Sustainable Landscaping
Williams College

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Integrated Pest Management

Integrated Pest Management (IPM) is an environmentally sensitive approach to pest management that relies on a combination of commonsense practices. Pests are populations of living organisms (animals, plants, or microorganisms) that interfere with use of the college for human purposes. They are managed for aesthetics, to reduce any potential human health hazard, prevent damage to school property, prevent pests or diseases from spreading beyond the college campus, and to enhance the quality of life for students, staff, faculty, and visitors. Strategies for managing pest populations are determined by the pest species and whether it poses a threat to people, property, or the environment. This document addresses the management of outdoor pests of turf and other plants including weeds, insects, and diseases (fungi).

IPM combines four different practices to control any given pest situation: cultural, mechanical, biological, and chemical. Cultural practices are preventative measures to create inhospitable environments for pests. Mechanical controls physically remove the pests. Biological control is releasing beneficial insects that prey on harmful pests. Chemical controls include pesticides (herbicide, insecticide, and fungicide) and natural compounds (insecticidal soaps, compost tea, vinegar and citric acid). IPM stresses only applying chemicals after all other methods have been tried and places emphasis on using the least toxic methods. Cost and staffing should not be adequate justification for the use of chemical controls.

In order for this to be plausible, natural preventative measures must be a priority. This begins with choosing the proper landscaping materials. Trees and shrubs should be chosen that require little water and maintenance, are insect and disease resistant, and if are non-native should not out-compete native species. A sustainable lawn care program should use a mix of grasses that are adapted to the local climate instead of a monoculture turf that requires excessive synthetic fertilizer and pesticide to maintain the desired aesthetic. It also means maintaining thick ground cover of grass, which outcompetes and masks weeds. This can be achieved by proper watering and mowing practices, among other things. Irrigation should be timed to eliminate moisture stress but also minimize duration of leaf wetness, both of which would encourage disease infestation. Mowing should be performed at maximum possible height for functional use and clippings should be left to recycle nutrients into the turf canopy.

This is only a short summary of cultural practices that are a part of an effective IPM plan, but they play a very crucial role. Taking natural preventative measures to reduce pest infestation will limit the amount of curative action that will be needed. For the most part, natural measures are only effective as preventative measures. Once a pest problem arises, it will either require mechanical, biological, or chemical control measures. All of these control measures involve some cost from purchasing the tools or chemicals to paying staff to implement them, in addition to the time lost in the process. Typically, biological control measures are not used for turf related pest problems.

One concern associated with the use of chemical controls is direct human contact when people use the fields that have been treated. There are regulatory agencies that outline which chemicals are appropriate to be used when human contact will happen. Even if a pesticide has been rated safe for treating an area with human contact, caution should be exercised when applying chemicals. Limiting the amount of pesticide use particularly protects the health of the licensed applicators that have the highest risk of over exposure. Additionally, the health of other mammals and birds that use the grass must be considered.

From an environmental standpoint, effective cultural practices are the key to avoiding chemical controls, which can have a negative impact on the surrounding area. The overall goal in an effective IPM plan when applying pesticides should be to minimize the amount of chemicals used. This means applying the pesticide in the most efficient and effective manner. To be as efficient as possible the machine applicators should be calibrated properly and checked regularly. Being as effective as possible is accomplished by applying the treatment when the weed, insect, or disease is in its most susceptible stage.

Additionally, there should be a conscious effort to contain all pesticide material applied to the intended area. Turf or plants that come in contact with pesticides, but were not meant to be treated, can suffer from chemical burn and even go dormant or die. Nearby groundwater can be contaminated by stormwater runoff that passes over turf that has recently been treated with fertilizer or pesticide and carries chemicals. This can reduce the water quality and make it less safe for human consumption. Also, when pesticides enter water they can have a negative effect on aquatic plants and animals. Pesticides meant to treat a grass turf may damage aquatic habitats to the point where it can no longer support all of the animal populations it once had. This can be prevented in part by checking the weather forecast and avoiding chemical treatment just before rain is predicted.

These are all general principles of integrated pest management. More important is making decisions on a situational basis. It is up to the individual/ institution to evaluate the circumstances and potential pest problems and choose the least toxic but effective means of control. The following provides a summary of the IPM program of Williams College.

