

CHAPTER 7 SURVEY STANDARDS

1. GENERAL

- A. Surveys shall be performed to collect the field data and required information outlined in this chapter to assist in the preparation of clear, concise, and accurate set of construction plans and easement maps for sewer and water pipelines and lift station projects.
- B. All field surveying shall adhere to the standards outlined in this chapter and be performed under the direct supervision of a licensed NC Professional Land Surveyor. Post-construction surveys shall be performed by a surveyor provided by Charlotte Water or the Engineer of Record and may not be employed by the contractor.
- C. All surveying for Charlotte Water projects shall be oriented to the NC State Plane Coordinate System and all elevations based on NGS and or NCGS datum.
- D. All data collected will be as per 21 NCAC 56.1608 (Class AA) *Classification Land Information System/Geographic Information System Surveys*, latest revision. Positional accuracy is deemed acceptable if 100% of the features are located according to the following specifications:
- 1) Horizontal accuracy should be in North Carolina State Plane 3200 NAD 83(2011/PA11/MA11) epoch 2010.00 for field data collection and be equal to or less than 0.10 feet (0.033 meters) to the center of the appurtenance lid or cover (center of rim for sanitary sewer and water manholes or operating nut for water or sewer valves and fire hydrants).
 - 2) Vertical accuracy should be in NAVD 88 Geoid 18 or latest version for field data collection and be equal to or less than 0.098 feet (3 centimeters).
- E. All Global Positioning System (GPS) Survey Requirements include:
- 1) Elevation Mask greater than 15 degrees
 - 2) PDOP value of 5 or less
 - 3) RMS error must be less than 70 millicycles
 - 4) Minimum Number of 30 epochs observed
- F. Topography shall be surveyed, do not use published GIS topography.
- G. All surveys shall follow NCGS Chapter 87 Article 8A *Underground Utility Safety and Damage Prevention Act*, latest revision.

1 H. Post-construction survey requirements and standards are provided in Section 4.
2

3 **2. DESIGN SURVEY REQUIREMENTS**
4

5 A. Sanitary Sewer Outfall and Trunk Lines
6

7 Important procedures to follow and field information to collect for gravity sewer trunkline,
8 at a minimum, are as follows:
9

- 10 1) Maintain and clear a line of sight between proposed manholes.
- 11
- 12 2) Proposed manholes shall be located with rebar or iron pipes of at least 1/2-inch
13 diameter. This helps to relocate manholes during construction.
- 14
- 15 3) Show centerline station on guard stakes at proposed manhole locations.
- 16
- 17 4) Locate existing downstream manhole from Station 0+00 manhole with flow line
18 elevation.
- 19
- 20 5) Locate all features within the proposed easement and temporary construction
21 easements. Generally, locate within 25' of either side of centerline.
22
- 23 6) Locate all important physical features relating to the proposed line such as creeks,
24 fences, other utility lines, property corners, buildings, large trees, R/W monuments,
25 and road or railroad crossings.
26
- 27 7) Show the distance to creek banks and the width of the banks.
- 28
- 29 8) Obtain bottom elevation of creek at 100-foot distances and elevation of top of creek
30 banks.
31
- 32 9) Locate any significant trees within the proposed alignment. These may be larger
33 trees than the average or species such as walnut, dogwood, or similar specimen that
34 may have a bearing on the final alignment or Charlotte Water's ability to obtain
35 easements.
36
- 37 10) Locate any significant ground features that may affect construction such as rock
38 outcrops and swampy ground conditions.
39
- 40 11) Locate any wells within 150 feet of centerline of proposed sanitary sewer.
- 41
- 42 12) Tie all elevations to NCGS or NGS monuments.
- 43
- 44 13) Verify elevation of flow line, pipe inverts, and rim of the existing manhole where the
45 proposed sanitary sewer line begins.
46
- 47 14) Set temporary benchmarks (TBM) along the proposed sewer route near each
48 manhole and establish by differential leveling. TBMs shall be located outside of the
49 easement or area to be disturbed during construction activities.
50

- 1 15) Place additional temporary benchmarks adjacent to any road or underground utility
2 crossings, as well as stream crossings that may require piers.
- 3
- 4 16) Obtain bank of creek and flow line of creek elevations at each proposed manhole.
- 5
- 6 17) When crossing underground utilities, obtain as much information as is available,
7 such as utility locate markings and nearby visible appurtenances.
- 8
- 9 18) Obtain the location, size, and elevations on all storm drainage pipes and culverts that
10 cross or parallel the proposed sewer centerline.
- 11
- 12 19) At road or street crossings, obtain elevations along the road in either direction as
13 necessary.
- 14
- 15 20) At bores or tunnels under roads, perform settlement monitoring per requirements of
16 governing agency.
- 17
- 18 21) On areas of extreme side slopes, take cross-section elevations to at least 25 feet on
19 either side of the proposed sewer centerline.
- 20

21 B. Sanitary Sewer Street Extensions

22
23 Important procedures to follow and field information to collect for sanitary sewer street
24 extensions, at a minimum, are as follows:

- 25
- 26 1) Locate all physical features within the street right-of-way or adjacent areas if feature
27 could impact construction such as property irons and monuments, utility poles,
28 existing valves and meters, curbs, driveways (define type), storm drainage pipes and
29 structures, planters, mailboxes, signs, fences, trees and shrubs, gas lines, telephone
30 cable, and electric lines at a minimum.
- 31
- 32 2) These features shall be located on both sides of the street. It may be necessary to
33 shift to the other side during design.
- 34
- 35 3) Show width of street surface and type of pavement.
- 36
- 37 4) If proposed lines are located in existing pavement, magnails shall be used in lieu of
38 stakes.
- 39
- 40 5) Show centerline station on guard stakes at proposed manholes. If proposed manhole
41 is in pavement, mark with paint on pavement.
- 42
- 43 6) Locate any wells within 150' of centerline of proposed sanitary sewer.
- 44
- 45 7) Verify flow line, pipe inverts and rim of existing manhole where extension begins and
46 the downstream manhole. Note all pipe and service lateral alignments and invert
47 elevations.
- 48
- 49 8) Note whether there is an outside drop in the manhole.
- 50

- 1 9) If a doghouse manhole is to be use for the beginning manhole, obtain flow line, pipe
2 inverts, rim elevations, and tie distances to both upstream and downstream
3 manholes.
- 4
- 5 10) TBMs shall be set near the beginning of the line (do not use the existing rim), at the
6 end of the extension, and near each proposed manhole. TBMs shall be located
7 outside of the easement or area to be disturbed during construction activities.
- 8
- 9 11) Locate and obtain elevations of any structure (finished floor and ground) or vacant lot
10 lower than the street. Note any structures with basements.
- 11
- 12 12) If there is a depression between the street main and any existing structure, run a
13 profile to the structure.
- 14
- 15 13) Obtain flow line elevation and location of lateral if a lateral is already installed at the
16 structure to be served by the extension main.
- 17
- 18 14) If the proposed extension does not extend to the crest of a hill, continue the profile to
19 a minimum of 300 feet upstream from the terminus manhole. Charlotte Water retains
20 the right to require additional information.
- 21
- 22 15) At bores or tunnels under roads, perform settlement monitoring per requirements of
23 governing agency.
- 24
- 25 16) Survey parallel storm pipes and storm pipe crossings that may impact sewer pipe
26 design elevations.
- 27

