# NEWTOWN TECHNOLOGY PLAN

## STORMWATER MANAGEMENT REPORT

Prepared for

NEWTOWN ECONOMIC DEVELOPMENT COMMISSION

May 10, 2010

REVISED
October 6, 2010
November 9, 2010

NEWTOWN TECHNOLOGY PARK

STORMWATER MANAGEMENT PLAN

The Newtown Technology Park is located in the Town of Newtown, Connecticut near Exit 10 of Interstate 84. The site contains approximately 41.75± acres. The site drains to Deep Brook, a perennial tributary of the Pootatuck River. The Park will be built as an industrial condominium which will utilize privately owned driveways and parking lots. There will be six buildings with a total floor area of 99,962 square feet. The total impervious area including the buildings, entrance drive, driveways and parking lots is 239,950 square feet. The main entrance drive will be approximately 1,530 lineal feet long. The entrance drive width will have a pavement width of 30 feet. The drive will cross two streams and associated wetland areas as it enters the site. The stream flows will be carried by concrete box culverts. These culverts will be three sided, thereby preserving the natural stream bottom. The industrial condominium will be built on the westerly 23.19 acres parcel. The current application does not propose any development on the easterly 18.56 acre parcel."

The objective of the Storm Water Management Plan is to protect the water quality of the watersheds and Deep Brook, to maintain the hydrology of the wetlands and to maintain hydrology of the aquifer. The development of a site has the potential to effect the hydrologic conditions of both the onsite wetlands and of the general area. Development will increase the amount of impervious area. Without mitigation, the additional impervious area will result in increased peak flow rates, increased runoff volume, decreased infiltration to the ground water, increased thermal pollution and increased sediment loads. The first three of these effects are modifications to the hydrologic cycle. The additional impervious surfaces reduce the infiltration into the groundwater. Not only does this increase the short term flow in streams it reduces the base flow to the streams. Base flow is the water that has infiltrated into the ground. This groundwater then flows through the soil toward the stream. The groundwater becomes surface water at the stream bank. Since the groundwater takes a longer time to reach the stream than surface water, this water becomes the base flow of the stream during periods of no rainfall. The last two of the effects are forms of pollution that will be mitigated with the measures proposed in this Plan.

The Storm Water Management Plan contains a series of onsite measures that have been incorporated into the plans for the Technology Park to mitigate these potential impacts. The mitigation measures and the site design are based on the principles of Low Impact Development, LID. The US EPA through its Low-Impact Development Center encourages the use of LID principles. The following is a list of principles that have been be incorporated into the site design to maintain the hydrology of the watershed.

1. Preserve and protect sensitive areas.
2. Locate impervious surfaces on less permeable soil type.
3. Mitigate the effects of impervious surfaces with facilities that maintain the initial abstraction of the site.
4. Reduce/ minimize impervious areas.
5. Disconnect the impervious areas from the drainage systems.
6. Maintain the time of concentration of the runoff.

The first two principles of LID are to protect sensitive area and have the development on less permeable soil and preserve the more permeable soils. The use of a condominium style of development allows for a more compact development area with less impervious area used for driveways and parking areas. The industrial uses are to be placed on the westerly portion of the site adjacent to the railroad tracks. This allowed the preservation of a buffer area adjacent to the more sensitive Deep Brook. Further, this allowed development area to be located on the less permeable soils located adjacent to the railroad tracks while preserving the more permeable soils along the stream. The US Soils Conservation Service (now call the Natural Resources Conservation Service) categorizes soils by Hydrologic Soil Groups (HSG) A through D. HSG A are the most permeable soils and HSG D the least permeable. HSG A soils account for 22 percent of the total site. However, there is no impervious development to be located on A soils. B soils account for 28 percent of the total site. However, only 12 percent of the proposed impervious development is located on B soils. The bulk of the development, 82 percent, is located on the less pervious C soils.

The third LID principle is to maintain the current hydrologic conditions of the site. The design criteria for the facilities proposed is to maintain the current volume of water that infiltrates on the site. The facilities will serve multiple purposes. The plans prepared for the development show a condominium style of development that minimizes the utilization of land and the amount of impervious areas. The plan also incorporates the use of treatment and infiltration basins and galleries.

