Title TBD

Abstract TBD

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# Introduction

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# Citizen Science and Volunteered Geographic Information

Aided by the development of interactive web platforms and applications for mobile data collection, citizen science has become a common method for field research (Curtis, 2018). Defined as “projects that engage both professional scientists and non-specialists in the process of gathering, evaluating or computing scientific data,” Curtis (2018, p. 1) describes two main strands of this research. The first is participatory action research, where community members themselves drive research into collectively identified problems (see also Kindon, Pain, & Kesby, 2007). The second is scientist driven research, where non-experts are enlisted in the process of data collection for already existing research projects. One of the most widely cited examples of this approach is the online project eBird, which collects data from bird watchers to create maps of species’ geographic distribution (Sullivan et al., 2014; The Cornell Lab of Ornithology, 2019).

A related term, volunteered geographic information (VGI), has been used to describe explicitly spatial data produced by ordinary citizens (Goodchild, 2007; Haklay, 2013). These data can be collected through both active or passive participation. The former includes research projects like eBird or online review platforms such as TripAdvisor. The latter includes services that collect data as background information, such as location services on cell phone applications, posts on social media that include geographic location, or surveillance footage (Haklay, 2013).

VGI is not synonymous with citizen science: VGI sometimes lacks the component of active engagement common to most citizen science projects, and not all citizen science includes explicitly spatial data. One of the most prominent examples of VGI is the web service OpenStreetMap, which provides user contributed global data on roads, buildings, and natural features (Bittner, 2016). While this dataset has been used within research projects or for social initiatives such as crisis mapping, it is not itself created to answer specific research questions (Haworth, 2017; Quinn & Yapa, 2015). Yet VGI and citizen science do overlap. For example, a website created to study the spread of disease between oak trees provided tools for concerned citizens to add nearly 2,000 observations to a research dataset (Connors, Lei, & Kelly, 2012). Another study used a participatory design to include both university faculty and community residents to collect, analyze, and report data on local watershed problems (Taki, Jelks, Hawthorne, Dai, & Stauber, 2018).

As crowdsourced tools for scientific inquiry, both VGI and citizen science have been credited with easing the process of data collection and increasing trust between scientists and the general public, though concerns about data quality and geographic sampling remain. A recent meta-analysis by Brown (2017) showed that data accuracy and participation rates have varied considerably in studies making use of a participatory citizen science model. To achieve better consistency, Brown argues for the use of techniques from survey design that are aimed at increasing motivations for participation as well as explicit attention to and systematization of the geographic distribution of community volunteers. These concerns are echoed by Brovelli, et al. (2015), who found that the effectiveness of mobile data collection projects was closely linked to intentional volunteer recruitment and clear project goals. Together, these studies show that while new technologies may help facilitate citizen science research, they do not replace the logistical and relational labor of recruiting researchers or developing and communicating clear project goals.

VGI and citizen science have played a prominent role in many smart city projects, which have incorporated data in bike sharing (Attard, Haklay, & Capineri, 2016), real time traffic data such as that provided by Google (Johnson & Sieber, 2013), or even emotional states (De Oliveira & Painho, 2015) into governance tools and decision making. Cardullo and Kitchin (2019) use Arnstein’s (1969) ladder of citizen participation as a way to classify the kinds of “digital citizenship” created though these projects. At one end of this spectrum, residents are merely passive providers of data or consumers for whom crowdsourced data supports more informed decisions. Traffic maps or energy use dashboards are two examples of this approach. At the other end of this spectrum, residents are empowered to rework existing policies and institutions through forums like hackathons or other meetups where new solutions to urban problems are identified and developed. In practice, Cardullo and Kitchin write, examples of these are rare, as communities tend “to organize their activities and activism around addressing social and environmental issues through political and policy solutions rather than technological ones” (p. 9-10). Still, they argue, the potential remains for something more than neoliberal, consumer focused models of smart citizenship.

