UPDATED ANALYSIS OF NITROGEN LOADING RATES FROM THE HILLS PDD BASED ON THE FINAL ENVIRONMENTAL IMPACT STATEMENT

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OCTOBER, 2017

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Executive Summary:

The Hills is a Planned Development District (PDD) proposed by Discovery Land Corporation (DLC) to be built in East Quogue. The Hills property is currently comprised of 591 acres of Pine Barrens, open space, and farmland and has been proposed by DLC via the PDD to be made into a seasonal resort with a golf course. The Hills property lies within the watershed of western Shinnecock Bay which has experienced significant losses of seagrass and bivalves in recent years due to increasing nitrogen loads, harmful algal blooms, and low oxygen events. Increases in nitrogen loading to this region is expected to worsen these conditions. For this evaluation, a dynamic nitrogen loading model was constructed using information generated by the NYS Department of Environmental Conservation's Long Island Nitrogen Action Plan (LINAP) as well as standard practices used to determine nitrogen loading rates across Long Island this decade. Using this model, the nitrogen loading rates currently delivered to this property and expected from multiple development scenarios were quantified using information provided by the PDD Final Environmental Impact Statement (FEIS) for The Hills, specific guidance from the Town of Southampton, information from LINAP, and the most up-to-date science available. The series of nitrogen mitigation measures proposed in the FEIS, that did not appear in the DEIS, considered in this report for the Town of Southampton included the preservation (or development) of 33 acres at the headwaters of Weesuck Creek within East Quogue, the purchase of 30 Pine Barrens credits and the associated potential increase housing density, community septic system upgrades, the installation of a sewage treatment plant (STP) to treat wastewater on the PDD property, the installation of a STP for East Quogue Elementary School with both STPs treating wastewater to 10 mg/L, and a conservative estimate of the impacts of fertigation on the site. Calculations demonstrated that the Hills PDD as described within the FEIS yielded a lower nitrogen loading rate compared to a higher and lower impact, as of right development on the property. After accounting for updates within the FEIS, as of right development is estimated to yield 2,500 to 5,100 lbs of nitrogen per year, depending on the level of occupancy, fertilization rates, and the extent of clearing, and the size of lawns on properties. The lower bound of this estimate primarily uses many of the details of the PDD without a golf course as well as the low impact development as proposed by The Group for the East End. The PDD nitrogen load was found to be ~2,000 lbs of nitrogen per year or more than 20% lower than the lowest As of Right scenario. Each scenario provides a greater nitrogen loading rate than the current, undeveloped property (1,200 lbs per year). All of these calculations are, of course, theoretical and the extent to which the actual nitrogen yields on the Hills property match these calculations will be partly a function of the extent to which the characteristics of development matches the details and practices outlined in the PDD. As such, careful monitoring of any potential development, the

watershed, groundwater, surface waters, and surrounding ecosystems will be required to assure optimal environmental outcomes.

Preface:

Christopher J. Gobler is a professor within the School of Marine and Atmospheric Sciences (SoMAS) at Stony Brook University. He received his M.S. and Ph.D. from Stony Brook University in the 1990s. He began his academic career at Long Island University (LIU) in 1999. In 2005, he joined Stony Brook University as the Director of Academic Programs for SoMAS on the Stony Brook – Southampton campus. In 2014, he was appointed as the Associate Dean of Research at SoMAS and in 2015, he was named co-Director of the New York State Center for Clean Water Technology. In 2016, he was given the Environmental Champion Award by the US Environmental Protection Agency for his research efforts and was named the 40th most influential person on Long Island by the Long Island Press. In 2017, he was awarded the Endowed Chair in Coastal Ecology and Conservation within SoMAS. The major research focus within his group is investigating how anthropogenic activities such as climate change, eutrophication, and the over-harvesting of fisheries alters the ecological functioning of coastal ecosystems. He has been researching these topics on Long Island for 25 years and has published more than 150 peer-reviewed manuscripts in international journals on these subjects. He has been calculating nitrogen loads to water bodies across Long Island for more than 20 years.