The amount of infiltration occurring on this site is analyzed using a water budget. An integral component of the water budget is initial abstraction. Initial abstraction is water that evaporates from land surfaces, transpires from plants, is stored in surface depressions and infiltrates into the soil. The water that evaporates from surfaces or is transpired though the leaves of vegetation is lost from water budget. Approximately 46 percent of the total annual rainfall is loss to evapotranspiration.[1] Water that is not lost through evapotranspiration or does not percolate into the ground becomes surface water runoff. This water will flow to the wetlands and then to Deep Brook. Initial Abstraction is the amount of water that a site can absorb before runoff occurs. The initial abstraction is dependant on the site soils and land use. Soils with high permeability rates will have higher initial abstraction volumes. Land uses with higher impermeability will have lower initial abstraction volumes. The NRCS has devised the Runoff Curve Number to relate land use and soils type to runoff volumes. Soils, for purposes infiltration analysis, are categorized by Hydrologic Soil Groups A through D. HSG A are the most permeable soils and HSG D the least permeable. For example, a meadow on A soils has a CN value of 30. Land with a CN value of 30 will be able to adsorb 4.66 inches of rain. Stated another way, 4.66 inches of rain must fall before runoff occurs. Pavement on any soil type has a CN value of 98. For this land use, rain in excess of only 0.04 inches will cause runoff to occur.

The following calculations are the basis for maintaining the base flow from this site. The amount of water that currently infiltrates into the ground is a function of the land use and soil types. The site contains about 52 percent meadows. Meadow is defined by the Soil

---

[1]"Aquifer Impact Assessment, Proposed Newtown Technology Park" March 28, 2007 by Leggette, Brashers & Graham, Inc.

Conservation Service, SCS, as land with "continuous grass, protected from grazing and generally mowed for hay." The remainder of the site, 48 percent, is woods in good condition. Good condition is defined by SCS as "Woods are protected from grazing, and litter and brush adequately cover the soil." The soils adjacent to Deep Brook are A soils and there are two pockets of B soils uphill of the A soils. The wetland corridors through the site are D soils. The remainder of the site is C soils. The distribution of the soil groups is 22% A soils, 28% B soils, 30% C soils and 20% D soils.

The existing land use by soil type was entered into TR-20, "Computer Program for Project Formulation Hydrology" to determine the Runoff Curve Number and runoff quantities. The CN value for the existing conditions is 59. The initial abstraction value for a CN of 59 is 1.39 inches of rain.

The same procedure was applied to the proposed land use as shown on the site plans for the Technology Park. This analysis is valid for any arrangement of building and parking area that have the amount of impervious area. For the proposed condition, four land use types were used: impervious surfaces that include buildings and paved areas, landscaping, meadows and woods. It is the recommendation of this plan that the undisturbed portions of the site are maintained in the existing condition. That is, areas that are currently hay fields be maintained as hay fields and areas that are currently wooded be maintained as wooded areas. The exception being those areas which are to become created wetland areas. (See Environmental Inventory, Evaluation and Impact Assessment by EPS) The CN value for the site with the proposed industrial park is 63. The initial abstraction for a CN value of 63 is 1.17 inches of rain.

The sizing of storm drainage and detention facilities are based on design storms (10-year, 25-year or 100-year storm). However, the calculations for base flow are based on small rainfall events. A review of the rainfall records of the NOAA weather station at Bridgeport, shows that the majority of the total annual rainfall occurs in the first one inch of rain and 94 percent of the total annual rainfall occurs in the first two inches of rain. The following table relates the inches of rainfall to the percent of total annual rainfall which occurs in storms of lower intensity.