28 C. Water Mains

29
30 Important procedures to follow and field information to collect for water mains, at a
31 minimum, are as follows:

- 32
- 33 1) Locate the main line valve, which will become Station 0+00, and blow-off at the end
34 of the existing line that the proposed line will connect to and obtain the elevation of
35 operating nut.
- 36
- 37 2) Locate all physical features within the street right-of-way or along the proposed water
38 main alignment if feature could impact construction such as property irons and
39 monuments, utility poles, existing valves and meters, curbs, driveways (define type),
40 storm drainage pipes and structures, planters, mailboxes, signs, fences, trees and
41 shrubs, gas lines, telephone cable, and electric lines at a minimum.
- 42
- 43 3) Locate any significant ground features that may affect construction such as rock
44 outcrops and swampy ground conditions.
- 45
- 46 4) Set TBMs along the proposed route near intersections and at all creek crossings.
- 47
- 48 5) When crossing underground utilities, get as much information as is available, such
49 as utility locate markings and nearby visible appurtenances.
- 50

- 1 6) Obtain the location, size, and elevations on all storm drainage pipes and culverts that
2 cross or parallel the proposed water main centerline.
- 3
- 4 7) At road or street crossings, obtain elevations along the road in either direction as
5 necessary.
- 6
- 7 8) At bores or tunnels under roads, perform settlement monitoring per requirements of
8 governing agency.
- 9
- 10 9) On areas of extreme side slopes, take cross-section elevations to at least 25' on
11 either side of the proposed water main centerline.
- 12
- 13 10) For water mains 16" and larger where profiles are required, obtain centerline ground
14 elevation, edge of pavement and side ditch elevations at 100-foot stations.

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16 **3. PRE-CONSTRUCTION SURVEY REQUIREMENTS**

17 **A. Construction Stakeout for Sanitary Sewers**

- 18
- 19
- 20 1) Cut sheets are required for any sanitary sewer that is being built under a Charlotte
21 Water contract. Cut sheets shall be signed and sealed by a licensed NC Professional
22 Land Surveyor and shall contain the firm's name, phone number, and email address.
23 A sample cut sheet is provided at the end of this chapter.
- 24
- 25 2) Changes to construction grade and/or alignment from the approved construction
26 plans to avoid obstructions must be pre-approved by Charlotte Water.
- 27
- 28 3) Place offsets for manholes outside of permanent easements but within the temporary
29 construction easement if possible.
- 30
- 31 4) Construction stakes shall be set at every manhole and pier.
- 32
- 33 5) If benchmarks or construction stakes have been destroyed during clearing, set new
34 TBMs or construction stakes.
- 35
- 36 6) Differential levels must be run on all construction stakes. Mark the offset from the
37 manhole or pier and the station number on the guard stake adjacent to each offset
38 hub.
- 39
- 40 7) Reference the centerline of all bores approximately 50 feet before beginning of bore
41 and 50 feet past the end of bore.
- 42
- 43 8) Set an offset stake at any existing manhole at the beginning of the project. Do not
44 use an existing rim as a reference; rims may be disturbed during excavation around
45 existing manholes.
- 46
- 47 9) Check stakes at a minimum of every 30 days. Provide Charlotte Water a letter
48 confirming accuracy following inspections.
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B. Construction Stakeout for Water Mains, Low Pressure Sewer Mains and Sanitary Sewer Force Mains

- 1) Cut sheets shall be signed and sealed by a licensed NC Professional Land Surveyor and shall contain the firm's name, phone number, and email address. A sample cut sheet is provided at the end of this chapter.
- 2) Cut sheets for water mains and sanitary sewer force mains are not required when running parallel to an existing curb.
- 3) Changes to construction grade and/or alignment from the approved construction plans to avoid obstructions must be pre-approved by Charlotte Water
- 4) Construction stakes shall be placed along the centerline of the pipe or offset from the alignment.
- 5) Place offsets and/or elevations for horizontal and/or vertical bends.
- 6) Construction stakes shall be set at grades for cut sheets on areas of critical elevation.
- 7) Reference the centerline of all bores approximately 50 feet before beginning of bore and 50 feet past the end of bore.
- 8) Check stakes at a minimum of every 30 days. Provide Charlotte Water a letter confirming accuracy following inspections.
- 9) Additional requirements for construction staking is provided in Part 3 of Chapters 10 and 13 for Water and Lift Station Specifications, respectively.

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FIGURE 7.1: CUT SHEET SAMPLE

SANITARY SEWER CUT SHEET

PROJECT NAME: _____ COMPANY: _____
 PROJECT NUMBER: _____ SURVEYOR: _____

EX MH# _____ TO MH# _____

STRUCTURE #	STATION #	INVERT ELEVATIONS	PIPE LENGTH	SLOPE	HUB ELEVATION	OFFSET	(-)CUT/(+)FILL	NOTES
EX MH	0+00.00	INV OUT INV IN(1)						
PROP MH 1		INV OUT(EX) INV IN(2)						
PROP MH 2		INV OUT(MH#) INV IN(MH#)						
PROP MH 3		INV OUT(MH#) INV IN(MH#)						
PROP MH 4		INV OUT(MH#) INV IN(MH#)						
PROP MH 5		INV OUT(MH#) INV IN(MH#)						
PROP MH 6		INV OUT(MH#) INV IN(MH#)						
PROP MH 7		INV OUT(MH#) INV IN(MH#)						
PROP MH 8		INV OUT(MH#) INV IN(MH#)						
PROP MH 9		INV OUT(MH#) INV IN(MH#)						
PROP MH 10		INV OUT(MH#) INV IN(MH#)						

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4. POST-CONSTRUCTION SURVEY REQUIREMENTS

All infrastructure and appurtenances (inclusive of the list on the subsequent pages) shall be field collected and inventoried to the survey specifications below after their construction has been completed. The resulting data shall be collected using Charlotte Water's current data dictionary and be delivered prior to final inspection. The data shall be submitted in an ESRI geodatabase (.gdb) and all features shall include Northing, Easting, and Elevation. Charlotte Water will provide the current data dictionary, an example geodatabase, and other necessary documents. The attributes to be collected and submitted are as follows:

