

Stamski & McNary, Inc.

Engineering - Planning - Surveying

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Drainage Calculations

for

**442 MASSACHUSETTS
AVENUE
ACTON, MA**

Applicant: **442 Massachusetts Avenue, LLC.**
P.O Box 2350
69 Great Road
Acton, MA 01720

Date: November 24, 2008

SM-4293

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Narrative

STORMWATER MANAGEMENT

The site is located at 442 Massachusetts Avenue in Acton, Massachusetts, and is approximately 0.7 acres in size. The site presently contains a single family dwelling and appurtenances. Virtually the entire site is developed as a yard for the house.

The Natural Resources Conservation Service (N.R.C.S.) soil survey report for Middlesex County and associated soil maps for Acton indicate that soils on site consist of Charlton-Hollis-Rock Outcrop Complex and Udorthents. These soils have been assigned to Hydrologic Groups B which is consistent with onsite soil testing.

Pre-Development

Virtually the entire site is developed with a single family house, appurtenances and yard area. The site drains to a Bordering Vegetated Wetland (BVW) just off the property to the south. The wetland drains to a culvert under the K-Mart parking lot to the east. The BVW contains a certified vernal pool, but it is hydraulically upstream of the area that collects the runoff from this site. There are no stormwater BMP's on the existing site.

Post-Development

The fully developed site will consist of the existing single family house and 3 new townhouse units that will be located in one new building. The developed site will also contain a new driveway, walkway and other appurtenances. Runoff from the site will continue to flow to the BVW to the south of the site. A subsurface infiltration system will mitigate runoff and promote infiltration. A Rain Garden will also be used to help treat the runoff from the driveway prior to reaching the wetlands.

COMPLIANCE WITH DEP STORMWATER MANAGEMENT STANDARDS

The project is subject to the DEP Stormwater Management Standards since there are point source discharges within jurisdictional areas of the Wetlands Protection Act. The Acton Board of Appeals' Rules and Regulations for Comprehensive Permits require attenuation of peak runoff rates. Also, the Stormwater Management Standards do not apply to multi-family housing developments with four or fewer units, provided that there are no stormwater discharges that may potentially affect a critical area. There are no stormwater discharges associated with the project and the site drains to a point hydraulically downgradient of the certified vernal pool within the BVW to the south of the property, therefore the stormwater management standards do not apply to this project.

Post-Development Peak Discharge: The Rules and Regulations for Comprehensive Permits require attenuation of peak runoff rates for up to the 10-year design storm and require that there is no serious flood hazard for the 100-year storm. Attenuation of peak discharge rates has been accomplished by using a subsurface infiltration trench. Overland flow from a portion of the site will be collected by a deep sump hooded catch basin then conveyed to a subsurface infiltration trench comprised of plastic chambers and

crushed stone. The following table summarizes pre- and post development peak rates of runoff for the project.

Peak Runoff Discharge Rate Summary

| 2 year storm | | 10 year storm | | 100 year storm | |
|-----------------|------------------|-----------------|------------------|-----------------|------------------|
| Pre-Development | Post-Development | Pre-Development | Post-Development | Pre-Development | Post-Development |
| 0.29 cfs | 0.28 cfs | 0.90 cfs | 0.63 cfs | 1.95 cfs | 1.19 cfs |

As noted in the table, post-development rates of runoff from all of the storm events are less than those under pre-development conditions. Detailed calculations are attached.

Groundwater Recharge/Water Balance Calculations: The Comprehensive Permit regulations require that an annual hydrologic water balance be prepared and included in the drainage calculations. Section 3.11 contains detailed calculations indicating that annual recharge rates are balanced on the site after construction with the use of the subsurface infiltration trench.

Erosion and Sedimentation Controls

In general, erosion and sediment controls are incorporated into the project design to prevent erosion, control sediment movement, and stabilize exposed and disturbed soils during construction. Temporary erosion and sedimentation controls include minimizing areas of exposed soil, directing and controlling runoff, and rapidly stabilizing exposed areas. Prior to the commencement of construction, trenched siltation fences and haybales will be placed down gradient of all work areas. Stockpiled soils will be contained within siltation fence or staked haybales. Soils left exposed for extended periods of time will be mulched and seeded for temporary vegetative cover. Following construction, exposed areas will be permanently vegetated with appropriate ground cover.

Erosion and sedimentation control measures will be maintained throughout all phases of construction. Inspections will be made regularly and after rainfalls exceeding 0.5 inches in a 24-hour period during construction. The contractor will be required to inspect erosion and sedimentation control measures at the end of each workday, when precipitation is forecast, and after each rainfall. All measures will be inspected prior to each weekend and the contractor will replace and repair any malfunctioning or damaged controls measures including vegetative stabilization as necessary. Long-term erosion and sedimentation control will be realized through the use of the Best Management Practices described previously. Areas where soils have been disturbed will be loamed and vegetated with lawn, trees, and shrubs.

Operations and Maintenance Plan

The implementation, inspection, and repair of the erosion controls are the responsibility

Design Basis

1. The United States Department of Agriculture Natural Resource Conservation Service (N.R.C.S.) TR55 methodology was used to determine off-site rates of runoff.
2. The twenty-four hour rainfall, taken from N.R.C.S. publications, is 6.4 inches for the 100-year storm, 4.5 inches for the 10-year storm, and 3.1 inches for the 2-year storm event.
3. The hydrologic calculations were performed using the computer program: "Hydraflow Hydrographs 2007", by Intelisolve.
4. The soil types of the site were taken from the N.R.C.S. Soil Survey Map for Acton.
5. Estimated Seasonal High Water Table (E.S.H.W.T.) was determined by on-site soil evaluations.