Pragmatist models of inquiry provide a useful structure for active forms of citizen engagement. Based in the work of early 20th century thinkers such as John Dewey and William James, pragmatism is a non-foundationalist philosophy that emphasize the social situatedness of knowledge (Dewey, 1997; James & McDermott, 1967). As Barnes (2008) puts it, pragmatism views ideas and knowledge “like knives and forks, implements to accomplish particular tasks, and not transcendent truths” (p. 1544). Those “tasks” are the ongoing routines that constitute social practice, or alternatively, processes of inquiry meant to identify social problems and develop new, more equitable practices. Through a process of inquiry, a diverse set of stakeholders develop a shared understanding of social problems, one that draws upon their respective experiences and perspectives. This knowledge is constructed *through* the process of inquiry and is thus specific to that time and place—it does not predate it, like an artifact waiting to be unearthed. In this sense, pragmatism’s influence is evident in later work such as Kuhn’s (1962) discussion of paradigm shifts, work in science and technology studies (Latour, 1993), or feminist critiques of positivism (Haraway, 1988) all of which emphasize the socially situated nature of knowledge production.

The models of civic engagement provided by citizen science and VGI share this emphasis on inquiry as a social process, one in which various publics can play an active role. Yet, as Harney et al. write, describing their model of process pragmatism, rather than working with

pre-existing publics that are already assembled around the pre-existing agendas that the academic is able and willing to endorse, process pragmatism seeks to use the process of research and knowledge production to construct new publics, new understandings, and new capacity to act. Working in the spirit of pragmatism involves bringing together diverse groups of people with differing worldviews, to find common ground and to create new publics united around issues of common concern. (Harney, McCurry, Scott, & Wills, 2016, p. 9)

In the context of citizen science, this approach emphasizes how the research process can generate new connections between diverse stakeholders. Through an inductive, collaborative process, research teams can construct new understandings of their local neighborhoods and the issues that face them. In this sense, the use of VGI moves beyond a framing of “citizens as sensors” (Goodchild, 2007), as community members play an active role in identifying problems and interpreting the data they collect.

At the same time, the task of building this shared understanding requires time and logistical coordination, as well as the ability to nurture social connections between members of a research team. Our research examines this process through analysis of a community housing assessment program in x cities across rural Georgia. Specifically, we give attention to the ways that a community based process of VGI data collection provided new insights into housing conditions within these communities, as well as ways that communities sometimes struggled to coordinate this process. In doing so, we contribute to the growing literature on how the use of VGI for citizen science can effectively facilitate community engaged research.

# Community Housing assessments

Role of housing assessments in community development and planning (Kim)—or is this necessary if I summarize in methods?

# Setting and Methods

The communities we partnered with for this research were part of the Georgia Initiative for Community Housing (GICH), a program designed to facilitate community planning for affordable housing (University of Georgia, 2019). Each year, five communities enter this program, and these are most often small municipalities from rural parts of the state. As part of their application, communities assemble a housing team that includes a range of key stakeholders, including elected officials, members of community organizations, and housing professionals such as real estate agents or mortgage lenders. Over the course of GICH’s three year program, planning teams attend bi-annual retreats where they attend sessions on issues including techniques for managing heir properties, tools for identifying and reducing blight, and information for working with state housing authorities and their funding programs. Each community also is assigned a facilitator who helps them identify and plan for goals, which often included targeted redevelopment of a set of properties along with a successful application for state or federal funding. Over it’s 12 year history, GICH has enrolled x communities throughout the state.

In recent years, many GICH communities have included community housing assessments to provide data for redevelopment plans and funding applications. These assessments use a winshield survey of properties in a targeted study area, going house by house to identify problems with the housing structure or lot conditions. In most cases, planning teams have opted to conduct this assessment themselves rather than hire an outside agency. Working with the city of Pembroke, one of the first communities to use this method, faculty at the University of Georgia (UGA), including one author of this paper (Skobba), developed a standardized data collection form for this process in 201x(?). It allowed survey teams to rate structural issues as either minor or major problems and created a three tier system of classification based on these classifications.

