DRAFT PRELIMINARY ENGINEERING REPORT

Piedmont Health Center
Hydrologic Report

FOR

THE TOWN OF CARRBORO
CARRBORO, NORTH CAROLINA
May 6, 2016

PREPARED BY:

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PIEDMONT HEALTH CENTER
PRELIMINARY HYDROLOGIC REPORT

I. Project Background

Sungate Design Group, PA (Sungate) was contracted by the Town of Carrboro to conduct a preliminary Hydrologic Study to evaluate possible causes of the frequent flooding which occurs at the Piedmont Health Center (The Center) located at 299 Lloyd Street in Carrboro. The building was occupied by Piedmont Health in 1994 and was enlarged in 2005. The parking lot in the rear of the property was flooded most recently during a rainfall event on March 14, 2016. The drainage system within the parking lot was so overwhelmed that a manhole cover on the system was dislodged from the junction box and stormwater discharged directly into the parking lot **(See Attachment 1)**. Stormwater was also flowing over the berm on the adjoining NSR/UNC railroad ditch directly into the parking lot **(See picture on cover of Report)**. The parking lot was also flooded during two rainfall events in late December of 2015. The worst flooding occurred on June 30, 2013 when flood waters got approximately 2-6 inches deep inside the building and caused approximately $48,000.00 in damages. This cost does not include the loss of revenue or that the Center was shut down while repairs were being made. Additional structural damages have been avoided during other subsequent flood events through the use of sand bags at all the entrance points into the facility. According to Mr. Brian Toomey, CEO Piedmont Health Services, no damage from flooding was incurred until the June 30, 2013 storm. Mr. Toomey also supplied photographs of a minor storm event which occurred on 4/7/16 which showed water again flowing out of the junction box but no overflow from the NSR/UNC rail ditch **(See Attachment 2)**. This would indicate that there may be debris in the system that inhibits flow between the junction box and the catch basin.

The watershed above the Center is the headwater to Tanbark Branch. Tanbark Branch technically begins just downstream of the Piedmont Health Center site according to the Town of Carrboro GIS and USGS topographical mapping. Upstream of the site, the stream has been replaced by manmade ditches, roadway and railway ditches and long pipe systems as a result of urbanization in the watershed. No semblances of a natural channel currently exist within the upstream watershed. The Norfolk Southern /UNC railroad is immediately upstream of the Center site. All of the discharge entering the drainage system at the Center comes directly through cross pipes and rail side drainage ditches. Based on historical topographic mapping of Carrboro dated 1918 (**Appendix A**), it appears that the rail and associated spur lines were in existence at that time and predate any construction on the Health Center site.

II. Preliminary Data Gathering

Sungate obtained available TOC GIS, zoning and contour data to create a preliminary base map (**Appendix B**). Current and historical USGS topographic mapping was also

obtained from the web. The NRCS Soil Survey Manual for Orange County was referenced to determine hydrologic soil types for the watershed area.

The stream in this area is not included in the FEMA flood study area according to the latest DFIRM maps from North Carolina Floodplain Mapping Program (NCFMP).

III. Field Reconnaissance and Survey

Sungate completed several site visits to visually observe the site and verify the existing drainage patterns and drainage areas. Measurements of the existing pipes were taken, and detailed field surveys were completed for this analysis including the location and elevation of the drainage system components within the Center. It was found that the inlet to the system is in the railroad ditch and is composed of a single 24" pipe **(See Attachment 3)**. The 24" system continues throughout the site with associated drop inlets and junction boxes. The system terminates at a catch basin in Lloyd Street **(See Appendix C)**. During the field survey, it was noted that the first junction box on the system that overflowed during the flooding events was largely filled with debris (parts of railroad ties, plastic bottles and other discarded trash). The debris was packed so tightly in the structure that efforts to push a metal rod to the invert of the box were difficult **(See Attachment 4)**. Debris within the system severely limits the conveyance of stormwater. Based on the amount of standing water in the junction box, it is likely that the 24" outlet pipe from the junction box is almost completely clogged. The past incidents of the manhole cover being dislodged from the junction box without water being backed up through the two downstream drop inlet grates verify the distinct possibility of debris blockage throughout the system. Pieces of old railroad ties were also found in the catch basin in Lloyd Street where the Center system ties in.

The survey also includes location and elevations of all ditches and cross pipes in the railroad Right-of-Way as well as cross sections of the rail ditch in the vicinity of the Center. It was found that there are a 24" corrugated metal pipe and a 36" reinforced concrete pipes under the railroad that discharge directly into the 24" system at the Center. The rail ditch on the east side of the tracks in the vicinity of the Center is basically flat with depressional areas that hold water even during dry periods **(See Attachment 5)**. The ditch is also littered with debris and old railroad ties **(See Attachment 6)**. Stormwater discharge from 25.3 acres of the total 27.7 acre drainage area must pass under the railroad before entering the Health Center system. During the 2013 storm and the December 2015 storms, the berm on the ditch in the rail Right-of-Way overtopped and water spilled directly into the Health Center parking lot. Overtopping was personally observed by an employee of Sungate during the December 30, 2015 storm event.