Hydrology & Drainage Maps

PRE-DEVELOPMENT

Worksheet 2: Runoff curve number and runoff

SM-4293

Project: LALLI TERRACE By TJR Date 08/14/08

Location: 442 MASSACHUSETTS AVE Checked _____ Date _____

Circle one: Present Developed Subcatchment 1

1. Runoff curve number (CN)

| Soil name and hydrologic group (appendix A) | Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio) | CN 1/ | | | Area Acres | Product of CN x Area |
|--|---|-----------|----------|----------|-------------------|-------------------------|
| | | Table 2-2 | Fig. 2-3 | Fig. 2-4 | | |
| CHARLTON B | Impervious | 98 | | | 0.08 | 7.74 |
| CHARLTON B | Open Spaces, good condition | 61 | | | 0.18 | 11.16 |
| CHARLTON B | Woods, good condition | 55 | | | 0.11 | 5.94 |
| UDORTHENTS B | Open Spaces, good condition | 61 | | | 0.26 | 15.98 |
| UDORTHENTS B | Woods, good condition | 55 | | | 0.06 | 3.14 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Totals = | | | | | 0.69 | 43.96 |

1/ Use only one CN source per line.

$$CN \text{ (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{43.96}{0.69} = 63.81 ; \text{ Use CN} = \boxed{63.8}$$

2. Runoff

Frequency..... yr
 Rainfall, P (24-hour)..... in
 Runoff, Q..... in
 (Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)
 Runoff, Q..... cf
 D-2

| Storm #1 | Storm #2 | Storm #3 |
|----------|----------|----------|
| 2 | 10 | 100 |
| 3.1 | 4.6 | 6.4 |
| 0.51 | 1.31 | 2.53 |

| | | |
|------|------|------|
| 1265 | 3287 | 6340 |
|------|------|------|

(210-VI-TR-55, Second Ed., June 1986)

Worksheet 3: Time of Concentration (Tc) or travel time (Tt)

SM-4293

Project: LALLI TERRACE By TJR Date 08/08/08

Location: 442 MASSACHUSETTS AVE Checked _____ Date _____

Circle one:

| | |
|---------|-----------|
| Present | Developed |
| Tc | Tt |

 through Subcatchment 1
subarea

Sheet flow (Applicable to Tc only)

1. Surface Description (table 3-1)
2. Mannings roughness coeff., n (table 3-1)
3. Flow length, L (total L <= 300 ft)
4. Two-yr 24-hr rainfall, P2
5. Land Slope, s
6. $Tt = 0.007 (nL)^{0.8} / (P2^{0.5} s^{0.4})$ Compute Tt

| Segment ID | A-B | B-C | |
|------------|-------|-------|------|
| | Woods | Grass | |
| | 0.4 | 0.24 | |
| ft | 25 | 25 | |
| in | 3.1 | 3.1 | |
| ft/ft | 0.04 | 0.08 | |
| hr | 0.09 | | 0.09 |

Shallow concentrated Flow

7. Surface Description (paved or unpaved)
8. Flow Length, L
9. Watercourse slope, s
10. Average Velocity, V (figure 3-1)
11. $Tt = L / 3600V$ Compute Tt

| Segment ID | C-D | | |
|------------|---------|--|------|
| | Unpaved | | |
| ft | 122 | | |
| ft/ft | 0.06 | | |
| ft/s | 3.90 | | |
| hr | 0.01 | | 0.01 |

Channel flow

12. Cross sectional flow area, a
13. Wetted perimeter, pw
14. Hydraulic radius, $r=a/wp$ Compute r
15. Channel Slope, s
16. Manning's roughness coeff., n
17. $V = 1.49 r^{2/3} s^{1/2} / n$ Compute V
18. Flow length, L
19. $Tt = L / 3600V$ Compute Tt
20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)

| Segment ID | | | |
|------------|--|--|------|
| sf | | | |
| ft | | | |
| ft | | | |
| ft/ft | | | |
| ft/s | | | |
| ft | | | |
| hr | | | 0.00 |

| | |
|-----|------|
| hr | 0.10 |
| min | 6.0 |

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.:

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph description |
|----------|--------------------------|-----------------|---------------------|--------------------|--------------------|---------------|------------------------|-------------------------|------------------------|
| 1 | SCS Runoff | 0.285 | 2 | 726 | 1,187 | — | — | — | PRE - SUBC 1 |

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Thursday, Sep 11, 2008

Hyd. No. 1

PRE - SUBC 1

| | | | |
|-----------------|--------------|--------------------|--------------|
| Hydrograph type | = SCS Runoff | Peak discharge | = 0.285 cfs |
| Storm frequency | = 2 yrs | Time to peak | = 726 min |
| Time interval | = 2 min | Hyd. volume | = 1,187 cuft |
| Drainage area | = 0.690 ac | Curve number | = 63.8 |
| Basin Slope | = 0.0 % | Hydraulic length | = 0 ft |
| Tc method | = USER | Time of conc. (Tc) | = 6.0 min |
| Total precip. | = 3.10 in | Distribution | = Type III |
| Storm duration | = 24 hrs | Shape factor | = 484 |

Hydrograph Discharge Table

(Printed values >= 90.00% of Qp.)

