

Brownfields to Healthfields: A Retrospective Ripple Effect Mapping Evaluation in Three Rural Communities

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Abstract

The environments in which we live influence our health behaviors and outcomes. The redevelopment of brownfields sites to health-promoting land uses may provide an array of benefits to individuals and communities, but these impacts can be particularly difficult to assess in rural communities using traditional evaluation approaches. This participatory evaluation aimed to explore the impacts of redeveloping rural brownfield sites into health-promoting land uses. Using a facilitated workshop-based Ripple Effects Mapping process, we evaluated three rural brownfields redevelopment sites across Appalachian portions of EPA Region 3 (mid-Atlantic). Adult members (n=32) of these communities participated in guided reflection on the redevelopment and subsequent impacts. Data were constructed as digital mind maps, then coded to the Community Capitals Framework by two authors coding independently. Member checking was conducted with representative workshop participants. Commonly cited impacts were site improvements, facilitation of social and physical activity, and engaging community identity. The most discussed community capitals were social and built; the least discussed capitals were natural and political. Rural brownfield redevelopment targeting physical activity provides the added benefit of engaging an array of community capitals, ultimately strengthening communities on the whole. Future directions for brownfield redevelopment evaluation are discussed.

Keywords: Environmental and public health; environmental remediation; ripple effect mapping; community-based participatory research; brownfield

The environments in which people live, work, and recreate influence their health behaviors and outcomes (Nolan et al., 2016; Kärmeniemi, 2018; Diez Roux, 2010; Smith et al., 2017; Wolf et al., 2020; Wang et al., 2023). This social ecological perspective underscoring the influence of the environment on health behaviors has influenced public health practice in creating physically active communities for decades (Sallis et al., 2006). Rural areas of the United States lag behind urban areas in implementing this approach to improving access to places for physical activity despite the well-documented health effects of physical activity (United States Department of Health and Human Services, 2018; Umstadd Meyer et al., 2016). Adults residing in rural areas of the United States experience a multitude of health disparities with persistent, pernicious gaps relative to urban dwelling adults in mortality and meeting physical activity guidelines (Cosby et al., 2018; Whitfield et al., 2019); Abildso et al., 2023).

The health of many rural US communities is challenged by physical environments that discourage daily physical activity, including the presence of brownfield sites, which simultaneously increase potential exposure to toxic substances. Brownfields are sites wherein previous land uses have been abandoned, past use resulted in environmental degradation, or a combination of the two. Often, these brownfield sites have resulted from decommissioned industrial uses. Costly environmental remediation can be a barrier to redevelopment, leaving communities with vacant, polluted sites. However, these sites can also provide untapped potential for new development. Recognizing the opportunity these sites provide, the federal government established the Brownfields Program in the Office of Land and Emergency Management of the US Environmental Protection Agency (EPA) to “provide grants to inventory, characterize, assess, and conduct planning related to brownfield sites... and perform targeted site assessments at brownfield sites”(Small Business Liability Relief and Brownfields Revitalization Act, 2002).

Legislative action has established rural communities as a focus area in brownfields redevelopment work. The Small Business Relief and Brownfield Revitalization Act of 2002, which codified the Brownfields Program, mandated that an equitable distribution of funds between urban and nonurban areas be considered in grant funding decisions (Small Business Liability Relief and Brownfields Revitalization Act, 2002). In a 2021 executive order establishing the Justice40 Initiative, the Biden Administration further directed that 40% of funds for climate crisis-related endeavors, including brownfields work, be allocated to disadvantaged communities, including rural areas (Executive Order 14008, 2021).

Brownfields programming represents a substantial investment in rural built environments to help these areas overcome the disinvestment that has created socially and physically unhealthy environments. Redevelopments that create new spaces for physical activity (“Brownfields to Healthfields”) directly meet a recommended strategy of the Community Preventive Services Task Force and the

physical activity priority strategy of the Centers for Disease Control and Prevention (CDC), by improving access to safe places for physical activity (e.g., new park or trail) and non-motorized access to everyday destinations (e.g., new health clinic at an abandoned neighborhood gas station) through built environment change (Ballogg et al., 2020; US Centers for Disease Control and Prevention, 2024, February 8). As such, Brownfields to Healthfields redevelopments represent an opportunity to learn from natural experiments in rural built environment change supportive of physical activity – a critical research need identified in the peer-reviewed literature (Umstadd Meyer et al., 2016; Heath et al., 2006; The Community Guide, 2016).