IV. Preliminary Engineering Evaluation

The drainage area at study location was delineated using the available contour data and field verified. The total drainage area to the 24" inlet pipe to the system at the Health Center is 27.7 acres **(See Appendix D)**. According to the latest TOC Zoning maps, the land within the contributing drainage area is zoned for Business (84 %), and Residential

(16%). The drainage area is almost entirely built out with approximately 16.7 acres (60%) of impervious surface. NRCS Soil Survey Manual for Orange County identifies the native soils as gravelly loams that belong to the hydrologic soil group "D" classification. Soils in the group are clayey in nature and have a high runoff potential due to slow infiltration rates when fully wetted. .

A hydrologic model of the drainage basin was completed using the HydroCAD model. HydroCAD is a Computer Aided Design system for modeling Hydrology and Hydraulics of stormwater runoff. The program is based on hydrology techniques developed by the (SCS/NRCS) and models complex watersheds. Peak discharge rates were determined using the SCS method for the 2, 5, 10, 25, and 100-year storm recurrence intervals for both existing conditions and current zoning and are as follows:

Frequency	24-Hour Rainfall (Inches)	Peak Flow Rate Existing Conditions (cubic feet/second)	Peak Flow Rate Current Zoning (cubic feet/second)
1-Year	2.9	95	95
2-Year	3.5	115	115
5-Year	4.4	145	145
10-Year	5.1	168	168
25-Year	6.0	198	198
100-Year	7.4	244	244

Based on these computed discharges and the discharges observed during storm events over the past 20 years at the Center and in other areas within the watershed, it appears that there is significant passive detention existing in the watershed provided by undersized or partially clogged pipes, flat or depressional lawns or other open space, and irregular or oversized ditches. These passive detention areas are not taken into account in the Hydrologic computations since changes in the land use, topography, street type, pipe sizes and/or other factors which affect discharge rates can change as properties develop or redevelop.

Hydraulics of the pipe system was checked using the Hydraulic Design Series No. 5 Hydraulic Design of Highway Culverts. It was found that the existing single 24" RCP controls the headwater depth and is grossly undersized. Based on the calculated peak flow rates shown above, the berm on the railroad ditch overtops when the discharge reaches approximately 37 cubic feet per second (less than the 1-year storm event) if the system were not clogged with debris. Based on the capacity of the system and the computed discharges shown above, the system should be overtopping very frequently.

According to the Carrboro LUO, this crossing should be sized to handle the 25-year storm event. In order to meet this requirement and not overtop the railroad ditch berm, a 66" RCP open-end pipe would be required. Due to the topographical constraints, the largest pipe that could presently be installed and still have a minimum of 1' of cover would be a 60" pipe. If a 60" pipe were to be used, storm events greater than the 10-year event would continue to overtop the existing berm and spill into the parking lot.

Therefore, 2 @ 48" pipes would be required in order to allow sufficient cover due to limited elevation difference between the railroad ditch bed elevation at the inlet to the existing 24" pipe and the berm elevation. Installation of a pipe system this large would require significant excavation in the Health Center parking lot and would require enlargement of the receiving downstream system in Lloyd Street, through private property and under Broad Street **(See Appendix E)**. It does not appear that the increased discharge at the outlet of the system would cause any flooding of existing structures; however, erosion of the outlet channel may increase due to the increased discharge.

A second alternative would be to provide an adequate system through the Center property that would convey the discharge passed by the existing railroad culverts to the Health Center system. The two pipes under the rail also appear to be undersized based on the projected discharge from the watershed and therefore presently dampen the peak discharge before it reaches the Center property. Since the rail in this area has not been flooded to the extent that train traffic has been disrupted, it is unlikely that the railroad will replace or upgrade the two pipes that discharge into the Center system. The two culverts under the railroad have approximately 10 square feet of cross sectional area. Retaining the existing 24" pipe and installing an additional 42" pipe system (total area = 12.7 square feet) on the Center property would likely provide adequate conveyance for most storm events even though it would not meet current Carrboro Standards. This alternative would require upgrading a portion of the system under Lloyd Street but not through private property or under Broad Street **(See Appendix F)**. The existing system on private property to the east of Lloyd Street consists of 48" pipes and could possibly be retained in its current condition. Conversation with the rail regarding planned upgrades to the current pipes under the rail or other planned activities that could that could increase the discharge on the Center should be initiated before any design activity is undertaken.

Another alternative would be to provide overflow relief for the present Center system down the existing ditch on the east side of the tracks. The existing ditch would have to be regraded to provide a minimum 5 foot base ditch that would be at least 3' deep. The grading would begin approximately 330 feet north of the inlet to the Center system at elevation 442.3 and would terminate at the outlet of a 36" crossing approximately 775 feet north of the Health Center. The grade of the ditch would be approximately 1.0% in order to carry the 25-year storm without overtopping **(See Appendices G and H)**. This alternative did not prove to be advisable since it would cause a discharge diversion of approximately 150 cubic feet per second in the 25-year frequency storm at the outlet of the 36" pipe. The diversion would cause the rate of discharge at the outlet to increase by 130%. The outlet ditch at this point is currently stable **(See Attachment 7).** This alternative is not recommended as there are existing homes and ancillary structures near the stream that could be impacted due to the increased discharge. Additional studies would be required to determine the increased flooding potential and channel stability at the new discharge.

