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SPECIAL DOUBLE ISSUE

concretepipenews

The Magazine of the American Concrete Pipe Association

Precast Concrete Pipe Helps Assure Healthy Water Quality for Years to Come

- Rave Reviews for RCP on South Broadway Avenue
- More Precast Concrete Boxes for TransCanada Highway
- Characterization of PE Materials – Part II
- Sewer Overhauls Drive Fee Hikes

This issue:

Volume 55, Number 4
Fall/Winter 2003
Concrete Pipe News is published four times each year by the American Concrete Pipe Association. It is designed to provide information on the use and installation of precast concrete pipe products for a wide variety of applications, including drainage and pollution control systems. Industry technology, research and trends are also important subjects of the publication. Readers include engineers, specifiers, public works officials, contractors, suppliers, vendors and members of the American Concrete Pipe Association.

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American Concrete Pipe Association

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President's Report

John J. Duffy

Protect Your Right to Choose

In California, it is illegal for a vehicle without a driver to exceed 60 miles per hour. In South Carolina, every adult male is required to take a rifle to church on Sunday in case of attack. In Maine, it's illegal to keep Christmas decorations up past January 14th. And in Dyersburg, Tennessee, it is illegal for a woman to call a man for a date. These are examples of stupid laws that may still be in effect. They are laws that were passed in legislative assemblies by good people believing they were doing the right thing at the time. As mindless as these laws may seem to you and me, they make the point that poorly considered legislation can have lasting effects that might take decades to correct. Such a law almost made it through the Missouri State Legislature under HB 327.

A Missouri State Senator recently agreed to preserve the rights of specifying engineers by removing an amendment to HB 327 that would require High Density Polyethylene (HDPE) storm sewer pipe as an alternate on all state stormwater projects. The requirement was not included in the original version of HB 327, but somehow got attached to the final version of the bill. Many members of the Association of General Contractors of Missouri expressed opposition to the bill that would limit one s ability to bid work competitively.

There are many circumstances and field situations where HDPE conduit just won't work; and by legislating its use on all storm water projects, Bill HB 327 was stripping the professional engineer of his or her duty of care to the public, limiting free enterprise, and creating potentially hazardous applications of a product. Specifying engineers must have the freedom to choose and specify products for applications that protect the health and safety of the public. They are applied scientists with the experience and knowledge to make the right choices of products and materials used for complex buried infrastructure. Governments should not be passing legislation that determines what products are to be used for buried structures and drainage systems. This is a function of agencies that specialize in developing local and national specifications and standards.

Governments continually try to shape our behaviors through legislation. Littering is bad – don't do it. Conservation is good – please recycle. Cocaine is illegal – don't do it. Drinking alcohol is legal – but don't drink and drive. In most cases, legal activities can assume the status of an endorsement from governments. Bill HB 237 could have become a government endorsement of HDPE, throughout the state and perhaps on course for a nation-wide endorsement. Whew, the engineering judgment of professionals was almost compromised.

The ACPA continues to work with state DOTs to serve their storm water conveyance needs. The Association implores specifiers throughout North America to be aware of initiatives that strive to reduce the role of design professionals in the selection of pipe materials for buried infrastructure.

Industry Spotlight

Bruce G. Hottle,

Vice President
Eagle Concrete Products, Inc.
Somerset, Pennsylvania

When it comes to government affairs, Bruce Hottle has never taken a back seat. He has testified on the impact of regulations on his business before U.S. Congress and before state committees. Hottle spoke out in the many industry associations in which he has served to encourage fellow entrepreneurs to challenge the shortcomings of poorly considered legislation and regulations that impact businesses – especially businesses associated with the precast concrete products industry. He not only talks the talk, but also walks the walk.

Hottle has served on numerous high profile industry associations in key positions and has been recognized across the nation for his work. He is a recipient of the prestigious C.I.T. Rebuilding America Award for work on the original PennVest Act. The award recognizes leadership in the rebuilding of America's infrastructure. The list of organizations on which he has served is extensive, including appointments by the Governor of Pennsylvania. But to many, his time as Chairman of the National Precast Concrete Association in 2001, time establishing the Pennsylvania Precast Association, time as Chair of Lincoln Township Municipal Authority and his service to the American Concrete Pipe Association's Government Relations Committee is remembered as outstanding.

To many who know Bruce, however, is his greatest accomplishment is the success of Eagle Concrete Products, Inc. He and his father, Dean, purchased the assets of Gnagey Precast Manhole & Pipe Company in 1974. Over 29 years, he has grown Eagle Concrete Products into a major supplier of precast concrete structures for water and wastewater treatment projects in Southwestern Pennsylvania, Western Maryland and Northern West Virginia.

Mr. Hottle is a most knowledgeable individual when it comes to interacting with public agencies and governments to advance industry interests. He agreed to provide some insight into the issues of the day and how governments affect business:

Q: *You have always been active in politics and know how government regulations addressing ergonomics and silicosis affect your business. What are some of the current challenges facing the precast concrete industries?*

Hottle: All government regulations affect anyone in business. In times of economic downturn, governments tend to increase public works spending, but it did not happen this time. There is no increased market demand

During one of his many visits to Capital Hill, Bruce Hottle, Eagle Concrete Products (center) discusses legislative items with former Congressman Bud Shuster (R-Pa), then Chairman of the House Transportation and Infrastructure Committee. Also attending the meeting is Bill Quenlin, Hanson Pipe & Products (left).

for products and services, yet government fees and taxes increase, while corporate budgets for funding government programs are weak or non-existent.

One of the biggest issues on my radar is the Family and Medical Leave Fairness Act of 2001 that amends the Family and Medical Leave Act of 1993 (FMLA) to extend coverage to employees at worksites where the employer employs at least 25 (currently 50) employees at the worksite and within 75 miles of that worksite. Some senators are calling for paid leave. The proposal is to use the surplus in the unemployment compensation account to pay for the leave. This has the potential to drive up unemployment payments by employers. No small business can have one or two unexpected employees on payroll, as it is very difficult to replace employees on short notice for short periods. This also has the potential of driving up unemployment payments of all employers at a time when businesses are expected to contribute more to governments in taxes to offset the deficits held by most states.

Q: *How have government regulations influenced changes since you formed Eagle Concrete Products in 1974?*

Hottle: As we all know, over the past 30 years numerous government regulations have been imposed on industry. Governments now want to increase the quality of purchased products to achieve a perceived greater value. Governments believe that by tightening their specifications, they achieve longer service life of projects. But, when producers are over-regulated, more cost is added to products, but not necessarily value. There is only so much cash in the marketplace for businesses to thrive. If regulations push up the cost of products by 25% but fail to increase the value of the products that would include extended service life, governments are just depleting the pool of cash available to industry. The consequence is a very limited market in which businesses can grow.

Q: *Reauthorization of a new federal highway bill is up in the air. How can state officials, engineers, and suppliers involved with highway construction influence the passage of a new highway act?*

Hottle: I don't believe that there will be a new highway bill until after next year's election. House Transportation and Infrastructure Committee Chairman Don Young, an Alaska Republican, has proposed raising the gas tax, among other things, to pay for a $375 billion highway bill. Unable to find agreement before highway and public transit programs expired Sept. 30, congressional leaders endorsed a five-month extension. The Senate's goal would be to pass a new highway plan in February, which covers programs giving states at least 80 percent of the money for roads and public transit in the United States.

Federal funding is required to keep pace with growth and demand for transit and transportation assets. Currently, there does not seem to be a will from congress to see Young's bill through.

Q: *As the past chairman of the National Precast Concrete Association, you championed a number of causes – including expanded national certification of precast concrete product plants. How has this program benefit the precast concrete industry?*

Hottle: National certification of plants owned by members of both the NPCA and ACPA can only increase the value of our products and credibility of the information that flows from our industries. As more states are accepting the NCPA's program and the ACPA's Q-Cast program, DOTs are insisting on prequalification as a prerequisite for supplying products to their projects. As mentioned earlier, governments are demanding higher quality products for money spent. The plant prequalification programs provide the assurance that governments are searching for. Both certification programs will continue to grow, and so will the opportunities of producers as they find new and better ways to produce quality products.