The Fields

Williams College has turf for different purposes and as a result they receive different maintenance treatments. The turfgrass species on campus are Kentucky bluegrass, perennial ryegrass and fescue. They are categorized below by function:

Priority A "Game Fields"
These fields are where varsity and junior varsity competitions are held. They are expected to meet NCAA standards for play and as a result require the most maintenance.

- Weston Field- Football
- Coombs Field- Baseball
- Cole Fields- Men's Soccer
  Women's Soccer
- Softball Field

Priority B "Practice Fields"
These fields are where varsity and junior varsity teams can practice. These fields are given much less maintenance than the game fields. Their upkeep is much closer to that of the common grounds. However, they are occasionally given extra care to maintain a field that is functional for a safe and productive practice. Only soccer has additional fields for practice. All other sports use their game field as a practice field. Typically, club sports and intramural sports do not have game fields or practice fields that are maintained as Varsity/ Junior Varsity sports do. Instead they play on fields that are maintained as all common grounds. The only exception is Rugby. For no specific reason, Men's and Women's Rugby have always played on athletic fields that are maintained in the same way as the soccer practice fields, despite being a club sport.

- Men's Soccer Practice
- Women's Soccer Practice
- Men's Rugby
- Women's Rugby

Priority C "Common Grounds"
These fields are the lawns surrounding residence halls, academic buildings, dining halls, and other college buildings. These are for day-to-day use, but not athletic events. They are typically used for gathering, relaxing, eating a meal, or playing Frisbee. This is where larger outdoor events take place as well, which usually involve a tent. These fields are not maintained to a high standard beyond being functional for use.

Priority D "Meadow"
There are a few areas of campus that are meadow, instead of typical turf grass. These are very low maintenance. They are in natural areas, utility areas, and on property edges. They require essentially no maintenance.

In addition to the natural turf fields on campus, the college has an artificial turf field, Lamb Field. This is where Women's Field Hockey and Men's and Women's Lacrosse games are played. However this field does not require the type of maintenance that pertains to IPM principles.

Cultural Practices

Species Selection. Williams College does not only landscape with native species. In choosing a species of tree or shrub to plant, priority is given to whether or not the plant is susceptible to common diseases in the area. The college would rather plant a non-native species that will not contract a disease and require applications of toxic chemicals than a native species that is going to need to be treated with pesticide. The college also tries to plant a variety of species so if a disease does target some trees or shrubs, not every plant on campus will suffer.

Soil Health. The pH is only monitored for the Priority A game fields. Typically, the pH is high on Williams' fields: between 7.2 and 7.6 (above the ideal range of 5.5 to 6.5). This is because the town water, which is used to water the game fields, has a pH of 7.6. However, this elevated soil pH has not lead to a noticeable decline in turf health or increased maintenance. The high pH of the water has only affected the health of the turfgrass of the infield of the baseball field. This is discussed below under the Watering section.

The pH of the soil of the non-game fields (Priority B, C and D) is not monitored and is therefore not maintained to be at a certain level. These fields do not have issues that indicate that the pH is drastically different than the optimal level.

Only the game fields (Priority A) soils are tested for phosphorous and potassium to determine the need for fertilization.

Mowing. The mowing heights are maintained as high as possible for functional use. During the playing season, the grass of the competition fields (Priority A) is maintained at an inch and a half per NCAA standards. This equates to mowing the game fields twice per week, which is typically just before a game. During the off-season, the height of the grass is raised to two inches which is accomplished by mowing approximately once per week. The practice fields and common grounds (Priority B and C) are mowed approximately once per week, keeping them at a height around two inches. During times of heavy rainfall this can increase to three times per week. The areas of campus that are meadow (Priority D) are mowed once per year to maintain the general appearance of the area. The height and sharpness of the blades of mowers are constantly monitored and adjusted as needed. All of these practices promote sustainability by reducing the time spent mowing and the amount of diesel and gas used by the mowers. Having a sharp blade avoids bruising and tearing the grass, which would make it more susceptible to disease and dormancy during drought. This is an important preventative measure that limits the amount of irrigation, fertilizer, and pesticide needed to maintain a healthy lawn.

