

Major Flood Spurs Construction of Large Capacity Storm Drain

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On July 28, 1997, Fort Collins, Colorado was hit by a major storm that caused massive flooding at Colorado State University and an established neighborhood east of the campus. The catastrophic effects of the downpour received coverage on all major national television networks over several days. The city had been developing its master drainage plans since the early 1990s, and was making progress in improving its storm drainage systems when the storm hit. The 1997 flood dramatically altered timetables for reconstruction, as funding suddenly became available for flood relief projects.

The Locust Street Outfall was a drainage improvement project designed to improve storm drainage and reduce flooding in the Old Town Storm Drainage Basin. At the time the design was initiated, there were 132 homes and 16 commercial structures that were within the 100-year floodplain. The goal of the project was to relocate the 100-year floodplain surrounding these structures. The project required phased reconstruction of nine blocks of residential streets to install a large diameter precast concrete storm sewer. The system discharges into a storm water quality pond adjacent to the Poudre River. There, the debris is removed by a water quality structure before entering the river.

Precast concrete pipe was specified because of

ease of installation and longevity. Other types of pipe material were investigated early in the design process. However, it was concluded that installation of other pipe materials would have been much more demanding, and that they did not have the same service life as precast concrete pipe. Carder Concrete Products Company, Littleton, Colo., was selected to provide the precast concrete products for the projects. Products included 84-inch and 108-inch diameter reinforced concrete pipe, and 16-foot x 5-foot; and 8-foot x 5-foot concrete box sections. Engineers specified gasketed joints in the storm sewer because the sewer runs through a 100 year-old neighborhood that is congested with utilities. Also, infiltration and exfiltration had to be limited.

Andrea Faucett, water resources engineer for Sear-Brown, Fort Collins, Colo., the lead design firm for the project said "There is no reason to believe that the storm sewer installed in the Locust Street project will ever be taken out of service, therefore it had to be built to last. Also the ease of installation of concrete pipe allowed the contractor to install an average of eight units of large diameter pipe per day, barring any unexpected interruptions. This cut down on the construction time which, of course, reduced the overall cost."

Faucett went on to say, "I appreciate all of the standards and testing which concrete pipe must adhere to. I know when I specify concrete pipe that I will get a uniform, quality product because of these standards. Also, I appreciate the flexibility I have in design because of the different sizes and

shapes which are available."

Grimm Construction of Louviers, Colo., was selected by the Fort Collins Utilities to construct the new storm and sanitary sewer because of their track record of successfully completing large projects for



The trench box used during installation of 8-ft. x 5-ft. reinforced concrete box sections allowed for smaller excavation and minimized site problems from wet weather runoff.

the city. Beginning in the fall of 2000, construction was scheduled to run through the winter, spring and summer of 2001.

Construction of the precast reinforced concrete storm sewer began with installation of 108-inch diameter reinforced concrete pipe (RCP) at Riverside Avenue, then to Laurel Street and on to Stover Street. The sewer construction continued south on Stover to Plum Street and west on Plum to Whedbee Street. Mid-block on Whedbee Street the 108" RCP transitions to a 16-foot x 5-foot reinforced concrete box (RCB) sewer. At the intersection of Whedbee and Locust the 16-foot x 5-foot box transitions to an 8-foot x 5-foot RCB sewer. Approximately 300 feet west of the Locust/Whedbee intersection the 8-foot x 5-foot box transitions to an 84-inch RCP (See Map). The 84-inch and 108-inch storm sewer pipe was placed in trenches ranging in depth from 12 to 20 feet, and 16 feet wide, which required Class II pipe.

The intersection of Whedbee and Locust is the area that exhibited the worst flooding along the storm sewer's route. It is referred to as "the sump" where the historical drainage of the Old Town Basin and the pipeline meet. The main feature in the area is a low street intersection requiring the 8-foot x 5-foot RCB and a transition structure to connect downstream to the 16-foot x 5-foot RCB sewer, and another transition structure further downstream to the 108-inch pipe. At the lowest point at the intersection, there are eight inlets to intercept flows from the north, east, south and west sections of the city. In addition to these surface flows, two existing storm sewers are intercepted and connected where the 8-foot x 5-foot structure transitions to 16-foot x 5-foot

box structure.

The Whedbee Street storm sewer was originally specified as a 16-foot x 5-foot cast-in-place structure. The excavation would have required considerable sloping and support. Such work was cost prohibitive, and would have eliminated most vehicular access during construction as it was to be constructed near the middle of a residential street. That, combined with the close proximity to the low point for flooding, and the prospect of having an excavation open for a lengthy period, made the perceived risk too great, and the decision was made

to use precast boxes.

Jeffrey Moore, project manager said, "Grimm Construction had learned while installing the 108-inch diameter RCP that it could control existing storm sewer flows by installing temporary connections (evenings and weekends) from existing pipes to the 108-inch conduit." Moore explained that the smaller excavation, permitted by using a trench box, limited damage to the excavation from wet weather runoff. An open cut, sloped excavation (without a trench box) with formwork and rebar would have been exposed to flooding over the period of the construction schedule.