A second version of this survey was developed in 2017. It includes a foundation to roof assessment of built structures as well as questions on the condition of the lot (e.g., overgrown grass, trash/tires) (appendix A). Each issue listed on the survey has a point value, and the sum of these points is used to create a general classification from a list of six categories. Table 1 also provides a summary of categories included on each of these two surveys and Table 2 summarizes the classification system of each survey.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | ***Version 1*** | ***Version 2*** |  |  | ***Version 1*** | ***Version 2*** |
| **Property status** |  |  |  | **Roofing** |  |  |
| Occupancy | x | x |  | Swaying roof | x |  |
| **Property characteristics** |  |  |  | Gutter repair |  | x |
| Single family/ multifamily | x | x |  | Missing shingles | x | x |
| Height/stories | x | x |  | Partial re-roofing | x | x |
| **Foundation** |  |  |  | Complete re-roofing | x | x |
| Cracked | x | x |  | Replace roof structure | x | x |
| Partial replacement |  | x |  | **Lot assessment** |  |  |
| Complete replacement | x | x |  | Overgrown/weeds | x | x |
| **Exterior** |  |  |  | Missing ground cover | x | x |
| Exposed insulation | x |  |  | Dead/hazardous trees |  | x |
| Gutter repair | x | x |  | Inoperable vehicle | x | x |
| Repainting | x | x |  | Junk in yard/porch | x | x |
| Minor dry rot | x | x |  | Porch used as storage | x | x |
| Needs replacement |  | x |  | Graffiti |  | x |
| Chimney repair | x | x |  | **Tax records** |  |  |
| Missing siding | x | x |  | Homestead status | x | x |
| **Windows/doors** |  |  |  | Owner name | x | x |
| Uneven windows/doors | x |  |  | Owner address | x | x |
| Repainting |  | x |  | Parcel location | x | x |
| Dry rot | x | x |  |  |  |  |
| Cracked glass | x | x |  |  |  |  |
| Window replacement | x | x |  |  |  |  |
| **Stairs/rails/porch** |  |  |  |  |  |  |
| Repainting |  | x |  |  |  |  |
| Dry rot/missing railing | x | x |  |  |  |  |
| Repair needed | x | x |  |  |  |  |

**Table 1: Topics included on housing assessment surveys**

|  |  |
| --- | --- |
| **Survey 1 classification** |  |
| *Standard* | No more than one minor issue |
| *Substandard* | More than one minor issue and at least one major issue |
| *Dilapidated* | More than three minor issues and more than 2 major issues |
|  |  |
| **Survey 2 classification** |  |
| *Well maintained* | (Less than 3 points): New or in good condition. Does not need any repairs. |
| *Sound* | (3-9 points): In good condition but is in need of some maintenance work, such as repainting or minor repairs. |
| *Minor repairs needed* | (10-14 points): Housing unit has several deferred maintenance issues or one moderate repair project (i.e. replacement of several windows) |
| *Moderate rehabilitation needed* | (15-39 points): Requires multiple repairs, including the repair/replacement of one major component. |
| *Substantial rehabilitation needed* | (40-55 points): Requires the repair and replacement of most or all exterior components. |
| *Dilapidated* | (More than 55 points): Housing unit suffers from excessive neglect, appears structurally unsound and not safe for human habitation, and may not be feasible to rehabilitate. |

**Table 2: Structure classification system**

With support of a USDA funded grant, the UGA research team created a set of digitized data collection tools to support these GICH communities. This two part suite of tools includes online forms for VGI data collection and a web application to map and analyze survey results. Data collection is accomplished through one of two platforms: OpenDataKit (ODK), an open source software that is most functional on Android devices, or Fulcrum, a proprietary multiplatform data collection tool that requires a paid subscription. Both tools allow users to input data via smartphones or tablets, greatly reducing the need for volunteers to do manual data entry. Both also allow for data to be linked to existing parcel records based on address or parcel number, which reduces the risk of error and allows for the import of data on parcel ownership and tenure status for analysis. Lastly, these platforms include the ability to link photos of the properties to the survey records.

Once collected, these data are visualized through an online web application. Few of the GICH planning teams include members with expertise in Geographic Information Systems (GIS) software for mapping and analysis, and learning how to operate desktop or online software can be overly time intensive. To ease this process, one UGA faculty (Shannon) and research assistants developed an online web application using the open source Shiny platform, created by the company RStudio for the R programming language (RStudio, 2016). R include support for mapping and analysis of spatial data, and through this online platform, planning team members can view properties by their overall rating and by specific property issues. They can also download records of selected properties and identify the most common problems listed in the survey data (Figure 1).