A. Water Features and Attributes to be Collected and Surveyed

1) **Water Air Release (wAirRelease)**

- a. Accessible – used to indicate whether the feature is accessible to the surveyor
 - i. Yes – feature is accessible to the surveyor and able to be opened, if applicable
 - ii. No – feature is not accessible to the surveyor and/or not able to be opened, if applicable, provide additional details in InaccessibleReason field
 - iii. Unknown – typically used if the feature is not found
- b. InaccessibleReason – used to indicate the reason the feature is inaccessible
 - i. PavedOver – feature is paved over with asphalt or concrete
 - ii. FullofDirt – feature is full of dirt or debris
 - iii. FullofWater – feature is full of water
 - iv. Locked – feature is locked and/or lock is unable to be operated due to damage
 - v. Sealed – feature has been sealed with tar or other material that is not easily replaced
 - vi. SubGrade – feature is buried more than 1 foot below existing grade
 - vii. Obstruction – feature is covered by debris or other objects that prevent access
 - viii. NotFound – feature is not able to be located, only used when there is reasonable evidence of the feature's potential existence
 - ix. Other – feature is inaccessible due to a situation that does not fit the other options, provide additional details in Notes field
- c. Notes – used to denote any extra or pertinent information about the feature or its collection

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- d. Accuracy – used to store the accuracy of the data collected
 - i. TSSurvey – feature located with conventional survey equipment or total station
 - ii. SurveyGPS – feature located with survey grade GPS
 - iii. MappingGPS – feature located with mapping grade GPS, sub-meter accuracy, Not adequate for our specification
 - iv. Digitized – feature’s location determined without survey of any kind, Not adequate for our specification
- e. Surveyor – used to store the initials of the survey firm and the surveyor with a space in between (Ex. CW ABC)
- f. Collection Date – date field for the date of collection

2) Water Backflow Device (wBackflowDevice)

- a. Type – used to denote the type of backflow device
 - i. DoubleCheck
 - ii. ReducePrinciple
- b. Location – used to denote the location of the backflow device
 - i. AboveGround – usually inside a plastic/fiberglass, insulated housing
 - ii. BelowGround – usually in a vault with a metal lid
 - iii. Inside – inside a building or structure
- c. Size – used to denote the size of the backflow device, noted on device
- d. Manufacturer – used to denote the manufacturer of the backflow device, noted on device
- e. ModelNumber – used to denote the model number of the backflow device, noted on device
- f. SerialNumber – used to denote the serial number of the backflow device, noted on device
- g. Accessible – used to indicate whether the feature is accessible to the surveyor
 - i. Yes – feature is accessible to the surveyor and able to be opened, if applicable

- 1 ii. No – feature is not accessible to the surveyor and/or not able to be opened, if
2 applicable, provide additional details in InaccessibleReason field
3
4 iii. Unknown – typically used if the feature is not found
5
6 h. InaccessibleReason – used to indicate the reason the feature is inaccessible
7
8 i. PavedOver – feature is paved over with asphalt or concrete
9
10 ii. FullofDirt – feature is full of dirt or debris
11
12 iii. FullofWater – feature is full of water
13
14 iv. Locked – feature is locked and/or lock is unable to be operated due to
15 damage
16
17 v. Sealed – feature has been sealed with tar or other material that is not easily
18 replaced
19
20 vi. SubGrade – feature is buried more than 1 foot below existing grade
21
22 vii. Obstruction – feature is covered by debris or other objects that prevent
23 access
24
25 viii. NotFound – feature is not able to be located, only used when there is
26 reasonable evidence of the feature’s potential existence
27
28 ix. Other – feature is inaccessible due to a situation that does not fit the other
29 options, provide additional details in Notes field
30
31 i. Notes – used to denote any extra or pertinent information about the feature or its
32 collection
33
34 j. Accuracy – used to store the accuracy of the data collected
35
36 i. TSSurvey – feature located with conventional survey equipment or total
37 station
38
39 ii. SurveyGPS – feature located with survey grade GPS
40
41 iii. MappingGPS – feature located with mapping grade GPS, sub-meter
42 accuracy, Not adequate for our specification
43
44 iv. Digitized – feature’s location determined without survey of any kind, Not
45 adequate for our specification
46
47 k. Surveyor – used to store the initials of the survey firm and the surveyor with a
48 space in between (Ex. CW ABC)
49
50 l. Collection Date – date field for the date of collection
51

1 **3) Water Blow Off Valve (wBlowOff)**
2

3 a. Accessible – used to indicate whether the feature is accessible to the surveyor
4

5 i. Yes – feature is accessible to the surveyor and able to be opened, if
6 applicable
7

8 ii. No – feature is not accessible to the surveyor and/or not able to be opened, if
9 applicable, provide additional details in InaccessibleReason field
10

11 iii. Unknown – typically used if the feature is not found
12

13 b. InaccessibleReason – used to indicate the reason the feature is inaccessible
14

15 i. PavedOver – feature is paved over with asphalt or concrete
16

17 ii. FullofDirt – feature is full of dirt or debris
18

19 iii. FullofWater – feature is full of water
20

21 iv. Locked – feature is locked and/or lock is unable to be operated due to
22 damage
23

24 v. Sealed – feature has been sealed with tar or other material that is not easily
25 replaced
26

27 vi. SubGrade – feature is buried more than 1 foot below existing grade
28

29 vii. Obstruction – feature is covered by debris or other objects that prevent
30 access
31

32 viii. NotFound – feature is not able to be located, only used when there is
33 reasonable evidence of the feature’s potential existence
34

35 ix. Other – feature is inaccessible due to a situation that does not fit the other
36 options, provide additional details in Notes field
37

38 c. Notes – used to denote any extra or pertinent information about the feature or its
39 collection
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41 d. Accuracy – used to store the accuracy of the data collected
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43 i. TSSurvey – feature located with conventional survey equipment or total
44 station
45

46 ii. SurveyGPS – feature located with survey grade GPS
47

48 iii. MappingGPS – feature located with mapping grade GPS, sub-meter
49 accuracy, Not adequate for our specification
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- 1 iv. Digitized – feature’s location determined without survey of any kind, Not
2 adequate for our specification
- 3
- 4 e. Surveyor – used to store the initials of the survey firm and the surveyor with a
5 space in between (Ex. CW ABC)
- 6
- 7 f. Collection Date – date field for the date of collection
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9 **4) Water Hydrant (wHydrant)**

