**Nutrient Management Plan for *Example Bog***

A nutrient management plan as defined by the Commonwealth of Massachusetts is a written plan to manage the amount, placement, timing, and application of plant nutrient materials in order to minimize nutrient loss or runoff and to maintain the productivity of soil when growing agricultural products. A nutrient management plan developed in accordance with University of Massachusetts Guidelines for the crops applied is required for farm operations that apply nutrients to ten or more acres.

This Nutrient Management Plan is a written in accordance with the requirements of 330 CMR 31.00 to ensure that plant nutrients are applied to agricultural land in an effective manner to provide sufficient nutrients for plant growth while minimizing the impacts of the nutrients on water resources in order to protect human health and the environment.

Farm information: [**enter name and location**]

Date of plan: [**enter date written and period covered - usually 3 years**]

Responsible person: [**enter name and contact of person who writes the plan**]

Crop grown: Cranberry

Basis of nutrient management: This is a primarily a Nitrogen-based plan with consideration given to Phosphorus.

Maps:

1) Aerial map showing bog sections [OS Exhibit A could be used here]

[**paste in or append your map**]

2) Google Earth map showing proximal surface waters.

[**paste in or append your map**]

Note: This bog is not in a Zone A, 1 or 2. [**change this sentence if the bog is in one of these zones**] Setbacks do not apply since cranberry production is a crop growing system that operationally requires proximity to surface waters and UMass Guidelines will be followed.

Cranberry bogs are nutritionally poor and typically hold applied materials in the top layers of the bog. Bogs are flat and surrounded by ditches and dikes so that sheeting run-off is not a risk factor. However, during the nutrient application period, surface transport can present a risk for release of any excess nutrients if storm water exceeds the holding capacity of the ditches and associated water storage in the bog system. The management of flood releases that may contain nutrients is based on research-based management recommendations by the UMass Cranberry Station (UMass Extension) in cooperation with USDA Agricultural Research Service (ARS).

The goal of nutrient planning for cranberries is to ensure healthy plants, good harvests, and the protection of environmental water resources (surface and ground). This plan has been developed with guidance and recommendations provided by the 2015 Cranberry Chart Book Management Guide for Massachusetts, published by the University of Massachusetts Cranberry Station, Massachusetts Experiment Station and University of Massachusetts Extension, USDA Cooperating (hereafter referred to as the Chart Book).

How nutrient rates (needs) will be determined.

*Selection of nutrients and rates:*

The UMass Cranberry Station provides MA growers with annually-updated nutrient management recommendations in the Chart Book. The recommendations for base application rates were developed from research determining crop removal rates and response to applied nutrients in field trials. The recommendations include guidance on how to use information from crop removal, tissue testing, and other factors in determining a base application rate for different varieties (cultivars) of cranberries.

The cranberry plant has evolved in sandy, acidic and nutrient poor soils. While they may require less nutrients than other crops, those requirements must be met for optimum growth and to achieve yield potentials. Yield potential is dependent upon the cultivar, condition of the plants as they come through the winter (including nutrient content at the end of the previous season - tissue test), weather, management activities such as rotational sanding and flooding, and any events that might limit production such as insect infestations or frost damage.

This plan is based on base N-rate and P-rate recommendations provided in the Chart Book and consideration of the factors listed above along with experience with previous responses of each management unit to fertilizer additions. Since some factors occur during the nutrient application season, the plan must be flexible and adjusted for change as conditions warrant. As recommended, this plan is based primarily on nitrogen (N). Phosphorus (P) considerations are also included.

For each management unit (as defined below), N rate will be selected based on cultivar and yield potential and using the table in the Chart Book. Adjustments of the selected base N rate will be made as follows:

* Increase or decrease if tissue N is outside the norm.
* Increase if uprights are stunted or pale or if stand is thin; decrease if density or length is excessive.
* Decrease if yield potential has been negatively impacted (pests, frost damage, etc.), heavy sand application.
* Decrease and eliminate early season applications if late water is held or if previous experience indicates that early season applications are not needed or detrimental.

Soil testing for P in MA cranberry soils is confounded by high iron and low pH making plant availability difficult to determine. Therefore, P recommendation rates provided in the Chart Book are based on plant use and tissue tests. Fertilizer formulations will be selected to provide P applications that fall within the rates recommended in the Chart Book, taking the tissue test P into consideration as recommended.

Potassium (K) will be applied in the fertilizer materials used to deliver N and P. Formulations will be chosen to provide the amounts recommended in the Chart Book. In most cases, K will be applied in amounts similar to N as both are removed by the crop in approximately equal amounts. K supplements will be applied if tissue tests fall below the normal range. Other nutrients will be applied as supplements if warranted by tissue test results.

*Soil and tissue tests:*

According to the Chart Book - Soil tests are not used to determine the base rate of fertilizer applied to cranberry bogs but they are used to monitor the organic matter and pH of the soils which effects how phosphorus mobilizes in the root zone or in flood water. Soil tests can be taken in the spring or summer and are recommended every 3-5 years. Tissue tests for mineral content should be done every 1-4 years depending on previous results and more frequently if the fertilizer management plan changes. Tissue testing must be done between mid-August and mid-September in order to provide a correct assessment. Interpretation guides are found in the Chart Book.