Q: *You are members of both the American Concrete Pipe Association and National Precast Concrete Association. Do you feel there is*

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RCP Drains Provide Immediate Health, Safety and Economic Benefits

By Robin Woodbury
Premarc Corporation, Durand, Michigan
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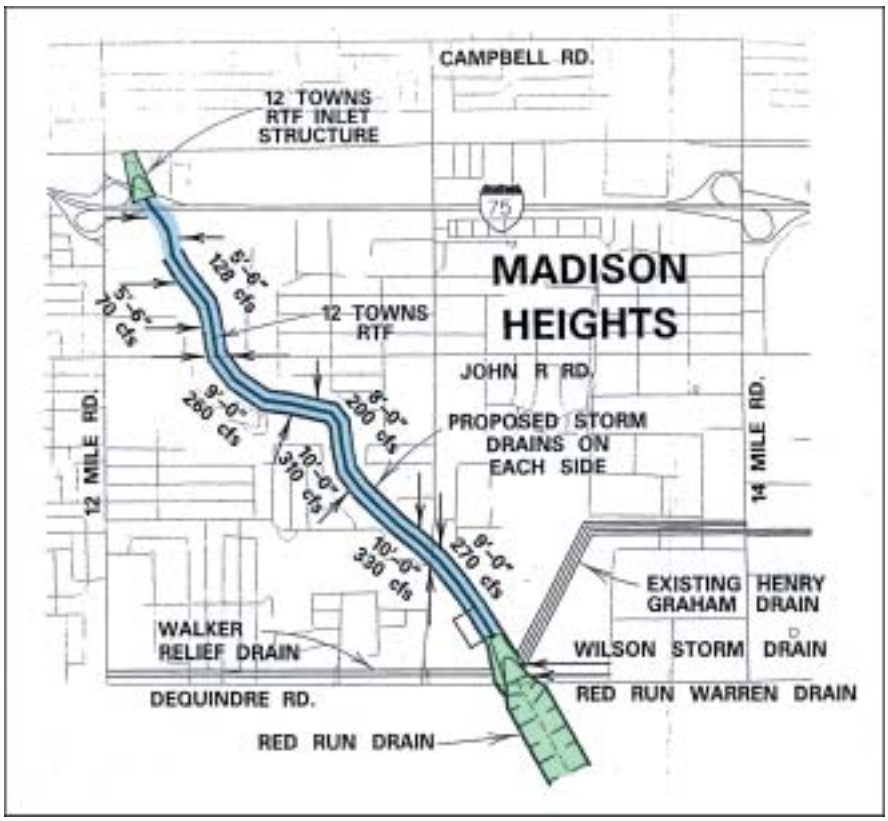
Lake St. Clair's Metropolitan Beach in Macomb County Michigan was closed most of the summer in 1994 due to persistent readings of high levels of Escherichia Coliform (E. Coli). Although the cause of the E. Coli was not conclusively identified, it had been alleged that some of this pollution could be attributed to Combined Sewer Overflow (CSO) coming from the Red Run Drain.

The Federal Clean Water Act of 1977 mandates that all discharges of pollutants into the waters of the United States must be authorized by a National Pollutant Discharge Elimination System (NPDES) permit. The Southeastern Oakland County Sewer District System (SOCSDS) Twelve Towns Retention/Treatment Facility (RTF), was originally authorized to discharge treated combined sewer overflows (CSOs) into the Red Run Drain, a tributary of the Clinton River that flows to Lake St. Clair, an international waterway. This 2.2 mile-long RTF was one of the first CSO control projects constructed in the U.S.A. When completed in 1973, it was considered state-of-the-art.

Time, however, revealed many deficiencies. While the storage volume of the facility approaches the standards now accepted by the Michigan Department of Environmental Quality (MDEQ), the configuration was insufficient to protect the environment. Rainfall events that exceed 1/2" to 3/4" inches in depth can generate large overflow volumes. Due to the mixing of sanitary and storm water, this discharge is inevitably contaminated with human, commercial and industrial wastes. The CSOs that are discharged from the Twelve Towns RTF were thought to have contributed to the high levels of E. Coli found at Metropolitan Beach.



Political pressure to address these deficiencies led to a solution known as the George W. Kuhn Drainage Improvement Projects. Through the cooperative effort between the Oakland County Drain Commissioner and the 14 communities that now make up the George W. Kuhn Drainage District, a mutually agreeable program was developed to upgrade the

RTF to improve the water quality of the Clinton River and Lake St. Clair.

Contract One of the new drainage improvement project dealt specifically with removing and rerouting storm water inflow from the Twelve Towns RTF, thus reducing the frequency of overflow of sewage to the Red Run Drain. The new reinforced concrete pipe (RCP) system was designed to intercept existing combined flows from a 60-inch and 72-inch line that previously discharged directly into the retention treatment facility without benefit of pretreatment. The system rerouted flow to a point upstream for future connection to the treatment facility proposed as a part of Contract Four.

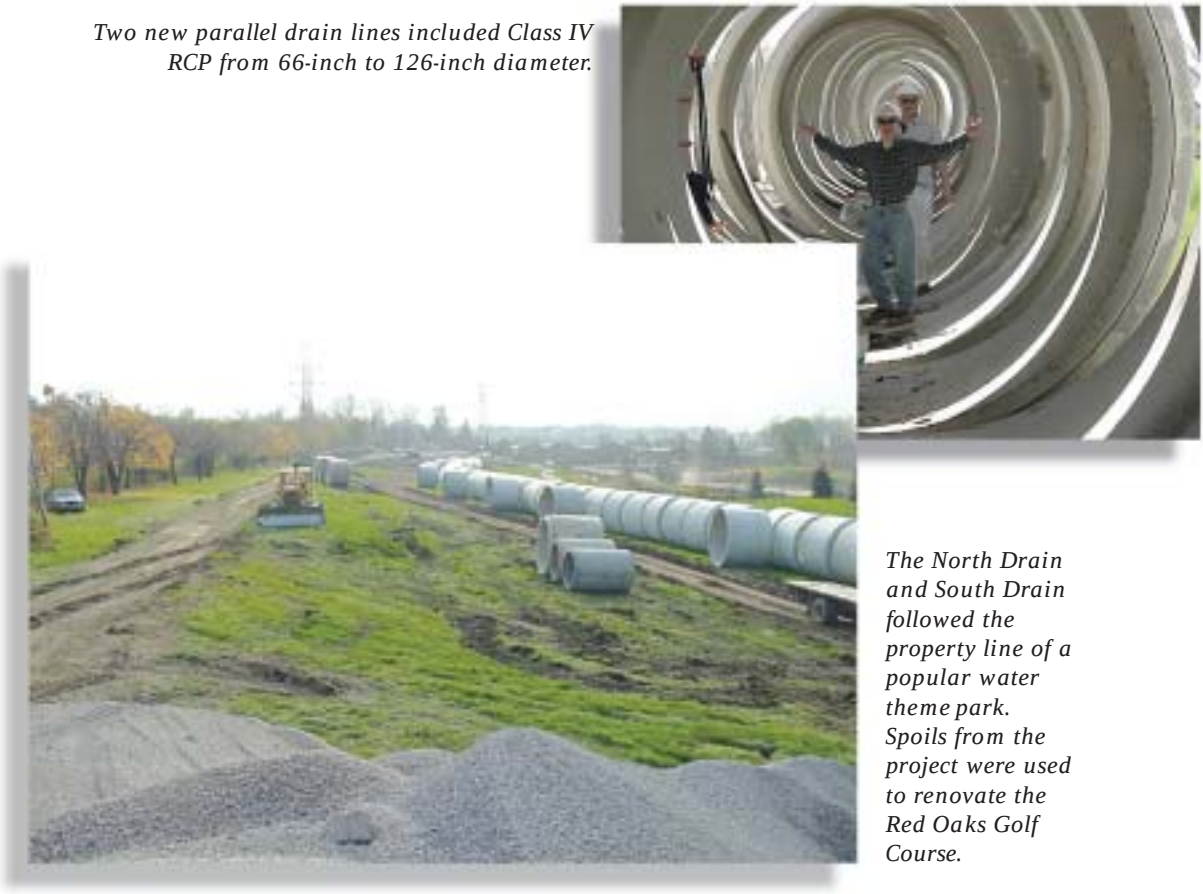
Construction of Contract One, started in October of 2000 and was completed in July of 2002. The project consisted of the installation of two new storm drains that run parallel to the RTF. These two parallel drains are known as the North Drain and South Drain. Construction of the North Drain included installation of approximately 9,600 linear feet of main line ranging in size from 78-inch to 126-inch diameter RCP. Construction of the South Drain included approximately 8,100 linear feet ranging in size from 66-inch to 126-inch diameter RCP.

