4.0 ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

4.1 LAND USE AND TRANSPORTATION

This section discusses impacts on land use and transportation as a result of the Proposed Action and subsequent site operations. The purpose of this analysis is to provide an assessment of potential impacts resulting from the Proposed Action.

4.1.1 Proposed Action

Land Use

No significant land use impacts would occur under the Proposed Action. With regard to zoning, the proposed project would be consistent with the project site's "University, College, Research-Park District" zoning designation assigned by the City of Columbus. This zoning designation affords large educational complexes like OSU a great deal of flexibility with respect to future development. The Ohio Department of Commerce, Division of Industrial Compliance issued a Certification of Plan Approval for the Ohio 4-H Center Project in February 2005 and granted an extension to this permit in February 2006 (Personal communication with Jeff Snively, Lincoln Street Studio on September 21, 2006).

The Proposed Action would not result in significant impacts to on-site or nearby, off-site land uses. The nearest sensitive land use is Chadwick North, the grove of native trees and Chadwick Lake to the north. Short-term and temporary impacts to this land use would result from construction noise. See Section 4.4 for a detailed description of project-related noise impacts. Long-term impacts would generally be limited to an increase in the intensity of land uses adjacent to the arboretum and lake; however, this would have minimal effects on those land uses.

Transportation

The Ohio 4-H Center is planned to include offices for 20-25 employees of the Ohio State Extension 4-H program. On a typical day, it is expected that 25-50 cars per day would access the site, however, since the Ohio 4-H Center employees would be relocated from their current offices just south of West Lane Avenue, these workers do not represent new commuters to the area. In addition to the full-time employees, the Ohio 4-H Center is expected to host a large number of public users participating in workshops and in-service training. For employees and public users accessing the Ohio 4-H Center, the project site would include approximately 60 parking spaces. Overflow parking is available east of Fred Taylor Drive at the Schottenstein Center.

Traffic levels in the area would increase in the short-term due to construction (construction workers, equipment, and delivery of materials); however daily operation of the Ohio 4-H Center is not expected to have a noticeable impact on area traffic. Although existing traffic volumes on the roadways surrounding the project site are high, because the commuters accessing the project site do not represent additional commuters to the area and because construction traffic would be short term, it is anticipated that the Proposed Action would result in less than significant impacts to traffic and roadway safety.

4.1.2 No Action Alternative

Under the No-Action Alternative, land use and transportation conditions would remain unchanged and no impacts would occur.

4.1.3 Mitigation Measures

No significant impacts associated with land use and traffic would occur; therefore, no mitigation measures are required or recommended.

4.2 VISUAL QUALITY/AESTHETICS

This section discusses visual impacts resulting from the Proposed Action and subsequent site operations. The purpose of this analysis is to provide a qualitative assessment of impacts to visual quality and aesthetics that the Proposed Action may have on the project site and surrounding area.

4.2.1 Proposed Action

The Ohio 4-H Center exterior is planned to be constructed of metal, glass and brick (see Figure 2-1). The design of the building is intended to be aesthetically pleasing and compatible with surrounding development associated with a campus in an urban setting. The 200-foot setback along Lane Avenue would allow for the construction of a welcome center for visitors to the campus. A 100-foot setback along Fred Taylor Drive would be retained to match the Schottenstein Center setback and to preserve area aesthetics. In addition, as stated in Chapter 2, measures would be taken to preserve in place and/or relocate existing mature vegetation in order to maintain the natural features of the project site, to the extent possible.

The proposed construction is planned to have minor impacts on local view sheds. Although the Ohio 4-H Center would be visible from the Chadwick North Arboretum, the Ohio 4-H Center would not obstruct the view of the arboretum from the road and would not significantly alter the overall visual setting of the area given the existing intensity of development and the consistency of the Proposed Action with this development (i.e. campus setting). Proposed development plans include an outdoor education area and demonstration gardens that would be consistent with arboretum development. The most prominent feature within the project site view shed is the Schottenstein Center. Given the high visibility of the Schottenstein Center and other surrounding development, the overall visual impacts of the Ohio 4-H Center on the visual setting would be less than significant.

4.2.2 No Action Alternative

Under the No Action Alternative, no construction would occur and existing visual conditions would remain unchanged.

4.2.3 Mitigation Measures

No significant impacts associated with visual resources would occur; therefore, no mitigation measures are required or recommended.

4.3 PUBLIC SERVICES AND UTILITIES

This section discusses impacts resulting from increased demands for public services and utilities as a result of the Proposed Action and subsequent site operations. The purpose of this analysis is to provide a qualitative assessment of construction and operational impacts to public services and utilities resulting from the Proposed Action.

4.3.1 Proposed Action

Storm Water Management

Construction plans for the Ohio 4-H Center include measures to minimize erosion and subsequent sedimentation caused by construction activities. Construction guidelines include minimizing the area and time of excavation, saving existing vegetation, especially trees, and installation of temporary or permanent measures (e.g. storm sewers) to control runoff. These storm water retention features have been designed and incorporated into the development plan. The NPDES general permit was issued by Ohio EPA on September 7, 2006 (Trishman, M., OSU Project Manager, personal communication on October 9, 2006). A temporary on-site detention pond would be constructed to store all groundwater encountered during borehole drilling. If groundwater is turbid, it would be stored in the detention pond until suitably clarified for disposal through area storm sewers.

It has been estimated that the building would cover 0.6 acres, while the building plus parking lot would cover 1.4 acres with impervious surfaces. Detailed plans for final site grading and storm sewers are included in the Ohio 4-H Center Construction Document Package. These plans comply with the City of Columbus Construction and Material Specifications (2002).

Sanitary Sewer

According to the Subsurface Exploration and Foundation Engineering Report for the project site the existing sanitary sewer lines located in the vicinity of the project site are considered adequate to serve the Ohio 4-H Center. Schematics of the offsite water plan and storm sewer profile were submitted to the City of Columbus Department of Public Utilities, Division of Sewers and Drainage and were approved on September 9, 2004 (Lincoln Street Studio et al. 2004). The Construction Document Package for the Ohio 4-H Center is available for public viewing at the OSU Construction and Development Office.

