

SCHOOL OF ENVIRONMENT AND NATURAL RESOURCES

Planting Trees for Storm-water Management: An Exploration of Central Ohio Resident Motivations

A Report from the Environmental and Social Sustainability Lab (ESSL 02-2019)



THE OHIO STATE UNIVERSITY

COLLEGE OF FOOD, AGRICULTURAL,
AND ENVIRONMENTAL SCIENCES

About the Environmental and Social Sustainability Lab

The Environmental and Social Sustainability (ESS) Lab is a community of scholars working to build scientific understanding of environmental and social sustainability in an interdisciplinary context. We collaborate to describe, analyze, and communicate environmental problems and potential solutions. We are staffed by a core group of affiliated faculty members and students representing a range of social sciences with focus on the environment and natural resources. In addition to a core of faculty leaders, the Environmental and Social Sustainability (ESS) Lab serves as a clearing-house, tailored to particular projects, by gathering research and support personnel from across the campus and nation as needed.

Author Contact Information:

Hugh Walpole (Corresponding Author)
Graduate Associate

School of Environment and Natural Resources
The Ohio State University
2021 Coffey Rd.
Columbus, OH, 43210
Walpole.23@osu.edu

Suggested Citation

Walpole, H.D., Naples, C., Rapp, C., Legget, R., Sintov, N. & Wilson, R.S. 2019. *Planting Trees for Storm-water Management: An Exploration of Central Ohio Resident Motivations*. The Ohio State University, School of Environment and Natural Resources.

Cover photo credit: The Ohio State University

Contents

| | |
|-------------------------------------------------------------------|----|
| Executive Summary: | 4 |
| Rationale:..... | 5 |
| Research Objectives: | 5 |
| Phase 1: Focus Groups | 5 |
| Rationale: | 5 |
| Methods: | 5 |
| Results (Objective 1): | 6 |
| Phase 2: Survey Data Collection | 10 |
| Methods: | 10 |
| Results: | 11 |
| Demographics: | 11 |
| Motivations, Constraints and Barriers (Objectives 2 and 3): | 14 |
| Predicting Tree-Planting intentions (Objective 4) | 17 |
| Storm-Water Knowledge (Objective 5)..... | 19 |
| Next Steps | 21 |
| Appendix A: Focus Group Questions | 25 |
| Appendix B: Survey Instrument | 26 |

Executive Summary:

This research project sought to investigate the key beliefs of residents in two central Ohio communities (Gahanna and New Albany) with regards to planting trees in their yards. Our purpose was to establish which beliefs were relevant to the decision to plant trees and the relative strengths of these beliefs across both communities as well as assessing participant's storm-water knowledge.

We conducted the research project in 2 phases to collect both qualitative and quantitative data assessing resident's beliefs about tree-planting and their knowledge about storm-water best practices.

Our findings show a large array of relevant beliefs to the decision to plant a tree including a broad variety of uncertainties that people have about planting trees. Participants generally reported much higher levels of motivations than either constraints or barriers. We see modest differences between communities in their perception of motivations and constraints but much more substantial community differences when it comes to informational and policy barriers to planting trees such that New Albany residents perceive much higher barriers (primarily due to HOA restrictions). We also see that barriers and constraints are associated differently with intentions to plant a tree in the future such that barriers that occur early in the decision process (i.e. uncertainty about rules, aesthetic concerns) are negatively associated with future intentions while more specific barriers that occur later in the decision process (uncertainty about how to dispose of planting residue, lack of sufficient information to tree-planting decisions) are positively associated with intentions suggesting that these barriers and constraints may be concerns for those who are already motivated.

We find that storm-water knowledge is generally fairly high, however there are a couple of key misconceptions that may benefit from concerted efforts to correct, particularly that applying fertilizer right before a rainfall event can increase fertilizer retention and that clearing vegetation around streams to maintain access is a good idea (this belief is particularly evident in New Albany).

Considering the findings from both phases of the research, the following recommendations are supported.

- Partner with local municipalities and/or HOAs to make the following information as readily accessible as possible either online or through personnel visits:
 - Precise local and HOA rules about tree species and placement
 - Location of pipes and utilities (where possible)
 - A short list of attractive, Ohio-native tree species with growth projections to simplify the decision for residents of what trees will likely thrive with little maintenance.
 - Species-specific guidelines for tree placement to reduce likelihood of property damage (particularly in Gahanna)
 - Any existing incentive programs
- In collaboration with local HOAs, identify which rules are most restrictive with respect to tree-planting and adjust them (where possible) to promote the planting of trees that are beneficial for storm-water management.
- Promote tree/shrub placement or species strategies that take up the minimum space possible while maintaining storm-water benefits (particularly in New Albany).
- Where possible, a program to assist (particularly older) residents in removing debris left over from planting (i.e. excess soil) could reduce uncertainty about what to do with it and can reduce the effort involved particularly for those who are less physically able.

- Focus storm-water education on fertilizer application BMPs and benefits of streamside vegetation.

Rationale:

We were interested in identifying what factors promote or constrain residential homeowners from planting a tree in their yard which can have substantial benefits for reducing the contamination and the rate of storm-water runoff (Center for Urban Forest Research, 2002; Seitz et al, 2014). Using techniques adapted from Community-Based Social Marketing (CBSM, McKenzie-Mohr & Smith, 2012) we identified a series of barriers and benefits to planting a tree in a residential yard, identified which are the most prevalent and strongly held in the two communities that we were assessing, identified differences in the strength of barriers and benefits between the two communities and assessed the extent to which identifying these barriers and benefits predicts intentions to plant a tree within the next 5 years.

Research Objectives:

1. Identify what motivations, constraints and barriers (beliefs) are relevant to the decision of whether or not to plant a tree in a residential yard.
2. Identify the motivations, constraints and barriers that participants indicate are the most impactful on their decisions about whether or not to plant a tree in their yard.
3. Identify differences between communities on which motivations, constraints and barriers are important
4. Identify if levels of different motivations, barriers or constraints predict intentions to plant a tree in the next 5 years.
5. Identify levels of storm-water knowledge among participants across both communities

The research effort proceeded in 2 phases. Phase 1 consisted of a qualitative data collection effort designed to address research objective 1 across a series of focus groups. Phase 2 consisted of a survey that was developed based on the results of phase 1. The phase 2 survey was designed to address research objectives 2-5.

Phase 1: Focus Groups

Rationale:

In order to determine which motivations, barriers and constraints are relevant to the decision of whether or not to plant a tree in a residential yard (Research objective 1) we needed qualitative data to learn how residents in our population of interest conceptualize what *motivates* them to plant trees in their yards (their motivations), what makes them *disinclined* to plant trees in their yards (their constraints) and what *prevents* them from planting trees in their yard (the barriers they face). Allowing participants to identify motivations, barriers and constraints in open-ended questions enables us to learn about specific beliefs held by the group that we may not have otherwise thought of to ask about in a quantitative survey. This increases our ability to tailor a survey instrument to assess the importance of motivations, constraints and barriers that are on the minds of members of the communities we are assessing.

Methods:

We conducted a series of focus groups in November of 2017 with residents of New Albany, Gahanna and Dublin who had provided their emails to the team at the Franklin County Soil and Water Conservation District (FSW) as part of a previous initiative oriented around rain barrels.

This population was selected because they would be easy to contact and had already demonstrated some motivation towards adopting behaviors in service of reducing storm-water runoff. The motivated population that we spoke with were well-suited to this task as they were more likely to have given some thought to adopting such behaviors, whether or not they did so for the purposes of storm-water management. While there were initial concerns that the motivated population would be unable to describe barriers or constraints to planting trees, these concerns were assuaged by initial findings showing that participants were identifying considerably more barriers and constraints than motivations. Participants were contacted via email by members of FSW staff and invited to participate in one of 4 focus groups held in local library branches between Nov 6th and Nov 16th 2017.

We conducted a total of 4 focus groups of 3-6 individuals for a total of 20 participants. The focus groups consisted of a series of open-ended questions asking the participants in each group to describe why they have or have not planted a tree in their yard, what things come to mind when they think about planting trees in their yard, whether they thought of tree-planting in relation to storm-water management, what barriers or constraints they perceive to planting a tree in their yards and what they saw as ways of overcoming these barriers (see Appendix A for a complete list of questions). Focus groups typically took between 45 minutes and 1 hour to complete. Each session was audio-recorded and detailed notes were taken during the session by a member of the research team.

Results (Objective 1):

Planting trees in the past

Many participants had planted trees on their property before. Most frequently, participants planted trees to replace older trees that had died or needed to be removed due to safety concerns. When replacing trees, participants typically chose small, aesthetically-pleasing trees (motivated by aesthetics of trees). For example, maples were popular replacements for ash trees. Some participants had planted trees to increase their tree coverage (for shade, privacy or other reasons). When planting additional trees, participants typically chose fruit trees or specific species they were fond of, or good species for privacy. A few participants planted free seedlings and saplings or let trees naturally recruit on their property. In several cases, participants belonged to Homeowners Associations (HOAs) that restricted which trees participants could plant and required species-specific replacements for dead or dying trees on their property.