Numerous impediments were encountered during construction of the new drains. Additional time and energy was spent snaking the pipe around utilities so that services were not disrupted. To limit impact on local traffic, construction through the road crossings was performed during weekends.

Coordination of construction activities was crucial around a recreation facility known as the Red Oaks Wave Pool. While the North Drain followed the property line of the wave pool complex, the South Drain went directly through the facility's parking lots. Work on this portion of the project was completed during fall and winter to ensure the opening of the complex in the spring.

Due to lack of space, and fear of damaging the existing RTF, soils from the excavation of the new storm lines could not be placed on or near the RTF. A solution to the temporary storage and disposal of excavated soils was found at the Red Oaks Golf Course where construction was to proceed through the facility. When the newly restored Red Oaks Golf

Two new parallel drain lines included Class IV RCP from 66-inch to 126-inch diameter.



The North Drain and South Drain followed the property line of a popular water theme park. Spoils from the project were used to renovate the Red Oaks Golf Course.

Course opens in the spring of 2004, golfers will face a new and more challenging course constructed with the spoils of the Kuhn Drainage Improvement Projects. Public concern arose, however, over the soils that were being excavated since a portion of the golf course covered an area that was once used as a landfill and incinerator. In conjunction with the MDEQ, the Oakland County Drain Office, held numerous public meetings informing and educating the public on the monitoring and dust suppression programs which were in use during this portion of the project.

Forty-two major storm drains were disconnected from the RTF and reconnected to the North and South Drains. Storms and flooding of the construction site were a major concern for the contractor, so a warning system was established that sounded an alarm when rainstorms were approaching. This allowed time to get people out of the RTF before the storm.

The George W. Kuhn Drainage Improvement Projects provide immediate local health, safety, and economic benefits. Additional contracts for the Twelve Towns Retention/Treatment Facility will contribute to healthier boundary waters between the United States and Canada.

The precast concrete pipe was supplied by the Premarc Corporation. Nowak & Fraus was contracted to prepare the engineering plans and specifications for Contract One of the 5 contracts. Hubbell, Roth & Clark, Inc. and NTH Consultants, Ltd., were subcontracted to complete the plans and specifications. Ric-Man Construction, Inc., was awarded the contract for the Contract One. Jerry Matthews of Natural Course Design was contracted for the golf course improvements.

Improvements to the Twelve Towns RTF included 15 projects under 5 separate contracts. All of the projects were incorporated into the facility's NPDES permit. The estimated project cost for these 15 projects is nearly $144 million.

(Article first appeared in June 2003 Issue of Environmental Science & Engineering. Republished with permission.)

Project:	George W. Kuhn Drainage Improvement Projects Macomb County, Michigan
Owner:	The Southeastern Oakland County Sewer District System
Consulting Engineer: (specifications)	Nowak & Fraus Royal Oak, Michigan
Engineering Subconsultants: (plans and specifications)	Hubbell, Roth & Clark, Inc. Bloomfield Hills, Michigan NTH Consultants, Ltd. Farmington Hills, Michigan
Contractor:	Ric-Man Construction, Inc., Sterling Heights, Michigan
Quantities:	9,600 feet of 78-inch to 126-inch diameter Class IV RCP (North Drain) 8,100 feet of 66-inch to 126-inch diameter Class IV RCP (South Drain)
Producer:	Premarc Corporation Durand, Michigan

The Premarc Corporation is a leading manufacturer of concrete products for the construction industry. Founded in 1927 in Durand, Michigan by the Marsh family, the company operated primarily in the Flint and Lansing area. In the past 15 years, it has expanded its sales territory with facilities in Cadillac, Traverse City, Grand Rapids, and Clarkston. Premarc's delivery fleet supplies the entire lower peninsula of Michigan and extends into Indiana. Premarc's manufactured product line includes all shapes and sizes of precast reinforced concrete sanitary and storm sewer pipes, manholes, catch basins, wet wells, and pump stations. For more information, see www.premarc.com.

Precast Concrete Pipe Receives RAVE REVIEWS on South Broadway Avenue

By Ron Almquist • North Dakota Concrete Products, Bismarck, North Dakota • 701-720-4581

Since its construction in 1961, South Broadway --the busiest thoroughfare in Minot, South Dakota -- had seen its condition steadily worsen. In 2003, the 42-year old roadway was 10 years beyond its service life and high costs to maintain the 1.7-mile segment of roadway had become harder and harder to justify. South Broadway served as Minot's major north-south traffic artery and played a vital role in the flow of traffic through the city, located in north central South Dakota.

In addition to the high maintenance costs, there were significant safety issues along South Broadway as well. In a three-year period more than 300 vehicle accidents occurred along the route; and there was traffic congestion at major intersections along the corridor.

Currently, South Broadway traffic volume is about 27,000 vehicles per day. By 2021, traffic volume is forecast to increase to 47,000 vehicles per day as the city grows.

Public utilities such as water and storm sewer lines under the roadway were even older than the street, requiring extensive ongoing maintenance at the public's expense. The capacity of the current storm sewer system had been exceeded several times, resulting in overland flooding. It was clear that the opportune time to reconstruct these and other public utilities would be while the street was reconstructed, lessening the inconvenience to the community. Approximately six miles of underground work was needed. With the underground work being done while South Broadway was being reconstructed there would be significant savings to the City of Minot.

A precast manhole with integral base is connected to the 60-inch diameter RCP along South Broadway.

The North Dakota Department of Transportation (DOT) became involved in the project, as South Broadway is also US Highway 83. The DOT divided the reconstruction project into phases to expedite completion of the project in one season. It was vital to local businesses that the roadway be open during the construction period, and construction activities completed quickly.

The first two phases, included reconstruction of South Broadway from 7th Ave. SW to 19th Ave. SW. Minot contractor, Minot Paving submitted the low bid of $5,921,536 and was awarded the contract. This

Fire hydrants are lowered into the trench for connection while work on the water, sanitary sewers and storm drain continued.

project started at 7th Ave. SW and went to 15th Ave. SW. Robert Gibb and Sons, a Fargo contractor, was the subcontractor for the water, sanitary sewer and storm sewer work. The sewer work consisted of replacing 13 precast manholes with integral bases and precast inverts for sanitary sewers and related sanitary pipe and service lines. The storm sewer system involved installing 2029 feet of 36-inch diameter RCP, 209 feet of 24-inch RCP, 15 precast concrete manholes from 48-inch through 84-inch diameter, plus 40 precast 2-foot x 3-foot and 2-foot x 6-foot inlets. There were also three special 8-foot x 6-foot box vault precast inlets installed on 11th Ave., a side street intersecting South Broadway.

The contractor on the second phase was Coughlin Construction, a Minot construction company that tendered a bid of $5,299,014. Coughlin Construction undertook construction of all the underground work and subbed the surface work to Northern Improvement, a Fargo company. On this project, the sanitary sewer work consisted of replacing 11 precast concrete manholes with integral bases and precast inverts, along with related piping and service lines. The storm sewer was a major part of this phase. Storm sewer pipe included over 3,000 feet of 24-inch diameter through 60-inch diameter precast concrete pipe. There were 12 precast concrete manholes ranging in size from 48-inch through 120-inch diameter, plus 25 (2-foot x 3-foot and 2-foot x 6-foot) precast concrete inlets. Two special precast concrete box vault 8-foot x 6-foot inlets were installed on 16th Ave SW, an intersecting street to South Broadway.

Precast concrete products were used to expedite construction and help reopen the major thoroughfare to travelers and local businesses.

Several multi-inlet precast structures were fabricated by North Dakota Concrete Products Company for the South Broadway project.

The work on both these projects was complicated by the fact that the contractors could close only half of the thoroughfare as traffic flow had to be maintained. In addition, there were a number of grade conflicts with existing sewer and water mains, and sanitary services. There were also a large number of other obstacles in the form of electrical lines, natural gas mains, service lines, and telephone lines. Work on these two projects, started in early May and by late-September all of the underground work was completed.

