Oakdale Campus Environmental Plan: An Environmental Supplement to the Oakdale Campus Master Plan

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Oakdale Campus Environmental Plan

An Environmental Supplement to the Oakdale Campus Master Plan

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May 15th, 1997

To fulfill requirements for:
Field Problems in Planning, 102:209
Faculty Advisors: Peter Fisher and Cheryl Contant
Graduate Program in Urban and Regional Planning

The University of Iowa,
Iowa City, Iowa

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University of Iowa
Oakdale Campus Environmental Plan
A Supplement to the Oakdale Master Plan for the University of Iowa's Oakdale Campus.

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EXECUTIVE SUMMARY

The Oakdale Campus Environmental Plan is a supplement to the Master Plan for the University of Iowa Oakdale Campus. As a supplement, the plan serves to inform, educate, and recommend ways to protect the sensitive, unique, and productive natural features of the Oakdale Campus. This plan should not be viewed as a replacement for the Master Plan. Instead, it should be applied as a tool to guide environmentally sensitive development.

Three important principals have guided this analysis. First, natural systems are deemed to function in ways that are superior to engineered systems. Second, human alteration to natural systems through development has impacts beyond the development itself. These impacts must be viewed cumulatively. Finally, human influence often accelerates naturally occurring processes creating problems for both the human and natural systems.

An inventory of seven important environmental features of the Oakdale Campus were collected and analyzed. The main six are soil erosion, water drainage, biodiversity, noise, hazardous and special management sites, and air quality. The last is a compilation of minor issues. A brief description of each is provided.

INVENTORY
Soil Erosion
Soil erosion is a serious land management problem. Soil type, vegetative cover, runoff, and slope steepness and stability determine the extent of soil erosion. Most of the soil on the Oakdale Campus is subject to severe erosion making it unsuitable for sparse vegetation, roads, and some types of development.

Vegetation is important for preventing wind and water induced soil erosion. The Oakdale Campus has three basic types of vegetation. These are, from least to most important in terms of their mitigative abilities, grasses (domestic and brome), wetlands, and forests. Wetlands offer a multitude of other environmental benefits.

Runoff is the water that fails to infiltrate the ground thus moving across the surface of the land into streams and surface water. Runoff volumes are increased in direct relation to the amount of impervious surfaces in a development. For Oakdale, this problem is compounded by the lack of a stormwater management system that would minimize the impact to soil and surface cover. Areas of the Campus that could be affected by increased runoff have been identified. Most importantly, it should be noted that landowners whose property is damaged by sediment runoff could file complaints against the Oakdale Campus (see Runoff section).

Slope inclination can limit development severely. Roads and buildings inappropriately placed can result in erosion and slope failure. A large part of the most suitable land for the development of roads and buildings has already been developed. Due to the steepness of the southern campus, future development should be limited to the ridge tops of slopes. Slope stability is affected by the four previously mentioned factors as well.
Water Drainage
Drainage Channels are necessary for conveying water. Human development often results in the destruction or replacement of natural drainage channels. Engineered channels mimic but are not effective replacements for natural channels. By reducing overall channels they increase water volumes and by straightening flows they increase water velocities. This may lead to erosion and flooding. On the Oakdale Campus, three small streams receive flows from drainage channels on the campus.

Of equal importance, flood-prone areas have been identified on the campus along the eastern property line. These areas occur as a natural result of the existing topography and drainage networks. Preservation of these areas is necessary for predictable flood management.

Biodiversity
Biodiversity describes the genetic, species, and ecosystem diversity of an area. It also considers the composition, structure, and function of the area as it relates to increasing this diversity. Biodiversity is important to protect for reasons of economics, ethics, aesthetics, and ecosystem services. On the Oakdale Campus, protection of biodiversity will require the preservation of wildlife corridors, existing wildlife, and habitat.

The Oakdale Campus is part of a larger deer corridor. Minimizing the segmentation of corridor linkages allow animals to migrate thus strengthening their genetic makeup. Site visits to the Oakdale Campus revealed the additional presence of squirrels, rabbits, and different types of birds. The vegetation on the campus consists of older Oak-Hickory forests, newer growth forests made up of many invasive types of trees, decorative trees, and domestic and brome grasses. Oakdale Campus also has three wetland areas. These house a diversity of wetland type plants. Wetlands perform a multitude of functions that improve biodiversity, regulate hydrologic flows, and filter water. There is no record of the existence of Endangered or Threatened species on the campus.

Noise
Noise generated from traffic, present and projected, is an important issue for the Oakdale Campus. The generation of traffic noise is dependent on the volume, speed, and composition of traffic. The primary factors for mitigating traffic noise are distance and shielding. Traffic links analyzed include Oakdale Boulevard, Highway 965, Interstate-80 (I-80) and the proposed Holiday Road. Based on the results of the analysis of current and projected noise levels, noise generated on I-80 will present the greatest challenges for the Oakdale Campus. Overall noise impacts to campus from increasing traffic will be minimal.

Hazardous and Special Management Sites
There are three special management sites on the Oakdale Campus: the landfill, the former wastewater treatment plant (WWTP), and the coal ash pile. There are also three hazardous waste storage facilities. The landfill of the Oakdale Campus was used to dispose of various wastes from 1940 to present. Some of these wastes were refuse, coal ash, asbestos, and the charred remains of hazardous waste. The nature of the refuse disposed of in the landfill is largely unknown due to poor records of earlier use. Leachate from the landfill is a potential threat to surface and ground water quality. A RCRA study tested the landfill for potential soil,
groundwater, and surface water contamination. Trace elements were found in soil samples; test well samples revealed chemical compounds. At that time these findings were not considered to be environmentally harmful.

The former WWTP operated from 1908 to 1969. It was used to dispose of coal ash and detonated hazardous waste after it was abandoned. Studies conducted by Versar, Inc. and a RCRA study revealed detectable levels of several metals and some chemical compounds. Groundwater samples were below US EPA maximum contaminant levels (MCL). For one sample, lead exceeded the US EPA MCL. Although, the site is also not considered to be an environmental threat, the potential does exist for contaminant transport from the former WWTP site to an adjacent stream if it is disturbed.

Coal ash generated by the burning of coal in the campus power plant was placed in a lot behind the plant. A RCRA study confirmed the presence of metal products and compounds. This site was removed during the writing of this document. It should be noted that coal ash has a tendency to delay the release of some toxicants. Thus while the site is presumably improved, residual amounts may lead to surface water contamination and should be occasionally monitored.

Finally, there are three hazardous storage sites on campus. These house radioactive waste, PCB’s, and hazardous chemicals. These are all regulated under RCRA and thus the facilities have been constructed to meet Federal Regulations. These sites should pose no threat to the future development provided the University continues to adhere to these regulations.

**Air Quality**
In general, Oakdale Campus and the City of Coralville are in compliance for ambient air quality. The three emissions sites on the Campus are also in compliance with federal regulation. Future development should not be effected by these emissions.

**Other Issues**
The existence of wells and archeological sites was also investigated. The Oakdale Campus has two production wells and three test wells. None of these wells pose contamination risks to the Jordan or Silurian aquifer. Additionally, the Office of the State Archaeologist has no record of archeological sites in the study area.

**SENSITIVITY ANALYSIS**
The aim of this analysis is to identify sites on the campus that are more environmentally vulnerable to development and human disturbance. Based on the client’s preference and the professional expertise of the researchers, the features were prioritized in terms of their relative environmental value. This scale was then combined with a weighting system to reflect the prioritization of these features to the Oakdale Campus environment. The value of each feature, scaled and weighted, was represented by a grid square representing a 40-feet by 40-feet area of Campus. A composite sensitivity map was produced based on the aggregate grid values for each feature in each given land area. With this system, environmentally sensitive features were identified and their vulnerability to alteration, disturbance, or development quantified. Grids indicating areas of greater sensitivity are represented by darker shades of red; the lighter the shades, the less sensitive an area is to development. Development features proposed by the
Master Plan (buildings, parking lots, and roads) were laid on top of the sensitivity map to depict how future development could impact these areas.

Eight areas have been identified as environmentally sensitive to development on the Oakdale Campus. Development of these areas should be avoided or mitigated to minimize the impacts of development. For many of the areas where development has been proposed on the Master Plan, the researchers would recommend against a strict adherence due to the implications associated with the features detailed earlier. Consulting the Oakdale Campus: Recommended Site Plan map could result in a better fit between the development needs of the Campus and the environment.

**RECOMMENDATIONS**

Realizing conflicts exist between the need to maintain the environmental integrity of the Oakdale Campus and the pressing need for future development, the researchers offer the following recommendations for environmentally sensitive development.

*Soil Erosion*

In terms of development, all projects should have an erosion control plan before construction starts. The Oakdale Campus should apply best management practices (BMPs) during the pre- and post-development stages. Development on slopes greater than 15% should be avoided. Soil should not be left unprotected without vegetative cover. Although development may inhibit the covering of exposed soil, temporary seeding may be an appropriate mitigation measure. Proper vegetative cover should be applied to reduce the amount of dust produced from construction related activities. Trees should be planted in designated areas to minimize soil loss, sediment deposition, and slope failure.

Runoff impacts can be reduced through preservation of existing drainage channels and wetlands. Maximizing infiltration opportunities, minimizing impervious cover, and routing runoff onto vegetative filters can further reduce runoff impacts.

*Drainage Channels*

All existing drainage channels should be preserved, and efforts should be made to restore disturbed channels to a pre-disturbed state. Also, development on or alteration to the floodplain should be avoided.

*Biodiversity*

Biodiversity on the campus can be improved through preservation and enhancement of vegetation and habitat corridors. Also, native vegetation should be planted when ever possible.

*Noise*

Noise impacts can be mitigated through preservation of berms and forests for shielding. Also, soft surfaces absorb sound; therefore, vegetative buffers could offer shielding opportunities when used at appropriate distances from noise generators. Finally, the height of buildings along I-80 should be no more than two stories in height unless properly constructed to reduce interior noise impacts from external sources.
Hazardous Sites
For hazardous sites on the campus, monitoring should continue and these sites should be mediated as needed. The intended clay capping of the landfill should occur as soon as possible. A wetland should be placed at the base of the landfill to absorb any leachate release. The former WWTP should be removed before development occurs in the east-campus area. The removal of the coal ash pile should continue to its completion. Future monitoring of the site should continue.

CONCLUSIONS
In conclusion, conflicting issues between the Master Plan and the Environmental Supplement should be addressed. The goals and objectives of this environmental study have been accomplished. Identification and acknowledgment of problematic areas can be the first step towards devising solutions that can link the attributes of the Master Plan and the Supplement. A Phase II investigation is recommended to specifically study the development problems that are impeded by environmentally sensitive features. Such issues include transportation flow analysis, economic land use viability, and specific site plans (i.e. building footprint and height). In any event, if future development of the Oakdale Campus is shaped to fit the land instead of shaping the land to fit the development, both economic and environmental advantages will be realized.
INTRODUCTION

The purpose of the Oakdale Campus Environmental Plan is to supplement the existing Master Plan for the campus with issues relevant to the environment. The intent is to inform, educate, and recommend ways to protect the sensitive, unique, and productive natural features during the development of the Oakdale Campus. This plan is thus a step in the direction of accomplishing the Oakdale Master Plan Goal of "enhancing and strengthening the natural elements unique to the site" (Crose-Gardner Assoc., 1994: 4, 22).

Three fundamental ideas guide this plan. First, as the Oakdale Campus is developed it should be done in a manner that considers the natural features of the area, not only for their potential landscape values but also as important components in the natural order of the ecosystem. By doing so, ecosystem functions can be maintained, benefiting both existing natural species and humans. Ehrlich and Wilson (1991) conclude that virtually all attempts to substitute for ecosystem services by using engineered solutions have been ultimately unsuccessful. These include chlorination for water purification, dams for flood and drought control, pesticides for pest control, and inorganic fertilizers for natural soil maintenance. Not only are these solutions inferior to their natural counterparts — wetlands, natural predators, and biodegradation — but they require the input of large quantities of energy, contributing additional environmental impacts of their own. If developed properly, Oakdale can maintain its natural functions and integrate additional development. The guiding principle is thus to fit the development to the land and not to alter the land to fit the development.

Second, Biologist Garrett Hardin (1985) suggested two ecological truths that must always be considered. They are:

- **The First Law of Ecology**: We can never do merely one thing;
- **The Second Law of Ecology**: Everything is connected to and intermingled with everything else; we are all in it together.

The development of Oakdale should consider not only the immediate impacts on the given site but also the impacts that will be felt throughout the ecosystem and the region. Development should be done in a manner that minimizes cumulative impacts.

Finally, many of the environmental impacts spoken of in this plan, such as flooding and erosion, occur naturally, independent of human effects. Human interaction, however, often accelerates these processes. This can create a situation where the natural systems are unable to adjust effectively and thus major changes occur. These changes are almost always detrimental to the environment and often to human development. To minimize such problems, which are often unpredictable and unanticipated, efforts should be made in the development of Oakdale to minimize changes to the natural systems. As said earlier, working with the environment is usually a preferred position to having to work against it.

The Oakdale Campus can be developed either with disregard for, or in cooperation with, the environment. It makes sense to work with the natural features and to use the natural functions of the land to accomplish the important tasks of flood and erosion control, water purification, noise reduction, etc. By doing this the University will not only be accomplishing its need for more
research space but will be educating the people of Johnson County on how development can proceed without detrimental effects to the environment.

The plan is divided into three main sections. First is the Environmental Inventory. These sections contain a listing of the primary existing environmental features of the site and explain their importance generally and with respect to the Oakdale Campus in particular. Second is the Environmental Sensitivity Analysis, the heart of the plan, which considers all of the environmental features of the site and determines what areas of campus are most vulnerable to development. The third section offers recommendations for protecting the environmental features of the campus and practices to better guide development. Located at the end of Chapters 1 – 5, and at the end of Section II are map which are provided to better illustrate specific issue of importance. The first map at the end of Chapter One is a reference map (Oakdale Campus: Reference Guide) intended to help the reader locate key reference points mentioned throughout the Plan.
SECTION I
ENVIRONMENTAL INVENTORY

The Environmental Inventory is a listing of the environmental characteristics of the Oakdale Campus. Each chapter begins with a brief paragraph introducing the major environmental issues associated with that particular factor. Following this a brief description of the features of the Oakdale Campus as they relate the environmental issues identified. It is from this inventory that the Sensitivity Analysis is developed and the recommendations and policy sections are derived.

CHAPTER ONE: SOIL EROSION

CHAPTER ONE SUMMARY

Issues:
- Soil types vary in their erodibility.
- Vegetation prevents both wind- and water-induced soil erosion.
- Runoff as an erosion problem is accelerated by the development of impervious surfaces.
- Slope inclination can accelerate soil erosion.