Background on regional groundwater and surface waters:

Current conditions

'The Hills in Southampton' is comprised of nearly 500 acres of undisturbed Pine Barrens in the town of East Quogue. Beyond the intrinsic value of open space and the ecosystem services and benefits of the Long Island Pine Barrens, this property has numerous benefits to water quality in the region. The natural vegetation on this property acts as a natural filter for nitrogen and other contaminants deposited from the atmosphere. This is clear from the levels of nitrogen and general contaminant currently present in the Suffolk County Water Authority's groundwater wells on Malloy Drive which show exceedingly low levels of nitrogen (< 0.5 mg per liter) and undetectable levels of pesticides and other organic compounds[1]. In contrast, other groundwater in the region has been contaminated by various land use processes. For example, the upper glacial aquifer in regions away from the Hills such as the SCWA Spinney Road well field is already contaminated with high levels of nitrate and perchlorate to the point Suffolk County Water Authority has stopped using these wells to deliver drinking water.[1]. Unfortunately, more than 100 families in East Quogue with private wells rely on upper glacial aquifer for drinking water.[1]

The proposed development in The Hills is located 1,500 feet from Weesuck Creek and western Shinnecock Bay and groundwater travels times from land to bay in this region are less than five years[2] meaning that land use changes on the Hills such as adding homes or a golf course will quickly impact the nearby coastal ecosystems. This being the case, it is important to clearly understand and document the current and recent conditions of these ecosystems. During Hurricane Sandy, the waters of Shinnecock Bay crossed Montauk Highway in East Quogue, flooded the three major communities on the East Quogue peninsula (Shinnecock Shores, Pinesfield, Pine Neck Landing) and approached Main Street[3]. East Quogue has been fortunate to still have lush stands of salt marsh along the east and west sides of Weesuck Creek. During Sandy, those salt marshes protected East Quogue from a significantly worse flooding scenario than it would have experienced without these marshes[4].

In 2010, NYSDEC declared Shinnecock Bay an impaired waterbody due to excessive wastewater nitrogen loads[5]; total nitrogen levels in the Bay exceed guidance levels set by USEPA[6]. Impairments brought about by high nitrogen loading to western Shinnecock Bay include: Annual toxic brown tides[6], dissolved oxygen levels in summer dangerously low for marine life[6,7], the near complete loss of seagrass beds[8], a critical habitat for fisheries[8], and low densities of hard clams and conditions under which baby shellfish cannot survive[9] . Brown tides in Shinnecock Bay continue to worsen. The brown tide in 2016 was the most intense on record

and excessive nitrogen loading will make such events worse in the future. Brown tides have a cascading effect on the marine ecosystem, killing off remaining seagrass and shellfish, which in turn makes the ecosystem more vulnerable to additional brown tides[6]. Western Shinnecock Bay is one of five places in NYS that experiences paralytic shellfish poisoning (PSP) caused by saxitoxin and was closed by NYSDEC to due to this toxin in 2011, 2012, and 2015.[10] In fact, every year the epicenter of PSP during these events has been in Weesuck Creek in East Quogue. And the PSP event in 2015 was three-fold more toxic than any measurement made to date[10] suggesting that conditions are worsening.

Future threats

Any additional nitrogen loading from land in East Quogue will worsen existing conditions in the bay. Enhanced nitrogen loading will push already high nitrate levels in public and private water supply wells for East Quogue closer to the USEPA federal limit for drinking water[1]. In conducting a state-wide assessment of coastal flooding, NYSDEC released a report in April 2014 that concluded that salt marsh habitats provide critical flood protection to New York coastal communities and that increases in land-to-sea delivery of nitrogen degrades, erodes, and eventually destroys salt marshes[4]. Given the progression of sea level rise, there could be an intensification of flooding risk in East Quogue coastal communities associated with storms, hurricanes, and/or extreme tides with more nitrogen loading. Furthermore, the numerous impairments in Shinnecock Bay including toxic brown tides, low oxygen levels, the loss of eelgrass, and the loss of shellfish will all worsen in Shinnecock Bay with additional nitrogen loads[8,13,14]. Increasing nitrogen loading has been shown to increase the intensity and toxicity of PSP on Long Island.[15] More nitrogen loading in East Quogue could intensify PSP in and around Weesuck Creek leading to larger and/or longer shellfish bed closures. This also creates the risk that citizens of Southampton could become seriously sickened or worse from eating contaminated shellfish. Due to diffusive groundwater flow and tidal exchange, the impacts of enhanced nitrogen loads on surface water will be experienced in regions to the east and west including Hampton Bays, Quogue, and Westhampton Beach. Finally, all of these worsened conditions have serious economic repercussions on tourism, fisheries, restaurants, and even home values[16].