Removing trees in the past

Participants removed trees for a variety of reasons mostly relating to safety and aesthetics. Many participants removed dead and dying trees, especially old fruit trees, ash trees, and improperly planted or poorly-suited trees. Several participants removed live trees they perceived as dangerous to their house, especially during storms; trees were planted too close to the house when their subdivision was built or the species had grown too large. Other participants removed trees for aesthetic reasons; for example, some wanted more sun and grass, others wanted open space for neighborhood children to play.

Perception of trees in relation to storm-water

Participants were largely aware of the storm-water benefits trees could provide. However, they did not cite it as a major motivator or concern when deciding to plant or remove trees. Several participants preferred rain gardens or rain barrels for storm-water management; a few participants were less concerned about storm-water because their home was on a relative high point compared to their neighbors which did not expose them to concerns related to localized flooding or standing water. Many participants expressed interest in seeing local governments

plant more trees in communal open spaces either in addition or in lieu of planting trees in their own yards.

Barriers and constraints to planting trees

Across all focus groups, participants were worried about spending money without results, and cited uncertainty, complexity and lacking information as key barriers to planting more trees. Many participants felt they did not know enough to even start researching, let alone make an informed decision. Areas of uncertainty included local regulation, property characteristics (soil, grade etc.) and tree selection (species growth characteristics or native-status).

Participants came from different municipalities and had HOAs of varying strictness. Participants were unsure what their local ordinances were, especially concerning liability if a street tree fell. They were concerned about damaging pipes and lines when planting a tree and were uncertain how to ensure they were digging safely and within code.

In addition, participants did not know how to evaluate the relevant characteristics of their property for tree-planting. For example, some participants noted they were aware the Columbus area typically had clay-rich soil, but they did not know how to tell if that was true for their property and what the implications of different soils were. Participants were also aware that trees could threaten their gas and water pipes and cable and power lines but did not know where those pipes and lines were; some participants mentioned that they could have the City mark where some, but not all, pipes and lines of concern were.

Most participants mentioned uncertainty surrounding tree selection. They knew characteristics they wanted their trees to have, such as being native and beneficial for pollinators, or small and low maintenance, but did not know which tree species have these characteristics. Participants with few preferences were most interested in being certain their tree would survive on their property with limited maintenance. In addition, participants wanted to know about tree growth, development, and maintenance over the long-term to attenuate worries that trees would become nuisances and grow unpredictably in the years to come. Not knowing the characteristics on their property nor the trees that would survive significantly discouraged many participants.

In addition, participants were worried about the sunk cost of planting a tree. Many emphasized they saw planting a tree as a significant investment in time, money, and energy and were averse to investing resources into planting a tree just to have it die. Participants noted that trees that were a sufficient size to provide immediate or near-term gratification were riskier, while younger, smaller trees were unappealing because they required immediate investment but delayed gratification. Some participants were also nervous that because they were not experienced in tree planting and maintenance, they would be taken advantage of by unscrupulous landscapers and gardeners.

Some participants noted that they would not plant more trees regardless the incentives to do so; they felt their property had as many trees as was safe or reasonable for their lot and did not intend to plant except to replace dead or dying trees. Figure 1 shows the distinct motivations, barriers, constraints and uncertainties identified by participants during the focus groups.

Participant Recommendations to Overcome Barriers

Participants came up with a variety of suggestions that they believed would help them and people in their community plant more trees. To overcome information deficits, many participants stressed that information had to be actively disseminated; often participants were not willing or able to invest the time to find reliable sources themselves. They recommended newsletters,

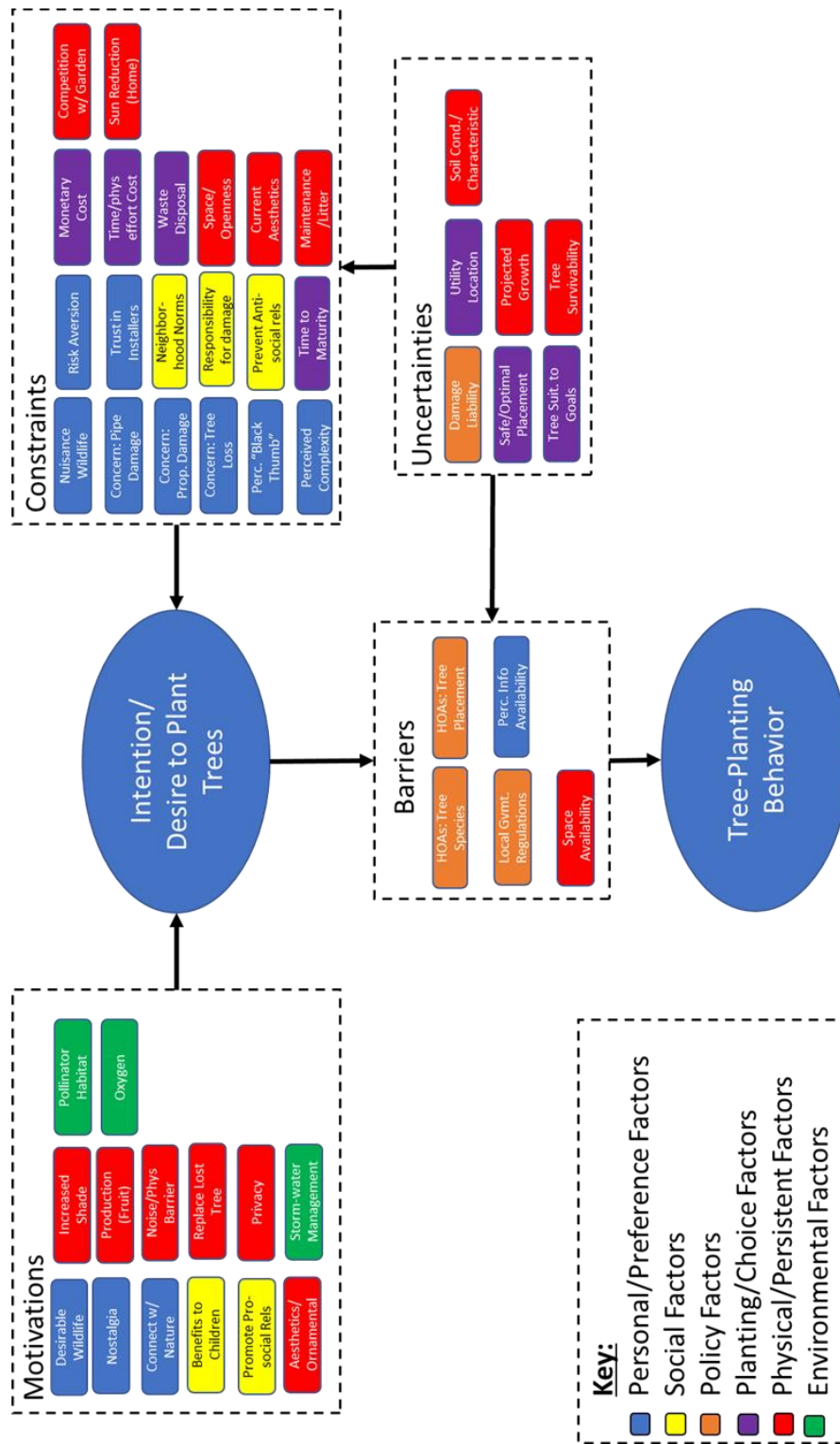
booths at community events, and collaboration with HOAs as potential avenues for awareness campaigns. Participants also recognized collaborating with HOAs may have additional benefits, like expanding acceptable tree lists to include fewer ornamentals and more native species. Many participants strongly emphasized that they believed the rebate programs offered through FSW needed to be better advertised and information about pipes and lines and municipal ordinances needed to be much more accessible in order to make planting trees attractive.

To help homeowners understand what kind of trees are right for their property, participants suggested having professionals come to their property and explain relevant characteristics and recommend trees. Some participants recommend listing plants in nurseries or publicly-available guides as Ohio native, small-statured or low-maintenance to help homeowners quickly identify trees that suited them. Other participants preferred that even less choice be left up to them; they wanted a very specific recommendation of the single best-suited species or small group of best-suited species.

Cost-reducing measures, like the rebate program, helped participants tolerate greater risk that their tree would not survive or would need to be removed. Several participants were very willing to experiment with planting several different types of trees if they were free. Other participants thought subsidies at different stages in the tree life cycle were important; some mentioned subsidies for planting may help overcome the tradeoff of investing one's energy or money into planting, while subsidies for pruning and maintenance, especially for senior citizens, may help address concern trees would create problems in the future.

