Wetlands, Watercourses and Conservation Concerns Associated with the Proposed Storrs Lodges Development

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A. **Overview of wetlands and watercourses on the site, and adjacent areas, that may be affected by the proposed development.**

1. **Current Attributes of Wetlands and Watercourses on the proposed development site.**

As noted by the developers and other parties, there are 3 wetland areas on the property designated as A, B and C. Wetlands A and B drain west to Cedar Swamp and Wetland C drains as a "semipermanent stream" south to Eagleville Brook. Wetland A contains an established vernal pool, Wetland B is a seepage wetland that ultimately drains downslope towards Cedar Swamp Brook, and Wetland C starts as 2 or 3 seepage wetland areas that converge, forming a first-order headwater stream (characterized by REMA as a "semi-perennial watercourse") which exits the property to the south as a tributary to Eagleville Brook.

The Eastern Connecticut Environmental Review Team (ERT) report of 2009, characterized the stream associated with Wetland C as it "… leaves the property, as water quality "A" … and flows downstream… it can be reasonably assumed that the outflow from the property's wetlands in this predevelopment stage yields excellent water quality…" This finding is in fact confirmed by the recent water sampling of the stream in Wetland C by the wetlands scientist in his September 2016 testimony. Unfortunately, there was no associated sampling of bioindicators of stream quality for C. This was in notable contrast to the sampling of the adjacent Cedar Swamp Brook for both analytical chemistry and bioindicators, which showed that this was also of high quality. The summary findings by REMA state that, contrary to initial indications by the developer, "…***it is apparent that neither of the two watercourses are currently impaired and do meet the Connecticut Water Quality Standards for Class A surface waters***."

Together Wetlands B and C **contain at least 3 cold, headwater springs or seeps**. These wetland types have been noted by Metzler and Wagner (1998) as "**one of the most imperiled ecosystems in Connecticut**". In part this designation is based on a number of species of conservation concern that are associated with these ecosystems. Moreover, Metzler and Wagner go on to state that it is likely that more than 95% of these wetlands have been modified or destroyed over time. The associated wildlife of conservation concern for these habitats, include various invertebrate species (which were not sampled on site) and the state threatened, northern spring salamander, which has been reported from on or near this site (see notes below on this species). Native brook trout (which do occur in linked, adjacent streams, e.g. Cedar Swamp Brook) are dependent on cold water streams fed by headwater springs and seeps. See additional details in: CTDEEP (2013), http://www.ct.gov/deep/lib/deep/wildlife/pdf_files/nongame/ctwap/CTWAP-Appendix2.pdf The Metzler and Wagner report is referenced throughout the region and elsewhere for sustainable conservation planning and prioritization. For example, see: http://www.fws.gov/uploadedFiles/Region_5/NWRS/North_Zone/Silvio_O_Conte_Complex/Silvio_O_Conte/11w_Entire_Document(7078KB).pdf The developer's wetland scientist noted that some of the seeps and headwaters in the interconnected Wetland C system are saturated and are "hydrologically active year around". Whereas the seeps in Wetland B are probably active only into mid-summer, these are nevertheless hydrologically connected to Cedar Swamp Brook. It is noteworthy that the developer's own wetlands experts (Gadwa

and Longan 2011) in their paper documenting *The Scientific Basis For Wetland &Watercourse Buffer Zones*, highlight the importance of cold, headwater springs or seeps (i.e. Wetlands B and C) and the need for "Generous protective buffers" to maintain the ecological integrity.