References

1: Suffolk County Water Authority, Spinney Road Well Head tests, 2010-2104; **2.** Suffolk County Comprehensive Water Resources Management Plan. 2010. Draft report; **3:** USGS Hurricane Sandy Storm Tide mapper. **4:** NYSDEC 2014. Nitrogen Pollution and Adverse Impacts on Resilient Tidal Marshlands Technical Briefing Summary. **5:** NYSDEC 2010. 303-d List. **6:** Suffolk County Department of Health Services 1976-2013. Annual reports of surface water quality. **7:** News 12 Water Quality Index Reports, 2014. **8:** New York State Department of Environmental Conservation 2009. Seagrass Task Force Final Report. **9:** Shinnecock Bay Restoration Project Final report 2013. Stony Brook University. **10:** NYSDEC 2011 – 2014. Marine Division annual monitoring of PSP on Long Island. **12:** Bowen, J. L., et al. 2007. NLOAD: an interactive, web-based modeling tool for nitrogen management in estuaries. Ecological Applications, 17(sp5), S17-S30. **13:** Valiela, I. 2006. Global Coastal Change,

Blackwell Publishing. **14:** Gobler CJ, Sunda WG. 2012. Ecosystem disruptive algal blooms of the brown tide species, Aureococcus anophagefferens and Aureoumbra lagunensis. Harmful Algae. 14: 36–45; **15:** Hattenrath TK, Anderson DA, Gobler CJ. 2010. The influence of nutrients and climate on the dynamics and toxicity of *Alexandrium fundyense* blooms in a New York (USA) estuary. *Harmful Algae* 9: 402–412. **16:** Johnston RJ et al. 2002. Valuing Estuarine Resource Services Using Economic and Ecological Models:The Peconic Estuary System Study. Coastal Management, 30:47–65.

Scope of this analysis

This document has been prepared to solely consider the potential impacts of the Hills PDD on groundwater and surface water in the region. Within this realm, the overwhelming majority of this document considers the loading rates of nitrogen that will be a consequence of differing potential land uses of the property given the sensitivity of surface water and habitats to nitrogen loading rates. The author has created a dynamic nitrogen loading model that uses the loading rate constants and assumptions that have been developed as part of the NYSDEC's Long Island Nitrogen Action Plan (LINAP). This plan has been collaboratively developed by CDM Smith, NYSDEC, Suffolk County, Cornell University, USGS, US EPA, and Stony Brook University and represents a scientific consensus among these teams and contains the most up-to-date and best science available on the subject of nitrogen loading within coastal watersheds. The tables and constants used in calculations appear in Table 1. This document comments on the actual contents of the FEIS only. The author acknowledges there are many other very important aspects of the project beyond nitrogen loading that are not considered here.

Current use of properties

Presently, the 591 acres of land that comprise the Hills PDD include open space, Pine Barrens forest, and farmland. My analyses indicate the nitrogen loading rate is 1,200 lbs per year if the farm fields within the property are actively being fertilizer (Gobler, March 2017). If they are not actively being fertilizer, the loading drops to ~660 lbs per year (Gobler, March 2017). Local observations have indicated that the singular farm field on the Parlato property is not used every year and thus not always fertilized. Similarly, it is not clear if the Kracke property under consideration is actively managed and fertilized. Further, the area contains shrubs and ornamentals which are typically fertilizer at a lower rate than row crops and thus at a lower rate than used in the DEIS. Differences between my calculated nitrogen loads and those of the DEIS also arise from the use of a leaching rates for nitrogen different than those that have been accepted by LINAP and a fertilization rate higher than has been accepted by LINAP.

