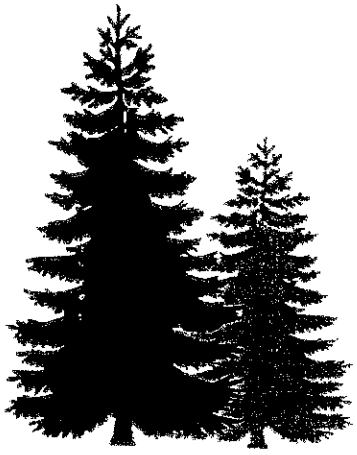
Environmental Review Report
& Utility Impact Assessment

For the

Application for a Definitive Subdivision Plan



Salisbury Pine Tree Estates
Holden, Massachusetts

APPLICANT:	**Holden Pine Tree, LLC** **42 Zottoli Road** **Holden, Massachusetts 01520**
PLANNER, LANDSCAPE ARCHITECT, CIVIL ENGINEER, SURVEYOR:	**PLACES Associates, Inc.**
DATE of SUBMITTAL:	**October 10, 2019**

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Environment Review & Utility Assessment Reports

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Diagrammatic Information and Narratives

The following is an Environmental Assessment (Analysis) of the potential impact of the development of the Holden Pine Tree Definitive Subdivision on the Town of Holden, its environs and the environment. This assessment has been developed and compiled by an inter-disciplinary team of land development professionals (Professional Land Surveyor, Professional Engineer (Civil), Registered Landscape Architect and Land Planner) and is provided pursuant to Section V, F of the Town of Holden's Subdivision Regulations.

Also included in this booklet is an assessment of the capacity and ability of adjacent sewer and water services to support the site as required.

This analysis follows the numbering and topics sequence of the cited regulation for purposes of clarity. The verbiage from the regulations is presented in *Italics.*

DIAGRAMMATIC INFORMATION AND NARRATIVES:

1. A set of plans at a uniform scale shall be submitted, encompassing the entire subdivision on a single sheet no larger than 24" x 36" showing the following:

a. *The same data as on the Definitive Plan.*

See Attachment i-1 (11" x 17", fold-out) which depicts the entire development with lot layouts, proposed grading and infrastructure as depicted on the the Site Plans.

b. *Topography at two-foot contour intervals, with graphic drainage analysis; indication of annual high water mark, location of existing structures, including fences, walls and watershed boundaries.*

This information is depicted on a variety of separate plans:

- **Attachment i-1:** Overall Development Plan (11" x 17", fold-out), depicts the topographic condition of the site along with boundary lines, stonewalls, wetlands and pond areas and adjacent areas to the site.
- **Attachment i-2:** GIS topography of site indicating lines of sight and locations of potential vernal pools.
- **Attachment i-3 –** Aerial Photo (11" x 17", fold-out), this map depicts the major vegetated areas on the site.
- **Attachment i-4** Aerial Photo with Watershed Protection Act regulated areas overlay (11" x 17", fold-out).
- **Figure j-2**: Pre-development Drainage Areas Map, This map depicts in a diagrammatic fashion the existing pre-development drainage areas which are the basis for the drainage system design calculations.
- **Figurej-3:** Post Development Drainage Areas Map. This map depicts in a diagrammatic fashion the existing post-development drainage areas which are the result of the drainage system design calculations.

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c. *Vegetative Cover Analysis, including identification of general cover type (wooded, cropland, ...etc.); location of all major tree groupings, plus other outstanding trees or other botanical features; important wildlife habitats; and identification of areas not to be disturbed by construction.*

This information is depicted on a variety of separate plans and attachments:

- **Figure i-1:** Overall Development Plan (11" x 17", fold-out), depicts the existing and proposed topographic condition of the site along with boundary lines, stonewalls, wetlands and pond areas and adjacent areas to the site.
- **Figure i-3** – Aerial Photo (11" x 17", fold-out this map depicts the major vegetated areas on the site.
- **Figure i-4** Aerial Photo with Watershed Protection Act regulated areas overlay(11" x 17", fold-out), this map depicts, in relation to existing conditions the Watershed Protection Act (350 CMR11.00), regulated areas on the site.

d. *Soil types, based on U.S.D.A. soils study; approximate groundwater level, location and results of soil percolation or other tests.*

- **Figure j-2**: Pre-development Drainage Areas Map, this map depicts in a diagrammatic fashion the existing pre-development drainage areas which are the basis for the drainage system design calculations.
- **Figurej-3:** Post Development Drainage Areas Map. this map depicts in a diagrammatic fashion the existing post-development drainage areas which are the result of the drainage system design calculations.
- **Test Hole Locations** are graphically depicted on the Site Plans.
- **Soils logs:** This information is provided as part of the drainage system narrative.

e. *Visual Analysis, including analysis of scenic vistas and location of visual prominence.*

- **Figure i-2:** (11" x 17", fold-out) this map depicts in a diagrammatic fashion the predominant views from the site looking out. In most cases the existing wooded or steeply sloped aspect of the site restricts views into and out of the site.

f *Location of surface water bodies, wetlands, aquifer or recharge areas for existing or potential drinking water supplies.*

- **Attachment i-1:** Overall Development Plan (11" x 17", fold-out), depicts the topographic condition of the site along with boundary lines, stonewalls, wetlands and pond areas and adjacent areas to the site.
- **Figure i-3** – Aerial Photo (11" x 17", fold-out this map depicts the major vegetated areas on the site..
- **Figure i-4** Aerial Photo with Watershed Protection Act regulated areas overlay(11" x 17", fold-out), this map depicts, in relation to existing conditions the Watershed Protection Act (350 CMR11.00), regulated areas on the site.
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- **Figure j-3:** Post Development Drainage Areas Map. this map depicts in a diagrammatic fashion the existing post-development drainage areas which are the result of the drainage system design calculations.
- **By reference only: Town of Holden, Water Resources Map from the 2019 Master Plan** indicates that this site is located in a Surface Water Protection Area, Zone C. The site is not located in an area identified on that map as a potential well site, an aquifer or existing community groundwater well protection area. [1]

[1] Holden Master Plan, Appendix F, Water Resources Map 2, Map 5-4, pg. 489

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Required Narratives

REQUIRED NARRATIVES:

2. A narrative statement shall also be submitted, documenting the following, with reference to the above maps as germane:

a. Impact upon surface water quality and level.

This site incorporates a variety of stormwater control measures to address the treatment of runoff and its impact on surface and ground water quality. The drainage system is designed to incorporate environmentally-sensitive stormwater system designs which incorporates low impact development techniques to prevent the generation of stormwater and non-point source pollution by disconnecting stormwater sheet flow paths, the use of vegetated swales, pre-treatment of first flush runoff and detention and recharge of collected stormwater. This project will not have a direct discharge of stormwater flows to any surface water. The use of recharge structures will mimic the natural rainfall recharge. The design of this system is based on the existing sand and gravel soils types that are predominant throughout the western portions of the site. The volume of recharge meets the Commonwealth's Stormwater Management Standards for recharge and will therefore mitigate impacts on Bailey Pond's water levels as will the other design features (man-made stormwater detention systems) and natural systems that exist between the site and downstream receiving waters.

As depicted and described in the Drainage System Analysis, no increase in runoff rate will leave this site at any of the points of analysis as compared to the pre-development condition. As required by the DEP established Stormwater Handbook, Management Standard No. 6, specific best management practices are used to set back outlets from receiving waters and wetlands and provide removal of Total Suspended Solids (TSS).

The surface water from the site in both the pre- and post-development conditions drains toward Bailey Pond to the north of the project and a small portions flows to adjacent property along the southerly line. Bailey Pond is a tributary to an un-named intermittent brook that flows northward, parallel to Malden Street, where it ultimately is tributary to Chaffin Brook. Chaffin's Brook is considered a "moderately septic polluted stream", and its lower reach "has noxious aquatic plants in impoundment." As such, the runoff from this site must be controlled to ensure no increase in the negative status of either Bailey Pond or downstream to Chaffin's Brook as a result of development.

All of the tributaries to the Wachusett Reservoir are regulated by the Watershed Protection Act (350 CMR 11.00), as administered by the Division of Water Supply Protection (DWSP) of the Department of Conservation and Recreation (DCR). In accordance with the cited regulations, the first two hundred feet from a mapped tributary permits extremely limited alterations within that area; the area from 200' to 400' permits alterations and development within prescribed guidelines. The Town of Holden, Master Plan, Map 5-4 indicates that the majority of this site is in a Surface Water Supply Protection Area, Zone C. Areas to the north, along Bailey Pond and a tributary intermittent stream to the north-west are noted as Zone A,[2] Tributary Areas to Bailey Pond and ultimately to a surface water supply. These protective zones are depicted on our site plans.

[2] Holden Master Plan, Appendix F, Water Resources Map 2, Map 5-4, pg. 489

All site related construction will be required to comply with the Erosion and Sedimentation Control Plan, the Stormwater Pollution Prevention Plan and other construction methodologies which are required to be implemented to prevent impacts from construction on sensitive areas. See the referenced plans and documents noted above, as well as the information presented in Section *d*, below, which outlines some of the criteria and methods to be used during construction phases to prevent soil loss, erosion, sedimentation and pollution to the site and sensitive off-site areas.

b. *Impact upon groundwater quality and level.*

As noted above, and described in the Drainage System Analysis, the introduction of low impact, decentralized drainage systems provides a greater level of stormwater treatment and recharge. When recharge systems are used, they collect runoff and recharge the water locally to mimic the natural system. The drainage system design meets DEP established Stormwater Handbook, Management Standard No. 3, which requires the use of infiltration of runoff matching the annual recharge from the pre-development condition, based on the site's soils type of hydrologic groups A and B. We do not anticipate that local groundwater levels will be increased or significantly altered by the development of this site, due to the use of these infiltration methodologies.

The site is not located within a mapped aquifer recharge area as described by the Town of Holden's Zoning Bylaws. The site is not located in an area identified on the Master Plan, Water Resources Map, 5-1 as containing any High or Medium Yield Aquifers, or Water Resources Map, 5-2 as containing any DEP Approved Zone 1 or Wellhead Protection Areas.[3]

The north-westerly corner of the site is located in a DCR mapped, low-yield aquifer. This area is not proposed to be disturbed as part of the site development.

c. *Effects on important wildlife habitats, outstanding botanical features, scenic or historic sites or buildings.*

1. Important Wildlife Habitats: The site is located to the south of Bailey Pond and is bordered by residential development to its immediate east (Salisbury Street) and west (Bailey Road), where single family house lots of ¼ to 1 acre predominate. To the immediate south of the site is an open wooded area which is partially developed along the frontage to the two, above-listed roads but also features undeveloped wooded land of the types described below, 2.) & 3.), respectively mixed softwood forest (White Pine) and mixed hardwood (Red Maple; Pine and Oak). Approximately ¼ mile from the property's southern-most border is the Dawson School which is a cleared and predominantly lawn area for the school's use.

Holden's 2019 Master Plan, Map 5-5, Major Habitats Map, does not depict this site as being located within NHESP/TNC BioMap2 Core Habitat or Critical Natural Landscape Areas. It does depict that there are potential vernal pools to the north west (semi permanent pool located on the site, between the railroad tracks and the sewer easement, as it crosses Bailey Road) and north east of the site (behind 19 Salisbury Street, on the northerly side of the railroad tracks). Both of these areas are outside the proposed area of development. In the spring of this year, 2019, members of our staff and the Town's Conservation Agent investigated the potential vernal pool located adjacent to Bailey Road (north-westerly portion of the site) and we were not able to observe indicator species in the permanent pool in this area.

[3] Ibid, Map 5-4.

The predominant species likely to utilize this site as habitat are those that have adapted to the proximity of residential and developed suburban landscapes. Species likely to be on-site would include skunks, opossums, raccoons, deer, fox (gray and red), rabbits, squirrel, weasel, mink, coyote, wild turkey, birds of all type, feral "domestic" cats and other common suburban species. "These species are attracted to human-dominated landscapes because they are highly-adaptable, opportunistic feeders that are energy efficient...By highly-adaptable means that they can easily adjust to changes in their environment. Opportunistic feeders in that most are generalists eating a variety of plant and animal material including food left around by humans." [4]

The proximity to Bailey Road Pond and on-site and adjacent wetlands areas will likely support amphibian habitat. However, no indication of vernal pool breeding activity or obligate species has been observed in any of these areas during the Spring of this year. The on-site and adjacent isolated wetlands appear to be too shallow to allow for a breeding period (short hydroperiod), see photo below. It is likely that Bailey Road Pond is a habitat source for turtles, frogs and salamanders that may migrate to this site for forage and cover. Such migration would require crossing the rail road and the open land of the sewer easement.

The site is not depicted on the "Priority Habitat and Estimated Habitat" of the Department of Fisheries and Wildlife, Natural Heritage and Endangered Species program, as being habitat for endangered, threatened or species of special concern, as determined from the latest mapping on Mass GIS.

2. Botanical Features/Communities: As depicted in Figure i-3 and other related Figures, the site is comprised of three (3) generally distinct botanical communities:

1.) Wetlands:

There are three distinct wetland areas on the site.

a. The largest wetland on the site is depicted by the 600-series flags, shrub swamp/wet woods. It is located in the northwest corner of the site in an area that was previously a gravel pit. This area is populated by shrub and young emergent tree species (poplar, cherry, grey birch, white pine, mountain laurel, etc).

b. A separate isolated wetland (by Town of Holden's Wetlands Bylaw, not the Massachusetts Wetlands Protection Act) is located at a low point on the southwest corner of the site near to the junction of Bailey Road and the proposed Henry Way. It is identified as series 1A to 8A flags. It is an isolated wetland, comprised of a low point and hydric soils and some wetlands vegetation as well as uplands plants (mature white pine), see figure 1.1.b, below.

[4] Brochure, "Living with Wildlife: Suburban Wildlife in Massachusetts", Massachusetts Division of Fisheries and Wildlife, undated.

Figure 1, 1.), b.

c. Bordering Vegetated Wetlands exist on the northerly side of the site, at the bottom (toe) of the hill and on the southerly side of the DCR sewer line easement. These are delineated as series 700 & 800 flags. It is likely that they were created by the construction of the sewer line, where isolated low pockets were never graded-off or filled. These wetlands are generally wet meadow comprised of ferns and other seasonal grasses and fobs. A no hydrologic connection appears to exist between these wetlands and the adjacent Bailey Pond. This area is part of the trunk line sewer easement and is regularly mowed by the DCR.

Off-site wetlands series 100, 200 & 300 are the edge of Bailey Road Pond. All three 100, 200 & 300 are a combination of wetlands mostly delineated by the edge of the rock ballast for the railroad, top of bank or edge of shrub swamp wetlands. Series 400 is an islolated pool that was identified as a potential vernal pool When visited in May of this year (2019), no indicator species were present. Series 500 wetlands is another isolated pond-like wetlands. Both the 400 & 500 series wetlands were observed to be full of water.

Also located offsite are the flags noted as OA, WF 301 to 305. We know that these are a delineation by Oxbow Associates of Boxborough, MA. We also visited this isolated pool during May and were not able to discern vernal pool species. At the time of the pool inspection the depth of the ponded water was less than 6". It is likely that this ponded area does not have a sufficient hydroperiod to support vernal pool species.

A small area of the isolated wetlands located by Bailey Road (Series 1A- 8A)are proposed to be altered by this project to allow for the construction of a headwall. The area adjacent to the altered area will be designated as a wetlands replication area.

