

# **Exploratory Analysis of Landowner Application Characteristics and Reverse Auctions in the Market Based Conservation Initiative**

By

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## **Abstract**

New conservation programs are evolving to meet a growing need for the most efficient use of funds while satisfying the needs of the participating landowner and the organization funding the program. The Market Based Conservation Initiative is an eastern North Carolina pilot conservation program using a reverse auction process to meet the needs of the military and voluntary landowners. Regression models are used to explore whether characteristics listed in the landowner applications have a significant effect on the annual contract bid amount per acre and preferred contract length chosen by the landowner in the first bid round. Various statistical methods are used in this study to explore the difference in selected annual contract bid amount per acre and contract length between Phase 1: Bid Round 1 and Bid Round 2. This information can be used to shape future conservation programs or to target viable landowners for existing programs. Further exploration should delve into analyzing the effect of each significant landowner application characteristic on the response variables- annual contract bid amount per acre and contract length. Focus should also be placed on collecting more landowner data and holding subsequent bid rounds if possible to provide additional insight.

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## *I. Introduction*

### **Alternative Approach to Conservation:**

In 2017, the federal budget for the United States included \$6.7 billion of funds for farm bill conservation programs such as the Conservation Reserve Program, Conservation Stewardship Program, Environmental Quality Incentives Program, and Agricultural Conservation Easement Program (United States Department of Agriculture, n.d.). These voluntary conservation programs seek to enhance conservation using financial incentives, and they are just a few examples of the conservation programs available in North Carolina. In order for conservation program funds to be utilized efficiently, alternative methods such as market-based approaches for structuring conservation programs should be considered. The Conservation Reserve Program in particular uses a reverse auction system where landowners request their desired payment for installing an established conservation practice or practices, although they do have a bid cap based on their property's characteristics, and their applications are then ranked before being considered for program participation (Hellerstein, D., Higgins, N., & Roberts, M. J., 2015).

### **Reverse Auction:**

A reverse auction is an auction where the roles of an auction have been switched, such that there is one buyer and there are multiple sellers (Hellerstein, D., Higgins, N., & Roberts, M. J., 2015). The sellers submit their bids for consideration to the buyer. The bids can either be sealed or there can be information released in subsequent bid rounds summarizing the selected bids. Some reverse auction systems have a bid cap, or a maximum bid amount, that can be requested. The agreement or contract term lengths can be open-ended, or they can have set term

lengths to select from. Conservation programs can use a reverse auction system when there is no established market price for the service being provided (Hellerstein, D., Higgins, N., & Roberts, M. J., 2015). This is extremely valuable when trying to expand conservation efforts to include specific services that have not previously been included in existing programs, and thus have no set market value. In addition, the reverse auction system allows for the collection of additional data from potential applicants, which can help establish key information about potential program applicants and their expectations.

### **Market Based Conservation Initiative:**

The Market Based Conservation Initiative (MBCI) is a pilot project based on ensuring military readiness by protecting family farms and forests. It is approximated that 90% of the land in eastern North Carolina, and thus the project area, is owned by private landowners (NC Association of Soil and Water Conservation Districts et. al., 2015). The program is designed to protect a military training flight path above 17 counties in eastern North Carolina by engaging private landowners in conservation contracts. Participating landowners agree not to develop their property in certain ways while still maintaining their conservation efforts and keeping the land in forestry and agriculture. The program is designed such that the restrictions are tied to the property deed for the duration of the contract, but the landowner is able to continue living on the property (if applicable) and continuing most activities unimpeded, including farming and forest management. The full list of property restrictions for the program is itemized below, as taken directly from the Market Based Conservation Initiative Final Report (NC Association of Soil and Water Conservation Districts et. al., 2015).

1. Maintain the tax parcel's enrollment into the Present Use Valuation or Wildlife Conservation Tax Programs (deferred tax program based on agriculture, forestry or wildlife habitat land usage)
2. Maintain an active land use management plan identifying techniques for improving natural resource management
3. Build no new structures greater than 100 feet above ground level
4. Project no lighting above the horizontal plane
5. Build no landfills requiring a permit or license by a state or local government entity
6. Build no multi-residential or commercial facilities not directly associated with the agricultural operations of the property.

The program area itself is broken up into 3 geographical phases- Phase 1, Phase 2, and Phase 3- and the bidding rounds were processed in that order (see Figure 1). Phase 1 includes counties with a robust agricultural community and development pressures from urban sprawl due to nearby cities such as Raleigh (NC Association of Soil and Water Conservation Districts et. al., 2015). Phase 2 is made up of counties with a large military presence, development pressures due to coastal tourism, and includes large expanses of timber (NC Association of Soil and Water Conservation Districts et. al., 2015). Phase 3 is comprised of counties that have both agricultural and forestry land, and is also subject to development pressure from urban sprawl due to nearby cities like Raleigh (NC Association of Soil and Water Conservation Districts et. al., 2015). Separating the bid rounds into these three geographical phases was intended to serve as a way to collect data in a manner that allowed for analysis to see if the predominant land use and other regional factors had a significant impact on the landowners' contract selections (NC Association of Soil and Water Conservation Districts et. al., 2015). Multiple information sessions were held in each Phase and applications were filed with the assistance of the local Soil and Water Conservation Districts.