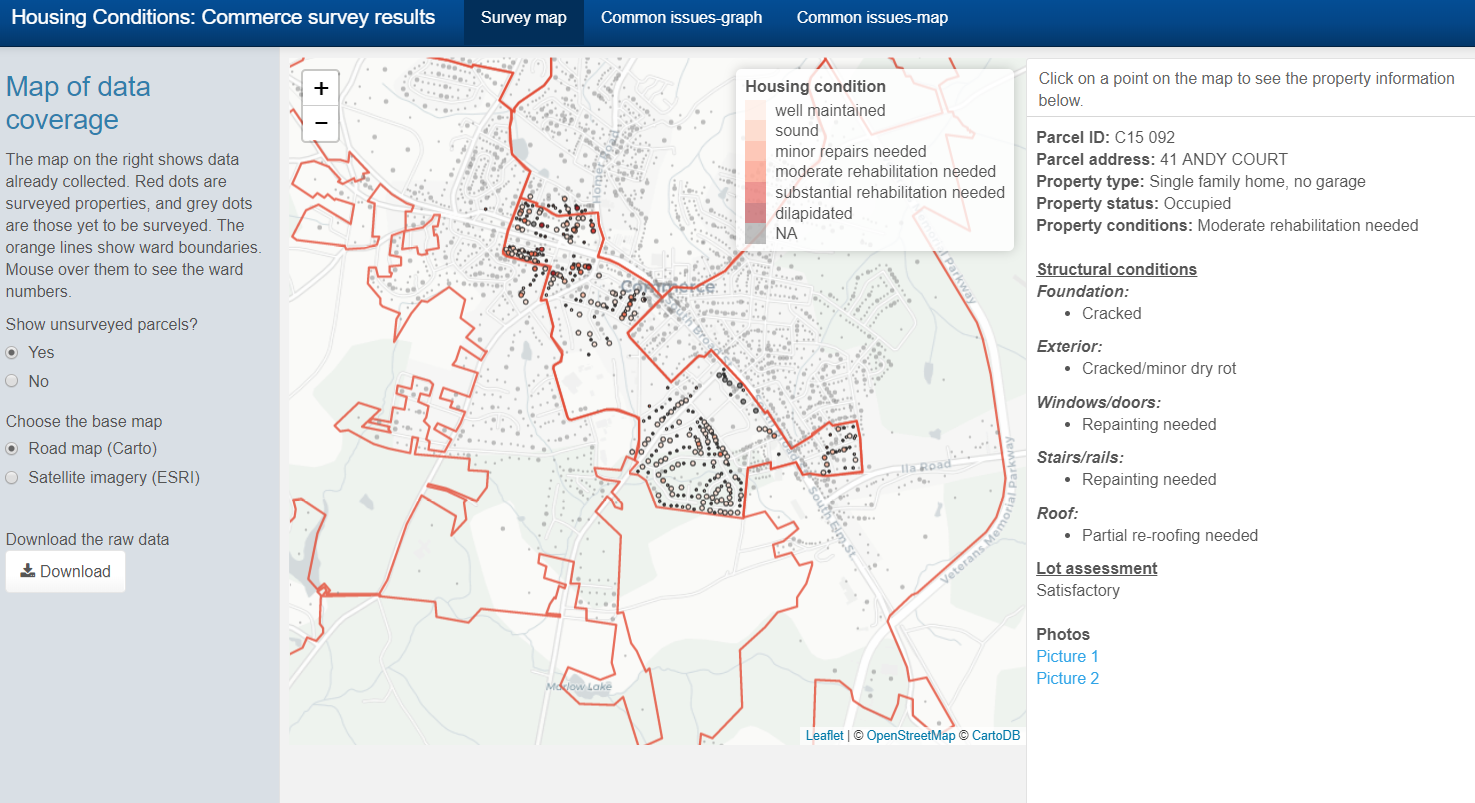


Figure 1: Screenshot from the online web application.

Since the creation of the housing assessment survey, ten Georgia communities have moved through this housing assessment process. We focus on seven communities that generated the most responses on this paper: Arlington, Marshalltown, Hancock, Benson, Stewart, Tyler, and Lewisville[[1]](#footnote-1). All but one of these communities—Lewisville (~25,000 residents)—have populations less than 15,000, and four have 5,000 or less. They are located throughout Georgia: Marshalltown and Arlington in the east near the South Carolina border, Hancock, Stewart, and Lewisville just outside the Atlanta suburbs, and Benson and Tyler in the central region of the state. Tyler is also home to a regional college.