Phase 3 of the work consisted of storm sewer work from Western Ave. south to approximately 6th Ave. SW. The low bidder on this project was Robt. Gibb and Sons with a bid of $762,719. This project crossed Burdick Expressway, a major east-west artery through Minot. The work consisted of installing 1617 feet of 36-inch diameter RCP, 31 feet of 24-inch diameter RCP and 12 feet of 44-inch x 27-inch arch RCP. Installation included eight precast manholes, 60-inch through 84-inch diameter, plus four special 8-foot x 6-foot box vault precast concrete inlets and 13 (2-foot x 3-foot or 2-foot x 6-foot standard inlets. Much of this work was difficult as the excavation was in gravel soils and the 36-inch diameter RCP was relatively deep and installed between a concrete telephone duct and a 10-inch high-pressure natural gas main. The work was completed by mid September.

The final phase of this work was bid on August 15th and started in the first week of September. Kemper Construction, a Minot contractor, submitted the low bid of $981,096. Work consisted of installing 1790 feet of 60-inch diameter RCP, 332 feet of 73-inch x 45-inch RCP arch, 156 feet of 18-inch diameter RCP and 13 precast manholes from 48-inch through 120-inch diameter.

Ulteig Engineering, a North Dakota consulting firm, completed the design work for all four of these projects at their Bismarck, N.D. office. They also undertook the construction inspection of the first two projects. Wold Engineering, a North Dakota firm, undertook construction inspection of the final two projects through their Minot office.

North Dakota Concrete Products, a mem-

continued on page 22

Project: Minot South Broadway Construction
Minot, North Dakota

Owner: North Dakota Department of Transportation

Consulting Engineer: Ulteig Engineers, Inc.
Bismark, North Dakota

Contractors: Minot Paving - Minot, North Dakota
Coughlin Construction - Minot, North Dakota
Robert Gibb and Sons - Minot, North Dakota
Kemper Construction - Minot, North Dakota
Northern Improvement - Fargo, North Dakota

Quantities:
2730 feet of 60-inch diameter Class III RCP
1307 feet of 54-inch diameter Class III RCP
3771 feet of 36-inch diameter Class III RCP
116 feet of 30-inch diameter Class III RCP
320 feet of 24-inch diameter Class III RCP
156 feet of 18-inch diameter Class III RCP
72 precast manholes (48-inch through 120-inch diameter)
12 feet of 44-inch x 27-inch arch RCP
332 feet of 73-inch x 45-inch arch RCP
78 precast 2-foot x 3-foot and 2-foot x 6-foot inlets
9 special 8-foot x 6-foot box vault precast inlets

Producer: North Dakota Concrete Products
Bismarck, North Dakota
A Division of The Cretex Companies, Inc.

Choice of Major Culvert Material Based On Proven Performance

By Ryan Finley, P.Eng.
Lafarge Canada, Inc., and
Khaled Nasery, E.I.T.
Mish Engineering, Ltd.

Use of precast concrete box units under the TransCanada Highway was based on the proven performance of concrete and the expected service life of precast reinforced concrete box culverts. At two crossings of the highway, one kilometer apart, cast-in-place double cell concrete box culverts were installed in 1955 to carry the flow of Hartell Creek. The culverts, located east of Calgary, Alberta, near the Town of Strathmore, were extended across new eastbound lanes with arched structural plate corrugated steel pipe (SPCSP) when this section of the highway was twinned in 1974.

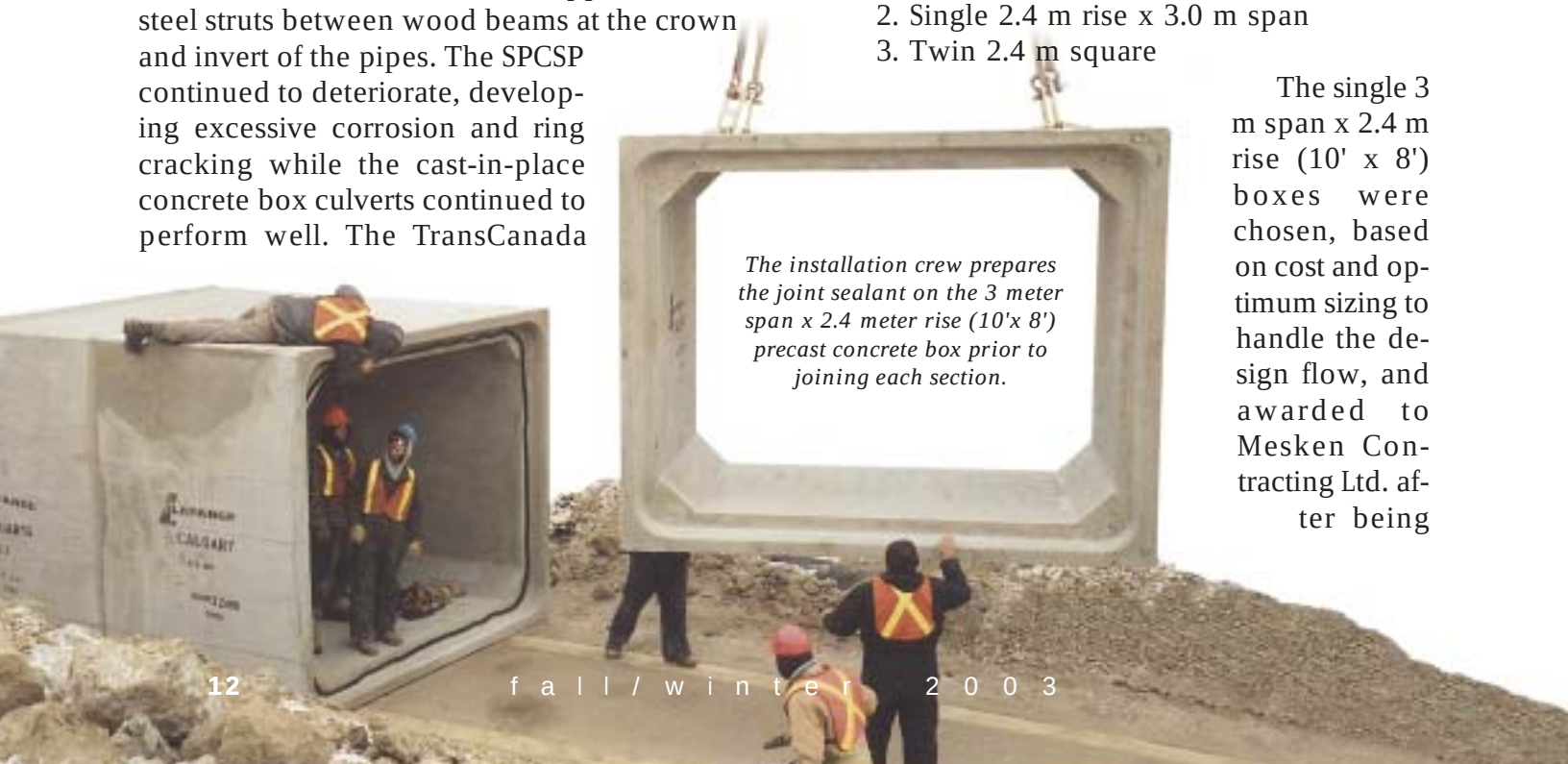
Soon after completion of the highway widening, the SPCSP culverts experienced excessive deflection and had to be supported with steel struts between wood beams at the crown and invert of the pipes. The SPCSP continued to deteriorate, developing excessive corrosion and ring cracking while the cast-in-place concrete box culverts continued to perform well. The TransCanada Highway is the world's longest national highway, stretching 7821 km (4660 miles). It is vital to Canada's economy that the highway be maintained without disruption and premature structural failures.

Alberta Transportation initially considered a liner installation inside the SPCSP arches to minimize disruption to traffic. This option was quickly discarded, as the largest usable liner was undersized for the design flows. Once a liner was no longer an option, only pre-cast concrete boxes were considered. This decision was based on the good performance of the nearly 50-year old cast-in-place twin boxes as compared to less than 20-year old SPCSP arches. The replacement culverts had to meet a 75-year design life as specified in the Canadian Highway Bridge Design Code (CHBDC). The other advantages of precast box culverts were better fit with the existing cast-in-place culvert, and superior results in past installations of concrete box culverts with regard to cost and construction method.

