Technical Memorandum

Potential Considerations of HDPE Pipe

Municipal Applications

for City of Rapid City

Prepared for:
City of Rapid City, South Dakota
Public Works

May 31, 2013

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Engineering | Architecture | Surveying

In association with:
BLACK & VEATCH
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Abbreviation Key for this Document:

AASHTO: American Association of State Highway and Transportation Officials
ANSI: American National Standards Institute
ASCE: American Society of Civil Engineers
ASTM: American Society for Testing and Materials
AWWA: American Water Works Association
CITY: City of Rapid City, South Dakota
CLSM: Controlled Low-Strength Material
CPE: Corrugated Polyethylene
DENR: South Dakota Department of Environment and Natural Resources
DIO: Ductile Iron Outside Diameter
DOT: Department of Transportation
DR: Dimension Ratio
EPA: Environmental Protection Agency
HDB: Hydrostatic Design Basis
HDD: Horizontal Directional Drilling
HDPE: High Density Polyethylene
ISO: International Organization for Standardization
LTHS: Long term hydrostatic strength
MJ: Mechanical Joint
NSF: National Sanitation Foundation
PE: High Density Polyethylene
PPI: Plastics Pipe Institute
PVC: Polyvinyl Chloride
RCP: Rapid Crack propagation
TM: Technical Memorandum
UV: Ultra violet
WERF: Water Environment Research Foundation
Technical Memorandum

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The contents of this report reflect the views of the author or authors responsible for the facts and opinions presented in this Technical Memorandum. The contents do not necessarily reflect the official views of the City of Rapid City or its Public Works Department. The survey polling and responses provided herein is intended only to provide an approximation of current HDPE use for a small cross section of municipal and/or water systems throughout the U.S.A. and Canada. This report does not constitute a standard, specification, or regulation.
Executive Summary

The purpose of this technical memorandum (TM) is to provide a recommendation regarding the potential addition of HDPE pipe materials to the City of Rapid City’s municipal utility and drainage system. Data were gathered on municipal utility applications with the sources of information being surveys/contacts with various municipalities (U.S. and Canada), website searches, ASTM and AWWA Standards currently in force. The results of this survey indicate various degrees of acceptance regarding the use of HDPE by municipal utilities. Of the 39 utilities contacted directly, 13 do not allow the use of HDPE and 6 limit its application. Twenty do allow the material in at least one application or more. Of those that do allow its use, several have limited conditions and approvals. Therefore, the first question which must be addressed is whether or not to make a recommendation to add the HDPE material as an alternate. Then, if it is to be permitted, for what applications and under what conditions should it be allowed? The motivation for the City to add an alternate material should be based upon the following:

- Meeting nationally recognized standards.
- Improvement to the longevity of the piping system.
- Improvement in life cycle costs which address operation and maintenance concerns.
- Improved constructability of the system.
- Compatibility with the existing system.

A major concern with the addition of any alternate material is the impact on the current and future operations and maintenance procedures of the utility. With the allowance for an alternate material some operational factors to consider are:

- Time-tested operating history of product systems.
- Training for inspectors and operations staff on proper installation and repair methods.
- Training and appropriate certification for contractors on installation.
- Training for repairs.
- Potential damage from excavating too close to the pipe.
- Maintaining inventory of spare parts.
- Knowing locations of installed material so parts are on hand for repairs or for extensions with dissimilar materials requiring special fittings/adaptors/restraints.
- Parts availability and training for repairs and connections.
- Duplication of parts/materials for dual material systems.

In summary, the HDPE industry has provided extensive outreach and technical information to the emerging municipal utilities market, developed new resin formulations to both improve performance and address previously identified issues, and helped to expand an
evolving product line of electro-fusion fittings, adapters and restraints with methods to connect to other common piping materials and appurtenances. HDPE pipe and tubing materials can offer properties such as flexibility, abrasion resistance, corrosion resistance, and lighter handling weight where needed.

On the other hand, HDPE pipe materials require that special considerations be taken into account at each level – from designer to contractor to maintenance and repair crews. From a technical standpoint, it appears that a properly designed and installed HDPE piping system has the potential to perform as well as other more commonly installed piping products in today’s market. However, it is also for these “developing and evolving” and “potential to perform” reasons the recommendation included within this TM must necessarily be conservative until there is a longer proven “track record”, i.e., more time-tested results before moving into HDPE installations for many of the traditional municipal utilities applications.