Changes from the DEIS to the FEIS

The FEIS differed from the DEIS with regard to nitrogen impacts of the PDD in five material ways:

1) The FEIS now includes preserving an additional 33 acres of land located at the headwaters of Weesuck Creek. The zoning associated with the parcel is R-40 which would result in an as-of-right yield of 30 homes.
2) The purchase and abandonment of 30 Pine Barrens Credits consistent with the objectives of Central Pines Barrens Program, which eliminates potential nitrogen load associated with 30 single family homes that could be otherwise constructed with these credits.
3) An On-Site Wastewater Treatment System that would remove nitrogen at a level at or below 10mg/L compared to allowable County standard of 19mg/L.
4) The construction of a Sewage Treatment Plant for the local school in addition that would remove nitrogen at a level at or below 10mg/L
5) A fertilizer cap of 2 pounds per year per 1000 square feet for the entire property cleared property.
6) A $1M fund to support community-wide septic upgrades. This final approach had been mentioned in the DEIS but was not part of the analysis provided by the author to the Town of Southampton. For completeness, this is now included here.

Changes to nitrogen loading due to additional nitrogen reducing measures in the FEIS

The analysis of the DEIS indicated the nitrogen loading rates of the PDD would be 4,128 lbs per year (Gobler, March 2017). For consideration of the 'As of Right' development, two scenarios were previously considered: One that included nearly all of the default assumptions made by the DLC consultants and a second considering considered a 'reduced impact' alternative, using some information proposed by the PDD as well as many of these assumptions and conditions within the 'reduced impact' alternative proposed by The Group for the East End for the property. The As of Right development using the DLC default assumptions would yield 3,454 lbs of nitrogen per year a level similar to the level determined by the DLC consultants in the DEIS (3,288 lbs). The reduced impact alternative provides a nitrogen loading rate (~1,700 lbs nitrogen per year) that is roughly half of the As of Right conditions but highly similar to the PDD without the golf course.

Preserving 33 acres of land located at the headwaters of Weesuck Creek

Following the guidance of Southampton Town, the zoning associated with the parcel is R-40 and would result in an as-of-right yield of 30 homes. The nitrogen loading model was used to include a development on this parcel with 30 homes and the associated changes in nitrogen loading to that land that would emanate from wastewater, fertilizer use, and land clearing. The model was run using parameters that were consistent with a higher and lower impact development as outlined within the analyses provided for the DEIS. As pristine, undeveloped forest, this land presently yields < 40 pounds of nitrogen per year. It is assumed any

development would include advanced septic systems to treat wastewater to 19 milligrams of nitrogen per liter. If developed with the maximal allowable amount of clearing, above average acreage of lawns, and a mostly year-round residency, such a development would yield 823 pounds of nitrogen per year. If developed more realistically, with a normal amount of clearing (based on Town averages), normal acreage of lawns (based on Town averages), and a realistic mix of seasonal and year-round residency (based on U.S. census data), such a development would yield 384 pounds of nitrogen per year. These totals must be added to the expected 'As of Right' scenarios as they are not part of the Hill PDD plan. This would bring the total nitrogen yield from the maximal As of Right scenario to 4,278 pounds of nitrogen per year and the yield from the more conservative / realistic development scenario to 2,122 pounds of nitrogen per year.

The purchase and abandonment of 30 Pine Barrens Credits

It has been proposed that DLC will purchase 30 Pine Barrens Credits within the Central Pines Barrens Program, which would eliminate potential nitrogen load associated with 30 single family homes that could be otherwise constructed with these credits. This is a challenging scenario to evaluate given the precise location of the additional homes that could be developed is not fully known. In one scenario, these homes were hypothetically sites on the Hills site as an additional 30 units build in a manner similar to the other units as proposed in the DEIS and FEIS. In this case, if developed to with the maximal allowable amount of clearing, above average acreage of lawns, and a mostly year-round residency using scenarios suggested by DLC consultants within the DEIS, the 30 additional units would yield 852 pounds of nitrogen per year. If developed with lesser impact including a lower amount of clearing, smaller acreage of lawns, and a realistic mix of seasonal and year-round residency, such a development would yield 362 pounds of nitrogen per year. These yields are similar to the hypothetical 33 acres scenarios run above, indicating that if these credits were placed elsewhere, the yields would likely be somewhat similar if the lot sizes were similarly small. More homes or larger lot sizes would yield more nitrogen. Regardless, using the scenarios described here would bring the total nitrogen yield from the maximal As of Right scenario to 5,130 pounds of nitrogen per year and the yield from the more conservative / realistic development scenario to 2,484 pounds of nitrogen per year. It is noted that if the PDD is not approved by the Town of Southampton and if the DLC desired to land the PBC on the Hills property (i.e. the scenario used here), this action would need to be approved by the Town Board and would not be an As of Right alternative without such approval.