Khaled Nasery, E.I.T. of Mish Engineering designed the culvert replacements under the supervision of Ash Morjaria, P.Eng. Mish Engineering presented Alberta Transportation with three different size pre-cast concrete box alternatives:

1. Twin 2.4 m rise x 1.8 m span
2. Single 2.4 m rise x 3.0 m span
3. Twin 2.4 m square

The single 3 m span x 2.4 m rise (10' x 8') boxes were chosen, based on cost and optimum sizing to handle the design flow, and awarded to Mesken Contracting Ltd. after being



The installation crew prepares the joint sealant on the 3 meter span x 2.4 meter rise (10'x 8') precast concrete box prior to joining each section.

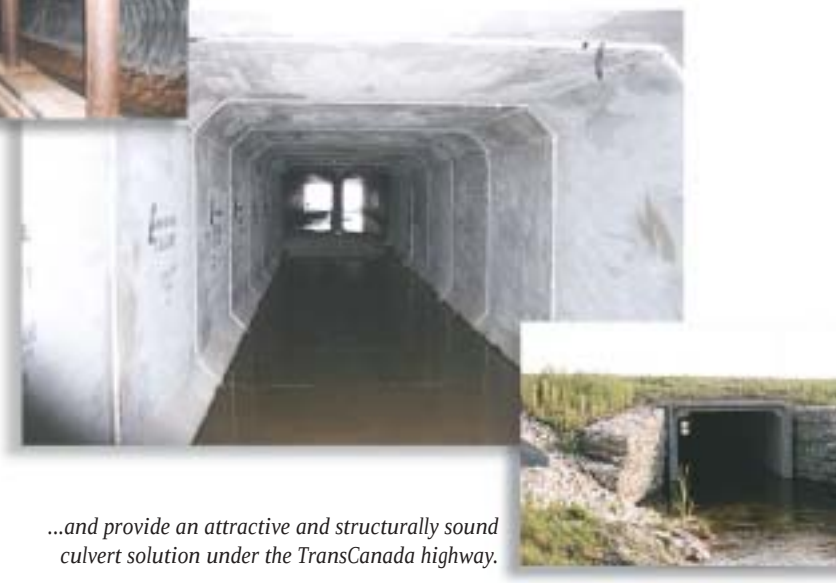
tendered in December, 2002. Lafarge Canada, Inc. supplied the box units from their Calgary pipe operation after designing the units in accordance with CHBDC for CL-800 truck loading and cover ranging from 0.2 m to 2.65 m (7.5" to 8') above the top of the culvert. The 44 box units, each 2 m long (6 1/2" feet), were produced from February 10 to 18, 2003 with AMEC Earth and Environmental inspecting the production. The west culvert required 19 units and the east culvert 25.

Construction took place in two stages. First, eastbound traffic was reduced to one lane and moved onto the south shoulder. The failed SPCSP was removed and 10 sections were installed at the west culvert and 11 at the east culvert. The first box units were cast with exposed reinforcing to facilitate an easy field connection to the existing culverts. After the first stage installation was backfilled, the contractor moved the traffic to the north shoulder over the newly installed boxes and installed the remaining box units at each site.

The roadway was surfaced and the eastbound lanes opened to two-lane traffic. The westbound lanes were unaffected by the construction, however, eastbound traffic was reduced to one lane for 16 days at the west end, and 18 days at the east end. The contractor worked at both sites simultaneously on a 24-hour basis in extreme cold conditions. Construction was complete in 22 days at both sites. A steel strut was placed at the upstream end of the new culvert sections to block large debris, not for structural support.

Installation of the precast concrete box culverts provided minimal disruption to traffic and an economical, long-lasting product that will stand up to the existing environmental and load conditions. With a 75-year design life, the new culvert sections will unquestionably outperform the previous structurally reinforced SPCSP that lasted only 29 years. The new sections should also outlast the cast-in-place sections. Time is now on the side of Canadian taxpayers.

Steel struts and wood beams were used to support the excessively deflected SPSCP...



...until precast concrete box sections could be installed while maintaining traffic flow...

...and provide an attractive and structurally sound culvert solution under the TransCanada highway.

Project:	Hartell Creek Culverts Replacement Town of Strathmore, Alberta
Owner:	Government of Alberta, Canada
Consulting Engineer:	Mish Engineering Airdrie, Alberta
Contractor:	Mesken Contracting Ltd. Okotoks, Alberta
Quantities:	44 (3 meter span x 2.4 meter rise) precast reinforced concrete box units
Producer:	Lafarge Canada Inc. Calgary, Alberta

The Lafarge Canada Inc. plant in Calgary is a key component of Lafarge North America's concrete pipe operations in Canada. Products include reinforced concrete pipe ranging in size from 300 mm to 3000 mm, jacking and tunnel pipe, manholes, catch basins, precast concrete box units and associated drainage products. Lafarge plants in Calgary, Edmonton and Winnipeg provide precast concrete pipe and an assortment of drainage products throughout western Canada. See www.lafargepipe.com for details.

Part II — Continued from Summer 2003 Concrete Pipe News)

THE CHARACTERIZATION OF POLYETHYLENE MATERIALS AND THEIR SUITABILITY FOR USE IN LONG-TERM SERVICE

Dr. Thomas S. Walsh, Ph.D.
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Introduction

In the summer 2003 issue of Concrete Pipe News, we presented the first part of an inclusive article by Dr. Walsh on understanding resin requirements needed to achieve a particular strength and durability balance in plastic pipe. Part I covered density, melt index, molecular weight distribution and the effect of these factors on high density polyethylene properties. The article summarized short-term yield, tensile properties and flexural properties. The second part of Dr. Walsh's article deals with long-term material properties and service issues with HDPE pipe materials. – Ed.

Stress Crack Resistance

The ability of polyethylene to resist slow crack growth or environmental stress cracking is known as the Environmental Stress Cracking Resistance (ESCR). Homopolymer materials and higher density copolymer materials do not have very good ESCR performance and have very short failure times on this test. The polymer structure, molecular weight, and molecular weight distribution will affect the environmental stress cracking resistance (ESCR) of a material. The mechanism of ESC failure or slow crack growth (SCG), as it is also referred to, is generally understood to involve chemical oxidative attack on the polymer backbone leading to chain scission and reduced physical properties.

There are many different ESC test methods used to determine the resistance of various PE materials. The most commonly used test method for PE materials is ASTM D1693, "Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics." However, this test, no longer provides adequate information on many modern MDPE and HDPE materials. ASTM D5397, "Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test," which is commonly termed the Notched Constant Tensile Load Test or NCTL Test, was developed for the geomembrane industry as an accelerated ESCR test. This test has much higher precision than ASTM D1693. Similarly, ASTM F 1473, "Standard Test Method for Notch Tensile Test to Measure the Resistance to Slow Crack Growth of Polyethylene Pipes and Resins," which is commonly referred to as the PE Notch Tensile Test or PENT Test, was developed for the gas distribution piping industry to test modern HDPE and MDPE piping resins that have excellent ESC resistance, and would not fail ASTM D1693 testing.

ASTM F2136-01, "Standard Test Method for Notched, Constant Ligament-Stress (NCLS) Test to Determine Slow-Crack-Growth

Resistance of HDPE Resins or HDPE Corrugated Pipe," was only recently developed and is based on ASTM D5397. This test specifies the tensile stress load upon the specimens in contrast to D5397, which requires a load based on a percentage of the tensile strength of the sample material. F2136 reduces the variations seen with ASTM D5397 when testing HDPE materials commonly used in corrugated piping applications.

Stabilization

Antioxidant stabilizers are added to polyethylene materials to prevent oxidation and the subsequent loss of physical properties during shipment, storage, processing and service. During processing, free radical molecules are formed, which react with the polyethylene polymer. Stabilizing additives, which react with the various free radicals to form stable molecules, inhibits these free

radical reactions. Since there is a finite amount of antioxidant added to the polymer, high processing temperatures or severe processing conditions, such as longer residence times in the extruder, will act to deplete the antioxidant. Once the antioxidant is consumed, the polymer will no longer be protected from degradative reactions, i.e. chain scission. The physical properties of the final product can be reduced to the point that it no longer meets appropriate industry standards.

There are several tests that can be used to indicate the amount of stabilizer present. Two common test methods are: Differential Scanning Calorimetry (DSC) testing and the Carbonyl Index testing. The DSC Induction Time or DSC Induction Temperature tests indicate the degree of stabilizer remaining in the resin. The carbonyl index test shows the degree of oxidative degradation by measuring the type and amount of carbonyl (>C=O) functionalities created on the surface of the pipe during processing or afterwards (?).