Also, the grass clippings are always left on the grass to be recycled into the turf canopy. The clippings can decompose and return nutrients to the soil. "Grass-cycling" acts as a natural fertilizer to improve turf health. This reduces the need for synthetic fertilizers and slows water loss during high temperatures. Leaving grass clippings on the lawn also reduces the amount of material that enters the municipal waste system and eventually landfills.

Watering. The college does very little irrigation. None of the practice fields, common grounds or meadow areas is irrigated. All of the water that these fields receive comes from rainwater. The only turf that is irrigated is on the game fields (Priority A). They are watered by permanent in-ground irrigation systems. The goal is to constantly maintain an inch of water per vertical foot of soil per week. To save time and money, this is only a rough estimate, evaluated by feeling soil samples and comparing to a chart to determine relative moisture. These fields are also visually monitored daily for moisture stress by looking for brown or wilting spots. The irrigation system is not set on a permanent timer schedule. It is only turned on if the water level is getting low or if a hot, dry day is predicted. This practice is important because the water that is used in the irrigation system comes from Williamstown's potable water source. A benefit of only watering as necessary is that the game fields are irrigated to minimize the duration of leaf wetness. This means watering early enough in the day that the grass is not damp when night falls. Moisture encourages disease so minimizing leaf wetness discourages disease and reduces the need for preventative and curative pesticides. Enough water is always provided after lawn installation, repair, and over-seeding. Having adequate water encourages the new seed to begin to root, and prevents them from being blown away or washed away by stormwater.

To promote sustainability, the goal is to minimize the use of potable water for irrigation purposes. Not watering the practice fields and common grounds and only irrigating the game fields as needed is done in accordance with this goal. Using the alkaline potable water from Williamstown for irrigation has had a visible negative effect on some campus turf. The town water used to irrigate has an elevated pH of around 7.7. Using this water for irrigation has contributed to the raise in soil pH to between 7.2 and 7.6, higher than the optimal level (5.5-6.5). On most fields, this has had no noticeable results. However, the turf of the infield of the baseball field is grown on a sand-based soil. The elevated water pH in combination with the sandy soil raises the soil pH too high to make iron available to the roots of the grass. As a result, the turf suffers from discoloration because of iron chlorosis. To treat this disease, a foliar application of pure iron and manganese must be made. However, the turf does not absorb all the iron and manganese when they are received through a foliar application, and, under some circumstances can lead to elevated iron and manganese concentrations in the soil.

Fertilization. The college takes some natural steps for fertilization. Grass-cycling returns nutrients to the soil, and frequent aeration helps those nutrients to be more accessible by the grass roots. An organic, slow-release fertilizer called NatureSafe 21-3-7 is applied to the common grounds (Priority C) in the autumn at 1.5 pounds of nitrogen per 1000 square feet. This fertilizer is a sustainable approach to improving soil health. The slow release application in the fall also nourishes the soil during the harsh winter months. Once the snow melts and temperatures begin to warm up, the new grass can emerge thick and healthy. The cool season turf of all of the lawns (Kentucky ryegrass and fescue) prefers this type of fertilizer application.

For fertilization, the college follows the principles of IPM and tries grass-cycling and aeration, before organic treatments and only resorts to synthetic fertilizers on the game fields and practice fields (Priority A and B). It has been decided that the organic fertilizer is not effective enough for the heavily used turf. The Baseball infield is fertilized every 6 weeks with 19-19-19 at 0.75 pounds of nitrogen per 1000 square feet from the end of April to mid October. Both game fields and practice fields are fertilized as follows:

• First week of June and last week in August: Fertilzed with Polyon 26-0-13 at 1.25 lbs nitrogen per 1000 sq ft.

• Last week of October: Fertilzed with 19-19-19 at 1.5 lbs nitrogen per 1000 sq ft.