Time -- Outflow

| (min | cfs) |
|------|----------|
| 724 | 0.276 |
| 726 | 0.285 << |

...End

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph description |
|----------|--------------------------|-----------------|---------------------|--------------------|--------------------|---------------|------------------------|-------------------------|------------------------|
| 1 | SCS Runoff | 0.900 | 2 | 724 | 2,942 | — | — | — | PRE - SUBC 1 |

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Thursday, Sep 11, 2008

Hyd. No. 1

PRE - SUBC 1

| | | | |
|-----------------|--------------|--------------------|--------------|
| Hydrograph type | = SCS Runoff | Peak discharge | = 0.900 cfs |
| Storm frequency | = 10 yrs | Time to peak | = 724 min |
| Time interval | = 2 min | Hyd. volume | = 1,187 cuft |
| Drainage area | = 0.690 ac | Curve number | = 63.8 |
| Basin Slope | = 0.0 % | Hydraulic length | = 0 ft |
| Tc method | = USER | Time of conc. (Tc) | = 6.0 min |
| Total precip. | = 4.50 in | Distribution | = Type III |
| Storm duration | = 24 hrs | Shape factor | = 484 |

Hydrograph Discharge Table

(Printed values >= 90.00% of Qp.)

Time -- Outflow
(min cfs)

| | |
|-----|----------|
| 724 | 0.900 << |
| 726 | 0.859 |

...End

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph description |
|----------|--------------------------|-----------------|---------------------|--------------------|--------------------|---------------|------------------------|-------------------------|------------------------|
| 1 | SCS Runoff | 1.953 | 2 | 724 | 5,951 | — | — | — | PRE - SUBC 1 |

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Thursday, Sep 11, 2008

Hyd. No. 1

PRE - SUBC 1

| | | | |
|-----------------|--------------|--------------------|--------------|
| Hydrograph type | = SCS Runoff | Peak discharge | = 1.953 cfs |
| Storm frequency | = 100 yrs | Time to peak | = 724 min |
| Time interval | = 2 min | Hyd. volume | = 1,187 cuft |
| Drainage area | = 0.690 ac | Curve number | = 63.8 |
| Basin Slope | = 0.0 % | Hydraulic length | = 0 ft |
| Tc method | = USER | Time of conc. (Tc) | = 6.0 min |
| Total precip. | = 6.40 in | Distribution | = Type III |
| Storm duration | = 24 hrs | Shape factor | = 484 |

Hydrograph Discharge Table

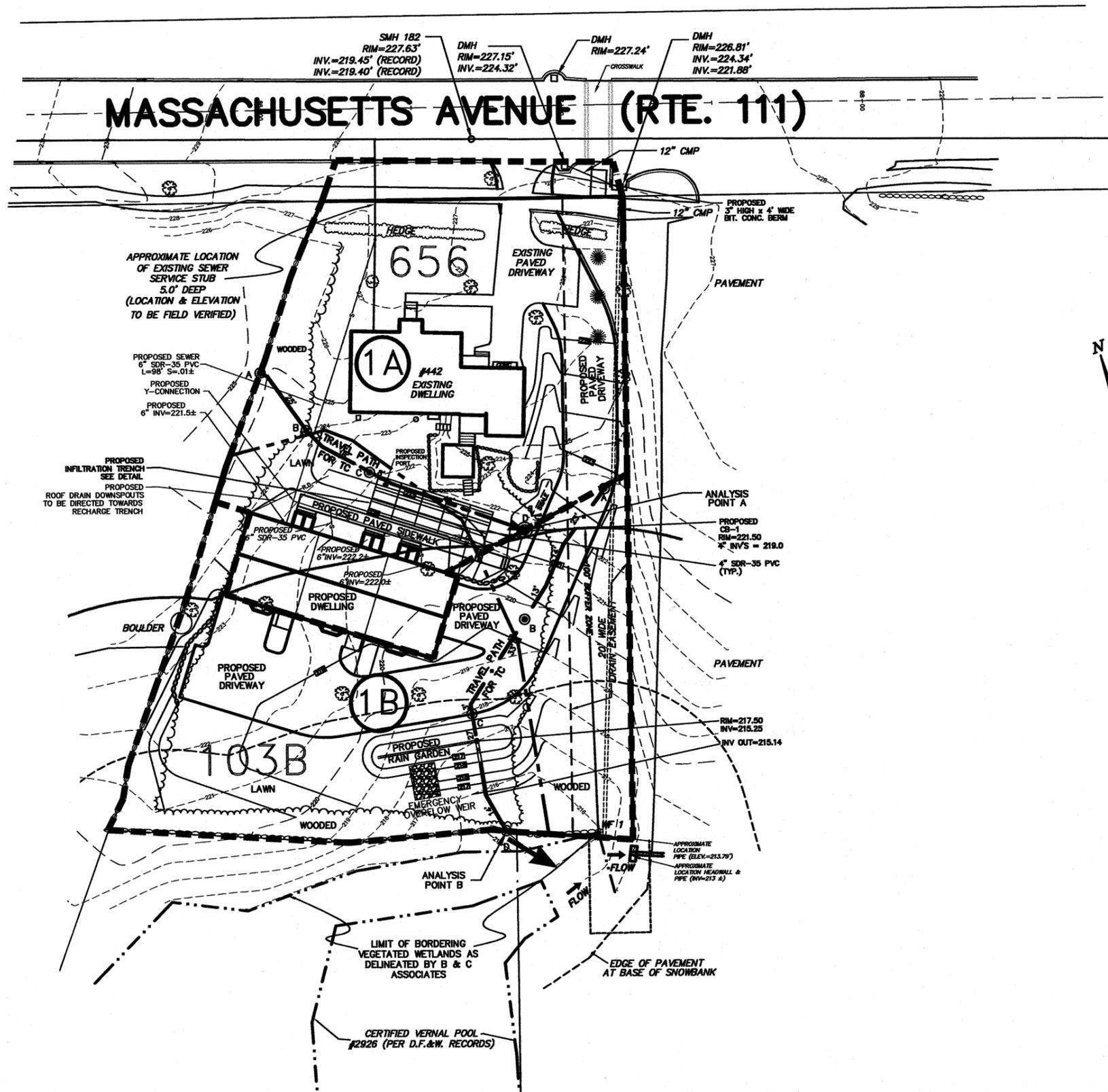
(Printed values >= 90.00% of Qp.)