Figure 1 – MBCI Phases Map

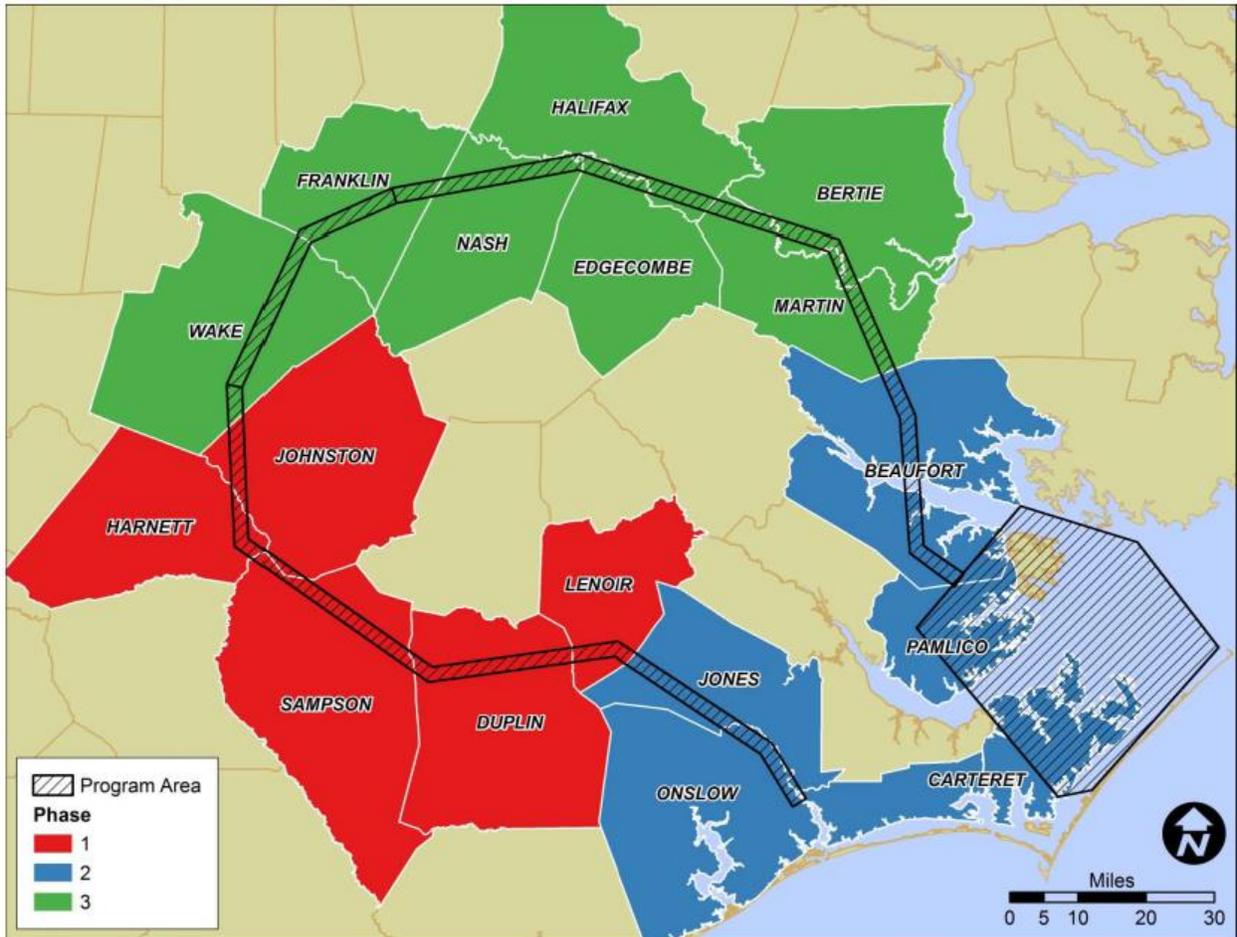


Figure 1: MBCI Phases Map. (NC Association of Soil and Water Conservation Districts et. al., 2015)

MBCI uses a reverse auction system to help allot the contract payment amounts and establish the contract terms for the pilot conservation program. The market price and expected tenure of the exact services being provided by the landowner is unknown, and thus the landowner is asked to select the annual contract bid amount per acre and the contract length they prefer. Annual contract bid amount per acre is an open-ended amount based on landowner preference. Landowners could choose to submit a bid for with a contract length of 10, 20, or 30 years. Landowners who owned parcel(s) under the flight path with a minimum amount of the following land use types enrolled in the Present Use Value program were eligible: 10+ acres in

agriculture and 20+ acres in forestry. No maximum acreages were established for this program. Specifically, the eligible parcel had to be both located under the two-mile wide military training route (MTR) or under the special use airspace (SUA), both of which are outlined in black in Figure 1, and also enrolled in the Present Use Value Program with at least the minimum acreage requirements (NC Association of Soil and Water Conservation Districts et. al., 2015). If only part of a parcel was located under the MTR, then only the acreage under the MTR was considered for payment (NC Association of Soil and Water Conservation Districts et. al., 2015). Landowners had to submit a separate application for each eligible parcel they chose to apply for the program with.

In order to participate, landowners submitted their applications during Bid Round 1 in their Phase, with the assistance of their local Soil and Water Conservation District in order to verify application details such as acreage under the flight path for each parcel the landowner chose to apply for (NC Association of Soil and Water Conservation Districts et. al., 2015). Each landowner application was scored based on information provided in the application using a ranking form and selections were made by the military on which contracts to fund. A copy of the blank application and ranking form are listed in Appendix B and Appendix C respectively. Although there was a robust ranking process compiled and applied specifically for this pilot program, it does seem that the military made their selections primarily based on contract bid amount (NC Association of Soil and Water Conservation Districts et. al., 2015). MBCI's original budget included \$6 million to be encumbered over 3 years, and thus three rounds of bidding at \$2 million per round (NC Association of Soil and Water Conservation Districts et. al., 2015). The original goal was to allocate contracts to conserve between 10,000 to 20,000 total acres over the life of the program (NC Association of Soil and Water Conservation

Districts et. al., 2015). Due to complications, only Phase 1 was able to have a second Bid Round. Information on the annual contract amounts per acre and contract lengths of selected contracts that were solicited for contracts from Phase 1: Bid Round 1 was released prior to Bid Round 2. A total of 14 applications were approved in Phase 1: Bid Round 1 with a combined request of \$390,496 and a total of 901 acres. The selected applications had the following combinations of contract amounts per acre and contract lengths:

- \$10 an acre for 20 years = 4 applications
- \$18 an acre for 10 years = 4 applications
- \$20 an acre for 20 years = 1 application
- \$25 an acre for 20 years = 2 applications
- \$25 an acre for 30 years = 3 applications

### **Questions for Exploratory Analysis:**

This study is an exploratory analysis of how the landowner application characteristics may affect annual contract bid amount per acre and contract length in Phases 1-3: Bid Round 1 based on regression modeling techniques. This analysis could be useful for future program creation and in understanding which types of landowners to target for a similar program. This study is also used to explore whether or not the release of the Bid Round 1 data has a significant effect on the annual contract bid amount per acre and contract length requested in Bid Round 2 due to the reverse auction system. In addition, a general data review is used to provide insight into landowner characteristics, which is valuable for future conservation work by agencies such as local Soil and Water Conservation Districts.

## II. Methods

The data from the pilot program applications was compiled and personal identifying information removed before being analyzed using JMP statistical software. A list of the available bid characteristics is shown below (see Table 1) and a full summary of the collected data is given in the Results section.

Application Characteristic:	Response Options:
Phase	1, 2, 3
Acreage under the Flight Path	Continuous
Bid Type	One landowner with multiple parcels (Bid Type M), One landowner with a single parcel (Bid Type S), Group of landowners (Bid Type G)
Contract Bid Amount Requested (Per Acre and Per Year)	Continuous
Contract Length Requested	10, 20, 30
Land Ownership Type	Individual, Joint/Partnership/Family, Estate/Trust, Corporation (including LLC)
Present Use Value	Yes, No
Voluntary Agricultural District Member	Yes, No
Enhanced Voluntary Agricultural District Member	Yes, No
Conservation Management Plan	Yes, No
Forest Management Plan	Yes, No
Wildlife Management Plan	Yes, No
Enrolled in Other Programs	Yes, No
Any Portion of Land under MTR above 100 Year Floodplain	Yes, No
Environmentally Important Land ( <i>wetland, presence of threatened or endangered plant or animal species, etc.</i> )	Yes, No
Adjacent to Protected Lands ( <i>adjacent to State or Federal protected land or land already enrolled in the MBCI program</i> )	Yes, No

Table 1: Bid Application Characteristics.