- 10
- 11 a. Manufacturer – used to denote the manufacturer of the hydrant, occasionally
12 noted on device
- 13
- 14 b. HydrantType – used to denote the style of hydrant
- 15
- 16 i. Standard – hydrant with one large connection
- 17
- 18 ii. DoubleSTORZ – hydrant with two large STORZ connections
- 19
- 20 iii. AirRelease – hydrant which doubles as an air release, usually painted blue
- 21
- 22 iv. NonConforming – hydrant with no large connections
- 23
- 24 v. Other – hydrant which does not fit the other options
- 25
- 26 c. BarrelSize – used to denote the barrel size of the hydrant, occasionally noted on
27 device
- 28
- 29 d. FabricationYear – used to denote the year the hydrant was made, occasionally
30 noted on device
- 31
- 32 e. SteamerStreet – used to denote the street the main steamer connection faces
- 33
- 34 f. SteamerConnection – used to denote the type of steamer connection
- 35
- 36 i. CMUD 4.875x6 – standard, non-STORZ connection
- 37
- 38 ii. STORZ – STORZ connection
- 39
- 40 iii. Other – some other type of connection, rare
- 41
- 42 g. Color – used to denote the predominant paint color of the hydrant
- 43
- 44 i. Black - usually only found in Uptown Charlotte
- 45
- 46 ii. Blue – denotes an air release hydrant
- 47
- 48 iii. Green - rare
- 49
- 50 iv. Red – usually denotes a private hydrant

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- v. Yellow – vast majority of hydrants
- vi. NotPainted – rare
- h. Notes – used to denote any extra or pertinent information about the feature or its collection
- i. Accuracy – used to store the accuracy of the data collected
 - i. TSSurvey – feature located with conventional survey equipment or total station
 - ii. SurveyGPS – feature located with survey grade GPS
 - iii. MappingGPS – feature located with mapping grade GPS, sub-meter accuracy, Not adequate for our specification
 - iv. Digitized – feature’s location determined without survey of any kind, Not adequate for our specification
- j. Surveyor – used to store the initials of the survey firm and the surveyor with a space in between (Ex. CW ABC)
- k. Collection Date – date field for the date of collection

5) Water Manhole (wManhole)

- a. LidType – used to denote the type of manhole lid
 - i. CMUDStandard – 24” lid
 - ii. CMUDLarge – 30” lid
- b. Accessible – used to indicate whether the feature is accessible to the surveyor
 - i. Yes – feature is accessible to the surveyor and able to be opened, if applicable
 - ii. No – feature is not accessible to the surveyor and/or not able to be opened, if applicable, provide additional details in InaccessibleReason field
 - iii. Unknown – typically used if the feature is not found
- c. InaccessibleReason – used to indicate the reason the feature is inaccessible
 - i. PavedOver – feature is paved over with asphalt or concrete
 - ii. FullofDirt – feature is full of dirt or debris

- 1 iii. FullofWater – feature is full of water
- 2
- 3 iv. Locked – feature is locked and/or lock is unable to be operated due to
- 4 damage
- 5
- 6 v. Sealed – feature has been sealed with tar or other material that is not easily
- 7 replaced
- 8
- 9 vi. SubGrade – feature is buried more than 1 foot below existing grade
- 10
- 11 vii. Obstruction – feature is covered by debris or other objects that prevent
- 12 access
- 13
- 14 viii. NotFound – feature is not able to be located, only used when there is
- 15 reasonable evidence of the feature’s potential existence
- 16
- 17 ix. Other – feature is inaccessible due to a situation that does not fit the other
- 18 options, provide additional details in Notes field
- 19
- 20 d. Notes – used to denote any extra or pertinent information about the feature or its
- 21 collection
- 22
- 23 e. Accuracy – used to store the accuracy of the data collected
- 24
- 25 i. TSSurvey – feature located with conventional survey equipment or total
- 26 station
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- 28 ii. SurveyGPS – feature located with survey grade GPS
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- 30 iii. MappingGPS – feature located with mapping grade GPS, sub-meter
- 31 accuracy, Not adequate for our specification
- 32
- 33 iv. Digitized – feature’s location determined without survey of any kind, Not
- 34 adequate for our specification
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- 36 f. Surveyor – used to store the initials of the survey firm and the surveyor with a
- 37 space in between (Ex. CW ABC)
- 38
- 39 g. Collection Date – date field for the date of collection
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41 **6) Water Meter (wMeter)**

- 42
- 43 a. MeterSerial – used to denote the serial number of the meter
- 44
- 45 b. ERTSerial – used to denote the serial number of the encoder receiver transmitter
- 46
- 47 c. HouseNumber – used to denote the house number corresponding to the meter,
- 48 should only be populated when obvious
- 49
- 50 d. StreetName – used to denote the street name corresponding with the house
- 51 number

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- e. LidType – used to denote the style of lid
 - i. Epoxy – white or green epoxy lid
 - ii. HingedMetalDoors – metal door(s) with hinge(s)
 - iii. MetalPlates – metal lid with no hinges
 - iv. Concrete – concrete surrounding smaller metal plate with hinge
 - v. Other – other type of lid which does not fit the other options
- f. Accessible – used to indicate whether the feature is accessible to the surveyor
 - i. Yes – feature is accessible to the surveyor and able to be opened, if applicable
 - ii. No – feature is not accessible to the surveyor and/or not able to be opened, if applicable, provide additional details in InaccessibleReason field
 - iii. Unknown – typically used if the feature is not found
- g. InaccessibleReason – used to indicate the reason the feature is inaccessible
 - i. PavedOver – feature is paved over with asphalt or concrete
 - ii. FullofDirt – feature is full of dirt or debris
 - iii. FullofWater – feature is full of water
 - iv. Locked – feature is locked and/or lock is unable to be operated due to damage
 - v. Sealed – feature has been sealed with tar or other material that is not easily replaced
 - vi. SubGrade – feature is buried more than 1 foot below existing grade
 - vii. Obstruction – feature is covered by debris or other objects that prevent access
 - viii. NotFound – feature is not able to be located, only used when there is reasonable evidence of the feature’s potential existence
 - ix. Other – feature is inaccessible due to a situation that does not fit the other options, provide additional details in Notes field
- h. Notes – used to denote any extra or pertinent information about the feature or its collection

- 1 i. Accuracy – used to store the accuracy of the data collected
- 2
- 3 i. TSSurvey – feature located with conventional survey equipment or total
- 4 station
- 5
- 6 ii. SurveyGPS – feature located with survey grade GPS
- 7
- 8 iii. MappingGPS – feature located with mapping grade GPS, sub-meter
- 9 accuracy, Not adequate for our specification
- 10
- 11 iv. Digitized – feature’s location determined without survey of any kind, Not
- 12 adequate for our specification
- 13
- 14 j. Surveyor – used to store the initials of the survey firm and the surveyor with a
- 15 space in between (Ex. CW ABC)
- 16
- 17 k. Collection Date – date field for the date of collection
- 18

19 **7) Water Valve (wValve)**

- 20
- 21 a. Subtype – used to denote the function of the valve
- 22
- 23 i. Inline – mainline valve
- 24
- 25 ii. Service – valve on a service connection
- 26
- 27 iii. HydrantGuard – valve on a hydrant service connection
- 28
- 29 iv. Unknown – used when unable to determine the function of the valve
- 30
- 31 b. Cover – used to denote whether the valve has a cover or not
- 32
- 33 i. Yes
- 34
- 35 ii. No
- 36
- 37 iii. Unknown
- 38
- 39 c. Accessible – used to indicate whether the feature is accessible to the surveyor
- 40
- 41 i. Yes – feature is accessible to the surveyor and able to be opened, if
- 42 applicable
- 43
- 44 ii. No – feature is not accessible to the surveyor and/or not able to be opened, if
- 45 applicable, provide additional details in InaccessibleReason field
- 46
- 47 iii. Unknown – typically used if the feature is not found
- 48