Other factors which influenced these TM recommendations included:

- **Lack of apparent widespread municipal utility adoption in the United States** – this situation could result in special fittings and materials being more difficult to obtain or longer delivery times. Banner/Black & Veatch believe it is appropriate to adopt a “wait and see” position at this time as appropriate for several of the applications under consideration to see how the municipal market fully develops. A side issue of not having widespread adoption is a lack of peer support (during design, construction and operation) to both receive and transmit tips and guidance on unique issues that may be associated with HDPE pipe municipal installations.

- **Costs** – a common assumption is that HDPE will be less costly than a comparable PVC piping system for HDD or trenchless applications such as trenchless directional drilling, in-situ lining, or pipe-bursting. However, some of the contacts made with municipalities for this TM survey indicated that for open-cut situations lower costs may not necessarily be the result. Lower material costs may be offset by slower production (e.g., fusion-cooling time, temperature limitations) and special connector and restraint considerations for HDPE. In cities such as Colorado Springs, that allow HDPE pipe for certain water system applications, designers and contractors are often opting to install PVC except in special situations that require the unique properties of HDPE. Market forces can also drive decisions – such as is the case with HDPE service lines currently. The cost savings of HDPE versus copper tubing for service lines may outweigh the risk of not having a long-term proven record for that application. However, no municipal system wants to have widespread implementation of an alternate piping or tubing material that ends up
costing more in the long run due to premature repairs or replacements, such as is the case with the City’s historical specification and allowance of the once popular “poly-B” polybutylene tubing materials. This material has now been discontinued.

- **Skill pool is still evolving**—Contacts in the larger metropolitan areas have indicated that the availability of specialty and certified technicians to properly fuse HDPE pipe is still limited. In those municipalities that have chosen to allow HDPE piping for some applications, their local contractors and municipal maintenance crews have had a “learning curve” (more than 10 years in some cases) to become proficient with installation and repair of HDPE pipe. In a community such as Rapid City that is somewhat remote from larger metropolitan areas, the HDPE skill and experience gaps here may also prove to be problematic. As HDPE becomes more “mainstream” and time-tested for municipal use, the skill pool and specialized experience is likely to increase accordingly. At that point, it may be a more beneficial time to expand and transition in a more focused manner to other HDPE uses or applications for Rapid City’s municipal utilities.

**RECOMMENDATION**

Based on the information obtained in the surveys, internet search and discussions with other municipal utilities, this TM recommends that HDPE be added as an alternate material for limited applications at this time. This recognizes the fact that once the pipe material is installed it becomes a permanent part of the system and must be maintained. With the recommendations provided below, it is also recommended that the City’s Infrastructure Design Criteria Manual and Standard City Specifications be revised accordingly.

Recommended applications for the use of HDPE include:

- Water transmission mains with no taps or connections (now or expected in the future).
- Sanitary sewer force mains.
- HDD Trenchless installations; horizontal directional drilling, pipe bursting, and slip lining.
- Roadway edge drains, also known as under drains.
- Water/sewer separation encasements.

Further basis for these recommendations are found in the survey results discussion and comparison sections following this Executive Summary as well as supporting technical and background information provided in the Appendices. This TM is not an exhaustive study of HDPE and its applications.
Purpose of Technical Memorandum

The City of Rapid City is considering introducing HDPE piping as an alternate material in their water, wastewater and storm water systems and requested Banner to do a survey of current use for this material. Banner was requested by the City to evaluate the potential use of HDPE piping materials for its various municipal applications as defined above. Banner teamed with Black & Veatch (which included team members from both Denver and Kansas City offices) to help bring a national perspective and its own technical experience to the overall survey.