A fourth alternative of providing detention or other infiltration devices in the watershed upstream of the Center was also thoroughly investigated. As previously mentioned the upstream watershed is completely built out and the soils are practically impervious. No

areas were identified that were owned by the Town where detention facilities could be constructed or other "green" retrofit techniques employed to reduce the run-off rate significantly. There are no privately owned tracts where there is sufficient open area to provide site detention or other infiltration devices that would significantly benefit the Center. It is, therefore, imperative that stormwater detention and infiltration be required when infill projects are proposed within the watershed to reduce the discharge to the Center system. Even though this may not eliminate the need for upgrades to the Center's system, it may reduce the overall size of the system as well as benefit downstream property owners.

V. Recommendations

It is recommended as a first step, before any upgrades to the Center's drainage system are undertaken, that the debris from the first junction box located between the system inlet and the first drop inlet be cleaned of all debris. All other junction boxes and drainage inlets should also be thoroughly inspected and any blockage removed. The rest of the pipe system should then be investigated for further blockage either visually between junctions in the system or by using a robotic camera. This should help to alleviate the flooding problem now experienced during low frequency storms as experienced on 4/7/16. After the system is thoroughly cleaned, the NRS/UNC rail authority should be contacted and requested to clean out all of the existing debris from the rail ditch on the east side of the of the track from Main Street to 36" pipe crossing on the north side of the Center. After this step is completed, the system should be monitored during subsequent rainfall events to determine if the improvements in system performance are satisfactory to delay or avoid further repairs or system replacement.

Based on the above observations and subsequent computations, it does not appear that any Town of Carrboro public infrastructure is causing or contributing to any of the flooding experienced at the Center. The downstream system in Lloyd Street (36" pipe) is currently sized to accept the discharge from the Center. The rail upstream of the property appears to be providing passive detention due to existing pipe sizes under the tracks and/or debris blockage at the inlet of the 36" pipe **(See Attachment 8)**. It is evident that there has been damage to structures on the Center property caused by flooding. It is recommended that this flooding event be added to the Town's list of flooding problems and to be evaluated for inclusion in the one of the Tiers (TBD).