LONG TERM PROPERTIES

Hydrostatic Design Basis

Hydrostatic stress rupture testing of pipe specimens is the traditional method for determining the long-term properties of polyethylene piping materials. ASTM D2837, "Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials," describes the procedure for obtaining the long-term hydrostatic strength of thermoplastic piping materials as a cell class value, the Hydrostatic Design Basis or HDB. The Plastics Pipe Institute's (PPI)[1] Technical Report TR3-02, "Policies and Procedures for Developing Hydrostatic Design Bases (HDB), Pressure Design Bases (PDB), Strength Design Bases (SDBs), and Minimum Required Strengths (MRS) Ratings for Thermoplastic Piping Materials or Pipe" provides further information on the test. These test methods analyze long-term tensile stress data (out to and in excess of 10,000 hours at ambient and elevated temperatures) and extrapolate the long-term hydrostatic strength at 100,000 hours and also 50 years. This test is designed to provide information on the long-term durability of thermoplastic materials under tensile loads.

ASTM D3350 Cell Classification System

ASTM D3350 "Standard Specification for Polyethylene Plastics Pipe and Fittings Materials," currently characterizes polyethylene materials for piping based on six physi-

Table 2: ASTM D3350 Cell Classes

Property	Test Method	Cell Class							
		0	1	2	3	4	5	6	7
1. Density (g/cc)	D1505	Unspecified	0.910-0.925	0.926-0.940	0.941-0.955	>0.955	…	…	Specify value
2. Melt Index (g/10 min)	D1238	Unspecified	> 1.0	1.0-0.4	<0.4- 0.15	<0.15	A		Specify value
3. Flexural Modulus MPa (psi)	D790	Unspecified	<138 (<20,000)	138-<276 (20,000-<40,000)	276-<552 (40,000–80,000)	552-<758 (80,000 – 110,000)	758-<1103 (110,000–<160,000)	>1103 (>160,000)	Specify value
4. Tensile Strength @yield, MPa (psi)		Unspecified	<15 (<2,200)	15-<18 (2,200 - <2,600)	18-<21 (2,600 – <3,000)	21-<24 (3,000 - <3,500)	24-<28 (3,500 - <4,000)	>28 (>4,000)	Specify value
5. Slow Crack Growth Resistance									
I. ESCR a. Test Condition (100% Igepal) b. Test duration, h c. Failure, max %	D1693	Unspecified	 A 48 50	 B 24 50	 C 192 20	 C 600 20			Specify value
II. PENT (hours) Molded Plaque 80C, 2.4 Mpa Notch depth, F1473 table 1	F1473	Unspecified	0.1	1	3	10	30	100	Specify value
6. Hydrostatic Strength Classification									
I. Hydrostatic Design Basis, MPa (psi), (230C)	D2837	NPR (not pressure rated)	5.52 (800)	6.89 (1,000)	8.62 (1,250)	11.03 (1,600)			Specify value
II. Minimum required strength, MPa (psi), (200C)	ISO 9080	…	…	…	…	…	8 (1160)	10 (1450)	

cal properties. The physical properties are density, melt index, flexural modulus, tensile strength at yield, environmental stress crack resistance (ESCR), and the hydrostatic design basis (HDB). A cell classification system is used to differentiate between the various range of properties provided by the wide range of available polyethylene materials. Color and ultraviolet stabilizer are indicated by a letter designation to be placed at the end of the cell classification. Thermal stability is required and the standard states that the PE material shall contain sufficient antioxidant so that the minimum induction temperature shall be 220^{0}C when testing in accordance with other requirements in the standard. Table 2 shows the cell Classes from ASTM D3350.

Discussion of the Use of ASTM D3350 to Characterize HDPE Materials

ASTM D3350 is widely used by the polyethylene pressure pipe, non-pressure pipe and the corrugated pipe industries to characterize the base materials used to make their products. Many ASTM piping product standards require that the cell classifica-

tion numbers for the base resin to be printed directly onto the piping products. However, the short term properties used to characterize PE materials by D3350 (density, melt index, flexural modulus and tensile strength) do not provide any information as to the suitability of each material for long-term service in piping applications. Nor does the ESCR test currently included in D3350 (ASTM D1693), really provide adequate information about modern PE pipe grades.

AASHTO M-294

The latest revision to the American Association of State Highway Transportation Officials' (AASHTO)[1] M-294, "Standard Specification for Corrugated Polyethylene Pipes, 300 to 1500 mm Diameter," now includes a reference to ASTM F2136. It will require that HDPE resins for use in applications covered by M-294, have slow crack growth resistance, as required by M294 and tested in accordance with ASTM F2136. M294-03 will require that the average failure time of the five test specimens exceed 24 hours, with no single test specimen failing in less than 17 hours. This is a slight increase in the slow crack growth requirements for HDPE corrugated piping. While the Plastics Pipe Institute claims F2136 "is a beneficial test method for the corrugated polyethylene pipe industry to determine slow crack growth resistance of the base resin and eventually the corrugated pipe"[2], it is only a slightly better differentiator of resin quality than the D1693 test, and is not appropriate for testing the finished pipe.

Applicability of These Tests

With the recent development of ASTM F2136, and its upcoming inclusion in AASHTO M-294, there is now available a more sophisticated and short term test procedure to establish the slow crack growth resistance of a wide range of HDPE materials The critical work that remains in testing the resin is determining minimum time to failure requirements for inclusion in AASHTO M-294 that will provide increased assurance of the long-term durability of corrugated piping products in these applications. ASTM D3350 should also be revised to include F2136.

Dr. Walsh is president of Walsh Consulting Services Company, Houston, Texas. Prior to starting the firm in 1993, Dr. Walsh was executive director of the Plastic Pipe Institute. As part of the Society of the Plastic Industry, Inc., Dr. Walsh created and managed marketing programs for the development of polyethylene pipe markets in North America. During his career, he has served on numerous government agencies and regulatory bodies. Dr. Walsh is a recognized expert in the areas of plastic piping materials, testing and long-term durability. He has a Doctor of Philosophy in Chemistry from Rensselaer Polytechnic Institute and a Bachelors of Science degree from Boston College. Dr. Walsh can be reached at (281) 493-2344, email: t.s.walsh@earthlink.net.

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[1] ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959
[2] The Plastics Pipe Institute, 1825 Connecticut Avenue, NW Suite 680, Washington, D.C. 20009, www.plasticpipe.org
[3] American Association of State and Highway Transportation Officials, 444 N. Capitol St., NW Washington, DC 20001
[4] ASTM Standardization News, October 2001

Sewer Overhauls Drive Fee Hikes

By Larry Copeland
Special Report from USA Today
(Reprinted with Permission)

ATLANTA — Most Americans don't give a second thought to wastewater once it swirls down the drain or toilet and out of their lives. As the sewage treatment professionals say, we flush and forget it.

But where that wastewater goes next affects daily life in many ways. A city's sewer system determines whether residents can fish and swim in their rivers and streams. And for 40 million residents in 772 communities in the Northeast, South, Midwest and Pacific Northwest, it could make a big dent in their wallets.

The sewage treatment systems in many cities are outdated. Many were built more than a century ago. They need costly upgrades to meet federal clean-water standards. But the federal money available for such updates is a fraction of what it was a generation ago.

The problem is part of the challenge the nation faces in overhauling highways, bridges, mass transit and other public works systems that are straining from decades of wear and tear and the demands of a rapidly increasing population. The question is how such improvements can be made and who will pay for them.

Rates Keep Rising

Many communities that have antiquated sewer systems are passing the costs of upgrades directly to residents through higher sewer bills:

- Residents of Atlanta could see their sewer bills almost triple over the next five years as the city tries to pay for $3 billion in improvements. Unless the city gets federal or state help, the average homeowner's sewer bill could go from about $36 a month to $102 in 2008. Equally alarming in a city that relies heavily on convention business, the monthly water-sewer bill for a downtown hotel could rise from $27,000 to $77,000.

- Indianapolis, Indiana, which has some of the nation's lowest sewer bills, expects to triple rates over the next 15 years to pay for a $1 billion update.