Time -- Outflow

| (min | cfs) |
|------|----------|
| 722 | 1.759 |
| 724 | 1.953 << |
| 726 | 1.814 |

...End

POST-DEVELOPMENT



| SUBCATCHMENT | AREA |
|------------------|----------|
| 2A TO AREA DRAIN | 0.37± AC |
| 2B TO WETLANDS | 0.32± AC |
| | 0.69± AC |

SOIL TYPE KEY

| MAP SYMBOL | SOIL NAME | HYDROLOGIC SOIL GROUP |
|------------|--------------------------------------|-----------------------|
| 103B | CHARLTON-HOLLIS-ROCK OUTCROP COMPLEX | B |
| 656 | SCARBORO MUCKY FINE SAND | B |

LEGEND

- ▬▬▬▬▬▬ PROPOSED SUBCATCHMENT
- ① SUBCATCHMENT NUMBER
- A—B TRAVEL PATH THROUGH SUBCATCHMENT (TC)
- - - - - HYDRAULIC SOIL BOUNDARIES (FROM SCS MAP)
- ~ TREELINE
- STONEWALL
- - - - - EXISTING CONTOUR
- - - - - EXISTING CONTOUR
- - - - - EDGE OF BORDERING VEGETATED WETLANDS
- ▲ WET FLAG
- FENCE
- TREE

UTILITY NOTE:

ALL UNDERGROUND UTILITIES SHOWN HERE WERE COMPILED ACCORDING TO AVAILABLE RECORD PLANS FROM VARIOUS UTILITY COMPANIES AND PUBLIC AGENCIES AND ARE APPROXIMATE ONLY. ACTUAL LOCATIONS MUST BE DETERMINED IN THE FIELD BEFORE DESIGNING, EXCAVATING, BLASTING, INSTALLING, BACKFILLING, GRADING, PAVEMENT RESTORATION OR REPAIRING. ALL UTILITY COMPANIES, PUBLIC AND PRIVATE, MUST BE CONTACTED INCLUDING THOSE IN CONTROL OF UTILITIES NOT SHOWN ON THIS PLAN. SEE CHAPTER 370, ACTS OF 1963 MASS. WE ASSUME NO RESPONSIBILITY FOR DAMAGES INCURRED AS A RESULT OF UTILITIES OMITTED OR INACCURATELY SHOWN. BEFORE PLANNING FUTURE CONNECTIONS, THE APPROPRIATE PUBLIC UTILITY ENGINEERING DEPARTMENT MUST BE CONSULTED. DIG SAFE TELE. NO. 1-888-344-7233.



POST-DEVELOPMENT DRAINAGE MAP
IN
ACTON, MASSACHUSETTS
(MIDDLESEX COUNTY)

FOR: 442 MASSACHUSETTS AVENUE, LLC
SCALE: 1"=40' AUGUST 15, 2008
REVISED: NOVEMBER 17, 2008
STAMSKI AND McNARY, INC.
80 HARRIS STREET ACTON, MASSACHUSETTS
ENGINEERING - PLANNING - SURVEYING



Worksheet 2: Runoff curve number and runoff

SM-4293

Project: LALLI TERRACE By TJR Date 08/12/08
 Location: 442 MASSACHUSETTS AVE Checked _____ Date 11/17/08

Circle one: Present **Developed** Subcatchment 1A

1. Runoff curve number (CN)

| Soil name and hydrologic group (appendix A) | Cover description (cover type, treatment, and hydrologic condition: percent impervious: unconnected/connected impervious area ratio) | CN 1/ | | | Area Acres | Product of CN x Area |
|--|---|-----------|----------|----------|-------------------|----------------------|
| | | Table 2-2 | Fig. 2-3 | Fig. 2-4 | | |
| CHARLTON UDORTHENTS B | Impervious | 98 | | | 0.17 | 16.26 |
| CHARLTON UDORTHENTS B | Open Spaces, good condition | 61 | | | 0.18 | 10.98 |
| CHARLTON UDORTHENTS B | Woods, good condition | 55 | | | 0.03 | 1.60 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| Totals = | | | | | 0.37 | 28.83 |

1/ Use only one CN source per line.

$$CN \text{ (weighted)} = \frac{\text{total product}}{\text{total area}} = \frac{28.83}{0.37} = 76.91 ; \text{ Use CN} = \boxed{76.9}$$