Attachment 1

Attachment 2

Attachment 3

Attachment 4

Attachment 5

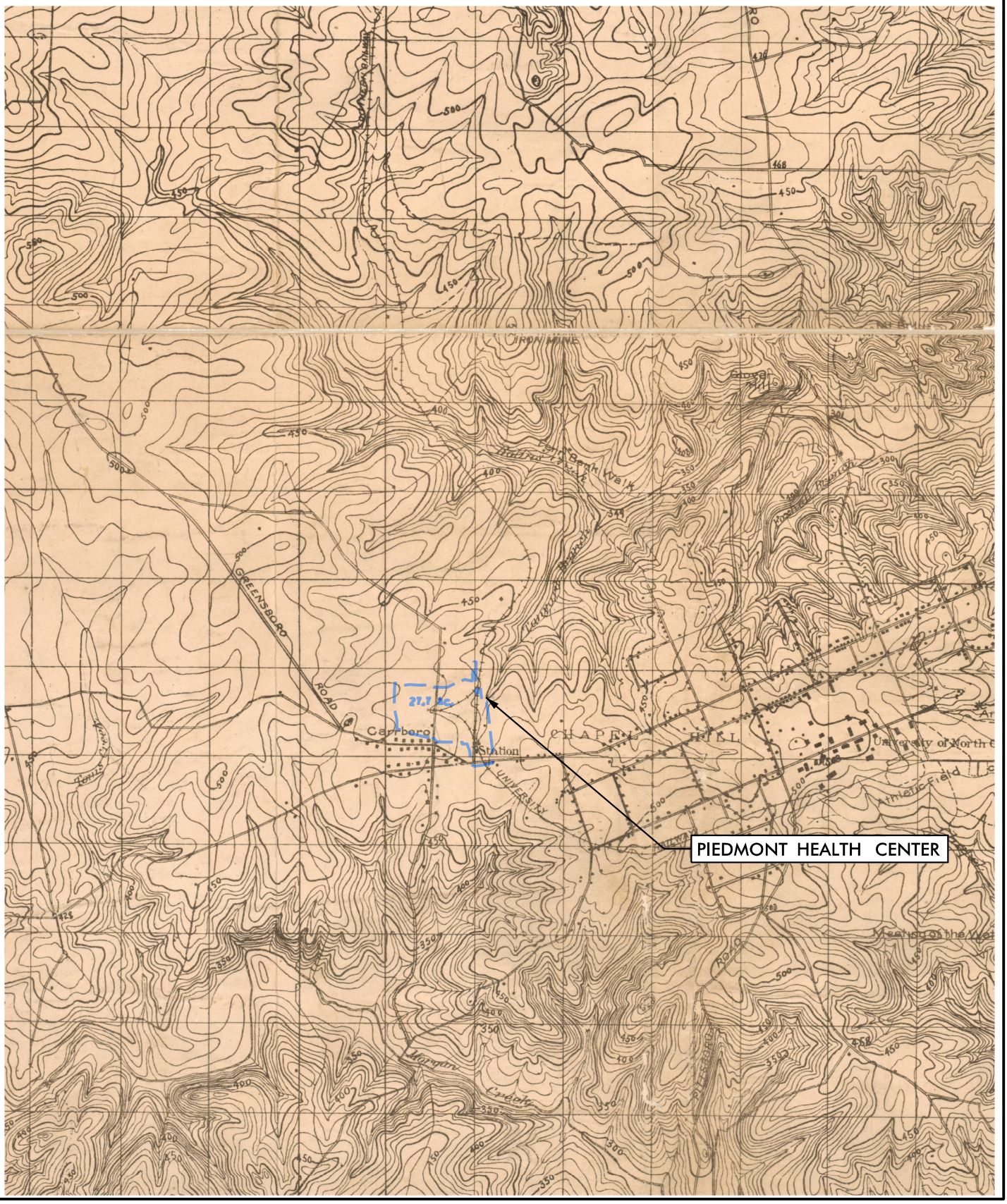
Attachment 6

Attachment 7

Attachment 8

APPENDIX A

PIEDMONT HEALTH CENTER
1918 USGS QUAD MAP
ORANGE COUNTY
SCALE: 1" = 2000'