### **Phases 1-3: All Bid Round 1 Data**

The ordinary least squares regression model is used to estimate the significance of certain recorded landowner application characteristics on the annual contract bid amount per acre requested by the study participant. This model seemed like the best fit given a continuous dependent variable (contract bid amount) and various independent variables that were categorical. Independent variables were selected based on multiple parameters. Phase was selected in order to test whether predominant land use (which define Phase) would have a significant effect on contract bid amount. Bid Type was selected in order to test whether multiple parcels or groups of landowners working together could significantly impact contract bid amount. For bid type, it was assumed that it was a given and not a choice as it is treated in the analysis. Voluntary Agricultural District Member and Enrolled in Other Conservation Programs were also chosen because it was hypothesized that involvement and awareness of other conservation programs could significantly affect contract bid amount.

The ordinal logistic regression model is used to estimate the significance of certain recorded landowner application characteristics on the contract length selected by the study participant. This model appeared to be the best fit given an ordinal dependent variable (contract length) and various independent variables that were either categorical or continuous. Independent variables were selected based on multiple parameters. Phase was selected in order to test whether predominant land use (which define Phase) would have a significant effect on contract length. Bid Type was selected to test whether multiple parcels or groups of landowners working together could significantly impact contract length. For bid type, it was assumed that it was a given and not a choice as it is treated in the analysis. Conservation Management Plans was chosen because it was hypothesized that long-term conservation planning may significantly

affect contract length. In addition, Acreage under Flight Path was selected because it was hypothesized that the amount of acreage to be enrolled in the program may significantly impact contract length.

### **Phase 1: Comparison of Bid Rounds 1 and 2**

Various statistical tests were used in order to see if there is a significant difference between the annual contract bid amounts per acre and contract lengths requested in Phase 1: Bid Round 1 and Phase 1: Bid Round 2. Data on the annual contract amount per acre and contract length was released on the selected bids from Round 1 before applications were accepted for Round 2. The paired t-test is used to determine if there is a significant difference between the means of the selected annual contract bid amount per acre in Bid Rounds 1 and 2 in Phase 1. The contingency analysis is utilized to produce two Chi-square statistical tests to determine if the contract length in Bid Rounds 1 and 2 in Phase 1 are independent. Using the Degrees of Freedom and Chi Square values calculated in the contingency analysis one can test the null hypothesis that the contract length in both Bid Rounds are the same; if the Chi Square value is higher than the critical value listed in the Chi-Square distribution table, one can reject the null hypothesis, and thus they are not independent. This bid round data is paired for analysis by using the Parcel Identification Number of each application to match the annual contract bid amount per acre and contract length selected in each round.

### *III. Results*

#### **Phases 1-3: All Bid Round 1 Data Review**

One should note some key points about the bid characteristics that are being analyzed. Phase was defined by the MBCI program using the predominant land uses in the region, then assigned to each application based on the associated parcel location. Acreage under the flight path was determined with the assistance of local Soil and Water Conservation District staff and web-based parcel information. Bid Type was based on three categories: single landowner with an individual parcel, single landowner with multiple parcels, and a group of landowners. Contract bid amount requested per acre, per year was open-ended and based on landowner preference. The MBCI program established contract length options and landowners selected their preference.

Landowners also indicated their land ownership types; originally an open-ended question, the results were compiled into the four categories seen in Table 1. The landowner verified present Use Value tax deferral enrollment, Voluntary Agricultural District Membership, Enhanced Voluntary Agricultural District Membership, Conservation Management Plan, Forest Management Plan, Wildlife Management Plan, and Enrolled in Other Programs characteristics with the assistance of local Soil and Water Conservation District staff. Any Portion of Land under MTR above 100 Year Floodplain, Environmentally Important Land, and Adjacent to Protected Lands were verified during the ranking process.

Out of the 900 applications for Phases 1-3: Bid Round 1 that were analyzed in this study, the following total acreages were submitted with the applications: Phase 1 had 15,735.3 acres; Phase 2 had 10,876 acres; and Phase 3 had 37,208.8 acres. Due to the nature of the application bid types and the fact that the data had personal identifying information removed, the exact

number of landowners who applied for MBCI is not available for this study. The majority of the applications were submitted from Phase 1 (43%) and Phase 3 (44%). The majority of those bid applications were also submitted by a single landowner with multiple parcels (60%), although there were some applications submitted by a group of landowners (26%) or a single landowner applying for a single parcel (14%). While the majority of applicants listed land ownership as an individual (74%), there were some other ownership types indicated: partnership/family (15%), corporation (10%), estate/trust (1%). The average acreage owned under the flight path per application (and thus per parcel) was 70.9 acres. The contract length requested was nearly even across the 10-year (31%), 20-year (34%), and 30-year (34%) contract options, although there was a slight trend towards 20-year and 30-year contracts. The annual contract amount per acre requested had an average bid amount of \$113 per acre per year across all Phases in Bid Round 1.

Present Use Value is a tax deferral program for certain land uses such as forestry and agriculture that has been available across North Carolina since 1973 due to N.C.G.S.105-277.4 (NC Department of Agriculture & Consumer Services, n.d.). Conservation management plans are custom guides created by local Soil and Water Conservation Districts or the Natural Resources Conservation Service to help manage agricultural land for the best conservation outcomes based on landowner and/or producer goals. Similarly, the North Carolina Forest Service can produce a forest management plan or the North Carolina Wildlife Resources Commission can assist with a wildlife management plan. Although 87% of landowners were listed as being enrolled in the Present Use Value tax deferral program for agriculture and forestry, only 36% of applicants indicated that they had a conservation management plan. Also,

only 38% indicated that they had a forest management plan and only 2% listed that they had a wildlife management plan.

Out of the 17 counties participating in MBCI there are 15 counties with a Voluntary Agricultural District program (Onslow, Jones, Lenoir, Duplin, Sampson, Wake, Johnston, Harnett, Franklin, Nash, Halifax, Edgecombe, Beaufort, Bertie, Pamlico) and 5 counties with an Enhanced Voluntary Agricultural District program (Pamlico, Halifax, Nash, Franklin, Edgecombe) (NC Department of Agriculture & Consumer Services, n.d.). Yet only 14% indicated that they were involved in the Voluntary Agricultural District program and only 2% were members of an Enhanced Voluntary Agricultural District. One should note that only 22% were enrolled in other conservation programs, which includes a plethora of state and federal incentive based and cost-share programs. 85% of the applications indicated that some portion of the associated parcels was above the 100-year floodplain and 59% of the applications indicated that the associated property was considered Environmentally Important Land. It can also be noted that only 4% of the applications listed that the associated parcels were adjacent to protected lands. Appendix D includes all of the compiled summary data on the landowner application characteristics.