Existing Conditions:
- The soil erosion potential associated with Oakdale’s predominate soils (Fayette, Chelsea-Lamont-Fayette Complex, and Lamont) subject the campus to severe erosion.
- Bare soils and those with grass covering display the highest degree of erosion on Campus. Little erosion is seen in the forested areas except where trees are sparse.
- Currently, 9% of campus is covered with impervious surfaces. Planned development will increase this to 15%. This may stress existing streams and drainage channels. This problem is compounded by the absence of an effective stormwater drainage system.
- The areas most susceptible to slope failure are those in the vicinity of the landfill and in the ravine west of Facility B.

Recommendations:
- Oakdale soils must be managed so as to prevent soil erosion and the negative effects associated with soil erosion and sediment deposition (see Appendix A for more detailed recommendations).
- Trees should be planted in the designated areas (see Oakdale Campus: Recommended Site Plan) to prevent soil loss, sediment deposition, and slope failure.
- At no time should soil be left unprotected by vegetation, except during brief times of development when temporary seeding may be appropriate (see Appendix A for more detailed recommendations).
- Decrease the impact of runoff by maximizing infiltration opportunities. Minimize impervious surfaces and route runoff into vegetative filters.
- Do not develop on slopes greater than 15%. Limit slope disturbance as much as possible.
William Marsh, author of *Landscape Planning: Environmental Applications*, declares soil erosion “the most serious land management problem facing humanity today” (Marsh, 1998: 224). Soil can be eroded, or moved from one place to another, by water or by wind. Erosion is a natural process that, when accelerated by human activities, can become a serious problem both for the environment and for humans. When sediment is delivered to streams and rivers via erosion, local and regional water quality can be greatly impacted. High sediment loads alter the macro and microorganisms present in surface water by adding nutrients and pollutants, and by decreasing the ability of light to penetrate to the streambed. Additionally, such sediments are often deposited in rivers, lakes, and ponds, filling them up and increasing the potential for flooding. Erosion can also greatly affect vegetation by removing the nutrient rich and water-retaining topsoil so essential to their growth and survival. The eventual loss of vegetation, and its ability to hold soil in place, may lead to further, more extensive erosion.

Understanding the factors that accelerate erosion is useful in determining the susceptibility of a potential development site to erosion. These factors include: (1) soil types, (2) vegetative cover, (3) runoff amount, and (4) slope steepness and stability (Carpenter, 1983). The following sections will include a discussion of each of these factors as they apply to the existing conditions, and potential concerns of the Oakdale Campus.

**Soils Types**

Soil is a mixture of solid and dissolved minerals, organic matter, air and water. Soil type is defined by the unique mixture of the above elements and determines the physical and chemical characteristics of the soil. These characteristics in turn are important in determining sustainable uses for corresponding soil types (Baldwin, 1985). The *Oakdale Campus: Soil Types* map shows that there are four predominant soil types located on the campus.

Most of the soils found on the Oakdale Campus fall into the Fayette-Downs association of soils. Fayette-Downs soils are dominated by soils formed of silty materials. The surface layer of the Fayette soils is only three inches thick or less. Ridge tops separated by a network of small, sloping drainage ways is characteristic of this association. The slope and erosion potential rankings associated with this soil type subject Oakdale Campus to severe erosion. Figure 1 below depicts a typical Fayette-Downs association cross-section. Because of these conditions, the soil types on campus are not well suited to row cropping or sparse vegetation coverage. (Soil Survey of Johnson County, 1978).

Fayette soils compose most of the soils on campus. The only areas on campus that are not Fayette soils are those that lie in the floodplain (see *Oakdale Campus: Flood Frequency/Drainage* map) and the upland slopes at the head of the floodplain near the former wastewater treatment plant (see *Oakdale Campus: Hazardous & Sensitive Sites*). Fayette soils are moderately permeable with medium runoff. This soil type poses an erosion hazard on any slopes that are greater than five percent. Since much of the Oakdale Campus has slopes greater than five percent (see *Oakdale Campus: Slope Percentages*) erosion from this soil type must be prevented and mitigated.
The second most predominant soil type on the campus is the Chelsea-Lamont-Fayette complex. Chelsea soils comprise about 40 percent, Lamont soils 30 percent, and Fayette soils account for 20 percent of this complex of soils. The rest of the complex is composed of a few other soil types too small in concentration to be mapped. The Chelsea-Lamont-Fayette complex is typically found on well-drained slopes of 15 to 25 percent incline. It is composed of sandy, loamy, and silty elements. These factors combine to create a soil that has medium to rapid runoff. The Chelsea-Lamont-Fayette soils are particularly subject to wind erosion, and as such, they should be kept covered with vegetation at all times. A major limitation of these soils is that they are not well suited for roads or other types of development. The laying out of trails and roads must be planned with only the utmost care and consideration due to the severe erodibility associated with these soils (Soil Survey of Johnson County, 1978). If at all possible, roads and other structures should not be built on this soil type.

A small parcel of land on campus has Lamont soil. The complex of Chelsea-Lamont-Fayette soils surrounds it on the eastern portion of the campus. Its characteristics are nearly identical to those of the Chelsea-Lamont-Fayette complex; to understand its characteristics see the previous description.

The area identified as a floodplain, as shown on Oakdale Campus: Flood Frequency/Drainage map, is identical to the area associated with the Nodaway-Arenzville-Sil soils. These soils are seasonally wet due to seepage from the upland slopes located to the north, east and west. As is the case elsewhere in the county, trees are naturally occurring in these soil types. The trees that are present in this location help to prevent gully erosion (Soil Survey of Johnson County, 1978). This function should be preserved given the campus' numerous erosion problems.
Recommendation
As shown on the Oakdale Campus: Soil Erosion Class map, Oakdale’s predominate soils (Fayette, Chelsea-Lamont-Fayette Complex, and Lamont) subject the campus to severe erosion. The surface layer for much of the soils on campus is only three inches thick or less. Because of these conditions, the soil types on campus are not well suited to row cropping, sparse vegetation coverage, and access development disturbances. The soil types present on the Oakdale Campus pose an increased erosion hazard on slopes that are greater than five percent. Since much of the Oakdale Campus is rolling hills (see Oakdale Campus: Slope Percentages) erosion must be prevented and mitigated by planting the proper vegetation and by following the best management practices outlined in Appendix A (Best Management Practices for Erosion Control).

**Oakdale soils must be managed so as to prevent soil erosion and the negative effects associated with soil erosion and sediment deposition (see Appendix A for more detailed recommendations).**

Vegetation
Vegetation is clearly the most important factor in preventing both wind- and water-induced soil erosion. Plant foliage disrupts falling rain, reducing its eventual impact on the soil surface. Decaying plant material and debris on the ground prevent the full force of the falling drops from contacting the soil directly. Plant roots bind the soil together, keeping it from being removed by the eventual runoff. The more vegetative cover available to the soil, the less erosion will occur (Marsh, 1998).

Additionally, vegetation tends to force wind upwards. This creates a zone of calm air over the ground. The taller and denser the vegetation, the thicker the layer of calm air will be. Even short grasses form a very small layer of calm air. Beyond the vegetation, on the downwind side, a sheltered zone also forms. This reduction in airflow prevents the removal and transportation of light soil and sediment by the wind.

Oakdale Campus has four basic types of vegetation. Their locations on campus can be seen on the Oakdale Campus: Vegetation map. Kentucky blue grass and decorative trees such as pine and cedar predominantly cover the developed northern sections of the campus. While these enhance the aesthetics of the campus, they are inferior ground covers for controlling erosion. This is demonstrated in areas where slopes are steeper, such as by Highway 965 and to the north of the Oakdale Hall parking lot near the volleyball court. In these areas the grass is sparse and erosion is evident. Brome grasses cover the southern undeveloped portion of the campus. Because this grass has not been cut a thick layer of dead grass has formed under the plants. This, combined with the deeper root system of brome grass, provides a better protective cover against erosion. This is important since the southern part of the campus is quite rolling and the steeper slopes are more vulnerable to erosion. Nonetheless, there are numerous erosion rills present, a few of which are beginning to form gullies.

The remaining vegetative cover is primarily forested area and secondarily wetland vegetation. These occur in essential areas for controlling erosion, each being found at the headwaters of the existing streams on Campus. The older forest near Highway 965 has a much better canopy cover
and thus less erosion is seen there. The younger forest in the central part of the campus still has patches where trees have not completely filled in; erosion is present in these areas. Fortunately, runoff from this forest goes directly into a wetland, which slows up the water and allows sediment to settle out before moving into the stream.

**Recommendations**

A large portion of soil erosion results from falling precipitation. Vegetation coverings, particularly trees and forests, are the most effective means at slowing the velocity of falling rain. Trees also slow the flow of runoff thus encouraging infiltration. We recommend that Oakdale retain and enhance all existing forests as well as add additional forest areas as shown on *Oakdale Campus: Recommended Site Plan* map. Native Oak-Hickory Community tree types (which are most adapted to this area) should be planted at a density high enough to ensure full canopy cover when the forests are mature.

If a diversity of vegetation is desirable, then prairie-type grasses are recommended in place of trees. While not as effective at breaking up rainfall, their long root systems are excellent for locking soil in place and slowing up runoff. Grasses may also be used as an intermediate ground cover while forests are being encouraged. Avoid leaving bare soil exposed without vegetation on it. When vegetation must be removed, replant it as soon as possible.

| Trees should be planted in the designated areas (see *Oakdale Campus: Recommended Site Plan*) to prevent soil loss, sediment deposition and slope failure. |

| At no time should soil be left unprotected by vegetation, except during brief times of development when temporary seeding may be appropriate (see Appendix A for more detailed recommendations). |

**Runoff**

Runoff is the part of precipitation, snowmelt, or irrigation water that runs off the land into streams or other surface water (Dennison, 1996). Although runoff occurs naturally, it can become a problem when enhanced artificially by human development, particularly the building of impervious surfaces. Impervious surface refers to those surfaces that do not allow water to permeate through. Specific examples include rooftops of buildings, roads, and parking lots. When water is prevented from soaking into the ground, an increased amount of water will flow over, or run off, the surface. The natural features affected by the additional water, such as streams, soil and vegetation, may not be able to effectively manage the increased runoff. The result is increased erosion and flooding (Schueler, 1994).

The problem of runoff on campus is compounded by the fact that no storm water management system is present. Normally, water landing on impervious surfaces is directed into storm water drains and piped away so that it does not run over the surrounding ground and impact the soil. Currently, runoff at Oakdale is diverted from building roofs onto parking lots, and water from roads and parking lots flows directly onto the surrounding terrain. Current structures on campus may have been designed and constructed without regard for the potential effects.
The current level of imperviousness over the entire Oakdale Campus is about 9%. This estimate reflects the total impervious cover on the campus based on the size of building footprints, parking lots and roads. Based on the assumptions for the future development reflected in the Master Plan, impervious cover for the campus could increase to approximately 15% of the total campus cover. A detailed breakdown of these figures is shown in the technical addendum. This increase will have substantial effects on the natural features of Oakdale.

For the purpose of this analysis seven major drainage areas have been identified for the Oakdale Campus based on the contour of the land and drainage patterns. The drainage areas, their points of discharge, and the present and future peak discharge rates have been identified on the Oakdale Campus: Drainage map. A discharge point is the point at which all the water collected in a given drainage area exits the boundaries of the Oakdale Campus. The numbers were calculated using the Ohio Engineering Model. A description of this process and the data is found in the technical addendum.

The most important problem associated with the increased runoff can be found in Areas 4 and 5. When the Oakdale Campus is developed according to the Master Plan, both of these drainage areas will see increased peak drainage flow of between 25 and 30 cubic feet per second due to the additional impervious cover. This is very likely to increase the amount of erosion that occurs. Additionally, Oakdale Creek, the stream into which drainage from both Areas flow, also collects the water from Area 7. The flow of these three drainage areas will place substantial pressure on the channel. This could result in changes in stream bank erosion, stream hydrology, stream morphology, and stream water quality.

These areas will also impact the runoff on neighboring development. Oakdale Creek flows from the Oakdale Campus, along its property line, and then crosses over into the property of the neighboring subdivision before crossing I-80. Runoff from Oakdale could contribute to flooding problems on the property of the adjacent subdivision during intense storms. If the Oakdale Campus does not take into consideration the proper precautions to manage its stormwater runoff, it could be liable for damage that occurs to neighboring property due to sediment deposition. Iowa law (Code Section 161A.47) allows the owner or operator of land being damaged by sediment runoff from eroding land to file a written and signed complaint with a Soil and Water Conservation District (SWCD). If SWCD investigations find that sediment damage is occurring as a result of erosion in excess of the limits, the commissioners will take action to have the erosion problem corrected (Cable and Dolling 1994).

Drainage Area 1 requires attention also. Although the change in cubic feet per second is less, there are problems of a different sort. The runoff from this area goes over and around the Landfill and the Coal Ash pile (See the Oakdale Campus: Hazardous and Sensitive Sites map). An increase in runoff could increase the potential for leaching contaminants from these sites directly into the stream system.

Recommendations
Increasing the opportunity for water to infiltrate into the ground will minimize runoff quantity and velocity. For short-term construction sites, silt fencing, hay bales, or mesh blankets can be
used on a temporary basis. However, for long-term management, use vegetative islands and buffers, porous pavement, infiltration trenches, filter berms, and terracing. See Appendix A for a more detailed description of these practices.

Avoid impervious surfaces whenever possible. Preserve the existing drainage ways where possible. If this is not possible, design all drainage routes to maximize the duration of travel before entering a water body, and to direct water through vegetated areas where infiltration will more readily occur.

To capture sediment that is dissolved in runoff use catchment ponds that detain water long enough to allow the sediment to settle out before the water leaves the site. It is also effective to use a design that is partially or totally a wetland, meaning that it consists of wetland vegetation. Wetlands not only capture sediment but are also effective methods for removing fertilizers, pesticides, and other pollutants.

| Decrease the impact of runoff by maximizing infiltration opportunities. For example, route runoff into vegetative filters. Minimize impervious surfaces. |

Slope
One of the physical features most limiting to development and having the greatest impact on soil erosion is the slope of the land. Placing buildings or roads on inappropriate slopes can result in severe erosion and eventual slope failure. The two common development mistakes regarding slopes are (1) the disturbance of steep but relatively stable slopes, leading to erosion or deterioration problems and (2) the placement of facilities on slopes that are already unstable (Marsh, 1998). These two issues will be discussed separately.

The Oakdale Campus Topography map show the topographic layout of the Campus using two-foot contours. The Oakdale Campus: Slope Percentages map interprets these contour lines into slope percentages. See the Appendix C: Technical addendum, for a discussion of how slopes are calculated. The ranges represented on the map are based on Kaiser's Urban Land Use Planning (1995) and Marsh's Environmental Analysis for Land Use and Site Planning (1978). While no inclination classification scheme is universal, the scheme applied to the Oakdale Campus adequately represents the full range of slopes present on the site. Table 1 below illustrates the ranges and their appropriate land uses.