This TM should be viewed as a limited scope and effort specifically for the City of Rapid City (hereafter referred to as City), and not a comprehensive or exhaustive evaluation of HDPE for water, sewer and street applications for any other municipal utility. The HDPE industry has invested heavily over recent years developing their product lines, addressing concerns, improving their product offerings, and working with associated manufacturers to develop products such as fittings, adaptors, etc. to incorporate their product into many municipal systems. It is also apparent that thousands of hours have and are being spent by the various standards committees such as AWWA, ASTM, PPI, ISO, etc. to provide updated testing protocol and criteria for the design and use of many HDPE piping systems that are becoming available. As the HDPE industry continues to evolve, it is expected this memorandum’s recommendations will be added to and expanded in the future as a working document for the City, as HDPE use and experience becomes more widely adopted and time-tested for the municipal utility market and corresponding National Standards become more established.

Together with input from the City’s technical staff, Banner’s Team helped develop the following list of potential applications for further consideration:

- Water service lines.
- Water distribution mains.
- Water transmission mains.
- Sanitary sewer service lines.
- Gravity sanitary sewer mains.
- Sanitary sewer force mains.
- Horizontal Directional Drilling (HDD) and pulling of pipelines for special applications (e.g., stream and highway crossings).
- *In-situ* lining to repair existing infrastructure piping (water, sanitary, storm sewer).
- *In-situ* pipe-bursting replacements (sanitary sewer and water).
- Storm sewer piping.
- Use as casings for carrier pipes.
- Water/Sewer separation encasement.
- Roadway edge or underdrains (currently allowed by City Specifications).

The purpose of the TM is to provide the City with a recommendation regarding the addition of HDPE as an alternative material based upon the total TM information collected and discussed, including Municipal Utility User Surveys, Internet Search and Standards Development, and follow-up contacts for more detailed information with current users.

**Alternate Pipe Materials – Motivators and Goals**

Potential City motivators for changing to an alternative material or system, what are the goals of a typical utility, and what are the City’s service goals are discussed below.

**A. Motivators for Change**

Theoretical motivators and reasons for advocating and implementing changes were identified during the TM Workshop Session with the City. Reasons discussed for introducing or allowing alternate HDPE materials and specifications included:

- Material and system improvements with a goal of fewer line breaks and repairs.
- Reduction in corrosion potential considering both pipe materials and appurtenances.
- Reduction in premature leaks and failures at connections.
- Allowance for implementation of alternative construction practices (HDD or trenchless methods for example).
- Influences due to marketing efforts from suppliers/manufacturers.
- Desire to reduce initial capital costs.
- Desire to reduce traffic congestion caused by open cut trench installations.
- Public input/complaints, appeals to reduce business interruptions and allow different installation methods.
- Desire for longer design life before repairs or rehabilitation.
The eleven ASTM D3350 specification revisions over the past twelve years shown here provide further evidence of the apparent evolving nature of the newer resins and products into the various pipeline markets. This will impact the starting dates for future field performance evaluations, and knowledge derived from experience, for these corresponding installations.

Generally speaking, relative to other materials, HDPE pipe materials are relatively new to the overall municipal market. Further, there currently exist only laboratory tests for predicting its service life under pressure. There is no HDPE pipe in municipal pressure or gravity service for more than 20 years that is available for study. Since HDPE has a more recent municipal history, it appears to be more suited for limited, lower risk, or other qualifying use applications based on the years it has been in service. As discussed later in this TM, many of the general material properties and performance features for the various types and configurations of HDPE pipe may either be favorable or unfavorable depending on the specific application under consideration, when compared with other materials that are available.

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5. In many instances, some structural performance issues have arisen due to a combination of factors. (Reference: 10 state study noted above) Premature distress has been seen, and has led to changes in products, profiles, installation procedures and inspection requirements over the last 5 to 10 years. The following states provide hundreds of pages of research investigations, findings, and recommendations:


d. In most cases they advocate a careful approach to where these applications are being considered.

C. General Characteristics of HDPE pressure tubing for potable water applications

1. Current standards for this HDPE application and use include: AWWA C901-08, Polyethylene (PE) Pressure Pipe and Tubing, ½ in. (13 mm) 3 In. Through (76 mm) for Water Service. Note there are many other related newer plastic tubing types identified below.