Participatory evaluation methods, such as Ripple Effects Mapping (REM), provide an avenue for rich outcome and impact assessment of natural experiments, while engaging community members as partners in exploring past efforts and thinking toward the future (Chazdon, 2017). Within REM, community capital frameworks (CCF) are routinely used to identify themes and analyze changes in community assets (Chazdon, 2017). Community capital frameworks are particularly useful for demonstrating sustainable community change as they embrace a systems perspective, recognize a diversity of governance actors, and consider relational aspects between actors and how these influence resource access and use in development activities (Flora et al., 2016; Stout, 2019). While not explicitly a theory of change, capital frameworks are grounded in asset-based and capacity building theories. Moreover, they are supported by decades of community observation that document the “spiraling up” pattern where strategic investments of one or more community assets, especially cultural, social, and human assets, can facilitate asset enhancement across the breadth of capitals (Emery & Flora, 2006). Conversely, a lack of investment in community resources may also explain asset depreciation and negative phenomenon. Most often used in community development research, especially in rural places, these frameworks include a number of factors typically referred to as the Social Determinants of Health in public health research, including Neighborhood and Built Environments, and Social and Community Context that influence health behaviors and outcomes (US Center for Disease Control and Prevention, 2024, January 17). As such, CCF have been applied to rural physical activity research to identify the factors present in rural communities with higher than expected rates of physical activity (Abildso et al., 2021).

While federal resources are available to assist rural communities in brownfields redevelopment efforts and rural areas are prioritized by legislative action, formal evaluation of such endeavors is very limited. The purpose of this participatory evaluation study was to explore the impacts of redeveloping rural brownfield sites into health-promoting land uses and understand how the redevelopment process activated and enhanced community assets.

Methods

Workshops were held in three rural communities to explore the impacts of completed brownfields redevelopment projects that support places for physical activity. For consistency, the first author served as primary facilitator and the third author drew the mind maps for all workshops. An REM approach was used to guide reflection, identify resulting activities and outcomes, and link those activities and outcomes in a map format.

Site Eligibility

Evaluation sites were identified through searching the EPA's Cleanups in My Community online database²⁵ and through consultation with the Technical Assistance for Brownfields Communities (TAB) Center serving EPA Region 3 (Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, West Virginia, and 7 federally recognized tribes) (US Environmental Protection Agency, 2024, June 17). Eligible redevelopment sites (1) were located in EPA Region 3; (2) represented a variety of states across Region 3 (i.e., no more than one site per state would be chosen); (3) provided opportunity for physical activity; (4) completed redevelopment no more than 10 years prior to the evaluation; (5) were located in rural communities; and (6) had established collaborative relationships with the regional Technical Assistance to Brownfields Communities Center (TAB) network. For the purpose of this study, "rural" was defined as meeting at least one of the following criteria: (1) county with at least 50% of residents living in rural areas using 2010 County Rurality Levels, indicating "mostly rural"; (2) county with 2013 Rural-Urban Continuum Code (RUCC) of 4 or greater, indicating "nonmetro county"; or (3) census tracts with 2010 Rural-Urban Commuting Area Code (RUCA) between 4 to 10, encompassing "micropolitan" to "rural" (US Environmental Protection Agency, 2024, August 21; US Census Bureau, n.d.; US Department of Agriculture Economic Research Service, 2024, January 22).

Participants

Upon tentative identification of sites, regional TAB center staff and collaborators provided authors with contact information for local project liaisons. The first author initiated contact with local liaisons via email and phone and requested the community's participation in the study. After the site agreed to participate, authors and liaisons collaborated on participant recruitment processes. Community members key to redevelopment and present land use were personally invited by email, phone, and in person to participate. Authors encouraged liaisons to identify prospective participants from various perspectives and positionality, including but not limited to representatives of local and regional government (elected and professional staff), school personnel, business owners, non-profit organization representatives, site neighbors, project critics, and members of the general public. Interested individuals were asked to RSVP to the liaison or evaluation team. Participants in the REM workshops met at least one of the following criteria: (1) lived in the same county as the project; (2) worked in the same county as the project; (3) had visited the project site at least once a month

for the past six months; or (4) were involved in the redevelopment process. As this pilot study sought to apply REM concepts in a new context, we made the methodological choice to limit participants to individuals over 18 years of age. This age parameter allowed for consistency among communities (i.e., some sites would not invite minors, but all sites would invite adults).