The Oakdale Campus: Slope Percentages map shows that the flattest sites, the large areas of gently sloping land in the northern half of the campus, have already been developed. This is consistent with appropriate practice regarding building on sloped lands. Future development should also follow this practice. By doing so the University will avoid costly damage to above ground structures, utilities, infrastructure, and the environment. It should be noted, however, that the scale of the map requires that a more detailed slope survey be conducted once a specific site has been determined.
To develop the southern portion of the campus would dictate the erecting of buildings and parking structures on the ridge tops. While the slope percentages of these ridge tops are considerably high (6-14%; see table above), it appears that building in those areas is the only option if development is to occur without massive earth moving. By limiting development to the least steep slopes, the University will avoid the costs of earth moving and at the same time preserve the natural systems associated with these slopes.

The steepness of the slopes and the soil types present at the east central part of campus leave little land available for building development. Roads and buildings should be limited to those that are necessary, and placement should be done with the utmost caution and care. Development should occur on smooth “S” shaped slopes rather than convex or concave slopes (Marsh, 1998). Figure 2 below shows the general shape that these differing slopes take. The combination of increased runoff from any new development and steep slopes could lead to slope failure and excessive erosion, as has already been seen in the area surrounding the bike trail development.

**Figure 2. Slope Forms**

Source: Marsh, 1998
In addition to the percentage of the slope, the stability should also be considered when assessing the susceptibility of a slope to failure. Slope failure occurs when “a slope is unable to maintain itself and fails by a mass movement such as a landslide, slump, or similar movement” (Marsh, 1998:406). Such an outcome will result in tremendous economic losses, possible human injury, and severe, virtually irreparable environmental damage. Criteria for assessing slope stability include: (1) soil types, (2) vegetative cover, (3) runoff amount, (4) slope steepness and stability.

Vegetation is of particular importance in preventing slope failure. Plant cover has proven to be one of the best methods of preventing slope failure. Logging studies from the western United States have shown that clear-cut slopes fail far more frequently than do forested slopes (Marsh, 1998). Drainage is also an important factor in assessing slope stability. This is particularly true when combined with certain soil types. Soils with high erodibility and high seepage can work to undermine the slope. Water reduces the soil’s resistance to displacement, weakening the skeletal strength of soil materials that compose the slope (Marsh, 1998). Planning for slopes as development occurs will greatly decrease the chances of mass movement, slope failure, and other erosion activities.

At present the areas most susceptible areas to slope failure are those in the vicinity of the landfill and in the ravine behind the Facility A (radioactive waste storage building). In both of these areas water has played a predominant role in weakening the slopes. Further planting of vegetation, particularly trees, would help to stabilize these areas. Development here would be very risky.

Recommendations
Avoid potentially unstable slopes, and slopes of greater than 15 percent (see Table 1). In particular avoid the lower two-thirds of slopes on the Oakdale Campus as they are severely erosive (refer to the Oakdale Campus: Soil Erosion Class Map). Construction on these areas should be avoided, and the associated disturbances limited as much as possible. The failure of a disturbed slope could result in damage to property and personal injury. Minimize these problems by avoiding cut and fill techniques whereby the slopes are reshaped with heavy mechanical equipment and by opting to develop on smooth “s” shaped slopes over convex or concave ones. New buildings should be positioned on the ridge tops. Not only are the ridge tops more stable, but construction in the upper one-third of the slope will result in less delivery of sediment to the drainage network (see Development Site recommendations below for related comments).

Do not develop on slopes greater than 15%. Limit slope disturbance as much as possible.
CHAPTER TWO: WATER DRAINAGE

CHAPTER TWO SUMMARY

Issues:
• Human development often leads to the ‘pruning’ of natural drainage channels. Pruning leads to increased volumes of water per drainage channel thus increasing erosion and flooding.
• Engineered channels increase water velocity and volume due to reduced stream meandering and infiltration. This may create flooding and erosion problems downstream.
• Flood Plains are an effective means for storing excess runoff after storm events.

Existing Conditions:
• Many seasonally wet, finger-like drainage ways flow through the Oakdale landscape.
• Water exits Campus via three slow moving, low volume streams.
• Flooding occurs an average of 50 times in 100 years in the area highlighted on the Oakdale Campus: Flood Frequency/Drainage map (Soil Survey of Johnson County, 1978).

Recommendations:
• Preserve all existing drainage channels. If development disturbs a channel, every effort should be made to restore the channel to its pre-disturbed state.
• Exclude development in or alteration of the floodplain. Preserve all vegetation in the floodplain.

DRAINAGE CHANNELS
As water flows overland it enters a system of drainage channels, each channel larger than the preceding one. This system of channels is called a drainage network. The drainage network is often divided into separate basins or watersheds for management at the site level.

Human development often leads to the ‘pruning’ of natural drainage channels (Marsh, 1998). As natural channels are destroyed, engineered channels are erected. Replacing natural drainage channels with concrete ditches and underground channels leads to an increase in water volumes and velocities in the system due to reduced infiltration and the lack of meandering. Increased water velocities and reduced infiltration, in turn, create two problems as the water exists the engineered channel: (1) erosion from the increased runoff and (2) increased flooding potential. Figure 3 illustrates how urbanization can result in decreased channels.

Many seasonally wet, finger-like drainage ways flow through the Oakdale landscape. They are illustrated on the Oakdale Campus: Flood Frequency/Drainage map. This system of drainage channels delivers the conveyed runoff and recharges groundwater. On the Oakdale Campus three small streams are fed by this system. The drainage channels leaving the southeast quadrant of the campus feed into Oakdale Stream, while the waters draining into the Older Forest (see Oakdale Campus: Vegetation map) feed into another small stream which leaves the campus under Highway 965.
Figure 3. Pruning of Drainage Channels

1800  1875  1900  1950

- Natural streams
- Field ditches
- Storm sewers
- Agricultural land
- Urbanized land

Recommendations
Drainage channels should not be simplified by pruning off branches, by channeling, or rerouting as the result of development or any other type of alteration. While channeling water into concrete ditches may appear to be an easier fix than trying to design with the land, it should be recognized that potential problems created by such activities are far more costly. By pruning off channels more water must then enter each of the remaining branches. This increases the possibility of exceeding the capacity of a particular branch, which may lead to flooding. Channeling and rerouting usually includes the designing of smooth surfaced systems and/or straight waterways. We recommend a natural stream that is rough on the bottom and meandering with the contours of the land. This slows the velocity of the stream current thus decreasing the potential of flooding and allowing for the release of sediment. In addition, the riparian vegetation associated with the drainage channels provides some of the best habitat available for flora and fauna (for additional discussion, see the Biodiversity section and the runoff subsection below).

**Preserve all existing drainage channels. If development disturbs a channel, every effort should be made to restore the channel to its pre-disturbed state.**

Floodplain
Floodplains are a consequence of the natural topography and the subsequent drainage channels that generally conglomerate in this area. During times of normal precipitation and runoff the area typically contains only a stream. During heavier events, however, the floodplain acts as a basin for water as it spills out beyond the banks of the stream. Such areas are particularly difficult to manage given the volumes of water that tend to collect here. The best policy, and generally speaking the mandated policy, is to simply avoid developing on or near a flood plain.
The Oakdale Campus: Flood Frequency/Drainage map illustrates the flood-prone areas associated with the Oakdale Campus. Flooding occurs an average of 50 times in 100 years\(^1\) in the highlighted area (Soil Survey of Johnson County, 1978). Due to the topography and soil types of the campus, inundation of the flood-prone area is a naturally occurring event. As with any land located in a frequently flooded area, development should be limited or excluded.

**Recommendation**

Avoid developing in or altering the natural floodplain. This is a standard, and often legal, requirement in virtually every organized city in this country. Previous experience has shown that it is bad policy to build where flooding is sure to occur. The engineering techniques available to prevent property damage are simply far less effective and far more costly than simply avoiding such areas altogether. In addition, the floodplain on the Oakdale campus is a diverse riparian habitat that protects the stream bank from erosion and sediment deposition.

| Exclude development in or alteration of the floodplain. Preserve all vegetation in the floodplain. |

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\(^1\) The area is also designated as a “probable” 100-year floodplain in the EPA Hazardous Waste Permit Application (1992).
CHAPTER THREE: BIODIVERSITY

CHAPTER THREE SUMMARY

Issues:
- *Biodiversity* in its simplest definition has been described as the "totality of genes, species, and ecosystems" (WRI, 1992). It also includes the structure composition, and function of the ecosystem. It should be protected for ethical, aesthetic, economic, and ecological reasons.
- *Wildlife corridors* allow animals to migrate from one area to another, thus resulting in a more diverse offspring population.
- *Existing Wildlife* should be preserved for ethical and aesthetic reasons.
- *Existing Vegetation* is valuable for its diversity and ecosystem functions.
- *Endangered species* are those that are threatened with total elimination as a species. This is caused primarily by habitat loss.
- *Wetlands, and the diversity of species associated with them, make* important contributions to the functioning of natural systems.

Existing Conditions:
- Oakdale Campus appears to be a part of a larger deer corridor.
- The existence of deer, squirrels, rabbits, and many different types of birds were noted.
- According to the Iowa DNR, no Iowa threatened or endangered species were known to be located at Oakdale.
- An Oak-Hickory forest exists on the west side of campus, running from the solid waste landfill to the laundry facilities between Highway 965 and Crosspark Boulevard. A younger, less diverse forest exists in the central part of Campus.
- The Campus has three functioning wetlands.
- Brome grasses cover much of the non-forested, undeveloped area of Campus.

Recommendations:
- Preserve and enhance the connectivity of habitat linkages and corridors to ensure the ability of species to migrate from one habitat to another.
- Encourage the planting of native plant types. Minimize the use of non-native species. If non-native plant types are utilized adequately study the possible negative impacts associated with their use.
- Preserve and enhance existing wetlands to preserve habitat, store storm event runoff, to filter sedimentation, and to remove contaminants.
- Strategically place wetlands where specified (see Oakdale Campus: Recommended Site Plan) to mitigate the impacts of sediment deposition and sediment-born pollutants.

Biodiversity in its simplest definition has been described as the "totality of genes, species, and ecosystems" (WRI, 1992). Thus it includes the number of animals or plants able to reproduce with each other (genetic diversity), the number of different types of plants and animals in an area (species diversity), and the number of different areas for plants and animals to live (ecosystem diversity). In addition, some have argued (Noss, 1990) that the composition, structure, and
function of an area should also be included in the definition of biodiversity because more important than the mere numbers of genes, species, and ecosystems is the nature of the system that allows their existence. This definition would then include the elements listed above and also issues such as habitat complexity and patterns, nutrient cycling, gene flow, and other ecological and evolutionary processes.

When evaluating the development of a 250-acre, semi-urban property like Oakdale one may question the value of considering biodiversity. Paul Ehrlich and Edward O. Wilson (1991) addressed this issue in an article written for Science, the premiere scientific journal in the world. They specifically outlined three reasons we should care about and give consideration to biodiversity in such a situation. These are:

- Ethics and aesthetics -- it is morally wrong to threaten the existence of other species and as humans we enjoy their presence.
- Humans have derived, and will no doubt yet derive, enormous, direct economic benefits from the diversity of species in the form of medicine, food, and other products.
- Humans benefit from the essential, yet often unrecognized, services provided by the diversity of natural functioning ecosystems, including the regulating of climate via atmospheric gases, the generation and maintenance of soils, the disposal and cycling of wastes and nutrients, the regulation of the hydrologic cycle, and many others.

To protect biodiversity it is necessary to preserve (1) wildlife corridors, (2) existing wildlife, and (3) habitat (forests, meadows, and wetlands).

**Wildlife Corridor**

Animals in different environments are exposed to different circumstances. Natural selection dictates that the animals, and their genes, that best adapt to these circumstances proliferate in the population. When animals migrate from one area to another their genes are combined with the genes of animals that have been exposed to completely different circumstances. The resulting offspring can better adapt to both environments and thus a stronger population is produced. Corridors of appropriate vegetation, primary woodlands and meadows, allow animals to migrate to different areas and to thus improve the genetic makeup of the species. When human development cuts off migration or limits it to one area, a limited, specialized genetic pool can leave animals susceptible to changes in disease exposure or weather to which they are not genetically adapted.

Oakdale Campus appears to be a part of a larger corridor for deer. The *Oakdale Campus: Deer Corridor* map shows the possible corridors. Additionally, the existing vegetation has served as a corridor for smaller animals such as rabbits, squirrels, and birds. Preservation of these corridors will maintain a strong animal population through genetic diversity preservation. It will also offer animals a place of habitat. When human development encroaches on animal habitat, some animals will adapt to coexist in human habitat. To some, particularly gardeners and landscapers, this can be viewed as a nuisance. The easiest way to avoid such problems is to allow for natural habitat to remain intact.
Recommendations
Maintain available wildlife corridors and habitat linkages. These allow wildlife to transverse between habitat nodes on and adjoining Oakdale Campus. Development in these areas should be avoided. In particular, this includes the older growth forest along the western border of campus. This corridor allows animals to migrate on and off of campus without having to pass through developed areas.

Preserve and enhance the connectivity of habitat linkages and corridors to ensure the ability of species to migrate from one habitat to another.

Existing Wildlife
An exhaustive listing of all animal life found on the site was beyond the scope of this plan. During an on-site visit, however, the existence of squirrels, rabbits, and many different types of birds were noted. Additionally, deer were spotted on the campus in three different locations. Deer trails were found readily throughout the site, indicating that the existing habitat was favorable for their living requirements. Additionally, two deer skeletons were found there. These trails are shown roughly on the Oakdale Campus: Deer Trails Map. As they are found primarily, but not exclusively, in the wooded areas of the campus and along the water bodies. Deer prefer habitat that is transitional from meadow to forest. This allows them to use the forest for protection and the meadow for feeding. The existence of deer adds credence to the argument that this site is part of a larger wild life corridor.

Endangered Species
Endangered species are often species that have developed a very specialized niche and can often only survive in their limited environment. It is therefore desirable to preserve ecosystem diversity within which a multitude of different environments exists, thus preserving places for all species. When one ecosystem is eliminated those species that can only survive under the specialized conditions of the ecosystem begin to die off and may ultimately go extinct. Loss of habitat by human development is by far the leading cause of species extinction.

According to a letter dated January 29th, 1992 from the Iowa DNR, no Iowa threatened or endangered species were known to be located on the site. It would be wise, however, to have one of the University biologists perform the necessary study to determine that this is truly the case.

Have a University biologists perform the necessary studies to determine that no Iowa Threatened or Endangered species exist on Campus.

Forest Areas
An extensive inventory of the varied species of vegetation on this land was beyond the scope of our study. However, an attempt was made to categorize the different vegetative species based on their general features and importance. The Oakdale Campus: Vegetation map shows where the different vegetative features are located on Campus.
Oakdale Campus has two very different forests on it. On the west side of campus, running from the solid waste landfill to the laundry facilities between Highway 965 and Crosspark Boulevard, exists an Oak-Hickory forest. Trees found here include Oak, Hickory, Cottonwood, and Hackleberry. In an older forest such as this the species diversity is quite abundant. In addition to larger, older trees there is an abundance of other species. Most of these have adapted specifically to this environment and the entire system works in delicate balance. A forest such as this takes 150 years or more to develop these interactive relationships (Miller, 1995). This site is therefore of very high ecological value and should be preserved at all costs.