2. Runoff

Frequency..... yr

Rainfall, P (24-hour)..... in

Runoff, Q..... in

(Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)

Runoff, Q..... cf

D-2

| Storm #1 | Storm #2 | Storm #3 |
|----------|----------|----------|
| 2 | 10 | 100 |
| 3.1 | 4.6 | 6.4 |
| 1.14 | 2.28 | 3.82 |

| | | |
|------|------|------|
| 1545 | 3109 | 5200 |
|------|------|------|

(210-VI-TR-55, Second Ed., June 1986)

Worksheet 3: Time of Concentration (Tc) or travel time (Tt)

SM-4293

Project: LALLI TERRACE

By TJR

Date 08/11/08

Location: 442 MASSACHUSETTS AVE

Checked _____

Revised 11/17/08

Date _____

Circle one: Present Developed

Subcatchment 1A

Circle one: Tc Tt through subarea _____

Sheet flow (Applicable to Tc only)

1. Surface Description (table 3-1)
2. Mannings roughness coeff., n (table 3-1)
3. Flow length, L (total L <= 300 ft)
4. Two-yr 24-hr rainfall, P2
5. Land Slope, s
6. $Tt = 0.007 (nL)^{0.8} / (P2^{0.5} s^{0.4})$ Compute Tt

| Segment ID | A-B | B-C | |
|------------|-------|-------|------|
| | Woods | Grass | |
| | 0.4 | 0.24 | |
| ft | 25 | 25 | |
| in | 3.1 | 3.1 | |
| ft/ft | 0.04 | 0.07 | |
| hr | 0.09 | | 0.09 |

Shallow concentrated Flow

7. Surface Description (paved or unpaved)
8. Flow Length, L
9. Watercourse slope, s
10. Average Velocity, V (figure 3-1)
11. $Tt = L / 3600V$ Compute Tt

| Segment ID | C-D | | |
|------------|---------|--|------|
| | Unpaved | | |
| ft | 54 | | |
| ft/ft | 0.01 | | |
| ft/s | 1.60 | | |
| hr | 0.01 | | 0.01 |

Channel flow

12. Cross sectional flow area, a
13. Wetted perimeter, pw
14. Hydraulic radius, $r = a/wp$ Compute r
15. Channel Slope, s
16. Manning's roughness coeff., n
17. $V = 1.49 r^{2/3} s^{1/2} / n$ Compute V
18. Flow length, L
19. $Tt = L / 3600V$ Compute Tt

| Segment ID | | | |
|------------|--|--|------|
| sf | | | |
| ft | | | |
| ft | | | |
| ft/ft | | | |
| ft/s | | | |
| ft | | | |
| hr | | | 0.00 |

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)

| | |
|-----|------|
| hr | 0.10 |
| min | 6.0 |

(210-VI-TR-55, Second Ed., June 1986)

| | | | |
|-------------------------------|-----|-----|-----|
| Rainfall, P (24-hour)..... in | 3.1 | 4.5 | 6.4 |
| Runoff, Q..... in | | | |

(Use P and CN with table 2-1, fig. 2-1,) or eqs. 2-3 and 2-4.)

| | | | |
|-------------------|---|---|---|
| Runoff, Q..... cf | 0 | 0 | 0 |
|-------------------|---|---|---|

D-2 (210-VI-TR-55, Second Ed., June 1986)

Worksheet 3: Time of Concentration (Tc) or travel time (Tt)

SM-4293

Project: LALLI TERRACE

By TJR

Date 08/11/08

Location: 442 MASSACHUSETTS AVE

Checked _____

Revised 11/17/08

Date _____

Circle one: Present Developed Subcatchment 1B

Circle one: Tc Tt through subarea _____

Sheet flow (Applicable to Tc only)

1. Surface Description (table 3-1)

2. Mannings roughness coeff., n (table 3-1)

3. Flow length, L (total L <= 300 ft)

4. Two-yr 24-hr rainfall, P2

5. Land Slope, s

6. $Tt = 0.007 (nL)^{0.8} / (P2^{0.5} s^{0.4})$

Compute Tt

| | | | |
|------------|-------|--|------|
| Segment ID | A-B | | |
| | PAVED | | |
| | 0.011 | | |
| ft | 50 | | |
| in | 3.1 | | |
| ft/ft | 0.064 | | |
| hr | 0.01 | | 0.01 |

Shallow concentrated Flow

7. Surface Description (paved or unpaved)

8. Flow Length, L

9. Watercourse slope, s

10. Average Velocity, V (figure 3-1)

11. $Tt = L / 3600V$

Compute Tt

| | | | |
|------------|-------|---------|------|
| Segment ID | B-C | C-D | |
| | PAVED | UNPAVED | |
| ft | 36 | 41 | |
| ft/ft | 0.04 | 0.08 | |
| ft/s | 3.80 | 4.60 | |
| hr | 0.00 | 0.00 | 0.01 |

Channel flow

12. Cross sectional flow area, a

13. Wetted perimeter, pw

14. Hydraulic radius, $r = a/wp$

15. Channel Slope, s

16. Manning's roughness coeff., n

17. $V = 1.49 r^{2/3} s^{1/2} / n$

18. Flow length, L

19. $Tt = L / 3600V$

Compute Tt

| | | | |
|------------|--|--|------|
| Segment ID | | | |
| sf | | | |
| ft | | | |
| ft | | | |
| ft/ft | | | |
| ft/s | | | |
| ft | | | |
| hr | | | 0.00 |