- 1 d. InaccessibleReason – used to indicate the reason the feature is inaccessible
- 2
- 3 i. PavedOver – feature is paved over with asphalt or concrete
- 4
- 5 ii. FullofDirt – feature is full of dirt or debris
- 6
- 7 iii. FullofWater – feature is full of water
- 8
- 9 iv. Locked – feature is locked and/or lock is unable to be operated due to
- 10 damage
- 11
- 12 v. Sealed – feature has been sealed with tar or other material that is not easily
- 13 replaced
- 14
- 15 vi. SubGrade – feature is buried more than 1 foot below existing grade
- 16
- 17 vii. Obstruction – feature is covered by debris or other objects that prevent
- 18 access
- 19
- 20 viii. NotFound – feature is not able to be located, only used when there is
- 21 reasonable evidence of the feature’s potential existence
- 22
- 23 ix. Other – feature is inaccessible due to a situation that does not fit the other
- 24 options, provide additional details in Notes field
- 25
- 26 e. Notes – used to denote any extra or pertinent information about the feature or its
- 27 collection
- 28
- 29 f. Accuracy – used to store the accuracy of the data collected
- 30
- 31 i. TSSurvey – feature located with conventional survey equipment or total
- 32 station
- 33
- 34 ii. SurveyGPS – feature located with survey grade GPS
- 35
- 36 iii. MappingGPS – feature located with mapping grade GPS, sub-meter
- 37 accuracy, Not adequate for our specification
- 38
- 39 iv. Digitized – feature’s location determined without survey of any kind, Not
- 40 adequate for our specification
- 41
- 42 g. Surveyor – used to store the initials of the survey firm and the surveyor with a
- 43 space in between (Ex. CW ABC)
- 44
- 45 h. Collection Date – date field for the date of collection
- 46

47 **8) Water Main (wMain)**

48 *Should be used only for cartographic connectivity. Not intended to be used for top of*

49 *pipe collection.*

50

51

- 1 a. Notes - used to denote any extra or pertinent information about the feature or its
2 collection
3
- 4 B. Wastewater Features and Attributes to be Collected and Surveyed
5
- 6 1) **Backflow Manhole (wwBackflowMH)**
7
- 8 a. Accessible – used to indicate whether the feature is accessible to the surveyor
9
- 10 i. Yes – feature is accessible to the surveyor and able to be opened, if
11 applicable
12
- 13 ii. No – feature is not accessible to the surveyor and/or not able to be opened, if
14 applicable, provide additional details in InaccessibleReason field
15
- 16 iii. Unknown – typically used if the feature is not found
17
- 18 b. InaccessibleReason – used to indicate the reason the feature is inaccessible
19
- 20 i. PavedOver – feature is paved over with asphalt or concrete
21
- 22 ii. FullofDirt – feature is full of dirt or debris
23
- 24 iii. FullofWater – feature is full of water
25
- 26 iv. Locked – feature is locked and/or lock is unable to be operated due to
27 damage
28
- 29 v. Sealed – feature has been sealed with tar or other material that is not easily
30 replaced
31
- 32 vi. SubGrade – feature is buried more than 1 foot below existing grade
33
- 34 vii. Obstruction – feature is covered by debris or other objects that prevent
35 access
36
- 37 viii. NotFound – feature is not able to be located, only used when there is
38 reasonable evidence of the feature’s potential existence
39
- 40 ix. Other – feature is inaccessible due to a situation that does not fit the other
41 options, provide additional details in Notes field
42
- 43 c. Notes – used to denote any extra or pertinent information about the feature or its
44 collection
45
- 46 d. Accuracy – used to store the accuracy of the data collected
47
- 48 i. TSSurvey – feature located with conventional survey equipment or total
49 station
50
- 51 ii. SurveyGPS – feature located with survey grade GPS

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- iii. MappingGPS – feature located with mapping grade GPS, sub-meter accuracy, Not adequate for our specification
- iv. Digitized – feature’s location determined without survey of any kind, Not adequate for our specification
- e. Surveyor – used to store the initials of the survey firm and the surveyor with a space in between (Ex. CW ABC)
- f. Collection Date – date field for the date of collection

2) Wastewater Cleanout (wwCleanout)

- a. LidType – used to denote the material of the cleanout lid
 - i. PVC
 - ii. DIP
 - iii. Brass
 - iv. Unknown
- b. Accessible – used to indicate whether the feature is accessible to the surveyor
 - i. Yes – feature is accessible to the surveyor and able to be opened, if applicable
 - ii. No – feature is not accessible to the surveyor and/or not able to be opened, if applicable, provide additional details in InaccessibleReason field
 - iii. Unknown – typically used if the feature is not found
- c. InaccessibleReason – used to indicate the reason the feature is inaccessible
 - i. PavedOver – feature is paved over with asphalt or concrete
 - ii. FullofDirt – feature is full of dirt or debris
 - iii. FullofWater – feature is full of water
 - iv. Locked – feature is locked and/or lock is unable to be operated due to damage
 - v. Sealed – feature has been sealed with tar or other material that is not easily replaced
 - vi. SubGrade – feature is buried more than 1 foot below existing grade

- 1 vii. Obstruction – feature is covered by debris or other objects that prevent
2 access
3
4 viii. NotFound – feature is not able to be located, only used when there is
5 reasonable evidence of the feature’s potential existence
6
7 ix. Other – feature is inaccessible due to a situation that does not fit the other
8 options, provide additional details in Notes field
9
10 d. Notes – used to denote any extra or pertinent information about the feature or its
11 collection
12
13 e. Accuracy – used to store the accuracy of the data collected
14
15 i. TSSurvey – feature located with conventional survey equipment or total
16 station
17
18 ii. SurveyGPS – feature located with survey grade GPS
19
20 iii. MappingGPS – feature located with mapping grade GPS, sub-meter
21 accuracy, Not adequate for our specification
22
23 iv. Digitized – feature’s location determined without survey of any kind, Not
24 adequate for our specification
25
26 f. Surveyor – used to store the initials of the survey firm and the surveyor with a
27 space in between (Ex. CW ABC)
28
29 g. Collection Date – date field for the date of collection
30
31 **3) Low Pressure Service Box (wwLowPressureServiceBox)**
32
33 a. Accessible – used to indicate whether the feature is accessible to the surveyor
34
35 i. Yes – feature is accessible to the surveyor and able to be opened, if
36 applicable
37
38 ii. No – feature is not accessible to the surveyor and/or not able to be opened, if
39 applicable, provide additional details in InaccessibleReason field
40
41 iii. Unknown – typically used if the feature is not found
42
43 b. InaccessibleReason – used to indicate the reason the feature is inaccessible
44
45 i. PavedOver – feature is paved over with asphalt or concrete
46
47 ii. FullofDirt – feature is full of dirt or debris
48
49 iii. FullofWater – feature is full of water
50