APPENDIX B

Piedmont Health Center Area Map

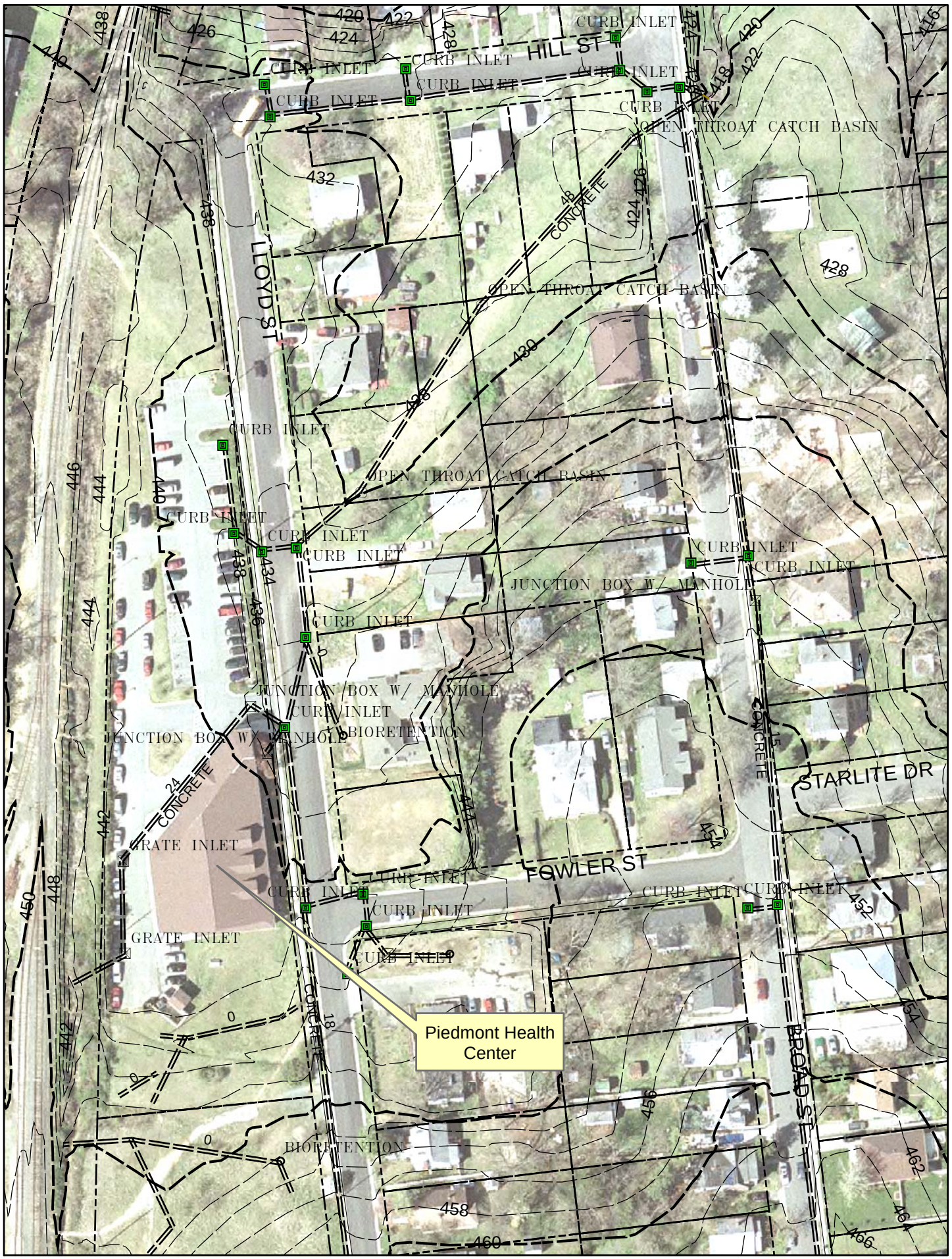
N

1 inch = 300 feet

APPENDIX C

Existing Piedmont Health Center Drainage System

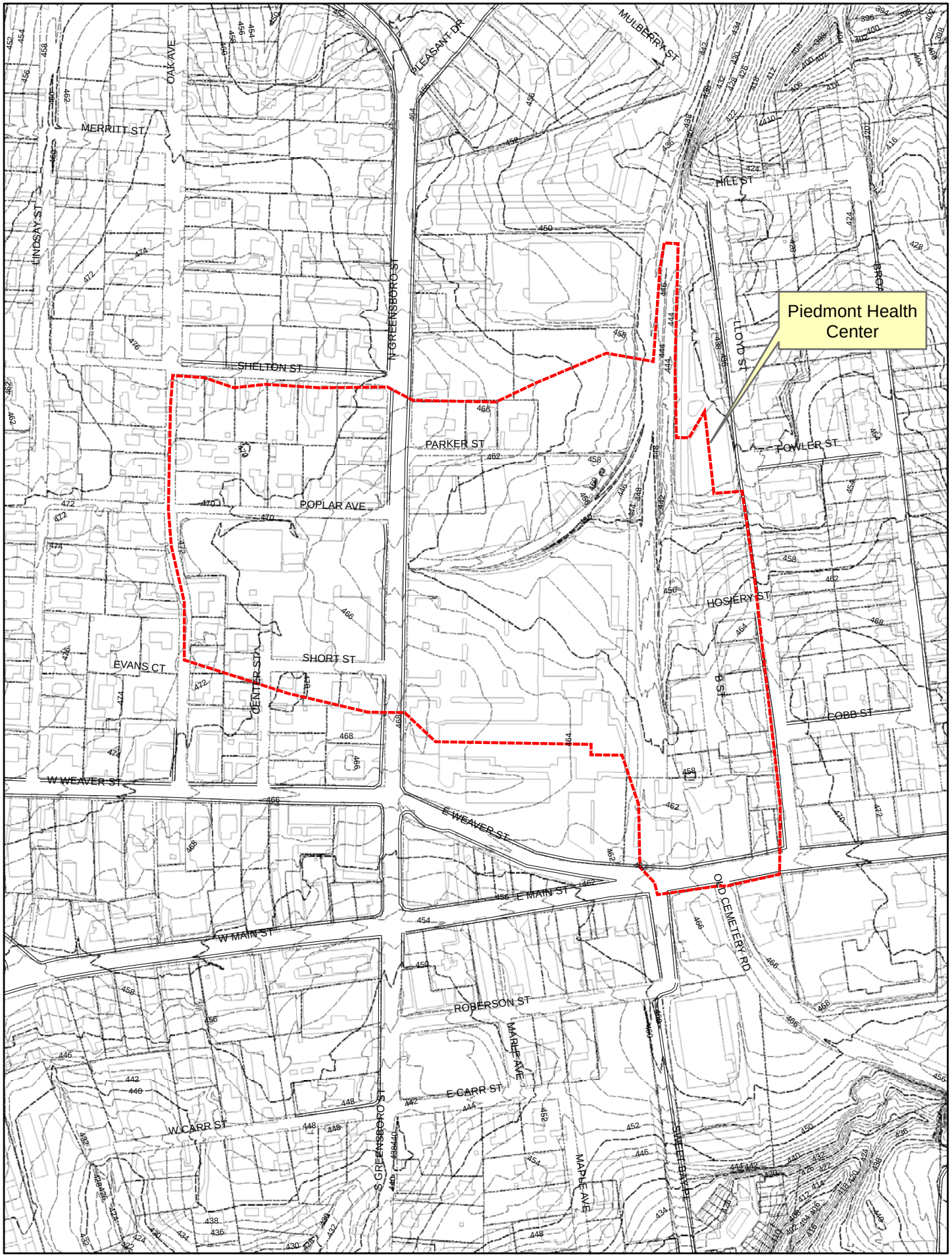
1 inch = 100 feet