Participants who could or would not plant a tree regardless of incentive frequently expressed interest in seeing more street trees and trees in public spaces. Many participants imagined planting trees in public spaces could double as a community-building event that local residents could volunteer in.

Figure 1: Motivations, Barriers, Constraints and Uncertainties Identified in Focus groups



Phase 2: Survey Data Collection

Methods:

Following the focus groups, we developed a survey designed to assess the strength and prevalence of each motivation, barrier and constraint identified in the focus group results. Survey development took place between December 2017 and May of 2018 focused on iterative meetings between members of the research team to develop items to assess each of the main motivations, constraints and barriers (Appendix B Sections 1, 2 and 3). The “uncertainties” listed above were collapsed into constraints as the uncertainty associated with these elements appeared to act as factors that disinclined residents to plant trees rather than preventing them outright. In addition, several similar motivations and constraints were collapsed together (for instance “soil conditions” and “tree survivability” were collapsed into an item asking about concerns that a tree will die prematurely) to save space in the survey. Items were also developed in collaboration with members of the Franklin Soil and Water Conservation District Team to assess storm-water knowledge (Appendix B, Section 4).

We collected a total of 174 surveys from 2 central Ohio communities in suburbs of the city of Columbus: Gahanna and New Albany. Original plans called for collecting data from Dublin in addition to Gahanna and New Albany, however, scheduling conflicts with the municipal leadership prevented sampling in Dublin. The primary method of data collection was a modification of drop-off/pick-up methodology in which neighborhoods identified by the Franklin County Soil and Water Conservation District experts in collaboration with officials from Gahanna and New Albany respectively were canvassed on foot by members of the research team. The research team entered the target neighborhoods on weeknight evenings in July and August 2018, approached each house in the target neighborhoods, explained the purpose and invited residents to participate in the study. If the resident agreed, they would be left with either a paper survey or a link directing them to an identical online version of the study. In the event that a resident was not home when the research team approached a house, a packet containing a cover letter explaining the study, a paper survey and a sheet with a link to the online version of the study was left hanging from the doorknob in a water-resistant plastic bag and the house would be revisited on a subsequent run through the community. Participants who elected to fill out the paper survey were instructed to leave the paper survey in the provided bag and hang it from their door knobs the following morning for collection. Members of the research team would return to the communities on the morning following every run to pick up completed paper surveys. Every street was covered on at least 2 mornings to ensure that all completed surveys were collected. In addition, the cities of Gahanna and New Albany published links to an identical (but separate) online survey through their social media accounts to allow members of their communities who were not in the target neighborhoods to participate in the study if they chose too. Table 1 shows the proportion of collected surveys that were on paper or online, and those that were collected from the target and non-target communities.

Response rates were considerably higher in New Albany, while this may be due to increased levels of interest among members of the community (as evidenced by the increased number of out of target online surveys when compared to Gahanna, $n=27$ in New Albany, $n=5$ in Gahanna), it may also be due to an alteration made to materials after a week of data collection with low response rates where it was made clear in the study materials that the research team would return on multiple days to collect paper surveys rather than only on the day following the drop-off of the survey. This may have encouraged those who forgot to leave out their surveys on the first day to leave them out on a subsequent day for collection rather than disposing of them if they thought they no longer had the opportunity to have the survey collected.

Table 1: Distribution of surveys across communities, mediums and targets

| | Total Surveys | Paper Surveys | In-Target Surveys | In-Target Resp. Rate |
|-------------------|---------------|---------------|-------------------|----------------------|
| Gahanna | 67 | 26 (38%) | 62 (93%) | 19.9% |
| New Albany | 107 | 30 (28%) | 80 (75%) | 38.5% |
| Total | 174 | 56 (32%) | 142 (82%) | 33.5% |

Analysis

We analyzed the importance of each motivation, barrier and constraint (Objective 2) by calculating mean values of responses to each across both communities together and separately. To assess whether there were community differences between Gahanna and New Albany (Objective 3), we ran simple regressions using a binary variable indicating community (0 for Gahanna, 1 for New Albany) as a predictor of responses to each motivation, barrier and constraint. Stepwise regression analysis was used to predict intentions to plant a tree from motivations, barriers and constraints (Objective 4). Descriptive statistics are also provided for storm-water knowledge (Objective 5) and sample demographics.

Results:

Demographics:

Gender

Participants were asked to select their gender as male or female with additional options for “prefer not to say” and “other” with a write-in category. Table 2 shows the gender distribution of the sample. Of 163 participants who responded, the overall sample was 46% male and 51% female. The sample from Gahanna (n=64) was 51% male, 42% female. The sample from New Albany (n=99) was 41% male, 56% female.

Table 2: Participant Gender Distribution

| | Overall | Gahanna | New Albany |
|--------------------------|----------|----------|------------|
| Male | 75 (46%) | 34 (53%) | 41 (41%) |
| Female | 83 (51%) | 28 (44%) | 55 (56%) |
| Prefer not to say | 4 (3%) | 2 (3%) | 2 (2%) |
| Other | 1 (<1%) | 0 (0%) | 1 (<1%) |

n=163, 11 responses are missing, 3 from Gahanna, 8 from New Albany.

Race

Participants were asked to identify their race from a list of 6 possible choices with additional options for “prefer not to say” and “other” with a write-in. Table 3 shows the distribution of racial identification. No participants identified as “American Indian or Native Alaskan”, “Native Hawaiian or Pacific Islander” or “Hispanic/Latino” and so these categories are not shown in the

table. Of those who responded to this item (n=153), the overall sample was predominantly white (79%) with 3% identifying as Black and 8% Asian. The rest of respondents either preferred not to answer or chose the “other” option and identified with a more specific racial group (“Greek” or “South East Asian”). The sample from Gahanna (n=60) was 87% white, 3% Asian and 1% Black, the sample from New Albany (n=93) was 74% White, 12% Asian and 4% Black.

Table 3: Participant’s racial identification

| | Overall | Gahanna | New Albany |
|----------------------------------|-----------|----------|------------|
| White | 121 (79%) | 52 (87%) | 69 (74%) |
| Black or African American | 5 (3%) | 1 (2%) | 4 (4%) |
| Asian | 13 (8%) | 2 (3%) | 11 (12%) |
| Prefer not to say | 6 (3%) | 2 (3%) | 4 (4%) |
| Other | 8 (5%) | 3 (4%) | 5 (5%) |

n=153, 21 responses are missing, 7 from Gahanna, 14 from New Albany.

Age

Participants were asked to write in their age in years. The mean age of for those who responded to this item (n=145), excluding 1 improbable case in New Albany listing their age as 145 years old was 51 (SD=12.9). The mean for Gahanna respondents (n=59) was 55 (SD=13.9) while the mean for New Albany respondents (n=86) was 48 (SD=11.2). See table 4 for a distribution of ages.

Table 4: Participant’s age distribution

| | Overall | Gahanna | New Albany |
|---------------------|----------|----------|------------|
| <30 Years | 2 (1%) | 1 (2%) | 1 (1%) |
| 31-40 Years | 36 (24%) | 11 (19%) | 25 (29%) |
| 41-50 Years | 42 (29%) | 10 (17%) | 32 (37%) |
| 51-60 Years | 28 (19%) | 11 (19%) | 17 (20%) |
| 61-70 Years | 25 (17%) | 18 (31%) | 7 (8%) |
| 71-80 Years | 9 (6%) | 6 (10%) | 3 (3%) |
| 80+ Years | 3 (2%) | 2 (3%) | 1 (1%) |

n=145, 29 responses are missing, 8 from Gahanna, 21 from New Albany

Income

Participants were asked to select an income range from 1 of 6 options plus a “prefer not to say” option. Table 5 shows the distribution of income. In general, for those who responded (n=136) both samples are relatively affluent, however a considerably larger proportion of New Albany residents (n=80) selected the highest income bracket at 74% than Gahanna residents (n=56) with only 30% selecting the highest income bracket. Roughly 30% of each sample either did not answer or reported that they preferred not to answer the question.