20. Watershed or subarea Tc or Tt (add Tt in steps 6, 11, and 19)

| | |
|-----|------|
| hr | 0.10 |
| min | 6.0 |

(210-VI-TR-55, Second Ed., June 1986)

| | | | |
|-------------------------------|-----|-----|-----|
| Rainfall, P (24-hour)..... in | 3.1 | 4.5 | 6.4 |
| Runoff, Q..... in | | | |

(Use P and CN with table 2-1, fig. 2-1, or eqs. 2-3 and 2-4.)

| | | | |
|-------------------|---|---|---|
| Runoff, Q..... cf | 0 | 0 | 0 |
|-------------------|---|---|---|

(210-VI-TR-55, Second Ed., June 1986)

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph description |
|---------------------------|--------------------------|-----------------|---------------------|--------------------|-----------------------|---------------|------------------------|-------------------------|------------------------------|
| 1 | SCS Runoff | 0.464 | 2 | 724 | 1,429 | --- | ---- | ---- | POST - SUBC 1A (TO AREA DRAI |
| 2 | SCS Runoff | 0.275 | 2 | 724 | 907 | --- | ---- | ---- | POST SUBC 1B (TO WETLANDS) |
| 4293 HYRDO POST REV 1.gpw | | | | | Return Period: 2 Year | | Monday, Nov 17, 2008 | | |

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Monday, Nov 17, 2008

Hyd. No. 1

POST - SUBC 1A (TO AREA DRAIN)

| | | | | | |
|-----------------|---|------------|--------------------|---|------------|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 0.464 cfs |
| Storm frequency | = | 2 yrs | Time to peak | = | 724 min |
| Time interval | = | 2 min | Hyd. volume | = | 4,810 cuft |
| Drainage area | = | 0.370 ac | Curve number | = | 76.9 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | USER | Time of conc. (Tc) | = | 6.0 min |
| Total precip. | = | 3.10 in | Distribution | = | Type III |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

Hydrograph Discharge Table

(Printed values >= 90.00% of Qp.)

Time -- Outflow
(min cfs)

| | |
|-----|----------|
| 724 | 0.464 << |
| 726 | 0.433 |

...End

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Monday, Nov 17, 2008

Hyd. No. 2

POST SUBC 1B (TO WETLANDS)

Hydrograph type = SCS Runoff
 Storm frequency = 2 yrs
 Time interval = 2 min
 Drainage area = 0.320 ac
 Basin Slope = 0.0 %
 Tc method = USER
 Total precip. = 3.10 in
 Storm duration = 24 hrs

Peak discharge = 0.275 cfs
 Time to peak = 724 min
 Hyd. volume = 3,544 cuft
 Curve number = 71.3
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 6.0 min
 Distribution = Type III
 Shape factor = 484

Hydrograph Discharge Table

(Printed values >= 90.00% of Qp.)

Time -- Outflow
(min cfs)

724 0.275 <<
 726 0.263

...End

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph description |
|---------------------------|--------------------------|-----------------|---------------------|--------------------|------------------------|---------------|------------------------|-------------------------|------------------------------|
| 1 | SCS Runoff | 0.926 | 2 | 724 | 2,773 | --- | ---- | ---- | POST - SUBC 1A (TO AREA DRAI |
| 2 | SCS Runoff | 0.631 | 2 | 724 | 1,926 | --- | ---- | ---- | POST SUBC 1B (TO WETLANDS) |
| 4293 HYRDO POST REV 1.gpw | | | | | Return Period: 10 Year | | | Monday, Nov 17, 2008 | |

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Monday, Nov 17, 2008

Hyd. No. 1

POST - SUBC 1A (TO AREA DRAIN)

| | | | | | |
|-----------------|---|------------|--------------------|---|------------|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 0.926 cfs |
| Storm frequency | = | 10 yrs | Time to peak | = | 724 min |
| Time interval | = | 2 min | Hyd. volume | = | 4,810 cuft |
| Drainage area | = | 0.370 ac | Curve number | = | 76.9 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | USER | Time of conc. (Tc) | = | 6.0 min |
| Total precip. | = | 4.50 in | Distribution | = | Type III |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

Hydrograph Discharge Table

(Printed values >= 90.00% of Qp.)

Time -- Outflow
(min cfs)

| | |
|-----|----------|
| 722 | 0.847 |
| 724 | 0.926 << |
| 726 | 0.849 |

...End

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Monday, Nov 17, 2008

Hyd. No. 2

POST SUBC 1B (TO WETLANDS)

| | | | |
|-----------------|--------------|--------------------|--------------|
| Hydrograph type | = SCS Runoff | Peak discharge | = 0.631 cfs |
| Storm frequency | = 10 yrs | Time to peak | = 724 min |
| Time interval | = 2 min | Hyd. volume | = 3,544 cuft |
| Drainage area | = 0.320 ac | Curve number | = 71.3 |
| Basin Slope | = 0.0 % | Hydraulic length | = 0 ft |
| Tc method | = USER | Time of conc. (Tc) | = 6.0 min |
| Total precip. | = 4.50 in | Distribution | = Type III |
| Storm duration | = 24 hrs | Shape factor | = 484 |

Hydrograph Discharge Table

(Printed values >= 90.00% of Qp.)