An On-Site Wastewater Treatment System for Hills PDD

The FEIS states that the Hills development will be outfitted with a Baswood sewage treatment facility that would remove nitrogen at a level at or below 10 milligrams of nitrogen per liter, lower than the allowable County standard of 19 milligrams of nitrogen per liter. It was estimated in the DEIS that the Hills development would produce 562 pounds of wastewater nitrogen per year using technology that treated to 19 milligrams of nitrogen per liter. Treatment to 10 milligrams of nitrogen per liter would remove an additional 330 pounds of nitrogen per year from the development.

The construction of a Sewage Treatment Plant East Quogue Elementary School

East Quogue elementary school is comprised of ~400 students, ages 5 – 12, and ~100 adults including faculty and staff. The school year is 180 days of the year and the building is fully occupied by people for approximately six hours per day. Faculty and staff work longer days and some staff are present all year. There are daily activities in the afternoons and evenings as well as special events such as sports, concerts, cub scouts, community meetings, plays, graduation, etc. It is estimated that the collective activities of the school releases 400 pounds of nitrogen from wastewater per year with standard septic tanks and leaching rings to the aquifer. The construction of a sewage treatment facility that treated wastewater to 10 mg N per liter would reduce the wastewater-based nitrogen output from the school to 65 pounds per year, removing 335 pounds of nitrogen per year. It is noted that sewage treatment plant operation can be expensive and that it is not clear who would be responsible for the operation and maintenance of this system.

A fertilizer cap of 2 pounds per year per 1000 square feet

This change effects the nitrogen load of the PDD in two ways. Firstly, it eliminates the possibility of additional nitrogen fertilizer being added to the proposed golf course beyond 2 pounds per year per 1000 square feet in the event that the proposed fertigation approach does not yield the expected level of nitrogen needed, a possibility acknowledged within the DEIS. This removes 500 lbs of nitrogen per year that had been added in the prior analyses given that the ability of fertigation to deliver a set level of nitrogen seems uncertain. This change also reduces the total amount of fertilizer added to the property by 257 lbs given a higher rate that had been planned for the golf course in the DEIS.

A $1M fund to support community-wide septic upgrades

Presently, there is great interest in reducing nitrogen loading from wastewater across Suffolk County and the resent renewal and update of the Community Preservation Funds within the Town of Southampton to include funds for upgrading septic systems will provide funds to convert standard septic systems to new, innovative and alternative systems that remove greater

amounts of nitrogen, specifically to levels below 19 milligrams per liter as per the recently approved Article 19 of the Suffolk County health code. The Hills PDD proposed to spend $1M on upgrading septic systems within the East Quogue watershed. While off-the-shelf septic systems that remove large amounts of nitrogen approved by Suffolk County can cost $20,000 installed (e.g. South Fork Septic Services, East Hampton, NY) additional costs may include landscaping, marking out utilities, pump out and abandonment of older systems, and electrical updates / installations. Hence, a cost of $25,000 per septic upgrade was used for the purposes of this analyses, which would result in 40 homes in East Quogue being upgraded as a result of the PDD. Given the known rates of seasonal occupancy for East Quogue as reported by Suffolk County's Department of Planning, 40 East Quogue homes with standard septic systems produce ~562 pounds of nitrogen annually, but would release 178 pounds of nitrogen annually with a system reducing down to 19 milligrams of nitrogen per liter, resulting in 384 pounds of nitrogen removed annually. It is notable that the upgrading of septic systems is presently voluntary and the extent to which associated nitrogen reductions are achieved will be a function of how many homeowners in the East Quogue watershed take advantage of this program. Even if this program along, with any programs developed by Suffolk County and/or the Town of Southampton, cover the full cost of installation, installing such systems require annual maintenance and inspection fees. How this may impact program participation is unknown.