For this management plan and per UMass recommendations for cranberry, tissue tests will be used (with the other factors listed above) to adjust base rates for nutrient application. Soil tests will be taken every 5 years for monitoring organic matter and pH unless there is a concern regarding soil pH. Tissue tests will be taken every [**3 or 4 - chose one**] year unless there is need to diagnose a deficiency. Beds (management units) will be alternated so that in any year 1/5 will have soil tested and [**1/3 or 1/4 to match choice above**] will have tissue tested.

*Timing and source of nutrient applications:*

Timing of N applications will be based on plant growth stage and soil temperature. Fertilizers will not be applied to the soil until soil temperature exceeds 55° F. As per the Chart Book, N is required as the plants begin to produce new growth and during fruit production and bud set. Fertilizers will be applied soon after bud break to supply N to support new growth and again at 75% bloom (early fruit set) to support the production of the berries and the bud for the following year. [**if you use a different timing among those discussed in the chart book, edit this section accordingly - this one is based on our practice at State Bog**] For each of these applications, a fertilizer containing N, P, and K will be chosen as described above.

Fertilizers will be chosen that have N entirely or primarily in the ammonium form. Potassium in the form of potassium chloride will not be used. Additional N (urea) will be applied after fruit set if there is a larger than expected crop and/or if loss of leaf green color is observed. Fall fertilizer will not be used. [**Again, modify as you wish to reflect your practices and include a reason why you chose to do these practices.**]

*Method of application:*

All granular materials will be applied using a whirly-gig style strap-on spreader. Any supplemental nutrients, including urea will be applied via chemigation. [**Again, modify as you wish to reflect your practices and include a reason why you chose to do these practices.**]

*Other considerations:*

* The cranberry plants will be observed during the season - color, density, length, fruit set (yield potential).
* Irrigation will be managed so that the plants have adequate water in the root zone while avoiding soil saturation.
* The level of water in ditches will be reduced as much as possible prior to application of fertilizer.
* Water discharge from the bog beds during seasonal fertilizer applications will be limited as much as is feasible (while avoiding oversaturation or flooding of the beds).
* P will not be applied when the soil is saturated.
* Harvest and winter floods will be managed according to UMass Extension recommendations to minimize mobilization and discharge of P.

Specific planning by management unit [**this section was written for State Bog, use as a model to edit for your plan**]

State Bog has multiple cultivars. Section A1 is planted predominantly in Early Black and Howes. Section A2 has 8 cultivars in a replicated design, including Rutgers materials. Sections A3, 4, and 5 are Stevens. We manage A1 separately, since it has native cultivars. We manage A2 with the Stevens sections since most of its area is planted in hybrids. Section A1 can be chemigated separately. In this plan, since we have no current tissue test, nutrient rates are based on cultivar and expected yields (using the Chart Book tables). When 2016 tissue tests are taken, rates for 2017 will be adjusted if needed.

For all sections:

Granular 10-12-24, partial slow release will be applied soon after bud break to support early plant growth. Granular 18-8-18 will be applied at 75% bloom to support fruit development and bud set for the following year. Rates and actual date of application will vary by unit, based on cultivar (rate) and observation (application date).

*Section A1 - Base N rate is 30 lb/acre; 2.6 acres* [**there will be an excel-based calculator**]

1) 10-12-24 after bud break on the Howes cultivar

100 lb/acre material

pounds per acre N = 10 P = 5.3 K = 19.9

total pounds N = 26 P = 13.8 K = 51.7

2) 18-8-18 at 75% bloom on Howes cultivar

110 lb/acre material

pounds per acre N = 19.9 P = 3.9 K = 16.4

total pounds N = 51.7 P = 10.1 K = 42.7

*Total to be applied to the section:*

total pounds N = 77.7 P = 23.9 K = 94.4

total pound/acre N = 29.9 P = 9.2 K = 36.3

*Sections A2-5 - Base N rate is 35 lb/acre; 8.4 acres*

1) 10-12-24 after bud break on the Stevens cultivar

100 lb/acre material

pounds per acre N = 10 P = 5.3 K = 19.9

total pounds N = 84 P = 44.5 K = 167.2

2) 18-8-18 at 75% bloom on Stevens cultivar

140 lb/acre material

pounds per acre N = 25.2 P = 4.9 K = 20.9

total pounds N = 211.7 P = 41.2 K = 175.6

*Total to be applied to the sections:*

total pounds N = 295.7 P = 85.7 K = 342.8

total pound/acre N = 35.2 P = 10.2 K = 40.8

Total to be applied to the property (all sections):

total pounds N = 373.4 P = 109.5 K = 437.2

total pound/acre N = 33.9 P = 10.0 K = 39.7

*Plan implementation and record keeping* [**see example record spreadsheet**]

* The planned (recommended) nutrients above will be considered 'work-orders' and recorded as "planned". As the applications occur - the actual amounts, materials (sources), method of application, and dates will be recorded as "applied" using an excel spreadsheet.
* In early June, observations of plant growth - color, length, density - will be recorded with notes regarding any need to modify application plans.
* Crop yield records will be kept.
* Records of sand applications, late water, and pest infestations will be maintained.
* Soil and tissue for the management units will be collected and sent for analysis in August 2016. The next planned soil testing will be in 2021. The next planned tissue testing will be in 2019 unless deficiencies are observed or seen in the 2016 tests. Results will be kept with the application records. Notes will be appended if results warrant changes to the Plan. [**this is for the State Bog example where we do not need to do 1/3 or 1/4 per year - small farm**]
* The plan will be reviewed annually and modified as needed. The plan will be updated in 2018 (every 3 years).