TABLE 1
RAINFALL OCCURRENCE

| Inches of rain | Percent of total annual rainfall occurring in storms of lesser intensity[2] |
|---|---|
| 0.75 | 70 |
| 1.00 | 79 |
| 1.25 | 84 |
| 1.50 | 89 |
| 2.00 | 94 |

[2]Source: Computations of data by Spath Bjorklund Associates, Inc. of the U.S. Department of Commerce, NOAA, "Local Climatological Data, Bridgeport, Connecticut" for 20 years from 1990 to 2009)

The following table shows the fate of rain falling on the site in the existing and proposed condition. Row 1of the table shows the area of the site. Row 2 shows the volume of rainfall during a 1 ½ inch storm that will fall on the site (area x rainfall). Row 3 shows the volume of water loss through evapotranspiration. Evapotranspiration losses assumed to be 46% of total rainfall. (See LBG Report) Row 4 shows the volume of runoff as computed by the TR-20 program. (See Appendix A) In the existing condition, this is the amount of water exceeds the initial abstraction and becomes runoff. In the proposed condition, runoff is the amount of water that exceeds the initial abstraction and is not infiltrated in the Water Quality Basins or the subsurface galleries. Row 5 shows the amount of water that is infiltrating into the ground. This volume is the total rainfall minus the evapotranspiration loss minus the runoff.

TABLE 2
NEWTOWN TECHNOLOGY PARK
WATER BUDGET

| | | Existing Conditions | Proposed Conditions |
|---|---|---|---|
| 1 | Area, in acres | 41.74 | 41.74 |
| 2 | Volume of rainfall in 1 ½ " storm, in acft | 5.218 | 5.218 |
| 3 | Evapotrans. , in ac-ft | 2.400 | 2.400 |
| 4 | Volume of runoff, in ac-ft** | 0.006 | 0.000 |
| 5 | Volume of infiltration, in ac-ft | 2.812 | 2.818 |
| | | | |
| 6 | Volume of rainfall in 2 " storm, in acft | 6.957 | 6.957 |
| 7 | Evapotrans. , in ac-ft | 3.200 | 3.200 |
| 8 | Volume of runoff, in ac-ft** | 0.168 | 0.089 |
| 9 | Volume of infiltration, in ac-ft | 3.589 | 3.668 |

In a 1½ -inch storm, 5.218 acre-feet of water falls on the site. In both the existing and proposed condition, 2.40 acre-feet of water is lost through evaportranspiration. The 1½ -inch storm is slightly greater than the initial abstraction rate of 1.39 inches. Therefore, only 0.006 acre-feet of the rainfall becomes runoff. The remaining 2.812 acre-feet infiltrates into the groundwater. During a 2-inch storm, in the existing condition, 0.168 acre-feet of the rainfall becomes runoff. After evaportranspiration losses, 3.589 acre-feet of the rainfall infiltrates into the groundwater. The volumes of runoff were determined from the SCS TR-20 program. The results of the computer analysis are shown in Appendix A.

In the proposed condition, the runoff from the site would be increased if mitigation measure were not employed. In an 1 ½ inch storm, the volume of runoff without infiltration facilities would be 0.204 acre-feet. However, the proposed infiltration facilities will store this

entire volume and allow it to percolate into the ground. In the 2-inch storm, the volume of runoff without the facilities would be 0.418 acre-feet. The infiltration facilities will store and percolate 0.329 acre-feet. Therefore, only 0.089 acre-feet becomes runoff.

There are two types of infiltration facilities proposed for this development. The first type of facility is subsurface infiltration galleries. The galleries will receive the runoff from the roofs of the buildings. Roof runoff is essentially clean water since it does not contain suspended solids normally associated with road runoff. These galleries are designed to store, as a minimum, the runoff from a 1 ½ inch storm.

The second type of facility is Water Quality Basins. These basins are primarily designed to treat the runoff from paved areas. The volume of the basins was based on the required Water Quality Volume. The WQV is determined from the requirements of the 2004 Connecticut Water Quality Manual. However, the normal design has been modified by using a high-level overflow weir. The use of this type of weir will store the runoff in smaller storms. The runoff will percolate into the ground reducing the amount of runoff from the site.

The proposed plans show the entrance drive without curbs from Commerce Drive to near the parking lots. The runoff from this portion of the drive will sheet flow without a point discharge. No curbs will disconnect the impervious surfaces from the nearby wetlands, will store the runoff and will increase the time of concentration of the runoff. No curbs were used in this area because it is a through road with no vehicles parking. Hydrocarbons and other pollutants will be limited in this paved area because of the short duration the vehicles are on the road. In the parking areas near the buildings, curbs have been used to confine the pollutants and allow them to be treated in the Water Quality Basins.