Aeration. Aeration is an important practice to naturally improve soil health without any chemical applications. It reduces compaction allowing stronger root systems, increases soil oxygen necessary for proper plant growth and improves water infiltration to increase the delivery of moisture. However, it is time consuming. So, only the game fields are aerated, both hollow core and slice. The practice fields (Priority B) are only slice aerated in front of the goal areas as needed. The slice aerating can be done at any time because it does not pull up soil plugs that would not be acceptable on a competition field during a game. So it is done frequently, especially in front of the goal areas for soccer where compaction is the most severe. Hollow core aerating is done twice a year once in the fall and once in the spring. Because it stresses the grass it cannot be done during the hot summer. After core aerating, the plugs are dragged and used as topdressing to over-seed the playing fields. This is a sustainable practice because it recycles materials already at the site to enhance the turf vitality instead of bringing in new topdressing.

Pest Control

The college does not exclusively use pesticides that meet the standards for organic crop production set by the U.S. Department of Agriculture or the Canadian Organic Standards (excluding on-campus farms). However, the college does not use chemicals banned by the Groundwater Protection List at Lower Cole Field and is further limited in chemical choice because the baseball field is in the Wellhead Zone.

Weed Management. The college's approach to weed management is commendable. Most controls are cultural preventative measures. Only weed-free sod and seeds are used for installation or renovation. Also, two slow-release fertilizers called NatureSafe® and Polyo® are used. Their slow-release nature never makes excess nitrogen available at any one time to weeds that thrive on it. Another preventative natural measure is the college's aeration schedule, which takes into the consideration periods conducive to crabgrass and *Poa annua* germination. Core aeration is necessary to reduce compaction allowing stronger root systems, increase soil oxygen necessary for proper plant growth and to improve water infiltration to increase the delivery of moisture. However, aeration exposes the cored soil to sunlight, which helps most weeds grow. The college also tries to manage weeds by mowing often enough to mow down the weed seed heads to reduce weed infestation. However some weeds, such as *Poa annua*, have a very low seed head; so, mowing does not prevent weed growth but definitely reduces its infestation.

In terms of treatment of weeds, for the most part the college chooses not control at all. Weeds in the Priority B, C and D fields are not managed and not treated with any herbicides.

The natural preventative measures are taken on all of the grass turf fields. However, the game fields (Priority A) are treated with herbicides. In order to promote sustainability, the goal is to minimize the amount of herbicide used and maximize its effectiveness. Usually, the herbicide is only applied as needed once a weed has begun to grow. The college tries to use spot spraying treatment for big patches of crabgrass and broadleaf plantain. The college chooses this as a more sustainable approach to weed management rather than treating an entire field either preventatively or post-emergent. Roundup® is spot sprayed on the grass skinned sand areas of the Baseball and Softball fields. However, it is a non-selective herbicide so it will kill any of the grass on the infield or outfield if it comes in contact with it. If the weeds in the sand are close to the grass of the infield or outfield, then Speedzone®, a selective herbicide, is used so that the grass is not damaged.

However, some areas that are particularly prone to crabgrass such as the softball and baseball fields are treated with a pre-emergence herbicide. To make the application of the herbicide most effective, they are applied at the weeds' most vulnerable growth stage (spring). A pure potassium fertilizer with pre-emergent crabgrass control is applied. This is only used on fields that are not going to be aerated then over-seeded afterward. A field cannot be over-seeded after a pre-emergent herbicide has been applied because the herbicide would kill the new seeds.

When selecting an herbicide, the college considers its active ingredients and selects those with lowest toxicity. Products containing 2,4-d are avoided as best as possible. Very rarely is Trimec, a 2,4-d containing product, used. It is applied if there is an unusually large weed infestation on the game fields. This has only been applied once in the last eight years.

Weeds growing through cracks in pavement or through rocks surrounding a building are spot-sprayed with Roundup®.

<u>Insect Management.</u> The goal for sustainable insect management is the same as weed management: to first use natural preventative techniques, then use insecticides sparingly and as effectively as possible. The primary cultural control for preventing insect infestation is core aerating to remove thatch that would help insects thrive.

Beyond this, essentially no active measures are taken to manage insects on the practice fields and common grounds (Priority B and C) because they rarely pose a problem. If an insect problem were to arise, it would probably be white grub, and would be spot treated with Dylox®. Because Dylox® may have some negative effects on the environment, it is used rarely and in as small of doses as possible to be effective.