2. There are numerous types and variations of ‘plastic tubing’ emerging onto the water service market, and it is possible that all are not equivalent in performance to the existing City standard, Type K copper. Some of the latest tubing specifications and standards are summarized as follows:

<table>
<thead>
<tr>
<th>Material</th>
<th>Reference</th>
<th>Date Updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDPE</td>
<td><a href="http://www.astm.org/Standards/D2737.htm">http://www.astm.org/Standards/D2737.htm</a></td>
<td>2012 updated</td>
</tr>
<tr>
<td>HDPE, composite</td>
<td><a href="http://www.astm.org/Standards/F1282.htm">http://www.astm.org/Standards/F1282.htm</a></td>
<td>2010 updated</td>
</tr>
<tr>
<td>PEX, composite</td>
<td><a href="http://www.astm.org/Standards/F2262.htm">http://www.astm.org/Standards/F2262.htm</a></td>
<td>2009 updated</td>
</tr>
<tr>
<td>PVC, composite</td>
<td><a href="http://www.astm.org/Standards/F2855.htm">http://www.astm.org/Standards/F2855.htm</a></td>
<td>2012 updated</td>
</tr>
<tr>
<td>Polypropylene</td>
<td><a href="http://www.astm.org/Standards/F2389.htm">http://www.astm.org/Standards/F2389.htm</a></td>
<td>2010 updated</td>
</tr>
</tbody>
</table>
3. There are dozens of manufacturers, not just for the various tubing materials, but also for the (2 inch and smaller diameter) fittings. Mechanical metallic type adapters appear to be the preferred method identified by this TM survey versus the electrofusion type. Many of the utilities allowing the use of HDPE material as noted above say that the service line itself is privately owned from the curb stop to the meter. The balance of the line is the responsibility of the utility. This fact apparently has had some bearing on their decision to allow the use of the material (not in the public right of way). One municipality recommends service line breakage insurance to homeowners, because the cost of replacement or repairs can be expensive. They also provide on-line information to advise them of the potential risks involved.

4. Oxidative Concerns and Testing: [http://hdpeoxidation.com/](http://hdpeoxidation.com/) Reference this website for disinfectants impacts as documented by the 2011 website for ‘Plastic Pipe Facts’. The recent test method update for evaluating oxidative resistance from ASTM can be found here: [http://www.astm.org/Standards/F2263.htm](http://www.astm.org/Standards/F2263.htm) also dated 2011, which shows four revisions since 2003 to this test method. Although there are concerns that have been raised by some in the water industry, there is no clear answer yet. Studies continue.

**Impacts on Operations and Maintenance**

A primary consideration with the addition of any alternative material is the impact on the City utility operations and maintenance. This is a significant reason why the TM telephone (and email) survey targeted operations personnel rather than the engineering personnel whenever possible. The perspective on the use of an alternate material is often different within operations than engineering. The engineering perspective typically looks for cost savings, life cycle costs and constructability issues, where operators look at ease of operation, minimizing repair occurrence, and ability to perform repairs quickly and cost effectively.

Some of the factors for the City to weigh when considering the allowance of an alternative material are:

- Creation of new design criteria and specifications
- Training for inspectors on proper installation methods
- Training for contractors on installation
- Training on potential damage from excavating next to the pipe.
o Training for repairs
o Maintaining inventory of additional parts
o Knowing locations of material so parts are on hand
o Parts availability and training for repairs and connections
o Training for Engineers/Designers on proper design methods for material
o Knowing installed locations of material so designers know how to extend or connect to the material in the future

Among several of the TM survey respondents from the 39 utilities interviewed that had experience with HDPE, a reoccurring theme was voiced regarding the time required for operations staff to learn how to work with this material. This “learning curve” is complicated by the fact that continuing changes in the HDPE resin formulations may make the newer products and installation different from those installed earlier so the learning could be continuous. With the exception of HDD directional drilling installations, it was learned that a utility typically uses their own crews to install the HDPE taps that are necessary for installation and where special considerations exist for upgrading or replacing older pipeline systems.