Fertigation:

Fertigation is a novel and innovative approach for groundwater remediation and holds promise to be one of many potential mitigation strategies used on Long Island to reduce the loading of nitrogen from land to sea. This concept employs turf-remediation by allowing vegetation to absorb nitrogen from groundwater. This "pump-and-fertilize" concept proposed is a primary mitigating measure for the PDD. Since this report was completed, the Town's consultant, AKRF, in developing the SEQRA findings statement attributed substantial nitrogen reduction to this methodology. The applicant indicated that some 1,800 pounds of nitrogen per year will be removed from the ground water due to the pumping of 20 million gallons of groundwater for irrigation per year and groundwater testing in the western portion of the subject property revealed nitrogen levels averaging 14 mg N per liter.

The largest uncertainty with regard to the success of the fertigation approach stems from the groundwater nitrogen concentrations which vary strongly both horizontally and vertically in the region where the groundwater is to be pumped, being as high as 28 mg per liter and as low as 1 mg per liter. Suffolk County Water Authority wells on Spinney Road have consistently produced high levels of nitrogen (7 – 14 mg per L) for many years, but there are currently no concrete plans to use this water source for fertigation.

Since my original report was written, fertigation has been implemented on the Indian Island golf course in Riverhead and I have become aware of its use in other locations including a golf course in Massachusetts. While the precise level of nitrogen in groundwater that will be used for fertigation remains an unknown, it seems highly likely that any nitrogen in solution that is applied to a turf will be absorbed at a significant rate. Being conservative and consistent with the on-going NYSDEC-led LINAP study as well as my prior evaluations, a 20% leaching rate of nitrogen by turf could be considered. Regarding actual concentrations of nitrogen in groundwater, 2 mg N per liter is substantially lower than the levels considered by the Hills consultants (14 mg per L) but is within the range of what is present near the proposed well to be used for fertigation. If an application rate of 20 million gallons per year is used by the golf course as proposed, this would result in the removal of 281 pounds of nitrogen per year (Table 1).

Summary:

Collectively, the additional nitrogen mitigation measured included in the FEIS as interpreted by the Town of Southampton would yield nitrogen loads of 2,500 to 5,100 pounds of nitrogen per year for lower and higher As of Right development scenarios whereas the proposed Hills PDD would yield 2,000 pounds of nitrogen per year. This equates to a lower yield than the lower impact As of Right development but is still more than the current yield of the forest and farmland.

The total calculation of nitrogen impacts and mitigation for this project are complicated by the challenge of attempting to quantify several inexact variables under differing regulatory requirements, while simultaneously making judgments about effective implementation, voluntary program participation, long-term enforcement, and site management over time. There are uncertainties in this analysis with regard to where the Pine Barrens Credits to be purchased would 'land'. Further, it is not known how many homeowners will participate in the septic upgrade program within the watershed.

Future considerations:

All of these calculations are, of course, theoretical and the extent to which the actual nitrogen yields on the Hills property match these calculations will be partly a function of the extent to which the characteristics of development matches the details and practices outlined in the PDD. Moreover, as more detailed information of the manner in which the Hills PDD may be developed and operated become available and as actual data is collected, these hypothetical scenarios and calculations could and probably should be refined. If the Hills PDD is approved

and The Hills at Southampton is developed, stringent enforcement along with careful monitoring of the development, watershed, groundwater, surface waters, and surrounding ecosystems will be required to assure optimal environmental outcomes.

Table 1. Nitrogen yields for the Hills property for the DEIS, as well as specific changes made to the FEIS and considered in this report for the Town of Southampton. Values are in pounds of nitrogen per year.

	Existing	Hill PDD	As of right, maximu	As of right, lower	Comment
DEIS	1,210	4,128	3,455	1,738	Reported in March
Fertilizer cap	1,210	3,371	3,455	1,738	2 lbs/1000 sq. ft. cap on applied fertilizer
Hills STP	1,210	3,041	3,455	1,738	STP for the PDD treating to 10 mg/L
School STP	1,210	2,706	3,455	1,738	STP for the school treating to 10 mg/L
Community septic upgrades	1,210	2,322	3,455	1,738	Using new technologies that treat to 19 mg/L
Fertigation, conservative estimate	1,210	2,041	3,455	1,738	Considers 2mg N / L groundwater
33 acres with 30 homes	1,210	2,041	4,278	2,122	Build out of 30 homes on 33 acres
Pine Barrens Credits, 30 homes	1,210	2,041	5,130	2,484	30 additional units via purchase of Pine Barrens credits
FINAL	**1,210**	**2,041**	**5,130**	**2,484**	Total yields