- Providence, Rhode Island has raised rates four times in the past four years to fund the first phase of a 20-year, $700 million project. The average annual residential bill has gone from $135 in 2001 to $235 this year. "People are definitely not happy about it," says

Atlanta's bills

Residents of many cities face sharply higher sewer bills in coming years to finance improvements in water treatment. Projected monthly fees for the average home-owner in Atlanta:

Year	Rate	Increase from previous year
2003	$35.60	13%
2004	$51.60	45%
2005	$74.80	45%
2006	$82.96	11%
2007	$92.08	11%
2008	$102.16	11%

Rate does not include cost of water
Sources: Atlanta Mayor's Office; Atlanta Office of Watershed Management

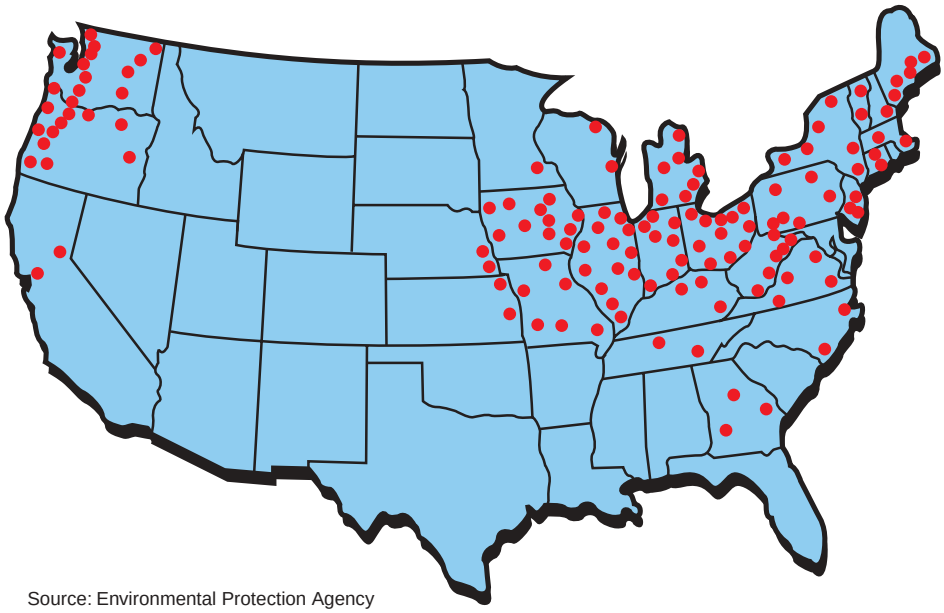
Jamie Samons, spokeswoman for the Narragansett Bay Commission, which runs Providence's sewer system.

- The Northeast Ohio Regional Sewer District in Cleveland, Ohio must complete a $1.3 billion update over the next 30 years. Rates there are about $35 a month. But "without any type of other source of funding, we're projecting a doubling of sewer rates over the next 10 years," says William Schatz, the district's general counsel.

The problems in these and about 770 other communities are systems that blend sewage from homes and businesses with runoff from streets, roofs and parking lots when it rains. For generations, these cities dumped untreated waste into rivers and streams whenever heavy rainfall overwhelmed the systems' ability to carry the load to treatment plants.

Areas that have outdated sewer systems

Hundreds of communities have antiquated sewer systems that need costly upgrades to meet federal standards for clean water. Many of the cities are concentrated in the Northeast, Midwest and Pacific Northwest.



Source: Environmental Protection Agency

Mandate For Clean Water

Then, in June 1969, the Cuyahoga River in Cleveland caught fire and all that began to change. Schatz notes that it was grease and oil on the river that caught fire — not the river itself. But the nation saw a river seemingly so polluted that it was in flames. That indelible image led to a national push to clean up America's waterways and to congressional passage of the Clean Water Act in 1972.

Cities that built separate systems for sewage and storm water in the first place also must meet the standards of the law and subsequent amendments. But the rules hit particularly hard at cities and suburbs that have combined systems.

Those communities were left with two options:

- They could build separate systems for sewage and storm runoff, which would mean huge disruptions and costs. "I'm not sure even God has enough money to do that," Schatz says.

- Or they could build massive underground tanks to hold the combined flows during storms. After the storm, the wastewater could be pumped to treatment plants and released into rivers. Most cities have picked the second option.

The federal government once paid 75% to 95% of the cost of such projects, industry

experts say. That share has dropped to about 5%. The Environmental Protection Agency estimates that the cost of clean- water improvements from 2000 to 2019 will be $388 billion more than federal money currently planned."

The federal government must re-commit to funding," says Adam Krantz, managing director for government affairs of the Association of Metropolitan Sewerage Agencies, which represents 300 public agencies and other groups involved in sewage treatment. Unless that investment takes place, he says, water pollution may increase to levels before the Clean Water Act took effect.

But there is little movement in Congress to finance major clean water initiatives at a time when the federal budget deficit is at record levels.

Many cities, already struggling from a weak economy that has hurt their finances, say drastic increases in utility bills could risk driving out residents and businesses.

"We need a national water policy and we need financing for clean water," Atlanta Mayor Shirley Franklin says. "Atlanta is a poster child for how badly we need that."

But some experts say the federal government is already doing enough. "Water and sewer systems are local services that should be paid for by the people who use them," says Adrian Moore, executive director of the Reason Public Policy Institute, a Los Angeles-based think tank that promotes privatizing water and sewer systems. Charging users the full cost of water and sewer services encourages conservation and efficiency, he argues.

Moore says Congress could help local governments by letting private companies issue tax-exempt bonds for water and sewer projects. Now, only local governments can issue such bonds.

Atlanta's Worries

Atlanta needs to overhaul its sewers not just to meet federal clean water rules but also to handle population growth in Georgia's largest city and its suburbs.

Franklin is seeking financial help from federal, state and suburban officials to ease the burden on city residents, but they have been cool to her pleas. Gov. Sonny Perdue has said he might ask the Legislature to help but says he doubts the state will chip in the $500 million Franklin seeks.

Atlanta officials say that De Kalb and Fulton counties, each of which includes parts of Atlanta, use the city's water treatment system but haven't helped pay for improvements.

Franklin is pushing a 1-cent sales tax increase in Fulton County. But officials in Fulton twice have refused to put the tax on the county ballot.

Some political observers say that Atlanta's sewer rates certainly will rise but that the huge increase Franklin is floating is a political gambit.

"I think this is a worst-case scenario," says William Boone, a political science professor at Clark Atlanta University. "You're just now beginning to attract people back to the city who can afford to expand the tax base in a positive way. So (Franklin) can't be thinking about increasing utility fees in a way that would frighten people away."

But Franklin rarely bluffs. She already has balanced the budget by hiking taxes and laying off city employees.

Franklin says she will pursue alternatives to the large fee hikes and appeal to the EPA on the grounds that the costs will make her city unaffordable for many residents.

The goal for Atlanta and hundreds of other cities and counties is how to keep more pollution from flooding into rivers, streams, lakes and bays.

Says Samons of the Providence system: "I think we're at a real turning point in terms of how we're going to set the priorities and how we're going to fund them."

Contributing: Dennis Cauchon in Granville, Ohio.

LEARN MORE ABOUT CONCRETE PIPE PRODUCTION

Attend ACPA's Spring Production Short Course School!

Sheraton Atlanta Hotel
Atlanta, Georgia
February 4-6, 2004

Today's infrastructure engineer and drainage professional is faced with many challenges. But most are willing to take on the task – because they have "No Fear." The same is true for concrete pipe production personnel – they fear nothing when meeting the challenge.

To learn more about these challenges and how precast concrete pipe can provide the answer for virtually any drainage or conveyance system, attend the American Concrete Pipe Association's Spring "Production & Quality" Short Course School.

Attendees will gain valuable insight into the production of quality concrete pipe products, and how these products stack up against competitive pipe materials. Other topics on employee safety, workplace efficiencies, management tools, employee training and advanced production techniques are easily transferable to other organizations and disciplines. Four different educational tracks are featured and allow for customized learning.

Bonus Attendance At MCPX 2004 Trade Show

As a Spring SCS attendee, you'll receive automatic registration to the precast concrete industry's biggest trade show event – the Manufacturers Concrete Products Exposition, Feb. 6-8 at the Georgia World Congress Center. ACPA has join with the National Concrete Masonry Association, National Precast Concrete Association, and Interlocking Concrete Pavement Institute to share with you new technologies, products and services to the industry. Your firm, organization or public agency will be years ahead of your peers by attending this unique trade show.