One HDPE user surveyed stated that it has had a significant operational impact. For example, Colorado Springs, Colorado in 2000 began using HDPE pressure pipe for a water main replacement project in an area with a history of waterline breaks due to both highly corrosive soils and known for its hillside movement potential. With that original installation they experienced considerable difficulty with the HDPE electrofusion tap methods that were available from the manufacturer at the time, and have not gone back to direct tapping using electrofusion methods. However, they have since invested in maintenance training, procedures, methods and materials to successfully install and maintain and provide replacement parts and fittings for future HDPE installations and repairs utilizing newer saddle tapping methods. According to this utility, the initial operational impacts were significant, but the results have overall been positive. The pressure to find a different suitable material appears to have been substantial at the time and they have continued to make investments in their training and tooling so that their program for using and installing HDPE material continues to be carried out in a satisfactory manner. Cost information for the overall conversion was requested from this utility, but not provided at the time of this writing. For the difficult conditions and applications noted above, their preferred material continues to be HDPE, over PVC or ductile iron bell and spigot type installations.
There is a significant volume of both industry technical (PPI) and manufacturer's product and design information and assistance currently available. Apparently there are newer resin materials and fitting types now available that are supposedly improved from that of the earlier versions (from two to five years ago). However, for municipal and pressure pipe use, many/most of the newer versions are reportedly only in the one to two years of experience range. Also, based on the survey interviews, not all product manufacturers have the same experience levels. This will have to be investigated further before any are placed on proposed material and supplier lists for City utility use.

It is also currently the case that most municipal-type piping contractors do not have the training or certifications needed to install HDPE pipe. Furthermore, even after proper training and certification, the contractor experience factor is the next most critical item that must be recognized, according to specifiers and users of the material that were surveyed. The consensus is that there are many details that must be attended to for a successful installation and the omission or inattention to any one of them can mean the difference between success and failure.

For this TM only those applications, as indicated later, that have the potential for having nominal impacts and/or the potential for positive effects will be recommended for use. In addition, conditional notes have been added to those recommended due to the fact that the consequences of failure at higher pressures and larger diameters will typically be greater than at lower pressures and diameters. Those applications that have the potential of having significant operational impacts, and/or which could include potential negative effects will not be recommended for acceptance or implementation. Therefore for purposes of this TM document they will fall into a category described as Do Not Recommend at this time.

Applications Summary — *Advantages and Disadvantages*

A. For Pressure Pipe applications-
   1. The *general advantages* of HDPE pipe materials can be summarized as follows:

   - Material appears to be minimally affected by normal corrosion potential from soil or water quality/chemistry. Early resin formulations noted concerns with premature pipe wall deterioration with extended exposure to
very high chlorine dosages, but newer resins are reportedly now more resistant.

- Suitable for HDD trenchless installations; fused joints do not require mechanical restraints
- Smooth wall provides improved friction factor for maintaining hydraulic capacity
- Good abrasion resistance properties
- Lower density translates into lighter weight allowing for ease in handling and installation
- In some instances installed cost may be competitive with other integral restrained PVC or ductile iron joint pipe systems for stream crossings, or rehabilitation of older piping systems. Material cost may also be competitive with other materials dependent on municipal/contractor demand and distributor availability.
- Short allowable bend radius allows for minor adjustments in alignment without fittings
- Development and availability of improved resin technologies within last 5 to 10 years
- Fewer joints compared to bell and spigot pipe material installations
- Viscoelastic properties of the material make it a good fit where flexibility and allowance for potential ground movement is needed
- Good surge pressure resistance features

2. The general disadvantages for HDPE pressure pipe materials use are:

- Requires special fittings, equipment and re-training of operators for installation and connection to existing pipe and fittings. Historical performance issues with taps, laterals, and branch lines due to potential for longitudinal movement of the pipe if not adequately restrained and confined. This is problematic for water distribution systems, but may not be so much for water transmission applications.

- Research for water use is ongoing as represented by this Water Research Foundation link: [http://waterrf.org/Pages/Projects.aspx?PID=4485](http://waterrf.org/Pages/Projects.aspx?PID=4485) The completion year indicated for the study is 2014. "The objective of this study is to determine the durability and reliability of large diameter high density polyethylene (HDPE) water mains, ranging from 24 to 48 inches internal diameter, as an economical alternative to other pipe materials. The project will focus initially on identifying key problems associated with modes, causes,
and rates of failure of HDPE water pipelines through a comprehensive literature search. Once these key problems are identified, durability and reliability of these pipes through surveys, experimental work, and case studies will be investigated. Research partners: WERF and EPA.