### **Phases 1-3: All Bid Round 1 Data – Preferred Contract Bid Amount Analysis**

The ordinary least squares regression analysis provided the following regression equation:  $Y = 150.59 + 90.34x_1 - 16.48x_2 + 56.15x_3 - 45.98x_4 + 25.74x_5 + 14.06x_6$  as outlined in Table 2 below. The ordinary least squares regression model where the response variable is Contract Bid Amount shows a p-value of less than .05 for Phase, Bid Type, Voluntary Agricultural District Member, and Enrolled in Other Conservation Programs (Table 2). Thus in the ordinary least squares regression model for Contract Bid Amount it is shown that Phase, Bid

Type, Voluntary Agricultural District Member, and Enrolled in Other Conservation Programs are significant variables. When moving from Phase 3 (agriculture, timber, and development pressure from Raleigh) to Phase 1 (agricultural), there is a positive relationship to contract amount and thus contract amount increases. When moving from Bid Type S to Bid Type G, there is a positive relationship and thus contract amount increases. When moving from Bid Type S to Bid Type M, there is a negative relationship and thus contract amount decreases. When moving from not being a Voluntary Agricultural District Member to being a VAD member, there is a positive relationship and thus contract amount increases. When moving from not being Enrolled in Other Conservation Programs to being Enrolled in Other Conservation Programs, there is a positive relationship and thus contract amount increases.

Variable	Coefficient	Standard Error	P-Value
Phase 1*	<b>90.3433</b>	<b>7.1503</b>	<b>&lt;.0001</b>
Phase 2*	<b>-16.4806</b>	<b>9.2653</b>	<b>0.0756</b>
Bid Type G**	<b>56.1472</b>	<b>7.5314</b>	<b>&lt;.0001</b>
Bid Type M**	<b>-45.9831</b>	<b>6.4131</b>	<b>&lt;.0001</b>
Voluntary Agricultural District Member (1)***	<b>25.7420</b>	<b>6.6791</b>	<b>0.0001</b>
Enrolled in Other Conservation Programs (1)****	<b>14.0640</b>	<b>5.7254</b>	<b>0.0142</b>

Table 2: Estimated coefficients, standard errors, and p-values of an ordinary least squares regression model predicting contract bid amount using selected landowner application characteristics.

Regression Equation:  $Y = 150.59 + 90.34x_1 - 16.48x_2 + 56.15x_3 - 45.98x_4 + 25.74x_5 + 14.06x_6$   
 $R^2 = .296$

\*Phase default= Phase 3

\*\*Bid Type default= Bid Type S

\*\*\*Voluntary Agricultural District Member where 1=yes and 2=no

\*\*\*\*Enrolled in Other Conservation Programs where 1=yes and 2=no

### Phases 1-3: All Bid Round 1 Data – Requested Contract Length Analysis

The ordinal logistic regression model where the response variable is Contract Length shows a p-value of less than .05 for Phase, Conservation Management Plan, Bid Type, and

Acreage under Flight Path. Thus in the Ordinal Logistic regression model for Contract Length it is shown that Phase, Conservation Management Plan, Bid Type, and Acreage under Flight Path are significant variables. When moving from Phase 3 (agriculture, timber, and development pressure from Raleigh) to Phase 1 (agricultural), there is a negative relationship to contract length and thus contract length decreases. When moving from Phase 3 (agriculture, timber, and development pressure from Raleigh) to Phase 2 (timber and coastal), there is a positive relationship and thus contract length increases. When moving from not having a conservation plan to having a conservation plan, there is a positive relationship and thus contract length increases. When moving from Bid Type S to Bid Type G, there is a negative relationship and thus contract length decreases. When moving from Bid Type S to Bid Type M, there is a positive relationship and thus contract length increases. There is a negative relationship between contract length and Acreage under Flight Path, thus contract length decreases as acreage under the flight path increases. See Table 3 below for more details.

Variable	Coefficient	Standard Error	Prob>ChiSquare
Phase 1*	<b>-0.5038</b>	<b>0.0945</b>	<b>&lt;0.0001</b>
Phase 2*	<b>0.4814</b>	<b>0.1260</b>	<b>0.0001</b>
Conservation Management Plan (1)**	<b>0.2993</b>	<b>0.0668</b>	<b>&lt;0.0001</b>
Bid Type G***	<b>-0.3706</b>	<b>0.1041</b>	<b>0.0004</b>
Bid Type M***	<b>0.1807</b>	<b>0.0881</b>	<b>0.0402</b>
MTR Acreage	<b>-0.0017</b>	<b>0.0006</b>	<b>0.0026</b>

Table 3: Estimated coefficients, standard errors, and ChiSquare values of an ordinal logistic regression model predicting contract length using selected landowner characteristics.

\*Phase default= Phase 3

\*\*Conservation Management Plan where 1=yes and 2=no

\*\*\*Bid Type default= Bid Type S

## Phase 1: Comparison of Bid Rounds 1 and 2

As expected from a reverse auction system, the statistical analysis of the annual contract bid amount per acre data from Phase 1: Bid Round 1 and Bid Round 2- specifically the 177 matched rebid applications- illustrates that after releasing information on the selected bids from Round 1, the annual contract bid amounts per acre in Round 2 changed (Figure 2). The mean is lower, going from \$129.60 per acre per year in Round 1 to \$26.71 per acre per year in Round 2. The contract amount requested in Round 2 was closer to the annual contract bid amounts per acre that were selected in Round 1- which trended towards \$20 per acre per year (NC Association of Soil and Water Conservation Districts et. al., 2015). The standard deviation also decreased, going from 141.3 in Round 1 to 6.77 in Round 2.

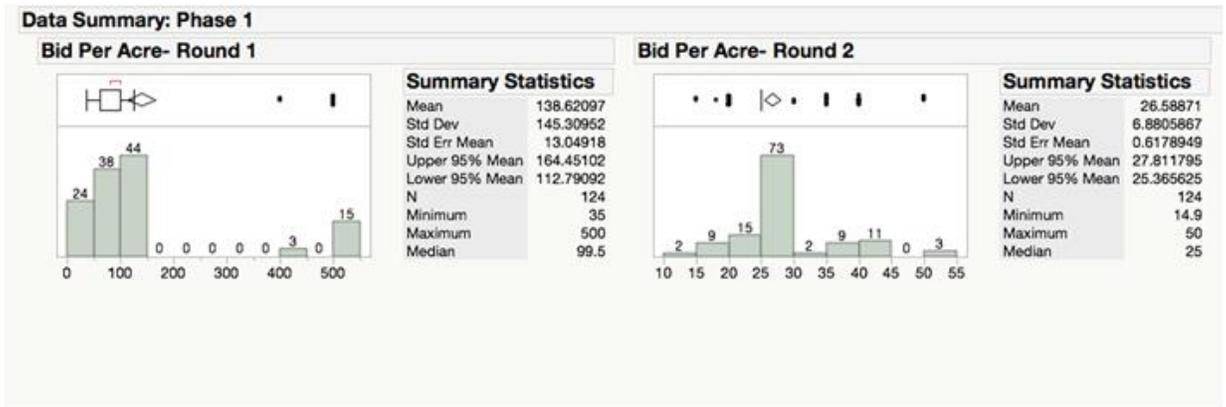


Figure 2: Statistical Analysis of Contract Bid Amount Per Acre for Phase 1: Bid Round 1 and Bid Round 2.