Table 5: Participant's income distribution

| | Overall | Gahanna | New Albany |
|-----------------------|----------|----------|------------|
| <\$35,000 | 1 (<1%) | 0 (0%) | 1 (1%) |
| \$35,000 - \$49,999 | 1 (<1%) | 1 (2%) | 0 (0%) |
| \$50,000 - \$69,999 | 2 (1%) | 2 (4%) | 0 (0%) |
| \$70,000 - \$89,999 | 7 (5%) | 5 (9%) | 2 (3%) |
| \$90,000 - \$119,000 | 19 (14%) | 13 (23%) | 6 (8%) |
| \$120,000 - \$149,000 | 12 (9%) | 8 (14%) | 4 (5%) |
| More than \$150,000 | 76 (56%) | 17 (30%) | 59 (74%) |
| Prefer not to say | 18 (13%) | 10 (18%) | 8 (10%) |

n=136, 38 responses are missing, 11 from Gahanna, 27 from New Albany

Education

Participants were asked to select their highest level of education attained from a list of 8 options plus an "other" category with a write-in. Table 6 shows the distribution of educational attainment. Because no participants selected the lowest category "Less than high school", it has been omitted from the table. Overall those in the sample who responded (*n*=141) are highly educated with over 70% having a 4-year degree or higher. There are very few differences in educational attainment between the two communities (Gahanna, *n*=58, New Albany, *n*=83).

Table 6: Participant's educational attainment distribution

| | Overall | Gahanna | New Albany |
|---------------------|----------|----------|------------|
| HS Graduate | 1 (<1%) | 0 (0%) | 1 (1%) |
| Some College | 12 (9%) | 9 (16%) | 3 (4%) |
| 2-year degree | 2 (1%) | 1 (2%) | 1 (1%) |
| 4-year degree | 54 (38%) | 21 (36%) | 33 (40%) |
| Master's Degree | 35 (25%) | 17 (29%) | 28 (34%) |
| Professional Degree | 16 (11%) | 6 (10%) | 10 (12%) |
| Doctorate | 10 (7%) | 4 (7%) | 6 (7%) |
| Other | 1 (<1%) | 0 (0%) | 1 (1%) |

n=141, 33 Responses are missing, 9 from Gahanna, 24 from New Albany

Years Living in Home

Participants were asked to write in how long they had lived in their current residence (in years). The overall average for participants who responded (*n*=137) was 12 years (*SD*=9.9), the average in Gahanna (*n*=54) was 17 years (*SD*=10.7) while the average in New Albany (*n*=83) was 9 years (*SD*=7.9). Table 7 shows the distribution of years binned into 5-year increments.

Table 7: Distribution of years living in home

| | Overall | Gahanna | New Albany |
|--------------------|----------|----------|------------|
| 0-5 Years | 49 (36%) | 12 (22%) | 37 (45%) |
| 6-10 Years | 26 (19%) | 8 (15%) | 18 (22%) |
| 11-15 Years | 25 (18%) | 5 (9%) | 20 (24%) |
| 16-20 Years | 7 (5%) | 5 (9%) | 2 (2%) |
| 21-25 Years | 12 (9%) | 9 (17%) | 3 (4%) |
| 26-30 Years | 12 (9%) | 12 (22%) | 0 (0%) |
| 31-35 Years | 3 (2%) | 2 (4%) | 1 (1%) |
| 35+ Years | 3 (2%) | 1 (2%) | 2 (2%) |

n=137, 37 responses are missing, 13 from Gahanna, 24 from New Albany

Presence of a Home-Owners Association (HOA)

Participants were asked to identify if they had a home-owners association (HOA) that covered their community. While the vast majority of the participants in the New Albany community (93%) identified that they had an HOA, less than half of the residents of the Gahanna community identified that they had an HOA. Very few participants indicated that they didn't know whether or not they had an HOA.

Table 8: Presence of a Home-Owners Association (HOA)

| | Overall | Gahanna | New Albany |
|-------------------|-----------|----------|------------|
| Yes | 107 (72%) | 26 (43%) | 81 (93%) |
| No | 37 (25%) | 32 (52%) | 5 (6%) |
| Don't know | 4 (3%) | 3 (5%) | 1 (1%) |

n=148, 26 responses are missing, 6 from Gahanna, 20 from New Albany.

Takeaways from demographics

The sample is primarily middle aged, well educated, affluent and white. These factors are worth taking into consideration when thinking about how the findings and recommendations in this report can be applied broadly in other central Ohio communities.

Residents in the New Albany community we sampled are considerably more likely to have a Home-Owner's association which may suggests that including the HOA as a partner in information distribution and rules development may be key in that area.

Similarly, residents in the New Albany area are generally more affluent than their counterparts in Gahanna, this may suggest that monetary incentives may be more necessary in Gahanna than in New Albany though it is not yet clear if this is the case.

Motivations, Constraints and Barriers (Objectives 2 and 3):

Participants were asked the extent to which each motivation, constraint and barrier identified in the focus groups influenced whether or not they felt inclined, disinclined or restricted

(respectively) with respect to planting a tree in their yard. The mean values for each belief were calculated for the overall sample and then each community individually. The respondents answered each item using a scale from 1 – 5, 1 meaning ‘not at all’ and 5 meaning ‘a great deal’. Each section below presents the mean values for each belief in a table. The tables are formatted such that higher values are shaded in a more saturated color (green for motivations, red for constraints and barriers) than lower values. The right 2 columns represent the results of simple regressions predicting each belief from the community where the participant resides. Results yield mean differences between the communities that are coded as the mean of Gahanna minus the mean of New Albany. Positive values show that the mean for New Albany is higher than the mean for Gahanna and negative values show that the mean for Gahanna is higher than the mean for New Albany. This difference score is also accompanied by a hypothesis test with a significance value. To avoid clutter, all non-significant differences (using the convention of $p < 0.05$ for significance) are not included in the tables. Beliefs that appear to be the most important (i.e have comparatively large values), and significant differences between the two communities in values for each belief are also highlighted in the text.

Motivations:

The overall sample shows 6 motivations with average values above 3.8 that appear to be the most important. The highest motivation means were for the visual appeal of the trees ($M=4.6$), providing shade to their yard and homes ($M=4.3$) connection to nature ($M=4.0$), Provide privacy to their home and yard ($M=3.9$) produce oxygen ($M=3.9$) and positive memories associated with trees ($M=3.8$). Providing spaces for children to play ($n=30$) and replacing a dead tree ($n=19$) were most frequently skipped or marked “not applicable”. Results of simple regressions predicting the value of the motivation from the participant’s community show only one significant difference between Gahanna and New Albany in motivation strength. Respondents in Gahanna report replacing a dead tree as a significantly stronger motivation than those in New Albany ($b=-0.76$, $p=0.004$) such that those in Gahanna show an increase of around 0.75 scale points on the 1-5 scale against those in New Albany. Table 9 shows the distribution of reported motivation strength.

Table 9: Importance of motivations for tree planting by community

| Motivation | Gahanna | New Albany | Overall | Mean Diff | Sig. |
|---------------------------|---------|------------|---------|-----------|-------|
| Desirable Wildlife | 3.0 | 2.8 | 2.9 | - | - |
| Positive Memories | 3.8 | 3.8 | 3.8 | - | - |
| Nature Connection | 4.0 | 4.1 | 4.0 | - | - |
| Play Space for Child | 3.3 | 3.3 | 3.3 | - | - |
| Positive Relationships | 2.6 | 2.6 | 2.6 | - | - |
| Visual Appeal | 4.6 | 4.6 | 4.6 | - | - |
| Shade for Yard and Home | 4.5 | 4.3 | 4.4 | - | - |
| Produce Fruit | 2.2 | 2.4 | 2.3 | - | - |
| Block Neighbor Noise | 3.5 | 2.8 | 2.7 | - | - |
| Replace Dead Tree | 3.6 | 2.8 | 3.1 | -0.76 | 0.004 |
| Privacy for Yard and Home | 3.8 | 4.0 | 4.0 | - | - |
| Reduce Flooding | 3.4 | 3.3 | 3.3 | - | - |
| Pollinator Habitat | 3.5 | 3.3 | 3.4 | - | - |
| Produce Oxygen | 3.9 | 3.9 | 3.9 | - | - |

Constraints:

Constraints for both communities had considerably lower values in general than the motivations. The top 3 constraints overall were concerns about tree roots spreading and damaging public utility pipes (M=2.6) or causing property damage (M=2.5) and that planting a tree would fill valuable space in these people's yards (M=2.3). Results of simple regressions predicting the strength of the constraint from the participant's community show only 1 significant difference between Gahanna and New Albany in constraint strength. Respondents in Gahanna report significantly higher concern about roots causing property damage (to their own property) than residents of New Albany ($b=-0.46$, $p=0.027$) by around 0.5 scale points. Table 10 shows the distribution of reported constraint strength.