The forest that runs from the Technology Innovation Center (TIC) to the Old Wastewater Treatment Plant site is a younger forest. While there are a few remnants of what appears to have been an Oak-Hickory forest, most of the trees are non-native, invasive species. These include Ash, Elm, and Mulberry. The trees are small and dense. At this time the biodiversity is less than the older forest mentioned above but this is still a significantly important site. It provides good habitat for animals, reduces soil erosion, and is a valuable buffer against wind and noise.

Additionally, decorative trees have been planted throughout the campus. These include mostly white pine and cedar. While technically adding to the diversity of the campus, the value of these as part of overall biodiversity is limited. They do perform an important function of erosion control, however.

**Recommendations**
Additional emphasis should be placed on planting native versus non-native vegetation on the Campus. Exotic species are often found to be invasive with many negative consequences associated with them. Native plants should be planted whenever possible. Native plants have adapted to the conditions found on the Oakdale Campus over time through the process of natural selection. Enhance existing vegetation, particularly the older areas, by allowing it to extend beyond its boundaries into areas that now have less desirable ground cover like Brome grass. The diverse older forests must be protected at all costs, as they are valuable in preserving the integrity and diversity of regional species.

**Encourage the planting of native plant types. Minimize the use of non-native species. If non-native plant types are utilized adequately study the possible negative impacts associated with their use.**

**Wetlands**
The diversity of species also contributes important natural functions that are of the utmost importance to the management of the environment (Ehrlich and Wilson, 1991). In the past, wetlands, which include swamps, marshes, bogs, flood plains, and the like, were seen as undesirable and were often drained and eliminated. Since 1780 about 55% of the total wetlands in the U.S. have been developed or changed to agriculture. In Iowa only about 1% of the inland wetlands that used to exist are still functioning (Miller, 1994). Because of the important roles that wetlands play, the preservation of these areas is crucial. Wetlands perform the following functions:
They are excellent habitat for species and contribute greatly to the biodiversity of an area.

They regulate stream flow by storing water during periods of rain and then releasing it slowly, thus reducing stream and riverbank erosion and flooding.

They filter nutrients, toxicants, and sediments from water, greatly improving the water quality; indeed they have been called nature’s kidneys.

By storing water they increase the amount of water that infiltrates into the soil thus replenishing groundwater and aquifers.

They are key players in the recycling of nutrients such as carbon, nitrogen, and sulfur.

The definition of what is a wetland is a controversial subject. Differing agencies define wetlands differently. For example, the Corps of Engineers defines it as an area that is "inundated or saturated by surface or ground water at a frequency and duration to support a prevalence of vegetation typically adapted for life in saturated soil conditions." The Fish and Wildlife Service requires that, in addition, hydric soils be present. The State of Iowa uses all of these requirements: (1) the presence of water, (2) the presence of hydric soils, and (3) the presence of associated vegetation, then adds to it the necessity of "spring" flooding and a two or more acre size (Kugler, 1995). Under the Iowa definition it is possible that Oakdale campus does not have any wetlands. However, the scope of this study did not include doing a thorough study to determine if areas that were potential wetlands met these regulatory guidelines.

For the sake of our study we have used the Corps definition, which includes only the vegetation and presence of water requirement. This being the case there are three areas that qualify as wetlands. The most productive one exists north of Oakdale Hall. Here, there is an abundance of wetland vegetation as well as some deciduous forest, including Ash, Maple, Cottonwood, and Sycamore. The ground is saturated and there is the presence of standing water. A second wetland area is found east of Highway 965 in the Northwest corner of Campus. It is located at the bottom of a ravine. A third is located just west of the old wastewater treatment site. This wetland runs the extent of the clearing in the forested area in the central part of campus. Each of these three sites is of particular importance in flood control given the future development plan. Interestingly, it appears the primary source of the water that has created each wetland is the storm water drains from the roofs and parking lots on campus. Additional water is provided by runoff. Each wetland also forms the beginning of a stream, which then flows off campus.

**Recommendations**
Where appropriate, and as designated on the *Oakdale Campus: Recommended Site Plan*, design wetlands and catchment ponds to store excess water during peak events. Such structures allow for greater infiltration and slower, more controlled discharge into downstream waterways. Because wetlands absorb a great deal of water and then release it slowly (allowing it to infiltrate into the ground), they are an effective feature for controlling runoff.

Wetlands are an excellent filtration system for removing sediment and pollutants from the water. It is recommended that at any point where water may be compromised by pollutants or sediment, a wetland area be built. Specifically, we encourage the placement of three wetland areas. Two wetlands are proposed for the southern portion of campus (see the *Oakdale Campus:*)

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Recommended Site Plan map). A pond/wetland combination is recommended for each of these sites. The third wetland is proposed for the base of the landfill. We suggest this wetland because it would act as a filter for any leachate that might potentially escape the landfill site.

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<tr>
<th>Preserve and enhance existing wetlands to preserve habitat, store storm event runoff, and to filter sedimentation.</th>
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Strategically place wetlands where specified (see Oakdale Campus: Recommended Site Plan) to mitigate the impacts of sediment deposition and sediment-born pollutants.
CHAPTER FOUR: NOISE

CHAPTER FOUR SUMMARY

Issues:
- Noise is unwanted or detrimental sound. This is usually associated with sound in excess of 65 dBA, the level of normal human conversation.
- Barriers (hills, berms or slopes) are an effective means in attenuating noise levels.
- Vegetation can be used to reduce the decibel levels of noise.
- Building placement can play a role in reducing impact both by using one building to shield another and by placing buildings where noise may be an issue in locations where noise levels will be lowest.

Existing Conditions:
- The largest generator of noise (presently and in the future) impacting the campus is Interstate 80.
- Other noise generators are Oakdale Boulevard and Highway 965. Neither generate noise sufficient to impact Campus, nor are they expected to.
- Holiday Road (proposed for southern campus) will soon be a noise generator in the near future. This will also have minimal impact except as combined with I-80 noise.

Recommendations:
- Preserve naturally occurring berms (slopes) for their noise mitigation qualities.
- Hard surfaces act as sound reflectors while soft surfaces have the ability to absorb sound energy, thus we recommend vegetative buffers (as opposed to built structures) at the appropriate distances from sound generators (see Oakdale Campus: Recommended Site Plan).

Noise, present and projected, is an important issue for the Oakdale Campus. Noise is unwanted or detrimental sound. It can be considered a nuisance depending on the existing level, the duration for which it is constant, and the disruption resulting from the increase. Most disruptive traffic noise depends on the volume, speed, and composition of the traffic. Composition has the greatest effect: one truck at 55mph produces as much noise as 28 automobiles. Speed also contributes to noise effects: a traffic stream moving at 55 mph is twice as loud as one traveling at 30 mph. Traffic volume has the least effect: 2,000 vehicles per hour sounds twice as loud as 200 vehicles per hour. Highway noise is considered moderate to severe at 60-90 dBA, and non-annoyance levels are considered to be 55 dBA or less.

By far the most effective mechanism for mitigating noise is the distance from the source to the receptor. Noise decreases at more than a linear rate with distance. Traffic noise (depending on traffic mix, speed, and volume) tends to diminish with distance from the road until it reaches background levels at about 1,000 feet from a source.

Attenuation due to shielding is an important mechanism for lowering dBA levels from highway noise. Shielding occurs when the observers' view of the highway is obstructed or partially
obstructed by objects that interfere with spreading of sound waves. Shielding can be provided by dense woods, rows of buildings, and/or barriers.

Vegetation can be used to reduce the decibel levels of noise. Trees and vegetation deflect and absorb noise energy. According to a Federal Highway Administration (FHWA) report, *Highway Traffic Noise Prevention Model*, dense woods offering no clear line-of-sight between the observer and the source, and with trees extending at least 5 meters above the line of sight can attenuate noise by 5 dBA for each 30 meters of thickness (FHWA, 1978).

Barriers in the form of large hills, berms or slopes are also effective in attenuating noise levels. According to the FHWA report, berms can lower noise up to 20-dBA. Recent data suggests that earth berms provide about 3 DBA more attenuation than freestanding walls. The attenuation of noise by barriers depends on the barrier’s shape and size (FHWA, 1978: 33, 34). The topography of the southern half of the campus offers the protection that a barrier would provide.

Additionally, existing buildings and structures provide some protection. While noise may be a factor for one such structure, it may reduce it for others behind it in the noise’s path. Strategic placement of buildings and occupants can go a long way to assure that the detrimental impacts of noise will be minimized.

**Traffic Links**
Oakdale Boulevard is an east/west arterial north of the Oakdale campus. Currently, this road is a connector between Highway 965 and 12th Avenue. The City of Coralville does have plans to extend Oakdale Boulevard eastward to North Dubuque Street and westward to Highway 6 (Lewis, 1992). According to the Iowa Department of Transportation (IDOT), average daily traffic (ADT) along Oakdale Boulevard is 2,500 vehicles. It is scheduled to be extended to 1st Avenue in 1998. Once the connection to 1st Avenue is established, traffic volumes for Oakdale Boulevard should be between 3,000 and 5,000 according to Johnson County Council of Governments (JCCOG). Volumes along Oakdale Boulevard are expected to rise again once the arterial has been extended to North Dubuque Street. Traffic volumes for the North Dubuque Street connection are not available currently, however, it is reasonable to assume an increase will occur because Oakdale Boulevard will establish a direct link with Iowa City. JCCOG’s projections along arterial streets were obtained from the Quick Response System (QRS) II traffic modeling system (Davidson et al., 1991). Volume capacity (V/C) ratios from JCCOG’s *Arterial Street Plan for the Urbanized Iowa City Area* are presented in the Technical Addendum.

Highway 965 is a north/south arterial adjacent to and west of the Oakdale campus. According to IDOT average daily traffic between Oakdale Boulevard and I-80 is 10,100 vehicles. No immediate changes are scheduled for Highway 965; however, deficiencies along Highway 965 are expected to occur over the next ten years and will worsen over the next 20 to 30 years (Davidson et al., 1991). Traffic along Highway 965 is likely see an increase due to the development of property west of this arterial and the steady growth of North Liberty. Noise will increase accordingly. Some buildings on the Oakdale campus will be affected because of the proximity to Highway 965. However, as a receptor, they will also help to shield other buildings from noise.
Interstate-80 is an east/west freeway and it runs south of the Oakdale campus. IDOT reports current average daily traffic to be 39,100. Because of the volume of vehicles, the mix, and the presence of grooved pavement, I-80 is the largest generator of noise among the links in this study.

Holiday Road currently runs west from 1st Avenue and stops east of the property line of the Oakdale Campus. This road is scheduled to be connected with Highway 965 by Fall 1998. The connection will require the road to run across the southern half of the Oakdale Campus. This is an important project for Coralville because Holiday Road is reaching its design capacity. Also, users of this link are virtually land-locked since it connects only to 12th Avenue. According to JCCOG, congestion problems on Holiday Road could be relieved once the Oakdale Boulevard extension has been completed.

**Noise Levels**
The *Oakdale Campus: Decibel Levels* map shows how current traffic noise impacts the campus. Excessive noise may not be a concern at present for the Oakdale Campus. It will become a gradual problem, however, over the next 10-15 years. This is shown on the *Oakdale Campus: Projected Decibel Levels* map. The largest generator of noise that will impact the campus is Interstate 80. The campus is presently shielded from Interstate noise due to the topography of the southern campus and forested areas. However, as development extends south, the perception of noise from the Interstate for persons in these buildings will be entirely different from that of persons in buildings sited on the currently developed portions of the Campus. This problem will be compounded by a gradual increase in noise caused by the new traffic that will be drawn to the Coral Ridge mall.

A traffic count was conducted to get an estimate of current trips along links during the AM peak hour (7:30AM-8:30AM). The results of this traffic count were applied to the highway noise prediction model. A discussion of the model and its assumptions is available in the Technical Addendum. The results of the model are represented on the *Oakdale Campus: Decibel Levels* map.

According to the results, current noise levels from traffic have a minimal impact on the developed portion of the campus. Most of the developed campus is positioned in an area where the dBA levels are less than or equal to 55. Decibels at these levels do not result in problems associated with annoyance. The map also shows that the buildings affected by decibel levels greater than 55 are primarily the Oakdale storage buildings, the helicopter pad, the radioactive incinerator, and animal quarters A. These decibel levels should not impede the productivity of workers within this area. The most concern would be for animal quarters A. Of all the buildings on the campus, this one receives the most exposure to high decibels, greater than 65 dBA, because it abuts Highway 965. Work conducted in this building could be subject to interruption during the peak hour.

Future noise levels are difficult to project given the changing nature of the area. To make these projections several assumptions had to be made. First, average daily traffic (ADT) along Oakdale Blvd. is projected to almost double over the next 15 years due to impacts of extending it. Second, ADT along Highway 965 is assumed to almost double over the next 15 years due to
land development west of Highway 965 and the consistent growth of North Liberty. Third, ADT along I-80 will increase by 25%, partly due to the establishment of the Coral Ridge Mall. Finally, vehicle mix will remain the same. Discussion of how these assumptions were arrived at is contained in the Technical Addendum. The results of this analysis are represented graphically on the Oakdale Campus: Projected Decibel Levels map.

Based on the results of the analysis and the presence of natural features, which add to the attenuation of noise levels on the campus, noise is not a troublesome issue for the Oakdale Campus. The only facility exposed to noise levels during the peak hour traffic that would be considered annoying is Animal Quarters “B”, along Highway 965. Otherwise, most of the existing campus experiences dBA levels below 55, which is considered background noise.

Results from the analysis of future noise levels indicate that the majority of the campus will not be burdened by peak hour dBA greater than 60. A slight increase in noise may be noticeable but not distracting. In addition to Animal Quarters “B”, structures sited in the lower one-third of the Campus could experience the greatest exposure to peak hour dBA greater than 60. Although exposure to excessive noise is not a problem now, it could be if valuable natural features, which attenuate noise, such as berms and densely wooded areas, are mismanaged. In order to mitigate the impacts of future noise levels demonstrated by our projections, it is necessary to minimize grading of slopes, increase the density and improve the shielding capabilities of existing woods by filling them in, and limit the height of newly constructed buildings to two stories.

In summary, peak hour noise impacts to the campus from increasing traffic will be minimal. The change in noise levels along Oakdale Blvd and Highway 965 will not be considerable. However, peak hour dBA levels generated by traffic along I-80 will change severely. Noise abatement methods should be applied to sites whose exposure to peak hour dBA levels is greater than 60. Finally, it would be advisable not to site building south of the proposed Holiday Road without proper shielding from noise generated by traffic along I-80.

Recommendations
Enhance existing vegetation to provide an additional noise buffer. Densely forested areas are effective vegetative barriers for mitigating noise disturbances. They both absorb and deflect sound waves. Also recommended is the establishment of measures that encourage the litter layer in forested areas.