- Wall thickness requires larger outside diameters compared to other pipe materials for an equivalent inside diameter. This will generally make it difficult for designers to design around one pipe size, for plans and specifications that allow either or both PVC and ductile iron pipe. Also it will be difficult to define ‘or equal’ for bidding purposes and misunderstandings/disagreements may occur.

- High coefficient of thermal expansion compared to other more commonly used materials. Temperature changes impact the pipe, and pipe movement can cause failures at fittings and laterals if not adequately restrained and reinforced.

- LTSH (Long Term Hydrostatic Strength) properties, and previous problems with slow crack propagation tendencies with former resin formulations means that more experience is necessary so that risk factors can be addressed with the newer and emerging resin technologies and additives. Until it is certain that this tendency has been significantly reduced or eliminated, it is recommended for this TM that low pressure applications only be considered for water transmission, force sewer (non-gravity) mains, or HDD type installations.

- Cannot be located in the field unless a tracer wire was initially installed and is operational.

- Material is relatively soft compared to other materials and has a higher potential for damage from third party excavations/drilling.

- Designs must incorporate additional or special considerations for buoyancy, loadings, trenching and backfill.

- Concerns with permeation of material in the presence of hydrocarbon compounds.

In summary, in our opinion there are a greater number of disadvantages than advantages at this point in time. When, or if in the future some of the disadvantages can be demonstrated to have been overcome, and shown to be based on significantly more field case histories, it may be appropriate to re-visit the recommendations herein for qualified and low risk applications for municipal pressure pipe systems (See paragraph F below).
o Potential rapid loss of strength and catastrophic failure of pipe if small areas of bedding support are inadvertently removed or compromised.

o Special inspections/testing typically required during and after installation.

In summary, in our opinion more positive case history performance and manufacturer and installation technique improvements are needed before a “Do Allow” recommendation for either gravity sewer or storm drainage HDPE applications can be given.

C. **For Water Service Line applications (HDPE General Advantages and Disadvantages)**

1. A handful of municipalities were identified that have switched to allowing HDPE service lines (tubing) over the last several years:
   a. Two contact reports were made; Covington, WA and Redmond, WA.
      Two other municipalities, whose on-line specifications show that they allow did not return a call: Lexington, KY and Austin, TX.
   b. Rapid Valley Sanitary District (RVSD) in western South Dakota was also interviewed. They started allowing HDPE for service lines approximately one year ago. Given the limited experience timeframe, few problems have arisen so far. RVSD suggested that the quality of copper tubing for service lines is not what it was a few years ago and that is one of the reasons for the switch to HDPE. RVSD stated that they allow either K type copper or copper size OD 200 psi PE tubing. They use standard saddles with compression fittings with the primary difference between copper and HDPE being the stiffening insert required at the HDPE tubing end to accept the compression fitting.
   c. The material price difference was listed as one of the reasons for the utilities’ change to allowing HDPE tubing as copper prices have been increasing, especially over the last several years.
   d. Colorado Springs, Colorado has allowed this tubing but it has been met with some difficulty in certain situations. In addition, installers have indicated that it is not at all like other materials they have experience with. Colorado Springs Utilities is currently updating their current specifications and will re-issue them in 2014 with revised details.
   e. Per the operator survey results summarized earlier, five municipalities (out of 39) surveyed stated they allow use of HDPE tubing. One municipality stated that they discontinued use of HDPE due to leakage
problems at the fittings, and will instead consider polypropylene tubing as an alternative material.

f. City representatives have expressed some concern regarding older homes, where an unintended consequence to switching to HDPE away from copper might result in the residential electrical system becoming ungrounded, where this practice was allowed in some situations under older electrical or plumbing codes to ground to the buried copper piping to provide the ground protection.