2.) White Pine Forest: This is the predominant vegetation type on the site. It exists in substantial part due to the sandy soils that comprise the majority of the site. The white pines (*Pinus strobus*) start at the northerly edge of the site and extend southward to Bailey Road and to the middle of the site. A transition to an immature upland red maple (*Acer rubrum*) forest occurs generally in the area of the intersection of the proposed Mary Drive and Henry Way roads, at the high point of the site. The white pines' diameters at breast height (dbh) vary from saplings to 40"+ mature trees. Mixed in this forest type are a variety of other tree types that are not as dominant - Red Oak, Grey Birch and other deciduous trees typically found in secondary growth softwood/hardwood New England forests.

3.) Upland Second-Growth mixed hardwood and softwood New England Forest: This is a mixture of northern red oak (*Quercus Rubra*), white pine(*Pinus strobus)* and red maple*(Acer rubrum)* as the predominant tree species. This area is located on the southeast portion of the site that is also the highest in elevation of the site. This vegetation is located on a knoll which has a highpoint some 65'-70'± feet above Salisbury Street. Trees in this area vary from 4" to 24" dbh.

4.) See also Holden Master Plan, Map 11-3, 2016 Land Use/Land Cover Map which depicts graphically the above information.

d. *Capability of soils and vegetative cover to support proposed development without erosion, silting or other instability.*

The USDA Soil Survey[5] identifies the site as being principally comprised of sandy loams to fine sandy loams on existing slopes of 0 to >25% grades. With the specific exception of soils with slopes from 15 to 25+% grades, the soils are listed by the USDA as being "Well Suited" for Mechanical Site Preparation (Deep) and (Surface). The test holes conducted by Places Associates, Inc. indicate that northern and north western portions of the site are comprised of deep layers of outwash; coarse sands, cobbles and gravel. The southerly and easterly portions (higher portions of the site) have a veneer of sandy/gravelly soils which overlay dense (with depth) sandy loams to loamy sands at the surficial layers (4'-12'). Given the gradation of the materials which includes some silt and its stony to extremely stony nature, we expect that these soils will be able to be worked readily for construction-related purposes (excavation, stockpiles, placement and compaction). No ledge or refusal was encountered during our on-site investigations, though we do expect medium to large boulders to be intermittently encountered during construction. We anticipate that these rock materials will be used as grade breaks, stone walls or other site development features.

The silt and loam components of soils are more subject to erosive factors and segregation by wind or water than the other more coarse soil components. As such, these earthen materials need to be maintained as cohesive stockpiles that minimize exposure to erosive factors and conditions. A detailed Erosion and Sedimentation Control Plan is included as part of the project. This Plan details the variety of construction practices, materials and methods that are to be implemented to ensure that no products of erosion leave the site or affect critical areas. This plan is based on a performance specification, where a variety of

[5] http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

measures are identified as being suitable. It is ultimately the site contractor's responsibility to utilize the variety of methods (sometimes multiple measures in one location) to prevent erosion.

The key components to the Erosion and Sedimentation Control Plan include:

1. Identification of existing soils, slopes, vegetation and drainage patterns.
2. Identification of site features, receiving waters, sensitive areas and routes of travel for products of erosion.
3. Identification of potential sources of pollution, including products of erosion, construction products, etc.
4. Listing and use of specific methodologies, construction materials and other Best-Management-Practices (BMP) to limit and control pollution and erosion.

   BMP's listed include, but are not limited to:

   a. Limiting the area of un-stabilized earthen areas/cleared areas.

   b. Controlling runoff velocities/wind exposures.

   c. Intercepting, diverting and collecting runoff in designated areas to allow for recharge, settlement and detention of runoff flows from disturbed areas.

   d. Stabilizing disturbed areas with permanent surfaces or temporary control measures as soon as possible.

   e. Regular maintenance and monitoring of control measures (permanent and temporary).

   f. Final permanent stabilization of all surfaces subject to erosion.

   g. Implementation of permanent Stormwater Pollution Prevention Plan for residents, developer and town.

In addition to the use of BMP's noted above and contained in the documents, the Town of Holden requires that the construction of the project be phased so that no more than 20% of the overall units shall be built in one year. This will assist in limiting the disturbed area at one time and minimize the overall disturbed area open for construction.

A separate federal filing is required prior to construction under the National Pollutant Discharge Elimination System (NPDES), which requires that the property owner and contractor submit a detailed plan identifying the methodologies, locations and inspection/repairs to such systems to prevent construction-related erosion. Also as required by local bylaw, a filing under the Town's Stormwater Management and Erosion Control Bylaw will be made. These filings will be prepared and submitted after approval of the project by the Holden Planning Board, but prior to initiation of any site-related construction which will alter or create the potential for earthen disturbance.

e. *Relationship to MGL Chapter 131, Sections 40, 40A (Wetlands Protection Act).*

The project contains jurisdictional wetland areas as defined by the Massachusetts Wetlands Protection Act (310 CMR 10.00 and MGL Chpt 131, Section 40 & 40A) and the more restrictive Town of Holden Wetlands Bylaw, Town of Holden's Bylaws, Article XXIII-Wetlands Bylaw. In September of 2007 an ANORAD Application (Abbreviated Notice of Resource Area Delineation) was filed with the Holden Conservation Commission and the Massachusetts Department of Environmental Protection to confirm the delineation of wetland resource areas on the site and adjacent to it which would impact the development of the site. That delineation order has expired, but based on our re-delineation, that the wetlands lines have not substantially changed since 2007.

On Feb 21, 2019 the Holden Conservation Commission issued an Order of Conditions on 2-21-2019, [DEP File No. CE 183-0656,] based on an application to develop adjacent land off of Bailey Road, "adjacent to 96 Bailey Road), 88-84 Bailey Road, (wetland flag series OA WF-301 to WF-305). This Order confirms and established those jurisdictional areas located on an adjacent to the site. We have depicted them on our plans for reference. By the issuance of the Order, the wetlands depicted on the adjacent property have been delineated and approved as to location and jurisdictional type for that project and this project. By regulation these jurisdictional areas are "set" for a three year period from the date of issuance of the Order (per 310 CMR 10.05, (6.), (d)).

In 2008 this applicant filed an Abbreviated Notice of Resource Area Delineation with the Holden Conservation Commission. The Commission issued an affirmative decision, Order of Resource Area Delineation in May of 2008, which has since expired. The current re-delineation of the on and off-site wetlands was conducted in August of 2019 and closely matches that previously conducted.

In May of 2019, two areas noted as potential vernal pools were walked by the Conservation Commission's agent and Places Associates' staff to observe vernal pool characteristic. A third area was reported by an abutter as containing vernal pool species. After observation this area is a small, ~ 4' diameter dug circle with a depth of less than 12". It was observed to be holding water in early May, but was nearly dry in late May. A member of the Holden Conservation Commission observed this dug hole, it was not determined to be a vernal pool as no vernal pool indicators species were observed.

After the application of this Definitive Subdivision, this office will be filing with the Holden Conservation Commission a Notice of Intent (NOI) as is required by local and state law. That filing will be to permit this same project as submitted to the Planning Board but for those regulatory topics and jurisdictional items under control and review by the Conservation Commission.

Additionally, as noted above, portions of this project are subject to review under the Massachusetts Watershed Protection Act, aka "Cohen Bill" (350 CMR 11.00. A copy of this Definitive Subdivision filing will be forwarded to the Department of Conservation and Recreation (DCR), Division of Water Supply Protection, Wachusett/Sudbury Section for their review, comments and input.

f. The report shall estimate the proposed traffic flow in relation to the roadways giving access to the subdivision.

This proposed project has been reviewed and assessed for its likely impacts on adjacent streets and their functions. We refer the reader to the separate booklet which is part of this application package as prepared by MDM Transportation Associates, Inc., entitled, "Traffic Impact and Access Study – Proposed Residential Development – Salisbury Pine Tree Estates, , Holden, MA, dated October 2019", which states *(in pertinent part...)*:

> "The proposed development is expected to have a minimal impact on the study area intersections as there will be a nominal overall change in level of services and operations of the study intersections under future conditions with the development. Adequate capacity is available under future Build conditions on both Salisbury Street and Bailey Road to accommodate the use of the site. "[6]

g. The report shall estimate the effect of the project on public services, such as water, sewer, schools, police, fire and waste disposal.

The following information is based substantially on information, statistics and budget data from the Town of Holden's 2008 Town Report and other available information as noted.

The overall project statistics are as follows:

Project Total Land Area: 25.71 acres.

Zoning: Residential Multi-Family (RM) and Residential –Suburban-3 (R-10) a

Proposed Roadways:

Reconstruction and extension of Pine Tree Road:	825 Linear feet (28' width, two sidewalks)
Farmers Way:	1,380 Linear Feet (28' width, two sidewalks)[7]
Henry Way:	1,180 Linear Feet (28' width, two sidewalks)[4]
Total Roadways	3,385± Linear Feet (0.64 mi)

Residential Construction type:

Wood-framed, asphalt-shingled roof, single family homes: 11

Wood-framed, asphalt-shingled roof, multi-family homes

21 duplex units; 4 triplex units* 9 quad units*
(* note structures with 3 or more units will have automatic fire sprinkler systems)

[6] MDM Traffic Impact and Access Study, E.3, Summary of Analysis and Findings, last paragraph, p.2.
[7] A waiver request has been made to request all streets to have a 24' width with one sidewalk.

The project proposed is for the development of the proposed roadways and infrastructure to support the development of 45 lots, with the proposed 90 multifamily units (2, 3 and 4 units per building) and 11single family home units, for a total of 101 units. It is anticipated that all of the units will be four (4) bedrooms per unit for the purposes of utility and infrastructure design. For the purposes of this application and community assessment of impact, the maximum estimated unit count of 101 units will be used.

Project Construction Phasing:

Due to the total number residential units proposed, the project is required to be phased over a minimum of a five-year period [8]. A total of 101 new dwelling units are proposed. Zoning Bylaws require that no more than 20% of the total count is permitted to be built in a single year, (101 units x 20% = 20.2). 20% equals a construction duration of 5 years. As depicted in the application package the project has been broken down into five (5) distinct construction phases in accordance with the requirements of the Zoning Bylaw. We note that for ease of explanation and to accommodate the required phasing criteria, that each project phase is assumed to require one year to build-out. This assumption is dependent on a variety of economic, market, environmental, infrastructure availability and construction factors which could cause one or more phases to require more than one year to build-out.

Phase 1 Construct Pine Tree Road (~ 825±') to a temporary "T" turn-around between lots 15 and 24 on Farmer's Way to station 3+00± (~300'). Create a temporary "T" turn-around, using the roadway as one leg and a separate leg to the west on part of Lot 14. The reconstruction of Pine Tree Road would extend municipal utilities from the eastern side of the site, off of Salisbury Street and would include upgrade to the connection to the DCR sewer main adjacent to the rail road tracks. The basins on Lot 17 and Lot 19 would be in integral part of the overall infrastructure development of this phase. This phase would enable the development of 20 dwelling units..

Phase 2 Construct Henry Way from its intersection with Bailey Road to approximately 675' into the site. This construction would permit the development of 20 units and would allow for the extension of municipal utilities into the site from the western side. Included in this phase is a temporary water line from Phase 1 to Henry Way to provide a cross connection for water flows. A cross country drain line from the large basin on Lot 17 would be extended to Henry Way between Lots 3 & 4. Sewer from these units would connect to the Main in Bailey Road. A total of 19 units would be built in this project phase.

Phase 3 Construct the remainder of Henry Way to the intersection of Farmer's Way at the top of the hill (~ 500'), create a "T" turn-around using the projections of Farmer's Way to the north and south. Sewer from this phase would be directed to Bailey Road connecting to Phase 2. Drainage from this phase would also be directed to the large basin located on Lot 17 via the cross country drain line depicted on the development plans. A total of 21 units would be built in this project phase.

Phase 4 This phase connects Henry Way to the stub portion of Farmer's Way at Pine Tree Road. This phase completes the loop of water through the site; the temporary cross country service would be removed at the completion of this phase. All of the units proposed to be built during this phase would have sewer

[8] Town of Holden, Zoning Bylaws, Chapter 7.1 Section XV – Phased Growth Zoning Bylaw, § 2-6. 4

services drain by gravity to the trunk line, not Bailey Road. Included in this phase is the construction of many of the single family homes.

Phase 5 This phase requires the completion of Farmer's Way to the end of the proposed cul-de-sac and the completion of all remaining undeveloped lots. Some of these lots are served by gravity sewer; others will have private "e-one" ejector systems to drain to the receiving sewer manhole. A total of 21 units would be completed on this project phase and would "build-out" the subdivision project.

Utilities:

The site will be served by municipal water, sewer and electric services. Cable Television, Internet, Telephone and Natural Gas utilities will be provided by the locally authorized entities. All proposed utilities will be underground. No municipal water booster station or sewer lift stations are proposed as part of this project. The last project phase, phase 5, will require some of the houses located on the lower (southerly) side of the cul-de-sac will need individual sewer ejector (E-One type) to pump to a receiving manhole in the street.

Municipal Water:

The site will be served by connecting to the municipal water system that exists in Bailey Road (6" un-lined cast iron pipe) and a dead-end line that exists in Salisbury Street and extends to Pine Tree Road (6" cast iron line). A benefit from the proposed construction is that this site will be extending a connecting main (8") to Salisbury Street to form a pressure/distribution loop and eliminate the dead end line at Salisbury St./Pine Tree Road, enhancing the water distribution in the entire area.

In September of 2008 and again in November of 2018, this office coordinated with the Holden Department of Public Works and Cogswell Sprinkler Co, a fire systems company, to perform fire flow tests at various intersections in proximity to the site. The purpose of these tests was to verify that sufficient water is available to meet the domestic and fire suppression needs of the proposed development. The results of these tests, as depicted in Utility Impact Assessment section of the project submission booklet, identify that sufficient water supply is available for fire suppression needs at the highest elevation interior to the site.

In conducting the modelling, all new water pipes are to be 8" cement-lined ductile iron. The assessment only assessed the flow from Bailey Road and did not take credit for the looped system, the second source of pressure and flow. Using one source of supply and the formula provided in the Subdivision Regulations for fire hazard structure ratings, we are able to obtain ~ 1,200 gpm at 20 psi at the hydrant located at the properties highest point (junction of Henry and Farmer's Way). This is also uphill and proximal to a three-unit structure and a four-unit structure, which were the structures that create the highest fire flow demand.

Multifamily buildings with 3 or more units per building will have automatic sprinkler systems as required by Code. Duplexes will not be sprinkled.

Municipal Sewer:

The Town of Holden has a municipal sewer system that collects sanitary sewage using approximately 80miles of pipe. A significant part of the sewer system was installed within the past thirty years, as part of a watershed protection plan implemented by the Massachusetts Water Resources Authority (MWRA) and the Metropolitan District Commission (MDC), *now Department of Conservation and Recreation (DCR)*. All wastewater flows from the Town are discharged either into the Rutland/Holden Trunk or Relief Sewers, which each extend through Town from Rutland to Worcester. These two interceptor lines are owned, operated and maintained by the DCR. The Rutland/Holden Trunk Sewer is approximately 9.5 miles in length while the Rutland/Holden Relief Sewer is approximately 8.3 miles in length and is located next to and parallel to the trunk sewer. The Trunk and Relief lines pass through and traverse the northerly border of the project site.