Table 10: Importance of constraints to tree planting by community.

| Constraint | Gahanna | New Albany | Overall | Mean Diff | Sig |
|---------------------------|---------|------------|---------|-----------|-------|
| Nuisance Wildlife | 2.0 | 1.9 | 1.9 | - | - |
| Roots: Utility Damage | 2.7 | 2.6 | 2.6 | - | - |
| Roots: Property Damage | 2.8 | 2.4 | 2.5 | -0.46 | 0.027 |
| No "Green Thumb" | 1.7 | 1.9 | 1.8 | - | - |
| Premature Death | 1.9 | 1.9 | 1.9 | - | - |
| Information Complexity | 1.4 | 1.6 | 1.5 | - | - |
| Landscaper Trust | 1.7 | 1.7 | 1.7 | - | - |
| Community Norms | 1.5 | 1.8 | 1.7 | - | - |
| Damage Impacting Others | 1.7 | 1.7 | 1.7 | - | - |
| Create Conflict | 1.4 | 1.6 | 1.5 | - | - |
| Too long for Benefits | 1.8 | 2.0 | 1.9 | - | - |
| Too Expensive | 2.0 | 2.0 | 2.0 | - | - |
| Too Much Effort | 1.7 | 1.9 | 1.8 | - | - |
| Planting Residue Disposal | 1.5 | 1.4 | 1.5 | - | - |
| Fills Open Space | 2.2 | 2.4 | 2.3 | - | - |
| Interfere w/ Aesthetics | 1.7 | 1.8 | 1.8 | - | - |
| Maintenance Effort | 1.7 | 1.6 | 1.7 | - | - |
| Effort of Debris Removal | 2.2 | 1.9 | 2.0 | - | - |
| Displace/Shade Garden | 1.7 | 1.7 | 1.7 | - | - |
| Block Sun for Home | 1.6 | 1.6 | 1.6 | - | - |

Barriers:

Similar to constraints, reported barriers appear to be lower in both communities than reported motivations. The barriers that stand out in the overall sample are the availability of space in the respondents' yards (M=2.9) and Home-Owner's Association rules about where community members can plant trees. (M=2.5). Results of simple regressions predicting the strength of the barrier from the participant's community show significant differences between Gahanna and New Albany in constraint strength for all but one of the presented barriers. In all cases, barrier

perceptions are higher in New Albany than in Gahanna. The most significant differences are in HOA rules about what species can be planted ($b=1.18$ $p<0.0005$) and where trees can be placed ($b=1.55$, $p<0.0005$). This is understandable given the differences in the proportion of the samples between the two communities who indicate that they have an HOA in their community. The other differences are smaller but are still significant, showing that those in New Albany indicate that government rules about species and placement, the availability of space and access to information about local rules are all more important barriers than respondents in Gahanna.

Table 11: Importance of barriers to tree planting by community.

| Barrier | Gahanna | New Albany | Overall | Mean Diff | Sig |
|----------------------------------|---------|------------|---------|-----------|---------|
| HOA Rules: Species | 1.5 | 2.7 | 2.3 | 1.18 | <0.0005 |
| HOA Rules: Placement | 1.5 | 3.0 | 2.5 | 1.55 | <0.0005 |
| Gvmt Rules: Species | 1.7 | 2.0 | 1.9 | 0.38 | 0.044 |
| Gvmt Rules: Placement | 1.7 | 2.2 | 2.1 | 0.50 | 0.011 |
| Availability of Space | 2.6 | 3.1 | 2.9 | 0.50 | 0.007 |
| Information Access: Trees | 1.8 | 2.0 | 1.9 | - | - |
| Information Access: Rules | 1.6 | 2.3 | 2.0 | 0.68 | 0.001 |

Takeaways from Motivations, Constraints and Barriers

Taken together, these results suggest that reported motivations are quite high but there may be key barriers that are preventing residents from acting on those motivations. The biggest motivators appear to be aesthetics and shade for homes and gardens. Strategies to promote planting of trees then should focus on species that are attractive (though not necessarily just decorative). Concerns about doing damage to either property or utility pipes (particularly in Gahanna) appear to be the biggest constraints to people's desires to plant trees. As indicated in phase 1, information about where utility pipes are in a person's yard and about how large particular trees are expected to grow (both in their root structure and above ground) may be helpful to reducing the impact of these concerns. Coupled with the findings that HOA rules (and ambiguity about those rules) are considerably more impactful in New Albany than Gahanna, this again suggests that partnering with the HOA in the New Albany communities may be key to removing barriers for residents.

Predicting Tree-Planting intentions (Objective 4)

While the previous section details the motivations, constraints and barriers that participants report being the most important to them, it can also be informative to look at associations between these beliefs and intentions to engage in the actual behavior. This can go beyond what people report about their motivation process and can provide insight at the population level as to what variables are associated with actual intentions to engage in the behavior.

Participants were asked to indicate how likely they would be to plant a tree in their yard in the next 5 years on a scale from 1 (extremely unlikely) to 5 (extremely likely)¹. We wanted to see which of the motivations, constraints and demographic variables would be most closely associated with likelihood of planting a tree in the next 5 years so we conducted a regression model including the 14 motivations, 20 constraints and 7 barriers, our demographic variables (gender, age, race (converted to a binary, white/non-white), # of years lived in home, presence of an HOA, income and education) and a sum score for storm-water knowledge. Because there was a very large number of predictors that were likely to be highly inter-correlated, we conducted a stepwise regression that enters the variables into the model one at a time beginning with the most impactful and excludes variables that do not meet a set cutoff for significance. We set the cutoff for inclusion in the model at $p=0.15$ (note that this does not mean that all variables included in the model are considered significant predictors, it merely takes the most impactful variables, whether or not they are significant and includes them to reduce the complexity of the model).

The final model included 10 variables that met the cutoff: Race (white vs. non-white), the constraints that planting a tree will interfere with current aesthetics of the yard, not knowing what to do with debris left over from planting, the effort involved in clearing debris and the possibility that the tree will die due to factors beyond the participant's control, the barriers of the participant's age, the community that the participant is from (New Albany vs. Gahanna).

Table 12: Results of stepwise regressions predicting likelihood of planting a tree in the next 5 years.

| Variable | b | p |
|-------------------------------------------|--------|-------|
| Race (White vs. Non-White) | 1.336 | 0.002 |
| Interfere with Aesthetics | -0.415 | 0.018 |
| Planting residue disposal | 0.656 | 0.001 |
| Age (in years) | -0.033 | 0.009 |
| Community (New Albany vs. Gahanna) | -1.345 | 0.001 |
| HOA Rules (Location) | 0.431 | 0.001 |
| Lack of Information (rules) | -0.635 | 0.001 |
| Lack of Information (trees) | 0.542 | 0.004 |
| Premature death | -0.239 | 0.098 |
| Effort clearing debris | -0.261 | 0.134 |

The model shows being white (vs. non-white), not knowing how to dispose of planting residue, being constrained by HOA rules about tree location and lacking sufficient information about trees are all positively associated with intentions to plant a tree in the future. This is quite surprising considering that participants were asked to consider the extent to which each of those factors (excluding race) were barriers or constraints to their desire to plant a tree. A potential explanation is that the barriers of HOA rules about location and considerations about what to do

¹ An error was found on the paper version of the survey showing that the scale was mislabeled such that both 1 and 5 on the scale were labeled as "extremely unlikely". This does not appear to have impacted responses, the distributions between the online and paper versions are similar and regressions predicting the selection of the 5th scale point based on whether the survey was taken online or on paper show no significant differences.

with planting residue are likely to only be barriers to those who have thought about planting a tree a considerable amount (i.e. a participant would have to be quite far along in the decision process to be obstructed by the rules of their HOA). Similarly the people who are most motivated to plant a tree may also be the least likely to suggest that they have sufficient information to make that decision. In this sense then, it may be motivation to plant a tree that is causing people to endorse these high-level barriers to planting rather than the other way around.

Conversely, the constraints and barriers that are negatively associated with likelihood of planting a tree are lack of information about rules, interference with current aesthetics, concerns about premature death and the effort associated with clearing debris (though these last two are only marginally significant). These barriers are encountered much earlier in the decision-process (in fact they occur before the decision process even begins) and so may be most closely associated with a lack of motivation to plant a tree. Other factors that are associated with a lower likelihood of planting a tree are residence in New Albany (vs. Gahanna) and older age. These make sense in the context of greater restrictions in New Albany (considered against Gahanna) and the physical barriers presented by older age in planting a tree oneself.

Takeaways from predicting tree-planting intentions

It may not be sufficient to simply look at associations between constraints and intentions to discover what the key constraints are as constraints can occur at different stages of the decision process. People who are suggesting that low level barriers are the most impactful may have the lowest current levels of motivation to plant trees because they are being deterred by more obvious, lower level considerations. Addressing these low-level considerations (for instance, uncertainty regarding HOA rules) may be crucial to motivating those early in the process but will not necessarily be sufficient for those who are already motivated. These people may need additional assistance overcoming higher level barriers such as making decisions about which species to plant simpler and better informed. Increasing the degree of certainty about the rules associated with planting trees and using HOAs or local authorities to help to simplify decisions about species and placement may help to address the concerns of residents who are either early or late in the decision process to plant a tree.