The plans prepared for the development show the use of subsurface galleries for storing and infiltrating the runoff from the building roofs. The galleries are efficient means to infiltrate the water. However, there are a number of other facilities that can be used for infiltration. These include bioretention trenches, rain gardens, cisterns, filter/buffer strips, grass swales and other landscape features. The final design of the facilities will be determined as part of the Site Development Plan for development. Any of these facilities are satisfactory as long as they meet the criteria of storing and percolating at least the volume from a 1 ½ inch storm from the building roof area.

Other measures which could be incorporated into the final Site Development Plan include disconnecting the impervious surfaces from the drainage system and using open swales rather than pipe for the drainage system. It would also be possible to use no curbs on the parking lots and direct the runoff into a bioretention trench. The trench would have the capacity to store runoff to provide treatment and allow infiltration. Other measures include using roadside swales. Flow in the swales could be directed into a bioretention trench. These facilities disconnect the impervious surfaces from the drainage system, will store the runoff and will increase the time of concentration of the runoff. The disadvantage of these measures is they require more land area which will increase the amount of land disturbance. Also, additional mechanical water treatment devices may be necessary to provide water quality treatment.

## OTHER HYDROLOGIC CONSIDERATIONS

Another objective of this Stormwater Management Plan is to maintain the hydrology of the wetland areas on the site. There is a wetland corridor on the site which runs from the northwest to the southeast through the site. The corridor is fed by a 7.7 acre watershed located west of the railroad tracks. The runoff from this area flows in a culvert under the tracks. The flows to the wetlands will be maintained by two box culverts which will carry the flow under the entrance drive. There are four Water Quality Basins proposed to treat the runoff from all paved areas. These basins are located uphill of the wetland corridors. The infiltration from these basins will maintain the base flow to the existing wetlands and to the created wetlands.

## WATER QUALITY

All runoff from paved surfaces will be treated before discharging to a wetland or watercourse. The primary source of suspended solids will be from road sand used during the winter. The runoff from the driveways and parking lots will be directed to water quality basins. There will be four basins to remove sediment before entering an existing or creates wetlands or watercourse. These basins are sized based on the criteria of the 2004 Connecticut Stormwater Quality Manual. The criterion is to treat the Water Quality Volume, WQV. This volume is based on the total area tributary to the basin and the amount of impervious area tributary to the basin. For this site, the buildings are not included in the calculations of WQV because the runoff from the building roofs is being detained in galleries before entering the basin. These galleries are designed to store, as a minimum, the runoff from a 1 ½ inch storm. The WQV is based on treating the runoff from a 1 inch storm. Therefore, the runoff from the building roofs will not enter the basin during the design storm.

Table 3 shows the required WQV and the designed size of the basins.

TABLE 3
WATER QUALITY BASINS
REQUIREMENTS AND CAPACITIES

| | Basin 1 | Basin 2 | Basin 3 | Basin 4 |
|---|---|---|---|---|
| Tributary area, in acres | 0.50 | 0.55 | 0.45 | 4.70 |
| Percent impervious | 66 | 62 | 50 | 47 |
| WQV, in cubic feet | 1,176 | 1,220 | 828 | 8,059 |
| | | | | |
| Volume below outlet weir, cubic feet | 1,303 | 1,258 | 861 | 8,229 |

The Water Quality Basins have high-level overflow weirs to release runoff when it exceeds the capacity of the basin. These weirs are designed to dissipate the energy of the

outflow by maintaining the velocity of the flow to less than 2.5 feet per second. Velocities less than 2.5 feet per second are considered non erosive for sand and silt loam soils with vegetation in fair condition. (2002 Connecticut Guidelines for Soil Erosion and Sediment Control). Table 4 shows the design of the overflow weirs.