Per the 2019 Master Plan:

> "In the past decade, sewer flows from Holden have averaged around 401 million gallons yearly, ranging from 347.7 million gallons (2012) to 496 million gallons (2017). As of 2020, Holden's allocation of UBWPAD's (*Upper Blackstone Water Pollution Abatement District*) treatment capacity will be raised to 1.69 MGD (or approx. 617 million gallons annually) per the District's Sewer Use Agreement. Some capacity for future user growth is therefor available. A recent study completed for the Town by engineers at Weston & Sampson estimated around 170,000 gallons in additional daily sewer use (or 62 million gallons annually) can be expected from long-term development of buildable lots within the existing sewer service area..." [9]

Calculations of proposed sewer flows:

This project proposes a total of 101new dwelling units, consisting of: 11 single family homes, 21 duplexes, 4, triplexes and 9 quadplexes. All of the units are being planned as four bedroom units. The anticipated sewer flow generated by these dwelling units based on 110 gpd per bedroom[10] is as follows:

101, 4 bedroom units x 110 gpd/bedroom = 44,440 gpd. ($Q_{daily\ flow}$)

Calculation of pipe capacities for flow:

Two separate analyses for pipe capacity have been conducted for Bailey Road, a third analysis has been conducted to determine peak flows to the trunk line. A final analysis was conducted to define for design purposes maximum and minimum pipe slopes solving for Q peak and V:

1. Capacity in existing pipes served by Bailey Road.

The Holden DPW, Water and Sewer Department has requested that this office conduct a "Sewer shed Analysis" to confirm that the existing sewer pipes in Bailey Road have sufficient capacity to support the project.

[9] Town of Holden Master Plan, Section 10 - Public Facilities and Services, pg. 219.
[10] Mass. Department of Environmental Protection, 314 CMR 7.15- Calculation of Sewer Flows

See the Utility Capacity Calculation portion of this report for the calculations.

The results of the calculations indicate that flattest section of Bailey Road sewer pipe (slope=1.9%) is immediately before the trunk line and collects the full flow amount from the sewer shed. The assessment also requires that the pipe is "full" when at ½ full (flowing at 4" depth).

The analysis indicates that the pipe (Q_{peak})is currently flowing at 59 gallons/min. or 84,960 gallons/day.

The capacity of the pipe flowing ½ full is 373 gallons/min. or 537,120 gallons/day.

The flattest pipe, receiving full flows in Bailey Road is flowing at 16% peak flow capacity and has sufficient capacity to serve the whole site's sewer flows. Proposed only 42 units are proposed to flow to Bailey Road, see next calculation, 2.

2. Remaining Capacity in Bailey Road with the Addition of 42, 4 BR units:

See the Utility Capacity Calculation portion of this report for the calculations

The proposed additional 42 units average daily flows to Bailey Road from the proposed project are: 18,480 gpd or 12.8 gpm.

The Q_{peak} = 102,265 gpd or 71.0 gpm.

Bailey Road has a total capacity of 537,120 gallons/day or 373 gallons/min.

Accounting for the 42 units, Bailey Road's remaining excess peak flow capacity is (373-(59+71)=243 gpm or 349,920 gpd.

3. Calculations for Peak Flows to Trunk Line:

See the Utility Capacity Calculation portion of this report for the calculations.

59 units will flow to the trunk line resulting in average daily flows tributary to the trunk line of:

25,960 or 18 gpm.

The Q_{peak} = 144,030 gpd or 100 gpm at the bottom of the collection system.

4. Overall pipe capacity for Design Purposes:

The allowable minimum flow velocity for sanitary sewer design is 2 feet/sec.[11], the maximum velocity is 10 feet/sec. The design of the system was checked for pipe capacity for an 8" Ø pipe at the flattest slope used for design and for the steepest slope used for design; therefore knowing all slope conditions in between these minimum and maximum slopes will work without further check or assessment. In calculating these values the pipe is considered full at ½ total pipe capacity (4" flow depth for an 8" Ø pipe) and using a Manning's "n" = 0.013.

See Utility Assessment Calculations, entitled, "Sewer Pipe Capacity Check", 3 pages.

[11] TR-16. 2.3.5.1, where minimum slope for an 8" line is 0.004'/,

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Using the above criteria, and the recommended flattest slope used in design which provides for a velocity of 2 feet/sec is at a slope of 0.004 (ft/ft). This results in a pipe flow capacity of 171.3 gpm or 246,634 gpd.

The maximum velocity allowed for design for an 8" Ø pipe is 10.09 feet/sec. resulting in a maximum slope of 0.085 (ft/ft). This results in a capacity of 789.6 gpm or 1,137,062 gpd.

Based on the calculations performed, the flattest pipe length used within the subdivision (0.004 '/,)is capable of handling the Q_{peak} for each of the sewer sheds (Bailey Road and Trunk Main).

Pipes designed within these parameters (s=0.5% to 8.5%) will meet the above requirements.

Municipal Electric Service:

The Town of Holden has a municipal electric department, Holden Municipal Light Department (HMDL) that serves the communities' electrical needs. The proposed electrical system will be supplied as an underground service and will be designed and installed in accordance with that Department's requirements and will connect between above ground services currently existing on Salisbury Street/Pine Tree Road and Bailey Road.

Per the Light Department that average residential user in the town of Holden uses 500 to 750 Kilowatt hour (Kwh) per month (~ 24Kwh/day). The current rate for residential service power from the HMLD is a rate of 14.727 cents per Kwh, plus any additional cost for fuel or purchased power and a $ 5.00 customer charge per bill for basic meter reading and administrative costs of monthly account maintenance. [12]

The project will be supported by the infrastructure from the HMLD. As is required by current construction and energy codes, the buildings will be built to ensure insulation and sealing of the structures is optimized to preserve energy loss caused by environmental factors. It is also anticipated that each unit will utilize current energy saving technology including: EnergyStar™ Appliances, programmable thermostats and energy efficient heating/cooling systems.

Drainage:

For a detailed description of the drainage system design see – Drainage System Analysis for Salisbury Holden Pine Tree Estates, by Places Associates, Inc., dated October 2019, which is part of the submission documents for this Definitive Subdivision Plan.

Natural Gas:

The project is located, in part, off of Salisbury Street where Eversource is the gas supplier. In 2008, Eversource petitioned the Town of Holden and some of its Departments to allow it up upgrade the gas supply line from Worcester up (northerly) on Salisbury Street. Eversource offers rebates and reductions in service rates to users of high energy efficient appliances and furnaces. Natural gas will be available to

[12] HMDL 11' information from Town Website: www.townofholden.net, Residential Service Rate, effective Jan 1, 2011..

all the units in this development for heating and cooling purposes. It is anticipated that natural gas will be the principal heating fuel for all structures in this development.

The provision of natural gas for heating benefits the future property owners as a source of clean fuel for heating, cooling and cooking. It benefits the town and environment by reducing the potential for oil deliveries, storage and potential for spills and contamination.

CATV/Telephone/Data:

The provision of these communication and internet services will be provided as a matter of course. It is anticipated that the latest technologies will be installed in this proposed development to allow the future homeowners that best in communications, television and internet/data services available. On behalf of the applicant, Places Associates, Inc. has contacted Spectrum to ensure their ability to extend their Broadband Internet Services Television/Communications/Internet and Verizon for hard line telephone services. The use of such technologies will likely enable the "Smart Home" technology to be utilized in this project (remote and/or automatic entry controls, security, lighting, heating/cooling, energy monitoring and saving, child monitoring and communications...). The 2019 Holden Master Plan notes that the contract with Spectrum will expire in 2020, which may result in a different provider for the community at the time that this project is likely to be initiated.

Waste Disposal:

During preliminary meetings with the DPW and Planning staff, we were informed that the buildings containing four (or more) residential units will need to coordinate for their own waste disposal services. There are 9 quad' lots included in the project, representing 36 units. As such, we anticipate that these units will contract with a trash hauling firm. The provision of on-site dumpster vs. toters will be left to the unit owners. If a dumpster is proposed, it will be placed on the subject lot, in a screened enclosure to shield it from view and contain trash.

We anticipate that the remaining lots will utilize the Town's contracted collection system and will utilize the trash and recycling toters. The individual unit owners will be responsible for payment of associated fees and compliance with the Board of Health's recently issued "Residential Trash and Recycling Collection Police and Fees, Effective July 1, 2019".

During construction, construction dumpsters will be utilized. As required by Mass DEP waste disposal policies, construction debris will be segregated prior to disposal to limit wood waste and other materials from being placed into landfills. We anticipate that the dumpster companies will coordinate this activity as part of the overall project contract.

PER CAPITA FISCAL IMPACT ON PUBLIC SERVICES

GENERATION OF NEW RESIDENTS

Proposed New Residents:

Per the 2019 Master Plan, pg. 399 Sources for Table 2, the development will generate 2.46 residents per unit:

	Unit Count	Residents/Unit	New Residents
Pine Tree (4 BR units)	101	2.46	249

The project is required to be phased so that no more than 20% of the total number of units will be developed. The maximum residential development would be the proposed Phase 5, where 21, 4 bedroom units are proposed to be built in year 5. That calculation results in a maximum single year impact of 52 new residents per year, maximum (see reference below for residents per unit).

Single Year Max. increase = 52 residents /yr.

Proposed New Students:

Per the 2019 Master Plan, Appendix C, pg. 399, Sources for Table, the development will generate the following school children per unit type:

	Unit Count	Students Unit	New Students
Student per new unit	101	0.35	35.35
		Total New Students:	**36**

The project is required to be phased over a minimum of five years. The largest phases develop 21 units in a year.

Single Year Max. increase = 7.35 or 8 students /yr.

REVENUES GENERATED:

Master Plan, Table 6, identifies potential revenue by development by Land Use Zoning Districts from the Town's Zoning Bylaw. It notes that Residential-Multifamily units have an Assessed Value of $ 121,351 per unit; R-10 has a value of $ 246, 310 per unit. It is the applicant's position that the units will have a decreasing sale value (and therefore appraised value) from quads (lowest) to triplexes, duplexes and single family homes(highest). However, the sale value of these units will not likely be $ 121,351, as they will be new construction, not deed-restricted [to over 55 or as affordable] and will potentially be custom built. It is the applicant's belief that the respective values for the units is likely:

	Value/unit	Total Assessed Value
Quad units (36, in nine buildings)	$ 250,000	$ 9,000,000
Triplex units (12 in four buildings)	$ 250,000	$ 3,000,000
Duplex units (42 in twenty-one buildings)	$ 300,000	$ 12,600,000
Single Family Homes		
In R-10 (9 in nine buildings)	$ 425,000	$ 3,825,000
In R-M (2 in two buildings)	$ 400,000	$ 800,000
	Total Taxable Value	**$ 29,225,000**

Total Assessment at tax rate of $17.61 per $ 1000

$29,225,000/$ 1000=29,225
29,225 x $ 17.61=**$ 514,652 yr.**
Avg. tax yield/unit = **$ 5,095 yr.**

Note that Tax revenue does not include fee for services such as water and sewer usage, waste disposal fees, electric usage and power fees, etc..

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IMPACT CALCULATION METHODOLOGY:

The following impact assessment uses a per capita (per person cost) approach to estimating the fiscal impacts of the proposed development on the Town. This is one method of assessing an impact and a variety of other methodologies can be used and have been used in the Master Plan.

In developing the per capita expenses, we have researched the fiscal budgets of the Schools, Police and Fire Departments to estimate per capita expenses. Other town-incurred expenses have already been calculated on a per capita basis and are presented in Table 13 from the Fiscal Impact Assessment of the Master Plan.

Residences:

As of January 1, 2018 the Town of Holden had 19,144 people. The Town of Holden has the following residential unit counts: [13]

	Unit Count	% of Total Real Estate	Proposed Lots	# of Units per Building	Proposed # of Units
Single Family Homes	5,984	82.80	11	1	11
Condominiums	734	6.28			
Two Family	76	0.85	21	2	42
Three Family	19	0.23	4	3	12
Multi-Unit Dwelling	23	0.36			
Four or more units	21	1.54	9	4	36
Proposed Total # of Lots:			**45**	**Proposed Total # of Units:**	**101**

As described in Appendix A, we have identified two sources of information identifying the number of residences that exist in Holden in the year 2017. Information describing the below estimates is provided in Appendix A.

Method 1: Adding 2010 Census Data to the city-data.com data for the years 2011 to 2013, and then adding the change in the number of units from 2014 to 2017 as shown in the above table yields the following:

6,646 + 164 + 213 = 7,023 Total 2017 Residential Housing Units

Method 2: Adding 2010 Census Data to the city-data.com data for the years 2011 to 2017 yields the following:

6,646 + 406 = 7,052 Total 2017 Residential Housing Units

Averaging the results of the above two methods yields **7,038 Total 2017 Residential Housing Units.**

[13] Holden, MA 2017 Annual Town Report, Year Ending December 31, 2018.

Education:

See Appendix B – Education. Using the student generation rate from the project of 0.35 students per housing unit [14]=36 new students, the total cost impact of the subdivision on the Holden District Schools is $8,456 per student x 36 students = $30,442.

The per capita value is (from Table 13-Budget Estimates) is a cost to educate Holden's students of $ 1,241.75, which seems to be based on a town wide population of 19,003. Using that formula to calculate the cost to educate 36 new students equates to an added expense of $ 44,703/yr.

Public Safety:

Extensive review and research was conducted by Places Associates to determine if the cost of public safety services is tied to population growth or some other parameter. Table 13 provided below, does not include public safety costs as a per capita expense making an analysis of costs of the project to the Town difficult. Using historical budgetary data, we have developed the following assessments:

Police:

See Appendix C – Police. This is a review of the Holden Police Department's budget from FY '06 to FY '17.

Average per capita expense 2006-2017:	$117.25
or using a shorter timeframe for assessment,	
Average per capita expense 2014-2017:	$122.64

Fire:

See Appendix D – Fire. This is a review of the Holden Fire Department's budget from FY '06 to FY '17.

Adjusted Average per capita expense 2006-2017:	$94.66
or using a shorter timeframe for assessment,	
Adjusted Average per capita expense 2014-2017:	$108.52

Other Town Provided Services

As noted previously, the Master Plan's Fiscal Impact Statement, Table 13, excerpted below, identifies the fiscal impact of most of the other town-provided services on a per capita basis. Accordingly, no detailed assessment need be conducted to estimate the fiscal impact of the proposed development on these various services provided by the various departments.

In making the below assessment, we are utilizing the values provided. However, some town departments and services are paid for on a fee for service basis and are not part of the overall tax levy. No downward

[14] Holden Master Plan 2019, Appendix C, pg. 399, Table 2

adjustment was made to accommodate the fee based services such as Water and Sewer, Electric (HMLD), Ambulance Service, Trash, and others.

PER CAPITA EXPENDITURE AND IMPACT ASSESSMENT:

Table 13 - Budget Estimates

	4-year Budget Averages	Per Cap	Increase above baseline	Total Budget
Animal Control	$57,377.00	$3.02	$48,478.23	$105,855.23
Public Works	$2,646,588.00	$139.27	$2,236,120.60	$4,882,708.60
Tresurer/Tax Collector	$265,601.00	$13.98	$224,408.13	$490,009.13
Board of Health*	$67,401.71	$3.55	$56,948.18	$124,349.89
Council on Aging	$255,245.00	$13.43	$215,658.27	$470,903.27
Assessors	$185,993.00	$9.79	$157,146.78	$343,139.78
Building/Grounds Department	$682,555.00	$35.92	$576,695.46	$1,259,250.46
Emergency Management	$47,437.00	$2.50	$40,079.85	$87,516.85
Planning & Development	$240,360.00	$12.65	$203,081.83	$443,441.83
IT	$329,093.00	$17.32	$278,052.96	$607,145.96
Library	$810,590.00	$42.66	$684,873.12	$1,495,463.12
Town Clerk	$213,342.00	$11.23	$180,254.14	$393,596.14
Town Manager	$386,928.00	$20.36	$326,918.16	$713,846.16
Trash and Recycling (Solid Waste)	$1,126,979.00	$59.31	$952,192.39	$2,079,171.39
Veteran's Agent (services)	$65,760.00	$3.46	$55,561.08	$121,321.08
Education	$23,596,989.00	$1,241.75	$6,236,469.18	$29,833,458.18

Per above, Police $ 122.64

Per above, Fire: $ 108.52

Total (adding all per capita expenses): $ 1,861.36

SUMMARY:

Using per capita costs as a basis for analysis, the project will introduce 249 people (2.46 per unit x 101 units). 249 x $ 1,861.36 = $ 463,479, cost of delivering services. The anticipated revenue is $ 514,652.

Because the project will be required to be phased as noted above, an average of only 50 new residents will be arriving per year; resulting in a yearly impact cost of $ 93,068. The average phase creates 20 new units. Using the average value of each unit as $ 5,095/yr. as tax revenue; this results in an estimated revenue of $ 101,900.

The above assessment is a "snap shot" in time. Naturally, as the project is built additional costs and increased budget demands will be placed on the Town's departments; such as plowing the newly created road and other impacts. The above assessment does indicate that the project is likely to be close to cost-neutral development on the Town's finances, while meeting other goals and objectives of the Town.

APPENDICES A - D – INDEPENDENT RESEARCH ON PER CAPTIA IMPACTS:

APPENDIX A – RESIDENTIAL UNITS

According to the 2010 U.S. Census Bureau, the total number of housing units in Holden, Massachusetts was 6,646.

According to the website city-data.com for Holden, Massachusetts, the number of new single-family house construction building permits for the years 2007 to 2014 were as shown in the table below. Data for the years 2015 to 2017 was taken from the 2019 Holden Master Plan Fact Sheet (HoldenMasterPlan.com).

	YEAR										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
# of New Single-Family House Construction Building Permits	49	31	27	53	45	48	71	55	58	59	70
					[164]						
					[406]						

According to data compiled from the Holden Annual Town Reports from 2014 to 2018, the number of housing parcels were as follows:

	Housing Unit Parcels by YEAR						
Property Use	2014	2015	2016	2017	Net Change	Resulting	Change in # of Units
Single Family	5,727	5,846	5,875	5,938	211		211
2-Family	79	80	76	76	-3	x 2 units/parcel =	-6
3-Family	19	19	19	19	0	x 3 units/parcel =	0
4+ Family	19	21	21	21	2	x 4 units/parcel =	8

Total Additional Housing Units 2014-2017: 213

Therefore, the total number of housing units for the year 2017 can be calculated using either of two methods.

Method 1: Adding 2010 Census Data to the city-data.com data for the years 2011 to 2013, and then adding the change in the number of units from 2014 to 2017 as shown in the above table yields the following:

6,646 + 164 + 213 = 7,023 Total 2017 Residential Housing Units

Method 2: Adding 2010 Census Data to the city-data.com data for the years 2011 to 2017 yields the following:

6,646 + 406 = 7,052 Total 2017 Residential Housing Units

Averaging the results of the above two methods yields **7,038 Total 2017 Residential Housing Units**.

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APPENDIX B - EDUCATION

Impact of Development on Education Costs:

[Source: doe.mass.edu/finance/statistics/ppx14-18.html]

Per the Massachusetts Department of Elementary and Secondary Education, FY 14-18 Expenditures per Pupil, All Funds, the Wachusett School District educated 7,440.6 students (233.5 out of District, which we are assuming to include the 72 [Source: Holden 2017 Annual Town Report] students at Montachusett Regional Vocational Technical School) at a cost per pupil of $13,000.72. The Wachusett Regional School District (WRSD) website, [15]indicates that the Town of Holden appropriated $26,188,811* out of a total assessment of $59,608,255* for the Member Town Assessment for FY18 to the WRSD. This is 43.9% of the total Member Town Assessment. The Annual Report also notes that approximately 32.7% of the total budget is from State Aid sources (Chapter 70 & 71, Charter School Reimbursements, District Revenues, etc.).

A decade earlier, in 2008[18], Holden appropriated 45.2% of the Member Town Assessment to the WRSD, with approximately 36% of the budget deriving from State Aid sources, very much in-line with the FY18 figures noted above. Therefore, it is not anticipated that the increase of students will negatively impact educational costs.

*Source: Holden's FY18BudgetBook.pdf, p. 14; wrsdonline.net/finance

Per Capita Calculation of Impact on Schools:

Based on the above, the cost to the taxpayers of Holden to educate a student is the total cost FY 2018, $13,000.72, less state aid and other non-tax revenue sources of the WRSD (approximately 32.7% less or $4,251.24) = $ 8,749.48 per student on average.

Calculation of Impact on Schools based on Student Population:

Fiscal year	Holden Enrollment[17*2]	Change in Enrollment	Assessment[16]*3 to Holden	Cost/Student	% Change Yearly Cost/Student
FY 16	3,188		$ 22,892,166	$ 7,181	
FY 17	3,207	+19 (0.60%)	$ 24,767,733	$ 7,723	+7.5%
FY 18	3,261	+54 (1.68%)	$ 26,188,811	$ 8,031	+4.0%
FY 19	3,219	-42 (-1.29%)	$ 28,087,047	$ 8,725	+8.6%
FY 20	3,258	+39 (1.21%)	$ 29,825,810	$ 9,155	+4.9%

[15] Annual Report, "Section VII FY09 Appropriation Narrative," pgs, 28 to 32
[16] Op cit; undated, Appendix 1, pg. 31.
[17] Wachusett Regional School District, Financial History and Preliminary Estimate of Revenues, undated, Appendix 6, pg 50 from on-line sources.

Average Cost per Student: $8,163

Based on the above cost per student calculation for FY2018 of $8,749 and the average from the above table, $8,163, it can be estimated that the average projected cost per student is $8,456. (Average of $8,749.48 and $8,163)

Using the proposed new student generation from the Subdivision of 0.35 students per housing unit [18]=36 new students, the total cost impact of the subdivision on the Holden District Schools is $8,456 per student x 36 students = $30,442.

*2 Source: Holden Budget Reports 2018-2020, as submitted by the WRSD.

*3 Source: wrsdonline.net/finance/FY BudgetBook.pdf.

[18] Holden Master Plan 2019, Appendix C, pg. 399, Table 2

APPENDIX C– POLICE

The following table shows the relationship between the actual budget, actual population, and per capita expense by the Holden Police Department for the years 2006 to 2017.

Holden Police Department – Per Capita Expense

Year	Actual Budget	% Change in Budget	Actual Population	% Change in Population	Per Capita Expense
FY06	$ 1,764,244		17,336		$101.77
FY07	$ 1,865,700	5.8	17,445	0.6	$106.95
FY08	$ 1,977,341	6.0	17,642	1.1	$112.08
FY09	$ 2,000,509	1.2	17,564	-0.4	$113.9
FY10	$ 2,106,138	5.3	17,379	-1.1	$121.19
FY11	$ 2,133,105	1.3	17,516	0.8	$121.78
FY12	$ 2,110,331	-1.1	17,653	0.8	$119.55
FY13	$ 2,145,683	1.7	17,999	2.0	$119.21
FY14	$ 2,185,351	1.8	18,455	2.5	$118.42
FY15	$ 2,210,354	1.1	18,373	-0.4	$120.30
FY16	$ 2,336,856	5.7	18,838	2.5	$124.05
FY17	$ 2,428,552	3.9	19,003	0.9	$127.80

Average per capita expense 2006-2017: $117.25

Average per capita expense 2014-2017: $122.64

[NOTE: Actual Budget Information from online Annual Holden Budget Reports within www.holdenma.gov.

Actual Population data from multiple sources, including Annual Holden Town Reports and US Census-sourced data found online.]

It should be noted that according to the FY17 Holden Budget Book, beginning in FY15, the Sealer and Weights budget, formerly included in the Police Department budget, was removed. This usually averaged between $3,000 and $4,000 per year.

Also, according to the FY18 Holden Budget Book, beginning in FY16, the Police Department budget included a budget for dispatch. According to the FY17 Holden Budget Book "On 12/10/2014, the Wachusett Regional Dispatch Center started operation.....the Town of Holden should see cost savings with added

professional dispatching." The dispatch budget averaged $316,570 for FY16 and FY17. This most likely accounts for the sudden increase in budget for the FY16 and FY17 budgets listed in the above table.

As seen in the table, the police budget in general has increased at a faster rate than the population. In fact, for the given years, the ratio of the average percent change in budget to the average percent change in population is 3.5 to 1. Between the years 2006 to 2017, the actual police budget increased by 37.65%, while the population increased by 9.62%, a ratio of approximately 4:1. Understanding that looking back to the year 2006 may factor in demographic conditions that are not necessarily applicable to more recent history, if we choose to look at the same data for only the most recent years of 2014 to 2017, the actual police budget increased by 11.13%, while the population increased by 2.97%, again a ratio of approximately 4:1. Therefore, the budget has increased four times faster than the population.

Using the average per capita expense for the years 2014-2017 of $122.64, as seen in the table above, and applying it to the estimated 2.46 people per residence (2.46 x 101 new units) = 249 additional residents that the proposed subdivision will generate, the fiscal impact on the Town of Holden is estimated to be $30,471.

APPENDIX D – FIRE:

The following table shows the relationship between the actual budget, actual population, and per capita expense by the Holden Fire Department for the years 2006 to 2017.

Holden Fire Department – Per Capita Expense

Year	Actual Budget	% Change Budget	Actual in Budget	% Change Population	Per Capita in Population	Public Safety Expense	Adjusted Bldg Per Capita Expense
FY06	$ 932,789		17,336		$53.81	-	$53.81
FY07	$ 1,099,531	17.9	17,445	0.6	$63.03	-	$63.03
FY08	$ 1,268,718	15.4	17,642	1.1	$71.91	-	$71.91
FY09	$ 1,320,848	4.1	17,564	-0.4	$75.20	-	$75.20
FY10	$ 1,818,233	37.7	17,379	-1.1	$104.62	-	$104.62
FY11	$ 2,276,290	25.2	17,516	0.8	$129.95	$73,811	$125.74
FY12	$ 1,988,116	-12.7	17,653	0.8	$112.62	$138,012	$104.80
FY13	$ 2,021,167	1.7	17,999	2.0	$112.29	$173,165	$102.67
FY14	$ 2,090,551	3.4	18,455	2.5	$113.28	$190,913	$102.93
FY15	$ 2,206,017	5.5	18,373	-0.4	$120.07	$208,392	$108.73
FY16	$ 2,230,328	1.1	18,838	2.5	$118.40	$185,812	$108.53
FY17	$ 2,342,544	5.0	19,003	0.9	$123.27	$177,956	$113.91

Adjusted Average per capita expense 2006-2017: $94.66

Adjusted Average per capita expense 2014-2017: $108.52

[NOTE: Actual Budget Information from online Annual Holden Budget Reports within www.holdenma.gov.

Actual Population data from multiple sources, including Annual Holden Town Reports and US Census-sourced data found online.]

Actual budget as shown includes Emergency Management and Emergency Medical Services (EMS). According to the 2011 Holden Budget Report, "In FY2011, a new budget has been added that reflects the operation and maintenance of the new Public Safety Building (PSB) which is anticipated to be occupied by October 2010." The actual budget includes this PSB budget for the years 2011-2017. However, to more accurately draw conclusions of how, over time, budget fluctuations may or may not relate to changes in

population, the actual budget has been decreased by the PSB budget for FY2011-FY2017, and an adjusted per capita expense has been calculated accordingly. Taking this adjusted data into consideration, and omitting the year 2011 due to that year's one-time budget spike, it is calculated that for the years 2012-2017 the population increased by 7.65% while the budget increased by 17%. Therefore, the budget increased 2.2 times faster than the population.

Using the average per capita expense for the years 2014-2017 of $108.52 (in order to parallel the years analyzed for the Police Department), as seen in the table above, and applying it to the estimated 249 additional residents that the proposed subdivision will generate, the fiscal impact on the Town of Holden is estimated to be $27,021.

At the end of 2018, the Fire Department command staff had 1 Chief, 1 Deputy Chief, 2 Captains, and 6 Lieutenants. In addition, 17 fulltime Firefighters, 20 on-call Firefighters, 3 Auxiliary member, 2 Administrative Assistants, and 1 Public Information Officer/Photographer.

HOLDEN FIRE DEPARTMENT

Year	Total Department Calls = (fire + other emergencies)	EMS Calls	+	Fire Calls
2012	1,826	1,454		372
2013	1,860	1,430		430
2014	1,895	1,420		475
2015	1,998	1,549		449
2016	2,240	1,696		544
2017	-	1,607		-
2018	-	1,545		-

According to the 2016 Holden Annual Town Report, the total number of calls to the Fire Department increased by 23% since 2012. The Town's population increased by nearly 7% during that same time period. Holden's 2018 Annual Report states that the Department has "never been as short-handed as in the last three years." They are continuing to extend the invitation to any persons with an interest in joining the Department, as the demand for their services continues to increase. However, Emergency Medical Services (EMS) calls, which are approximately 75% of the total calls, have averaged 1,529 and increased by 6.3% for the years 2012-2018. Holden's 2018 Annual Town Report states the 2018 population as 19,144. This is an 8.4% increase in population since 2012 which is only slightly larger than the increase in EMS calls for the same time period.

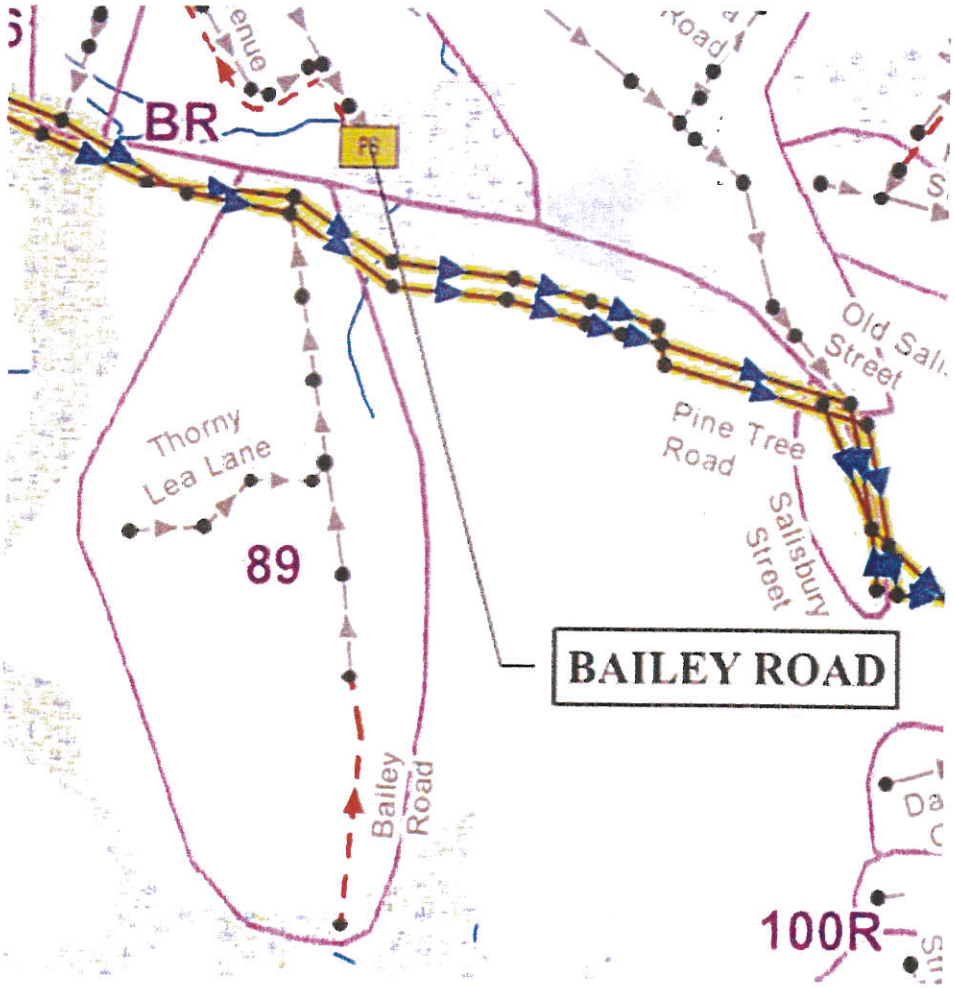
Therefore, in summary, it appears that the number of EMS calls roughly increases at the same rate as an increase in population, and the budget increases at just over twice that rate.

Utility Impact Assessments

- Sewer Capacities and Flows
- Water Flow Tests and Fire Flow Assessment

Bailey Road Sewer-shed Capacity Assessment

The Department of Public Works, Sewer Division has requested that the Applicant prove that sufficient capacity exists in the Bailey Road "sewer-shed" to support any sewerline connections from the proposed development to the existing sewer line in Bailey Road. The DPW has provided us with the below sketch of the properties currently served by the Bailey Road sewer. They include a forcemain (pump) system at the southerly end of the sewer service area (in red) and all of Thorny Lea Lane.



Sketch from DPW, not to scale.

7602: Holden Pine Tree

Existing Sewer Flow Calculations - Bailey Road and Thorny Lea Lane

Address	Map-Parcel	# of Bedrms	Address	Map-Parcel	# of Bedrms
Bailey Rd			Thorny Lea Ln		
67	172-2	1	7	172-46	3
70	172-7	3	10	172-39	3
74	172-8	2	13	172-42	4
75	172-9	3	16	172-38	4
85	172-10	3	17	172-31	3
96	172-11	3	18	172-37	3
97	172-1	6	21	172-32	3
105	172-45	4	22	172-36	3
105A	172-26	3	25	172-33	4
114	172-12	3	26	172-35	3
123	172-24	3	33	172-34	3
124	172-14	3			
129	172-28	4			
135	172-27	3			
138	172-15	3			
139	172-23	3			
144	172-43	2			
147	172-22	4			
152	172-41	1			
155	172-21	3			
159	172-20	1			
160	173-44	3			
167	172-19	2			
171	172-18	3			
176	185-2	2			
179	185-37	3			
180	185-3	3			
185	185-38	4			
186	185-75	3			
189	185-41	4			
193	185-11	5			
195	185-39	4			
200	185-78	4			
227	185-72	3			
	Subtotal BR's:	104		Subtotal BR's:	36

Grand total # of Bedrooms: **140**

310 CMR 15.203: use 110 gpd/BR .....

Therefore, 110 gpd/BR x 140 BR's = **15,400 gpd**
Existing Sewer Design Flow

1,440 mins/day= 10.69 gpm

Peaking rate = 5.5x (TR-16, Figure 2-1) 58.82 gpm

Peak hour flow is 59 gpm.

Estimated capacity of 8"dia. pipe at slope = 1.9% flowing at a depth of 4" (half-full) is 373 gpm.

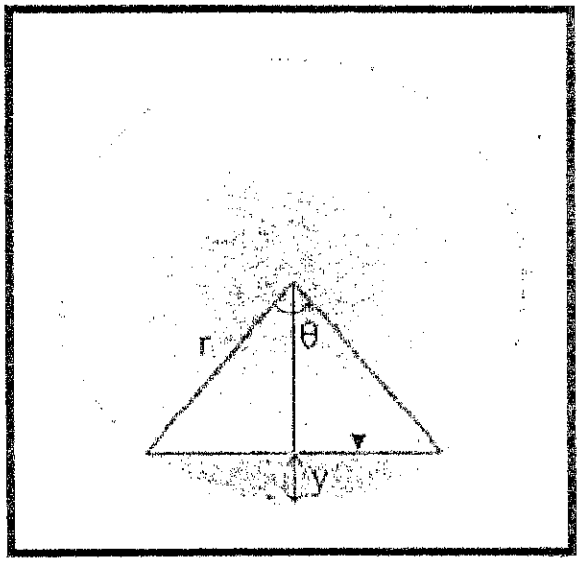
Inflow and Infiltration:
375 gpd * 8"dia * 0.266 miles = 798 gpd I & I
798 gpd /1440 mins/day = 0.554 gpm

Q (full) is when pipe is at 50% capacity (flow depth of 4"). = 0.83 cfs See attached calc sheet.
1 cfs = 448.8325 gallons per min (gpm)

Q full = 373 gpm

Therefore, 373 gpm - 59 gpm = **314 gpm (or 452,160 gpd) remaining capacity in line**

onlinechannel03.php: Discharge in a partially full circular culvert



Formulas

$\theta = 2\cos^{-1}[1 - 2(y/D)]$

$A = (D^2/8)(\theta - \sin\theta)$

$P = r\theta$

$R = A/P$

$Q = (k/n) AR^{2/3}S^{1/2}$

$V = Q/A$

INPUT DATA:

Select: SI units (metric) / U.S. Customary units

Pipe diameter D: .667 ft

Flow depth y: .333 ft

Bottom slope S: .019 ft/ft

Manning's n: .013

INTERMEDIATE CALCS:

Constant k: 1.485

Flow area A: 0.174 ft^2

Wetted perimeter P: 1.046 ft

Hydraulic radius R: 0.166 ft

Relative depth y/D: 0.499

Froude number [based on y]: 1.457

OUTPUT:

Discharge Q: 0.8317 cfs

Flow velocity V: 4.7701 fps

Q= 0.8317 cfs
1 cf = 7.4805 gallons
1 day = 86,400 sec = 1440 min
Therefore, 0.8317 x 7.4805 x 86,400 = 537,540 gpd
= 0.538 MGD
= 373 gpm

CAPACITY 8" PIPE FLOWING HALF FULL, SLOPE = 1.9%

Calculations for Existing Capacity in Bailey Road:

Using on line information from the Holden Assessor' Office, we were able to ascertain the lots served and the number of bedrooms per lot. Using Title 5 (Septic System Design Criteria), each bedroom discharges 110 gallons per day (gpd). A total of 140 bedrooms drain to the DCR trunk line at the railroad crossing on Bailey Road. We have calculated, using a peaking factor of 5x, that substantial excess capacity exists in the Bailey Road sewer pipe using the following:

1. The existing sewer line is an 8" diameter pipe; it is considered to be flowing "full" at 50% depth or flowing at 4".

2. A peaking factor of 5.5 x was applied using TR-16 methodologies.

3. Inflow & Infiltration (I&I) were also assessed and added to the assessment. The portion of Bailey Road that is a pump based system was excluded from I&I calculation.

4. The flattest section of pipe exists just prior to its connection to the sewer main. This pipe therefore collects all of the flow and is the most restrictive pipe along the entire reach. We have calculated its capacity as noted on the attached spreadsheet.

Results:

The Average Daily Flow = 140 bedrooms x 110 gpd/bedroom = 15,400 gpd = 10.7 gpm. (see source 1)

The peak existing flow rate Q_p = 58.85 gpm + 0.554 gpm I&I = 59 gpm. (see source 1)

The capacity of an 8" diameter pipe flowing ½ full at a slope of 1.9% is 373 gpm . (see source 2)

The pipe has an excess capacity of 314 gpm or 452,160 gpd. (373-59 = 314)

See attached two sheets (sources 1 & 2) for supporting data:

1. Spreadsheet for summary of tributary units and calculations

2. www.onlinecalc.sdsu.edu Partial Full Pipe Flow Calculator for 8" flowing d=4" at slope of 1.9%, n =0.013

Calculated flows from the Project to Bailey Road:

A total of 42 units (Lots 1 to 9, Lots 38 to 45) will flow to Bailey Road sewer from the project. Accordingly, the Q_{peak} Flows to Bailey Rd are:

42 units x 4 bedrooms/unit x 110 gpd/bedroom = 18,480 gpd, 12.8 gpm (Average Daily Flow)

$Q_{peak} = 5.5 \times Q_{design} + I$ where Q_{peak} = peak design flow

$Q_{design} = Q_{daily\ flow}$, from above, (18,480 gpd)

I = inflow and infiltration, where:

(I = pipe dia. (inches) x 375 gpd/inch dia/mile pipe)

5.5 = peaking factor for pipes ≤8"in diameter

Solving for I; there are approximately 1,100± total linear feet of proposed 8" sewer line for the Henry Way sewer

I = 8 inch Ø x 375 gpd/inch/mile x 1,100ft/5,280ft/mile = 625 gpd, 0.434 gpm

Solving for $Q_{peak;}$:

$Q_{peak;} = 5.5 \times Q_{design} + I$

or $Q_{peak;} = (5.5 \times 18{,}480\ gpd) + 625\ gpd$

or **$Q_{peak;}$ = 102,265 gpd Peak Flow = 71.02 gpm**

Per above the existing Bailey Road sewer pipe has a remaining capacity of 452,160 gpd or 314 gpm.

314 gpm – 71.02 gpm = $Q_{peak\ remaining}$ = 243 gpm or 349,920 gpd. **[Remaining peak flow capacity]**

Therefore, Bailey Road sewer has sufficient capacity to support the portion of the proposed project (Henry Way) flowing to it.

Calculation for Remaining System Peak Capacity:

From the previous calculation 42 units flow to Bailey Road, leaving 59 units (101- 42 = 59 units) flowing to the trunk line.

59 units x 4 bedrooms/unit x 110 gpd/bedroom = 25,960 gpd., 18 gpm, (Average Daily Flow)

$Q_{peak} = 5.5 \times Q_{design} + I$ where Q_{peak} = peak design flow

$Q_{design} = Q_{daily\ flow}$, from above, (25,960 gpd)

I = inflow and infiltration, where:

(I = pipe dia. (inches) x 375 gpd/inch dia/mile pipe)

5.5 = peaking factor for pipes ≤8"in diameter

Solving for I; there are approximately 2,200± total linear feet of proposed 8" sewer line for the Pine Tree Road and Farmer's Way sewer

I = 8 inch Ø x 375 gpd/inch/mile x 2,200 ft/5,280 ft/mile =1,250 gpd

Solving for $Q_{peak;}$:

$Q_{peak;} = 5.5 \times Q_{design} + I$

or $Q_{peak;} = (5.5 \times 25{,}960\ gpd) + 1{,}250\ gpd$

or **$Q_{peak;}$ = 144,030 gpd Peak Flow = 100 gpm**

The Q_{peak} flowing to the trunk line at the lowest point of connection is through an existing 8" line to the trunk.

The capacity of an 8" line at s=0.005'/, at 2 fps = is 152.6 gpd

The capacity of an 8" line at s=0.13'/,, at 10 fps is 448.8 gpd.

Based on the above the flattest slope proposed (s=0.004 ft/ft) is capable of supporting Q_{peak} = 100 gpm at a velocity of 2.2 fps for peak flows.

Note that the average daily flow is 25,960 gpd.,18 gpm for the non-Bailey Road sewer shed.

PLACES Associates, Inc.
256 Great Road, Suite 4
Littleton, MA 01460
(P): 978.486.0334
(F): 978.486.0447
www.placesassociates.com

PROJECT NO. 7602 - SALISBURY PINE TREE
SHEET NO. ONE OF THREE
CALCULATED BY WSP
CHECKED BY
SCALE
DATE

SEWER PIPE CAPACITY CHECK.

PURSUANT TO THE DESIGN REQUIREMENTS OF TR-16, CHAPTER 2.3 - DETAILS of SEWER DESIGN, SECTION 2.3.5.1 - RECOMMENDED MINIMUM STUDIES STATES PIPES SHOULD BE DESIGNED for a MINIMUM VELOCITY of 2 FT/SEC, CALCULATED USING A MANNING'S n = 0.013.

THE FOLLOWING TWO PAGES UTILIZE AN ON-LINE PARTIALLY-FULL PIPE CALCULATOR FROM WWW.ONLINECALC.SDSU.EDU THAT CALCULATES FLOWS BASED ON INPUT VALUES.

MINIMUM FLOW CHECK

S = 0.004 FT/FT 8" PIPE, FLOW DEPTH of 4", n = 0.013

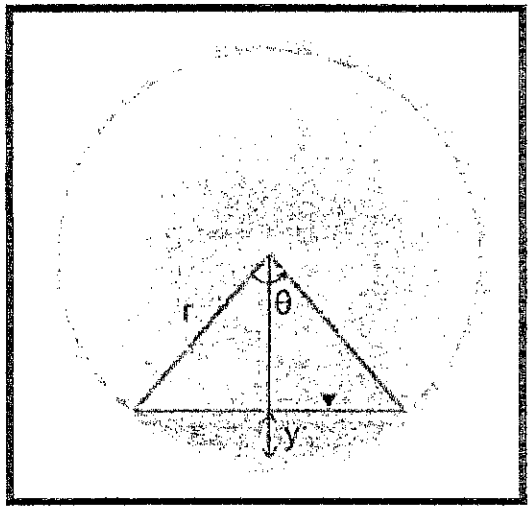
RESULTS IN A VELOCITY of 2.19 FT/SEC and A CAPACITY of 246,634 gpd

MAXIMUM FLOW CHECK

S = 0.085 FT/FT 8" PIPE, FLOW DEPTH of 9", n = 0.013

RESULTS IN A VELOCITY of 10.09 FT/SEC and A CAPACITY of 1,133,062 gpd

onlinechannel03.php: Discharge in a partially full circular culvert



Formulas

$$\theta = 2\cos^{-1}[1 - 2(y/D)]$$

$$A = (D^2/8)(\theta - \sin\theta)$$

$$P = r\theta$$

$$R = A/P$$

$$Q = (k/n)\,AR^{2/3}S^{1/2}$$

$$V = Q/A$$

INPUT DATA:

Select: SI units (metric) / U.S. Customary units

Pipe diameter D: 667 ft

Flow depth y: .333 ft

Bottom slope S: .085 ft/ft

Manning's n: .013

INTERMEDIATE CALCS:

Constant k: 1.485

Flow area A: 0.174 ft^2

Wetted perimeter P: 1.046 ft

Hydraulic radius R: 0.166 ft

Relative depth y/D: 0.499

Froude number [based on y]: 3.082

OUTPUT:

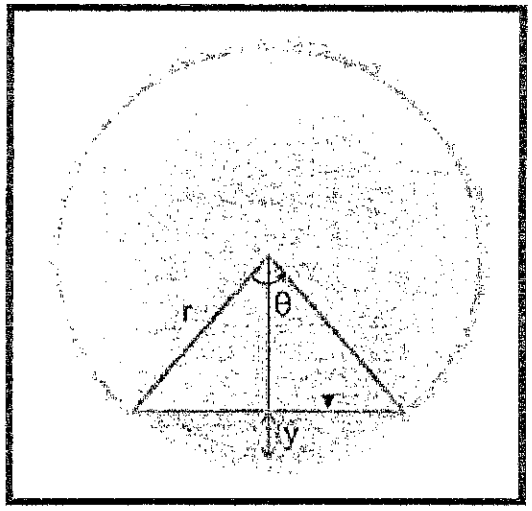
Discharge Q: 1.7593 cfs

Flow velocity V: 10.089 fps

Q= 1.7593 cfs
1 cf = 7.4805 gallons
1 day = 86,400 sec
Therefore, 1.7593 x 7.4805 x 86,400 = 1,137,062 gpd
= 1.137 MGD

FOR DESIGN PURPOSES - SEWER MAXIMUM SLOPE CHECK

onlinechannel03.php: Discharge in a partially full circular culvert



Formulas

$$\theta = 2\cos^{-1}[1 - 2(y/D)]$$

$$A = (D^2/8)(\theta - \sin\theta)$$

$$P = r\theta$$

$$R = A/P$$

$$Q = (k/n)\,AR^{2/3}S^{1/2}$$

$$V = Q/A$$

INPUT DATA:

Select: SI units (metric) / U.S. Customary units

Pipe diameter D: .667 ft

Flow depth y: .333 ft

Bottom slope S: .004 ft/ft

Manning's n: .013

INTERMEDIATE CALCS:

Constant k: 1.485

Flow area A: 0.174 ft^2

Wetted perimeter P: 1.046 ft

Hydraulic radius R: 0.166 ft

Relative depth y/D: 0.499

Froude number [based on y]: 0.668

OUTPUT:

Discharge Q: 0.3816 cfs

Flow velocity V: 2.1886 fps

Q= 0.3816 cfs
1 cf = 7.4805 gallons
1 day = 86,400 sec
Therefore, 0.3816 x 7.4805 x 86,400 = 246,634 gpd
= 0.247 MGD

Note that TR-16 guidelines require a minimum slope of 0.004. Associated velocity at this slope = 2.19 fps as calculated above.

FOR DESIGN PURPOSES - SEWER MINIMUM SLOPE CHECK

Cogswell Sprinkler Co., Inc.
"Fire Protection Specialists"
22 Canterbury Street • Worcester, MA 01610
Tel: (508) 753-0015 • Fax: (508) 753-5629
www.cogswellsprinkler.com

November 9, 2018

Places Site Consultants, Inc.
694 Main Street Suite 3
Holden, MA 01520

Attn: William Murray

RE: Hydrant Flow Testing
Pine Tree Rd.
Holden, MA

Dear William

On November 9, 2018 Cogswell Sprinkler conducted a series of flow tests on Salisbury and Bailey streets in Holden Massachusetts. This was conducted with the assistance of the Holden Water Department. These tests were conducted between 10:00 AM and 11:30AM.

A total of 6 hydrants were involved in the testing. They are noted as follows:

Hydrant A- Corner of Salisbury St and Pine Tree Rd.
Hydrant B- Corner of Salisbury St and Old Salisbury St.
Hydrant C- In front of the Town Pool (hydrant in front of Dawson School out of service at this time.)
Hydrant D- Near the intersection of Bailey Rd. and Thorny Lea Lane.
Hydrant E- Next hydrant on Bailey Rd. (approx. 180 Bailey Rd)
Hydrant F- Next hydrant on Bailey Rd (approx. 222 Bailey Rd)

Test #1

Flow hydrant A, Gauge Hydrant B
Flow 964 GPM
Pressure hydrant B – Static 105 psi, residual 69 psi

Test #2

Flow hydrant C, Gauge Hydrant B
Flow 1311 GPM
Pressure hydrant B – Static 105 psi, residual 88 psi

Test #3

Flow hydrant D, Gauge Hydrant E
Flow 856 GPM
Pressure hydrant E – Static 100 psi, residual 85 psi

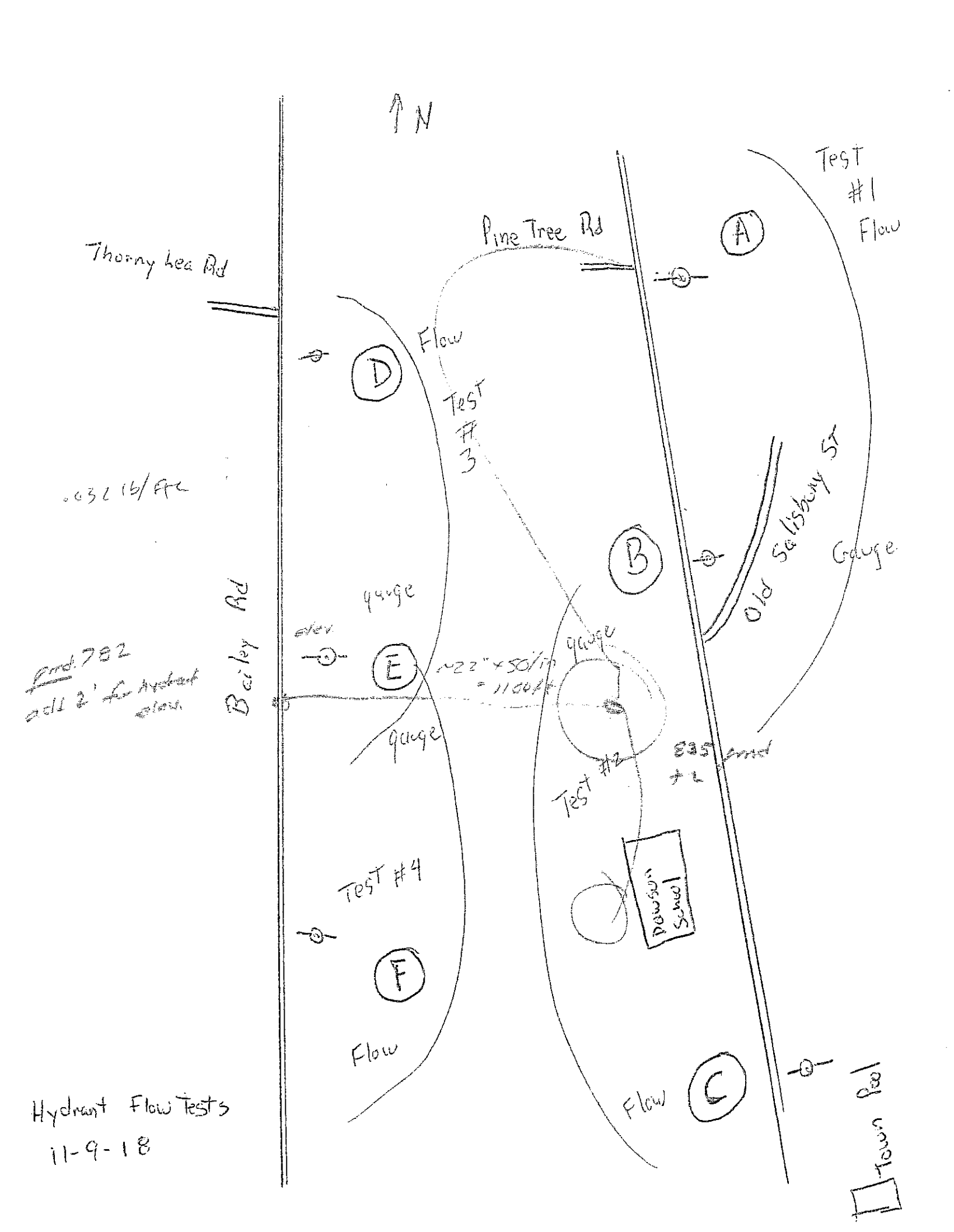
Test #4

Flow hydrant F, Gauge Hydrant E
Flow 1256 GPM
Pressure hydrant E – Static 100 psi, residual 65 psi

Please see the attached sketch and Hydrant Flow Test data sheets and graphs.

Very Truly Yours,

Jeff Grabauskas
Service Department
Cogswell Sprinkler Co Inc.



Hydrant Flow Tests
11-9-18

Hydrant Flow Test

Test #1

Cogswell Sprinkler Co. Inc.
22 Canterbury Street
Worcester, MA 01610
508-753-0015

HYDRANT # A DATE: 9-Nov-18

TEST BY: Cogswell Sprinkler and HDPW TIME of DAY: **11:00 AM**

PURPOSE OF TEST: Gauge static, residual and water flow on site for fire sprinkler hydraulic calculations

FLOW TEST DATA

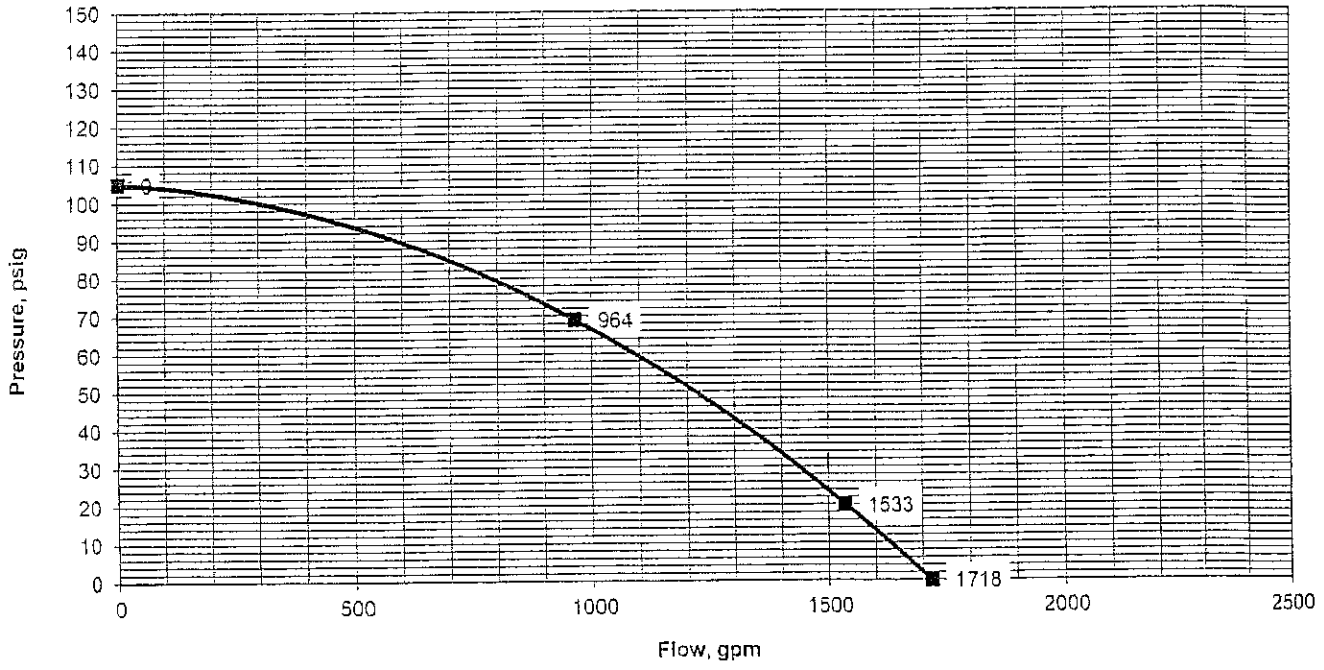
FLOW HYDRANT(S)	A1	A2	A3
SIZE OPENING:	2.5		
COEFFICIENT:	0.9		
PITOT READING:	33		
GPM FLOW:	964	0	0

TOTAL FLOW DURING TEST: 964 GPM

STATIC: 105 PSI RESIDUAL: 69 PSI

RESULTS: AT 20 PSI RESIDUAL 1533 GPM AT 0 PSI 1718 GPM

REMARKS:



Hydrant Flow Test

Test #2

Cogswell Sprinkler Co. Inc.
22 Canterbury Street
Worcester, MA 01610
508-753-0015

HYDRANT # C DATE: 9-Nov-18

TEST BY: Cogswell Sprinkler and HDPW TIME of DAY: **11:00 AM**

PURPOSE OF TEST: Gauge static, residual and water flow on site for fire sprinkler hydraulic calculations

FLOW TEST DATA

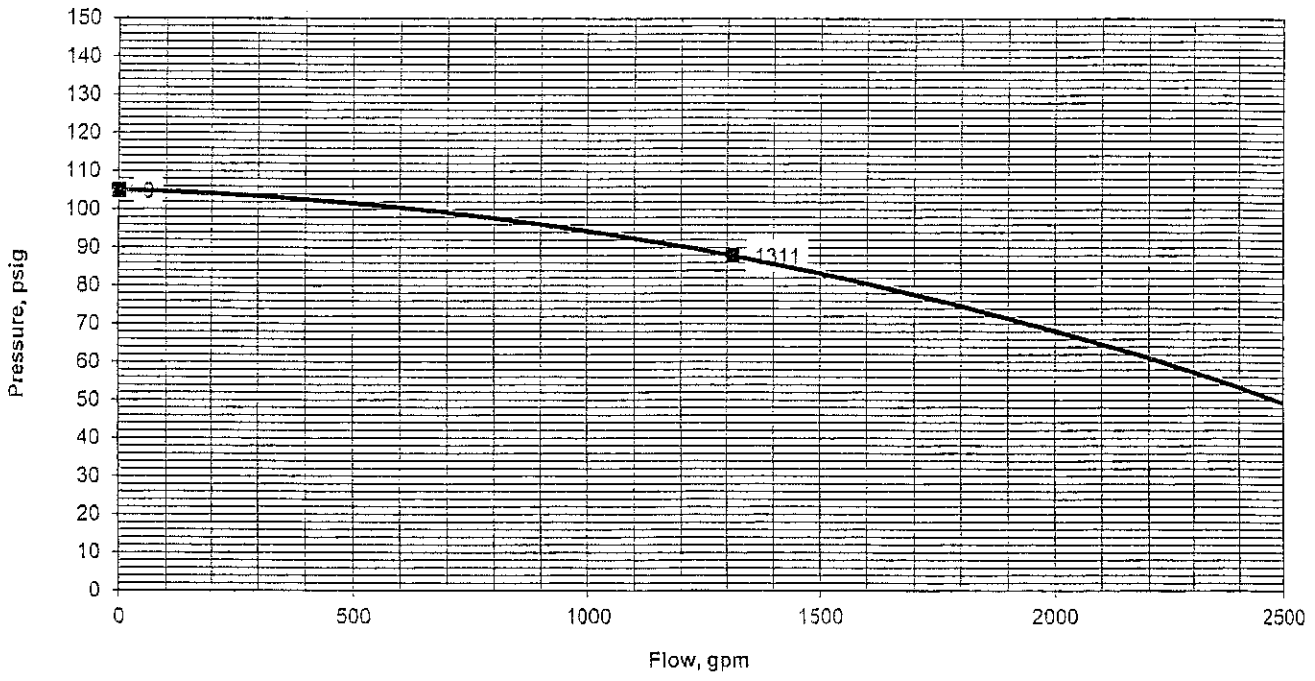
FLOW HYDRANT(S)	A1	A2	A3
SIZE OPENING:	2.5		
COEFFICIENT:	0.9		
PITOT READING:	61		
GPM FLOW:	1311	0	0

TOTAL FLOW DURING TEST: 1311 GPM

STATIC: 105 PSI RESIDUAL: 88 PSI

RESULTS: AT 20 PSI RESIDUAL 3125 GPM AT 0 PSI 3503 GPM

REMARKS:



Hydrant Flow Test

Test #3

Cogswell Sprinkler Co. Inc.
22 Canterbury Street
Worcester, MA 01610
508-753-0015

HYDRANT # D DATE: 9-Nov-18

TEST BY: Cogswell Sprinkler and HDPW TIME of DAY: 11:00 AM

PURPOSE OF TEST: Gauge static, residual and water flow on site for fire sprinkler hydraulic calculations