Only the game fields (Priority A) are treated with a preventative insecticide called

Merit® whose mode of action is neurotoxicity. They are treated with grub control in June when the white grub is most susceptible in its egg laying stage. This maximizes the effectiveness of what insecticide does need to be applied in order to eliminate curative treatments.

Disease Management. As with weeds and insects, the college tries to use cultural preventative disease management methods and natural controls before applying any fungicides. The first step to naturally preventing disease takes place during landscaping. Shrubs and trees are spread out far enough for proper air circulation and to minimize shade that would lock in moisture and encourage disease. Another cultural practice to prevent disease is using watering techniques that minimize the duration of leaf wetness that encourages disease. Also, excessive thatch is managed through aeration that eliminates an environment for a fungus to thrive in. Typically disease does not affect the common grounds and practice fields because the majority of the lawn is weed and is not susceptible to diseases that target grasses.

However, there are three diseases on the game fields that must be treated, and are done so preventatively: summer patch, brown patch, and Pythium blight. Because the game fields are maintained weed-free, they are much more susceptible to these diseases. They are applied every 21 to 28 days during the summer depending upon the temperature conditions. Typically the fungicides are applied two to three times throughout the summer. A propiconazole fungicide is used for the first summer patch treatment and a product called Insignia® for the last two treatments. The Insignia® is also effective for treating brown patch. A product called Armortech-44® is a fertilizer used to treat Pythium blight. Though a fungicide must be applied, consideration is given to its pesticide nature. In order to minimize phyto-toxicity, fungicides are never applied above 85 degrees or during times of dry weather. Also, the area treated is roped off for 24 hours after application and a sign is posted with the chemical name to minimize the likelihood of human contact.

Chemical Applications

Fertilizers

Most commercial fertilizers contain nitrogen, phosphorous, and potassium, the major nutrients needed for turf and plant growth. Fertilizers are given a name followed by three numbers which indicate the percentage by weight of nitrogen, phosphorous, and potassium, respectively. For example Polyon® 26-0-13 is 26% nitrogen by weight, 0% phosphorous by weight, and 13% potassium by weight. The following table provides a list of the fertilizers used of all of the fertilizers used on campus.

Fertilizer	Place of Application	Time of Application	Application Amounts
NatureSafe® 21-7-13	All common grounds (Priority C)	Fall	1.5 pounds of nitrogen per 1000 square feet
19-19-19	Baseball Infield (Priority A) All competition fields and practice fields (Priority A and B)	Infield: Every six weeks from end of March to mid-October Other game and practice fields: last week of October	Infield: 0.75 pounds of nitrogen per 1000 square feet Other game and practice fields: 1.5 pounds of nitrogen per 1000 square feet
Polyon® 26-0-13	All competition fields and practice fields (Priority A and B)	First week of June and last week of August	1.25 pounds of nitrogen per 1000 square feet

Pesticide Appendix

Chemical Name	Use	Active Ingredients
Merit®	White grub control	Imidacloprid
Roundup®	Weed control	Glyphosate
Dylox®	White grub control	Trichlorfon
Speedzone®		2,4-D MCPP Dicamba Carfentrazone
	Pythium blight	Urea Phosphite
Propiconazole	Summer patch and brown patch	Propiconazole
Insignia®	Summer patch	Pyraclostrobin

Ice Removal. For ice removal, the college uses either sodium chloride (halite, rock salt) or magnesium chloride. Sodium chloride is used the majority of the time in a 3 parts sand, 1 part rock salt mixture. Magnesium chloride is more expensive and is only used on parking garages and at the entryway of buildings. The magnesium chloride is used on the parking garages because it does not eat away at the connecting joints of the structure as rock salt would. Also, magnesium chloride does not destroy the grass like sodium chloride. In the spring when the snow melts, yellow patches where sodium chloride killed the grass can be seen. These chemicals can have a negative effect on the grass and nearby groundwater plants and animals in concentrated amounts. However, safety is a number one priority and these chemicals effectively remove ice.