Slopes also play an important role as natural barriers to noise generators. Naturally occurring berms have been shown to effectively deflect and absorb noise. The FHWA has shown that berms can lower noise by up to 20-dBA. Along the extreme southern boundary of campus there exists a significantly large naturally occurring berm. Since this slope runs parallel to the largest noise generator for the Oakdale Campus (I-80), it is an excellent buffer for the proposed buildings in this area. As such, it should be left intact and not commercially developed as called for in the Crose-Gardner Master Plan.

Buildings should be placed at appropriate distances from sound generators. As sound travels from a noise generator to a destination point it loses energy and thus loudness. By far the best method for controlling sound is simply to locate as far from the source as possible. At Oakdale,
the largest traffic noise generator is I-80. Buildings should not be erected near the southern campus boundary due to the close proximity of this noise generator to the campus.

Attenuation due to shielding is an important mechanism that lowers highway sound levels. Buildings constructed in the lower half of the Oakdale Campus should be limited to two stories in height. This height restriction is suggested in order to reduce the likelihood of noise impacts from I-80 for the new buildings. Depending on where newly constructed buildings are sited the second or third floor of a building could be exposed to direct sound from I-80. The higher the building, the less obstructed the line-of-site.

<table>
<thead>
<tr>
<th>Hard surfaces act as sound reflectors while soft surfaces have the ability to absorb sound energy, thus we recommend vegetative buffers (as opposed to build structures) at the appropriate distances from sound generators (see Oakdale Campus: Recommended Site Plan).</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Enhance existing forest and encourage new growth to serve as a barrier to sound. Preserve naturally occurring berms (slopes) for their noise mitigation qualities.</th>
</tr>
</thead>
</table>

| Buildings located along the proposed Holiday Road should be no more than two stories in height to reduce the likelihood of noise impacts from I-80. |
CHAPTER FIVE: HAZARDOUS AND SPECIAL MANAGEMENT SITES

CHAPTER FOUR SUMMARY

Issues:
- Landfill is built adjacent to a stream. With groundwater draining from the landfill into the stream it is possible that contamination of the stream will occur.
- Wastewater Treatment Plant is built next to a stream and a wetland. With groundwater draining into the stream it is possible that contamination will occur.
- Hazardous Storage sites house products that are potentially harmful. If maintained under EPA and Iowa DNR regulations risk of harm is minimal.

Existing Conditions:
- Small amounts of contamination were found at all special management sites (Landfill, WWTP, and Coal Ash Pile) during a RCRA study. Levels were not considered to be a threat to human health or the environment.
- All Hazardous storage sites are maintained under EPA and Iowa DNR regulations.

Recommendations:
- Clay cap the landfill to ensure minimal infiltration of rainwater as soon as possible.
- Design a wetland at the base of the landfill to scrub leachate and protect the adjacent stream.
- Before development occurs in the east-central section of the Oakdale Campus, remove the former WWTP carefully.
- Complete the removal of the Coal Ash pile as soon as possible.
- Continue to adhere to EPA and Iowa DNR regulations concerning hazardous sites.

There are three potentially hazardous sites on the Oakdale campus. These include the landfill, the former wastewater treatment plant (WWTP), and a coal ash pile. Additionally, there are three hazardous waste storage facilities. These are Facility A (a PCB storage facility), Facility B (a radioactive waste storage facility), and Facility C (a hazardous waste chemical storage facility). Finally, there are three major sources of emissions. These are the Medical Waste Incinerator, the Radioactive Waste Incinerator, and the Boiler Stack.

Landfill

From 1940 until 1965, the landfill site was used to dispose of waste from both the Oakdale sanitarium and from campus facilities. The location of the site shown on the Oakdale Campus: Sensitive Sites map. After 1965 the site was also used to dispose of refuse until 1977 and coal ash until 1985. Between 1983 and 1984 hazardous wastes were detonated and burned in this vicinity. More recently, an asbestos-insulated stack was buried on the site. At this time the site is no longer receiving any kind of disposal materials and plans are to clay-cap it.

The nature of the refuse disposed of in the landfill beyond that listed above is largely unknown. The exact nature of the construction techniques used, if any, are also unknown. Having been built prior to 1972, there is little chance that any engineering features were installed to ensure protection of the surrounding environment. The greatest environmental threat that is posed is the migration of leachate from the site into ground waters and nearby surface waters. Leachate
results from the following sources (LaGrega et al., 1994):

- precipitation falling directly onto the landfill
- surface flow that runs across the cover of the landfill
- groundwater that flows through a portion of the landfill lying below the groundwater table
- liquid products disposed of in the landfill

The feature that is most likely to be impacted by the landfill is the stream that runs directly east and south of the site. While today the wisdom of locating such a volatile site next to a stream would be questioned, prior to 1972 this was common practice. It was considered standard then to locate landfills in lowland sites, preferably sand pits near streams. This ensured a maximum amount of dilution of leachate by fresh recharge and established a boundary, the stream, for the migration of such leachate. Any leachate that leaked out of the site would run into the stream and no further. It was assumed that the stream would sufficiently dilute the leachate as to render it non-toxic. In 1972, however, the Iowa Geologic Survey created a statewide hydrogeologic hazard zone classification system for landfill siting. This system required that: (1) there be no significant topographic or hydrologic connection between the landfill and surface water, (2) the base of the landfill be at least 5 feet above the water table, and (3) the site have a natural or artificial means of inhibiting downward percolation of liquids if it lies above a bedrock aquifer (Kross, 1987). Leachate from a landfill is a significant threat to both surface and groundwater quality.

A Resource Conservation and Recovery Act (RCRA) study tested the landfill site for potential soil, groundwater, and surface water contamination. The soil samples showed the presence of cadmium in one location and a trace of cyanide in another. Test wells installed at these sites showed no migration of these compounds. Several samples contained low levels of phthalate and poly aromatic hydrocarbons (PAH) compounds. It was assumed that these were the results of the coal ash buried on the site and were not considered to be a threat. Such a conclusion may be in haste, however, given the nature of coal ash chemical releases. See the discussion of the coal ash pile below for further insight on this matter.

The site was also evaluated for groundwater flow velocity and vertical water movement between the surface water and groundwater. It was found that the groundwater is likely discharging into the nearby stream. Given this information it can be assumed that the potential exists for contaminant transport from the landfill to the stream.

**Recommendations**
Proceed with measures to stabilize and secure the landfill. This should include a clay cap to ensure minimal infiltration of rainwater. Every effort should be made to leave this site undisturbed either by human-made features or natural features.

At the base of the landfill, where it is adjacent to the stream, a wetland should be developed. Wetlands have the ability to scrub water clean and to remove contaminants. If leachate were to escape the landfill in the future, before reaching the stream itself it would pass through this
wetland and presumably be removed. This would add additional protection to the stream and at the same time add valuable habitat, erosion and flood protection.

| Stabilize and secure the landfill to ensure minimal infiltration of rainwater. |
| Design a wetland at the base of the landfill to scrub leachate and protect the adjacent stream. |

**Former Wastewater Treatment Plant (WWTP)**
The former wastewater treatment plant (WWTP) was in operation from 1908 until 1969 when the Oakdale campus constructed a connector line with the City of Coralville's sewer system. The WWTP consisted of several buildings, two trickling filter beds, and two sludge drying beds (which are located to the south of the site). The location of the site can be seen on the *Oakdale Campus: Hazardous and Sensitive Sites* map. Following its abandonment the site was used to dispose of coal ash and to detonate hazardous wastes.

Studies done by Versar Inc. in 1987 indicate the presence of mercury, nickel, silver, and copper. A sample taken from the stream to the west of the site also showed detectable levels of several metals. The RCRA study tested the site for soil, groundwater, and surface water contamination. In the soils it also found the presence of cadmium and silver. The silver was found not to have migrated from the point where it was found. To further monitor the cadmium a test well was installed. The cadmium was located just above the water table. Several samples also contained low levels of phthalate and PAH compounds. Again, it was assumed that these were the results of the coal ash buried on the site and were not considered to be a threat. See the discussion of the coal ash pile below.

The groundwater samples were all below the US EPA maximum contamination levels (MCLs). However one sample did exceed the US EPA Action Level for lead corrosion control in public water systems. A couple of other samples exceeded the US EPA Secondary Drinking Water Standards (SDWS). The SDWS are based, however, on issues of taste and odor rather than human health risk. Additionally, one of the surface water samples exceeded the US EPA MCL for lead concentration. This sample was collected upstream from the site and is therefore very unlikely to be a result of contamination from the site.

The site was also evaluated for groundwater flow velocity and vertical water movement between the surface water and groundwater. It was found that the groundwater is likely discharging into the nearby stream. Given this information it can be assumed that the potential exists for contaminant transport from the former WWTP site to the stream.

**Recommendations**
Before development in the east-central part of campus occurs, remove the former WWTP. This needs to be done with great care as the location of this site is in one of the most environmentally sensitive areas of the campus. Effort should be made to retain existing vegetation and to avoid disturbing the nearby stream and wetland.
Before development occurs in the east-central section of the Oakdale Campus, remove the WWTP carefully.

Coal Ash Pile
The coal ash generated by the burning of coal in the campus power plant was disposed of in a small ravine to the west of the power plant. The site is shown on the map entitled Oakdale Campus: Sensitive Sites. The area is approximately 40 feet east to west and 80 feet north to south. Currently the coal ash is being removed from the site but the work, as of yet, is not completed.

The site was tested in the RCRA study for soil and sediment contamination. Prior studies by Versar, Inc. showed the existence of several metal products. The RCRA study confirmed this finding. Several of the samples also contained samples of low level Phthalate and poly aromatic hydrocarbons. However these levels were so small that they warranted no further consideration.

It should be noted that the relatively low levels of contamination found at the coal ash site do not warrant dismissing the site as no longer a threat. According to Shi and Sengupta (1995), while many non-toxic chemicals begin to leach out of a site immediately, toxic chemicals such as arsenic, copper, and zinc do not appear until much later. When they do begin to enter leachate, their original concentrations are typically low. They will rapidly increase, however, and then subsequently drop off to zero. A finding of little-to-no chemicals could indicate the site has already run its course, or it could indicate that toxic chemical levels have not yet begun to rise. Presuming that the removal process will continue, this site should eventually be eliminated as a threat. However, coal ash was also buried at the landfill and the WWTP site. These sites should be carefully monitored for such delayed release toxicants.

Complete the removal of the Coal Ash pile as soon as possible. At present this site is particularly dangerous because all vegetation has been removed and erosion is happening freely. The eroded soils can carry contaminants from the pile into the nearby stream and degrade it and other water bodies downstream.

Complete the removal of the Coal Ash pile as soon as possible.

Hazardous Waste Storage Sites
In addition to having several hazardous sites, Oakdale Campus has three hazardous waste storage facilities. These sites can be located on the Oakdale Campus: Sensitive Sites map. They include Facility A, which is a storage location for PCB’s; Facility B, which is the storage location for radioactive wastes; and Facility C (Bat Cave), which is the storage location for hazardous chemical waste.

The University of Iowa generated approximately 12,000 items of chemical waste in 1991, representing 5,500 different chemicals. About two-thirds of these are regulated under RCRA. Discarded unused chemicals are kept in their original, labeled containers and evaluated by a professional chemist. They are designated as ignitable, reactive, corrosive, or toxic, or they may be listed as directed under the Code of Federal Regulations. They are then stored in the
appropriate facility based on their compatibility.

The Facilities are constructed as per Federal Regulations, thus minimizing the actual threat. Each facility has poured concrete floors and is capable of containing leaks and spills. All containers are elevated on boards and pallets to prevent contact with any liquid that may be on the floor due to a spill. Access to these is limited to authorized personnel. Doors are kept locked at all times and this as was verified by the University Health Protection Office. The main doors are marked with a "Danger" sign. In the event of an emergency these sites are each equipped with a fire extinguisher and vermiculite. Employees are trained in proper handling of all materials so as to prevent accidents and spillage. A contingency plan and emergency procedures have been developed pursuant to federal regulations. This includes agreements with local fire protection, police departments, and hazardous chemical handlers.

Facility A (PCB Storage) is capable of storing approximately 5600 gallons of liquid but is allowed by the University to store only 3850 gallons. Facility B (Radioactive Storage) has the capacity to store 200 gallons of liquid but will be used to store only 55 gallons. Facility C (Hazardous Waste Storage) has an outdoor, fenced-in, covered area. This, too, has concrete floors with leakage control. In total, the floors can contain 3000 gallons of liquids. There is a sump to collect spilt chemicals. It also has an extensive CO2 fire extinguishing system that is fully automated. This facility also has explosion-proof wiring.

Recommendations
Monitor potentially hazardous sites for leachate and mediate these sites as needed based on the outcome of the monitoring. Ensure that sites are properly secured, contained, and stabilized. Avoid disturbing these sites. Prevent damage to the site by vegetation disturbance (tree roots) and erosion from runoff that might lead to contaminated runoff (leachate). Runoff can be prevented by grading the land to run excess water around the site rather than over it.

Continue to adhere to EPA and Iowa DNR regulations concerning hazardous sites.
CHAPTER VI: AIR QUALITY

CHAPTER SIX SUMMARY

Issues:
- Poor air quality can pose risks to public health and welfare, including injury to agricultural crops and livestock, damage to and the deterioration of property, and hazards to air and ground transportation.

Existing Conditions:
- There are three main emissions sources. These include the:
  - Medical Waste Incinerator
  - Radioactive Waste Incinerator, and
  - Boiler Stack.
- None of these sites are emitting levels that even approach the maximum allowable levels under federal regulations.

Recommendations:
- If at all possible avoid releasing emissions during times of temperature inversion (in Iowa this is in the early morning hours and the evening hours).
- Continue to adhere to the regulations of the USEPA and the Iowa DNR regarding air emissions.

The problem of air pollution has become more complex in recent years due to urbanization, industrial development, and the increasing use of motor vehicles. Poor air quality can pose risks to public health and welfare, including injury to agricultural crops and livestock, damage to and the deterioration of property, and hazards to air and ground transportation. Air pollution prevention and air pollution control must be carried out at the locally.

Emission Sources
There are three main emissions sources. These include the Medical Waste Incinerator, the Radioactive Waste Incinerator, and the Boiler Stack. The location of each of these sites can be determined from the Oakdale Campus: Hazardous and Sensitive Sites map. All stacks are operated under the guidelines provided by both the Iowa Department of Natural Resources and the US EPA. More information, including the maximum emission rates, the technology used, and so forth, can be obtained from the Title V Voluntary Permit Application filed by the University of Iowa in 1995. None of the sites are emitting levels that even approach the maximum allowable levels under federal regulations.

Ambient Air
Air quality in Iowa has only been an issue only in more densely populated areas such as cities: Cedar Rapids, Davenport, Muscatine, and Clinton. Ambient data is obtained by measuring the concentrations of pollutants in the air at specific monitoring locations. There are no ambient air monitoring locations in Coralville. The closest monitoring location is in Cedar Rapids, which is in compliance. In that this area, Coralville or the Oakdale Campus, will not likely ever reach comparable population or industrial activity, air quality is not likely to become an issue at the
specific sites reported earlier, which are independently regulated.