APPENDIX D

Piedmont Health Center Drainage Area Map

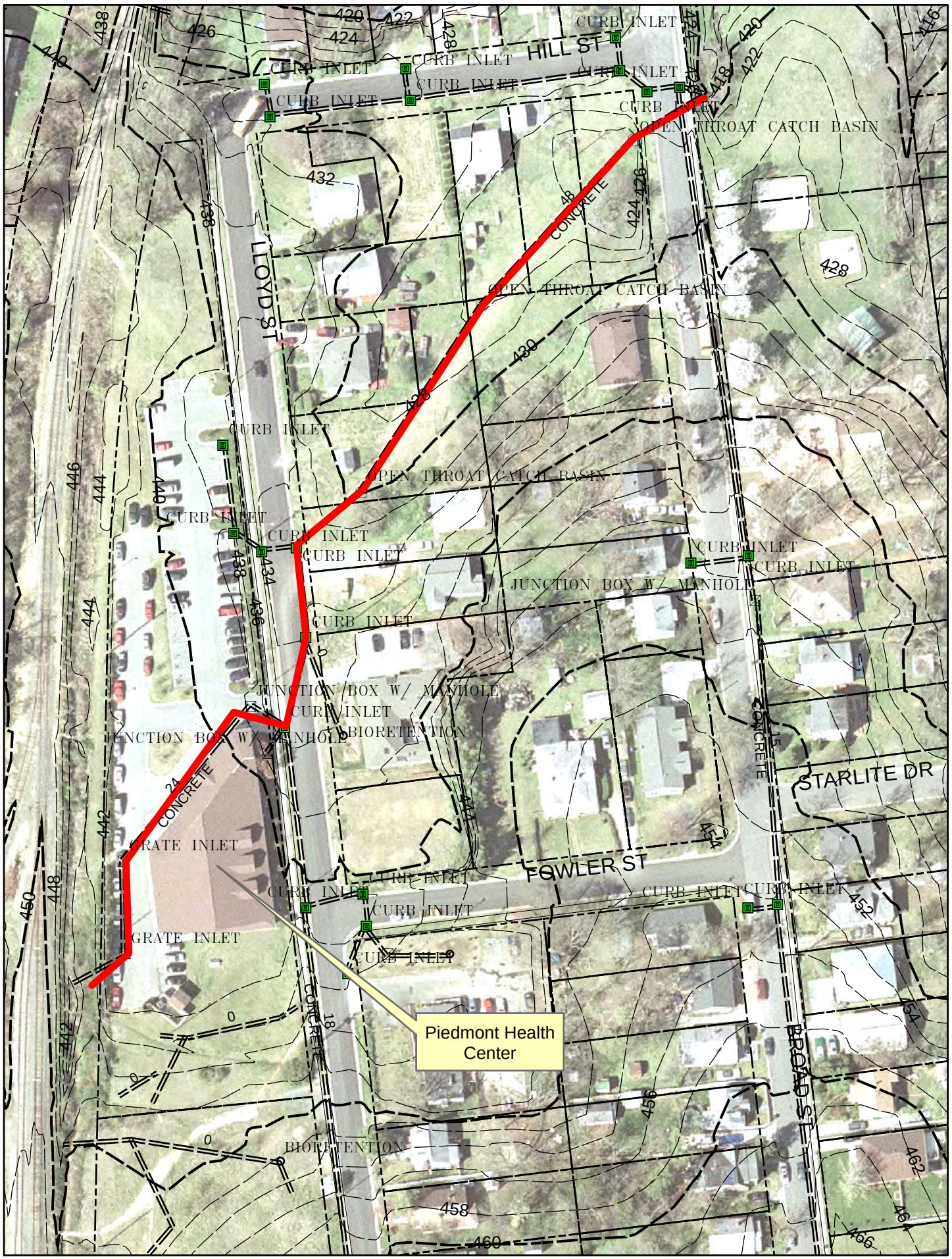
1 inch = 300 feet



APPENDIX E

Piedmont Health Center Alternative #1 - 2@48" RCP

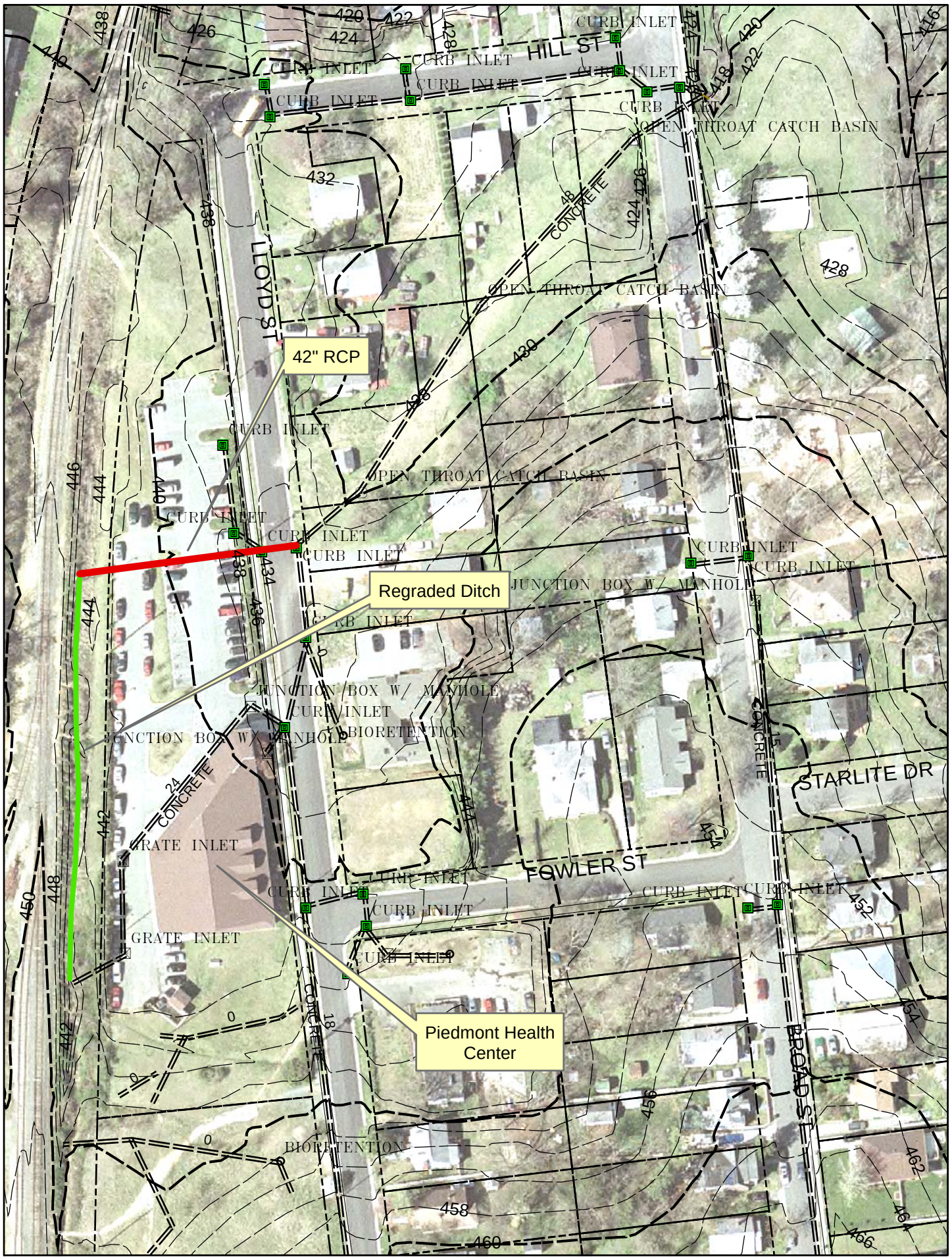