Storm-Water Knowledge (Objective 5)

Participants were asked to respond to a series of 8 storm-water knowledge questions developed and selected by experts at the Franklin County Soil and Water Conservation District. Table 13 shows the distribution of results across the two communities. Of the 8 questions, 5 were “True or False” questions (designated T/F in the table) and 3 were multiple choice with 4 response options. Each item also had a “don’t know” option, participants were encouraged in the introduction to the question set to check the don’t know box if they were unsure of the answer, however it appears, based on the rarity of “don’t know” responses, that participants may simply have skipped items they didn’t know the answers to.

The mean number of correct answers across the overall sample was 5.07 (SD=1.85), the mean for Gahanna was 5.30 (SD=1.82) and the mean for New Albany was 4.91 (SD=1.86). Results of a simple regression predicting the number of correct answers from community was not significant suggesting that there is no significant difference in overall number of questions correct between the 2 communities.

For the individual questions, in the overall sample, each question was answered correctly by a substantial proportion (over 70%) of the respondents with the exceptions of question 3 concerning whether or not streamside vegetation should be mowed to allow access to

waterways (51% correct) and question 6 concerning the proper application of lawn fertilizer (31% correct). This suggests that for question 3 around half of the participants either didn't know (10%) or thought that regular clearing of streamside vegetation should be regularly cleared to allow access to the stream (39%) (though it is worth noting that they may have had ulterior motives for selecting this response other than storm-water runoff prevention). For question 6, a substantial majority of participants identified applying fertilizer right before rainfall to ensure roots soak up fertilizer as the best advice about how to apply fertilizer to a lawn either by selecting it directly as their answer (24%), selecting it in conjunction with the correct answer (6%) or selecting "all of the above" (34%) which also includes a belief that applying a little extra fertilizer is okay if the lawn needs a boost. Logistic regressions predicting the likelihood of getting each question correct from community show significant differences between Gahanna and New Albany resident's likelihood of answering questions 3 and 5 correctly such that New Albany residents were roughly 25% less likely to answer correctly than Gahanna residents for question 3 ($b=-0.273$, $p=0.002$, $OR=0.761$) and 17% less likely than Gahanna residents to answer correctly for question 5 ($b=-0.187$, $p=0.012$ $OR=0.829$).

Table 13: Storm-water knowledge by community

| Question | Overall | | | Gahanna | | | New Albany | | |
|-------------------------------------------------------------------------------------------------------------------------------|---------|--------------|-------------|---------|-------------|------------|------------|-------------|-------------|
| | N | Correct | Don't know | N | Correct | Don't know | N | Correct | Don't know |
| 1. Storm-water is rainwater or snowmelt that runs off surfaces such as roofs, lawns, streets driveways and parking lots (T/F) | 158 | 150 (95%) | 5 (3%) | 62 | 60 (97%) | 2 (3%) | 96 | 90 (94%) | 3 (3%) |
| 2. All storm drains flow to a treatment plant where the storm-water is treated before it goes into a river or stream (T/F) | 132 | 97 (74%) | 15 (11%) | 55 | 43 (78%) | 5 (10%) | 77 | 54 (70%) | 10 (13%) |
| 3. Streamside vegetation should be cleared and mowed regularly to allow access to the stream (T/F) | 127 | 65 (51%) | 13 (10%) | 52 | 35 (67%) | 4 (8%) | 75 | 30 (40%) | 9 (12%) |
| 4. Trees help reduce storm-water runoff (T/F) | 154 | 148 (96%) | 5 (3%) | 59 | 55 (93%) | 3 (5%) | 95 | 93 (98%) | 2 (2%) |
| 5. Only rain should go into a storm-drain (T/F) | 147 | 109 (74%) | 5 (3%) | 56 | 48 (86%) | 1 (2%) | 91 | 61 (67%) | 4 (4%) |
| 6. Which of the following is the best advice for how you should apply fertilizer to your lawn? (Multiple Choice) | 142 | 44 (31%) | 8 (6%) | 57 | 15 (26%) | 3 (5%) | 85 | 29 (34%) | 5 (6%) |
| 7. The best way to dispose of dog waste is to... (Multiple Choice) | 144 | 127 (88%) | 5 (3%) | 58 | 50 (86%) | 1 (2%) | 86 | 77 (89%) | 4 (5%) |
| 8. Yard waste, including fallen leaves and lawn clippings can be a problem because... (Multiple Choice) | 139 | 106 (76%) | 6 (4%) | 56 | 44 (79%) | 2 (4%) | 83 | 62 (75%) | 4 (5%) |

Total N=174, between 16 and 47 responses are missing for each question, 5-15 for Gahanna, 11-32 for New Albany

Takeaways from storm-water knowledge.

Taken together this suggests that overall storm-water knowledge across the two communities is fair, but several beliefs persist that may need to be addressed, particularly that applying fertilizer right before a rainfall event can increase fertilizer retention and that clearing vegetation around streams to maintain access is a good idea (this is particularly persistent in New Albany).

Next Steps

The findings from this research project provide some insights to support future action to promote the planting of trees among residents of central Ohio communities. While the research findings here do not, on the surface, immediately suggest a form for a behavioral intervention, it does provide some insight into the potential content that the intervention should include. In order to determine the form that an intervention should take, we need to turn to the broad spectrum of behavior change tools available to researchers and practitioners in promoting sustainable behaviors. Choosing the appropriate tool can be somewhat challenging, however there is guidance available that suggests a short list of tools depending on the perceived levels of barriers and benefits among the target population, that is, different tools are more appropriate for situations where barriers are perceived as high and benefits are perceived as low than for the converse circumstance (Schultz, 2013).

In order to determine, then, what the best tools to employ might be, we require an understanding of how the barriers and benefits are perceived in our target audience. Based on results from the phase 2 survey and our assessment of research objective 2 we have some evidence to suggest that the benefits of the behavior are viewed as quite high. The majority of the motivations laid out in the survey were broadly endorsed and are generally rated above a 3 on a 5-point scale. Conversely, many of the barriers and constraints were rated considerably lower on a similar scale. This pattern of results would suggest that most people consider the benefits of the behavior to be high, while the barriers are correspondingly low. However, there are 2 other factors that are worth bringing under consideration when making this judgment. First is the ever-present potential for sample bias. It is possible that because participant recruitment and response was dependent at least in part on residents being interested in the topic (and our survey response rates hardly constitute a census of the population) we may see a systematic bias in the relative ratings of motivations and constraints due to a sample that is more motivated (and less constrained) than their neighbors. The second factor worth considering is the predictive power of the constraints for behavioral intentions. We see from research objective 4 that many of the predictors that are associated with likelihood of planting a tree within the next 5 years are themselves barriers and constraints. This suggests that, even though the barriers were rated as quite low in the survey, they are still having a significant impact on whether or not a person plans to plant a tree in the future. Taken together, these factors suggest that the relative levels of motivation and constraint may not be as they appear at face value in the survey data and that while perceived benefits may indeed be high, perceived barriers may also be higher than they appear.

In terms of next steps then, it is worth considering two scenarios: one in which we accept the data from the survey at face value and suggest that, for at least a subset of the population, planting a tree in a residential yard is considered a high-benefit, low-barrier behavior, and another scenario in which we integrate our survey data with our inferences about the sample and predictive ability of constraints over behavior and suggest that the behavior is viewed as

both high-barrier and high-benefit. The two scenarios are logically associated with different sets of suggested tools for behavior change (Schultz, 2013). In the case of Scenario 1 (High-benefit, Low-barrier), the challenge is simply to remind people to engage in the behavior, they already believe that it is beneficial and don't feel particularly constrained in their ability to do it, so having them adopt the behavior is (in theory) as simple as reminding them about the behavior and providing them with opportunities to engage in the behavior whenever possible. In the case of Scenario 2 (High-benefit, High-barrier), behavior change becomes a little more challenging in that the barriers either have to be reduced to meet levels of perceived benefit, or the existing benefits have to be leveraged in such a way that they overcome current levels of perceived barriers.

Specific tools for accomplishing these goals are suggested in Schultz (2013). For High benefit, Low-barrier behaviors characterized by our Scenario 1, Schultz recommends Education, Prompts, Cognitive dissonance manipulations and Feedback. For High-barrier, High-benefit behaviors such as those characterized in Scenario 2, Schultz recommends interventions aimed at making the behavior easy (and/or fun) and securing commitments to engage in the behavior.