The statistical analysis of the contract length data from Phase 1: Bid Round 1 and Bid Round 2 illustrates a shift in contract length as well (Figure 3). Out of the 177 matched rebids in Phase 1: Bid Round 1, the applications were primarily 30-year contracts (44%), followed by 20-year contracts (29%) and 10-year contracts (27%). In Phase 1: Bid Round 2, the applications were primarily 20-year contracts (47%), followed by 10-year contracts (30%) and 30-year

contracts (23%). It appears that with a reduction in expected contract payments, there is an associated shift away from long-term contracts and towards short-term contracts.

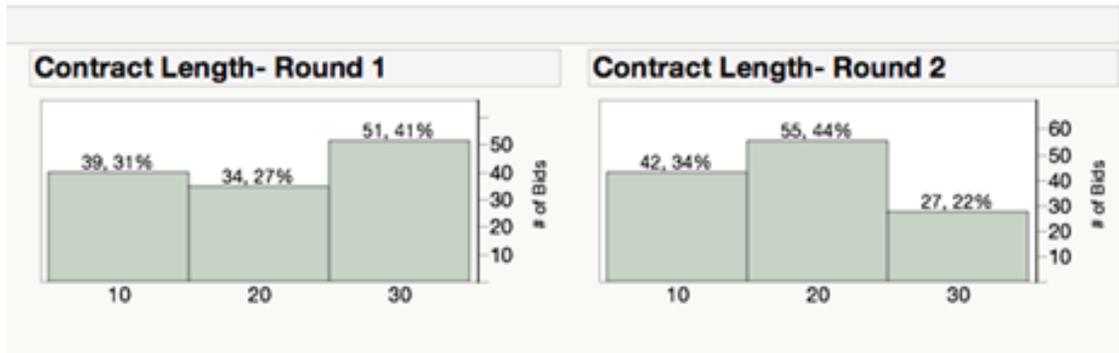


Figure 3: Statistical Summary of Contract Length for Phase 1: Bid Round 1 and Bid Round 2.

The paired t-test comparing the 177 matched rebids from Phase 1: Bid Round 1 and Bid Round 2 data produced a mean difference of -102.89 and a probability > absolute value of t at <.0001. The paired t-test results indicate that we can reject the null hypothesis that there is no change between Bid Round 1 and Bid Round 2. There is a significant difference between the means of Contract Bid Amount requested in Bid Rounds 1 and 2.

The contingency analysis produced a Likelihood Ratio test and a Pearson test where Chi Square is 124.032 and 119.208 respectively, with 4 degrees of Freedom. The Prob>ChiSq was a value of >.0001 for both tests. The Chi-square Likelihood Test and the Pearson test show that the contract lengths chosen in Bid Rounds 1 and 2 are significantly different. During the interim period between Bid Rounds 1 and 2, information was released to landowners on the selected contract lengths and annual contract bid amounts per acre from Round 1, and that could account for the results.

#### *IV. Discussion*

##### **Phases 1-3: All Bid Round 1 Data**

This study has shown that the landowner application characteristic data from the reverse auction bidding process in Phases 1-3: Bid Round 1 can be used to model annual contract bid amount per acre and contract length in order to show the statistically significant application characteristics. This information can be used to shape future program ranking characteristics and better understand potential program applicants as well. However, further in-depth study needs to be done in order to identify the exact effects of each characteristic on the chosen annual contract bid amount per acre and contract length. Further research would also benefit from additional landowner data, such as age, income, and education level to gauge their effect on the bid applications.

The ordinary least squares regression illustrates multiple factors that could be researched further. The relationship between phase and contract amount is not conclusive enough to assume that predominant land uses in each phase affects contract length across the landscape. The significant effect of Bid Type on contract length suggests that individual landowners with multiple parcels submit the lowest contract amounts, followed by individual landowners with a single parcel, and then groups of landowners with higher contract amounts. This may be attributed to landowners with multiple parcels being willing to accept a lower contract bid amount due to overall higher income with multiple parcels, and groups of landowners feeling more confident when working together. Being involved in a Voluntary Agricultural District or Enrolled in Other Conservation Programs increases the contract amount requested, potentially due to more confidence in their applications being selected due to extra points or valuing their land more.

The ordinal logistic regression indicates several factors that could be further explored. The relationship between Phase and contract length suggests that geographic factors such as land use types may be affecting the contract length requested, or there may be other factors affecting the change. In this case, Phase 1 would have the lowest contract length, followed by Phase 3, and Phase 2 would have higher contract lengths. This may be due to longer term planning related to forest management. The relationship between bid type and contract length suggests that individual landowners with multiple parcels prefer longer-term contracts while group landowner applications prefer shorter-term contracts; single landowners with individual parcels are in the middle. The significant effect of the Conservation Management Plan variable could indicate that long-term planning for the environmental management of a property, and potentially awareness of other conservation programs and services, positively affects the amount of time requested by the landowner to participate in this pilot program. The emergence of Acreage under Flight Path as a significant variable with a negative relationship to contract length illustrates that landowners who have larger acreages eligible for the program are less likely to prefer longer contract lengths, potentially due to future opportunity costs. Further analysis would be needed to thoroughly examine these relationships and the effect of each significant characteristic on contract length requested.

### **Phase 1: Comparison of Bid Rounds 1 and 2**

This exploratory study has also shown that the annual contract bid amount per acre and preferred contract length changed after the release of Bid Round 1 data, and that it was a statistically significant change. The simultaneous shift from longer-term contracts to shorter-term contracts, along with the reduction in requested annual contract amounts per acre, would

indicate that landowners are willing to accept a lower payment for the conservation services they are providing, but they are less willing to commit to a longer-term contract in those cases.

One could interpret this to indicate that the reverse auction system worked as intended, and worked towards establishing a market price for the services provided along with moving towards establishing the preferred associated contract lengths. Further bid round data in the future could be used to create a more thorough analysis of the difference between initial and subsequent chosen contract length and annual contract bid amount per acre.

### **Local Soil and Water Conservation Districts**

One thing to consider is the connection between the local Soil and Water Conservation Districts- the agencies hosting the information workshops and assisting with application intake for MBCI- and the application characteristics that were found to be significant. For contract bid amount, the significant characteristics were Phase, Bid Type, Voluntary Agricultural District Member, and Enrolled in Other Conservation Programs. The significance of the effect of Phase may end up being attributed to geographical differences and that of Bid Type may end up being attributed to owning more land parcels or the effects of working in a group to submit an application. More research would need to be done in order to establish those effects, so we can focus on the remaining characteristics: Voluntary Agricultural District Member and Enrolled in Other Conservation Programs.