Green Waste. The college is committed to recycling as much as possible and reducing the amount of unnecessary waste that enters the municipal waste system and eventually landfills. Included in "unnecessary waste" is green material. This includes grass clippings, shrub and tree trimmings, large logs and trees. All grass clippings are recycled into the turf canopy to return essential nutrients into the soil. Leaves and non-woody herbaceous plant material are transferred to the composting operation at Peace Valley Farm, Treadwell Hollow Road, Williamstown, MA. Wood chips are firstly given to Caretaker Farm on Hancock Road, Williamstown, MA. Caretaker Farm is a local, organic farm that uses the woodchips for compost. If Caretaker Farm does not have need for woodchips, they are put in the Williamstown landfill "stump dump." All logs and stumps go to the town landfill. The logs are burned in the DPW wood furnace. Tree contractors take away all waste and either take the logs to the town landfill or sell the wood for firewood.

Street Cleaning. The streets are typically cleaned just after snowmelt. The debris from the streets is collected and piled in the Denison Park maintenance facility area until all of the streets and sidewalks have been cleaned. Then it is taken to the Williamstown landfill.

On campus a few years ago there was a chemical spill. After it was cleaned up, the spill was mitigated by the college labeling all sewer drains.

Catch Basin Cleaning. The catch basins in the drainage systems collect excess water that the ground could not absorb, filter out solids, and direct the water to nearby groundwater. However, the debris that they filter accumulates, and eventually needs to be removed from the catch basins. In the past the college has cleaned every catch basin once per year, usually in the fall. Some are not accessible to the large vacuum truck. These are done periodically by hand on an as needed basis. Starting this year (2009), half will be cleaned every other year due to budgetary constraints. The liquid material removed from the catch basin is drained into the sanitary sewer and the debris is generally dumped at Mt. Hope Farm and then carted to a fill site off campus.

Wetland and Groundwater Protection/ Stormwater Management. The first step to promoting sustainable landscaping as it pertains to groundwater protection is proper site selection for projects. Construction of building sites can damage site ecology, indigenous plants and regional animal populations. Ecological site damage can be reduced by restoring native and adapted vegetation and other ecologically appropriate features on the site, which in turn provides habitat for fauna. Open space and sensitive areas should be protected by strict boundaries to reduce damage to site ecology and preserve wildlife habitat.

Williams College recognizes wetland boundaries that have been defined by the state. However, since 1972, the College has authorized construction within these buffer zones with permission of the local Conservation Commission. On campus, there are two groundwater sources whose protection should be a top priority with any landscaping plan. The first is Christmas Brook that runs on the south side of campus and the second is the Hoosic River on the north side of campus. Lamb Field is a 2-acre artificial turf field where field hockey and men's and women's lacrosse take place that neighbors Christmas Brook. When Lamb Field was constructed in 2004, one acre of it was built within the Wetland Buffer Zone. As mandated by the state, this loss could either be mitigated on or off site. The college chose to mitigate off site. It signed a contract that guarantees that Williams College will never develop on a specified two acres of wetland that the college owns just off of the Green River at the Mount Hope Farm facility.

Proper site selection is only the first step in preserving wetlands and protecting groundwater features. Effective stormwater management practices are important as well. Development can disrupt natural stormwater flows and introduces contaminants into the water sources. When vegetation is removed and/or impervious surfaces are created, the natural capacity of the land to absorb rainfall is reduced ad the amount of stormwater runoff increases. An increase in stormwater volume entering groundwater exposes stream beds and banks to more erosive flows and can result in channel-widening. The stormwater can contain sediment and other contaminants that may have a negative effect on water quality. This can be limited with stormwater mitigation tools in two ways: using alternative surfaces and non constructional techniques. Alternative surfaces include vegetated roofs and pervious pavement and nonconstructional techniques include rain gardens and disconnection of imperviousness, and stormwater recycling. The college has adopted enhanced stormwater management practices recently. The recently constructed academic buildings feature green roofs and a rain garden. The green roof allows stormwater to be absorbed by the vegetation and soil on the roof and reduces the amount of water that enters the stormwater system. The rain garden is a planted depression that allows rainwater runoff from impervious areas like roofs, driveways, walkways, and compacted lawn areas the opportunity to be absorbed. This reduces rain runoff by allowing stormwater to soak into the ground as opposed to flowing into storm drains and surface waters which can lead to erosion, water pollution, flooding.