The precast option was a major public relations boost for the project. It reduced risks associated with installing

the cast-in-place conduit, and represented a considerable savings to the City of Fort Collins. The precast option also allowed the use of a trench box for sidewall support, eliminating the need for ex-



◀ 16-ft. x 5-ft. precast RCB sections replaced a similar-size cast-in-place structure.



▲ Installation of 108-inch diameter RCP approaches the transition/drop structure.



▲ 45 special fabrications were used on the project, including this 83-degree bend.

tensive excavation associated with cast-in-place conduits. The precast option provided homeowners with vehicular access during construction, residential parking, use of front yards, and a significant acceleration of the construction schedule.

Grimm Construction presented the RCB option to Carder Concrete Products, who explored twin cell and single cell equivalents against the original 16-foot x 5-foot cast-in-place-structure. Carder took the concept a major step further by proposing that the 108-inch diameter RCP be extended upstream until it ran out of cover. At this point Carder proposed joining the 16-foot x 5-foot RCB to a 108-inch diameter RCP transition, and continuing upstream with the 16-foot x 5-foot RCB. This approach solved a major hydraulic problem associated with the original design, as it made the transition from 16-foot x 5-foot box sewer to 108-inch RCP in-line rather than a 90-degree bend at the downstream street intersection. The 90-degree bend was accomplished by using two 45-degree 108-inch diameter RCP bends. The in-line transition and the 45-degree bends considerably improved the hydraulics in this stretch of the project.

Carder Concrete Products was contracted in the summer of 2000 to begin production of the 108-inch diameter and 84-inch diameter RCP system. Specifications also called for ASTM C443 rubber gasket joints for the reinforced concrete pipe, and ASTM C990 flexible mastic sealant joints for the reinforced concrete box portion of the sewer.

Close coordination between Carder Concrete staff, the contractor and engineer were key in obtaining quick approvals from the city. The Internet played a significant role from the beginning of the project by allowing Carder Concrete Products to quickly respond with numerous product submittals and provide weekly production schedules. The Carder staff sent e-mails on a weekly basis, noting how many pieces of 108-inch diameter RCP, 84-inch diameter RCP, and 8-foot x 5-foot RCB units were in their yard. The weekly e-mails also outlined which specials were complete, which specials were in fabrication, and approximated the dates that specials needed further upstream were to be fabricated. Grimm Construction was never delayed by a lack of precast concrete pipe or pipe specials.

The \$7 million Locust Street Outfall Drainage Improvements Project substantially improved the storm sewer systems in the Old Town drainage basin. In addition to the new infrastructure, citi-

zens of Fort Collins are also equipped with a comprehensive flood warning system, which began operating in June 1999. When the next major storm hits the city, the effect of the storm will be much less of a hardship due to the foresight of its council in the early nineties to prepare for such events, and the performance of the newly-installed precast concrete drainage system. ☺

Project:	Locust Street Outfall Drainage Improvements Project
Owner:	Fort Collins Utilities Fort Collins, Colo.
Designer:	Sear Brown Fort Collins, Colo. Andrea H. Faucett, P.E. Water Resources Engineer
Contractor:	Grimm Construction Louviers, Colo. Jeffrey J. Moore, Project Manager
Quantities:	1,500 linear feet – 84-inch diameter Class II RCP 3,950 linear feet – 108-inch diameter Class II RCP 240 linear feet – (16-foot x 5-foot) RCB units 275 linear feet – (8-foot x 5-foot) RCB units 45 special fabrications (wyes, manhole tees, bends)
Producer:	Carder Concrete Products Company, Inc. Littleton, Colo.

Carder Concrete Products Company (CCP) was founded in the late 1960s in Littleton, Colorado. During the 70s and 80s, CCP orchestrated a series of acquisitions that included the formation of Wyoming Concrete Products Company (WCP) in Casper, Wyoming. Both companies are currently employee-owned and operated. In 1997, CCP expanded operations by constructing a new production facility in Colorado Springs. CCP employs approximately 130 people in Colorado and WCP employs approximately 25 in Wyoming. CCP manufactures circular nonreinforced concrete pipe (NRCP) and RCP, horizontal elliptical (HERCP), concrete jacking-pipe, and precast RCB units. WCP manufactures circular RCP, HERCP, concrete jacking-pipe, precast RCB units, precast manholes, vaults and various other specialty precast concrete infrastructure products. CCP and WCP are also the official licensees (in Colo., Wyo., Utah, Idaho, Mont., N. Dak., and S. Dak.) for the "Stormceptor System" stormwater quality device. All CCP plants are ACPA "Q-Cast" Quality Certified and the WCP plant is also NPCA Plant Certified. For information on Carder Concrete Products Co., visit www.carderconcrete.com