- 1 iv. Locked – feature is locked and/or lock is unable to be operated due to
2 damage
- 3
- 4 v. Sealed – feature has been sealed with tar or other material that is not easily
5 replaced
- 6
- 7 vi. SubGrade – feature is buried more than 1 foot below existing grade
- 8
- 9 vii. Obstruction – feature is covered by debris or other objects that prevent
10 access
- 11
- 12 viii. NotFound – feature is not able to be located, only used when there is
13 reasonable evidence of the feature’s potential existence
- 14
- 15 ix. Other – feature is inaccessible due to a situation that does not fit the other
16 options, provide additional details in Notes field
- 17
- 18 c. Notes – used to denote any extra or pertinent information about the feature or its
19 collection
- 20
- 21 d. Accuracy – used to store the accuracy of the data collected
- 22
- 23 i. TSSurvey – feature located with conventional survey equipment or total
24 station
- 25
- 26 ii. SurveyGPS – feature located with survey grade GPS
- 27
- 28 iii. MappingGPS – feature located with mapping grade GPS, sub-meter
29 accuracy, Not adequate for our specification
- 30
- 31 iv. Digitized – feature’s location determined without survey of any kind, Not
32 adequate for our specification
- 33
- 34 e. Surveyor – used to store the initials of the survey firm and the surveyor with a
35 space in between (Ex. CW ABC)
- 36
- 37 f. Collection Date – date field for the date of collection
- 38

39 **4) Wastewater Manhole (wwManhole)**

- 40
- 41 h. MH_Geometry – used to denote the geometry or shape of the manhole structure
- 42
- 43 i. Eccentric – manhole lid is offset slightly from the rest of the structure
- 44
- 45 ii. Concentric – manhole structure is conical, and not offset
- 46
- 47 iii. Box – manhole structure is square or rectangular, typically used for lamp
48 holes in older areas of the system
- 49
- 50 iv. Flattop – manhole is usually precast concrete with a flat surface above
51 ground, typically found on larger diameter mains and/or outfalls

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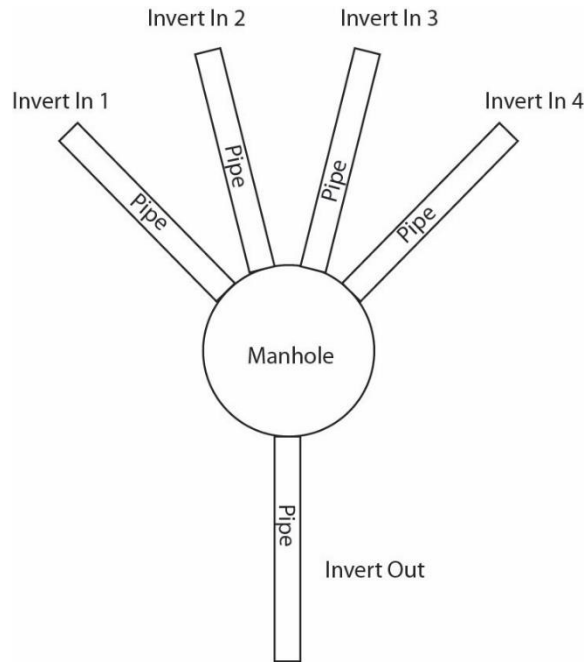
- v. Other – shape of manhole that does not fit any of the above options – provide additional details in Notes field
- vi. Unknown – typically used when manhole is not accessible
- i. MH_Function – used to denote the function or purpose of the manhole
 - i. Inline – manhole has pipes in and out, most commonly seen manhole
 - ii. HeadofLine – manhole has only one pipe out
 - iii. Lamphole – manhole has small, square lid and sides
 - iv. DoubleHead - manhole has no invert in and two invert out pipes typically at the same elevation
 - v. SiphonBox –manhole where gravity main connects to upstream and/or downstream side of siphons generally at creek crossings
 - vi. JunctionBox – manhole used to allow flow to pass between systems
 - vii. DiversionBox – manhole where flow can be diverted from one gravity line to another parallel gravity line, generally includes a weir
 - viii. Wetwell – manhole receiving flow for a lift station, generally very deep with a float inside
 - ix. Other – manhole function that does not fit any of the above options; provide additional details in Notes field
 - x. Unknown – typically used when manhole is not accessible
- j. Material – used to denote the predominant material used to construct the manhole
 - i. Concrete – usually precast
 - ii. Brick – red brick laid with mortar
 - iii. MasonryBlock – concrete brick or block with or without mortar
 - iv. Unknown – typically used when manhole is not accessible
 - v. Other – material that does not fit any of the above options, provide additional details in Notes field
- k. LidType – used to denote the type of lid covering the manhole opening
 - i. Vented – lid with holes for ventilation

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- ii. VentedCamLock – vented lid with locking cam devices
 - iii. Solid – lid with no holes for ventilation
 - iv. SolidCamLock – solid lid with locking cam devices
 - v. SolidBoltedSeal – bolted solid lid which bolts down and has a gasket around the manhole opening
 - vi. SolidBoltedNoSeal – solid lid which bolts down
 - vii. WaterTight – solid lid which has been sealed with tar or other waterproofing material
 - viii. WaterTightLocked – watertight lid with locking cam devices
 - ix. CertainTeed – specific brand of lid with a thinner lid that rotates in the frame to lock
 - x. Unknown – typically used when manhole is not accessible
- I. LiningType – used to denote the type of material used to line manhole to prevent ground water from leaking into manhole walls
- i. Cementitious
 - ii. Epoxy
 - iii. CuredInPlace
 - iv. PVC
 - v. None – no lining is visible
 - vi. Unknown – typically used when manhole is not accessible
- m. Manhole Invert Numbers – Invert In numbers are assigned by going clockwise around the manhole starting from the Invert Out. When going clockwise around the manhole, the first 6-inch or larger line will be named “Invert In 1”, unless that 6-inch line is an obvious lateral serving a nearby building. Lines of 4-inch are laterals are should not considered an Invert In or included in this numbering.