Table 3 provides a demographic summary of these communities from the 2013-17 American Community Survey (United States Census Bureau, 2019), with values rounded to mask their identity. None of these communities have a median income more than 50% than Georgia’s ($52,977). The rate of renter-occupied housing ranges from 40%-65%, which is at or above Georgia’s statewide rate of 40.3%. The racial composition of these communities varies widely. Arlington is 80% African-American, while the rate Lewisville is only 15%. Similarly, 70% of the population in Hancock is classified as White, in contrast to only 30% of the population in Tyler. Housing structures are somewhat older than the statewide average, with a median construction dates ranging from 1965 to 1985.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Population | Median age | Median income | % rental households | % Hispanic | % African-American | % White | Median year for structures |
| Benson | 5,000 | 30 | $ 20,000 | 40% | 5% | 50% | 50% | 1975 |
| Hancock | 7,500 | 35 | $ 25,000 | 35% | 10% | 20% | 70% | 1980 |
| Lewisville | 25,000 | 30 | $ 25,000 | 65% | 25% | 15% | 40% | 1985 |
| Marshalltown | 5,000 | 40 | $ 15,000 | 45% | 10% | 35% | 50% | 1970 |
| Tyler | 3,000 | 40 | $ 18,000 | 40% | 5% | 60% | 30% | 1965 |
| Stewart | 15,000 | 35 | $ 20,000 | 65% | 5% | 40% | 50% | 1985 |
| Arlington | 2,000 | 40 | $ 15,000 | 55% | 0% | 80% | 20% | 1975 |
| |  | | --- | | **All of Georgia** | | 10,201,635 | 36.4 | $ 52,977 | 40.3% | 9% | 31% | 54% | 1988 |

**Table 1:** Demographic summary of study communities. Actual values are rounded to mask identity.

# Findings

## Community housing data

Drawing from work in all seven communities, our data contains ratings for 6,841 structures. Table 1 shows the overall classification of structural conditions based on collected responses. In all communities, a plurality of structures were classified as standard (v1) or well maintained (v2), and in five of the seven, a majority of structures received this classification. The notable exception to this trend is Marshalltown, where only 28% of properties were rated well maintained. This community had the one of the oldest median structure ages of all communities and also one of the lowest median incomes. Along with Lewisville, it was one of the two communities that was predominantly surveyed by students at [institution redacted for review], though structures in Lewisville were rated much better overall. On the high end, 27% of structures in Tyler were rated as dilapidated, and Stewart, Benson, Arlington and Marshalltown all had approximately 10% of structures rated as needing serious repair.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Survey version 1** |  |  |  |  |
| **City** | **Lewisville** | **Stewart** | **Tyler** |  |
| **# of records** | 468 | 2,208 | 1,315 |  |
| **Standard** | 65.4% | 75.1% | 56.3% |  |
| **Substandard** | 26.9% | 15.2% | 16.5% |  |
| **Dilapidated** | 7.7% | 9.7% | 27.1% |  |
|  |  |  |  |  |
| **Survey version 2** |  |  |  |  |
| **City** | **Arlington** | **Benson** | **Hancock** | **Marshalltown** |
| **# of records** | 745 | 1,059 | 621 | 425 |
| **Well maintained** | 69.5% | 49.7% | 61.7% | 28% |
| **Sound** | 8.5% | 14.7% | 13.2% | 21.4% |
| **Minor repairs** | 3.9% | 7.9% | 6.3% | 10.4% |
| **Moderate rehab** | 8.7% | 16.9% | 11.3% | 22.4% |
| **Substantial rehab** | 2.8% | 4.2% | 1.3% | 5.6% |
| **Dilapidated** | 6.6% | 6.5% | 2.9% | 4.9% |
| **Not classified (e.g., vacant lot)** | 0% | 0% | 3.4% | 7.3% |

**Table 4: Housing classifications by city**

Submitted photos provided additional detail on property conditions in these communities. Figure 1 provides representative images from both survey versions of structures that were rated in the middle and bottom end of our classifications. The houses shown in the substandard and moderate rehabilitation images had significant damage to the exterior, though they both appeared structurally sound. The two buildings rated dilapidated had significant roof damage and in the case of the bottom image, the image also shows significant damage to the exterior and windows. For community teams, the ability to collect and browse through these images provides a holistic image of how multiple structural issues can contribute to unsafe housing environments and provide evidence to outside funders of the need for grant funding for housing rehabilitation or replacement.