Scenario 1 (High-Benefit, Low Barrier):

For Scenario 1, some of the tools that are recommended are not appropriate for tree-planting behavior in the context of central Ohio. For instance, Feedback interventions are generally aimed at providing people with feedback over time about their behavior in the hopes of adjusting that behavior to be more in line with the goals of the organization providing the feedback. Such interventions are typically employed in the context of flexible behaviors that are repeated over time where there are multiple opportunities for engaging in and adjusting behavior over time (think, for instance, of adjusting a thermostat, it can be set back 1 degree or 10 and is adjusted daily or weekly). For a one-time, binary behavior like planting a tree (you either plant the tree or you don't), there are considerably fewer opportunities for providing feedback on the behavior and for the resident to adjust their behavior based on the feedback. Education is another tool that, while tempting, is unlikely to be impactful in this context as the educational materials already exist and are being employed currently, simply engaging in more education is unlikely to make a difference, particularly in light of the fact that most participants didn't think about storm-water runoff reduction as a salient benefit to them of planting a tree in their yards. This leaves prompts and cognitive dissonance manipulations.

Prompts are generally small reminders that are placed near the point of decision-making for a person that encourages and reminds them to engage in the target behavior. Often these prompts take the form of small signs or infographics that help people remember to engage in the target behavior. Important elements of prompts include that they be visible, easy to understand and close to the point of decision-making. Prompts have most often been shown to be successful in the case of repeated, very-low barrier behaviors such as turning off lights or composting food waste in cafeterias. While this is a different context than tree-planting which is a one-time behavior, prompts are not impossible to use in this context. In the case of tree planting, prompts may take the form of signs at local home and garden stores providing directions to the gardening department and depicting tree-planting as an enjoyable and beneficial activity. In such a case, the data from the survey can be used to suggest content for the prompts. For instance, the highest rated motivations for planting a tree were for visual appeal, shade, privacy and connection to nature. Prompts that are designed with these key motivations in mind (i.e. depicting a shady, private summer yard scene with attractive native trees providing a natural barrier to noise with accompanying language that leverages these benefits succinctly) are more likely to be successful in this instance. It is important to reiterate

that prompts can only be successful if they are employed close to when a person is able to make a decision. Placing a prompt in a post-card might briefly encourage a desire to purchase a tree for planting. However, placing them in a location where a person can immediately purchase a tree is considerably more likely to be successful in translating that desire into behavior.

Cognitive dissonance manipulations are a little more complex and are often employed as a content element in other types of interventions such as prompts or commitments. In essence, these are interventions that are based on the human motivation to be consistent in thought and deed. Essentially these interventions capitalize on the discomfort that people feel upon being reminded that they are behaving in a way that is inconsistent with their beliefs (particularly their stated beliefs). In the event that people believe that planting a tree is a good thing (it is high benefit) and that they can plant a tree (it is low barrier) then reminding them that they are not doing it, despite the fact that they should be doing so can be effective at getting people to change their behavior. As with prompts, these interventions are primarily used in the context of more plastic, repeated behaviors such as water or electricity use where smaller scale adjustments are easy to make on a repeated basis over time. For one-time behaviors, these interventions generally take the form of commitments which we will cover under Scenario 2.

Scenario 2 (High-Benefit, High-Barrier):

Under Scenario 2, the goal would be to either leverage existing benefits to get people to overcome the barriers associated with the behavior or to take steps to reduce the existing barriers. Commitments are one way of highlighting existing benefits. Getting people to commit to engaging in a behavior in an environment where the benefits of the behavior are obvious and the barriers less so and then reminding them of this commitment at a later date can be one way to help them to overcome the concrete barriers that come up and prevent them from fulfilling their best intentions. The interventions are often quite simple, merely asking people to make a commitment in plain terms to engage in the behavior in a specified time frame (i.e. "I commit to planting an Ohio native tree in my yard in the next 12 months") and often having them sign the commitment. These interventions hence have 2 parts, first you have to provide an environment that encourages people to make a commitment to engage in a behavior. This requires that the benefits are salient to them while the barriers are less so. This commitment serves as a concrete reminder of their beliefs and their commitment to act. Following this, you must then remind them of their commitment to help them to engage in the behavior, these reminders serve a similar function to both prompts and cognitive dissonance manipulations, because there is evidence of a prior commitment, not following through on that commitment is psychologically uncomfortable and the reminders also serve as a prompt to engage in particular steps to take the desired action. There are a couple of ways that commitments could be organized in the context of tree-planting in central Ohio communities. Because a number of participants in phase 1 suggested that they would like to see more engagement from the municipalities in planting trees in areas that are currently bare, one way to induce a commitment might be to hold a tree-planting event on city property. This would be an excellent venue to provide specific educational and informational needs that could help to make the behavior easier (see below) and would also provide an excellent environment to induce a commitment from participants. Giving residents experience with the behavior can help them to reduce uncertainty about the barriers and also can get them excited about the process. This could be an ideal time to ask them to commit to planting a tree in their yards in the future. Such a commitment is likely to be more effective if made public, as a result, having people commit at the fair using a commitment board or posting a list of names (with consent) on the municipality's website could be an effective way of increasing the impact of the commitment. If email addresses are collected at

the time of commitment, then reminders can be sent over time intervals and people can be asked to provide photos of their tree planting which can serve as social models for other members of the community. The reminders can also serve as a mechanism to provide helpful directions about HOA rules (where applicable) and about who to contact for consultation on placement and species selection.

Another possible way to induce a commitment might be to tie it to existing incentive programs for trees and rain-barrels. Because the system in place is a rebate system, it is motivating only insofar as it reduces the cost associated with the behavior which is generally not the biggest barrier that we identified in the survey. However, the availability of these rebates provides an excellent opportunity to ask residents to commit. If residents are asked to apply for a rebate prior to making the purchase, this creates an opportunity to ask them to commit to following through. In the absence of a commitment, not following through on the behavior is merely a missed opportunity to reduce the costs associated with a costly behavior. This isn't necessarily the most motivating circumstance psychologically. On the other hand, associating the behavior with a commitment can increase motivation to follow through because it is now tied to the desire to be consistent and to feel good about oneself (i.e. following through on commitments is generally understood as a positive trait). These two ways of engaging in commitments are not mutually exclusive and could certainly go together organized either through municipalities or FSW.

Finally, there are a series of recommendations in the report tied to making information easily available and reducing the complexity of the decision. This is likely to take a more passive form than the previously described initiatives and should be used to supplement other interventions such as tying the behavior to a commitment or providing prompts. The following recommendations are from the executive summary of the report:

- Partner with local municipalities and/or HOAs to make the following information as readily accessible as possible either online or through personnel visits:
 - Precise local and HOA rules about tree species and placement
 - Location of pipes and utilities (where possible)
 - A short list of attractive, Ohio-native tree species with growth projections to simplify the decision for residents of what trees will likely thrive with little maintenance.
 - Species-specific guidelines for tree placement to reduce likelihood of property damage (particularly in Gahanna)
 - Any existing incentive programs
- In collaboration with local HOAs, identify which rules are most restrictive with respect to tree-planting and adjust them (where possible) to promote the planting of trees that are beneficial for storm-water management.
- Promote tree/shrub placement or species strategies that take up the minimum space possible while maintaining storm-water benefits (particularly in New Albany).
- Where possible, a program to assist (particularly older) residents in removing debris left over from planting (i.e. excess soil) could reduce uncertainty about what to do with it and can reduce the effort involved particularly for those who are less physically able.

Some of these adjustments will take place behind the scenes, in training experts to make recommendations that reduce the complexity of decisions or working with municipalities or HOAs to adjust rules, where some of them can be accomplished using mechanisms built into the other recommendations (i.e. the placement and content of prompts, the scheduling or presentation of a tree fair or commitment-based website etc.).

Appendix A: Focus Group Questions

1. Have any of you planted one or more trees in your yard?
 - a. [If Yes] Could you describe the single most important reason why you did plant a tree in your yard?
 - b. [If No] Could you describe the single most important reason why you haven't planted a tree in your yard?
2. Would each of you please describe in a few words or a short sentence, what's the first thing that comes to mind when you think about planting trees in your yard?
 - a. Have any of you considered planting trees in order to help improve local water quality or storm-water quantity?
3. Some people find the idea of planting trees difficult, inconvenient or unpleasant, is that a perception that each of you shares?
 - a. [If Yes] Can you talk a little bit about what makes planting trees difficult, for you?
4. Do you have any ideas regarding what could be done to make planting trees less difficult, inconvenient or unpleasant?
5. Is there anything else that comes to mind about planting trees in your yard that you think it would be important for us to know?

Appendix B: Survey Instrument

This is the survey portion of the study, if you haven't yet read the cover letter that was included in the research packet, please do so before completing the survey. Thank you for your participation!

