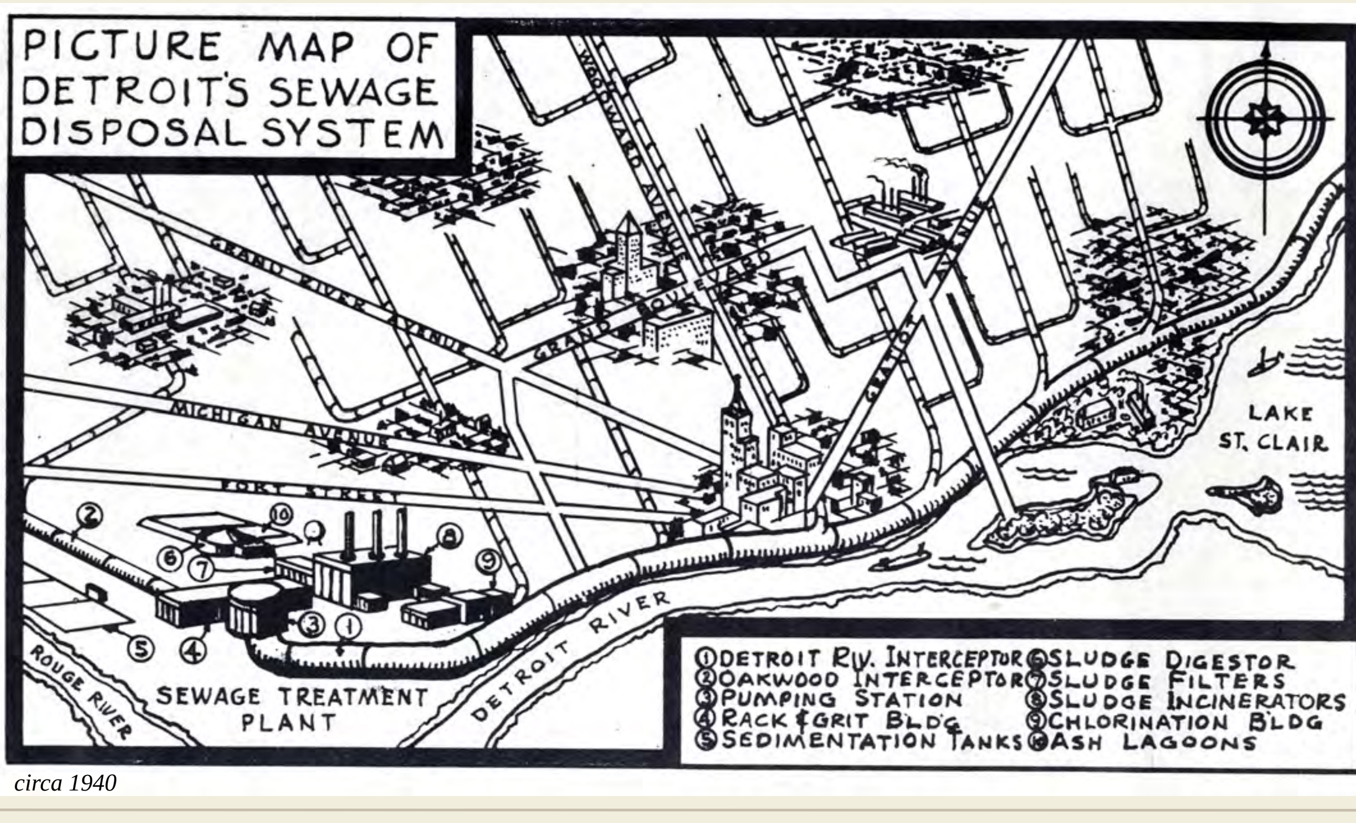
The removal of solids is the second step in the treatment process and is done in three separate parts. Upon reaching the Plant the sewage is lifted about 30 feet by large electrically-driven centrifugal pumps (Picture No. 2). These pumps were designed especially to handle sewage and because of their large size have no screens ahead of them. This means that they have handled bricks, coal, tin cans, short planks, and even a two-foot length of railroad tie without damage to the pump. Following the pumps, the sewage is screened on self-cleaning bar racks (picture No. 3) to remove the larger objects such as blocks of wood, paper, rags, etc. Next, the gritty material is settled out in the grit channels. The grit consists of sand, cinders, gravel, and other heavy materials that enter the sewerage system. This collected material is dropped onto conveyor belts and sent to the incinerator building. Next, the sewage flow is measured by two large Venturi meters as it passes on to the Sedimentation Tanks (picture No. 4 and Flow Diagram) for final settling to remove the fine solids which are still held in suspension. The sewage is kept in these large tanks, which cover over 7 acres, for an hour and a half. In that time the heavier suspended solids settle to the bottom to form a black sludge. The lighter ones, which include oils and greases, rise to the surface to form a scum. The sludge and scum are collected by scrapers and skimmers. The sludge is pumped to the Digestor and the Filter Building for further processing, while the scum is sent to the incinerators to be burned.

The third step is the safe disposal of the solids which have been removed from the sewage. This is ultimately done by burning them in the incinerators, but before they are burned they go through several processes. One of these processes is called digestion. About one-

Picture No. 2—PUMPING STATION, SHOWING SIX MAIN PUMP MOTORS.

Picture No. 3—RACK & GRIT BUILDING WITH BAR RACKS ON LEFT AND GRIT-COLLECTORS ON RIGHT.

Sweet water is Michigan's most precious natural resource, and we are rich in this resource in comparison to the rest of the world. The daily treatment of water and wastewater in Michigan is a big part of keeping our water safe and clean.



circa 1940

“Green” Infrastructure

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Water and wastewater treatment plants can be significant energy users, thus, measures to reduce energy at these facilities can be beneficial to the environment and reduce operating costs. Adding oxygen to biological treatment units using finer bubbles is more energy efficient than the older coarse bubble devices. Since pumps are some of the biggest energy users in treatment systems, higher efficiency pumps can make a difference. Creating an environment conducive to organisms that absorb more nutrients than conventional wastewater treatment organisms reduces chemical usage and sludge production requiring disposal. Waste solids (biomass) from wastewater treatment processes can be treated in an oxygen-free and warm environment that promotes methane gas production. This gas can be used to produce electric power to run processes at the plant (Delhi Township, Michigan was an EPA 2008 PISCES award winner for this innovation).

What's below the ground, under our tires, or out of sight, the infrastructure of our Country, can have a big impact on the environment. Greening of our infrastructure began decades ago, but has only recently been recognized as such. Increasingly, designs are building in even more features that protect and even enhance the environment.

It's important to note that the net cost of these green measures can be positive rather than negative. Reducing peak storm flows via local retention systems can result in smaller downstream sewers, or preclude the need to build bigger sewers in areas where infrastructure is already in place. Conversion from coarse bubble to fine bubble aeration at wastewater plants often has a quick payback period, a matter of a few years. Optimizing road systems may preclude the need for road expansion and the associated cost. It isn't unprecedented for cost economy and environmental improvement to go hand in hand.

Defining costs, savings, benefits, and risks in a disciplined manner is important to reach a prudent and defensible decision. This disciplined process approach, drawing on experience from other projects, viewing the project as an integrated whole rather than separate pieces, and balancing costs, benefits, and risks, is an effective way to ensure that outcomes meet expectations. ◈

A full text version of this abbreviated article is available in the May 2009 issue of APWA Reporter.

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