TABLE 4
WATER QUALITY BASIN OVERFLOW WEIRS

| | Basin 1 | Basin 2 | Basin 3 | Basin 4 |
|---|---|---|---|---|
| 25-year storm outflow, in cfs | 4.42 | 4.38 | 2.70 | 17.48 |
| 25-year depth of outflow, in ft | 0.33 | 0.33 | 0.20 | 0.56 |
| | | | | |
| Weir length, in feet | 7 | 7 | 7 | 15 |
| Cross-sectional area of outflow, in square feet | 2.31 | 2.31 | 1.40 | 8.40 |
| outflow velocity, in fps | 1.91 | 1.90 | 1.93 | 2.08 |

## THERMAL POLLUTION

During summer months, rain falling on pavement is heated and the runoff carries the heat to the stream into which it discharges. Without mitigation, the runoff from the proposed project would flow into Deep Brook. However, all road runoff will enter a Water Quality Basin. The basins have the capacity to store and infiltrate all storms up to 1 ½ inches. These basins are design to store the runoff from a storm and allow it to infiltrate into the groundwater which will then seep into the downstream wetland areas. This will allow the runoff to mix with cool groundwater. The ground water and surface water from the wetlands will flow to Deep Brook. This water will be at the same temperature as currently flows to the Brook.

## WETLANDS MITIGATION PLAN

The site plan for the Technology Park proposes several mitigation measures to offset the wetlands disturbance caused by the entrance driveway. These include creating new wetland areas, enhancing existing wetland areas and enhancing upland areas near these wetlands. See “Environmental Inventory, Evaluation and Impact Assessment” by EPS for a complete description. There are three created wetland areas near the existing wetlands downhill of the Water Quality Basins. Soil testing in these areas determined that with some soil excavation hydrologic conditions can be established which will support a wetland. Further, the infiltration of the storm water from the water quality basins will help maintain these hydrologic conditions. The created wetland areas will contain 0.76 acres.

The plan also proposes to restore two existing wetland areas. The first area has been converted into a wet mowed hay field. This area will be re-vegetated with grasses, forbs,

shrubs and trees. The second area is an existing stream crossing in the wetlands. The existing stone ford will be removed and the area will be re-vegetated. The total wetland enhancement area will be 0.39 acres.

Invasive species are found along the perimeter of the mowed area in both the wetland and upland soils. An enhancement program is proposed to remove these invasive species and deter their return.

The proposed wetland mitigation plan will enhance and expand the functions of the onsite wetlands. These functions include groundwater recharge, flood storage and sediment and nutrient removal.

## DETENTION

The design criteria for detention facilities are based on large storms called design storms. Normally, the storms occur less than once per year and they account for less than 3 percent of the total annual rainfall. The Technology Park is located in the lower portion of the Deep Brook watershed. The time of concentration of the runoff from the entire watershed to the point of discharge from this site is approximately 4 hours and 10 minutes. The time of concentration of the runoff in the Pootatuck River from the entire watershed to the confluence with Deep Brook is approximately 4 hours and 40 minutes. The time of concentration for the portion of the site tributary infiltration basin is about 20 minutes. The peak flow from the site will pass through the streams before the peak flow of the streams occurs.

Detention basins reduce the peak flow rate. However, the basins will also delay the time the peak flow will leave a detention basin. The delay is caused by the temporary storage to allow a reduction in the flow rate. For example, the peak flow into Water Quality Basin 4 will occur about fifteen minutes after the maximum rainfall intensity occurs. The peak outflow out of the basin will occur about 62 minutes after the maximum rainfall intensity occurs. (The purpose of this basin is water quality treatment and infiltration and not detention. The peak flow reduction and time delay is less than in a detention basin.) When a site is located in the lower potion of the watershed, the delay will cause the peak flow from the site to occur closer to the time of the peak flow of the watershed. This may cause the flow in the stream to be higher in spite of the reduction caused by the detention basin. Therefore, detention is not proposed for the development.

## RIPARIAN BUFFER

The industrial condominium development was design to follow LID guidelines by placing the buildings on the less permeable C soils near the railroad tracks and avoiding the A and B soils nearest to Deep Brook. This area is more favorable for development. The Technology Park will be sited on the westerly 23.19 acres parcel. The current application does not propose any development on the easterly 18.56 acre parcel." The distance from Deep Brook to the nearest disturbance of this project ,the created wetlands, is about 530 feet.

APPENDIX A

TR-20

RUNOFF COMPUTATIONS

# EXISTING CONDITIONS

PROPOSED CONDITIONS