Time -- Outflow (min cfs)

| | |
|-----|----------|
| 722 | 0.568 |
| 724 | 0.631 << |
| 726 | 0.587 |

...End

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.2

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph description |
|---------------------------|--------------------------|-----------------|---------------------|--------------------|-------------------------|---------------|------------------------|-------------------------|------------------------------|
| 1 | SCS Runoff | 1.606 | 2 | 724 | 4,810 | --- | ---- | ---- | POST - SUBC 1A (TO AREA DRAI |
| 2 | SCS Runoff | 1.185 | 2 | 724 | 3,544 | --- | ---- | ---- | POST SUBC 1B (TO WETLANDS) |
| 4293 HYRDO POST REV 1.gpw | | | | | Return Period: 100 Year | | Monday, Nov 17, 2008 | | |

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Monday, Nov 17, 2008

Hyd. No. 1

POST - SUBC 1A (TO AREA DRAIN)

| | | | | | |
|-----------------|---|------------|--------------------|---|------------|
| Hydrograph type | = | SCS Runoff | Peak discharge | = | 1.606 cfs |
| Storm frequency | = | 100 yrs | Time to peak | = | 724 min |
| Time interval | = | 2 min | Hyd. volume | = | 4,810 cuft |
| Drainage area | = | 0.370 ac | Curve number | = | 76.9 |
| Basin Slope | = | 0.0 % | Hydraulic length | = | 0 ft |
| Tc method | = | USER | Time of conc. (Tc) | = | 6.0 min |
| Total precip. | = | 6.40 in | Distribution | = | Type III |
| Storm duration | = | 24 hrs | Shape factor | = | 484 |

Hydrograph Discharge Table

(Printed values >= 90.00% of Qp.)

Time -- Outflow (min cfs)

| | |
|-----|----------|
| 722 | 1.488 |
| 724 | 1.606 << |
| 726 | 1.455 |

...End

Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.2

Monday, Nov 17, 2008

Hyd. No. 2

POST SUBC 1B (TO WETLANDS)

Hydrograph type = SCS Runoff
 Storm frequency = 100 yrs
 Time interval = 2 min
 Drainage area = 0.320 ac
 Basin Slope = 0.0 %
 Tc method = USER
 Total precip. = 6.40 in
 Storm duration = 24 hrs

Peak discharge = 1.185 cfs
 Time to peak = 724 min
 Hyd. volume = 3,544 cuft
 Curve number = 71.3
 Hydraulic length = 0 ft
 Time of conc. (Tc) = 6.0 min
 Distribution = Type III
 Shape factor = 484

Hydrograph Discharge Table

(Printed values >= 90.00% of Qp.)

Time -- Outflow (min cfs)

| | |
|-----|----------|
| 722 | 1.087 |
| 724 | 1.185 << |
| 726 | 1.084 |

...End

Infiltration Trench Sizing

STAMSKI AND McNARY, INC.

80 Harris Street
ACTON, MASSACHUSETTS 01720
TEL (978) 263-8585
FAX (978) 263-9883

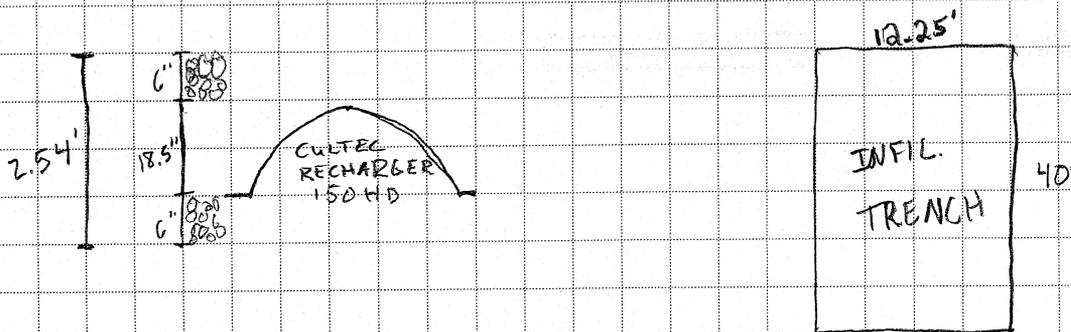
JOB 4293
SHEET NO. 1 OF _____
CALCULATED BY TJR DATE 11/17/08
CHECKED BY _____ DATE _____
SCALE _____

INFILTRATION TRENCH SIZING

100 YR Storm Volume = 4,810 CF

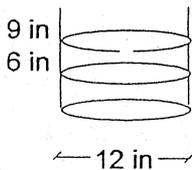
PERC RATE = $\frac{3 \text{ MIN}}{1 \text{ INCH}}$ $\therefore K = 7.06 \text{ FT/DAY}$ (WFS=2
SEE CALC
NEXT SHEET)

$4,810 \text{ CF} \times \frac{1 \text{ DAY}}{7.06 \text{ FT}} = 681 \text{ SF}$ REQUIRED FOR INFILTRATION



INF. AREA PROVIDED = BOTTOM AREA + SIDEWALL
= $(12.25 \times 40) + [(2 \times 12.25) + (2 \times 40)] \cdot 2.54$
= 490 + 265
= 755 SF > 681 SF OK