Voluntary Agricultural Districts are programs intended to highlight the continued presence of agriculture or forestry in a given area. Generally, there are no fees to become a member, no financial incentives involved, and it is administered by the local Soil and Water Conservation District. It is usually marketed as a program that is used to promote pride in their

continued land use and to ensure the general public is aware of their intention to continue with that land use for the foreseeable future. Voluntary Agricultural Districts are defined in N.C.G.S. 106-737 and require the following: that the

“Farm [be] participating in the farm present-use-value taxation program (G.S. 105-277.2 – 105-277.7)...; Farm [be] managed in accordance with the Soil Conservation Service defined erosion control practices that are addressed to highly erodible land; [and] Farm is the subject of a conservation agreement, as defined in G.S. 121-35, between the county and the owner of such land that prohibits nonfarm use or development of such land for a period of at least 10 years, except for the creation of not more than three lots that meet applicable county zoning and subdivision regulations. By written notice to the county, the landowner may revoke this conservation agreement (if a VOLUNTARY Agricultural District). Such revocation shall result in the loss of qualifying farm status. Other eligibility requirements [may be] required by the individual county.”

Enhanced Voluntary Agricultural Districts (as defined in G.S. 106-737 & G.S. 106-743) build upon Voluntary Agricultural Districts and include the same requirements along with the following additional requirements:

[A] Conservation agreement as defined in G.S. 121-35, between the county and the landowner prohibits nonfarm use or development of such land for an irrevocable period of 10 years. [Along with an] Automatic renewal of conservation agreement for 3 years absent a written notice to the county revoking the conservation agreement as required by the ordinance.

The application characteristic labeled as “Enrolled in Other Conservation Programs” refers to other programs administered by several different agencies, including the conservation cost-share

programs administered or assisted by the local Soil and Water Conservation District. It should be noted that the two significant characteristics correlated with annual contract bid amount per acre that are based on landowner's decisions about conservation prior to MBCI, are also associated with the work done by local Soil and Water Conservation Districts. This connection suggests that local Soil and Water Conservation Districts have an impact on conservation and their farm and forestry landowners, and that more research into this connection could benefit future conservation program planning as local Soil and Water Conservation Districts are considered as partners or administrators.

This is further evidenced by the fact that one of the significant characteristics for contract bid length is "Conservation Management Plan." Conservation Management Plans are free plans created by agencies such as local Soil and Water Conservation Districts for landowners and producers to assist them with reaching their land management goals and either comply or go beyond regulatory standards in terms of conservation needs. This is reflected by the fact that one of the significant characteristic that affects contract bid length that is based on the landowner's conservation decisions prior to MBCI is also associated with work done by the local Soil and Water Conservation Districts. Two of the other significant characteristics, Phase and Bid Type, are discussed above and "Acreage Under the Flight Path" may be attributed to the landowners' amount of acreage impacting their assessment of how long they are willing to enroll in the program.

### **Shortcomings:**

There are several things to consider when extrapolating information from this analysis and using it to create future conservation programs. Some of the characteristics used in the

models may not be available in other regions or states (Voluntary Agricultural Districts and Enhanced Voluntary Agricultural Districts) and some of the landowners may not be aware of certain plans or programs available to them (Present Use Value, Voluntary Agricultural Districts, Enhanced Voluntary Agricultural Districts, Conservation Management Plans, Wildlife Management Plans, Forestry Management Plans, Other Conservation Programs). This would impact which characteristics were listed as part of each application and the associated ranking, and thus the potential impact on their selected annual contract bid amount per acre and contract bid length. Clearly, our applicant pool was also pulled from a specific geographical area (under the military training flight path in Eastern North Carolina) and there may be unknown impacts from that on which characteristics were significant. In essence, care should be taken before assuming that these characteristics would also be significant for a program in a different area with different services available. However, a reverse auction could still be created for a similar conservation program in order to determine the market price and gather information about program participants for a similar analysis.

One of the shortcomings of this data analysis stemmed from a lack of multiple bid rounds for each Phase. It was initially intended for each Phase to go through three bid rounds, with information about the selected bids to be released to potential program applications after each round. By the end of the three bid rounds, all three rounds of data from each Phase could have been analyzed for comparison and to see the changes in annual contract bid amount per acre and contract length over the multi-part reverse auction process. While we were able to analyze the bid application data from bid rounds 1 and 2 in Phase 1, more information from subsequent bid rounds and other Phases would have been more comprehensive. The information that we were able to gather and analyze can still be considered however when

creating future programs, and the value of multiple bid rounds should be accounted for when using a reverse auction system.

**Weaknesses:**

This exploratory analysis also has some weaknesses that should be considered. The characteristics included in the application did not include basic demographic questions such as age, income, and education level. This would have been valuable data to include and could have had a significant impact on their decision-making. There could also be hidden factors that were not revealed by studying the landowner application characteristics. For instance, if a landowner had a set income requirement, then they may not have been willing to change their annual contract bid amount per acre in Round 2 of Phase 1 even if they were aware that their contract bid amount was higher than the selected bids from Round 2. This analysis also can't account for future anticipated commitments, such as planning to have changes in land ownership due to inheritance and thus potentially being unwilling to commit to a longer contract term.

**Opportunities:**

This exploratory analysis offered a glimpse of North Carolina landowners and their current connections to conservation. Based on the low participation in certain conservation programs and services as evidenced by the statistics in the data review, it is clear that there is an opportunity to reach out to landowners and enhance their conservation opportunities. Even without funding from future conservation programs, other services are still available that can foster a relationship between the landowner and conservation agencies such that they are better

prepared to administer conservation programs when they arise. For instance, the data summary has made it clear that there is a large target audience of landowners for the local Soil and Water Conservation Districts to reach out to and assist with creating a conservation management plan that meets the needs of the individual landowners. Doing so could increase landowner awareness of the services and programs available for conservation work, and could help increase the amount of conservation work implemented.

They can also further advertise the Voluntary Agricultural District Program and the Enhanced Voluntary Agricultural District Program where available. In addition, local Soil and Water Conservation Districts could facilitate relationships between landowners who may benefit from a forest management plan or a wildlife management plan, and the corresponding conservation agencies such as the North Carolina Forest Service and the North Carolina Wildlife Resources Commission. This is an incredible opportunity to expand their client base and to enhance the amount and quality of conservation work that is implemented in North Carolina.

In addition, it would be possible to use the Parcel Identification Number from each bid to associate each application's characteristics with a more exact location than just Phase, as is analyzed in this report. In doing so, one would be able to relate the bid applications to a more robust and tailored set of variables that are specific to that sub-region. If that information was aggregated at a county level and made available to the local Soil and Water Conservation Districts, then they would also have a better idea of what services and programs they could focus their efforts on for future outreach.