FLOW TEST DATA

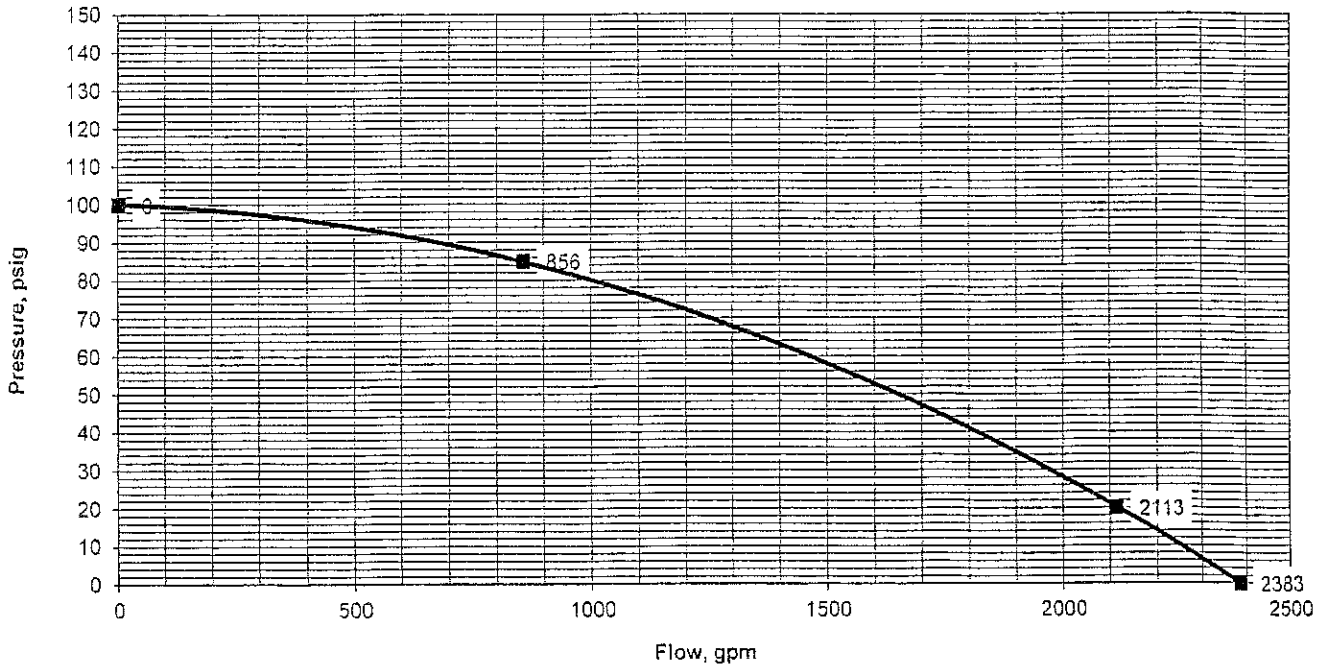
FLOW HYDRANT(S)	A1	A2	A3
SIZE OPENING:	2.5		
COEFFICIENT:	0.9		
PITOT READING:	26		
GPM FLOW:	856	0	0

TOTAL FLOW DURING TEST: 856 GPM

STATIC: 100 PSI RESIDUAL: 85 PSI

RESULTS: AT 20 PSI RESIDUAL 2113 GPM AT 0 PSI 2383 GPM

REMARKS:



Hydrant Flow Test

Test # 4

Cogswell Sprinkler Co. Inc.
22 Canterbury Street
Worcester, MA 01610
508-753-0015

HYDRANT # F DATE: 9-Nov-18

TEST BY: Cogswell Sprinkler and HDPW TIME of DAY: 11:00 AM

PURPOSE OF TEST: Gauge static, residual and water flow on site for fire sprinkler hydraulic calculations

FLOW TEST DATA

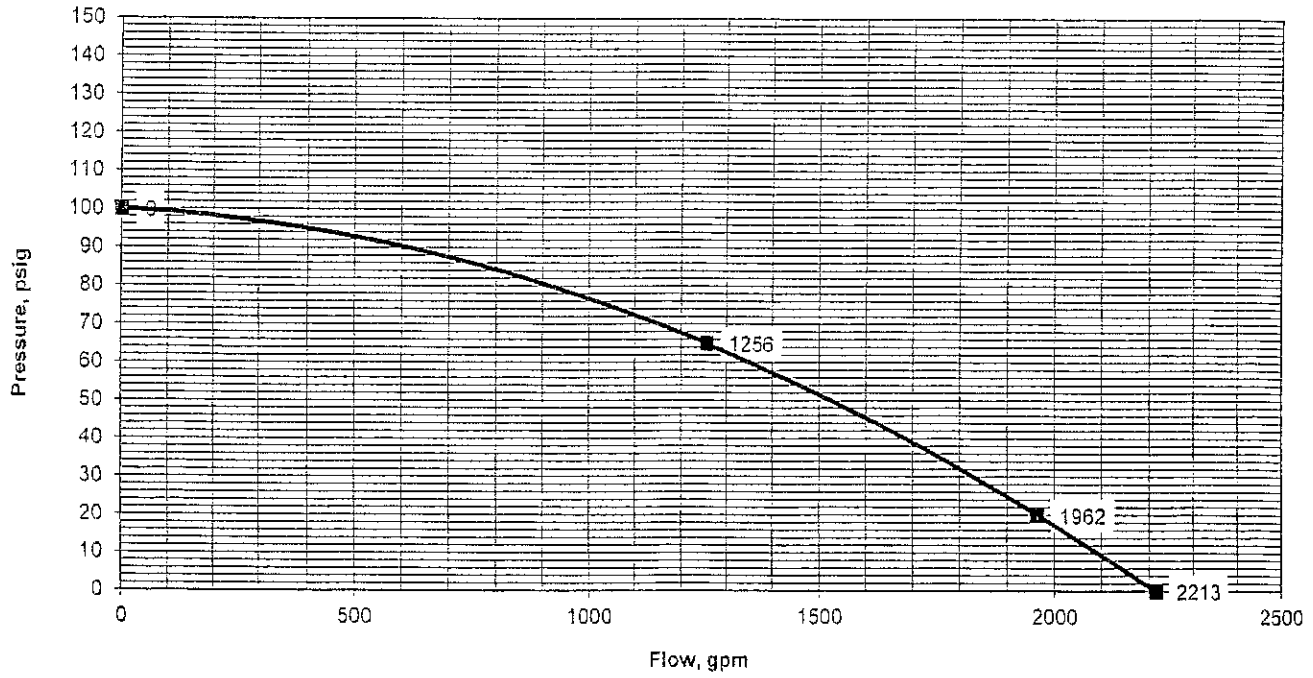
FLOW HYDRANT(S)	A1	A2	A3
SIZE OPENING:	2.5		
COEFFICIENT:	0.9		
PITOT READING:	56		
GPM FLOW:	1256	0	0

TOTAL FLOW DURING TEST: 1256 GPM

STATIC: 100 PSI RESIDUAL: 65 PSI

RESULTS: AT 20 PSI RESIDUAL 1962 GPM AT 0 PSI 2213 GPM

REMARKS:



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PROJECT NO. 7602 - Holden Salisbury Pine Tree
SHEET NO. 1 OF 5
CALCULATED BY CAM
CHECKED BY WBM
SCALE
DATE 10.2.2019

According to Holden's Subdivision Control Regs (12.8.1973), the minimum req'd fire flow

$$F = 18 \times C \times A^{0.5}$$

where F = req'd flow, gpm
C = coefficient relevant to construction type
A = total floor area, including all stories, excluding basements

QUAD SCENARIO (w/ sprinklers)

∴ Footing: 32' x 96' = 3072 ft²
x 3 floors: 3072 x 3 = 9,216 ft²

∴ C = 1.0 for ordinary wood-frame construction

∴ $F = 18(1)(9,216)^{0.5}$
$= 1728$ gpm

Required flows may be ↓ by 50% due to sprinkler use

∴ 1728 x 0.5 = 864 gpm

This must be ↑ by 25% to account for proximity of structures in R-10 and R-4 Residential zones

∴ 864 x 1.25 = **1080 gpm**

REQUIRED FIRE FLOW for QUADS

EXISTING HYDRANT CAPACITY @ HYDRANT E

(Data taken from 11/9/18 flow tests by Cogswell Sprinkler, using equation for determining rated capacity from hasenrouter.com

$$QR = QF \times \left(\frac{HR}{HF}\right)^{0.54}$$

QR = Flow Rate Predicted @ desired residual pressure, gpm
QF = Total Test Flow Rate measured during test, gpm
HR = Pressure drop from static to desired residual
HF = Actual Pressure drop measured during test (Static - Actual Residual)

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PROJECT NO. 7602 - SALISBURY PINE TREE
SHEET NO. 2 OF 5
CALCULATED BY CAM
CHECKED BY WEM
SCALE
DATE 10.2.2019

Desired Residual Pressure = 20 psi

∴ Flow @ HYD. D = 856 gpm (TEST 3)

$$\text{CALCULATED PROJECTED AVAILABLE FLOW} = 856 \left(\frac{100-20}{100-65}\right)^{0.54}$$

$$= 2114 \text{ gpm}$$

∴ Flow @ HYD E = 1256 gpm (TEST 4)

$$\text{CALC. PROJ. AVAIL. FLOW} = 1256 \left(\frac{100-20}{100-65}\right)^{0.54}$$

$$= 1963 \text{ gpm}$$

∴ HYDRANT E is between HYD D & HYD E, using interpolation w/ above 2 calculated flows

PROJECTED ESTIMATED FLOW @ HYD E = 2039 gpm @ 20 psi

[The above calculated projected available flows @ HYD D & HYD E were hydraulic calculations data generated by Control Solutions in their 4/9/18 report.]

ESTIMATING ELEV @ PROPOSED HYDRANT near intersection of Farmers Way & Henry Way

∴ Ground elev @ exist'g HYD E = 782'
Add 2' to hyd. outlet

∴ = 784'

∴ Ground elev @ proposed hyd on Farmers Way = 835'
Add 2' to Hyd. outlet

= 837'

(Contour Plan)

∴ Δ elev = 837 - 784

= 53' over a span of ~ 1100 ft

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PROJECT NO. 7602 - SALISBURY PINETREE
SHEET NO. 3 OF 5
CALCULATED BY CAM
CHECKED BY WEM
SCALE
DATE 10.2.2019

∴ 1 foot of elev. Δ creates a Δ in water pressure = 0.433 psi

∴ 53' elev. Δ × 0.433 psi/ft
= **23 psi**

DROP IN PRESSURE DUE TO VERTICAL HEIGHT Δ from HYD E to PROP. HYD.

∴ Using Nomograph* ....

[* Source: globalspec.com, appendix 5, Hazen Williams formula pipe flow chart, from April 1977 issue of Water, Sewage Works magazine]

→ @ a flow = 2039 gpm ; pipe ϕ = 8", headloss = 60 ft/1000'
interpolated fire flow @ HYD E — line loss

60 ft/1000' × 1100' = 66 ft of headloss

→ @ a flow = 1056 gpm ; pipe ϕ = 8", head loss = 16 ft/1000'
interpolated test flow @ HYD E — line loss

16 ft/1000' × 1100' = 17.6 ft of headloss

Interpolate Residual Flow to be 75 psi @ HYD E since Resid. @ TEST 3 = 85 psi ; Resid @ TEST 4 = 65 psi.

☆ There are 3 components of energy loss w/ Bernoulli's Equation, pressure loss due to Elev. Δ, pipe ϕ Δ, and Headloss.

Since we are using an 8" proposed pipe downstream of the existing 8" ϕ pipe on Bailey Rd, the 2nd component (which would affect velocity) does not apply.

∴ We are looking @ Elev. Δ ; Headloss.

ELEV. Δ: As calculated above, pressure drop = 23 psi

Headloss Calc. using Hazen-Williams Nomograph: H_L = 17.6 ft

17.6 ft × 0.433 psi = 7.62 psi loss in press

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PROJECT NO. 7602 - SALISBURY DWF TRUST
SHEET NO. 4 OF 5
CALCULATED BY DAM
CHECKED BY WEM
SCALE
DATE 10.4.2019

Adding these two components together yields

$P_{30psi} + 2.62\,psi = \sim 31\,psi$

ESTIMATED PRESSURE DROP @ PROPOSED NEW HYDRANT NEAR 1 FARMER'S @ HENRY WAYS

USING DARCY-WEISBACH EQUATION TO ESTIMATE FLOW, Q, ASSOCIATED W/ a 31 psi PRESSURE DROP ALONG THE ESTIMATED PROPOSED PIPE LENGTH.

$$dP = 2.16 \times 10^{-4}\left(\frac{fLpQ^2}{d^5}\right)$$

dP = Pressure Δ, psi
f = Darcy Friction Factor (dimensionless)
L = pipe length, ft
ρ = fluid density, lb/ft³ [Density of water = 62.4 lb/ft³]
Q = flow rate, gpm
d = pipe diameter, inches

Solving above for Q ...

$$Q = \sqrt{\frac{(dP)(d^5)}{(2.161\times10^{-4})(fL\rho)}}$$

... for laminar flow, $f = \frac{64}{Re}$

where Re = Reynolds #

$$Re = \frac{Vd}{(\text{kinematic viscosity})}$$

where V = velocity, ft/s and d = pipe ⌀ in ft and kin. visc. in ft²/s

$$\therefore Re = \frac{(6.5)(0.667)}{1.2}$$

Nomenograph of Hazen-Will., @ 1058 gpm in 8" ⌀.

kinematic viscosity of water @ 70°F

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PROJECT NO. 7602 - SALISBURY PINETREE
SHEET NO. 5 OF 5
CALCULATED BY JAM
CHECKED BY WEH
SCALE
DATE 10.9.2019

$\therefore Re = 3.6129$

and friction factor, $f = \frac{64}{Re} = \frac{64}{3.6129} = 17.7143$

Plugging into Flow Rate, Q, formula from p.4 ...

$$Q = \sqrt{\frac{(3)(8^5)}{(2.161 \times 10^{-4})(17.7143)(1100)(62.4)}}$$

$$= \sqrt{\frac{1015808}{262.7551}}$$

$= 622$ gpm ← CHANGE IN FLOW from HYD E to PROPOSED HYD.

$\therefore$ 1056 gpm − 622 gpm = ~994 gpm ← FLOW, Q, @ PROPOSED HYDRANT

Pressure @ new hydrant

= 75 psi − 3 psi = 44 psi

Using same fire flow calculation methods on p. 2 ...

$$994\left(\frac{100-20}{100-44}\right)^{0.54}$$

$$= 994\left(\frac{80}{56}\right)^{0.54}$$

$$= 1205 \text{ gpm}$$ ← PROJECTED ESTIMATED FIRE FLOW CAPACITY @ NEW HYDRANT.

In Summary ...

The required maximum fire flow (see p.1) = 1080 gpm

The projected estimated fire flow capacity = 1205 gpm @ 20 psi

Therefore, adequate fire flow capacity is estimated to exist.