Special Rates for Drainage Products Engineers and Designers

The cost of attend ACPA's Spring SCS is $175. However, to attend you must be sponsored by a ACPA member company. For on-line registration, go to www.concrete-pipe.org, or contact the American Concrete Pipe Association for registration details and details. Hurry, early registration closes January 9, 2004.

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Industry Spotlight

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synergy by being involved in both associations? Explain.

Hottle: Yes, there are synergies between both organizations that work to benefit members. The certification programs of ACPA and NPCA serve to elevate the public perception of our products. This is especially true and significant within the specifier's community. We are doing a lot of things together, well. The MCX joint training programs provide a fundamental knowledge base on the production of quality concrete. Both organizations work together to protect and expand markets in manholes and pipe by focusing on raising the level of quality of products in a market that is approximately 70% public and 30% private.

Q: *Stormwater containment and detention has become an important market for precast concrete products. How do you see this market growing, and why?*

Hottle: The market is really taking off in this sector, especially in high population density growth areas. The public and governments have recognized that units of water are used and reused several times before returning to the hydrologic cycle. The technology for removing pollutants from stormwater is only now gaining momentum as regulations under the Clean Water Act come into force. Phases I, II and now III require permitting and mitigation technology for reducing or eliminating pollutants from stormwater under the National Pollutant Discharge Elimination System (NPDES). Most municipalities and industries are now subject to the legislation. Many treatment systems use components that fit into precast concrete manhole and box structures.

Q: *You have been a strong proponent of watertight products. Are you able to achieve watertight seals with your pipe products, as well as manholes, vaults and other structures? Please explain.*

Hottle: We have very good success passing vacuum and infiltration/exfiltration testing. States now require absorption tests that run 5% or less on wet and dry cast samples. This issue is about making good watertight products in the first place with quality sealing products. The solutions for watertight products must be built into the products at the time of production. You shouldn't have to go back after the product is in place to correct problems. Our plant certifications programs like Q-Cast helps assure that products are being made the right way, every day. We are not a low cost producer. We offer products that have the best value for the price.

South Broadway Avenue

continued from page 11

ber of the American Concrete Pipe Association, manufactured all of the precast concrete products at its Menoken Plant. The plant is located nine miles east of Bismarck and 120 miles from the job site.

Now that the city of Minot is equipped with a major new asset, the community can continue its planned growth under safe roadway conditions. The community will see the greatly improved roadway with lane additions, traffic signal timing improvements, better lighting and pedestrian curb ramps. Residents and businesses alike however, will soon forget the vital reinforced concrete storm sewers buried below South Broadway that will ensure that the city's growth is healthy as well as safe. Reinforced concrete pipe and associated products are engineered to function as major unnoticed infrastructure for decades, requiring little or no maintenance for the design life of the asset.

Founded in 1926, North Dakota Concrete Products started as a manufacturer of reinforced concrete pipe and related precast concrete products. Expansion and innovation has led to the development of new and different products, although the focus remains on its basic material, precast concrete. Today, North Dakota Concrete Products provides a varied product line, including erosion control materials, prestressed concrete bridge members, manholes, box culverts and reinforced concrete pipe

"Quality Cast" Certified Plants

In an effort to improve the overall quality of all concrete pipe products, the American Concrete Pipe Association offers an on-going quality assurance program to member and non-member companies. Called the "Quality Cast" Plant Certification Program, the 124-point audit-inspection program covers the inspection of materials, finished products and handling/storage procedures, as well as performance testing and quality control documentation. Plants are certified to provide storm sewer and culvert pipe or under a combined sanitary sewer, storm sewer and culvert pipe program. The following plants are currently certified under ACPA's Quality Cast Certification Program:

Storm Sewer and Culvert Pipe

- Atlantic Concrete Pipe, San Juan, PR - Miguel Ruiz
- Boughton's Precast, Inc., Pueblo, CO - Rodney Boughton
- California Concrete Pipe (Oldcastle), Stockton, CA - Qing Lian Gao
- Carder Concrete Products, Littleton, CO - Bruce Spatz
- Carder Concrete Products, Colorado Springs, CO - Tom Walters
- Cayuga Concrete Pipe Company (Oldcastle, Inc.), Croydon, PA - Allen Reed
- Cayuga Concrete Pipe Company (Oldcastle, Inc.), New Britain, PA - Kim Venable
- Elk River Concrete Products (Cretex), Billings, MT - Bill Cooper
- Geneva Pipe Company, Hurricane, UT - Brent Field
- Grand Junction Concrete, Grand Junction, CO - Ben Burton
- ndependent Concrete Pipe Company, London, KY - Ed Wilkerson
- Kerr Concrete Pipe Company (Oldcastle, Inc.), Hammonton, NJ - Bob Berger
- Kerr Concrete Pipe Company (Oldcastle, Inc.), Farmingdale, NJ - Scott McVicker
- NC Products (Oldcastle, Inc.), Raleigh, NC - Mark Sawyer
- Rinker Materials-Hydro Conduit Division, Denver, CO - Mike Leathers
- Riverton Concrete Products Company (Cretex), Riverton, WY - Butch Miller
- Sherman-Dixie Concrete Industries, Inc., Chattanooga, TN - Chris Mears
- Sherman-Dixie Concrete Industries, Inc., Franklin, TN - Tony Jackson
- Sherman-Dixie Concrete Industries, Inc., Lexington, KY - Darrel Boone
- South Dakota Concrete Products (Cretex), Mitchell, SD - Andy Fuhrman
- South Dakota Concrete Products (Cretex), Rapid City, SD - Jeff Ullrich

Sanitary Sewer, Storm Sewer and Culvert Pipe

- Amcor Precast (Oldcastle, Inc.), Nampa, ID - Mike Burke
- Amcor Precast (Oldcastle, Inc.) Ogden, UT - Bob Jolley
- Elk River Concrete Products (Cretex), Elk River, MN - Bryan Olson
- Elk River Concrete Products (Cretex), Shakopee, MN - Steve Forslund
- Geneva Pipe Company, Orem, UT - Fred Klug
- Kansas City Concrete Pipe Co. (Cretex), Shawnee, KS - Lynn Schuler
- Langley Concrete & Tile, Ltd., Langley, BC, Canada - Mark Omelaniec
- NC Products (Oldcastle, Inc.), Fayetteville, NC - Preston McIntosh
- Ocean Construction Supplies Limited (Inland Pipe), Vancouver, B.C., Canada - Ron Boyes
- Amcor Precast Company (Oldcastle, Inc.), Ogden, UT - J. P. Connoley
- Waukesha Concrete Products Company (Cretex), Waukesha, WI - Jay Rhyner

Box Culvert

- Sherman-Dixie Concrete Industries, Inc., Franklin, TN - Tony Jackson
- Langley Concrete & Tile, Ltd., Langley, BC, Canada - Mark Omelaniec

STANDARD INSTALLATION BROCHURE AVAILABLE FROM ACPA

Earlier this year, the American Concrete Pipe Association unveiled an all-new publication to help explain the differences between indirect design and indirect design. Called "Standard Installations" (Resource Item 07-126), the brochure was well received by ACPA membership with quite a few member companies ordering copies for distribution to their local engineering, specification and design customers.

The 8-page full-color brochure provides a brief history on Standard Installations using the Direct Design method, and describes the various installation types. Covering beneficial characteristics and soil/pipe terminology for standard trench and embankment installations, the brochure is easy to understand. The "Standard Installation" brochure is the first in a series of new brochures under development by the Association.

If you are interested in obtaining a copy of the "Standard Installations" brochure, your first call should be to your local ACPA member. You can obtain contact information by visiting ACPA's website, www.concrete-pipe.org. If you prefer to order directly from the ACPA Resource Center, call 800-290-2272 and request Resource Item 07-126. Cost is $3.00 each, plus shipping and handling. Check, money order, Visa, MasterCard and American Express are accepted. All orders must be prepaid.

Indirect Design: Comparison of the structural strength of the pipe (Three-Edge Bearing Test) to the field support strength of a buried pipe.

Direct Design: The design of pipe in the installed condition. The magnitude and distribution of loads are determined and the physical properties necessary to support those loads are calculated.

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