## ***V. Conclusion***

The Market Based Conservation Initiative and the data collected from the associated applications during the reverse auction process provided invaluable insight. Statistical analysis also indicated several significant characteristics that could attribute to their annual contract bid amount per acre and contract length preferences, and those could be considered when planning future conservation programs. The exploratory analysis of the data revealed that landowners were willing to lower their annual contract bid amount per acre requested in Bid Round 2 once they were aware of the winning bid amounts in Bid Round 1, but in turn they lowered their contract length requested. In addition, the general data review conducted using all Bid Round 1 data illustrated that there is an opportunity to increase participation in conservation services that agencies like the local Soil and Water Conservation District can provide, such as the Voluntary Agricultural District program or conservation management plans, and in turn create relationships for future conservation programming purposes.

## VII. Literature Cited

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**Appendix A: Terms for Submission of** non-thesis masters papers to the NCSU Digital Repository:

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- You grant to the NCSU Libraries a non-exclusive, perpetual license to deposit the work (your submission) in the NCSU Digital Repository, a non-commercial, openly available collection of institutional scholarly research.
- Furthermore, you grant to the NCSU Libraries the right, without changing the content, to migrate one or more copies of the submission to any medium or format for backup and preservation purposes.

## Appendix B: MBCI Application Form



### Market Based Conservation Initiative (MBCI)

#### Landowner Application

Agency Use Only

Application No.

Applicant Name:

Date:

#### Application Directions

- 1) Please download this form and complete it using a word processor (preferred) or you may complete it manually.
- 2) Fill in the required information to the extent possible. If you do not know all the information, complete what you can.
- 3) If completed electronically, save the completed file using your name and MTR, e.g., John\_Galt\_MTR, and print a copy for submission.
- 4) Obtain information about the acreage of your land under the Military Training Route (MTR) from your Soil and Water Conservation District.
- 5) Obtain the required attachments as a hard copy and as an electronic copy if possible.
- 6) Submit the application and available attachments to your Soil and Water Conservation District.
- 7) You must submit one separate application for each tax parcel being considered.
- 8) You can visit your Soil and Water Conservation District office for assistance in completing this application.

#### Application Requirements

- 1) Landowner must own land under the Military Training Route (MTR).
- 2) Landowner must be enrolled or agree to enroll in the Present Use Valuation (PUV) Tax program for agriculture, forestry, or wildlife, and obtain the actual highest use valuation and the actual PUV value or estimated PUV value if they plan to enroll.
- 3) Landowner must have an active land management plan in effect or agree to develop one.
- 4) Landowner must have and attach a copy of the deed.
- 5) Landowner must have and attach a copy of the tax property record/tax parcel card.
- 6) Landowner must have and present evidence of ownership and ability to authorize a long term contract for the property.

Equal Opportunity Statement: This MBCI program prohibits discrimination on the basis of race, color, national origin, sex, religion, age, disability, political beliefs, and marital or familial status.

**Appendix B: MBCI Application Form (continued)**



**I. Applicant**

1. Name:
2. Mailing Address:
3. Telephone Numbers: a. Home:  b. Business:   
b. Cell:  d. Fax:
4. Email address:

**II. Property Information**

5. Name of County:
6. Total Parcel Acres:
7. Total acres of parcel under the Military Training Route (MTR):   
(Obtain from your local district)
8. Tax Parcel Number (PIN):
9. General Property Description (crops, pasture, forests):
10. Existing Structures on Property and Indicate if any exceed 100 feet in height (houses, barns, sheds, towers, etc.):

**III. MBCI Landowner Bid Requested:**

11. Length of contract requested to keep land in qualified rural land uses  
 10 Years  
 20Years  
 30Years
12. Bid Submitted \$  per acre per year

**Appendix B: MBCI Application Form (continued)**



**III. Detailed Property Ownership Information**

13. Land is Owned by:  Individual  Partnership  Corporation

Other (please explain):

14. Name(s) on Deed:

15. Deed of Record Book and Page Number:

16. You must be prepared to show evidence of ownership, including self-certificates from all landowners, indicating ownership of the offered land and/or provide any applicable power of attorney. Are you able to meet this requirement?

Yes  No

17. Does the property have direct access from a public road?

Yes  No

If no, explain access arrangements:

**IV. Current Program Information**

18.  Yes  No Property is enrolled in Present Use Value (PUV) Tax Designation or Wildlife Conservation Lands Reduced Assessment Program  
(If yes, attach tax documentation showing highest use value and PUV)

19.  Yes  No If no to question 18, are you willing to enroll the offered property in this application into a PUV program during the next enrollment period (January 1-January 31 each year; obtain an estimate of the highest use value and PUV from your tax office for the MBCI application)?

20.  Yes  No Is the property enrolled in a Voluntary Agricultural District (VAD)?

21.  Yes  No If no to question 20, are you willing to enroll in a Voluntary Agricultural District (VAD) program if available in your county?

22.  Yes  No Is the property enrolled in an Enhanced Voluntary Agricultural District (EVAD)?

23.  Yes  No If no to question 22, are you willing to participate in a Enhanced Voluntary Agricultural District (EVAD) program if available in your county?

**Appendix B: MBCI Application Form (continued)**



24. Which of the following are in place and current for your property (Check all that apply)?

- Conservation Plan    Forest Management Plan    Wildlife Plan

25. Is the land offered under this application enrolled in any of the following conservation programs? (check all that apply)

- |  |  |
|--|--|
| <input type="checkbox"/> Conservation Reserve Program                      | <input type="checkbox"/> Biomass Crop Assistance Program   |
| <input type="checkbox"/> Conservation Reserve Enhancement Program          | <input type="checkbox"/> NC Agriculture Cost Share Program |
| <input type="checkbox"/> NC Agriculture Water Resources Assistance Program | <input type="checkbox"/> Ecosystem Enhancement Program     |
| <input type="checkbox"/> Environmental Quality Incentives Program          | <input type="checkbox"/> Wetland Reserve Program           |
| <input type="checkbox"/> Conservation Security Program                     | <input type="checkbox"/> NCFS* Forest Development Program  |
| <input type="checkbox"/> NCFS Southern Pine Beetle Prevention Program      | <input type="checkbox"/> NCFS* Forest Stewardship Program  |
| <input type="checkbox"/> American Tree Farm System                         | <input type="checkbox"/> Sustainable Forestry Initiative   |
| <input type="checkbox"/> Other(s) explain: <input type="text"/>            | *North Carolina Forest Service                             |

**V. Affirmation:**

I hereby offer this bid under the Market Based Conservation Initiative program. This application does not guarantee approval or obligate the applicant to enter into a long term contract if the bid is accepted. For the purposes of processing this application, I authorize the release of records that are in custody of USDA. I acknowledge that information contained in and associated with processing this application may be subject to the North Carolina Public Records Law.