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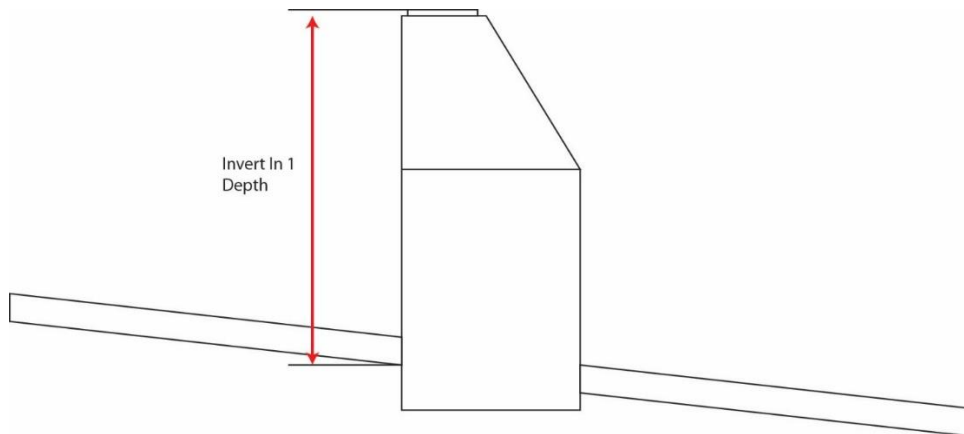
FIGURE 7.2: MANHOLE INVERT NUMBERS



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- n. InvertIn1 – used to denote the distance in feet between the bottom of the pipe at Invert In 1 and the top of the manhole rim that holds the lid

FIGURE 7.3: INVERT IN 1

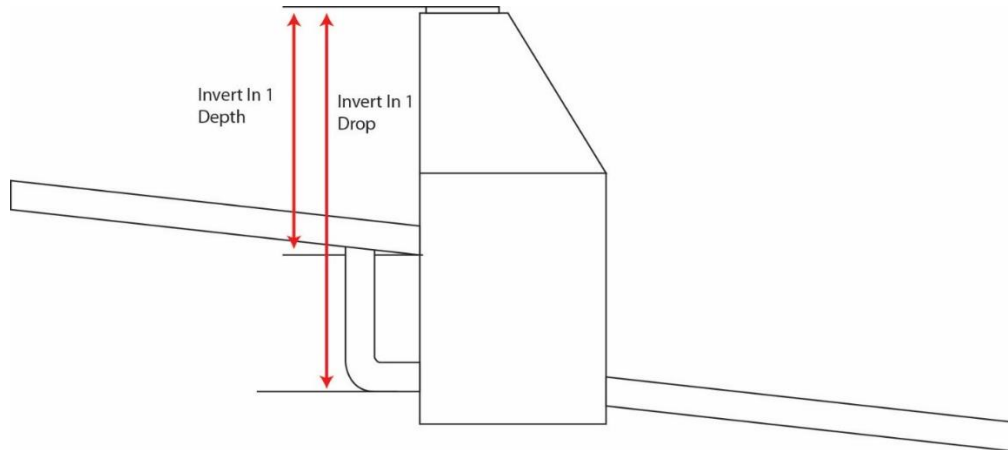


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- o. InvertIn1Drop – used to denote the distance in feet between bottom of the drop pipe at Invert In 1 and the top of the manhole rim that holds the lid

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FIGURE 7.4: INVERT IN 1 DROP



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Repeat this process as needed for additional invert pipes:

InvertIn2 – if applicable, same as InvertIn1 applied to Invert In 2

InvertIn2Drop - if applicable, same as InvertIn1 applied to Invert In 2

InvertIn3 – if applicable, same as InvertIn1 applied to Invert In 3

InvertIn3Drop - if applicable, same as InvertIn1 applied to Invert In 3

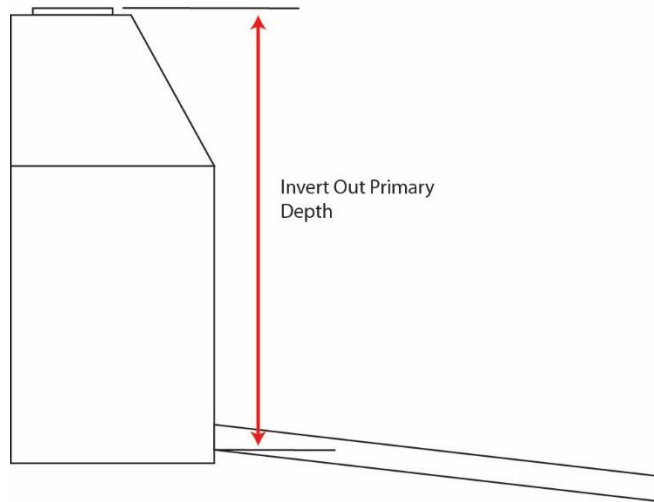
InvertIn4 – if applicable, same as InvertIn1 applied to Invert In 4

InvertIn4Drop - if applicable, same as InvertIn1 applied to Invert In 4

- p. InvertOutPrimary – used to denote the distance in feet between bottom of the outflowing pipe at the lowest elevation or at the outflowing pipe that collects a majority of the flow leaving the manhole and the top of the manhole rim that holds the lid

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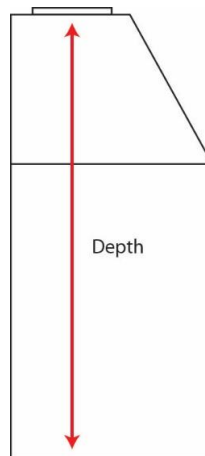
FIGURE 7.5: INVERT OUT PRIMARY



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- q. InvertOutSecondary – if applicable, used to denote the distance in feet between bottom of the outflowing pipe at the second lowest elevation or at the outflowing pipe that collects a minority of the flow leaving the manhole and the top of the manhole rim that holds the lid. If the Primary Out and Secondary Out are at equal depths and/or there is no majority/minority flow, then there is no preference for which Out gets which values.
- r. Depth – used to denote the distance in feet from bottom trough of the manhole to the top of the manhole rim that holds the lid

FIGURE 7.6: DEPTH



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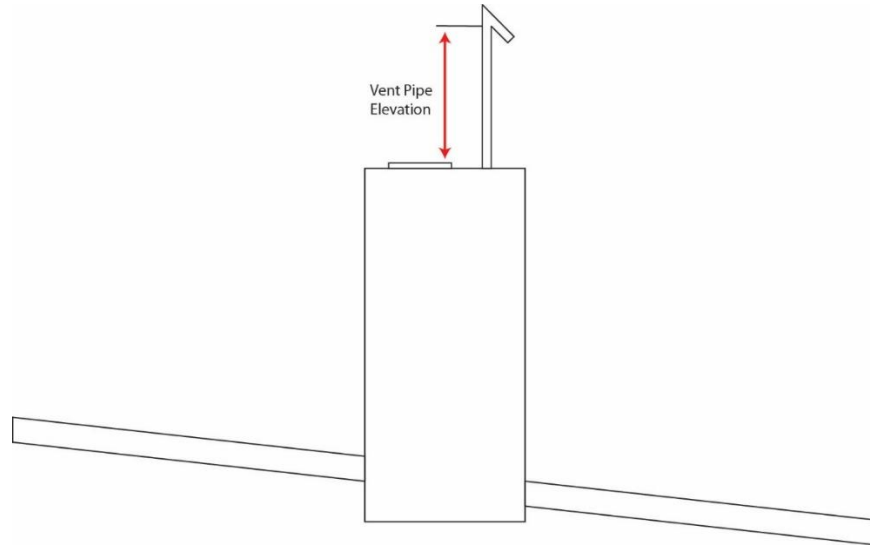
- s. Vent – used to denote the presence of a vent pipe on the manhole structure
 - i. Yes
 - ii. No