**Recommendations**
On the Oakdale Campus, the release of emissions during times of temperature inversion should be avoided. In Iowa, this occurs in mornings and evenings. Temperature inversions occur when air is trapped at the ground level and cannot escape. If emissions are released into trapped air they remain where they can be hazardous to human health rather than be diluted by atmospheric air. Additionally, continued adherence to the regulations and guidelines of the State and Federal government is, of course, recommended.

**If at all possible avoid releasing emissions during times of temperature inversion** (in Iowa this is in the early morning hours and the evening hours).

**Continue to operate under the guidelines and regulations of the State and Federal governments.**

**OTHER ISSUES**

**Wells**
On record, there are two production wells, one Jordan and one Silurian, and three test wells that are checked by Iowa Geological Survey (IGS). All the wells have casing. The three test wells are grouted, and the two production wells are not. The two production wells are a potable water source and are enclosed in the well house for protection. Based on our interviews with IGS and University staff, we believe there is no risk of contamination to the aquifer from the standpoint of those wells. A third production well is also suggested to exist. At this time, no one is sure of the location or the condition of the well, but its existence has been verified in records of well construction collected by the IGS. It is possible it could have been covered up and a probable location is the power plant.

**Recommendations**
Properly cap and close wellheads when they are no longer in use. Since this is a State law it really goes without saying, however, its importance cannot be over emphasized. Wellheads are a direct link to ground aquifers which, at Oakdale, are 400 feet and 1700 feet below the surface. Here the water is very pure from having passed through the many layers of sediment. One site can contaminate a huge area.

**Properly cap and close wellheads when they are no longer in use.**

**Archaeology**
According to the Office of the State Archaeologist no archaeological sites were recorded within the project location. This ensures that no findings of historical or cultural significance could be potentially disturbed due to construction on the site.
Section II
ENVIRONMENTAL SENSITIVITY ANALYSIS

The aim of this analysis is to identify sites on the campus that are more environmentally vulnerable to development and human disturbance based on the findings of the Environmental Inventory.

METHOD
As indicated in the prior chapter, an inventory of all environmental characteristics was collected for the Oakdale Campus. These were then divided into groups of associated features (Example: Vegetation Types) and ranked based on their relative environmental value (i.e. grass=1, new forest=2, and wetland or old forest=3). Each of these features were then assigned a weighting factor based on the priorities of the clients and the professional judgement of the researchers. The intent was to capture the relative importance of each independent item as it related to the environmental sensitivity of the campus. Table 4 below presents this matrix.

<table>
<thead>
<tr>
<th>Features</th>
<th>Environmental Value</th>
<th>Weighting Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slope</td>
<td>0-2% 3-5% 6-14% &gt;14%</td>
<td>5</td>
</tr>
<tr>
<td>Watershed Runoff</td>
<td>&lt; 50 cfs &gt;= 50 &lt; 100 cfs &gt;= 100 &lt; 150 cfs &gt;= 150 cfs</td>
<td>5</td>
</tr>
<tr>
<td>Soil Erosion Class</td>
<td>None Slight Moderate Severe</td>
<td>5</td>
</tr>
<tr>
<td>Drainage</td>
<td>None Drainage Channel Stream Channel Floodplain</td>
<td>3</td>
</tr>
<tr>
<td>Vegetation</td>
<td>None Grass New Growth Forest Older Forest or Wetland</td>
<td>3</td>
</tr>
<tr>
<td>Noise Hazardous Sites</td>
<td>&lt; 55 dBA &gt;= 55, 60 dBA &gt;= 60 &lt; 65 dBA &gt;= 65 dBA Special Management Site</td>
<td>3</td>
</tr>
<tr>
<td>Wildlife Corridor</td>
<td>None Deer Trail Habitat Potential Habitat w/ Corridor</td>
<td>1</td>
</tr>
</tbody>
</table>

Each of the features was then mapped using ArcView, a GIS mapping program. Each feature was translated into a grid, or a series of small squares (each square representing and area of approximately 40 feet by 40 feet of the Campus) to which a value can be assigned. Each grid was assigned an aggregate number equal to the combined Environmental Values multiplied by the Weighting Factor as listed in the Sensitivity Matrix. The grids allows the maps to be "added" together and a value to be assigned to each 40 foot-squared piece of ground on the campus based on the values assigned to the different features that are found on that particular site. For example,
if a 40 foot-square section includes a 10% slope, with a Severe Soil Erosion class, located in a < 50 cfs watershed, and is covered with grass, the computer would assign it a value as shown in Table 5.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Sensitivity Level</th>
<th>Weighting Factor</th>
<th>Total Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>10% Slope</td>
<td>2</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Severe Erosion class</td>
<td>3</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>&lt; 50 cfs Watershed</td>
<td>0</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Grass Vegetation</td>
<td>1</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>28</strong></td>
</tr>
</tbody>
</table>

Using a color gradation system, the computer then assigns 13 different shades of red to the grid values. The higher the grid value the darker the shade of red used to represent it on the map. By looking at the map it becomes obvious by the shades of red which areas will be more sensitive to development. This map is called *Oakdale Campus: Environmental Sensitivity*.

A second map, called *Oakdale Campus: Future Sensitivity*, performs the same analysis but with the projected values for runoff and noise that will exist when the Oakdale Master Plan development is completed.

**Analysis**

Based on the outcome of the *Oakdale Campus: Environmental Sensitivity* map, eight areas have been determined to be highly sensitive to development. These areas should be avoided as sites for development or efforts should be made to mitigate possible impacts. An analysis is offered for each of these areas.

**Area 1**

This area is a narrow, deep ravine. In the bottom of the ravine wetland vegetation has formed and an intermittent stream flows off the property. The banks of the ravine are very steep and are currently experiencing severe erosion in several areas. Several buildings surround the area. It is possible that runoff from these buildings is responsible for both the erosion and excess water in the ravine promoting the wetland.

The Master Plan suggests lining this section and thus creating a small pond. Presumably the intent is to create an attractive entrance to the Campus since the ravine appears close to the entrance. This suggestion has merit as an aesthetic improvement and as a means of improving the erosion situation. The ravine is deep enough that it is unlikely that a shallow pond would create any threat of flooding if designed properly. The primary concern would be the pond banks. Using appropriate vegetation could most effectively protect these.

**Area 2**

This particular area is perhaps the most challenging environmental area on the Oakdale Campus. It includes a coal ash pile (which currently is being removed, leaving a large piece of land unvegetated and susceptible to erosion), and an old landfill that was built without the appropriate protective technologies of today and houses an abundance of environmental contaminants. The
area also contains steep, eroding slopes, a persistent stream, and an older forest. Further, a radioactive incinerator and a medical waste incinerator overshadow this section of the campus. The extreme variations in topography, presence of rare yet valuable vegetative and physical features, and the risk associated with the presence of the two special management sites demand that this area not be disturbed if at all possible. The exception to this would be the efforts to cap the landfill and remove the ash pile, which should be considered the top priorities of any environmental activity on the Campus.

One action that will assist in reducing the threat of contaminating the nearby stream is the development of a wetland in the streambed directly adjacent the landfill. Wetlands have been shown to be excellent means of filtering pollutants from water. Any leachate that would migrate from the landfill into the wetland would be forced to pass through the wetland before entering the stream.

Area 3
This area houses one of the wetlands on the campus. This appears to have been created, or at least expanded, by the excess runoff from the surrounding buildings and parking lots. The lack of an effective stormwater management system for conveying runoff amplifies problems associated with erosion, scouring of streams, increased stream flows, and the degrading of stream quality due to the depositing of sediment, vehicle oils and other wastes into this area. The existence of the wetland as a sink for water before it proceeds into the nearby stream is essential for protecting the water quality by the settling of sediment, breaking down of pollutants by wetland vegetation, and controlling against potential flooding.

Area 4
This section is targeted for moderate to heavy development requiring the addition of three new buildings, several parking lots, and additional roads. Based on the sensitivity analysis the layout for development in this area, as illustrated by the Master Plan, is not recommended. This section of the campus is hampered by the presence of erodible soil types found only on this particular part of campus and an abundance of slopes ranging from 15 to 25% steepness. Even with the presence of Bromegrasses this area is experiencing significant erosion problems and efforts have had to be made to control these artificially with silt fencing. Erosion of the soils when the bike path was put in covered up half of the path.

The best solution would be to leave this area largely undeveloped and encourage appropriate vegetation. This would prevent the inevitable problems that a construction site on this land would create, would protect this highly erodible soil from rainfall, and anchor it in place.

Area 5
This is the second most environmentally sensitive area. Features include a forest that serves both to protect against erosion and to provide animal habitat, a wetland connected to a permanent stream, both medium and highly steep slopes, unique and erodible soils, and the old wastewater treatment site. This area thus possesses high ecological value and is particularly vulnerable if disturbed.

The Master Plan suggests the building of a road directly over the former WWTP site which,
unless the soil and associated contaminants are removed, could result in the disturbance and possible release of trapped contaminants into the nearby stream. Additionally, a building is suggested in an area that would require the partial removal of the forest and thus the exposure of the same highly erodible soil mentioned in Area 4, which is unique to this particular portion of campus. We recommend relocating both the road and the building. However, this may compromise the effectiveness of the Campus traffic circulation as envisioned in the Master Plan. Further study is needed to determine if this is the case.

**Area 6**
This area is typified by its highly erodible soils, steep slopes, and poor vegetative cover. Currently, erosion rills are present in excess across this area. Efforts need to be made to avoid directing runoff over this land from new development. It is also advised that vegetative cover be improved from Brome grasses to either forest growth or prairie grasses, which would provide an interesting contrast to the existing forests and a nice transition to the wetland/pond.

**Area 7**
The Master Plan proposes the design of a retention pond in this area and along the eastern property line. In order to do this the existing forest area would have to be removed. This goes against the Master Plan’s mandate to preserve the existing forest vegetation. It is also unadvisable because of the important flood control and sediment trapping qualities. We recommend that the campus opt for two small ponds surrounded by a wetland buffer that could absorb additional water as needed. Each would be placed at the lowest points of the topography on either side of the existing forest. They would act to filter additional sediment and act to slow up the water as it flows off campus into the adjacent subdivision, thus reducing the threat of flooding there.

**Area 8**
This section of the campus could be susceptible to excessive noise levels from traffic along interstate-80. However, the topography of the campus and existing trees in the area serve as an effective barrier for reducing decibel levels considerably. According to the Oakdale Master Plan, this section of the campus is targeted for the placement of additional buildings and the extension of Holiday Road from the eastern subdivision on to Highway 965. Grading of slopes and removal of trees in this area will not only increase the area’s exposure to greater decibel levels, but will also increase problems associated with erodible soils and the depositing of sediment into the stream along the eastern property boundary. Topography should be left intact so as to provide a physical barrier to noise and the current forest, which is heavy to the east and sparse to the west, should be encouraged to fill in completely across the top of the ridge. This is the best mechanism for controlling potential increases in freeway noise.

**CONCLUSION**
The Oakdale Campus: Recommended Site Plan map suggests how the preferred option of the Master Plan might be slightly modified to take into consideration these environmentally sensitive areas. Using this analysis and the included recommendations and policies will result in a development that preserves the natural functions of the physical and biological systems. This will save the University money by using natural, instead of engineered, means to control such
problems as flooding and erosion, and will establish a workable relationship between the human and the natural environment.

It should be noted that an attempt was made to retain the same number and size of building structures. However, such an analysis does not take into consideration the potential traffic flow and economic land use issues that were considered in the Master Plan. This map is intended only as a guide for development. When actual development occurs site-specific analysis needs to be conducted, both for existing environmental features and for other issues beyond the scope of this study.

Also, the outcome of the Sensitivity Analysis is greatly influenced by the priorities established by the client in weighting the individual environmental features. The specified areas would probably remain the most sensitive on Campus irregardless of the scale, however the relative values might change slightly depending on which features were preferred. Such a limitation should be acknowledged as specific sites are more closely evaluated for development.
This map is a composite of all environmentally sensitive natural features. Each feature is weighted according to its prioritized importance. The darker the red, the more sensitive the given area will be to development.
This map is a composite of all environmentally sensitive natural features. Each feature is weighted according to its prioritized importance. The darker the red, the more sensitive the given area will be to development.
SECTION III
CONCLUDING STATEMENTS

The purpose of this plan is to provide the University of Iowa with an accurate assessment of the environmental features located on and relevant to the Oakdale Campus. In pursuit of this goal we have inventoried the site, conducted a composite analysis of the surveyed features, and provided interpretations and recommendations based on our findings. In this section we discuss the implications of our findings in the context of future development and the Master Plan.

The first accomplishment of the Oakdale Campus Environmental Plan is to bring to light several important issues that had previously gone unnoticed on the Master Plan that will significantly affect development. First, due to the topography Holiday Road will have to follow a single and slightly altered path than previously proposed. Second, the water feature intended for the floodplain would have required the removal of a tremendous amount of forested vegetation. An alternative pair of wetland/ponds have been suggested in its place. Third, if a road is to run from Oakdale Hall to the central part of Campus (through the area now containing the former WWTP) the WWTP will first need to be removed and then special care will need to be used to assure that the existing wetland is protected. Fourth, the berm area and forest on the very southern end of campus will need to be retained so as to minimize the impacts of noise from Interstate-80. Fifth, due to practices in the first half of this century, the landfill was built in what is now considered a very inappropriate location. Due to this location special remedial actions will need to be taken to minimize any risk of contaminating the adjacent stream. This will include clay capping the site and developing a wetland to assimilate any leachate that does migrate from it. Finally, in spite of the fact that it appears to be a good site for development, the northeastern edge of campus is highly susceptible to erosion due to the soil types, steep slopes, sparse vegetation, and heavy runoff. Thus any development that might occur needs to be done with caution. Each of these discoveries came about principally via the Environmental Sensitivity Analysis.

The Environmental Inventory has also been important in noting several important characteristics relevant to the existing environmental features of the Oakdale Campus. Primarily, it was noted that much of the land not yet developed is made up of highly erodible soil. This problem is further compounded by an abundance of 15% plus slopes. A floodplain was identified in the central portion of the southern campus. It was discovered that the forest next to the landfill site is very old and of potential ecological value. In addition to the two existing wetlands, a third wetland was identified next to the WWTP and running up into the nearby deciduous forest. Finally, it was shown how Oakdale is a part of a larger habitat linkage for deer and other wildlife and that it has potential habitat existing on site as well.