1 inch = 100 feet



APPENDIX F

Piedmont Health Center Alternative #2 - 42" RCP

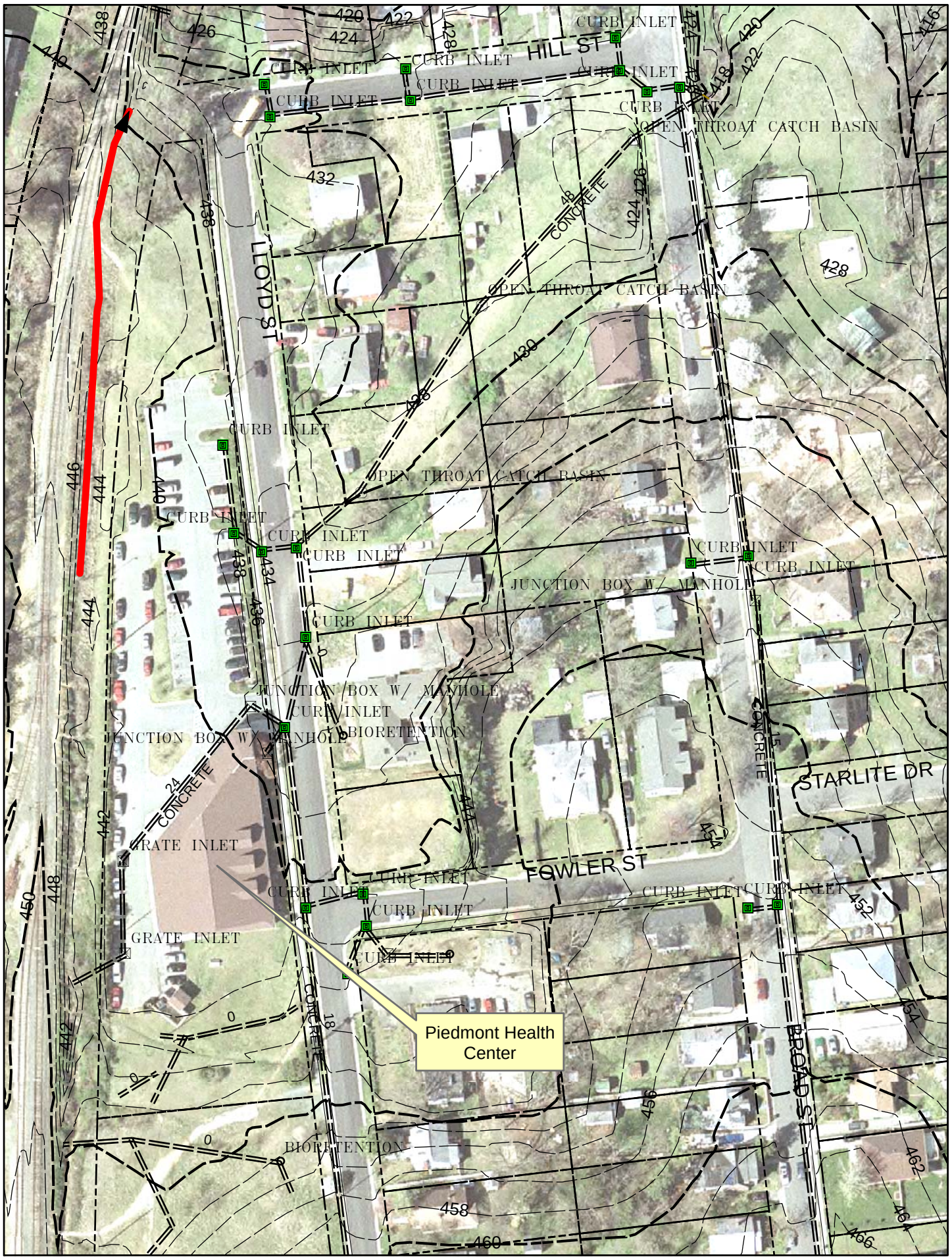
1 inch = 100 feet



APPENDIX G

Piedmont Health Center Ditch Regrade

1 inch = 100 feet