Williams College faces a specific challenge with groundwater protection because of the location of its competition game fields. Williams College is in a Zone II Wellhead Protection area, which limits which chemicals may be used on campus. The college complies with the ban on chemicals on the Wetland Protection list. Also, the campus abides by any restrictions that are placed on landscaping or construction in wetland buffer zones and riparian zones.

On the South end of campus, Weston Football Field and the synthetic Lamb Field neighbor Christmas Brook. The football field is irrigated and treated with synthetic fertilizers and pesticides. Extra consideration needs to be given how to contain the irrigation water and chemical applications to the desired area and avoid contaminating the brook. The fields are monitored daily for moisture content and are only watered to maintain one inch of water in the soil at all times. This prevents the irrigation system from providing too much water that cannot be absorbed and would run into the brook. Also, the college avoids applying fertilizers and pesticides just before a rain storm. The heavy traffic in the area could also pose a threat to the ecology of the brook. There is a paved parking area that is used for games that is close to the brook and increases the opportunity for car fluid and debris from cars to contaminate the water. Since part of Lamb field was built in the brook’s wetland buffer zone, the human activity could also threaten the natural boundary of wetland vegetation separating the brook and the game field.

Similarly, the baseball fields, softball fields, and soccer fields border the Hoosic River. Since these fields are also irrigated and treated with synthetic fertilizers and pesticides, the same consideration needs to be given to containing irrigation water and chemicals to prevent river contamination. When the baseball field near the Hoosic River was renovated, the college was required to provide water samples from the drain water from the field to the state for five years. The school had to prove that the water from the fields that was entering the Hoosic did not contain elevated levels of nitrates or nitrites. None of these samples have ever had elevated levels of these contaminants.

When Weston Football field is renovated the college is going to make improvements in stormwater management and treatment. A new drainage system is going to provide better filtering and reduce runoff. Currently, the drainage system involves drains that send water into catch basins that have silt filters to try to collect debris in the runoff before it enters into nearby Christmas brook. The new drainage system incorporates rain gardens that allow more opportunity for stormwater to recharge the soil. The crushed pea stone below the rain garden will act as a primary filter of suspended solids before any excess water is directed into a catch basin and filtered again.

The college also takes some common sense measures to protect groundwater during construction and landscaping maintenance. During construction, the entire perimeter of the construction site must be surrounded by a silt fence, which must be checked daily. Then, any extra materials such as topsoil that will be stockpiled for use later must also be surrounded by an additional silt fence. These fences are permeable enough to allow water to pass through but not enough to allow any solids to pass through that would accumulate in the nearby water sources.

Suggestions to Continue Sustainable Landscaping at Williams College

Lawn Mowers. The lawn mowers run on gas and diesel. The college could look into transitioning to biodiesel to fuel the mowers and perhaps the smaller landscaping equipment. This could be complicated by the fact that a manufacture warranty on a mower may not be valid if it is running on biodiesel rather than the suggested fuel. Also, biodiesel does not perform well in cold temperatures. However, this should not be an issue since mowing is not done during the winter when the weather would be cold enough to effect biodiesel texture.

Potable Water. Williams College is moving towards sustainable landscaping by only irrigating the game fields and relying on rainwater to provide moisture to all other lawns. However, the water that is used for irrigation is potable, and taken from the town water supply. Perhaps a source of non-potable water should be investigated. This can be done by collecting stormwater and storing until needed. However, this can be both challenging and very expensive. During the summer, the most water is needed to maintain a health lawn. However, this is typically the driest time of year. It may be difficult to collect enough water during the more wet seasons to provide for the dry summer months. Developing a collection and filtering method can also be a challenge. The college does not have any ponds to collect water that it can draw from. So, there would need to be a vessel to collect all the water. Elon University irrigates with 100% stormwater. The majority of the stormwater is directed to ponds on campus, which are then pumped from into portable containers to water and irrigate lawns and plants. In 2008 all of the automatic irrigation systems were connected to the ponds.

Weed Control. Williams College follows an Integrated Pest Management (IPM) plan to manage weeds across campus. It strives to limit the amount of herbicides used and instead relies on natural preventative measures. Yet weeds growing through cracks in pavement or through rocks surrounding a building are spot-sprayed with Roundup. Hand removing them would require more time and manpower. Perhaps there could be a way to be more time-efficient in one area of the daily landscaping routine so that more time is available to hand pick weeds. Perhaps students could voluntarily participate in this as well.