1. People sometimes report positive factors that make them want to plant trees in their yard. To what extent do each of the following make you want to plant a tree in your yard?

| | Not at all | Somewhat | Moderately | A lot | A great deal | Not Applicable |
|------------------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Planting a tree will attract desirable wildlife to my yard | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I have positive memories associated with trees | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Trees make me feel a closer connection to nature | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Trees give my children a place to play | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Planting a tree in my yard could create positive relationships with neighbors | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I like the visual appeal of trees | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Planting a tree in my yard would provide shade for my yard and home | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I want trees which produce fruit | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Planting a tree in my yard would help to block the noise of neighbors | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I want to plant a tree in my yard to replace a tree that died | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Planting a tree in my yard would help provide privacy for my yard and home | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Planting a tree in my yard would help absorb storm water and reduce flooding | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Planting a tree in my yard would help to provide habitat that attracts pollinators | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Planting a tree in my yard would help to produce oxygen | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

2. People sometimes report factors that prevent them from planting trees in their yard. To what extent are each of the following barriers that limit your ability to plant a tree in your yard?

| | Not at all limiting | A little limiting | Somewhat limiting | Very limiting | Extremely limiting | Not Applicable |
|---------------------------------------------------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| My Home-Owner's Association's rules about what species of trees I can plant | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| My Home-Owner's Association's rules about where I can plant trees | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Local government rules about what species of trees I can plant | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Local government rules about where I can plant trees | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Availability of space in my yard | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I don't have access to sufficient information about trees to make a decision about planting a tree in my yard | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I don't have access to sufficient information about local rules to make a decision about planting a tree in my yard | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

3. People sometimes report concerns that make them hesitant to plant a tree. To what extent do each of the following get in the way of you wanting to plant a tree in your yard?

| | Not at all | Somewhat | Moderately | A lot | A great deal | Not Applicable |
|------------------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Nuisance wildlife may be attracted to my yard | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Tree roots may spread and damage public utility pipes | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Trees may cause damage to my home or property | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I don't have a "green thumb" and any tree that I plant will die | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I am concerned that trees on my property will die due to factors beyond my control | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

| | Not at all | Somewhat | Moderately | A lot | A great deal | Not Applicable |
|-----------------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| The information I would need to make a decision to plant a tree is too complex | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I do not trust tree installers or landscapers to deal with me honestly | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| It is not common for people to plant trees in my neighborhood | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I am concerned about my tree causing damage which affects others | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Planting a tree may cause conflict with my neighbors | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| It takes too long to get the benefits of planting a tree | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| It is too expensive to plant a tree. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| It takes too much time and effort to plant a tree | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I do not know what to do with the mess created when I plant a tree | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Planting a tree will fill valuable open space in my yard | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Planting a tree will interfere with the current aesthetics of my yard | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| It takes too much time and effort to maintain and trim a tree | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| It takes too much time and effort to deal with leaves and other litter from trees | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Planting a tree will take yard space and sunlight away from my garden | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| I do not want a tree to block sun from reaching my home | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

4. Next, we'd like to know a little more about what you know about storm-water runoff. People have a range of different beliefs and levels of knowledge about what storm-water is and how it behaves. Please answer each of the following to the best of your ability, but if you aren't sure of the answer, please feel free to check the "don't know" box.

| | True | False | Don't know |
|------------------------------------------------------------------------------------------------------------------------|--------------------------|--------------------------|--------------------------|
| Storm-water is rainwater or snowmelt that runs off surfaces such as roofs, lawns, streets, driveways and parking lots. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| All storm drains flow to a treatment plant where the storm-water is treated before it goes into a river or stream. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Streamside vegetation should be cleared and mowed regularly to allow access to the stream. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Trees help reduce storm-water runoff. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Only rain should go into a storm drain. | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

| | | | | |
|----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|--------------------------------------------------------------|-------------------------------------|
| Which of the following is the best advice for how you should apply fertilizer to your lawn? | | | | |
| <input type="checkbox"/> Apply right before rainfall to ensure roots soak up fertilizer | <input type="checkbox"/> A little extra fertilizer than recommended is OK if your lawn needs an extra boost. | <input type="checkbox"/> Keep fertilizer off of hard surfaces. | <input type="checkbox"/> All of the above. | <input type="checkbox"/> Don't know |
| The best way to dispose of dog waste is to... | | | | |
| <input type="checkbox"/> Wash it down the storm drain. | <input type="checkbox"/> Scoop it, bag it, and place it in the trash. | <input type="checkbox"/> If it is in a park, Parks and Recreation picks it up. | <input type="checkbox"/> Leave it on the lawn as fertilizer. | <input type="checkbox"/> Don't know |
| Yard waste, including fallen leaves and lawn clippings can be a problem because... | | | | |
| <input type="checkbox"/> It can clog storm drains. | <input type="checkbox"/> It contains nutrients that spur algae and aquatic weed growth our water. | <input type="checkbox"/> Some put it in the trash where it takes up space at the landfill | <input type="checkbox"/> All of the above. | <input type="checkbox"/> Don't know |

5. Next, we'd like to know a little more about you and your plans for your property

In general, are you someone who is fully prepared to take risks or do you try to avoid taking risks?

Don't like to take risks

1. ☐

2. ☐

3. ☐

4. ☐

5. ☐

6. ☐

7. ☐

Fully prepared to take risks

When you think about planting a tree in your yard, which of the following risks (if any) are you concerned about?

| | Not at all concerned | Somewhat concerned | Moderately concerned | Very concerned | Extremely concerned |
|------------------------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Violating community rules or norms | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Wasting money | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Interfering with the aesthetics in my yard | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Damaging relationships with neighbors or community members | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Making too much work for myself | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Have you planted a tree in your yard in your current home?

☐ Yes

☐ No

If so, when was the last time you planted a tree on your current property?

☐ >5 years ago

☐ 3-5 years ago

☐ 1-2 years ago

☐ <1 year ago

How likely are you to plant a tree on your property in the next 5 years?

Extremely unlikely

Somewhat unlikely

Neither

Somewhat likely

Extremely unlikely

☐

☐

☐

☐

☐

When you think about planting a tree in your yard, where are you likely to go to get information to help you decide what kind of tree and where to plant it (select all that apply)

☐ A local nursery

☐ Friends/ colleagues

☐ University extension

☐ Franklin Soil and Water

☐ Your HOA

☐ Local government

☐ Internet resources

☐ Other:

In the next 5 years, which of the following would you be most likely to do on your current property?

☐ Plant a tree myself

☐ Plant a tree with assistance from friends and family

☐ Use a landscaping or garden service to have a tree planted

☐ None of the above, I don't plan to plant a tree in my yard in the next 5 years

6. Finally we'd like to know a little more about you

| | | | |
|-----------------------------------------------------------------------------------------|----------------------------------------------------|-----------------------------------------------------------|--------------------------------------------|
| Please indicate your gender | | | |
| <input type="checkbox"/> Male | <input type="checkbox"/> Female | <input type="checkbox"/> Prefer not to say | <input type="checkbox"/> Other: |
| Please indicate the race with which you most closely identify | | | |
| <input type="checkbox"/> White | <input type="checkbox"/> Black or African American | <input type="checkbox"/> American Indian or Alaska Native | <input type="checkbox"/> Asian |
| <input type="checkbox"/> Native Hawaiian or Pacific Islander | <input type="checkbox"/> Hispanic/Latino | <input type="checkbox"/> Prefer not to say | <input type="checkbox"/> Other: |
| Please indicate your age in years: | | | |
| How long have you lived in your current home in years? | | | |
| Do you have a Homeowner's Association (HOA) that regulates your neighborhood? | | | |
| <input type="checkbox"/> Yes | | <input type="checkbox"/> No | <input type="checkbox"/> Don't know |
| Which of the following comes closest to your household income? | | | |
| <input type="checkbox"/> <\$35,000 | <input type="checkbox"/> \$35,000-\$49,999 | <input type="checkbox"/> \$50,000-\$69,999 | <input type="checkbox"/> \$70,000-\$89,999 |
| <input type="checkbox"/> \$90,000-\$119,000 | <input type="checkbox"/> \$120,000-\$149,999 | <input type="checkbox"/> More than \$150,000 | <input type="checkbox"/> Prefer not to say |
| Which of the following is closest to the highest level of education you have completed? | | | |
| <input type="checkbox"/> Less than high school | <input type="checkbox"/> High school graduate | <input type="checkbox"/> Some college | <input type="checkbox"/> 2-year degree |
| <input type="checkbox"/> 4-year degree | <input type="checkbox"/> Master's degree | <input type="checkbox"/> Professional Degree | <input type="checkbox"/> Doctorate |

7. Is there anything else you would like to tell us about why you would or would not want to plant a tree in your yard?

Thank you so much for completing the survey! Please remember to return the survey to the bag it came in and leave the completed survey hanging on your door knob on the date indicated on the instruction sheet included in the packet. A member of the research team will come on the indicated date to collect the survey and if the survey is hanging on the door it will save us from disturbing you.

Thank you again and feel free to contact a member of the research team if you have any questions! (Contact information can be found on the instruction sheet in the research packet).