In accordance with REM best practices, and aiming to meaningfully engage all participants, we aimed to recruit between 12 and 20 participants per workshop (Chazdon et al., 2017). Individual incentives were not provided, but refreshments and food were provided at workshops.

REM Workshops

Workshops were held in-person, in a publicly accessible facility proximate to the site being evaluated. Settings and scheduling were determined in collaboration with the local project liaison. REM workshops were scheduled for 1 hour. Where feasible, seating was arranged in a semi-circle to facilitate discussion and ease of viewing the paper-based mind map throughout the session. Two trained authors (first and third authors) led each workshop. At the beginning of each workshop, a consent cover letter was reviewed, paper copies provided, and verbal consent obtained.

Workshops engaged the four required REM components: (1) appreciative inquiry, (2) a participatory approach, (3) interactive group interviewing and reflection, and (4) mind mapping.¹⁹ Agendas were distributed to participants, outlining the workshop's activities and providing space for appreciative inquiry note-taking. Following a pre-set schedule, the first author began the workshop with a welcome, orientation to its purpose, and a brief introduction to the REM process.

Participants paired off to conduct the appreciative inquiry interviews. The workshop leaders/authors encouraged participants to partner with individuals they did not know well; however, the close-knit nature of some communities made this request impractical. Written notetaking on the reverse side of the agenda was encouraged. The first partner interviewed the second partner for approximately five minutes using three pre-determined questions. All three questions were asked, regardless of the interviewee's involvement with the redevelopment process. After completion of this interview, the partners switched roles to complete a second round of interviews. Informed by the methodology outlined in Chazdon et al.'s REM field guide and minimally amended to fit the brownfield context, questions included (Chazdon et al., 2017):

Q1: What is a highlight, achievement, or success you experienced or observed in your involvement with [project]?

Q2: What unexpected things have happened as a result of the [project]?

Q3: What, if anything, has been difficult about the [project]?

Mind Map

Upon completion of paired interviews, the workshop leaders/first and third authors led the whole group in sharing interview findings and collaboratively mapping the “ripple effects.” An in-depth rippling approach was utilized wherein ripples were mapped by writing the group’s shared interview findings onto mounted paper (Chazdon et al., 2017). The first author asked participants to share their stories and outcomes, after which other participants were invited to share additional stories to build upon those outcomes. As narratives unfolded, the third author documented them on the paper mind map. Probing questions were used to elicit more detail (e.g., then what happened?; who was involved?; what is different as a result?).

After the mapping activity, the authors led a reflection process. Participants were asked to identify the most significant changes and consider possible next steps. Authors briefly outlined the analysis process and the timeline for findings to be returned to the community. At the end of the workshop, the paper mind map was photographed, with the image and paper copy collected by the authors for processing into a digital mind map via XMind software. Workshops were audio recorded to provide clarification in drafting the final mind map.

Qualitative Approach

Ripple effect mapping is a participatory qualitative evaluation research method which has been used to evaluate an array of physical activity, healthy eating, and social connectedness programming (Gold et al., 2020; Hall et al., 2021; Haskell et al., 2019; Naccarella et al., 2019; Sadeghzadeh et al., 2022). Three distinct avenues to REM data collection and analysis are possible: web mapping, in-depth rippling, and theming and rippling (Chazdon et al., 2017; Washburn et al., 2020). Upon consideration of the target audience and time limitations placed on workshops, we chose to use the in-depth rippling approach. In-depth rippling involves facilitators mapping ripples onto butcher paper in real time and later transcribing into digital mapping software (Chazdon et al., 2017). During digital

transcription, related observations were inductively grouped into top level themes by the first author, verified by the third author, and then verified by member checking with participants. As opposed to the web mapping approach which categorizes impacts to the chosen framework in real time, in-depth rippling opts to code data to frameworks after the completion of the workshop and digitization of the mind map (Chazdon et al., 2017). As such, we deductively coded data from each community’s mind map to the Community Capitals Framework (CCF) with two authors (first and third authors) coding independently then meeting to reconcile discrepancies (Flora et al., 2016).

Analysis Plan

Using paper maps, audio recordings, and author workshop notes, digital mind maps were created in XMind for each workshop site. Related observations were grouped together under emerging themes. The first author created the preliminary map, with review and edits provided by the third author. After digitization of the mind map, authors conducted member checking with workshop participants at each site. Feedback was requested via email. Authors documented any discrepancies or recommendations and made revisions as appropriate.

Mind map data was then exported to Microsoft Excel³⁶ with a separate line designated for each data point (Microsoft Corporation, 2021). Working independently, two authors deductively coded data into one or more of the eight forms of capital described by the various Community Capital Frameworks (Flora et al., 2016). These frameworks include a number of factors that are typically structured into seven or eight forms of assets (i.e., cultural, human, social, organizational, political, financial, natural, built) (Table 1) that communities can leverage for quality-of-life improvements (Flora et al., 2016; Stout, 2019; Roseland et al., 2023). Given the intersections between capitals, individual data points were allowed to be coded to multiple capitals, as appropriate (Flora et al., 2016; Kretzmann & McKnight, 1993). Upon completion of independent coding, coders met to resolve any discrepancies through consensus. Findings were reported as counts and percentages, descriptively, and graphically.

Table 1: Forms of Community Capital and Definitions Utilized for the Qualitative Data Analysis (Stout, 2019; Emery & Flora, 2006)

Form of Capital	Definition
Cultural Capital	Cultural capital reflects the way people “know the world” and how they act within it, as well as their traditions and language. Cultural capital influences what voices are heard and listened to, which voices have influence in what areas, and how creativity, innovation, and influence emerge and are nurtured. Hegemony privileges the cultural capital of dominant groups., The way people “know the world” that hinders or fosters how they act within it (i.e., cultural beliefs and traditions influence individual decisions about engaging in PA), as well as their language about and attitudes toward PA. Cultural capital influences whose voices are heard and which voices have influence in what areas, and how creativity, innovation, and influence emerge and are nurtured. Hegemony privileges the cultural capital of dominant groups.
Human Capital	Human capital is understood to include the skills and abilities of people to develop and enhance their resources and to access outside resources and bodies of knowledge in order to increase their understanding, identify promising practices, and to access data for community-building. Human

	capital addresses the leadership’s ability to “lead across differences,” to focus on assets, to be inclusive and participatory, and to act proactively in shaping the future of the community or group., The skills and physical abilities of people to develop and access outside resources and bodies of knowledge about PA in order to increase their understanding and identify promising practices. Human capital addresses the leadership’s ability to “lead across differences,” to focus on assets, to be inclusive and participatory, and to act proactively in shaping the future of the PA of the community or group that they have influence over. It also includes the facilitators of and barriers to using skills and abilities to affect community level PA (e.g., time).
Social Capital	Social capital reflects the connections among people and organizations or the social “glue” to make things, positive or negative, happen. Bonding social capital refers to those close redundant ties that build community cohesion. Bridging social capital involves loose ties that bridge among organizations and communities., The connections among people and organizations or the social “glue” to make things happen that increase community PA level. Bonding social capital refers to close ties that build community cohesion. Bridging social capital involves loose ties that bridge across social groups, organizations, and communities.
Organizational Capital (Stout, 2019)	The structure, policies, plans, and track record of existing groups (informal groups, organizations, and networks), The structure, policies, plans, and track record of existing groups (informal groups, organizations, and networks) and their ability to collaborate in supporting PA.
Political Capital	Political capital reflects access to power, organizations, connection to resources and power brokers. Political capital also refers to the ability of people to find their own voice and to engage in actions that contribute to the wellbeing of their community., Community political power, influence, and access to power brokers at local, county, state, and federal levels who support PA.
Financial Capital	Financial capital refers to the financial resources available to invest in community capacity-building, to underwrite the development of businesses, to support civic and social entrepreneurship, and to accumulate wealth for future community development., Financial resources available to invest in programs and infrastructure that support PA.
Natural Capital	Natural capital refers to those assets that abide in a particular location, including weather, geographic isolation, natural resources, amenities, and natural beauty. Natural capital shapes the cultural capital connected to place., Those assets that exist in a particular location without human intervention (i.e., not parks) that either foster or hinder community level PA, including weather, topography, natural resources, and natural beauty. Natural capital influences the cultural capital connected to place.
Built Capital	Built capital includes the infrastructure supporting these activities.

Note: sources cited by Emery and Flora in the original definitions of the forms of capital were removed.

PA: Physical Activity

Trustworthiness

Trustworthiness in qualitative research is explored under four concepts: credibility, dependability, confirmability, and transferability (Shenton, 2004). Endeavoring toward credibility, coding to the CCF remained close to the actual mind map text being coded. Dual coding supported dependability and the maintenance of an audit trail bolstered confirmability. Transferability was served in the cautious interpretation and limited application of findings to communities beyond those profiled in this evaluation.

Ethical Considerations

The [REDACTED FOR PEER REVIEW] Institutional Review Board acknowledged exemption for protocol 2304760354.

Results

Site Settings and Demographics

All workshops and intercept interviews were conducted in August 2023. The three profiled communities represented three different states across EPA Region 3, and all communities were situated within the Appalachian region (Appalachian Regional Commission, n.d.). Time elapsed from project completion to the REM workshop ranged from three months to five years (Table 2). New uses included a pocket park, a soccer complex, and a park with basketball and skate park components. While pocket parks do not facilitate vigorous physical activity to the extent of athletic facilities, this site was included because of the role of pocket parks in contributing to downtown walkability and access to everyday destinations (The Community Guide, 2016; Dong et al., 2023).

Table 2: Community, Site, and Evaluation Characteristics

	Site A	Site B	Site C
Community Characteristics			
<i>Community</i>			
Population, 2020	6942	753	8925
RUCA, 2010	4 (Micropolitan area core)	3 (Metropolitan area low commuting)	4 (Micropolitan area core)
<i>County</i>			
County Population, 2020	91,647	17,063	33,800
RUCC, 2013	4 (Nonmetro county)	8 (Nonmetro county)	3 (Metro county)
County Rurality Level, 2010	34.9%	100.0%	46.9%
Site Characteristics			
Prior Land Use	Jewelry Store, Photography Studio, Retail	Agriculture, Auto Repair, Furniture Manufacturing	Foundry for a Chemical Company
Current Land Use	Pocket Park	Soccer Field	Skate Park and Basketball Court
Time Elapsed Since Redevelopment	3 months	6 years	1 year
Evaluation Characteristics			
Workshop Setting	Town Council Chambers	Hotel Conference Room	Municipal Community Building
Workshop Participants (n)	9	13	10

RUCA: Rural-Urban Commuting Area Codes
 RUCC: Rural-Urban Continuum Codes

All profiled municipalities recorded populations of less than 9,000 in the 2020 US Census, with corresponding county populations ranging from 17,063 to 91,647. County rurality measures (2010) ranged from 34.9% to 100.0%.

Workshop recruitment liaisons served in roles of town manager, county parks director, and revitalization coordinator. Workshops were held in publicly accessible

locations, with attendance ranging from nine to thirteen. Intercept interviews were attempted at each site; however, no eligible interviewees were encountered at project locations during the time of author visits.

Mapped Inputs and Impacts

Findings for all workshops are discussed jointly, with individual maps available as Supplemental Material. Main themes from the workshops are noted in the following subsections, utilizing language aligning with the imagery of creating a cascade of ripples on a pond.

Engaging/Strengthening Multiple Forms of Capital to Complete the Redevelopment - "Throwing the Stone in the Water"

All communities identified barriers to redevelopment, including lengthy environmental and historical reviews and limited available funds. While redevelopment at Site A took approximately 2.5 years from inception to completion, other sites reported timelines in excess of eight years. Engaging multiple forms of capital (*italicized parenthetically*) was critical to success, including a spirit of community persistence (*Cultural*), strong support from local elected officials (*Political*), commitment of dedicated project liaisons (*Human*), and multiple external funding sources (*Financial*) (e.g., EPA Brownfields funds, Community Development Block Grant funds, American Rescue Plan Act funds, and state-level grants). Additional on-site labor was provided by volunteers, local contractors, and the local government.

While each project was prompted by a variety of forces, informants identified key catalysts. At Site C, redevelopment was catalyzed in part by a group of teenage skateboarders (*Social*) who advocated to the local elected body in pursuit of improved skate facilities (*Political*) and launched a small online crowdsourcing campaign to raise project funds (*Financial*). For Site B, leadership of a pre-existing youth soccer club (*Organizational*) sought dedicated facilities for the club. At Site A, the local government and its partners developed a community revitalization plan (*Political, Organizational*), of which the redevelopment project was identified as a key priority.

Built Capital - "The Stone Hitting the Water" / "Creating the Ripples" - Continued Improvements on the Site

All participants spoke positively of the resulting site improvements. Referring to the dilapidated buildings previously on the site, Site A participants noted that "those buildings were going to kill somebody," and now the site is a park. Additional beautification has occurred in response to redevelopment. One adjacent property owner painted the side of their building to improve the appearance (*Built*), and the garden club has adopted the pocket park concept into their volunteer work throughout the town (*Human/Social*).

Environmental benefits (*Natural*) have also been identified as redevelopment outcomes. Site C required pollutant remediation and site capping, not only reducing exposure to site users, but mitigating chemical runoff into the adjacent creek. Informants shared about upcoming plans to advance this environmental stewardship, including a study by the U.S. Army Corps of Engineers on creek ecology and flooding (*Organizational, Political*). The creek was also identified as an important resource in providing in-town nature access. Development of a walking loop is

planned, which will cross the creek, travel through downtown, and pass through the new skate park (*Natural, Built*).

Due to previous use as an auto salvage facility, Site B was challenged with solid debris contamination requiring removal and replacement of the top foot of soil. As replacement soil was sourced from farmland in an adjacent state, the new soccer complex was challenged by non-native weeds that were difficult to manage; however, workshop participants reported that the challenges were taken in stride and redevelopment was a vast improvement. Multiple soccer fields were developed on-site (*Built*). The complex was well-used upon opening, and the desire for a playground facility emerged. One informant noted that playground facilities have been lacking in the area for many years. Community members secured additional grant funding to purchase playground equipment and contributed volunteer hours to install the structures (*Financial, Human/Social, Built*).

Human and Social Capital Ripples - Facilitating Physical and Social Activity

All new uses facilitate physical activity (*Human*) and social activity (*Social*) to varying degrees. At Site A, informants reported that while residents are not accustomed to the practice of spending time downtown, a father-daughter dyad, as an example, have been observed having daily lunch in the park (*Social*). Community members discussed plans to operationalize the park by using the space in already-occurring community events, hosting new events such as art in the park, movie nights, and yoga gatherings. The grand opening alone gathered a "cross-section of people who aren't usually involved." (*Social*)

Site B's connection to physical activity is more evident, as organized soccer practices, games, and tournaments have been held throughout the year for youth ranging from pre-kindergarten through eighth grade (*Human*). Informal physical activity opportunities have been reported (*Human*), including family soccer games, adult soccer games, and frisbee. The site has also provided opportunities for social connection, as parents interact with coaches and other parents, and soccer club participants practice teamwork and sportsmanship (*Social*).

The skating community at Site C predates the park planning process, and as such, many of these early skaters are now parents and professionals within the community. The new skate park has become the setting of naturally developing mentorship (*Social*) and skill teaching (*Human*), as seasoned adult skaters are now teaching their own children and other youth to skate. Informants report seeing locals and visitors of all ages using the site, and as the popularity became apparent, the municipality placed bleachers on-site to provide needed seating and initiated plans for lighting.

Cultural Capital Ripples - Engaging Community Identity and Visibility

Site A reported the community's concern for maintaining their authenticity and identity as the area transitions from a coal-based economy to a tourism economy. Some locals expressed resistance to change. For others, the decline in economic opportunities and subsequent disinvestment in the local community produced an attitude of "nothing good can happen here." Thoughtful park design not only enhanced the community's built environment but preserved and celebrated components of the community's history through the inclusion of a portion of original building wall in the final park layout, and the on-site installation of three interpretive panels highlighting early area history, the historical cultural district, and the influence of the energy industry.

While serving the community's recreation needs, redevelopment at Site C also contributed to a plan to make the town an attractive option for potential residents and business owners (*Organizational*). According to informants, residents understand that outside sources of income are necessary for the town to thrive, and they are willing to share the park with others. As property values continue to grow in nearby cities and university towns, the town hopes to draw in new residents through completed and planned investments in housing and recreation facilities, such as this skate park.

All sites reported that redevelopment has resulted in positive visibility and attention outside the community. Site A reported that other communities have expressed interest in replicating the pocket park concept, citing recent correspondence with a neighboring mayor and senator (*Cultural, Political*). Site C shared that skaters from around the region are learning about the park and visiting, and that private interest in downtown investment is growing. Site B's redevelopment prompted a tour with EPA officials, putting the county "on the map at the federal level... a nice feather in the cap for our small community" (*Political*). The soccer complex now hosts annual regional soccer tournaments, and has prompted other local interests (e.g., disc golf, football) to lobby local officials for additional improved facilities.

Outer Ripples – Engaging/Strengthening Multiple Forms of Capital to Respond to Challenges

Ongoing maintenance and supportive infrastructure needs challenge the completed projects. Site A does not yet have a designated individual or office charged with management and maintenance (*Human, Organizational* – lacking). Site B is supported by an involved soccer league board but has no paid personnel to maintain the site (*Human, Organizational*). The soccer league has plans for improved driveway access, concessions, and comfort facilities (*Organizational*), but is challenged by project costs and a current lack of public water and wastewater utilities at the site (*Financial, Built* – lacking).

Two of the three sites reported minor vandalism incidents (*Cultural*). At Site A, concrete curbs were damaged by skateboards and black marks were left by bicycle tires (skateboard and bicycle riding was not

permitted in the park). The park was briefly closed, security cameras and rule signage installed, and police patrols increased. Vandalism has not recurred, and discussions were spurred on the need for a skate park because an existing skate park was closed in previous years. At Site C, on-site porta-potties were vandalized in a style consistent with other vandalism in the area. Porta-potties were then removed, and no vandalism has recurred. Community stewardship of the park has generally been positive and use has not been problematic, resulting in police allowing patrons to use the park after posted evening closing time.

Discussion

This project explored the myriad impacts of redeveloping rural brownfield sites into health-promoting land uses. For each of the sites, all eight capitals were positively impacted by redevelopment, thus reinforcing the notion that capitals interact in mutually beneficial ways to produce change.⁴² The primary capitals discussed generally corresponded with the characteristics of the resulting land use, despite increased physical activity or time spent outside being a logical, immediate outcome of the new land use. For the new pocket park that integrated historic structures and interpretive signage, cultural capital was most discussed. For the new soccer complex that promotes the development of physical skills and sportsmanship, human and social capital were most readily identified. And for the new skate park that facilitated the gathering of multiple generations around a shared activity, informants pointed most toward social capital. While some findings show clear linkages to the project's unique redevelopment process and reuse trajectory, other trends can be identified across projects. For example, all communities identified social capital among the three most often mentioned capitals. Brownfields redevelopment, particularly in rural communities, requires the engagement of existing social connections, and often facilitates the development of new connections. This finding is consistent with other community capitals and community development literature which identifies social capital as a critical entry point for enhancing local communities as it connects the breadth of actors and resources necessary to effect community change (Emery & Flora, 2006; Stofferahn, 2012; Pitzer & Streeter, 2015; Emery et al., 2016). Two of three communities identified built capital in the top three capitals. Specifically, in the profiled communities, successful brownfield redevelopment prompted additional on-site and off-site infrastructure improvements, including but not limited to, utility extensions to provide on-site comfort stations, installation of park lighting, demolition of derelict buildings to provide park parking, and visioning for new pocket parks.

In all communities, natural capital and political capital were among the three least-frequently discussed capitals. While each redevelopment project objectively improved the natural environment through clean-up and mitigation, cultural orientations and utilitarian land reuse strategies may have influenced the readiness of participants to identify and discuss such impacts. And while redevelopment processes engaged multiple levels of

political capital, the rural, small-town communities profiled may have given more credence to grass-roots efforts in contributing to success. Taken together, these findings confirm the mutually reinforcing nature of the Community Capitals Framework, as each of the eight forms of capital is supportive of, and supported by, the other forms (Flora et al., 2016; Stout, 2019).

These findings suggest that Brownfields to Healthfields built environment changes present the potential to impact individual health behaviors in multiple ways over time. Most immediate, the development of sport facilities (e.g., basketball court, skate park, soccer field) and downtown recreation enhancements (e.g., pocket park) provides nearby opportunities for residents to engage in physical activity. Long-term, findings suggest that these initiatives may catalyze planning and organizing toward larger-scale physical activity infrastructure and programmatic investments, expanding the reach of the health-promoting built and social environment.

Strengths and Limitations

This participatory qualitative approach gave the authors deep insights into the impact of redevelopment processes and new land uses on the lived experience of local residents. The workshop-based methodology allowed the authors to explore implications for all eight CCF capitals in a time-efficient process. Further, the workshop setting provided an opportunity for residents to reflect, identify keys to success, and discuss community vision; across all communities, workshop participants identified next steps in ongoing community revitalization.

By using a participatory workshop methodology, however, we only heard the voices of those who were invited to participate. While authors coached community liaisons in the selection of a diverse participant pool, some important voices were likely not captured. Only adults were eligible to participate, thus the unique perspectives of youths and teens were not represented. Participation was constrained by a one-hour workshop time limit, so significant contributions may have been missed.

At each site, we aimed to interview three individuals as they naturalistically accessed the facilities; however, we did not encounter any users during site visits. Visits were conducted approximately between 2 PM and 4 PM, which was not ideal considering the August heat. Site visits in the evening may have been more successful in encountering facility users and engaging them in conversation.

Because two of the projects were recently completed, it was too soon to identify some community impacts. Future follow-up would add to the exploration of short-term impacts conducted by this work and enhance our understanding of redevelopment outcomes over time. Additionally, these REM workshops captured viewpoints during a singular moment in time among a small subset of community members. Further qualitative inquiry should explore the deeper factors of identity and community culture as they inform motivations and behavior.

Implications and Future Directions

Evaluation is frequently challenged with delineating attribution and contribution (US Centers for Disease Control and Prevention, 1999, September 17). Considering the myriad societal forces and cultural changes at play in communities in the years spanning site planning, remediation, redevelopment, and deployment of the new land use, the outcomes and impacts identified by REM participants may not be solely attributable to the successful brownfield redevelopment process. To gain a clearer understanding of the impacts of such redevelopment, future studies should include data collection through pre-redevelopment, redevelopment, and multiple post-redevelopment periods (King et al., 2020). A longitudinal design such as this could also identify the presence or absence of each capital and their association with success or lack of success in a project outcome – in this case, the remediation and redevelopment of a dilapidated structure and/or piece of land. A larger sample and/or comparison of projects across the rural-urban spectrum would also be valuable additions to help practitioners understand the best practices for such a substantial investment in communities suffering tremendous disparities in social determinants of health.

Conclusion

Physical activity-oriented brownfield redevelopment in rural communities offers benefits beyond the intended impact of increasing physical activity. Community connections and capabilities can be strengthened through redevelopment processes, resulting in holistically strengthened communities.

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Funding and Disclaimer

This research has been supported by a grant from the U.S. Environmental Protection Agency's Technical Assistance to Brownfields (TAB) Communities program. This publication was developed under Cooperative Agreements No. 96390301 and 95332501 awarded by the U.S. Environmental Protection Agency to [REDACTED FOR PEER REVIEW]. It has not been formally reviewed by

EPA. The views expressed in this document are solely those of the authors and do not necessarily reflect those of the Agency.

Acknowledgements

The authors express our gratitude to all participants who shared their knowledge and experiences.

Author Contributions

Conceptualization: C.G.A.; Methodology and Data Collection: S.I.M. and C.G.A.; Analysis: S.I.M., D.E., and C.G.A.; Writing – Original Draft, S.I.M.; Writing – Review and Editing, S.I.M., D.E., and C.G.A.

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