**Figure 1: Representative photos of structures rated as substandard or dilapidated**

Text text text

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **City** | **Tyler** | **Stewart** | **Benson** | **Hancock** | **Marshalltown** | **Arlington** | **All** |
| **Survey version** | **v1** | **v1** | **v2** | **v2** | **v2** | **v2** |  |
| **Exterior** | Cracked/minor dry rot | 29.6% | 16.6% | 12.9% | 7.6% | 25.2% | 7% | 16.1% |
| Repainting needed | 0% | 23.4% | 20.6% | 13% | 27.8% | 12.8% | 15% |
| Replace siding/exterior | 17.1% | 2.2% | 7.1% | 4.2% | 15.8% | 4.4% | 6.9% |
| **Foundation** | Cracked foundation | 10.7% | 1.3% | 13.1% | 7.1% | 22.8% | 9.4% | 7.6% |
| Partial replacement needed |  |  | 8% | 3.5% | 13.6% | 2.6% | 2.7% |
| **Roof** | Gutter repair | 0% | 5.1% | 5.2% | 6.6% | 26.8% | 1.1% | 3.2% |
| New roof structure | 12.7% | 3.4% | 5.9% | 2.6% | 13.4% | 4.4% | 6% |
| Partial re-roofing |  |  | 7.6% | 3.4% | 12.5% | 2.8% | 2.6% |
| Total re-roofing |  |  | 5.4% | 3.5% | 13.2% | 2.6% | 2.3% |
| Missing shingles | 29.3% | 11.7% | 5.8% | 6.8% | 20.2% | 8.7% | 13.1% |
| **Stairs/ porch** | Cracked/minor dry rot |  |  | 13.5% | 11% | 26.6% | 8.9% | 5.7% |
| Major repair/replacement | 17.2% | 2.8% | 7.4% | 3.4% | 13.6% | 9.8% | 7.6% |
| Repainting needed |  |  | 18.3% | 10.1% | 24.9% | 6.8% | 6.1% |
| **Windows/ doors** | Cracked panes | 10.5% | 6.6% | 12.7% | 8.1% | 18.6% | 6% | 8.6% |
| >3 windows replacement | 12.3% | 3.8% | 4.4% | 1.4% | 9.9% | 5% | 5.6% |
| <= 3 windows replacement | 12.3% | 4.8% | 5.7% | 2.3% | 13.2% | 2.3% | 6.1% |
| Repainting needed |  |  | 19.2% | 10.5% | 29.2% | 8.5% | 6.7% |
| **Yard** | Junk in yard | 0% | 8.4% | 0% | 2.1% | 9.4% | 0% | 3.5% |
| Missing ground cover | 0% | 16% | 0% | 6.8% | 12% | 0% | 6.5% |
| Porch used as storage | 0% | 8.1% | 0% | 4.3% | 6.1% | 0% | 3.4% |
| Overgrown/weeds | 0% | 16.8% | 0% | 8.4% | 12.7% | 0% | 7% |

Table 5: Prevalence of top issues across communities

--*What’s the average distance from the overall rate by community?*

## Connections to residents

Interview data and our observation: Value of the community assessment at finding unexpected outcomes:, Millen tire cleanup, Focus on landlords in Monroe; Contrast between communities that did data collection vs those who outsourced it

## Technology and process

The digital tools created for this project greatly improved each community’s capacity to collect and analyze housing data. Yet many housing teams focused on these tools to the exclusion of broader needs for planning, training, and community outreach. Once these teams had decided to start a housing assessment, they often wanted to begin data collection as quickly as possible, usually within a few weeks. A sense of urgency

-Submission timeline-how sustainable

-Interviews on process issues

-Community vs. student involvement

Communities focus on technology itself, jumping right in, rather than preparation or analysis. Our effort to create a more structured process. Shape of submission timeline.  
  
Putting the data to work

Kim’s interviews--how do stakeholders talk about the outcomes of this process (or do they?). How is it being used by communities? Importance of leadership. Use of the data to prioritize interventions and make progress.

# Conclusions

Restate potential value of this approach and best practices we’ve identified for making it work. Effective at helping identify issues even if it heads in unexpected directions.

Importance of knowing what you’re looking for--why important to do the assessment.

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1. All city names are pseudonyms [↑](#footnote-ref-1)