Finally, the plan offers a group of recommendations, including a substantial list of Best Management Practices for erosion control. The recommendations have offered ways that the University can prevent flooding, erosion, slope failure, protect biodiversity, minimize noise impacts, and has noted special management sites that require extra attention to prevent environmental problems. Where hazards could not be all together prevented suggestions are offered as to how these might be mitigated to minimize possible impacts. The recommendations have focused on methods that use primarily natural system services to accomplish their end. This provides economic advantages as well as encouraging environmental cooperation. The heart of
the plan is the Environmental Sensitivity Analysis that provides a quantitative analysis of the aggregate environmental features at all sites on Campus. From this a recommended site plan is suggested. While maintaining the basic locations and number of buildings, and the majority of roads proposed in the Master Plan, this plan offers a more environmentally friendly option.

The intent of this plan was to supplement the Master Plan. It was never intended to replace it, nor should it. As development of the Master Plan proceeds this plan should be referenced to determine what details may need to be considered to best protect the valuable, natural features of Campus. This plan has made no attempt to surmise the impacts such consideration will have on the economic utility of the land nor on such issues as traffic circulation. Further study is needed in order to reconcile these issues. Presumably, the University will use judgement in making such decisions and that consultation of this plan will be included in that process. The data provided here is neither exact enough, nor intended to be used for specific site preparation. Before a specific site is developed an onsite visit and assessment of the specific existing features must be done to ensure an accurate understanding. The cumulative impacts should be considered as well. Development of the Oakdale Campus will have far reaching effects and every effort should be made to try to assess the impacts of development before they are realized. This way appropriate actions can be taken to mitigate any potentially detrimental impacts to the community and the environment.

Like any instrument this plan is only valuable if used. We have tried to follow a format that makes such use as easy as possible. One may scan the chapter summaries, delve into the actual text, or even probe the appendixes. We truly hope that this plan may be a benefit to the University. Emphasis has been place on proactive alternatives for the management of the Oakdale Campus. It is now up to the University to follow the general guidance of the plan through to its actualization.
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-----. Interview by Carlton Eley, 15 February 1998. Tape Interview, Johnson County Council of Governments, Iowa City, IA.


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Appendix A  
BEST MANAGEMENT PRACTICES FOR EROSION CONTROL

The following practices are intended to guide erosion control and mitigative measures (best management practices (BMPs)) during the pre-construction and post-construction phases of the Oakdale Campus. The goal of these practices is to retain sediment on site and to reduce the amount delivered to receiving basins through preventive and mitigative measures.

Preventative Methods for Eliminating Erosion  
The most effective way of controlling erosion is to use preventive management approaches. We recommend a systematic approach that focuses on the prevention of erosion before it occurs. This approach requires active management of the soil that is in place on site, rather than reacting to sediment after erosion has occurred (SWCS, 1996). This requires that soil be kept in place on the construction site as much as possible.

Prevention of erosion and sediment transfer can be encouraged in the following ways:

- Maintain natural systems
- Protect, maintain and enhance riparian zones
- Reduce impervious surface cover
- Prohibit groundbreaking during rainy seasons
- Establish setbacks from stream corridors
- Require stabilization of construction sites before certain dates
- Develop large projects in stages to minimize disturbances
- Develop on the contour
- Establish a controlled access point
- Install a perimeter sediment control measure (small dike) to prevent runoff through the construction site
- Use temporary seeding where appropriate
- Stockpile topsoil for future use
- Use mulching to cover disturbed ground
- Place biodegradable erosion control matting on freshly seeded areas

A number of the above measures should be utilized during any construction on the Oakdale campus. Developers and appropriate University officials should conduct a detailed, site-specific erosion control assessment of selected sites before any groundbreaking takes place. The guidelines used by the Natural Resource Conservation Service (NRCS) for conducting a site review of a construction site is located in Appendix B. Policies based on this recommendation statement must be formalized and put into the construction contracts of the Campus’ developers. An environmental review panel composed of qualified University personnel can establish these policies, and others. For a more detailed discussion of the proposed environmental review panel see recommended policy statement two.

Mitigative Techniques for Controlling Sediment  
A certain amount of erosion is inevitable. Even the best mix of strategies will not stop all erosion from occurring. In addition to applying preventative methods, it is necessary to implement a number of mitigation measures to control sediment loss after soil erosion has occurred. These are often referred to as Best Management Practices (BMP’s). The selection of proper BMPs for the Oakdale Campus requires identification and assessment of existing and potential sources of
contamination. They are recommended for the Oakdale Campus because BMPs assist natural systems in removing pollutants and reducing runoff generated from additional impervious cover.

The following BMPs are recommended based on the inventory findings and analysis conducted for the Oakdale Campus. Be aware, there are other BMPs, which could be installed for permanent mitigation on the Oakdale Campus; the BMPs chosen for application should be site specific. BMPs that could be installed on the Oakdale Campus include:

- Direct water (and sediment) toward sediment trapping basins and vegetative buffer zones
- Maximize the water surface (rather than water depth) of sediment basins to increase sediment trapping efficiency
- Develop water features or ponds before breaking ground for building sites if water features are to be developed later
- Erect silt fencing on the contour
- Buffer zones for decreasing the velocity of storm water runoff
- Permanent seeding and planting for stabilization of soil
- Porous pavement to allow surface water to permeate through parking lots
- Infiltration trenches or filter berms for removal of fine sediment and soluble pollutants
- Gradient terraces for reduction of erosion damage by capturing surface runoff and directing it to outlets at a slower speed
- Wetlands and catchment ponds for controlling the volume of stormwater runoff and removing pollutants from runoff

We recommend the above measures be used as a model to guide development of an erosion control policy for the Oakdale Campus of the University of Iowa. The University’s goals and objectives should be met through application of the policy while striving for the preservation and protection of the integrity of natural systems.
BMP Diagram 1. Silt Fence
**Description:** A temporary barrier of geotextile fabric used to intercept sediment.
**Purpose:** To trap sediment from sheet flows before it leaves the construction site.

Source: Cable et. al., 1994

BMP Diagram 2. Buffers
**Description:** A conservation strip or buffer area of land adjacent to seasonally wet areas.
**Purpose:** To maintain a permanent vegetation buffer between erodible lands and water bodies.

Source: USDA/NRCS, 1996
BMP Diagram 3. Straw Bale Barrier
Description: A temporary barrier row of anchored straw bales.
Purpose: To trap sediment from sheet flows before it leaves the construction site.

Source: Cable, 1994

BMP Diagram 4. Erosion Blanket
Description: A protective blanket of straw or other plant residue, or plastic fibers formed into a mat, usually with a plastic mesh on one or both sides.
Purpose: To protect the soil surface from raindrop impacts and overland flow during the establishment of vegetation.

Source: USDA/NRCS, 1995
BMP Diagram 5. Porous Pavement
Description: A pavement consisting of strong structural materials having regularly interspersed void areas of pervious materials.
Purpose: To increase infiltration and to reduce runoff impacts.

Source: USDA/NRCS, 1995

BMP Diagram 6. Infiltration Trench
Description: A structure filled with several grades of sand and a filter fabric through which stormwater is conducted.
Purpose: To filter the first 0.5-inch of runoff which is heavy in contaminants.

Source: Marsh, 1998
BMP Diagram 7. Filter Berm
Description: Elongated earthen mounds constructed along the contour of a slope.
Purpose: To spur infiltration and filtering of runoff; they are designed like infiltration trenches.

Source: Marsh, 1998

BMP Diagram 8. Terracing
Description: Earthen structures that intercept runoff on moderate to steep slopes.
Purpose: They reduce sheet and rill erosion and prevent gully erosion.

Source: Wayne Petersen, 1998
BMP Diagram 9.  Wetland/Pond Feature

Description: Wetlands providing a transition to catchment ponds.
Purpose: These features work in tandem to filter, infiltrate and store excess runoff.

Source: USDA/NRCS, 1997
Appendix B
NATURAL RESOURCE CONSERVATION SERVICE SITE REVIEW GUIDELINES

A. Inventory and Analysis of Site (Watershed Approach)
   1. Topography
      What are the slopes of the site?
   2. Drainage patterns
      How much drainage comes on/leaves the site?
      Where are the drainage patterns located?
   3. Soils (erodability/hydric soils)
   4. Ground Cover
   5. Adjacent areas – What is adjacent to the proposed development? – various land uses
      (presence of water bodies/woodlands)
   6. Are there areas where erosion is currently occurring?

B. Items of Consideration – Preliminary Plat
   1. Does the development fit the site or has the site been adjusted to fit the development?
      (location of roads and buildings)
   2. Are the natural drainage systems being used?

C. Items of Consideration – Erosion and Sediment Control Plan
   1. What are the clearing and grading limits of the site?
   2. How much drainage comes onto the proposed development?
      How will runoff travel over the proposed development? Has the site been divided into
      drainage areas? How is each drainage area being treated?
   3. What erosion control measures have been selected?
      a. Vegetation and Non-structural measures (Can silt fence handle the drainage
         area?)
      b. Structural measures
      c. Installation of perimeter erosion control measures

D. Plan Preparation
   1. Site Plan
      a. Location map
      b. North arrow and scale
      c. Contours (existing and proposed)
      d. Existing vegetation/woodlands/soils
      e. Critical erosion control locations (areas currently eroding or likely to erode)
      f. Drainage patterns (Is the drainage pattern identified?)
      g. Clearing and grading locations
      h. Erosion control locations
      i. Stock piles – Where will they be located? What measures will be in place to
         keep soil in a pile?
   2. Narrative
      a. Description of land (legal)
      b. Adjacent areas (watershed)
c. Soil Map

d. Erosion and Sediment Control
   – description and approximate footage of matting, silt fence, basins, ponds, waterways, and diversions
   – seeding/mulching/fertilizing options/dates
   – installation specifications
   – stabilization seeding shall be done on all disturbed areas if grading stops for more than fourteen days

e. Maintenance
   GOAL: KEEP SEDIMENT ON SITE
   – All erosion and sediment control measures shall be checked once a week and after each rainfall to locate damages and to conduct maintenance operations.
Appendix C
TECHNICAL ADDENDUM

Slope

Calculation
The percent of a slope is determined by the number of units of rise per 100 of the same units in length. The formula for percent of slope is:

\[
Percent\ Slope = \frac{\text{change in elevation}}{\text{length}} \times 100
\]

Noise

Measurement
For the purposes of this study, the term decibel is used to refer to the measuring unit of sound. When measuring traffic noise, adjustments to high and low-pitched sounds are required in order to approximate human hearing. Adjusted sounds are called "A-weighted levels" (dBA). This term will be used in this Technical Addendum. The dBA scale is logarithmic. In terms of perception for the human ear, the intensity or loudness of noise doubles for every 10 dBA (FHWA, 1992: 3).

Most disruptive traffic noise depends on the volume, speed, and composition of the traffic. The table 6 has been provided to show the relationship between traffic volume, noise, and distance from the road. These levels should be considered approximations since other factors, barriers or shielding, can influence noise levels.

<table>
<thead>
<tr>
<th>Average Daily Traffic</th>
<th>55 dBA</th>
<th>65 dBA</th>
</tr>
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<tbody>
<tr>
<td>Up to 7,999</td>
<td>404</td>
<td>57</td>
</tr>
<tr>
<td>8,000-27,999</td>
<td>736</td>
<td>159</td>
</tr>
<tr>
<td>28,000-47,999</td>
<td>970</td>
<td>209</td>
</tr>
<tr>
<td>Greater than 48,000</td>
<td>1339</td>
<td>289</td>
</tr>
</tbody>
</table>


Depending on the individual, noise can cause communication interference, annoyance, or sleep disturbance. Communication interference occurs when nearby traffic masks normal conversation. Annoyance describes physical and psychological stress. The effects of increasing noise levels are summarized in table 7 (Bureau of Transportation Statistics, 1994: 169).

People vary in the degree to which they tolerate noise. Some individuals show high annoyance at 60 dBA, while others remain unconcerned at 80 dBA. The intensity, duration, predictability,
and controllability of noise are related to the negative impacts noise has on each individual (Llewellyn, 1981: 192-196).

<table>
<thead>
<tr>
<th>Table 5. Effects of Noise Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise levels</td>
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<tr>
<td>55-64</td>
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<tr>
<td>65-69</td>
</tr>
<tr>
<td>70-79</td>
</tr>
<tr>
<td>Above 80</td>
</tr>
</tbody>
</table>


Traffic noise along a highway link is influenced by various factors. However, the two basic factors are transportation and land use. When analyzing the issue of noise and transportation, it is important to consider the traffic count and vehicle mix. The traffic count is useful for determining the base level of noise along a given link. The vehicle mix shapes the degree to which the noise level will rise or recede. Current traffic counts and vehicle mix data are easy to acquire. This information is available from the state Department of Transportation. Prediction of noise levels is generally based on the peak hour. The peak hour is used because daily traffic counts are highest at this time. Peak hour counts can be obtained by conducting a personal vehicle count of the links.

Future traffic counts are a little more difficult to ascertain. Traffic counts are generally enumerated based on trips. Trip generation is influenced by established land uses. One method for predicting future trips generated in a community is to base it on future land uses. This method of analysis can produce useful results depending on the level of specificity. Unfortunately, the state Department of Transportation does not calculate peak counts and the Johnson County Council of Governments (JCCOG) has not conducted the analysis required for offering future peak count data at this time.

Unfortunately, time will not permit the completion of a full traffic analysis reflecting future land use and the peak trips generated. If more detailed information is required on future traffic counts, then a traffic analysis should be conducted. For the purposes of this study, future trips along links are based on forecasts offered in the JCCOG Arterial Street Plan, and historical traffic data obtained from the Iowa Department of Transportation (IDOT). The JCCOG study does not take into consideration future land development as indicated in the City of Coralville’s Master Plan, nor does it consider the extension of Oakdale Blvd. or Holiday Road. For this reason, future counts along the links will be adjusted. Table 8 presents the volume/capacity (V/C) ratio for links of the JCCOG Arterial Study. Projections are included to indicate future volumes expected along links as reported by the findings of the arterial study.

<table>
<thead>
<tr>
<th>Table 6. Volume Capacity Ratios</th>
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<tbody>
<tr>
<td>Link</td>
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<tr>
<td></td>
</tr>
<tr>
<td>Oakdale Blvd.</td>
</tr>
<tr>
<td>Hwy 965 N</td>
</tr>
<tr>
<td>Hwy 965 S</td>
</tr>
<tr>
<td>I-80</td>
</tr>
<tr>
<td>Holiday Rd.</td>
</tr>
</tbody>
</table>
Methodology for Noise

For this analysis, a highway traffic noise model developed by Hayata Takeshita of the University of Minnesota was applied. The highway traffic noise model estimates the noise levels at a receptor adjacent to a highway. The calculations of Takeshita's model are based on the report, "FHWA-RD-77-108, FHWA Highway Traffic Noise Prediction Model," T.M. Barry and J.A. Reagan, December 1978. The inputs for the model are the number of vehicles, speed, distance and the condition of the site, hard or soft. The FHWA Highway Traffic Noise Prediction Model describes soft sites as possessing a vegetated surface and exhibiting a natural cover. The site refers to the area of land between the noise generator and the receptor. The model's assumptions are: the highway is infinite in length; one lane of traffic only; no shielding; and terrain is flat. The results of this analysis should be verified by speaking with a professional who works with predicting noise levels along highway links.