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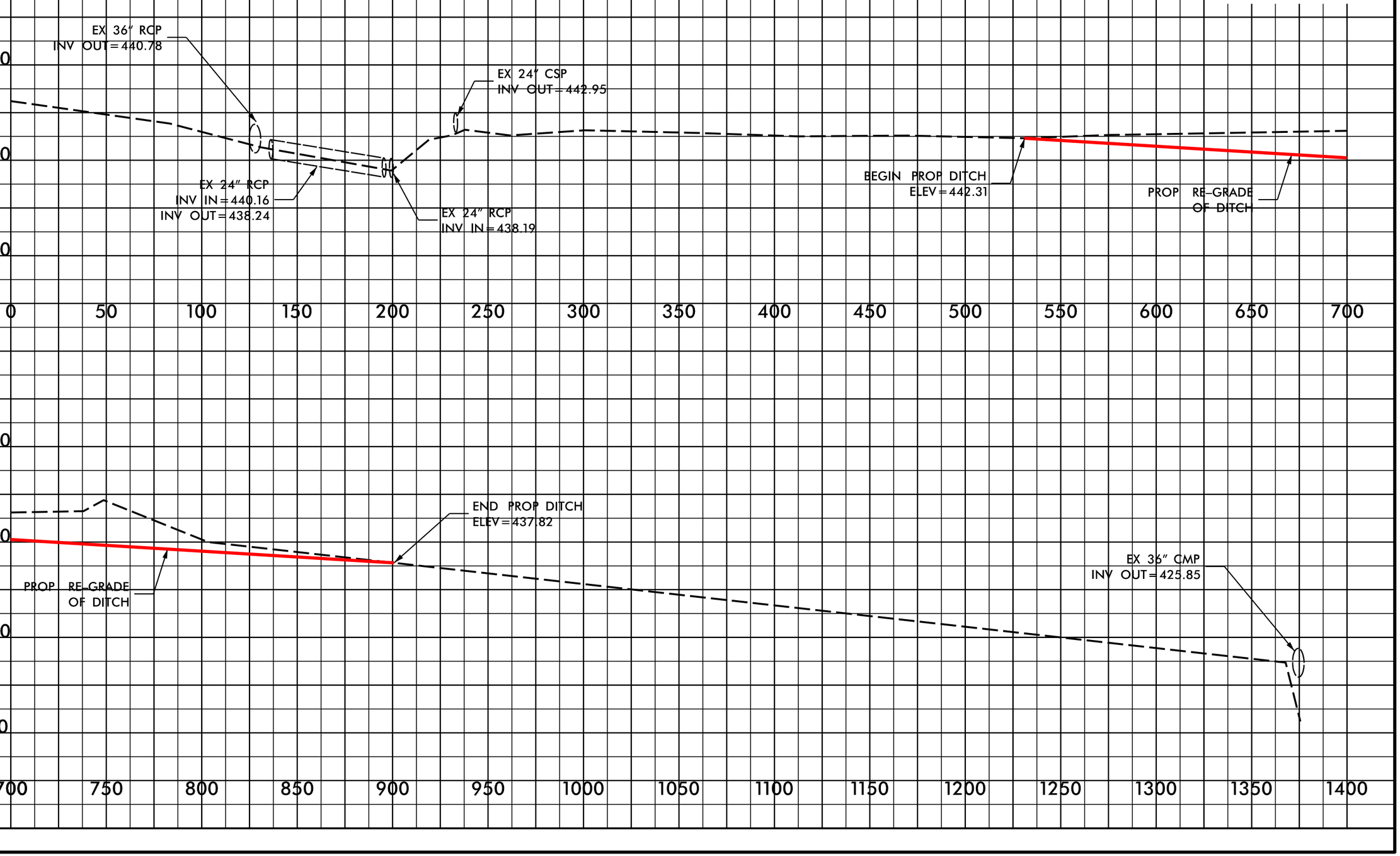
APPENDIX H

PROJECT REFERENCE NO.	SHEET NO.

ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER



5/6/2016
Appendix H_Piedmont_psh_pfl_ditch.dgn
Revised