Installation of HDPE tubing (from www.energicity.net)

2. Copper service as required by current City standard specifications is still the preferred material, and is recommended by this TM for 2 inch and smaller diameters. However, with an amendment to the current City Ordinance (current citation shown below) the door could be opened to allow more landowner say on the selection of materials other than copper that will meet acceptable potable water and certification requirements. (City of Rapid City Reference: Code of Ordinances—

13.08.060 Responsibility for costs—indemnification of city.
All costs and expenses incident to the installation, connection and maintenance of the water service lines shall be borne by the owner. The owner shall indemnify the city from any loss or damage that may directly or indirectly be occasioned by the installation of the water service lines.) (Ord. 5794 (part), 2012)

3. For City consideration, the next illustration provides an example for a potential change in service line ownership. Currently in the City the property owner owns and is responsible for the entire service line from the house all the way to the water main which is often under or on the other side of the street. The
illustration shows the typical configuration for how several municipalities allowing HDPE use for service lines, split the responsibility of ownership.

Ownership of Water Service Lines  
(source of illustration: Grand Rapids, Michigan Public Works Dept.)

In several cases, the municipalities contacted have chosen to continue to allow copper tubing to remain in their specifications, to be used within the street right of way area.

In summary, in our opinion more positive case history performance and manufacturer and installation technique improvements are needed before a “Do Allow” recommendation for HDPE water service line applications can be given.

\( \uparrow \) For HDPE Roadway Edge Drains Applications (defined as Under-Drains per 2007 City Specifications) — General Advantages and Disadvantages

1. Drainage tubing has been around and utilized in highway projects for more than a decade. Tubing is similar to: ADS Single Wall HWY Pipe Specification or equal, AASHTO M252 Type C in 4 inch, 6 inch, or 8 inch sizes or, ADS N-12® Plain End Pipe Specification or equal, AASHTO M252, Type S or SP, 4- through 10 inch. Corrugated polyethylene tubing shall conform to the requirements of ASTM F 405 and M 252-09 Standard Specification for Corrugated Polyethylene Drainage Pipe.

2. Because of the widespread allowance and service level performance for these smaller diameter corrugated HDPE drainage tubing materials along the edges of roadway surfaces among county and state highway departments, it is viewed as a time-tested HDPE application.

3. Along with corrugated PVC, corrugated HDPE is currently allowed by the 2007 City of Rapid City Standard Specifications. Reference: Section 64 Under-Drains
Recommendations

A. CITY APPLICATIONS USING HDPE ALTERNATE MATERIAL

Based on the information obtained in the operator surveys, internet search and more detailed follow-up contacts with other utilities, and comparison listings of general advantages and disadvantages of the material, it is recommended that HDPE be added to the City’s Design Criteria and Standard Specifications for the several City municipal applications listed below. Conditional notes have also been included as reviewed with and approved by City Staff. If accepted by the City, the City’s Infrastructure Design Criteria Manual and Standard City Specifications should be revised accordingly.

Further descriptive information regarding how these TM recommendations were arrived at, including recommendations for continuing education is included in the following paragraphs A) ii, iii, and iv and paragraph B).

i. The applications being recommended to allow HDPE as an alternate material are:

1) For water transmission mains that will not require taps or connections, now or in the future:
   
   ☑️ “Do Allow” only under following conditions:
   
   a) Recommend City Staff initiate a change to City Ordinance to include a definition for ‘raw water transmission main’ and/or ‘water transmission main’ before implementing this recommendation to change the City design criteria and specifications to allow this application. Note: This recommendation is made in order to differentiate clearly between water distribution main and water transmission main applications as they have different recommendations for do allow or do not allow within this TM.
   
   b) Recommend for low pressure applications only: (Max. 160 psi operating pressure).
   
   c) Recommend for maximum 16 inch diameter (flow rate equivalent to ductile iron pipe size), consistent with size limitations for materials as specified by the City’s 2012 Infrastructure Design Criteria Manual.
2) For sanitary sewer force mains:
   □ “Do Allow” only under following conditions:
   a) Recommend for low pressure applications only: (Max. 160 psi operating pressure).
   b) Recommend for maximum 16 inch diameter (flow rate equivalent to ductile iron pipe size), consistent with size limitations for materials as specified by the City’s 2012 Infrastructure Design Criteria Manual.