Permeable Pavement. No permeable paving has been incorporated into the campus, though it has been considered at Weston Field. The issue was that soil that the permeable paving was going to be placed on had a very low percolation rate. This means that though stormwater could pass through the paving surface, it would not be absorbed into the ground and essentially the same amount of water would runoff and carry sediment as it would with non-permeable pavement. If permeable paving is going to be added, the soil at the location will need to be in proper condition to absorb the water that passes through the paving. Alternatively, a sub-base of crushed stone under the permeable paving could retain water long enough to allow its penetration into the clay layer.

Ice Removal. Ice removal is done with a sodium chloride and sand mixture or magnesium chloride. Both of these chemicals in concentrated amounts can have a negative effect on the environment. Sodium chloride can burn the grass leaving yellow spots when the snow melts. If they enter groundwater sources through stormwater runoff, they can be mildly toxic to aquatic plants and animals. Though more gentle chemicals such as potassium acetate (KA) and Calcium

Magnesium Acetate (CMA) can be used, it has been shown that they are less effective and more expensive. Since safety is a priority during the icy months, it is most likely that sodium chloride and magnesium chloride will continue to be used.

Also, the sand used in combination with the chemicals could also ender streams and rivers through runoff. An accumulation of excess sediment may disrupt water flow and animal habitats. Though a large amount of sand would be needed to be destructive, consideration should be given to limiting the amount of sand that can runoff to groundwater sources. This can be done by making sure that sand has been thoroughly swept up after a storm.

Green Waste. The College makes an effort to recycle green waste when possible. Grass clippings from lawn mowing are not collected and woodchips are given to Caretaker Farm. However, when Caretaker Farm does not need wood chips or the college has larger stumps, logs, and trees, they are taken to the landfill. Here they are either put in the landfill or burned in the wood furnace. Improvements could be made to reuse more of the woodchips on campus. Perhaps the college could find a company nearby that could turn logs and trees into wood chips that could be used for landscaping on campus. This could help reduce the amount of green waste that enters the municipal waste system.

Debris. Consideration is given to how to protect nearby groundwater from chemicals. This means respecting wetland buffer zones and reducing chemical-tainted runoff. However, another type of pollution is debris that can reach groundwater is through the drainage systems. Now on campus, the drains are labeled to draw attention to them in hopes of reducing the amount of waste that is put into them. A less obvious contaminant of the drains is through street cleaning and catch basin cleaning. When the streets are cleaned, the debris is collected by the machine and piled at the Agway waste processing facility. However, some debris may still be pushed into drains on the edges of campus.

After all the streets have been cleaned and the debris has been collected, it is sent to the landfill. However, the Agway waste processing facility borders Christmas Brook. It is possible that some debris piled from street cleaning can be blown or washed into the brook. A buildup of solids in the brook can disrupt water flows and aquatic habitats. Another concern with groundwater contamination by debris is from catch basin cleaning. The liquid from the catch basins is drained into the sewers. However, this water may have suspended solids in it that will not be filtered out. Then, the solid waste from the catch basin that has been vacuumed out is dumped at nearby Mt. Hope Farm, which neighbors the Green River. Then it is taken to a fill site off campus. Again, it is possible that piled solid debris may enter the Green River through wind or stormwater. The college could take measures to ensure this does not happen. For example, when debris is stockpiled before entering the landfill or before being used as fill off campus, it should not be stockpiled near groundwater sources. Also, it could be covered to prevent wind and stormwater from carrying it to groundwater.

More Rain Gardens. Outside of the newly built South Academic Building, a rain garden has been planted. The rain garden is a planted depression that allows rainwater runoff from impervious areas like roofs, driveways, walkways, and compacted lawn areas the opportunity to be absorbed. This reduces rain runoff by allowing stormwater to soak into the ground as opposed to flowing into storm drains and surface waters which can lead to erosion, water pollution, flooding. As the College takes on new construction projects, it should make a point to incorporate a rain garden into the landscaping design if the new project is near a large amount of impervious surface.

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