Applicant(s) <input type="text"/>	Date <input type="text"/>
<input type="text"/>	Date <input type="text"/>
<input type="text"/>	Date <input type="text"/>

Below for agency use only

Technical Specialist <input type="text"/>	Date <input type="text"/>
District Chair <input type="text"/>	Date <input type="text"/>

## Appendix C: Ranking Form for MBCI Applications

### Market Based Conservation Initiative (MBCI) - Military Training Route (MTR) Evaluation Point System for Working Lands

\_\_\_\_\_ **Landowner**

\_\_\_\_\_ **Parcel Tax ID Number**

#### Screening Criteria

- ❖ Land offered must be under the MTR or under the Special Use Air Space
- ❖ Land must be classified as agriculture, forestry, or wildlife land and enrolled in the Present Use Valuation program (PUV) and/or Wildlife Conservation Program OR owner must agree to enroll the land.

#### Ranking Criteria

<b>Conservation Characteristics</b>	<b>Points</b>
Is any portion of the land under the MTR above the 100 Year Flood Plain? If Yes, <b>1 point</b>	
Managed Agricultural or Forest Land in the MTR Does the landowner have a current Conservation Plan, Forest Management Plan, and/or Wildlife Plan? If Yes, <b>1 point</b>	
Environmental Sensitivity Does the land have any official State or Federal designated environmental importance (e.g., wetland, presence of threatened or endangered plant or animal species, etc.) If Yes, <b>1 point</b>	
Voluntary Agricultural District Status (one of below)	
VAD Designation – If Yes, <b>1 point</b>	
EVAD Designation – If Yes, <b>2 points</b>	
Landowner Cooperative—Is offered land a part of a partnership of landowners with adjacent directly connected land which is being offered? Must be accompanied by a letter of intent signed by all cooperating landowners. If Yes, <b>1 point</b>	
Adjacent to other protected lands—Is the property adjacent to State or Federal protected land or land already enrolled in the MBCI program? If Yes, <b>1 point</b>	
<b>Total Conservation Character Points (7 maximum)</b>	

<b>Land Threat to Conversion Coefficient Points (~1-6 usually)</b>	
This is the ratio between the county appraised value for land under the MTR and the Agriculture, Forest, or Wildlife Present Use Value designated by the county. If these values include land outside the MTR for a tract of land, the value for the whole land tract will be used to calculate the points.	
<u>County Appraised Property Value:</u> Present Use Value (Appraised-Deferred Tax Value):	<b>Land Conversion Coefficient</b> = _____

<b>Landowner Bid and Contract Term</b>		<b>Points</b>
Bid per acre	Ranked from 1. Lowest to Highest Bid per acre then 2. Highest to Lowest acreage under MTR for Each Bid Round ( <i>to be completed by the Selection Committee</i> )	
Term of Contract (length in years)	30 year contract— <b>2 points</b> 20 year contract— <b>1 point</b> 10 year— <b>no points</b>	
Number of Acres under the MTR	Greater than 201 – <b>2 points</b> Between 100 and 200 – <b>1 point</b> Less than 100 – <b>no points</b>	

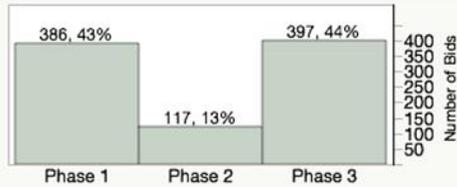
**Ranking Criteria Score** = \_\_\_\_\_

Total of Conservation Characteristic points + Land Threat to Conversion points

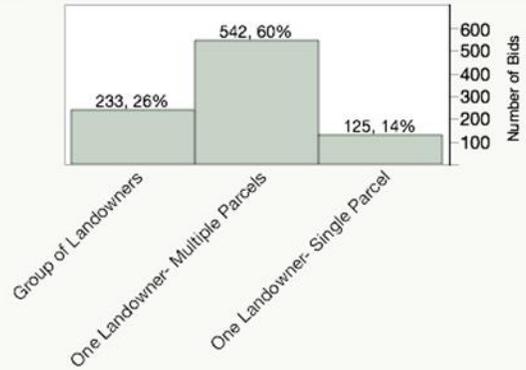
## Appendix D: Data Summary from JMP Software of Phases 1-3: Bid Round 1

### Data Summary for Phases 1-3: Bid Round 1

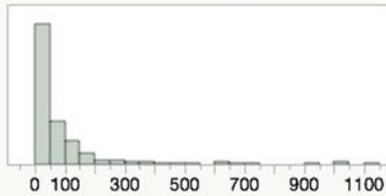
#### Phase



#### Bid Type



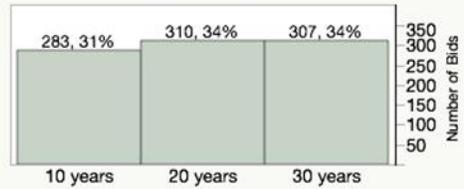
#### Acreage Under the Flight Path



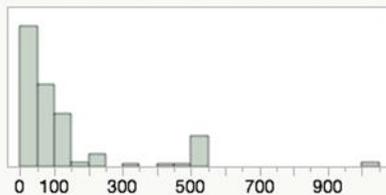
#### Summary Statistics

Mean	70.911172
Std Dev	116.4199
Std Err Mean	3.8806632
Upper 95% Mean	78.527386
Lower 95% Mean	63.294958
N	900

#### Contract Length Requested



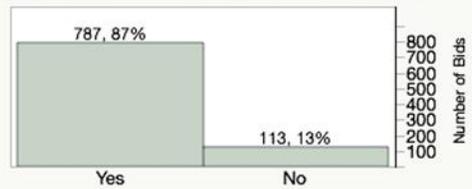
#### Annual Contract Bid Amount Requested Per Acre



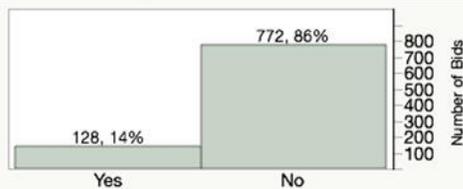
#### Summary Statistics

Mean	113.84
Std Dev	161.84775
Std Err Mean	5.3949249
Upper 95% Mean	124.42811
Lower 95% Mean	103.25189
N	900

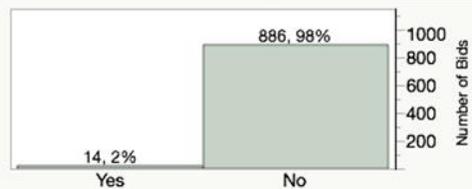
#### Present Use Value Tax Designation



#### Voluntary Agricultural District Member



#### Enhanced Voluntary Agricultural District Member



**Appendix D (continued): Data Summary from JMP Software of Phases 1-3: Bid Round 1**