3) For HDD trenchless installations, horizontal directional drilling for stream or highway crossings where casings are not required, and In Situ pipe bursting and/or slip lining applications to rehabilitate older water or sewer trunk (without laterals or branch)main lines:
   □ “Do Allow” only under following conditions:
   a) Recommend for low pressure applications only: (Max. 160 psi operating pressure).
   b) Recommend for maximum 16 inch diameter (flow rate equivalent to ductile iron pipe size), consistent with size limitations for materials as specified by the City’s 2012 Infrastructure Design Criteria Manual.
   c) Recommend only for those approved by City Engineering where special installation methods are required to meet overall project goals.

4) For water/sewer separation encasements:
   □ “Do Allow” only under following conditions:
   a) Sizing and placement in accordance with current City design criteria and standard specifications for encasements, and as otherwise required by SD DENR.
   b) For only those installations outside of roadway pavement areas.
   c) Maintain minimum annular space between carrier pipe and encasement pipe.

5) For roadway edge drains or, under drains:
   □ “Do Allow” only under following conditions
   a) Recommended for less than or equal to 10 inch diameter perforated tubing for roadbed subgrade drainage purposes only.
ii. The following applications to allow HDPE as an alternate material are not recommended at this time:

- Water service lines.
- Water distribution mains.
- Sanitary sewer service laterals.
- Sanitary sewer gravity distribution mains.
- Storm or drainage pipe.
- Casing pipe.

iii. In general, the reasons taken individually or in combination for not recommending the above particular applications include the following:

- Some negative experiences reported by several of the utilities and operators contacted, particularly with regard to connections and taps for pressure piping systems.
- For many municipal applications, the HDPE piping industry is relatively young. Actual long-term municipal case histories are very limited upon which to base a decision for a significant investment into new materials, spare parts inventory, and expanded City staff responsibility, training time, re-tooling and record-keeping effort.
- Adoption of HDPE pipe for open-trench installations of municipal utilities has not yet become widely adopted locally, regionally, or nationally according to the survey results. Products are just beginning to emerge in the market, and experience is still limited.
- HDPE standards development and research continues to evolve and is clearly in transition. The HDPE industry has made recent strides towards adapting its products for municipal applications with improved resin formulations and associated product lines to better connect to fittings and other pipe materials for pressure applications. However, this also implies that for the fewer number of municipal applications that have been and are being attempted elsewhere, many of these installations have not yet been sufficiently time-tested.
- For non-pressure CPE applications, emerging research indicates 'proceed with caution' type recommendations, for example from the adjacent DOTs surrounding South Dakota, including Minnesota, North Dakota, and Wyoming which have a similar climate and soil type. Even though a few municipalities around the U.S. have recently (within the last 3 years) opened
their specifications to allow CPE for larger diameter storm pipe use, it is not in our opinion as time-tested at this point in time for this TM, especially for those installations located beneath roadway subgrades. Standards and specifications development for the newer resin materials and profiles (which now also includes wire reinforced ribs and triple profile wall configuration options) is just now emerging and/or in transition. More case history performance and time-tested experience is needed before a recommendation for HDPE use can be given for this municipal application.

- Trial and error experience continues to be gained by many installers/suppliers in an effort to determine the best methods to install and connect HDPE materials to more traditional types of municipal and highway/street drainage pipes, fittings, services, and appurtenances. This is not a disadvantage per se, but we recommend the City take a conservative approach and allow the best methods and products to emerge from a relatively young municipal industry. As new industry standards also emerge, then those along with the latest experiences are likely to be shared at training conferences, etc. with potential future customers, both installers and users.

- It is advisable that City staff learn from others experiences if and where possible (both positive and negative), to better understand the cost and risk factors, and avoid unnecessary negative consequences before proceeding with these alternate material applications. See paragraph B. Continuing Education Recommendations below.

iv. The following discussion provides an outline synopsis of how the different application recommendations were considered (weighted) for this TM showing that the predominant basis comes from Operator and User Survey Responses with the follow-up detailed contact reports. The secondary basis comes from the Internet Search and Status of Standards Development.

**TM Recommendations Weighting**

70% based on Initial 39 Operator/User Survey Responses and Contacts;

- Types and trends of applications, national contacts and response.
- Both Allow and Do Not Allow responses received, but not always a definite yes or no.
- Not sufficiently time-tested for municipal applications, by some comments.
- Operations impacts, Contractor training, Engineer familiarity issues.