Plans and Images Related to Environmental Review Report

PROVIDENCE & WORCESTER RAILROAD
BK 5813 PG 91
SEWER EASEMENT
BARBARA CHARTIER
BK 23832 PG 302
ALAN LUND
BK 7061 PG 53
DEBORAH & DANIEL SLAWINSKAS TRUSTEE
BK 38444 PG 288
BAILEY ROAD
DRAINAGE EASEMENT
MIGUEL A SANTOS
BK 59259 PG 27
200' ZONE A
STEPHANIE CARELLI
BK 58709 PG 150
LOT 18
29,649 Sq.Ft.
LOT 19
69,428 Sq.Ft.
UPLAND AREA
LOT 17
UPLAND AREA
170,064 Sq.Ft.
100' BANK OF TRIBUTARY OF CSET
68,070 Sq.Ft.
PINE TREE ROAD
Road 3
LOT 16
LOT 15
LOT 24
21,610 Sq.Ft.
LOT 23
23,804 Sq.Ft.
LOT 22
23,117 Sq.Ft.
LOT 21
17,846 Sq.Ft.
LOT 20
LOT 25
9,145 Sq.Ft.
LOT 26
13,570 Sq.Ft.
LOT 27
11,17
20' WIDE DRAINAGE EASEMENT
PRE-EXISTING LOT B PARCEL B HOLDEN PINE TREE
LOT 14
LOT 13
LOT 12
LOT 11
LOT 10
LOT 9
LOT 8
HOLDEN REALTY
BK 3708 PG 112
Existing 3
30,854 Sq.Ft.
Existing 2
25,000 Sq.Ft.
SUSAN BERTHIAUME
ARTHUR POWELL
BK 56665 PG 96
SALISBURY STREET
TEMP. CONSTRUCT. EASEMENT
60 SALISBURY REALTY TRUST
GABRIEL ALZATE, TRUSTEE
BK 56915 PG 332
MICHAEL COLLINS
JANELL COLLINS
BK 40251 PG 211
MICHAEL A RALLI
BK 41677 PG 205
REMAINING LAND
25,352 Sq.Ft.
LOT 28
10,564 Sq.Ft.
LOT 29
12,14
LOT 30
LOT 31
10,009 Sq.Ft.
BA SUNDIN & SONS, INC
BK 32487 PG 397
JAMES SCHNEIDER
CYNTHIA SCHNEIDER
BK 12803 PG 218
LOT 32
10,4
LOT 33
10,349 Sq.Ft.
LOT 34
16,192
LOT 35
13,412 Sq.Ft.
Road 2
74,943 Sq.Ft.
LOT 36
LOT 37
LOT 38
LOT 39
20,320 Sq.Ft.
LOT 40
LOT 41
LOT 42
LOT 43
LOT 44
LOT 45
UPLAND AREA
20,858 Sq.Ft.
LOT B
13,492 Sq.Ft.
THORNY LEA LANE
(PUBLIC 50' WIDE)
MARK KENT
BK 21550 PG 45
LEONARD BELLIVEAU
BK 29860 PG 158
DENNIS F.CUMMINGS
BETSY R.CUMMINGS
BK 8042 PG 149
MICHAEL ELMES
BK 12939 PG 9
NORMAN WHITTLES
BK 5540 PG 203
JAY GAGNON
BK 8669 PG 29
50' WIDE ROADWAY & UTILITY EASEMENT
ALAN LEPAIN
BK 23484 PG 170
JOEL SPAKAUSKA
BK 15646 PG 50
MATTHEW MELVIN
BK 56526 PG 43
JASON
CRYSTA
BK 32726

BAR SCALE
50' 0 50' 100'
CHECK GRAPHIC SCALE BEFORE USING

SALISBURY PINE TREE ESTATES
OVERALL SITE PRESENTATION PLAN

LOCATION: SALISBURY, PINE TREE AND BAILEY
TOWN: HOLDEN, MASSACHUSETTS
PREPARED FOR:
HOLDEN PINE TREE, LLC
SCALE: Not to Scale
DATE: October 2019

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placeslt@placesassociates.com

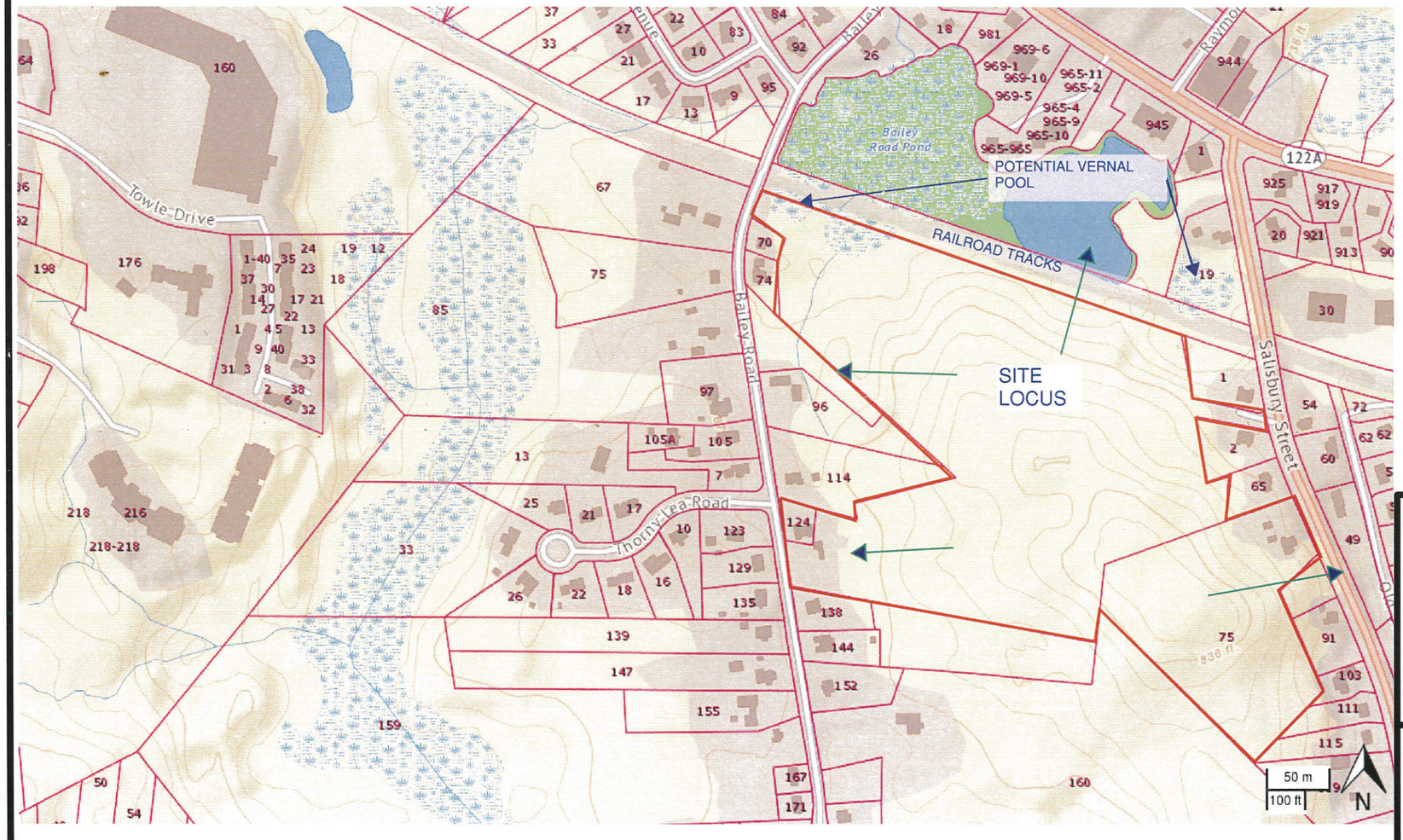
PROJECT No.: 7602 PLAN No. 7602 I-1

INFORMATION TAKEN FROM MASS GIS, OLIVER VIEWER.

Green arrows indicate sight line out of the site.

The site consist of two peaks and the side slopes from the peaks to the adjoining land. Except for the south-westerly boundary, the site is higher than the surrounding land and looks down toward the adjoining land. In all cases except lots 1 & 2 Pine Tree and 138 & 124 Bailey Road, all other abutters will have woods and slopes between them and the developed project.

North



OVERVIEW OF SITE ENVIRONS

LOCATION: Salisbury Holden Pine Tree

TOWN: Holden, Massachusetts

PREPARED FOR:

HOLDEN PINE TREE, LLC
42 Zottoli Road
Holden, MA 01520

SCALE: AS SHOWN DATE: October 2019

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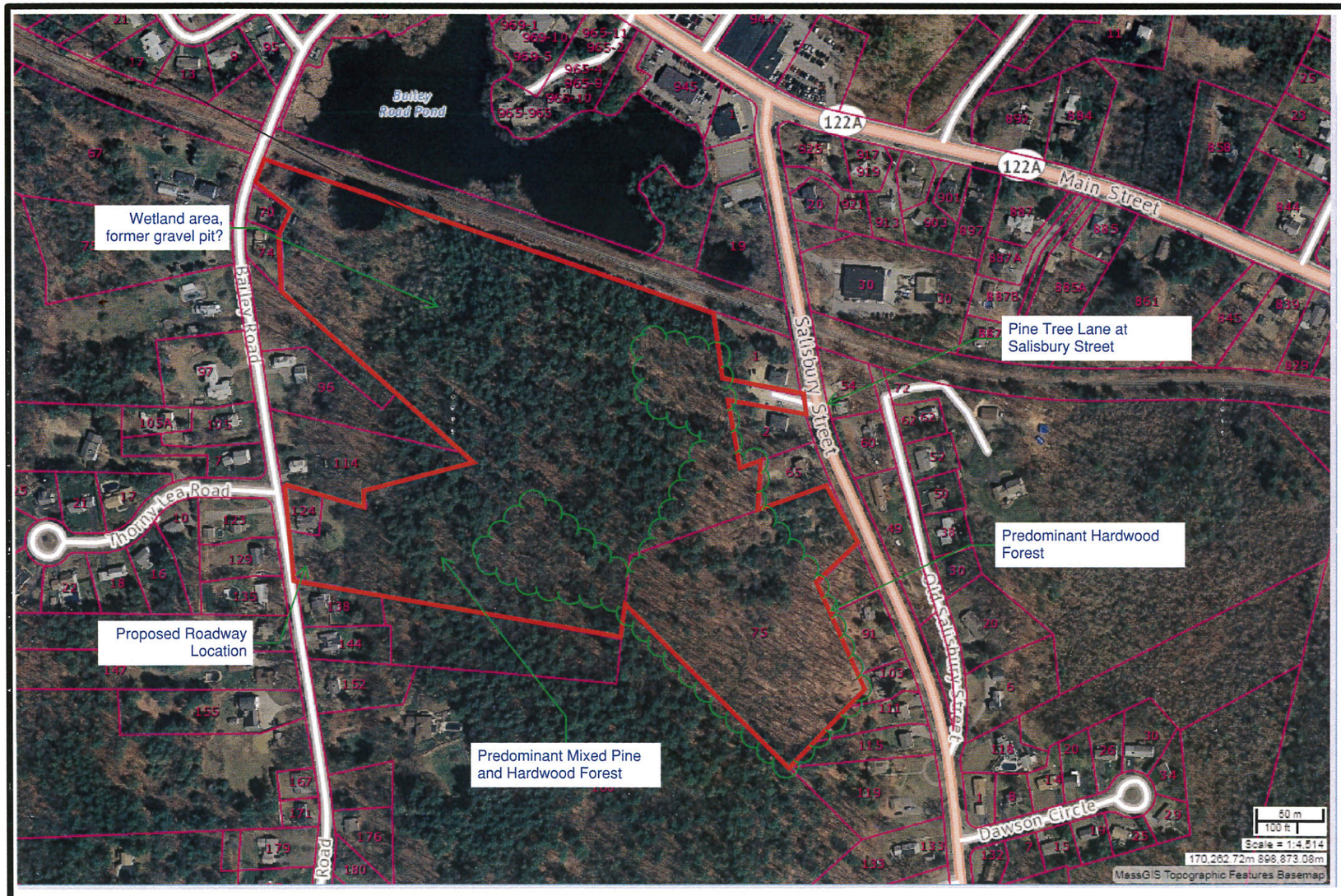
PROJECT No.: 7602 PLAN No.: i-2



INFORMATION TAKEN FROM MASS GIS, OLIVER VIEWER.

Aerial Photo Vegetation Depiction

LOCATION: Salisbury Holden Pine Tree

TOWN: Holden, Massachusetts

PREPARED FOR:

HOLDEN PINE TREE, LLC
42 Zottoli Road
Holden, MA 01520

SCALE: AS SHOWN

DATE: October 2019

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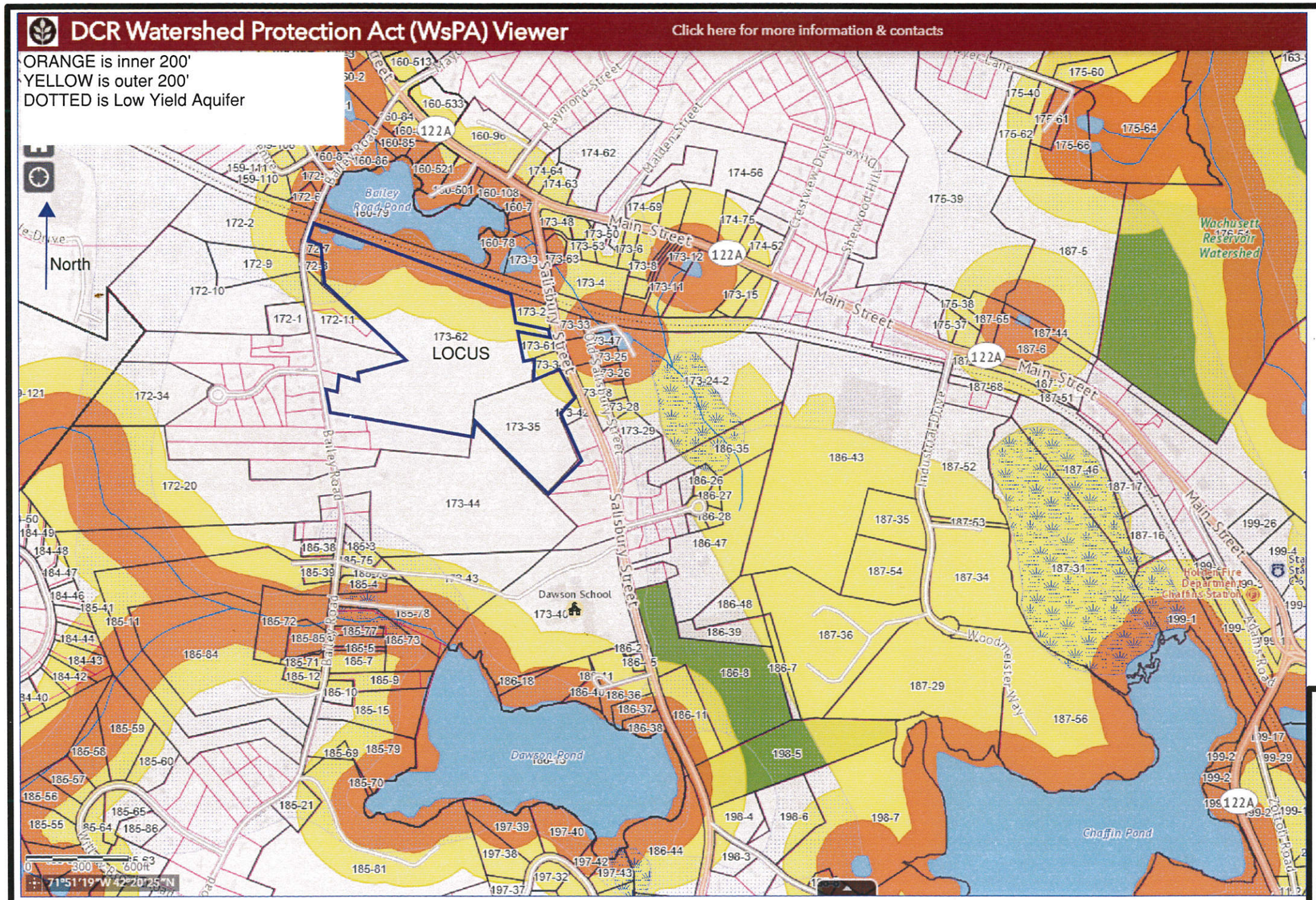
PROJECT No.: 7602

PLAN No.: i-3



INFORMATION TAKEN FROM MASS GIS, DCR VIEWER.

DCR RESOURCE OVERLAYS

LOCATION: Salisbury Holden Pine Tree

TOWN: Holden, Massachusetts

PREPARED FOR:

HOLDEN PINE TREE, LLC
42 Zottoli Road
Holden, MA 01520

SCALE: 1'=600'± DATE: October 2019

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