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iii. Unknown

t. VentElevation – used to denote the distance in feet between the manhole rim and the inside bend of the vent pipe

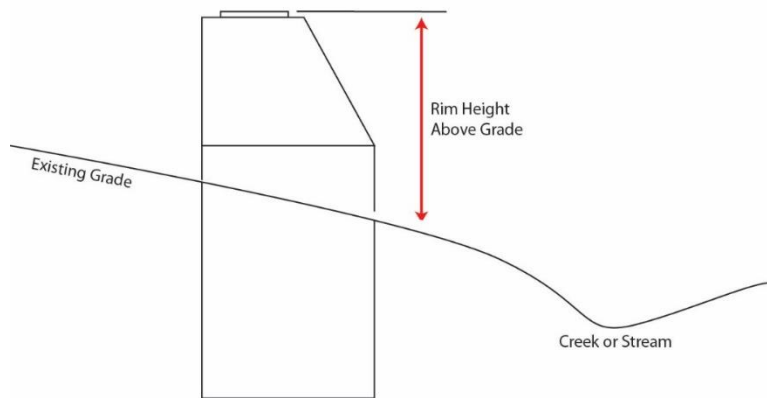
FIGURE 7.7: VENT ELEVATION



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u. RimHeightAboveGrade – used to denote the distance in feet between the manhole rim and the existing grade on the creek side of manhole. If the manhole is in the street or is flush with grade, enter 0 for the value. Do not leave as null or blank.

FIGURE 7.8: RIM HEIGHT ABOVE GRADE



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v. Accessible – used to indicate whether the feature is accessible to the surveyor

i. Yes – feature is accessible to the surveyor and able to be opened, if applicable

- 1 ii. No – feature is not accessible to the surveyor and/or not able to be opened, if
2 applicable, provide additional details in InaccessibleReason field
3
4 iii. Unknown – typically used if the feature is not found
5
6 w. InaccessibleReason – used to indicate the reason the feature is inaccessible
7
8 i. PavedOver – feature is paved over with asphalt or concrete
9
10 ii. FullofDirt – feature is full of dirt or debris
11
12 iii. FullofWater – feature is full of water
13
14 iv. Locked – feature is locked and/or lock is unable to be operated due to
15 damage
16
17 v. Sealed – feature has been sealed with tar or other material that is not easily
18 replaced
19
20 vi. SubGrade – feature is buried more than 1 foot below existing grade
21
22 vii. Obstruction – feature is covered by debris or other objects that prevent
23 access
24
25 viii. NotFound – feature is not able to be located, only used when there is
26 reasonable evidence of the feature’s potential existence
27
28 ix. Other – feature is inaccessible due to a situation that does not fit the other
29 options, provide additional details in Notes field
30
31 x. Notes – used to denote any extra or pertinent information about the feature or its
32 collection
33
34 y. Accuracy – used to store the accuracy of the data collected
35
36 i. TSSurvey – feature located with conventional survey equipment or total
37 station
38
39 ii. SurveyGPS – feature located with survey grade GPS
40
41 iii. MappingGPS – feature located with mapping grade GPS, sub-meter
42 accuracy, Not adequate for our specification
43
44 iv. Digitized – feature’s location determined without survey of any kind, Not
45 adequate for our specification
46
47 z. Surveyor – used to store the initials of the survey firm and the surveyor with a
48 space in between (Ex. CW ABC)
49
50 aa. Collection Date – date field for the date of collection
51

1 **5) Wastewater Valve (wwValve)**
2

3 a. InManhole – used to denote whether the valve is inside a manhole or not
4

5 i. Yes
6

7 ii. No
8

9 iii. Unknown
10

11 b. Cover – used to denote whether the valve has a cover or not
12

13 i. Yes
14

15 ii. No
16

17 iii. Unknown
18

19 c. Accessible - used to indicate whether the feature is accessible to the surveyor
20

21 i. Yes – feature is accessible to the surveyor and able to be opened, if
22 applicable
23

24 ii. No – feature is not accessible to the surveyor and/or not able to be opened, if
25 applicable, provide additional details in InaccessibleReason field
26

27 iii. Unknown – typically used if the feature is not found
28

29 d. InaccessibleReason - used to indicate the reason the feature is inaccessible
30

31 i. PavedOver – feature is paved over with asphalt or concrete
32

33 ii. FullofDirt – feature is full of dirt or debris
34

35 iii. FullofWater – feature is full of water
36

37 iv. Locked – feature is locked and/or lock is unable to be operated due to
38 damage
39

40 v. Sealed – feature has been sealed with tar or other material that is not easily
41 replaced
42

43 vi. SubGrade – feature is buried more than 1 foot below existing grade
44

45 vii. Obstruction – feature is covered by debris or other objects that prevent
46 access
47

48 viii. NotFound – feature is not able to be located, only used when there is
49 reasonable evidence of the feature's potential existence
50

- 1 ix. Other – feature is inaccessible due to a situation that does not fit the other
- 2 options, provide additional details in Notes field
- 3
- 4 e. Notes – used to denote any extra or pertinent information about the feature or its
- 5 collection
- 6
- 7 f. Accuracy – used to store the accuracy of the data collected
- 8
- 9 i. TSSurvey – feature located with conventional survey equipment or total
- 10 station
- 11
- 12 ii. SurveyGPS – feature located with survey grade GPS
- 13
- 14 iii. MappingGPS – feature located with mapping grade GPS, sub-meter
- 15 accuracy, Not adequate for our specification
- 16
- 17 iv. Digitized – feature’s location determined without survey of any kind, Not
- 18 adequate for our specification
- 19
- 20 g. Surveyor – used to store the initials of the survey firm and the surveyor with a
- 21 space in between (Ex. CW ABC)
- 22
- 23 h. Collection Date – date field for the date of collection
- 24

25 **6) Wastewater Main (wwMain) – Cartographic Sketch Only**

26 *Should be used only for cartographic connectivity. Not intended to be used for top of*

27 *pipe collection.*

- 28
- 29
- 30 a. Diameter – used to denote the diameter of the wastewater main
- 31
- 32 b. Material – used to denote the material of the wastewater main
- 33
- 34 c. Notes - used to denote any extra or pertinent information about the feature or its
- 35 collection