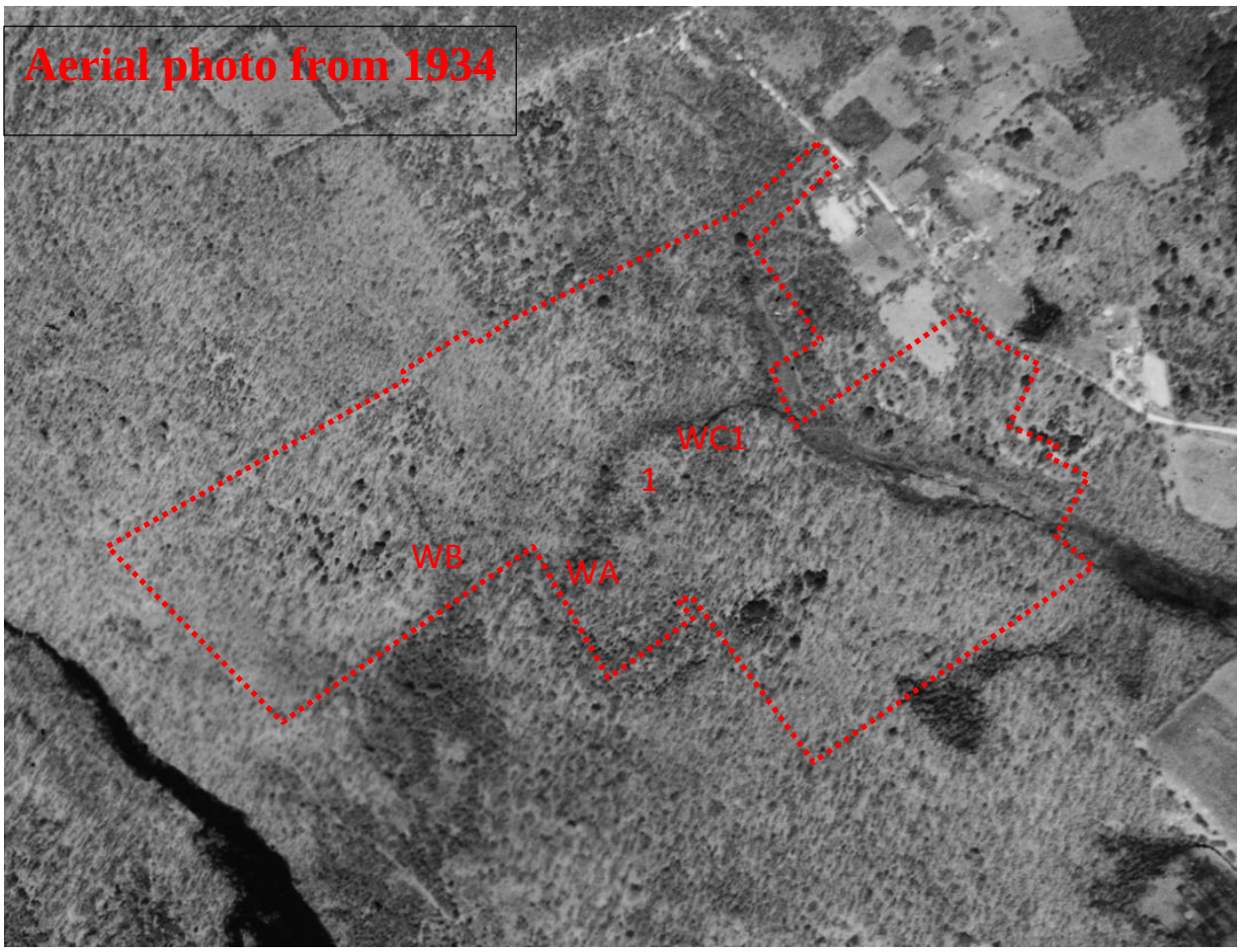
Wetland site A is an important vernal pool that does support a range of amphibian populations; there may also be a secondary vernal pool associated with Wetland C, as indicated in the ERT report, but this is contested by the developer's wetland scientist. The amphibian breeding populations include at least wood frogs, spring peepers and spotted salamanders. These species have been found here on repeated surveys over the years, pointing to sustained, viable populations at this site. This is in contrast to the original claim by the developers that "the pool likely dries out too soon for successful metamorphosis of salamanders, in most years." No evidence supporting this conclusion is in fact provided.

Overall the wetlands at this site provide a rich diversity of amphibians that inhabit the wetlands including at least 3 species of salamanders and 5 species of frogs. Moreover, at least one amphibian species of conservation concern (Threatened), the northern spring salamander, *Gyrinophilus porphyriticus* has been reported historically from this site, or possibly neighboring sites. The wetland attributes of the property do match those preferred by the spring salamander. According to DeGraaf and Yamasaki (2001) and others (Lowe 2003), this species "requires cold streams (predominantly near headwaters), seeps or springs containing large flat rocks or rock crevices in temperate forest…, …but is also likely to be found in any wet depression beneath logs, stones, or leaves in the surrounding forest.." "…highest densities are in waterways that lack an abundance of predatory fish…" Of all the surrounding areas, including Cedar Swamp Brook, this would point to the stream and seep areas on site (i.e. wetland C) as the most likely location for these historical occurrences, and an inspection of the water courses on the property suggests this possibility. It should also be noted that spring salamanders are notoriously difficult to find in the field, and are thus easily missed in typical surveys; it is certainly possible that the salamander may still occur on site. It should further be noted that the spring salamander is intolerant of disturbances.

Two other species of State Special Concern have also been found historically on the property or adjacent sites: the southern bog lemming and the wood turtle. The bog lemming occurs in a "…wide range of habitats in addition to sphagnum bogs… along the east coast of the United States…. also occur in heavily forested areas, …and sphagnum bogs with shrub cover… it may also be found in wet meadows, …and among mossy boulders in conifer forests." As the developer's wetlands scientist noted in his report sphagnum is quite common in some of the wetland areas (WC1 and WC2), pointing to the suitability of likely habitat on site for this species. But note that "poor trapping success in situations where runways are not produced [such as this site] precludes reliable estimation of density" (Linzey 1983). Thus as with spring salamanders, typical surveys are likely to yield absences when in fact the species may be present. The wood turtle's preferred locations are more typically along streams similar to Cedar Swamp Brook, but individuals do range one or more kilometers from streams, remaining in uplands for up to 1-2 months (Tuttle and Carroll 2005). Indeed wood turtles were found on the property in 2007, indicating that sampling of this species of conservation concern on the property may have been incomplete. It should also be noted that no comprehensive inventory of aquatic invertebrates has been conducted on the property, even though there are a number of species of conservation concern (including endangered species) that are known to occur in headwater seeps and streams.

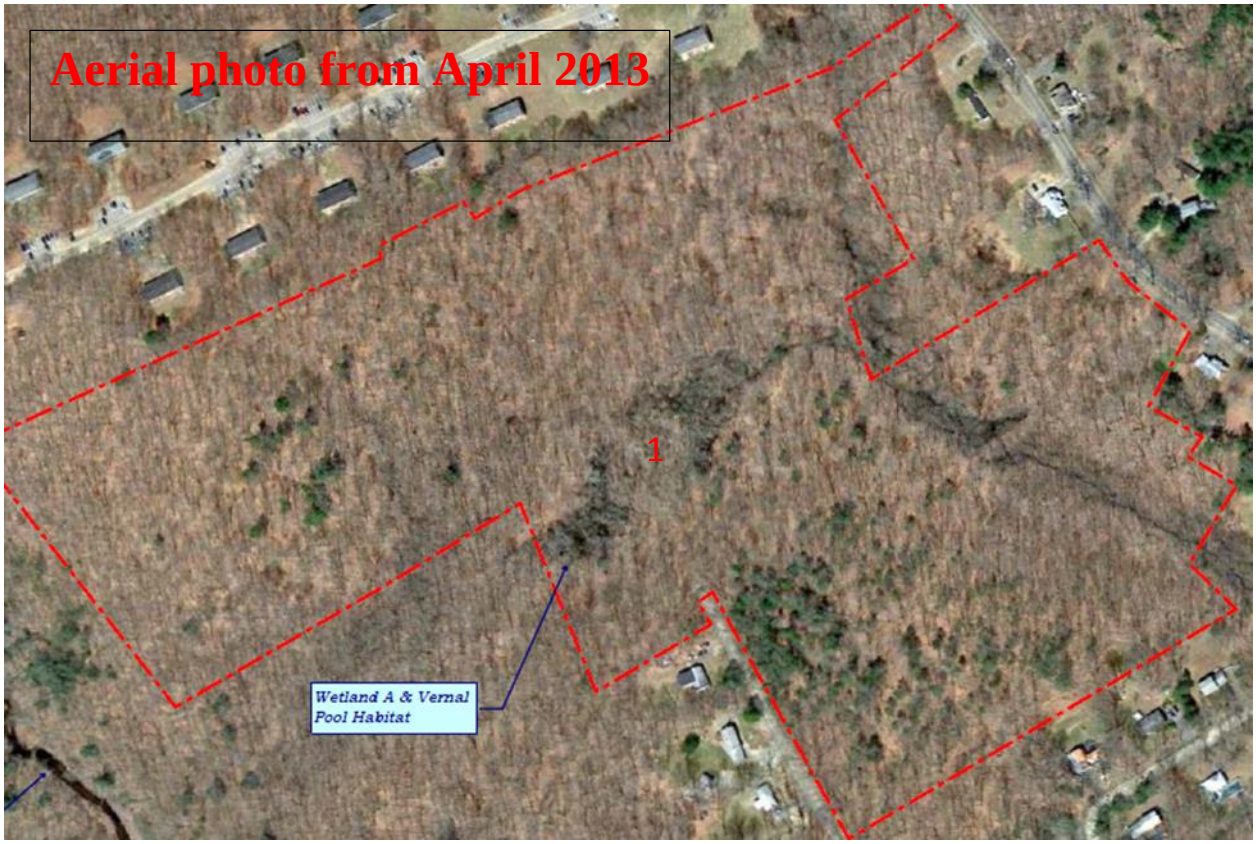
2. Historical ecosystem integrity and contiguity of wetlands and watercourses on the site.

A survey of aerial photos of the area from 1934 to the present indicate that these forested wetlands, including the vernal pool, have remained remarkably intact over the past 80 years with little in the way of disturbances; this is also reflected in the current high water quality of these wetlands. The developer's wetland scientist reports that some filling between wetlands WA and WC1 did occur between 1965 and 1970, as seen in the aerial photo from 1970 (coinciding with area #1 on the aerial photos below). But as the fill straddled the natural, existing drainage divide demarking the Eagleville Brook and Cedar Swamp Brook local watersheds (as mapped by the developer and by ERT), it appears to have had little direct effect on the exiting wetland systems. Note how similar the area and associated wetlands A, B and C appear today (2013 aerial photo below) compared with 1934 (below).



Current property boundaries are superimposed (approximately) on this 1934 aerial photo (above). Note that area of the vernal pool (WA), the adjacent wetland WC1 and the oval-shaped area in between (#1), which was later subject to some fill, does not appear to be a wetland in 1934. Regardless of any fill, area 1 in the aerial photos look very similar in 1934 and in 2013: the geometry, and wet areas appear to be the same. Moreover the watershed boundaries bisected WA and WC1 through (#1) then as they do today (cf. 1934 & 2013 aerial photos). As well, the stream channels are very clearly defined and are very similar to as they appear today. My interpretation of these remotely sensed images (and I have a number of publications on remote sensing of ecological patterns and processes) is that the hydrology and location of

wetlands, including the vernal pool, have been surprisingly little altered over the past 80 years. Moreover, contrary to the testimony of the developer's wetlands expert, my interpretation is that the vernal pool probably existed in 1934 and has continued to exist up to today. Further, my interpretation is that this is not a "man-made pool" and neither does it have "man enhanced hydrology". But regardless, the vernal pool today supports a sustained, viable population of amphibians and other aquatic biota.



3. Current attributes of Cedar Swamp Brook,

Cedar Swamp Brook neighbors the site. As noted in the June 2016 REMA report, Cedar Swamp Brook does in fact meet ***the Connecticut Water Quality Standards for Class A surface waters***, contrary to initial claims by the project's wetland scientist, but confirmed in the most recent water quality sampling done**.** Moreover, according to the 2009 ERT report, Cedar Swamp Brook "…was found to support a coldwater fish community comprised of: fallfish, white sucker, common shiner, blacknose dace and native brook trout…. the Eastern Brook Trout Joint Venture (EBJTV)… a geographically focused, locally driven, scientifically based effort [has primary] goals to protect, restore, and enhance aquatic habitat throughout the eastern range of brook trout…." including this stream corridor. Moreover, Cedar Swamp Brook and the reservoir at Pink Ravine (with its associated old waterworks plant) is also a past and potential future source of water for UCONN and Mansfield.

B. Potential negative impacts of the proposed Storrs Lodges development on the wetlands and watercourses on site and adjacent wetlands.

Following from Connecticut State Statutes, 440 section 22a-41: Major questions to address include: What are the potential negative impacts of the proposed regulated activity on wetlands and water courses both on-site and outside the area? Are the impacts irreversible affecting loss of wetland and watercourse resources? What measures have been taken to minimize pollution or other environmental damage? Will the regulated activity likely impact or affect the physical characteristics of such wetlands and watercourses (not just aquatic plant and animal life)? Are there feasible and prudent alternatives to the proposed regulated activities?

As the 2009 ERT report states:

"…These wetlands are positioned so that proposed access to the non-wetland portions of the property **must impact the existing wetlands**. These impacts will come in the form of road construction and road crossings… A rule of thumb for any given drainage: the water quality decreases as impervious surface in the watershed increases…. Generally speaking, the water quality of the stream is considered to be well protected when the imperviousness in the watershed is 0-10 percent of the total land cover [see Project NEMO fact sheet: [http://nemo.uconn.edu/publications/fact_sheets/nemo_fact_sheet_3_s.pdf]. The studies show that from 10 percent to about 26 percent imperviousness, the water quality is impacted [other studies actually show a lower threshold]. After about 26 per cent, definite degradation takes place… [as would be the case for current the proposed development]… upon completion, this small, 112 acre **watershed will be well into the "Impacted" category for water quality** and approaching the 26 percent "Degraded" rating [as summarized in the Project NEMO fact sheet] as a result of the proposed increase in impervious surface…. this is one of the few watersheds that currently yield clean water into the degraded Eagleville Brook… **proposed construction will boost the future water quality well on its way towards a "Degraded" rating**."

The developers claim that the current plan is considerably modified from the prior plan filed in 2007 for Ponde Place. But in fact the currently proposed plan has a larger build-out envelope than the prior plan, with some 47 scattered residence units housing some 692 students, in contrast to the prior plan with a smaller number of larger, clustered units, for a smaller number of students; parking spaces in the current plan are admittedly fewer than the prior plan (but that is a separate, problematic issue). The consequence of the currently proposed development are a larger disturbance footprint, larger disturbed surface area with impervious surfaces, necessitating more forest clearing, with an expanded impact on wetlands on the site and adjacent areas.

Many prior studies have shown that the impact of forest clearing for development on adjacent wetlands, is to considerably alter local hydrology, elevate wetland water temperatures (Chen et al. 1998, Arrington et al. 2004, Nelson & Palmer 2007, Kausal et al. 2010, Hester & Doyle 2011, Studinski et al. 2012), including groundwater temperatures (Alexander et al. 2003), stream microclimates (Moore et al. 2005), and degrade the quality of small streams overall (Thornton et al. 2000), which is exacerbated by urbanization (i.e. the proposed development plan). This in turn has significant deleterious effects on diverse stream biota, including amphibians (Gibbs 1998, Price et al. 2006, Lowe 2005, Urban et al. 2006, Marczak et al. 2010, Hester & Doyle 2011), biodiversity in general (Rubbo & Kiesecker 2005), and ecosystems processes overall (Ellison et al. 2005, Kaushal et al. 2010). The consequences of increased impervious surfaces is known to have ***significant, irreversible impacts*** on many aspects of the hydrology of small catchment areas (Shuster et al. 2005, Jacobson 2011) including base flow, flood discharge and

duration, lag phases, channel geomorphology, drainage density, bank erosion, size of bed material, sedimentation patterns, distribution of woody debris, etc. These effects are likely to be particularly significant given the importance and sensitivity of the wetlands on this site. All of this is in contrast to the overall objective as stated by developer's wetland scientist in testimony "that what we want to be sure that we do not alter the hydrology of the wetland systems…" In stark contrast, based on the long list of studies cited above and elsewhere, t**he development, as proposed, will clearly alter irreversibly the hydrology of the sensitive wetland systems on site.** Moreover, the wetlands scientist in testimony goes on to claim that with the proposed development, "that the effect of runoff, will be negligible…" contrary to the evidence in the studies cited above.

There are a variety of ways to model these various potential hydrological effects, pre- and post-development, along with the uncertainty thereof (e.g. Roa-Espinosa 2003, Harmel et al. 2005, plus many others). But these have not been done for this study. Thus one must conclude that as a result, the development will likely permanently and irreversibly affect the physical characteristics of the wetlands and watercourse on the property and adjacent areas. This in turn will have deleterious effects on associated wetland biota that have adapted over the long-term to local conditions on the site.

Quoting directly from the developer's wetland scientist (Gadwa & Logan 2011): "headwaters seeps will be irreversibly degraded by nutrients in sediment and partially treated stormwater runoff, especially phosphorus. These wetland types are often valuable, due to high functions and/or values." In consequence: "Generous protective buffers are especially important for low order streams and headwater wetlands. Mark Brinson emphasized the vulnerability of headwater wetlands in his 1993 landmark paper. He pointed out that a given area of adjacent soil disturbance would affect lower order, headwaters streams proportionately more than large, higher order streams. Biodiversity, including rare species, is especially high in headwaters seeps and streams (Meyer et al 2003). Because significant denitrification takes place in the microbe-rich substrate of healthy streams and stream banks, maintaining the integrity of lower order streams has a significant role in protecting down-gradient waterbodies,… from excess nitrogen inputs (Meyer et al. 1997). Buffer areas and level spreaders between stormwater outfalls and streams help reduce concentrations of roadway pollutants, but ***headwaters open space preserves and "soft" drainage systems (without catch-basins and storm-drains) provide the best protection for headwater streams***. Note that headwaters streams in urbanized watershed may already be so degraded that their value and functional level is low, reducing the impact of activities within buffers, although downstream impacts remain an issue." But fortunately, that is not yet the case for the headwaters seeps and streams on the property, as noted by the developer's wetland scientist in his September 2016 testimony. According to his own paper (Gadwa and Logan 2011); "As discussed… in Section 4.2, the ecological communities in … ***headwater seeps and streams are all vulnerable to nutrient pollution, far more so than [many other wetland types], ...based on the scientific literature, a minimum 100 - foot wide upland review area (URA) is prudent, from a regulatory perspective***. ***However…..Examples of highly sensitive resources needing wider setbacks are nutrient-sensitive …perennial headwaters seeps, productive vernal pool wetlands,…"*** Thus, based on this document by the developer's own wetland scientist, the set-backs from buildings and roads should be at least 100 feet and arguably greater than this for the sensitive headwater seeps and streams on the property. This is in contrast to the wetland scientist's testimony that he wanted to see "…a minimum of 40 feet undisturbed setback". But then he goes on to hedge this by saying "that may not be possible everywhere". Yet for the proposed development the setbacks are much less than 100 feet from many of the buildings and are only a few feet from the edge of roads. This conclusion is also

reached by Sweeney & Newbold (2014) who state that for small forested streams, a buffer of natural forest vegetation of at least 30m [~107 feet] is needed is "to protect the physical, chemical, and biological integrity of small streams". Even more conservatively, the 2010 paper by Marczak and colleagues, states that to effectively conserve riparian biota, a "forested buffer of more than 50 meters [~163 feet] is needed".

The developers do propose wetland restoration to mitigate for wetlands being lost or compromised as a result of the proposed development. Nevertheless, wetland restoration is a process fraught with difficulties that too often fails to effectively meet the objectives of reestablishing ecosystem function, as Maron and colleagues (2012) have shown in their widely cited article. In addition the plan to mitigate amphibian migration between natural areas via tunnels is likely to be quite ineffective as Dr. Klemens carefully points out in his report, when a large parts of the adjacent natural habitat has been developed or otherwise compromised. Moreover, even Scott Jackson's evaluation of the effectiveness of amphibian tunnels (Jackson & Tyning 1989) remains problematic. For example, in his 1989 study, wood frogs would not migrate through his tunnels, and a number of salamanders ~25% would also not pass through.

I note that the setbacks recommended for vernal pools are even greater than that recommended above for headwater seeps and streams. Even the developer's wetland scientist admitted in testimony that the buffer needed to be "at least 150 feet, if not more". Dr. Klemens has gone into considerable depth in discussing the issues related to setback and the maximum area for development, i.e. "not exceeding 25% of critical terrestrial habitat zone maintenance" to sustain viable amphibian populations. Thus based on these criteria, a prudent setback for the proposed development is not met. I further note that in the case of the Storrs Center Alliance, the developers in fact followed Dr. Klemens recommendations regarding setback and development limitations around a similar vernal pool on their property. In consequence, the development's IWA approval in 2007 was for "a much smaller portion than originally contemplated" illustrating "good-faith efforts on the part of the developer to produce an environmentally sensitive plan." Indeed, in granting a wetlands permit the IWA stated that this was conditional upon: "***Best Development Practices, as outlined by Calhoun and Klemens in their book by the same title, shall be followed***;" (IWA minutes of October 1, 2007). Note that the article by Marczak and colleagues (2010) show that for amphibians and reptiles, a buffer area even greater than that recommended by Dr. Klemens may be needed to effectively maintain pre-disturbance populations.

Some additional prudent alternatives that should be considered regarding the proposed development: Quoting from Dietz and Arnold 2011 (report on mitigation plans to minimize the impact of development on Eagleville Brook: The watershed of stream reach CT 3100-19_01 .Eagleville Brook watershed "…contains large tracts of undeveloped forest and fields [including the Storrs Lodges site], and some low-density residential housing. This reach drains … the upper reach of Eagleville Brook (CT 3100-19_02). Therefore, the management measure recommended in this sub-basin is anti-degradation. This sub-basin is not located on UConn property, so the **Town of Mansfield would have primary responsibility for maintaining its function**. This could be achieved through evaluating any new proposed development through the lens of this plan…to encourage ***responsible growth*** *using Low Impact Development (LID) techniques.* ***The goal of LID is to preserve the predevelopment hydrology of a site***…Some LID tools … include the following…2. Preserve natural hydrologic features where possible 3. Keep disturbance of soils and existing vegetation to a minimum 4. Use …rain gardens, grassed swales, water harvesting, and vegetated roofs where possible…" Clark (2010) also reiterates the use of green

infrastructure to reduce thermal impacts associated with developments. But only some of the more minor LID recommendations are being proposed by the developer here. See Freeman et al. (2007) and Gomi et al. (2010) for broad overviews of the critical local-to-regional importance of headwater streams in this context, mitigating the impacts on catchment basins of development and urbanization, and the need to preserve natural hydrological features especially in headwater streams and associated wetlands.

B. Other species of conservation concern on the site or on immediately adjacent areas.

In addition to the aquatic and wetland species of conservation concern mentioned above, several bird species of conservation concern have been sighted on or adjacent to the site, historically as well as recently. Of the 66+ species inventoried in recent years in the area of Pink Ravine (which is a known Connecticut ornithological hotspot) with which the Storrs Lodges site is contiguous, 3 are on the CT-DEEP list of species of concern (see: http://www.ct.gov/deep/cwp/view.asp?a=2702&q=323472&deepNav_GID=1628): Northern Parula (SC), identified in 2015 by Professor Morgan Tingley, Ornithologist at UCONN, Brown Thrasher (SC), also identified in 2015 by Professor Morgan Tingley, and *Accipter sp*; this would be either the Northern Goshawk (Threatened) or the Sharp-shinned hawk (Endangered) (from the state list of known species to occur in CT) Identified in 2009 to genus by Professor Chris Elphick, Ornithologist at UCONN. More details can be obtained directly from Professors Tingley and Elphick. For a full list of species observed at these sites, see: http://ebird.org/ebird/hotspot/L3599408?yr=all&m=&rank=mrec

C. Conclusions

Based on my reading of the Connecticut State Statutes regulating wetlands, the current status of wetlands and watercourses (unique, of high environmental quality, and also rare or threatened within the state) on the proposed development site, the data gathered by the developer's team and other parties (including ERT and independent consultants), and based on an extensive literature search (a partial list provided below), I am forced to conclude that the current proposed development plan will indeed have a significant negative impact on wetlands on the site and potentially adjacent areas. Furthermore, the regulated activities are likely to affect the physical characteristics of the wetlands and watercourses in diverse ways (including potential alterations in wetland hydrology (base flow, flood discharge and duration, lag phases, etc.), water temperatures and other aspects of wetland microclimates, degradation of water quality, changes in stream morphology (channel geomorphology, bank erosion, size of bed material, sedimentation patterns, distribution of woody debris, etc.). These in turn are likely to have an adverse effect on the associated wetland biota and biodiversity, as well as on ecosystems processes overall. Moreover, these effects are likely to be irreversible. In summary, given the current plan for development on this site **there will be a likelihood of unreasonable harm to wetlands resources**. Moreover, it appears that insufficient effort has been made to minimize environmental damage, not even following recommendations that the project's wetland scientist has made in published reports for similar systems elsewhere. Finally, it would appear that the developer has not made a feasible and prudent, good faith effort to address alternative development designs such as other developers have used for similar situations elsewhere in Mansfield.

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