Domestic and Fire Water Supply

Potable water used for operation of the Ohio 4-H Center would be provided by the City of Columbus Division of Public Utilities through a master meter agreement. The City of Columbus Division of Fire would provide fire protection to the project site.

Schematics of the Ohio 4-H Center storm sewers were submitted to the City of Columbus Department of Public Utilities, Division of Sewers and Drainage and were approved on September 9, 2004 (Lincoln Street Studio et al.2004). These connections are adequate to meet the Ohio 4-H Center's needs. The interior fire protection system would conform with Ohio Building Code, National Fire Protection Association Standards and Underwriter Laboratories, Incorporated specifications. Final approval of the fire protection system would be granted by the

Ohio Division of Industrial Compliance and the State Fire Marshall's Office (Lincoln Street Studio, et al. 2006).

The Ohio 4-H Center is planned to reduce potable water needs and achieve water efficiency by using water conserving plumbing fixtures (e.g. dual flush toilets, waterless urinals, and faucet sensors).

Heating and Cooling Utilities

A preliminary energy analysis of the Ohio 4-H Center was performed by W. E. Monks & Company. This analysis compared a budget building design representing minimum standards in terms of energy efficiency for a building built today with the proposed design for the Ohio 4-H Center. This analysis estimates that the proposed energy efficiency design of the Ohio 4-H Center is planned to result in yearly annual savings of 30% for heating, ventilating and cooling alone (W. E. Monks & Company 2004). The geothermal/cooling tower HVAC system works with only the electrical energy needed to power the pumps. There would be no need for coal, natural gas or petroleum based fuel sources.

Electrical

Existing electrical power supplies in the vicinity of the project site are adequate, and the project is planned to implement electricity efficient features to the extent possible. The Ohio 4-H Center design includes monitoring systems to measure energy use and consumption.

4.3.2 No Action Alternative

Under the No Action Alternative, additional public service and utilities needs under the Proposed Action would not be required. Therefore, no impacts would occur.

4.3.3 Mitigation Measures

No significant impacts associated with public services and utilities would occur; therefore, no mitigation measures are required or recommended.

4.4 NOISE

Impacts resulting from increased noise levels are indicated by changes in the ambient noise levels as a result of specified actions. This section discusses impacts to the sensitive receptors from site preparation and construction at the project site resulting from the Proposed Action and subsequent site operations. The purpose of this analysis is to provide a qualitative assessment of construction and operational impacts to ambient noise levels resulting from the Proposed Action rather than to define precise noise levels and corresponding mitigation measures. Consequently, modeling was not performed to estimate future noise levels.

4.4.1 Proposed Action

Construction Noise

Construction noise under the Proposed Action would be intermittent and would occur during normal working hours beginning in Fall 2006. Construction would cause temporary increases to the ambient noise level near the project site. The Proposed Action would result in construction noise from heavy equipment operation, building of foundations and structures, earthwork, trenching and utility installation and drilling of the geothermal boreholes. Noise levels associated with increased vehicle traffic resulting from construction activities would be temporary and limited to the times when construction actually takes place.

Construction operations could generate temporary noise levels up to 95 dBA measured at a reference level of 50 feet (15.5 meters) from the source (Salter, 2000). Table 4.4-1 displays the reduction in noise intensity associated with a 95-dB construction-related source over increasing distances. Table 4.4-1 does not consider additional factors that contribute to the reduction of noise intensity, such as topography, weather conditions, and noise sources external to the project site.

Table 4.4-1. Reduction of Sound Level Intensity of a 95-dBA (Construction-Related) Source and 75-dBA (Bus Idling) Source as a Function of Receptor Distance.

Distance in feet (meters)	Construction-Related dBA	Bus Idling dBA
50 (15.5)	95	75
100 (30.3)	89	69
200 (60.6)	83	63
250 (75.7)	81.5	61.5
300 (90.9)	80	60
400 (121.2)	77	--
500 (151.5)	75.5	--
800 (242.4)	71	--

The project site is located in an urban environment bordered by State Route 315 to the west and Schottenstein Center to the east. Sensitive receptors in the vicinity of the project site include people at the Chadwick Arboretum Grove 50 feet north of the project site. Based on the distance of the project site to the arboretum, it is anticipated that noise levels at the arboretum would be approximately 95 dBa during construction. However, this estimate can be considered conservative since it does not account for factors such as tree cover located between the arboretum and the construction site, which would serve to reduce noise levels. No residences, academic facilities, or any other potential sensitive receptors are located within 500 feet of the project site. Construction of the Ohio 4-H Center would be temporary and would not result in significant noise impacts. Continuous noise generated by State Route 315 and intermittent noise generated by activities at the Schottenstein Center could surpass noise generated at the project site.

Operational Noise

Noise from operation of the Ohio 4-H Center would come from air handling equipment associated with the HVAC system and vehicle traffic associated with workers and public users

of the facility. There will be no rooftop equipment at the Ohio 4-H Center. All HVAC pumps and air handling equipment would be located within the building and operational noise from this equipment would not be audible outside the building (Personal communication with Jeff Snively, Lincoln Street Studio on September 21, 2006). The 4-H Center will have the impact of operational noise generation at the project site is expected to be incidental and insignificant both within the Ohio 4-H Center and to off-site receptors. Most noise generating equipment would be confined to the interiors of buildings. Traffic generated by the Proposed Action would likely be dispersed throughout the day, and low vehicle speeds in the vicinity of the project site would reduce traffic-related noise levels. Given the distance to any sensitive receptors, it is not anticipated that operational noise would exceed any established thresholds and would not affect sensitive receptors, including the arboretum.

4.4.2 No Action Alternative

Under the No Action Alternative, noise characteristics of the project site would remain as described in Section 3.4 and no impacts would occur.

4.4.3 Mitigation Measures

There are no significant impacts associated with noise; therefore, no mitigation is necessary or recommended.

4.5 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

This section discusses socioeconomic and environmental justice impacts resulting from the Proposed Action and subsequent site operations. The purpose of this analysis is to provide a qualitative assessment of impacts to regional socioeconomics and environmental justice resulting from the Proposed Action.

4.5.1 Proposed Action

Socioeconomics

The Proposed Action would not result in significant local population or economic impacts. During construction of the Ohio 4-H Center there would be short-term construction jobs available. It is likely that these construction jobs would be filled by local construction workers. Because the 20-25 workers associated with the Ohio 4-H Center already work in the same area at OSU, the Proposed Action would not result in the creation of any new, long-term jobs.

Environmental Justice

Due to several factors, the Proposed Action would not result in negative impacts associated with environmental justice. First, it is not anticipated that the Proposed Action would result in any significant environmental or socioeconomic impacts. Second, the lack of development surrounding the project site would minimize or preclude the potential for any impacts on local residents or businesses. Although Franklin County features a high proportion of black residents relative to other geographic areas, the lack of any concentrated residential development in the vicinity of the project site, reduces the likelihood that any disproportionate environmental or human health impacts would occur to any minority community.

4.5.2 No Action Alternative

Under the No Action Alternative, socioeconomic conditions would remain unchanged and no impacts would occur.

4.5.3 Mitigation Measures

There are no significant impacts associated with economics or environmental justice; therefore, no mitigation measures are necessary or recommended.

4.6 BIOLOGICAL RESOURCES

This section discusses biological resource impacts resulting from the Proposed Action and subsequent Ohio 4-H Center operations. The purpose of this analysis is to provide a qualitative assessment of potential impacts to biological resources from the Proposed Action.

4.6.1 Proposed Action

Vegetation

The process of developing the project site would result in the direct loss of urban habitat. A total of approximately 4 acres of undeveloped vegetative land could be disturbed by the Proposed Action. However, mature trees within the 4 acres, selected to remain on site would be fenced at the drip line (See Figure 2-3). To protect the selected trees these areas would not be disturbed during construction activities. The project site has been altered in the past and does not reflect a natural assemblage of plant species. The vast majority of the project site is currently covered by maintained lawn grass. The Proposed Action calls for the use of native species plant material that may actually enhance the existing habitat. Land clearing activities, excavation and construction staging areas associated with the Proposed Action would disturb site vegetation, increasing the susceptibility of these areas to noxious weed invasion. This would be addressed by the establishment of native planting following building completion. The Ohio 4-H Center's construction document package includes provisions for the installation and maintenance of lawn, grasses and exterior plants. A qualified landscape installer will be employed to ensure the successful establishment of exterior plants. To ensure that trees indicated to remain on site are protected during construction and promptly and properly treated and repaired if damaged, a landscape architect and arborists from the Chadwick Arboretum and Learning Gardens will be available for consultation. Since the project site currently has a managed grass cover no change in site habitat or vegetative resources is anticipated. Overall impacts to vegetation would be less than significant.

Wetlands and Other Waters of the U.S.

Based on a review of topographic maps, National Wetlands Inventory wetlands mapping, and the site visits, it was determined that wetlands and other waters of the U.S. do not occur on the project site. Therefore, there would be no impacts to wetlands and other waters of the U.S. under the Proposed Action.

Wildlife

Wildlife in the area is limited due to the surrounding development and altered vegetation at the

project site. Wildlife species observed during site visits are consistent with common species that inhabit urban and suburban environments. See Section 3.6.3 for a more detailed discussion of wildlife observed at the project site. The vast majority of the project site is currently covered by maintained lawn grass. Impacts to wildlife from development under the Proposed Action would be considered less than significant because current conditions are not conducive to biological diversity or the presence of wildlife on the project site.

Species of Concern

The USFWS has concluded that the Proposed Action should not impact any rare and/or protected species or their habitat (USFWSa 2006). ODNR (2006a) had no records of any a species of concern within one-half mile of the project site. Therefore, no impacts to species of concern are anticipated.

4.6.2 No Action Alternative

Under the No Action Alternative, vegetation, wetlands, wildlife, and species of concern conditions would remain the same and no additional impacts to biological resources would be expected to occur.

4.6.3 Mitigation Measures

No significant impacts to biological resources have been identified; however, OSU has committed to implementing the following measures to reduce any less-than-significant, direct impacts to species and habitats on the project site:

- If construction is to occur during the nesting season, migratory bird surveys and nest searches should be conducted in the 30 days prior to starting construction. If nests are discovered, consultation with USFWS should be initiated to determine if disturbance to the species present must be avoided.

- Construction areas will be fenced to limit disturbance to the adjacent arboretum property outside of the construction zone.

4.7 CULTURAL RESOURCES

4.7.1 Proposed Action

Historic Resources

No historic resources were identified within the project site. Therefore, the Proposed Action would not result in significant impacts with regard to historic resources. Correspondence from the Ohio Historical Society (see Appendix B) indicates that they concur with these findings.

Archaeological Resources

No archaeological resources were identified within the project site. Large construction projects, including the adjacent Schottenstein Center and State Route 315, have drastically altered the setting of this area over the past several decades. As a result, the area retains little historic integrity. Therefore, the Proposed Action would not result in significant impacts with regard to archaeological resources. However, if during construction buried archaeological resources are

encountered, all construction should stop and a qualified archaeologist should be called in to assess the resource.

4.7.2 No Action Alternative

There are no known historic resources or archaeological resources within the project site. Therefore, no impacts are anticipated as a result of the No Action Alternative.

4.7.3 Mitigation Measures

No significant impacts to cultural resources would occur; therefore, no mitigation measures are required or recommended.

4.8 AIR QUALITY

Air emissions resulting from the Proposed Action were evaluated in accordance with federal, state, and local air pollution standards and regulations. Air quality impacts from a proposed activity or action would be significant if they:

- increase ambient air pollution concentrations above any NAAQS;
- contribute to an existing violation of any NAAQS;
- interfere with or delay timely attainment of NAAQS; or
- impair visibility within any federally mandated federal Class I area.

The approach to completing the air quality analysis was to estimate the increase in emission levels due to the Proposed Action.

According to USEPA's General Conformity Rule in 40 CFR Part 51, Subpart W, any proposed federal action that has the potential to cause violations in a NAAQS non-attainment or maintenance area must undergo a conformity analysis. A conformity analysis is not required if the Proposed Action or Alternative Action occurs within an attainment area. Since Franklin County is non-attainment for O_3 and $PM_{2.5}$, a conformity determination must be performed if project emissions exceed the *de minimis* thresholds of 100 tons per year for these pollutants or their precursors.

4.8.1 Environmental Consequences

The Proposed Action would involve construction and paving activities, plus commuting of worker personnel and transport of materials to and from the site during the construction period. Long-term emissions associated with the Ohio 4-H Center would include commuting of personnel to and from the building, and emissions from building operations.

Construction Emissions: Emissions during the construction period were quantified to determine the potential impacts on regional air quality. Calculations of VOC, NO_x, CO, SO_x, and PM_{10} emissions from construction, grading, and paving activities were performed using USEPA emission factors compiled in the California Environmental Quality Air Quality Handbook (South Coast Air Quality Management District 1993), Calculations Methods for Criteria Air Pollution Emission Inventories (Jagelski and O'Brien, 1994), and Air Emissions Inventory Guidance Document for Mobile Sources at Air Force Installations (O'Brien and Wade, 2002). The emission factors for building construction include contributions from engine exhaust emissions (i.e.,

construction equipment, material handling, and workers' travel) and fugitive dust emissions (e.g., from grading activities). Trenching and grading emissions include fugitive dust from ground disturbance, plus combustive emissions from heavy equipment from trench work during the entire construction period. Paving emissions include combustive emissions from bulldozers, rollers, and paving equipment, plus emissions from a dump truck hauling pavement materials to the site. Estimated emissions that would occur from construction, grading, and paving activities under the Proposed Action are presented in Table 4.8-1. The emissions shown would occur over the duration of the construction period. The heat exchanger boreholes will be installed using two drill rigs equipped with standard steel drill rods using sonic drilling techniques. Although this source was not specifically included in the emission calculations, this source would be the equivalent of two diesel engines running for 72 days assuming 2-days drilling per well with a standard 8-hour workday.

Emissions generated by construction projects are temporary in nature and would end when construction is complete. The emissions from fugitive dust (PM_{10}) would be considerably less than those presented in Table 4.8-1 due to the implementation of control measures in accordance with standard construction practices. For instance, frequent spraying of water on exposed soil during construction, proper soil stockpiling methods, and prompt replacement of ground cover or pavement are standard landscaping procedures that could be used to minimize the amount of dust generated during construction. Using efficient practices and avoiding long periods where engines are running at idle may reduce combustion emissions from construction equipment.

Table 4.8-1. Construction Emissions – Proposed Action

Source	Emissions (In Tons)				
	CO	VOC	NO_x	SO_x	PM_{10}
Construction	0.4	0.1	1.8	0.0	0.1
Grading/Trenching	0.5	0.1	0.6	0.1	0.2
New Pavement	0.1	0.0	0.1	0.0	0.0
TOTAL	0.9	0.2	2.5	0.1	0.3

$PM_{2.5}$ emissions are expected to be less than or equal to PM_{10} emissions.

In general, combustive and fugitive dust emissions would produce localized, short-term elevated air pollutant concentrations, which would not result in any long-term impacts on the air quality in Franklin County or AQCR 176. The temporary construction-related emissions of PM_{10} and SO_x under the Proposed Action are not expected to adversely impact the air quality or visibility in the project area. The projected emissions for the entire Proposed Action are below the *de minimis* annual thresholds for conformity and less than 10 percent of the regional emissions shown in Table 3.8-3. A conformity determination, therefore, is not required for this action.

Operational Emissions: Air emissions at the Ohio 4-H Center after the Proposed Action is completed are expected to be minimal. The heating equipment in the new building is anticipated to be more efficient and have lower air pollutant emissions than typical boilers and heaters. Because the Ohio 4-H Center is a relatively small building, less than 5,000 square feet, it is expected that operational emissions would be insignificant.

Commuting: The Ohio 4-H Center would include office facilities for 20-25 employees of the Ohio State Extension 4-H program who would be relocated from their current offices just south of West Lane Avenue. These workers do not represent new commuters. It is expected that 25-50 cars per day would access the site, including vehicles that may be at the site during special events at the Ohio 4-H Center. Due to the relatively small number of cars accessing the site daily, emissions from commuting are expected to be insignificant.

4.8.2 No Action Alternative

Implementation of the No Action Alternative would not adversely impact the air quality or visibility in the vicinity of the project area. The projected emissions for the No Action Alternative are virtually identical from current emissions. A conformity determination, therefore, is not required for this action.

4.8.3 Mitigation Measures

OSU has committed to implementing the following measure to reduce any less-than-significant impacts associated with particulate emissions during construction:

- To minimize impacts associated with particulates, best management practices (BMPs), such as covering of dirt stockpiles and application of water sprays, would be implemented.

Additional detail on excavation support and earthwork are provided in the Construction Document Package (Lincoln Street Studio, et al 2006)

4.9 WATER RESOURCES

4.9.1 Proposed Action

The footprint of the Ohio 4-H Center alone is estimated to be 0.6 acres, the Ohio 4-H Center plus parking areas would cover approximately 1.4 acres. Given the small area affected, the loss of groundwater recharge due to the creation of impervious surfaces would be less than significant. During construction, the site would employ surface stabilization after clearing, as well as silt fences and inlet protection. An on-site detention pond is planned to be constructed to store all groundwater encountered during borehole drilling. Groundwater would be stored until suitably clarified for on disposal through storm water sewers.

As described in Section 2.1.3, the vertical geothermal heat exchanger is planned to consist of a series of 72-80 boreholes, 4.5 inches in diameter and approximately 280 feet deep. The vertical geothermal heat exchanger is planned to be covered by a research and display garden surrounded by the Ohio 4-H Center parking lot. The heat exchanger fluid contained in the closed loop piping would be a 20% inhibited propylene glycol solution and, under normal operation, would not contact the soil or ground water. Since the heat exchanger pipes would be configured as a closed loop, little to no impact to existing ground water resources is expected.

A potential negative effect of all closed loop geothermal heat pumps is the release of antifreeze solutions to the environment. Antifreeze solutions are required in colder climates to prevent the circulating solution from freezing (ISGS 2004). The potential environmental impact resulting from a leak in the geothermal heat exchanger is dependent on the toxicity and volume of antifreeze released to the environment. The Ohio 4-H Center heat exchanger would contain

approximately 1,800 gallons of diluted Dowfrost HD® in the vertical heat exchanger pipes, the same volume in horizontal pipes and 7,000 gallons in piping inside the building (Miller, Todd at W.E. Monks & Company, personal communication on Oct 3rd, 2006).

Best Management Practices (BMPs) would be employed to ensure that impacts to soil or groundwater would be minimal to non-existent. These BMPs include:

- The use of high-density polyethylene piping installed and hydrostatically tested by a loop contractor certified by the International Ground Source Heat Pump Association.

- Installer would supply notarized documentation confirming compliance with industry standards and a written warranty of fifty years or greater, specifying material replacement and labor allowance (Lincoln Street Studio et. al 2006).

- Following installation, the boreholes would be backfilled with thermally enhanced bentonite grout to protect the pipes and ensure good heat transfer. The use of thermally enhanced grout reduces the likelihood of surface water infiltration, inter-aquifer flow and antifreeze leakage by maintaining low hydraulic conductivity within the vertical boreholes (ISGS, 2004).

- The heat exchanger would utilize a solution 20% Dowfrost HD® heat transfer fluid and 80% water.

- A fluid make-up package consisting of a 100-gallon pressure tank and pump to maintain system fill pressure at 12 pounds per square in gauge (Lincoln Street Studio, et al 2006) would be used to maintain system pressure. The pressure tank would have a low level cutoff so if the level of heat exchanger solution were to drop below some preset level, a remote alarm would sound at the Building Automation System. If even a small amount of fluid leaked from the system the system would shut down.

- To minimize the loss of heat exchanger solution in the event of a pipeline rupture eight heat exchanger boreholes would be arraigned in parallel sequence along nine lateral supply and return headers (See Figure 2-4). A rupture in any one borehole would, at most, affect one ninth of the heat exchanger containing 400 gallons of diluted Dowfrost HD® heat transfer fluid.

Dowfrost HD® consists of 94% propylene glycol, less than 5% dipotassium phosphate added as a corrosion inhibitor, less than 5% deionized water and a bright yellow to aid in leak detection. Direct contact with Dowfrost HD® may cause slight transient eye irritation. Dowfrost HD® mist may cause irritation of the nose and throat but the single dose oral toxicity is considered to be extremely low and prolonged contact with the skin is essentially nonirritating (Dow 2004). Based on data for its major components Dowfrost HD® is practically non-toxic to aquatic organisms on an acute basis (Dow 2004). The potential for bioconcentration is low as polypropylene glycol and dipotassium phosphate are readily biodegradable and pass the (Dow 2004). Atmospheric degradation of polypropylene glycol is expected within minutes to hours (Dow 2004). The potential for movement of polypropylene glycol in soil is high (Dow 2004), however, the Ohio 4-H Center heat exchanger would contain a solution of 20% Dowfrost HD® and 80% water so movement and partitioning would be similar to that of water.

Common antifreeze compounds used in geothermal heat exchangers include calcium chloride, potassium acetate, potassium carbonate, sodium chloride, ethanol, methanol, ethylene glycol and propylene glycol. All of these compounds work but have varying degrees of toxicity, flammability or corrosivity. Dowfrost HD® with propylene glycol was selected as the fluid with the least environmental impact in the event of a pipe rupture. Propylene glycol is used commercially as antifreeze solution, as an anti-oxidant in soft drink syrups, as a coolant in refrigeration systems and as a deicer for airport runways (Verschueren 1983). Heinonen et al. (1996) recommended propylene glycol for geothermal heat pumps based on its low health, fire and environmental risks.

In *A Short Primer and Environmental Guidance for Geothermal Heat Pumps* EPA (1997) geothermal heat pumps were identified as one of the most energy efficient heat and cooling technology available and concluded that increased reliance geothermal heat pumps would reduce emissions of greenhouse gases, such as sulfur dioxide ($SO_{2)}$) and nitrogen oxides ($NO_{x),}$ precursors to acid rain, and achieve these benefits with very little risk to the environment.

Based on current drainage patterns the nearest surface water that could potentially be impacted by the Ohio 4-H Center would be the Olentangy River located approximately 1750 feet east of project site. It is unlikely that an antifreeze leak of the size needed to reach the Olentangy River would occur at the Ohio 4-H Center. Since there is no surface water of note present on or adjacent to the project site, no negative impacts to surface or groundwater are anticipated.

4.9.2 No Action Alternative

Under the No Action Alternative, no construction would occur and no impacts to water resources would occur. Conditions would remain as described in Section 3.9.

4.9.3 Mitigation Measures

No significant impacts to water resources are likely to occur; however OSU has committed to implement the following measures to reduce any less-than-significant impacts associated with impacts to water resources during construction and operation of the Ohio 4-H Center:

- During construction the site will employ surface stabilization after clearing, silt fences and inlet protection.
- An on-site detention pond will be constructed to store all groundwater encountered during borehole drilling. Groundwater would be stored until suitably clarified for on site disposal.
- Heat exchanger piping will be closed-loop piping that will be hydrostatically tested. The boreholes will be backfilled with thermally enhanced grout to protect the pipes and ensure good heat transfer.
- The heat exchanger installer will supply a notarized document confirming compliance with industry standards and supply a written warranty of fifty years or greater.
- The heat exchanger will be equipped with a fluid make-up package that would include a pressure tank with a low level cutoff and a remote alarm that would sound at the Building Automation System if a leak were to occur.

- The heat exchanger would utilize a solution 20% Dowfrost HD® heat transfer fluid and 80% water.

Additional detail on the construction and operation of the geothermal heat exchanger storm water protection measures are provided in the Construction Document Package (Lincoln Street Studio, et al 2006).

4.10 GEOLOGY AND SOILS

4.10.1 Proposed Action

Geology

Under the Proposed Action, the physiography, underlying geology, and topography of the area would not change. A limited amount of grading would likely be required for building foundations, but given the project site's limited topographic variation, the change is planned to be minimal. No geologic risks are known or anticipated.

ODNR indicated that paleokarst had been encountered during the installation of a test well installed near the project site (ODNR 2006b). ODNR also noted that a prior bore hole drilled very close to the failed hole was successfully completed, demonstrating the erratic distribution of paleokarst features in the carbonate bedrock (ODNR 2006b). During the installation of a test borehole drilled at the project site on December 2003 a fracture filled with easily shifting materials was encountered from 119 feet to 125 feet below ground surface (Lincoln Street Studio et. al, 2006). When the drill casing was withdrawn to insert the heat exchanger piping, the walls of the hole collapsed. To eliminate this problem the Ohio 4-H Center geothermal boreholes would be installed using standard steel drill rods advanced by sonic drilling techniques. The sonic drill rig vibrates the casing into place and no drill cuttings are removed. Material removed from the drill core would be incorporated into the site grading. The casing would be left in place while the piping is inserted. Once the heat exchanger piping is in place, the hole would be grouted with bentonite grout. The casing would be pulled out of the hole during the grouting process, so the surrounding materials collapse on the grout (Jackson Geothermal, personal communication on November 5, 2006).

A large void in the subsurface materials could result in poor heat transfer if the pipe did not have sufficient contact with the earth. The Ohio 4-H Center geothermal heat exchanger was designed to allow for the possibility for some voids in each hole. Small air pockets would be pumped full of grout and would not significantly impact efficiency of the geothermal heat exchanger. Only a very large underground cavern would impact the performance of the vertical boreholes, and no such caverns have been encountered in this area before. Although the geothermal heat exchanger would consist of 72 boreholes, a range of 72-80 boreholes has been included in the EA to account for the possibility of large void spaces or a broken drill stem. If a large underground cavern is detected at the project site, the placement of the heat exchanger boreholes may need to be adjusted (Jackson Geothermal, personal communication on November 5, 2006).

A building's performance during a seismic event depends not only on the severity of sub-surface rock motion, but also on the type of soil upon which a structure is founded (Ghosh 2000). A building's Seismic Design Criteria is assigned on the basis of location relative to historic seismic

activity, building occupancy, and soil type. These characteristics were considered for the Ohio 4-H Center project site and the building was designed for compliance with Seismic Design Category "B" (Miller, Todd, W.E. Monks & Company, personal communication on October 10, 2006).

Although the north end of the Ohio 4-H Center would be constructed over a full basement, increasing the risk for indoor radon, the basement would be used to house mechanical systems and would not include assignable office space. To further reduce risks due to radon the basement would be constructed with a perimeter floor drained tied to an interior sump pump system and would include a vapor barrier below the slab in areas where moisture could cause problems (Lincoln Street Studios et al. 2006). Occupational exposures to radon at the Ohio 4-H Center are expected to be well below the EPA action level of 4 pCi/L for indoor air in residential structures.

Soils

The footprint of the Ohio 4-H Center plus parking areas and roadways is estimated to cover 1.4 acres, however under the Proposed Action, it is conservatively estimated that a total of approximately 4 acres of land could be disturbed by the Proposed Action. Mature trees within the 4 acres, selected to remain on site would be fenced at the drip line (See Figure 2-3). To protect the selected trees these areas would not be disturbed during construction activities. This area includes the area needed for the vertical geothermal heat exchanger. Soils would be disturbed during installation of the heat exchanger boreholes, but when complete the top of the boreholes would be 5 feet below grade and are planned to be covered by a research and display garden surrounded by the Ohio 4-H Center parking lot. Based on the Soil Survey of Franklin County (USDA 1980) and soil borings advanced at the project site, area site soils appear to have undergone extensive excavations and fillings. Area soils were most probably disturbed during the construction of State Route 315 to the west and the Olentangy River transportation corridor east of the project site.

Given the relatively small areas potentially disturbed under the Proposed Action, if BMPs are employed during construction to minimize potential wind erosion, impacts to soil resources are expected to be minimal.

4.10.2 No Action Alternative

Under the No Action Alternative, no construction would occur, leaving conditions as described in Section 3.10. No impacts to geological resources would occur.

4.10.3 Mitigation Measures

OSU has committed to implement the following measure to reduce any less-than-significant impacts associated with wind erosion:

- To minimize impacts associated with particulates, BMPs such as covering of dirt stockpiles and application of water sprays would be implemented.

4.11 HAZARDOUS MATERIALS AND WASTE MANAGEMENT

4.11.1 Proposed Action

Construction Impacts

The construction phase of the Ohio 4-H Center would require the use of some hazardous materials such as paints coatings, sealant and adhesives. However, as part of the measures provided in the Construction Document Package only materials with a low VOC content would be employed (Lincoln Street Studios et al. 2006). The geothermal heat exchanger piping would be constructed on site. The propylene glycol solution used in the geothermal heat exchanger was selected as the fluid with the least environmental impact in the event of a pipe rupture. Standard procedures for the handling of hazardous materials, such as the use of secondary containment, would be used during construction phase. Additionally, during excavation the potential exists to encounter unknown, buried materials that could be considered hazardous. If this were to occur, measures would be taken to properly remove and dispose of these materials. The OSU Office of Environmental Affairs *Chemical Management Guidebook* is available on the OSU website to help hazardous waste generators comply with the various environmental regulations relating to infectious waste, defining a hazardous waste, spill cleanup procedures, waste minimization and chemical redistribution, collecting, packaging and manifesting waste, and dealing with waste requiring special handling or disposal procedures (OSU 2006) No impacts are anticipated during the construction phase.

Operational Impacts

Operations at the Ohio 4-H Center are likely to require only small, insignificant quantities of hazardous materials. The Ohio 4-H Center is planned to be constructed using low VOC content adhesives, coatings, and carpet, and 50% of all construction debris would be recycled. To minimize the need for pesticides the Ohio 4-H Center landscape plan specifies the use of native plant materials. Demonstration gardens would be located near the center to promote innovative and organic gardening techniques. The housekeeping plan for the Ohio 4-H Center calls for the use of soy-based cleaning products when possible. When hazardous materials are needed, they would be properly stored, handled, and disposed.

4.11.2 No Action Alternative

Under the No Action Alternative, conditions related to hazardous materials and wastes would remain as described in Section 3.11 and no impacts would occur.

4.11.3 Mitigation Measures

There are no significant impacts; therefore, no mitigation measures are required or proposed.

4.12 SUMMARY OF SECONDARY AND CUMULATIVE IMPACTS

Secondary impacts are those that are caused by a Proposed Action, but may occur later in time or farther removed in distance, relative to the primary impacts of the Proposed Action. “Cumulative impacts result from the incremental impact of the Proposed Action when added to other past, present, and reasonably foreseeable future actions" (40 CFR Section 1508.7).

This EA considers past, present, and reasonably foreseeable short-term and long-term future actions on the project site. In addition, it considers off-site factors and reasonably foreseeable off-site projects.

As discussed in Section 3.1, the project site is located within the campus of OSU. Past uses of the predominantly undeveloped project site included small-scale agriculture (poultry). The site has been owned by and been under the control of OSU since the early to mid-1900s. Zoning for the site and the surrounding lands owned by OSU is, zoning designated as "University, College, Research-Park District" as assigned by the City of Columbus. This zoning designation allows OSU flexibility with respect to future development. Development at OSU is generally not subject to NEPA review because it is state owned property and development is typically funded by state and private funding. However, to assess potential cumulative impacts in a more regional context, an inventory of recently completed projects and projects scheduled to be completed within approximately the next 5 to 6 years on the OSU campus were inventoried (Table 4.12-1).

Table 4.12-1. Cumulative Projects

Building Name	***Construction/ Renovation Year (FY)***	***Gross Square Feet***	***Description***
Recent Past Projects			
Blankenship Hall	*2000*	*58,108*	*Offices and meeting rooms*
Davis Heart and Lung Research Institute	*2000*	*133,856*	*Research labs and offices*
Parker Food Science & Technology Building	*2000*	*78,285*	*Labs, offices, and classrooms*
Poultry Brooding House 2	*2000*	*5,661*	*Agriculture (off campus)*
Stillman Hall	*2000*	*67,287*	*Offices and classrooms*
Younkin Success Center	*2000*	*68,705*	*Computer labs, classrooms, offices*
Hay Storage Building	*2001*	*6,000*	*Hay storage*
Jesse Owens Memorial Stadium	*2001*	*27,987*	*Track, field, and soccer stadium*
Meet Management Building	*2001*	*1,568*	*Offices, meeting and training rooms*

Table 4.12-1. Cumulative Projects (Continued)

Ohio Stadium	*2001*	*812,422*	*Renovation, code upgrades, expansion of box seating and press area*
Waterman Laboratory Headquarters	*2001*	*8,448*	*Offices*
Blackwell Inn	*2002*	*128,031*	*Hotel and conference center*
Retractable Shade Structure	*2002*	*6,566*	*Greenhouse*
Veterinary Medicine Academic Building	*2002*	*113,602*	*Classrooms, offices and library*
Aronoff Laboratory	*2003*	*107,593*	*Labs, offices and classrooms*
Heffner Wetland Research and Education Building	*2003*	*9,157*	*Offices and meeting rooms, wetland monitoring equipment*
Learning Gardens Storage Shed	*2003*	*210*	*Landscaping maintenance storage*
Neil Building	*2003*	*129,889*	*Student housing*
North and South Cannon Drive Parking Garages Renovation	*2003*	*445,943*	*Parking garage renovation for an additional 1,200 cars*
Scholars House East	*2003*	*19,377*	*Student housing*
Scholars House West	*2003*	*19,377*	*Student housing*
Worthington Building	*2003*	*50,023*	*Student housing*
Adventure Recreation Center	*2004*	*84,883*	*Recreation center*
Buckeye Village Community Center	*2004*	*27,086*	*Childcare and community meeting space*
Hagerty Hall Renovation	*2004*	*142,512*	*Offices, classrooms, computer labs, auditorium addition*

Table 4.12-1. Cumulative Projects (Continued)

Knowlton Hall	*2004*	*173,370*	*Offices, classrooms, studios, library, etc.*
Page Hall	*2004*	*64,578*	*Classrooms, offices, computer labs, meeting rooms*
Hospital Parking Garage	*2004*	*366,956*	*New parking garage for 1,000 cars*
Neil Avenue Parking Garage	*2004*	*318,475*	*New parking garage for 1,000 cars*
Ross Heart Hospital	*2004*	*227,123*	*Hospital*
Beef Barn Shop	*2005*	*2,750*	*Agriculture (not on campus)*
Biocontainment Laboratory	*2005*	*2,862*	*Laboratory*
Gateway Building A	*2005*	*130,000*	*Mixed use office, retail, housing*
Gateway Building B	*2005*	*111,000*	*Mixed use office, retail, housing*
Gateway Building C	*2005*	*200,000*	*Mixed use office, retail, housing*
Gateway Building D	*2005*	*74,000*	*Mixed use office, retail, housing*
Gateway Building E	*2005*	*390,000*	*Parking for 100 cars*
Gateway Building F North	*2005*	*18,500*	*Housing*
Gateway Building F South	*2005*	*18,500*	*Housing*
Golf Course Pesticide Building	*2005*	*1,518*	*Pesticide storage building (not on campus)*
McCorkle Aquatic Pavilion	*2005*	*128,894*	*Competition swimming facility, locker rooms, etc.*
Physics Research Building	*2005*	*238,108*	*Labs and offices*

Psychology Building	*2005*	*132,712*	*Labs, offices, and classroom*
Recreation and Physical Activities Center	*2005*	*283,806*	*Recreation center, gym, swimming pool, meeting space, offices, etc.*
Smith Electrical Substation	*2005*	*23,889*	*Electrical substation*
Scott Laboratory	*2006*	*262,805*	*Labs, offices, and classrooms*

Table 4.12-1. Foreseeable Future Projects

Main Library Renovation/Expansion	*2007-2010*	*N/A*	*Renovation and expansion of Main Library*
Brown Hall Renovation	*2007-2012*	*N/A*	*Renovation*
Hughes Hall Renovation	*2007-2012*	*N/A*	*Renovation*
Murray Hall Renovation	*2007-2010*	*N/A*	*Renovation*
Graves/Meiling Halls Renovation	*2007-2010*	*N/A*	*Renovation*
Human Ecology	*2007-2008*	*N/A*	*Construct early childhood development center at Weinland Park*
MBA Housing	*2009-2010*	*N/A*	*Housing*
Advanced Laser	*2007-2008*	*N/A*	*Research and development*
Koffolt Infill	*2007-2008*	*N/A*	
Electro Science	*2007-2008*	*N/A*	*Research and development*
Nanoscale Science	*2007-2008*	*N/A*	*Research facility*
Airport Improvements	*2009-2010*	*N/A*	*Airport facilities*
Ross Heart Hospital Expansion (Medical Center)	*2007-2010*	*N/A*	*Expansion of medical center*

Table 4.12-1. Foreseeable Future Projects (continued)

North Doan Building (Medical Center)	*2007-2008*	*N/A*	*Medical facilities*
Tower & Diagnostic Core (Medical Center)	*2007-2008*	*N/A*	*Medical center*
Parking Garage Replacement (Medical Center)	*2007-2008*	*N/A*	*Replace medical center parking garage*
Ambulatory Expansion (Medical Center)	*2007-2008*	*N/A*	*Medical center*
Cancer Tower, Diagnostic Core, and Infrastructure (Medical Center)	*2007-2012*	*N/A*	*Medical center*
Remediation on Rhodes/Doan (Medical Center)	*2007-2012*	*N/A*	*Medical center*
Other (Medical Center)	*2007-2010*	*N/A*	*Medical center*
Larkins Replacement	*2007-2008*	*N/A*	
Ohio Union Replacement	*2007-2010*	*N/A*	*Administrative building*
Wilce Student Health Center Renovation	*2007-2010*	*N/A*	*Renovation of health center*
Archer House Residence Hall Renovation	*2007-2008*	*N/A*	*Renovation of housing*
Fawcett Center Renovation	*2007-2008*	*N/A*	*Renovation*
Lincoln Tower Residence Hall Renovation	*2011-2012*	*N/A*	*Renovation*
Student Affairs Renovation and Renewal	*2007-2012*	*N/A*	*Renovation*
Food Service Master Plan Renovation	*2007-2012*	*N/A*	*Renovation*
Physical Facilities	*2007-2012*	*N/A*	*Electrical, heating/cooling, campus circulation, and storm water management improvements*

Table 4.12-1. Foreseeable Future Projects (continued)

Woody Hayes Athletic Center Phase I	*N/A*	*N/A*	*Renovation and expansion*
New Crew Team Boat House	*N/A*	*N/A*	*New facility*
Varsity Tennis Center	*N/A*	*N/A*	*Athletic facility*
Softball Field Upgrade	*N/A*	*N/A*	*Improve existing softball field*
French Field House	*N/A*	*N/A*	*Resurfacing and renovation*
Ice Rink	*N/A*	*N/A*	*Expansion and renovation*
Nicklaus Museum	*N/A*	*N/A*	*Construct new museum*

Past uses and development aggregated together have altered the native conditions of the project site and surrounding area. Various impacts such as degradation of habitat and habitat fragmentation, creation of impervious surfaces, air emissions, and traffic have occurred incrementally on the project site and the surrounding area over time. These developments and their impacts are the subject of individual reviews and approvals over time. Other processes are embodied in plans and policies adopted by local governments such as those associated with zoning designations, wetlands, and sensitive species and their habitat. These issues are discussed in previous sections of Chapter 4 of this document.

Potential impacts are discussed in Sections 4.1 through 4.12, as appropriate. As stated in other locations within Chapter 4, the Proposed Action's incremental contribution to these impacts would be insignificant and the No Action Alternative would not contribute to these impacts.

The most important examples of secondary and cumulative impacts associated with the Proposed Action are as follows:

- Temporary increased traffic (from construction) on area roads in the vicinity of the project site;
- Temporary regional and local air pollutant emissions;
- Short-term (construction) noise impacts;
- Development intensification; and
- Loss of urban habitat from vegetation removal.

Based on surrounding past, present, and future land uses in the project area, the additive impact of this project would not be significant.

4.13 IRREVERSIBLE/IRRETRIEVABLE COMMITMENT OF RESOURCES

An irreversible commitment of resources is defined as the loss of future options. The term applies primarily to the effects of use of nonrenewable resources such as minerals or cultural resources, or to those factors such as soil productivity that are renewable only over long periods. It could also apply to the loss of an experience as an indirect effect of a "permanent" change in the nature or character of the land. An irretrievable commitment of resources is defined as the loss of production, harvest, or use of natural resources. The amount of production foregone is irretrievable, but the action is not irreversible. If the use changes, it is possible to resume production.

The Proposed Action would not have irreversible impacts because future options for using this site would remain possible. A future decommissioning process could restore the site for alternative uses, ranging from natural open space to industrial development. The location for the OSU 4-H Center is consistent with surrounding development and is planned to not significantly affect surrounding uses. No loss of future options would occur.

The primary irretrievable impacts of the Proposed Action would involve the use of energy, labor, materials and funds, and the conversion of some lands from an undeveloped condition through the construction of buildings and facilities. Irretrievable impacts would occur as a result of construction, facility operation, and maintenance activities. Direct losses of biological productivity and the use of natural resources from these impacts would be inconsequential, as discussed in Section 4.6.

4.14 THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE HUMAN ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

This section addresses the commitment of resources associated with the Proposed Action relative to the loss of long-term productivity associated with these commitments.

The Proposed Action would commit resources in the form of energy, labor, materials, and funds for the foreseeable future. The justification for these commitments at this time is described in Section 1.4, Purpose and Need for the Proposed Action. Long-term productivity associated with the site relates to demonstrating the efficiency of geothermal mechanical systems and the benefits of a “green housekeeping plan” in an educational environment. Additionally, the Ohio 4-H Center is planned to serve 4-H youth, volunteers, and youth professionals from around the state of Ohio, the nation, and the world. It would be a training resource for other youth organizations, as well as a location for OSU Extension programming reaching throughout Ohio.

The Proposed Action would create no long-term risks to public health and safety.

4.15 UNAVOIDABLE ADVERSE IMPACTS

There would be no significant unavoidable adverse impacts of the components of the Proposed Action. Where adverse impacts might be expected, OSU has committed to implementing measures identified to reduce or eliminate these impacts. These impacts and corresponding applicant committed measures are described throughout other sections of Chapter 4 and are listed in the Summary of this EA.

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