Noise Levels

A traffic count was conducted to get an estimate of current trips along links during the AM peak hour (7:30AM-8:30AM). Trips were counted for 15 minutes, and the 15-minute totals were expanded to reflect the hour. The assumption was that the vehicle mix would remain constant during the peak hour. The results of this traffic count were applied to the highway noise prediction model. Please refer to the table 9 for a summary of the traffic count and prediction.
model results. The output of the model was mapped to represent noise levels on the campus (Refer to the Oakdale Campus: Decibel Levels and Project Decibel Levels maps).

| Vehicle Mix | Distance Feet | | | | |
|--------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
|              | >= 65 dBA    | < 65 dBA      | < 60 dBA      | <= 55 dBA     | N/A           | 50            | 100           | 190           | 130           | 150           | 290           | 630           | 600           | 710           | 1600          | 3300          |

<table>
<thead>
<tr>
<th>Links</th>
<th>Peak Volume</th>
<th>% Cars</th>
<th>% Buses</th>
<th>% Mid-Size Trucks</th>
<th>% Heavy Trucks</th>
<th>Distance Feet</th>
<th>N/A</th>
<th>50</th>
<th>100</th>
<th>190</th>
<th>130</th>
<th>150</th>
<th>290</th>
<th>630</th>
<th>600</th>
<th>710</th>
<th>1600</th>
<th>3300</th>
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<td>2.0</td>
<td>2.0</td>
<td>N/A</td>
<td>50</td>
<td>100</td>
<td>190</td>
<td>130</td>
<td>150</td>
<td>290</td>
<td>630</td>
<td>600</td>
<td>710</td>
<td>1600</td>
<td>3300</td>
<td></td>
</tr>
<tr>
<td>Hwy 965</td>
<td>1012</td>
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<td>0.4</td>
<td>2.4</td>
<td>130</td>
<td>150</td>
<td>290</td>
<td>630</td>
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<td>I-80</td>
<td>2584</td>
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<td>N/A</td>
<td>18.9</td>
<td>600</td>
<td>710</td>
<td>1600</td>
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</tbody>
</table>

Note: Results obtained from noise model developed by Hayata Takeshita, University of Minnesota

Before proceeding to future decibel levels, it is necessary to discuss the significance of the model's assumptions and the adjustments required for the results. Assumptions for the model, no shielding and flat terrain, inhibit its ability to consider the affects of slope and terrain on noise levels. Since Takeshita's model was based on the FHWA Highway Traffic Noise Prediction Model, this source was referred to for adjustments that should be applied to modeled noise levels for interpreting results more accurately. Attenuation refers to the process by which decibel levels are reduced. The Oakdale Campus has a significant amount of natural shielding and man-made barriers, which protect it from noise.

These factors should be considered when reviewing the noise section of the plan. Noise levels east of Highway 965 and in the southern half of the developed campus could be 10 dBA less than reported by the model. For the undeveloped property extending north of I-80, noise levels could be up to 15 dBA less than reported due to attenuation resulting from the natural topography and the woods.

<table>
<thead>
<tr>
<th>Distance Feet</th>
<th>N/A</th>
<th>50</th>
<th>100</th>
<th>190</th>
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<th>150</th>
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<th>1600</th>
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<td>0.4</td>
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<td>150</td>
<td>290</td>
<td>630</td>
<td>600</td>
<td>710</td>
<td>1600</td>
</tr>
<tr>
<td>I-80</td>
<td>2584</td>
<td>81.1</td>
<td>N/A</td>
<td>N/A</td>
<td>18.9</td>
<td>600</td>
<td>710</td>
<td>1600</td>
<td>3300</td>
<td>600</td>
<td>710</td>
<td>1600</td>
</tr>
</tbody>
</table>

Assumptions: AM Peak Traffic is 10% of average daily traffic (ADT).
The vehicle mix will remain constant.
ADT on Oakdale Blvd. will double due to extension.
ADT on Hwy 965 will double due to development west of Hwy 965.
ADT on I-80 will increase by 25%.

Note: Results obtained from noise model developed by Hayata Takeshita, University of Minnesota

Several assumptions were made for modeling future noise levels along links encompassing the Oakdale Campus. They are presented in table 10 and described below.
The first assumption is based on general trends reported by Jeff Davidson in a February 1998 interview. The second assumption was applied because there is no reason for assuming the vehicle mix will change dramatically despite the expected increases in traffic due to arterial expansion and land development.

For the third assumption, JCCOG stated traffic along Oakdale Boulevard could be just under 10,000 vehicles ADT 15 years from now. When Oakdale Boulevard is connected to 1st Avenue, JCCOG anticipates ADT will rise to approximately 5,000. However, the connection will result in greater traffic volumes on Oakdale Boulevard once it has been extended to North Dubuque Street. This could occur because Oakdale Boulevard will establish a direct link to Iowa City.

The fourth assumption is based on future trends of the area. According to the Report on the West Coralville Land Use Plan, the property to be developed west of Highway 965 will plan space for: office and research uses, a variety of residential uses and commercial development, and the western extension of Oakdale Blvd. The Coral Ridge Mall will be sited south and east of the Highway 965/I-80 intersection. These types of land uses will generate a substantial increase in traffic along Highway 965. The extent of the increase is unknown at this time. Based on V/C ratios of the JCCOG Arterial Street Plan, traffic volumes on the Highway 965 south link will be less than 20,800. Based on the future land uses and the projection for volumes south of Oakdale Boulevard, the I-80 to Oakdale Boulevard link of Highway 965 was assigned 20,000 ADT to reflect the traffic increase over the next 15 years.

Projected ADT for I-80 was based on an existing traffic trend. Between 1986 and 1996, IDOT traffic figures report ADT increased by approximately 40% on I-80. In 1996, ADT west of 965 was 38,300. It's unlikely that traffic volumes on I-80 will rise an additional 40% over the next 10 years. V/C ratios for I-80 in the JCCOG Arterial Street Plan report traffic volume for I-80 would be less than 37,200 vehicles. Settling between the historic data and the study, I-80 was assigned 49,000, increase of approximately 25%, to reflect the projected rise in traffic. Based on these assumptions, future decibel levels were projected. They are reported in table 10. Keep in mind these are peak traffic decibel levels. Decibel levels for the majority of the day should be less than the levels reported.

Runoff
Definitions and Measurements
Before attempting to explain some of the scientific issues associated with runoff, it is necessary to define some terms that will be recurring throughout this analysis. They should be discussed here to ensure the report can be reviewed with clarity. The following definitions are based on an April 1998 interview with Daniel Scotts of the Iowa City Public Works Department.

Frequency- refers to the storm event (for example, the term "2 year storm" or "100 year storm"). This classification system refers not only to the turnaround time associated with the event but it also offers an indication of its size. Discussion of the storm event generates confusion occasionally. A large part of the confusion stems from trying to anticipate the event before it occurs. The designation for the storm occurs after the event has subsided. The frequency assigned to an event is based on the discharge and its duration. Frequency can be thought of in
two ways. The "100 year storm" is used as an example. One way to look at this term is the event that may occur on average once every hundred years. Another way of interpreting the term is that a "100 year storm" has a 1% chance of occurring every year. Once again, the frequency is based on the duration and discharge associated with the event. A "100 year storm" could occur 3 years in a row; however, having a storm of this magnitude so frequently is highly improbable.

24-hr rainfall- refers to the duration of the event. For purposes of calculating discharge in this analysis, the 24-hr rainfall is a parameter used for distribution in the model. As a parameter, it indicates the amount of precipitation that a storm event should yield in a 24 hour period (Ohio Engineering Model, Year: 2-2).

Peak discharge- is the maximum amount of water exiting the drainage area (refer to the Oakdale Campus: Drainage Map, exit points identified as drainage dots). The unit for measuring peak discharge is cubic feet per second (cfs). Although it sounds confusing, the term refers to the volume of water discharged from the drainage area. When discussing the peak discharge, another important factor is the duration of the peak. As the peak, this volume represents the maximum amount of water exiting the site. Like a bell curve, the volume of water discharged could rise to the peak and subside, or the volume of water could rise to the peak, level off, and then subside. When the peak for runoff has been reached, the likelihood that it will be sustained for an extended amount of time is small. If it does, then the frequency of the storm may be greater than expected. For example, a "100 year storm" with a long peak could be a "500 year storm" or greater.

Relevance of Runoff
In a February 1998 interview, Dean Lundberg, Business Manager of the Oakdale Campus, stated that the Campus does not have an effective storm water management system. Some of the pipes that were in place to convey storm water off the campus are clogged due to sediment buildup. As a result, the ravines are required to serve as the system for conveying water off the campus. Runoff can occur naturally. When land reaches a point of saturation due to rain, water is forced to run over the surface instead of percolate into the ground. However when the volume of runoff rises due to an increase in impervious cover, ravines, rills, and channels are forced to accommodate more water than normal. The outcome is currently visible on the Oakdale campus in the form of erosion. According to the Soil Survey of Johnson County, 90% of the soil on the Oakdale campus is highly erodible. The 10% not highly erodible consists of land that was previously graded to fit current campus development and a flood plain that extends along the eastern lower half of the campus.

Another issue impacting erosion is the high irregularity of land on the Oakdale Campus. Slopes on this campus range from 0-25%. A significant portion of the land that has not been developed varies from 15-25% in slope. As a result, development in hilly areas should be limited to the ridge tops in order to minimize disturbance of the land. Still, increased runoff volumes, highly erodible soils, and steep slopes are not a good combination, especially for a development that does not have a storm water management system.

Development of the Oakdale Campus will require the provision of additional roads, parking lots, and buildings. The current level of imperviousness for the entire Oakdale Campus is about 9%.
This estimate reflects the total impervious cover over the entire campus based on the size of building footprints, parking lots and roads. The area of the buildings was obtained from University Facility Services Group; the researchers measured the area of roads and parking lots. Table 11 has been provided to show the current and projected level of imperviousness for the Oakdale campus based on the Master Plan.

<table>
<thead>
<tr>
<th>Table 9. Level of Imperviousness for the Oakdale Campus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Level</td>
</tr>
<tr>
<td><strong>Entire Campus</strong></td>
</tr>
<tr>
<td>Acres</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>Roads</td>
</tr>
<tr>
<td>Parking Lots</td>
</tr>
<tr>
<td>Buildings</td>
</tr>
<tr>
<td>Pervious</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Projected Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Entire Campus</strong></td>
</tr>
<tr>
<td>Acres</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Total</td>
</tr>
<tr>
<td>Roads</td>
</tr>
<tr>
<td>Parking Lots</td>
</tr>
<tr>
<td>Buildings</td>
</tr>
<tr>
<td>Pervious</td>
</tr>
</tbody>
</table>

Source: University of Iowa Facility Services Group

Assumptions underlying projected level of imperviousness:
- 20 additional buildings will be constructed.
- None of the old parking lots will be destroyed.
- 14 additional parking lots will be constructed.
- Vehicular Circulation Study "C" will be implemented.
- Roads servicing the campus will be about 20-ft width.
- Roads servicing the city will be about 30-ft width.

Based on the assumptions associated with future development, impervious cover for the campus could increase to 15% of the total campus area. How much additional runoff this will produce is the subject of the next section of the report.

Methodology for Runoff
The Ohio Engineering Model was used to calculate flow rates for storm water runoff coming from the campus. The flow rates were converted to gallons to provide a more common picture of the volume of runoff coming from the campus. The inputs for this model are: rainfall type, hydrologic soil groups, cover type, hydrologic conditions, topography, watershed length, and drainage area. An assumption for the model is the intensity of the rainfall is the same across the drainage area (Ohio Engineering Model, Year).

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Findings
For this analysis, the "100 year storm event" was modeled. The basis for choosing this event was the Iowa City Revisions to Design Standards for Public Works Improvements. According to the standards,

"The storm sewer system for each project shall be designed to transport the rainfall excess from a five-year storm. The excess storm water passage shall be designed to transport the peak rate of runoff from a 100-year return frequency storm assuming all storm sewers are inoperative and upstream areas are fully developed" (City of Iowa City 1981).

The "100 year storm event" is the worst case event and the most expensive to plan for. This increases the necessity of designing a storm water management system for the campus. The peak discharge rates of the drainage areas and their conversion to gallons are presented in tables 12 and 13 respectively.

Table 12. Present and Projected Runoff Flow Rates for the 100-Year Storm Event

<table>
<thead>
<tr>
<th>Area</th>
<th>Present</th>
<th>Projected</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Runoff</td>
<td>Peak discharge-cfs</td>
<td>Tc</td>
</tr>
<tr>
<td>1</td>
<td>2.89 in</td>
<td>62</td>
<td>0.5</td>
</tr>
<tr>
<td>2</td>
<td>3.29 in</td>
<td>107</td>
<td>0.68</td>
</tr>
<tr>
<td>3</td>
<td>2.99 in</td>
<td>112</td>
<td>0.45</td>
</tr>
<tr>
<td>4</td>
<td>2.23 in</td>
<td>84</td>
<td>0.38</td>
</tr>
<tr>
<td>5</td>
<td>2.42 in</td>
<td>149</td>
<td>0.53</td>
</tr>
<tr>
<td>6</td>
<td>2.14 in</td>
<td>23</td>
<td>0.26</td>
</tr>
<tr>
<td>7</td>
<td>2.14 in</td>
<td>95</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Note: 24-hr rainfall for a 100-year storm is 6.6 inches
Tc is in hours

The time of concentration (Tc) is an important factor to consider when analyzing runoff flow. The Tc is the time it takes for runoff to travel from the hydraulically most distant point of the watershed to the outlet. Tc influences the peak discharge. For a given watershed (drainage area), the shorter the Tc, the larger the peak discharge. (Ohio Engineering Model, Year: 2-5).

As stated earlier, the discharge is the volume of runoff exiting the drainage area. According to the results presented in the table, drainage areas 4 and 5 will experience the greatest change in peak discharge, almost 30 cfs for each due to projected future development. Change is not as dramatic, but significant for drainage areas 1 and 2, 7 and 11 cfs respectively. Change will be
considerable for drainage area 7, estimated at 6 cfs. Change for drainage areas 3 and 6 will be minimal.

<table>
<thead>
<tr>
<th>Area</th>
<th>Present</th>
<th>Projected</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>463.76</td>
<td>516.12</td>
<td>52.36</td>
</tr>
<tr>
<td>2</td>
<td>800.36</td>
<td>882.64</td>
<td>82.28</td>
</tr>
<tr>
<td>3</td>
<td>837.76</td>
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</tr>
<tr>
<td>4</td>
<td>628.32</td>
<td>822.8</td>
<td>194.48</td>
</tr>
<tr>
<td>5</td>
<td>1114.52</td>
<td>1331.44</td>
<td>216.92</td>
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<tr>
<td>6</td>
<td>172.04</td>
<td>179.52</td>
<td>7.48</td>
</tr>
<tr>
<td>7</td>
<td>710.6</td>
<td>755.48</td>
<td>44.88</td>
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