CONVERSION OF PERCOLATION RATE TO PERMEABILITY



$$\begin{aligned}\text{bottom area} &= \pi \times r^2 = 0.785 \text{ sf} \\ \text{avg sidewall area} &= 2 \times \pi \times r \times 7.5 = 1.9625 \text{ sf} \\ \text{Total avg area} &= 2.7475 \text{ sf}\end{aligned}$$

$$\text{volume infiltrated} = 0.0628 \text{ cf}$$

$$\text{percolation rate} = 2.33 \text{ min/in} = 0.001618 \text{ day/in}$$

$$Q = A (K_i) t; \quad i=1, Q=\text{Vol}, A=\text{area}, K=\text{permeability coefficient}$$

$$K = Q / A t i = \boxed{14.13 \text{ ft/day}}$$

$$\text{w/Factor of Safety of 2} = \boxed{7.06 \text{ ft/day}}$$

Rain Garden Sizing

Water Quality Calculations:

Project: 442 MASSACHUSETTS AVE

By TJR Date 11/24/08

Location: ACTON, MA

Checked _____ Date _____

RAIN GARDEN

Storage

Impervious: 4,334 sf
 Required Water Quality Volume(1/2"): 173 cf

Filtration

Filtration rate w/ 12"Loam (Est.) = 1.02 in/hr
 2.36E-05 cfs/sf

Stormwater Basin 9
 Water Quality Swale

filtration time = 24 hrs
 Filter Area = 445 sf
 Volume = 363 cf

| ELEV | Area sf | Cumm Volume cf |
|--------|------------|-------------------|
| 217.25 | 445 | 0 |
| 217.5 | 528 | 122 |

Storage Volume = 122

Storage Volume + Filtered Volume = Treated Volume > 173 OK
 122 + 363 = 485

Soil Evaluations



Massachusetts Department of Environmental Protection
 Bureau of Resource Protection - Wastewater Permitting Program
 Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Site Address or Map/Lot Number

C. On-Site Review (minimum of two holes required at every proposed disposal area)

Deep Observation Hole A: 8/20/08 2:00 SUNNY 70's
 Date Time Weather

1. Deep Observation Hole Logs

Deep Hole Number 1 Ground Elevation at Surface of Hole 220.5

Location (Identify on Plan)

2. Land Use: YARD FEW 5-8
 (e.g. woodland, agricultural field, vacant lot, etc.) Surface Stones Slope (%)
LAWN ON SLOPE
 Vegetation Landform Position on landscape (attach sheet)

3. Distances from: Open Water Body _____ Drainage Way _____ Possible Wet Area 95
 (feet) (feet) (feet)
 Property Line _____ Drinking Water Well _____ Other _____
 (feet) (feet)

4. Parent Material: ABLATION FILL Unsuitable Materials Present: Yes No
 If Yes: Disturbed Soil Fill Material Impervious Layer(s) Weathered/Fractured Rock Bedrock

5. Groundwater Observed: Yes No
 If Yes: Depth Weeping from Pit _____ Depth Standing Water in Hole _____
 Estimated Depth to High Groundwater: 49" + < 26.4'
 Inches elevation



Massachusetts Department of Environmental Protection
 Bureau of Resource Protection - Wastewater Permitting Program
 Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

Site Address or Map/Lot Number

Deep Observation Hole A: Deep Hole Number: 1

| Depth (In.) | Soil Horizon/Layer | Soil Matrix: Color-Moist (Munsell) | Redoximorphic Features (mottles) | | | Soil Texture (USDA) | Coarse Fragments % by Volume | | Soil Structure | Soil Consistence (Moist) | Other |
|-------------|--------------------|------------------------------------|----------------------------------|-------|---------|---------------------|------------------------------|------------------|----------------|--------------------------|-------|
| | | | Depth | Color | Percent | | Gravel | Cobbles & Stones | | | |
| 6 | A | 10YR3/3 | | - | | SL | | | M | F | |
| 12 | B | 10YR5/6 | | - | | LS | | | M | F | |
| 49" | C | 2.5Y5/4 | | - | | LS | 5 | 5 | M | F | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

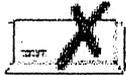
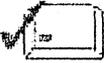
Additional Notes: (VERY WET SUMMER - NEAR SPRING GW CONDITIONS)



Commonwealth of Massachusetts
 City/Town of
Percolation Test
 Form 12

Percolation test results must be submitted with the Soil Suitability Assessment for On-site Sewage Disposal. DEP has provided this form for use by local Boards of Health. Other forms may be used, but the information must be substantially the same as that provided here. Before using this form, check with the local Board of Health to determine the form they use.

Important:
 When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A. Site Information

MARGOT GRALLERT
 Owner Name
442 MASS. AVE
 Street Address or Lot #
ACTON MA 01720
 City/Town State Zip Code
 Contact Person (if different from Owner) Telephone Number

B. Test Results

| | Date | Time | Date | Time |
|--------------------|------|------|------|------|
| Observation Hole # | | 1 | | |
| Depth of Perc | | 49" | | |
| Start Pre-Soak | | 2:08 | | |
| End Pre-Soak | | 2:23 | | |
| Time at 12" | | 2:23 | | |
| Time at 9" | | 2:29 | | |
| Time at 6" | | 2:36 | | |
| Time (9"-6") | | 7 | | |
| Rate (Min./Inch) | | 2.33 | | |

Test Passed:
 Test Failed:

Test Passed:
 Test Failed:

GEORGE DIMAKARAKOS ; STAMSKI AND McNARY INC
 Test Performed By:

Witnessed By:

Comments: